WEB Services, NSDI and E-government

Çetin CÖMERT and Halil AKINCI, Turkey

Key words: Web services, interoperability, e-government, National Spatial Data Infrastructure

SUMMARY

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. Various communities that either produce or use Information and Communication Technologies are working on web services nowadays. There are already a number of software companies providing tools to develop and deploy Web Services. In the Web Services view, every different system or component offers some services for some others. Any system does its job by just calling suitable services over Internet. From this respect, one can derive the analogy between the philosophies behind Web Services and Object-Orientation. In general, Web Services seems to have a great potential for wherever there is a need for cooperation or "interoperability". In Today's World, the interoperability, the ability of different systems cooperate with one another, is the only way to assure rapid, cost-effective and quality solutions or services. This need, backed up and in a sense provoked by Internet, and the Web have opened up the road to Web Services. National Spatial Data Infrastructures (NSDI) has emerged as the way of enabling interoperability throughout a country. Similarily, Electronic (e-) government has emerged as a solution to the problems of traditional governments, such as declining revenues, high costs, poor quality services, and corruption. Both NSDI and e-government needs an interoperability infrastructure. Web services seem to satisfy this need. This paper summarizes our ongoing work on designing and developing web services for electronic (e-) local governments. Web Services would enable lowering costs, improving service quality, and increase revenues in local governments. This is an urgent need especially for local governments in Turkey as well as in many other countries. We have implemented a number of web services for the Trabzon municipality in Turkey. The implementation has been done via Cape Clear ™ Web Services development and deployment software.

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1. INTRODUCTION

Today, for any sector, the need for integrating applications is more pressing than ever. This is felt rather strongly in the business-to-business (B2B) sector, where every different company has applications in their particular area of specialization. Nokia (2003) highlights this need for the mobile community. The business model of today necessitates the cooperation among these applications. Consider different parties involved in a business trip reservation for instance; at the requestors side there might be desktops, mobile phones, or PDAs, while at the providers side there would be airline, car rental, and hotel reservation systems. The ultimate business goal here is to provide the requestor with a high quality service that would enable him to effect his bookings in a quick and an easy way. For this to happen, all the systems involved should be able to "talk" to each other. And the provision of this "talk" should be easy and cost-effective for businesses to be able to make money.

The ability by which the different applications can talk and cooperate with each other is known as interoperability. The differences of applications may be in either hardware or software platforms, or in data formats. To date, spatial data interoperability solutions have been either inefficient, proprietary, or complex. National Spatial Data Infrastructures (NSDI) has emerged as the way enabling interoperability throughout a country. NSDI would cut down data production costs, improve spatial data access and use in a country. To achieve this, a NSDI connects all the parties that somehow use or produce spatial data via a computer network, namely Internet. Although there have been achievements concerning NSDIs in some developed countries, there are still more to be done. This fact and the emergence of Web services implicate improvements in NSDI implementations. That is why some of the NSDI undertakings such as Canadian Geospatial Data Infrastructure (CGDI) and major bodies such as Open GIS Consortium (OGC) have directed their work towards Web services (CGDI, 2001; Reed, 2002). Hence, NSDI implementations have to be re-considered to adopt Web Services technology. Although CGDI seems to pioneer in this respect, there does not seem any implementation of web services currently in CGDI (2004).

The need for interoperability is also strong for municipality and government applications. 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 has been proposed for solving these problems by making 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).

Web services have recently emerged as the solution to the interoperability problem. Two significant developments have made Web Services a reality. One of them is Java which has provided software and platform independence. The other one is XML, which has provided software and data independence (Nagappan et al, 2003). Web Services has its roots on distributed systems and it is an evolution of the work on that area. They both have the same philosophy behind, which is the well-known concept of “distributed but cooperating” systems. But the way that the “cooperation” takes place is different. While the stress is on the distribution of the “data" in distributed systems, it is on the distribution of the “tasks” in Web services. In the Web Services view, every different system or component offers some services for some others. Any system does its job by just calling suitable services over Internet. Once a Web service is deployed, other applications and Web services can discover and invoke that service.

Both NSDI and e-government needs an interoperabilty infrastructure. Web services seems to satisfy this need. Moving from this point on, we, in our ongoing work, have designed and implemented a number of Web Services for the Trabzon Municipality in Turkey. In doing this, some of the activities of the Municipality have been examined in detail in Şahin (2003). Then a number Web Services have been identified and specified. Finally some of these services were implemented using Cape Clear (Cape Clear, 2003) Web Services development and deployment software. We have also designed a toolbox for additional client side functionality.

2. WEB SERVICES

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.

There are three components of the Web services architecture (fig. 1). These are service provider, service broker and service requestor. Service broker is sometimes referred to as service registry (Cerami, 2002). The interactions among these components involve publishing, finding and binding Web services. In a typical scenario, a service provider hosts a network-accessible software module, the 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 the Web service implementation (Kreger, 2001). 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.

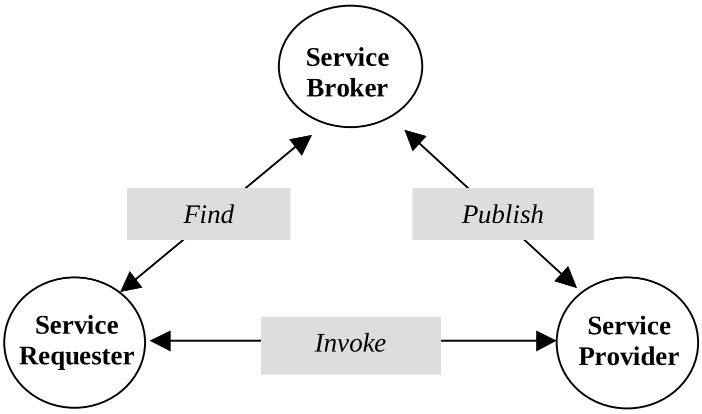

Figure 1: Web services architecture (Nagappan et al., 2003)

Web services mean a shift from "human-centric" Web to a "application-centric" Web (Cerami, 2002). In its widespread use today, Web is human-centric, where the Web has been perceived as the means of merely disseminating information to as large an audience as possible. This view falls short in meeting the expectations of Today, in which users of the Web do not only want to get information but also want to do business or develop applications over the Web. There are three components of "human-centric" Web; The Web, user, and the application programs. The way of achieving a goal or "doing the job" is the user-Web interaction. What usually happens is the user browses through many web pages, spending plenty of his time and hopefully gets some useful information. However this is not the end of the story, he might also need to use an application program to do the job. This means that the user might have to go through many lengthy searches and then transfer the results to the application programs. Besides being error-prone, this is an unacceptably time consuming process. In the "application-centric" Web, it is the applications that discovers and manipulates the information. In short, in "human-centric" Web it is the human who controls the processes and does the job, whereas in "application-centric" it is the applications that control and do the job by interacting with each other over the Internet and present the results to the users. Web services have emerged from the need for such applications. There are other names for the "application-centric" Web in the literature. For instance, Ryman (2000) uses the term "Service Web". Tim Berners-Lee, the original inventor of the Web, has coined the term "Semantic Web" and envisioned the Web services as an actualization of the Semantic Web vision Cerami (2002). See Berners-Lee et al. (2001) for more on Semantic Web.

An example from the local government activities will be given below to highlight the need for Web services. Ryman (2000) also presents a very representative scenario for the potential of Web services.

3. OUR WORK

In our ongoing work, we have designed and implemented a number of Web Services for the Trabzon Municipality in Turkey. In doing this, some of the activities of the Municipality have been examined in detail in Şahin (2003). Then a number Web Services have been identified and specified. Finally some of these services were implemented using Cape Clear (Cape

Clear, 2003) Web Services development and deployment software. We have also designed a Graphical User Interface for additional client side functionality.

3.1 Web Services for e-Government

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 are graphics 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. Figure 2 shows these servers.

By the ZPO GUI in Fig. We mean GUI running on the nternet browser. That is, the ZPO officer initiates the service from his Internet browser. How then it works is explained below:

- The user sends a parcel's RealEstateID using a HTML Form. *getAParcelsZoningPlanStatus* Web service invokes *getParcelGeometry* Web service in CO server using RealEstateID. g*etParcelGeometry* returns an array that includes parcel's 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.
- *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 includes parcel's attributes.
- *getZoningPlanBlockInfo* Web Service is called. It returns an array that includes zoning plan block's attributes.

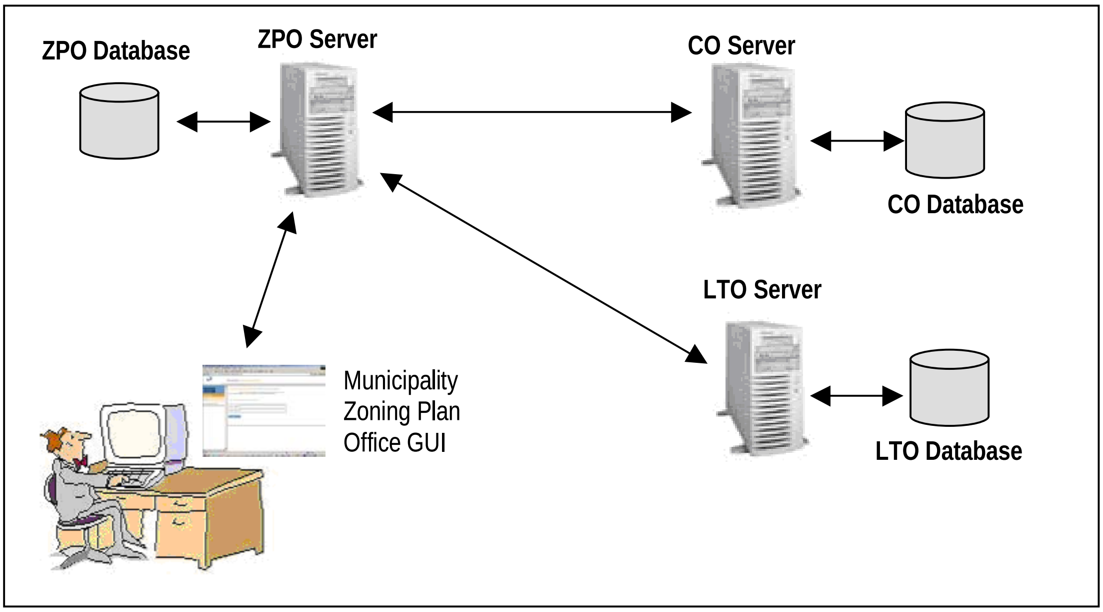

Figure 2: ZPO server is a client of CO and LTO servers

Finally, ZPF is prepared using all returned data by web services, and sent back to client in the form HTML (Figure. 4).

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. Currently, getting a ZPF from a municipality would take at least a whole working week. Because in the tarditional way, the requestor of the ZPF collects data by himself via conventional means. For instance, he travels in the city and goes to the Cadastre Office for the Cadastral data. This is explained in detail in Cömert, Akıncı (2004). Whereas in the Web Services scenario, coressponding web services colllect data from the related web sites. How a citizen gets a ZPF in this scenario is briefed below:

- The citizen goes to the ZPO officer and ask for a ZPF. He does not have to actually go to the municipality; He can make this request over the Internet.
- ZPO officer initiates *getParcelZoningPlan (imarDurumuGetir)* 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.

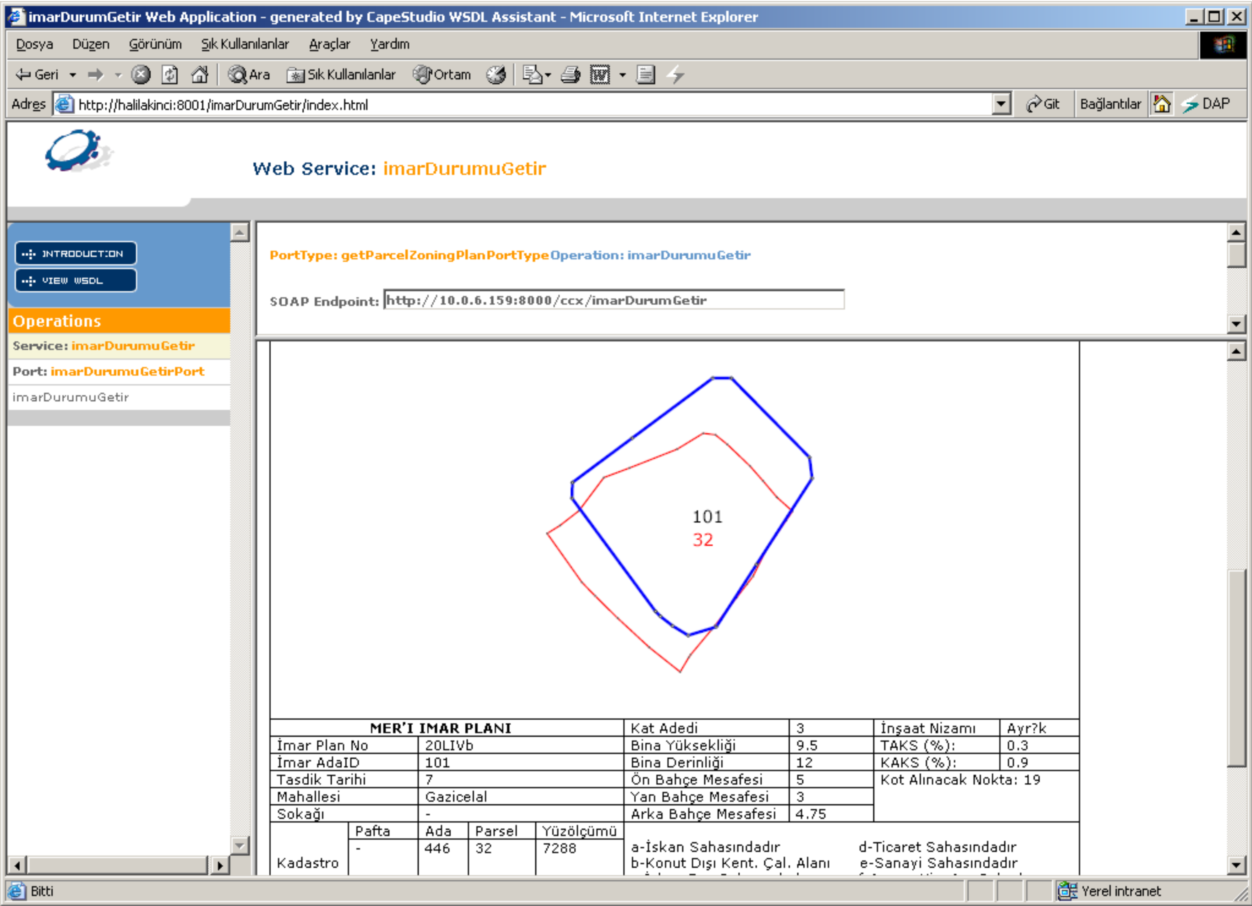

Figure 3: Response of *getParcelZoningPlan (imarDurumuGetir)* Web service

We currently use static binding of the services for service composition (Systinet, 2002). A municipality officer can develop his applications using available web services in a very short development time. It took about 15 minutes to build a *getParcelZoningPlan* application. The *getParcelZoningPlan* is also a web service that calls other web services to do its job. *getParcelZoningPlan* will be a service of the Zoning Plan Office (ZPO) of the municipality.

3.2 Client Side Graphical User Interface

In the Web Services architecture, which is based on "Service Oriented Architecture" (SOA), 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 everbody offer 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 practicle to be defined as a Web service. A characterictic 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, SVG (Scalable Vector Graphics) elements, and Document Object Model (DOM). Using this toolbar, a user on the client can perform such funtions as measuring distances, computing line intersections, computing intersecting areas, displaying x, y coordinates, displaying information about objects, move objects. Figure 4 shows the toolbar and the results of performing some functions. Different departments of municipalities would have different toolbars due to their differing needs.

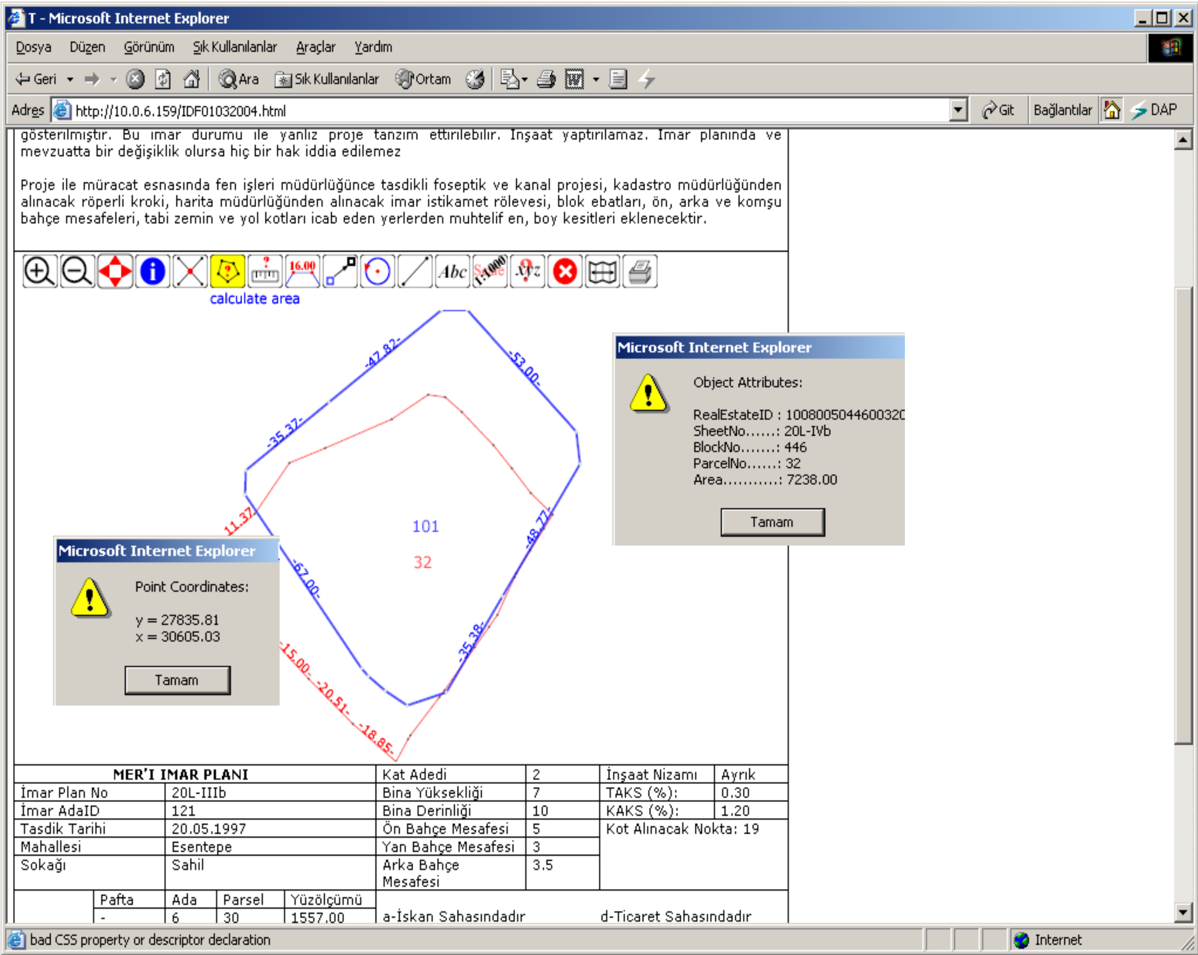

Figure 4: Zoning Plan Office SVG Toolbar

One of the key points of our design is that the GUI on the client will be the internet browser plus added functionality, if any. This way, a user on a municipality department will be able to call web services of remote servers and perform certain tasks on his machine using the same program which is the internet browser. He uses the browser as in Fig.3 to call the Web Services and upon the implementation of Web services he gets the toolbar of Fig. 4 to carry out his specific tasks. There is no need to have GIS and other proprietary softwares unlike the current situation in many municipalities in Turkey, where generally there exists different GIS or CAD softwares sitting, in isolation, in different departments of municipalities.

4. NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI)

National Spatial Data Infrastructure (NSDI) had originally been envisioned for "sharing data" to cut down the data production cost, improve spatial data access and use throughout networked systems in a country. Public and private sectors, local governments, universities, and finally citizens would have been connected to each other via NSDI. That is, the needed was both a technical and a legal infrastructure. The technical infrastructure had to enable data sharing among the different parties of the NSDI. The more important was the legal infrastructure to officially enforce cooperation among the participants. Because, it is well accepted that the obstacles on the way to the cooperation has always been the organizational ones rather than technical.

One of the very first countries with an NSDI initiative was the US. Altough there had been related works before, the US NSDI has been officially started in 1994 by the famous executive order of Clinton. NSDI has gained a great interest since then. The NSDI is now a well documented and highly active research area. There are plenty of Web sites such as FGDC (2004) and CGDI (2004), and numerous studies such as MSC (1993) and McLaughlin and Nichols (1994). Furthermore, NSDIs are underway in may countries.

An NSDI for Turkey was first proposed by Cömert and Banger (1995). Although there has been related work especially by the General Command of Mapping, an NSDI has not been officially started yet. Our NSDI vision has been in line with the US NSDI (Fig. 5) That is, participants and users of NSDI will provide data for and get data from the NSDI. Providers with their responsibility and rights will be determined by the policies of the NSDI. The main responsability of providers will be to provide certain types of updated data. Currently, the public sector is in no ways able to satisfy this need. This is one of the critical areas where the private sector should be employed. This is so valuable in terms of creating new market and job opportunities, which is crucial for the countries like Turkey with a high unemployment rate. Besides this, NSDI will enable many applications which cannot be efected currently. One such application is the new real estate taxation system envisioned by Cömert and Akinci (2002).

It is our view that the emergence of Web services has necessitated a major shift in both the vision and implementation of NSDIs. Because NSDIs had originally been envisioned for "sharing data". And they have been implemented with the existing Web technology which was the "human-centric" web. The idea was to provide users with a metadata based search mechanism and let them transfer the discovered data in a data format. This is not an acceptable solution for mainly two reasons: First, as already mentioned, it is not easy to find what one wants in the human-centric Web. Second, spatial data transfer has always been a major problem due to the disagreement over a single spatial data format. It is not easy, for instance, to locate some data from the US Clearinghouse [FGDC, 2004] and make it "usable" for a client system.

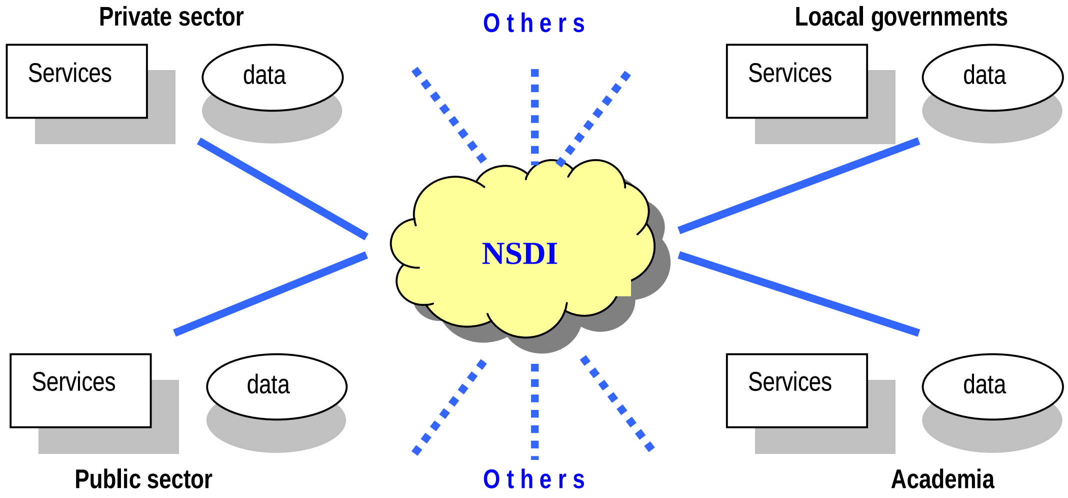

Figure 5: Parties and Web services in NSDI

As already implied above, in the Web services philosophy, users do not go through the Web to search data for their applications. Instead, web services search for and fetch the to the application which might also be web service itself. As explained above the *getParcelZoningPlan* Web service calls many other web services to do its job. One of those services for instance is *getParcelGeometry* Web service in CO server using RealEstateID. *getParcelGeometry* returns an array that includes parcel's attributes, vertice coordinates, and bounding box coordinates. NSDI should be implemented with the same vision (Fig. 5). In fact, all the services we have designed will also be used in NSDI. Because local governments are already an important component of the NSDI. For instance the *getParcelGeometry* Web service of CO servers will be used by many clients. Actually our intention with the municipality web services was to show the way that the NSDI might be implemented with Web services.

5. ELECTRONIC GOVERNMENT

Electronic (e-) government has been proposed as a solution to the problems of traditional governments, such as declining revenues, high costs, poor quality of services, and corruption [World Bank, 2002]. In Turkey, the traditional governments have similar problems due mainly to the lack of interoperability within and among government agencies. These problems were identified and classified in Şahin (2003) as the lack of auto-control mechanisms, high economical losses, high cost of services, poor service quality, and low efficiency. Although these problems have been determined for a municipality, they are also valid for government-to-citizens (G2C), government-to-business enterprises (G2B), and government to government (G2G) in the Country.

NSDI is a very important component of e-government. Actually, NSDI and e-government are meant for the same thing. The difference in the naming is bacause the term "NSDI" had been coined long before the "e-government". The other difference is the type of data they deal with; NSDI deals with spatial data whereas e-government deals with just any type of data including spatial data. In other words, a functional NSDI will be a very important component of e-government. For instance, Land Title and Cadastre (LTC) servers would be the indispensable components of both NSDI and e-government. Because neither can be functional without LTC data. For instance, the *getParcelInfo* explained above gets the parcel id and returns attributes of a land parcel. Such a service will not only be neded in the NSDI but also by many public and private sector organizations of e-government.

E-government is not 'old government' plus the Internet [CEUC, 2003]. E-government means a transformation from traditional to "electronic", which would make government-to-citizens G2C, G2B, and G2G interactions more friendly, convenient, transparent, and inexpensive. This can only be achieved through the interoperability infrastructure. Being one of the best works in this context, OeE (2003) proposes e-GIF (e-government Interoperability Framework) for the UK's e-government. It suggests that successful implementations are needed for the provision of support, best practice guidance, toolkits and centrally agreed schemas. To provide this, the UK government has launched the UK GovTalk™ web site, which is a Cabinet Office led, joint government and industry facility for generating and agreeing XML schemas for use throughout the public sector.

As explained above, we have already implemented Web services for a municipality and suggest in [Cömert and Akinci, 2004] that web services can be employed for the interoperability infrastructure of e-government. In the same study, potentials of web services for e-government were also identified. To summarize, through Web services e-government will enable "on-line" or "e-services". G2B, G2C, and G2G transactions will be performed in seconds over Internet. Without actually going to the municipality and spending plenty of time in frustration, citizens and the other parties will be able to request information, pay their taxes, get building permits, get zoning plan forms and so on over the Internet. This will make valuable contributions to the economy [Cömert and Akinci, 2004]. On ther other hand, 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.

6. CONCLUSION

Both NSDI and e-government needs an interoperabilty infrastructure. Web services seems to satisfy this need. Moving from this point on, we, in our ongoing work, have designed and implemented a number of Web Services for the Trabzon Municipality in Turkey. In doing this, some of the activities of the Municipality have been examined in detail in Şahin (2003). Then a number Web Services have been identified and specified. Finally some of these services were implemented using Cape Clear (Cape Clear, 2003) Web Services development and deployment software. We have also designed a toolbox for additional client side functionality. Thus, a user on a municipality department will be able to call web services of remote servers and perform certain tasks on his machine using the same program which is the internet browser. We can conclude that Web services can be used to implement both NSDI and e-government interoperabilty infrastructures. From this respect current NSDI implementations should be re-considered.

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BIOGRAPHICAL NOTES

Dr. Çetin Cömert is an Associate Professor in the Department of Geodesy andPhotogrammetry 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.

CONTACTS

Dr. Çetin Cömert and Halil Akinci
Geodesy and Photogrammetry Department
Karadeniz Technical University
61080 Trabzon
TURKEY
Email: ccomert@ktu.edu.tr; hakinci@ktu.edu.tr