Interoperable and Distributed Processing in GIS to sustain the development of Local Authorities in Mali

ABSTRACT

Since 1992, implement decentralization reform in Mali has made it possible to empower the populations in their own development planning. Resources distribution to local authorities requires detailed information of the constraints and the assets linked to their development. Data collected on the rural area are often poorly defined, redundant or incomplete and inefficiencies for sharing due to a lack of applied standard tools. The information is too descriptive and it is difficult to extract useful one for decision making process. There is inadequate information upon which to base resource allocation decisions. The purpose of this paper is to define data, that can be collected on rural municipalities or localities and handled by GIS to make information available to decision-makers, planners and beneficiaries. The data used from Malian poverty survey performed in 2001-2002 focused on the satisfaction of basic household needs. This concept is based on meeting those who lack access to basic living needs, which generally include clean water, sanitation, nutrition, primary health services, and basic education. The method used the platform of "MapGIS IGS, IIS6, Windows Server 2003, ASP.NET and MS SQL Server 2000" to develop an application GIS Web Service. Data are integrated to the platform and published as services.
The product output have been tested successfully on the intranet of Wuhan Zondy Cyber in the term of interoperability and extraction of the information needed. With this tool, each local authority can be a potential collector of his own data and participates to update the database. The Web Services model of the GIS systems described provides users with the services and data they need, without having to install, learn, or pay for any unused functionalities. The extension of this standardization in all ECOWAS countries would be a great advantage regarding the sharing of geographic information between countries.

Keywords: Local authority, Web Service, Distributed GIS, Poverty line, MapGIS IGS,

1. INTRODUCTION

Development interventions in the rural municipalities are effective and sustainable only if there is sufficient information available to decision-makers, planners and beneficiaries- and sufficient capacity to use that information. In Mali however, all these conditions do not yet exist. Specifically, spatial information in Mali is sparse and difficult to access and manage. The data collected on rural communes are not well coordinated resulting in redundant maintenance of datasets, duplication of applications, and inefficiencies for the sharing of data due to a lack of applied standard tools. The diagnostics have demonstrated that the department responsible of national statistical data has no adequate tools to handle and share the necessary information. The information is too descriptive and it is difficult to extract useful one for decision-making. There is inadequate information upon which to base resource allocation decisions. However in Mali, there are big amounts of spatial data collected on rural localities located at different level of the governmental institutes, organizations and privates sectors).To better understand how this data can best be process by GIS to help

rural municipalities' development, research is needed on new approaches to make available GIS data and services. As part of the optimization, together producers ,users of GIS data in Mali will lead to a consensus on the sharing of basic geographic information. Through the world, most municipalities have been using GIS for many years. Geographic information systems (GIS) provide us with a way of capturing geographic information in digital form, and manipulating, sharing, and displaying it in myriad ways.GIS has a long history of successfully adapting to new technologies, applications, customer types, and business models. From mainframe to the desktop and, more recently, to the Internet, the mobile device and cloud computing, each round of technical innovation has resulted in improvements for GIS. Today, GIS is still evolving in response to infrastructure changes. Due to the popular recent use of the Internet and the dramatic progress of communications and telecommunications technology, the paradigm of linking GIS and decision making is shifting into distributed computing technology with independently provided, specialized, interoperable geo data and services.GIS projects usually take several months to set in place. The GIS Server is a solution to this problem. The public wants to consume a product right away; he prefers to access it remotely, by importing the data that interest him or by working directly online. To interact with such systems and talked mentioned problems above, the broad aim of this study is focused on approaches of distributed computing technology based on web services as well as the role of interoperability in information process.This project initiative is to promote Municipality GIS in developing Country and to contributing to the standardization and interoperability of GIS data and functions in Mali. It is designed for local authorities, NGOs, searchers and whom interested by rural development and fight against poverty in Mali. It is a tool that should be able to play a large part to sustain the decentralization process and the development of rural spatial infrastructure in Mali. Related researches This study learnt from the experiences and knowledge of previous efforts of GIS municipalities'solutions through the world and some local cases:ARP's Cartography of Republic of Mali CD-ROM" and SIGMA Database ,a Information System for Water Resources Management in Mali.

2. MATERIAL AND METHODS

Data used by the methodology from different sources. The map Data representing administrative localities, road and Water network, Villages location are getting from the IGM (Institut Géographique du Mali). The project especially uses census data and data collected on rural area (water, health, education…) that the government has entrusted the management to the local communities. The data mainly provided by the SNS "Système National de la Statistique":INStat and CPS (Planning and Statistic Unity) of the corresponding department, are the basic information needed to formulate, conduct and evaluate the socio-economic development policies in rural communes.The same data are used to establish the poverty range. at the village or commune level.

The poverty range or line is a measure of a certain amount of material well-being possessions or money, a government or a society believes it is necessary for a person to have a minimum level of subsistence or standard. In developing country as Mali, the basic needs in education, health ,sanitation and water is a priority and can be more easily satisfied by the public and local services than to increasing personal incomes, especially since individuals do not always use their extra income to satisfy more needed cause. This poverty range is evaluated from an index of targeting or poverty score (Is) that recognizes the existence in the locality the based need infrastructure: education, sanitation, health, clean water, cereal bank and rural savings bank. This score is 20 if all of these services are available. The methodology is therefore based on an indicator (Is) called "poverty score" that takes account of population size and distance from a selected number of socio-economic infrastructures. The score, which ranges from zero to 20 is a sum of partial scores attributed to each infrastructure. The "Is" of a village is the sum of partial scores. The "Is" of a commune is the average of the scores of its villages. The poverty range is "Is" = 10. Based on this poverty line, two factors are using to set the degree of poverty in Mali: 1) the incidence of poverty in a locality or country is the proportion of people living below the poverty range, 2) the depth of poverty is the poverty index percentage of the poverty range. For example, a locality which has six as poverty range, the poverty depth would be (10-6) / 10 or 40%. The census data has been processed by Ms SQL Server 2000. In addition to the information cited below, methodology took into account the access to mass media: radio, television, mobile phones.

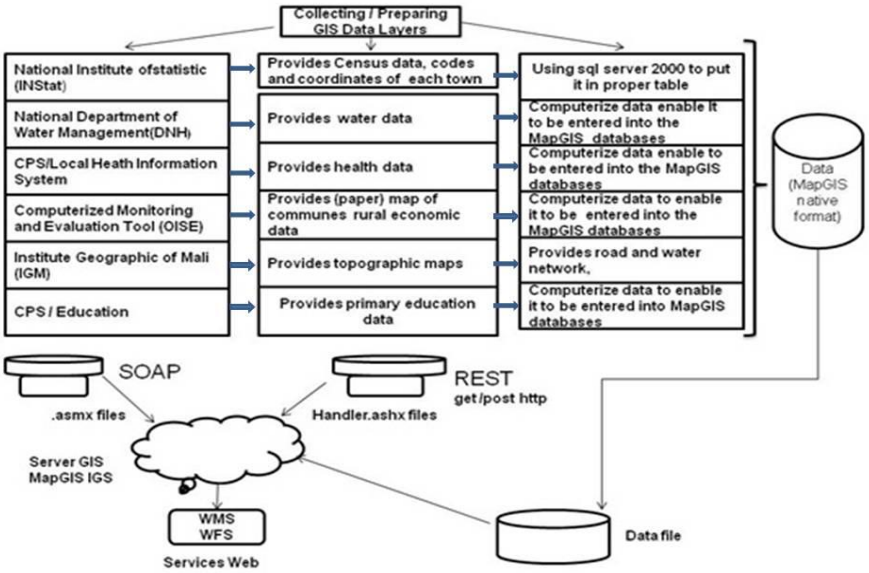

Fig.1.Data imput and MapGIS IGS - SOA & REST protocols

The approaches, used to build GIS data and functions, are based on web Service (SOAP and REST), Open GIS Consortium specifications (WMS and WFS) and a DBMS solution. The method has used the platform of "MapGIS IGS, IIS6, Windows Server 2003, ASP.NET and MS SQL Server 2000" to develop an application GIS Web Service. Data are integrated to the platform and published as services. MapGIS IGS is under the license of MapGIS (www.mapgis,com.cn). MapGIS IGS meets the standards and ISO of Information Technology, Web and GIS to support multiple approaches to interoperability. The developers can use MapGIS IGS to create reactive and user friendly applications that take the best part of the common Web technologies such as AJAX, SOAP, REST, JavaScript, Adobe Flex... The SOAP is based on asmx and REST (HTTP, GET/POST. Data on villages were integrated into MapGIS Database by using OLE DB connection.

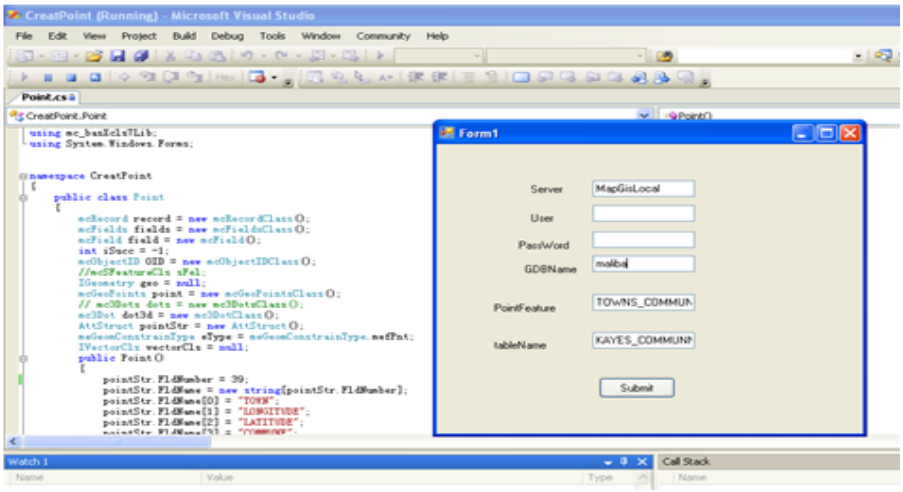

Fig.2. OLE DB connection

3. RESULTS AND DISCUSSION

The following samples “get WMS” and “WMFS service” request have been implemented from the REST encoding.Web Map Service provide interfaces which allow client to access maps as illustrated by the fig.3 ,4,5.

Getmap
:http://kone/MapgisOGCWebService/rest/kone/WMSServer?VERSION=1.3.0&REQUEST=getmap&LAYERS=Commune.WP&STYLES=&CRS=&BBOX=12.24131,11.898007,8.133862,15.700753&WIDTH=700&HEIGHT=800&FORMAT=image/gif&TRANSP

ARENT=true&BGCOLOR=&EXCEPTIONS=&TIME=&ELEVATION=

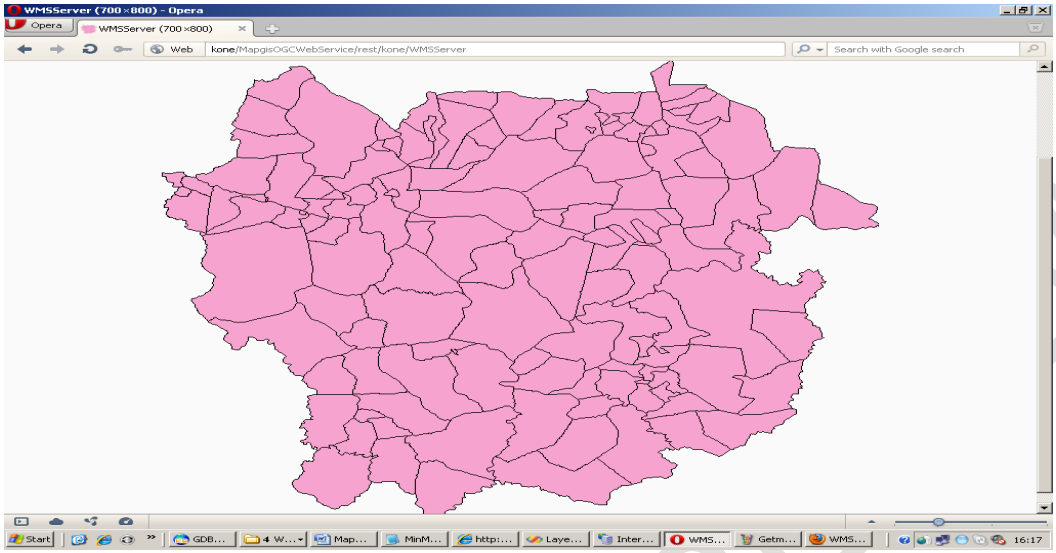

Fig.3. GetMap request output –Communes of Kayes Province (region)

GetFeature

Http://kone/MapgisOGCWebService/rest/kone/WFSServer?Version=1.1.0&Service=WFS&Request=GetFeature&TypeName=Commune.WP&OutputFormat=&Filter=<?xmlversion="1.0"encoding="utf8"?><WFS_GSQLxmlns="http://www.opengis.net/wfs"xmlns:gml="http://www.opengis.net/gml"><FeatureName>communewp</FeatureName><Filter><PropertyIsMoreThan><PropertyName>ID</PropertyName><Literal>111</Literal></PropertyIsMoreThan></Filter></WFS_GSQL>&PropertyName=

Transaction WFSs:This specification allows transforming a WFS server into transactional server. It is then possible to add, modify and delete objects in geographic databases searched by the WFS server fig.5

http://kone/MapgisOGCWebService/rest/kone/WFSServerVersion=1.1.0&Service=WFS&Request=Transaction&TypeName=region.WP&OPERATION=delete&Feature=5

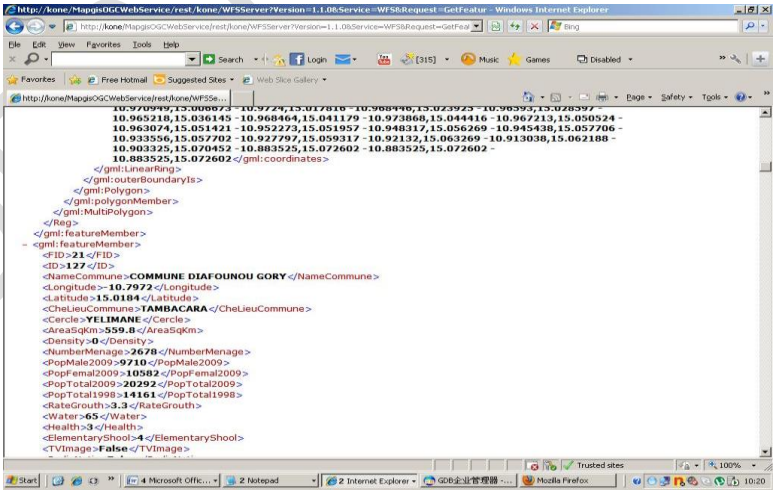

Fig.4.Getfeature request output

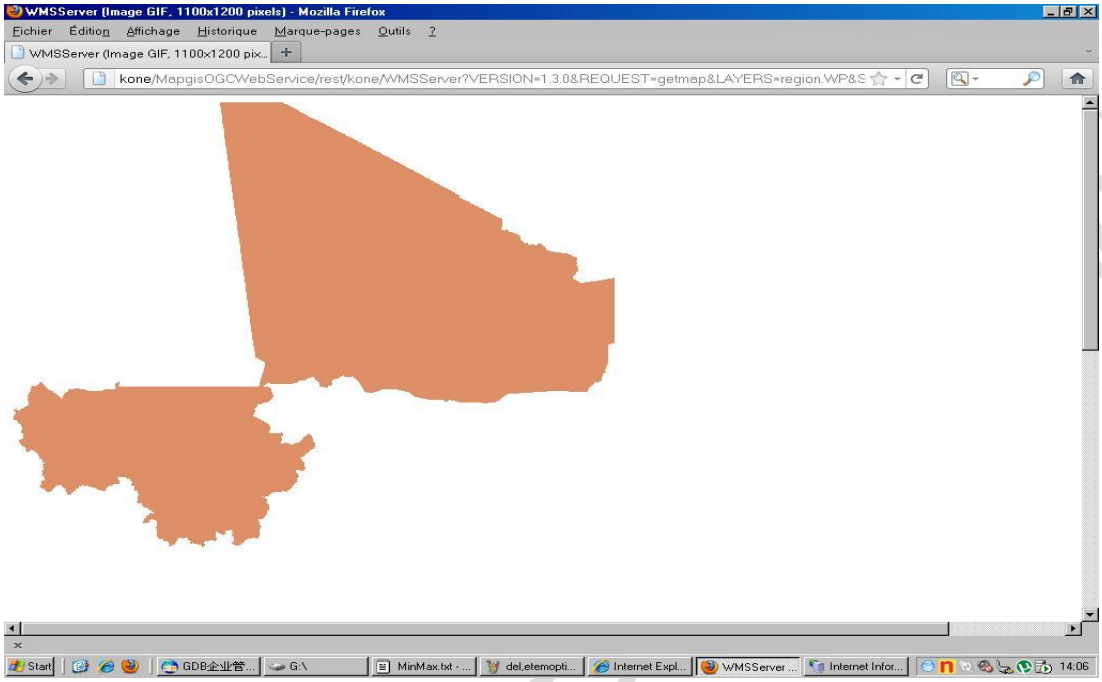

Fig.5. Transaction request Output: feature (Region of Mopti)

The tool achieved, have been tested successfully on the intranet of Wuhan Zondy Cyber in the term of interoperability and extraction of the information needed.

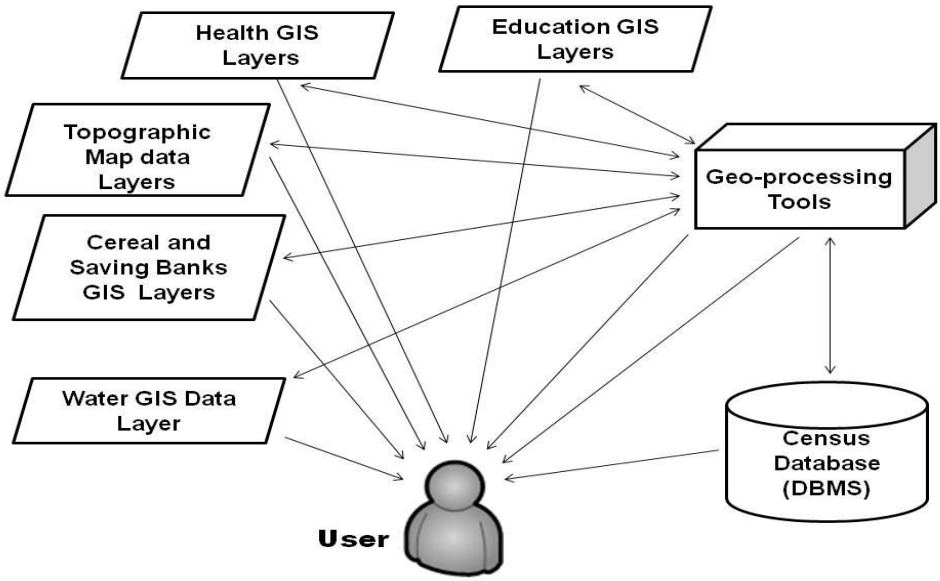

Fig.6. Architecture of rural municipality's solution

4. CONCLUSION

The web services model of the gis systems described provides to the user, the services and data they need, without having to install, learn, or pay for any unused functionalities.The use of such service holds many advantages for municipalities in terms of required qualification of users, cost of software, efficiency of workflows and decision-making.
In order to benefit from the use of GIS in Mali a standardization of geographic information management is a necessity. The extension of this standardization in all ECOWAS countries would be a great advantage regarding the sharing of geographic information between countries.

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