Federated Data Model to Improve Accessibility of Distributed Cadastral Databases in Land Administration

A. M. Tula dhar, M. Radwan (the Netherlands), Fatma Abdel kader and Samir El Roby (Egypt)

FIG Working Week 2005 and GSDI-8
From Pharaohs to GeoInformatics
Intercontinental Samiramis, Cairo, Egypt, 16-21 April 2005

Content

- Introduction
- Cadastral data management
- Federated database management and three key dimensions of FDBM
- Architecture and schema mapping
- Alternative approach using UML/OCL
- Preliminary findings
- Conclusions

Introduction

- GIS manages a large volume of cadastral data and other related data such as data about market value, tax and use of land.
- Many agencies involved in a distributed and heterogeneous processing environment.
- Accessing data and integrating them in a single synchronous, consistent dataset using GIS software.
- Tremendous challenges.
- High resource, time and money.
- Federated data model - a solution?
- Integrating layers on the top of existing database systems.
- Reduce complex tasks at the users’ desks.

Cadastral data management

- Many developing countries organize their land data in separate agencies.
- Cadastral Parcel data
- Topographic data
- Ownership data
- Tax data
- Managed at different location at central, provincial and local levels.
- Egypt:
  - Egyptian Survey authority (Ministry of public work and irrigation)
  - Cadastral data
  - Topographic data
  - Real Estate department (Ministry of Justice)
  - Ownership data and registered data
  - State owned Land Agency
  - State owned data
  - Tax department (Ministry of Finance)
  - Revenue Tax Collection

Federated Database system (FDBS)

- FDBS - a collection of cooperating but autonomous component databases.
- A component db can participate in more than one federation.
- Integrated to various degree dependent on the needs of federation users and desires of the administrators of the component dbs to participate in the federation and share their databases.

Three key dimensions of FDBS

- Distribution
- Heterogeneity
- Autonomy

- Distribution
  - Multiple databases on a single/multiple computer systems - increased availability and reliability as well as improved access time.
  - Existence of multiple Databases before FDBS.
Three key dimensions of FDBS

- **Heterogeneity**
  - Database management systems
  - Different in data models
  - Different in data schema
  - Different in data views
  - Semantic heterogeneity (Birn, 1993)
- **Autonomy**
  - Organizations that manage databases are not always under the same or independent control
  - Time types
    - Design autonomy — ability to change its own design
    - Execution autonomy — ability to execute legal operations without interference from outside operators
  - Association autonomy — ability to decide whether or how to share its functionality and resources with others.

Federated Database Architecture

- **Critical issue** is to map export schema to federated schema
- Resolving semantic heterogeneity

Mapping Export Schema to Federated Schema

- Definition of common ontology for context to share
- Mapping its elements on federated schema
- Resolve semantic heterogeneity

Alternative approach for Land Administration (1)

- The above approach requires common ontology and precise design of domain within context
- Alternatively, we can use simple approach for land administration based on mediation using three-tier architecture

Alternative approach for Land Administration (2)

- UML/OCL - the notion of derived class facilitates as a means to integrate certain classes and constraints which need to be shared in a federated context
- A mediator class is used for derived federated schema
- Conflicts can be resolved within a mediator class (Balusters, 2003a and 2003b)

Federating distributed databases

- Component frame is specified in UML
- Semantic heterogeneity is analyzed to detect conflicts
- Introduce an Intermediate class
- Construct an Integrated schema
- Resolve conflicts via mediator class using suitable conversion functions
**Preliminary findings**

- Integration process does not affect individual databases
- Local people can work independently to satisfy local users
- Component frame means that local administration maintains the control over their systems and yet provides access to their data by global users
- Three level concept is possible in client/server environment

**Conclusions**

- We discuss various approaches for data access using federated schema (i.e., federated data model)
- Three-level federation architecture is promising, but detail investigation is recommended.
- Resolving conflicts through a mediation class require more research using real case data in land administration.
- Emerging concept in spatial data infrastructure

**Thank you for your attention**