

BIOGRAPHICAL INFORMATION

Craig A. Wilder
Manager, Engineering Systems
El Paso Corporation, Eastern Pipeline Group

Specific Responsibilities

As Manager of Engineering Systems for El Paso's Eastern Pipeline Group, Craig is responsible for Pipeline AM/FM and drafting, GIS Mapping and Analysis, Plant and Mechanical Drafting and Engineering Records. In addition to these responsibilities, he served as the project manager for the development of El Paso's corporate pipeline GIS, also known as GeoFusion, which serves as the central repository for all of El Paso's corporate interstate transmission facility data. Craig is responsible for on-going maintenance and development of the GeoFusion database and associated Engineering applications.

Past Experience

Craig has been in his current position since November of 1999. Prior to that, he was the Manager of DOT Compliance Services for Tennessee Gas Pipeline. He also has held jobs of varying responsibilities in Pipeline Services, Field Operations, Engineering Project Management, Engineering Design, Gas Control and Transportation Marketing. Craig is a registered Professional Engineer.

Educational Information

B.S. – Civil Engineering, Texas A&M University

Professional Memberships

GITA
State Board of Professional Engineers

Abstract:

This presentation will address the design and implementation of the El Paso AM/FM/GIS system, which is the largest transmission system in the world. There will be discussion regarding technical business requirements, guiding principles that enabled successful implementation and potential pitfalls that were overcome. Risk factors associated with data conversion and implementation will be discussed as well. Also, the presentation will cover the application of GIS technology to pipeline risk assessment and integrity analysis.

EL Paso GIS Design and Integration

El Paso Corporation needed a unifying Geographic Information System (GIS) initiative for their interstate nationwide pipeline system, the combined length of which totals approximately 50,000 miles. El Paso Corporation's system is consolidated into three regional operations. The Western Pipeline group consists of El Paso Natural Gas Company and Colorado Interstate Gas Company and is headquartered in Colorado Springs, Colorado. The Eastern Pipeline group, consisting of ANR Pipeline Company and Tennessee Gas Pipeline Company, is headquartered in Houston, Texas. Southern Natural Gas Company is headquartered in Birmingham, Alabama.

Due to the challenge of merging three, and then five, major interstate pipeline companies into one GIS environment, it was necessary to define a common vision and common mission. This was done by defining the core stakeholders and processes around which the system would be built and how broad the system would be initially applied. Once this was completed and agreed upon by the respective parties, guiding principles were developed. These guiding principles supported the vision and were used to make decisions regarding the selection of software, hardware, application development and third party partnerships. Developing these project controls was vital to the cohesiveness of the project team and the applicability of the designs.

To combine the various GIS programs, El Paso Corporation used the ISAT open pipeline GIS standard model as a database design for the company. GE Integrity Services, an industry leader in pipeline transmission implementations and a leading proponent of the extended, industry standard ISAT database model, was employed to perform a comprehensive system analysis. This included designing the system architecture, and performing data conversion from existing hard-copy, analog, and digital map data into the ISAT format. GE Integrity Services implemented ESRI's ArcSDE as a backbone data management system to act as an enterprise repository for all converted spatial data. GE Integrity Services also enhanced their PipeView and SheetGen software incorporating ArcSDE to allow both CAD-based and ArcGIS-based viewing and editing of spatial and ISAT data. By employing ArcSDE, the individual business units of El Paso Corporation can share GIS data in a common format, database development costs and a consistent database maintenance environment. This framework allows El Paso to more easily distribute strategic business information and provides a foundation for the integration of other company units. The consolidated GIS provides El Paso Corporation with a solid platform for the creation of integrated pipeline transmission applications such as alignment sheet generation, MAOP (maximum allowable operating pressure) calculations, class location and HCA (high

consequence area) analysis, ROW (right of way) applications and intranet-based data entry, query, and display capabilities all powered by data stored in ArcSDE.

The first challenge was data interchangeability between five different pipeline companies with approximately 50,000 miles of transmission data crossing most of the contiguous United States. A common spatial data format in a universal projection was required to store the spatial data. ArcSDE allowed the graphic data to be stored in Geographic coordinates (latitude/longitude) in its native ShapeFile format. However, each pipeline system possessed a large (15 Gigabytes+) repository of orthophotography projected differently. El Paso Corporation wanted a central repository in a common coordinate system but was not prepared to re-project the existing photographic base. Compounding the need for custom projections was that CAD was the preferred engine for displaying and editing spatial data. GE Integrity Services implemented a custom projection and data transformation tool using Safe Software Inc.'s FMEOBjects Toolkit. The custom component was integrated into GE Integrity Service's PipeView product to allow data stored in ArcSDE in geographic coordinates to be transformed from Shape format to CAD format and then to be projected to the coordinate system of the underlying orthophotographic images.

The second challenge was the need to maintain the ISAT database structure in conjunction with ArcSDE architecture. The ISAT transmission pipeline data model was designed by a team of representatives from several transmission pipeline companies, the Gas Research Institute (now the Gas Technology Institute), the Battelle Memorial Institute, and GE Integrity Services. The model provides support for the centerline and facilities routinely managed by a pipeline company along with some operational data required by federal regulatory agencies. It can easily be expanded to meet the specific needs of any pipeline transmission company. Current extensions to the model include provisions for:

- corrosion analysis
- risk analysis
- inline inspection systems
- one-call systems
- marketing analysis

A major goal of the design team was to define a model that was database and application independent so that it could be compatible with any SQL compliant database system and GIS system. The model, as designed, makes no provisions for application specific linkages for graphic or GIS functionality. The system allows for the addition of specific columns to the tables in the model to provide linkages between graphic elements and associated attribute data. Using ArcSDE to extend the ISAT model to store, manage and distribute spatial data using ESRI's ArcSDE was an obvious choice for providing an enterprise repository for spatial data, since ArcSDE is an open architecture based on standard Relational Database Management Systems. Custom tools for maintaining database integrity between the ISAT and ArcSDE databases and for data-mining the spatial relationships between ArcSDE features were written by GE Integrity Services using ESRI ArcObjects tools.

To serve El Paso's Mapping and Engineering departments for the five separate business units, plus external consultants, the following architecture was implemented. Four servers were set up in El Paso's Houston data center:

Compac Proliant Servers with 2-4Gb RAM, twin or quad 750Mhz Xenon processors with RAID 1 disk arrays with 10-36 6Gb disks running Windows2000 Server (SP2)

ISAT and ArcSDE production database server running Microsoft's SQL Server 7.0 (SP2) and ArcSDE 8.1.1. This CITRIX server allows 15 clients to run PipeView for ISAT/ArcSDE access and SheetGen for the generation of Alignment Sheets using CAD as the graphic engine. The CITRIX server has mapped drives to the orthophotographs for each company to be accessed by PipeView, SheetGen and the web-based applications.

Server hosting the Pipe Information Manager query and analysis web applications used to mine information and relationships from the ISAT database and the ArcSDE data layers

Development server used to test applications and run the ISAT-ArcSDE data integrity and synchronization applications

This architecture allows field staff and engineers to access and maintain the ISAT/ArcSDE databases from disparate and remote locations through the Citrix environment using CAD tools familiar to them. Experienced GIS technicians can generate high quality cartographic products and perform high-end geographic analysis on the data stored in ArcSDE using ESRI's ArcGIS product suite. Managers, analysts and field personnel can browse, analyze, and report on the tabular data stored in the ISAT and ArcSDE databases using the web-based Pipe Information Navigator applications.

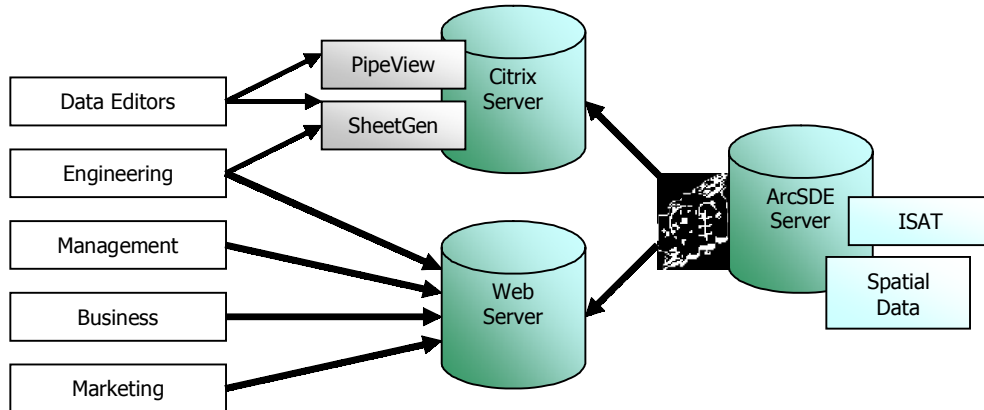


Figure 2: El Paso Corporation ArcGIS/ISAT Architecture

ArcSDE provides a robust, open and scalable solution to implement this project. ArcSDE allows storage of spatial features into a common projection and common data format for distinct and separate spatial regions as seamless spatial data. This framework allows operators in each

business unit to view, query and manipulate common spatial data in a local projection in conjunction with existing orthophotography. Storing data in ArcSDE and translating and projecting it using FMEObjects allows field crews, engineers, marketers, database administrators, spatial data editors and other personnel to retrieve and view spatial data in either Shape or CAD format as required. ESRI's open architecture within the RDBMS framework allows GE Integrity Services to extend the ISAT model to incorporate the spatial representation of features in the ISAT database within ArcSDE. GE Integrity Services extended their existing PipeView and SheetGen Software products, as well as their Internet-based Pipe Information Manager query tool to seamlessly incorporate ArcSDE. ArcSDE provides a common access point for shared spatial data and the security and scalability needed for expanded operations. By extending the ISAT data model to incorporate ArcSDE links to historical and regulatory information, ISAT and PipeView maintain this data and provide instant access to the spatial data, which is available to clients using ESRI's ArcGIS tools: ArcView, ArcEditor and ArcMap.

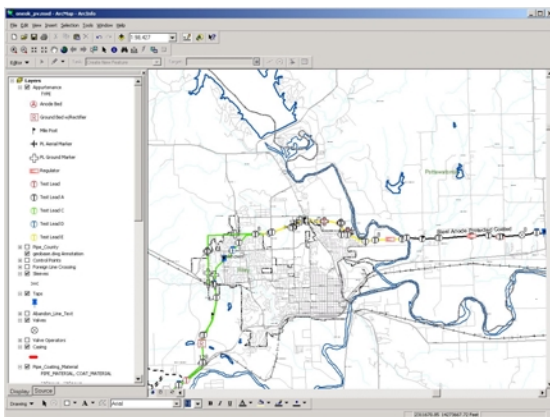


Figure 2: ArcGIS Display of Transmission Pipeline Features

El Paso Corporation required an enterprise, interoperable, standardized GIS implementation between business units. The company wanted to move to the ISAT model and ultimately expose the model to ESRI GIS environment. GE Integrity Services implemented a solution using ArcSDE that allowed El Paso to use both the ISAT model and the ESRI model in a scalable RDBMS environment. It took eight months from conception of the idea to delivery of the first of the five pipeline company's data in the required ISAT and ArcSDE format. Now El Paso has a spatially enabled database that is serving GIS information to a variety of business and engineering departments across the United States.

For more information about El Paso Corporation contact Craig Wilder, (tel: 832-676-2525; email: craig.wilder@elpaso.com) or visit www.elpaso.com