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Facilitating E-government Services through SDIs, an Application for Water Abstractions Authorizations

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Abstract. In the last years, there has been a huge increment in the number of e-government services offered to the citizens and companies. However, environment-related permits are among the least developed kind of e-government services in Europe. Environmental management and government requires the use of geographic information and spatial data infrastructures (SDIs) are being providing the framework for optimizing its management, and they are becoming a legal obligation for some countries and institutions.

In order to make profit of geographic information technologies and of the obligation of building SDIs to contribute to the development of e-government services, this paper analyzes an e-government opportunity in the environmental management linked to the use of SDIs and presents how to use them in a real tool: the application for a water abstraction authorization. SDI services are used for the capture, management, and assess of geographical information in a full transactional level e-government service.

Keywords: e-government, Spatial Data Infrastructures, INSPIRE, Water Authorities, Hydrology, Water abstraction requests

1 Introduction and Motivation

The United Nations Division for Public Economics and Public Administration [24] defines e-government as "utilizing the Internet and the World Wide Web for delivering government information and services to citizens". Evans and Yen [11] add the concepts of "*communication* between the government and its citizens" and stress the advantages "in timeliness, responsiveness, and cost containment". In the last years, there has been a huge increment not only in the number of e-government services provided, but also in their quality and sophistication, due to the fact that many countries are implementing e-government policies, strategies and programs. [1, 6, 15].

However, environment-related permits are among the least developed e-government services in Europe [15]. As an example, in many countries, both surface and ground waters are public and their use for private purposes requires an authorization given by a governmental authority according to certain conditions. Citizens, companies and other organisms are required to make an application in order to obtain this authorization, providing certain information in order the administration to evaluate it and approve or reject the authorization. In Spain, these water abstraction authorizations are still a paperwork process and it constitutes an excellent example of a governmental service that can be provided electronically to the final users.

In this case, as within any other environmental management process, a lot of data and information involved in the administrative process is geographic information, that is, data that make reference to a location on the Earth surface, being much more complex in aspects related to data creation, maintenance and exploitation than other kinds of data. Not surprisingly, the main creators and users of geographic information are public administrations [3, 20], needing it to be of controlled sources and quality, and being required its use for the implementation of e-government services. According to [19], "a *spatial data infrastructure* (SDI) is defined as the infrastructure that provides the framework for the optimization of the creation, maintenance and distribution of geographic information (and environmental data by specialization) at different organization levels (e.g., regional, national, or global level) and involving both public and private institutions [18]". In this line, the European Commission launched INSPIRE (*INfrastructure for SPatial InfoRmation in Europe*) [10], an ambitious legislative directive whose aim is the creation of a European spatial information infrastructure that delivers integrated spatial information services, based on a hierarchy of national, regional and local spatial data infrastructures. The first area where INSPIRE is going to be developed is environmental information.

In Europe, diffusion of information is also an e-government service imposed not only by the INSPIRE directive, but also by pieces of legislation form the environmental domain, such as the Water Framework Directive [9], that identifies information supply as the base to allow consultation and active involvement in the management of river basins to the general public, stakeholders and other authorities.

Geographic information technologies and spatial data infrastructures have to contribute to the success of e-government programmes. Delivering information and government services to the public via internet and other digital means is enabling government agencies to meet the challenges of having to reduce costs, deliver services faster, provide better customer service, and increase productivity. But it is also necessary to take advantage of these infrastructures (taking into account that the obligations derived in Europe from the application of directives such as INSPIRE and the WFD, are pushing towards the creation of SDIs, not only at European or national levels, but also at the regional level) to provide more sophisticated, added-value e-government services.

The rest of the paper is structured as follows. Next section deals with geographic information, spatial data infrastructures and the European directive INSPIRE. Section 3 discuses about e-government opportunities in the environmental management, especially in the case of European Water Authorities. Section 4 shows how e-government services can be developed over a spatial data infrastructure, presenting the process of applying for a water abstraction authorization. This work ends with a conclusions section.

2 Geographic Information and Spatial Data Infrastructures

Geographic information (also known as geospatial data) is information that describes phenomena associated directly or indirectly with a location with respect to the Earth surface. Nowadays, there are available large amounts of geographic data that have been gathered with different purposes by different institutions and companies. For instance, geographic information is vital for decision-making and resource management in diverse areas (natural resources, facilities, cadastre, economy), and at different levels (local, regional, national or even global) [4]. Furthermore, the volume of this information is growing significantly [21, 12] due to, for instance, sensors at monitoring sites, automatically collecting and transmitting measurements at small time intervals, technology advances in high-resolution satellite imagery or GPS georeferenced data. Even more, it is possible to also georeference complex collections of a broad range of resource types, including textual and graphic documents, digital geospatial map and imagery data, real-time acquired observations, legacy databases of tabular historical records, and multimedia components such as audio or video.

One feature that makes geographic information different from other information resources is the complexity of the processes involved in data creation, maintenance and exploitation. As a result of this continuous generation of elaborated information, the need for effective data access, sharing, services, and processing becomes increasingly important.

Spatial data infrastructures are the paradigm for the new management and distribution of geographic information. Spatial data sets, metadata, spatial data services form part of spatial data infrastructures, together with network services and technologies, agreements on sharing, access and use; and coordination and monitoring mechanisms [10]. Discovery, access and distribution of up-to-date information is achieved by means of a set of standard web services: among others, catalogue services (that enable the search and retrieval of geographical metadata), web map services (WMS, that provide geographic visualization of the data in the form of maps), web feature services (WFS, that allow for querying for data satisfying certain characteristics or attribute values and provide the requested data in GML format) and gazetteer services (that enable the search and retrieval of geographical names). Ideally, this should be done at any public administration level that has the responsibility of creating and maintaining geographic information.

In the field of spatial data infrastructures, the European Union approved in 2007 the INSPIRE Directive (*INfrastructure for SPatial InfoRmation in Europe*) [10], an ambitious legislative directive whose aim is the creation of a Eu-

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ropean spatial information infrastructure in order to support Community environmental policies, and policies or activities which may have an impact on the environment. It is being build hierarchically based on the infrastructures for spatial information established and operated by the member states, while these ones, should be organized into a hierarchy that includes infrastructures developed at different political-administrative levels [22], including regional, environmental-related agencies.

3 E-government Opportunities in the Hydrological Management

It is interesting to take into account that environmental protection is one of the interests of the European Union. Different initiatives and pieces of legislation in the environmental field are taking place in the European Union, with a strong focus and need of environmental data. A considerable amount of these initiatives affect directly to Water Authorities, such as the Water Framework Directive (WFD) [9], which is considered to be the most important piece of legislation in this aspect [25]. The main objective of the WFD is to achieve an accurate management of all water bodies and it expects to reach a *good status* for them by 2015. Diffusion of information to the public is an e-government service imposed to the water authorities by its 14^{th} article [9] and by the *Guidance on Public Participation in Relation to the Water Framework Directive* [7, 8], considering that information supply is the base to allow consultation and active involvement in the management of the river basin to the general public, stakeholders and other authorities. In addition to this, the *Guidance Document on Implementing the GIS Elements of the Water Framework Directive* [26] recommends the use of the SDI mechanisms proposed by INSPIRE in order to communicate data among the member states and the European Commission and to disseminate this information to the public.

The most basic e-government application consists clearly in providing citizens with access to information [16]. Governments produce huge volumes of information and an increasing amount of it is now available through the web and other electronic means. In this sense, each spatial data infrastructure provides a first set of standardized, organized core services associated with the public administration level that has the responsibility of creating and maintaining the corresponding infrastructure level. Regarding this subject, each public administration is offering implicitly a minimum set of e-government services [20]. But this is only an e-government service at the basic level of maturity (*web presence* [2, 23] or *information dissemination* [5, 17]). However, these services provide a good base for developing more sophisticated services oriented to the satisfaction of specific functionality. A higher level of sophistication is desired, such as the level of *interaction*, [2, 23] where governments provide help and assistance to citizens (e-mail, official forms downloads and help to fill them), although paperwork is needed to finalize any application; or *transaction* [2, 5, 17, 23] level, where users can perform complete, legally valid, online transactions. In the case of environmental agencies, these levels can be achieved by using spatial data infrastructures to deal with the geographic information needed for these transactions, as it is exemplified in the next section.

This means that a spatial data infrastructure can provide interesting services for e-government. So, if there are many initiatives to built spatial data infrastructures, and they offer services that can be used by developing e-government services, spatial data infrastructures can be considered as the first step for developing e-government in the case of environmental agencies, where they are more developed than e-government services.

4 Water Abstraction Requests at the Ebro River Basin Authority

The Ebro River Basin Authority (*Confederación Hidrográfica del Ebro*, CHE) is the Spanish organization in charge of physically and administratively managing the hydrographical basin of the Ebro River, according to the Water Framework Directive requirements. Part of its administrative work deals with the analysis and approval or refusing of water abstractions that are applied by particulars, companies and other public authorities, in conformance with the river basin management plan objectives.

The initial GIS infrastructure at the CHE evolved into a Spatial Data Infrastructure (IDE-Ebro[1]). The mere existence of this SDI implies that a certain level of e-government services are being provided, enough to cover, for instance, the requirements of the 14th article of the Water Framework Directive about public information supply. IDE-Ebro gives public access to data related to the WFD (surface waters, groundwater bodies and protected areas), their inventory of water points (including wells, springs and monitoring points) and other data of reference of the Ebro River basin district. This access is provided through a set of standard web services, as described previously in section 2: a catalogue service, web map services, web feature services and a gazetteer service.

However, this kind of e-government service belong to the most basic levels of the e-government stage models proposed in the literature, named *web presence* or *interaction* [2], *enhanced presence* or *interactive presence* [24], *information publishing/dissemination* [5], *catalogue* [14] or *simple information dissemination* [13, 17].

The SDI infrastructure should be also used to provide to the citizens and companies with more sophisticated services. In the case of application for water abstractions, an e-government service can be provided that can achieve the level of *transaction* [23], built on top of the services provided by the SDI.

The specific administrative process the requests of water abstractions follow depends on characteristics such as water use, amount, source (surface or groundwater) and geographical location. Among the requested information, a map showing the location of abstraction and discharge points, the demand unit

[1] `http://ide-ebro.chebro.es`

(a polygon for an irrigated area, a point for any other demand unit: centre of population, farm ...) and any other infrastructure irrigated area (if any) must be provided. The administrative process also involves a great amount of time because the user has to wait until being informed whether the application is granted or not. Due to a large queue of requests and the fact that some queries have to be redirected to other authorities, this delay can be estimated at about twelve months.

The introduction of a web tool, based on SDI services, to provide this service electronically, improves this administrative process and allows for the elimination of the paper work and related to the user following the process is eliminated, achieving a *full transactional* service [23]. Additionally, by using an electronic tool, stakeholders can make use of the official information the organization is sharing through its own SDI, increasing the reliability of the data and parameters provided with the request. It is also possible to provide users with immediate feedback about the request, informing them about the kind of processing their request will follow, and providing an estimate of the feasibility of the request based on objective criteria included in the process. This feasibility report cannot be legally binding (only the competent authorities can legally inform about a water abstraction request, after their staff have carefully and individually analyzed each request) but by providing it, users can get a straightaway estimate of the result. Finally, by making use of electronic signature services, the request is formally submitted, and its processing at the water authority starts.

4.1 Functionality and Architecture

The architecture of the application is presented in Fig. 1. The core of the tool is a web service (*water abstraction service*), in charge of coordinating the whole process: acquisition and storage of data, generation of the feasibility report, validation of electronic sign, management of users' feedback, ...

The graphical user interface of the tool (*web water abstraction service*) is in charge of acquiring in an on-line manner the parameters of the request, both non-spatial data (such as water use: human supply, irrigation, industrial, aquiculture recreational, navigation, or other; requested amount of water; and water abstraction nature: surface or groundwater) together with the geographical elements of the request (location of the water abstraction points, discharge points, demand units: irrigated areas, centre of population, farms, or others), by pointing onto the map the requested locations or by drawing the perimeter of the irrigation area.

This geographical data capture component (Fig. 2) is based on the services provided by the subjacent spatial data infrastructure, and presented previously, e. g.:

- The location of the area of interest is done by means of the gazetteer service for searching for administrative features by name and/or by zooming in on an interactive map provided by web map services.

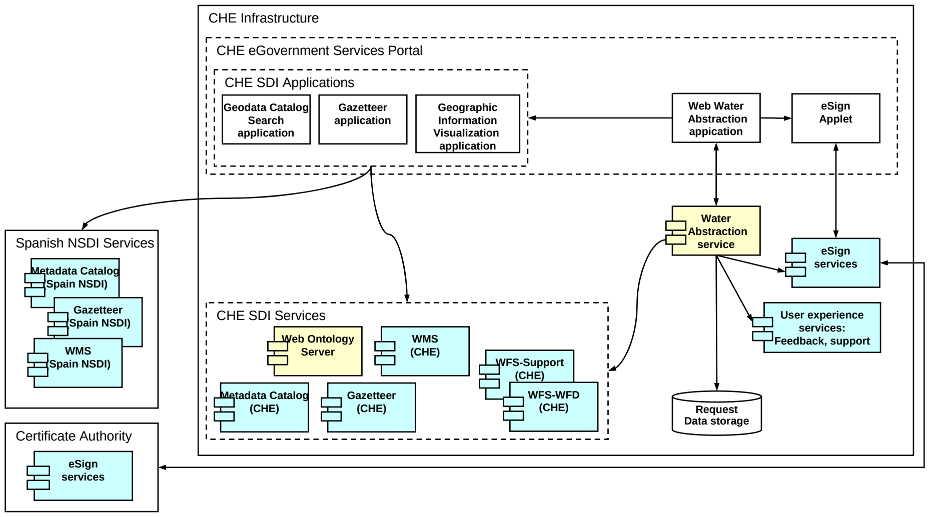

Fig. 1. Architecture of the application for water abstractions requests

– The visualization tool allows for the selection of the reference data that is more suitable to input the geographical information (administrative boundaries, settlements, river network, transport network, ...) and from the most appropriate source: services from the hydrological SDI or services from a mapping agency SDI.
  Provided the scales at that the work is done, raster imaging and orthophotos are used as background in order to do it properly, together with cadastre parcels.
– The determination of certain geographic elements that have an impact on the request (such as municipality, river subbasin, hydrogeological domain, aquifer, ...) is done by making requests to a web feature service of either the hydrological SDI or the mapping agency SDI.

Data obtained during the request is included into the information systems of the Ebro River Basin Authority and it is used to provide the user with a feasibility report and information of the administrative process that will be followed (Fig. 3). To achieve a full transactional service, the web application integrates an electronic signature applet, in order to formalize administratively the whole process by using a certification tool valid in Spain (digital certificate or electronic identity card). The electronic signature service validates the signature by checking it against a certificate authority. It is the existence of this electronic signature service what makes the water abstraction request service a *transactional* one. Nevertheless, without them, the application could be used just to help the user to generate the documentation and paper work needed to submit

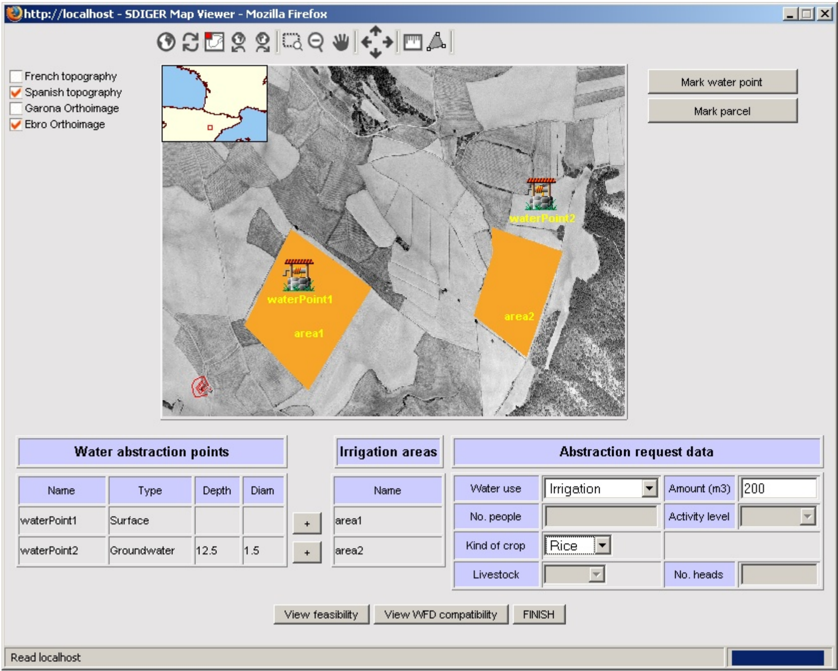

Fig. 2. Graphic user interface for data input

the request in a traditional way, resulting the electronic service in a *one-way communication* or just *interactive* e-government service).

Finally, some services and functionality are included in the infrastructure in order to provide a globally positive user experience by increasing usability (help functionality and process tracking) and user satisfaction monitoring (user feedback and reporting) [15]. Regarding process tracking, users are informed about the administrative statuses and updates of their requests as they are processed. These administrative statuses can be consulted via web (once the user has been authenticated) and updates on the status are sent to the user's e-mail or mobile phone.

5 Conclusions

In the last years, there has been a huge increment not only in the number of e-government services offered to the citizens and companies, but also in their quality and sophistication. However, environment-related permits are among the least developed e-government services in Europe.

A particularity of environmental, administrative management is that a lot of data and information involved in administrative process is geographic information. Spatial data infrastructures (SDIs) are being providing the framework for

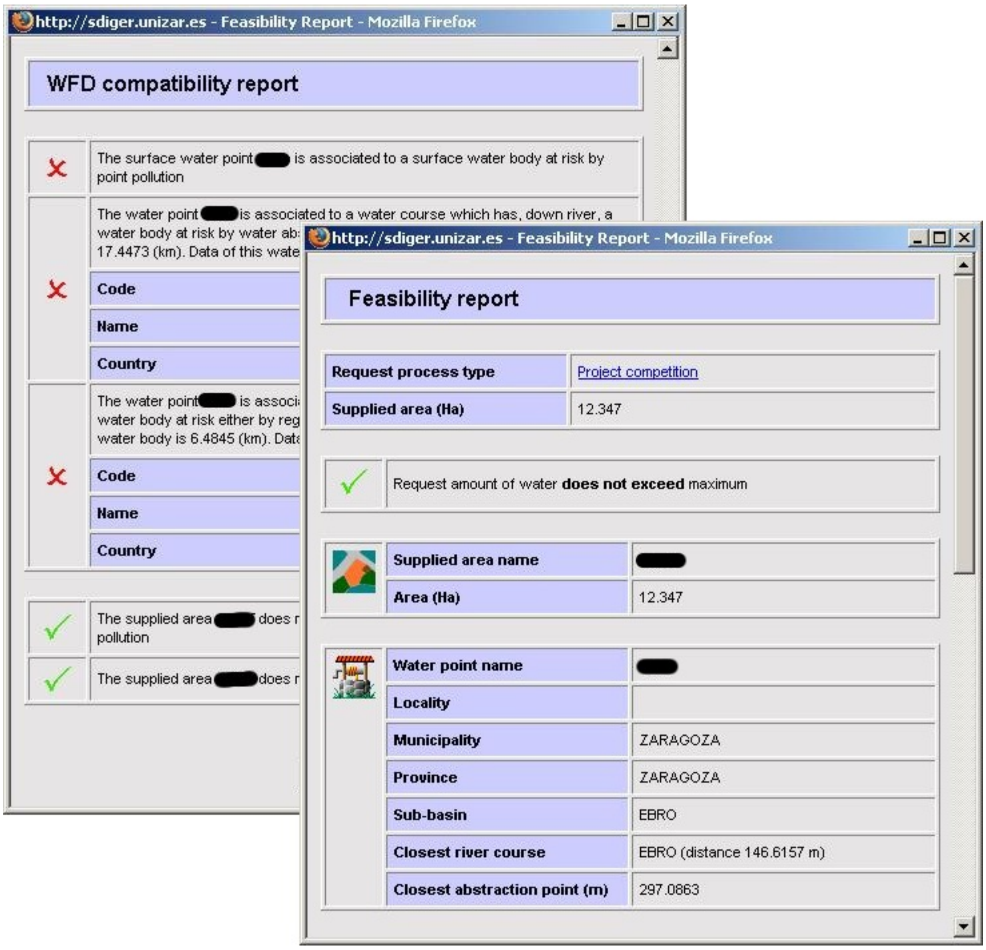

Fig. 3. Feasibility report

the optimization of the creation, maintenance and distribution of this kind of information at different organization levels, and they are a legal obligation for some countries and institutions.

It is necessary to make profit of geographic information technologies and of the obligation of building SDIs to contribute to the development of e-government services. This paper has analyzed an e-government opportunity in the environmental management and the role of spatial data infrastructures in the success of e-government initiatives in this field. A real application has been presented, showing how to use SDIs in this context: the process of applying for a water abstraction authorization. SDI services are used for the capture, management, and assess of geographical information in a transactional level e-government service. The tool improves this administrative process and allows for the elimination of the paper work, the reliability of the data and parameters provided with the request are increased and users are provided with immediate feedback about the request about the kind of processing needed and the feasibility of the request.

Future work will deal with extrapolating the application to other River Basin Authorities and with the implications of cross-border (administrative vs. hydrographic limits of basins) and international approaches in the interoperability of the services belonging to the SDIs that support the tool.

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Note. All links in the reference section checked March 11, 2010.