Integration of geo-spatial web services using Adobe Flex

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Abstract

Background

To demonstrate the use of geo-spatial web services, a user-friendly internet GIS application framework called Luigi which seamlessly integrates geo-spatial web services was developed using the Adobe Flex development framework.

The Adobe Flex platform

Adobe Flex is a platform independent environment for developing rich internet applications (RIA's). The Flex framework is highly suitable for the development of interactive internet GIS applications. The Flex software development kit (SDK) has been released as open source and might thus be a basis for the development of open source rich internet application frameworks.

Functionality

The Luigi framework currently supports OGC services such as WMS, WFS and catalog services, geo-coding services, a coordinate transformation service and charting services. Users have the usual pan, zoom and identify tools at their disposition. Using the so called swipe tool, users can "see through" layers covering other layers. Spatial editing tools are also available.

Design

The application has been designed according to the model-view-controller (MVC) software architecture. The model consists of classes to administer the map layers available in the application and to keep track of the current and the full extent of the application. The map model is being modified by a controller which supports functions like for example panning, zooming and adding and removing map layers. These functions are being called by the visual controls from the view layer.

Extension

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. Changing the user interface and adding support for additional data formats (for instance a custom data format) is a breeze.

Conclusion

The Luigi framework has been used in numerous projects by partners participating in the Geoloketten project to create both simple internet GIS applications for novice users and complex internet GIS applications for professional users. The response from end users has been overwhelmingly positive so far. The dilemma now is whether to make the Flex internet GIS framework open source or not.

1. Background

The Geoloketten project supports the use of geographical information in the Netherlands. Within the frame of this project, a network of geo-spatial enabled web services has been created. These web services can be used to enhance existing web applications. To make these web services available to end-users, a user-friendly internet GIS application framework called Luigi which seamlessly integrates web services was developed using the Adobe Flex development framework. End-users navigate to a web-site from where the internet GIS application created using the framework is downloaded. This application subsequently connects to the various web services (see Figure 1).
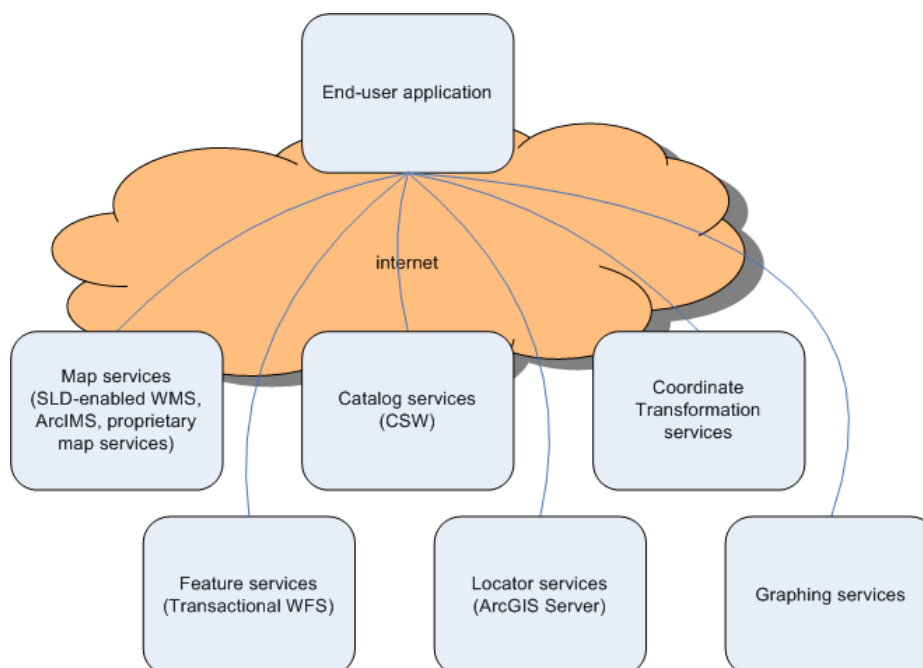

Figure 1 Integration of geo-spatial web services

2. The Adobe Flex platform

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 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.

The Flex software development kit (SDK) and an integrated development environment (IDE) are required to develop Flex applications. The Flex SDK has been released as open source. Developers can use the Flex SDK to freely develop and deploy Flex applications using either the closed source Adobe Flex Builder or an IDE of their choice, for instance Aptana.

3. Luigi and OGC services

The Luigi framework currently supports a number of web services. The Open Geospatial Consortium (OGC) services supported by the framework are: Web Map Services (WMS), Web Feature Services (WFS) and Catalog Services (CSW). Table 1 indicates which versions and which combinations of client and server have been tested.

Table 1 Supported OGC services

	Versions	**Output formats**	**Tested using**
WMS	1.1.0, 1.1.1, 1.3.0	png, gif, jpg (GetMap)	ArcIMS WMSConnector, GeoServer, MapServer
		GML2[1] (GetFeatureInfo)	
WFS	1.0, 1.1	GML2, GML3	GeoServer, MapServer, Snowflake
CSW	2.0.1, 2.0.2	ISO19139	eXcat

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[1] Other GetFeatureInfo formats (for instance WMS XML) are supported using a XSLT stylesheet which converts the GetFeatureInfo response to GML2. This functionality is available as a servlet.

A Web Map Service (WMS) produces maps of spatially referenced data dynamically from geographic information. A "map" is in this case a portrayal of geographic information as a digital image file suitable for display on a computer screen (Open Geospatial Consortium Inc., 2004). Virtually all internet GIS applications will include the viewing of maps and WMS is very suitable to realize this functionality. The WMS implementation in the frame work supports both basic WMS and SLD-enabled WMS. SLD stands for Styled Layer Descriptor (SLD) and is used to define symbolization for the map layers in the WMS. Whereas a basic WMS only supports named layers and named styles which are defined server-side, a SLD-enabled WMS applies client-side defined styling to features retrieved from a WFS (Open Geospatial Consortium Inc., 2007b). Symbolization can be defined in the Luigi framework and passed on to a SLD-enabled WMS.

A transactional Web Feature Service (WFS) allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) (Open Geospatial Consortium Inc., 2005). WFS can be used when information on the feature itself and not just an image of the feature is needed client-side, for instance when "zoom to feature" functionality is desired. To facilitate editing functionality, support for transactional WFS was added to the framework. This editing functionality was for example used to develop an internet GIS application used to manage information with regard to nature conservation aimed at meadow birds in the Netherlands (see Figure 2). This application amongst others contains tools to split parcels and to update alphanumeric attributes of parcels.
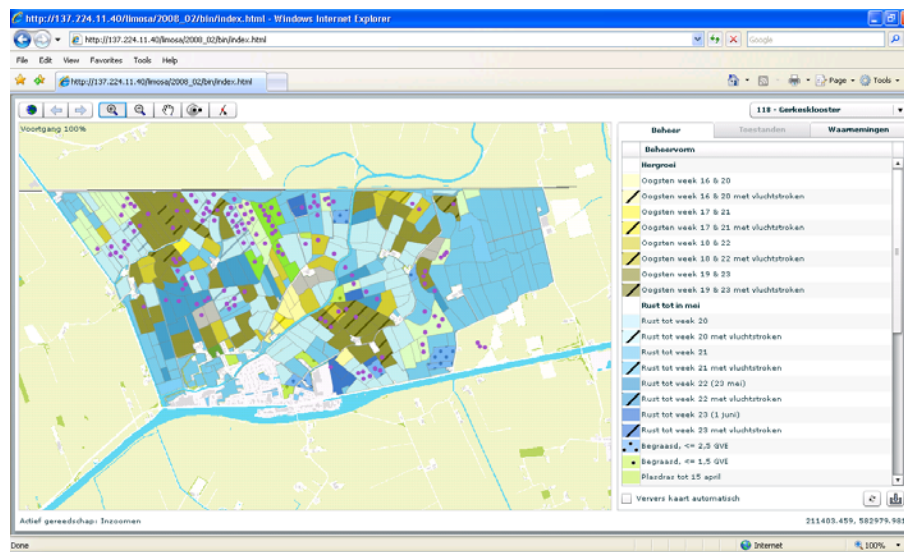

Figure 2 Internet GIS application to manage information with regard to nature conservation aimed at meadow birds in the Netherlands

Catalog services (CSW) support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects (Open Geospatial Consortium Inc., 2007a). The framework supports querying of CSW's. End-users enter a search term which is

passed to the CSW. The results of the query are presented in a list. If a result contains a link to a WMS layer or a WFS layer, the layer concerned can be added to the map. CSW support has been integrated in a prototype for a national geo-portal for Romania (Figure 3).
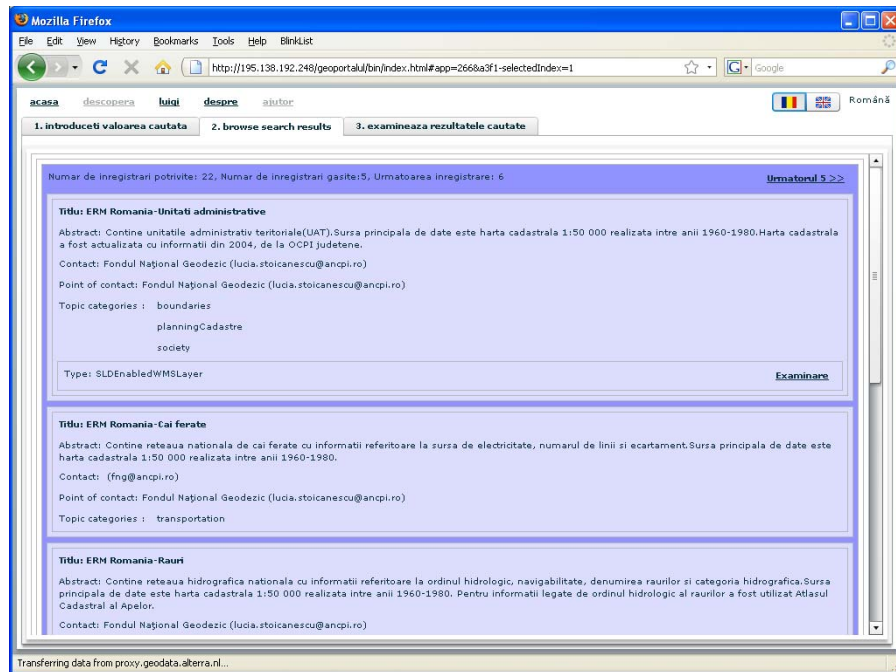

Figure 3 Prototype of national geo-portal for Romania

4. Design

The application has been designed according to the model-view-controller (MVC) software architecture. The model consists of classes to administer the map layers available in the application and to keep track of the current and the full extent of the application. The map model is being modified by a controller which supports functions like for example panning, zooming and adding and removing map layers. These functions are being called by the visual controls from the view layer. Currently, a map control, a navigation map control and a legend/table of contents control are available.
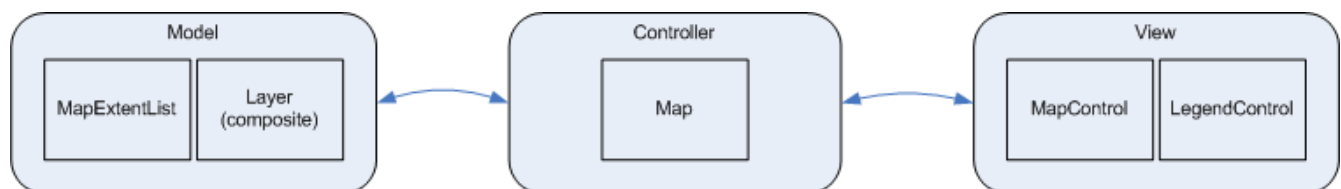

Figure 4 Model-view-controller architecture of the Luigi framework

This software architecture allows for example for the development of "geographically linked" map windows, since multiple views can be synchronized based on one common model. Moving the cursor, panning and zooming can occur simultaneously on multiple map windows. The "geographical link"

with the parent window can be broken up on de demand, but it can also be re-established on demand (see Figure 5).
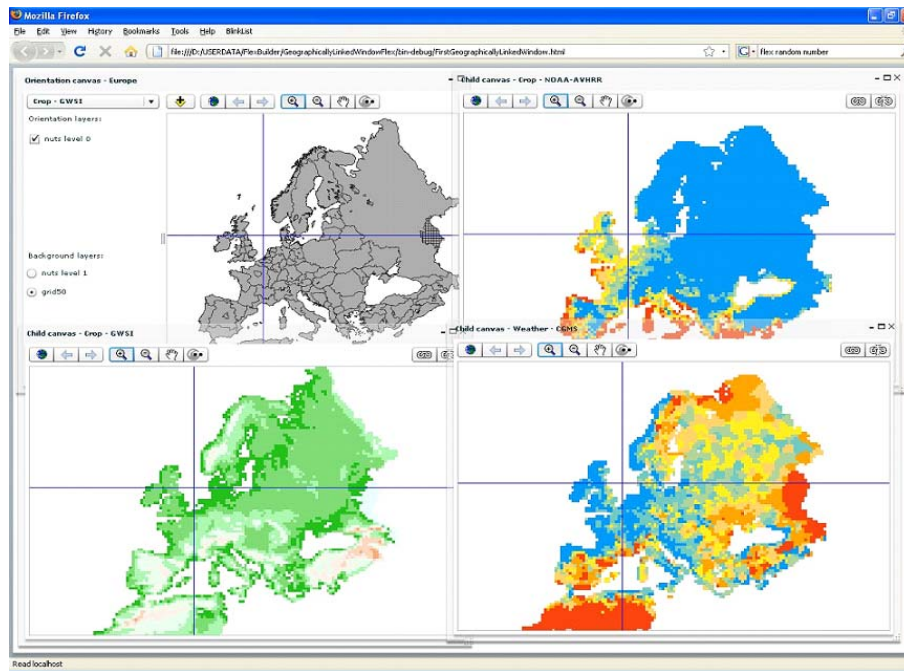

Figure 5 Geographically linked windows

5. Extension of the framework

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.

An example of the extension of the framework is demonstrated in the TopoXplorer internet GIS application. The Wageningen UR 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 analogues maps were scanned and geo-referenced. The TopoXplorer internet GIS application (see Figure 6) was developed to make the digital maps available to users. Since a WMS GetMap request does not contain all the information needed to produce a map for the TopoXplorer (information regarding the year requested by the end-user is required), a custom data format was implemented for this project.
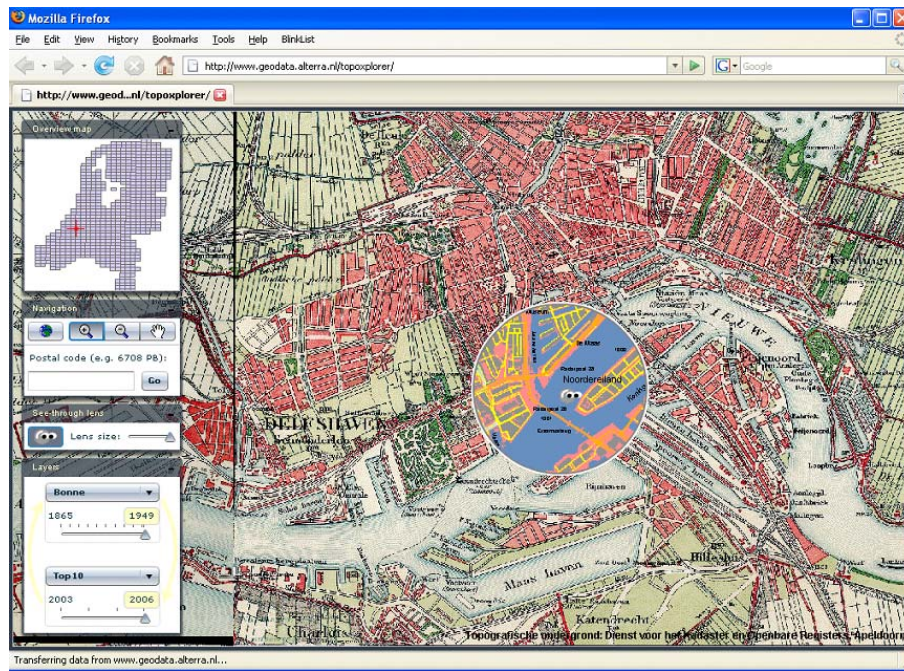
Figure 6 TopoXplorer internet GIS application

Within the frame of this project, the so called swipe map control tool was developed. It allows users to "see through" layers covering other layers and thus compare topographical maps for different years. Of course, usage of the swipe map control tool is not confined to topographical maps only.

6. Conclusion

The Luigi framework has been used by partners participating in the Geoloketten project to create both simple internet GIS applications for novice users and complex internet GIS applications for professional users, not only within the frame of the Geoloketten project itself, but also for other projects. The response from end users has been overwhelmingly positive so far. Considering the evident demand for highly interactive internet GIS applications and the absence of applicable frameworks in this area, we consider providing Luigi as an open source internet GIS applicationframework.

7. References

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