CASE STUDY - USE OF GIS FOR AUTOMATED VEHICLE LOCATION (AVL) – NEWTON POLICE DEPARTMENT

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The Police Department at City of Newton, Massachusetts has recently implemented an Automated Vehicle Location application utilizing the city's pre-existing GPS/AVL hardware. The implemented solution leverages the city's existing GIS map data to provide a rich display of thematic map information critical to the emergency responders. The application not only allow dispatchers to view current vehicle activity in real time against a map display but allow police personnel to view the same information in police cars and record activity for replay. In addition, the application will pull call incidents in real time from a Computer Aided Dispatch (CAD) system to display incident locations and police units that are dispatched to respond to those calls. The final application will allow dispatch personnel to know where all police units are located at all times and where incident calls are coming from to make better judgment on which units are best assigned to respond to those calls.

Introduction
Newton, Massachusetts is a city of approximately 85,000 residents located just outside of Boston. Although Newton can trace its roots back to 1630, its police department is definitely in the 21st century.

Officer Geagan has been a police officer with the Newton Police Department (NPD) for 20 years and has been using GIS in his work with the Information Technology Bureau for the last ten. But lately things in "IT" have gotten more interesting than ever. In this paper, Officer Geagan will share some of the anecdotes and experience in introducing GIS in general and Automatic Vehicle Location (AVL) specifically to the Newton Police Department. Mansour Raad and Ewe-Leng Lim are both principals from the Institute of Information Technology, Inc., a company headquartered in The Woodlands (Houston), Texas.

Background
NPD had done some computerized mapping before, but nothing to the extent of what they are doing now. NPD has weekly COMPSTAT meeting where all crimes and incidents are mapped out and analyzed for patterns. Anything you can think of gets mapped. Last year NPD contracted with ESRI to do a direct interface into our records management system resulting in a real-time crime mapping system. Anyone from the chief right on down to a patrol officer can access the program and query the database to be shown geographically on their computer exactly where in the city a crime or incident took place. Information can also be pulled up based on a list of the incidents that are hyperlinked right into the CAD/Records Management System. So not only can you see where the crime took place, but also read the incident report. "You can look behind the dot" as the chief says.

Both Officer Geagan and his immediate supervisor, Sgt. Thomas Demeo, credit the new Chief of Police, Jose M. Cordero, with many of the initiatives that the IT Bureau has or is about to unveil. Chief Cordero came from the New York City Police Department in 2002 and was very technologically oriented.

The Information Technology Bureau was only recently expanded when Chief Cordero came here. The chief has given NPD the means and the resources to do a better job and the department is meeting that challenge.

Discovering GIS
Like many users in many fields, Officer Geagan first discovered that GIS was a great tool to convey information intuitively to others, and over time, he began to dedicate more and more time to exploring its potential.

One of his first experiences with GIS was trying to show the relationship between a crime scene and the arrest location. Back in the early 1990s, there was a reported car theft that developed into a pursuit. The suspect ended up bailing out and ran down into a park and was subsequently arrested about a mile away. If you didn't know the area, based on the time and the distance, you might think that this couldn't be the guy.

Officer Geagan went over to City Hall and met with the GIS administrator. The GIS Administrator pulled up the area on his computer screen using ArcView to display all the detailed information that could be retrieved. When the map was analyzed and plotted with information from what witnesses had reported, they were able to show that the distance was not that great because it was not a straight line. When the case went to court, the plotting and display of distances was one of the key pieces of evidence that led to a conviction. Since then Officer Geagan has been asked to provide detailed maps to colleagues for numerous cases.

In the mid-1990s, a gang of men were chopping up sections of copper cable on the Massachusetts Bay Transit Authority (MBTA) Green Line when the line was shut down for service after-hours, and would then sell the copper to salvage yards. One of NPD's officers found the guys in the act of cutting up the cable and made an arrest. The arresting officer asked Officer Geagan for maps and aerial photos of the area. Because of the type of display made possible with GIS maps the case never even made it to a jury.

The day of trial, Officer Geagan brought the maps and aerial photos with to court. Before anyone was in the courtroom, the maps were inadvertently laid them out on the defense attorney's table. Officer Geagan was showing the photos and maps to the district attorney. The MBTA inspector who had been assigned to

the case came in and started pinpointing where the cable had been cut and taken up. We were able to show the exact sections of the track affected in relationship to where the officer stopped the suspect in a van. The defense attorney, who was standing behind us, had seen the maps and photos and decided to call for a sidebar right then and there and pled out the case.

In addition to court cases, the Newton Police have put GIS to use in many ways resulting in increased efficiency.

NPD redistricted their patrol areas this past year by mapping out calls for service, and shifted the patrol areas slightly to balance the call load per car, and per shift. This enabled NPD to free up some cars for other uses. Some tasks that would have taken hours were accomplished in a fraction of the time. For instance, in the Commonwealth of Massachusetts there is an additional charge when caught selling drugs within 1,000 feet of a schoolyard. These areas are called 'Drug-Free Zones'. One of the first things Officer Geagan did when that law became effective was to come up with 'Drug-Free Zone' maps especially for their drug unit so they could see the 1,000-foot distances. Without GIS, doing it with a ruler to measure out distances would have been quite a task. With GIS, these maps look professional, take less time to produce and are very easy to certify for court purposes through the GIS administrator.

The Next Phase – Automatic Vehicle Location
Along with introducing and implementing COMPSTAT to the department the NPD Chief was very interested in Global Positioning Systems (GPS). GPS would allow NPD to see where the units were in relationship to a crime or incident so that we could dispatch the closest unit. The timing couldn't have been better. We had just begun researching the different types of services that where available with the intent of moving from our Radio Frequency (RF) data network to a Cellular Digital Packet Data (CDPD) one. The IT bureau started looking into different solutions that would meet all of their needs of passing data and a GPS signal using one modem. NPD looked at a number of different turnkey solutions but none of them could really make use of the ESRI data that we had and was within their budget. NPD decided to look for a vendor that would be willing to work with them and develop a system using the type of hardware along with making use of the extensive ESRI databases NPD had built. ESRI's regional office in Boston recommended the Institute of Information Technology (IIT), an ESRI business partner who has had great success in implementing automated vehicle location (AVL) services for large fleets.

IIT was selected to provide a solution that would interface with their Computer Aided Dispatch (CAD) system. When a call for service comes into the communication center a dispatcher will enter it into the Computer Aided Dispatch System. The AVL solution was developed to do routing very quickly and efficiently – not based on how the crow flies, but on actual, real time conditions of routes to and from a scene. For example, if an officer is responding to a call and some routes are blocked by fallen trees, poor or flooded road conditions, etc., the officer could then be re-routed around that obstacle.

It was important for NPD to get the information out to everyone who needed it.

The officers on the street have the data as well using a MapObjects application. It is in sync and live in the cruiser. It also provides all the parcel data – for instance, by knowing where the call is made, the officer can tell that a house has three bedrooms and three bathrooms. So if the officer were executing a search warrant for drugs, he would know how many officers he'll need to cover all the entrances, exits, hallways, bedrooms and bathrooms when they conduct that search.

The system will also have a direct effect on the safety of the officers. Even a routine traffic stop can escalate and turn life threatening very quickly. Pinpointing the location on a mapping display of an officer whom is in need of assistance or where an incident is taking place may have taken minutes before. Now it takes only seconds.

The AVL system supports a multitude of real world situations that involve the dynamic tracking and display of vehicles and the real-time communication of route changes to need-to-know personnel, whether they are in the field, in transit or at operations headquarters. Example scenarios include the tracking of police, fire, and other emergency response units.

GIS/AVL

The IIT AVL application implemented at NPD consists of two separate modules – a web based DispatchView and a stand-alone application VehicleView that can reside on a ruggerdized laptop in the vehicle. The web based AVL solution is based on ESRI's ArcIMS technology. One of the key challenges in an AVL solution is dealing with low bandwidth issues. The VehicleView allows for the rich map display and functionality to be available in the vehicle in spite of low cellular bandwidth issues encountered in most in-vehicle communications equipment.

The AVL application has the flexibility for the use of existing street network and other GIS layers such as Orthophotos, Fire Hydrants, Parcels, Water mains, Sewer mains, etc. that may be available to the organization.

The basic functionality of the AVL application include:
- Display all vehicle locations in real-time
- Integration with existing Computer Aided Dispatch (CAD)
- Display CAD call locations and types of emergencies in real-time
- Display status of responses to dispatched calls (in pursuit, on location, etc…)
- Filter type of vehicles and incidents for display
- Record history of vehicle activities (driven routes) for play-back and analysis
- Take snapshot of vehicle locations for easy retrieval and analysis
- Reside in vehicle, with low bandwidth communication channel
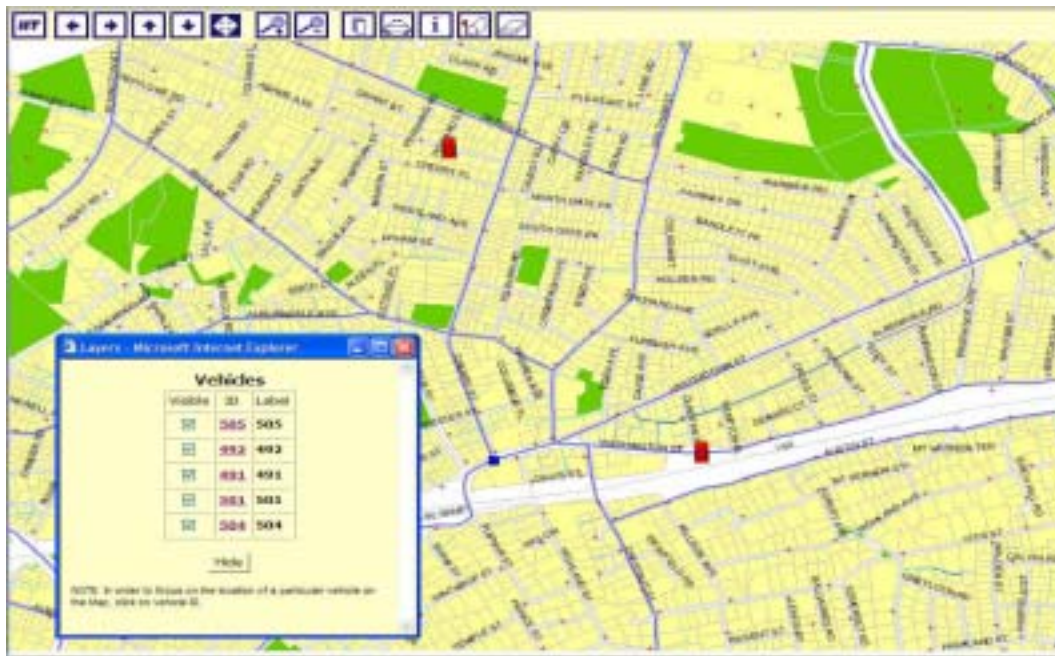
IIT AVL – Overview

The IIT AVL solution features:

- Java-based open-architecture using commercial off-the-shelf software- *can operate on any platform*
- Web-based - *accessible through a browser anywhere/anytime and yet limits need to know through a hierarchy of user privileges*

- Client-side components operating in and out of coverage area- *recording events for later transmission.*
- Client-side component hosting on a variety of platforms- *Windows XP, Windows CE, Palm OS, Unix, Linux, etc...*
- Server-side component hosting by any web server supporting Java servlets and JSP- *Apache, Tomcat, WebSphere, Iplanet, IIS, etc...*
- IIT AVL applications operating over a variety of geospatial databases- *Oracle Spatial, ArcSDE, MySQL.*
- IIT AVL applications – flexible and modular- enabling customization today and expansion tomorrow- *integrate territory analysis, route planning and prospecting applications*

Conclusion

The Newton Police Department has been very pleased with the system, that has been up and running for several months. Officer Geagan believes the patrol officers will adapt quickly to the new high-tech systems. There is much technology built into modern police cars. You have police radios with multiple channels, thermal imaging cameras, in-car video systems and a computer running multiple applications, so, limiting the number of tasks or buttons that they have to deal with is key. The AVL solution has been pared down to about 8 buttons that officers need to work with; using touch-screen laptops – zoom in, zoom out, pan left or right – and the information that they need to have is right there at their fingertips. Any useful information can be extracted and distributed to the officers in the field. In the words of Officer Geagan, "NPD has such a rich GIS database; not making use of it would simply be criminal."

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