APPLICATION OF TRANSIT ITS FOR SECURITY AND EMERGENCY RESPONSE AT THE CHICAGO TRANSIT AUTHORITY

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Introduction

How prepared are the transit agencies in the face of terrorism and security breaches? In the face of a nation whose sense of security has been shattered by the events of September 11th, what can transit ITS technology offer?

The Bus Emergency Communication System/Bus Service Management System (BECS/BSMS) CAD/AVL system developed and implemented by Orbital TMS offers Chicago Transit Authority a variety of security features designed to meet the customer’s needs. It is imperative for agencies to train their employees for emergency situations, to instill a security mindset and to have effective coordination and collaboration with fire and police departments. Modern CAD/AVL systems like BECS/BSMS provide critical functions to promote system security and passenger safety, respond to and recover from emergency situations, develop mitigation responses, perform post-mortem analyses of incident response, and analyze archived incident data.

When a transit agency has effectively implemented security policy and procedures, it demonstrates its preparedness to respond during incidents and crises. The installation of BECS/BSMS included the implementation of features promoting response preparedness, such as backup power, communication systems, data storage systems, and GIS-based location data.

Several support tasks are required during a response to emergency incidents. During the response phase to an incident, an agency must have the capability to:

- Alert public safety officials
- Ensure attention and assistance to ridership
- Arrange for transportation alternatives, and
- Collect and preserve details of an incident and the response taken.
Background

Prior to the completion of the BECS/BSMS system the CTA relied on an obsolete and deteriorating emergency communications system that was implemented in the early 1970s. This system consisted of signpost transmitters placed along major bus routes throughout the City of Chicago. These transmitters were always powered on to broadcast their ID code via a low-power radio. As a bus passes the signpost, it receives the signpost’s ID signal and stores this data on board in a data packet along with the vehicle’s own ID. In the event of an emergency the vehicle operator may depress the silent alarm switch to transmit a signal to the Control Center over the (high-power) radio channel. This signal is then picked up and processed by the Control Center radio equipment. A PC monitor displays the signpost ID number, the vehicle ID number, the ID of the run the vehicle’s operator is working, and an indication of the time since the vehicle encountered the signpost (see Figure 1). By manually looking up the location of the identified signpost and schedule data associated with the operator’s run, a CTA security controller would be able to estimate where the vehicle is and where it is heading.

With very little information available about the nature of the incident, the security controller must consider the most appropriate response:

- Contact the bus operator by radio and find out what is occurring and obtain all the pertinent information required to fill out a report
- Send a field supervisor to determine the nature of the problem, or
- Dispatch the law authorities to intercept the vehicle or to.

For every incident, the security controller or other dispatcher/controller writes out a paper report to include bus number, run number, route number, reporting garage, operator badge number, operator name, location, direction of travel and the nature of the disturbance. As is immediately noticeable, fast response is not likely using this system. Also, as paper reports are filed away, information retrieval on past incidents (e.g., for processing legal claims) is difficult.

The signpost radio system that was in use dated back to the late 1960s/early 1970s. Many wayside radio units have become unreliable and required significant labor to maintain. The system designed and installed by Orbital avoids many of these problems by using global positioning system (GPS) signals to determine vehicles’ location status. The system can locate a specific vehicle anywhere within the city as long as the in-vehicle equipment is powered on and receiving sufficient GPS signals. With the Orbital system, the information sent back to the Control Center with a vehicle position report includes all the basic vehicle status information that used to be asked for over a voice call by the Control Center personnel except for the vehicle’s current route number.

ITS Filling the Needs

The following paragraphs outline how BECS/BSMS helps CTA meet its security and emergency response needs.
Alert Public Safety Officials

A primary objective of BECS/BSMS implementation was to improve radio coverage and ensure basic communications functions – voice radio and emergency silent alarm – for the entire fixed-route fleet over the whole of the CTA service area.

The emergency silent alarm is used in situations where an overt act by a vehicle operator may result in a greater danger to the operator and/or the riders while a crime is taking place on board the vehicle. This alarm is of a covert nature; the action of triggering it is silent aboard the vehicle. Once the alarm is received at the Control Center, the security controller acknowledges it and simultaneously establishes a discreet, one-way voice communication from the vehicle so the Control Center personnel can listen in and evaluate the immediate situation on board. The security controller’s acknowledging response to this alarm is returned as a discreet indication to the vehicle operator, so the latter is aware that the situation is being observed and a response is on the way.

Combined with this covert voice monitoring function, the on-board automatic vehicle location (AVL) function – based on differentially-corrected global positioning system (DGPS) data – transmits critical information to the Control Center such as: vehicle ID number, the operator’s badge number, run number, current vehicle location, direction of travel, and door status. The vehicle’s location and direction of travel are presented graphically on a GIS-based mapping screen (see Figure 2), allowing the security controller to track the movement of the vehicle and dispatch response units as necessary to intercept the vehicle. Since no manual lookup of signpost location or operator run schedule is required to estimate the location of the vehicle, the security controller is freed to evaluate the situation (via the covert voice monitor) and dispatch the appropriate resources much more quickly. The AVL data is updated every fifteen seconds while the vehicle remains in an alarm condition. Once a silent alarm situation is cleared, the controller has the option to contact the operator by voice.

For more general, non-emergency, situations, BECS/BSMS supports operator-controller data message communications over radio frequency (RF). Data messages are sent over one of several dedicated data radio channels. The operator can compose a “vehicle event” data message using a few keystrokes on the Mobile Data Terminal (MDT; see Figure 3) to indicate the nature of the incident. Types of vehicle events include accidents, disturbances, equipment defects, field observations, messages regarding relief status, and street blockages. The Control Center may opt to return the message via a canned data message, free-form text, or by a voice call. Once voice communication is established between a controller and an operator, further information can be obtained without any outside radio interruptions.

Under BECS/BSMS, control of CTA’s limited voice radio resources is assigned to the controllers. Operators must request to set up a voice call with the Control Center. The CAD system allocates the voice channel to use to the requesting controller on a first-come,
first-served basis, streamlining the contention for radio space that existed previous to the
provision of quasi-trunking. By encouraging operators to use data messages instead of
voice communications, controllers receive information more efficiently and can reserve the
valuable voice communication resources for resolving emergency and other high-priority
incidents. For any vehicle, not just those with the emergency alarm engaged, the controller
has the option of initiating location tracking.

During a response to an emergency incident on board a transit bus, the CTA
controller/dispatcher may alert police, fire, and other government agencies (E911) via
telephone. The controller will contact the proper resources after a determination is made of
the nature and severity of the incident by either monitoring the voice interchange on the
vehicle via the covert monitor, the incoming data message, or via a direct conversation with
the operator. Dispatch of police now occurs within five minutes, a significant improvement
over the system in use before BECS/BSMS. Location of the vehicle is much more precise
since BECS/BSMS refreshes a vehicle’s location every fifteen seconds. CAD translates the
GPS-based longitude-latitude coordinate into a street address using the street map database
from the City of Chicago’s 911 GIS. In contrast, the previous signpost system only
allowed an approximate estimate of a vehicle’s location based on the last reported signpost
passed and time since this point was passed. Location was presumed to be somewhere
along the vehicle’s known route and it would not give any indication of whether vehicle
had gone off route or made a detour. Under the old system, locating a vehicle could take
ten minutes or longer if there were multiple vehicles in the area.

The BECS/BSMS implementation included built-in redundancy to ensure availability of the
critical emergency alarm, voice, and data communications functions described above.

**Ensure Attention and Assistance to Ridership**

As described above, BECS/BSMS uses a covert voice monitoring function to allow Control
Center personnel to listen to activity on vehicles. This function is only available if the
vehicle operator engages the silent emergency alarm and is not active at any other time. It
cannot be activated by any other action than a silent alarm event from the vehicle in
question.

During emergency situations, controller/dispatchers can reroute CTA buses to safe
locations (e.g., away from an active security incident) via BECS/BSMS text messaging and
voice communications. With the use of a real-time AVL, all vehicles can be accounted for
and rerouted safely to other routes with supervision being notified of the reroutes, which
vehicles are affected, and where the re-routed vehicles are. Operators of vehicles leading
and following a vehicle with a problem can be informed of the incident and rerouted (or
respaced) accordingly by data messaging. Separate data messages may be sent to each
individual bus or they may be broadcast to a grouping of buses (identified by vehicle ID or
run ID), all buses on a route, all buses from the same home garage, or the entire fleet. To
fill in for service lost because of a vehicle problem, Control Center personnel can send
additional buses to affected locations.
Arrange for Transportation Alternatives

As Control Center personnel perform incident response and track affected vehicles to nearest street address or via the GIS-based mapping display, they may dispatch another vehicle to transfer any affected riders, allowing them to continue on their trip with a minimum of disruption. BECS/BSMS may be used to facilitate communication of service cancellation and changes in schedule (using text messaging and/or voice communications). The system allows the Control Center to fill any gaps in service coverage more quickly than before. BECS/BSMS can also assist the CTA in dispatching buses to follow pre-established emergency evacuation routes, say by sending canned messages to selected vehicles, notifying operators to follow a standard emergency protocol. The advanced capabilities of BSMS provide the foundation to allow for automated transfers and reroute of buses along previously-defined detour patterns.

Collect and Preserve Details of an Incident

BECS/BSMS helps the CTA to collect and preserve all details of an incident for later review and reference for updating security and emergency response protocols and procedures. Every operator-generated event data message, and Control Center response message, is captured in the CAD log with a date-timestamp and identification of the sender. CAD stores data for later retrieval of individual events/incidents and summary reports. Vehicle event messages automatically include AVL location and vehicle/operator/service identification. The CAD application generates several canned, detailed incident reports and saves data in an open relational database system (Oracle) allowing BECS/BSMS or other CTA users to make queries against the rich event database to see any details related to past incidents.

The incident-response stage has the most visibility during a crisis. BECS/BSMS provides tools to support CTA’s ability to respond successfully to emergency incidents.
Metrocom Signpost Locator

Figure 1

GIS Locator (911 Map)

Figure 2
Figure 3

Mobile Data Terminal (MDT)