Improving Emergency Response - A Routable Master Address Data Model for the Sacramento Region

GIS-T Symposium

March 19, 2003

Colorado Springs, Colorado

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Presentation Overview

- The Premise
- The problem – Traditional Address Geocoding
- Requirements – Street Network
- Requirements – Address Database
- Solution Approach
- Proposed Network Model
- Proposed Address Model
- Routing Components
- Proposed System
- What's Next

The Premise

Develop a street network and address database that accurately identifies addresses and facilitates efficient dispatching and routing of emergency personnel to the location.

The Premise

- A more complex street network data model, which could accommodate multiple addressing data models, together with a routable network
- Was driven by the needs of a large number of users
- As a result, data model needed to be robust enough to accommodate everything from simple mapping, permitting and asset management, to more complex vehicle dispatching and tracking, to ITS and emergency response
- While the project initiation predated 9/11, it has taken on increased importance from a public safety point of view

The Premise

- Project included three separate components:
  - A street network model
  - An address data model
  - A routable network component
- Needed to include web-based tools for maintenance and updating the master database

The Problem – Traditional Address Geocoding

- Approximate interpolation based on minimum and maximum address range values
  - Wrong street segment
  - Wrong side of the street
- Does not handle complexes with multiple levels of address elements (e.g., 123 A St., Building 100, Apt. 120)
- Cannot locate places without street address
- Does not support addresses without street names, e.g. houseboats

The Problem – Traditional Address Geocoding (contd.)

- Does not handle multi-storey buildings with suite addresses
- Does not know about buildings covering multiple city blocks
- Does not consider buildings with multiple addresses
- Cannot handle addresses with fraction or alphanumeric addresses (e.g. 123-1/2 First St. or 123A Glen Avenue)

Requirements – Street Network

- Support for multi-agency maintenance
- Support for discrete addressing
- Vehicle routing support
- Unambiguous street names by jurisdictions
- High and low -end cross streets
- Needed to include barriers and restrictions
- Support for planned street for infrastructure planning of utility agencies

Requirements – Address Database

- Support for every discrete address representing each building and unit (123 1st St, building G, Unit 5)
- Addresses should be identifiable by network segments whenever possible
- Address location should be identifiable by commonly known names (Civic Center)
- Should accommodate fractional addresses (123-1/2 Center St.)
- Must support facility/structure/building locations that may not have numbered address (Science Bldg., Utah State University)

Requirements – Address Database

- Must support multiple identifiers within one structure/address (auditorium and library in the same school building)
- Must support multiple numbered addresses for the same location (building at the intersection of A & B st. may have addresses for both streets)
- Each discrete address should carry its own geographic coordinates as attributes
- Discrete addresses must be represented by point shapes

Solution Approach

- Develop a discrete master address database model that supports all variety of addresses
- Develop a street network model that supports –
  - Exhaustive address ranges
  - Actual address ranges
- Build routing capability in the street network
- Integrate the master address database with the street network

Solution Approach

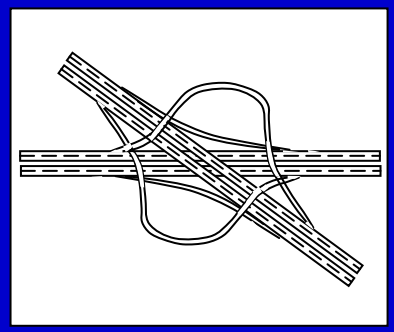
- Stepwise address geocoding
  - Match address in the master address database
  - Apply address geocoding using actual address ranges
  - Apply address geocoding using exhaustive address ranges
- Utilize routing feature of the street network to dispatch emergency personnel to the matched location
- Log unmatched address to update master address database and/or street network and address ranges

Data Model – Network Character

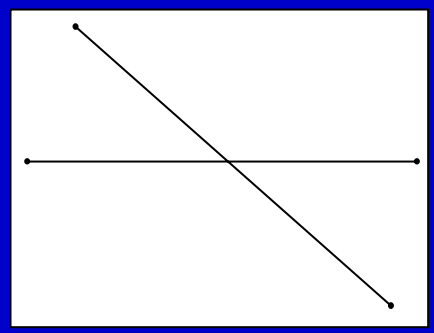
- Geocoding of discrete addresses to get X-Y from parcel database
- Discrete address validation using address ranges
- Multiple methods of address matching
- Spatial query and display of discrete addresses on street network
- Vehicle routing through tie-ins with routing components of the database

Street Network – Roadbed

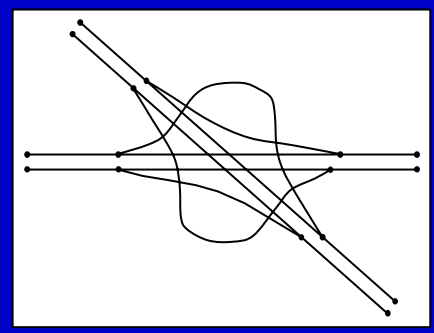
- Accommodates ramps, connectors, staked decks, frontage roads, HOV-lanes, etc.
- Allows separate routing impedances on each roadbed of the named roadway
- Facilitates traversing through actual network connectivity



Real World Features



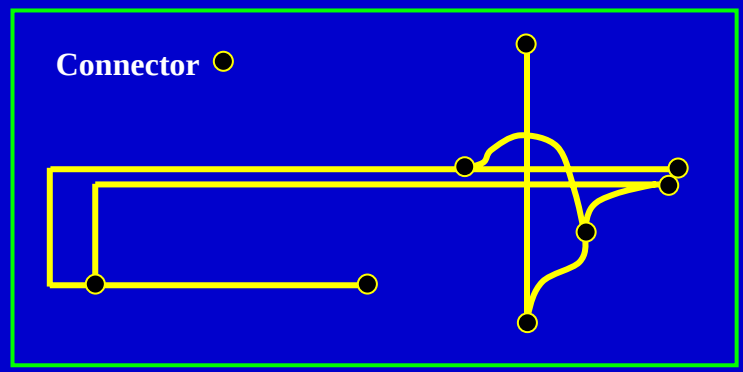
Conventional modeling



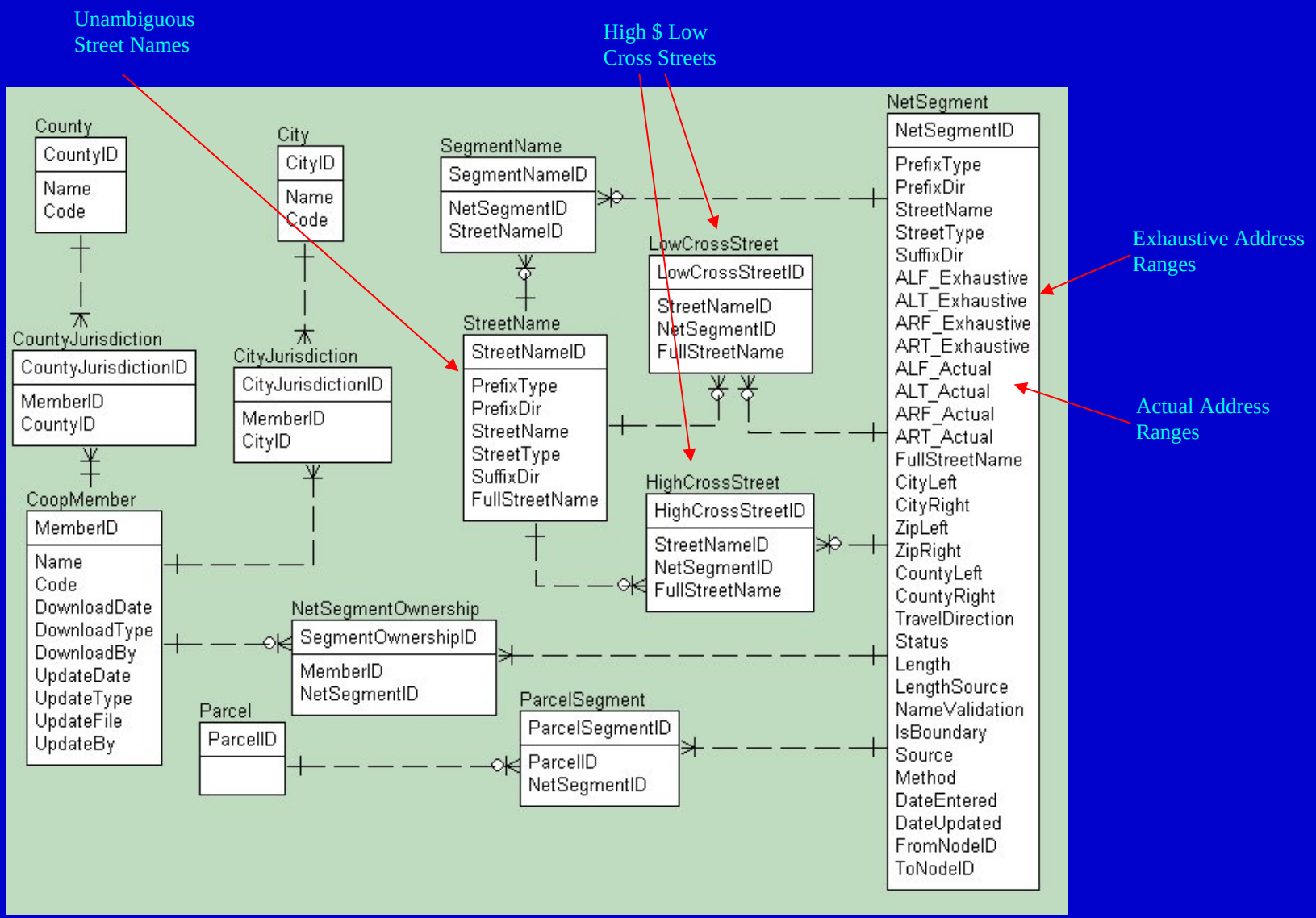
Roadbed modeling

Street Network – Base Railroad Segmentation

- Nodes permitted at actual intersection
- Segments do not split at simple crossover
- Non-intersection nodes
  - jurisdiction boundaries
  - street name change
- Facilitates proper routing and turning



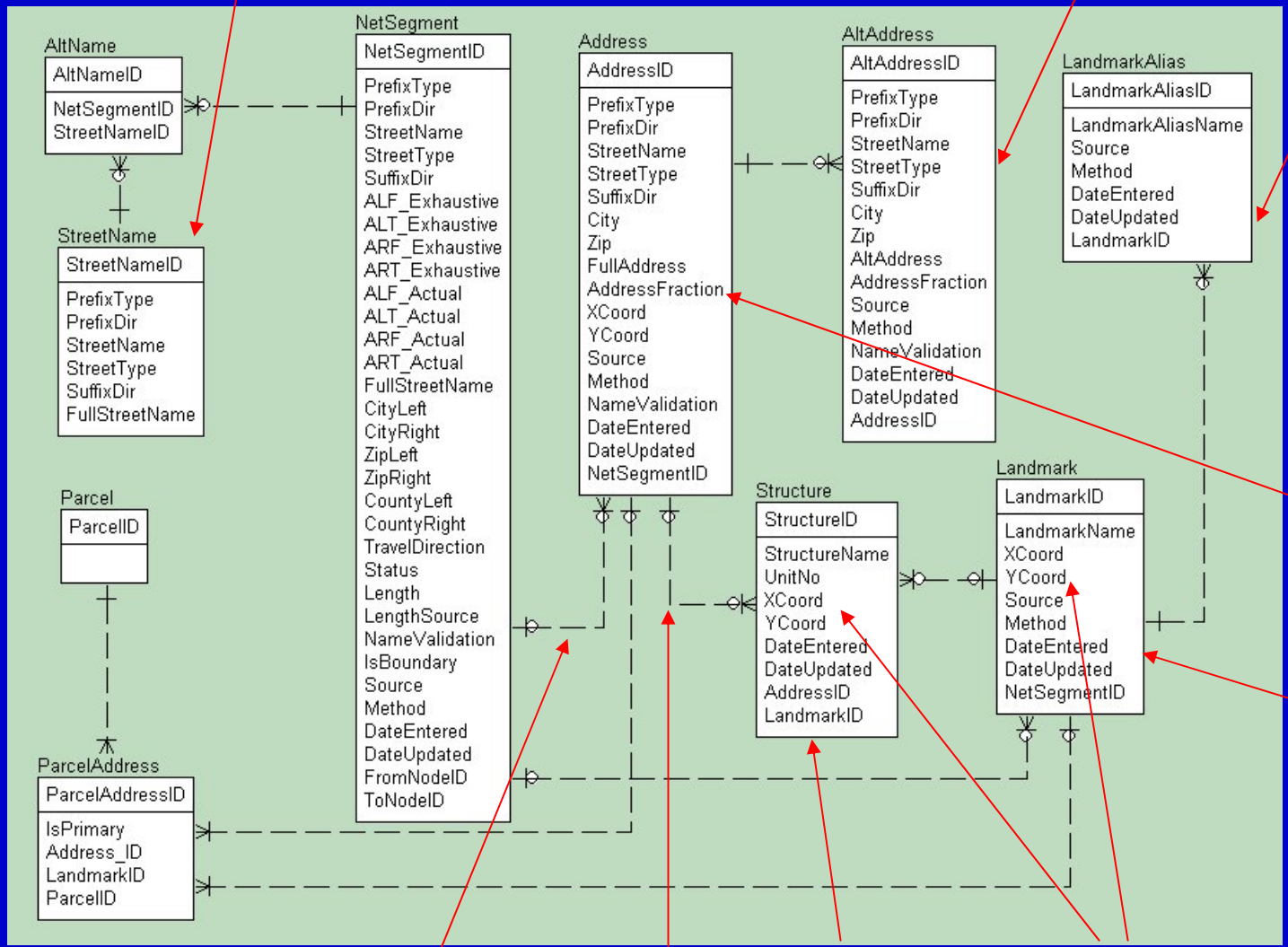
Data Model - Network



Data Model – Discrete Address

- Each unit is modeled as individual entity
- Structures with 1+ units are tied to addresses
- Address fraction is modeled as an attribute
- Addresses and all units have X-Y coordinates as attributes
- Addresses are tied to street segments
- Addresses may have alternate addresses
- Commonly known places are modeled separately with possible alternate names

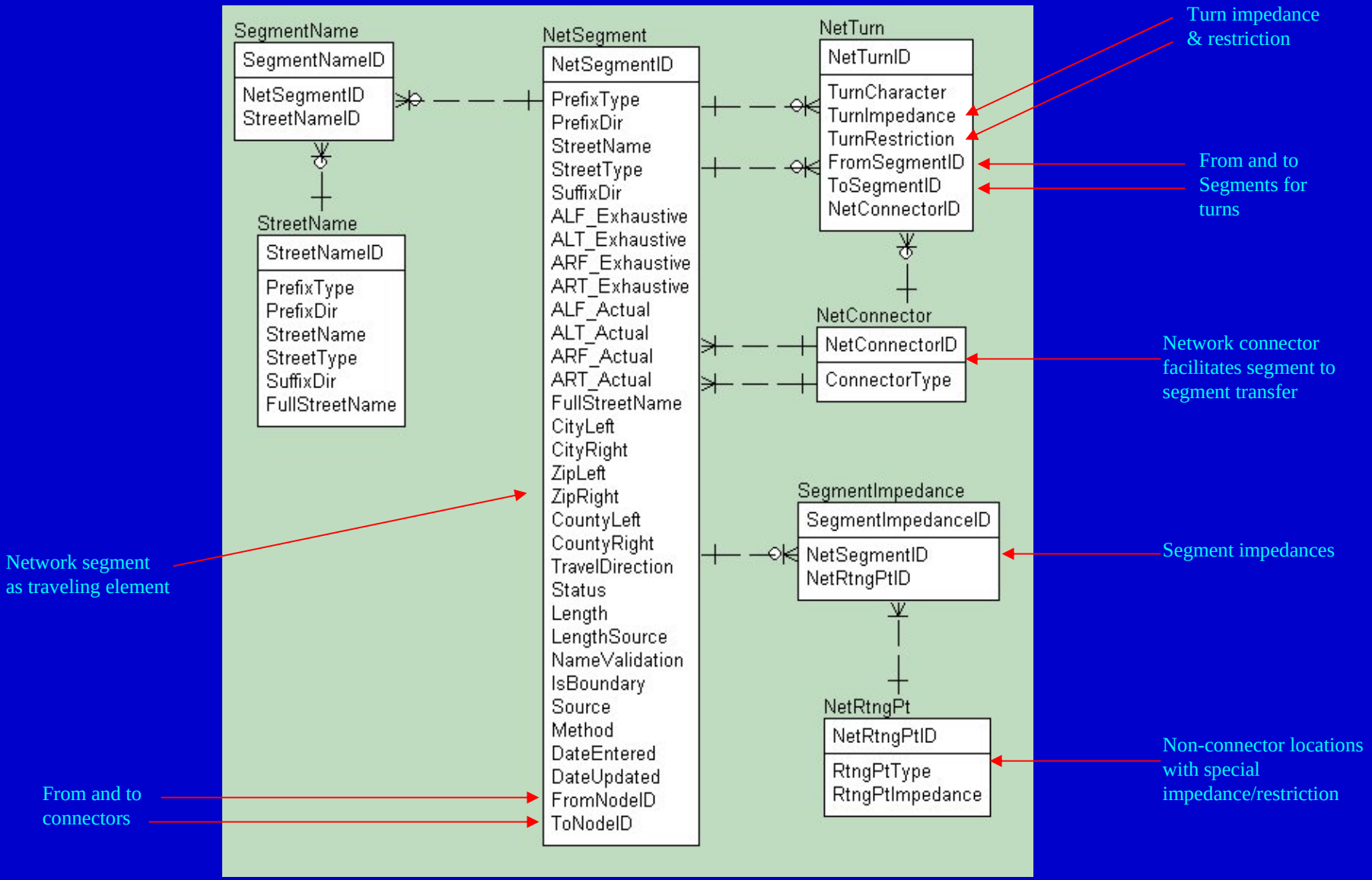
Data Model – Discrete Address



Data Model – Routing Elements

- Network segment as traveling element
- Network connector for segment to segment transfer
- Segments have from and to connectors
- Turns at connectors are modeled with from and to segments in a turn table
- Turn restrictions and impedances are attributes of turn entities
- Turn description (‘turn slightly right’) and connector type (‘fork’) together provides textual direction for routing
- Overpass/underpass, tunnel, etc. modeled separately from connectors as segments at these locations do not physically connect

Data Model – Routing Elements



Proposed System – Components

- Data Maintenance – submission, formatting, loading
- Data Validation – update, resolve conflict, notification of actions
- Distribution – browse, select, submit request, download

Proposed System – Applications

- Data update logging & submission utility
- Data review, validation, and posting app.
- Data exchange/refresh tool
- Web based data clearinghouse

What's Next

- Pilot implementation
- Develop tools for –
  - Web based multi-agency address data maintenance application
  - Web based multi-agency street network maintenance tools
  - Tools to export address data for CAD systems maintained by police, fire, 911, and emergency medical response agencies
  - Web based street network & address data clearinghouse