Real-Time GIS Analysis in Patrol Units

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Abstract

As part of research activities, GIS capabilities are being added to a mobile client system located in patrol cars in order to study the effectiveness of the system to patrol officers. By incorporating these features into the patrol car, the officer will be able to perform immediate GIS analysis tasks in the field that would normally only occur at the station. The mapping system currently includes street centerline, parcel, and aerial imagery layers. The officer in the field can map addresses, view the aerial layout of an area such as the immediate area around an on-going incident and visually select a location or area on the map, and retrieve real-time call and/or incident information for that location or area. Real-time information is incorporated through wireless transmission to a server located at the police station which has access to the entire police database.

Background

Sam Houston State University has developed a Records Management System (RMS) for use in police agencies. The system includes a Computer Aided Dispatch (CAD) module as well as a link to remote information and retrieval system in the mobile units and is bundled under the name Criminal Research Information Management and Evaluation System (CRIMES). The system is currently utilized in several cities and counties in the state of Texas. Two of the cities are utilizing wireless technologies for remote access to laptops in the mobile patrol cars. From the patrol car, the officer is able to:

- retrieve call information
- enter call status (enroute, arrived, etc.)
- enter incident reports, and
- perform searches on the CRIMES database, including both call and incident information.

The overall CRIMES system is depicted in Figure 1 below, with immediate information from the CAD and RMS database being available to the patrol car through the wireless link.
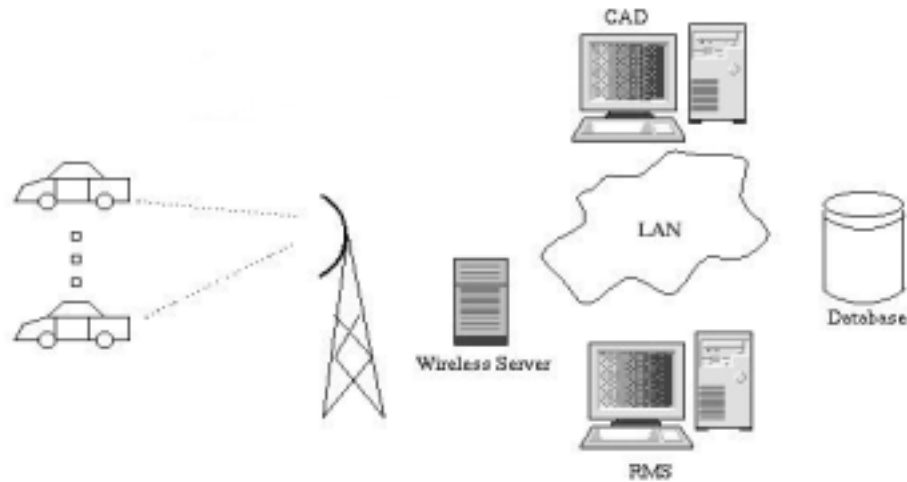
Figure 1: System Design

A client-server implementation was utilized for the mobile component of the CRIMES system. The client component is run in the patrol car while the server component runs at the station on the wireless server. CAD information is transferred to the wireless server which in turn transfers the information to the client program running in the patrol car. The officer utilizes the client program to send information back to the station through the wireless server. The server performs most of the compute intensive functions available from the mobile component. For example, when an officer initiates a search from the client in the patrol car, the search parameters are sent to the server program which actually performs the search. As the search is finished, the results are sent back to the client for display to the officer. This approach was taken because the server has a much more direct connection to the CRIMES database.

Geographic Information Systems (GIS) are becoming commonplace in law enforcement agencies, both for immediate location information and for longer-term crime pattern analysis. As a test to study the effectiveness of GIS capabilities in the patrol car, the mobile component of the CRIMES system was enhanced to include GIS functionality that would normally only be available at the police station.

Implementation Details

Both the client and server portions of the mobile CRIMES component were written as Delphi applications. The client utilizes ESRI's MapObjects as an ActiveX component for the mapping capabilities. The server acts as a gateway from the client to the database and therefore needs no GIS capabilities. The server provides real-time information to the client. For example, an officer can immediately see calls that have been made for that officer or any set of officers.

The two cities utilizing CRIMES that have wireless links are currently utilizing CDPD for the wireless link. As CDPD is a low-bandwidth transmission mechanism, care must be taken to limit the amount of information that is sent across the wireless network. Searches from the patrol car are limited so as to not return too many results as it is infeasible to send large amounts of data, images or GIS layers across the network.

The GIS subsystem of the client currently includes street centerline, parcel, and aerial imagery layers. All three layers are resident on the laptops. Currently, the must be manually updated when necessary to avoid sending large files over the CDPD network. It is anticipated that as the wireless network is moved to a faster transmission mechanism or a 'hot-spot' system is developed with localize high speed transmissions, that we will incorporate automatic updating of the layers.

The initial pilot GIS program was developed for the city of Colleyville located in the Dallas-Fort Worth Metroplex. Colleyville currently utilizes a non-GIS mobile interface program. As the GIS version is completed, a test of the system at Colleyville will be undertaken.

Figure 2 showing street centerline along with Figure 3 showing centerline, parcel and aerial layers are given below.
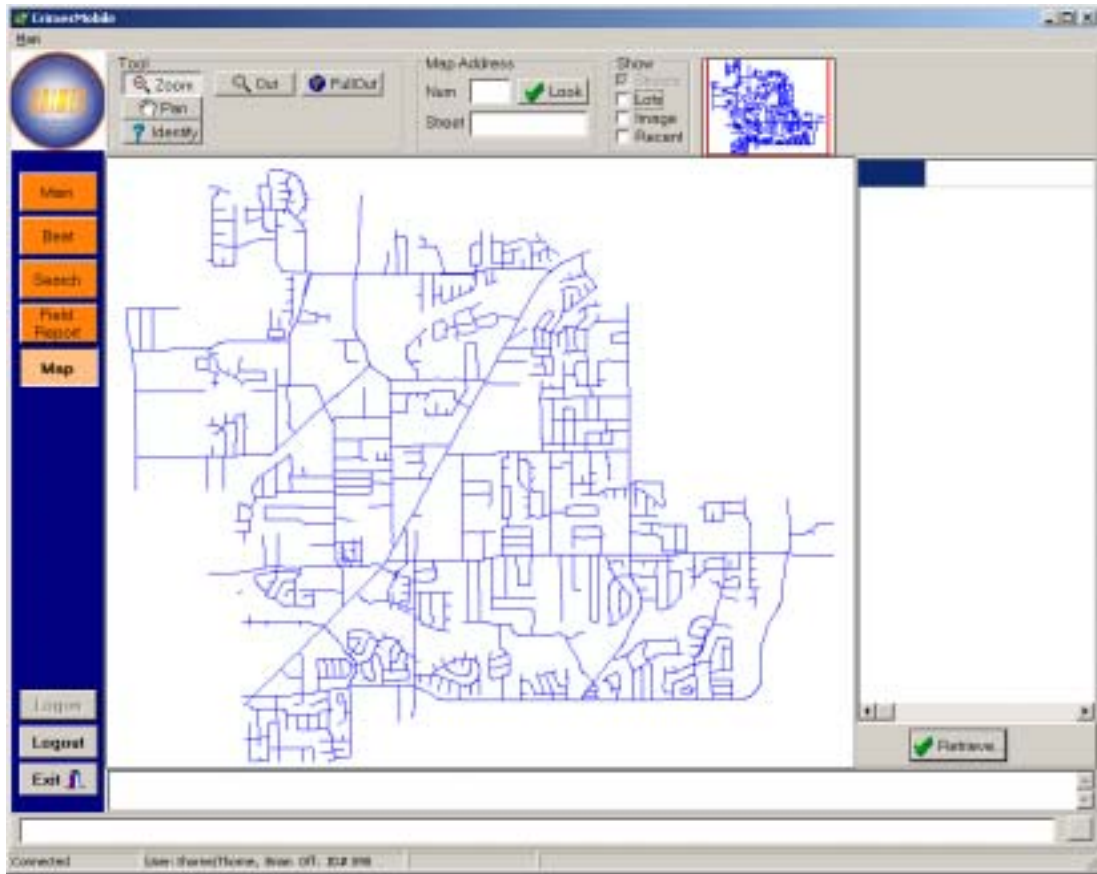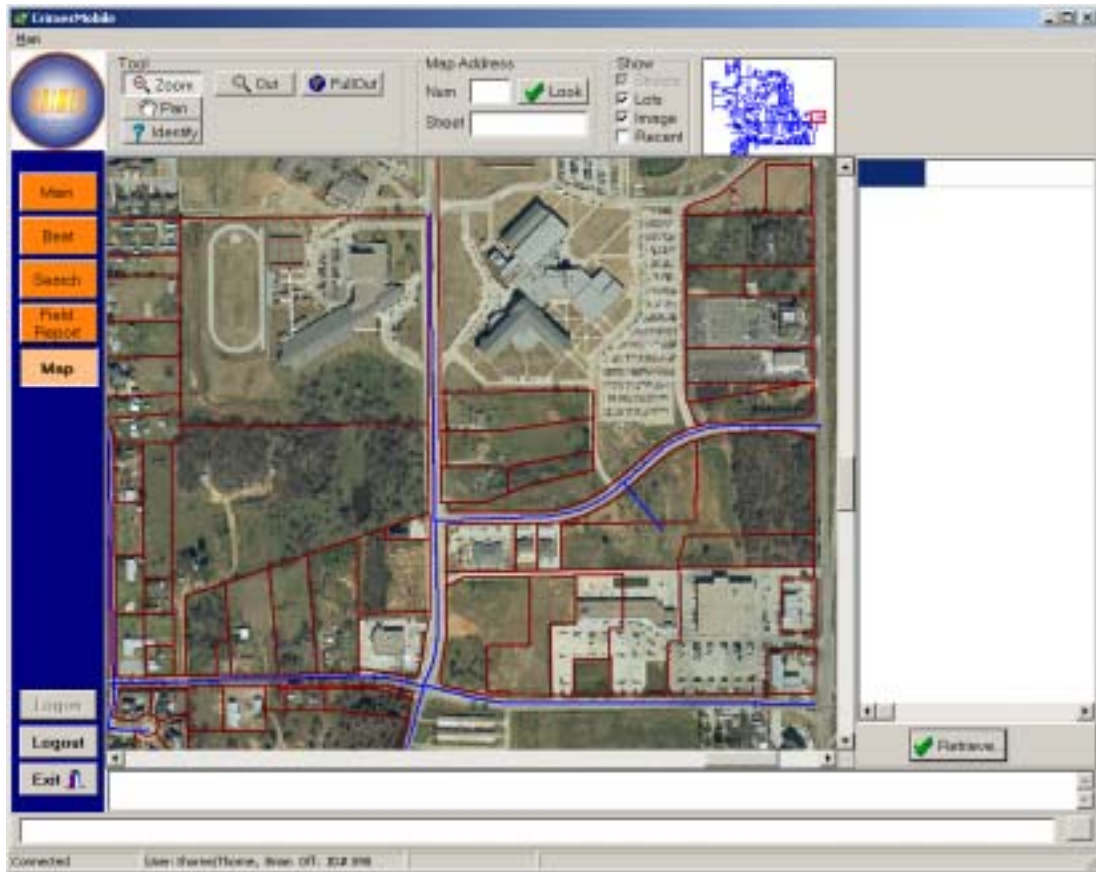
Figure 2: Street Centerline

Figure 3: Centerline, Parcel and Aerial

Care was also taken to make the mobile program interface as simple as possible as the laptops in the patrol cars are rather difficult to use compared to standalone workstations. Buttons are easily accessible and simple mechanisms must be utilized to return information with as little effort as possible. The laptop computers in the patrol cars are also limited by screen-size issues.

Along with the general use of the maps for information purposes, functionality was built into the system to allow the officer to:

- Map any address. This includes immediate call location, locations of any citizen currently in the name file of the CRIMES database and locations of any business in the database utilizing common names for the businesses. The system is linked so that the officer can perform a search and with one click see the address mapped using parcel and/or street centerline approximation. Geocoding accuracy is highly dependent upon the input method for the address. Addresses already within the CRIMES database show a good accuracy rate but could be improved with further tie in of the CAD system with GIS functionality.
- Select a lot (parcel) or set of lots utilizing either a single point click, a rectangular selection box or an arbitrary distance from a single point.

- Look up ownership and other information for any lot. Information is shown from the tax parcel layer.
- See addresses of a recent call or a set of recent calls such as all calls within the last 8 hours, all within the last 24 hours, recent calls for individual officers, etc. The geocoding is done 'on-the-fly' with real-time data obtained from the database.
- See all service calls or incident information for either a single lot or a selected set of lots. For example, select a neighborhood and see all calls in that neighborhood. Or select a location such as a school and see all calls within some distance of that school. The call information is obtained in real-time from the CAD subsystem of CRIMES.

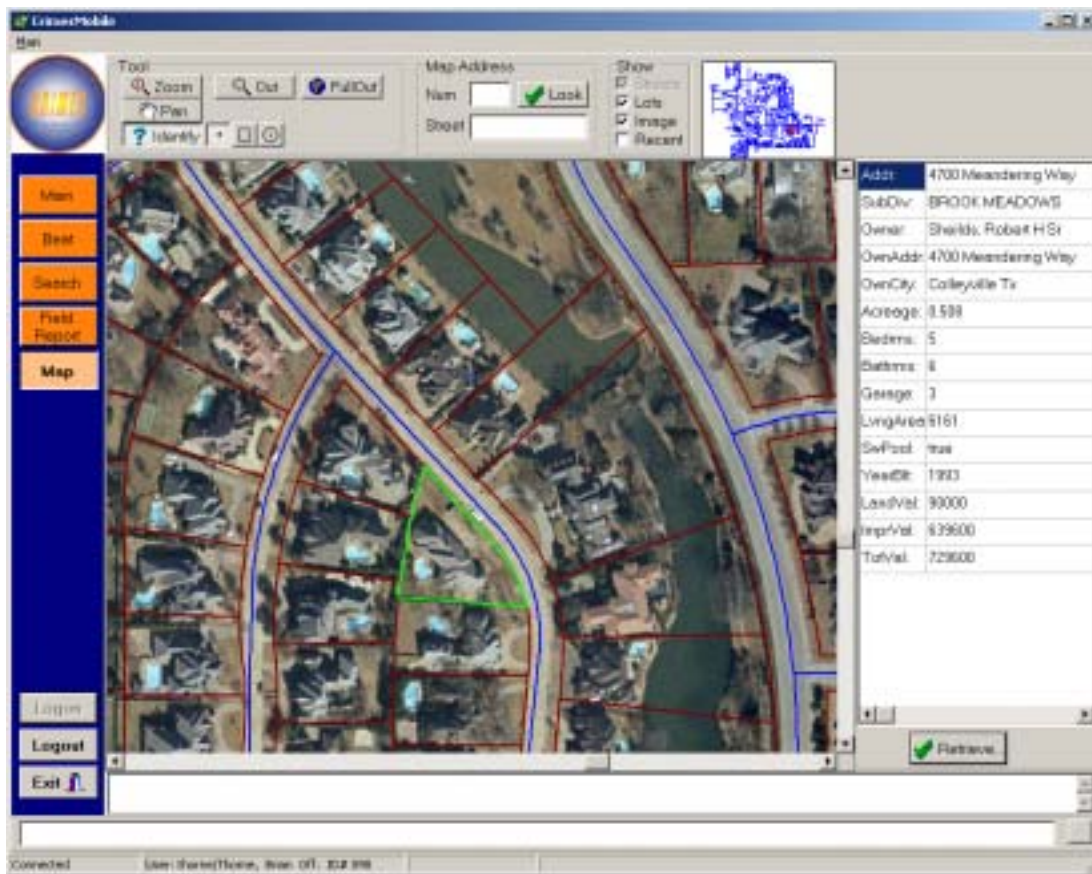Figures demonstrating much of this functionality are given below.
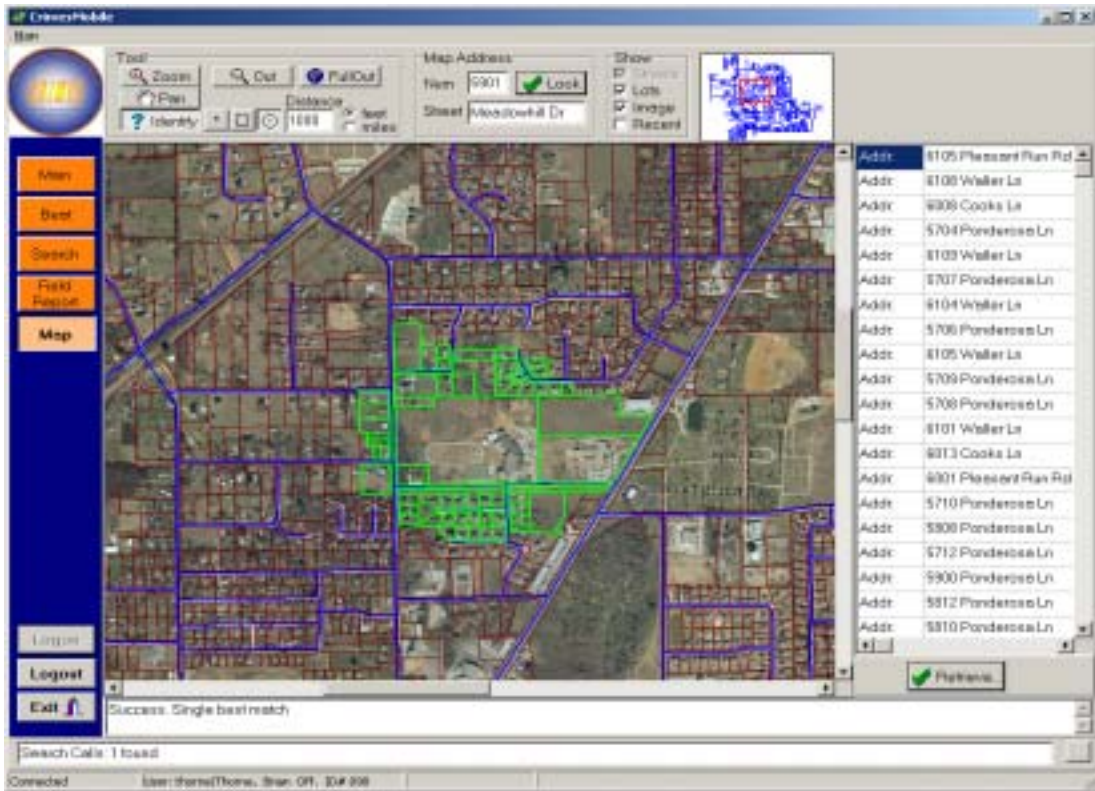

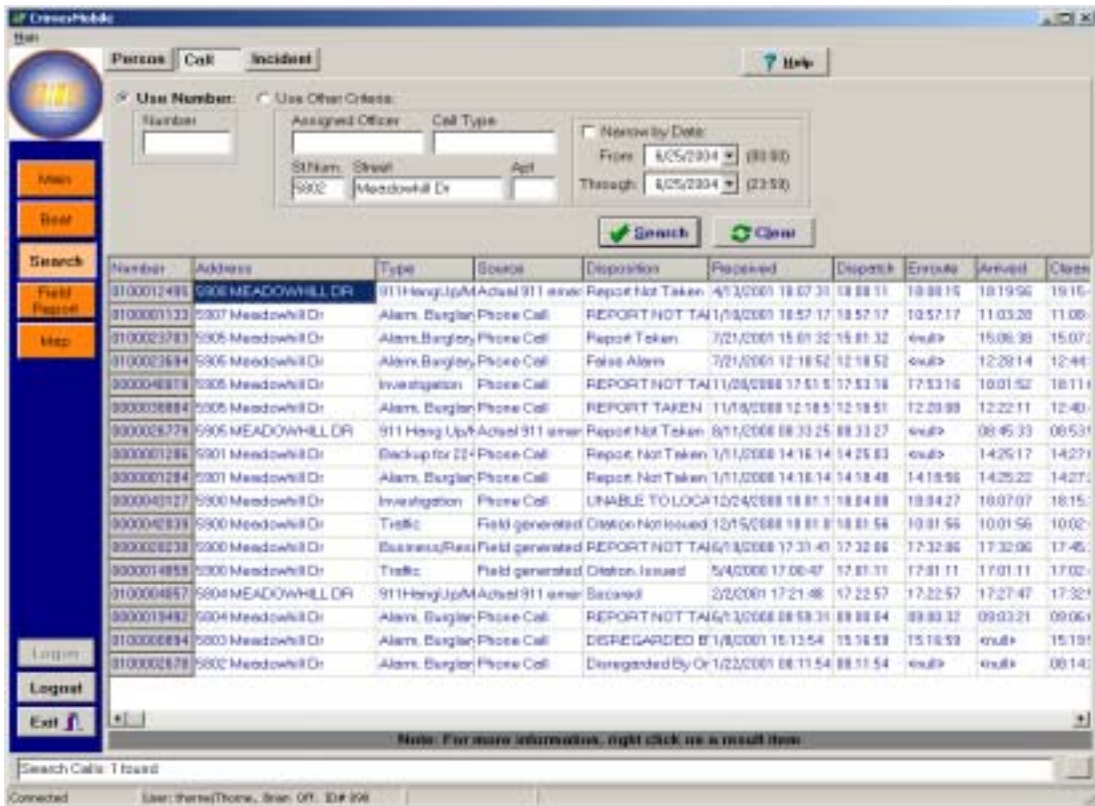**Figure 4: Information for Single Lot**

Figure 5: Distance from School

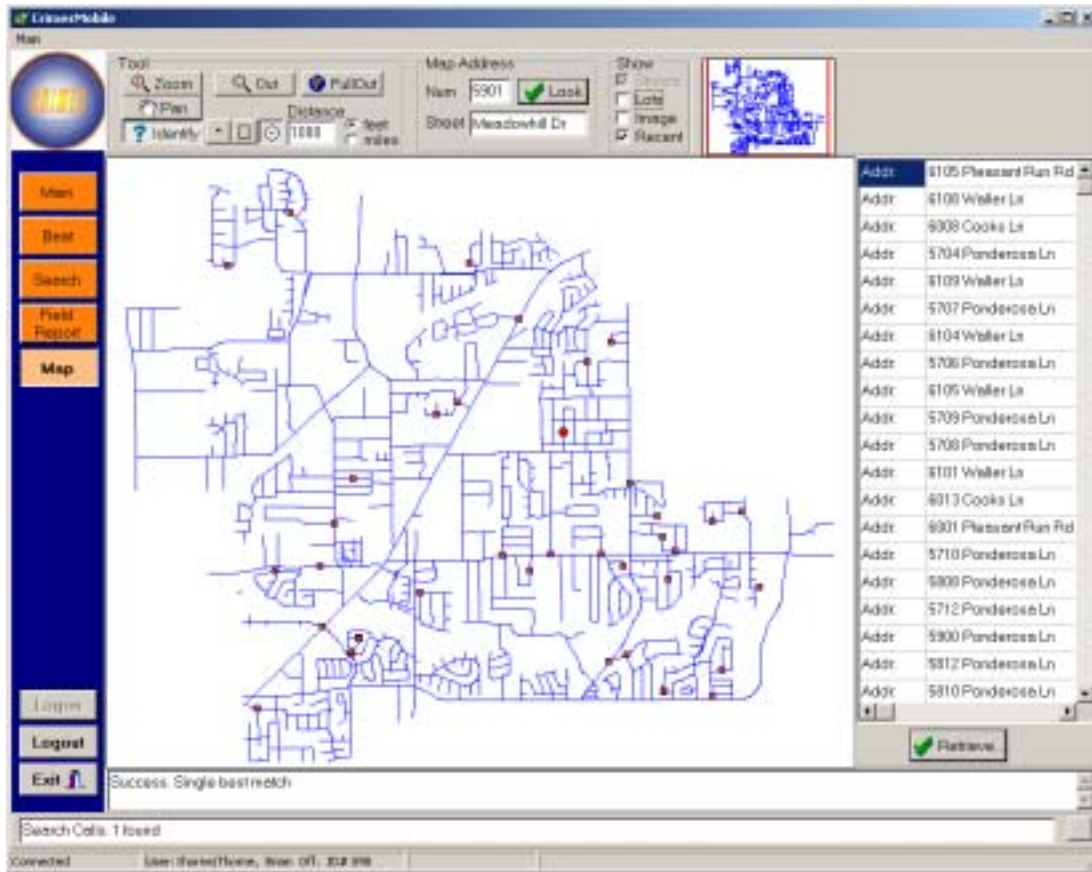**Figure 6: Calls for Selected Set of Lots**

Figure 7: Recent Calls

Concluding Remarks

The prototype GIS version of a mobile interface to the CRIMES system has been developed and targeted for the city of Colleyville, Texas. As the system is completed, we anticipate installing it in one or more patrol cars in order to get feedback on its usefulness as well as feedback on what features to add and or enhance within the GIS portion of the component. We will also investigate whether large pre-geocoded maps can be realistically sent across the slow wireless network or whether we need to wait until a higher speed network access is utilized for the system.

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