AVL
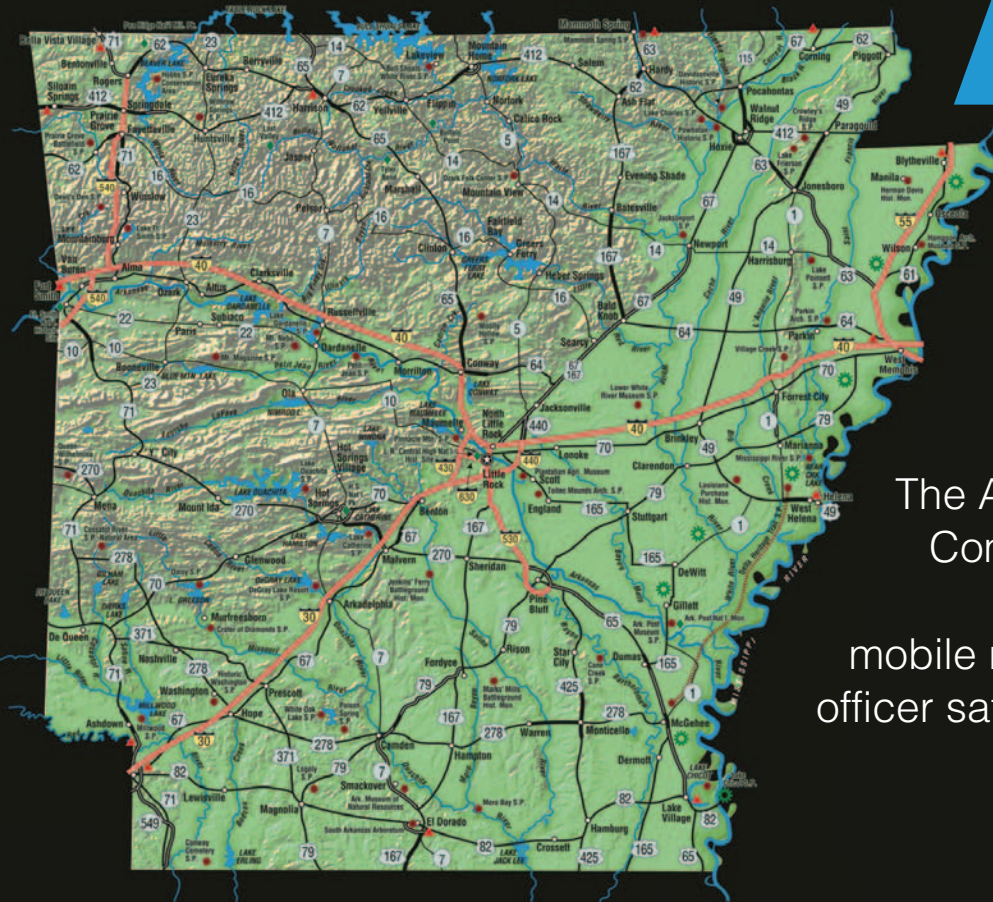## on a Budget

The Arkansas Game and Fish Commission cost effectively added AVL to its current mobile radio network to improve officer safety and response times.

By William J. Carlin

Many public-safety agencies are pursuing statewide digital radio systems and the promise of interoperability and enhanced features such as mobile data and AVL that digital technology offers. Digital systems take years to plan and procure, are expensive, and have complex buildout and testing schedules. An Arkansas public-safety agency combined its existing radio system with a clever design and commercially available AVL equipment to implement a statewide vehicle tracking system for security, accountability and backup at a price that didn't break the bank.

The Arkansas Game and Fish Commission (AGFC) employs 170 sworn law-enforcement officers to regulate and enforce the state's fishing, hunting and boating laws. The nature of the commission's work takes officers to remote locations, with the possibility of having to confront suspects who may be armed or to pursue vehicles at high speeds across great distances.

System Design

AGFC's current radio system is based on conventional VHF mobile radios and base stations. The state is divided into four quadrants, each with its own system of hill-top repeaters. The central dispatch facility is located in Mayflower just outside Little Rock and coordinates all of the communications with the officers statewide. Central dispatch consists of four operator consoles, each with access to all four quadrants. The remaining radio infrastructure can be broken down into the following elements:

Mobile Radios. AGFC officers use Kenwood and Midland mobile radios in enforcement vehicles. The mobiles communicate with dispatch on one of five channels. The officer, depending on location, manually selects the mobile frequency. The mobiles operate half duplex to communicate with the mobile relay stations. Conversations are repeated mobile to mobile.

Relay Stations. Fixed-base relay stations are located throughout each quadrant and operate on one of five mobile frequency pairs in the southwest quadrant and one of four frequency pairs in all other quadrants. Adjacent sites don't use the same frequency pair, but frequency reuse throughout the quadrant is permitted. Each quadrant uses up to 16 relay stations. The relay station repeats a mobile transmission to other mobiles as well as to the remote base stations.

Remote Base Stations. Each quadrant has a centrally located remote base station that combines all of the radio traffic from the relay stations onto a dedicated four-wire voice-quality leased line. The base station site consists of four receivers tuned to the relay station transmit frequencies. The received audio is gated by the presence of carrier and continuous tone controlled squelch system (CTCSS) from the relay station transmitter. The four audio paths are summed together through a quasivoting system that
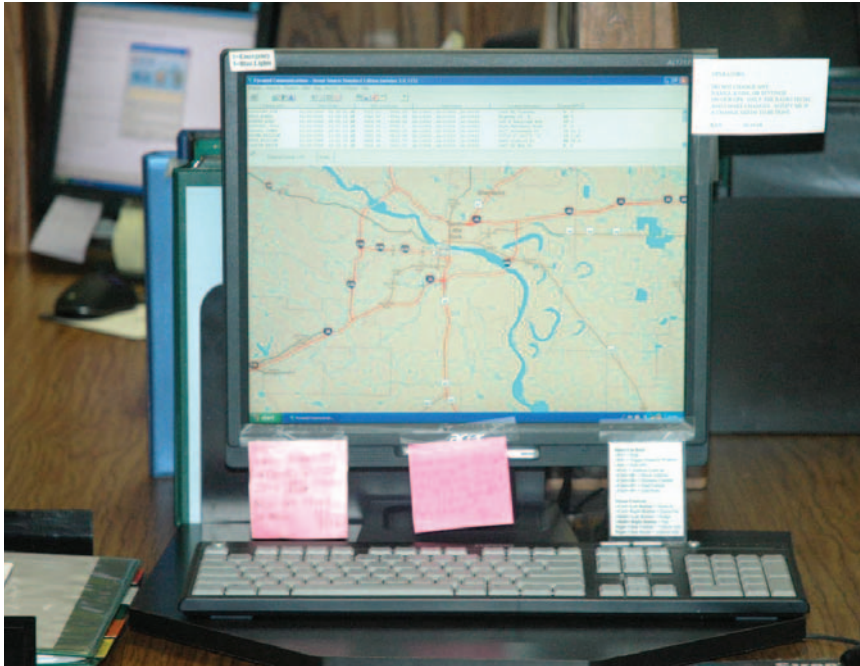
The AGFC's central dispatch facility is located just outside of Little Rock.

prevents traffic on more than one channel from interfering with an ongoing transmission.

When a remote base station receiver decodes a transmission from the relay station, it becomes the primary transmission and is passed to the dedicated receive pair at normal volume. If any of the remaining three receivers become active, their audio will be summed with the primary audio. When dispatch selects a transmit channel to respond, the primary receive channel remains at normal volume, and all other receive channels are attenuated by 20 decibels until the transmit channel is deselected. The agency designed its own custom hardware to provide this capability.

The remote base station has a dedicated transmitter that is frequency agile to four of five channels corresponding to the four relay station receive channels. Base-to-mobile transmissions are initiated by manually matching the transmit channel to the relay station from which the mobile message was received. The four remote base station transmit frequencies are the same as the four mobile transmit frequencies and are repeated to all mobiles within the relay station service area. Transmit audio is sent

from the dispatch center to the remote base station via the second pair of each four-wire leased lines.

Central Dispatch. The central dispatch site has termination panels for the four-wire leased lines from each of the four remote base station sites. The termination panels interface between the leased lines and Zetron model 4010 dispatch consoles. Each dispatch console has access to all four termination panels, and therefore, access to all mobiles in all four quadrants.

Additionally, central dispatch contains a dedicated base radio to communicate with local vehicle traffic. The dedicated base radio is a Kenwood dual-head TK-730 and isn't connected to the Zetron dispatch consoles. When the Zetron console receives audio from a mobile in the field, a front-panel LED indicates where the transmission originated. The driver informs the dispatcher verbally which channel within the quadrant he is using. The dispatcher manually selects the reply quadrant and channel via front-panel controls on the Zetron console. Central dispatch can monitor and communicate with any of the vehicles statewide through a Zetron console. At peak periods of radio activity, each console can be

assigned to a particular quadrant and be operated by one dispatcher.

Adding New Features

AGFC wanted to enhance the capabilities of its existing radio system by adding AVL using GPS receivers from Pyramid Communications in each of the mobile vehicles. The Merlin AVL units include the GPS receiver and an intelligent packet modem and will broadcast each vehicle's latitude and longitude, speed and heading on a programmed interval. The Merlin interfaces to the existing mobile radio and includes vehicle identification, date and time information, as well as the GPS location and velocity. The transmission is sent to central dispatch using the existing radio infrastructure with only minor modifications.

Central dispatch can also poll an individual vehicle for its GPS location at any time regardless of the automatic timing interval. The dispatcher can manually select the quadrant and channel number corresponding to the vehicle's service area. In addition to AVL capabilities, the packet modem also provides officers with a number of safety and support functions:

■ An emergency status indication to alert the dispatcher of a pending crisis in the field.

■ Code 3 input. When the officer driver goes to code 3 status — active siren and lights — the packet modem broadcasts a message to dispatch indicating the change of status along with the vehicle location, speed, heading, date and time.

■ Push to talk (PTT) automatic vehicle identification (ANI). When the officer completes a mobile-to-base transmission, the packet modem notifies dispatch of the vehicle identification, location, speed, heading, date and time within a predetermined interval after the last PTT.

To accommodate the additional capabilities using the existing infrastructure, the AGFC installed AVL units in each of the vehicles, base modems at each of the four termination panels at central dispatch, dedicated data communications lines to existing

infrastructure and a custom data routing device at each remote base station. The data routing device was developed by Pyramid Communications and uses a proprietary signaling format to switch the mobile data traffic from the leased voice lines to the dedicated data leased lines. The signaling from the modified AVL units will switch the audio to the dedicated line every time a data transmission is sent. All other times, the audio path is summed with the other receivers and transmitted over the four-wire leased voice lines.

There are five base modems required at central dispatch — one connected to each of the new dedicated data lines and one connected to the Little Rock direct radio. The modem output is an RS-232 serial data connection, and the unit interfaces to the main server PC in a local area network. Street Smarts Server software running on the server PC aggregates all of the data from the four quadrants and distributes the location information to the client PCs that run the Street Smarts mapping software. Each client PC receives the same data and can poll any vehicle in any of the four quadrants. The GPS transmissions are displayed

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on the map as a vehicle icon; the location, status, speed and heading are displayed in a dispatch window, and all of the data is stored in a database. The software can also record and play back individual or groups of vehicles.

The dedicated data lines were procured and the custom data switches installed prior to the rest of the system. M.J. Communications of Little Rock was involved with the installation, and Pyramid Communications provided engineering support for the modem and PC software installations. The central dispatch installation took two days to implement and go online. Several vehicles in the Little Rock area were fitted with the mobile AVL equipment, and local testing verified the complete system operation. The rest of the enforcement vehicles were outfitted during the next three to four months, and the statewide system of 175 vehicles was completely operational.

Since the AVL system was installed,

response times to accidents have decreased, officer safety has improved and the commission has a record of all incidents. The wait for Project 25 (P25) systems and the increased capabilities could take years, especially with statewide reduced budgets. GPS location technologies that can provide many needed capabilities at a substantially reduced cost currently exist and will work with radios and infrastructure on the market. For agencies that find delayed deployment unacceptable, currently available equipment may be the best solution. ■

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