Long Term Disconnected Editing Sessions and Periodical Updates with ArcObjects

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ABSTRACT

This paper will describe a framework that supports long-term sessions of disconnected editing of a Personal or Enterprise Geodatabase allowing periodical updates. It's based on an ArcObjects software-based extension for ArcCatalog/ArcMap and control tables added to Geodatabase schema for data integrity. Feature Classes or Tables are extracted from a "server" (enterprise Geodatabase) to a ”client" (Enterprise or personal Geodatabase) using ArcCatalog. Extracted data can be edited with ArcView or ArcEditor depending on if it's a personal or enterprise Geodatabase. Changes will be sent periodically to update the server in two ways. First, changes are extracted to a delta XML file to update the server in a disconnected environment. Second, changes are sent directly if there is a network connection between client and server. This schema was created to meet requirements of state organizations in Peru, hierarchically organized by a central office (Main Geodatabase) and regional or local dependencies (Disconnected Editors).

1.0 INTRODUCTION

Editions and updates in a distributed Geographic Databases environment is an issue that concerns to National Organizations in Peru, which are hierarchically organized by a Central Office in the capital city and Regional or Local Dependencies distributed in other Regions and Provinces along the Peruvian territory.

Geographic Data is edited by Local Dependencies (Provinces), and information should update Regional Geodatabases and then, in turn, changes in Regional

Geodatabases should be sent to update a main Geodatabase located at the Central Office.

To accomplish this requirement this paper proposes a disconnected editing framework, where disconnected editing sessions are permanently opened, as long as every local dependency can deal with large volumes of geographic information, only changes (inserts, updates, deletes) made to the data should be sent to update Regional and Main Geodatabases. This schema is aware to keep referential and data integrity, limitations on network communications and economic restrictions of some Local/Regional Dependencies.

2.0 GENERALITIES

Many state organizations in Peru are hierarchically organized by a Central Office in Lima and many local and regional dependencies, and have similar geographic information requirements.

A Peruvian state organization helped to analyze information requirements, user needs, communications framework for this project.

2.1 STUDY CASE

Study and information requirements were acquired from a state, nation – wide organization that is aware to keep track of cadastral properties that supervise its state and use. It has a central office in Lima city and many regional dependencies in each region of Peru (Local governments), and some local dependencies (provinces) in provinces along the Peruvian territory.

This institution helped to this project by sharing their needs and requirements. And also by sharing their data and time for testing phase.

3.0 GIS APPLICATION

The objective is to offer a GIS solution for the requirement of edit and update Distributed Geodatabases according to user’s communication conditions and possibilities.

In a distributed Geodatabases environment it's important to keep data integrity when updating information to servers by each disconnected editor.

This solution will be based on ArcGIS software (ArcView, ArcEditor, ArcSDE), an ArcObjects customization and some changes to the Geodatabase schema for data exchange and integrity.

3.1 NEEDS ANALYSIS

3.1.1 GEOGRAPHIC INFORMATION REQUIREMENTS

- The geographic information consist of layers about general interest, real state, cadastral and state's properties.
- Geographic data will be stored in a main Geodatabase, located at a Central Office.
- Geographic data will be edited by Local Dependencies and initially stored in Local Geodatabases
- Every local dependency can deal with large volumes of geographic information, so only changes (inserts, updates, deletes) made by local dependencies should be sent to update the corresponding Regional Office's Geodatabase.
- In turn changes made to each Regional dependency should update to the main Geodatabase in the Central Office.
- Information updates have to be replicated from Local Dependencies to Regional or Central Geodatabases as soon as possible, because this information is important for decision makers and also because this geographic information will be shared with other

3.1.2 OTHER REQUIREMENTS

- In some cases there is network connection (LAN) between local, regional and main offices. In other cases, there is not a network (LAN) connection, but these offices can communicate using Internet, e-mail.
- Some Local and Regional dependencies have economic limitations and will only be able to acquire ArcView Licenses. Though, other dependencies will afford to have ArcEditor/ArcSDE licenses. The central office will have ArcSDE and ArcEditor License.

3.2 DESIGN

The challenge was to design a solution that meets all the requirements described above. The solution proposed is based on the idea of 'Disconnected Edition'. A Geodatabase schema is created in the *Central* Geodatabase and geographic information is first loaded to this repository. Eventually information of all Peru would be loaded.

To begin the Disconnected Edition process, information of each Region of Peru will be *extracted* from Central to a Regional Geodatabase, which could be a Personal o ArcSDE Geodatabase. And, in time, information of every Province in a Region could be extracted to its corresponding Local Geodatabase, usually a Personal Geodatabase.

As long as the clients (Editors) in Local or Regional dependencies could use ArcView or ArcEditor, the database repository can be either a Personal or ArcSDE Gedatabase.

Information in the client could be edited using ArcView or ArcEditor along with an ArcGIS Extension, written with VB.Net and ArcObjects.

Once ***clients*** edit the information Changes made in Local dependencies will be used to update Regional Geodatabases and in turn information changes in Regional Geodatabases should update information in the Central Geodatabase.

Editors (Local dependencies) can send changes (Inserts, Updates, Deletes) at any time to update ***Servers*** (Regional or Central Geodatabases). Every time information is sent to from the client to the server, the disconnected editing session is not closed, in fact the session is always opened.

Editors will be free to decide when to send changes, some of them will decide to do it every week while others can send information once every six moths, it depends how dynamic are changes made to the data in each local or regional dependency.

In this distributed Geodatabases environment, some of them will be connected by a LAN or WAN and others will not. Editions made in Local dependencies should be replicated to regional and central Geodatabases.

Only changes (inserts, updates, deletes) made to the data will be extracted from Local Geodatabases to a XML file, this file will be used to update *Servers.*

As long as this XML file will only content changes, its small size allows a reduced network traffic when updating, or will make it possible for some editors to send this XML file by email when there is not a LAN or Wan connection.

XML file with information extracted from Local dependencies will update Regional Geodatabases, and then changes made to a Regional Gedatabase will be extracted to a XML file to update the Central Geodatabase.

An editor extension built with ArcObjects keeps track to changes made to the data in the *Clients* (editors) during edition sessions. To record these changes some "Control Tables" and fields were added to the Geodatabase schema. These control tables also needed for data integrity.

A module of the extension allows the user to extract changes to a XML file, and other module makes it possible to read the XML file and update the information.

Once a *Server* Geodatabase is updated, a second XML file is generated for confirmation. This *confirmation* XML file should be sent to the *client* (Editor), to let the client Geodatabase realize that changes were made in the server.

3.3 IMPLEMENTATION

The designed solution was implemented based on:

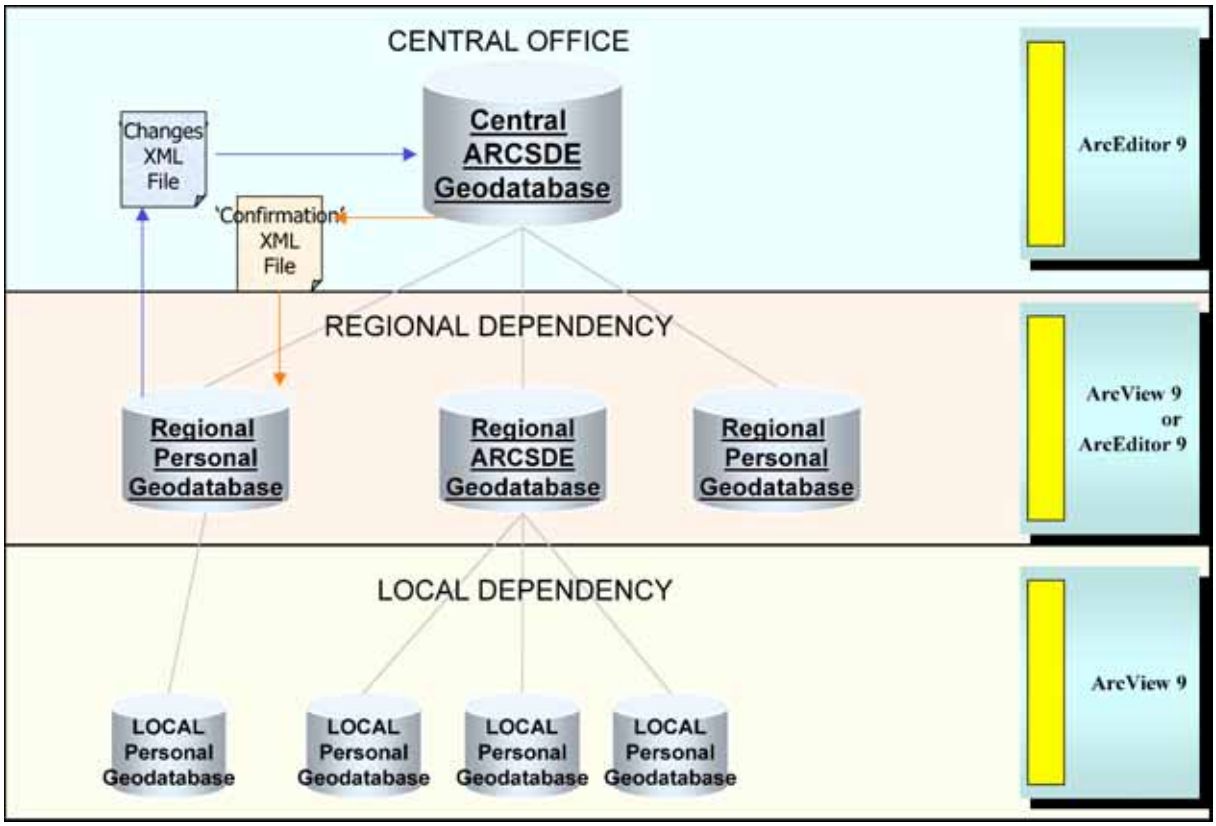
3.3.1. Changes to the Geodatabase schema, that consist of "Control tables" where changes to the data will be recorded along with extractions (Server) and updates (clients), so data integrity will be guaranteed.

3.3.2. An ArcGIS Extension built with ArcObjects and Visual Basic .NET. This application will accomplish the next functionalities:

- Extract schema and data from a Server Geodatabase to a Cliente Geodatabase, to start the disconnected edition process. During this extraction process, changes will be made to the Geodatabase schema in the server and client, and control tables are added.

- Handle edition sessions to keep track of changes made to the data.
- Extraction of changes made in the client Geodatabase to a XML file.
- Read XML files to update the *Server* Geodatabase with information sent by the client.
- Generate a *confirmation* XML file every time information is updated in the *server*.
- Let the *client* Geodatabase realize that changes were made in the server by reading the *confirmation* XML file

FIGURE 1: Disconnected Editing Architecture in a Distributed Geodatabases schema



4.0 RESULTS

- Long terms of disconnected editing sessions. In fact these sessions could always be opened. The session will not be closed when a server is updated.
- Disconnected editor clients could be ArcView or ArcEditor users.

- A light XML file will be created to send changes made to the data and also for confirmations of updating.
- Data repository for servers or clients could be either a Personal or an ArcSDE Geodatabase.
- Users can edit information inside the same environment provided by ArcGIS, where the application hides the complexity of recording changes and updating information to the user.

5.0 CONCLUSION

The proposed solution, that is based on a disconnected editing schema, has satisfied all the user editing requirements in a distributed Geodatabase environment.

Even though this solution is not implemented on production yet, it has proven to be a solution for information editing requirements of centralized organizations with remote editors. Tests were made in a pilot area and results on edition, updating and data integrity were good enough for clients.

As long as this solution was developed with ArcObjects and VB .NET, it offers an easy and flexible environment that allows the implementation of customized solutions to extend ArcGIS functionalities for future requirements, so this solution can be enhanced and supported later to keep this solution on production.

6.0 RECOMMENDATION

After testing phase, users were concerned about the security of information transmitted by XML file. It was not an initial requirement but is certainly an important issue. So encrypting of these XML files will be considered in a next release before any final implementation.

7.0 ACKNOWLEDGMENTS

- SBN (Super Intendencia de Bienes Nacionales) an state organization in Peru that shared their needs and requirements, which are the same of many state organizations in Peru. This requirements were used for this implementation.

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