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GIS and Paratransit

Map-Based Solutions Respond with Efficiency to Paratransit Operations Demands

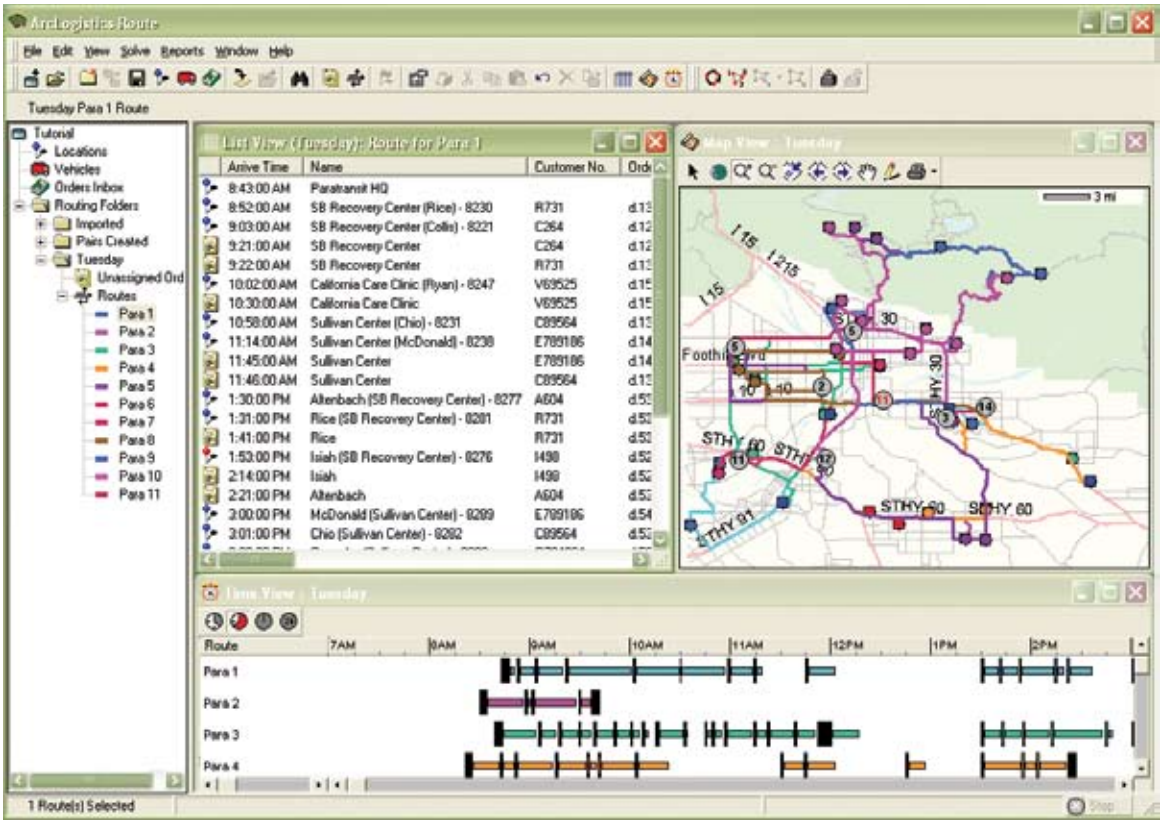
By Karl Terrey and Susan Harp

From crime-scene investigations on television to home-buyer guides on the Web, using digital maps to communicate information is becoming a household concept. Now paratransit operators and other demand-responsive transportation agencies can tap into this useful technology, too. As noted at the recent Community Transportation Association of America Expo in Orlando, Fla., many companies are offering map-based software solutions for smaller-scale, demand-responsive transportation agencies. That's good news for paratransit operators who want to reduce costs, improve safety and increase customer satisfaction.

Digital maps that include detailed information about transportation infrastructure have made it possible for a myriad of support systems to offer improved routing and scheduling applications, vehicle tracking applications, in-vehicle navigation terminals and distance calculators. The many applications are based on geographic information system (GIS) technology and provide real benefits for the agencies, drivers and, ultimately, the riders and the community.

Through the use of GIS technology, agencies and community transportation organizations offering paratransit services can save money, improve their on-time performance, and know exactly where their vehicles are at all times. Some applications contribute to improved driver and rider safety. Others give managers tools to better collect and understand performance metrics for feedback and reporting.

"Map-based technology is being fine-tuned to the point where it makes financial sense for any paratransit operation to use the technology," says Brett Lim, marketing director for Radio Satellite Integrators Inc. (RSI). RSI is a Torrance, Calif., company specializing in automatic vehicle location utilizing global positioning system (GPS)



An Arc Logistics Route software system customized for paratransit activities displays a map of the day's color-coded routes for the fleet (top right), a vehicle's manifest with scheduled arrival times and customer descriptions (left) and the fleet's daily timeline overview (bottom).

and GIS technology. "The fact that GPS and wireless technology are a lot more prevalent in the everyday world is also helping operations like these assimilate the technology," adds Lim.

A few key technical trends have made transportation applications more effective. Commercial street databases are increasingly available and are less expensive. Growth in "Intelligent Transportation Systems" technologies has also improved access to local traffic, weather and emergency services data. Communication and coordination abilities have improved, thanks to technology that allows information sharing among loosely coupled systems using common data models.

ROUTING AND SCHEDULING TECHNOLOGY

Each day, paratransit schedulers spend hours shuffling options and requirements to come up with a workable schedule. A last-minute cancellation or request, however, can throw a monkey wrench into a smooth schedule. In the past, transportation schedulers probably viewed computerized routing and scheduling systems with skepticism because of the complex parameters involved. However, today, map-based software uses complex, definable algorithms that take into account realistic rules for both riders and vehicles. The new technology turns what used to be daunting routing problems into easily manageable exercises that lead to more efficient service.

Demand response routing performed all day "on the fly" is incorporating geographic data to improve automated decision making. "The greatest challenge is making GIS and the related schedule and dispatch tools easy to use for everyday users," says Tim Quinn, executive vice president at RouteMatch Software, an Atlanta, Ga., transportation and logistics software engineering firm focused on the paratransit and demand-response industry. A modular architecture approach allows customers to start small with basic data management and grow into fully automated scheduling, dispatching, vehicle tracking and mobile data systems. RouteMatch applications address everything from planning a system to providing scheduling, billing and reporting solutions.

A good GIS-based routing system should easily allow the user to create an accurate benchmark model of existing scheduled routes. It then provides reports detailing miles driven, driving time and time per passenger on the vehicle as well as trips per hour, trips per route, miles per trip by route and so on. Once this benchmark exists, the user can add other customized business logic to improve routing efficiency further. For example, rules can be made for a wheelchair-accessible vehicle to pick up a wheelchair-bound passenger at a specific location within a 15-minute time window and allow an extra eight minutes for the stop. Optimization includes the allocation of all requested trips among available vehicles, not just the sequencing of stops on an individual route.

Costs of such systems can seem expensive for very small operators, but the benefits can be well worth the investment. The San Diego Regional Center (SDRC), which organizes paratransit services for two counties in Southern California, saw a 32 percent increase — from 4.4 to 5.8 — in the number of trips completed per hour after switching from a paper, grid-coordinate routing method to a customized GIS system based on ESRI software comprised of ArcLogistics Route, ArcView and the ArcGIS Network Analyst extension.

SDRC personnel used ArcLogistics Route to create optimized routes that maximize the efficient use of their vehicles and result in cost and time savings. They knew the number of stops their vehicles must make and the service areas that contain those stops. They used the software to create routes that make the best use of their vehicles and optimize time spent on the road.

"First, we were able to get a much clearer understanding of how our system worked," says Bernard Arroyo, SDRC transportation coordinator. "Second, we were able to effectively use the limited resources that were available in the community. In that respect . . . it's been well worth the money the agency paid."

In addition, if the stops change during the day, the software can be used to create opti-

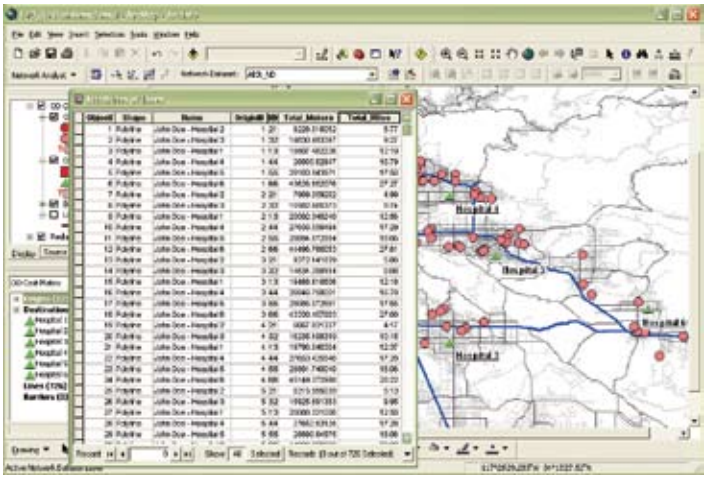
mized routes on demand or on the fly to redesign a route in progress. The newest version offers enhanced parameters for routing choices. Orders can be assigned priority, time windows can be flexible or fixed, and service orders can have defined grace periods to be considered "on time." ArcLogistics Route comes with Tele Atlas Dynamap/Transportation, a high-quality U.S. street database that includes transportation infrastructure details such as one-way streets, physical turn restrictions, improved ramp structures and calculated speed information.

However, paratransit agencies using automated scheduling need to know that training is critical to success and return on investment. No matter how simple the application's user interface, successful routing solutions are ultimately dependent on the people using the application. When S.C.M. Elderbus Inc., a nonprofit paratransit company serving central Massachusetts, first implemented RouteMatch TS software to automate scheduling, improvements were not immediately observed. However, after personnel received additional training, they successfully mastered the system. Time needed for daily scheduling fell by 72 percent, and it fell 75 percent for verification processes. Total driver hours were reduced by 12 percent per week and more efficient scheduling allowed Elderbus to eliminate one of its 23 passenger vans. Timothy O'Day, executive director at the company, estimates Elderbus saved more than $100,000 a year while providing service to 21 communities spread across 540 square miles.

VEHICLE TRACKING TECHNOLOGY

Knowing exactly where vehicles are at all times is becoming a necessity. Vehicle tracking using GPS technology not only makes service more efficient, it also acts as a security device for drivers, passengers and vehicles. On its own, GPS data is useful for managing assets. It is even more powerful when combined with a vehicle routing and scheduling system. Dispatchers can make sure a driver stays on the route and meets time obligations. If necessary, estimated times of arrival can be updated in real time and made available to riders, thus narrowing pickup and delivery windows.

Location tracking can integrate with in-vehicle navigation systems or other mobile data terminals (MDTs). Drivers can see their own vehicle's "blip" located on a digital map; they can also see part of or the entire day's route and generate on-the-fly driving directions. RSI, mentioned earlier, provides customized GPS-based vehicle tracking and mobile data systems using ultra high-frequency, two-way radio communications or cellular phone technology and GIS mapping software. Paratransit operators can benefit by using an RSI tracking system as a first step into GIS-based operations even before they tackle an automated routing and scheduling solution.



A table displays the distance (total miles) between a passenger's pickup point and destination, grouped by vehicle, as calculated by the ESRI ArcGIS Network Analyst extension.

The Whatcom Transportation Authority (WTA) in northwest Washington State chose an RSI solution to provide added safety measures for its specialized transportation fleet even though it was not using any other GIS-based solution. The 35-bus fleet provides paratransit service to ADA-eligible riders as well as the public covering both urban and rural areas. The RSI system tracks each bus's GPS signal and includes a panic button in each vehicle. Drivers do not carry a map viewer in the vehicle but do communicate with dispatchers who see all of the fleet's vehicles on a big-screen map display. When the panic button activates, dispatchers see a display of the vehicle's identification and location within moments of activation. The system has worked so well that WTA planners decided to develop a more fully integrated system and are currently working toward that goal.

> The maps help the drivers decide which highways to take or avoid.

"I think vehicle tracking whetted people's appetites for a fully integrated system," says Cris Colburn, WTA specialized transportation manager. "We could begin to show in more concrete terms the value of having real-time information in such a dynamic service. Directors and board members could better understand and visualize what an integrated system would mean. They could picture that, when traffic is bad out by the mall and delays vehicles by 10 or 15 minutes, how great it could be to see how that might affect the next hour of everyone's schedules."

IN-VEHICLE NAVIGATION

GIS-based technology also helps increase driver productivity with the use of color touch- screen Mobile Data Computers (MDCs) installed in vehicle cabs. GreyHawk Technologies Inc., a systems integration company located in Vancouver, Wash., specializes in MDCs for paratransit drivers who use specialized vehicles with wheelchair lifts to pick up and drop off elderly and disabled people. The onboard GPS is used to show on the touch-screen map exactly where the vehicle is located. With the touch of a button, the touch-screen system calculates turn-by-turn directions to get to the next stop and graphically displays the suggested path with blue highlighting on a map. "This is ideal for newly hired drivers or substitutes because all they have to do is follow the blue line," says Terry Colson, vice president of sales and marketing for GreyHawk.

To help drivers safely follow the blue line, GreyHawk developed the Follow Function. In this mode, the vehicle icon remains stationary in the middle of the map screen and always faces toward the top of the screen (straight ahead). As the vehicle moves along the streets represented by the blue line, the map rotates underneath. That way, if the blue line shows a left turn, the driver turns left and the map rotates underneath. This allows drivers to glance at the map to see upcoming turns in the same perspective as the view through the windshield, thus eliminating any confusion about which way to turn. "The chances of making a wrong turn in the Follow Function mode are slim to none," says Colson.

In Seattle, Wash., the paratransit drivers for Metro Transit have the added advantage of pushing a button on the GreyHawk touch screens to see the latest traffic information, usually less

than 10 minutes old. The system accesses the Washington Department of Transportation's Web site, pulls raw traffic data and plots it on the map with color-coded bands that represent congestion levels on the highways. The maps help the drivers decide which highways to take or avoid.

DISTANCE CALCULATIONS

A table displays the distance (total miles) between each passenger's pickup point and destination, grouped by vehicle, as calculated by the ESRI ArcGIS Network Analyst extension. Transportation providers can use the data to prepare accurate reimbursement requests.

For some agencies, accurate distance information is key to receiving maximum reimbursement from federal or state agencies on a per-mile, per-passenger basis. With geocoded street addresses becoming common, it is now possible to generate very accurate calculations of distances between hundreds of locations. GIS technology allows for batch processing of addresses and will generate a table of distances used for accurate reimbursement for every passenger transported.

APPLICATION SERVICE PROVIDER

A cost-saving alternative for building an automated scheduling and dispatching system is to subscribe to an application service provider (ASP) such as Trapeze or RouteMatch. The entire application, including the database and data, resides on an off-site, secure server. Access is over the Internet using a Web browser.

Trapeze's NOVUS solution uses thin-client technology to enable all business logic and data to reside on a central server, which reduces initial investment costs and simplifies implementation and maintenance. NOVUS also provides a client management system and custom report generation. The system is based on proven Trapeze scheduling algorithms and offers the full range of scheduling, tracking and navigation capabilities.

In addition to reducing costs, an ASP provides the ability to share information with others. The Northern Shenandoah Valley Public Mobility Program took advantage of RouteMatch's ASP solution when it set up a centralized, Internet-based system for several agencies that serve this rural northern Virginia area, which is spread over more than 1,650 square miles. Now, when one agency receives a trip request, it can check on not only its own but also other participating agencies' vehicles for available slots.

Transportation GIS in general is growing from primarily planning-only systems to operations support systems that integrate scheduling, routing, vehicle tracking, navigation and reporting. A modular approach using software built on compatible standards makes it easier for paratransit agencies to reap immediate benefits with an initial application. This approach also helps agencies build confidence in using GIS technology and create a successful example that can support further integration.

The most obvious time-saving application is probably automated routing and scheduling because it can replace tedious hours of manual labor. However, integrated GIS-based applications — such as combined routing, scheduling, vehicle tracking and real-time mapping applications — can greatly increase efficiency and savings. ■

Karl Terrey is the ArcLogistics route product manager for ESRI, and Susan Harp is a marketing writer for ESRI.

ESRI
380 New York Street
Redlands, California
92373-8100 USA

Phone: 909-793-2853
Fax: 909-793-5953
E-mail: info@esri.com

For More Information

1-800-GIS-XPRT (1-800-447-9778)

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