BIOGRAPHICAL INFORMATION

Ken Lenser
Director, Integration Services
VELOCITIE Integration, Inc.

## Specific Responsibilities

Mr. Lenser joined VELOCITIE (formerly part of KEMA, Inc.) in 2000. Mr. Lenser is a Director of VELOCITIE Integration, Inc.'s software integration team. On GIS integration, implementation, and data migration projects, he assists in identifying system requirements and oversees software design, development, testing, and deployment. Having extensive experience with geospatial data issues, he consults on data conversion projects to design effective data conversion processes, select data conversion vendors, and implement data quality assurance procedures and systems.

## Past Experience

Prior to joining VELOCITIE, Mr. Lenser worked as a Project Manager in GIS data conversion providing management and process design services to implement efficient and quality conscience data conversion processes.

## Professional Memberships

GITA – Mr. Lenser has been a GITA member since 1999. In 2002 he served as President on GITA's Wisconsin Chapter Executive Committee.

BIOGRAPHICAL INFORMATION

Carolyn Bakke
Director, GeoSpatial Electric Solutions
Intergraph Corporation

Specific Responsibilities

Joined Intergraph Utilities in 1992. Responsible for industry consulting and direction of Intergraph solutions for GIS, design, outage and mobile workforce management.

Past Experience

Eleven years of past experience at Intergraph includes:

?? Technical marketing and consulting for Intergraph's dispatch, outage, mobile computing and GIS products for electric utilities.
?? Product planning and GUI development
?? Software project management, design, and implementation for FRAMME, Intergraph's AM/FM product.

Experience in software development, project management, marketing, and industry consulting, coupled with her masters-level studies in the human factors of software, provide Carolyn with a strong history in relating utility business problems to available technical alternatives.

Educational Information

Mississippi State University, Master of Science, Computer Science
Mississippi State University, Bachelor of Science, Computer Science

Professional Memberships

GITA
DistribuTECH Advisory Committee

## BIOGRAPHICAL INFORMATION

Bob Dirmeyer
Geosolutions Consultant
Intergraph Corporation

### Specific Responsibilities

Mr. Dirmeyer is a Geosolutions Consultant at Intergraph Corporation. Responsibilities primarily focus on system configuration of Outage Management and Mobile Workforce Management Solutions for customers in the Utilities and Communications industries. Mr. Dirmeyer is also responsible for product planning for the InService product suite and coordinating InService User Group Activities.

### Past Experience

Mr. Dirmeyer's 16 years of experience at Intergraph include system configuration, proposal management, SAP project team participation, and program management.

### Educational Information

Bachelor of Science – Mechanical Engineering, Tennessee Technological University
Master of Business Administration, Tennessee Technological University

### Professional Memberships

GITA
Pi Tau Sigma
Beta Gamma Sigma

# GIS MODELING TO SUPPORT OPERATIONS

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## ABSTRACT

Many electric utilities have made a significant investment in implementing a GIS to model the "As-Built" state of their electric network. The focus of this investment is engineering and asset management. The value of this investment can be significantly increased if the data in the GIS is used to create an Operational (As-Is) Model of the electric network that can be used for such applications as Outage Management, Distribution Management, and Switch Planning. All too often, utilities find that the GIS model has not been designed to capture the data required by an Operational Model or that data errors in the GIS prevent productive use of the Operational Model.

This presentation will discuss modeling options with regard to data needed to support an Operational Model. Major topics covered include:

?? Operational Modeling versus As-Built Modeling
?? Common Data Problems and Remedies
?? Case Studies
?? Operational Benefits

## OPERATIONAL MODELING VERSUS AS-BUILT MODELING

An Operational Model typically has greater data requirements than an As-Built Model used exclusively for engineering and asset management. In particular, the Operational Model requires more robust data in the areas of:

?? Connectivity
?? Switchable Devices
?? Phasing
?? Substations
?? Customer Information
?? Landbase

### Connectivity

For a GIS data model to effectively support operational applications, one key requirement is connectivity. Some geographic information systems were developed to provide automated mapping functionality and may not include network connectivity. When developing an interface to an operational application in these cases, a process needs to be designed and implemented to build connectivity into the GIS. Tools used to maintain data in the GIS may need to be modified so that connectivity is correctly maintained going forward. Quality assurance tools such as network tracing can be implemented and run periodically to verify that connectivity is correct at a circuit or system level.

When network connectivity does exist in a GIS to support an operational application, thought needs to be given to how the GIS connectivity compares to what is expected in the target system. For example, the GIS connectivity may be stored in database attributes, not requiring the endpoints of linear elements to "snap", whereas the operational application's connectivity may be topological requiring coincident endpoints. A process may need to be run on the GIS model to snap endpoints so that the connectivity requirements of the operational application are supported. The reverse situation may exist where the topological connectivity of a GIS needs to be translated to database nodal connectivity as the data is exported to an operational application. Also, the operational application may require that devices be grouped to nodes at the end of linear features. Do devices split linear features in the GIS? If not, this requirement may need to be addressed during development of the interface between the GIS and operational application.

### Switchable Devices

Are all points where switching can occur modeled in the GIS? Are fuses and switches within switchgear modeled? How are elbows modeled in the GIS? An operational application such as OMS will depend on these switchable devices being in the operational model.

Phasing

Electrical phasing can be an important piece of information for an operational application. For a GIS it may not have been modeled because of perceived lack of importance from a mapping standpoint or lack of accurate source data. Consideration may need to be given to how phasing information can be populated in the GIS to support the operational model. Without accurate phasing data, it can be impossible for an OMS to provide accurate customer counts for outages, or it can be impossible for a switching application to generate a usable switch plan.

Substations

For an electric network, how are substations modeled in the GIS compared to what is required in the operational system? Substation modeling may be an exception to the general rule that operational models require more robust information than what is included in GIS. For example, a GIS may include significant detail showing the internals of a substation. For an OMS it may be desirable to model only the circuit breakers as the start of each feeder at substation locations. In this case, the interface between GIS and OMS can be built to generalize the features at a substation.

Customer Information

An operational model may require customer information that isn't typically stored in a GIS. Data identifying customer types or emergency customer information may need to be pulled from CIS to support operational applications.

Landbase

In addition to facility network connectivity, a connected centerline street network, along with related address data, is required if routing functionality is desired.

## COMMON DATA PROBLEMS AND REMEDIES

Connectivity and phasing errors are common data problems that adversely affect an operational model, but steps can be taken to resolve these issues in the GIS. Connectivity and phase trace validation tools available within the GIS should be used to identify errors. Error browsing functionality can be configured in the GIS and is useful if the number of connectivity errors to correct is significant.

A second line of verification is available during initial prototyping of an interface between the GIS and an operational application. Once data is imported, tracing functionality available in the operational application should be run to verify that GIS trace routines are identifying all connectivity and phasing problems that impact the operational model.

CASE STUDIES

The following case studies illustrate customer experience with the following Operational Model issues:

?? Modeling devices within switchgear
?? Augmenting GIS with CIS data
?? Building a street network for routing

Modeling Devices within Switchgear

While implementing an Outage Management System (OMS), the project team identified the requirement to have switches and fuses within switchgear included in the operational model. This would allow OMS operators to see the normal switching status of devices in switchgear cabinets and to change switch status as necessary in the OMS. The GIS data interface was not supplying this information because the GIS only modeled simple switchgear locations. The "box" symbol which represented the switchgear location connected to upstream and downstream conductors, but without the detailed switch and fuse devices modeled, electrical open and closed status could not be indicated.

GIS functionality was created to support the placement and modeling of fuses and switches inside the switchgear cabinet. A linear busbar component was also added to the switchgear object enabling placement of various bus configurations within switchgear. Switch, fuse, and busbar objects were placed at a very small scale inside the existing switchgear cabinet symbols. The new objects were added to the OMS interface to supply normally open and closed status data at switchgear locations.

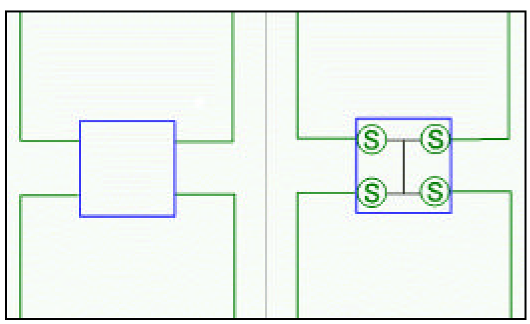


Figure 1: Switchgear location before and after modeling devices

Augmenting GIS with CIS Data

In this case study project, critical customer data was needed in support of an Outage Management System (OMS) implementation. It was desirable to have medical alert data and other selected customer category codes included in the OMS data model so OMS operators could make timely decisions in the event of an electrical outage. An interface to the company's GIS was being developed, but this information wasn't included in the GIS model.

The medical alert and customer code data existed in the company's Customer Information System (CIS). An interface from the CIS to the OMS could have been developed to provide this data. However, an interface between the CIS and GIS already existed, so the project team decided to leverage this existing interface. The medical alert and customer code data was populated in the GIS via the CIS/GIS interface, and this data was then passed to the OMS operational model through the GIS interface.

Building a Street Network for Routing

Outage Management Systems (OMS) often use street centerline networks to route field crews to job locations. This was planned for this case study project, but it was identified that the company's GIS street data was not modeled in a way that would meet routing requirements.

For routing functionality, the OMS required a connected street centerline network, with centerlines split into individual segments between street intersections. In addition, the centerline segments needed attribution to indicate left and right address ranges and the segment geometry needed to be drawn from the low address end to the high address end. The GIS data didn't meet these requirements. GIS centerlines were represented by a single geometry that ran the continuous length of the street within a community.

The project team determined that the splitting of centerline data and assignment of address ranges required significant data processing, and decided that the GIS/OMS interface's performance would suffer if the processing occurred each time the GIS data was extracted to populate the OMS data model. The approach taken was to modify the GIS data model to accommodate the address range data, and software was developed to perform a "one time" modification of street segments in the GIS. Procedures and tools to maintain the GIS street data were changed to meet the new requirements.

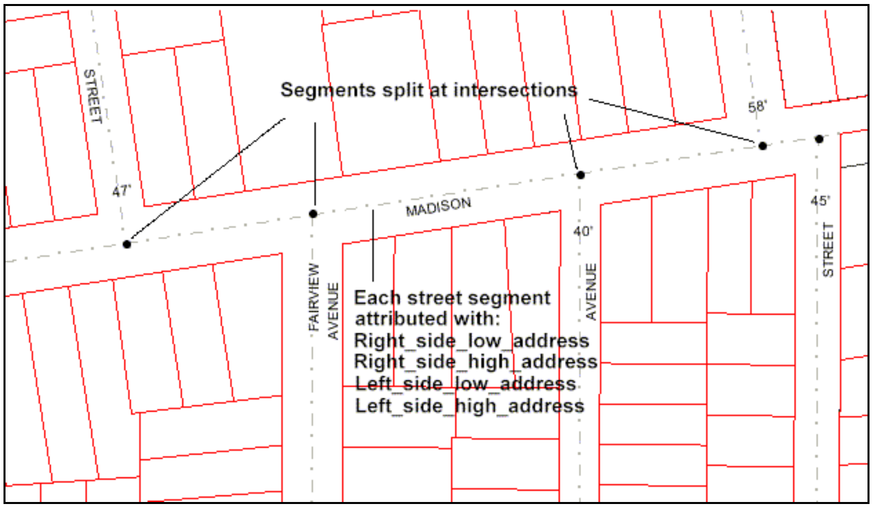


Figure 2: Street segment requirements for OMS routing

OPERATIONAL BENEFITS

The following table lists the operational benefits associated with the data modeling elements discussed in this presentation.

| **Data Modeling Element** | **Operational Benefit** |
|---|---|
| Connectivity | Accurate connectivity facilitates tracing in the operational model. Outage analysis is dependent upon connectivity data to accurately predict the probable outage device. Connectivity also allows distribution management system to calculate the load on a given circuit, both when configured as-built and when in an abnormal configuration due to temporary switching operations. |
| Switchgear | Complete modeling of switchgear allows switching applications to generate comprehensive and valid switch plans. |
| Customer Information | Adding customer information to the As-Built GIS data in the Operational Model allows an OMS to capture customer outage history data and to quickly flag when critical customers are impacted by an outage. |
| Street Network | Adding a street network to the Operational Model allows OMS and Workforce Management Systems to route field crews to job locations. Accurate travel time estimates can be added to the work time estimates when providing customers with estimated repair times. Accurate street networks allow Workforce Management Systems to generate work schedules that minimize travel time and maximize on-site work time for field crews. Accurate maps are particularly useful on mobile clients when field crews are working outside of their normal service area. |