An Urban Planning Web Viewer Based on AJAX*

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Abstract. The *Program for Promoting the Urbanism Network* is a Spanish project promoted by *red.es*. The main goal of this project is the systematization of the urban planning of all the municipalities of the country using a single conceptual model that will end with the regional differences. The program has two main goals: first, building a *Transactional Planning Management System* based on a service-oriented architecture (SOA) of spatial services for processing the urban information, and second, providing an environment for publishing the information in the urban planning based on the standards for the creation of Spatial Data Infrastructures (SDIs). In a first phase, a collection of databases for the urban planning of different areas was generated, as well as a collection of services for the exploitation of the databases, and finally, different versions of viewers for the urban planning information. The services isolate the designers of urban data systems from the internal complexities of the data model, whereas the viewers allow final users to access the information in an easy and fast way. We show in this paper the Urban Planning Web Viewer for the Spanish municipality of Abegondo. The main features of the application are the modular architecture based on standard services, and the exclusive use of both AJAX (Asynchronous JavaScript and XML) and DHTML (Dynamic HTML) technologies in order to provide an extensible and very useful application with a high level of accessibility.

Keywords: urban planning, geographic information system, spatial data infrastructure, web viewer, service-oriented architecture, AJAX, interoperability.

1 Introduction

Red.es is the public entity within the Spanish Ministry of Industry, Tourism and Trade (MITyC) responsible for executing certain projects devoted to promote the information society. This is done in collaboration with the different autonomous

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communities, provincial councils and local entities of the country as well as with the private sector of the information and communication technology sector (ICT).

The *Program for Promoting the Urbanism Network* arises from a collaboration agreement between the MYTyC, the Spanish Federation of Municipalities and Provinces (FEMP) and *red.es* in order to introduce the ICT in the urban planning field of the local entities. More precisely, this program aims to define the appropriate systems, structures and technological resources to turn the urban planning information, which is usually drawn and written in paper documents, into digital information, and to use the digital information during all the life cycle of the urban planning process. That is, from the initial draft to the final application, without loss of information. The digital conversion of the information gives the urban planning process the typical advantages of information systems, that is, higher accuracy, consistency, universal access and ease of navigation through the information and reduction or even elimination of the distribution and copy costs [1].

Under this context, *red.es* proposed the definition and implementation of a *Transactional Planning Management System* using a service-oriented architecture of spatial services to deal with the urban planning information and a web-based publishing environment based on the standards for the creation of spatial data infrastructures. Therefore, three different components were generated:

1. A single conceptual model for urban planning that removes the differences between the different regions, and a collection of urban planning databases from selected areas following this conceptual model.
2. A collection of services for publishing the information stored in the urban planning databases. These services also isolate the designers of applications dealing with urban planning information from the internal complexities of the urban planning data model. Among these services, there is a *Web Map Service (WMS)* [2] that publishes the urban planning information as map images with different layers, a *Web Document Service (WS)* that provides a direct access to documents and urban planning repositories, and a *Planning Service* that provides an application programming interface (API) with different operations for the management of the urban planning database. There are operations in this API to compute the urban classification of a geographic point, to search urban planning areas by keywords, etc.
3. Different versions of web viewers for the urban planning information that allow people to access the information easily and quickly.

In this paper we present the urban planning web viewer for the Spanish council of Abegondo (in Galicia, Spain). This viewer acts as a client of the *WMS*, the *WS* and the *Planning Service* using AJAX and DHTML to provide a really useful application with a high level of accessibility.

The rest of the paper is organized as follows. In Section 2 we describe the application focusing on its main functional features. Then, Section 3 is devoted to technical features with special attention to the architecture of the system and to the interaction with external services. Finally, we conclude the paper showing the advantages of the solution and future lines of work in Section 4.

2   The Urban Planning Web Viewer: Functional Features

The Urban Planning Web Viewer is a web-based light client for browsing and querying the urban information of the council of Abegondo using the services developed by *red.es* as part of the *Program for Promoting the Urbanism Network*. These services provide the urban planning information by means of geographic information as well as alphanumeric information and documents.
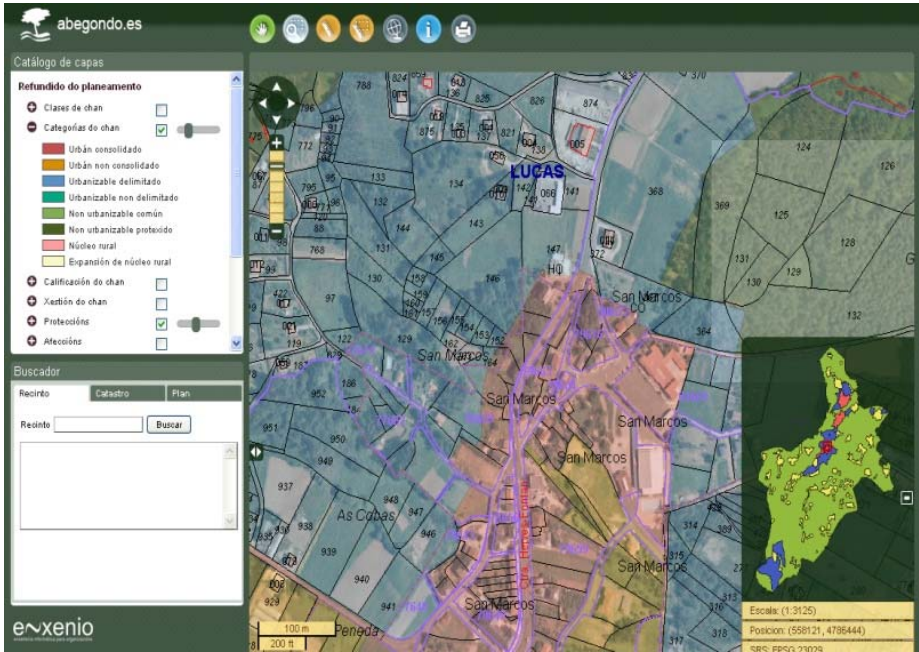

Fig. 1. Urban planning web viewer interface

As it can be seen in Fig. 1, the application user interface consists of a *Map Window* and several panels and toolbars. The *Map Window* shows graphical information about the urban planning information using geographic layers provided by the *WMS*, and other external sources such as the *WMS* of the Spanish Cadastre, the *WMS* of the National Plan of Air Ortophotography (PNOA) or the *WMS* of the Geographical Information System of the Agricultural Plots (SIGPAC). Furthermore, the panels provide the users with additional information and the toolbars enable them to apply several different functions, more precisely:

1. *Navigation Toolbar*: to move the *Map Window* over the council surface. It provides functions such as: zoom in, zoom out, window zoom, zoom to initial extension, drag-based movement, movement to the four cardinal directions, and an overview map that shows the situation of the current view with respect to the municipality and that provides a quick way to move the view to a certain location.

2. *Current View Information Panel*: this panel shows dynamical information about the current view such as the coordinates of the cursor, the spatial reference system used, the displaying scale (both numeric and graphical) and the address (street and number) that is closest to the position pointed by the mouse.
3. *Content Panel*: it allows the users to select the information layers that are shown in the *Map Window*. The layers are categorized into those that deal with the urban planning (Classification, Categories, Qualification, Management, Systems, Protections, Affections and Reservations) and those which provide background information (Cadastre and Orthophotographs). The user can also set the transparency level of each one of the layers in order to display several ones at the same time.
4. *Query Tool*: this tool allows users to obtain urban information for a given point of the map. This information includes: (1) the information of the current urban planning layers, (2) the collection of documents storing the urban planning information related to that point along the time, and (3) the graphic plans for that point. Figure 2 shows an example of a query result with the tab displaying the collection of documents selected.
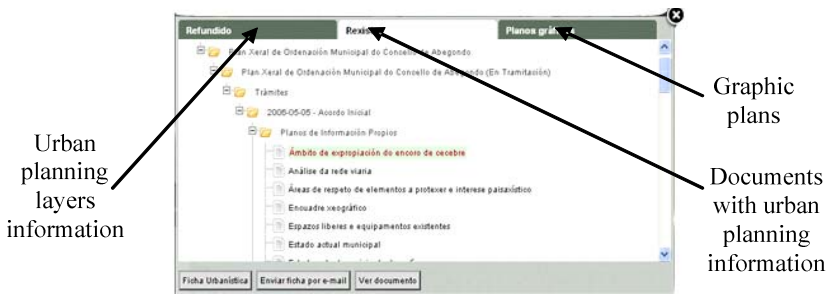

Fig. 2. Query result

5. *Geocoding Toolbar*: a toolbar with a group of tools for searching urban planning information using keywords. It also gives the option to search using the identifiers of the Spanish cadastre, or even by postal address. This toolbar is divided into several tabs, one for each kind of search, and each tab contains a form where the users can introduce the information needed (that is, a keyword, a cadastre identifier, or an address). All searches are performed in three steps: (1) the user introduces the search data and clicks on the button *Search*, (2) the application shows in the results panel the list of elements retrieved that fulfill the criteria, and finally, (3) the user selects one of the elements retrieved to automatically position the *Map Window* over that element.
6. *Measuring Toolbar*: it contains different tools to measure distances and surfaces over the *Map Window*.
7. *Map and Urban Planning Report Generation Toolbar*: these tools provide the user with an easy way to generate maps and urban reports from the current view in PDF format. The map generation tool creates urban maps using the cartography currently loaded in the *Map Window* (layers and styles associated).
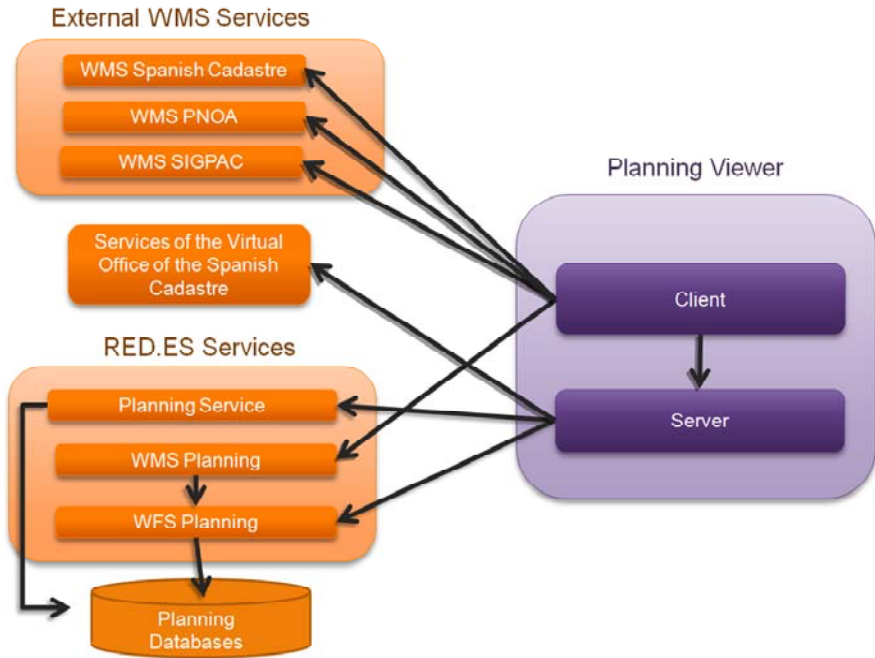
With respect to the tool for the generation of urban planning reports, the user can request this functionality after performing a query. That is, the user requests this functionality from the query results window and the application creates a report with the urban planning qualification information for the given point. Furthermore, the report can also be sent by email. Figure 3 shows two examples of a report and a map generated with the application.

Fig. 3. Examples of a report and an urban map

3   The Urban Planning Web Viewer: Technical Features

One of the most relevant features of the Urban Planning Web Viewer of Abegondo is that it is entirely based on open source software. This assures a low cost of maintenance as well as technological independence because the application can be run on any platform.

The architecture of the application is shown in Fig. 4. Notice that it is modular and based on the standard services defined by the *International Organization for Standardization (ISO)* and the *Open Geospatial Consortium (OGC)*. This important feature ensures that the system is interoperable, it is easy to be extended, and it is easy to integrate within a spatial data infrastructure [3] following the INSPIRE directives.

With respect to the technologies used in the implementation, the exclusive use of AJAX/DHTML technologies in the client side clearly improves the accessibility of the application because the installation of plug-ins or applets is not necessary in the client for its properly performance [4].

3.1   Architecture of the Application

The Urban Planning Web Viewer follows a three-layer architecture following the Model-View-Controller architectural pattern. The client side (the View of the

Fig. 4. Application architecture

application) has been implemented using only AJAX/DHTML, whereas the server side (the Model and the Controller) has been implemented using Java 2 Enterprise Edition (J2EE) technology.

With respect to the client side, the implementation uses the library *OpenLayers* [5] for the *Map Window* and the different tools that interact with it. *OpenLayers* is an open source library in *Javascript* for displaying maps using geographic information services as data sources. Some of the panels and toolbars of the client side (such as the *Geocoding Toolbar* or the *Content Panel*), have been implemented using *jQuery* [6]. This is a *Javascript* framework that simplifies the interaction with HTML. It also simplifies the usage of AJAX technology for handling events and adding interactivity to web applications.

In the server side, the *Spring* [7] framework has been used for implementing the Controller. This framework is an open source software as well, and it speeds up the implementation of the Controller of a MVC architectural pattern. We also use *JasperReports* [8] in the server side for the creation of the PDF maps and reports. This open source library makes the creation of paper reports very simple.

3.2 Interaction with External Services

Beyond the architecture and internal functionality of the application, the most powerful feature of the Urban Planning Web Viewer is its capability to interact with external services. This feature makes the application interoperable and extensible, and

provides for an easy integration in a spatial data infrastructure. To explain this feature, we describe the main interactions of our application with the urban planning services of *red.es* and with other services.
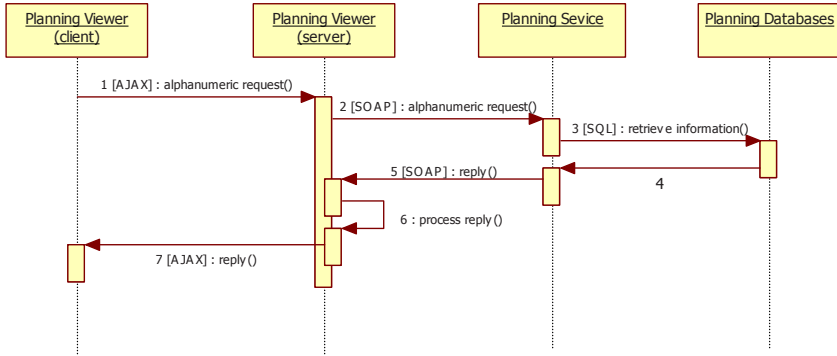

Fig. 5. Accessing urban planning alphanumeric information

To access the urban planning information, the application uses the red.es services. In order to access the alphanumerical information, the application acts as a client of the *Planning Service* provided by red.es. This service uses SOAP (Simple Object Access Protocol) as the communication protocol, and therefore, XML requests and replies are exchanged between the server side of the Urban Planning Web Viewer and the Planning Service. A sequence diagram for this process is shown in Fig. 5.
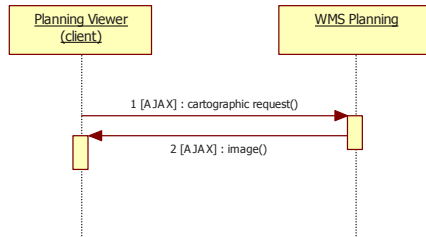

Fig. 6. Accessing urban planning geographic information

With respect to geographic information, the *WMS* service of the provided by *red.es* is used as the information source. The *WMS* service fetches the geographic information from the urban planning database and generates image maps for the information. The client side of the Urban Planning Web Viewer uses *OpenLayers* as a client of this *WMS* service. Figure 6 shows a sequence diagram that represents this situation. In order to access external *WMS* such as the one provided by the Spanish Cadastre or the one provided by the National Plan of Air Ortophotography, the client side of the Urban Planning Web Viewer uses the same strategy used for the *WMS* provided by *red.es*.
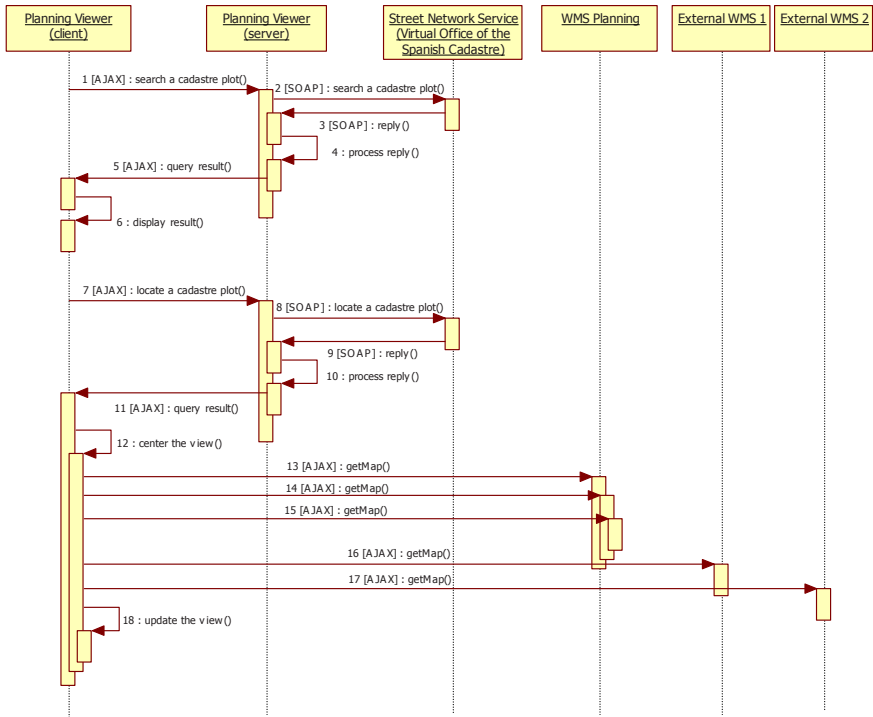
Fig. 7. Searching using the Cadastre web service

Regarding the search tool, the Urban Planning Web Viewer uses the street network service provided by the Virtual Office of the Spanish Cadastre [9]. Using this service, a client application can search the street network of the Spanish Cadastre and the information of the Cadastre that is not protected by law. The service defines a protocol that uses XML to represent the requests and the replies of the service. Figure 7 shows a sequence diagram of this process. First, the server side of the Urban Planning Web Viewer queries the external services to retrieve a list of search results that fulfill the query terms and then it displays the results to the user. When the user selects one of the query results, the Urban Planning Web Viewer uses the geographic location associated to the query result to position the *Map Window*. The client side of the application uses *OpenLayers* to center the *Map Window* and to retrieve the new maps.

A more complex use case involves using the urban planning services provided by red.es to retrieve information from the urban planning database. This process is described by the sequence diagram shown in Fig. 8. The process consists of the following steps:

1. The user types in the *Geocoding Toolbar* the information and clicks the *Search* button.

> The client side of the application sends an AJAX request to the server side of the application to retrieve the elements that fulfill the search criteria.
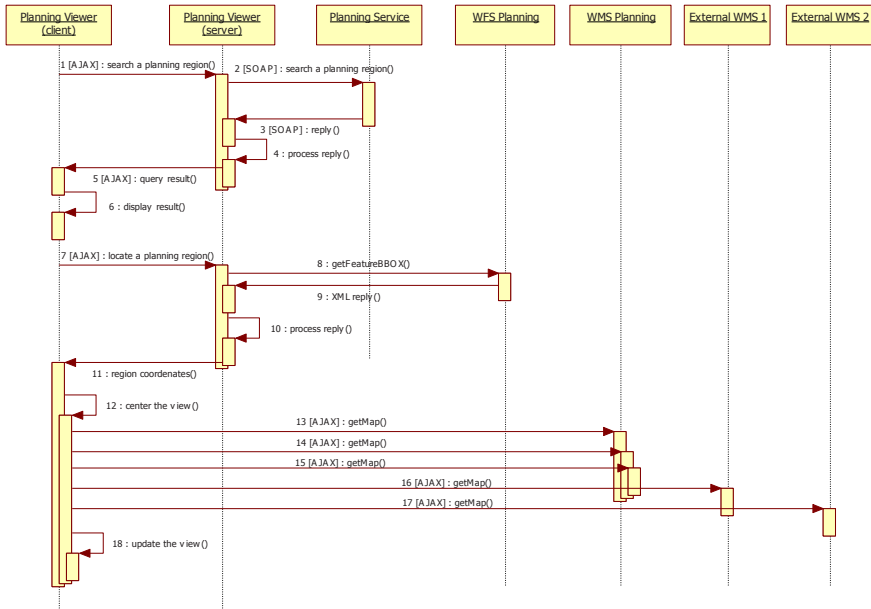
Fig. 8. Searching using the urban planning services

> The server side of the application invokes the *Planning Service* using a SOAP request.
>
> The server side of the application retrieves the reply from the *Planning Service*. The reply is processed and sent back to the client side of the application.
>
> The client side of the application displays the search results in the results panel of the *Geocoding Toolbar.*

2. The user selects one of the search results

> The client side of the application sends an AJAX request to the server side to retrieve the geographic location of the element selected.
>
> The server side of the application performs a request to the *Web Feature Service (WFS)* [10] provided by *red.es* in order to compute the geographic location of the element selected.
>
> The server side of the application retrieves and processes the XML response provided by the *WFS*, and sends the result back to the client side of the application.
>
> The client side of the application uses *OpenLayers* to position the *Map Window* centered over the element. In turn, *OpenLayers* requests the required map images from the *WMS* services associated to the layers that are being displayed in the map.

4   Conclusions and Future Work

In this paper, we show the Urban Planning Web Viewer that we have developed for the municipality of Abegondo. This work was developed under the *Program for Promoting the Urbanism Network* funded by *red.es*. The Urban Planning Web Viewer allows the citizens of the municipality to browse and query the urban planning information. Furthermore, the application provides tools for: (1) finding easily and quickly a given Cadastre plot or an urban planning region, (2) querying the classification given by the urban planning to a specific geographic point, (3) generating paper maps and reports with the urban planning information, and (4) performing other operations such as measuring distances, surfaces, or browsing the urban planning documents. The paper also describes the architecture of the system and the interaction process between the system and the external services are described with detail.

The most important features of the system are the following: (1) it was developed using open source software, (2) the architecture was designed using the standard services defined by ISO and OGC, and the client side of the application was developed using AJAX and DHTML. These features imply that the application has a very low maintenance cost, an extensible architecture that is interoperable, and a high level of accessibility. Finally, the process of integrating the application in a spatial data infrastructure is also very easy.

As future lines of work, we are considering the following functionality:

1.   Using other external services to perform searches. For instance, we plan to use the services provided by *Cartociudad* [11], which were developed by the National Geographic Institute of Spain, to be able to search using postal codes, census districts, or street names.
2.   Retrieving from the Cadastre service the complete information of a land parcel and displaying this information in the user interface and in the paper reports.
3.   Including *e-government* functionality such as producing urban planning certificates.

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