A norma WPS na integração do cadastro

Ricardo Pereira, Mario Rui Gomes, Bruno Martins

Resumo

Without a national standardized cadastral record, several organizations have produced their own cadastral records. These, were developed and dedicated to the individual organization's needs with differentiated and heterogeneous information systems. This thesis deals with urban cadastre in Portugal, seeing it has an integration systems problem. As it is today, the cadastre can be improved using the recent technologies related with Web services and with Web Services orchestrations (e.g. Business Process Execution Language). The urban cadastre requires a strong geographical component, for this reason, these services must be able to deal with spatial information. One of the objectives of this work is to investigate the recent standard Web Processing Service (WPS), launched by the Open Geospatial Consortium (OGC), and evaluate if it can help to solve some of the integration problems existing in the systems involved.

It was developed a service-oriented architecture containing various web services related to the activities of each entity involved in the management of the urban cadastre processes in Portugal. It was also developed a web service orchestrator, responsible for executing the processes and has been tested the WPS and BPEL technologies. This architecture is intended to act as a proof of concept of the ease of development that this platform provides, demonstrating the applicability of these architectures to the urban cadastre problem.

Keywords: Geographic Information Systems, WPS, OGC, Cadastral Information Systems, Information Systems Integrated, BPEL

1 Introduction

Portugal is one of the few EU countries which have only part of the territory with cadastral information. Several processes involving the public administration rely on information depending on cadastral information. The cadastre refers to a register with information about a given parcel of land. For each parcel, this record must contain data as, the localization, the form (geometric limits), the composition of each building (if available in the parcel) and the taxes [3].

Nowadays the cadastral information sources are distributed and outdated [1]. In the absence of a national cadastre, each entity (e.g. City-Halls, Finance, *Conservatória*, etc.) had to produce their own records, which were made dedicated to the individual needs of each organization using different information systems. The explanation for this phenomenon may perhaps be explained by the complexity that characterizes the Cadastre.

The urban cadastre's processes don't have any kind of automation so, it is the citizen who has to deal with the exchange of information between the entities involved in order to run the process. This happens because the information systems involved are independent and with little interconnection. The information is not harmonized in concepts and terminology because each entity is acting on its own without worrying about whether the data is consistent between the stakeholders.

In fact, it is imperative to develop a system which serves as a facilitating tool for the management and decision making. Given this situation, a Geographic Information System (GIS) is presented as a fundamental tool for management of the urban cadastre. A GIS is a system used to store analyze and manipulate spatial data, which means, data representing objects and phenomena where the geographic location is an important characteristic for the analysis. One of the main features of a GIS is its ability to manipulate spatial data and descriptive data in an integrated way, delivering them consistently for analysis, consultation and decision making. The diversity of types of the data, shows the need of system capable to deal with various types of data sources.

One of the objectives of this work is to investigate whether the recent standard Web Processing Service launched by the Open Geospatial Consortium[1] (OGC) can help in the described problem. This standard was developed to process spatial information, but it could bring much more value if exists a connection between the standards associated with management processes (e.g. the standard Business Process Execution Language (BPEL), proposed by the Organization for Advancing Open Standards for the information society[2] (OASIS) for orchestrating Web Services) and standards related to the processing of spatial data (e.g. standards proposed by OGC for the management of spatial data) through WPS.

2 Related Work

This section introduces the concepts and works of the major areas of geographic information systems, integration systems and cadastral information systems, which will be referred to the rest of the document.

2.1 GIS Standards

As the urban cadastre will have to deal with sharing and interoperability of spatial information issues, for that reason, this section describes some concepts related to interoperability in a Spatial Data Infrastructure (SDI).

A SDI is a distributed system which provides an environment to the management of spatial data [5]. These services share common standards to avoid interoperability problems. Among the services normally associated with SDI, are services to access maps and to management and processing of spatial data. The SDIs have become very important in determining the way in which spatial data are used throughout an organization, a nation, different regions and the world. It helps to avoid duplication of expenses associated with generation and maintenance of data and their integration with

[1] http://www.opengeospatial.org/
[2] http://www.oasis-open.org/home/index.php

other datasets. The Infrastructure for Spatial Information in Europe[3] (INSPIRE) is an initiative launched by the European Commission during 2002, which intends to trigger the creation of a European SDI that delivers to the users integrated spatial information services. In Portugal, the Portuguese Geographic Institute is responsible for the implementation and the development of the Sistema Nacional de Informação Geográfica (SNIG) which is a national SDI based on new standards.

The OGC is an international organization whose mission is to develop and define standards for the interoperability of geographic information services. Some examples of these OGC standards are the Geographic Markup Language (GML) [6] and Keyhole Markup Language[7] (KML) to represent spatial data by XML (eXtensible Markup Language), the Web Feature Service (WFS), the Web Map Service (WMS) and the Web Processing Service (WPS), which describe Web services interfaces to access maps, manage and process spatial information. Most commercial GIS or Open Source support the OGC standards.

This document focuses on the Web Processing Service proposed by OGC. The idea behind a WPS is to offer any kind of GIS functionalities for the processing of spatial data. The goal is to standardize an interface to facilitate the publishing of geospatial processes, the discovery and binding to those processes by clients. Processes refer to any kind of model or algorithm that deals with spatially referenced data and in principle there are no restrictions on what types of operations can be realised based on the WPS interface. WPS can be seen as a global repository where are stored the processes by a publishing action. The interface operations are:

- Getcapabilities, which returns a list containing the processes inside WPS;
- DescribeProcess, which describes in more detail a selected process including the inputs and outputs;
- Execute, which executes the process;

One of the strong points of this standard is its compatibility with Simple Object Access Protocol (SOAP) and WSDL. SOAP has the function to handle the requests and responses messages. The WSDL identifies how a service should be described, but not what the service interface should look like. WPS describes a significant portion of what any service should look like. WSDL offers a less comprehensive but more widely adopted alternative to the publishing mechanism built in to the WPS interface specification [8].

The 52 ° North[4] is an organization which develops GIS based on OGC standards. One of the rules implemented by this organization is the WPS version 1.0.0. However, in addition to the original standard, this organization is developing the WPS-transactional, that is a prototype still being developed. This adds two operations to the specification of the OGC in order to resolve a gap in traditional WPS, which doesn't allows to publishing a process and removing in a dynamic way [2]. This extension allows publishing any type of action depending on a deployment profile, for example, BPEL. The new operations, deployProcess and undeployProcess, are accessed like the other existing operations in the interface (getCapabilities, describeProcess and execute).

[3] http://inspire.jrc.ec.europa.eu/
[4] www.52north.org

2.2 Integration Systems standards

A Web service is defined by the W3C as software designed to support connections between machines within a network by an interoperable way through its application programming interfaces (API). It is a solution used in the integration systems and communication between different applications involved. With this technology it is possible that new applications can interact with those that already exist and that systems developed on different platforms are compatible. Web services are software that allows applications to send and receive data using the XML format.

The BPEL is a standard defined by OASIS widely used in the world of information technology, can be used to run Web services orchestrations [4]. This standard describes a business process using XML. The definition of a BPEL process consists of two types of files: a WSDL file and a BPEL file, which contains the definition of the process, specifically:

• The partners representing the services involved in the workflow;

• The variables used to manipulate the data exchanged between the partners and to save the processes states;

• Activities which describe the flow, such as invoking a Web Service, an equal value to a variable, etc;

In the case of orchestration, there are some implementations such as Oracle BPEL Process Manager and Apache ODE ActiveBPEL that focus on the processing of cases. While Microsoft BizTalk, Netbeans and Eclipse are just some examples of tools for integrating Web services that support the standard BPEL. Business processes specified in BPEL are fully executable and portable between BPEL tools.

2.3 Urban Cadastre

The Portuguese cadastre can be decomposed in two parts, namely the rustic and the urban. The Instituto Geográfico Português (IGP) is responsible for the first and it is not this research's focus. The cadastre refers to a record about a parcel of terrain which contains information of a certain jurisdiction. This information should describe the location, geometrical shape and, if something exists in that parcel, the composition of each building (geometric component), tax situation (tax component) and / or the identification of rights, liens, and charges that the owner passed on (legal component). In other words, it is through the information provided that it is possible to find what the composition of a particular building is, to whom it belongs and what kind of charges the owner should expect.

3 Problem

This project focuses on two processes considered by the City Hall to be the most important, respectively, Avaliar IMI and Actualizar Proprietário de Imóvel, which will be detailed below.

3.1 Process *Avaliar Imposto Municipal sobre Imóveis (IMI)*

IMI it is a tax for a certain property paid by the proprietary to the City-Hall. The process *Avaliar IMI* aims at the first evaluation of the IMI of a certain property. In this process it is required a form, named Modelo 1, which serves for the registration and evaluation of the IMI.

Currently, as a non-automated way, this process starts by the citizen going to the City-Hall and request some important documents such as, *licença de utilização. planta de implantação, planta de localização and projecto de arquitectura*. The next step for the citizen is to move to the Finances, fill in the form Modelo 1 and deliver it together with the documents requested in the City-Hall. These documents are necessary for the registration and evaluation of the building based on data received from citizens and assign the value of IMI.

3.2 Process *Actualizar Proprietário de um Imóvel*

Currently, this process starts at Conservatória where it is requested to the citizen to provide the documents *licença de utilização* and the *certidão de teor* updated. To do this, the citizens have to move to their local City-Hall and Finances to request these documents and deliver them to Conservatória. At this place, the proprietary is changed if the documents are OK. After this step the other entities are outdated about the new legal proprietary, so the citizen has to go to Finances and fill in a new Modelo 1 to update the information, but it rarely happens to go to the City-Hall to make the update. For this reason the City-Hall is outdated for years till, the citizen needs to expand the house or make some modification.

4 Proposed Solution

This section details the proposals for the automation of the two processes explained in the previous chapter.

This new process avoids the unnecessary citizen's movements. If each entity has one web service which allows an external entity to use the available operations to deal with the data, there can exist an orchestrator that makes the delivery of the documents between the entities.

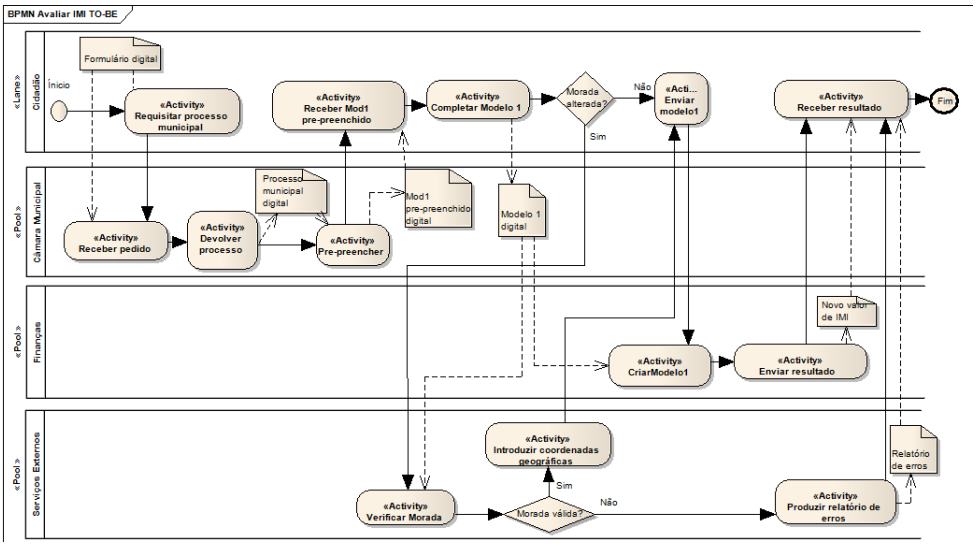

Fig. 1: Proposed process *Avaliar IMI*

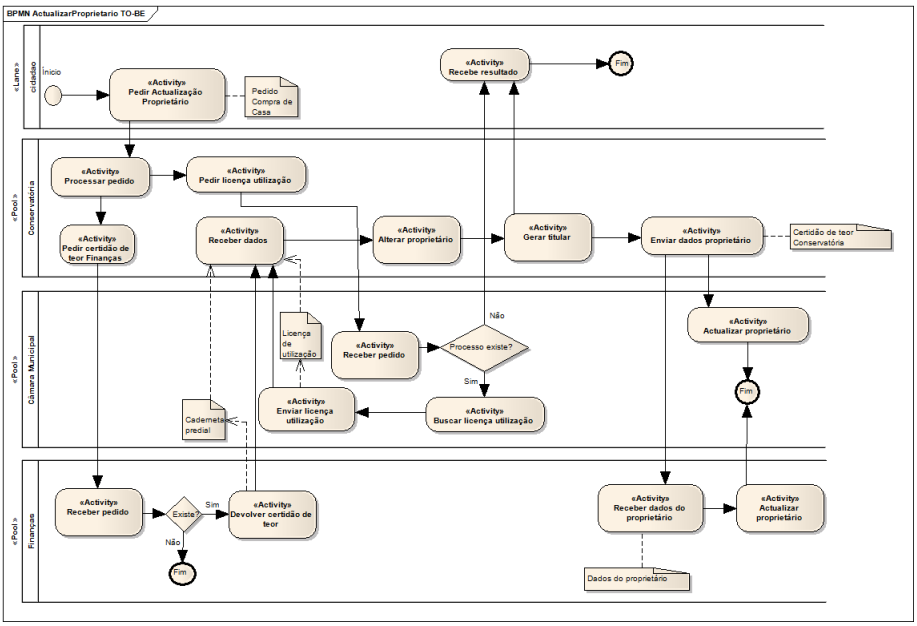

Fig. 2: Proposed process *Actualização do proprietário de um Imóvel*

5 Architecture

The Figure 3 shows the proposed architecture which is essentially a service-oriented architecture. This architecture is distributed because the services are at different places, but it is also integrated because every entity involved can communicate with each other. Each of these entities involved has its own Web Service. There is also an orchestration service which orchestrates processes and a UDDI directory where the contracts of the services are published. In this architecture there are three Web services corresponding to the public entities involved.

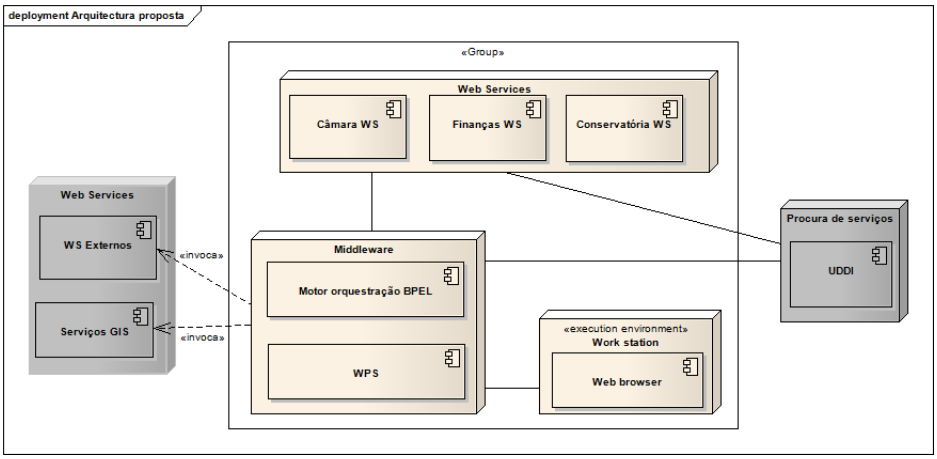

Fig. 3: Architecture

5.1 Integration Platform

The integration platform is the core component of this architecture where the processes are executed. This platform can be seen as a set of components that provide, to the business logic layer, a basic set of integration services.

The main target is to provide means of communication between various incompatible systems, without developing it for its own needs, allowing a basic messaging mechanism for the various services and customers. In an environment of distributed services, a process can be seen as service that provides data to other services and can itself take advantage of the scalability, robustness and interoperability features provided by the platform.

The WPS standard specified by OGC there isn't any connection with the BPEL standard, because of this reason, this platform uses the WPS to orchestrate the processes involving spatial data and the BPEL processes executed by a BPEL engine. The WPS is this architecture's point of contact which works as a wrapper around a BPEL engine, through the three standard operations (getCapabilities, describeProcess and ex-

ecute). When necessary to execute a BPEL processes, the WPS maps the inputs for the BPEL process and invoke it like a Web Service published in the responsible engine.

Thus, this architecture allows interacting with other services based in OGC standards, such as GML, WFS and WMS. As shown in Figure 3, it is also possible to make an integration with GIS services (e.g. Google Earth and ArcGIS) which wasn't implemented in the prototype of this work.

5.2 Services Model

The service model provides a conceptual organization for the various services running on the platform. The services used in this architecture were:

Orchestration Services - All services that provide the facilities of the platform, including the execution environment, the mechanisms for discovery and orchestration of services;

• Services Implemented - The implemented services represent a category of services which provide additional capabilities providing features that can be used to take better advantage of the platform and other services. These services were implemented to satisfy each entity's individual needs;

• External Services - The concept of external services is related to the set of services that are available to any public web user (e.g. Yahoo and Google);

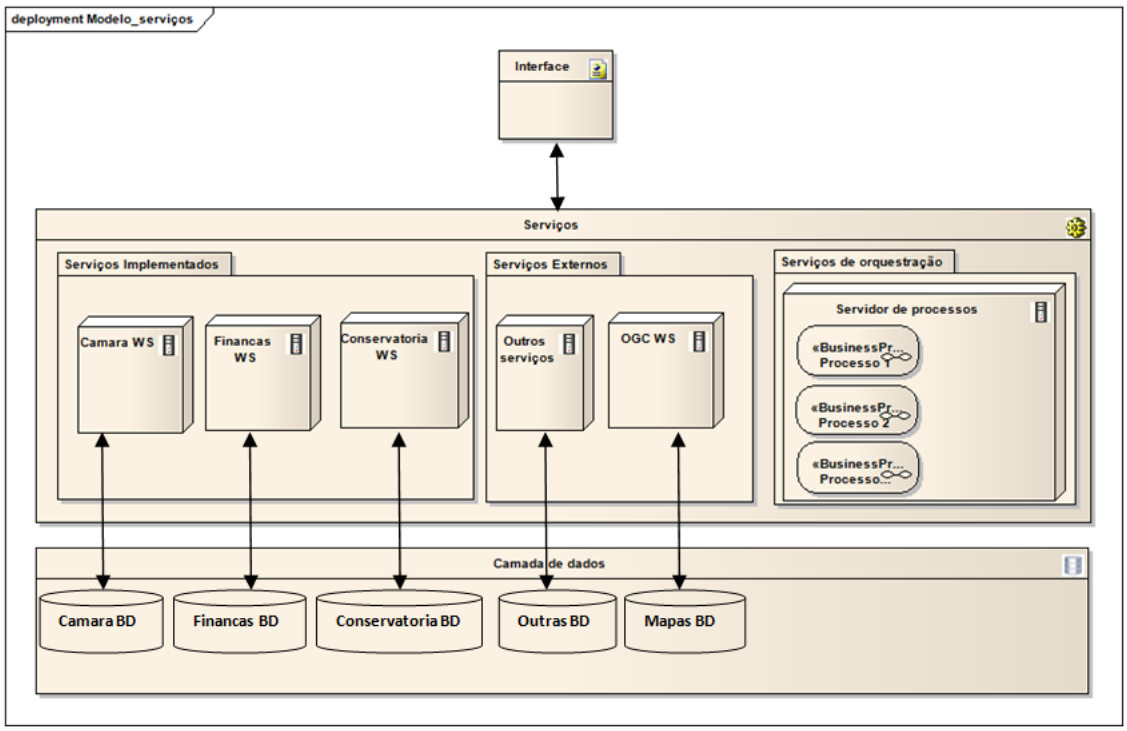

Fig. 4: Services model

6 Results

In this chapter it was made two types of evaluations, the first where it was compared the two processes, how they are today with the processes proposed using this architecture. The second, it was made some performance tests.

Through some interviews with some of the stakeholders involved in these processes it can be stated that the entities, for example, do not know the current state of a certain process because it is the citizen who has the process's responsibility. Comparing with the proposed architecture there is an orchestrator that knows every time what is the current state of a process. Using this architecture the citizen's efforts are reduced:

- In the present it is the citizen who has to deliver the documents between the entities physically, so it can take several hours depending on various factors. Using this architecture it is the orchestrator who does it via Web;
- Currently the citizen has to fill in all the forms' fields. This architecture allows the sharing of data, and makes possible to pre-fill this forms, by this way, the citizen only has to fill the necessary fields, resulting in a reduction of 28,22% in the Modelo 1 form;

Total fields	Number of fields pre-filled	Reduction in %
83	34	28,22

Tab. 1: Modelo 1 fields comparative table

It was also made some performance tests using different technologies to test the web services and the processes. To test the processes it was developed a java application to execute the WPS processes which also invoke the BPEL processes. It was made tests to the BPEL engine using the Soap UI technology. Comparing each technology it was concluded that the difference between the invocation using the WPS and the directly to the BPEL is about 100 ms. Currently there isn't any study showing the average time it takes to make these two processes but it usually takes about days or months to complete it, using the architecture to execute the processes it varies between 1286 to 5428 ms which is a better performance result.

7 Conclusions

This work was a proof of concept which showed that the WPS standard together with the BPEL standard can be used to support the cadastral processes. To achieve this result it was studied the Portuguese cadastre in collaboration with the involved entities, mainly the Palmela's City-Hall, but also with Finances and *Conservatória*. The urban Portuguese cadastre is very wide, so the Palmela's City-Hall choose the two most important processes (Avaliar IMI and Actualizar Proprietário de Imóvel). After a study of this processes it was discovered the weak points and inefficiencies of this processes. To solve these problems it was studied the important standards and technologies of integration systems and GIS.

Based on this technologies and standards it was proposed a redesign to these processes. The proposed architecture was built with two targets, the first to be possible to execute the cadastre processes, and the second, to use the WPS and the BPEL standards. The objectives were accomplished and with this architecture it is possible to use BPEL, the most common standard of the information systems and the WPS which allows executing processes with spatial data.

References

[1] Bordalo A. Desenho urbano e cadastro predial. *Declaração política de arquitectura da Ordem dos Arquitectos, texto de opinião P04, A cidade para o cidadão*, 2006.

[2] Schaeffer B. Towards a transactional web processing service (wps-t). *Institute for Geoinformatics, University of Muenster*, Proceedings of the 6th Geographic Information Days, 2008.

[3] C. M. Cruz. A importância do cadastro no processo de desenvolvimento urbano português. In *XI Colóquio Ibérico de Geografia*, 2008.

[4] Maldaner L.; Pasqual E. Uma análise de linguagens de composição de serviços: A utilização de bpel e yawl. Master's thesis, União Dinâmica de Faculdades Cataratas (UDC), 2005.

[5] Júnior F. Sws-gis: uma arquitetura baseada em serviços para uma federação de spatial data infrastructures. *Programas de Pós-graduação da CAPES*, 2007.

[6] C. Portele. Geography markup language encoding standard. *Open Geospatial Consortium, Inc*, 2007.

[7] Lake R. Kml and gml working together. *http://www.galdosinc.com/archives/317, acedido a 08/07/2009*, 2007.

[8] Beate Stollberg and Alexander Zipf. Geoprocessing services for spatial decision support in the domain of housing market analyses – experiences from applying the ogc web processing service interface in practice. 2008.