

BIOGRAPHICAL INFORMATION

Brook Durant
GIS Web Developer
City of Bellevue

Specific Responsibilities

Joined the City of Bellevue in 1992. Responsible for developing and maintaining GIS and web applications for the City.

Past Experience

Began at the City as a GIS intern in 1991. Moved up to GIS Data Technician and then Data Analyst. Managed the Transportation Department's GIS team for several years. Moved to IT and became a developer in 2002.

Educational Information

B.A. – Geography, Central Washington University

Professional Memberships

None.

BIOGRAPHICAL INFORMATION

Jubal Harpster
GIS Web Developer
City of Bellevue

Specific Responsibilities

Joined the City of Bellevue in 2001. Responsibilities include designing and maintaining address databases and developing and maintaining GIS and web applications for the City.

Past Experience

GIS Analyst for Mundy and Associates, an appraisal firm based in Seattle Washington.
Lead GIS developer at Teligent, a fixed wireless communications company based in Washington DC.
Started as Lead GIS analyst at the City of Bellevue in 2001. Moved to GIS Web Developer in 2002.

Educational Information

B.A. – Geography, University of Washington

Professional Memberships

None.

INTEGRATING GEOSPATIAL TECHNOLOGY AT THE CITY OF BELLEVUE - BALANCING APPLICATION INTEGRATION AND USER NEEDS

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ABSTRACT

In 2001 the City of Bellevue, Washington IT Department undertook a large GIS integration effort. The City decided to use ArcSDE from ESRI as the database platform and ArcIMS from ESRI as the user front end to spatial data. During that time an alternate Web based system had been developed by the Transportation Department using MapGuide from Autodesk. This system used cadastral data maintained in AutoCAD with GeoSQL and Shapefiles from the city GIS. The City's GIS integration plan required standardizing software across all departments, focusing on using ESRI tools for client, server and web GIS applications. The GIS standardization plan put IT at odds with its customers, many of whom were satisfied MapGuide users.

This paper describes how the City standardized its systems despite using multiple, often competing, technologies. The paper will focus on the technology and procedures used to create spatial interfaces which keep various systems up to date and how using a hybrid approach to integration have gained widespread acceptance of both end users and management.

BACKGROUND

The City of Bellevue is a medium sized city on the east side of Lake Washington just a short distance from Seattle. The city staff of approximately 1200 people provides service for the city of approximately 110,000. As with many cities of similar size, the City's Information Technology department maintains a complete set of GIS software while departments contribute the bulk of the data collection and maintenance. The City's GIS software and people were distributed among multiple departments including survey, transportation, planning, parks and utilities. Software installations included a dozen ArcInfo and ArcView seats and two dozen AutoCAD installations across departments.

Various city systems, which relied on the GIS data, were updated by manually copying shapefiles across the network. Because of decentralization of application administrators, this led over time, to some systems being out of date and incomplete. City employees

looking for spatially related information could go to three separate applications and get three different answers. Amid this environment the Transportation Department funded and developed an internet based mapping system using MapGuide from Autodesk. This system gave users in the transportation department easy access to the wealth of spatial data maintained city wide. While the application was officially limited to the Transportation Department, the successful implementation soon became an enterprise resource.

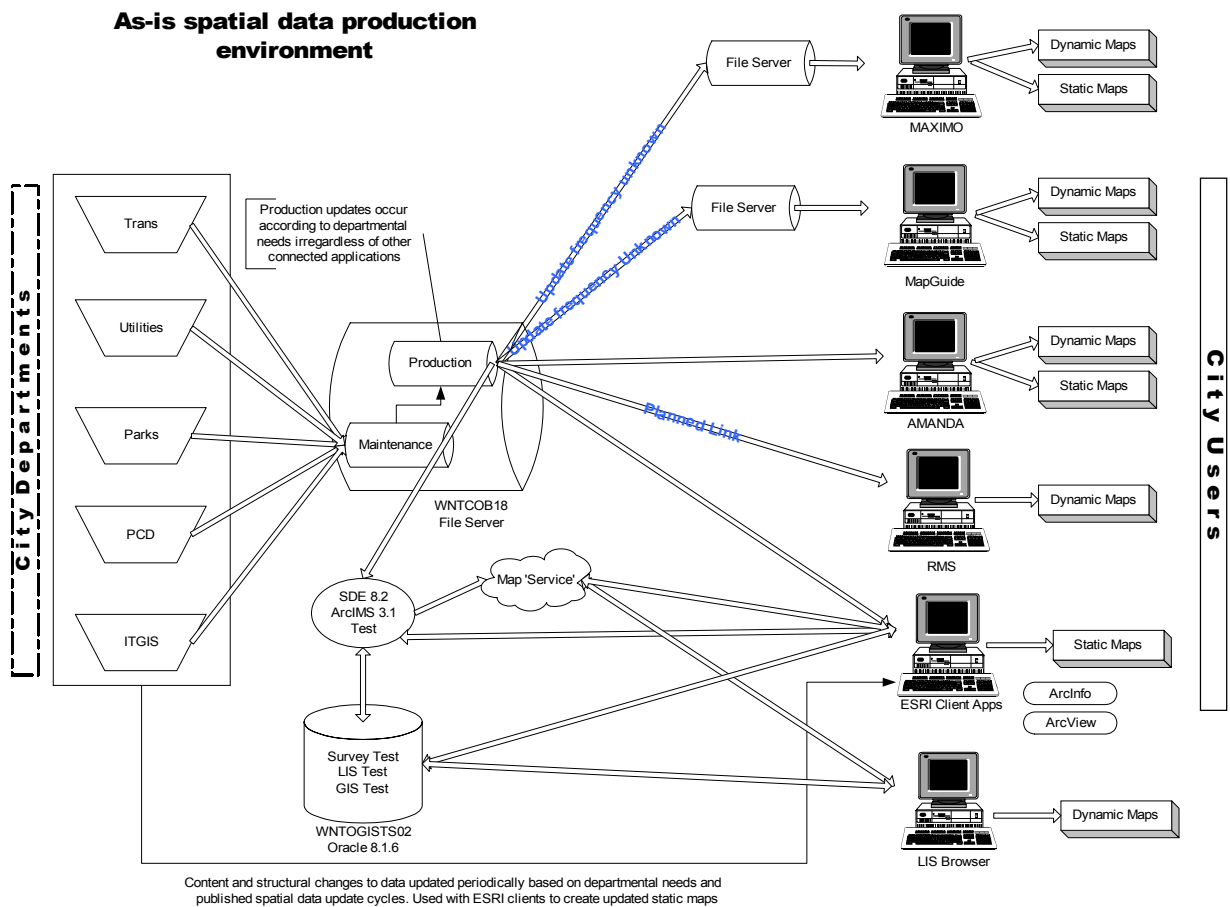


Figure 1: City's initial GIS Data environment

LAND INFORMATION SYSTEM PROJECT

In order to tame this mess of disparate and multiple copies of data, Bellevue in 2001, began a project to integrate the increasingly decentralized set of GIS data, software and procedures to reduce overall cost and to standardize update procedures. An ambitious Land Information System (LIS) project was introduced to be designed with input from all city departments and to be implemented by the City department of Information Technology.

Among the project goals were to standardize the City's GIS environment on the ESRI platform for database, applications and middleware. Many of the procedures dealing with city wide addressing, parcel management and street network updates and naming were to be overhauled. In particular, parcel maintenance procedures, which were duplicated in two departments, would be simplified and streamlined. An address database would serve the entire City and all its applications. The key components of the system were to be an Oracle ArcSDE geodatabase to host citywide GIS data, an ArcIMS internet application and a robust set of automated update procedures. Under the plan several stand-alone GIS applications were to be decommissioned with their functionality re-hosted to a web environment.

Initially, key players throughout the departments were on board, but the LIS project soon bogged down in ownership and architecture decisions. After months of grinding meetings, the project was slightly re-scoped and re-phased allowing several key parts of the LIS project to move forward successfully, including revamping the city GIS and migrating towards an ArcSDE Geodatabase. A new data model for parcels, street centerlines, addresses and owners was created and new maintenance procedures and applications were built for these key components. Maintenance and update procedures for linking Survey's database updates with the LIS were put in place.

Despite our initial successes, there were still difficulties and project goals that were not being met. For example, there were several departmental applications from Permitting to Police Records which had GIS components already in place which were not compatible with our new architecture. The desire of our IT department to use off-the-shelf software was coming in conflict with the need of the City to have tightly integrated systems that could share data across the organization.

Rewriting these 'legacy' applications—many of which were actually brand new as of just prior to the Y2K changeover—was not an option. Some means of accommodating the new LIS architecture while maintaining support for current "coverage and shapefile" applications would be necessary, but appeared quite expensive and daunting.

Additionally, other parts of the plan needed to be tweaked to bridge the gap between the ideals of system integration (simplified licensing, maintenance and support) and the needs of user who are driven by particular business needs. The GIS group got together with IT to develop a revised plan which might meet many of the goals of integration while delivering critical functionality to users.

A REVISED PLAN

Our revised plan would need to be based on key realities of the City's GIS environment, like:

- No matter how integrated our systems became, existing applications like permit tracking would require continued special exports of GIS data because of their application's strict data formatting requirements,
- Because of the time and effort involved, and given the limited benefit, it would not be cost effective to rebuild the existing MapGuide application on a different platform. The MapGuide application, which was a hit with users, would be maintained and integrated as tightly as possible with our backend database. ArcIMS from ESRI would still be used for external web based GIS applications.

IT and the GIS group decided to focus on a hybrid approach to system integration. This would emphasize data integration over application integration. In this way each application could keep their own user interface which had been built for specific business purposes, with each using the same backend data. Thus, as users switched between different applications they could always get the same answer for spatial queries, no matter which tool they happened to be using.

Towards this end, the GIS group created metrics of application compliance for existing applications. These metrics could be applied to analyze the compliance of any new GIS application to the Cities standards.

- Level 1: Application reads SDE directly
- Level 2: Application reads Shapefiles directly
- Level 3: Application reads copy of Shapefiles
- Level 4: Application reads conversion of Shapefiles

Level 1 compliance being the most desirable, as little, if any additional effort is involved to keep GIS data up to date. Level 4 being the least desirable, as it requires custom exports and scheduled maintenance procedures.

SPATIAL INTERFACES: PUTTING THE PLAN INTO ACTION

The revised plan called for data integration which ultimately meant the development of custom spatial interfaces. Spatial interfaces would have to support loading GIS data into ArcSDE and exporting GIS data to departmental systems on a scheduled basis. A front end application for the spatial interfaces was built so that running non-scheduled routines were not dependant on specific administrators with expert knowledge of the system, any analyst could run an interface. Scheduled interfaces were designed to run only when necessary by detecting changes during the night and triggering the correct routine.

Integrating our Legacy GIS with the new SDE

The first set of interfaces created was between our old GIS model -- which featured coverages and shapefiles -- and our new ArcSDE model -- which featured geodatabases. To accommodate the old and new, interfaces were created which allowed us to freely transfer data between our central SDE database and our central coverage and shapefile

library, thus ensuring that our GIS maps would show the same data regardless of whether they were created in ArcMap or ArcInfo AMLs.

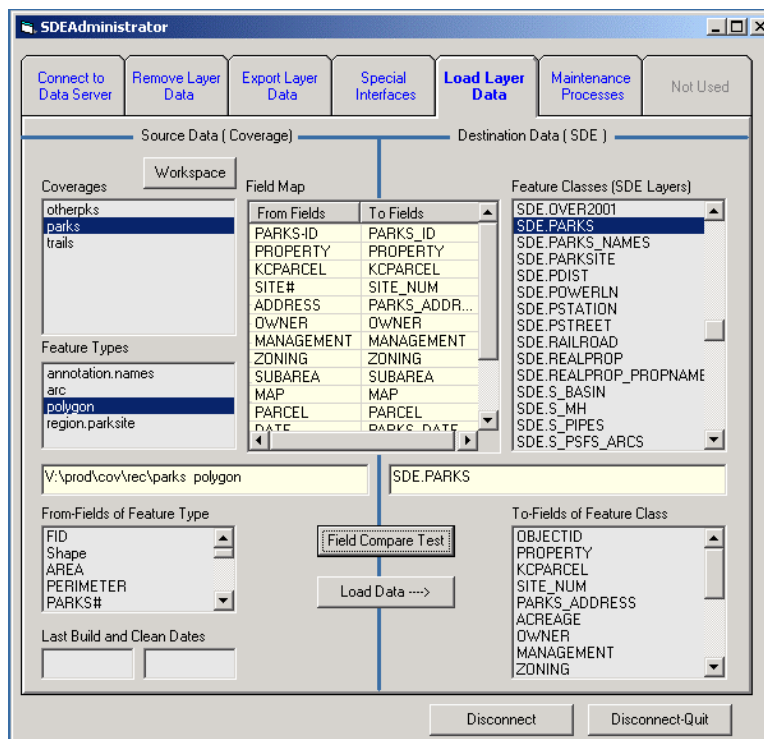


Figure 2: SDE/GIS interface tool

Integrating Survey's Geo/SQL with ArcSDE

The Survey department, which has always performed detailed and accurate parcel line maintenance was naturally going to retain that responsibility in the new LIS plan. They were extremely satisfied with their tools, AutoCAD and Geo/SQL, and would not change to use ArcSDE. Since streamlining parcel maintenance was a key goal of the LIS project, this integration between the LIS and the Survey database would have to be handled with interfaces. The City outsourced the development of a spatial interface between GeoSQL and ArcSDE. It turned out to be rather seamless, since both Survey and the LIS applications reside on the same Oracle instance. The interface simply needed to reformat the feature geometry from one Oracle data type to another using the native ArcSDE C-API. Thus, the translation is easy and Survey and GIS are both happy.

INTEGRATING OTHER APPLICATIONS

A Tool for All Interfaces

Because we saw the need for data exports growing, the City needed a new tool to help us build and maintain these interfaces and exports. Therefore, we purchased a server license of FME (Feature Manipulation Engine) from Safe Software. FME is a spatial ETL (Extract Transfer and Load) software designed to convert data between formats and

which rely on spatial searches now use the ArcSDE feature geometry tables for those searches. While the features themselves are still translated from the Geodatabase to the native SDF via the FME translations, general geometry calculations involving centroids and envelopes can be obtained directly from the Geodatabase and feature attribute searches can be conducted in the Geodatabase and displayed in MapGuide.

The existing MapGuide was officially endorsed by the IT department as the enterprise browser for spatial information (essentially making it the standard). The existing features were expanded to include new interfaces for public safety, permitting, utilities and customer information. Thus the system became a portal for all spatially related information maintained in the City. Any new GIS applications desired by departmental users are considered as a MapGuide enhancement unless there is a specific and compelling reason not to.

CONCLUSION

A hybrid, data-centric approach to GIS integration can be efficient and satisfy both management and users without creating a maintenance burden for the system integrators. In fact, in many ways, the real world hybrid approach is preferable to attempting to shoehorn an organization into a unified, monolithic, system. Meeting the goals of the organization rather than striving for the holy grail of “total system integration” has proven to be a sustainable and cost effective way of uniting users and management while making GIS widely available across the enterprise.