



Utility Networks in GIS

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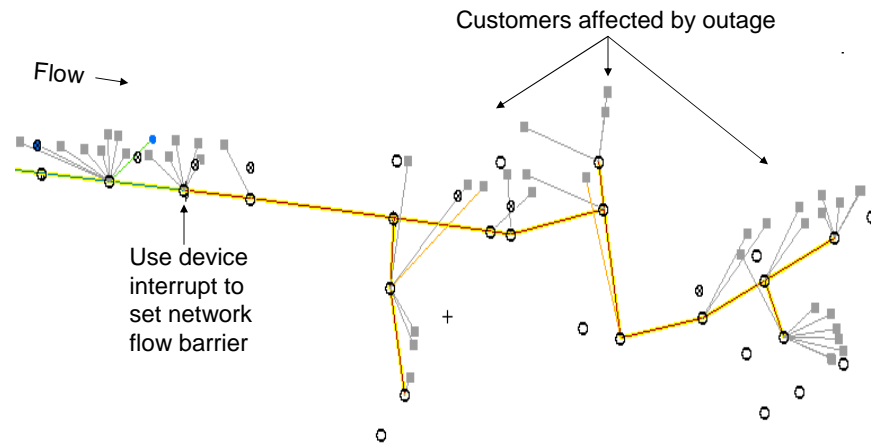
Lisa Utz



Background

- Network data stored in multiple legacy systems
 - Scanned paper maps
 - CAD data
 - Mainframe tables
 - Outage management system
- Planned outages

Planned Outage



Benefits of GIS

- More accurate data
 - CAD-based systems typically use GPS or as-built design coordinates for nodes, but representational design standards to position many other system components
- Lower data maintenance overhead
 - CAD-based system data can be difficult to update and integrate
 - System object attributes are often scattered among various operational DBMSs
- Comprehensive reporting
- Powerful, flexible analysis tools

Project Goals

- Consolidate fundamental network objects into a simple network data model
- Create a simple tool for modeling planned outages
- Establish a foundation on which a more complex network data model and more sophisticated tools can be built

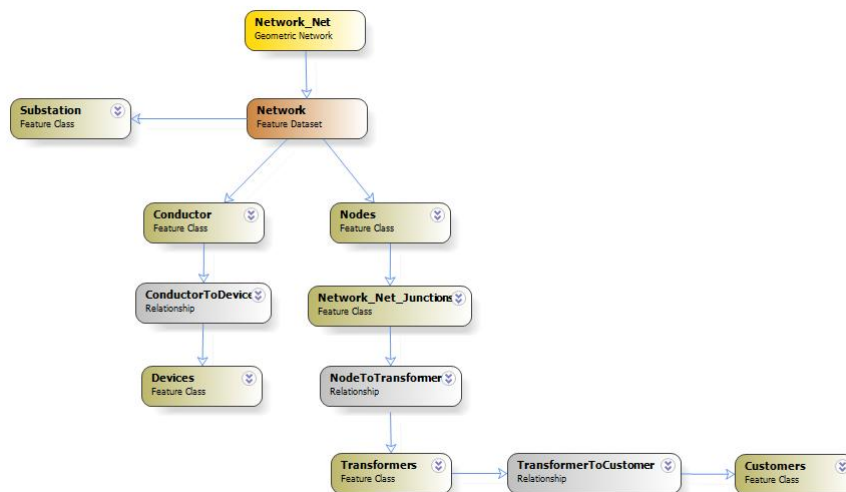
Source data

- Outage mapping system – node and line (conductor) tables
- Construction mapping system – transformers
- Mainframe customer service system – customer locations (geocoded/GPS)

Step 1 – Determine data structure

- In order to build network, geometry is needed for nodes and conductors
- Geometry is not necessary for transformers and customers – they are linked via relationship classes

Network Data Structure



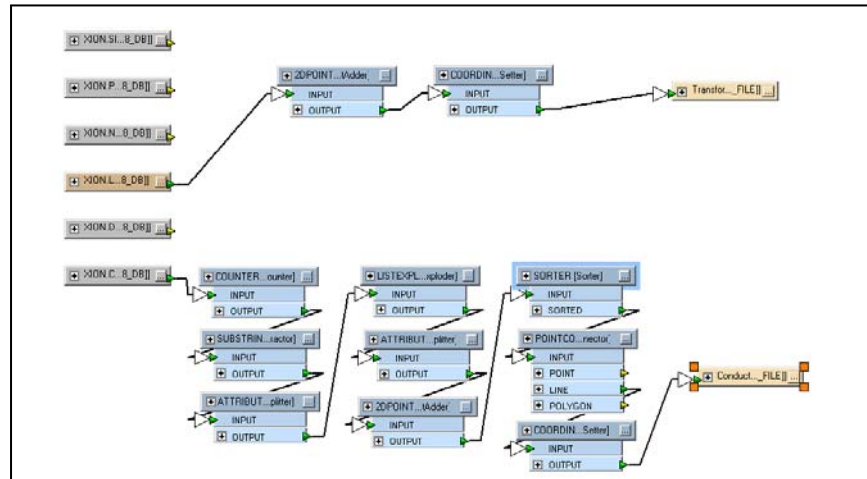
Step 2 – Consolidate data

- Export nodes, conductor, and transformers from mapping systems to Oracle tables using FME
- Export customer data from customer service system to Oracle tables using a mainframe script

Step 3 – Create geometry

- Create geodatabase
- Using FME, export nodes from Oracle as point feature class, conductor as line feature class
- Export transformers and customers from Oracle to geodatabase as tables

Creating geometry with FME



Step 4 – Create topology

- Attempted to create topology within ArcGIS
 - Snap tolerance issues:
 - CAD-based transformer and device layers offset from nodes for mapping purposes by up to 20'
 - Features were being moved too much, even with feature weights set
- Used FME (AnchorSnapper) to snap conductor endpoints to nodes

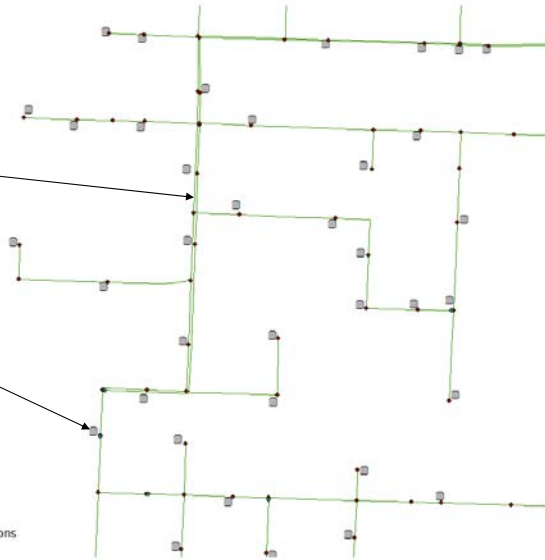
Input Data Configuration

Parallel
conductors less
than 10 feet
apart

Variably-spaced
transformers up
to 20 feet from
nodes

Legend

- Transformers
- Network_Net_Junctions
- Conductor

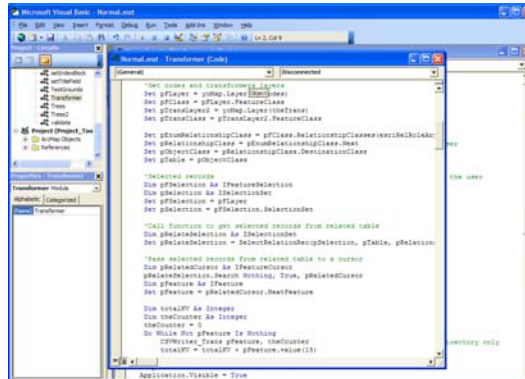


Step 5 – Create network

- Built new geometric network from node and conductor feature classes
- Added connectivity rules to link nodes to conductor
- Added relationship classes to link nodes to transformers, and transformers to customers
- Set substation node as “source” and generated flow direction

Automation

- Used VBA to automate several steps and generate reports.



Creating tools

- Some functions needed are:
 - Create cursor with records selected with the network trace functions.
 - Programmatically summarize records.
 - Get related tables' selected records and summarize them as well.
 - Present reports in any possible format: tables, files, maps, pdfs, etc.

Creating tools

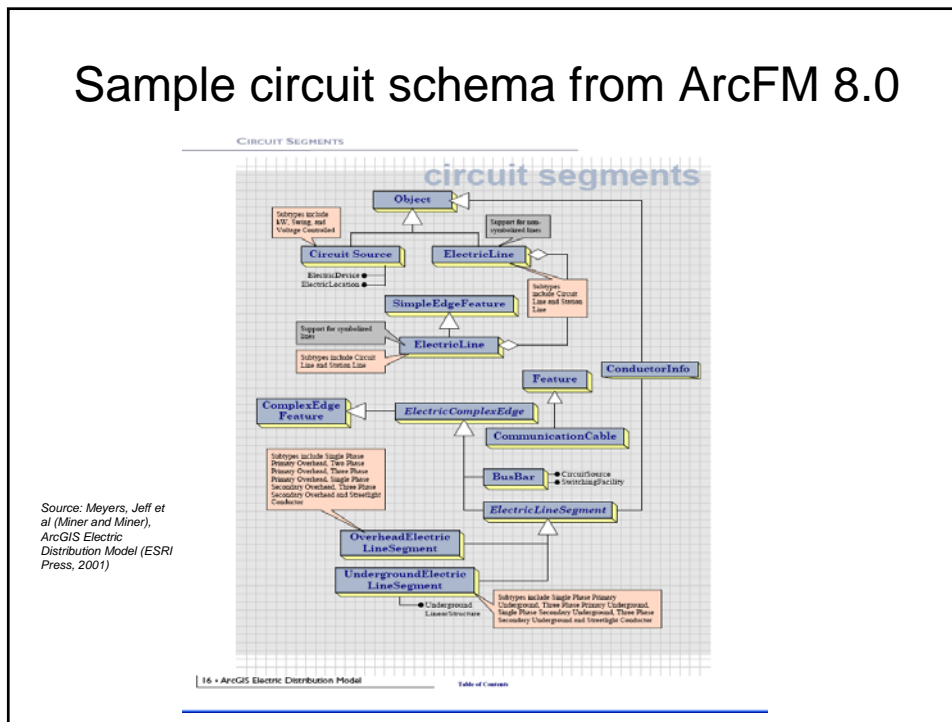
- Instant report in message box
- Transformer CSV report (Excel format)
- Customer CSV report (Excel format)
- PDF of outage



Where do we go from here?

- Add more feature classes (poles, devices, secondary)
- Incorporate complex edges and junctions
- Incorporate more complex network functions (examples: transmission, load balancing)
 - More feature class subtypes and domain ranges (i.e., transmission poles ≥ 50 feet)
 - More relationship class constraints to ensure node-related devices and conductors are matched for flow and impedance rating

Sample circuit schema from ArcFM 8.0



Challenges

- Data cleanup – customer locations, customer connectivity, rectifying data from multiple mapping systems
- Streamlining data model – our model may not be the most efficient
- Adding feature classes to geometric network – connectivity rules get complicated in a hurry
- Maintaining data – how do you add, remove, and update data efficiently and easily

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Questions?