Geospatial Information Systems and Enterprise Collaboration

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INTRODUCTION

Organizations and teams are becoming increasingly more distributed as groups work to expand their global presence while rationalizing team members across skill sets and areas of expertise instead of geographies. With this expansion comes the need for a robust and comprehensive language for pinpointing locations of globally distributed information systems and knowledge workers. Geospatial information systems (GISs) provide a common framework for jointly visualizing the world. This shared understanding of the world provides a powerful mechanism for collaborative dialogue in describing an environment, its assets, and procedures. The collaborative framework that GIS provides can help facilitate productive dialogue while constraining impulses of extreme positions. Collaboration and GIS intersections take many forms. Under a collaborative work-flow model, individuals use GIS to perform their job and post data back to the central database (e.g., engineering designs and as-built construction).

This article addresses the increasing role of GIS in emerging architectures and information systems in a number of applications (e.g., land planning, military command and control, homeland security, utility-facilities management, etc.). Real-time applications, mobile access to data, GPS (global positioning satellite) tracking of assets, and other recent developments all play a role in extending the scope and utility of the GIS-enabled enterprise. The impact of new GIS Web services standards and open geospatial-data archives are also addressed as areas of increased potential for remote GIS collaboration in global organizations. The expansion of enterprise GIS within organizations increases the opportunity and necessity of using GIS collaboratively to improve business processes and efficiency, make better decisions, respond more quickly to customers and events, and so forth.

BACKGROUND

The term *geospatial* is increasingly used to describe digital data about the earth in GIS, image, or GPS formats. The related technologies of GIS, remote sensing image-processing systems, and GPS data collection are all components of geospatial information systems. Geospatial-technologies use continues to expand in a great variety of applications ranging from land planning to utility-engineering design and military command and control. Those applications, which were once relegated to discrete groups of specialists, have now begun to take a more prominent role in the enterprise. Duffy (2002) describes the transition of GIS from a specialist technology to a more mainstream environment in the industry information-systems department from the end of the last decade into 2002.

The essence of collaboration is people and organizations working together to accomplish a common goal. Information–technology- (IT) enabled collaboration has improved business processes in many organizations and contributed to more functional and profitable operations. Collaboration technologies are characterized by three major generic attributes: communication, information sharing, and coordination (Munkvold, 2003). These characteristics can be further refined into available channels such as synchronous or asynchronous, the medium of sharing information through repositories or real-time interaction, and work-flow management to coordinate steps in a decision process or protocol. Geospatial technologies and systems extend collaboration in unique ways for problems that are related to location.

GIS provides a geographic dimension to enterprise collaboration, which helps solve a variety of problems that are difficult to address by any other means. For example, vehicle-routing and dispatching applications make it possible for Sears to deliver goods to customers more efficiently within tighter time windows. As a result, Sears is more profitable and customers are more satisfied.

This example of distributed-network optimization using efficient queuing mechanisms based on location information is a simple illustration of the impact that GIS data may have on existing business processes. In fact, most aspects of business-process automation initiatives at present require some element of collaboration either between networked systems or dispersed individuals.

Collaboration utilizing GIS and geospatial frameworks continues to be a focus of research both in the United States and abroad (Boettcher, 2000; Songnian, 2004; Stasik, 2000).

EMERGING GEOSPATIAL INFORMATION-SYSTEMS ARCHITECTURES AND COLLABORATIVE ENTERPRISE APPLICATIONS

As organizations become more dispersed in an effort to rationalize across areas of expertise in lieu of geographies, complex infrastructures for location analysis and coordination may emerge (Munkvold, 2003). In recent years, GIS software companies have developed an expanding and increasingly capable enterprise suite of tools. Early generations of GIS were used by GIS specialists only; these systems were available in stand-alone or project-systems configurations. GIS product options have improved and now provide a sound basis for supporting casual users as well as specialists with desktop, distributed client-server, and Internet solutions.

Geospatial data standards and interoperability have greatly improved the ease of using data in different formats or geographic projections. Geospatial Web-services standards provide Internet access to geospatial data stored in geospatial-data archives. Federal-government initiatives (e.g., Geospatial One Stop, the National Map, Homeland Infrastructure Foundation Level Database, etc.) will increase data standardization and access, and reduce expensive, redundant data collection.

GIS-enabled collaboration can now involve a broad range of different types of users within and outside of a particular organization. These users can be expert or casual as well as stationary or mobile. Medeiros, de Souza, Strauch, and Pinto (2001) present an analysis of aspects of coordination in a collaborative system for spatial group-decision support that resulted in a prototype system for a distributed GIS.

Geospatial Information-Systems Products and Architectures

GIS-product vendors continue to innovate and expand the solution set available to the user (Atkinson & Martin, 2000).

Enterprise suites of GIS include the following different types of products.

- Desktop GIS with varying levels of functionality
- Spatial analysis extensions
- Internet GIS with limited functionality or full functionality
- Mobile GIS
- Geospatial-data middleware
- Software to embed geospatial functionality in business applications
- 3D GIS
- Geospatial-data visualization software
- GPS tracking software
- Remote sensing image-processing software
- Geospatial Web-services software
- Location services

GIS products are available to support stand-alone users, and distributed client-server and centralized Internet architectures. GPS tracking units and mobile GIS on Personal Digital Assistants (PDAs) and pocket PCs extend the range of the technology into the field. Wireless communication of data is improved through the use of data compression and area-of-interest extraction techniques.

Geospatial-data management functionality is improving but is less capable than business-data management functionality. While Oracle states that their products now provide equivalent data-management functionality for spatial and business data, experience is limited for enterprise replication of geospatial data. ESRI, the GIS-software market leader, promises to add geospatial-data replication to its ArcSDE product with the release of ArcSDE 9.1, which is projected for 2005. The large size of geospatial-data files means that substantial bandwidth is needed to move data through a communications network.

Location services refer to mobile geospatial services that will primarily be delivered to location-aware smart phones. The E-911 legislation mandates that cell phones must become location aware so emergency vehicles can locate 911 callers who use cell phones. Cell-phone operators and partners are and will offer an increasing array of location services to provide users with directions for

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