Enterprise Geographic Information Systems

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SUMMARY

This paper will provide a look at Enterprise Geographic Information Systems as this ICT architecture is becoming more and more common in support of large cadastre administrations.

GIS, in parallel with ICT, has evolved from desktop systems that supported a single user working on a project, to department workgroups on a shared local network, to large enterprise systems with no limit to physical location, made possible by high speed Internet connections.

Land records administration requires the management of diverse forms of data and enterprise GIS is recognized as a specialized form of ICT that is capable of integrating data from disparate sources and diverse contributors. GIS also has the means to produce new data as a result of geoprocessing, and report this data in new and useful ways, by its powerful visualization tools.

Using ICT standards, such as data base management systems, application servers, communication and programming protocols, enterprise GIS is possible and productive in land administration workflows and data sharing.

Local and national examples of enterprise GIS in support of data integration, data processing, workflow, and data dissemination will be given.

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1. INTRODUCTION

The Internet has transformed ICT and it has made possible a new architecture to support large organizations, whether in a single location, or multiple locations spread across geographic territories. However, an Enterprise system is more than just ICT, it is a way for different groups within an organization to share information and collaborate on decision making. An Enterprise system is most typically comprised of three components: a data server for data management, an application server to manage the business logic, and clients for the presentation of the application. A modern GIS adheres to ICT standards and therefore can be deployed on the Internet to enable organizations to operate from enterprise servers, or integrate GIS as part of an enterprise system. Land records administration is well-served by an enterprise approach, because the workflow, data, and administrative management involves: multiple staff and approvals, multiple data types, integration with other processes and systems, and the administration of legal records which last for centuries.

1.1 GIS is Evolving

GIS has a long history as a tool for land planning and land management. 20 years ago GIS was a system for reviewing individual projects that had impact on the land and surrounding community. GIS was used to assess that impact and quantify by some means the social and environmental impact of land development, allowing decision makers to review alternatives and potential change the way in which land was subdivided and taxed. In the mid-1980's, with the advent of network computing – servers and workstations – GIS became a shared resource and analytical tool for workgroups within a land administration department. GIS began as a highly specialized, propriety system, but as it evolved, and evolved around ICT standards, it is now deployed as an information system for decision making and records keeping, not simply within the land administration department, but as an enterprise system for the whole of the government organization and the citizens and commercial entities.

2.0 ENTERPRISE CHARACTERISTICS

Information systems are comprised of a set of ICT resources which include data, applications, hardware and communications. The purpose and goal on an organizational system is to provide useful information for management and decision making. In so doing, it supports the missions of the organization. In land administration, ownership, land value, land use, and the land's characteristics, are the information that is maintained for the purpose of generating revenue and balancing economic development with social and environmental considerations.

The land administration department has the task of maintaining land ownership and other land characteristics, but does not maintain all of the spatial layers needed to support the formulation of policy and laws pertaining to rights and restrictions. Thus the need for collaborative study and analysis, which is made possible by enterprise systems, such as an enterprise GIS.

These systems are characterized by their adherence to modern ICT standards, and they are deployed and managed like any other ICT. Most often the enterprise GIS is integrated with other systems, such as land ownership, valuation, and tax billing are separate systems, but are linked by some common data key like parcel identification number. Enterprise GIS are built upon centrally managed ICT, with large servers, middleware, and client applications.

2.1 Requirements

To be successful within an organization, enterprise systems must support the workflow of data and procedures that each individual department and multiple departments utilize to conduct land administration. An enterprise GIS must be well designed by knowledgeable teams, who understand GIS technology, data management, know how to tune the data base to provide a high performance and reliable applications. The GIS must conform to ICT standards, and the support staff must understand GIS technology.

3.0 TWO APPROACHES TO ENTERPRISE ARCHITECTURE

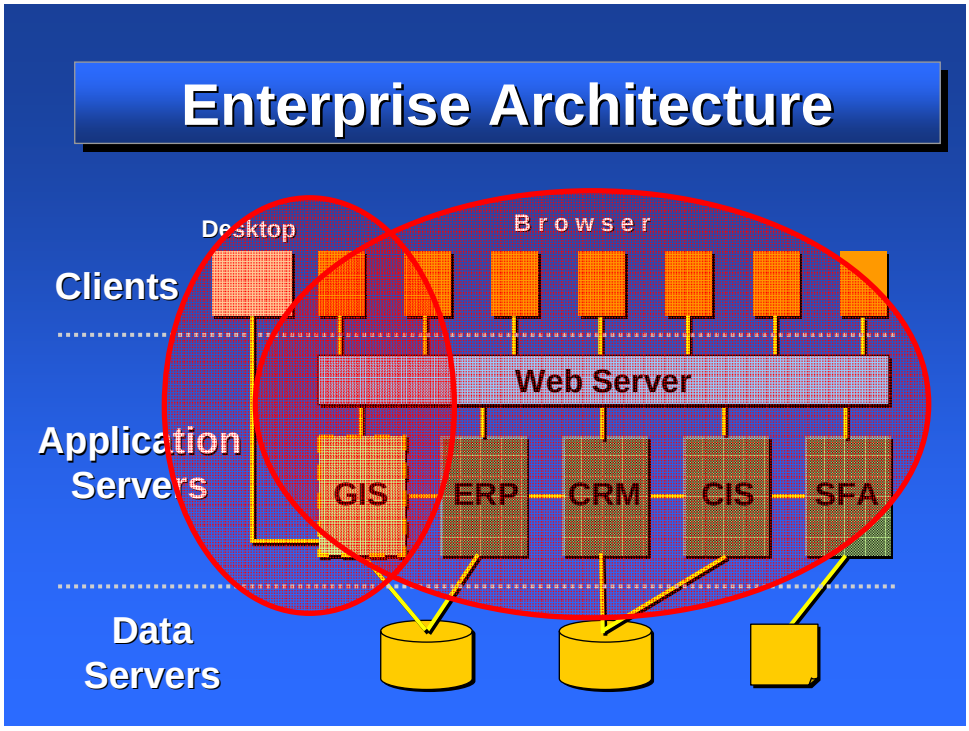
There are now two approaches that have been implemented in enterprise GIS systems. One approach can be called a spatially-enabled information system (IS). This architecture is characterized by building a spatial reference in the data base, supporting a business-centric workflow, providing simple applications and data query, and it is managed by IT professionals. The second approach can be referred to as an enterprise GIS. It is characterized by GIS as core technology. It has geo-centric workflows (e.g., land consolidation, environmental impact analysis), and thus supports more complex applications for modeling and analysis, and is managed by a team of GIS and IT professionals.

3.1 Enterprise Systems Using Web Standards

The Web (Internet) has a common architecture and standards utilized by ICT professionals to make data access and application integration work among a variety of hardware, software, and data systems. The architecture used most often today is a three-tiered architecture consisting of a data management system and data servers. The middle tier is the application server that manages all of the business logic, data integration, and the integration of different systems using Web protocols. The top tier is the client or desktop component. This is the application as the user sees it, either through a browser, or as a more complex application. For example, in a land records application the parcel

geometry and parcel attributes (owner name, address, size, etc.) would be managed in a data base management system on high performance data server. In some systems the spatial data server is a separate server that is integrated with other enterprise data servers using a Web approach. The middle tier consists of a Web application server that manages security and permissions, and the business logic server (e.g., GIS server for locating the parcel, displaying the parcel, viewing other data layers). Finally, the top tier is the façade of the application, where the land administrator or citizen can open a session, locate a parcel based upon some selection criteria and the attribute data that is associated with it, and view a map of the selected record(s).

Whether it is access to spatial servers or enterprise systems, this architecture has become the standard for open access and integration of a variety of applications using Web services.



3.2 Industry Leaders' Views

As reported by InformationWeek, a top ICT reporting journal, both Oracle and IBM offer solutions and technologies referred to as Web Application Servers and services as the means to access and integrate disparate data types, enterprise applications, and legacy systems.

4.0 GEOGRAPHIC INFORMATION SYSTEM – AN ENTERPRISE SYSTEM

Much the same as business systems like Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), and Supply Chain Management (SCM), GIS are now deployed as enterprise systems. They have prescribed architectures; programming interfaces; development tools; follow ICT system design principles; and conform to ICT industry standards.

4.1 Standards for GIS

There are many standards today, and everyone requires continual attention to keeps the conformance current. Standards include:

ICT

- support for market leading DBMS
- Web Services: J2EE, .NET, XML/SOAP
- Computing Platforms: Windows, UNIX
- Development Languages: C++, Java, Visual Basic, .NET

Domain Standards

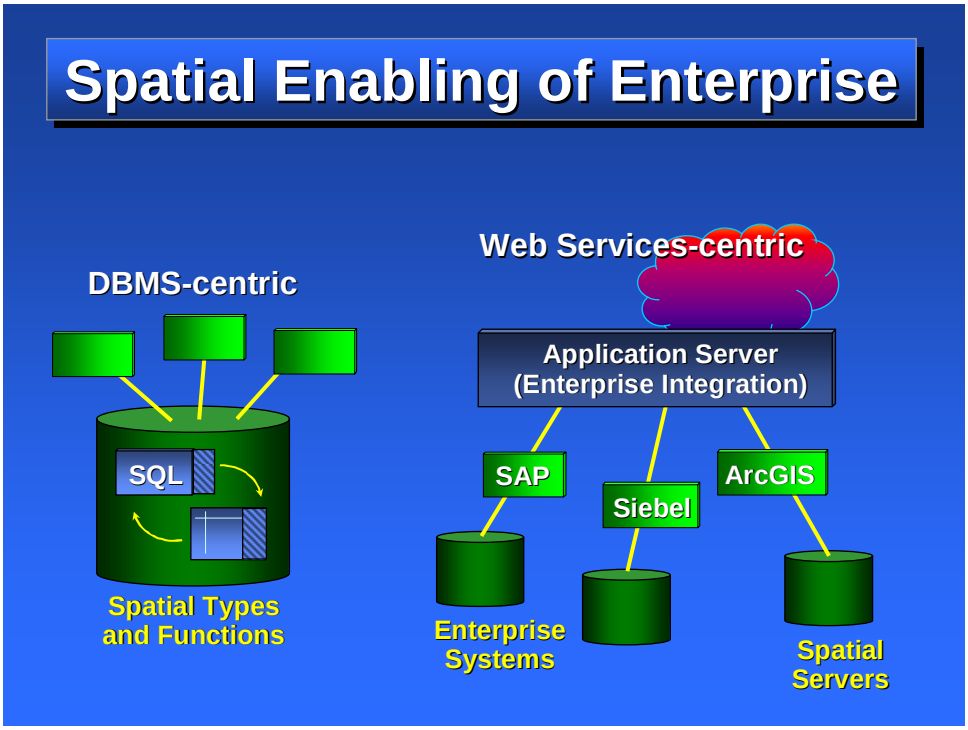
- ISO, OGC
- Data and Metadata formats
- Web Service APIs

User Community/Professional Organization Standards

- Land records industry (e.g., Cadastral 2014)

4.2 Enterprise GIS Architecture

GIS, standards compliant, and Web enabled, has the same architecture as all ICT enterprise systems. Enterprise GIS will have clients (desktop, Web, or mobile devices); server (spatial, Web, and data); and work on networks (LAN/SWAN, Internet). GIS does not have to be resident on the data base, to serve the enterprise. GIS, and the power of spatial application is no longer niche technology, but has become a corporate business tool, an integral part of e-government, and consumer services (location and routing services).



5.0 EXAMPLES

City/County of San Francisco, California, USA

The C/C of San Francisco employs GIS to share data and collaborate on decision making GIS is an essential tool for the administration this large metropolitan city. The Mayor's Office and the elected Board of Supervisors have access to the activity of several municipal departments. Additionally, data can be shared among departments, while keeping the data secure within the department tasked with managing that data.

Pierce County, Washington, USA

The Pierce County, like many multi-department government administrations, had many CPUs (data servers) it was maintaining. The goal was to reduce the hardware maintenance costs and reduce the amount of data redundancy in the government. By implementing an enterprise architecture, and enterprise GIS, the government was able to reduce the number of servers to 13, down from 27. The cost savings were significant, and yet the performance and data access were improved.

Centerpoint Energy, Houston, Texas, USA

As the third largest energy utility in the US, Centerpoint had millions of dollars in assets to manage; spread over six states. With pressure from regulatory authorities, the company was pressured to keep costs to consumers as low as possible. The company leadership made a decision that GIS would be a key technology in managing the various

aspects of the service delivery. GIS was integrated into the ERP system; the document management system; with mission applications like mobile operations and pole management.

GIS is used to drive business modeling of asset management, business risk, and distribution optimization. Substantial return on investment was realized across the company and the enterprise GIS program gained the support at the executive level.

Geospatial One-Stop II

The US Government saw the need to provide access to the historical and current spatial and cartographic data it was tasked with maintaining. Each department had its own ICT, and legacy applications for maintaining their respective spatial data. The mandate was set for citizen access to all published geospatial data. The cost of creating a single standard system and converting all of the existing systems would be overwhelming and more that any government could pay. However, using Web technology and Web standards, a portal was created using ESRI's GIS technology, to access, link, and integrate multiple agencies and the spatial data that each produces. As a result, there has been an expanded use of geospatial information within a wider e-government community.

Sprint (US telecommunications company)

Sprint is one of the largest telecommunications companies in North America, with customers in more than 70 countries. Sprint is now pioneering in this industry by expanding mobile data services and partnering with developers and technology companies that can leverage Sprint's wireless network capabilities. Their business initiative, called Sprint Business Mobility Framework, enables web service delivery over the telecom network. A GIS which is fully Web compliant, is the technology that performs geospatial services at the request of millions of mobile, wireless users – an enterprise as large as the world's telecom network.

6.0 CONCLUSION

GIS has been and always will be an information system, managing geospatial data. GIS technology that supports Web standards and Web architectures enables enterprise implementations. GIS is a powerful application, and can be geo-centric or business centric. Enterprise GIS can be characterized by servers and Web services, built on ICT standards, offering more than simple location information, and there are case studies that are visible today.

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BIOGRAPHICAL NOTES

Dr. Maguire is the director of Products and International and member of the senior management team for Environmental Systems Research Institute, Inc. (ESRI). He joined the ESRI family in 1990 as the technical director, later becoming the managing director for ESRI's international office in the United Kingdom. Dr. Maguire has authored or co-authored over 90 books and publications on GIS, including the industry recognized *Geographical Information Systems* and *Geographic Information Systems and Science*. He received his doctorate degree in Geography from the University of Bristol in 1983.

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