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Vermont Moves Forward on E-911 Rural Addressing

asked with a mandate to establish a statewide enhanced 911 system by July 1997, the Vermont Enhanced 911 Board is mapping rural addresses using Global Positioning System (GPS)/GIS technology. By the project’s completion, every participating municipality in Vermont will be addressed, a statewide GIS will be developed and a master street address guide (MSAG) will be created. The finished MSAG will be combined with telephone company records to become an automatic location identification (ALI) database—the primary E-911 database.

For the Vermont Enhanced 911 Board, the first step in developing the rural addressing scheme was acquiring accurate state road maps. Fortunately, much of the road map data already had been compiled in GIS format by the Vermont Center for Geographic Information (VCGI), Burlington, Vt. In addition to providing road data in GIS format to municipalities, VCGI helped the E-911 Board establish standards for municipalities to follow in developing and maintaining local GIS databases that would support community-enhanced 911 systems. VCGI assisted the 911 Board in its bid solicitation process, which led the board to contract with GeoResearch Inc., Bethesda, Md., and microDATA, St. Johnsbury, Vt., for the rural address field mapping project.

Based on a cost/benefit analysis of the five submitted proposals, the board concluded that a plan incorporating vehicle-mounted GPS with drive-to-drive field data collection and GIS-assisted address assignments with modifications was the fastest and most accurate method.

The Addressing Plan

Because addresses are used by many community members, it’s important that 911 committees cultivate good working relationships and communication with all stakeholders, including the U.S. Postal Service (USPS), emergency service personnel, town governments, regional planning commissions (RPCs), utilities, local businesses and citizens. According to consulting firm Spatial Data Research, Cedar Hill, Mo., which analyzed addressing alternatives for the Vermont initiative, communities often use the 911 addressing implementation as a funding source for mapping applications that eventually may be used by utilities and other government agencies for different purposes. Politics may undermine addressing plans’ logicality, but the plans must be in place and accepted by all stakeholders before a field addressing project starts.

The 911 Board’s goal was to guide development of regional addressing plans through established standards and assistance. By coordinating regional plans on a statewide basis, personnel traveling within the state will understand the addressing schemes and not get lost.

Road Naming

After the addressing plan is established, road naming or identification must be conducted before field crews proceed to map address locations. For example, two roads that join may have separate names initially, but may be changed to a single name after field addressing. Such a situation may require crews to return to the field for readressing and renotification. The road naming approval process also can become politicized. Spatial Data Research recommends allowing local residents to name roads whenever possible and presenting for public comment maps showing approved road names before field work starts.

Database Construction

The GIS provides links to several databases and map layers that will compose the 911 system, including the road-naming database, addressing-plan database, community boundary database, emergency service zone (ESZ) database, the Public Safety Answering Point (PSAP) jurisdiction database, the address calculation database and the MSAG database. Also linked to map locations are such attributes as occupants’ names, old mailing addresses, new mailing addresses and phone numbers. ESZ boundaries frequently need to be researched and verified during field work. Community boundaries are used in constructing the MSAG and more closely resemble ZIP-code boundaries, but they might not coincide with legal community boundaries. Defining and maintaining these boundaries in the GIS is a challenging task.
**Vermont's Implementation**

After the 911 Board chose a method for addressing and mapping, a bid solicitation was sent to interested vendors in August 1995. The GeoResearch/microDATA technical plan specified an integrated series of tasks distributed among the vendor team and the 12 participating RPCs, which performed all aspects of town coordination, including completion of the road naming project. The vendor team completed the field data preparation, CPS data collection, GIS post processing and cartography tasks. Teamwork, communication and coordination among all parties involved in the project was a key factor in the project's ultimate success.

The technical plan divided the project into six essential stages.

Stage 1: Road Naming and Town Coordination

The formal road-naming task was performed by the participating Vermont municipalities with assistance and guidance from the RPCs. Fortunately, a Vermont Department of Health road-naming project was under way in several areas, providing a rapid start for the E-911 project. To assist each town, the RPCs prepared sets of composite town road name maps and sets of tables listing road names by highway number. One map type also showed ZIP-code boundaries for confirmation by the postmaster.

At the first meeting between an RPC and each town's 911 committee, these town maps were distributed and town personnel were told how to gather and update map information. Three map types were used to enter three separate information classes: (1) road name update and preferred direction; (2) ZIP-code boundary review and postal carrier route entry (general path); and (3) ESZs for law enforcement, fire protection and emergency medical services. In several cases, towns had to update original maps with new housing developments not shown on the maps.

Stage 2: Preparation for Field Operations

To prepare for field operations, a combination of existing data and field data was used to develop a fully populated database while reducing costs by minimizing the number of site visits required. GeoResearch's GeoLink GPS/GIS field mapping system made all existing data available for querying, updating or editing in the field while real-time GPS coordinates and field observations were collected.

Preparation of data for field use began with the entry of USPS edit sheets into a dBASE data file in the GeoLink field computers. A unique number relating the USPS address locations with GIS site data was established. Town, postal and existing digital data were combined to form a uniform dataset for field viewing and updating.

To reduce the number of home sites requiring visits during field data collection, brightly colored cards were delivered to post office box holders notifying them to place the card in a window facing the driveway or tack it to the house during the CPS/CIS data-capture field work. This procedure sped the work of data-collection field crews.

Stage 3: Field Operations

GPS address coordinates were collected with laser rangefinders used to record offset bearings and distances from the vehicle-mounted GPS receiver/antenna. This approach allowed the field worker to capture coordinate points within view of the vehicle without exiting the vehicle. The bearing and azimuth data were processed in GeoLink to determine the site's precise coordinates.

Street-style addressing must be in place in rural areas so emergency personnel can respond to calls.
For sites visible from the road, access points (GPS points) and actual building site locations (offset points) were captured in a single operation. For sites served by long driveways and sites not visible from the road, two alternative methods of mapping were used: (1) field workers captured driveway line work and site points using GPS by driving to the site along the private driveway, and (2) if the driveway and site were visible on available digital aerial photography, field workers screen digitized information to record coordinate locations.

The three types of addressing coordinates were (1) access coordinate point (Type A), the point of access to the structure from the road; (2) building coordinate (Type B), for locations where building site density is high and where using the structure’s actual location would improve locating the site (commonly used where houses were separated by less than 50 feet, or for two adjacent houses that shared the same driveway), and (3) driveway node on the road (Type D), for structures with long driveways, driveways serving obscure sites or single driveways serving multiple sites.

Each site was assigned USPS address identification, the road name number, type of site and type of address capture used (access, building or driveway).

Stage 4: Processing, Database Development and Draft Maps
Field-collected data for the project were uploaded daily to an electronic bulletin board system (BBS) for review by the director of field operations. Problems identified during the review were posted on the BBS for confirmation and recapture as required, allowing rapid field data integrity checks so corrections could be made while the data were fresh in the minds of field crew members. After road names, road centerlines and address coordinates were complete and quality checked, addresses were generated using the dynamic segmentation feature of Redlands, Calif.-based ESRI Inc.’s ARC/INFO GIS software. Special software routines were developed using ESRI’s Arc Macro Language to ensure that odd/even numbers were generated appropriately based on the left/right road side designation of the address coordinate.

After town ESZ and ZIP-code polygon coverages were finalized, address points were automatically updated. Following this step, all new address components were reviewed by the town and used to generate the MSAG. Draft map atlases covering the entire town in a series of 11-by-17-inch maps at 1:10,000 scale also were generated and provided to towns for review.

Stage 5: Town/Postal Addressing Review
During this phase, the RPCs formally reviewed the new address data. The GeoResearch/microDATA project team developed a special program to provide a straightforward means for RPC personnel to review, edit and confirm existing and new addresses. For example, the program provided data filtering capabilities that enabled users to view only unconfirmed addresses. The program also supported data record sorting by new addresses, occupant name or an identification based on the existing address. Address edits were made to the data records, and features requiring spatial updating were marked on the draft atlas map sheets for updating by the contractor.

Stage 6: Final Update and Delivery
After all edits were made, address geocoding was conducted by building address coverages in ARC/INFO. For towns with existing addresses, the draft maps included address ranges. For towns in which all new addresses were generated, the draft maps displayed individual addresses and 1/100th-mile hatch marks along the road. If a change was entered, final address ranges were generated directly from the route system, displayed on the final maps and included as an address coverage in the final GIS database.

The Vermont Enhanced 911 Board is well down the road to implementing the first statewide enhanced 911 system. Cooperative community efforts, effective project management and the use of GPS/GIS technology appear to be a winning formula for producing a statewide E-911 system on time and within budget.