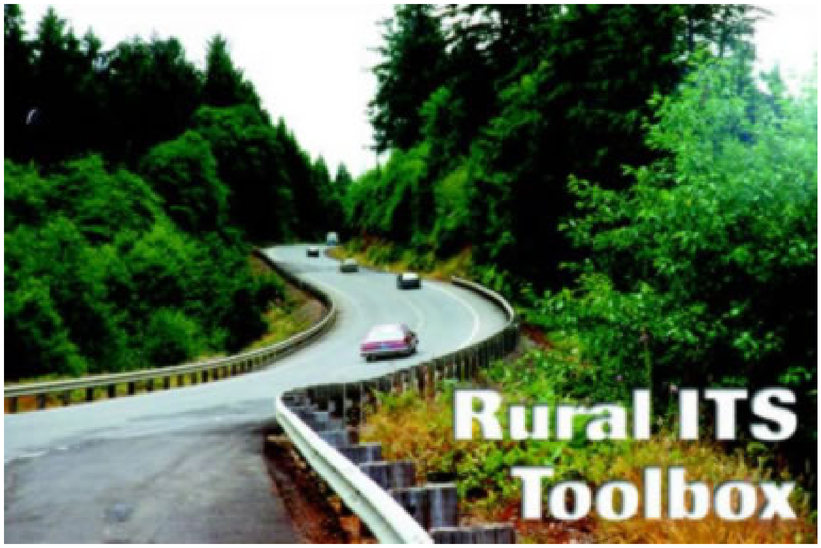
Rural ITS Toolbox



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Acknowledgment

This document has been prepared as part of U.S. DOT's Rural Intelligent Transportation Systems (ITS) Program activities to develop guidance for implementation of ITS in Rural and small urban areas. The development of this guidance was undertaken by the U.S. DOT's rural ITS support contractors - Science Applications International Corporation (SAIC), Castle Rock Consultants, Transcore and the Western Transportation Institute within the framework of the Rural ITS Support Services contract. This document identifies successful rural ITS projects from across the nation.

1.0 INTRODUCTION

1.1 BACKGROUND

In recent years, it has become increasingly common for states and regions across the country to consider the potential of developing and deploying ITS solutions for their rural and small urban areas. Some of the most progressive states have also examined these opportunities from a statewide perspective.

However, while there is a body of experience developing in this area, it has not been shared effectively with all potential users. As such, each group that embarks on efforts such as these typically has to start with limited information of past installations and has to develop their own techniques for accomplishing the goal of regional or statewide ITS deployment.

1.2 DEVELOPING RURAL INTERIM BASIC GUIDANCE

In order to assist with making this body of experience more accessible to potential new users, the U.S. DOT commissioned the development of Best Practices on the deployment of rural ITS. The development of this Best Practices Document was undertaken by the U.S. DOT's rural ITS support contractors Science Applications International Corporation (SAIC), Castle Rock Consultants, Transcore and the Western Transportation Institute within the framework of the Rural ITS Support Services contract.

The development of this Best Practices Document has leveraged earlier and parallel investments to identify and catalogue rural and statewide ITS initiatives that have been performed across the country. These have included the FHWA's Simple Solutions project, the New York State rural toolbox, press releases, and interviews. It is also intended that information gathered as part of developing this Best Practices Document will be shared to support other initiatives such as The State of the ARTS prepared by ITS America.

It should be noted, however, that the examples presented in this document do not represent the full extent of rural ITS deployment. Indeed, other rural ITS deployments may be identified elsewhere. Agencies or other organizations should email ITShelp@fhwa.dot.gov if they wish to submit their rural ITS deployment for inclusion in future updates to this document.

This document is designed to assist a broad range of users who have or who may have a stake in the deployment of rural ITS. These users include:

- State transportation agencies;
- Transit properties;
- Local government agencies; and,
- Non-traditional stakeholders such as fire and rescue groups, law enforcement agencies, the emergency medical community and tourism groups.

1.3 THIS DOCUMENT

This document is intended to support those agencies and groups that are beginning the process of rural or statewide ITS deployment plans. This toolbox is intended to assist public agencies and private organizations with rural and statewide ITS deployment plans. It consists of two components:

- A toolbox or resources document that identifies successful rural ITS projects and statewide applications from across the nation; and
- A Best Practices Document that illustrates proven processes for the preparation of a rural or statewide ITS deployment plan.

This document represents the first of these components, the toolbox or resources document.

2.0 SUMMARY OF TOOLBOX

2.1 INTRODUCTION

This section of the document provides some background information on how the toolbox was developed, how the tools are categorized and what information is provided in each of the tool descriptions. Users may search for tools based on the categories described below in 2.2 or may search based on the specific need they wish to address. To facilitate this latter process, an alphabetized list of needs addressed in this document along with corresponding section numbers is presented in Appendix A.

It should also be noted that many of the tools described (or pictured) in this document are in the process of being tested prior to full implementation. As such, the systems may appear to be outside normal regulatory configuration (e.g., compliance with the Manual of Uniform Traffic Control Devices, MUTCD). Needless to say, permanent implementation of systems conforms to all appropriate regulations and guidelines.

2.2 CATEGORIZATION OF TOOLS

The tools are categorized on the basis of the seven Rural ITS Development Tracks defined in the FHWA report Rural ITS User Needs. These seven tracks are:

- Emergency services;
- Tourism and travel information;
- Traffic management;
- Rural transit and mobility;
- Crash prevention and security;
- Operations and maintenance; and
- Surface transportation and weather.

Each of these tracks is defined below:

2.2.1 Emergency Services

The emergency services development track focuses on services provided by law enforcement, fire departments, Emergency Medical Services (EMS), and related organizations. The organizations are multijurisdictional in nature, involve complex operations and require a great deal of planning, organization and interoperability among their constituents.

Transportation and public safety are closely intertwined - the transportation system supports the delivery of public safety services and also generates emergencies and incidents of its own requiring public safety agency response. Click here for more information.

2.2.2 Tourism and Travel Information

The tourism and travel information development track focuses on the core infrastructure and standards needed to support data sharing that meets the information needs of travelers. Traveler information is comprised of a wide range of information types, including pre-trip advisories, such as road closures, weather, and events; en-route data, such as tourist messages; and real-time dynamic traffic information. Click here for more information.

2.2.3 Traffic Management

The traffic management development track focuses on the use of ITS technologies to control operations as well as provide guidance and warning of traffic to improve operations on freeways.

2.2.4 Crash Prevention and Security

The crash prevention and security development track focuses on the prevention of crashes before they occur and on reducing crash severity. By examining the needs of travelers, crash prevention measures and advanced technologies can be implemented to assist in crash avoidance, hazard warning, work-zones and highway rail crossing alerts, and dynamic speed zones. Click here for more information.

2.2.5 Rural Transit and Mobility

The rural transit and mobility development track focuses on the ability to increase transportation access services through transit/paratransit system management for those who are mobility impaired and the referral of mobility impaired people to appropriate transportation services. Click here for more information.

2.2.6 Operations and Maintenance

The operations and maintenance development track focuses on improving the efficiency and capabilities of services to maintain and operate the transportation system. Highway operation and maintenance organizations are typically responsible for monitoring and maintaining roads, along with improving the physical condition of the infrastructure. They maintain the condition of public vehicle fleets and ensure safe operation of the system, especially under adverse travel conditions, such as winter weather, or during construction and other work zone activities.

They also ensure the efficient operation of the system, including the use and maintenance of various traffic management and traffic control devices. Click here for more information.

2.2.7 Surface Transportation and Weather

The surface transportation and weather development track area focuses on the development of improved road weather information systems and maintenance technologies for winter mobility, and the development of traffic operations/incident management procedures under all weather events.

By providing weather information that is more accurate and easily understood, outcomes of improved mobility, safety, and productivity will be achieved. Click here for more information.

2.3 INFORMATION PROVIDED FOR EACH TOOL

The same information is provided for each of the tools under each of the seven development tracks.Tools described herein refer to solutions or approaches for addressing rural transportation needs.

In certain cases these tools may be relatively narrow in focus (e.g., a portable system that displays the speed of approaching traffic) or a system comprised of remote sensors providing data to a central processing location for dissemination over the Internet. Specific information provided for each tool includes:

- Needs addressed : the typical needs addressed by the tool;
- Description of the tool : a concise description of the tool, including a summary of the technical components and options;
- Real-world examples : a description of a real world example of the tool. These descriptions use the following headings:
  - Goals : a description of the goals that the application of the tool was intended to address;
  - Approach : the approach that was taken to develop, design, implement and operate the application of the tool;
  - Location/geographic scope : the geographic area covered by the application;
  - Current status : the current status of the real-world application (for example, is it still in development, is it operational, etc);
  - Future activities : what, if any, plans exist for continuing the development and use of the application;
  - Cost information : information relating to the cost of the tool application; where possible the total cost of the deployment is given;
  - Participating institutions : a list of the institutions and organizations involved in the application of the tool together with an indication of how they participated;

- Impacts : an identification of the actual and/or expected impacts of the application of the tool; and
- Key contacts : a list of the key contacts for the application of the tool.

The real-world examples have been selected to show how the tool has been used in a practical way. Where the tool has been used in different ways, several examples have been selected and described:

- Lessons learned : lessons learned through the development, implementation and operation of the tool;
- Benefits : an identification of the typical benefits that can be realized through the use of the tool; however, benefits listed in this section may also apply to the overall approach, not just the real world example that has been highlighted;
- Opportunities : in many cases, a tool has also been used for applications other than that for which it was first developed. This section is intended to identify other potential applications that the tool can be used for and also identifies any relationship with other tools included in this document;
- Implementation : this section describes the typical implementation process and highlights any particular implementation issues that have occurred;
- Institutional issues : this section describes the typical institutional issues that have occurred with the development, installation and operation of the tool;
- References : a list of the references that were used to develop the description of the tool. In addition to the references listed for each application, the ITS Resource Guide for 2001 provides a comprehensive listing of documents, websites, training courses, and points of contact related to ITS.

3. EMERGENCY SERVICES

This Section contains descriptions of the tools that fall within the emergency services rural development track. These are:

- Emergency vehicle traffic signal pre-emption;
- Mayday systems;
- Accident investigation systems; and
- Dispatching systems.

3.1 EMERGENCY VEHICLE TRAFFIC SIGNAL PRE-EMPTION

Needs Addressed

To assist emergency vehicles in improving emergency response times.

Description

Traffic signals can disrupt the progress of emergency vehicles by causing them to slow or stop. Since other vehicles in cross traffic often have the right of way when the emergency vehicle reaches the intersection, hazardous situations often occur. Pre-emption involves switching the appropriate signal at a signalized intersection to green to grant an approaching emergency vehicle right-of-way regardless of the normal signal-phasing pattern.

Various types of pre-emption systems are in use in urban areas across the nation. The solution described below is an example of a low-cost siren-activated system. As it requires minimal additional equipment, it is considered to be a suitable solution for rural communities.

Real World Examples

Siren Activated Signal Pre-emption (British Columbia)

Goals: To improve emergency response by providing simple and cost-effective signal pre-emption capabilities to emergency service providers.

Approach: The Sonem 2000 Digital Siren Detector detects the sirens of emergency vehicles up to half a mile away from an equipped intersection. This activates a signal pre-emption phase, giving a green light to the oncoming emergency vehicle and switching all pedestrian crossings to the Don't Walk message. The green light can be held for a pre-set time of between 5 and 45 seconds. A visual verification system consisting of a white light and a blue light is installed next to the regular traffic signal. When the white light is activated, this confirms to the driver of the emergency vehicle that it has been given right of way. The blue light indicates that the intersection is being controlled by an emergency vehicle approaching from another direction. The system is manufactured by Sonic Systems Corporation of Vancouver, Canada.

Location: To date, the system produced by this vendor has been installed in the Cities of Squamish, Nanaimo, and Whistler, and the University of British Columbia campus in the City of Vancouver, all in British Columbia, Canada.

Current Status: The project is currently operational as identified above.

Future Activities: No future activities have been established.

Impacts: The impacts have not been documented.

Cost Information: The cost of equipping an intersection is approximately $4,000. Discounts for equipping multiple intersections apply. Vehicles do not need to be equipped with any additional equipment, assuming they are fitted with a siren.

Institutions: Participating Cities of Squamish, Nanaimo, and Whistler, and the University of British Columbia.

Contact: Robert Scragg, Sonic Systems Corporation. 1-800-33-SONIC.

Other Examples: LifeLink : rural version. E. Sterling Kinkler Jr. (210) 522-3478
URICA, New Mexico; Regional Emergency Action Coordination, Arizona.

Benefits

- Emergency vehicles activating a traffic signal pre-emption system can negotiate an intersection more safely;
- Traffic approaching an intersection where preemption has been activated by an approaching emergency vehicle is safer;
- Patients transported in emergency vehicles will reach their destinations in a more timely and safe manner; and
- More timely response to emergency calls.

Opportunities

Traffic signal pre-emption is not limited to emergency vehicles; it has successfully been used on vehicles such as snowplows or street cleaners during late-night or early-morning operations. It can assist the operation of these kinds of vehicles by limiting unnecessary stopping and starting at intersections. In the case of snowplows, a pre-emption capability could also be valuable during severe weather conditions. Pre-emption systems are also widely used to grant public transit vehicles right-of-way at intersections. This application has been successfully used for both normal transit operations (i.e., preemption grants right-of-way to all transit vehicles) and where right-of-way is only granted to transit vehicles running behind schedule.

Low powered wireless communication devices in vehicles, similar to garage door openers, could also be used to trigger receivers mounted on the signaled intersections to give oncoming vehicles a green phase. In addition, systems using infra-red technology could perform this function. In noise sensitive operations or environments, a non-siren based system should be considered.

Institutional Issues

As no special equipment on the emergency vehicle is required, equipped vehicles could cross jurisdictional boundaries and activate the signals of neighboring cities or counties if the same siren-based system is also deployed there.

Implementation Issues

In one instance, shortly after implementing a sirenactivated signal pre-emption system (manufactured by another vendor), local drivers discovered that signals could be pre-empted by activating their car alarms.
Depending on the frequency of the siren technology, this may occur with other implementations as well.

References

Technology in Rural Transportation Simple Solutions, FHWA publication number FHWA-RD-97-108, October 1997.

US DOT booklet on signal preemption, available from the Electronic Document Library.

3.2 MAYDAY SYSTEMS

Needs Addressed

An emergency notification system that will:

- Reduce accident response time in remote areas;
- Provide an advanced ability to utilize cellular technologies and geographic information systems for emergency notification;
- Transmit geo-coded location information and valuable crash severity data; and
- Enhance emergency management through integration of technologies and coordination among emergency service providers.

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Description

Mayday systems provide some kind of notification to a response center in case of a breakdown or accident.

They utilize wireless communications from vehicle to call center and units and can be activated manually or automatically. They typically use GPS location technology to automatically identify the location of the vehicle.

Enhanced Mayday systems can detect and transmit crash information (e.g., crash primary direction of force, crash delta velocity, final resting position of the vehicle, etc.) to a call center that subsequently contacts an appropriate response organization (fire, ambulance, police) and provides them with all necessary data derived from the in-vehicle Mayday system.

In the case of a severe crash, a victim's chances of survival are directly linked to the time it takes for the emergency service to respond. Essentially, three time-related factors are relevant:

- The time it takes stranded or injured travelers to establish communications with a Public Service Answering Point (PSAP), and relay a request for help;
- The time it takes dispatchers and response personnel to acquire information about the crash location, the nature of injuries and the number of victims involved, either from the motorist involved or by other means; and
- The time it takes for response personnel to reach the victims with the proper equipment (i.e., able to treat and transport all victims appropriately).

Emergency response times associated with these three time factors average 52.4 minutes in rural environments, and 34.9 minutes in urban environments. Responding to severe accidents within one hour (the so-called "golden hour") can significantly reduce fatalities.

Real World Examples

Minnesota Mayday Plus (Minnesota)

Goals: To implement a system that will evolve into scalable deployment and identify and resolve institutional issues that surround Mayday implementation.

Approach: In 1995, Mn/DOT developed a concept, implemented, tested and subsequently evaluated its Mayday Plus project through a unique public-private effort. The goals of this 11 county project were:

- To help resolve institutional issues concerning the necessary exchange of information between public and private emergency service providers;
- To evaluate the technical enhancements required to fully automate collision and severity notification at an acceptable cost;
- To assess the commercial viability of motorists' emergency call services utilizing stateof-the-art positioning and communications technologies; and
- To promote national and international standards for information exchange relating to advanced emergency call systems.

Mayday Plus integrated global positioning, in-vehicle sensors and digital and cellular phone technology.

Location: Southeastern Minnesota (11 county area surrounding Rochester).

Current Status: The six-month evaluation of the Mayday Plus system commenced in August 1999, the final evaluation report was completed in March 2000.

Future Activities: Mn/DOT is seeking to identify new opportunities to continue the development of its Mayday system. Interest at the national level to further pursue ITS implementation in public safety efforts has provided funding for a national field operational test of Mayday involving the commercial sector.

Impacts:

- Data and voice calls from the vehicle to emergency response centers proved successful.
- Average time between initial button push of Mayday device to receipt of the call at the emergency response centers was 75 seconds.
- Demonstrated the technical feasibility of a Mayday emergency response infrastructure.

- Volunteer participation in the project was more than expected.
  Operational, sets the stage for linkages with commercial devices.

Cost Information: $3,000,000

Participating Institutions: This project brought together numerous stakeholder agencies with Mayday interests in the form of a public/private partnership. They were:

- Minnesota Department of Transportation (Mn/DOT),
- Minnesota State Patrol District 2100 (MSP 2100),
- Mayo Clinic including the Mayo Emergency Communication Center (MECC), Gold Cross Ambulance, and Emergency Room and Trauma Center,
- Veridian Engineering,
- Midwest Wireless Communications Cellular 2000,
- Rural Metro Medical Services (Rural Metro),
- American Automobile Association (AAA) of Minnesota/Iowa, and
- Castle Rock Consultants (the independent evaluator).

Throughout the project, these partner agencies (the Core Group) met at least once a month. This project provided considerable insight into the needs of medical response agencies and law enforcement response agencies as they relate to Mayday.

Contact: Farideh Amiri, Project Manager, (651) 296-8602

Other Examples: NY Automated Collision Notification (ACN) System
Colorado Mayday Project
Puget Sound Help ME (PuSHMe) Project (Seattle, Washington)
US 93 Mayday System, AZ

Benefits

- Identification of location of traveler in need of assistance.
- Communication of crash information to emergency response providers to enable most appropriate response team and equipment.
- Reduced fatalities.
- Reduced incident impacts.
- More efficient use of emergency response resources.

Lessons Learned

- Strong partnerships were the basis of the success of the Mayday Plus project.
- Training (initial and on-going) is key for user acceptance of the system.
- Mayday devices need to be affordable (under $250) for users to want a system in their vehicle.
- Accurate time stamps and time synchronization is difficult to achieve.
- Integration of Mayday interfaces in emergency response centers with existing systems would improve user acceptance and facilitate usage.
- The number of originally anticipated test calls for adequate training was underestimated. More appropriated test days were required.
- The uncertainty of workload presented difficulties for dispatchers to handle test calls.

Opportunities

The research performed thus far has only begun to address a small number of issues that inhibits the successful deployment of a Mayday infrastructure. Many opportunities still exist for

further testing and
evaluation. These include:

Research to document the "gaps" in cellular coverage or to work with cellular providers to discuss plans for coverage expansion. Addressing cellular roaming issues. The extent of this problem is not well documented nor has there been any formal public sector interaction with cellular providers to discuss such issues. A research project that defines the problem and discusses possible solutions with representatives of cellular providers (such as the Cellular Telecommunications Industry Association CTIA) is recommended. Institutional issues related to communications with public and private emergency response providers including: answering point challenges and accuracy issues, and testing of emerging and developing new Mayday standards. Public sector funded research and testing involving both the technical and medical professions must continue to ensure that potential for Mayday is advanced (at least in a demonstration environment) to the level that medical and transportation professionals can make educated recommendations to the degree of which such deployments are justifiable. Research is needed to determine, from the medical perspective, what improvements in patient care are considered significant. Research is also required to encourage that current Mayday systems be as upwardly compatible as possible.

Institutional Issues

- Protocol differences in call routing of cellular 9-1-1 calls need to be examined at the beginning of the project.
- Successful statewide, regional, and nationwide infrastructure is dependent on increased commercial provider involvement.
- Commercial Mayday products, while they function in a similar manner as the system tested within the Mayday Plus project, do not provide a direct data link to emergency dispatch centers.
- Third-party message centers currently use the National Emergency Number Association database for forwarding emergency calls. These calls do not receive the same amount of priority as other cellular 9-1-1 calls.
- PSAPs do not want to receive third party calls.
- The lack of knowledge of public and private sector operations has spurred the need for increased cooperation. Issues that need consideration include call routing to the most appropriate public safety response agency as well as better information for appropriate points of contact of commercial devices.
- A highly regarded issue is ensuring proper training of third party dispatchers. The primary concern is providing adequate queries of drivers. Following proper procedures will limit the number of false alarms and better qualify call routing for appropriate response.
- Public agencies fear they will have to carry the burden of inadequate response as a result of third party misinformation.
- There is fear of the invasion of privacy, for example, using Mayday devices for vehicle tracking or monitoring.
- States are unaware of the promises made by private vendors to customers. In all likelihood, when a system fails to perform in an emergency and public safety is unable to respond to the scene, the emergency service providers will take the blame. The public sector may play a role in managing the expectations of Mayday systems.

Implementation Issues

- Implementation of Mayday infrastructure equipment may be too costly for smaller public safety answering system.
- Lack of end-to-end, reliable, nationwide wireless communications infrastructure particularly in rural environments.
- Some rural areas are not even equipped to answer land-line 9-1-1 calls.

- Answering point challenges and accuracy of information.
- Private sector need for standardization of message sets and call routing procedures, and government approval of Mayday devices.
- Transferring calls between PSAPs of varying technical capabilities.

References

- Mn/DOT Mayday project page
- ENTERPRISE Multi-Jurisdictional Mayday project
- Washington State PuSHMe project

3.3 ACCIDENT INVESTIGATION SYSTEMS

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Needs Addressed

Efficiency in police field reporting is needed to streamline the process of issuing citations, filing accident reports, and noting road conditions in the field. This frees up officers' valuable time to address other activities.

Description

Law enforcement vehicles are equipped with laptop computers and in-car portable printers to automate accident-related reports and traffic citations. Field data are transmitted via radio frequency, disk or modem directly to a central database, where the data are stored and studied. This eliminates paperwork for the police officer filing the report. When they get back to the station, they do not have to enter their paper notes into a database. GPS is also integrated into the system to geo-code each incident in the database.

Real World Examples

Minnesota State Patrol Automated Field Reporting (Minnesota)

Goals: To increase the overall efficiency of field reporting.

Approach: The Minnesota State Patrol is now using a computerized system to issue citations or send/receive data on vehicle license plates or drivers' licenses.

Location: A pilot test of the system has taken place in the Twin Cities metro, Mankato and Virginia areas in Minnesota. It is anticipated that the system will be used statewide.

Current Status: The system is currently in use. GPS capabilities are being added to the system to geo-code incidents.

Future Activities: The Minnesota State Patrol would like to implement this system on a statewide basis.

Impacts: Anecdotal evidence has established that this system is very convenient for reporting incidents, since a step of paperwork has been eliminated.

Cost Information: $8,000 to $10,000 needed to equip a police vehicle.

Participating Institutions: Minnesota State Patrol, Minnesota Department of Transportation, Federal Highway Administration.

Contact: Captain Craig Hendrickson, Minnesota State Patrol (612) 215-1768

Other Examples: Wisconsin State Patrol, City of Sun Prairie, Wisconsin

Automation of Paper Logs for Radio Communications (Minnesota)
Goals: To automate the recording of information received by radio communication operators by entering it directly into the computer. **Approach:** Currently, most of the information received by radio communication officers via radio or telephone is handwritten on paper logs. Minnesota State Patrol (MSP) has plans to develop computer software to enable radio communication officers to enter information directly into a computer at the time of the call, enhancing information access among radio operators, and integrating data into the MSP's Wide Area Network (WAN). The software would allow operators to attach information from the radio log and queries to the report forms. There would also be a series of customized reports developed for radio operators, districts, and central office to access targeted information. **Location:** The system is being tested in the Twin Cities Metropolitan area. **Current Status:** A prototype has been developed, but plans for implementation have been put on hold as the MSP hopes to obtain funding for a CAD 9-1-1 system for the Twin Cities metro area which would meet the same need as this automated logging system. **Future Activities:** On hold pending funding availability. **Impacts:** System has not yet been implemented. **Cost Information:** There are some commercially available packages that perform these functions, varying in price. It is estimated that having a customized package developed would cost in the region of $40,000 to $60,000. This application is of interest as it could provide a lower cost alternative to a CAD 9-1-1 system. **Participating Institutions:** Minnesota State Patrol. **Contact:** Captain Craig Hendrickson, Minnesota State Patrol. (612) 215-1768

Benefits

- Less paperwork for the State Trooper to fill out in the car. Data is transferred directly to a central database.
- The trooper has more time to deal with other incidents if needed.
- Data is already compiled and can be manipulated as needed for incident statistics right in the database.
- More accurate incident data collection since notes are already stored in the computer for ready use, and the trooper does not have to recollect the accident to write a report on the incident.

Lessons Learned

System may be unnecessary in areas with CAD 9-1-1 already in place.

Opportunities

In-vehicle personal computers can lead to a whole host of uses:

- In passenger vehicles, these computers can be used to download traveler information from a proprietary source or even connect to the Internet via satellite or even FM subcarrier frequency data transfer. Services such as On-Star from General Motors are proliferating.

- In ambulances, the computer could be used to radio the medical conditions of the patient and the hospital can be ready for the patient when the ambulance reaches the hospital. The computer can also be used to pinpoint the position of the accident using GPS. This may be used in fire trucks as well.
- Snowplow operators could use the computer to operate an in-vehicle guidance system using a GPS satellite tracking system. This computer can also be used for field reporting of weather conditions. Sometimes, sensors can be attached to the plow that automatically radio weather conditions to the central locations.

Institutional Issues

Considerable time must be spent training staff and ensuring that all users are comfortable with the system.

Implementation Issues

Existing law-enforcement fleets will have to be retrofitted to accept the computer terminals in the squad cars. Other issues include installing a receiving station for the data when it is entered into the terminal. If the computer is to be connected to an outside source, then the route of the vehicle using the equipment must be within range of the transmitter whether radio frequency or satellite.

References

National Model for Statewide Application of Data Collection & Management Technology to Improve Highway Safety

Technologies in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

3.4 DISPATCHING SYSTEMS

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Needs Addressed

The need to centralize and share data between many types of providers including emergency personnel, transit providers and highway helpers.

Description

On-the-scene incident data, road condition or other data may be routed through a single dispatch center for processing. The dispatch center acts on the information request by dispatching the proper emergency personnel to a traffic incident. Road and weather conditions data may also be uploaded to a central source and disseminated via various means from the center.

For example, police vehicles can act as an information provider for other emergency personnel. In-vehicle digital cameras and pen-based notebook computers with in-car printers are mounted in all police vehicles for crime scene and accident data collection, input and downloading to a central database for immediate availability to other vehicles responding to the scene, including emergency management personnel. Information is sent via radio frequency to a command center and then transmitted along fiber to the in-house dispatch system.

Real World Examples

Dane County, Wisconsin Interagency Dispatch and Reporting Coordination (Wisconsin)

Goals: To improve the response of emergency services in Dane County by providing incident data and other information before other emergency vehicles, such as fire trucks and ambulances, arrive at the scene.

Approach: Police officers transmit incident data via in-car personal computers to a central dispatching database which is then distributed to other emergency responders (i.e. hospitals, fire stations, etc.) over a fiber-optic network.

Location: Dane County, Wisconsin

Current Status: The system is fully implemented in Dane County. Incident data are now shared throughout the county.

Future Activities: As software improves, more capabilities will be added to the system to enhance the information being shared. If successful in Dane County, then a similar system will be expanded to serve the entire State of Wisconsin.

Impacts: The system has enhanced response time and the preparedness of emergency crews responding to incidents.

Cost Information: $8,000 to $10,000 are needed to equip emergency vehicles with the laptop computers. It is assumed that the system will operate over existing fiber optic infrastructure between State districts. Funding was provided by the City of Sun Prairie Wisconsin Police Department, the
Federal Highway Administration and the National Highway Transportation Safety Administration.

Participating Institutions: City of Sun Prairie, WI Police Department, Federal Highway Administration, Office of Transportation Safety, and various other emergency response agencies.

Contact: Frank Sleeder, Chief of Police, City of Sun Prairie. (608) 837-7336

Other Examples: Sweetwater County, Wyoming Coordinated Rural Transit Service

Benefits

- Enables emergency responders to be properly prepared for an incident scene before they get to the scene. This decreases response time and increases preparedness of emergency crews.
- Enables State agencies, such as engineering and public safety, to research statistics on incidents for sections of roads. These agencies can mitigate any safety problems relating to roadway design or maintenance.
- Transit dispatch centers will request that the closest transit provider pick up the customer and take them to their destination. This saves resources for all transit providers and participants form a stable transit network that can service entire counties.
- Travelers and commuters do not have to search through separate sources to get their road, weather and traffic information. They can visit one source that will supply them with their weather information.

Lessons Learned

Emergency response providers in rural areas are eager to have a system like this implemented because it helps provide efficient services in rural areas. If their personnel are more prepared at

the scene, then safety for emergency personnel is increased and the chances of giving adequate
medical care in the "golden hour" will increase.

Opportunities

Centralizing data at one dispatch center has other possible uses:

- Sweetwater County, Wyoming has a coordinated rural transit service where a variety of public and private transit providers (i.e. churches, schools, daycare centers, senior-citizen centers, etc) coordinate their transit services through a single dispatch hub. The customer call is routed through the dispatch center, and a transit provider will take the customer to their destination. Local businesses may also make use of this concept by having the providers perform deliveries.
- Statewide road, weather and tourist information may be collected at one server and disseminated from that point via many methods such as fax, Internet or telephony.
- Traffic Operations and Communication Centers (TOCCs) and Traffic Management Centers (TMCs) could function as the dispatch centers by dispatching police, fire, ambulance or highway helper crews to the scene of an incident. At the same time the incident is pinpointed, the proper personnel could be routed to the incident scene via the most direct and least congested path. TOCCs and TMCs also act as hubs where all sorts of pavement and traffic conditions data are centralized at one point and disseminated by various means including Internet, radio, TV, fax and telephony.

Institutional Issues

For a coordinated emergency or transit dispatch system to work, a high level of coordination and cooperation is needed by all participants involved. Public and private participants may have to form an official partnership to gain cooperation between sides.

Implementation Issues

A system which meets the needs of the various service providers should be specified, taking into account the available funding, and commercially
available products should be assessed against these requirements. Should no suitable products exist, then a custom-built system should be considered, bearing in mind the available resources.

The existing services offered by those agencies that have agreed to join forces should be inventoried and assessed to ensure that a joint system will, at a minimum, meet existing levels of service.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Intelligent Transportation Systems: Real World Benefits; pp. 7, 17. Available from the FHWA.

4. TOURISM AND TRAVEL INFORMATION

This Section contains descriptions of the tools that fall within the tourism and travel information rural development track. These are:

- Broadcast traveler information;

- Traveler information using phones;
- Traveler information using faxes;
- Interactive kiosks;
- Traveler information on the internet;
- Dynamic message signs;
- Traveler Information Services via personal communications devices;
- Traffic cable TV channel;
- Integrated traveler information systems; and
- Smart call box.

4.1 TRAVELER INFORMATION USING PHONES

Click the image to see a full size version

Needs Addressed

Providing weather and road condition information to travelers pre-trip to assist them in making travel decisions in a cost-effective manner.

Description

This service is useful to pre-trip travelers who, by using the telephone menus, may judge the current conditions of the roadways and the other transportation modes. The service is flexible in that it allows for the provision of different levels of detail, and geographical and modal separation, under the menu structure. This service is also flexible in that cellular telephone users may access this information en route. A drawback is the problem of raising travelers' awareness of the service to the level where they will use it frequently. For a service that is provided in conjunction with other activities, such as on TV or on roadway-based signing, the traveler does not have to make a conscious decision to initiate the service: whereas for this type of service, the user's actions are required.

Required for the system is an easy-to-remember toll-free number that will either connect to an operator or, more inexpensively, play pre-recorded traveler information messages. The messages need to be updated regularly by staff members and should include the date and time of the message.

For commercial vehicle operators and travelers making long multi-state journeys, telephone dial-in systems allow users to access information for not only the current state, but also future states along the route. This is important in the planning for route diversions and "go / no-go" decisions.
Initiatives in this area have been advanced by USDOT's commitment to the establishment of a single number (5-1-1) that will be available
nationwide.

Real World Examples

Wisconsin 1-800-ROADWIS (Wisconsin)

Goals: To increase traveler safety in inclement weather by providing information to deter or postpone trips. Construction information is provided to decrease congestion in construction zones, and provide information ahead of time so travelers can plan to take alternate routes.

Approach: The Wisconsin Road Conditions 800-number is a telephony-based traveler information system that can be accessed at 1-800-ROAD-WIS (762-3947). This system currently provides:

- Seasonal construction information on interstate and state trunk highways. The system provides a voice recording of road closures and restricted lane widths or weight restrictions on specified sections of highways. An advisory board takes a compilation of all construction projects around the state and highlights 12-14 construction projects that are on main trunk highways.
- Winter road conditions on interstate and U.S. highways. The system provides a voice recording of driving conditions on specified sections of highway. The information is updated at least three times per day during the winter season using county sheriff reports and state patrol observations.

The system consists of two AEC (Automated Electronics Corporation) Messenger 612 automated answering systems with 24 phone lines per unit. The system plays the recording once and disconnects. During the winter season, the Road Report system averages approximately 55,000 calls/month. The Wisconsin State Patrol is primarily responsible for manually processing a majority of the data for the Road Report system.

Location: Interstate and US highways across Wisconsin.

Current Status: Construction data are provided during the summertime. All construction for state and interstate highways are provided for the season. Wintertime data is updated 3 times per day.

Future Activities: No future activities are currently planned.

Impacts: The program is considered a success.

Cost Information: System setup costs will vary according to complexity, however on a per-call basis, each minute costs the DOT $.05-$.07. A voice recognition system that allows the caller to verbally make selections may be implemented for $20,000.

Participating Institutions: Wisconsin DOT

Contact: Tyrone Paulson, (608) 846-8500

Other Examples: Washington DOT Mountain Pass Report

Benefits

- Improved weather information for operations such as snow removal, anti-icing activities, and paving operations.
- Centralized repository and distribution point for weather information.
- Platform independent system provides greater access to information.
- Real-time access to weather information pre-trip and en-route.
- Improved local weather information for towns and cities.
- Consistent resource for statewide information.

Lessons Learned

System may be overrun during peak travel times, leading to user dissatisfaction.

Money for highway signs advertising the 511 number should be included in project budget.

Opportunities

If funding is an issue, it may be beneficial for agencies to consider asking a private company to sponsor the traveler information line in exchange for including the company's name in the messages. An Internet data entry tool can be developed that enables a Web site to dynamically display current road forecasts and conditions. RealAudio can be used to play the advisory messages over the Internet.

Institutional Issues

Staff time is required for the composition and recording of messages, which must be updated several times a day. In some cases, road conditions may be provided by multiple agencies, such as the State Patrol and DOT Maintenance, in which case some coordination will be necessary.

Implementation Issues

Dial-up phone systems are easily implemented, however a challenge may lie in making the public aware of the system's availability.

Reference

Inventory of Traveler Information Services and Commercial Opportunities in the I-95 Corridor, pp 2-45. Available from FHWA.

4.2 TRAVELER INFORMATION USING FAXES

Click the image to see a full size version

Needs Addressed

Provides weather and road condition information to a wide range of users to assist in making travel decisions in a cost-effective manner. Faxes concerning weather, road conditions and road closures sent to key users (such as commercial vehicle dispatchers, taxi dispatchers, or delivery services) can be broadcast to a large number of fleet vehicle operators. Also, faxes may be sent to major employment hubs (such as large office buildings, or factories) to be posted in central locations (e.g. where employees sign in/out, or enter/exit the building.)

Description

Increasingly detailed and up-to-the-minute information is becoming available concerning road and weather conditions. This simple solution provides a means of providing this information to a wide audience at a low cost. With access to a fax machine, road and weather condition information together with other types of traveler information can be received from a central agency. Information can be faxed either on demand, according to a predefined schedule, or on a flexible basis to alert users to changes in conditions. Information may be specific to the needs of the user or may be more general in nature.

Other means of disseminating general traveler information or specific road/weather condition information on a low-cost basis using widely available equipment could include:

- E-mail could be used to disseminate information to anyone with access to an e-mail account. Email could also allow for transfer of data files, pictures, written text or audio;
- Voice messages could be recorded and sent out over commercial voice messaging systems;
- Voice messages could also be recorded on an agency's voice mail announcement allowing end users of the system to call up and listen to the announcement; and
- Internet information services.

Real World Examples

Colorado Traveler Information via Fax Machine (Colorado)

Goals: To provide weather and road condition information to a wide range of users in a cost-effective manner.

Approach: Current weather and road condition information and short-term forecasts are faxed to a list of approximately 200 user agencies, including freight haulage companies, ports of entry, visitor centers, ski areas, radio stations and television networks. The information, which is around two pages in length, is usually faxed out by a service once a day in the summer months and approximately four or five times a day during the winter. In addition to these regular bulletins, supplementary faxes are also sent to warn of unusual or particularly severe conditions, such as avalanches, the opening and closing of passes, or to advise travelers to put on or remove snow-chains. The information is collated using a variety of sources including Colorado DOT's 88 weather stations installed around the State, a NOAA terminal situated at the Traffic Operations Center, the Colorado State Patrol, and verbal reports from ports of entry personnel.

Location: Agencies throughout the State of Colorado receive the information. In addition, agencies along the I-70 and I-80 corridors into Wyoming and Utah are also provided with the information.

Current Status: This project is currently operational.

Future Activities: CDOT plans to work with the telecommunications service provider to customize the system to better meet their needs. Additional features CDOT requires are as follows:

- More detailed transmission reports providing details of failed transmissions in a more timely manner so faxes can be sent to these recipients manually by CDOT.
- More flexibility to stop the fax run partway through if new information is received.
- One rather than two retries if a fax number cannot be reached at first in order to speed up the overall process.

Impacts: The current system has been in operation since the beginning of December 1996. So far, the system has proved to be a vast improvement over the previous method due to the increased speed with which information is transmitted to the users. In addition, TOC staff time can be better utilized, now that CDOT personnel do not fax the information themselves. No staff positions have been lost as a result of the fax automation.

Cost Information: IdealDial charged CDOT $250 for the set-up fee. However, the customary fee for setting up such a service depends on the number of fax recipients, and is usually around $1,000. As CDOT uses IdealDial for other services a discount was applicable. In addition to the set-up fee, CDOT pays a per minute usage fee for fax transmission. The costs for transmission also vary by volume of transmissions and would decrease significantly for greater quantities of information.

Participating Institutions: The system is operated by the Colorado Department of Transportation Traffic Operations Center. The fax services are provided by Expedite through the IdealDial service provider.

Contact: Michele Kayen, Colorado DOT Traffic Operation Center.
(303) 512-5802.

Other Examples: Branson TRIP, Missouri
Duluth / St. Cloud TOCC, Minnesota

Benefits

- Travelers are better informed about conditions on the roadways before embarking on trips, without requesting information;

- Fleet operators are more informed about the road conditions and can plan dispatching accordingly;
- Agencies can provide services at a low-cost;
- Improved safety and efficiency on the roadways;
- Greater client confidence in adherence to delivery schedules;
- Improved public perceptions of value provided by public agencies.

Lessons Learned

The information used to be sent out from the Traffic Operations Center itself, using a series of six fax machines using pre-programmed broadcast lists. Given the number of recipients and the frequency of faxes, especially in winter, this system was very laborintensive. Recently, CDOT contracted with a consultant and telecommunications company to provide fax services. The information is faxed from a CDOT PC to the service provider, from where information is broadcast virtually simultaneously to all recipients. Users receive the information in between three and nine minutes from the time of receipt at the service provider depending on the number of "retries" that are necessary to connect with their fax machines.

Opportunities

Although requiring some software modifications, other potential uses for this technology could include:

- On-demand directions to and from specific locations;
- Traffic and road condition reports tailored to a specific route, either for a regular commute or for a less frequent trip, such as a vacation or traveling to relatives for holidays; and
- Software such as WinFax can be used to send a fax to a preprogrammed set of phone numbers without manually dialing each one.

Institutional Issues

Interested agencies must define the geographic area for which information will be provided, for example, a city, corridor, county, or statewide. Agencies must decide what types information will be included in the fax. It also may be appropriate to determine what information services are already being offered by other agencies, including private sector organizations, so as to avoid providing redundant information, or providing a service where none is needed. Agencies should also determine whether they plan to charge users for the faxes, and whether this would be on a flat subscription fee basis or whether charges would vary according to the actual amount of information and number of times faxes are received.

Implementation Issues

Agencies should perform some research into the potential numbers of users interested in receiving the faxes, given the area of coverage, the types of information available, and the fees for receiving information, if applicable.

When considering implementation the system, agencies should consider the cost implications of future demand by additional users. If the service is currently provided for free, the agency may, at some point, need to start charging new subscribers to receive the faxes.

References

Technology in Rural Transportation Simple Solutions, FHWA publication number FHWA-RD-97-108, October 1997.

Inventory of Traveler Information Services and Commercial Opportunities in the I-95 Corridor, pp 2-39. Available from FHWA.

4.3 INTERACTIVE KIOSKS

Needs Addressed

Kiosks enable travelers to access a variety of information typically including:

- Special event and parking;
- Tourist (i.e., hotel accommodations, restaurants, recreational activities, local event calendars);
- Road (directions, closures, detours, snow plow routes) and weather conditions (snow and ice removal);
- Transit schedules; and
- Corridor-wide information, including the international border with Canada.

Description

Click the image to see a full size version

Interactive kiosks provide users with real-time information via simple text and graphical interfaces. Kiosks can use commercial Internet technology and web pages to display real-time information; alternatively, they can use displays and communication systems proprietary to the agency.

Kiosks are traditionally located at tourist areas, rest stops or activity centers in rural areas. Interactive kiosks can allow business employers, transit riders and other users to access any road construction and weather information currently available on State DOT web pages. Interactive kiosks provide a cost effective, short-term ITS deployment. The interactive kiosk network system is scalable in that units can be added or subtracted from the system without disruption. Currently, kiosk networks have been deployed in several areas.

A kiosk may access traveler information for an entire region, as well as local advertising and information of local interest. Travelers may also have the ability to print maps and coupons. Information feeds to a kiosk may include links to the National Weather Service, Road/Weather Information Systems (RWIS) and a statewide database of construction work zones, closures, and detours.

Selecting the correct sites for kiosk placement can be critical to successful deployment. Optimal locations have a significant amount of walkthrough traffic such as rest stops, visitor centers, and tourist attractions. Live on-screen maps can show other kiosk sites so the traveler knows where the information is available throughout the State.

Real World Examples

Minnesota Rural Kiosks in Duluth and St. Cloud (Minnesota)
Goals: To allow travelers to access real-time weather and road condition information at a stopping point along a trip. **Approach:** Internet based kiosks were installed that allow free access to DOT pages offering traveler information. Kiosk users wishing to check email and surf the Internet for pleasure, pay a fee. The fees collected subsidizes the machine and pays the communication and ISP charges. **Location:** Duluth shopping mall, St. Cloud hotel **Current Status:** Roughly 3-4 months was spent identifying hosts willing to locate kiosks at their business. Installation of the machine takes less than a day.

Future Activities: Add additional kiosks if supported by the revenues

Impacts: Kiosks reach a limited number of travelers, but are very visible to travelers and perceived as very useful when needed.

Cost Information: Kiosk hardware is roughly $5,500. Monthly connection/phone costs are $50. Anticipated CPU replacement after 3 years is $800. Monthly revenues range from $75 - $150/month seasonally.

Participating Institutions: Castle Rock Consultants is the private partner, operating each kiosk.

Contact: Tom Peters, Mn/DOT (651) 296-3062

Other Examples: Montana tourism kiosks
Branson Interactive kiosks

Benefits

- Free, easy access to information at any time of the day, week or year.
- Stimulates local economies, bringing tourist revenue into a city or region, and promoting local businesses to residents
- Cost effective supplement to existing tourism information services
- Available method to disseminate collected information
- Sites often have links to neighboring cities / regions providing easy access to a wide range of information sources
- Traffic/congestion management when travelers re-route around work zones.
- Increased work zone safety due to less congestion.
- Promotes local transit, traveler services, and parking facilities.

Lessons Learned

Several host sites were identified to house kiosks. Each of these potential hosts were approached with an opportunity to host the kiosks with no cost to the host, and opportunities for joint marketing of the project. Host sites were typically skeptical of the prospects of hosting kiosks, primarily due to unfamiliarity with such devices. Therefore, one key lesson is to not underestimate the time and costs of locating willing hosts.

Opportunities

Various options exist for increasing the sophistication of services offered via the Internet, including:

- Traveler/tourist information tailored to a specific route, such as a planned or potential vacation route. Users could enter an origin and destination within a state or region and be offered a variety of attractions and activities, accommodations, and restaurant options within a specified distance of their main route. Again, by diversifying the kiosk locations in both public (i.e., DOT Regions, visitor centers, airports) and private (hotels, large corporations) sites will attract all types of users to the public information.
- Traveler/tourist information tailored to the needs of specific travelers, such as their budget, whether they are looking for a children-oriented vacation, or any special interests or mobility needs they may have.
- Reservation facilities could be offered to travelers enabling them to remotely book and pay for accommodations, special events, excursions, restaurants, for example. On-line booking capabilities will broaden the audience the kiosk will serve to include persons needing to make hotel reservations, and transit/paratransit ride reservations.

Institutional Issues

The deployment of an interactive kiosk network requires operations and maintenance for upkeep at on-site locations (i.e., collecting cash in machines, cleaning, equipment tune-ups). Appropriate agreement must be in place to support public-private partnerships if they are to be used.

Implementation Issues

Depending upon the vendor, most kiosks are off-the-shelf and easily deployed. In rural areas, the quality and speed of local ISPs may be an issue.

References

Report on Observations of Tourists using Kiosks, available from FHWA Electronic Document Library

ITS Field Operational Test Summary: Atlanta ATIS-KIOSK Project, available from FHWA Electronic Document Library

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4.4 TRAVELER INFORMATION ON THE INTERNET

Click the image to see a full size version

Needs Addressed

Disseminate traveler and traffic information that can be accessed by the greatest number of individuals and provide timely and accurate traffic and tourist information.

Description

More and more agencies are providing some form of traveler or tourist information on Internet web sites. These agencies include states, cities, counties, Chambers of Commerce, and private organizations, for example, associations of innkeepers. Not only is this type of service relatively inexpensive to provide and maintain from the agency perspective, it is also available at very low cost to the end user, assuming they have access to a PC, modem, and the necessary software. Information provided varies widely and can range from general information concerning a state or region, to detailed information such as specific accommodations, restaurants and parking facilities.

Real World Examples

Oregon DOT Statewide TripCheck System (Oregon)

Goals: To disseminate statewide information on the Internet to assist travelers in reaching their destination.

Approach: The Oregon TripCheck System allows ODOT offices across the state to easily enter conditions such as road closures, vehicle restrictions (i.e., width or weight), construction, or other closures. The TripCheck system then disseminates information to travelers by displaying clickable icons on a map for display.

Location: Statewide

Current Status: Currently operational, enhancements and expansions expected in 2001.

Future Activities: Through relationships with other agencies, additional information is being considered for implementation to support travelers.

Impacts: Oregon DOT tracks the number of user sessions. The number of user sessions during peak months (i.e., January) has reached 350,000 user sessions per month. During non-peak months, user sessions range from 100-200,000 per month.

Cost Information: Annual operating budget of approximately $117,000. This does not include the costs of staff that enter condition reports around the State. Also, this cost does not include maintenance of in-field cameras and sensors. These costs are absorbed into the budget as part of ODOT's Traffic Management System.

Participating Institutions: Oregon Department of Transportation

Contact: Galen McGill (503) 986 - 4486

Other Examples: Minnesota Statewide Traveler Information

Benefits

- Inexpensive, easy access to information.
- Stimulates local economies, bringing tourist revenue into a city or region, and promoting local businesses to residents.
- Cost effective supplement to existing tourism and information dissemination services.
- Sites often have links to neighboring cities/regions providing easy access to a wide range ofinformation sources.
- Promotes local transit, traveler services, and parking facilities.

Lessons Learned

Systems such as this result in many feedback email messages sent from end users to the site providers. The emails contain both positive and negative feedback. ODOT plans for staff time to respond to the comments of travelers.

Opportunities

Various options exist for increasing the sophistication of services offered via the Internet, including:

- Kiosks that provide access to an agency's traveler information web site may be installed either at rest areas or other locations within the area of interest, or at other regions' tourism offices, including neighboring states. The kiosks could also be provided at travel agencies, airports, car rental locations, and transit hubs.
- Traveler/tourist information tailored to a specific route, such as a planned or potential vacation route. Users could enter an origin and destination within a state or region and be offered a variety of attractions and activities, accommodations, and restaurant options within a specified distance of their main route.
- Traveler/tourist information tailored to the needs of specific travelers, such as their budget, whether they are looking for a children-oriented vacation, or any special interests or mobility needs they may have.
- Outside links may be provided to reservation facilities, enabling travelers to remotely book and pay for such services as accommodations, special events, excursions, and restaurants.

Additional information types could also be provided, if the information is readily available at reasonable cost and if any required inter-agency agreements can be reached, to offer the following information:

- Forecast road and weather condition information.

- Information on construction and maintenance activities likely to affect travelers on their specified route.
- Real-time weather and delay information.

Institutional Issues

When deciding to provide an Internet information service, the agency should be sure not to underestimate the effort required to maintain the service and keep all information current. If the site is not maintained adequately, the service and the agency could lose credibility with users. Public-private partnerships may be considered to help minimize the public sector maintenance costs.

Implementation Issues

No significant issues were identified. It has been concluded that Internet dissemination is a good mechanism for extending the benefits of cameras and sensors.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

National Road Closure and Information

TripCheck

TripUSA.com

4.5 DYNAMIC MESSAGE SIGNS

Click the image to see a full size version

Needs Addressed

Dynamic Message Signs (DMS) are useful for advising travelers en-route of upcoming or existing events on the roadway. The intent is to increase safety and prepare travelers for road conditions ahead, or notify travelers that certain events will be happening in the near future.

Description

DMS provide text messages via a large lighted display, which can be varied in width and height. The text the signs display can be programmed from a remote location using a wireless transmitter or phone line and modem. DMS can have either a permanent or portable installation. Either way, DMS are useful in disseminating traveler information.

Metropolitan traffic management centers prefer a strategically placed permanent installation. Usually, the DMS are mounted as overhead signs or on overpasses and are hard-wired with a power supply and telephone line. These are used more for incident management, since traffic conditions can change by the minute. A permanent installation can also be used as part of some type of warning system, such as fog, avalanche or ice detection systems.

DMS can be used to inform travelers of other spot hazardous conditions, such as construction or other events that may cause traffic congestion or an area that extra caution needs to be taken when traveling.

Portable DMS offer special advantages. They are lower in cost (in terms of installation costs and the fact that a supporting structure is not necessary) and may be shared between agencies. Due to their mobile nature, they may be moved around to various locations as the need arises. They have the capability of being multi-purpose, for example they may post weather, event or incident information.

Real World Examples

Dane County Dynamic Message Sign Deployment (Wisconsin)

Goals: To notify the traveling public of upcoming construction or maintenance.

Approach: A dynamic message sign is deployed a few weeks prior to construction or road maintenance to notify roadway users to take an alternative route, for example. Or, if construction is in progress, it may advise motorists of lane restrictions.

Location: Dane County, Wisconsin. Any location where traffic will be impacted, including construction and maintenance sites, special events, and emergencies.

Current Status: As of January 2001, Dane County has four portable Dynamic Message Signs.

Future Activities: The DMS are useful. Anecdotal feedback has been positive and use of the DMS will continue. The county would like to add more signs for a few permanent and semi permanent locations.

Impacts: Travelers respond well to the advance notification of construction and maintenance activities. Phone calls from angry or distressed citizens regarding traffic delays have stopped. County officials appreciate having another form of communication available in times of crisis and/or emergency.

Cost Information: Each DMS costs $25,000. Dane county is currently funding them through Capital Improvement funds and Federal grants.

Participating Institutions: Dane County; FHWA

Contact: John Norwell, Dane County. (608) 266-4011

Other Examples: DMS can be found in use on a nation-wide basis. Minnesota uses them extensively for upcoming urban construction projects.

Colorado Incident Management Using Dynamic Message Signs (Colorado)

Goals: To enable corridor incident management using dynamic message signs.

Approach: The Colorado Department of Transportation is installing 23 DMS on an interstate corridor. The signs are controlled from a central hub, with an on-screen visualization of the network being available to the operator. This corridor experiences heavy seasonal traffic and the objective is to place signs at interchanges where alternate routes can be taken to enable travelers to bypass congested areas and any incidents that occur.

Location: The signs are located on the I-70 corridor between Utah and Vail Pass, Colorado.

Current Status: The signs have been installed and are in use.

Future Activities: The DOT is looking to link the signs to a central location using a planned fiber optic network.

Impacts: No results are available at this time, but from previous experiments with dynamic message signs, it is shown that they can mitigate traffic flow during incidents.

Cost Information: Mobile DMS units cost $25,000 each plus cellular telephone connection. Permanent installations cost $18,000 to $20,000, depending on the availability of communications infrastructure. DMS may also be rented or leased. There are also installation and integration costs, which may be thousands of dollars depending on the expense of the fiber optic network they plan to install for these signs.

Participating Institutions: Colorado Department of Transportation

Contact: Jim Nall, Colorado DOT. (970) 248-7213

Other Examples: Many cities with traffic management centers use DMS in their incident management plans.

Benefits

- When there is construction in progress, travelers feel safer when they know what is ahead of them. The DMS may also post a detour, so travelers may feel more inclined to avoid the construction if they see the DMS. The use of detours will help to reduce traffic backups near the construction zone.
- Portable DMS may be placed in an area with a notice that construction is set to begin on a certain date. This advance notice allows commuters time to plan a different route to work.
- Safety of workers in construction zones is improved because travelers are warned ahead of time of conditions downstream and are less apprehensive about driving in the construction zone.
- The blinking sign acts as a beacon, catching the attention of the drivers and gets them to make lane changes and detours as soon as possible.

Lessons Learned

- DMS are more effective than regular construction signs for capturing the attention of travelers.
- Travelers not only want to know that there is construction, but what kind of construction it is and why the construction zone is there.
- DMS may be used for multiple purposes, including weather warnings and incident reporting.

Opportunities

DMS may be used to:

- Warn of spot hazardous conditions such as rough roads during spring thaw or traffic backups approaching a construction site or accident scene.
- Assist with traffic management during events that attract a large amount of people.

Institutional Issues

For permanent DMS, the DOT will be the primary user, however for temporary DMS, users may include highway patrol and construction contractors. DMS requires minimal staffing. However, agencies will need to delegate responsibility in terms of who is responsible for the messages that appear on the signs, and in the case of portable DMS, who is responsible for tracking the signs' location. Instutional issues associated with DMS messages are few as long as the portable DMS do not create a diversion to drivers and the messages conveyed are correct and concise.

Implementation Issues

DMS is a simple and widely used technology that is easy to install and use.

References

[New York State ITS Toolbox for Rural and Small Urban Areas]

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

ITS Standards Web site, DMS Application Area

FHWA MUTCD Web site

Roadway Flash Flooding Warning Devices Feasibility Study, available from FHWA Electronic Document Library.

4.6 BROADCAST TRAVELER INFORMATION

Needs Addressed

Stakeholders want a simple, easily accessible mechanism through which traveler information can be disseminated. Such a mechanism should offer the flexibility to disseminate information over a more localized area or over a much wider area (for example, regionally or statewide).

Commercial vehicles are one example of a specific user group that benefits from broadcast traveler information. Typically, for commercial vehicles to benefit, they must receive frequent updates on road conditions over large areas to schedule departure times or plan for route diversions.

Highway Advisory Radio (HAR) is one broadcast traveler information solution. Information typically disseminated via HAR includes:

- Special events and parking;
- Road closures and detours;
- Inclement weather conditions;
- Alternative routes in known congested areas; and
- Trail information.

Click the image to see a full size version

Description

HAR systems have been used by many DOTs throughout the US and have provided valuable information to system users. The primary advantage of HAR is that it reaches travelers using a device they already have in their vehicle: the radio. Most HAR stations broadcast at 10 watts or less, meaning their effective range is no more than a few miles. HAR can be broadcast on both AM and FM frequencies.

Many HAR systems broadcast recorded information on traffic conditions and tourist-related activities to users in a limited geographical area; new recordings are made when conditions change sufficiently. Some systems provide the capability to remotely switch between alternative messages.

Historically, these systems have been best deployed to meet the needs of travelers in tourist or work-zone areas where the information to be provided is reasonably predictable and as a result, significant effort is not required to update the system.

Information signs to indicate to the travelers that the service is operational are commonly used. As with dynamic message signs, travelers can become desensitized to the medium if information is not kept up-to-date or incorrect information is broadcast.

HAR systems can be deployed quickly to provide work-zone and tourist-related information for example. In the longer-term, enhancements to traditional HAR systems open up opportunities such as linking successive HAR broadcast towers in order to deliver a continuous message to travelers as they move between HAR coverage areas.

Real World Examples

Florida Traveler Information Network (Florida)

Goals: Provide emergency alerts and traveler information to Florida travelers through a cost effective public/private partnership.

Approach: TIRN Broadcasting has contracted with Florida DOT to provide traveler information to Florida travelers in exchange for right-of-way access to erect large signs that say "Traveler Information Radio" and the particular radio frequency of the affiliate in the area. Under the partnership, Florida DOT gets one minute for every ten-minute segment to report traffic incidents, lane closures, work-zones, etc. During natural disasters and emergencies, Florida DOT has the authority to take over TIRN Broadcasting to disseminate emergency traveler information. TIRN Broadcasting is allowed to erect a total of 4,600 signs along Florida highways and sell four minutes of each ten-minute segment as commercials. The broadcasting will be similar to popular news formats where information is given at predetermined times - traffic information at quarter-past, tourist information at half-past. Also, for each ten-minute block, four minutes will be local information and six minutes will be statewide information. TIRN Broadcasting will recoup their costs through selling airtime for advertising.

Location: All limited access highways in the State of Florida.

Current Status: A total of 18 commercial radio stations will blanket the Stateof Florida. As of January 2001, one station is operational in Orlando and Brevard Counties. Currently, 161 of the 2,200 signs have been installed. Five more stations are scheduled to begin broadcasting in the next six months. The remaining 12 will be operational by January 2002.

Future Activities: TIRN is upgrading its website, www.tirn.com, to provide out of state travelers with audio broadcast and incident information. Currently Florida has no centralized system to gather or disseminate incident information. TIRN will implement free * cell numbers for the public to call and report traffic situations. This information will be made available on both the audio broadcast and the website.

Impacts: Feedback from phone calls has been positive; they have also provided helpful suggestions. Official surveys of public opinion will be done later in the project, as more stations come online.

Cost Information: Florida TIRN will be paid for entirely through private-sector funds. Commercial spots will cost $25 for 30 seconds and $45 for 60 seconds. Florida DOT does not control the cost of commercial spots. The program is currently breaking even. With statewide coverage, income from commercials is expected to increase, as larger chains and franchises are approached.

Participating Institutions: Florida DOT, TIRN Broadcasting

Contact: Dick Kane, Florida DOT (850) 414-4590; Joe Gettys, TIRN Broadcasting (407) 481-0551

Other Examples: Herald: An undertaking of the ENTERPRISE consortium, Herald successfully tested the utility of employing a sub-carrier on an AM broadcast station to provide traveler information in rural areas.

Benefits

- Easy access to statewide traveler information;
- Provide reliable traveler information to the most number of people with minimal cost; and
- Favorable public perception of DOT

Lessons Learned

Partnering with local media and local Chambers of Commerce can be a cost-effective means for DOTs to disseminate traveler information, as well as a positive example of public-private partnership.

Opportunities

HAR offers the opportunity to disseminate non-transportation information such as promotion of community events, attractions and seasonal events.

Institutional Issues

More information relating to typical HAR institutional issues can be found in the Herald project Web site.

Implementation Issues

HAR is a relatively simple technology to deploy in a cost-effective manner. HAR is easy to maintain and has few, if any, implementation issues. However, to ensure the usefulness of HAR, the information disseminated must be timely and accurate. The use of HAR requires prior Federal Communications Commission approval, however, vendors will typically assist DOTs in this process.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Montana Department of Transportation, Draft ITS Strategic Plan, July 2, 1998. Call Montana DOT at (800) 714-7296 for availability

ITS Online Article, "HAR of Steroids", July 22, 1998

ENTERPRISE program

4.7 TRAVELER INFORMATION SERVICES VIA PERSONAL COMMUNICATION DEVICES

Needs Addressed

Disseminate timely and accurate traffic and traveler information.

Description

Personal communication devices (PCDs) are small, portable, wireless devices for sending and/or receiving information. PCDs usually consist of a handheld computer device such as an organizer or palm top computer combined with some form of wireless communications. PCDs have varying degrees of processing capabilities depending on the design and the model. PCDs have been used for a number of functions, including: navigation, pre-trip information, traveler advisories, and emergency services. Pagers and cellular phones are the best examples, and the most widely used PCDs. Other handheld devices include AT&T's EO, Palm, Hewlett Packard has several, and Motorola and GTE both have personal digital communicators.

Real World Examples

Houston's TranStar Smart Commuter (Texas)

Goals: The overall goal of the field operational test is to determine if commuters will modify their travel mode and plans when they have easy access to transit and real-time traffic condition information.

Approach: Fastline provided PCD-based software as one means of disseminating information to the commuters on the I-45 North corridor. TranStar's field operational test installed and operated a Commuter Information Delivery System (CIDS) at the TranStar facility. The CIDS will receive real-time traffic information from the TranStar Integrated Transportation Management System and format it for distribution to the travelers. The information distribution to the handheld computer will be provided through a wireless FM subcarrier broadcast channel. The participants will be provided a Sony Magic Link Personal Intelligent Communicator to receive and display the transit and real-time traffic information. Fastline created the client application software for the handheld communicator with integration to the FM subcarrier receiver. Access to the dynamic traffic information and connection through the integrated landline is provided for two-way communication between the PCD and the remote CIDS server for updated transit information and user survey feedback.

Location: This project focused on the Houston I-45 North corridor with an emphasis on commuters residing in the outlying corridor areas who regularly travel to their workplace in downtown Houston.

Current Status: The operational test has been completed.

Future Activities: Initially, it was anticipated that the Smart Commuter project would include a second component. Testing real-time ride matching in the I-10 West (Katy) Freeway and using pagers to provide traffic information to a small group of commuters were both considered. Although it was decided not to move forward with a second phase, the study provided the TxDOT with several other ideas for future studies.

Impacts: The project successfully developed and tested the provisions of real-time traffic and static transit information through a hand-held device and a telephone system. The core results of the study (that travelers will seek out traffic conditions information on a regular basis and will modify their travel patterns as a result) will help Tx/DOT determine future traveler information programs.

Cost Information: The project was federally funded, however the exact amount was not available.

Participating Institutions: The Field Operational Test is sponsored by the coordinated and cooperative effort of TxDOT, METRO, the City of Houston, Harris County, and others. Funding is provided by TxDOT, METRO, FHWA and FTA. Local evaluation was performed by the Texas Transportation Institute.

Contact: Katherine Turnbull, k-turnbull@tamu.edu; Texas Transportation Institute

Benefits

- Better informed decision-making by travelers;
- Potential to avoid incidents and congestion; therefore reducing emissions, reducing the possibility for secondary collisions, reducing delay, etc.;
- Increased safety when used as a navigational aid and/or communication device.
- Increased emergency response and shorter emergency response time due to automated location notification.

- Potential for appropriate emergency responses.

Opportunities

PCDs can be combined with any number of ITS technologies to expand their usefulness. As a standalone technology they can contain traditional pre-trip navigation information and information that is commonly referred to as "yellow-pages" information.

Institutional Issues

When developing an integrated traffic and traveler information dissemination system, the potential of public/private partnerships should be examined. Issues will include ownership of data (collected and disseminated).

Implementation Issues

Availability of timely and accurate traffic and traveler data is essential to ensure the success of the system.

References

[NYSDOT ITS Toolbox for Rural and Small Urban Areas]

Rural Applications of Advanced Traveler Information Systems: User Needs and Technology Assessment, FHWA publication number FHWA-RD-97-034.

[Houston TranStar Web site]

Turnbull, Katherine, (TTI) Farnsworth, Stephen and Puckett, Darryl; Houston SMART COMMUTER ITS Operational Test: FY 99 Status Report; Texas DOT Report No. TX-00/1985-5

4.8 TRAFFIC CABLE TV CHANNEL

Needs Addressed

Provide traveler information and traffic conditions through a dedicated cable TV channel. The cable TV channel would be geared towards resort areas and the more urban of the rural areas. The channel would disseminate the following information:

- Special events;
- Tourist hotel accommodations, restaurants, recreational activities, local event calendars;
- Road closures, construction, detours;
- Weather conditions;
- Transit; and
- Traffic.

Description

Disseminating traveler and traffic information to the most number of viewers with minimal infrastructure costs is important to ensure a traveler information system is a success. One hurdle that ITS has is installing the necessary, and sometimes expensive, infrastructure systems required for them to operate. Currently, a vast majority of the population own at least one television and many of these people subscribe to some sort of cable television.service.

Providing traveler and traffic information through a dedicated traffic channel can reach a great number of people. The infrastructure needed will include a television studio and production facilities. The traveler and traffic cable TV channel can be set up to provide any type of information from traffic, transit and weather, to information about snow conditions at ski resorts and special events.

Real World Examples

SmartTraveler TV (Washington D.C. Metropolitan Area)
Goals: Provide traffic information to the Washington D.C. metropolitan area through a cable TV channel. **Approach:** SmartTraveler TV operated four hours a day, from 5:30 am to 9:30 am in a news wheel format. The show aired in five-minute blocks. The first four minutes provided traffic, transit and weather information. The last minute was for commercials. The channel was event driven; if there was a specific accident the show would focus on providing traffic information related to that. SmartTraveler TV was just one component of the overall Washington Traveler Information System. The traffic cable TV channel also utilized Internet and phone technologies to disseminate traffic information from collection components. The website offers the same information that was available on the TV. The phone system offers an audio version of the TV program on both land and cell phone lines. **Location:** The studios were located in Washington, D.C. The traffic channel disseminated information for the entire Washington, D.C. metropolitan area, which included Montgomery and Prince William Counties in Maryland; Washington, D.C.; Arlington, Fairfax, Loudoun, and Prince William Counties in Virginia; Fairfax City; and the City of Alexandria. **Current Status:** The SmartTraveler TV has been cancelled as of January 2001. The new station owners, Westwood One, citing business reasons, chose not to offer this service. The website and phone system is still active. **Future Activities:** With the change in station ownership, all plans for the website and phone system are in review. At this time there are no plans to restart the cable TV show. **Impacts:** The project was successfully deployed. However, the service was discontinued following purchase by Westwood One. **Cost Information:** The cable TV channel got all traffic information from the existing SmartTraveler system. Costs for the cable channel included construction of a studio and five individuals to run the studio. With the change in ownership previous budget information was not available. **Participating Institutions:** SmartRoute Systems, SmartTraveler, Fairfax County, Prince William County, Prince George's County, Montgomery County, Loudon County **Contact:** Ed Bowers, SmartTraveler, (202) 554-7700 **Other Examples:** Atlanta Traveler Information Showcase

Benefits

Can allow travelers to make intelligent mode choice decisions:

- Reduction in road rage accidents and emergency response due to better-informed travelers.
- Reduction in road rage due to congestion.
- Reduction in pollution levels due to decreased congestion.
- Better informed traveling public.

Lessons Learned

Creation of a traffic cable channel requires a data clearinghouse for the traveler and traffic information collected. If such a clearinghouse does not exist, the cost of development must be considered.

Opportunities

In order to reach commercial vehicle operators, televisions showing the traveler information channel can be placed in truck stops.

Institutional Issues

Creating a traffic cable TV channel will require significant effort by many individuals on both the public and private side. The technical challenges associated with such a product is low.

Implementation Issues

Some regions may have multiple cable companies, in which case several partnerships may be necessary. Some companies may wish to only sponsor the channel if they can have an exclusivity agreement, resulting in their customers receiving the channel.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Atlanta Traveler Information Showcase, pp.121; available from FHWA Electronic Document Library

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4.9 INTEGRATED TRAVELER INFORMATION SYSTEMS

Needs Addressed

Stakeholders want the ability to disseminate rural traveler information through a variety of dissemination media that will work together as one system. Collectively, an integrated traveler information system will support pre-trip planning, immediate information prior to departure, and en-route information. Some combination of the Internet, landline telephone, cellular telephone, pagers, kiosks, and dynamic message signs will jointly comprise such a system. The information to be disseminated includes:

- Special event directions and parking;
- Road closures and detours;
- Inclement weather conditions;
- Alternative routes in known congested areas; and
- Directions and routing information.

Description

An Integrated Traveler Information System provides a platform for the collection, storage and dissemination of traveler information that maximizes the potential for private sector involvement. Typically, a base level of information will be made available in a standardized format and disseminated by the State DOT agency. This data may also be available to information service providers for repackaging and adding value for dissemination over private sector media outlets.

Real World Examples

Duluth / St. Cloud TOCCs (Minnesota)
Goals: Provide pre-trip and en-route traveler information for tourists, commuters and all travelers to the region. **Approach:** Through a public / private partnership, Mn/DOT has developed a database of information to support an Internet site, automated telephone dial-in system, email/pager push system, and kiosks. The Traffic Operations Communications Center (TOCC) is also

capable of controlling a variety of permanent and temporary roadside dynamic message signs. The data is disseminated through the project Internet sites as well as additional Internet sites developed by private agencies and departments of tourism.

Location: Regional areas that include the major cities of Duluth and St. Cloud, Minnesota.

Current Status: The project was deployed between the Fall of 1998 and the summer of 2000. Currently, the system is fully operational.

Future Activities: Mn/DOT is expanding traveler information systems statewide by expanding the information available over currently statewide phone systems, and adding additional information to Internet systems. Kiosk deployment will be slow in response to usage.

Impacts: Public response has been positive. Daily use of the Internet and phone systems continues to grow. Kiosk usage is high during winter months and inclement weather days, due to a greater need for weather information in these conditions.

Cost Information: This system was integrated as part of a major operations center deployment, so individual costs are difficult to estimate. Statewide expansion of detailed weather and road condition dissemination over the Internet (allowing users to click road segments to view current and forecasted information) is being funded at $95,000. Individual kiosks cost around $5,000 each but can go as high as $10,000. A city's traveler information web site may be designed for as little as $2,000.

Participating Institutions: Minnesota Department of Transportation

Contact: Tom Peters, Mn/DOT OATS Office, (651) 296-3062

Other Examples: Branson Ozark, Highroad Project
IRTIS, Tahoe Basin
Oregon TripCheck System

Benefits

- Easy access to statewide traveler information;
- Provide reliable traveler information to the most number of people with minimal cost; and
- Favorable public perception of DOT.

Lessons Learned

A limited amount of information should be disseminated by the public agency, either directly or through a contract of operations. This will maintain a critical mass of information being disseminated and allow third party information service providers to jointly disseminate information as part of private ventures.

Opportunities

It may be possible to generate revenue for traveler information endeavors by offering local businesses the opportunity to be involved in some way, such as by sponsoring a traveler information telephone line. For example, Recreational Equipment International (REI) sponsors the Washington DOT mountain pass information line.

Institutional Issues

Clear arrangements must be understood regarding what rights other private agencies have to use and repackage the information.

Implementation Issues

Businesses receive many solicitations for their advertising dollars and can be apprehensive about becoming involved with another project. For example, finding a business that is willing to host a kiosk, even a travel-centered business such as a hotel, can be a challenge even if little or no resources or involvement is required.

References

[Arizona Highway Closure and Restriction System (HCRS)]

[Minnesota TOCC project]

4.10 SMART CALL BOXES

Needs Addressed

A means of communicating and processing data that may be deployed on the roadside and does not require traditional power sources or land-line communications.

Description

The basic concept of a smart call box involves multipurpose data processing and transmission involving an independent solar power supply and wireless communications. The overall system includes a microprocessor, a cellular telephone transceiver, a solar power supply (solar collectors and a storage battery), field data collection devices, call box maintenance computers (used to periodically check the operating status of call boxes), and some type of data handling system at a central location such as a TMC.

The key features of the ideal smart call box system include: 1) it should serve multiple functions, to include voice transmission and possibly several types of data transmission and 2) it should be able to function without an external power supply. Additionally, it may be desirable for the call box to be capable of communicating with the TMC.

Real World Examples

Smart Call Box Field Operational Test (FOT) (California)
Goals: The goals of the FOT were to demonstrate the feasibility of using smart call boxes as an alternative to providing electrical and telephone conduits to the roadside terminal, and evaluate their potential cost-effectiveness, and identify institutional issues, which might affect their deployment. **Approach:** The Smart Call Box Field Operational Test (FOT) evaluated the feasibility and cost-effectiveness of using smart call boxes for five data processing and transmission tasks: traffic census, incident detection, hazardous weather reporting, dynamic message sign control, and video surveillance. Evaluation focused on cost-effectiveness, with effectiveness understood to include both functional adequacy and rechallenges and costs to include capital costs, telephone charges, and maintenance costs. Test systems were designed and installed by two vendors, GTE Telecommunications Systems of Irvine, California and U.S. Commlink of San Leandro, California. **Location:** Test sites were set up along major freeways in the San Diego area, including I-5, I-805, I-8, SR 175, SR 63 and I-15. **Current Status:** Funding for the project was secured in 1993. The FOT took place from 1995~1996. The final report was published in 1997.

Future Activities: No future activities are planned.

Impacts: The study resulted in numerous conclusions with regards to the feasibility of smart call boxes. It is highly recommended that the final report be carefully reviewed before such systems are considered. A link to the final report is listed below as a reference for this project.

Cost Information: It appears that at most sites all types of smart call box systems have significant capital cost advantages over hardwire systems. This cost advantage is due primarily to the extra costs of trenching, wiring, and jacking of conduit that are involved in hardwire systems. Even where external A/C power was required, the cost advantage was substantial, because distances to the nearest access points for the telephone system tended to be greater than those to the power system; however, the greatest cost advantages were for systems that did not require A/C power. The final report on this project provides detailed cost information.

Participating Institutions: The Smart Call Box FOT was funded by the FHWA and the State of California, acting through the Caltrans Office of New Technology and Research. It was carried out by a consortium (the FOT Partners) consisting of Caltrans District 11, the Border Division of the California Highway Patrol (CHP), and the San Diego Service Authority for Freeway Emergencies (SAFE). TeleTran Tek Services provided project management support.

Contact: Dr James H. Banks, San Diego State University, (619) 594-7051

Lessons Learned

The smart call box concept was found to be feasible but not necessarily optimal. As part of the study, functional systems for traffic census, hazardous weather reporting, and video surveillance were produced. Due to high wiring installation costs, they will often be cheaper to deploy than hardwire systems but are not necessarily superior to other wireless options.

Institutional Issues

Institutional problems encountered in the FOT itself included inadequate involvement of the sponsoring agencies and potential users in system development, delays due to a lengthy vendor-selection process, and cumbersome contracting procedures; some of these might have been avoided by including all major participants as partners in the FOT proposal.

Implementation Issues

Significant system integration problems were encountered. Agencies considering deployment of smart call boxes should prepare detailed deployment plans to resolve such issues as ownership, financing, and provision of maintenance services.

References

Final report on the Smart Call Box Field Operational Test, available from the California PATH Web site.

5. TRAFFIC MANAGEMENT

This Section contains descriptions of the tools that fall within the traffic management development track. These are:

- Automated lane indication systems;

- CCTV;
- GIS applications;
- Integrated signal systems;
- Pager activation of warning beacons;
- Route diversion systems;
- Vehicles as traffic probes;
- Incident management systems;
- Parking management systems;
- Work zone safety systems; and
- Low-cost detection.

Click the image to see a full size version

5.1 AUTOMATED LANE INDICATION SYSTEMS

Needs Addressed

Improve safety through technology enhancements for driving during foggy and whiteout conditions.

Description

In areas that are mountainous and rural, poor visibility caused by fog, whiteouts, and smoke creates unsafe driving conditions. During these events, drivers are unable to tell where the edges of the roadway are. Located using fog lights and high-beam lights installed on the vehicle does not always allow for improved driving conditions, and sometimes worsens the driver's view of the road. The utilization of in-pavement lights, such as those used on runways at airports, will ensure the definition of the roadway edges and thereby allow drivers to stay on the roadway and within their lane. The installed inpavement lights have a projection above the pavement of only 2", allowing snowplow blades to pass over the fixture, nor do they hinder bicyclists.

Other lane indication equipment, such as raised pavement markers (RPMs) can be vulnerable to snowplows. The fixture is 8" in diameter and is set in an underground canister of galvanized steel. The fixtures are able to withstand a dynamic load of 11 tons and routinely handle rollover by Boeing 747s when used on airport runways. The fixtures are able to display up to three separate colors in a range of angles, wide to narrow.

Real World Examples

Kirkland Low Visibility Lighting System (Washington)
Goals: Improve the safety of drivers during low-visibility conditions, improve the safety of pedestrians in crosswalks, and improve demarcation of lanes in complicated intersections. **Approach:** The city of Kirkland installed their first in-pavement lights in the fall of 1997 at two locations- Central Way and 4th Street and NE 124th Street at the North Kirkland Community Center for the purpose of illuminating crosswalks. All of the systems installed in Kirkland require pedestrian to use a push-button to activate the system. **Location:** Some locations that have deployed similar systems are Santa Rosa, CA; West Hollywood, CA; Reno/Tahoe International Airport; and Orlando, FL. **Current Status:** Project has been deployed. **Future Activities:** Seventeen more crosswalks in Kirkland will be outfitted with the lights.

Impacts: The system has been so successful that the city won a special award from the Washington Traffic Safety Commission.

Cost Information:

- Fixtures - $525.00
- Spare lamps - $15.00
- Electrical installation (per six fixtures) - $3,000 - $5,000
- Operations and Maintenance - N/A

Participating Institutions: City of Kirkland

Contact: David Godfrey, Traffic Engineering Manager, City of Kirkland: godfrey@ci.kirkland.wa.us

Benefits

- Improved visibility of the roadway edges;
- Fewer accidents on curvy and potentially hazardous rural roads;
- Decrease in costs of repairs to crash locations and incident management;
- Decrease in costs incurred in repairs or insurance through avoiding accidents; and
- Similar to raised pavement markers, the lights create an audible warning and "rumbling" sensation when a vehicle crosses over the line into the other lane.

Lessons Learned

There are many technologies that are currently being used in other industries, such as the air industry, that have the potential for use by DOT's to assist in solving highway transportation issues.

Opportunities

Automated lane indicators have been used extensively in Europe, Australia, and New Zealand on roundabouts (traffic circles) and at intermodal facilities. In the United States, however, this technology has not been heavily utilized. Primarily, foreign municipalities have used in-pavement lights on crosswalks to give drivers another indication that pedestrians are present. Other areas of opportunity for lane indicators include:

Railroad Crossing - Installing a series of inpavement lights before at-grade railroad crossings. The lights would emit a red beacon that is triggered by the presence of a train some distance away from the crossing. Currently, there are numerous at-grade crossings with only a stop sign to indicate the driver to stop before proceeding. In-pavement lights would be a dynamic instrument to warn drivers of the presence of a train.

Speed Warning Systems - Speed warning systems have been used for a number of years on potentially hazardous roads, intersections and interchange ramps to warn drivers of their potentially hazardous speed. Users of these systems include any motorist traveling at excessive speeds. An automated warning system could be used to augment and enhance the system by indicating the roadway edges.

Recreational Trails - In-pavement lights could be utilized for recreational trails where light needs to be present for trail indication.

Institutional Issues

The challenges associated with an automated warning system would be small.

Implementation Issues

Installing and evaluating a test system will ensure the system operates properly and meets the criteria set forth by the DOT or enforcement agency. Maintenance issues will include ensuring that the visibility sensors are working properly and that the inpavement lights are operating.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

In-Pave Lights, Urban Transportation Monitor, Lawley Publications, December 19, 1997, page 1. Kirkland, WA project

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5.2 CLOSED CIRCUIT TELEVISION

Needs Addressed

Click the image to see a full size version

Closed Circuit Television (CCTV) should provide the following services:

- Allow traveler information web pages to display images from rural routes;
- Allow observation of conditions near work zones and events/attractions;
- Allow maintenance operators to view conditions along rural highways to plan for treatment; and
- Allow DOT personnel to view dynamic message signs to verify messages.

Description

CCTV technology used in combination with communications to view facilities allows monitoring staff to accomplish numerous activities such as incident detection and verification, weather and roadway conditions monitoring, DMS message verification, and event management. CCTV images can be sent back through wireless communication to an information clearinghouse, via cellular digital packet data (CDPD), and cellular telephone signals.

Wireless communication using CCTV has been used successfully in ambulances, allowing physicians at the destination medical center to view patients prior to their arrival, improving advice during transport and allowing better preparation at the receiving facility. However, other wireless communication applications are available. CCTV is proven effective in providing efficient response to incidents when a visual verification is made, and deploying the appropriate emergency personnel (fire, police, ambulance).

Real World Examples

Rural Cameras at Key Locations (Oregon)

Goals: To provide a monitoring system and to supply images to the Internet site

Approach: Oregon has deployed a number of cameras that are able to display still images on Internet sites. Cameras are typically installed at weather stations. An image capture device triggers the camera to capture an image every 5-15 minutes, depending upon need. The device then connects to a local Internet Service Provider and transmits the image over the Internet.

Location: Key rural areas, primarily mountain passes

Current Status: ODOT currently has over 80 cameras deployed, and operational, over half of which are in the Portland metropolitan area. Additional cameras are added as funds are available and the need is present. Camera installation can typically be done in half a day.

Future Activities: Additional cameras are to be added when needed.

Impacts: Cameras are one of the popular areas of ODOT's site. The public enjoys seeing the images of conditions. ODOT is still gathering information from the public in terms of overall reactions.

Cost Information: Installation costs per camera are approximately $3,000. Operations and maintenance costs are minimal.

Participating Institutions: ODOT

Contact: Robert Fynn, ODOT ITS unit, (503) 986-3588

Benefits

- Allow traffic management personnel quick confirmation of incidents and weather events.
- Allow traveling public to view conditions before traveling.
- Provide increased detection capabilities at known accident locations.

Lessons Learned

Vandalism was a concern, however there have been fewer occurrences than expected. Cameras are placed high enough to discourage pedestrian access. Agency Internet servers will experience increased use when cameras are installed and operational, so it is worthwhile to consider the capacity of the current system and purchase additional hardware if necessary.

Opportunities

The relay and display of camera images can be useful to a variety of agencies. For example, other states have partnered with the Parks Department to deploy cameras in open parking lots. Parks benefit from knowing how many cars are in the lot, and the DOT benefits from cost sharing with the Park service, and by using the right-of-way. Additionally, parking lots in recreational areas often experience a high level of drivers driving through lots searching for a place to park. The presence of visible cameras may also help to deter crimes.

Institutional Issues

The deployment of a CCTV system locally or regionwide requires operations and maintenance of equipment, and a working knowledge of the technology. Personnel can be located in-house or the work can be contracted out. To make best use of the technology, a multi-agency, multi-jurisdictional approach to sharing data and responding to incidents is recommended.

Implementation Issues

It is important to determine the functionality required by the individual deployment site. For example, if cameras are required to have pan/tilt/zoom capability or to provide real-time video feedback, costs for infrastructure and communications can increase significantly.

References

TripCheck

Getting Around Puget Sound; WSDOT pamphlet; pp. 12. Available from FHWA Electronic Document Library

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5.3 GEOGRAPHIC INFORMATION SYSTEMS (GIS) APPLICATIONS

Needs Addressed

Stakeholders want to utilize geographic information systems (GIS) to plan and analyze transportation networks (roads as well as transit). Also, they would like to integrate automatic vehicle location with GIS to better manage maintenance, transit and emergency vehicles.

Description

GIS is a computer-based tool for visualizing, mapping, analyzing, and processing data that have a geographic component. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. GIS can be used to integrate mapping analysis into decision support for network planning and analysis, vehicle tracking and routing, inventory tracking, and route planning and analysis. GIS combined with AVL can be utilized to track vehicles visually, plan their routes and to signal an alert if vehicles go off schedule. In this application, GIS can also be used to view actual routes taken.

Real World Examples

Grade Crossing GIS Database (Nebraska)

Goals: To efficiently determine where safety and traffic related improvements should be made to roadways and railroad crossing sites.

Approach: A video log of trackside and roadway characteristics at at-grade crossings and a log of the numbers of vehicles and trains per day at crossings are being created. The mileposts on rural roads assist in identifying, tracking, and documenting specific areas that need maintenance through the use of a GIS database, coupled with a video log of the number of grade crossings.

An in-vehicle video camera is used to document on tape, roadway and trackside conditions for early detection and examination of possible problem areas. The video camera is able to tape fifty feet ahead of the vehicle, and automatically records to disk for later downloading into a database. Multiple users access the database for various purposes including traffic counts, railroad crossing measures (i.e. crossings per day) and projections. Users that access the information include the legal department, statistical analysis specialists, general administration, infrastructure personnel, and maintenance districts.

Location: Statewide

Current Status: Nebraska began using video in 1975, and has gradually deployed the current system.

Future Activities: New uses for the information are continuing to be discovered.

Impacts: All goals were achieved and expectations exceeded. The project continues to gain support as additional uses are defined.

Cost Information: A GIS database system for this application may cost $100,000 to set up. Personnel must also be trained to maintain the database. The budget for the creation of the video log is $125,000.

Participating Institutions: Nebraska Department of Roads

Contact: Randy Peters, Department of Roads Traffic Engineering Division Manager, 402-479-4594

Benefits

- Better analysis of road network to prioritize congested or potentially hazardous areas for road improvements.
- Improved analysis tool to prioritize funding for certain areas.
- Improved fleet management.

Lessons Learned

By compiling in-field video and supporting information in a geographical database, a large number of additional uses for and benefits of a GIS system have been discovered.

Opportunities

Opportunities for GIS in rural areas include nearly every area, with particular emphasis on those that require real-time mapping to location databases. As an example, accidents, construction, or heavy vehicle permit restrictions can be tied to GIS in order to allow automatic consideration and display by numerous response agencies.

Institutional Issues

GIS software can be used for a wide range of situations, from static network analysis to dynamic, real-time tracking of vehicles. Any organization utilizing GIS will recognize the benefits it has to offer soon after the software is installed. GIS software is mature and is readily used by numerous public and private agencies. Issues associated with GIS are few, however, GIS software can be difficult to install, setup, and maintain, and requires adequately trained personnel. To ensure the maximum utilization of the GIS software, a information technology position should be created, at least on a part-time basis, to maintain the GIS software.

Implementation Issues

Initial costs may be large. Agencies must consider the various opportunities for other applications when investing in GIS systems and potential issues involving integrating the new GIS with legacy systems. Also, ongoing support or licenses may be required to continue to operate GIS software. Agencies should be aware of and consider any such costs.

Reference

Technology in Rural Transportation "Simple Solutions", FHWA, Publication No. FHWA-RD-97-108, October 1997.

5.4 INTEGRATED SIGNAL SYSTEMS

Needs Addressed

Improvement of local traffic signal system operations and increasing the options for interagency signal control.

Description

Many signals in operation today are controlled by time-of-day cycle timing. A cycle-timed system is one where the amount of time given to any particular direction is changed based upon a preprogrammed timing plan entered into the signal's memory. In order to change the cycle pattern, someone has to go out to the signal and manually change it. Today, integrated signal systems have been successfully installed throughout the U.S. An integrated signal system allows an agency to coordinate surface street traffic flow along a roadway by controlling the signal timing at individual signal controllers. Data collected through surveillance components can be analyzed and signal timings automatically changed.

Real World Examples

Inter-agency Signal Master System (Colorado)
Goals: To improve the operations of local traffic signal systems and to increase the options interagency signal control. **Approach:** A microcomputer based traffic signal control system has been developed which interfaces with type 170 intersection controllers. The system, which operates in a widely used graphical operating system environment and can monitor over 10,000 intersections, can store up to 15 years of data on a single optical disk. The system can transmit data simultaneously over a variety of communications media including voice grade telephone lines, fiber optic cable, and cellular, packet, and spread spectrum radio. The system can also automatically page a standby technician to report intersection and equipment failures. Technicians can then access the main computer with a notebook computer via cellular phone. The system is able to monitor the signals of multiple agencies, such as city, county, and state systems. **Location:** The system was initially used to operate intersections in Colorado Springs, Colorado. The system is now being used throughout much of Colorado and in parts of Kentucky, Connecticut, and Texas. **Current Status:** Some 400 intersections are currently covered by the system. This project is currently operational. **Future Activities:** The system will soon be implemented in Boulder and Loveland, Colorado. **Impacts:** The system has proven highly successful and met project goals. **Cost Information:** System costs range from $150,000 to $1,000,000+ depending on the size of the system. **Participating Institutions:** City of Colorado Springs, Traffic Engineering Department. **Contact:** John Merritt, Principal Traffic Engineer, Colorado Springs, CO. (719) 444-2460

Benefits

- Improved signal system operations and traffic operations;
- Maintenance dispatching capabilities for signal failure events; and
- Graphical User Interface for easy use.

Lessons Learned

System upgrades must be factored into the project budget. With the implementation of the PCS II version, the Colorado system will be on its fourth upgrade since 1993.

Opportunities

In many municipalities, traffic management centers utilize the traffic signals as traffic sensors to collect information on congestion and traffic volume for incident detection, traffic information dissemination and later analysis.

Institutional Issues

Interested agencies should be willing to operate the signal system in a joint effort that would improve the operation of the signal system.

Implementation Issues

There currently exists a hardware standard for 170 intersection controllers, however there is not a similar standard for central system software. Each of the major system integrators has slightly different protocols and therefore requires that firmware which controls the individual signals have the appropriate protocols.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

National Capital Area Umbrella ITS Early Deployment Study, pp. 22-23. Available from FHWA Electronic Document Library

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5.5 PAGER ACTIVATION OF WARNING BEACONS

Needs Addressed

An efficient means of controlling warning beacons without altering the existing infrastructure.

Description

Warning beacon lights that are accompanied by advisory road signs can help convey critical safety messages to travelers. The lights may be set to flash when the safety message is especially urgent. The activation of the beacons to flash is either triggered according to the time of day or manually. The system described below enables beacons to be activated remotely using common pager services and low cost receivers on the road signs.

Real World Examples

Pager Activation of School Crossing Beacons (Oregon)

Goals: To reduce the costs of installing and operating flashing beacons at schools and to provide greater flexibility and cost-effectiveness in programming the beacons for special events.

Approach: Flashing beacons have been installed to warn drivers that they are in a school zone. The original system used special timers to activate the beacons just before and after school. Any changes in school hours or special events required a special trip to the beacon to reprogram the clock.

To streamline this process, a pager-controlled system was designed and built. Each sign installation has a pager, and a 386-PC and paging software which is used to control the pager units. Messages are sent from the PC to the pagers. These messages contain the unique ID code of the pager and a code to switch the outputs on or off. The use of unique pager codes allows the city to use one pager telephone number for a subset of the school installations covered by the system. The central PC schedule is easily modified and allows greater flexibility for handling special school events.

Location: The City of Portland, Oregon.

Current Status: The system is fully operational at all elementary schools.

Future Activities: System has been deployed citywide. No further expansion is planned.

Impacts: The system has reduced costs and streamlined the beacon activation process.

Cost Information: The previous system, with individual timers and the necessary overhead cabling, cost about $2,500 per sign to install. The pager-activated system is much more cost-effective, costing around $100 per site for the pager units themselves. As the pagers do not require separate housing, this also reduces costs. The paging service costs $5 per month per number. At present, five to six schools utilize one paging number. System software was created in-house.

Participating Institutions: The City of Portland Office of Transportation.

Contact: Bill Kloos, City of Portland Office of Transportation. (503) 823-5382; Paul Zebell, City of Portland Office of Transportation. (503) 823-7300

Other Examples: Pagers Replacing Photo Cells for Highway Lighting, Indiana

Lessons Learned

Lessons associated with the implementation of this system include allowing for future system expansion. Given the potentially high number of schools within an area that could benefit from the system, agencies should ensure that the system is configured so that it can be augmented to cover additional schools in the future with minimum disruption to the school beacons already covered by the system. In addition, the possible expansion of the system to activate other types of signs via paging should also be taken into account when specifying the system.

Opportunities

Remote beacons could be activated to indicate a series of unpredictable but repeating events. For example, a flashing beacon to indicate ice on a bridge could be remotely activated. Ideally, such a system would be activated by sensors on the bridge.

However, as the decision to activate the beacon may be made remotely, at least under the simplest scenario, wireless technology may be needed to communicate with the beacon. The following list includes candidate applications for remotely activated beacons:

- Danger of objects in roadway / falling rocks.
- Roadway floods.
- Snow and ice on roadway.
- Emergency vehicles approaching.
- Incidents/crashes.
- Trucks entering roadway.
- Children at play.

Institutional Issues

As with all such warning systems, it is important to regularly verify that the beacons are working properly. Drivers become desensitized to the flashing lights if they see them when there is no hazard present.

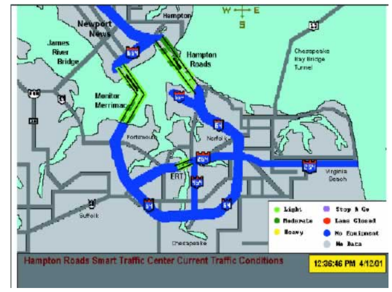
Implementation Issues

As this application relies on paging coverage, only those areas with existing terrestrial coverage can take advantage of this system. However, paging services via satellite are also available and offer far greater coverage.

Reference

Technologies in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

5.6 ROUTE DIVERSION SYSTEMS



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Needs Addressed

During peak tourist seasons, local traffic can cause serious delays for through traffic on rural routes. This solution offers diversions for this through traffic.

Description

The low-cost route diversion system concept uses static guide signs and route markers to define permanent alternates to primary routes with recurrent problems.

Typically this is not an advanced system, but the static signs can be supplemented with highway advisory radio (HAR), road weather information systems (RWIS), or other advanced technologies to enhance their effectiveness in affecting driver behavior.

Real World Examples

VDOT Hampton Roads Route Diversion (Virginia)

Goals: To effectively redirect traffic during typically congested tourists seasons.

Approach: Hampton Roads has a number of predefined alternate routes to heavily traveled tourist routes. Each alternate route is assigned a distinctly shaped and colored identifier (e.g., triangle, square, circle, diamond). Frequent diversion confirmation is given along the route by placing the appropriate colored symbols on existing static signs and the end of the diversion route. In addition, Hampton Roads also utilizes HAR and flashing lights to indicate when the alternate route is recommended.

Location: Virginia Beach/Hampton Roads, Virginia. This technique is used during the summer to divert tourist traffic around the Hampton Roads area. A large portion of traffic entering the Virginia Beach area during warmer months of the year is enroute to North Carolina.

Current Status: The system is operational and is used heavily between Memorial Day and Labor Day.

Future Activities: Continued operations

Impacts: Vehicles taking the diversion routes avoid heavily congested areas.

Cost Information: Costs vary according to the number of signs used, and typically only include sign costs. HAR systems could be added for $10,000-20,000.

Participating Institutions: Virginia Department of Transportation's Suffolk District

Contact: Mr. Stephany Hanshaw, Virginia Department of Transportation, Smart Traffic Center (STC), (757) 424-9907

Benefits

- Low cost and effective route diversion tool
- Minimal maintenance requirements
- Easily utilized by visitors

Lessons Learned

Vehicles traveling through a congested area appreciate alternative (diversion) routes. Such routes can be established on a seasonal basis (i.e.,only during summer months) or for work zones.

Opportunities

This tool can be combined with almost any number of advanced techniques, including:

- DMS.
- In-vehicle navigation devices.
- HAR.
- Centrally controlled and integrated RWIS.

This tool is intended to address one tourism congestion problem and, when combined with other advanced traveler information systems can be an effective means to address other road problems and congestion issues, such as inclement weather, and special events.

Institutional Issues

The route diversion may have impacts on tourist sites and corridors as traffic is diverted onto other routes.

Implementation Issues

A maintenance plan will need to be implemented to ensure all of the permanent signs are in-place, especially during the peak season, so motorists do not get lost. In addition, diversion routes may need capacity and safety improvements.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Rural Applications of Advanced Traveler Information Systems, Recommended Actions, FHWA publication number FHWA-RD-97-042

5.7 VEHICLES AS TRAFFIC PROBES

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Needs Addressed

Use vehicles as traffic probes for the collection of traffic information such as incidents, incident locations, travel times and traffic congestion areas.

Description

Vehicles acting as traffic probes allow for the collection of accurate data on current traffic conditions. The system utilizes transponders that are installed in vehicles and transponder readers that are placed along the roadway. Fixed reader sites are located at areas along roadways where traffic congestion is endemic. Portable transponder readers can be used in areas such as work zones or for facilities serving special events to determine travel times at those locations.

The reader scans the transponder and sends the tag identification to a computer where the information is analyzed. Traffic incidents are automatically identified through an incident detection algorithm. The algorithm determines the probability of an incident when transponder-equipped vehicles detected at an upstream reader site are not detected at the downstream site within the expected arrival time.

Real World Examples

New York TRANSMIT (New York, New Jersey, Connecticut)
Goals: Collect accurate and timely traffic data about current road conditions through non-intrusive means. **Approach:** The TRANSMIT system uses transponders issued as part of the EZ Pass electronic tollcollection systems. TRANSMIT has installed a number of readers along specified roadways with the capability of identifying the vehicles equipped with transponders at periodic intervals. **Location:** New York, New Jersey and Connecticut Tri-State area. Garden State Parkway, I-87/287, Sprain Brook Parkway, Hutchinson Parkway, I-95, I-278, Route 440 **Current Status:** Operational. Due to success of system, it will be expanded. Future Activities: Phase 2 will provide transit vehicle locations in real time to Port Authority Bus Terminal personnel. Information on bus locations from strategically located TRANSMIT readers will enable improved routing and dispatch decisions. Phase 3 will consist of expanding TRANSMIT to include reader installations on missing highway locations and in NJ Transit garages. Impacts: TRANSMIT will provide a fast and efficient method for detecting incidents and measuring travel times. NJ Transit bus dispatchers at the Port Authority terminal will make a greater number of correct dispatch decisions when armed with bus location data. More travelers will use travel time data to modify their route. **Cost Information:** Phase I: $2.3 million. Phase II: $1.2 million **Participating Institutions:** TRANSCOM, New York/New Jersey/Connecticut transportation agencies **Contact:** Tom Batz, TRANSCOM, (201) 963-4033

Benefits

- Improved and more accurate traveler information;
- Better and improved data source for traffic information dissemination and analysis; and
- Traffic information.

Lessons Learned

The project has been extremely successful. The use of this project as a model for future deployments should be considered.

Opportunities

The TRANSMIT system has the potential to provide extensive data for traveler information systems. Its current capabilities in terms of real time link and travel time estimates should be exploited. TRANSMIT system data could be used to provide estimates for incident duration and to predict effects of incidents on the roadway as well as adjacent roadways.

The rapid high volume data acquisition capability of the TRANSMIT system can enhance research in advanced traffic flow theory. It could provide an unmatched opportunity to verify various proposed models with real time traffic flow data. The TRANSMIT system should become a case study for multi-jurisdictional project types. Various metropolitan areas in the U.S. could benefit from the experiences gained through the implementation of the TRANSMIT system.

TRANSMIT has been primarily sponsored with federal funds and resources. Various innovative alternativefunding mechanisms should be sought for establishing public/private partnerships for future expansion and operation.

Institutional Issues

Institutional issues include significant privacy concerns. Using vehicles equipped with transponders as probes is very beneficial for traffic monitoring purposes as well as incident detection. Today, ITS Privacy Principles stipulate that the transponders used as probes would be assigned a random number and that random number would be used for traffic probe purposes. The actual transponder ID would remain private. This prevents any entity from tracking any individual user.

Implementation Issues

In order for probe applications to be useful, the number of transponder-equipped vehicles would have to attain a certain system specific threshold.

Reference

NYSDOT ITS Toolbox for Rural and Small Urban Areas

5.8 RURAL FREEWAY ACCESS MANAGEMENT SYSTEMS

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Needs Addressed

Access management along rural freeways is typically related to weather, crashes, emergency evacuations or maintenance operations that close the freeway for periods of time. As a result, large volumes of traffic (many of which are commercial vehicles) are routed on to local surface streets often for many hours or even days. Local services in small and rural towns are not sufficient to support these large masses of traffic. Many times freeway travelers are not alerted to such closures until they reach the point of closure.

Description

Rural freeway access management systems attempt to spread the number of vehicles diverted off freeways over a larger geographic area such that sufficient services (i.e., hotels, restaurants) are available, and not to overcrowd small rural towns. Rural freeway incident management systems typically use combinations of freeway closure gates (either remote controlled or manual) and information systems to alert travelers to the closures.

Real World Examples

Freeway Gate Operations (Minnesota)
Goals: To direct traffic off Interstates and to prohibit access during unsafe driving conditions. **Approach:** Gates are used in the mainline to direct traffic off the Interstate and also on the on-ramps to prevent more traffic from entering the Interstates. Gates may either be manual swing gates, or remote controlled gates that may be lowered automatically from the roadside. **Location:** Original deployments were along I-94. Currently, 65 gates are in use along I-94, Highways 10 & 210, and along I-90. **Current Status:** The first gates were deployed in 1996/97. Deployment of gates does not take considerable time, however Mn/DOT conducted a series of user needs and feedback

discussions during the process to ensure proper placement of gates.

Future Activities: Mn/DOT is planning expansion of the number of gates deployed and planning to coordinate operations of closure gates on a statewide level.

Impacts: The overall opinion of Mn/DOT and law enforcement personnel is that the gate systems offer an effective method for closing gates. The travelers noted that the gates provide a clear indication that the road is closed.

Cost Information: The costs for materials and installation of 43 gates was found to average approximately $3,700 per gate.

Participating Institutions: Minnesota Department of Transportation

Contact: Farideh Amiri, Mn/DOT OATS Office, (651) 296-8602

Other Examples: North Dakota closure gates, Wyoming, and Montana

Benefits

- Reduced delays by not allowing travelers to enter a freeway that is closed ahead;
- Reduced number of incidents by not allowing travelers to enter or remain on a freeway that is unsafe for travel; and
- Reduced risk of injury to maintenance personnel by not entering the roadway to manually close gates (if remote controlled gates are used).

Lessons Learned

Gate closures are much easier to implement than other methods for closing access to the freeway (i.e., barricades, vehicles or snow piles). Gates offer a low cost method for allowing the closure of roadways, however, local guidelines must be followed regarding who has the authority to close freeways and such operations must also comply with standards set forth in the MUTCD.

Opportunities

Gates may be useful in traffic control during planned construction / maintenance activities.

Institutional Issues

Travelers expressed some confusion as to why the freeway was closed when the weather seemed fine locally (which was done to keep traffic from having to be rerouted at the point of closure several miles down the road).

Implementation Issues

The gate closure systems are proven and effective, however they do not simplify the difficult decisions of when to close the freeway. These decisions still involve several agencies that together must reach decisions. Public information is also a component that must be considered.

Reference

Documentation and Assessment of Mn/DOT Gate Operations October, 1999; prepared for Office of Advanced Transportation Systems, Mn/DOT; prepared by: BRW, Inc.

5.9 PARKING MANAGEMENT SYSTEMS

Needs Addressed

To increase municipal parking revenues and improve the enforcement and servicing of parking meters.

Description

New parking meters accept coins, tokens and electronic keys. The keys work like a debit card: they are programmed with a certain value when purchased, which decreases as they are used for parking. The amount of money deducted from the key each time it is used is determined by the number of times the key is turned in the meter. The keys can be reprogrammed at a kiosk. The parking meters can also be equipped with a sensor to detect when a car has left the parking spot, so the next driver would need to insert money to park there. A microchip in each meter tracks the amount and rate of collection, allowing pick-ups to be conducted only when needed, as well as the times when parking enforcement is most critical.

Information that is kept by the parking meter can be downloaded to a personal computer. Parking ramps and parking meters are now using a more automated system of payment for parking services. Ramps and parking meters still accept regular money, but also use an electronic debit key to purchase parking time. Parking ramps will deduct from the account depending on the amount of time they use the ramp. Meters deduct money dependent on how many times the key is inserted.

Real World Examples

Smart-Key Payment for Parking Meters (California)

Goals: To raise parking meter revenues by providing more payment options, to improve the enforcement and service of meters, and to provide more payment flexibility to users.

Approach: New parking meters accept coins, tokens and electronic keys. The keys work like a debit card: they are programmed with a certain value when purchased, which decrease as they are used for parking. A microchip in each meter tracks the amount and rate of collection, allowing pick-ups to be conducted only when needed, as well as the times when parking enforcement is most critical.

Location: The meters can be used in any area where parking meters are used. A kiosk for purchasing keys and parking time must be easily accessible.

Current Status: In West Hollywood, CA, 500 smart-key meters were initially installed to replace traditional coin- and token-operated meters. The city had intended to replace the remaining 1,200 meters over a period of several years but accelerated the process due to the popularity of the meters. All of the meters have now been replaced.

Future Activities: The program has been fully implemented.

Impacts: Revenues from parking meters rose about 5 percent in the first year of operation, although this is partly attributed to more coin options as the older meters only accepted quarters. This program became immensely popular with local businesses, which requested that all the meters be replaced to allow key use.

Cost Information: The meter mechanism, not including the housing, costs about $190, which is $25 more than a coin-only meter. Other components include a hand-held personal computer for downloading information form the meters, and kiosks for dispensing and reprogramming keys.

Participating Institutions: The City of West Hollywood, CA.

Contact: West Hollywood Transportation and Public Works 323-848-6375

Smart Parking Meters (Pennsylvania)
Goals: To raise parking meter revenues by resetting parking meters when each car leaves a parking space. **Approach:** Meters contain sensing technology to determine when a vehicle has left a parking space. It then resets the meter to zero, requiring each new driver to put money in the meter. Programming options can also enforce the maximum amount of time allowed in a parking space and will record when the meter last expired. A hand-held computer is used to collect the information from the meters. Information is then downloaded to a PC, which is used to process information about the meters, including the average duration of parking, most popular times for the meter and duration of unpaid parking. To defray criticism of the meters, mostly from local retailers, drivers are given five free minutes when they enter the space and five grace minutes after their paid time expires. **Location:** Meters with sensors can be used anywhere a parking meter is used. New Hope, Pennsylvania is piloting the system. **Current Status:** Fifty-eight meters were converted to include sensor technology and tested for a one-year trial. **Future Activities:** Plans to replace existing meters are currently on hold. Impacts: Revenues from parking meters have increased more than 50 percent since the new meters were installed, which more than covers the increased cost of the meters. **Cost Information:** The equipment cost $2,200 per quarter for all 58 meters on a 5-year lease. The meters can be purchased for approximately $4,000 to $5,000 each. **Participating Institutions:** Borough of New Hope Police Department **Contact:** Chief Robert Brobson, Borough of New Hope PD. (215) 862-3033 Vince Yost, President, Intelligent Devices Inc., (610) 584-8830.

Benefits

- Decreased enforcement and money collection costs. The meters are computerized and will alert personnel automatically when they need to be serviced.
- Increased convenience to customers and businesses. Customers have other options to pay for parking, and businesses can receive more customers due to the increased convenience.

Lessons Learned

While the public generally appreciates the opportunity to pay for meters with currency other than coins, there may be some initial frustration from users who do not understand the system and receive parking tickets.

Opportunities

Many other transportation-related applications exist for this debit-key technology.

- This type of technology enables a one-stop shop approach to purchasing transportation services. This technology could be used to purchase bus fare, train fare or pay for parking in municipal lots or ramps. The key can be recharged at any number of places the accept the key as payment. Also, the system could be used more as a billing system, where the

user can use as many services as they need, and they get billed monthly for the usage on their key code.
- Some municipalities and private companies use a magnetic key system similar to this for dispensing fuel, for example. The user takes the vehicle to a fueling station, inserts the key for that vehicle, enters the mileage and the fuel dispenses in the vehicle. Hence, the record keeper has an automatic record of fuel usage by every vehicle in the fleet.

Institutional Issues

City may wish to recommend that parking enforcement be more lenient during the introductory phase of the project. Local media should be encouraged to have brief news segments on the new meters.

Implementation Issues

In order for this system to become a true, municipal "one-stop shopping" system, parking meters, buses, trains, parking ramps and other transportation components should be retrofitted with the debit-key system. Convenient areas to recharge the key are also needed.
There will be problems with opposition to the plan of having a car detection system. Drivers and businesses may think that all meter time should not be lost once the driver leaves.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-91-108, October 1997.

City of West Hollywood

New Hope, Pennsylvania Smart Parking Meters

5.10 WORK ZONE SAFETY SYSTEMS

Needs Addressed

To improve work zone safety using traffic calming techniques.

Description

Roadway construction and other events often result in restricted right-of-way, lane drops, detours and other restrictions, which affect travel flow and safety across the roadway network. Drivers need sufficient advance notification to facilitate smooth traffic merging and minimize delays. The project example described below uses advance warnings to calm the traffic and induce smoother transitions into limited lane areas.

Real World Examples

"Lane-Drop Smoothing System" (Indiana)
Goals: To improve work zone safety and traffic operations by encouraging drivers to merge sooner in advance of construction zones. **Approach:** A series of portable "DO NOT PASS" signs equipped with flashing beacons is placed at the approach to a construction site. Electronic occupancy sensors are placed in the roadway. At the outset of operations only the sign nearest to the work zone has activated beacons. When a certain threshold is detected by these sensors, that is, as the volume of traffic grows more heavy at the approach to the construction, the beacons on the next sign

upstream will also be activated, and so on. As traffic flow varies, the signs are activated or deactivated in sequence.

Location: State of Indiana

Current Status: The lane-drop smoothing system is in use, and a statewide specification for the solution has been written. Currently, there are experiments to use four signs instead of five, thereby making it more inexpensive to use.

Future Activities: The system will become a standard for use in the State of Indiana for contractors working on road construction.

Impacts: Reports claim that there is a drop in driver anxiety and "road rage" when a driver reaches the construction zone. Anecdotal reports have claimed that the system effectively encourages drivers to merge sooner before they reach the construction zone.

Cost Information: The current system cost approximately $3,500 per sign. This includes the beacons, the signs and the sensors for the traffic counts.

Participating Institutions: Indiana DOT

Contact: Indiana DOT, Public Affairs Division. (317) 232-5533

Other Examples: PA DOT uses a late merge concept

Benefits

- Less delay due to construction and maintenance work.
- Decrease in vehicle repair and other costs due to fewer accidents.
- Increased safety for construction and maintenance personnel.
- Smoother traffic flow at construction sites.

Lessons Learned

Providing travelers with information regarding the delay which they are currently encountering has been shown to reduce traveler anxiety and also improved travel conditions by allowing vehicles to merge sooner, thus "smoothing" the lane drop process. This project undertook a new and innovative way to dynamically adjust the location of the lane drop to facilitate travel through the work zone.

Opportunities

Given the portable nature of the signs used for this system, various additional uses for the equipment can be envisioned. These may or may not need to be used in conjunction with the occupancy sensors which are part of the Indiana lane drop smoothing system. Numerous additional uses can be envisioned including:

- Warnings to drivers about construction personnel in or near the roadway ahead.
- Sensors could provide data on current travel times or average operating speeds to maintenance or construction personnel.
- Temporary speed limits - either regulatory or advisory limits.
- Directions to parking facilities with dynamic information on available spaces for special events.
- Diversion advice.
- Warnings of temporary hazardous roadway or weather conditions.
- Temporary vehicle width, height or weight restrictions.
- Dependent on the various types of uses suggested above, different communications, additional sensors, or alternate data needs would need to be accommodated. For

example, in the case of providing information to drivers on parking facilities with available spaces, appropriate instrumentation at these facilities would need to be installed.

Institutional Issues

Institutional issues may arise regarding enforcement, when used, etc.

Implementation Issues

A potential implementation issue associated with this technology is ensuring that construction personnel are given adequate training and guidance regarding positioning, operation, and uses of signs to achieve the desired results. For example, if signs are positioned too closely to the work zone, positive benefits may not be achieved. Indeed work zone safety could even be negatively affected. As was described above, the lane drop system signs could be used for a variety of other messaging purposes. It is likely that different sign sittings would be required depending on the messages being displayed, in which case care should be taken to ensure that personnel are aware of the different sign locations appropriate for each type of message.

As a means of encouraging use of these signs, State DOT could consider purchasing the signs, which could then be "rented" by cities and counties or contractors, if appropriate, for their use.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

FHWA Work Zone Safety web site

FHWA Operations

5.11 LOW-COST VEHICLE DETECTION

Needs Addressed

Vehicle detection to determine traffic volumes or lane occupancy is essential for timing traffic signals, planning roadway expansions and predicting traffic impacts, even on low volume roads or rural areas. Traditional loop detectors require permanent installation and are expensive.

Description

This simple solution uses less expensive audio technology to detect the presence of vehicles in order to determine lane occupancy, perform vehicle counts and detect vehicular speed.

Real World Examples

Acoustic Energy Sensor for Traffic Applications (AZ, TX, VA, Mass.)
Goals: To develop a low-cost alternative to loop detectors for monitoring traffic flow and lane occupancy. **Approach:** The sensors measure the acoustic energy radiated by passing vehicles to determine the lane occupancy and vehicle count. The acoustic detector can also determine vehicle speeds, types and, when used as part of a network, link travel times. The sensors work very well in free-flow speed traffic because of the sound-wave compression, but do not work very well in congested conditions.

Location: Sensors are currently in use in Arizona, Texas, Virginia and Massachusetts and can be used where there is a pole, bridge or overpass on which to mount it.

Current Status: This technology has been tested and deployed in multiple localities.

Future Activities: No future activities are planned. The current deployments are considered permanent.

Impacts: These sensors are inexpensive and maintenance is easier than a loop detector.

Cost Information: Equipment per lane including installation is approximately $2000 per lane.

Participating Institutions: FHWA, Arizona DOT, Texas DOT, Virginia DOT, Massachusetts DOT.

Contact: Manny Agah, Arizona DOT, (602) 712-7640

Benefit

The ability to install temporary vehicle detection during special events or temporary construction activities.

Opportunities

Because this system is capable of being moved, it may be used in temporary conditions such as construction sites and special events. Detection systems such as this may be linked to incident detection algorithms to determine when traffic conditions merit response actions.

Implementation Issues

Because this system relies on acoustic information to detect traffic, there may be locations, such as busy intersections or in the vicinity of airports, where the system is unsuitable due to interference from other sources of noise. In addition, because the sensor require mounting on a pole, bridge, or overpass, some locations may be unsuitable for this system.

Reference

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

6. RURAL TRANSIT AND MOBILITY

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This Section contains descriptions of the tools that fall within the rural transit and mobility rural development track. These are:

- Coordination of rural transit services;
- AVL on agency vehicles; and
- Improving public mobility.

6.1 COORDINATION OF RURAL TRANSIT SERVICES

Needs Addressed

Stakeholders had concern about providing transit services for their rural communities. In addition, there is a need to provide a coordinated transit service with a central dispatching area.

Description

The purpose of most Advanced Public Transportation Systems (APTS) in rural areas is to increase the mobility of the residents within the area. Rural public transportation systems can take many forms and involve many or a few advanced technologies. Types of APTS range from a paratransit or demandresponsive system to a fully coordinated public transportation system that incorporates both fixed route as well as paratransit operations and combines the services with APTS technologies.

Technologies that may be applied to rural transit systems may include:

- Demand-Responsive Transit Services: These systems currently predominate in rural areas. Demand-responsive only systems typically have more vehicles than fixed-route only systems.
- Automatic Vehicle Location (AVL): AVL systems measure real-time positions of vehicles using onboard computers, electronic tags and a positioning system (such as global positioning system, sign post, or dead-reckoning) and relay the information to a central location.
- Transit Operations Software: Automates, streamlines, and integrates many transit functions and modes, including computer-aided dispatch, service monitoring, route planning, and supervisory control and data acquisition.
- Geographic Information System: GIS is a computerized database management system in which databases are related to one another using a common set of location coordinates. GIS is used to display fleet and route data on a display map.
- Traveler Information: When applied to rural transit, traveler information can take many forms, including pre-trip information, in-vehicle information, and interminal/wayside information.

Real World Examples

ARTIC Transit AVL (Minnesota)

Goals: Minnesota's ARTIC project uses AVL technologies to allow a rural transit system to provide, among other things, real-time location and communications with buses.

Approach: Through cooperative effort among agencies, the system tries to eliminate gaps or duplications in the communications systems, while enabling computerized reservation and scheduling services, improved response times to highway emergencies, and the combination of decentralized dispatch centers. Minnesota's ARTIC project has several different elements of AVL, including real-time location and communications with buses. It can be used to locate buses, as well as reporting schedule adherence information, communications with buses via text messages, and tracks system efficiency.

Location: Arrowhead Region (Minnesota District 8, including Virginia, Minnesota) 18,000 square miles; 3,000 miles of roadways. The area is almost exclusively rural, and has a high percentage of transit dependent citizens. Annual totals: Arrowhead Transit (3 yr. Avg - 1994, 95, 96) = 366,072 and the City of Virginia Dial-A-Ride (3 yr. avg. - 1994, 95, 96) = 58,060.

Current Status: Project has been deployed.

Future Activities: N/A

Impacts: The successful deployment of this project has lead to a statewide system of transportation operation and communication centers (TOCCs) throughout Minnesota.

Cost Information: The cost of the entire project was $1.5 million dollars. Of this, $500,000 is slated for design and development. Costs were split between FHWA, Mn/DOT and Qwest Communications. The agencies have built the cost of continuing the program into their current budgets.

Participating Institutions: Arrowhead Transit, Mn/DOT, City of Virginia Dial-A-Ride, Minnesota State Patrol, Qwest Communications, FHWA.

Contact: Dick Maddern, ITS Coordinator, District 8 Virginia, (218) 749-7798 ext. 3804, richard.maddern@dot.state.mn.us

Other Examples:

- Cape Cod Rural Transit Information and Coordination, MA
- Beaver County Mobility Manager, PA
- AVL Systems for Rural Transit Providers
- Smart Flexroute Integrated RT Enhancement System, VA
- Urban/Rural Corridor Application, NM
- ATHENA, OR
- WS DOT Ferry System ITS Application "Status Flash"
- FL Coordinated Transportation System
- Santee Wateree Regional Transportation Authority, SC

Benefits

- Increased mobility and access to community services and businesses for seniors, younger travelers, and any citizens without access to a vehicle;
- Increased sales and enlarged service area;
- Decreased operating costs and increased efficiency of mobility services; and
- Improved quality of life and vitality in rural towns and communities.

Lessons Learned

Operator training can be an unexpectedly large cost for this type of project.

Opportunities

Cellular technology could be utilized to accomplish the same results, however, constant communication with the driver regarding location could be distracting and expensive.

Institutional Issues

This solution is ideally suited to an area, which has existing transit and mobility services that may be streamlined. A new organization may need to be established so as to minimize the likelihood of local service providers perceiving the initiative as diminishing their control over their own operations.

Implementation Issues

This type of multi-agency system may be most effective in areas with a large elderly population, communities in which health care providers are long distances away from the majority of residents, or communities with numerous active agencies providing some form of ride assistance to non-driving members. A high level of cooperation and coordination among mobility service providers will be required for such a system to be a success.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Rural Public Transportation Technologies: User Needs and Applications, Prepared for FHWA and Federal Transit Administration by TransCore, 1998.

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

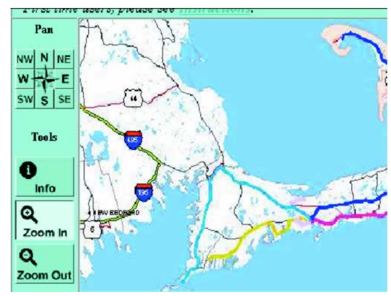
Intelligent Transportation Infrastructure, US Department of Transportation publication number FHWA-JPO-96-0022.

Advanced Public Transportation Systems: The State of the Art Update >98, Federal Transit Administration publication number FTA-MA

Minnesota Guidestar Web site for ARTIC

AVL on Agency Vehicles project example in this document

6.2 AVL ON AGENCY VEHICLES



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Needs Addressed

Utilize automatic vehicle location (AVL) technologies to track the location of agency vehicles, including snow plows, transit, maintenance, and police vehicles, in real-time.

Description

The majority of AVL technologies use the Global Positioning System (GPS) to pinpoint the location of various vehicles equipped with a GPS receiver. GPS is a free service provided by the US Government, which allows the use of a constellation of 24satellites in orbit 10,900 miles above the earth. Vehicles with GPS receivers have their position determined by a space/time triangulation of three or more of the 24 satellites. AVL also incorporates a wireless communications system to communicate the vehicle location back to the control center. Some options for this communications link are the State's existing radio frequency system, cellular communications, cellular digital packet data (CDPD), or satellite communications. The goal of implementing AVL on agency vehicles is to track vehicle locations to incident sites for fleet management, for special applications such as salting and snow plowing, and to provide communications, both voice and data, between agency vehicles and dispatch centers.

Combined with GIS software or mapping database, and road weather information systems, this technology can ensure the most cost-effective use of resources and deploy snow plows and de-icing materials to those areas most critically in need.

AVL has been utilized heavily in the commercial vehicle industry in fleet management and the US Government uses GPS regularly for the deployment of ships, airplanes and missiles. It should be noted that, in order to protect GPS from being used against the US, the US Government builds a degradation into the signal, resulting in less accurate location. However, depending upon the accuracy needed, agencies can also use differential GPS (DGPS) to gain extremely accurate locations for additional ongoing fees. The AVL system could also be used as traffic probes for improved traffic management and traffic information dissemination.

Real World Examples

Advanced Rural Transportation Information and Coordination (ARTIC) (Minnesota)

Goals: To locate vehicles for improved fleet management of agency vehicles. The AVL component of ARTIC supports the overall goal to coordinate and integrate the communication between various public agencies.

Approach: GPS equipment is installed on fleet vehicles to allow for quick location identification and deployment. ARTIC also uses mobile data terminals (MDTs) for the ability to send data between the vehicle and dispatching center for increased communication capabilities.

Location: Arrowhead Region (Minnesota District 8)

Current Status: The operational test started in October 1997 and ran through September of 1998. AVL and MDT are functional on 15 Mn/DOT vehicles, 4 Minnesota State Police vehicles, and 15 transit buses. An interface was developed between the MDTs and the sand spreader control on the plow trucks to demonstrate downloading of spreader information to the communications center.

Future Activities:

- Continue expanding application of the system for State Patrol and Mn/DOT.
- Provide for automated transfer of accident location from GPS to accident reporting software.
- Expand radio service from Little Fork through the ARTIC Communication Center to the Gilbert Transit Center.

Impacts:

- Success of the interagency cooperative endeavor has spurred interest in creating 9 statewide rural/small urban transportation operation and communication centers.
- Reductions in response time for accident and road condition emergencies through combining DOT and public safety dispatching.
- Proactive response to maintenance need and traveler information.

Cost Information: Total budget $1.8M; expenditures to date $1.5M. GPS equipment is currently available from multiple suppliers with costs ranging from $300 to $40,000.

Participating Institutions: Minnesota State Patrol; Mn/DOT; Arrowhead Transit; City of Virginia Dial-a-ride; FHWA; US West Communications

Contact: Dick Maddern, District 8 Virginia, (218) 749-7793 ext. 3804, richard.maddern@dot.state.mn.us

Other Examples: Mount Desert Island, ACADIA National Park ITS FOT

Benefits

- Better removal of snow from the roadway resulting in faster incident response and reduction in delays;
- Improved safety on roadways during inclement weather. Quicker dispatching of emergency vehicles;
- Ability to monitor agency vehicles in real-time. Optimize the dispatching of agency vehicles for numerous operations;
- Reduction in travel time delays and increased supply of traffic information; and
- Favorable public perception of DOT.

Lessons Learned

- Initial budgets and schedules proved to be quite optimistic. Longer deployment schedules and increased costs are expected along the implementation process.
- Implementing an AVL system will require at least one full-time agency person dedicated to the project as the system is designed and integrated.
- Developing and maintaining solid partnerships is critical to the success of the process. This may entail establishing memoranda of understanding between stakeholder agencies to lie communicate fiscal and operational responsibilities.
- A committed project champion (empowered to make key decisions) at the local level is necessary to keep the project moving.

Opportunities

In the ARTIC deployment, the success of the project increased the DOT's awareness of the benefits of sharing resources among stakeholder agencies. As a result, Minnesota is seeking to deploy a statewide network of transportation operations and communications center that will address the needs of rural and small urban areas. Again, the approach is to leverage the resources, knowledge and opportunities of the combined stakeholder agencies.

Institutional Issues

Likely participants include DOTs, police agencies, and transit. If vehicles, such as police vehicles, are equipped, there may be issues pertaining to data access as well as vehicle whereabouts. As more agencies choose to participate, costs can be decreased as they are shared among more parties; however, greater coordination between these participating agencies will be necessary. The need to anticipate and identify institutional issues between multiple agencies may also arise as participation increases.

Implementation Issues

- Design and deployment consideration of ITS technologies in the rural environment (e.g., communications availability)
- Need considerable interaction with numerous vendors and examination of numerous products to ensure technology is feasible in the rural environment, and to ensure cost-effectiveness.
- Partnership involvement may either inhibit or expedite project deployment. Strong representatives and good involvement from stakeholder agencies will help to alleviate these concerns.
- Project must satisfy a common vision and partners need to be committed to work through institutional and technical issues.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Virginia Department of Transportation Northern Virginia District, Automated Vehicle Location System Pilot Project, December 1997.

6.3 ENHANCED PARATRANSIT DISPATCHING

Needs Addressed

This tool addresses the need to make public transit more known and accessible to potential users.

Description

Urban transit consists of a combination of rail types. What about rural transit? The lack of density in rural populations cannot financially support the use of buses and light rail. Instead, lower-density vanpools, paratransit vehicles, and car-pool programs are used to increase mobility in rural areas. The challenge is not the willingness to provide this service or availability of rural transit. The challenge is making the transit service known and making it just as convenient to customers as using their own cars.

Real World Examples

Self-Drive Dynamic Van Pooling Program (California)

Goals: To get partially full vanpools filled to capacity with short-distance riders.

Approach: Via in-vehicle radio/cell phone technology equipment , the vanpool operator is able to communicate en-route with a dispatcher by sending numerical message packets that relay a variety of information including: time and location of departure; number of available seats; and the need for emergency assistance.

Location: Anaheim, California

Current Status: The project was active for a year, but now complete. Anaheim's vanpooling system is still in use, but without the Teletrack technology.

Future Activities: No further experiments with this system will be performed.

Impacts: Goals to get ridership to increase with short-distance travelers failed. The program was not financially feasible for short distance vanpooling.

Cost Information: A $50,000 grant for the program went toward marketing and the purchase and installation of Teletrack equipment in five City of Anaheim vans. The grant was issued by the South Coast Air Quality District.

Participating Institutions: Anaheim Transportation Network and the City of Anaheim

Contact: Diana Kotler, Anaheim Transportation Network (714) 254-5277

Community Transit / Car-Pooling Internet Site (Pennsylvania)

Goals: To improve the accessibility of transit service information to potential users, and improve the car-pooling service offered by this transit authority.

Approach: The Community Transit Agency of York County provides fixed-route service scheduling information, paratransit service information and a car-pool / ride-share matching service on an Internet site. The agency sees this as a long-term business investment as they can trace where patterns of travel are occurring then introduce bus services there in the future if economical. Individuals interested in the ride-share matching service fill out an on-line form. Information is added to a database that is surveyed by people providing rides. In addition, the authority also offers services tailored to the travel needs of the employeesof local businesses. Shuttle services are provided for various groups of night-shift workers, for example, often partially subsidized by the employer.

Location: The web site provides information for residents of York County, Pennsylvania. The county has an area of approximately 900 square miles. The transit authority operates fifty vehicles at present. The majority of these travelers use transit to commute to York City, Baltimore, or Harrisburg.

Current Status: The web site has been active since May, 1996. The site can be accessed at http://www.rabbittransit.org.

Future Activities: The web site has recently been redeveloped. In September 2000, the county introduced StopHopper, a service that allows riders to call the day before their trip to make a reservation for service. StopHopper operators give the rider information on the stops closest to their origin and destination and then work out what time the rider will need to leave in order to arrive at the desired time.

Impacts: Positive response to the original web site provided the county with the customer input needed to create such service expansions as StopHopper.

Cost Information: Precise costs involved in operating the web site are not available, but it is fairly inexpensive depending on the amount of Internet traffic it receives on a monthly basis.

Participating Institutions: York County Transit Authority

Contact: Steve Bland. York County Transit Authority. (717) 846-5562

Benefits

- Advertisement of services and better communication between the vehicles and the central dispatch helps to create a more efficient transit system that is more responsive to those who need it.
- Making short-distance services available makes more people aware of the service. The vanpool can operate more like a city bus service with a fixed route.

Lessons Learned

In Anaheim, the marketing and the equipment investment to get more short-distance riders to use the vanpool was not very effective. Not enough people required short-distance transit service to make the project financially feasible.

Opportunities

Partnerships with the private sector may be possible, in which companies donate a van in exchange for being listed as a sponsor on transit schedules and on banners displayed on the vehicle.

Institutional Issues

Local Health and Human Services departments may already be providing rideshare services to the elderly or disabled. Alignment with these providers may be both necessary and beneficial. Other institutional issues should be explored such as insurance requirements and challenges limitations.

Implementation Issues

Low-volume transit generally must be subsidized. A transportation network analysis and surveying of residents should be done before a paratransit system is implemented to ensure that a considerable need exists for the service.

Reference

Community Transit Agency of York County (PA) Web site

7. CRASH PREVENTION AND SECURITY

This Section contains descriptions of the tools that fall within the crash prevention and security rural development track. These are:

- Speed warning systems;
- Work zone safety systems;
- Automated visibility warning systems;
- Animal warning systems;
- Portable speed warning systems;
- Highway-rail alert systems;
- Bike safety systems;
- Rail-highway crossing safety systems;
- AVL on agency vehicles; and
- Pedestrian safety systems.

7.1 SPEED WARNING SYSTEMS

Click the image to see a full size version

Needs Addressed

Use speed warning systems for traffic approaching at high- volume intersections, work zones and accident locations. Speed warning systems are also effective for locations that cause sizeable speed differentials such as mountain passes or curves that require commercial vehicles to slow more than passenger vehicles.

Description

Informing drivers, based upon weather conditions, road geometry and their vehicle speed, will enable them to reduce their speed and maintain control of their vehicle. In addition to warning drivers they are driving too fast, the speed warning systems can also vary the posted speed based upon algorithms defined by the DOT. Typical speed warning systems can be composed of speed measurement technology, an automatic vehicle classification (AVC) system and a weigh-in-motion (WIM) system, and a DMS to communicate to the driver. The AVC and WIM technologies are primarily used for commercial vehicle operations.

Some systems merely inform the driver of the recommended speed for prevailing roadway conditions (fog, construction, congestion, etc.) and the driver's actual speed. Other systems run an algorithm to determine the recommended speed for the particular vehicle's characteristic (loaded or empty truck, etc.) and the vehicle's actual speed. Speed warning systems are not necessarily infrastructure intensive. They can require minimal permanent equipment installation or they can be set up as a completely mobile system.

Real World Examples

Truck Speed Warning System (Colorado)
Goals: To improve safety by lowering the speed of trucks on steep grades with a history of severe runaway truck accidents. **Approach:** A radar gun is installed to determine the speed of trucks approaching the curve. If a speeding truck is detected, a dynamic message sign is activated which reads, YOU ARE SPEEDING AT [XX] M.P.H. 45 M.P.H. CURVE AHEAD. The maximum design speed for the curve initially outfitted with this system was 45 mph due to limited sight distance. Speed tests were performed before and after the installation of the sign.

Location: The curve, which is on a down grade, and which tightens from 7 to 5 degrees midway, is on I-70 in Glenwood Canyon, Colorado.

Current Status: The system has been in place and operational since September 1996.

Future Activities: CDOT plans to leave the system permanently installed. At this time there are no plans to implement the system in additional locations.

Impacts: Prior to installation, the 85th percentile of truck speed was 66 mph. Following installation, this was reduced to 48 mph.

Cost Information: The cost of the system is estimated to be between $25,000 and $30,000.

Participating Institutions: Colorado DOT

Contact: Jim Nall, CDOT, (970) 248-7213

Other Examples: Seattle Speed Advisory on Curves
California Dynamic Speed Warning Systems
ADVISE I-215 Utah Speed Advisories During Fog

Travel Aid on Snoqualmie Pass (Washington)

Goals: Improve safety and reduce the hundreds of accidents that occur every winter on Snoqualmie Pass east of Seattle, WA by using dynamic speed limits.

Approach: The dynamic speed limit capability uses information from a number of sources to set a safe speed over the Snoqualmie Pass. Wide aperture radar will track vehicle speeds. Six weather stations will monitor temperature, humidity, precipitation, wind and specific road surface conditions. This information will be gathered and transmitted by packet radio and microwave transmission to the control center on top of the mountain. Travel Aid will then calculate safe speeds that are confirmed by WSDOT staff and transmitted to travelers via nine dynamic message signs.

Location: Travel Aid covers a 40-mile stretch of I-90. WSDOT has also added pass condition information to their web site.

Current Status: Travel Aid has been operational since the winter of 1997-1998.

Future Activities: The project is considered a success and will continue.

Impacts: Reduced speed over the hazardous mountain pass.

Cost Information: Design and implementation of Travel Aid cost $5,000,000

Participating Institutions: WSDOT, University of Washington, PB Farradyne, Traffic Master, Engineering Research Associates, Surface Systems Inc.

Contact: WSDOT, Pete Briglia, (206) 543-3331

Benefits

- Less costs incurred in making repairs to crash locations;
- Fewer fatalities and injuries;
- Less costs incurred in repairs or insurance through avoiding accidents;
- Less costs incurred in repairs, insurance and loss of shipments through avoiding accidents;

- Favorable public perceptions of safety improvement schemes; and
- Reduced incident management costs.

Speed warning systems will help increase the safety of roadways, particularly during inclement conditions. Speed warnings advise motorists when they are operating at unsafe speeds and provide information regarding proper speeds for roadway conditions and roadway geometry. Vehicles traveling too fast for conditions, particularly on curves or long downslopes, increase their risk of being involved in an accident.

Lessons Learned

The public has a favorable perception of safety improvement schemes such as these. In the case of Travel Aid, as the reduced speed limit is widely publicized via local media, travelers can use the information as a measure of how bad the road conditions are, and also to more accurately calculate their drive time.

Opportunities

The signs in place for the speed warning system could also be used to communicate additional types of communications links and sensor systems would need to be installed to enhance current systems. If multipurpose DMS, and other sensor technologies were utilized, information provided could include:

- Warnings about construction or maintenance occurring ahead;
- Temporary speed advisories and warnings due to construction activities or severe weather;
- Snow chains usage advice;
- Advice on the status of mountain passes in winter weather conditions;
- Traveler information, including diversion advice;
- Warning for vehicles approaching high-speed intersections;
- Warnings of hazardous roadway or weather conditions; and
- Vehicle width, height or weight restrictions ahead.

Interconnection of signs to a regional traffic management or traveler information center may provide maximum flexibility in the messages, which could be displayed. Should additional types of information be displayed on the speed warning signs, rules would need to be established for determining how and when a speed-warning message should override a more general informational message.

Institutional Issues

Periodic testing should be undertaken to ensure that drivers are continuing to alter their speeds in response to the warnings. In cases where the speeds are not just recommended but are actually enforceable, the enforcement agencies should be involved.

Implementation Issues

Calibration of speed warning systems is critical. Care should be taken to ensure that speed-readings displayed on the warning signs are consistently accurate, as readings that differ from the speedometer readings in vehicles will negatively impact the credibility of the system.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Smart Trek Web site

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

7.2 WORK ZONE SAFETY SYSTEMS

Needs Addressed

Provide a smart work zone system to aid the traveling public and enhance the safety of field personnel. Some of the types of needs identified include:

- Enhanced work zone safety and management measures.
- Advanced utilization of technology for work zone areas (e.g., lighting, traffic controls, mobile maintenance equipment, dynamic message signs, flashing lights, signing, and vehicle speed displays).
- Increased work zone visibility (e.g., advanced detection and warning systems, advanced notice to the public via advanced traveler information systems).

Click the image to see a full size version

Description

Smart work zones are becoming more common, with an increased safety emphasis for both on-site field personnel and the motoring public. Smart work zones include the use of one or more of the technologies listed below, but are not limited to the following:

- Stationary and mobile DMS announcing detours or "construction ahead with possible delays";
- Speed display signs to make the driver aware of their actual approach speed;
- HAR to facilitate communications within the work site area among project manager and site supervisors;
- Vehicle detection and surveillance (e.g., queue length detectors, closed circuit television);
- Links to traffic control center; and
- Connection to an advanced traveler information system (ATIS), with a Web site to provide travelers pre-trip information about preferred routes and potential delays, relieve congestion and also provide early incident detection with advanced detour notification capabilities.

Click the image to see a full size version

Real World Examples

Mid-America Smart Work-Zone Deployment Initiative
(IA, NE, MO, KS)

Goals: To address and improve safety in work zones by applying intelligent transportation systems technologies.

Approach: A group of Midwestern states have collectively pooled resources and efforts to further investigate technologies that can address safety concerns in work zones. A primary reason for convening the group is to prevent duplication of efforts. This consists of holding stakeholder workshops to identify and prioritize work zone safety problems, and selecting technologies for evaluation that will improve the safety and efficiency of traffic operations and highway work. Evaluations were performed of a number of technologies, including: Solar-Powered Barricade Warning Lights, Solar-Powered Illuminated RPMs, LightGuard System, Orange Rumble Strips, Advanced Lane Drop Arrows, Safety Cade Barricade, Safety Warning System, Wizard CB Alert System, Drone Radar, Speed Monitor Display, Portable Traffic Management System, Adaptir, and Traffic Control Plan Design.

Location: Iowa, Kansas, Missouri, and Nebraska

Current Status: The Mid-America Smart Work-Zone Deployment Initiative (MwSWZDI) has begun planning for their third year. Vendors have been invited to a committee meeting to present technologies that can be used in work zones. Select technologies will then be identified for testing and evaluation by participating states.

Future Activities: To test further the different technologies in work zone applications. The group is looking forward to other states joining in the research and efforts of the pooled-fund study.

Impacts:

- Opportunity to evaluate the real-world effectiveness of technologies in work zones.
- Provide recommendations to other states on best practices.
- Each partner state has benefited from the research results of other states.

Cost Information: Approximately $60,000 to $80,000 per state.

Participating Institutions:

- Iowa Department of Transportation
- Kansas Department of Transportation
- Missouri Department of Transportation
- Nebraska Department of Transportation
- Federal Highway Administration
- University of Nebraska Mid-America Transportation Center (MATC)

Contact: Patrick T. McCoy, Chairman, MwSWZDI Technical Committee (402)-472-5019

Other Examples:

- Smart Work Zone - Minnesota
- Portable ITS Technology in Work Zone - Iowa, Missouri, Indiana

Benefits

- Reductions in traffic delays, stops, and crashes experienced at highway work zones;
- Savings to road users in accident costs and travel time costs;
- Effective, efficient traffic management techniques that improve the public's perception of work zone management;
- Reduction in frustration of traveling public if delays are experienced;
- Implementation of technologies such as the queue length detectors provide additional data on the traffic situation;
- Provides continuous and updated information to the traveling public as they approach or travel through the construction zones;
- Provides motorists with an earlier notice of when incidences occur. This information helps the motorist to consider other options;
- Improves emergency response time to the incident; and
- Decreased variability of speed through work zones.

Lessons Learned

- Implementation of highly integrated portable ITS technologies will require training and expert advice.
- Field survey of communications capability prior to implementation of devices that require linkages to traffic management centers or other field devices.
- Alternative power sources (e.g., batteries and solar) are good alternative for mobile applications.

- Lengths of messages on message boards are imperative to being read and understood by drivers. For example, two-phase message may be too long.

Opportunities

The pooled-fund structure of the MwSWZDI presents great opportunities to establish real-world tests and applications of new and emerging technologies for work zone safety. As more partners are brought on board the magnitude of the research can greatly increase with the fresh resources brought on board.

The relationships established among both public and private sector partners will help the evolution of products that directly cater to the issues relating to work zone safety.

Institutional Issues

Safety is a considerable issue that departments of transportation would like to resolve. There is great support at the national and local level for work zone safety applications. Most institutional issues relate to determining proper messages and alerts to the traveling public and training required for the deployment of field devices. For example, proper placement of message boards to distance of work zone is imperative to credibility by drivers.

Drivers will likely believe the text and audio messages if they are too far in advance of the construction zone, or if the messages are not supported with visual activity. In regards to training, as new techniques for addressing work zone safety emerge and systems become more integrated, initial expertise is required for successful deployment. Training of field personnel is also required to ensure that the technologies are properly performing.

Implementation Issues

- Physical layout of the work zone can affect the ease of implementation.
- Interference can inhibit communications of work zone devices and decrease performance and rechallenges of system.
- Machine vision and other ITS technologies may be sensitive to construction activities.

References

[Midwest States Smart Work Zone Deployment Initiative Web site]

[FHWA Work Zone Program Web site]

[Portable Traffic Management System Smart Work Zone Application: Operational Test Evaluation Report] - From FHWA Electronic Document Library

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7.3 AUTOMATED VISIBILITY WARNING SYSTEMS

Needs Addressed

Stakeholders need the capability to detect fog and whiteout conditions in order to post advisories to motorists through dynamic message signs (DMS) or other information dissemination means (HAR, Internet, kiosks) and to improve roadway conditions by turning on in-pavement lights defining the roadway edges.

Description

Weather sensors have been utilized for a number of years to detect adverse weather conditions. One application of the weather sensors are to detect inclement weather conditions and warn drivers before they drive into the affected areas. Automated visibility warning systems use weather sensors to detect reduced visibility conditions (heavy rains, fog white-out) and then trigger a permanent or portable DMS with a message indicating the adverse driving conditions. In addition to triggering messages on DMS signs, the sensors could also trigger inpavement lights to turn on, or for information to be sent to a traffic management center for dissemination through traveler information systems.

Click the image to see a full size version

Real World Examples

Visibility Sensors on I-64 (Virginia)

Goals: Ensure the safety of travelers on I-64 over Afton Mountain near the intersection of I-81.

Approach: VDOT has installed a weather sensor to detect low visibility conditions on I-64. The sensors are set up on either side of the road. One sensor sends a light to the other. When the intensity of the light reaches a certain threshold, the system triggers a number of inpavement lights to turn on defining the edges of the I-64 roadway.

Location: Interstate 64 on Afton Mountain near the intersection of Interstate 81.

Current Status: The system has been operational for approximately one year with limited functionality.

Future Activities: The system shall be implemented on I-77 near Fancy Gap, VA.

Impacts: The system has not been in full operation for a sufficient time to determine the impact of its use.

Cost Information: Final costs for the system have not yet been determined.

Participating Institutions: VDOT

Contact: Gene Martin, Sr. Demonstration Project Engineer, VDOT, (804) 786-4168

Other Examples:

- Highway Fog Warning System
- Visibility Warning Project, CA
- Idaho Storm Warning System
- I-526 Fog Mitigation Project, SC
- Tennessee I-75 Fog Warning System

Benefits

- Decrease in crashes on roadway;
- Decrease in major crashes involving a pile-up of cars and trucks due to fog or white-out; and
- Favorable public perception of safety improvement efforts.

Lessons Learned

The most significant lesson learned with this project has been the need to establish contractual guidelines that meet the specific needs of ITS implementations.

The use of unit price type contracts that historically have been used by DOTs for construction projects does not meet the specific performance (or percent completion) type contracts that are more effective in managing an ITS project.

Opportunities

There are many opportunities for systems of this nature, including the ability to detect and alert travelers to high winds, blowing dust or potentially assisted distance vision in night driving conditions.

Institutional Issues

The greatest benefit of utilizing this technology is the potential to decrease the risk of accidents to all motorists traveling these sensor-equipped roads. An automated visibility warning system requires little maintenance. The system would need to be checked periodically to ensure the sensors are calibrated and working properly. The challenges associated with them, if they did not detect a whiteout or foggy conditions, could be high.

Implementation Issues

There were no technical implementation issues found during this project, however the contractual issues of the project provided implementation issues.

References

Technology in Rural Transportation "Simple Solutions", FHWA, Publication No. FHWA-RD-97-108, October 1997.

Engineered Visibility Warning Signals: Tests of Time to React, Detectability, Identifiability and Salience. IDEA project final report. Available from FHWA Electronic Document Library

"Description of a low-cost ($300) visibility sensor", Research & Technology Transporter - February 1996 Issue. Publication of FHWA Office of Research and Technology

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7.4 ANIMAL WARNING SYSTEMS

Click the image to see a full size version

Needs Addressed

Develop a system or device to prevent animal/vehiclecollisions in areas prone to animal accidents.

Description

Animal/vehicle collisions are becoming more frequent. These crashes cause damage to the animal as well as the vehicles, and frequently result in the death of the animal and/or persons. Traditional solutions have included fencing and other barriers, deer whistles, providing grade separation between vehicles and animals crossing the corridor, roadside improvements, vegetation and biologicalmanagement to control the feeding of animals within the corridor, and modifying driver behavior.

In recent years, several technological solutions have been tested that can prevent or reduce the number of animal/vehicle collisions. These solutions vary based upon the type of animal in the area, but include radio collars that trigger flashing signs when the animals are near the roadway, and transmitters that activate avehicles radar detector, encouraging the driver to slow down.

Real World Examples

Greater Yellowstone Rural ITS Priority Corridor Project (Wyoming)
Goals: To reduce collisions with animals such as bison that are devastating to both humans and wildlife.

Approach: Radar detection activation is intended to inform the driver of in-road objects that the driver is unable to see because of low visibility or poor geometric alignment. This system would activate any current, commercially available radar detector to warn the driver of a hazard. A transmitter is placed along the roadway where there are a high number of animal-vehicle accidents. The transmitter has a detection range of one mile in each direction. If an animal is detected, the transmitter would send a signal to an in-vehicle radar detector commonly used to identify police. On older detectors, the K-band alert will sound. New detectors under development will transmit dynamic text. Fixed messages would be stored in the newer detectors that would provide the driver with more details about the hazard.

Since many vehicles do not have radar detectors, Yellowstone is considering loaning detectors to tourists for use on Park roads.

Location: The Greater Yellowstone Rural Intelligent Transportation Systems (GYRITS) corridor comprises a loop roadway system traversing through Wyoming, Yellowstone National Park (YNP) and Grand Teton National Park, connecting Bozeman, Montana with Idaho Falls, Idaho.

Current Status: Project has been deployed.

Future Activities: The Western Transportation Institute (WTI), which initially recommended this technology, is currently reviewing new animal-vehicle mitigation methods.

Impacts: Improved safety along the corridor, especially at night when animals can be very difficult to see.

Cost Information: The estimated cost for this system is $3,800, which includes one transmitter, one solar pack and estimated installation costs.

Participating Institutions: Montana DOT, WTI, University of Montana at Bozeman, National Automated HighwayConsortium, California DOT, Lockheed-Martin Inc.

Contact: Kerry A. Gunther, Yellowstone National Park biologist, Kerry_Gunther@nps.gov; Steve Albert, Western Transportation Institute, stevea@coe.montana.edu

Other Examples: Near the town of Sequim, Washington a system is being tested that outfits several members of the local elk herd with radio transmitter collars. These collars activate flashing roadside warning signs when the elk are within a quarter mile of the road. At the time of this writing, the system had just been implemented and the effectiveness of the system was not yet known.

Benefits

Drivers are warned in advance of animals or objects on the roadway, providing drivers with the necessary time to slow down and make the appropriate maneuver to avoid a collision. This technology may be very useful in areas where there are many animal-vehicle collisions.

Lessons Learned

Since many vehicles do not have radar detectors, it may be beneficial to loan them to those visiting National Parks or campgrounds. Small towns may want to consider offering a rebate to local residents who purchase certain models of detectors.

Opportunities

Many new models of radar detector offer a feature called Safety Warning System (SWS). SWS alerts drivers with a specific audio or text message of approaching hazards. The messages are transmitted by roadside equipment purchased by the local DOT.

Institutional Issues

Radar detectors are not legal in all states.

Implementation Issues

It may be beneficial to consult with a wildlife biologist before implementing any sort of animal warning or control device.

Reference

Gomke, Russ; Rural Automated Highway Systems Case Study: Final Report; Western Transportation Institute, Dept. of Civil Engineering, University of Montana.

7.5 PORTABLE SPEED WARNING SYSTEMS

Needs Addressed

Utilize a speed warning system that can be moved from site to site to deter speeders on various roads.

Description

Police departments throughout the US are using portable speed warning systems to slow drivers on roads. Portable speed warning systems use a two-digit dynamic message sign, radar gun, computer, and generator to run the system. In most cases, the system is taken to a site that has seen a high number of speeders or is requested by community residents.

Portable speed warning systems operate off of solar power and require minimal operations and maintenance work. The unit is placed in the general direction of on-coming traffic with the radar gun mounted inside the unit. The system determines a vehicle's speed with the radar gun and displays the current speed, in real-time, and also stores the speeds in a computer for further analysis.

Recently, portable speed warning systems have been developed that will determine a vehicle's speed, take a picture of the vehicles license plate, and then issue a citation if the vehicle is speeding in excess of a certain threshold.

Real World Examples

Leesburg Speed Monitoring Awareness Radar Trailer (SMART) (Virginia)

Goals: Slow drivers in residential areas.

Approach: SMART, Speed Monitoring Awareness Radar Trailer, utilizes a KR10SP microwave radar gun that is installed within the trailer housing. Also installed is a palm-top PC and speed display. The system has the capability to determine the speed of a passing vehicle and to display and/or store the speed in the palm-top PC.

The Leesburg Police Department uses SMART in three different operations:

- Speed Awareness - The system displays the speed and records the speeds on the palmtop PC for further analysis.
- Speed Monitoring - The display is turned off and the system records the speeds on the palm-top PC for further analysis.
- Enforcement - The system displays the speed, records the speeds on the palm-top PC, and an officer is on-site to issue speed violations.

Location: SMART is setup on various streets throughout the Town of Leesburg. Residents may call the Leesburg Police Department to request SMART be set up on their street.

Current Status: SMART is operational and is used on a daily basis.

Future Activities: There are currently no plans to expand the system.

Impacts: Improved safety in residential areas as drivers become more aware of their speed.

Cost Information: $15,000 for each trailer

Participating Institutions: Leesburg Police Department

Contact: Ofc. Bruce Wolf, Leesburg Police Department, 65 Plaza St. NE, Leesburg, VA 20176, (703) 771-4503.

Other Examples: Mobile radar device in San Jose, CA. The system uses a digital photo radar device installed in a mobile unit and operated by a specially trained staff person. The device photographs the drivers and license plates and records the speed of vehicles. Offenders are then contacted by mail. Citations become official when the offender submits an inquiry for citation. Signs in the town are posted on streets warning motorists of the use of the radar device.

Benefits

- Community residents see the system as pro-active
- Data collection device

Lessons Learned

Because of police union concerns for jobs, the units are only allowed to operate in low-priority enforcement situations.

Opportunities

Data collected by the equipment may be used for other safety-related studies.

Institutional Issues

Many jurisdictions are currently using speed-warning systems to deter speeders. This type of speed warning system has minimal institutional issues. In fact, most communities welcome the units in their neighborhoods.

Implementation Issues

The portable speed warning system will need to be calibrated on a regular basis and when in operation not cause a hindrance to traffic.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

7.6 HIGHWAY-RAIL ALERT SYSTEMS

Needs Addressed

To reduce the number of collisions at highway-rail intersections through the use of in-vehicle warning technologies.

Description

There are numerous collisions annually at highway-rail intersections throughout the country. While there exists active and passive crossing systems, many of the intersections in rural areas may not have any crossing safety system and thus examination into possible alternatives should be considered. One alternative is to make use of the millions of existing radar detectors present in personal vehicles around the country. These radar detectors could be activated to alert drivers of approaching trains.

Real World Examples

Radar Detection Activation (Georgia)
Goals: To improve road safety by providing drivers with advance warnings of hazards. **Approach:** The system activates any current, commercially available radar detector to warn of a hazard. The basic system emulates the effect of approaching a police vehicle, sounding the detector's K-band alert. It is intended to encourage drivers to slow down prior to encountering a hazard or potentially hazardous situation, such as railroad grade crossing. A more advanced system is being developed which will require enhanced radar detectors and transmitters. The Safety Warning transmitter will transmit a continuous wave to halt a smart detector's scanning. The transmitter can issue a dynamic text message to the detector or activate any of a series of fixed text messages, which have been pre-stored in the "smart" detector, giving more precise details of a hazard. **Location:** The system could potentially be deployed in any state where use of radar detectors is legal. Deployment could take place either at site-specific locations, such as at railroad grade crossings, or on a corridor or region-wide basis. **Current Status:** The system has been developed and successfully tested in non-live situations. Ultimate success of the system depends on FCC approval and market uptake. **Future Activities:** The implementation time frame depends on the system being granted the necessary FCC approval for use of radar frequencies. However, the Safety Warning System company established to market the system is proceeding with marketing activities, both to consumers and to state DOTs. Both the "smart" transmitters and receivers are said to be market-ready. **Impacts:** No impacts or results of a system of this nature have been determined. **Cost Information:** Information is not currently available on costs incurred during the development of the system, or on the anticipated retail prices of the "smart" transmitters or detectors. It has been estimated that the cost of "non-smart" transmitters for a site-specific application, such as a railroad grade crossing, would be $600 to $800, plus installation costs. Given that the system is capable of activating any of the estimated 10 to 15 million radar detectors currently in use, the system can provide basic warning capabilities at no additional cost to a driver already owning a radar detector. **Participating Institutions:** The Safety Warning System is a cooperative effort involving the Radio Association Defending Airwave Rights (RADAR), a national non-profit organization representing those who make, sell, and own radar and laser detectors, along with manufacturers B.E.L.-Tronics Limited, Sanyo Techica USA Inc., Uniden America Corporation and Whistler Corp. Research and development is being conducted by Georgia Tech Research Institute.

Contact: Gene Greneker, Georgia Tech Research Institute. (770) 528-7744
Janice Lee, Safety Warning System, L.C. (941) 473-1555

Other Examples:

- Sound/light Alarm For Extra Reaction Time (SAFER)
- Intersection Alert System
- FHWA

Benefits

- Drivers would be alerted when approaching a highway-rail intersection of an approaching train and could take the necessary precautions to slow and stop their vehicle prior to the crossing;
- Reduction in collisions at highway-rail intersections;
- Potential to reduce cost for more significant active or passive crossing safety systems.

Lessons Learned

The system provides the capability to alert a driver of the approaching train by triggering their radar detector. However, there exist additional issues that must be resolved before this product can be implemented, including obtaining approval from the FCC and implementing the system in states where possession of a radar detector is prohibited.

Opportunities

As a result of the large number of radar detectors on the market and currently owned by drivers, there exists the potential to reach these travelers at highway-rail crossings.

Institutional Issues

The necessary rules and legislation must be enacted to permit drivers to use radar detectors to gain benefit from this system. Discussions with the local and state law enforcement agencies would be required to gain their buy-in to the project.

Implementation Issues

The implementation time frame depends on the system being granted the necessary FCC approval for use of radar frequencies. In addition, implementation of this type of system in states where possession of radar detectors is illegal would not be possible without a change in legislation.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Slide presentation of ITS HRI Standards

7.7 BIKE SAFETY SYSTEMS

Needs Addressed

Bicyclists need to have the perception that they are safe sharing the road with automobiles. In some areas, it is difficult to see bicyclists on the side of the road, especially in tunnels and on hilly roadways.

Click the image to see a full size version

Description

These types of solutions bring to the attention of drivers that there are bikers on the roadway. Using flashing beacons, drivers are reminded that bicycles are using the shoulder.

Real World Examples

Bicycle in Tunnel Warning System (Washington)

Goals: To increase the bicyclists' perception of safety while traveling through tunnels.

Approach: Prior to the entrance to a tunnel the shoulder was widened sufficiently to allow bicyclists to pull off the road safely and activate a push-button, which triggered flashing beacons on a fixed message sign further upstream of the tunnel entrance. The sign reads "PEDS / BICYCLES IN TUNNEL WHEN FLASHING". The flashing beacons operate for a period sufficient for the bicyclist to pass through the tunnel before timing out.

Location: This system is installed at a tunnel on Highway 971 in Washington State near the city of Chelan. The system could be used anywhere there are problems with bicycle visibility on the roadway.

Current Status: The system has operated since its installation in 1979.

Future Activities: There are no future plans to implement this system within the state.

Impacts: No information has been gathered on accidents involving bicycles in the tunnel either before or after the system was installed. It is believed that no serious accidents took place prior to the system being installed, rather the system was put into place in response to reports of bicyclists feeling unsafe in the tunnel environment.

Cost Information: The system cost $5,000 to build and install in 1979. These costs were relatively low as a power supply was already in place to provide lighting in the tunnel. Had this not been the case, installation costs would have been significantly higher.

Participating Institutions: The system was installed and funded by the North-Central region of Washington State DOT.

Contact: Janine Ring, North-Central Region, Washington State DOT. (509) 663-9638

Other Examples: Safe Bicycle-Auto Road Sharing, Colorado DOT

Benefit

Drivers will be more vigilant when looking out for bicycles on the highway.

Lessons Learned

Costs for such a system is significantly higher in areas where there is not a readily available power source. Solar power may be an option.

Opportunities

This type of warning system can be used for pedestrian crosswalks. Pedestrians will press a button that activates a yellow beacon above a pedestrian crossing sign. Vehicles must stop for the pedestrians in the crosswalk.

Institutional Issues

Partnership opportunities may exist with the National Safety Council, which would like to make this a national standard for areas with significant bicycle traffic.

Implementation Issues

A power supply must be nearby to make this feasible.

References

The FHWA Inform Web site contains information on both the Colorado and Washington projects.

FHWA Pedestrian and Bike Safety Research page

7.8 HIGHWAY-RAIL CROSSING SAFETY SYSTEMS

Click the image to see a full size version

Needs Addressed

The at-grade crossings of highways and railroads present two distinct types of challenges for rural areas. The first challenge relates to the potential for vehicle - train collisions at these intersections. Vehicle train collisions are common in areas where the crossing is not controlled by a gate, and often times there are not even flashing lights to warn of approaching trains.

The second challenge related to rail-highway crossings is that presented by long trains passing through rural towns that prevent traffic from crossing over the rail line. In these instances, emergency vehicles that may be based on one side of the track may be delayed as they wait for trains to clear the at-grade crossings. Often, one or more bridges or underpasses exist that would allow emergency vehicles to cross and advanced information to alert the vehicle driver to proceed along the route that
involves the bridge could result in serious time savings.

Description

A variety of technologies have been deployed and tested to detect approaching trains and provide realtime information that could address both types of needs. For example, pilot studies have equipped school buses with receivers and display devices capable of announcing the presence of a train by picking up a signal sent out by the intersection. While such devices may not be practical in every vehicle, transit vehicles may be early winners for such devices.

Similar reception devices are considered solutions for emergency vehicles and dispatch centers so they may be alerted to the approaching trains and make provisions for finding crossing points at bridges or underpasses in order to avoid the at-grade crossings.

Real World Examples

Advanced Railroad Crossing Status (ARCS) - Reno (Nevada)
Goals: There were two goals of the ARCS-Reno system. 1. To enhance Reno's existing railroad crossing warning system. 2. To improve emergency response in Reno.   **Approach:** Reno has eleven at-grade crossings in the downtown area. The downtown area has heavy pedestrian traffic because of the casinos and other tourist attractions. It also experiences traffic congestion. People are killed each year at the busy railroad-grade crossings. The ARCS system collects information on approaching train speed and distance from an intersection from the existing train detection system. The information is reported to an operations center, where it is shown on a digital map. This information helps dispatchers route emergency vehicles around closed railroad-grade crossings.

Location: This project was proposed for downtown Reno, Nevada.

Current Status: The project utilized existing technology in the field and could be deployed in less than six months.

Future Activities: Reno is considering several alternatives to improve highway-rail safety. The city is considering lowering the railroad tracks to eliminate all crossings. If they do lower the railroad tracks, the ARCS-Reno system will not be needed.

Impacts: System has not yet been deployed.

Cost Information: The complete system, including five closed circuit cameras to monitor the intersections could be built for less than $260,000.

Participating Institutions: The City of Reno, the Nevada Department of Transportation and Union Pacific have assigned Memorandum of Understanding, with Union Pacific paying for the system and the city
operating and maintaining it.

Contact: B.E. (Bruce) Williams, Dir., Signal Design Union Pacific, 1416 Dodge Street, Room 1000, Omaha, NE 58179, (402) 271-4582; Steve Varella, City of Reno, (757) 334-2215

Other Examples: There are several other projects being developed to provide advanced warning of oncoming trains. In Los Angeles and Boston, systems are being designed to provide a second sign, which gives vehicles a warning of an occupied grade crossing. Drivers can then decide whether to alter their route or to wait at the crossing.

Benefits

- Reduced risk of highway - rail crossing accidents;
- Improved communication between rail companies and DOT; and
- Residents feel safer crossing rail intersections.

Lessons Learned

The existing active warning systems for grade crossings provide much valuable information that can be easily imported to a traffic operations center or computer-aided dispatch system. That information includes an accurate way to measure the distance of a train from a signal, the speed of the train, and an estimate of how long a crossing will be closed to vehicles. Though small cities may not be interested in a system as sophisticated as ARCS, the data can be collected with the simple addition of a modem and software to collect it.

Opportunities

This project was developed by the Union Pacific as a response to the City of Reno's request that the railroad grade-crossing safety be improved. This is a common situation in many cities, particularly in the Midwest, and a system such as this is a less expensive alternative to moving the tracks. In Reno, the City and Union Pacific will likely spend hundreds of millions of dollars to lower the tracks and eliminate the crossings, but that solution is not feasible in smaller communities. Because the system uses existing and common rail technology, it can be deployed at almost any active-warning grade crossing, or series of grade crossing.

Institutional Issues

The ARCS project was not the first choice of Reno, who has wanted the tracks lowered from the beginning. However, Union Pacific developed the ARCS system as a lower-cost alternative that would improve safety. The cost issue between ITS and the physical movement of tracks has also occurred in other states, particularly Lincoln, Nebraska. Cities want the railroads that own the tracks to pay the entire cost of moving them, and the railroads seek lower cost solutions. In Reno, it appears that the City and Union Pacific have reached a compromise where they will share the costs.

Implementation Issues

The system was never implemented.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

ITS Technology at Highway Rail Intersections: Putting it to the Test. Available from FHWA Electronic Document Library

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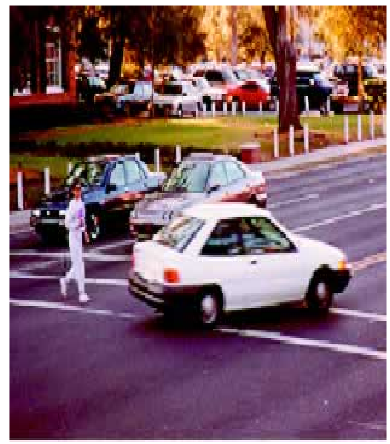
7.9 PEDESTRIAN SAFETY SYSTEMS



Needs Addressed

A means of improving safety for pedestrians at crosswalks.

Description

This modification to the traditional crosswalk is designed to improve pedestrian safety in crosswalks where visual obstructions (e.g., high medians, parked cars or traffic) impede the drivers view. Through the use of in-pavement lights, illuminated crosswalk signs and pedestrian activated beacons, vehicles will be warned to slow to a stop when lights are flashing and allow pedestrians to safely pass through the crosswalk.

Click the image to see a full size version

Real World Examples

Pedestrian Crossing Illumination System (Colorado)
Goals: To encourage drivers to stop for pedestrians in crosswalks. **Approach:** Pedestrians activate a series of four flashing in-pavement lights per lane, along with two flashing pedestrian signs. The lights flash long enough for pedestrians to safely cross theintersection. **Location:** Boulder, Colorado. The system is currently in use between the Justice Center and the downtown area at the 11th and Canyon intersection, which receives a high volume of pedestrian traffic. **Current Status:** System is deployed and operable. **Future Activities:** A number of additional locations throughout Boulder have been proposed. **Impacts:** The Traffic Operations Department conducted a compliance study among pedestrians and vehicles, before and after the system was deployed. The results showed an overall improvement in compliance of 95%. **Cost Information:** Design and development costs were minimal, while costs for the actual system are estimated at $6,000-8,000. Installation costs range from $2,000-8,000. **Participating Institutions:** City of Boulder Traffic Operations and Traffic Safety Corporation

Contact: Bill Cowern, Traffic Operations Engineer, (303) 331-3266, cowernb@ci.boulder.co.us

Other Examples: San Francisco, CA: Talking Signs for Visually-Impaired Pedestrians

Benefits

- Increased safety for pedestrians;
- Increased awareness for both motor vehicles; and
- As crosswalks become safer, walking becomes more popular as an alternative mode of transportation.

Lessons Learned

Sand used in winter months to improve traction on the streets can inhibit the brightness of the lights.

Opportunities

- Fog Areas: In-pavement illumination with clear lenses marks the edge of street, highway and/or off-ramps in heavy fog areas.
- Lane control for bridges and tunnels: Switchable illumination change direction of travel by showing green in the correct direction and red in the wrong direction.
- Wrong-way warning systems: In-pavement lights connected to loop detectors warn drivers that they have erroneously entered a freeway off ramp or other restricted zone.

Institutional Issues

It may be useful to involve the local police department in the deployment of enhanced crosswalks, as failure to yield to pedestrians is against the law in most areas.

Implementation Issues

Lights may be vulnerable to snowplows.

References

FHWA Pedestrian and Bike Safety Research Web page

Traffic Safety Corporation Web site

8. OPERATIONS AND MAINTENANCE

This Section contains descriptions of the tools that fall within the operations and maintenance rural development track. These are:

- Integrated communication systems;
- Information/data clearinghouses;
- Highway Lighting Systems;
- Traffic signal operation;
- Fleet Management systems;
- Smart plows/agency vehicle monitoring;
- Automated anti-/de-icing capabilities;
- Site management during avalanches;
- Transportation operations optimization; and

- Public agency outreach for transportation management.

8.1 INTEGRATED COMMUNICATION SYSTEMS

Needs Addressed

Utilize technologies to coordinate operations and integrate communication systems between agencies, including transit, maintenance, and police in real-time.

Description

Development of a single centralized communications center to serve multiple agencies was viewed as a positive step towards coordinating activities between agencies in a real-time manner when circumstances such as large events, major traffic incidents or inclement weather requires coordination.

Real World Examples

Advanced Rural Transportation Information and Coordination (ARTIC) (Minnesota)

Goals: The objective was to test the shared application of ITS among various public stakeholder agencies such as transportation, public safety and transit. The core of the project was to develop a single centralized communications center serving multiple agencies.

Approach: GPS equipment is installed on fleet vehicles to allow for quick location identification and deployment. ARTIC also uses mobile data terminals (MDTs) for the ability to send data between the vehicle and dispatching center for increased communication capabilities. Plows, buses, volunteer, and trooper vehicles are also equipped with cellular phones or pagers for communications. The integrated system allows vehicles on the road to report accidents, stranded motorists, and information on road conditions to the dispatch center. The center will, in turn, direct emergency response or other appropriate action-making everyone feel safer in this rural region. Communications is available with data message exchanges between call center and vehicle.

Location: Arrowhead Region (7 counties in the northeastern region of Minnesota).

Current Status: The operational test started in October 1997 and ran through September of 1998. AVL and MDT are functional on 19 emergency response vehicles, and 15 transit buses. An interface has been developed between the MDTs and the sand spreader control on the plow trucks to demonstrate downloading of spreader information to the communications center. The consolidated communication center provides dispatching for the Minnesota State Patrol, Mn/DOT, Virginia Dial-a-Ride and Arrowhead Transit fleet management and emergency response communications equipment and functions. System is currently fully operational. The evaluation report is available as document #13328 in the ITS Electronic Document Library.

Future Activities:

- Improving heating and ventilation system control in the communications center.
- Continue expanding application of the system for State Patrol and Mn/DOT.
- Provide for automated transfer of accident location from GPS to accident reporting software.
- Expand radio service from Little Fork through the ARTIC Communication Center to the Gilbert Transit Center.

Impacts:

- Success of the interagency cooperative endeavor has spurred interest in creating 9 statewide rural/small urban transportation operation and communication centers.
- Reductions in response time for accident and road condition emergencies through combining DOT and public safety dispatching.
- Improved communications.
- Proactive response to maintenance need and traveler information.

Cost Information: Funding sources include: $903,000 federal, $622,000 state, and $49,000 other partners. GPS equipment is currently available from multiple suppliers with costs ranging from $300 to $40,000.

Participating Institutions: Mn/DOT, FHWA, Minnesota State Patrol, Arrowhead Transit (AEOA), City of Virginia Dial-a-Ride, Qwest Communications

Contact: Dick Maddern, ITS Coordinator, District 8 Virginia, (218) 749-7793 ext. 3804, richard.maddern@dot.state.mn.us

Other Examples:

- Sweetwater County Transit Authority, Wyoming.
- Dane County, Wisconsin coordination of incident response.
- Potomac and Rappahannock Transportation Commission (PRTC).

Benefits

- Reductions in response time for accident and road condition emergencies through combining DOT and public safety dispatching;
- Improved communications;
- Shared resources among agencies increase amount of funding for improvements;
- Better removal of snow resulting in faster incident response and reduction in delays;
- Improved customer service with more accurate scheduling of transit service;
- Improved safety on roadways during inclement weather;
- Ability to monitor agency vehicles in real-time;
- Optimize the dispatching of agency vehicles for numerous operations;
- Reduction in travel time delays and increased supply of traffic information; and
- Favorable public perception of DOT.

Lessons Learned

- Initial budgets and schedules proved to be quite optimistic. Longer deployment schedules and increased costs can be expected along the implementation process.
- Developing and maintaining solid partnerships is critical to the success of the process. This may entail establishing memoranda of understanding between stakeholder agencies to lay out fiscal and operational responsibilities.
- A committed project champion (empowered to make key decisions) at the local level is necessary to keep the project moving.
- The partnerships have resulted in positive working relationships that will likely facilitate cooperative ventures in the future.

Opportunities

An integrated, interagency communications center allows for the sharing of resources. In the example of the ARTIC deployment, the success of the project increased the DOT's awareness of the benefits of sharing resources among stakeholder agencies. As a result, Minnesota is seeking to deploy a statewide network of transportation operations and communications center that will address the needs of rural and small urban areas. Again, the approach is to leverage the resources, knowledge and opportunities of the combined stakeholder agencies.

Institutional Issues

Implementing an AVL system will require at least one full-time agency person dedicated to the project as the system is designed and integrated.
Likely participants in such an undertaking include DOTs, police agencies, and transit. If other vehicles, such as police vehicles, are equipped, there may be issues pertaining to data access as well as vehicle whereabouts. As more agencies choose to participate, costs can be decreased, as there are more parties to absorb them; however, greater coordination between these participating agencies will be necessary.

Implementation Issues

- Design and deployment consideration of ITS technologies in the rural environment (e.g., communications availability)
- Need interaction with numerous vendors and examination of numerous products to ensure technology is feasible in the rural environment,
  and to ensure cost-effectiveness.
- Partnership involvement may either inhibit or expedite project deployment. Strong representatives and good involvement from
  stakeholder agencies will help to alleviate these concerns.
- Project must satisfy a common vision and partners need to be committed to work through institutional and technical issues.

References

Mn/DOT ARTIC Web site

Advanced Public Transportation Systems: State of the Art, Update '94 from the FHWA Electronic Document Library

Advanced Rural Transportation Information and Coordination (ARTIC) Operational Test and Evaluation Report from FHWA Electronic Document Library

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8.2 INFORMATION/DATA CLEARINGHOUSES

Needs Addressed

Technology enhancements could be used in the following systems and services:

- Dissemination of special event, tourist, weather, parking, road conditions, closures, detour, work zone location, and recreational activities information.
- Enhanced multimodal information (i.e., transit, bikeways, trails, train, carpool).
- Coordinated information sharing within the regions among international, state, and local agencies.
- Centralized communications center for coordination of activities (notification system to public agencies and travelers alike), with colocation of police, transit and other agencies.
- Distribution of non-emergency 911 calls to a more appropriate source.
- Improved information dissemination to law enforcement officials via in-vehicle laptops.
- Serve the commercial community with information related to restaurants, lodging, etc.

Description

An Information/Data Clearinghouse would provide transportation agencies with a valuable, statewide information network that can be utilized by authorized users across a variety of adjoining municipalities to view and enter transportation activities throughout the State. An integrated clearinghouse system would allow efficient incident response, congestion management, and accident wrap-up with communications between emergency service providers (state and local highway patrol/ police, international transportation officials, ambulance services, fire, helicopter, and others) occurring electronically. A system that has multiple inputs from public and private industry allows for a comprehensive information network for travelers to reference. By including lodging, restaurant, and local community activities information with road, weather and other traveler information, a sustainable traveler information system can be developed, attracting potential partners and funding from a variety of organizations.

Real World Examples

Statewide Traffic Operations Center (Arizona)

Goals: To serve as the statewide information collection and dissemination resource.

Approach: The Arizona Statewide Freeway Management System (FMS) is housed in the Phoenix TOC. The FMS serves as a data information clearinghouse for metropolitan jurisdictions and for agencies throughout the State via "virtual TOC's". The FMS collects information from mainline detection, ramp metering, CCTV monitoring, traffic interchange signals, a drainage monitoring system, DMS and a communications system. Jurisdictions are able to communicate among themselves on this statewide system, sharing information that assists in event, incident, congestion, and other traffic management scenarios. The FMS encompasses the following components: a simulcast radio system; the I-10 deck tunnel monitoring system including lighting, fans, fire detection and cameras, and elk alert sign control. The FMS is controlled by a network of computer systems and communications systems located at the TOC where a team of operators staff a control room 24 hours a day, seven days a week. They are in constant contact with responsible rescue and response agencies and state highway maintenance and construction forces statewide in order to provide motorists with safe and efficient driving conditions.

Location: The web page (http://www.azfms.com) provides general information and can be accessed worldwide.

Current Status: Project is deployed. The Arizona FMS is operating 24 hours a day, 7 days a week.

Future Activities: The Arizona FMS maintains ongoing operations, with phased implementation of added field devices throughout the State continually occurring.

Impacts: With the extensive computer network purchased for the FMS, ADOT has the capability of bringing more systems into the TOC at very little cost. Systems throughout the State can be controlled directly from the TOC, and the network has the potential to be utilized by other agencies to simply collect and disseminate data to users at remote locations.

Cost Information: $1.3 million annually to handle all operations.

Participating Institutions: ADOT and the FHWA

Contact: Tim Wolfe, Assistant State Engineer, (602) 255-6622, tim@azfms.com; or Glenn Jonas, Senior Systems Engineer, (602) 255-6587, glenn@azfms.com

Other Examples: Condition Acquisition and Reporting System, Iowa, Minnesota, Missouri, and Washington

Benefits

- Reduce response time to incident;
- Enhanced institutional coordination for multistate events;
- Provide detours or advanced traveler information for rerouting and congestion management; and
- Improved planning and coordination.

Lessons Learned

A survey of the latest technologies and solicitation of partner ideas will assist in the development of a state-of-the-art clearinghouse that allows multiple, simultaneous site usage, information updating and dissemination, and high speed interconnects for the most efficient and effective dissemination methods.

Opportunities

Creation of a website that publicly disseminates information collected by the FMS paves the way for an effective traveler information resource. Links to local transit, road closures and road cameras can be provided, as well as constantly updated road and weather conditions information.

Institutional Issues

The deployment of an Information/Data Clearinghouse requires hardware and software operations and maintenance as well as consistent communications with other participating partners (public and private) to continually make sure all needs are being met and that organizational changes are reflected in the philosophy of the clearinghouse information dissemination. The system must be designed such that it minimizes the burden on the agencies entering data.

Implementation Issues

Concise specifications for the Information/Data Clearinghouse must be developed, and include equipment needs, funding sources and availability, and define all the activities that will be offered as part of the Clearinghouse service package (i.e., 911 nonemergency call support, road closure and work zone information). There are also critical open systems standards issues and must be able to share data with neighbors.

References

National Road closure and Information Web page

NYSDOT ITS Toolbox for Rural and Small Urban Areas

CHARTING Your Course, Maryland CHART Program from FHWA Electronic Document Library

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8.3 HIGHWAY LIGHTING SYSTEMS

Needs Addressed

The need to reduce the cost of highway lighting while still providing an acceptable level of service to the public.

Description

Highway lighting systems on most highways are activated by photocells. Photocells detect the intensity of light, and at a certain darkness threshold,
activate a switch that sends power to the lights. Sometimes, the thresholds on photocells cannot be set low enough to detect low-intensity light, and turn on when there is still an ample amount of light on the roadway.

A pager system, which can turn lights on later in the evening and turn lights off earlier in the morning, will have a large impact on energy savings if applied system-wide. The pager system consists of a pager attached to an electrical circuit similar to that of a photocell only "dialed in to" from a remote source.

Real World Examples

Pagers Activating Highway Lighting (Indiana)

Goals: To reduce the cost of highway lighting.

Approach: The concept involves activating highway lighting using pagers rather than photocells. Researchers calculate savings of between 15 and 30 minutes of lighting per day per circuit, which applied over a whole network, could result in substantial energy savings.

Location: Testing has taken place in Indiana. The concept could be applicable nationwide.

Current Status: Negotiations between the DOT and a private party were unsuccessful. This solution is technically feasible, but was not implemented.

Future Activities: No future activities for this solution have been scheduled at this time.

Impacts: Results of testing reveal that system implementation would be too costly due to the costly expense of installing new meters on all lights.

Cost Information: It is estimated that it would cost approximately $100 per pager unit and $5 per month per number for the paging service costs, though one paging number can trigger multiple units. Software to govern the system will also be required - in the case of the pilot testing. This was developed in-house. After testing, it was found that the local power company required new meters.

Participating Institutions: Indiana DOT

Contact: Jay Wasson, Indiana DOT. (317) 233-9605

Benefits

- More flexibility in the times the lights may be activated, thus potentially saving money from tighter control of when the lighting system was activated and deactivated daily; and
- Can be centralized into one automated system. One PC could run the entire lighting system for a metropolitan area.

Lessons Learned

- Costly start-up costs. Power company required new equipment for implementation.
- Interagency or partnership agreement with private party was required to enable the technically feasible system to be implemented, however the lack of an agreement stopped further progress of the project.

Opportunities

Pager activation could be used in a variety of situations. One example is the activation of beacons during special events. A beacon could be set up next to an area that has seasonably high traffic, and the flashers could be activated via pager to warn motorists of the event. Portland is using a pageractivated system on school crossing beacons.

Institutional Issues

The power company required substantial review of this plan and initially had some operational concerns. The new system required new electricity meters in order to work with the pagers.

Implementation Issues

There were significant costs associated with this project that should be considered before undertaking a similar project. These costs may be prohibitive to a smaller municipality retrofitting streetlights with a system of this type. Additionally, the potential for new developments in technology may decrease the cost of electrical hardware required for this project, thus making this solution more cost effective in the future.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Report on highway lighting and driver performance

8.4 TRAFFIC SIGNAL OPERATIONS

Needs Addressed

To effectively manage the operation and maintenance of traffic signals in the most cost-effective manner.

Description

Large municipalities have many traffic signals. Signal coordination has always existed for large municipalities with certain areas that may benefit from timed coordination. However, traffic volumes vary on different days of the week and time of the day. Timed signals are effective, but are not dynamic enough to address the problem of varying traffic volumes.

Therefore, a system is needed to connect the traffic signals to one central location, so that timing on the lights can be adjusted during certain times of the week or day. Usually, fiber optics or a normal copper wiring system is used to communicate with the traffic signals.

Real World Examples

Cable TV for Signal Coordination (Texas)
Goals: To utilize local cable companies communication backbone to control traffic signals and revise timing plans remotely in order to address any changes in the traffic flow efficiently and cost effectively. **Approach:** Cable television is used to communicate signal-timing schemes to 98 percent of the City's on-line signals. The City has two-way communications with signal controllers utilizing the cable company's fiber system. The system allows for readjustment of signal timing for incidents, monitors preemption, and notes any incoming communications from the signal regarding broken signal head or other malfunction. Further, the system provides confirmation that appropriate data has been received and implemented at the signal site.

Location: The cable franchise provides coverage for the City of Richardson, Texas. Also common in other areas of Texas with two way cable communications.

Current Status: City traffic engineers have been changing signal timing via cable television since 1987.

Future Activities: This project is on-going. Still in use, the only change that has been made is upgrading the software.

Impacts: This program has been successful since 1987.

Cost Information: There is no cost involved, the cable company utilizes the City's right-of-way in exchange for fiber service to the traffic signals. Hardware for system is unknown.

Participating Institutions: City of Richardson, Texas and local cable franchises.

Contact: Walter Ragsdale, President of ITS, Texas (972) 744-4322

Benefits

- Through innovative funding means, by trading resources, each partner has no costs but benefits from the partnership in some manner.
- More flexible timing of traffic signals during rush hours and events.
- Better congestion management and air quality mitigation.

Opportunities

Another potential partnership with the local cable company is the creation of a traveler information channel that displays weather warnings and images from traffic cameras.

Institutional Issues

The agreement between the DOT and the cable company must be equivalent so that the system may be provided at no cost to either institution.

Implementation Issues

The cable system needs to be a two-way fiber-optic network capable of carrying the data for the traffic light system.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Operation Green Light, Kansas City Signal Coordination Program

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8.5 PUBLIC VEHICLE FLEET MANAGEMENT SYSTEMS

Needs Addressed

Increase the efficiency of public vehicle fleet management operations.

Description

The widespread use of new technologies such as Global Positioning Systems (GPS) and hand-held computers with wireless capability allows for many new and innovative ways of improving operational efficiency in many transportation-related areas. With regards to fleet management, GPS can be used to locate vehicles and deploy to incident sites for congestion mitigation, or for special applications, such as salting and snow plowing, thus maintaining smooth traffic flows. Hand-held computers allow vehicle inspectors in the field to enter information onsite and then synchronize it with their office PC. This process eliminates the redundancy of re-entering information, and also allows for on-site comparison with data from prior years.

Real World Examples

Computerized Maintenance Fleet Inspection Process (Indiana)

Goals: To facilitate fleet vehicle inspections and reduce input redundancy.

Approach: A pen-based computer is used for maintaining routine fleet vehicle information (i.e., identification numbers, and previous year's facts and figures) and updating current conditions (i.e., mileage) in a table format for tracking purposes. This fleet management application allows for convenient access to the vehicle's (i.e. trucks, snowplows, cars, front-end loaders) history and easy input capabilities via a table-based software for updating vehicle data.

Location: This program is currently active at the Indiana Department of Transportation district level.

Current Status: Project has been fully deployed since 1997.

Future Activities: No future activities are planned.

Impacts: The project is considered a success, and has smoothed operations in this area.

Cost Information: No specific cost information was available, however hand-held pen-based computers can be purchased for around $500.

Participating Institutions: Indiana Department of Transportation

Contact: Jay Wasson, Indiana DOT. (317) 233-9605

Other Examples: GPS Location System for Maintenance Vehicles, Wisconsin; Electronic Proof of Insurance, Minnesota

Benefits

- Vehicle maintenance operations become more streamlined
- Accuracy of data entered can be improved due to on-site entering of information and the availability of previous years' information

Lessons Learned

The cost of GPS systems for fleet vehicles varies widely; thorough research of available systems will need to be conducted before equipment and software is chosen.

Opportunities

Some municipalities and private companies use a magnetic key system for dispensing fuel. The user takes the vehicle to a fueling station, inserts the key for that vehicle, enters the mileage and the fuel dispenses in the vehicle. Hence, the record keeper has an automatic record of fuel usage by every vehicle in the fleet. This information may then be downloaded to a hand-held computer.

Institutional Issues

Simple technologies to enhance fleet management have few, if any, institutional issues. Challenges with such a system is low.

Implementation Issues

- Training on how to use the hand-held computers may be necessary.
- Need consideration interaction with numerous vendors and examination of numerous products to ensure technology is feasible in the rural environment, and to ensure cost-effectiveness.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Commercial Vehicle Fleet Management and Information Systems from FHWA Electronic Document Library

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8.6 SMART PLOWS/AGENCY VEHICLE MONITORING

Click the image to see a full size version

Needs Addressed

Winter maintenance activities such as snow and ice control may account for a significant portion of an agency's maintenance budget. Additionally, the quick and efficient clearing of snow-covered roadways is imperative to the safety of travelers. The application of automatic vehicle location technologies on snow plows allows for increased efficiency through realtime tracking of which roads have been plowed, and which ones still require attention. Furthermore, the ability to equip snow plows with technology that will help manage the accurate application of anti- and deicing materials will allow for more proactive maintenance treatment thus provide a cost-savings in chemicals applied.

Description

ITS can be used to assist with monitoring agency vehicles during maintenance activities and with monitoring the activities that occur on the vehicle (e.g., determining the amount of chemicals applied to each lane; ensuring that the amount of chemicals applied is appropriate to the road surface conditions; and determining the location of each vehicle in real-time). Smart Plows can be equipped with location technologies, vehicle status monitoring (plow up/down, rate of chemical application) and communicated back to a central management point. Additionally, vehicle-mounted sensors can detect the conditions of the road surface, and apply the appropriate amount of chemicals or sand to treat the condition of the roadway.

Real World Examples

Advanced Technologies Highway Maintenance Vehicle (Iowa)
Goals: The vision for the highway maintenance concept vehicle is to improve the level of service of snow and ice control based on collection and application of better highway, vehicle, and materials distribution information through the use of advanced technologies. **Approach:** Research is underway supported through a consortium of three snow belt states: Iowa, Michigan and Minnesota. The research solutions are focused in four areas: pavement surface snow and ice control (plowing and de-icing), fleet utilization (AVL and communications), on-vehicle materials management (combining roadway surface information with onboard inventory systems), and equipment management (onboard engine diagnostics).

The mission and objective of the study include:

- Evaluating the technologies for the concept vehicle;
- Assessing the cost implications of the technologies;
- Develop benefit/cost analysis;
- Improve roadway safety for the traveling public;
- Develop operator input and acceptance;
- Investigate integration of data with DOT management systems; and
- Develop real time data for storm management decisions.

The project is divided into four phases. The first phase focused on describing the desirable functions of a concept maintenance vehicle and evaluating its feasibility. Phase II included the development, operation, and evaluation of prototype winter maintenance vehicles. Phase III consists of the prototype evaluation, benefit/cost analysis, and business system integration. Phase IV will be to perform a comprehensive field evaluation of 30 vehicles and the development of the procurement specifications.

Location: Prototype vehicles are being tested in each of the three member states, Iowa, Michigan, and Minnesota.

Current Status: Phase I and II are complete. Three concept vehicles were installed with selected technologies (PlowMaster computer, global positioning system, Norsemeter ROAR friction meter, pavement/air temperature sensors, engine power booster, high-intensity discharge warning lights, and reverse obstacle sensor) to conduct proof of concept. Phase III is currently underway.

Future Activities: Future integration opportunities include development of a transportation management data collection, analysis, and information distribution system.

Impacts: Full implications of the concept maintenance vehicle has not been completed. However, several impacts have already been determined:

- Proof of concept was successful for all functions (pavement friction condition, ambient condition measures, automatic vehicle location, applying materials, providing additional horsepower during periods of high demand, and on-board data processing) except for improving vehicle visibility, rear obstacle alarm, and real-time data communications.
- Results of proof of concept activities resulted in modifications to technologies for Phase III.
- Operators found that the automatic material spreaders to be the best working feature.

Cost Information: Per-state costs range from approximately $200,000 to $225,000. The final budgeted costs for three states are approximately $650,000.

Participating Institutions: Initial membership in this consortium: State Departments of Transportation for Iowa, Michigan, and Minnesota; and the Iowa State University Center for Transportation Research and Education. Other public sector participants and observers include FHWA, other state transportation departments, public works agencies, and representatives of local government agencies. Potential private sector participants: vehicle manufacturers, vehicle component manufacturers, onboard vehicle tracking and communications manufacturers, and technology manufacturers and integrators.

Contact: Duane Smith, Center for Transportation Research and Education, Iowa State University (515) 294-8103; Leland Smithson, Maintenance Division, Iowa DOT, (515) 239-1519

Other Examples: ADOT-Caltrans Snowplow Research Project; VDOT Smart Plows

Benefits

- Improved motorists and operator safety;
- Allows equipment operations and fleet managers to make more informed and cost-effective decisions;
- Better facilitation of the management of vehicle maintenance tasks;
- Reduced snow and ice control costs;
- Current road surface conditions available at control center;
- Better able to respond to customer inquiries;
- Improved customer service;
- Provides continuous visibility of fleet operations;
- Reduces vehicle life-cycle cost;
- Better management of de-icing and anti-icing materials; and
- Provides better control of maintenance labor.

Lessons Learned

- High development costs were avoided with technologies provided by participating private partners.
- Adequate training is necessary to ensure end user acceptance of technology.
- Successful implementation and ownership of technologies requires involvement of snowplow operators, mechanics, and supervisors from the very beginning of the project.

Opportunities

Combining AVL technologies with route optimization software can assist with appropriate and uniform plowing practices and allow real-time modification of routes to meet current demands and priorities. Also, AVL technologies can be used throughout the year on maintenance vehicles. This will assist with scheduling workload and in determining the location of the appropriate vehicles to promptly respond to customers' requests for action.

Institutional Issues

- Increasing the complexity of the technologies installed on maintenance vehicles will require additional maintenance capabilities.
- Additional institutional issues may arise where winter maintenance activities utilize contractors.
- Challenges associated with winter maintenance remain relatively unchanged unless use of technology results in non-coverage of potentially hazardous conditions that would have otherwise been covered.

Implementation Issues

- Installation of the friction meter proved to be the most problematic including interference with underbody blade and susceptibility to spray.
- Training is required for end user acceptance of technology.
- Difficulties with individual technologies will result in end-user frustration and incorrect data.
- Checks and calibration procedures need to be developed to ensure equipment is working properly and providing accurate data outputs.
- Raw data provided by technology components need to be translated to meaningful terms (e.g., converting latitude/longitude to mileposts).

References

CTRE Concept Maintenance Vehicle project Web site

[NYSDOT ITS Toolbox for Rural and Small Urban Areas]

Virginia Department of Transportation, Northern Virginia District Automated Vehicle Locations System Pilot Project, Ronald P. Minor, 1998.

Advanced Technologies Highway Maintenance Vehicle, Smithson et al; presented at Rural ITS National Conference, September, 1995.

Concept Highway Maintenance Vehicle Final Report: Phase One. Smite, Simondynes, and Monsere, Center for Transportation Research and Education, March 1997.

[Real Time Road and Weather Traveler Information Web site]

8.7 AUTOMATIC ANTI-ICING SYSTEM

Click the image to see a full size version

Needs Addressed

The anti-icing system addresses a number of safety issues and provides solutions for improving road conditions by eliminating ice in spot locations.

Description

Automatic anti-icing systems will detect ice in likely locations, such as bridge decks or shady areas, and treat the roadway before it becomes hazardous to drivers. It requires environmental or in-road sensors, a processor to determine when conditions require de-icing, and a device for removing ice.

Real World Examples

Click the image to see a full size version

City of Ft. Collins Anti-Icing System (Colorado)

Goals: To improve road safety in areas that are prone to icy conditions.

Approach: The City of Ft. Collins installed and deployed two anti-icing systems that are capable of operating automatically using a sensor, via remote control, by way of a wireless paging system or manual activation. The system is programmed with the number of activations necessary to fully de-ice the specified area and the amount of time the pump needs to run. A trailer containing the chemical tanks and the decision-making processor is located near the road and the only requirement is a 120-volt single-phase power source. The Fort Collins system covers 200 feet of a two-lane highway but may be adjusted to cover a larger surface area.

Location: The anti-icing system in City of Ft. Collins Colorado is located on a bridge at the bottom of steep hill, a short distance before a railroad grade crossing.

Current Status: Installation and testing of the anti-icing system in Ft. Collins took roughly 16 to 24 hours, while estimated time for installation for a bridge deck system is roughly 40 to 50 man-hours. Scheduled maintenance must be done four times a year, at the start of the winter, twice during winter, and once at the beginning of spring.

Future Activities: The city of Ft. Collins plans to install and deploy an additional anti-icing system that will surround the perimeter of a roundabout.

Impacts: Anti-icing impacts include an increase in roadway safety in areas that are prone to icy and potentially hazardous conditions, and a reduction in maintenance costs.

Cost Information: Total costs include; utilities, communications costs (i.e., transmit road and weather information), de-icing solution, nozzles, sensors, spray pumps, and tanks. Total cost was estimated at $15,000.

Participating Institutions: The city of Ft. Collins and Odin Inc. a private sector manufacturer of de-icing equipment.

Contact: Scott Bowman, Traffic Engineer City of Ft. Collins (970) 221-6762, Tom Ask, Odin Systems Inc. (912) 638-2400.

Other Examples: Anti-Icing Systems are currently in use in the following states; Kansas, Michigan, Kentucky, Maryland, Minnesota, Nebraska, New Mexico, New York, North Carolina, Pennsylvania, Utah, Virginia, and Wisconsin.

Benefits

- Potential to avoid incidents and congestion; therefore reducing emissions, reducing the possibility for secondary collisions, reducing delay, etc.
- Reduced maintenance costs as crews do not have to be dispatched.
- Safety

Lessons Learned

Likely causes of failure are due to nozzles occasionally becoming clogged with debris and damage from snowplows.

Opportunities

Anti-icing systems offer the potential to solve freezing road conditions that can make travel hazardous at key spots that either freeze earlier than other spots, are in particularly vulnerable locations, or are difficult for maintenance vehicles to reach.

Institutional Issues

Issues that need to be considered include system failure and subsequent accidents. In addition, maintenance personnel may have issues with such automated systems relieving them of their previous duties.

Implementation Issues

The anti-icing system located on the bridge deck was incorporated into the bridge reconstruction, which greatly reduced the installation costs and efforts.

References

Maintenance Schedule, New Mexico State Highway and Transportation Department - District IV Rural ITS Implementation Report, September 2000.

FHWA Web site: Manual of Practice for an Effective Anti-Icing Program

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8.8 SITE MANAGEMENT DURING AVALANCHES

Needs Addressed

To improve safety along roadways with a high number of avalanches.

Description

Traffic logging stations at either end of an avalanche prone corridor and avalanche sensors at the roadside are installed. Based on readings from the roadside sensors, automatic gates prevent drivers from entering the corridor during avalanches. As traffic counts will be made at the entry and exit of the corridor, it can be calculated if any vehicles remain in the corridor at the onset of the avalanche. This will facilitate better-informed rescue operations if necessary.

Real World Examples

Avalanche Sensing Technology with Automated Road Closure (Utah)
Goals: To prevent traffic from driving into the paths of avalanches. **Approach:** When the sensors detect the onset of an avalanche, gates at either side of the avalanche path installed on the roadway below will automatically close to prevent vehicles from traveling into the danger area. The system is intended for use at locations where avalanches have relatively predictable paths and where the avalanche typically has a long descent time of between 90 and 180 seconds. The system is designed for sites where avalanches usually affect particular stretches of road of between 100 to 200 feet in length. **Location:** The system is being tested on a 200-yard stretch of roadway on State Route 210 in Utah, in the Little Cottonwood Canyon. This steep two-lane road has 22 established avalanche tracks and experiences numerous avalanches each winter. Colorado, Wyoming, Utah, Washington, and Idaho are looking into implementing the system as well. **Current Status:** System components are installed in problem areas, and the solution has become standard operational maintenance practice. The hardware and the software are currently available for purchase from vendors. **Future Activities:** The University of Utah ended its part of the research on the project in September of 2000. Development of the system continues through private sector vendors. **Impacts:** Preliminary reports from Utah and Colorado have reported that downhill moving truckers have been stopped before reaching a danger zone where an avalanche has occurred. However, more testing of the system will be done on a site-specific level. **Cost Information:** The various types of sensors range in cost from around $500 to $2,500 each. A preliminary estimate of the cost of all the required hardware, including a suite of sensors and the roadside gates, is approximately $30,000. In addition, a power supply would also need to be installed in what would usually be a remote area. However, the alternative of building avalanche sheds is many times more costly. **Participating Institutions:** Utah DOT, Idaho DOT, FHWA, University of Utah **Contact:** Rand Decker, University of Utah. (801) 581-3403 **Other Examples:** Another corridor, SR 21 in Idaho, is being tested with the same technology.

Benefits

- Improved safety along avalanche-prone corridors by providing advanced warning or closing the road prior to a serious incident
- Potential saving over the cost of building traditional avalanche sheds

Lessons Learned

The system must be adapted to each specific deployment and requires some engineering work.

Opportunities

System may be integrated with an overall traveler information system so that avalanche warnings are automatically posted to a web site and disseminated through highway advisory radio or a dial-in telephone system.

Institutional Issues

Some issues arise with regard to the accuracy of the detection and warning system. Travelers may rely too heavily on the warning and proceed if the road is open despite warnings from other sources or the travelers' own intuition that the road appears hazardous.

Implementation Issues

As mentioned above, each deployment of the system must be handled differently in order to ensure accuracy.

References

Technologies in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

US DOT Web page: Development and Trial Deployment of Avalanche Sensors

FHWA Road Weather Management Program

8.9 PUBLIC AGENCY OUTREACH FOR TRANSPORTATION MANAGEMENT

Needs Addressed

Education of the general public on the roles of transportation agencies.

Description

The roles of public sector transportation agencies are often misunderstood or misinterpreted at many levels by citizens. This solution builds upon an agency's outreach activities by promoting communications between the public sector and residents on various issues. This type of communication link provides easy access to residents, travelers, and businesses on the issues of public interest dealt with by various government agencies.

Real World Examples

Kalamazoo County Roads Commission Web Site (Michigan)
Goal: To allow interaction between the residents of Kalamazoo County, Michigan, and the County's Road Commission. **Approach:** An Internet site has been developed which provides the road commission's mission, goals, policies, county and local township maps, road and bridge closures and detour information, bids for services and goods, and news releases on vehicle weight restrictions, road project hearings, budget hearings and approvals and board elections. **Location:** Kalamazoo County Road Commission is responsible for nearly 1,200 miles of county roads. The Internet site offers information relating to this network of roads. **Current Status:** The web site is fully operational and can be accessed at http://www.kcrc-roads.com.

Future Activities: The web site will be continuously updated to provide information to the public on what the county roads commission is doing for the roads.

Impacts: Anecdotal reports show that the residents of the county and surrounding area appreciate the information that is given on the web site.

Cost Information: Costs include the cost of developing the web pages and purchasing space on a web server to house them. Keeping the pages up to date requires further maintenance cost.

Participating Institutions: Kalamazoo County Road Commission

Contact: Kalamazoo County Road Commission. (616) 381-3171

Benefits

- Easy and cheap access to local roads information at any time of day;
- Easy and cheap access to local roads information and current available contracts;
- Information is disseminated in a cost-effective manner, freeing up agency resources;
- Positive public perceptions of information dissemination activities; and
- Residents are better informed of local initiatives.

Lessons Learned

Working with the Internet service provider, if applicable, the agency should design, implement, and test their service. In order to ensure maximum visibility and use of the system, the agency should ensure that links to neighboring, regional, or state sites are created wherever possible. The agency needs to collect and analyze user feedback to ensure that the users' needs continue to be met by the service.

Opportunities

Various other options exist for communicating information on local road initiatives, construction, or closures, for example, including:

- Dial-in telephone recorded messages.
- Dial-in operator-based information services.
- Circulation of newsletters, or advertisement of road projects in the local press.
- Broadcast fax service to information service subscribers.
- Informational billboards or signs at the sites of future construction or maintenance activities.

None of the above systems can offer the breadth and depth of information, and comparable ease of manipulation of information, that is offered by the web site example described above. In addition, most of these sources, although they will be used as supplementary mechanisms, are likely to be less costeffective from the agency's perspective.

A road information web site could be enhanced to provide many other services including the following:

- Current and forecast road and weather condition information.
- Information on possible detours to avoid construction or maintenance work zones.
- Information on local special events, including parking options, locations and pricing, and suggested routes.
- Information on other local attractions.
- Links to neighboring region's information sites or to statewide information sites.

Institutional Issues

When deciding to deliver an Internet information service, the agency should be sure not to underestimate the effort required to maintain the service and keep all information current. If the site is not maintained adequately, the service and the agency could lose credibility with users.

Implementation Issues

It is likely that such an Internet service would supplement a parallel telephone-based information service. If this is not the case, the agency should consider supplying a help-line for users who experience difficulties with the service, or for users who would prefer to deal with an operator when needing additional information or assistance.

Reference

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97- 108, October 1997.

9. SURFACE TRANSPORTATION AND WEATHER

This section contains descriptions of the tools that fall within the surface transportation and weather rural development track. These are:

- Data gathering and processing systems;
- Weather information dissemination systems; and
- Integrated weather monitoring/prediction systems.

9.1 DATA GATHERING AND PROCESSING SYSTEMS

Needs Addressed

One of the most requested information types is weather information. Both travelers and maintenance operators have expressed serious needs for rural weather information about current and forecasted atmospheric and road condition information. In addition, commercial vehicle operators rely heavily on weather reports to define cross-country routes, select departure times and plan trips.

Description

Beyond the transportation industry, various other industries collect and process weather in real time. These include the National Weather Service, the Federal Aviation Administration, and others. Typically, it is common that these various agencies have very good coverage of weather sensors around a state, and each sensor may serve different industries. Coordination is the key to combining this data and assembling it together to develop as comprehensive a set of monitoring and reporting stations as possible. Once combined, the data from each of these stations can be used by all agencies to more accurately report current conditions statewide. In the transportation industry, statewide weather reports can be used to support modeling tools to forecast conditions and prepare for treatments.

Real World Examples

State DOT rWeather Program (Washington)

Goals: To collect and assemble real-time and predictive statewide road and weather information.

Approach: The first step was to create a highly dense database of Washington State weather observations. The Northwest Regional Weather Consortium is a group of local, state, and federal agencies that pool together data from weather measuring devices located around the State. Sources include agricultural monitoring networks, air pollution sensing stations, airport monitoring stations and DOT Environmental Sensor stations. Together, nearly 400 sites statewide report weather conditions.

The second step was to use a high-resolution weather prediction system to generate detailed weather forecasts around the State. This system supplies detailed forecasts for WSDOT and other government agencies around the State. The third step was to develop a road condition prediction model for use with observed and forecasted weather conditions. The pavement condition model helps maintenance crews make decisions about when and where to apply treatments to the road. Collectively, all the weather data is assembled and processed to also support the public sector traveler information system.

Location: Statewide

Current Status: The project is underway. A beta system is operational and can be viewed at http://www.wsdot.wa.gov/Rweather. Available from the site are weather conditions across Washington, mountain pass information, radio messages (played using RealAudio), radar, and road conditions.

Future Activities: Continued testing and tailoring of the system.

Impacts: The system is in the early stages to accurately report impacts.

Cost Information: The project is paid for by a $1.25 million grant from the U.S. Department of Transportation and $312,500 from WSDOT.

Participating Institutions: Washington Department of Transportation, University of Washington, Northwest Regional Weather Consortium

Contact: Bill Brown, WSDOT (206) 616-6183

Other Examples: Aurora Local Climatological Model FORETELL, (Iowa, Missouri, Wisconsin), ATWIS (South Dakota, North Dakota, Minnesota)

Benefits

- More accurate and detailed weather reports and forecasts;
- Less costs to deploy monitoring equipment if ties with other agencies are formed;
- More appropriate treatment of roadway surfaces based on more accurate pavement forecasts which results in better LOS, and cost savings by the public agencies;
- Better informed travelers.

Lessons Learned

The gathering and combining of existing weather monitoring devices is a very efficient means for reaching statewide weather monitoring coverage quickly. The institutional relationships can typically benefit each party as all agencies can share in the combined data.

Opportunities

Additional private sector weather observation sites can also be added.

Institutional Issues

The combination of weather data from a variety of sources presents some technical challenges, however the most significant issues relate to institutional relationships that are needed to openly exchange data, and to handle data ownership.

Implementation Issues

One consideration is quality of data. Standards exist for placement and operation of weather sensors that enable other partners to trust in the quality and type of data being reported. However, when one agency deploys a weather monitoring station for one purpose, care must be taken when the data is to be used for another purpose. Ensure that standards are used.

References

WSDOT information on rWeather

rWeather Web site

rWeather newsletter

9.2 WEATHER INFORMATION DISSEMINATION SYSTEMS

Needs Addressed

To provide travelers and winter maintenance decision makers with the most up to date and detailed road and weather condition information to permit them to make travel decisions.

Description

Poor weather conditions affect transportation operations and traveler safety, and can have enormous consequences on society. To assist in minimizing the impacts of adverse weather conditions, it is important to provide detailed and accurate road and weather condition information to end users either pre-trip or while en-route. Users can include such groups as commercial vehicles, highway maintenance operators, leisure travelers and the general public.

Real World Examples

Emergency Managers Weather Information Network (EMWIN) (TX, DC, OK)

Goals: To provide a low cost weather information access system for emergency management personnel.

Approach: EMWIN is a non-proprietary weather information dissemination system. It provides a continuous, dedicated low speed data broadcast, which may be received by a number of mechanisms including radio, the Internet, and satellite. The EMWIN data stream consists of:

- Real-time weather warnings, watches, advisories, and forecasts.
- A subset of alphanumeric products for each state.
- A limited suite of non-value-added graphical products.
- Some satellite imagery.

The EMWIN data may be viewed on a personal computer using software developed by the National Weather Services (NWS). This software is available free of charge through the Internet. Commercially supported software is also available at low cost.

Location: EMWIN is currently available on a region-wide basis throughout North America for both Internet and satellite users. Radio access is limited to a 30 to 60 mile radius of those areas where EMWIN transmitters are located. At present, transmitters are located throughout the States of Oklahoma and Texas as well as the Washington, D.C. area.

Current Status: The system has been operational since May, 1994.

Future Activities: The system is operational with real-time data being provided to multiple user groups. EMWIN contributes to meeting the NWS goal of protecting life and property. The system is deployed and available to users. NWS is working with FEMA and other organizations, public and private, to deploy additional radio transmitters.

Impacts: No impacts or results of a system of this nature have been determined.

Cost Information: NWS designed and implemented EMWIN for less than $50,000. User costs vary according to the data reception method used, ($500 for a satellite system to approximately $250 for a radio receiver and demodulator). Internet access is free, subject to set-up and monthly connection rates, which vary by service provider. Additionally, a personal computer is required to display and interpret data. Total user costs should be less that $2,500, including computer procurement.

Participating Institutions: The system was developed and is supported by the National Weather Services - Office of Systems Operations (NWS-OSO), in partnership with the Federal Emergency Management Agency (FEMA). It should be noted that various private sector agencies provide value-added weather information via the Internet. NWS has created a list of these agencies which is available at this Web site.

Contact: Kevin Kay, National Weather Service. (301) 713-0191, Ext. 172

Other Examples:

- NOAA Weather Radio
- Weather Radio Network
- FORETELL, (Iowa, Missouri, Wisconsin)
- ATWIS (South Dakota, North Dakota, Minnesota)

Benefits

- Reduction in accidents and fatalities due to inclement weather
- Reduction in societal costs from large storms
- Improved knowledge of approaching weather conditions
- Improvement in road maintenance operations from greater information dissemination
- Improved lead-time to assist in developing and initiating a planned response to inclement weather conditions.

Lessons Learned

Providing information to the public and other users to assist them in making effective travel decisions is imperative. While it is not possible to influence all people to undertake the actions that are recommended by authorities and agencies regarding travel decisions, providing as much detailed information to end users allows them to make more educated decisions.

Opportunities

Many opportunities exist in providing information to end users beyond emergency management personnel. Travelers, commercial vehicles and other such users could greatly benefit from the availability of advanced warning and detailed weather information. Additionally, many of the sources of information for end users are currently limited to pre-trip information, with the exception of radio broadcasts.

Institutional Issues

There are few institutional issues involved in this application, unless there is integration of value-added and RWIS products. Many of the agencies coordinate activities with each other and have the ability to share information. Weather information is available from the National Weather Service through a satellite broadcast system that can be purchased by outside agencies. Other opportunities for this technology may require further assistance and consideration of potential institutional issues, which will likely involve the sharing and dissemination of information between agencies and with the public.

Implementation Issues

Implementation of current systems is straightforward and no known implementation issues exist, since many of the systems use existing and proven technologies.

References

Technology in Rural Transportation "Simple Solutions", FHWA publication number FHWA-RD-97-108, October 1997.

Surface Transportation Weather Decision Support Requirements from the FHWA Electronic Document Library.

9.3 INTEGRATED WEATHER MONITORING/PREDICTION SYSTEMS

Click the image to see a full size version

Needs Addressed

Stakeholders want a road/weather information notification system that provides the following:

- Information on road and weather conditions;
- Early notifications to alert authorities and travelers of inclement weather (i.e., black ice, flash flooding, snow chain requirements, fog); and
- Access to the most recent weather predictions.

Description

RWIS allows for greater knowledge by operations and maintenance personnel of current and predicted conditions at remote locations. RWIS components include:

- Remote sensors that can measure precipitation, temperature, wind speed, and humidity;
- Communications that can transmit weather and roadway data to regional and central hubs; and
- Decision support systems that allow DOT personnel to respond to field conditions.

The incorporation of RWIS data with National Weather Service information, weather modeling capabilities and other environmental data sources allows the DOT to be better prepared for all types of extreme weather conditions. RWIS can be utilized in conjunction with traveler information systems, and dynamic speed limit technologies to provide current information to travelers doing pre-trip planning and via VMS en-route.

Real World Examples

FORETELL (Iowa)
Goals: Create a self-sustaining road and weather information system fully integrated within a wider basket of ITS services, enhancing safety and facilitating travel throughout North America.

Approach: Utilize state-of-the-art National Weather Service data sources, models and technical/human resources to provide basic nowcasts and forecasts and linking this energy balance models for pavement condition forecasting, greater detail for weather and road condition information than is currently available.

Location: Upper Mississippi Valley, with expansion to a continent-wide system within 5 years.

Current Status: System is currently concentrating on the Upper Mississippi Valley region. User needs definition and initial system architecture work has been completed. System development is completed, with minor modifications continuously made to further improve the system. Initial user feedback for the system occurred during the spring of 1999 with full-scale testing and operations during the winter of 1999-2000.

Future Activities: Testing and operations within the Upper Mississippi Valley is scheduled for the winters of 1999-2000 and 2000-01. North American expansion of the system is planned within 5 years.

Impacts: Initial user feedback has been extremely positive and system operations and testing during the winter season will provide further details on the impacts to winter maintenance activities.

Cost Information: $4.45 million using funds and in-kind matches from federal, state and private participants. States involved in the initial operational test contributed $300,000 each. States wishing to join FORETELL for the remainder of the operational test should contact the individuals listed below.

Participating Institutions: Iowa DOT, Missouri DOT, Wisconsin DOT, Illinois DOT, FHWA, Castle Rock Services, Colorado Research Associates.

Contact: John Whited, Iowa DOT, (515) 239-1411 and Peter Davies, Castle Rock Services, (603) 431-2152.

Other Examples: Sierra Project (RWIS, HAR, VMS, etc.), California Road/Weather Advisory System, Nevada State Highway 431, Washington State rWeather.

Benefits

- More detailed road and weather condition information available for maintenance supervisors to make operational decisions regarding winter maintenance activities.
- Providing maintenance supervisors with detailed forecasts to make overnight staffing decisions.
- A decrease in labor and material costs from more timely and detailed information.
- Increased traveler safety from having maintenance staff be able to view road and weather conditions and then be able to inform travelers of the conditions or close roadways if necessary before travelers get stuck.

Lessons Learned

- Essential that early user buy-in of parameters needed for display and times at which information must be available to ensure that all users would be open to accepting a new concept in winter maintenance operations.
- A high level of interagency interaction was necessary to keep all participants active and interested in the project since the development time for the software and system design was substantial.

Opportunities

- As computer horsepower increases and the further refinement of weather models is achieved, even more detailed forecasts (both geographically and time-wise) will be able to provide greater assistance to winter maintenance operations in pinpointing the location, intensity and time of expected winter weather.
- In addition to winter maintenance activities, schools, emergency services, construction activities and the general public could be well served by providing detailed weather and road condition information to make operational or personal decisions for their respective activities.

Institutional Issues

RWIS project deployment requires significant training to enable effective usage of the system and equipment maintenance. Agencies must also decide how much of the RWIS information should be made available to the public in real-time.

Implementation Issues

The infrastructure needed to effectively operate a road and weather prediction system is quite substantial. The amount of data that is collected, processed and then disseminated to end users can be very large and thus requires enormous forethought to ensure that information distribution systems do not get overwhelmed. Finally, the software development process can vary substantially from project to project and from task to task, but is a very costly process. A significant brainstorming session at the beginning of the project to identify potential methodologies for tackling the project is extremely valuable. The ability to adhere to a planned deployment schedule is often very dependent upon the amount of initial groundwork investigation of any potential obstacles done.

References

NYSDOT ITS Toolbox for Rural and Small Urban Areas

FORETELL Web site

FHWA FORETELL field operational test page

APPENDIX A. NEEDS INDEX

This section provides an index of needs addressed by the ITS solutions described in this document. This index will help users quickly locate those sections that address their specific needs. Needs are listed in alphabetical order followed by the section number where the discussion of the need begins. Colored/Shaded cells in the table indicate the beginning of a new letter series.

APPENDIX B. LOCATION OF REAL WORLD EXAMPLES

This appendix lists the locations (state or in some instances Canadian province) of the real world examples cited in the main body of this report to help readers determine whether there have been activities in a given region. This list should in no way infer, however, that these are the only states investigating ITS solutions for its rural transportation needs.

Arizona - Acoustic Energy Sensor for Traffic Applications (Sec. 5.11), Statewide Traffic Operations Center (Sec. 8.2)

British Columbia - Siren Activated Signal Pre-emption (Sec. 3.1)

California - Smart Call Box Field Operational Test (FOT) (Sec. 4.10), Smart-Key Payment for Parking Meters (Sec. 5.9), Self-Drive Dynamic Van Pooling Program (Sec. 6.3)

Colorado - Colorado Traveler Information via Fax Machine (Sec. 4.3), Colorado Incident Management Using Dynamic Message Signs (Sec. 4.6), Inter-agency Signal Master System (Sec. 5.4), Truck Speed Warning System (Sec. 7.1), Pedestrian Crossing Illumination System (Sec. 7.9), City of Ft. Collins Anti-Icing System (Sec. 8.7)

Connecticut - New York TRANSMIT (Sec. 5.7)

District of Columbia - SmartTraveler TV (Sec. 4.8), Emergency Managers Weather Information Network (EMWIN) (Sec. 9.2)

Florida - Florida Traveler Information Network (Sec. 4.1)

Indiana - Lane-Drop Smoothing System (Sec. 5.10), Pagers Activating Highway Lighting (Sec. 8.3), Computerized Maintenance Fleet Inspection Process (Sec. 8.5), Snow Route Design Optimization Software (Sec. 8.9)

Iowa - Mid-America Smart Work-Zone Deployment Initiative (Sec. 7.2), Advanced Technologies Highway Maintenance Vehicle (Sec. 8.6), FORETELL (Sec. 9.3)

Kansas - Mid-America Smart Work-Zone Deployment Initiative (Sec. 7.2)

Maryland (DC metropolitan area) - SmartTraveler TV (Sec. 4.8), Emergency Managers Weather Information Network (EMWIN) (Sec. 9.2)

Massachusetts - Acoustic Energy Sensor for Traffic Applications (Sec. 5.11)

Michigan - Kalamazoo Country Roads Commission Web Site (Sec. 8.9)

Minnesota - Minnesota Mayday Plus (Sec. 3.2), Minnesota State Patrol Automated Field Reporting (Sec. 3.3), Automation of Paper Logs for Radio Communications (Sec. 3.3), Minnesota Rural Kiosks in Duluth and St. Cloud (Sec. 4.4), Duluth/St. Cloud TOCCs (Sec. 4.9), Freeway Gate Operations (Sec. 5.8), ARTIC Transit AVL (Sec. 6.1), Advanced Rural Transportation Information and Coordination (ARTIC) (Sec. 6.2), Advanced Rural Transportation Information and Coordination (ARTIC) (Sec. 8.1)

Missouri - Mid-America Smart Work-Zone Deployment Initiative (Sec. 7.2)

Nebraska - Grade Crossing GIS Database (Sec. 5.3), Mid-America Smart Work-Zone Deployment Initiative (Sec. 7.2)

Nevada - Advanced Railroad Crossing Status (ARCS) - Reno (Sec. 7.8)

New Jersey - New York TRANSMIT (Sec. 5.7)

New York - New York TRANSMIT (Sec. 5.7)

Oklahoma - Emergency Managers Weather Information Network (EMWIN) (Sec. 9.2)

Oregon - Oregon DOT Statewide TripCheck System (Sec. 4.5), Rural Cameras at Key Locations (Sec. 5.2), Pager Activation of School Crossing Beacons (Sec. 5.5)

Pennsylvania - Smart Parking Meters (Sec. 5.9), Community Transit/Car-Pooling Internet Site (Sec. 6.3)

Texas - Houston's TranStar Smart Commuter (Sec. 4.7), Acoustic Energy Sensor for Traffic Applications (Sec. 5.11), Cable TV for Signal Coordination (Sec. 8.4), Emergency Managers Weather Information Network (EMWIN) (Sec. 9.2)

Utah - Avalanche Sensing Technology with Automated Road Closure (Sec. 8.8)

Virginia (DC metropolitan area) - SmartTraveler TV (Sec. 4.8), VDOT Hampton Roads Route Diversion (Sec. 5.6), Acoustic Energy Sensor for Traffic Applications (Sec. 5.11), Visibility Sensors on I-64 (Sec. 7.3), Leesburg Speed Monitoring Awareness Radar Trailer (SMART) (Sec. 7.5), Emergency Managers Weather Information Network (EMWIN) (Sec. 9.2)

Washington - Kirkland Low Visibility Lighting System (Sec. 5.1), Travel Aid on Snoqualmie Pass (Sec. 7.1), Bicycle in Tunnel Warning System (Sec. 7.7), State DOT rWeather Program (Sec. 9.1)

Wisconsin - Dane County, Wisconsin Interagency Dispatch and Reporting Coordination (Sec. 3.4), Wisconsin 1-800-ROADWIS (Sec.4.2), Dane County Dynamic Message Sign Deployment (Sec. 4.6)

Wyoming - Greater Yellowstone Rural ITS Priority Corridor Project (Sec. 7.4)