Role of a Clearing House Server Infrastructure for GIS Interoperability

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Abstract

This paper discusses the development GIS interoperability infrastructure which allows end user to search, locate and finally work at the end with all available geo-spatial data without bothered too much by format differences.

Rapid development of internet technology allows more spatial and tabular data available and accessible publicly. However, it has been identified those data can not be utilized directly due to the differences in data acquisition techniques, data definition and differences in their semantic meaning. This situation reveal the need of interoperable GIS to support seamless information sharing.

From the whole frame work of the on going research there are four components to support the application of GIS interoperability. In this paper the discussion is focused on the architecture and the role of resources clearing house component (server) to facilitate end users to search, locate and retrieve the required meta data from different organization at different time and places. It allows to make further enquire about particular spatial data. The discussion on GIS Interoperability model as well as the development of architecture of the proposed clearing house server are given also a special emphases.

1. Introduction

This research has been conducted under the framework of GIS Interoperability Project financed by KUTKM's research grant. It is intended to increase the usefulness of GIS in different possible user application domains.

Within last few decades, GIS has been approved as a powerful (research) tool for scientific investigations, resources management and development program. In this regards, GIS shows its strong capability for assembling, storing, manipulating, displaying spatial relationship and providing timely predefined information [7].

There are so many GIS users using different GIS platforms with a very limited interoperability. This situation does not allow spatial data and information sharing between two or more different GIS platforms used by different GIS users. In addition to this, a rapid development of internet (information) technology support different data, information easily available and more accessible publicly [2]. However those data are not always useable for other users due to lack of compatibility. Because of this situation, unnecessary redundant spatial data acquisition from the same geographical area conducted by different GIS users becomes unavoidably and frequently occurred. Data acquisition is very costly and time consuming.

Several vendors have introduced export and import conversion or translation file converter machine. But it has been found the introduced conversion techniques may cause unavoidable losing too much information and geometry accuracy during the process. Editing spatial data is also a problematic.

Brief explanation as above shows the requirement of interoperable GIS that can be considered to become the option of the future GIS architecture. Hopefully borderless data sharing between two even more different GIS users can be implemented. This promising technology break through will be economically beneficial to all GIS users those who have plan to utilize the available spatial data.

The GIS interoperability covers several aspects. This paper discusses the development of one GIS interoperability infrastructure names as a clearing house server (CHS) that can facilitate end GIS user to search, locate and retrieve the required information.

2. Problem of information sharing and GIS interoperability defined

Million of users all over the world utilize the capabilities offered by Internet Provider with emerging of GIS to perform their business in numerous industries. But one of the difficulties for GIS is that the interoperability between two more different GIS platform. Most of translation algorithms developed up until now has been specifically designed to suit only for a particular GIS software. Due to the fact there is no perfect union between the functionality of two more different GIS platforms. From observation there are two or more GIS users work with the same GIS platform and database management system, but still they may be having problems because of differences in the conceptual data models, different data collection scheme and differences in quality parameters used. Difference

semantic definition of spatial data systems is known as an edge that cause GIS suffers from interoperability.

The above are defined as problem of information sharing or interoperability between two or more different GIS platform. These problem can be approached using the interoperability of distributed GIS referring to the ability of GIS to provide information sharing and inter-application processes control within distributed collection of GIS users, data, software hardware whose purpose to satisfy some predetermined objectives.

The concept of interoperability as above therefore can be understood as well as the integration of software components. Thus, interoperability refers to the capability of software systems to communicate with each other independent of vendors and platforms or the system architecture. Therefore it is a complex concept, which involved many technical and business ramifications. The interoperable GIS(s) in current research is aimed at achieving a computerized process that will allow us to use data and software services at any time and any where across the boundaries. At the end of the all effort done to achieve interoperability is to assist people to locate, retrieve the required data .

Interoperability means sharing of information. This includes interoperability network of computer software, hardware, spatial data, procedures, application, and personnel. The network of GIS components provides a framework in which users can access, utilize, and share spatial information via the internet or an intranet. The GIS components themselves are used for collecting, manipulating, analyzing, and presenting information that is tied to a location on the earth's surface. Procedures such as methods, flowcharts, scripts, and data models can also be incorporated into the network when data analysis becomes complex or tedious.

To achieve interoperability, a system should be able to accommodate the semantic meaning of the user's query and use the available resources as well as it provides meaningful answer [4]. The role of semantic translator associated within each module has a very significant role to support a seemless information sharing. The semantic translator engine enable the systems to identify the similarity and the differences semantic meaning associated with a particular spatial databases. However, the important issues associated with semantic translator is not treated in this paper.

From Figure 1 it becomes apparent that the interoperability takes place at different levels of interoperability as follows:

1. Application
2. GIS
3. Database system (search and access)
4. Remote procedure call
5. File operating system
6. Network protocol

This paper discusses the interoperability at the application level. From literature survey shows that there is not much works has been completed on application level particularly in the GIS application domain.

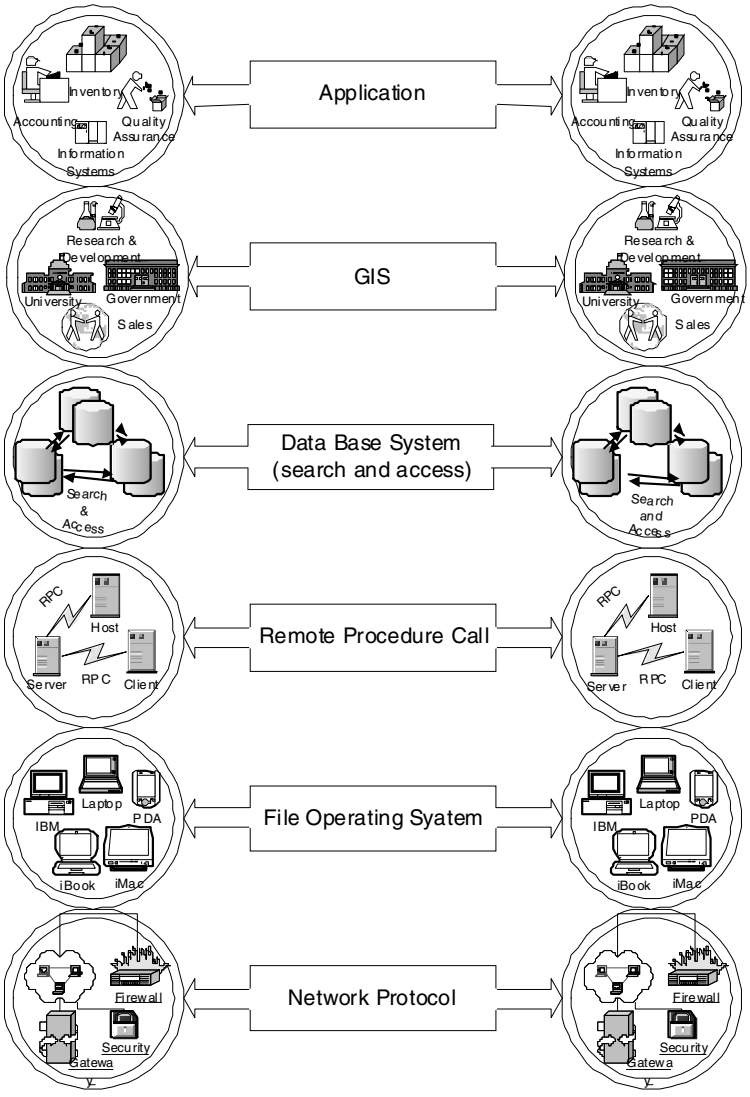

Figure 1. Level of Interoperability.

As stated by [5] the sophisticated geo-spatial data processing has been pushing the computing power and storage capabilities of the GIS clearing house server (CHS) in order to increase the efficiency of information sharing such as memory, security issues, computing processing, communication, power ability, bandwidth and mobility capability. However, most of the GIS do not permissible direct translation and utilization [6] because it involves working in heterogeneous systems.

Part of the system development for GIS implementation now involves establishing crossing point with other systems. If it involves just a few systems, custom one to one interface development satisfies these particular needs. In case involving many different systems this approach becomes unsustainable. Since each application must be altered with every change made to overall workflow or business structure. Thus middleware has regularly been choosing as preferred method as an integration tool for adding functionality to legacy systems.

To develop CHS infrastructure to facilitate GIS users to access, share and disseminate information at any time, any places no matter how the CHS will be accessed but in no doubt with the company of highly interoperable in system, data, semantic and information integration issues.

The genuine goal of this work is in establishing CHS component in order to be able to function as a clearing house to provide metadata of a particular request of end user.

3. Metadata and clearing house server for GIS interoperability

Metadata is data about data. It normally provides important background information about datasets such as information on what it is, when and where it was compiled finally contains who collect the information. Under the framework of GIS interoperability research a datasets stored in a particular GIS platform will be less meaningful or less useful without accompanied by the availability of its associated metadata.

The availability of metadata can be considered as the precursor to solve problem associated with information sharing. Some literatures has mentioned that metadata have gained trust from users as indexing tools particularly since the advent of large scale repositories on internet. This implies the needs of metadata and a techniques to register and store very large size metadata that enable the implementation of information sharing.

The on going research proposes clearing house server as alternative solution to assist a particular GIS user to access to a particular predetermined information. The clearing house server provide all information related to all GIS users at particular time and places. In addition to this, it provides also information on associated metadata and direct link to a particular GIS users who

may have the detail of the required information. In other words, the clearing house enable GIS users to search, locate and retrieve the required information.

From brief explanation as above, the function of the proposed clearing house is comparable with some techniques that have been introduced earlier such as techniques developed by the Dublin Core Standard for metadata, OSCI consortium who has been developing standard for geo-spatial data, Platform for Internet Content Selection (PICS), XML and Resources Description Framework. However, it is worth to mention that the proposed clearing house in this research has been developed mainly using "Open Sources" (down loaded free) application software and tools including Jakarta-Tomcat 5.5.9, Alovmap, Application Server 2.5.5 which include Apache, PHP, My SQL and PHP my-admin.

It has been also a very challenging task to integrate all the said open sources and bring the proposed clearing house into operational one. It has been incorporated to support the entire objective of GIS interoperability. Some security features log in facility has been also added to secure any transaction completed by authorized and registered users only.

4. GIS interoperability and clearing house server architecture (CHS)

The need to setting up geographical (spatial) data infrastructure is to make the use of geo-data more efficient. In this paper the importance of GIS interoperability infrastructure is highlighted to achieve the following objectives:

- Simplicity - user no need to understand what is deal with the system in order to retrieve or import the data that they need.
- Transparent - complexities related with data transfer should be hidden from user aspect.
- Open--interoperability in term of exchanging data should be independent of the technology used.
- Secure and Effective - data transfer should be reliable, and the resultant data should be useful for the intended purposes.
- Universal - all geo-spatial databases should be accessible.
- Data management - the data integrity of common dataset shareable by user.

Within the whole frame work of current project as presented in Figure 2, three components or modules of GIS interoperability have been identified and developed as follows:

- GIS users module focusing on technical aspects of achieving interoperability such as protocol, semantic translator, file format and technical solution used.
- Clearing house module in which content such as metadata format, vocabulary use, semantic dictionary.

- GIS service provider module that address organizational and operational aspects of interoperability such as agreement of exchanging of data, rules for accessing data, and reuse of data.

However in this paper the discussion is focused on the development of clearing house module in which all GIS users from different organization will be registered. This module provides summary of all existing data from different GIS users including meta data on attribute and positional accuracy. In addition to this, the clearing house provides also list of links (addresses) from different but relevant information providers. Thus, the clearing house is considered as a precursor to support the interoperability.

In other words, CHS acts as catalogue that providing metadata on GIS data and services thus as a middleware that generally provide adaptability, flexibility, reduce development effort, shrink integration effort, and boost return of investment [8] to the users of heterogeneous GIS system.

Clearing House Server (CHS) as a database engine which is intended to simplify the process of connecting application as to whether either in distributed, running on heterogeneous platform or otherwise. This architecture will concern on data access among different geographic information systems employed by different organizations at different places and times. The CHS employs client to DBMS server architecture [8] to facilitate cross platform communication to the server from client side driver.

As stated earlier the development of CHS component (see Figure 2) has been constructed mainly using open sources.

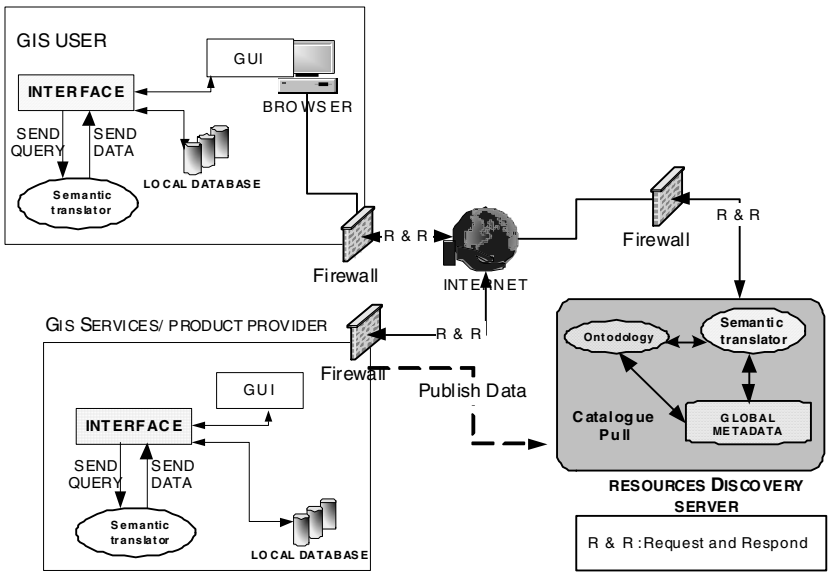

Figure 2. Interoperability GIS and clearing house architectures.

Catalogue pull in CHS will consist of the metadata - data about data [7] and operations working on these metadata [8]. In general each service providers or data owner such as government, commercial entities, non government organization, educational institution, news organization and general public has to register (publish) its offering by means of metadata to a catalogue to permit accessibility. This CHS with its catalogue will carry out responsibility to search data across different sources that may be scattered geographically.

5. Conclusion

In today's business and industries scenario, sharing of information could increase return of investment on business infrastructure, thousand to million of GIS user all around the world depend largely on other party provided information to support own business. As yet, interoperability within the organization has meant exchanging data between systems based on a smallest amount common denominator file format. This costs time and money, degrades data precision, introduces data loss and quality issues as the data is translated and copied numerous times within the organization.

Sharing of information suppose should be 'easy' tasks even both party are separate by physical aspect. One such GIS system should be capable to enables end-user accessing geographic information that would be working with a state-of-the-art GIS package with all data that is interested in on our own computer. Interoperability should be containing several factors to make it effective and efficient since we know the key investment for organizations that deal with geo-spatial information is in the data itself. In order to make interoperability of GIS become a reality, organizations and data provider must willing to make the data shareable by the user, in other words, they must create effective frameworks for data exchange among geographic information communities [10].

Through the review of the paper we can see an interoperability of GIS that capable share geo-spatial information is increasingly importance. In this paper we presented architecture of Clearing House Server (CHS) to achieve interoperability. Yet still a variety of issues remain to be resolved in future study such as security, network architecture, agreement, policies and metadata standard.

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