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Interfacing ArcInfo 9.1 to Tacoma's Fire Dispatch System

Abstract:

In 1992 the City of Tacoma wrote an interface from the GIS street center line database to the fire dispatch system. This interface has been modernized to ArcInfo 9.1 with the new release of network software and topology.

Using a GIS as the front end for address updates into a dispatch system enhances the accuracy of addresses, eliminates redundant data updates, and saves a significant amount of personnel time. Agency-wide address standards and data sharing are discussed in this presentation.

This paper was presented on July 27, 2005.

Introduction

The Tacoma Fire Department's 911 Communication Center dispatches Fire and EMS for the City of Tacoma, City of Fircrest, and Fire District 10 which includes the City of Fife and a portion of Pierce County, WA. In 1992 the City of Tacoma developed a custom GIS application to extract GIS street center line data for input into their commercial Computer Assisted Dispatch (CAD) system. The process was written as a batch job using AML (Arc Macro Language), Arc/Info 7.2, Arcplot, Network Allocate, and INFO database programs. The original development investment was recovered immediately by eliminating the manual effort to populate address data into the dispatch system, and by preventing duplicate address updates from being done in both GIS and the fire dispatch system.

That custom system was adopted by the City of Spokane and Spokane County, and in 1993 the three agencies presented a professional paper at the annual ESRI conference. ("Integrating Arc/Info With the PRC Dispatch System", Donna Wendt, Christine Diebel, Ian Von Essen, Veronica Dykas.) The system is still in use by these agencies in 2005. PRC has since been acquired by Northrop Grumman.

With the advances made in GIS, computer hardware, and scripting software, it is appropriate to convert the address extract to the new Network Analyst for ArcGIS 9.1 released in May, 2005, move street data from a coverage to a geodatabase, and change scripting and programs to Python. This will enable the city to retire some older UNIX hardware and the older versions of

Arc/Info and INFO, in addition to having software that takes advantage of improvements in topology, map editing, and network analysis. A modernized system will be maintainable by newer GIS personnel. As of June 3, 2005, this conversion project is in the design stage. Upon presentation of this professional paper in July, 2005, significant progress will have been made on the system upgrade.

Why Use a GIS Extract for Computer Assisted Dispatch (CAD)?

Using GIS data to supply the addresses needed for CAD is a win-win proposition. Personnel time is saved by combining efforts, and the overall quality of the address records is improved. Following are some of the advantages:

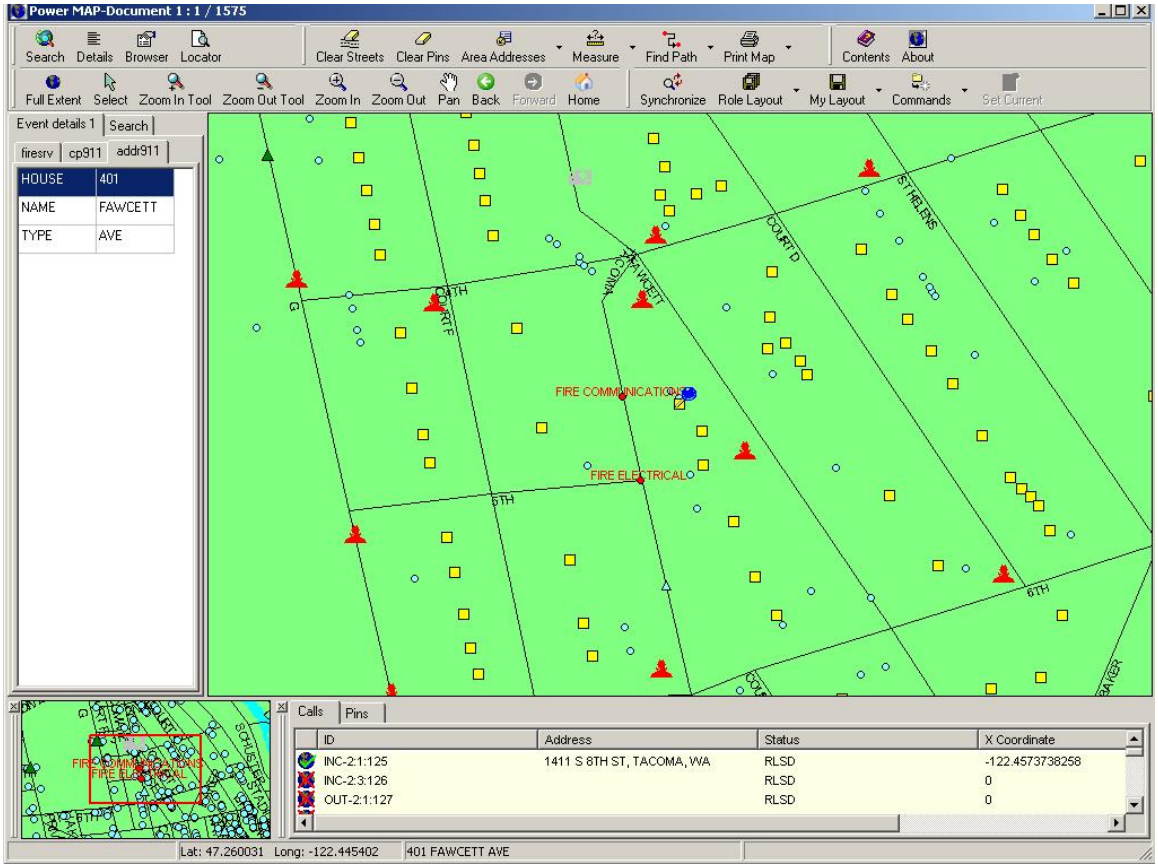
- Lives are saved through fast and accurate dispatching.
- Street address changes and updates are fast.
- New dispatchers unfamiliar with the city's streets are immediately productive.
- Lack of duplicate data updating between GIS and CAD saves personnel time.
- GIS produces travel time analysis, statistics, and response maps.
- GIS maps complement the dispatching process when taking a citizen call or directing a rescue unit to a specific location.
- CAD response data integrated with GIS address data gives the capability to measure and analyze response performance by geographic area.

By importing the GIS address data into CAD, closest stations and move-up stations have been pre-calculated using fastest route analysis from the GIS network module. Travel times are calculated based on speed limit, and routes take turn restrictions and one-way street directions into account. The alternative to using GIS to calculate the station orders for every intersection in the city is to do a manual data entry into the CAD system, which is not only tedious but could be prone to error. When a street is closed, such as for a construction project, that change is made in GIS, and the travel time calculations and station order matrix are re-created for export into CAD. The exported data is formatted as a simple ascii text file, and it can be uploaded into the CAD system as often as needed.

Having a map of the incident area is a definite plus for the dispatcher. Fire response zone maps are created as part of the GIS extract process and are distributed to each fire station for study by the responding crews. The CAD system uses a theoretical address range so that the call will almost always match to an address.

Following is a sample from a pre-fire planning GIS map. A clear up-to-date ortho photo is an important component of this map, together with other GIS themes such as hydrants, street names, fire lines, access routes, and notations.

Tacoma uses additional software, Positron's Power 911 and Power Map for 911 computer telephony and mapping. The Power Map product uses the same street center line and common place datasets that the CAD system uses, though they are completely separate systems. The street center lines, common places, parks, specific address points, schools, and railroads are written to a CD in a shape file format for uploading into the Power Map system. Following is a screen capture from Power Map.



Record Keeping and Measurement

When using manual dispatch, record keeping about the dispatches is done manually. With a CAD system, call times, addresses, dispatch times, and statuses are kept in a database. Together with GIS information, this information is invaluable for analysis of the demand for fire department responses and the speed and accuracy of the response. In Tacoma, a recent audit conducted by a consultant resulted in a rich report of maps, charts, and graphs showing current response patterns. Using GIS population projection data created for use in transportation analysis, the consultant was able to show that growth patterns in the southeast area of Tacoma will soon require the addition of another fire station.

GIS Benefits Too

When the street center line geodataset is updated to the quality demanded for public safety, it becomes a valuable asset for other city departments. For example, the standardized street name file along with the street center line geodataset were used for scrubbing and converting over 209,000 utility customer addresses with a 98.2% accuracy rate during a recent data conversion to their new billing system in SAP. The Police Department geocodes crime incidents to a GIS

point layer using the addresses in the street center line geodataset. Tax and License geocodes locations of businesses. Public Works did refuse truck routing using street center lines. There are many more examples. Of all of the GIS datasets, one of the most used is the street center line geodataset.

The Importance of Address Standards

Addresses are the glue that holds government data together. There are very few datasets not containing some form of address. They are used for linking data from different files and departments together; they are geocoded to become map features; they enable a GIS map user to zoom into a particular place on a map. Benjamin Franklin would be amazed with what has been accomplished with the addressing schemes he invented.

Addresses work best if they are complete and are used with consistent spelling and abbreviations, not just by a single department, or at a city level. Standardized addresses should be implemented at the county level to support their most stringent and important use, for emergency response. In an emergency, seconds count. If a confusing address, or a similar address to another one in the same county causes a mis-dispatch, lives could be at stake.

Following are some of the more important features of standardizing addresses:

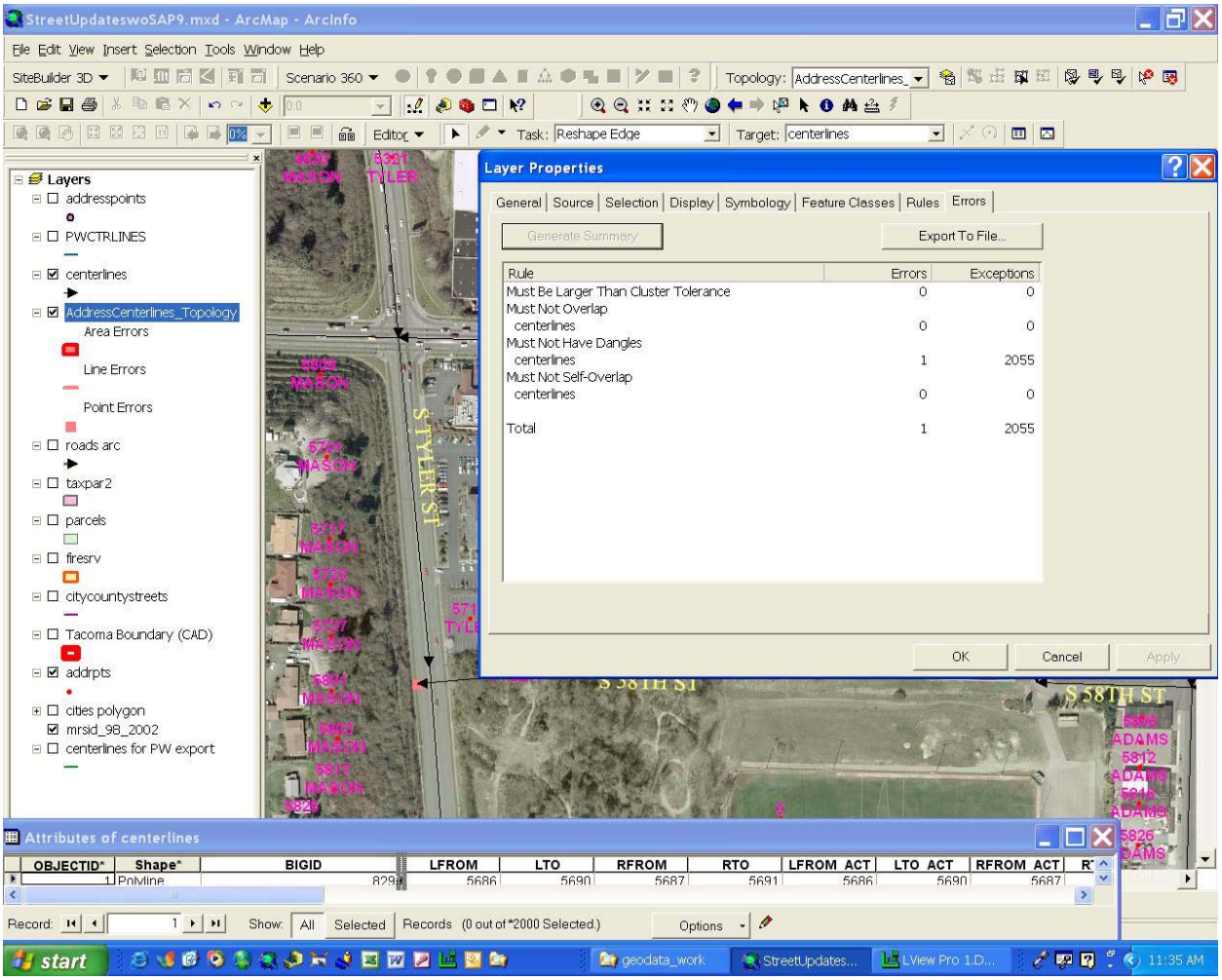
- A standard street name file used for editing the correct spelling and format of an address.
- Complete and up-to-date addresses updated before a plat is constructed. (There are rescue calls during construction.)
- Street signage that matches the correct format of the street name for accurate incident reporting from the field.
- Logical address numbering grids.
- House and building numbers present and visible.
- No similar street names in different localities that could cause confusion.
- No difficult to pronounce street names.
- A county-level ordinance governing the process of naming streets with a board having authority to approve or deny street name proposals.

Addressing should be driven from a public safety point of view first, and must meet the standards required for emergency services. Other standards come into play, too, such as industry standards for cellular phones. More than 40% of Tacoma's 911 calls are from cell phones. With the current Phase I wireless standards, a call back phone number is captured by the dispatch system but no address is captured. Land line phone calls automatically download the caller's address to the dispatch system. By the end of 2005, Phase II wireless data will provide the location of the caller based on GPS coordinates. This will speed up dispatch time because the dispatchers will no longer have to type in the address by hand. The Tacoma Fire Department is beginning to get a few VOIP calls (Voice Over IP). In those cases, the address must be verbally verified before entering the call to assure that the caller is phoning from his or her residence.

Current Project Progress – Move the Street Center Line Coverage to a Geodatabase

The street center line coverage was converted to a personal geodatabase with topology. Previously, a standardized street name file did not exist, so the first step was to create one and do iterative review with the master addresser in Public Works and the Post Office until the street names were standardized. Zip codes were added as attributes to the street center line file, and a parcel-level zip code map was created to assist in getting the correct zips on the street file as well as with address points. Again, iterative work was done with the Post Office to verify zip codes; this resulted in both city and Post Office records being corrected.

Street center lines are edited with ArcMap. When a street segment is updated, the street name is verified against the street name table, and topology checks insure that there are no intersections that do not connect. Following is an example of a deliberate intersection error and how the dangling node is flagged in the ArcMap session. The red square marks the location of the dangling node at the end of the street segment. Topology insures that a street dataset has the data quality needed for a transportation network.



Technical Issues to Resolve in ArcGIS 9.1 Network

Node, arc, and polygon topology must work similarly to Arc/Info 7.1. These topological elements are used to calculate adjacent fire response zones, intersecting street names and address ranges, and to reconstruct the data into the 100-block record segments needed by the CAD software.

When the allocation model is run, currently it is run separately for each fire station to each intersection, then all of the resulting response time tables are merged together. There is potential to create the station-to-intersection matrix in a single network model execution with the new software. This functionality will be tested and has the potential to shorten the job stream.

Edit functions such as "Addresserrors" for flagging overlapping address ranges for a specific street name, are slated for ArcGIS 9.2 and have not been included with the initial release of the new Network. Determine if this edit will be done from a coverage format with the old network module, or if this capability has been written by another ArcGIS customer.

Data fields used by Network for cumulative response time and other network data will need to be captured on the main attribute table for street centers, not a related table. Decide how to integrate this need with the street center line data model.

Complex INFO programs will need to be rewritten in Python and/or handled with a modified data model. The INFO programs are used extensively to interpret topology relationships and to reformat the street center line data into the CAD text file import formats.

Turntables and elevation connectivity data fields need to be imported and tested with the new network editing tools for defining allowable turns. Many improvements have been put into the new Network software for managing turn data.

Conclusion

When the first GIS extract for CAD was written for a Prime 9955/II minicomputer using Arc/Info 5.0 in 1992, the job took 24 hours to run. As the system was ported to UNIX on a SUN computer, the process completed in 6 hours of computer time. On the current SUN Blade, it runs in 2 hours using Arc/Info 7.1. Although yet untested, similar improvements are expected as the GIS extract for CAD is moved to ArcGIS 9.1. At the time of the writing of this paper, the ArcGIS 9.1 Network software has just been released. Considerable progress on this project is expected by the time the paper is presented on July 27, 2005.

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