GIS TECHNOLOGY ON NETWORK TO SUPPORT REMOTE EDUCATION AND ECONOMIC – ENVIRONMENTAL DATA MANAGEMENT IN DEVELOPING COUNTRIES

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ABSTRACT

Data acquisition and Management, correlation between human activity and available resources, govern of change and forecast are some of the basic topics to guaranty the quality of a complex project.
All the aspect cannot be separately treated, since they are strictly related once to the other through logical connections which require an effort to build congruent description in open systems. Therefore for decision makers it's important to use organized information in a suitable GIS.
This proposal is focused on *Remote and Relational Data Banks Management System to support and facility Public and non Public DATA BANK access organized in GIS:* it's related the architectures of developing GIS model on Network.
The *level of data acquisition*, surveys and cartographic representations, will be more and more differentiated from *the level of the information access* (which can be a virtual citizen window and the specialised users: from the segretation of data procedures, to the public domain access, in any case it's necessary to project network system of GIS (on Internet or Intranet) determining standard procedures, formats, protocols to make possible the free transmission of data limiting the loosing of time and data knowledge and avoiding the duplication of the efforts to collect data already acquired from everybody else in the fixed rules.
GIS technology on Network could allow to improve technology transfer applies in two direction and research fields.
Remote Education: GIS technology on Line architecture could improve the acquisition level of GIS, the transfer of GIS functionality and the basic knowledge, and above all the transfer of competence. It can be thought Educational Module with SQL (System Query Language) connection to the relational Data Base and in the future it can be also represent a chance to support Remote Education and Knowledge transfer in Developing Countries.
Remote access to Relational Data Bank: the remote access to Relational Data Bank 'global positioned' using perhaps GIS SW as a client could be an useful approach to support Economic – environmental Data Management in developing countries with GIS.

1. INTRODUCTION

Environmental risk information, Data acquisition and Management, correlation between human activity and available resources, govern of change and forecast are some of the basic topics to guaranty the quality of a complex project.
For the Public Administration it's mandatory to use geographic information for the description of possible dangerous events, natural phenomena, degree of the cities, social and economic depression.
For developing Countries will be mandatory to use geographic information to support, plan and forecast demographic trend, economic development, financial policies of best suitable investment related to the depression areas, to the natural resources, to the infrastructures of the territory and to the geographical state of art (that's to say relate perhaps water resources and access, communication network with technological network, water pipes, etc.). All these aspect cannot be separately treated, since they are strictly related once to the other through logical connections which require an effort to build congruent description in open systems. Therefore for decision makers it's important to use organized information in a suitable GIS.
Such a GIS operates in geographic domain and has to be able to acquire, handle, produce georeferenced data, that is the Numerical Cartography with all the linked data. The Internet is becoming a potentially dominant force in global communications and a part of the infrastructure of cultures around the world. It continue to grow extremely rapid, develop and become even ensconced in society.

Geographic information Systems (GIS) has the potentially to be one of the fields growing up.
The Internet holds promise for exponential increases in the efficiency and effectiveness of the ways in which we obtain, use, and share geographic information in all its forms (including maps, graphics, text and data).
Many extraordinary systems have already been built, and over the next few years, an increasing number of GIS application will *"go online"*.

2. DGI: DISTRIBUTED GEOGRAPHIC INFORMATION

The research deal with the use of Internet technologies to give people access to geographic information in a variety of forms, including maps, images, data sets, analysis operations, queries and reports.
Distributed Geographic Information (DGI) is a term proposed to refer to this entire field; that is, the widespread (perhaps to a larger audience than would have access using traditional GIS technology) distribution of geographic information in different forms. DGI applications range from simple, pre-drawn maps on a Web Page to network-based collaborative GIS in which GIS users at remote locations share common data and communicate with one another in real time (not yet widely available). The technologies being developed to make DGI applications possible include servers (which store data and applications), and network communications (which control the flow of information between servers and clients).
On the server (dissemination) side of the equation, issues include such things as the speed of query and transfer, the possibility of including full GIS functionality or just basic mapping, and the efficient storage of and access to large quantities of geographic information.
On the retrieval side, issues include effective user access to and location of desired information, as well as means of viewing and analyzing the information., often with GIS sofware unfamiliar to the user.
There is a wide variety of ways in which you can distribute geographic information on the Internet, but they are all founded on the same general design. The basic architecture is similar to the client/server model, a model on which the World Wide Web and most Internet services are based.
The classic model includes a client program (a Web browser such as Netscape) which makes a request to a server program: i.e. a specific page by its uniform resource locator (URL) address. The server processes the request and returns the information (e.g., a hypertext mark-up language - HTML - page) to the client.

The model used in DGI is an extension of the client/server concepts, known as a multi-tiered server. A client is typically a WEB Browser or other Internet access SW such as the File Transfer Protocol (FTP). It is even possible to conceive of an entire GIS program as a DGI client. The multi-tiered server consist of a normal Web server and a running GIS program, with communication between the two facilitated by a specialized DGI program.
When someone make e request for a map or other GIS product, the request message is sent over the Internet to the Web Server. The server recognizes it as a DGI request, and passes it to the DGI program, which translates it into some type of internal code (e.g. queries or map drawing commands). This is passed to the GIS SW which processes the request, usually using custom scripts (programs interpreted by the GIS SW).
The SW the returns the result, which could be a map, text or even a row data file. The DGI SW is then responsible for reformatting the output into an Internet-standard format, or at least something understood by a browser plug-in or Java Applet. (An Applet is a module that extends the functionality of a Web Browser). The reformatted information is then returned by the Web Server to the client, where it is displayed.
This display might in turn be used to issue a new request, such as if someone were to click on the map. This pattern repeats itself many times during the DGI session.
The DGI SW can incorporate data reading, mapping, and basic analysis capabilities, which eliminates the need for dedicated GIS SW. This is commonly found in simpler applications such as street map Browsers, which come with their own pre-packaged data.
The aim is to give users access to the full analysis capabilities of your GIS (or some subset thereof). This would allow them to perform complex multi-theme queries, create buffers and customised maps, perform statistical spatial analysis, and other tasks. Only rarely you would want people to be able to modify the data bank. This type of service allows the user to create new data sets from their own analyses without altering the data you maintain. The data sets the user created could be stored on your server for their future use or you might offer the option of downloading their results as a map, report or raw data set. A good example is represented by the site of the City of Oakland (California) Map Room (*http://ceda.ci.oakland.ca.us/index1.htm)*: this Site uses MapObject Internet Map Server to create an interactive map browser for the city's GIS, including parcels, streets, and aerial photographs.
When viewing parcels, the user can query a particular plot and get complete attribute information.
MapObject Internet Map Server is an extension to the MapObjects package, a collection of components for building mapping and GIS applications. It can be used to build a wide variety of dynamic mapping and GIS applications, using any functionality in Map Objects (which includes a large part of the functionality of Arc/Info).
The SW packages provided for building DGI applications are produced by different Commercial Software houses (Intergraph, AutoDesk, Oracle, ESRI, GRASS, etc.) programming tools which provide GIS and mapping functionality.
But there are also some SW not specifically designed for the Internet (i.e. Spatially Enabled Database Servers).
One of the problems in managing and using large GIS systems is that they are proprietary, and have not mixed well other information in an organization. In the recent past, many of the major database vendors and some GIS vendors have introduced tools for incorporating spatial data into a standard relational database. That is, database tables store the geometry of each object, as well as its attributes. Spatial queries can then be run through standard interfaces such as SQL.
As with a normal database management system, custom applications can be built to access this spatial functionality through an application programming interface (API). Therefore, although these extensions are not designed specifically for the Internet , their

functionality can be incorporated into Internet applications, provided you are willing to write the program yourself. A great advantage of storing GIS data in a DBMS rather than a traditional GIS program, especially when using it for DGI, is scalability. DBMS are designed specifically to work in situations with many users and high load. The SW is multithreaded (many request can be processed simultaneously) is built on a transaction model (which prevents data changes from coming from two directions simultaneously), and has greater security capabilities.
The spatial analysis capabilities of this SW are still rather weak, limited primarily to simple spatial queries. However, spatial extensions are available for most of the major database management systems. Descriptions of some of these tools follow.
Spatial DataBase Engine by ESRI (SDE) can interface with several database systems to provide spatial functionality. Custom DGI development is not usually necessary to the same degree as the others because it can be accessed through both the Map Object Internet Map Servers and the ArcView Internet Map Servers.
Spatial Data Option by Oracle (SDO) is an element of the Universal Oracle Server, which adds spatial data types and retrieval methods. Although it requires extensive programming to build a useful application, to create a DGI applications, this product can be interfaced with Oracle's Own Web Application Server or to SDE Server and then to the Map Object Internet Map Servers too. The distributed data approach can be very valuable in different situations.
If you are combining data from many sources , a single DGI/GIS program can read themes from more than one remote disk. If you are using one 8or both) of the two distributed-processing architectures, like distributed DGI servers or distributed GIS servers, all of the distributed processors can share the same data source, making it easier to keep the data source current.
The other situation will be the case for most readers. It allows you to use existing GIS data from wherever it is already being stored, which will rarely be the Web server machine.
A large installation is built by distributed Web servers, DGI servers, GIS servers and data servers: data can be stored anyway, they are readable by the DGI program, including drives on other computers in the local network (or remotely using NFS or dFS); locally installed data is not necessary!.

3. ARCHITECTURES TO SUPPORT GIS DATA BANK ORGANIZATION on NETWORK

The geographical spatial temporal information updating is required to avoid the redundancy and the efforts made to collect data; for this purpose several client/server Architectures have to be designed for the data transferring and remote management: on one side there are *Numerical Data Banks* (it will be tested the use of RDBMS, relational Data Banks Model System, such as **Oracle** and **SQL** link methodologies which run on Line without needing GIS Software on the client side); and in the other side there are *Geographical Data Banks* to manage millions of geographic objects with multi-access connections on Network, such as **SDE-ESRI, SDO-Oracle.**

The research has to improve type of *net data handling* defined following different procedures: from GIS Software, such as arcing used as Client to connect to the *Remote Data Bank on different Servers* till to the Distributed Geographic Information System **(DGI)** on Line to support citizens services through GIs tools developed on WEB Servers by different Software (i.e. Map Object Interment Server).
The *level of data acquisition*, surveys and representations, in the architectural objects like in the urban cartographic scale, will be more and more differentiated from *the level of the information access.*
The level of the information access can be differentiated due to the typologies of users: from the virtual citizen service windows to the specialised users. Client/Server architecture would be the core of this "GIS Data Bank Organization on Network".
From the segretation of data procedures, to the public domain access, in any case it's necessary to project network system of GIS (on Internet or Intranet) determining standard procedures, formats, protocols to make possible the free transmission of data, limiting the loosing of time and data knowledge and avoiding the duplication of the efforts to collect data already acquired from everybody else in the fixed rules.

4. STATE OF THE ART: DATA AVAILABILITY AND ACCESS BETWEEN TRADITIONALLY DISPARATE CAD AND GIS GROUPS. CLIENT/SERVER INTEROPERABILIY AMONG ALL GEOPROCESSING SOFTWARE: SDE – SPATIAL APPLICATION SERVER AND ORACLE

The major developments are improving the interoperability of servers and client software: SDE Spatial Data Base Engine is an example of software support for additional data types and new clients. Currently known for its best-inclass retrieval of spatial shapes in a multiuser environment, SDE is becoming the universal spatial application server at many organizations world-wide.

SDE - Architecture

SDE in an ESRI's client/ server technology for storing and managing vector, CAD and image data in a database management system (RDBMS) . SDE treats spatial data like any other business data since it can now be stored with an organization other information in a single database. The interface that couples SDE to a DBMS provides high-performance access to both spatial and nonspatial data in multi-user environments.
The SDE three-tier architecture extends the two-tier model by adding a middle application server that supports distributed computing services. In this role it can be acts as an universal spatial application server providing advanced spatial search functions, spatial geometry verification, projection function, fast-loading of data, and administration tools.
The SDE server will support three new spatial data types: Open GIs Specifications, spatial extensions, from the database vendors, and arcing coverage. The Open GIS Simple Features Specification for SQL was adopted by the Open GIs Consortium, Inc. (OGC) Technical Committee in August 1997 and is now in draft form. Three draft Simple Features Specifications resulted from

an unprecedented collaborative effort by ESRI along with IBM. Informix, Intergraph, MapInfo, Microsoft, Netscape, Oracle, and others to develop interoperability specifications for geoprocessing software interfaces and services. By allowing applications from different vendors and developers to share a common geospatial, these specifications will help promote widespread use of interoperable geoprocessing software and geospatial products. One of the three draft specifications pertains to storage of spatial data in SQL databases.

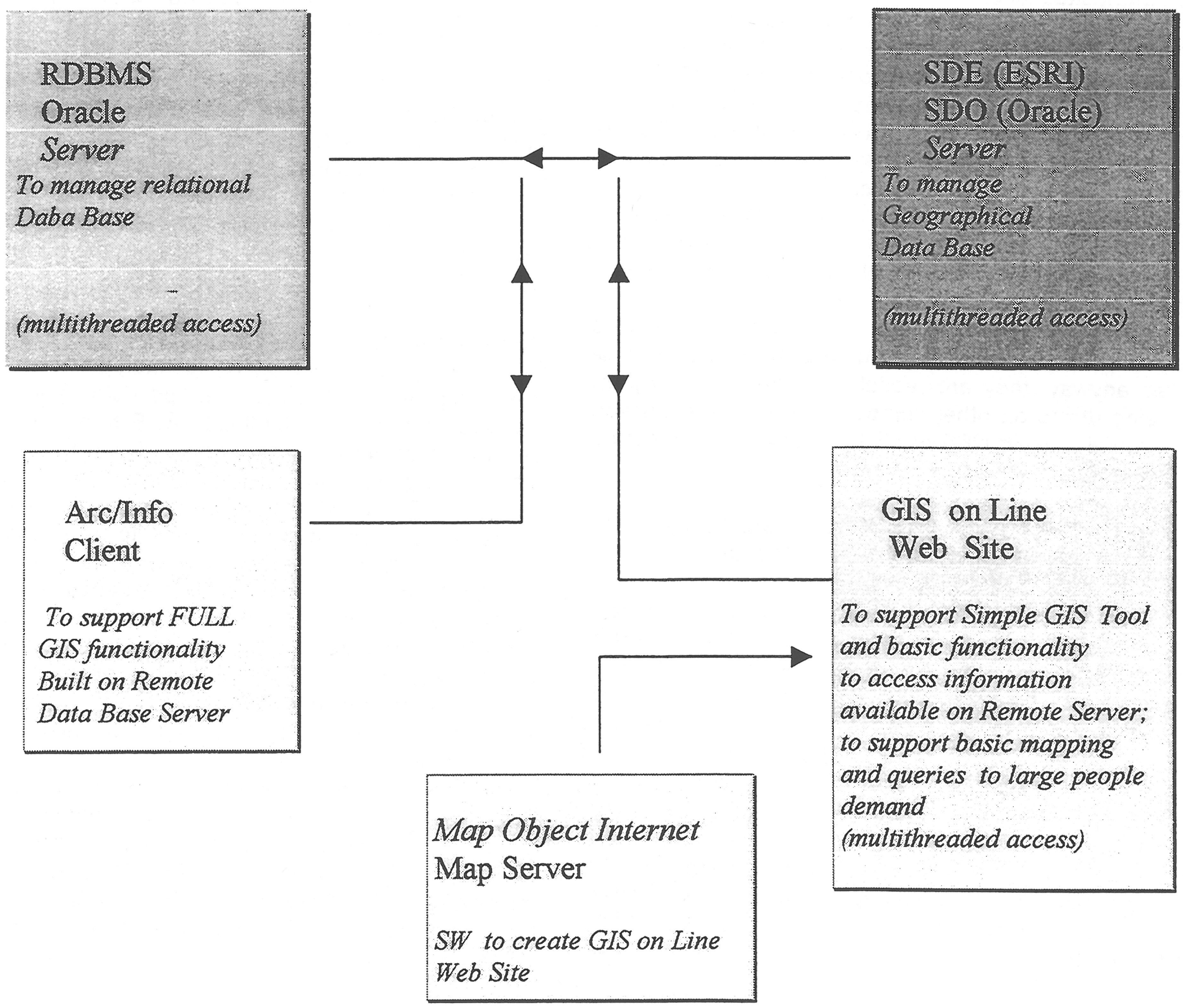
The Simple features Specifications for SQL defines three schemes that support storage and management of geospatial feature collections in SQL database systems.

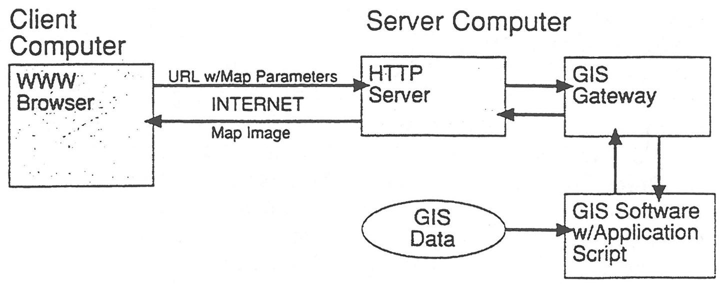
All three representations are logically equivalent and share the same definitions for spatial geometry. Although implementers can choose to support any one of the three alternatives, SDE can support all three alternatives in addition to the current SDE compressed binary format

The Open GIS Simple features Specifications for SQL defines three schemes that support storage and management of geospatial feature collections in SQL database systems.

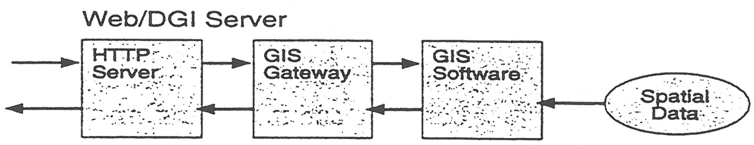
Since SDE will support all three methods defined by the specification, SDE conceals any differences in the details of data storage from the client applications.

Multithreaded Architectures to support GIS Data Bank Organization on Network: many request can be processed simultaneously

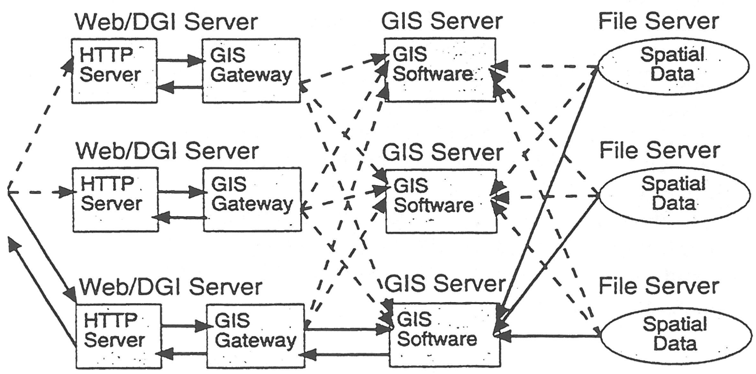




Architecture of a live GIS interface.



A small installation with the Web server, DGI software, and data all residing on a single computer.



A large installation with distributed Web servers, DGI servers, GIS servers, and data servers.

Support for the Open GIS Simple features Specification for SQL will be a component of SDE (version 3.0.2) which is scheduled for the first quarter of 1998. Database vendors are extending their database engines to directly support spatial data types. As functionality, performance enhancements, and data administration tools become available from core relational database technology, these features will exploit in SDE.
A recent join ESRI and ORACLE announcement regarding SDE support for Oracle spatial technology is one example of this commitment. SDE for Oracle Version 3.0.2 will support the Oracle8 Spatial Cartridge and the Oracle7 Spatial Data Option. As a result, Oracle customers will be able to use GIS application software with the Oracle data Server. It also means that ESRI users will be able to take advantage of the current and future capabilities of Oracle's spatial extension products.
ARC/INFO coverage are the third new data type. SDE will be able to directly serve ARC/INFO data to any SDE client. This capability is scheduled for release in conjunction with ARC/INFO 7.2 early in 1998.

Client Developments

SDE CAD Client allows MicroStation and AutoCAD users to act as SDE clients to store and retrieve data in a standard DBMS. CAD objects are stored in database rows: there is no loss of geometric definition, properties, or database connections stored in extended entity data or attribute linkages. Including CAD users in the enterprisewide sharing of spatial information opens new doors for data availability and access between traditionally disparate CAD and GIS groups.
With MicroStation and AutoCad now participating in spatial data sharing, different users within an organization can select the correct client tool for their type of work. Engineers can use a CAD package, while other users can choose a lightweight viewer such as ESRI's ArcExplorer or any of the other SDE clients. SDE CAD Client version 1.0 began shipping in October 1997.
To promote interoperability among all geoprocessing software, ESRI published the SDE client application programming interface (API). The SDE C Developer's Guide describing the C programming language API is now downloadable from the ESRI Web site. From the SDE software page follow the technical documentation link.
The SDE client API was used in the first public demonstration of the Open GIS Simple features CORBA Interface conducted in co-operation with the Federal Geographic Data Committee in October 1997. SDE features were served using CORBA transport to a Web-mapping client. The SDE client API was "glued" to a client developed by BBN Techbuild custom applications with the SDE client API.
These new developments will be incorporated into all the DBMS platforms supported by the SDE including Oracle (UNIX and NT), Microsoft SQL Server, IBM DB", INFORMIX, and Sybase.

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