

Why new tools were developed for the “GeoPortal Network: Liberty United” project

Bas Vanmeulebrouk¹, Rob van Swol², Marjolijn Kuyper³, Jandirk Bulens⁴, Jaap Zevenbergen⁵

¹Centre for Geo Information, Wageningen University and Research Centre,
bas.vanmeulebrouk@wur.nl

²National Aerospace Laboratory, vanswol@nlr.nl

³Centre for Geo Information, Wageningen University and Research Centre,
marjolijn.kuyper@gmail.com

⁴Centre for Geo Information, Wageningen University and Research Centre,
jandirk.bulens@wur.nl

⁵TU Delft-OTB j.a.zevenbergen@tudelft.nl

Abstract

As part of the national innovation co-funding scheme “Space for Geo-information” the project “GeoPortal Network: Liberty United” ran from late 2005 till the end of 2008. Purpose of the project was to promote access to geo-spatial information via web services. To achieve this goal, a network of geo-portals that is governed by a minimum set of rules was developed.

Several approaches for finding spatial data were investigated. Earlier experiences show that a top down approach as tried in the Dutch National Clearinghouse Geo-Information does not work. Instead, it was decided to use a thematic approach for opening up metadata. Several thematic portals were created. In line with the INSPIRE principle the data are located and maintained at its source and the application of open standards allows everyone to contribute to the network. However, this is still a supply driven approach whereas a more demand driven approach seems more appropriate. Therefore, attention in the project shifted from the creation of thematic portals to the underlying web services and the creation of web applications developed with a specific purpose in mind.

Initially, it was our intention to implement the network using existing software. However, as it turned out, not all the tools needed to implement the network outlined in this paper were available. Existing tools work really well for specific applications or in predefined environments, but a lot of the tools available do not strictly adhere to the open standards or do not use all possibilities offered by the standards. This prevents an adequate adaptation of interoperability standards. Innovations in the application domain are still a prerequisite to force these developments to take place.

This led to development of a true OGC/ISO compliant CSW dubbed eXcat and a platform independent, extensible framework for the development of standards compliant internet GIS applications dubbed Luigi. Together with of the shelf tools, the newly developed tools provide the technical foundation of our network. It can therefore be concluded that software is not a barrier for the adoption of the principles laid down in the INPSIRE directive. It is now up to the owners of geo-spatial data to take the next step and make their data available using standards compliant web services.

Keywords: OGC, open standards, INSPIRE, GeoPortal Network: Liberty United, mash ups

1 APPROACHES TO FINDING SPATIAL DATA

As part of the national innovation co-funding scheme “Space for Geo-information” the project “GeoPortal Network: Liberty United” ran from late 2005 till the end of 2008. Purpose of the project was to promote access to geo-spatial information via web services. To achieve this goal, a network of geo-portals that is governed by a minimum set of rules was developed (Zevenbergen, Bulens et al. 2009).

There are several approaches for finding spatial web services (Hoogerwerf, Kuyper et al. 2008). One approach for opening up metadata is a top down approach as depicted in Figure 1. Such an approach was for instance followed for the Dutch National Clearinghouse Geo-Information (NCGI). The NCGI as a clearinghouse was started in the mid nineties already (Crompvoets 2006). A clearinghouse was initially meant to disclose spatial data through the internet. Key element was to provide metadata on spatial datasets.

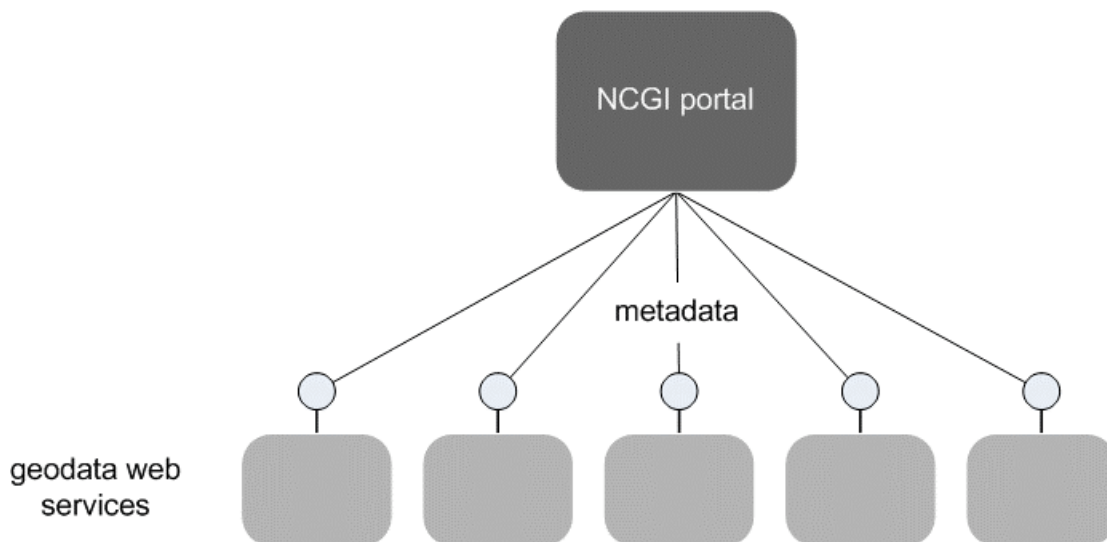


Figure 1 Top down approach for disclosing metadata

In the Netherlands the NCGI appeared to be far ahead of time. Major drawback was the complete absence of the ability to obtain the data themselves. Finding data was not the only function of clearinghouses, another major function was to serve as an internet shop to get access to the data. Because owner organizations were not yet able to deliver data through the internet clearinghouses struggled to survive. So, experiences of organizations participating in both the GeoPortal Network project and the NCGI show that this approach does not work very well for a geo-information infrastructure.

Instead, it was decided to use a thematic approach for opening up metadata (see Figure 2). In line with the INSPIRE principle the data are located and maintained at their source and the application of open standards allows everyone to contribute to the network. Within the frame of the GeoPortal Network project, several thematic portals were created. The “Red Portal” for instance contains information regarding the built environment, the “Brown Portal” deals with subsurface data and the “Green Portal” focuses on environmental data.

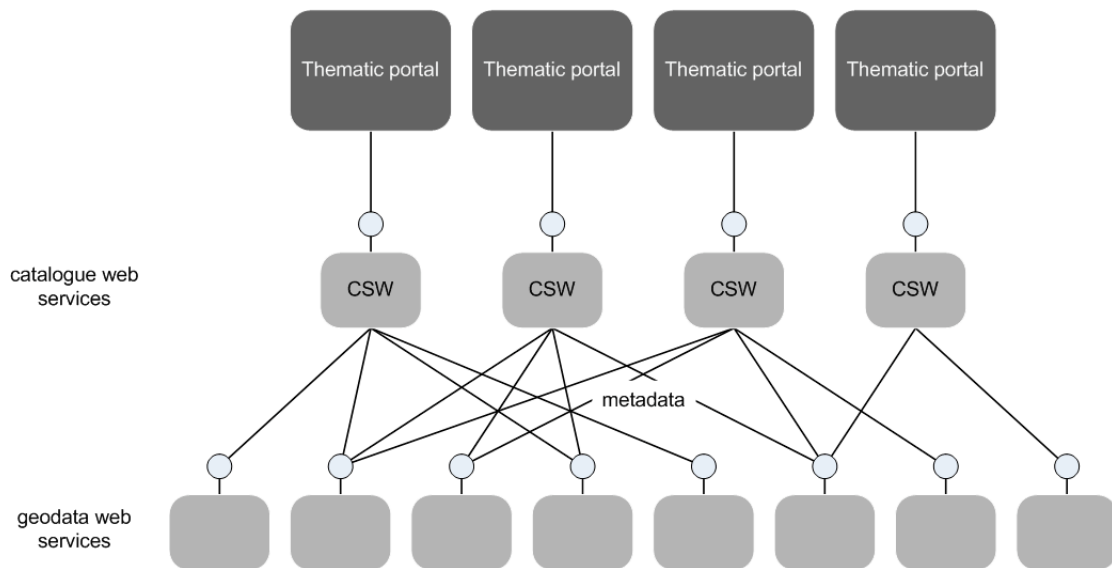


Figure 2 Thematic disclosure of metadata

This thematic approach is still supply driven. However, a more demand driven approach seems more appropriate. Users who are looking for spatial information to answer a certain question will get in touch with an organization close to them (for instance a municipality) instead of searching for an answer using a thematic portal. Therefore, attention in the project shifted from the creation of thematic portals to the underlying web services and the creation of web applications developed with a specific purpose in mind (see Figure 3).

A lot of these web applications are so called mash ups. A mash up is a web application which has been created by combining data and functionality of existing web applications. Organizations have two options for publishing spatial information on their web site: they can either develop their own application or they can re-use existing components and embed those in their web site.

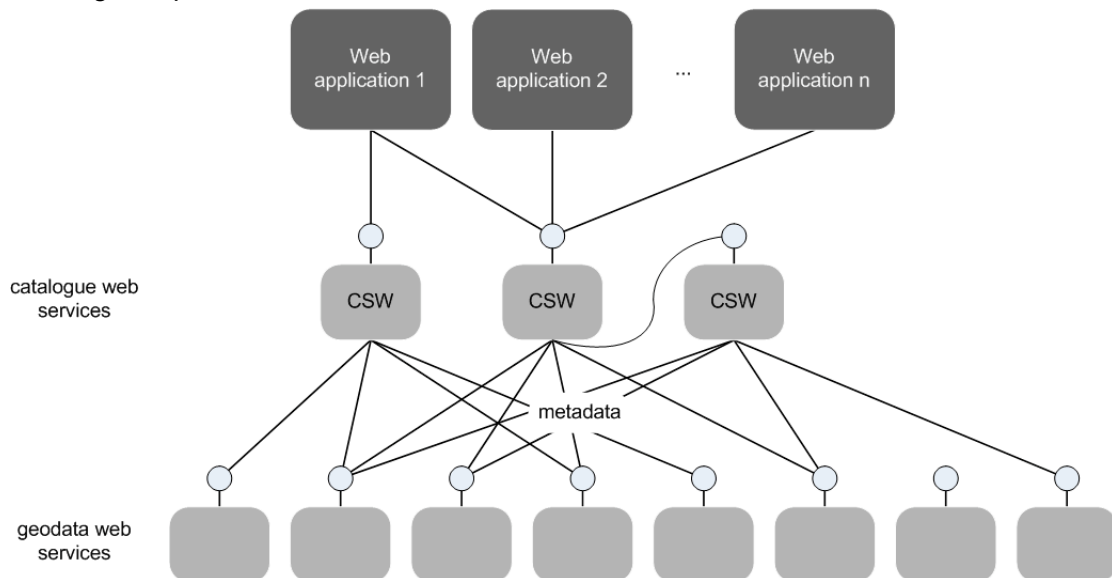


Figure 3 Disclosure using user oriented web applications

The web services layer of the architecture outlined in the previous paragraph consists of services to publish spatial data. Examples of web services found in this layer are Web Map Services (WMS), Web Feature Services (WFS) and Web Coverage Services (WCS). A Web Map Service (WMS) produces maps of spatially

referenced data dynamically from geographic information (Open Geospatial Consortium Inc. 2004). A Web Feature Service (WFS) provides a client with access to the actual features encoded in Geography Markup Language (GML) (Open Geospatial Consortium Inc. 2005). A Web Coverage Service (WCS) describes and delivers multi-dimensional coverage data over the internet (Open Geospatial Consortium Inc. 2008).

Catalogue services are used to discover spatial data. A Catalogue Service for the Web (CSW) supports the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects (Open Geospatial Consortium Inc. 2007).

Initially, we did not set out to develop new tools within the frame of the GeoPortal Network project. It was our intention to implement the network using existing software. However, as it turned out, not all the tools needed to implement the network outlined in this paper were available. Existing tools work really well for specific applications or in predefined environments, but a lot of the tools available do not strictly adhere to the open standards or do not use all possibilities offered by the standards (Vanmeulebrouk, Bulens et al. 2009). This prevents an adequate adaptation of interoperability standards. Innovations in the application domain are still a prerequisite to force these developments to take place.

2 TOOLS DEVELOPED

Spatial data can be published using a number of applications. The tools needed to publish spatial data were catered for. However, there are little standards compliant CSW implementations available and therefore a true OGC/ISO compliant CSW dubbed eXcat was developed. A platform independent, extensible framework for the development of standards compliant internet GIS applications was also lacking, which led to the development of such a framework. This framework was dubbed Luigi.

2.1 eXcat

eXcat offers an OGC compliant CSW server and client written in Java and based on the eXist XML database management system (eXist 2009) and the Geotools open source library (GeoTools 2009). The catalogue server can be used to publish ISO19115/19139 compliant metadata in accordance with the CSW 2.0.2 standard. Metadata queries are very efficiently processed by the server using the web technology standards XQuery and XPath which are incorporated in eXist. The server can be easily configured to support XML representations of other metadata formats. Metadata can be stored using the standard eXist administration client or by using the WebDAV interface.

Two CSW clients are offered. The integrated client, entirely written in XQL (XML Query Language), is very useful for developers and experts, offering access to the eXcat server and other remote CSW servers and supporting flexible setting of request parameters. Queries can be expressed using the Common Query Language (CQL) and are optionally translated to ogc:Filter expressions. XSL style sheet transformations are used to present the responses in XML or human readable format. In addition, a stand-alone CSW client based on JavaScript and AJAX was developed. This client can be easily integrated in existing web pages and offers a simple search tool for querying local or remote CSW servers.

Harvesting of metadata is also supported by eXcat, allowing retrieval of (selected) metadata records from remote servers for local storage. Selection criteria can be configured for each remote server individually. eXcat is a web application and is available as a war file which can be downloaded from <http://gdsc.nlr.nl/gdsc/tools/excat>. Basic installation is as simple as dropping the war file in the webapps directory of the servlet engine.

2.2 Luigi

Luigi is a user-friendly internet GIS application framework which seamlessly integrates web services from different sources (Vanmeulebrouk, Lokers et al. 2008). End-users navigate to a web-site from where the internet GIS application created by using the framework is downloaded. This application subsequently connects to the various web services. Luigi was developed using the Adobe Flex development framework.

Adobe Flex is a platform independent platform for developing rich internet applications (Adobe 2008). The client platform for applications developed using the Flex SDK is either the Flash Player plug-in (for browser based applications), or the Adobe AIR runtime (for desktop applications).

The Flex platform is quite suitable to develop highly interactive internet GIS applications like the one described here as:

- Flex is platform independent. Flex applications have to be developed for one platform only, the Flash platform.
- Flex applications can both run in a web browser, using the Adobe Flash Player or on the desktop, using the Adobe AIR runtime. Flash Player is available on 98.8% of the PC's in some countries (Frei, Dübendorfer et al. 2008).
- Flex offers a rich set of user interface components
- Flex offers a rich set of user interface effects
- Flex server calls are asynchronous. This allows users to continue to work with the application while the server is processing their requests.

Because of the modular design of the framework, adding new functionality is easy for Flex developers having access to the source code or a pre-compiled library of the framework. Developers can for example add new visual controls, support for additional data formats and new tools operating on the map control, thus adapting or extending the “out-of-the-box” functionality of the framework according to the specific requirements of the application.

3 EXAMPLE APPLICATIONS

In this paragraph, some of the application which have been developed within the frame of the GeoPortal Network project will be discussed. All the examples are set up according to the architecture described in Figure 3 and use eXcat and Luigi if needed.

3.1 TopoXplorer

The TopoXplorer internet GIS application was developed for the Wageningen UR library. This library possesses numerous analogous topographical maps from the Netherlands, the oldest dating back as far as 1850. These maps are used by students and researchers. To simplify the use of these maps, the analogous maps were scanned and geo-referenced. The TopoXplorer internet GIS application was

developed to make the digital maps available to users. It allows users to choose between different topographical maps and to choose a year for which they want to call up a map. The so called swipe tool allows users to compare two topographical maps at a certain location (see Figure 4). TopoXplorer was based on the first incarnation of the Luigi framework.

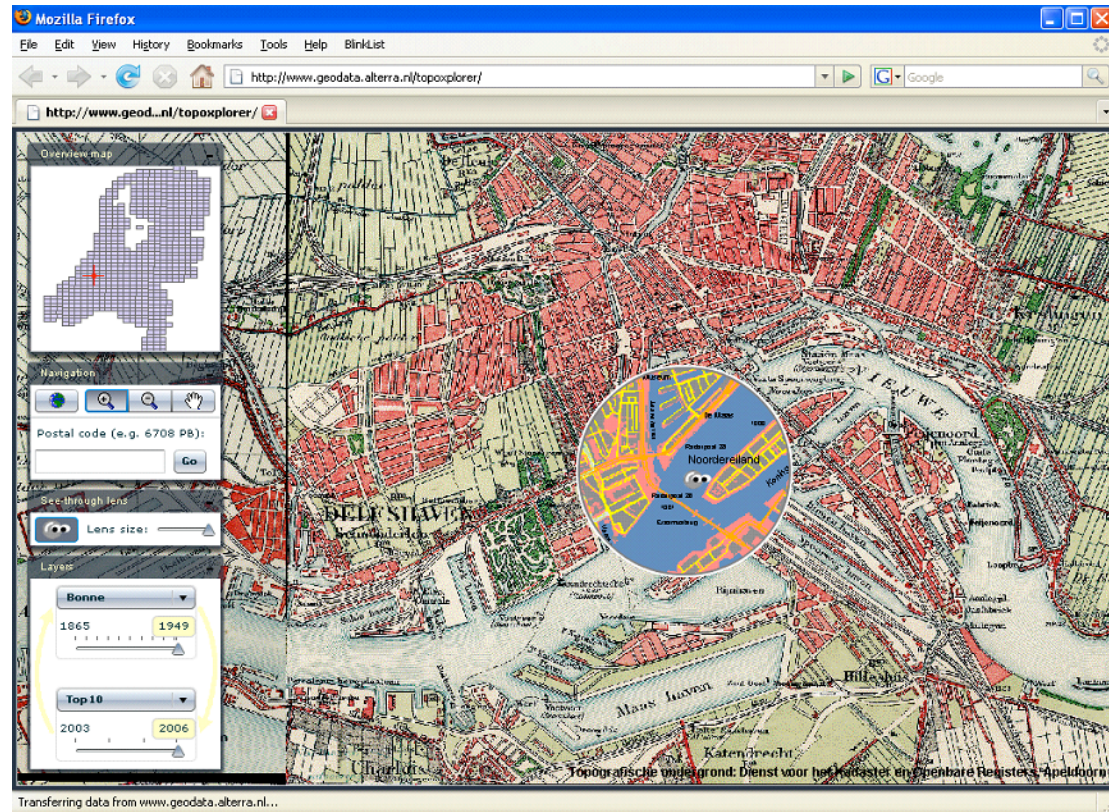


Figure 4 TopoXplorer internet GIS application

3.2 Cross border Water Management Initiative (CWMI)

Purpose of the Cross border Water Management Initiative (CWMI) was to integrate subsurface data from Germany and the Netherlands. A portal was developed in which data regarding soil and groundwater from both sides of the border are presented. Users can not only call up maps, but also graphs. Users can choose between the Dutch and the German representation of the data. The portal contains an internet GIS client which was based on Luigi.

3.3 Atlas Demonstrator

There is a strong need for information on external conditions or surroundings in which people live or work. Environment, health and safety are important factors for our social well being. The Ministry of VROM in the Netherlands started a project called "Atlas Leefomgeving" to provide professionals and citizens with this information. Therefore the Atlas project started to build an Atlas Demonstrator (see Figure 5) based on the INSPIRE principles. It is meant to demonstrate the use of distributed web services from national, regional and local governmental organisations to bring together all data sources in order to provide adequate information on the living environment for the users. The Atlas Demonstrator end-user application was based on the Luigi framework. Metadata (both from spatial data and documents) plays an important role in the application. This metadata was opened up using eXcat.

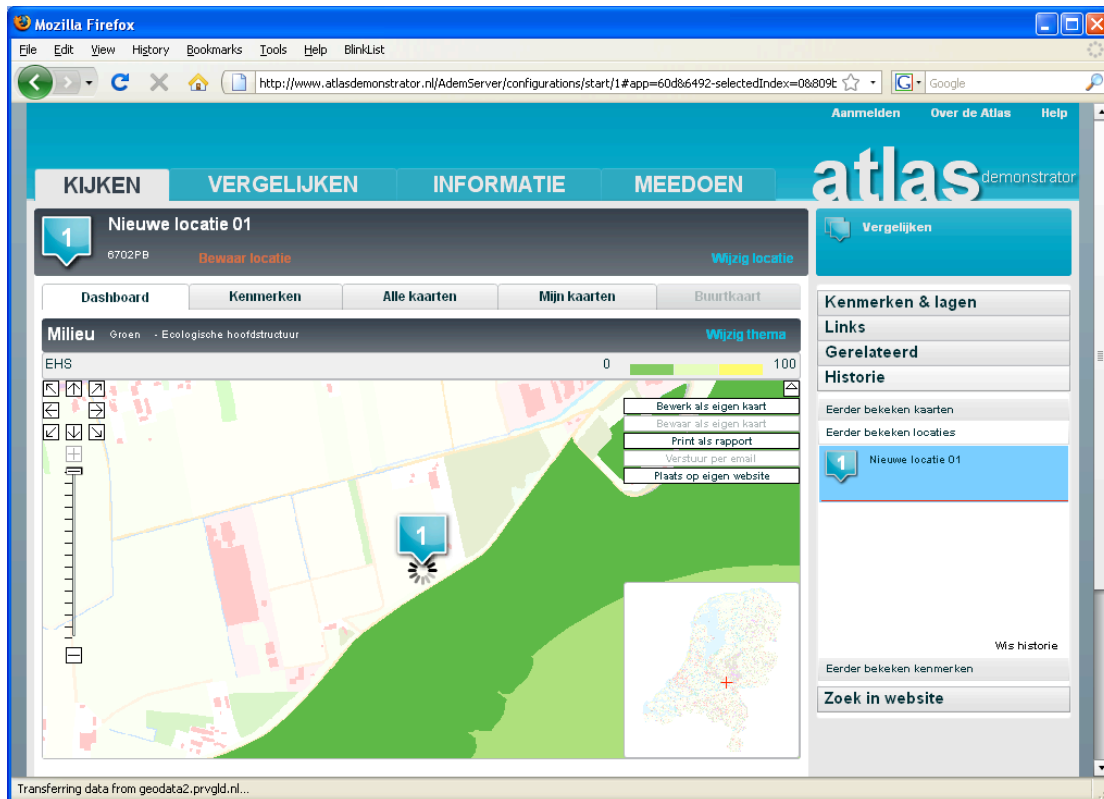


Figure 5 Atlas demonstrator

3.4 Designer

The above mentioned examples of internet GIS applications are compiled by GIS specialists for a certain target audience. The GIS specialist decides what components and spatial data should be present in the application. A web-tool dubbed designer was developed which allows end-users to compile their own application. Users can select components and services from a panel and link those together to create their own internet GIS application. It is a service chaining environment for spatial web services.

Users can choose from a number of components: a map control, a navigation map control and a legend control. A locator client can be used to provide geocoding functionality. The following spatial web services are supported by Designer: CSW, WMS and WFS. Users can either select a service from a predefined list or enter the URL of their own web service. The CSW client facilitates searching of remote CSW's. A coordinate transformation service can be used to obtain bounding boxes in the WGS84 coordinate reference system. This bounding box can also be used to filter CSW records.

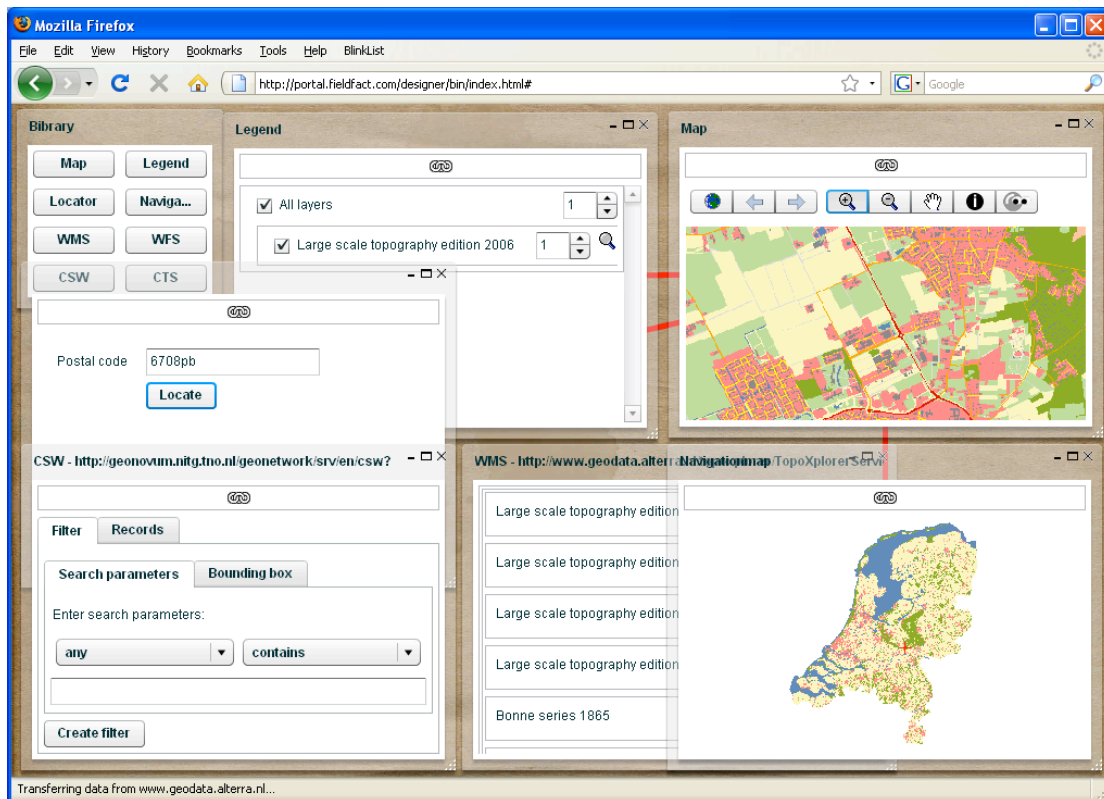


Figure 6 Designer

4 CONCLUSION

Together with of the shelf tools, the newly developed tools provide the technical foundation of our network. It can therefore be concluded that software is not a barrier for the adoption of the principles laid down in the INPSIRE directive. It is now up to the owners of geo-spatial data to take the next step and make their data available using standards compliant web services.

5 REFERENCES

Adobe. (2008). Adobe - Flex 3, at <http://www.adobe.com/products/flex/>, [accessed 2008-08-12].

Crompvoets, J. (2006). National spatial data clearinghouses, worldwide development and impact. Wageningen, the Netherlands, Wageningen University. **PhD thesis**.

eXist. (2009). Open Source Native XML Database, at <http://exist.sourceforge.net/>, [accessed March 31, 2009].

Frei, S., Dübendorfer, T., Ollmann, G. and May, M. (2008). Understanding the Web browser threat: Examination of vulnerable online Web browser populations and the "insecurity iceberg", at <http://www.techzoom.net/publications/insecurity-iceberg/>, [accessed 2008-08-10].

GeoTools. (2009). GeoTools - The Open Source Java GIS Toolkit, at <http://geotools.codehaus.org/>, [accessed March 31, 2009].

Hoogerwerf, M., Kuyper, M., Kooijman, J., Vermeij, B. and Bulens, J. (2008). GeoLoketten leert: hanteerbaarheid voor de gebruiker is grootste knelpunt. *VI Matrix*: 22-25.

Open Geospatial Consortium Inc. (2004). OpenGIS® Web Map Server Implementation Specification, at <http://www.opengeospatial.org/standards/wms>, [accessed December 8, 2008].

Open Geospatial Consortium Inc. (2005). Web Feature Service Implementation Specification, at <http://www.opengeospatial.org/standards/wfs>, [accessed December 8, 2008].

Open Geospatial Consortium Inc. (2007). OpenGIS® Catalogue Services Specification, at <http://www.opengeospatial.org/standards/cat>, [accessed December 8, 2008].

Open Geospatial Consortium Inc. (2008). Web Coverage Service (WCS) Implementation Standard, at <http://www.opengeospatial.org/standards/wcs>, [accessed January 31, 2009].

Vanmeulebrouk, B., Bulens, J., Krause, A. and de Groot, H. (2009). 'OGC standards in daily practice: gaps and difficulties found in their use', *GSDI-11 Building SDI bridges to address global challenges, June 15-19, 2009*, Rotterdam (to be published).

Vanmeulebrouk, B., Lokers, R. and Bulens, J. (2008). 'Integration of geo-spatial web-services using Adobe Flex', *Proceedings of the Free and Open Source GIS Conference 2008, September 29 - October 4, 2008*, Cape Town, South Africa, GISSA.

Zevenbergen, J., Bulens, J., Kuyper, M., Koerten, H., Jellema, M. and Welle Donker, F. (2009). "GeoPortal Network" – More process catalyst than project', *Proceedings UDMS, June 23-26, 2009*, Ljubljana, Slovenia, Taylor & Francis (in press).