

GEOSPATIAL WEB SERVICES FOR E-MUNICIPALITY

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ABSTRACT:

Municipality activities require interoperability both between municipality offices, and government and private sector. Due to the lack of interoperability, traditional municipalities, and governments face serious problems. These are mainly poor quality and high cost of services, and low economical revenues. E-municipality has been proposed for solving these problems. An interoperability infrastructure is at the heart of e-municipality and e-government applications. Web services have emerged as the next generation of Web-based technology for interoperability. Web services are modular, self-describing, self-contained applications that are accessible over the Internet. Based on open standards, Web services enable to construct Web-based applications using any platform, object model, and programming language. Although Web services were initially suggested for e-business, they have collected a great interest from various communities. Recently, they became a current issue for developing distributed applications and sharing geospatial data between GIS communities. GIS data and application providers can develop geospatial web services, and share their information over the Internet using Web services.

The motivation of this work was to determine the potentials of the Web services technologies for an interoperability infrastructure for e-municipality, and suggest Web services for municipalities to lower costs, improve service quality, and increase revenues in municipality. This is an urgent need especially for municipalities in Turkey. We have first examined major municipality activities for the municipality of Trabzon in Turkey. And identified possible geospatial Web services. We have also implemented some of these services using Cape Clear™ Web Services development and deployment software. We have found out that Web services have a great potential for e-municipality.

1. INTRODUCTION

E-government has been on the agenda of many developed and developing countries recently. Although the common sense exists, a formal definition of “e-government” is not in place yet. World Bank defines e-government as the use of information and Communication Technologies (ICT) to transform government by making it more accessible, effective and accountable (World Bank, 2002). E-municipality can be defined as a municipality realizing all kind of communication, business and service offer in electronic environment.

An interoperability infrastructure is at the heart of e-government (OeE, 2003). The ability by which the different applications can talk and cooperate with each other is known as interoperability. It is this infrastructure which would make the interaction between government and citizens (G2C), government and business enterprises (G2B), and inter-agency relationships (G2G) more friendly, convenient, transparent, and inexpensive (World Bank, 2002). Due to the lack of interoperability, traditional governments and municipalities face serious problems. These are mainly poor quality and high cost of services, and low economical revenues. E-government, and e-municipality has been proposed for solving these problems.

Web services have emerged as the next generation of Web-based technology for interoperability. Web services are modular, self-describing, self-contained applications that are accessible over the Internet. Based on open standards, Web services enable constructing Web-based applications using any platform, object model, and programming language (Barefoot, 2002). A service is a collection of operations accessible through an application-programming interface that allows users to invoke a service, which could be a response to a simple request to create a map or a complicated set of image-processing operations running on several computers (Hecht, 2002).

The motivation of this work was to determine the potentials of the Web services technology for an interoperability infrastructure for e-government and e-municipality. For this aim, we have first investigated the activities of the municipality of Trabzon, Turkey and determined the problems of the traditional system. Then we have determined, developed, and implemented a number of these services. We have concluded that Web services are very promising for the e-municipality infrastructure. Since e-government and e-municipality share similar structures and problems, the findings of this work would also be valid within the context of e-government.

2. PROBLEMS OF TRADITIONAL MUNICIPALITIES

In Turkey, the traditional governments have many problems that stem from both insufficient and improper use of ICT. "Insufficient use" refers to the traditional means such as manual archiving systems. "Improper use", on the other hand, refers to the lack of an interoperability infrastructure within and among the government agencies. In this work, a number of such problems have been identified for the Municipality of Trabzon in Turkey. Although they have been determined for a municipality, they are also valid for such sectors as G2G, G2C, and G2B in the Country. World Bank (2002) has also identified similar problems for many developing and even developed countries around the World. To identify these problems, some of the activities of the Zoning Plan Office, and Map and Cadastre Office of the Municipality were closely investigated (Figure 1, Figure 2). The selected activities were the ones that involve spatial data and are most characteristic within the context of e-municipality or e-government (Table 1). Identified problems were classified under five different though interrelated categories. These are the lack of auto-control mechanisms, high economical losses, high cost of services, poor service quality, and low efficiency. These problems are briefed below.

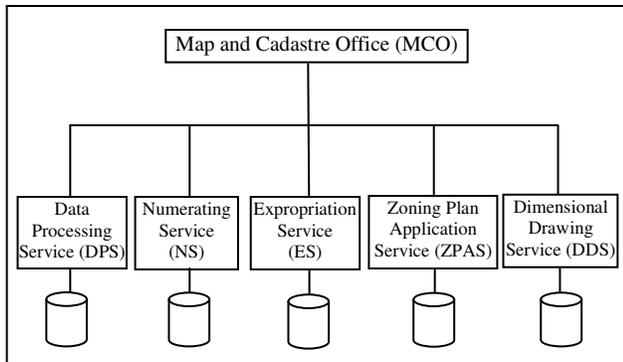


Figure 1. Map and Cadastre Office and its subunits

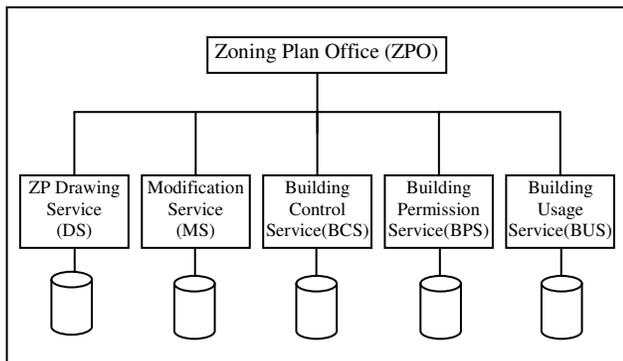


Figure 2. Zoning Plan Office and its subunits

Table 1. ZPO and MCO Activities

Department	Activity
Zoning Plan Office (ZPO)	Preparing zoning plan form
	Making zoning plan
	Evaluating zoning plan modification suggestions
	Giving construction permit
	Making building control
	Giving building usage permit
Map and Cadastre Office (MCO)	Making base maps
	Determining district boundary
	Determining street and alley
	Creating buildings table
	Preparing expropriation maps
Implementing zoning plan applications	

Auto-Control: The lack of auto-control mechanisms is the direct result of improper use of ICT. One of the most striking side effects of this problem is high economical losses. There are many examples of economical losses due to the lack of auto-control. One of them is experienced in real estate tax collection. Different studies report %70-90 outages in real estate taxes. As a remedy, the author of this paper have already proposed and implemented a system called REIS (Real Estate Tax Information System), which would be a very important component of the e-municipality (Cömert, Akinci, 2002).

Another side effect of auto-control is the risk of using outdated data in applications and thus obtaining undesired results. The current system does not have a legal mandate to update the data. Actually, an interoperability infrastructure, which would facilitate the updates, is not in place. Therefore, updating is either neglected or addressed by auxiliary archiving mechanisms. For instance, in case of revisions to a zoning plan, the plan has to be redrawn by the law. But since this is not practical it is not applied in practice. Instead, revisions are just noted on the related parcel of the plan by the date and number of the related archive file. It is very difficult to trace such modifications in manual archiving systems considering especially very high pace of the large municipalities such as Istanbul. Therefore the risk of running into conflicts between the plan and the archive files will always be there yielding eventually undesired results in such applications as "zoning plan form preparation" where the currency of the data is crucial.

Finally, a crucial aspect of auto-control is the corruption. It has a high priority in World Bank (2002) as well. Auto-control will enable mechanisms to fight with corruption.

Efficiency: Due the traditional ways of doing things, the pace of activities is rather slow. By traditional ways we mean manual archives, manual procedures, visual analyses, traditional ways of interoperability, and finally requesting data from the citizens, which is already under responsibility of some government agency or municipality department. There are many examples to this issue. A characteristic example is the preparation of zoning plan forms, which will be mentioned below. Low efficiency may have a negative impact on the economy since it may postpone transforming resources to the economy. Consider how the time to get a building permit will

effect the construction business and related sectors for instance. On the other hand, low efficiency will yield poor quality services.

Quality of Services: Quality of services not only causes dissatisfaction of citizens with their government or municipality, but also results in economical losses. Several problems may be associated with the quality of government and municipality services. The main problem stems from the lack of how a service should be. In the traditional way, citizens are perceived as, in a sense, a “worker” of the services. Because, traditionally and even backed by the regulations, almost all government agencies and municipalities ask citizens to collect some of the data needed for their applications. And this is the data that government agencies and municipalities could have obtained from each other if there had been an interoperability infrastructure such as NSDI in place. This view of services is far behind the implications of “Information Age”. Similarly, citizens have to declare and then pay their taxes by traditional means. Like in the case of many other services, this puts a heavy burden on citizens who have to visit several government or municipality departments, wait in the long lineups spending their times with frustration. This is rather annoying and has been the subject of prevailing complains all over the Country. This has also side effects. For instance, due to such frustrations, some citizens do not bother with declaring their taxes at the first place. And this is one of the reasons of high tax losses.

Another aspect of the quality of services is related to the Public participation in governance. Let alone the participation, the way of informing citizens about government and municipality decisions is rather clumsy at the moment. A characteristic example of this is proclaiming the zoning plan modifications to the citizens from a bulletin board where citizens may hardly see their parcels and related owner information. Such modifications arise as a result of some special zoning plan applications in Turkey.

Economical losses: These are the result of the problems in the other categories. As already explained, one of these problems are the lack of auto-control as in the case of real estate taxes. And the rather one is the rather slow pace of activities as in the case of building permits.

Cost of services: There are many causes of high costs in traditional governments. First of all, due to the lack of interoperability, development and production costs are high. For instance, data transfers between municipalities and other parties and between different offices within the same municipality are still performed by traditional methods. As very well documented in the literature, this is a costly and time-consuming operation. As an example, the rate of using Internet for data transfer between municipalities and government agencies or private sector is very low at the moment. There are even cases where one has to actually travel to another city and get the data. On the other hand, due to insufficient and improper use of ICT, more than needed personnel are employed in municipalities in Turkey.

3. GEOSPATIAL WEB SERVICES FOR E-MUNICIPALITY

Web services have emerged as the next generation of Web-based technology for interoperability. Web services are modular, self-describing, self-contained applications that are accessible over the Internet. Based on open standards, Web services enable constructing Web-based applications using any platform, object model, and programming language (Barefoot, 2002). A service is a collection of operations accessible through an application-programming interface that allows users to invoke a service, which could be a response to a simple request to create a map or a complicated set of image-processing operations running on several computers (Hecht, 2002). There are many other definitions of web services in the literature. It suffices to say that these definitions have some points in common. First, web services are for application-to-application communication. Second, web services are accessed over Internet. And Finally, web services are XML based and not for proprietary solutions.

Although Web services were initially suggested for e-business, they have collected a great interest from various communities. Recently, they became a current issue for developing distributed applications and sharing geospatial data between GIS communities. GIS data and application providers can develop geospatial web services, and share their information over the Internet using Web services.

The activities of Zoning Plan Office, and Map and Cadastre Office working with spatial data were examined during the studies carried out in Trabzon municipality. Required Web services were designed for the activities of these office units. Web services for preparing zoning plan form were implemented by using Cape Clear Professional 4 Web services development and deployment software (Figure 3).

The Web services in Table 2 were designed for ZPO and MCO to realize the activities in Table 1 by using Web services. Required Web services both in ZPO and MCO, and other government offices’ servers that are providing data for performing activities are given in Table 2. Detailed information about all ZPO and MCO Web services can be found in Şahin (2003).

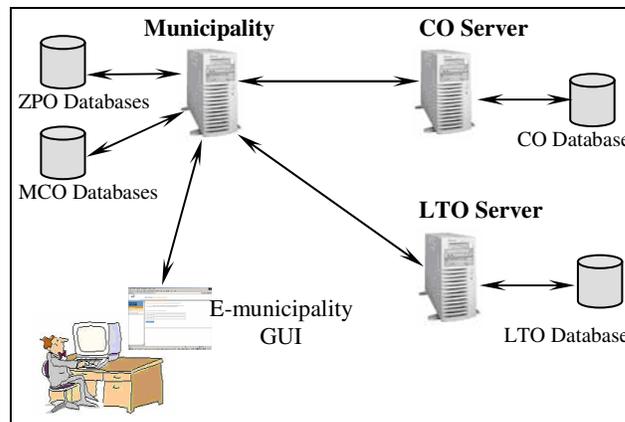


Figure 3. Interoperating databases and Web services for ZPF

Table 2. Some Web services and their servers designed for ZPO and MCO activities

Unit	Web Services	Server
Zoning Plan Office (ZPO)	getZoningPlanBlockID	ZPO
	getZoningPlanBlock	ZPO
	vectorSuperimpose	ZPO
	getParcelZoningPlan	ZPO
	getZoningPlanBlockAttributes	ZPO
	getZoningPlan	ZPO
	getLimitations	ZPO
	getArchitecturalProject	ZPO
	getConstructionPermit	ZPO
	getParcelGeometry	CO
	getCadastralMap	CO
	getParcelCoordinates	CO
	getParcelAttributes	LTO
getParcelAttributesMap	LTO	
Map and Cadastre Office (MCO)	getBaseMap	MCO
	getClippedBaseMap	MCO
	vectorSuperimpose	MCO
	getDistrictBoundaryPlan	MCO
	getStreetAndAlleyPlan	MCO
	getParcelGeometry	CO
	getCadastralMap	CO
	getParcelCoordinates	CO
	getControlPointCoordinates	CO
	getControlPointSketch	CO
	getParcelAttributesMap	LTO
	getParcelAttributes	LTO
	getBuildingAttributes	LTO

4. IMPLEMENTING E-MUNICIPALITY WITH WEB SERVICES

A highlighting example of the implemented services is the *getParcelZoningPlan* service, which generates a Zoning Plan Form (ZPF). ZPFs are one the most popular documents due to the fact that they are the very first step of many activities. For instance, obtaining a ZPF is the first step in getting a building permit. ZPFs are given by the Zoning Plan Offices (ZPO) of municipalities upon the request of the “interested” which might be citizens, government agencies, private sector, or municipality departments. For the sake of clarity, it is assumed here that the requestor is the citizen.

A ZPF geometrically shows the location of a land parcel in relation to the zoning plan, and includes construction conditions of the zoning plan block that covers the parcel. In other words, a ZPF includes both graphics and text data. Graphics data comes from the cadastral map and the zoning plan while text data comes from the zoning plan and land title data. Laying out a ZPF, involves bringing all these data together. In Turkey, these data are maintained by different government and municipality offices. Cadastral and Land Title data are under the responsibility of Cadastre Offices (CO) and Land Title Offices (LTO), which are separate Central Government organizations. Zoning plan data is handled by the ZPO of the municipalities. Hence, *getParcelZoningPlan* is a service of ZPO and gets its data from different servers through related

Web Services. The user or the officer in ZPO will initiate this service from his Internet browser. A brief explanation of what happens then is given below:

1. A user sends a parcel's RealEstateID using a HTML Form. *getParcelZoningPlan* Web service invokes *getParcelGeometry* Web service in CO server using RealEstateID. *getParcelGeometry* returns an array that includes parcel's vertice coordinates, and bounding box coordinates.
2. *getParcelZoningPlan* Web service invokes the *getZoningPlanID* Web service in ZPO server using parcel's bounding box coordinates. Thus, we find the zoning plan's ID(s) that cadastral parcel is located.
3. *getParcelZoningPlan* Web service invokes the *getZoningPlanBlock* Web service using parcel's vertice coordinates. This service takes vertice coordinates and finds zoning plan block ID(s) using `java.awt.Polygon` class. Then, it creates an array that includes block ID(s) and coordinates.
4. *getParcelZoningPlan* Web service invokes the *vectorSuperimpose* Web service. It takes two arrays that include cadastral parcel, and zoning plan block(s) as input parameters, and creates a GML file. Then, transforms result map from GML to SVG.
5. *getZoningPlanBlockAttributes* Web Service is called. It returns an array that includes zoning plan block's attributes.
6. The *getParcelAttributes* Web service is called. It returns an array that includes parcel's attributes.

Finally, ZPF is prepared using all returned data by web services, and sent back to the user in the form HTML (Figure 5). How a citizen gets a ZPF in the web services scenario is as given below:

1. The citizen goes to the ZPO officer as for a ZPF in a short time. He does not have to actually go to the municipality; He can make this request over the Internet.
2. ZPO officer initiates *getParcelZoningPlan* Web service from his Internet browser.
3. The *getParcelZoningPlan* calls other Web services to get the ZPF done. These services get the needed data on-line from the remote databases that are Cadastre, Land title, ZPO databases. The services do also the necessary processing.
4. The officer takes ZPF output from his printer and submits it to the citizen.

If there is no problem with the communication lines, getting a ZPF would take seconds or minutes. This is a great improvement compared with the traditional way. Therefore, we can say that Web services provide solutions to the aforementioned problems of the traditional system. Figure 4, illustrates the workflow of *getParcelZoningPlan* service as an UML sequence diagram.

5. CONCLUSIONS

The need for interoperability, the ability by which the different applications can talk and cooperate with each other, is more pressing than ever. Interoperability infrastructures are needed in such sectors as business-to-business (B2B), government-to-citizens (G2C), government-to-business enterprises (G2B), and government-to-government (G2G) to increase revenues and to enable high quality, low cost services. In this work, we have proposed Web services for e-government and e-municipality interoperability infrastructure. We have compared traditional and Web services scenarios for a traditional service of the Municipality of Trabzon, Turkey. As a result we have found that Web services enable quick and high quality services. In addition web services would enable cost savings in software development and service provision. Web services do have problems like security. We have not tackled these problems in this study. We have only examined the usability of a new technology, Web services, for the e-municipality infrastructure. Since e-government and e-municipality share similar structures and problems, the results of this work is valid within the e-government context as well.

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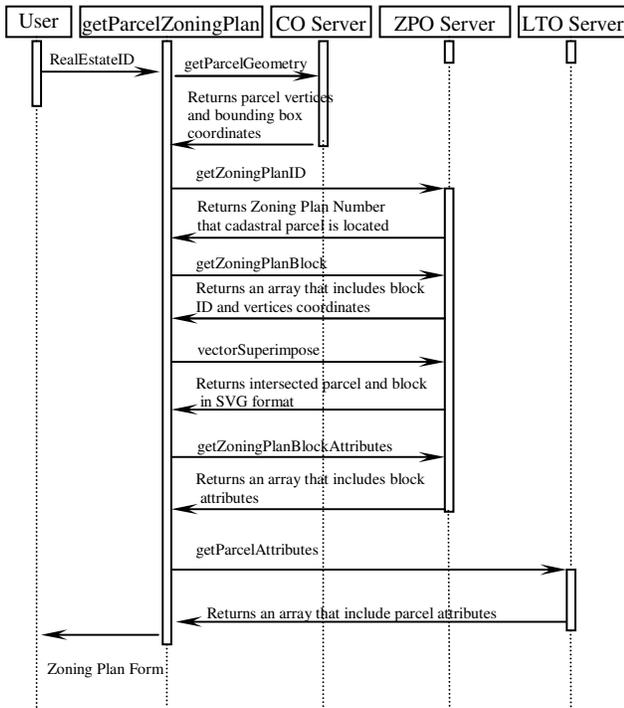


Figure 4. The UML sequence diagram of *getParcelZoningPlan* service

In the Web Services architecture, a client does its job by simply calling the Web Services of some servers. A client in a specific application may become a server in another. That is everybody offers some Web Services for some others. However, there may still be some tasks that a client has to perform, which are both client-specific and may not be practical to be defined as a Web service. A characteristic example to such tasks might be to display the length of a parcel boundary on the boundary line, which is often needed in many applications of the municipality. We have designed a toolbar for the client side using JavaScript, Scalable Vector Graphics elements, and Document Object Model. Using this toolbar, a user on the client can perform such functions as measuring distances, computing line intersections, computing intersecting areas, displaying x, y coordinates, displaying information about objects, move objects. Figure 5 shows the toolbar and the results of performing some functions.

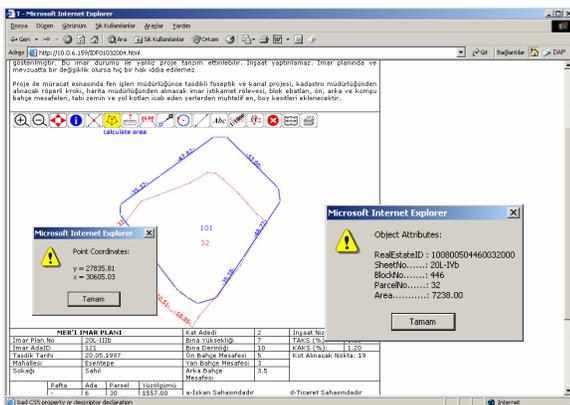


Figure 5. Response of *getParcelZoningPlan* Web service