Web Services: An e-Government Perspective

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Key words: Web services, e-government, e-municipality.

SUMMARY

"Web Services" have been gathering a great interest from various communities. In the Web Services philosophy, every different system or provider offers some "services" for certain user groups. Any user does its job by just calling proper services over Internet. In general, Web Services seems to have a great potential for wherever there is a need for cooperation or "interoperability". This need has long been felt in spatial data management communities and in traditional governments. This is what has brought the notion e-government into the scene. It has been envisioned that the e-government will solve the interoperability problems of the governments. The motivation of this work was to determine the potentials of the new Web services technology for an interoperability infrastructure for e-government. 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. To our knowledge, this work is one of the very first of its kind.

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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, (2002) defines e-government as the use of Information and Communication Technologies (ICT) to transform government by making it more accessible, effective and accountable. According to Gartner Group, e-government represents a way to transform public sector internal and external relationships and to optimize government service delivery, constituency participation and internal government operations [Stafford, 2002].

The common word in these definitions is the "transformation". The need for this transformation is such problems as declining revenues, high production and service costs, poor quality of services, rather low pace of activities, lack of auto-control mechanisms, and corruption of traditional governments. In other words, the notion e-government has emerged as the solution of these problems.

An interoperability infrastructure is at the heart of e-government (OeE, 2003). 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).

The motivation of this work was to determine the potentials of the Web services technology for an interoperability infrastructure for e-government. 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 WITH THE TRADITIONAL GOVERNMENT

In many countries, 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, 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 various departments of the Municipality were closely

investigated. The selected activities were the ones that involve spatial data and are most characteristic within the context of e-municipality or e-government.

Identified problems were classified under five different though inter-related 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.

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 loses 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 authors 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-municapility (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.

2.1 An Example of Traditional Service Provision: Laying out Zoning Plan Forms

A Zoning Plan Form (ZPF) geometrically shows the location of a land parcel in the zoning plan, and includes construction conditions of the zoning plan block that covers the parcel (Figure 3). ZPF data are required by many applications of municipalities. For instance, obtaining a ZPF is the first step in getting a building permit. Laying out a ZPF involves combining Cadastral and Land Title data with the zoning plan data. In Turkey, Cadastral and Land Title data are under the responsibility of Cadastre and Land Title Offices, which are Central Government organizations. Zoning plan data is handled by the ZPO of the municipalities. In short, the activity involves combining the data from different providers.

Figure.1, shows a ZPF, involved data and their legal and effective providers. By the “legal provider” we mean the legal responsible and owner of the data. By the “effective provider” we mean the supplier who supplies the data to the municipality in traditional system.

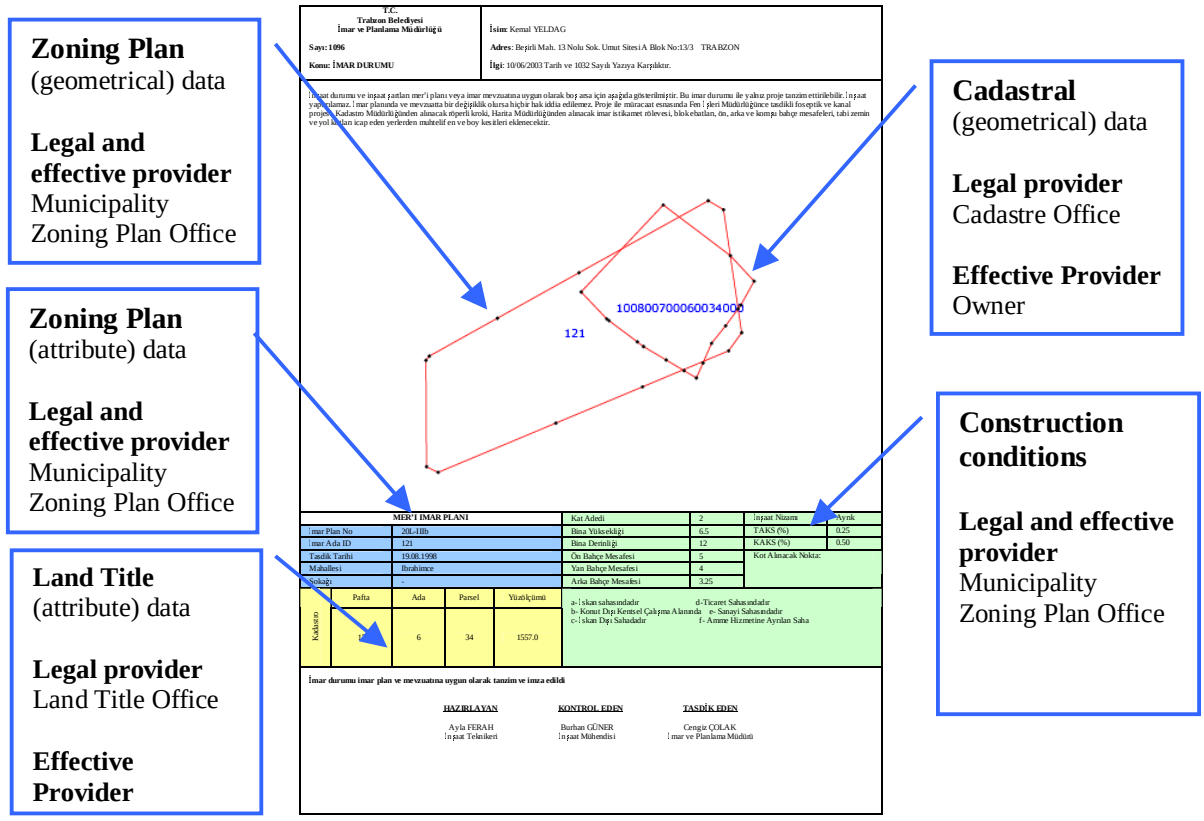

Figure 1: Zoning plan form, involved data and their legal and effective providers.

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 it is the citizen. The steps a citizen has to follow to get a ZPF are illustrated in Figure 1. The steps of the citizen’s workload are as the following:

He goes to the ZPO of the municipality and asks for a ZPF for the parcel of interest. ZPO requests Cadastral and Land Title data from him.

He travels in the city and to go to the Cadastre office for the Cadastral data. For the citizen, this means lengthy legal procedures and may involve frustrations due to the rather slow pace of the activities. For the officer it involves finding the related map sheet and performing a manual clip on the part containing the parcel. If the citizen is lucky, he can get the job done on the same day.

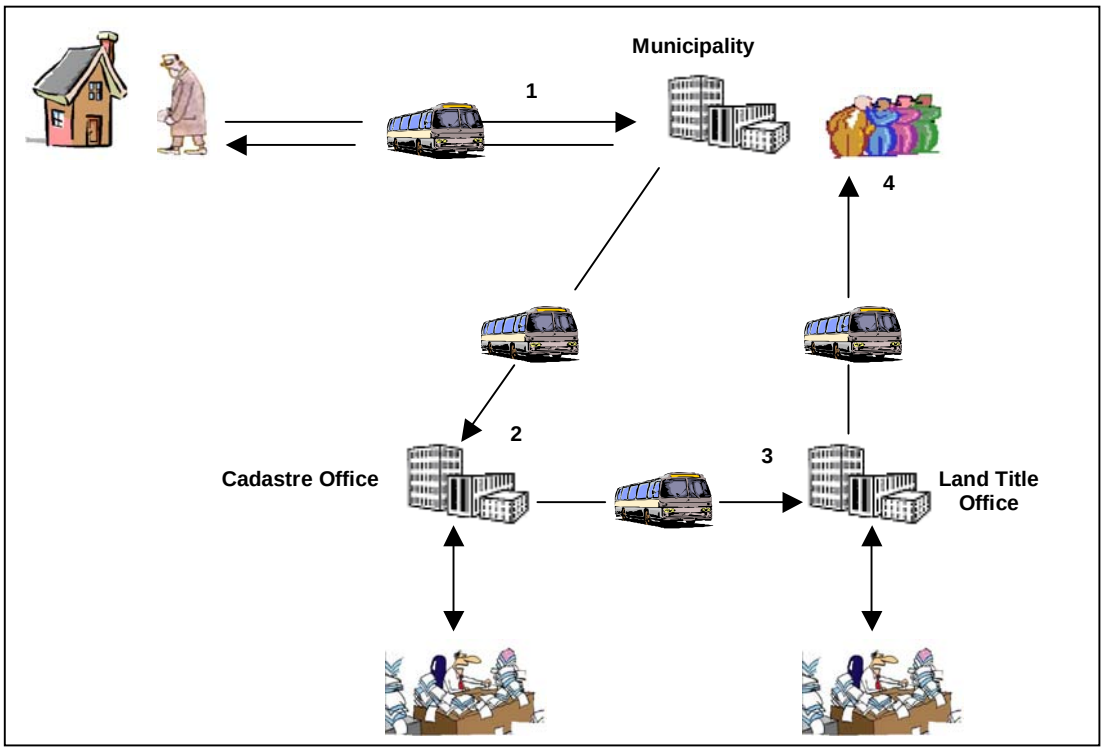

Figure 2; The workload of a citizen in getting a ZPF.

He goes to the Land Title Office for the Land Title data. If Cadastre and Land Tile Offices are not in the same building as in some cities, the citizen has to have another travel for this. For the citizen, once again, this requires lengthy legal procedures may involve frustrations due to the rather slow pace of the activities. For the officer it involves locating the related record via usually a computerized database interface. Again if he is lucky he can get the job do on the same day.

He goes to the municipality by another travel and presents the data he had been collecting. He, in most of the cases, could not get the ZPF immediately. Because the ZPF is laid out by manual or semi-automated methods. And either of methods takes time. So, he is advised to come back two to three days later and get the ZPF.

In short, with an optimistic view, it can be claimed that getting a ZPF would take at least a whole working week. And this, in no ways, is an acceptable way of providing services to the general public.

As another conclusion, some of the aforementioned problems of the traditional system are also observed in this example. For example, the low pace, high cost, and the poor quality of services may are clearly noticeable in this activity. Once again the main cause of these problems is the lack of an interoperability infrastructure among the data providers of the activity.

We may also spell out corruption due to the involvement of Land Title and Cadastre Offices. The basis of this statement is the Country wide statistics which show that Land Title and Cadastre Offices are one of the least counted agencies.

3. WEB SERVICES

Recently, one of the most used words in the arena of Web technologies is “Web services”. Web services, were first uttered by Microsoft chairman Bill Gates at the Microsoft Professional Developers Conference in Orlando, July 12, 2000 (Lewitt, 2001). Web services have emerged as the next generation of Web-based technology for exchanging information. 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). Once a Web service is deployed, other applications and Web services can discover and invoke that service.

3.1 Roles in a Web Services Architecture

The Web services architecture is based upon the interactions among three components: Service provider, service broker and service requestor. Service broker is sometimes referred to as service registry (Cerami, 2002). The interactions involve the publish, find and bind operations. In a typical scenario, a service provider hosts a network-accessible software module (an implementation of a Web service). The service provider defines a service description for the web service and publishes it to a service broker. The service requestor uses a find operation to retrieve the service description locally or from the service broker and uses the service description to bind with the service provider and invoke or interact with the Web service implementation (Kreger, 2001). Figure 1 illustrates these components, and roles. The components are explained further below:

Service provider: From a business perspective, this is the owner of the service. From an architectural perspective, this is the platform that hosts access to the service. Service provider is responsible for developing and deploying the Web Services. The provider also defines the services and publishes them via the service broker.

Service requestor: The service requestor is the one who request a service. The requestor locates the Web service using the service broker, invokes the required services, and executes it from the service provider.

Service broker: The service broker is responsible for service registration and discovery of the Web services. The broker lists various service types, descriptions, and locations of the services that help the service requestors find and subscribe to the required services.

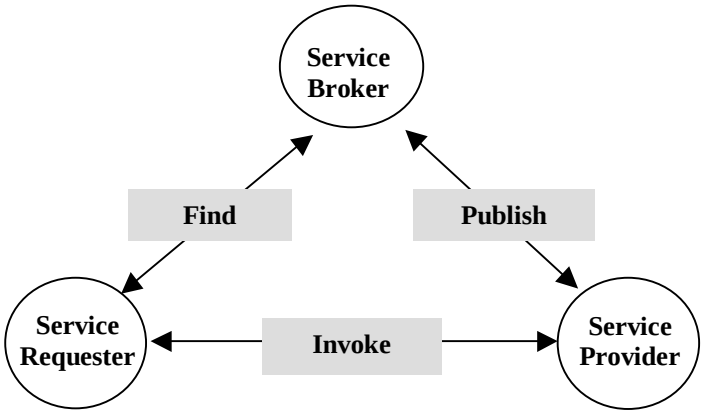

Figure 3: Web services architecture (Nagappan et al., 2003)

3.2 Web Services Technologies

Web Services can be developed using any programming language and can be deployed on any platform. Web Services can communicate because they all speak the same language: the Extensible Markup Language (XML). Web Services use XML to describe their interfaces and to encode their messages. XML-based Web Services communicate over standard Web protocols using XML interfaces and XML messages, which any application can interpret.

The three core XML-based technologies for building and enabling Web services are:

- Simple Object Access Protocol *(SOAP)* defines a standard communications protocol for Web Services.
- Web Services Description Language *(WSDL)* defines a standard mechanism to describe a Web Service.
- Universal Description, Discovery and Integration *(UDDI)* provides a standard mechanism to register and discover Web Services.

When a service provider wants to make the service available to service requestors, he describes the service using WSDL and registers the service in a UDDI registry. The UDDI registry will then maintain pointers to the WSDL description and to the service. When a service requestor wants to use a service, he queries the UDDI registry to find a service that satisfies his needs and obtains the WSDL description of the service, as well as the access point of the service. The service requestor uses the WSDL description to construct a SOAP message with which to communicate with the service (Systinet, 2003).

Despite all its merits, Web services are not free of problems. Some major issues are related to security and privacy. Medjahed et al. (2003) makes a clear distinction between security and privacy and points out that privacy is more difficult to deal with than the security. Web services are also criticized for what they had originally been proposed for; interoperability. However, we do not deal with these issues in this work whose purpose was to seek the feasibility of using Web services for a e-municipality or e-government infrastructure.

4. WEB SERVICES FOR E-MUNICIPALITY

A number of Web services for the investigated activities of the Trabzon Municipality have been designed and partially implemented. These services were developed and deployed using Cape Clear Software (Cape Clear, 2003). A municipality officer can develop his applications using these web services in a very short development time. It took 15 minutes to build a *getParcelZoningPlan* application which produces ZPF in a fully automated fashion. We currently use static binding of the services for service composition (systinet, 2003). The *getParcelZoningPlan* is also a web service which calls other web services to do its job. The *getParcelZoningPlan* will be a service of the Zoning Plan Office (ZPO) of the municipality. The user or the officer in ZPO will initiate this service from his Internet browser. Figure 5, illustrates the workflow of *getParcelZoningPlan* service as an UML sequence diagram.

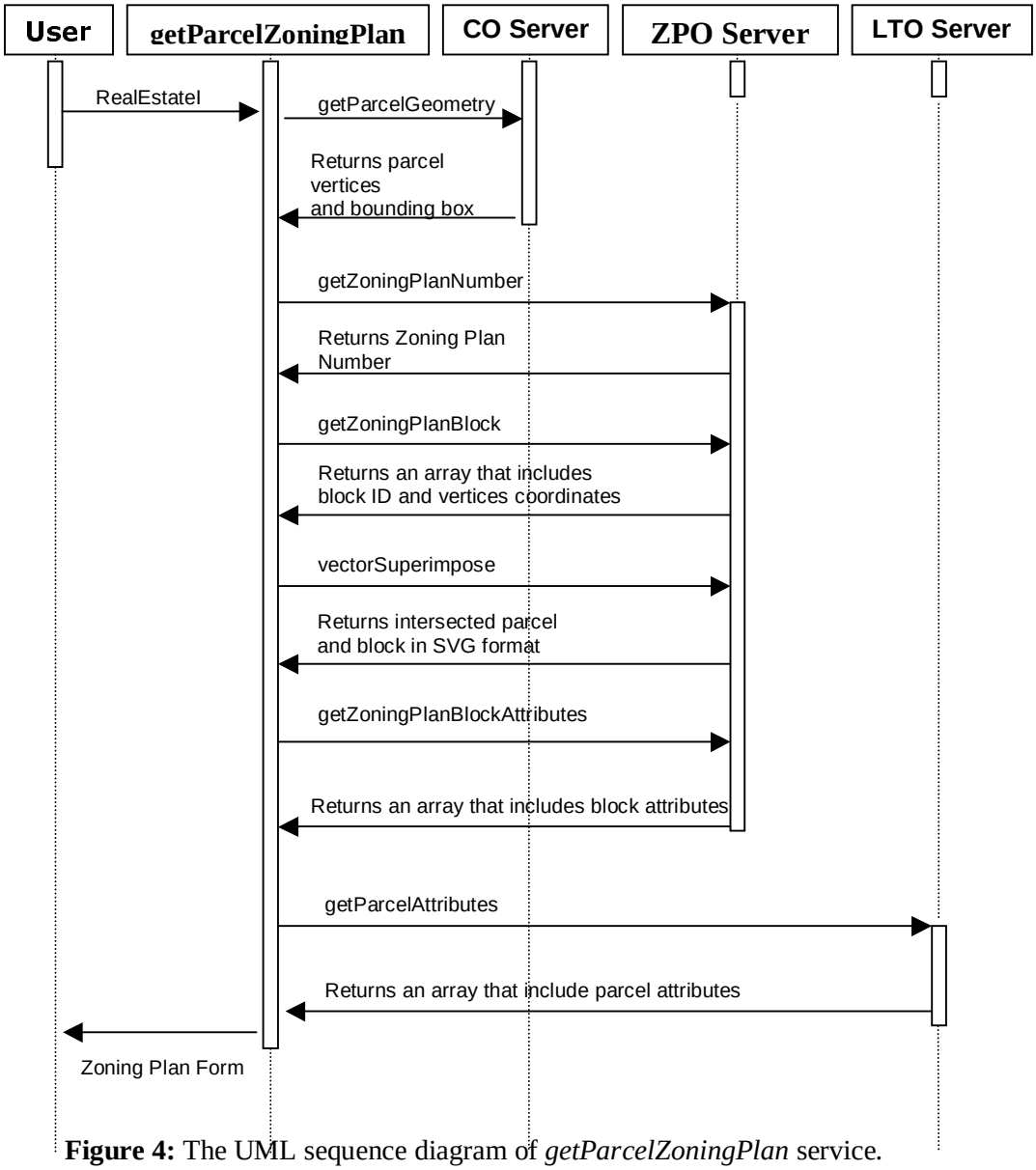

Figure 4: The UML sequence diagram of *getParcelZoningPlan* service.

A brief explanation of the steps of the UML sequence diagram is given below:

- A user sends a parcel's RealEstateID using a HTML Form. *getAParcelsZoningPlanStatus* Web service invokes *getParcelGeometry* Web service in LCD server using RealEstateID. g*etParcelGeometry* returns an array that includes parcel's attributes, vertice coordinates, and bounding box coordinates.
- *getAParcelsZoningPlanStatus* Web service invokes the *getZoningPlanID* Web service in ZPD server using parcel's bounding box coordinates. Thus, we find the zoning plan's ID(s) that cadastral parcel is located.
- *getAParcelsZoningPlanStatus* 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.

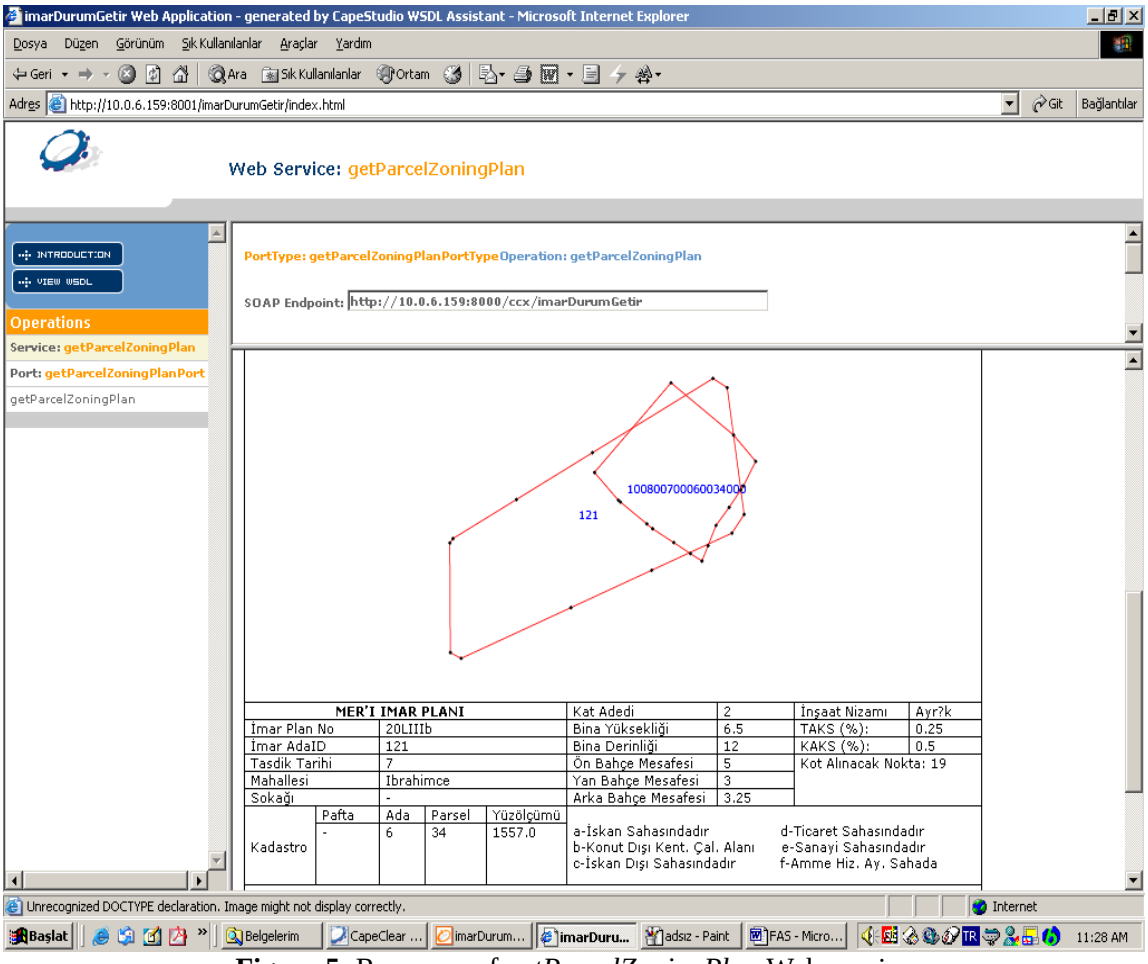

Figure 5. Response of *getParcelZoningPlan* Web service

- *getAParcelsZoningPlanStatus* Web service invokes the *overlayBlocksAndParcel* Web service. It takes two arrays that includes cadastral parcel, and zoning plan block(s) as an input parameters, and creates a GML file. Then, transforms result map from GML to SVG using a XSLT stylesheet.

- The *getParcelInfo* Web service is called. It returns an array that include parcel's attributes.
- *getZoningPlanBlockInfo* Web Service is called. It returns an array that include zoning plan block'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).

4.1 Potentials of the Web Services

In this part, the solutions that Web services promise for the problems of the traditional system are identified. For this aim, traditional and web services scenarios of ZPF preparation are compared. Therefore, given in the following is what happens in the Web services scenario:

- 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.
- ZPO officer initiates *getParcelZoningPlan* Web service from his internet browser
- 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.
- 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. This is briefed in the following:

Web services enable "quick" services. Citizens and other parties can get answers to their requests within seconds. This greatly improves the service quality and yields very valuable economic contributions.

Web services cut down application development and service provision costs. Because once a number of main services are defined, new services can be built on the existing ones in a short time with a minimum development cost. As already mentioned, developing the *getParcelZoningPlan service* has taken only 15 minutes. Also, data transfer costs will decline due to both the data transfer medium and reduced transfer requirements of a Web services environment.

High quality services will make positive sociological impacts on the people of a country. High quality services will make people feel honored by their government and they will feel the joy of being served well. This will make them happy and greatly improve every single person's productivity. This continues to be a dream concerning the reality in Turkey.

Web services is a new paradigm which had been envisioned for a notion of environment where everybody provides some services for some others. Therefore, for a Web services based interoperability infrastructure for e-government to work all the involved parties have to

have at least databases plus web services. In other words, Land Title and Cadastre units must have functional databases and must offer services needed by the municipality as well as other parties for the Web services based e-municipality to function. However, activities of Land Title and Cadastre and municipalities are not limited to each other. There are many parties involved; other government agencies, private sector, universities, citizens and many others. Therefore, what is needed actually is the NSDI for e-municipality and e-government to work. Even the name, "NSDI" may sound obsolete given the implications of the Web services. But, that is another discussion we might face in the coming years.

5. CONCLUSIONS

Traditional governments have many problems that stem from both insufficient and improper use of ICT. These problems have been identified and classified in this study. These are high economical losses, high cost, lack of auto control, poor quality of services, and low efficiency. The main goal of E-government is to solve these problems. E-government requires an interoperability infrastructure which would make interactions between government and citizens (G2C), government and business enterprises (G2B), and government and government (G2G) more friendly, convenient, transparent, and inexpensive. In this work, we have proposed Web services for this 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. And they yield 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. And to our knowledge, this work is one of the very first of its kind.

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BIOGRAPHICAL NOTES

Dr. Çetin Cömert is an Associate Professor in the Department of Geodesy and Photogrammetry at Karadeniz Technical University. He obtained his graduate and masters degrees from the same department in . He was a Ph.d. student from 1988 to 1994 in the Surveying Engineering Department of New Brunswick University. His work involved on designing a Object-Oriented layer over a conventional GIS. He has also worked on designing an Object-Oriented Interface for spatial data exchange. He completed his Ph.d. at KTU. The title of it was "determining an interchange standard for National Spatial Data Infrastructure of Turkey". His main interests include Web Services, Geographic Information Systems, National Spatial Data Infrastructure, E-Municipality, E-government, and Object-Oriented Programming. He is currently the Head of Cartography Division of Geodesy and Photogrammetry Department**.**

Halil Akinci is a research assistant at the Karadeniz Technical University, Turkey. He graduated from Department of Geodesy and Photogrammetry Engineering at KTU in 1996. He received his MSc degree with the thesis "Spatial Data Translation Between Geographical Information Systems with FME" in July 1999. He began Ph.D. in September 1999. His research interests are Interoperablity, Distributed Computing, Web Services and Geographical Information Systems.

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