EVALUATION OF ROADSIDE EMERGENCY CALL BOX TECHNOLOGY*

A SUMMARY REPORT

By

Harold R. Paul, P.E.
Associate Director, Research

Louisiana Transportation Research Center and

Louisiana Department of Transportation and Development

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Introduction

Motorist aid call boxes are used to provide motorist assistance, improve safety, and can serve as an incident detection tool. More recently, Intelligent Transportation Systems (ITS) applications have been added to call box systems to enhance data collection for traffic data, weather data collection and dissemination, fog detection, and video surveillance equipment for incident and congestion management. Motorist aid call boxes are often combined with other services such as motorist assistance patrols, police patrols, CB radio groups, and surveillance equipment to enhance safety and congestion management.

This report is written in response to House Resolution No. 1, by Representative Downer from the 1999 regular session of the Louisiana House of Representatives. The resolution requests a study regarding the upgrading of call boxes along Louisiana's interstate system to a cellular-based system. The study is to include an analysis of the technology available in the call box industry and a cost analysis of the proposed upgrade. A task order to undertake this study was issued to Louisiana State University.

In order to address the resolution, the study was divided into a number of tasks that included a literature search to identify and define the available technologies, a survey of other state highway agencies, a survey of manufacturers, a survey of state police, and the preparation of cost estimates. This report summarizes the information provided by that study.

Literature Search

A literature search revealed that only a few serious studies of motorist aid call boxes have been undertaken within the last ten years. A Minnesota study developed a benefit/cost ratio of 0.61 indicating that 61 cents in benefits are received for every dollar spent on their call box system. These benefits were predicated on congestion mitigation only with no methodology attempted to incorporate measures of safety effectiveness. Minnesota has since removed its system because of the high maintenance cost for the determined usage.

The state of Washington evaluated their system in 1996 through a national review of system descriptions, usage and cost analysis, state operation cost study, and a user survey. While the conclusions did not seem to be supported by the information presented, a recommendation was made to increase the system size when funding was available.

One report providing factual data was received from the San Francisco Metropolitan Transportation Commission. Level of service, call demand, cellular performance, maintenance and contractor data, and knockdown and vandalism data were clearly presented.

Much of the information derived in the LSU study was anecdotal in nature owing to the surveys. In fact, the literature search in general provided mostly anecdotal information, as evidenced by a number of newspaper articles containing little factual data. It was evident from the information received that the largest and apparently most effective motorist aid call box systems were operated in states with dedicated funding, such as California and Florida. Also evident was the lack of methodology for objective measures for evaluating the effectiveness of these systems. For most states, the choice between having a system and not having a system is reduced to the rational argument of cost versus a subjective argument of safety.

Survey of States

A survey contained in appendix A was sent to each state requesting information on type of system used, if any; location and type of roadway; initial, maintenance and operational costs; and, future plans. Twenty-three surveys were returned. Follow-up phone calls and the Washington state study were used to develop additional information. There were a few minor discrepancies between the Louisiana and the Washington surveys. Again, some of the information returned was anecdotal.

Twenty nine states were identified as not having call box systems. Table 1 provides a list of these states. Most of these states indicated the expense of maintaining and operating a call box system,

use of police, CB radios and pay phones, proliferation of individual cellular phones, use of *HP/#HELP/*SP or other toll free numbers, other response teams for emergencies, and vandalism as reasons for not installing motorist aid call boxes. Minnesota had call boxes at one time, but removed them because of low use and the reporting of four to five cellular phone calls in addition to the call box call. Kentucky and Maryland had also removed call boxes. It is possible that smaller municipalities may have call boxes within these states, such as the system on the Lake Ponchartrain Causeway. Because of the short duration permitted for the study, this data could not be collected.

Table 2 presents the 21 states reporting the use of motorist aid call boxes. Some of these report minimal use, such as Arkansas and Nevada. Four states, New Jersey, North Carolina, Oklahoma and Texas indicated that their call box systems may be removed. Too costly, high cellular phone use, poor maintenance, and the use of cellular *55 and *HP services were cited as reasons to discontinue the call boxes. Texas attempted to expand its system statewide on three occasions through the use of increased taxes, but the proposals were defeated. Therefore, Texas is considering removing the existing boxes. Conversely, Arizona, Illinois, and Massachusetts are considering upgrades to their systems.

The most reliable and successful systems are located in states with high political support or routine maintenance contracts. California and Florida have the largest systems, followed by Pennsylvania. California's system is administered at the county/regional level through local Service Authorities for Freeways and Expressways (SAFEs). The program is funded through a one dollar per vehicle per year surcharge assessed by the department of motor vehicles. This fee is only collected within those counties with SAFEs and is used for installation, maintenance, operations, and administrative costs under localized SAFE authorities. These fees can also be used for other motorist assistance measures such as patrols. Statewide guidelines provide standardization in operations. The California Highway Patrol is statutorily required to provide dispatch service. This system is highly reliable because of the dedicated funding and standardization of the program through the local management and staffing of the SAFEs.

Installation and maintenance is locally controlled; CalTrans and the CHP provide technical assistance. Maintenance includes twice-per-year preventive, on-going corrective, and knockdown/vandalism (three to seven percent per year).
Florida's system is funded through federal funds for construction and state funds for operations. All operations and management are conducted at the state level with the Florida Highway Patrol providing dispatch services. Pennsylvania's system was exclusive to the turnpike authority using toll fees for funding. Recently Pennsylvania installed a 100-unit cellular system on an interstate with the intention to evaluate its effectiveness until 2001. At that time the system will be expanded or disassembled based on performance.

Call Box Technologies

Generally, communication systems are classified as common carrier or private radio. Common carrier includes either hardwire or cellular technologies, while private systems use radio frequency technologies. Hardwire systems are still used in tunnels and sometimes on bridges, but cellular technologies have replaced hardwire elsewhere because of telephone deregulation. Radio transmissions can be either trunked for multiple channel switching or conventional, which uses single or multiple frequencies. Information is transmitted by either voice or data.

Voice systems permit two-way communication such that specific information can be gathered. The data systems transmitted by radio frequency generally use button activated signals to the dispatch center indicating a need for medical, police, fire, service, or a cancel function.

Operational features for these systems that can improve efficiency and improve management include automated location reporting, automated status reporting, self diagnostics, automatic disconnect, automated data collection, and remote programming. The cellular systems can be modified to include a variety of ITS data collection efforts including traffic, loading, weather, congestion, and visual surveillance. All systems include up-to-date technologies incorporating the latest in micro-processing.

Three manufacturers/suppliers of motorist aid call box technologies responded to a request for information. Cost data, usage, and system technology information were requested. Signal Communications Corporation (SigCom), which manufactures the current call box system used in Louisiana, Comarco Wireless Technologies (CWT), a cellular system, and Connectivity, Incorporated, a radio call box system, provided information.

Signal Communications Corporation (SigCom) manufacturers a push-button call box system available in the United States. This system is indicated as a radio technology, data transmission system in table 2. The call boxes are electro-mechanically powered, stand alone units that are operated by pulling down a door handle, pressing one of the button options available, and releasing the door handle. There is no need for battery or solar power or hardwire. The call is connected to the state police dispatcher in the form of a radio signal to a dispatching console indicating the type of assistance required and the location of the call box. The dispatcher can then respond to motorist's needs appropriately. The radio frequency transmission is 20 miles line-of-sight, with increased distance with the use of repeaters. Beyond the costs for the call boxes, base stations and dispatch installations, this system requires additional infrastructure development in the form of communication towers, and support buildings and equipment.

The SigCom system that is currently used in Louisiana provides the motorist with four push-button options: service, police, ambulance, and cancel. Because the call box is a push-button system, it is readily usable by the hearing and speech impaired and is accessible by wheelchair confined users.

The system includes five components: the call boxes placed along the roadside, base stations to relay the signals to the dispatch center, a multi-channel interface, a system processor, and a dispatch computer. A tilt/knockdown signal is automatically processed to the dispatch center indicating malfunction of the box. SigCom reported over 10,000 call boxes in use in the U.S.

CWT manufactures a cellular telephone call box system. This cellular, voice transmission system is a solar and battery powered stand-alone unit that is operated by opening the door to the call box, picking up the phone, and pressing a button to active the phone. The call is connected to the state police dispatcher who can communicate with the motorist and respond to their needs appropriately. The location of the call box from which the call originated is also indicated on a CWT answer center. CWT also manufactures a Teletype (TTY) call box to provide emergency access for the hearing and speech impaired.

The system includes five components: the call boxes placed along the roadside, a cellular telephone network, a public switched telephone network, a CWT call box maintenance system, and a CWT call box answer center. An automated identification number is transmitted to the dispatcher providing box location even if the caller does not speak. Self-diagnostics are reported on a pre-selected basis to the base station so that malfunctions, knockdowns, and tampering are reported. Various performance indicators can be programmed from the maintenance computer. CWT currently maintains over 16,000 call boxes in California and an additional 4,000 throughout the rest of the United States. In addition, many of the California SAFEs are experimenting with adding ITS applications to the CWT technology providing additional data which can be used for funding, management, or promotional programs.

Connectivity, Incorporated manufactures a radio call box system available in the United States. The call boxes are solar and battery powered stand-alone units that provide two-way voice communication with up to a 20-mile range depending on antenna type and elevation. As such, this system is a hybrid, providing voice transmission, but requiring infrastructure similar to the SigCom system. Call box operation is initiated by opening the door. This action transmits an alert tone and a digitally stored voice recording, which includes the location of the call box, over a radio channel monitored by emergency personnel. Responding personnel are then able to begin two-way radio communication with the motorist in need. Because the call box transmits basic call box information upon opening the door, it is usable by the hearing and speech impaired.

The radio call boxes transmit their message directly over frequencies currently monitored by emergency dispatchers using emergency radio equipment already in place in each state. Therefore, no additional equipment is needed to support the call boxes.

System Cost Information

System cost information, including initial cost and installation, maintenance, operations and administrative, was requested from both manufacturers/suppliers and states. The information from the states is difficult to interpret because each system was custom ordered, provided for various components, and sometimes included additional communications package items such as microwave towers and relays. Likewise, maintenance and operational costs from the states are predicated on the figures supplied and are not likely to have common basis. The data from the manufacturers/suppliers is subject to competition and can vary substantially from prices actually bid. Similarly, maintenance costs provided by the manufacturers/suppliers vary depending on items required to be included by the states' request for proposals; that is, there are no standards.

SigCom provided a combined initial and installation cost of $5,450 per unit for the call box, $20,000 per base station, and $40,000 for processor/computer and interface. Louisiana paid $7,620, $20,000, and $110,000 for these items respectively for its original 487 box system. These costs included microwave equipment which added to the state's communication system. They are incorporated into table 3 as capital costs. Similarly, Florida added substantial communications infrastructure costs to its capitalized cost for the SigCom system. Massachusetts and Pennsylvania provided capitalized per unit costs of $6,505 and $8,000, respectively, which are similar to Louisiana's reported box cost but higher than the price provided by the manufacturer.

The costs for maintenance and operations are as reported by the states on the survey. It is not known whether the states used similar factors to represent these costs. SigCom has provided the $202/box/yr figure for the state of Massachusetts because they hold the maintenance contract for

that system. This system includes 840 call boxes, 9 base stations, 13 microwave equipment sites, and 6 dispatch centers. SigCom has also indicated that their contract for maintaining the call box system for the Lake Ponchartrain Causeway, which includes variable message signs and lighting, is $285/box/yr and that it has contracts for Florida (which contracts for some of its maintenance) at $225/box/yr. The Florida survey indicated its costs to be $150 for maintenance and $365 for operations. Overall, the costs range from $67-300, which seems reasonable, provided the uncertainty concerning the factors included in these costs.

Table 4 presents a similar set of costs for the CWT cellular system. CWT presented information indicating costs of $4,700 for box/assembly/installation/commissioning, $5,000 for the answer center, and $10,000 for the maintenance computer. CWT offers a full-service maintenance program of $400/box/yr.

Reporting by the states on maintenance, operational, and other costs was similar to the SigCom reporting in that the actual factors determining these costs was not explicit. The capital cost per box does not appear to include the dispatching and maintenance computers for the California and Washington systems. The maintenance costs are similar to the SigCom system ranging from $85-350. However, operational costs are significantly higher with the cellular system, as these annual recurring costs are required for dispatcher service and cellular service. The price of $10/box/month seemed consistent in the data provided. Generally, this provides 30-60 minutes of air time with additional charges for time beyond those limits. The number of dispatchers and dispatch centers will also affect the operational costs. Ventura County, not represented in the table, indicated that its operational costs are on the order of $950/box/yr.

It is not apparent whether or not the maintenance costs include knockdown replacement or vandalism costs. This could be a factor in the difference in maintenance costs reported for both the SigCom and CWT systems. Different states have reported a range of knockdowns from three to seven percent, and five to fifteen percent for vandalism.

The Connectivity, Incorporated radio call box system is capitalized at $4,900-6,700 depending on

quantity and installation requirements. As reported, this system has not been employed by any state DOT at this time. Maintenance cost is estimated at seven to eleven percent of capital cost for on site, dispatched service personnel and six to nine percent for contracted local personnel. It would require communication towers and infrastructure similar to the SigCom system. Therefore, its costs would be between that of the SigCom and CWT systems

Estimated Cost for Replacing the Louisiana System

The current Louisiana system contains 487 SigCom boxes and support equipment. Replacement of this system with the CWT, cellular system would include the call box assembly and an answer center and maintenance computer at each of the troops.

The CWT maintenance costs used are $400/box/yr as provided by CWT for contract services. This is similar to the costs reported for the MTC SAFE (California) system and a recent Georgia contract.

Operational costs for the CWT use the following basis: assuming one dispatch operator per shift, 3 shifts/day, pay base of $20,000/yr with 50 percent state overhead and a cellular service fee of $120/box/yr, the operational costs are based on a dispatch center in each of four troops. A 15 percent mark-up has been included for administrative costs. This figure would be a minimum and would increase with increased capacity requiring additional dispatchers. The MTC SAFE reports dispatch personnel years as 5.59 years. The $795/box/yr cost generated using these assumptions are similar to the $950/box/yr cost reported by Ventura SAFE, although the derivation of that cost is not known. No costs have been included for knockdowns or vandalism.

The total estimated capital cost for replacing the existing 487 box SigCom motorist aid call box system with the CWT system would be $2,348,900 for capital expenditures and recurring costs $581,965 for annual maintenance and operations. Beyond knockdowns or vandalism, these costs

do not include accessibility for the speech and hearing impaired or wheel-chair users.

Cost Item	CWT System ($)
Capital Expenditure	
Call Box	2,288,900
Dispatch Center	60,000
Maintenance (annual)	194,800
Operations (annual)	387,165

Other Discussion

Both technologies, radio and cellular systems, are equipped with the latest microprocessor technology and are capable of providing motorist aid functions. The main difference in operation is the transmission mode, with SigCom using data only and CWT using voice. Both systems have advantages and disadvantages. The data system transmits to the dispatch center, signals the appropriate service, and responds to the caller in less than one second. Speed with little or no need for a dispatch person is seen as an advantage. In a medical emergency speed is often critical. However, the voice system provides the additional advantage of providing the opportunity for added information which could also assist in a critical situation such as a multiple car accident where more than one service vehicle is needed. The voice system, though, could become obstructive if people stay on the line or multiple calls are made with private cellular service, tying up dispatchers. Similarly, police dispatchers have reported non-emergency/distress calls with voice systems such as “Can you give me directions to...” and “ My beeper went off. Can you patch me through to...”

While speed of information transfer is used by the data system as a promotional tool, the cellular system has been demonstrated to work with acceptable efficiency. California SAFEs produce

annual operational reports documenting level of performance, call demand, cellular performance, and maintenance data. The Metropolitan Transportation Commission SAFE (San Francisco and surrounding counties) sets performance goals and reports results in their annual report. It is reported (4th quarter '98 through 4th quarter '99) that greater than 90 percent of all calls were answered within two minutes, 98 percent of all calls are answered within three minutes, and that the call answering delay is less than 30 seconds. With a goal of less than 15 percent lost calls, they reported less than two percent for the 4th quarter '99.

Motorist aid call box usage is sometimes used as a measure of effectiveness of the system to justify either expansion or deletion of systems. Data collected indicates that per box usages range from 1.4 to 9.7 calls per box per month. The higher numbers are for large metropolitan areas such as San Diego, Los Angeles, and Dallas/Fort Worth. Minnesota used a low usage rate (3.6) with high maintenance costs to reinforce a decision to remove their system. Call box calls reported by Louisiana State Police are at the low end of this range with Troop B at 1.1 calls/box/month and Troop I at 3.2/box/month (with 10 percent down time).

Some states use the proliferation of private cellular phones as a reason not to initiate a call box system or to eliminate a system. A review of registered Louisiana vehicles indicates 210,236,393 vehicles registered in 1996. The number of cellular subscribers was 38,195,466 in 1996, indicating an 18 percent potential for cars to carry cellular phones. The rate of growth of cellular phones is much greater than the growth of vehicles registered. The number of cellular subscribers had doubled to 78,284,735 in 1999, for a potential of 38 percent. If the growth rates of subscribers and vehicle registrants continue as is, cellular subscribers would equal vehicle registrations in approximately 2008. Various studies have also shown that private cellular phones, CB radio, or police patrols are used more often to report emergencies. In general, these studies attempt to relate a limited section of roadway with call boxes to all other roads within a county, police troop or state; a comparison of the emergency calls reported by other means for that particular section of road with the call boxes would be more revealing. With the exception of one evaluation, several studies have shown that while other means of reporting are increasing, such as

private cellular phones, the number of call box reports have not declined.

The California SAFEs are currently upgrading their systems to make them accessible for the hearing and speech impaired (TTY - teletype capable). Call box areas are being retrofitted to accommodate wheel-chair confined users because of litigation.

An additional consideration not discussed is the potential use of future technology using the fiber optic cable currently being installed along Louisiana's interstate roadways. Use of that system could reduce maintenance and operations costs.

Conclusions

1. Both radio/data and cellular/voice systems are used in 21 states with proponents for each system. Four states have indicated that they are upgrading their systems. Both systems have demonstrated the ability to perform. The minimum costs for replacing the existing 487 box SigCom system with the CWT cellular system would be $$2,348,900 in capital expenditures with recurring annual costs of $581,965 for maintenance and operations.

2. Twenty-nine states reported no call box systems in use or had recently removed systems. Three additional states indicated that they were considering removing their existing systems. The reasons cited were high maintenance and operations costs, vandalism, use of police patrols, video surveillance, private cellular service, CB radios, and the use of other toll free numbers such a Louisiana's *LSP. It was reported that the toll free numbers should be well publicized.

APPENDIX A

STATE SURVEY

Call Box State Survey

. 1. Does your state currently use call boxes of any kind? (Y / N)
   a) If NO – Has your department ever looked into it? (Y / N)
   b) If YES – Why did you decide not to install the devices in your state?

2. If YES – What type of call box system does your state use (i.e., talk or buttons, and manufacturer) and how long has your state had the current call box system?

3. On which types of roadways are they located?

4. <question deleted due to misunderstanding of the meaning of the question>

5. How did your department decide on where to locate these call boxes?

6. How many roadside accidents and/or breakdowns are reported by:
   a) Cellular phones
      i) For self
      ii) For others
   b) Call boxes
   c) Police patrollers

7. How much did your current call box system cost:
   a) Initially
   b) To maintain
   c) To operate

8. How long do you expect to use your state's current call box system?

9. Does your state have future plans for changing or enhancing the current call box system?

APPENDIX B

DATA TABLES

Table 1

States without Call Boxes

Alabama	Minnesota	South Carolina
Alaska	Mississippi	South Dakota
Connecticut	Missouri	Tennessee
Idaho	Montana	Utah
Indiana	Nebraska	Vermont
Iowa	New Hampshire	Virginia
Kansas	New Mexico	West Virginia
Kentucky	North Dakota	Wisconsin
Maine	Ohio	Wyoming
Maryland	Oregon	

Table 2
States With Call Boxes

State	Technology	Medium	No. Boxes	Facility
Arizona	Cellular	Voice	12	Interstate/Urban
Arkansas				Tunnel
California	Cellular	Voice	16,000+	All Types
Colorado	Radio Hardwire/Cell	Data Voice	37 166	Interstate/Tunnel
Delaware	Radio	Data	150	Interstate/Urban
Florida	Radio	Data	2,742	Interstate/Rural
Georgia	Cellular	Voice	147	Interstate
Hawaii	Cellular	Voice	131	Rural
Illinois	Radio	Data	283	Interstate/Urban
Louisiana	Radio	Data	487	Interstate
Massachusetts	Radio	Data	850	Interstate
Michigan	Cellular	Voice	5	Interstate
Nevada			Several	Mountain Passes
New Jersey	Radio	Voice	400	Interstate
New York	Trunk Radio Cellular	Voice Voice	64 863	Interstate/Rural
North Carolina	Hardwire	Voice	22	Interstate
Oklahoma	Hardwire	Voice	48	Interstate
Pennsylvania	Radio Cellular	Data Voice	1,040 100	Turnpike Interstate
Rhode Island	Radio	Data	400	Interstate
Texas	Cellular	Voice	118	Interstate Urban/Rural
Washington	Cellular	Voice	42	Interstate/Rural

	Hardwire	Voice	165	Urban/Bridges/ Tunnel

Table 3

SigCom System Costs as Reported by States ($)

State	Capital/Box	Maintenance Box/Yr	Operations/ Admin/Box/Yr	No. Boxes
Delaware	8,130	67		150
Florida	18,234	150	365	2,742
Illinois		290		283
Louisiana	12,115	300		487
Massachusetts	6,505	202		850
Pennsylvania	8,000			1,040
Rhode Island		250		400

Table 4
Cellular System Costs as Reported by States ($)

State	Capital/Box	Maintenance Box/Yr	Operations/ Admin/Box/Yr	No. Boxes
California MTC	3,200	290	300 +100 overhead	3,500
California Various		85 - 213	10/box/month cellular service	
Georgia	6,240	350	264	147
Washington	3,500	143	76	42