Chapter V

Spatial Data Repositories: Design, Implementation and Management Issues

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Abstract

This chapter identifies and discusses issues associated with integrating technologies for storing spatial data into business information technology frameworks. A new taxonomy of spatial data storage systems is developed differentiating storage systems by the systems architectures used to enable interaction between client applications and physical spatial data stores, and by the methods used by client applications to query and return spatial data. Five distinct storage models are identified and discussed along with current examples of vendor implementations. Building on this initial discussion, the chapter identifies a variety of issues pertaining to spatial data storage systems affecting three distinct aspects of technology adoption: systems design, systems implementation and management of completed systems. Current issues associated with each of these three aspects are described and illustrated along with a discussion of emerging trends in spatial data storage technologies. As spatial data and the technologies designed to store and manipulate it become more prevalent, understanding potential impacts these technologies may have on other technology decisions within an organization becomes increasingly important. Furthermore, understanding how these technologies can introduce security risks and other vulnerabilities into a computing framework is critical to successful implementation.
Introduction

Various organizations and authors estimate that more than 80% of all data used by businesses has an inherent spatial component (Adler, 2001; Haley, 1999; ESRI, 1996). Street addresses, postal codes, city names, and telephone numbers are common components of business data which can be used by geographic information systems (GISs) to orient these data in space, revealing spatial patterns and relationships between records which might otherwise remain latent. Experience has shown that organizations that exploit these spatial patterns and relationships can reduce operating costs (Weigel & Cao, 1999; Ratliff, 2003), increase efficiency and manage risk (Murphy, 1996), and reduce the time required to make complex decisions (Mennecke et al., 1994).

Spatially Enabled Business Frameworks

In order to exploit spatial data, organizations need to integrate spatial data and spatial services with their traditional business applications. This integration can be achieved by developing a technology framework, which facilitates interaction between business applications, spatial services, and data management systems (Figure 1). Business applications such as Enterprise Resource Planning (ERP), Business Intelligence, Electronic Commerce, and Customer Relationship Management (CRM) systems interact with a layer of services designed to manage and exploit spatial dimensions of business data. Spatial services, in turn, interact with a layer of traditional and spatial data storage systems.

This three-tier architecture is typical for many leading spatially-enabled enterprise business applications, including Oracle’s 11i Application Suite and systems available from SAP, Siebel and others. In Oracle’s case, spatial services are delivered as part of the application suite and spatial data is stored along side traditional data in a relational database system (Oracle, 2001). In contrast, SAP and Siebel systems use third-party GIS software for managing and manipulating spatial data. These third-party components, often purchased separately, integrate with business applications through standardized application programming interfaces (APIs). Spatial and traditional business data in these applications are usually stored in different data management systems, often using very different storage technologies for managing spatial and traditional data elements.

Spatial Data Repositories

Organizations often purchase spatial services and GIS software from a variety of vendors resulting in heterogeneous collections of spatial data and spatial services within an organization. A typical business, for example, might use address geocoding services from one vendor, mapping solutions from another vendor, and use traditional workstation-based GISs to define, create and manage their intrinsic spatial. Different spatial services often have differing spatial data storage needs in terms of both data content and data organization, resulting in a variety of different spatial data storage formats on
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