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Implementation of Web Geoservices by National Cartographic Center [*]

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Implementation of Web Geoservices by National Cartographic Center[1]

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Abstract: Creation and usage of spatial Web services is considered inevitable with expanding the use of Web services in different industrial and commercial fields. Therefore, many academic and industrial institutions have included research in this area in their agenda. This article introduces different techniques for implementing Web GIS and their benefits. In addition the current status and activities of National Cartographic Center (NCC) of Iran in this area and review of upcoming NCC's programs related to spatial Web services will be introduced.

1 – Introduction

In the recent few years, Web services have had a lot of development in commercial and industrial relationships. In the past few years, WWW Consortium (W3C) has released the required instructions for implementing and using Web services. Also exposing services related to geospatial information are increasingly growing. Due to recent developments in Web especially Web 2.0 and Semantic Web, the field of Web GIS have been included in the research agenda of many academic and industrial institutions and such services are publicly being accessible now by large companies such as Google, Yahoo and ESRI.

National Cartographic Center of Iran has produced significant amount of geographic information which are valuable from both of quality and quantity aspects. Data produced in this agency is an important national asset which has been provided with large amount of efforts and costs over the years. These data are applicable in various governmental and public sector and Internet and World Wide Web (WWW) offers the best litter for extending use of such data. Creating possibility of selecting suitable products and data from various data and products is fundamental advantage of Web for customers or end users. Data and service providers can also target their desired groups of users by providing the necessary provisions. With reference to the development of Web applications in business and commerce (e-commerce & e-

[1] Cost of implementing the research described in this paper has been paid by National Cartographic Center of Iran

business) and also extension of data security techniques, buying and selling of information and or data services on the Web is a high rates business, and the presence in this market has been included in NCC's agenda.

In the recent years, NCC has prepared an appropriate bed to move towards the use of the Web by creating and starting geospatial databases. This organization has included the creation of geodatabase according to OGC (Open GIS Consortium) instructions for its produced data since 2005 and it has been one of the few surveying organizations in the world which has begun this task at that time. Currently the prepared geospatial databases at scales 1:1000000 and 1:25000 are operational and accessible to end users. These operational geodatabases have been a basic step forward to the production and initiation of Web services. In the middle of 2007, National Cartographic Center launched a system for public browse of the topography database on the Internet. This system has been implemented and launched based on technologies proposed by W3C and in this article a sample of the implemented services is introduced.

2 - Basic technologies for creating geospatial services

It is awhile that required considerations for applying new technologies and the more important, forecasts needed to facilitate expansion of system's facilities in the future has been included in the NCC's agenda. The ultimate goal of this mapping agency is to prepare necessary foundations for initiating a system with capabilities of complete Web GIS in the near future. So the design and implementation current geoservices is preparation of the necessary foundations for initiating a system with capabilities of complete Web GIS in the desired future. Moreover the latest existence technologies on the Web such as Web Services and Web 2.0 are used in current projects.

2-1 – Three-layer systems

Three-layer architecture has been considered since the beginning of 90^{th} decade when traditional two-layer system (client-server) could not satisfy the need of information systems designers. In the three-layer system the customer layer (client) has only the responsibility of displaying information to customer and receiving data from him/her. In this architecture, activities related to the functionalities of system are transferred to a new layer which is called application layer and logic of operation and computations of a system are implemented by programs installed on this layer. End layer is made of the database and its related systems. This layer, independent of the application type is responsible for the task of data storage and retrieval. In this architecture, there is no direct connection or data exchange between presentation layer and data layer, and the connection or data exchange is always

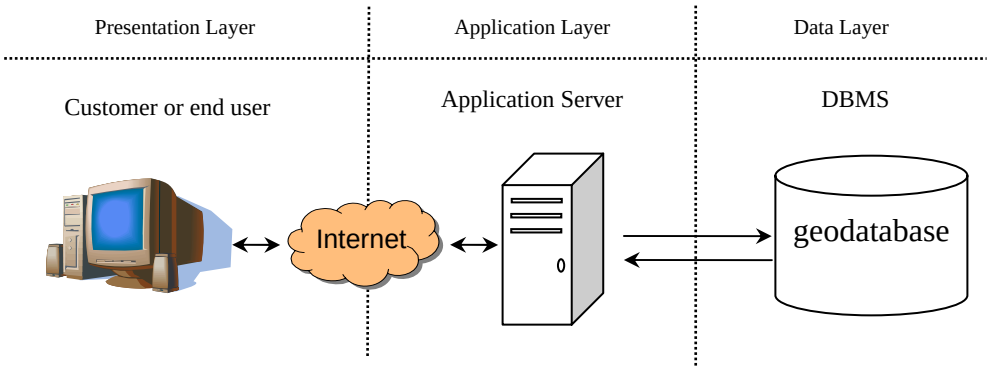

Figure 1: General illustration of Geospatial Information System (GIS) with three-layer architecture on the Internet

performed through the middle or application layer. Increment in efficiency and dynamism of systems and ease of their maintenance, support and expand can be counted as the advantages of using this architecture. For example, a change in the maintenance modeling and type of database only affect the middle layer and the data layer will not be changed.

For example, for compliance with this architecture, the ESRI Company (as one of the well known active companies in the field of GIS) presented ArcSDE software to the market. ArcSDE software plays the role of middle layer in this architecture so that ArcGIS software operates without dependence on the type of database. Although independence of ArcSDE application is limited and still considerable processes is taken place in the user layer (ArcGIS). Using Web services in the middle layer installed on the Internet make many facilities and benefits on this popular media for system designers which will be covered in the next section.

2-2 – Web Services

Web services were proposed by W3C to facilitate the interaction between the systems available on the Web. These services are substantially software programs which have the following characteristics:

- They are used with a standard method (invocation),
- Representation and creation of data structure within the input and output messages exchanged between the programs are done based on a particular standard (usually XML),
- The required description about the performance and how to use the programs are available by other programs and there is the ability to dynamically discover and execute these services by other programs

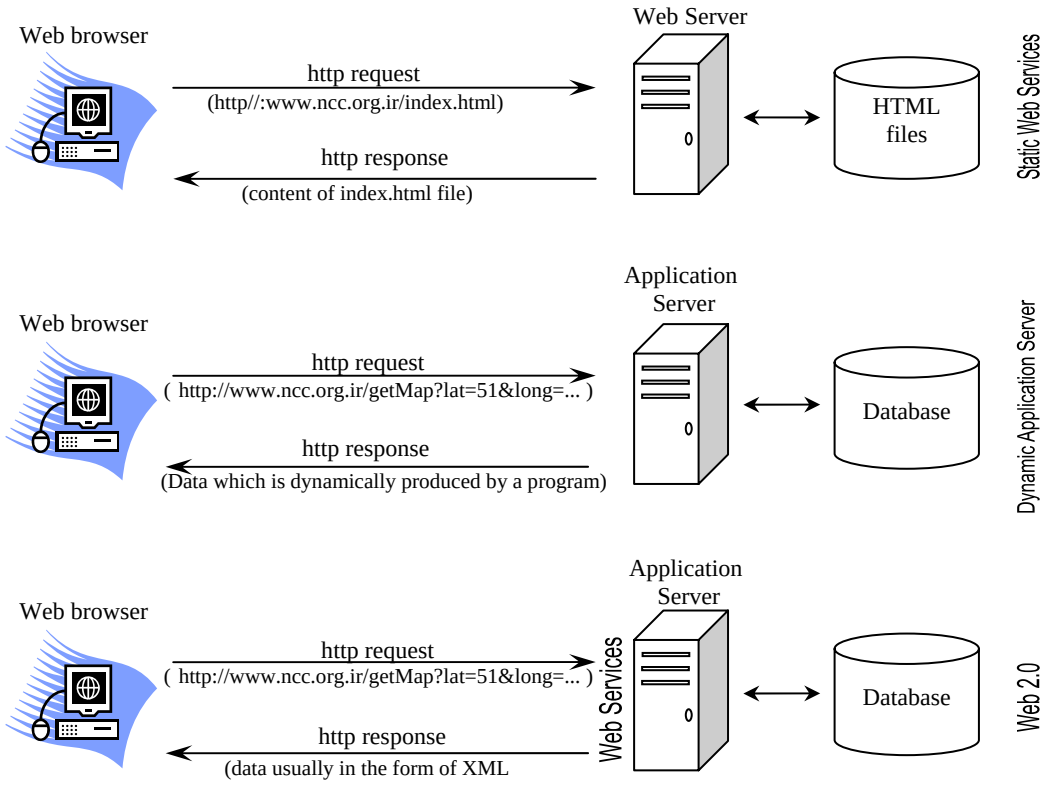

Figure 2: The evolution of how to use Web-based systems and http

- Existence of standard methods provide search for discovering other programs.

Web services have no constraint or dependency to any particular programming language or technology. The only constraint in applying these services is to follow the W3C standards. Thus, this technology makes possible interoperability between softwares provided by different programming languages or technologies.

2-3 - Web 2.0 Technology

Figure 2 shows the evolution of how to use Web-based systems, from static systems to systems based on Web 2.0 technology. Static systems (first row in Figure 2) usually used for information and required data for users have already been provided in the form of html files. The content of html files is recovered by Web Server based on the request of the Web browser and then sends to the Web browser. Dynamic systems (second row in Figure 2) can be implemented using evolved type of Web Server called Application Server. In this method, Web Server runs a program according to the received request. The program produces an output in html form and will be sent to the browser by the Application Server.

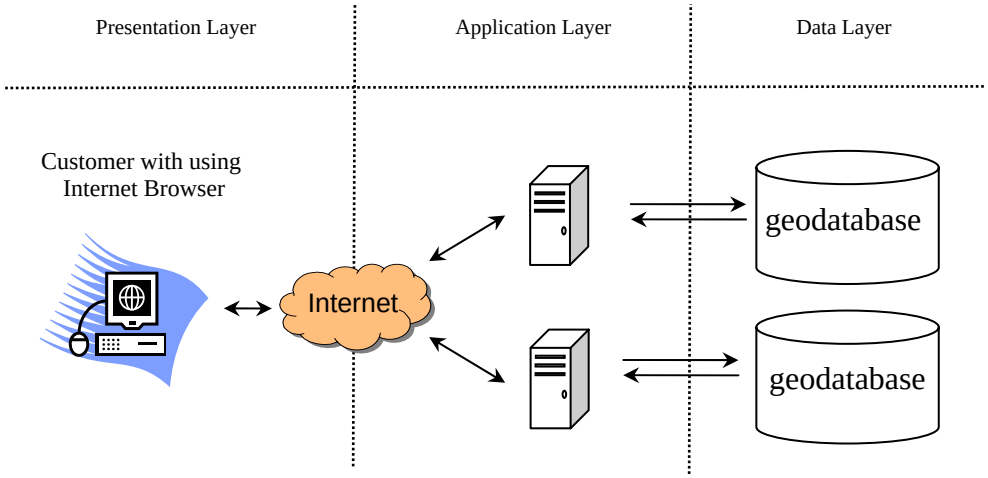

Figure 3: General illustration of Web 2.0 based systems

Principle of Web 2.0 is based on using service. In this Web generation, output of programs is not necessarily in the html form but generally is in the XML form. Another important difference is increasing the share of browser activity. In other words, browser is directly responsible for interpretation and display of the data. Important advantage of Web GIS based on Web 2.0 in compare with traditional systems of Internet GIS is in tasks of presentation layer. In the traditional system this layer is composed of large volume software which must be installed on the computer of the user. In the previous example the traditional products offered by ESRI are using ArcGIS software as a user layer (Figure 1). In this example main calculations are performed in the presentation layer and the middle layer do not perform much of calculations. Web GIS systems based on Web 2.0 makes possible use of a Web browser (such as Internet Explorer, Netscape or Firefox) alone in the presentation layer. Thus users can use new Web-based GIS without need to install heavy software (like ArcGIS). In this way, the middle layer (Web servers) is responsible for a significant amount of processes. Companies producing software related to GIS (such as ESRI or Oracle) have now released their primary products for such systems based on OGC (Open GIS Consortium) suggestions. Figure 3 shows how a Web browser can be accountable for more complex needs with combining services from different sources.

3 – NCC's Services and how to use them

NCC and other organizations have produced extensive usable geospatial datasets and certainly they simultaneously deliver geoservices along with data to their users in the near future. NCC is now establishing, expanding and providing service on the Web. Technical information needed to use these services will be published on the web as soon as possible; however they are currently available on the NCC’s network (Intranet) through the following address:

http://ngdbi.ncc.org.ir/NccMapper/

These services will be increased based on long-term goals of NCC for implementing a Web GIS system over the time. The first implemented service is called getMap for producing image map from existing data on the National Topographic Database and there is a complete description about how to use it in the above address. A brief description of performance and usage of this service will be explained here till the benefits of using this method will become clearer.

With receiving latitude, longitude and map center the GetMap service produce an image map from the desired area with .png format. An example of how to invocate this service is as follow:

http://ngdbi.ncc.org.ir/NccMapper/getMap?layers=HIWAY_L25:WRONG_LAYER&width=640&height = 480 & long = 54 & lat = 32 & size = 16 (1)

- Long and lat Parameters specify coordinates of the map center.
- Size parameter determines width of the map on the coordinate system of map.
- Image size in term of pixel is specified by width and height parameters.
- Layers parameter also determines the name of layers which appears on the image.

With invocating the service a file with .PNG format is created on the server computer and its address is sent for the invoker. An example output of this service is shown as follow:

```
<NccMapperResponse>
   <MapURL>http://ngdbi.ncc.org.ir/MapImage/xxxxxxxxxx.png</MapURL>
   <Warning>Theme: 'WRONG_LAYER' not found.</Warning>
</NccMapperResponse>                                                    (2)
```

The produced output is in the form of XML and content of MapURL address is an image file which was produced from Nation Topographic Database. In the case of a problem which may be appeared during the process of producing image map a warning parameter will be sent which contains the description of the problem. When no image map is produced due to an existence error, just the error parameter will be sent.

Web browser tasks, here, is to provide and send an http request contains (1). Also the interpretation of details of the http response similar to an XML in form of (2) is performed by web browser. If there is an image map the web browser displays it to the end user otherwise with representing an appropriate message makes him/her aware of an error. Important point in using these services is the freedom to use them. This

means that other data centers on the Web can use and supply the images provided by these services on their pages.

4 - Summary and Conclusion

National Cartographic Center as one of leading organization in the field of geospatial information systems in Iran and the world is such an organization that has enough abilities in the field of GIS technology. This article introduced the basic principles of geospatial services and their development process. With presenting a sample of geospatial services of National Cartographic Center the details of such a service has been discussed. Since the ultimate goal of NCC is to prepare necessary foundations for initiating a system with capabilities of complete Web GIS, for performing this project the latest technology provided by the W3C has been used.

Flexibility and distribution of processes in different layers are some advantages of using these kinds of service. NCC will move toward sales of services instead of data in the long-term and with comprehending usage of geospatial services on the Web. One of the important benefits of business model based on geospatial services in NCC is to completely control not only geospatial data but also how to use and process type of users. While users can access to the largest and most update geodatabase in Iran they only pay for data they use and their payment only depends on the amount of the processing on their data.