EMERGENCY MANAGEMENT

EIGHTY (80) PERCENT OF EMERGENCY MANAGEMENT VEHICLES IN MAJOR METROPOLITAN AREAS OPERATE UNDER COMPUTER-AIDED DISPATCH.

MANAGEMENT AND OPERATIONS

In the United States, there are over 400 tropical storms, hurricanes, tornadoes, and hazardous materials (HAZMAT) incidents that require evacuation each year. In order to minimize loss of life and improve safety, prompt action is required from multiple agencies before, during, and after each event. Responders must reach the scene, victims must be evacuated, and clearance and recovery resources must arrive on time. Each day, smaller scale emergencies occur in communities and emergency responders must travel quickly and safely to fires, traffic crashes, or crime scenes. ITS applications for emergency management aim to improve public safety by giving agencies the tools and equipment they need to plan for and implement response actions quickly and efficiently.

Safe and secure transport of HAZMAT includes vehicle tracking, roadside detection, driver authentication, and route planning. Vehicle-mounted hardware provides the capability to track HAZMAT shipments and support the notification of management centers when a shipment deviates from its intended route. Roadside detectors can monitor for the presence of hazardous shipments in sensitive areas and, if electronic tag information is available on the detected vehicle, confirm that the shipment is on the expected route. Driver authentication technology can confirm that the individual operating a HAZMAT vehicle is authorized to do so and report operation by unexpected drivers to public safety entities. ITS can also provide assistance to commercial vehicle operators via electronic route planning services, ensuring compliance with HAZMAT shipment restrictions along planned travel routes.[372]

Advanced automated collision notification (ACN) and telemedicine address the detection of and response to incidents such as vehicle collisions or other incidents requiring emergency responders. In rural areas, response time for emergency medical services is greater than in metropolitan areas, resulting in more severe consequences for those in need of medical assistance. Advanced ACN systems can notify emergency personnel and provide them with valuable information on the crash including location, crash characteristics, and possibly relevant medical information regarding the vehicle occupants. Telemedicine systems provide a link between responding ambulances and emergency medical facilities, enabling doctors to advise emergency medical personnel regarding treatment of patients en route to the hospital. ACN systems are also discussed in the collision notification chapter of this report.

The freeway management chapter discusses how lane management techniques such as reversible flow lanes are often used for evacuation during emergencies. The collision notification chapter discusses systems that notify emergency responders when crashes occur.

A variety of sensors deployed on the transportation infrastructure can help provide an early warning system to detect large-scale emergencies including natural disasters (hurricanes, earthquakes, floods, blizzards, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents; nuclear power plant accidents; and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). In the event of a large-scale emergency, ITS applications can assist with response management through services such as the tracking of emergency vehicle fleets using automated vehicle location (AVL) technology and two-way communications between emergency vehicles and dispatchers. When responding to emergencies of any scale, emergency vehicle signal preemption implemented through coordination with arterial management agencies, can speed the safe arrival of emergency responders on scene. Evacuation operations often require a coordinated emergency response involving multiple agencies, various emergency centers,

EMERGENCY MANAGEMENT CATEGORIES IN THE ITS KNOWLEDGE RESOURCES

Hazardous Materials Management

- Tracking
- Detection
- Driver Authentication
- Route Planning

Emergency Medical Services

- Advanced Automated Collision Notification
- Telemedicine

Response and Recovery

- Early Warning System
- Response Management
- Emergency Vehicle Signal Preemption
- Evacuation and Re-Entry Management
- Emergency Traveler Information

CONTRAFLOW FREEWAY OPERATIONS IN SOUTH CAROLINA ENABLED 76 PERCENT INCREASE IN TRAFFIC VOLUMES.

OTHER ITS KNOWLEDGE RESOURCE CATEGORIES RELATED TO EMERGENCY MANAGEMENT

Refer to other chapters in this document.

Freeway Management

- Lane Management: Emergency Evacuation

Collision Notification Systems

- Mayday/Automated Collision Notification
- Advanced Automated Collision Notification

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and numerous response plans. Integration with traffic and transit management systems enables emergency information to be shared between public and private agencies and the traveling public. This communication and cooperation also enables the use of the variety of ITS information dissemination capabilities to provide emergency traveler information.

Improvements in the command and control of emergency management can lead to increased cooperation among agencies. An interoperable communications network and the use of common terminology between agencies can lead to more reliable and effective emergency operations. Studies of ITS deployed to enhance emergency response have shown the potential of these technologies to assist organizations in improving emergency response actions.

The Emergency Transportation Operations initiative, undertaken by the U.S. DOT's ITS Joint Program Office (JPO), supports the development of new of tools, techniques, technical guidance, and standards necessary for state and local agencies and their private sector partners to improve emergency management. Effective real-time management of transportation during major incidents results in more timely responses to highway and HAZMAT incidents, and shorter incident durations. This initiative aims to improve the management of all forms of transportation emergencies through the application of ITS technologies. Advances in in-vehicle communication and information systems will provide access to essential real-time data about an incident and about transportation conditions on all routes throughout the affected region.[373] Additional information on this initiative is available at the ITS JPO's Web site: *www.its.dot.gov/eto.*

Findings

Benefits

ITS applications for emergency management can improve the efficiency of transportation capacity during emergencies, increase productivity for HAZMAT shipping operations, and improve overall traveler safety and security (see table 10). Evaluation data collected from a number of studies suggest that customer satisfaction with emergency management is largely positive. Stakeholders perceive positive impacts and indicate that these technologies are widely accepted.

The HAZMAT Safety and Security Technology Field Operational Test (FOT) tested a variety of technologies designed to improve the security of HAZMAT shipments. In this study, it was estimated that the technologies would reduce the risk and vulnerability of HAZMAT shipments and therefore reduce the potential consequences of a terrorist attack on HAZMAT shipments by 36 percent. Through improved operations for carriers, the technologies were found to have a payback period of 3 to 34 months across the range of technologies and shipment types studied.[374]

Successful operations for emergency management require agencies to communicate and coordinate effectively with little or no notice at times when resources may be limited. To help optimize the effectiveness of available resources, agencies can use ITS technologies to prioritize, allocate, track, and coordinate the deployment of personnel, supplies, and equipment.[375] Different agencies, however, can have different core missions and are sometimes unaware of the capabilities and priorities of other agencies. Transportation agencies, for example, may focus on reducing the time to restore normal traffic conditions, while an emergency services agency may focus on improving safety for responders.[376] Although

goals and objectives may differ significantly between agencies, most officials agree that ITS technology can be used to promote interagency coordination and improve emergency management. This coordination can beget significant improvements in evacuation and re-entry management, such as the 76 percent increase in traffic volumes accomplished with freeway contraflow operations in South Carolina as residents returned following a hurricane evacuation.[377]

TECHNOLOGIES THAT ENHANCE THE SAFETY AND SECURITY OF HAZMAT TRANSPORTATION OPERATIONS RANGE IN COST FROM $250 TO $3,500 PER VEHICLE.

Table 10—Emergency Management Benefits Summary

	Safety	Mobility	Efficiency	Productivity	Energy and Environment	Customer Satisfaction
Hazardous Materials Management	●			●		
Emergency Medical Services						✱
Response and Recovery			●			

● Substantial positive impacts
✚ Positive impacts
❍ Negligible impacts
✱ Mixed results
✖ Negative impacts
blank Not enough data

Costs

The HAZMAT Transportation Safety and Security FOT was conducted to assess commercially-available, off-the-shelf technology that could be deployed in the near term to enhance the safety and security of HAZMAT transportation operations. Part of the assessment included collecting cost data for the different technologies. The study found that the technologies that enhance the safety and security of HAZMAT transportation operations range in cost from $250 to $3,500 per vehicle. These estimates represent only the hardware installed on the trucks in commercial quantities. The costs provided did not reflect the price of servers and dispatch systems amortized over the number of vehicles since this can vary widely depending on customer setup. While none of the technologies tested was described as prototypes, several had limited prior field usage outside of government applications.[378]

The Federal Highway Administration initiated a study to explore the benefits and costs of fully deploying operational strategies and integrating ITS in metropolitan areas. Seattle, Cincinnati, and Tucson were selected as large, medium, and small metropolitan areas, respectively. Strategies included for Seattle and Cincinnati were identified through the next 25 years and brought forward to the current year (2003); while those for Tucson were forecasted for 2025. One of the strategies identified was emergency management systems. For each of the three metropolitan areas the amount of deployment and coverage were identified. Deployment data included the number of emergency vehicles and ambulances equipped with control service, AVL, and telemedicine. Percentages of emergency vehicles

and ambulances defined the amount of coverage. The annualized life cycle costs of emergency management systems were estimated at $1.8 million for Seattle, $1.8 million for Cincinnati, and $2.1 million for Tucson.[379] See sample costs of ITS deployments in the tables below for more specific examples of other emergency management systems.

Deployment

Figure 15 shows deployment trends for three key ITS technologies used in emergency management from 2000 to 2006, based on a multi-year survey of the country's 78 largest metropolitan areas. As of 2006, 80 percent of emergency management vehicles operate under computer-aided dispatch (CAD), an increase from 67 percent in 2000. As of 2006, 20 percent of emergency management vehicles are equipped with in-vehicle navigation, up from almost no deployment in 2000. Also as of 2006, 6 percent of emergency management vehicles were equipped with the on-board equipment needed for emergency vehicle preemption. Additionally, 21 percent of traffic signals in the country's 108 metropolitan areas were equipped with the roadside components of emergency vehicle preemption.

In 2006, the survey of metropolitan areas was expanded to the country's 108 largest metropolitan areas. This survey is the source of deployment statistics presented later in this chapter.

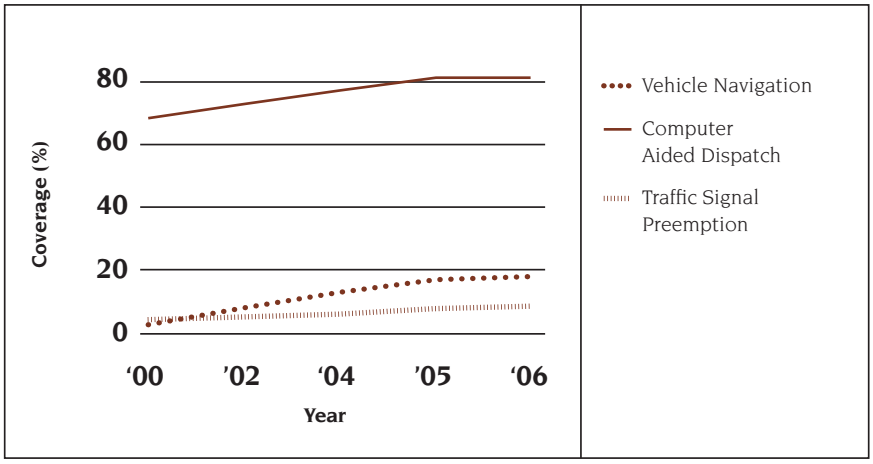

Figure 15 – Deployment Trends for Emergency Management Systems

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Selected Highlights from the ITS Knowledge Resources on Emergency Management

Hazardous Material Management

ITS applications associated with HAZMAT shipments can accomplish four major functions intended to provide safe and secure transport of hazardous materials by road:

- Vehicle-mounted hardware provides the capability to track HAZMAT shipments and support notification of management centers when a shipment deviates from its intended route.
- Roadside detectors can monitor for the presence of hazardous shipments in sensitive areas and, if electronic tag information is available on the detected vehicle, confirm that the shipment is on the expected route.
- Driver authentication technology can confirm that the individual operating a HAZMAT vehicle is authorized to do so and report operation by unexpected drivers to public safety entities.
- ITS can also provide assistance to commercial vehicle operations via electronic route planning services, ensuring compliance with HAZMAT shipment restrictions along planned travel routes.

Hazardous Material Management	
Deployment	
ITS technology to assist emergency management agencies in managing hazardous materials shipments is not widely used. For example, only four of the country's 108 largest metropolitan areas use roadside detectors to monitor for the presence of hazardous shipments in sensitive areas. Only five of these 108 metropolitan areas use vehicle-mounted hardware to track HAZMAT shipments and detect when a shipment deviates from its intended route. In contrast, 24 of these 108 metropolitan areas use driver authentication technology to confirm that the individual operating a HAZMAT vehicle is authorized to do so.	
Benefits	
ITS Goals	**Selected Findings**
Safety	The HAZMAT Safety and Security Technology FOT tested a variety of technologies intended to improve the security and operational efficiency of HAZMAT shipments. A qualitative assessment found that the technologies tested, combined with best practices in motor carrier driver and safety management, and incident response, had the potential to improve the safety of HAZMAT shipments by truck. The study also found that cosmbinations of the technologies tested had the ability to improve security by addressing shipment vulnerabilities. The tested technologies were estimated to reduce by 36 percent the potential costs of terrorist attacks.[380]

Hazardous Material Management	
Benefits	
Productivity	The HAZMAT Safety and Security Technology FOT found that many of the technologies tested yielded productivity benefits to motor carriers in the form of more efficient operations, with the combined technologies of wireless communications with global positioning system (GPS) capabilities providing the greatest benefits. The time period of payback of investment costs was 3 to 34 months across the range of technologies and shipment types evaluated. [381]
Costs	
Unit Costs Data Examples (See Appendix A for more detail)	
Fleet Management Center subsystem: • Software Upgrade for HAZMAT Management: $19K-$39K • Hardware Upgrade for HAZMAT Management: $3K • Electronic Cargo Seal Reader: $0.3K-$1.4K Commercial Vehicle On-Board subsystem: • Electronic Cargo Seal—Reusable: $0.034K-$0.42K • Autonomous Tracking Unit: $0.35K-$0.8K	
Sample Costs of ITS Deployments	
United States: The HAZMAT Transportation Safety and Security FOT was conducted to assess commercially-available, off-the-shelf technology that could be deployed in the near term to enhance the safety and security of HAZMAT transportation operations. Part of the assessment included collecting cost data of the different technologies. Fleet-wide management software and licensing to support mapping and tracking of HAZMAT shipments ranges from **$10,000 to $33,000**. Biometric systems evaluated consisted of predominately fingerprint and, to a lesser degree, facial recognition technologies to provide secure access for authorized personnel. Most systems evaluated were compatible with smart cards and other technologies. The average cost of a complete biometrics system is **$1,000.**[382]	
Benefit-Cost Studies	
United States: Assuming full deployment across the motor carrier industry, the combined benefit-to-cost ratios, across all load types and technology combinations in the HAZMAT Safety and Security Technology FOT, range from 1.3:1 to 96.9:1. These ratios include benefits to motor carriers as well as societal benefits, with the proportion varying with, among other things, the potential consequences of a terrorist attack involving the goods shipped. Bulk fuel carriers are expected to experience 60 to 72 percent of the benefits, less-than-truckload carriers 81 to 92 percent, bulk chemical carriers 5 to 13 percent, and carriers of truckload explosives 1 to 3 percent.[383]	

Emergency Medical Services

Advanced ACN and telemedicine address the detection of and response to incidents such as vehicle collisions or other incidents requiring emergency responders. In rural areas, response time for emergency medical services is greater than in metropolitan areas, resulting in more severe consequences for those in need of medical assistance.

Emergency Medical Services
Deployment
Public safety agencies in 20 of the country's 108 largest metropolitan areas have access to ACN and public safety agencies in 10 of these 108 metropolitan areas have access to advanced ACN that includes information on the severity of a vehicle crash. Public safety agencies in 17 of these 108 metropolitan areas have access to commercial ACN systems such as OnStar®. More widespread is telemedicine, i.e., providing an audio and/or video link between responding ambulances and nearby emergency medical facilities. Telemedicine is in use in 46 of the country's largest 108 metropolitan areas.

Emergency Medical Services: Advanced Automated Collision Notification

Advanced ACN systems use vehicle-mounted sensors and wireless communication to notify emergency personnel and provide them with valuable information on the crash including location, crash characteristics, and possibly relevant medical information regarding the vehicle occupants.

Emergency Medical Services—Advanced Automated Collision Notification
Costs
Unit Costs Data Examples (See Appendix A for more detail)
Emergency Response Center subsystem: • Emergency Management Communications Software: $5K-$10K • Hardware, Software Upgrade for Enhanced 9-1-1 and Mayday: $102K-$175K • Emergency Response Labor: $73K-$240K (annually)

Emergency Medical Services—Advanced Automated Collision Notification
Costs
Sample Costs of ITS Deployments
New York: The National Highway Traffic Safety Administration's Office of Vehicle Safety Research conducted an ACN FOT to demonstrate the feasibility of fielding an ACN system and to measure the benefits of an ACN system to victims of motor vehicle crashes. The ACN test area covered rural and suburban areas of Erie County, New York. The dispatch center equipment capital costs were approximately **$23,300**. These costs covered personal computers, uninterruptible power supplies, fax modems, Ethernet cards, phone equipment, and the purchase of software for the dispatch equipment at both the Erie County Sheriff's Office and the Erie County Medical Center. The costs of developing the dispatch center equipment were **$152,400**. These costs included dispatch system design, design and development of dispatch communications software, design and development of dispatcher user interface, system integration efforts, and conducting dispatcher system component tests. The costs of installing the dispatch center equipment at the sheriff's office and medical center were approximately **$5,600**. These costs included expenses to install computer equipment and telephone lines. The dispatch center training costs were approximately **$5,000**. These costs included expenses for initial training and continuing tests at the sheriff's office and medical center. The repair and maintenance costs for the dispatch center equipment were approximately **$15,000**. These costs included expenses for routine maintenance checks, updating software, and resolving voice quality problems. These costs do not include routine operating costs such as monthly phone costs.[384]

Emergency Medical Services: Telemedicine

Telemedicine systems provide a link between responding ambulances and nearby emergency medical facilities, enabling doctors to advise emergency medical personnel regarding treatment of patients en route to the hospital.

Emergency Medical Services—Telemedicine	
Benefits	
ITS Goals	**Selected Findings**
Customer Satisfaction	The LifeLink project in San Antonio, Texas enabled emergency room doctors to communicate with emergency medical technicians using two-way video, audio, and data communications. Technicians and doctors had mixed opinions about the system; however, it was expected that this technology would have more positive impacts in rural areas.[385]

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Response and Recovery

In the event of a large-scale emergency, ITS applications can assist with response management through services such as the tracking of emergency vehicle fleets using AVL technology and two-way communications between emergency vehicles and dispatchers. Evacuation operations often require a coordinated emergency response involving multiple agencies, various emergency centers, and numerous response plans. Integration with traffic and transit management systems enables emergency information to be shared between public and private agencies and the traveling public. This communication and cooperation also enables the use of the variety of ITS information dissemination capabilities to provide emergency traveler information.

Response and Recovery
Deployment
The use of ITS technologies to improve emergency response and recovery is quite common of emergency management agencies and almost universal among law enforcement agencies. Emergency management agencies in 63 of the country's 108 largest metropolitan areas and law enforcement agencies in 94 of these metropolitan areas use AVL/CAD to assist in locating and assigning appropriate responders to incidents. Many emergency management agencies use ITS to support evacuation and re-entry management. Emergency management agencies in 37 of the country's 108 largest metropolitan areas and 81 law enforcement agencies in these metropolitan areas use integrated ITS and communications technology to coordinate evacuation management with different agencies.

Response and Recovery: Early Warning System

The variety of sensors deployed on the transportation infrastructure can help provide an early warning system to detect large-scale emergencies including natural disasters (hurricanes, earthquakes, floods, blizzards, tsunamis, etc.) and technological and man-made disasters (HAZMAT incidents; nuclear power plant accidents; and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). Early warning systems monitor alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notify all responding agencies of detected emergencies.

Response and Recovery—Early Warning System
Costs
Unit Costs Data Examples (See Appendix A for more detail)
Roadside Detection subsystem: • Inductive Loops on Corridor: $3K-$8K • Closed Circuit Television (CCTV) Video Camera: $9K-$19K Transportation Management Center subsystem: • Hardware, Software for Traffic Surveillance: $131K-$160K Emergency Response Center subsystem: • Emergency Response Hardware: $8K-$10K • Emergency Response Software: $68K-$146K • Emergency Management Communications Software: $5K-$10K • Emergency Response Labor: $73K-$240K (annually) Roadside Telecommunications subsystem: • Conduit Design and Installation—Corridor: $50K-$75K (per mile) • Fiber Optic Cable Installation: $20K-$52K (per mile)
Early Warning Costs
Sample Costs of ITS Deployments
Louisiana: In order to better manage hurricane-related evacuations, the Louisiana Department of Transportation and Development worked with the United States Geological Survey (USGS) to deploy information stations. The information stations—part of the USGS Hydrowatch program for monitoring hydrological data in flood-prone states—are fitted with vehicle detectors. These information stations gather and transmit real-time data on traffic and water level conditions along evacuation routes. Data are transmitted via satellite communications. An information station costs approximately **$26,000** and operating and maintenance costs are approximately **$14,000 per year**.[386]

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Response and Recovery: Response Management

Response management may include the tracking of emergency vehicle fleets using AVL technology and two-way communications between emergency vehicles and dispatchers. Integration with traffic and transit management systems enables emergency information to be shared between public and private agencies and the traveling public.

Response and Recovery—Response Management	
Benefits	
ITS Goals	**Selected Findings**
Customer Satisfaction	Survey responses collected from 166 key professionals at state and local agencies in five states (Kentucky, Georgia, Tennessee, North Carolina, and South Carolina) indicated the following ITS technologies have the highest potential to benefit emergency transportation operations: [387] • Interoperable radio communications • Dynamic message signs • GPS and geographical information systems • CCTV roadway surveillance • Enhanced 9-1-1
Costs	
Unit Costs Data Examples (See Appendix A for more detail)	
Emergency Response Center subsystem: • Emergency Response Hardware: $8K-$10K • Emergency Response Software: $68K-$146K • Emergency Management Communications Software: $5K-$10K • Emergency Response Labor: $73K-$240K (annually) Emergency Vehicle On-Board subsystem: • Communications Interface: $0.3K-$2K • Signal Preemption Emitter: $0.5K-$2.1K Transportation Management Center subsystem: • Integration for Traffic Information Dissemination: $83K-$101K • Labor for Regional Control: $214K-$262K (annually)	
Sample Costs of ITS Deployments	
Michigan: The Flint Mass Transportation Authority developed a plan to deploy ITS technologies throughout the agency. Establishing a back-up emergency management center for coordinated emergency response between agencies was identified as one of the longer term priorities. Costs were estimated at **$500,000** for capital and **$50,000 per year** for operations and maintenance.[388]	

LESSONS LEARNED

Effectively communicate plans for implementing contraflow operations during hurricane evacuations.

Most state emergency management officials recognize that providing contraflow operations (i.e., opening all lanes of a roadway to travel in a single direction) is an effective way to evacuate an area before a hurricane. However, understanding how the reversed roadways should function is essential for achieving acceptable levels of performance. Sharing information and coordinating with adjacent states at the agency level is vital to the success of an evacuation using contraflow lanes, as is educating the public to understand what is expected of them.

- Coordinate plans across state lines.

Talks between Mississippi and Louisiana officials resulted in an agreement in June 2003 for contraflow operations on I-59 in Mississippi to occur if Louisiana implements a contraflow plan on I-59 in Louisiana.

- Conduct face-to-face strategy meetings.

(*Continued on next page.*)

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Response and Recovery: Emergency Vehicle Signal Preemption

Signal preemption systems for emergency vehicles use sensors to detect an approaching emergency vehicle and provide a green signal to the vehicle.

Response and Recovery—Emergency Vehicle Signal Preemption	
Deployment	
Preemption for emergency vehicles has nearly doubled from 2000 to 2006, and is deployed at more than 20 percent of signalized intersections. Six percent of the emergency vehicle fleet is equipped to operate traffic signals supporting preemption.	
Benefits	
ITS Goals	**Selected Findings**
Safety	A study in Houston, Texas found signal preemption reduced average emergency vehicle response times by 16 percent in 1 fire district, and by 23 percent in another.[389]
Mobility	A simulation study in the Virginia suburbs of Washington, D.C. found emergency vehicle preemption caused minimal increases in average travel times (2.4 percent) for all traffic.[390]
Costs	
Unit Costs Data Examples (See Appendix A for more detail)	
Roadside Control subsystem: • Signal Controller Upgrade for Signal Control: $2.4K-$6K • Roadside Signal Preemption/Priority: $5K-$6K Emergency Vehicle On-Board subsystem: • Signal Preemption/Priority Emitter: $0.5K-$2.1K Roadside Telecommunications subsystem: • Conduit Design and Installation—Corridor: $50K-$75K (per mile) • Fiber Optic Cable Installation: $20K-$52K (per mile)	
Sample Costs of ITS Deployments	
Canada: Several intersections in British Columbia were equipped for emergency vehicle preemption. The siren of an emergency vehicle is detected and initiates a green signal for the oncoming vehicle. Pedestrian crossing signals are switched to DON'T WALK. When the system has been activated, a visual verification system (set of blue-and-white lights) indicates that the intersection is controlled by an emergency vehicle preemption system. The system costs **$4,000 per intersection**, but can be less if multiple intersections are equipped.[391]	

Response and Recovery: Evacuation and Re-Entry Management

Evacuation operations often require a coordinated emergency response involving multiple agencies, various emergency centers, and numerous response plans. Various communication technologies can support the management of evacuations, which may also include a variety of traffic and transit management activities.

Response and Recovery—Evacuation and Re-Entry Management	
Benefits	
ITS Goals	**Selected Findings**
Efficiency	In South Carolina, dynamic message signs and highway advisory radio systems made it easier for hurricane evacuees to return home during the aftermath of Hurricane Floyd (1999). Traffic volume during the evacuation, when outbound traffic used only one side of the freeway, was 44 percent less than the traffic volume during the return trip when inbound traffic used both sides of the freeway.[392] An assessment of the hurricane evacuation plan in Hampton Roads, Virginia found that lane reversal is warranted for any hurricane predicted to make landfall as a Category 4 or 5 storm, and is strongly recommended for any Category 3 storm. In addition, the study found that with lane reversal, increasing ramp metering rates reduces ramp queuing and allows more efficient use of available mainline capacity.[393]
Costs	
Unit Costs Data Examples (See Appendix A for more detail)	
Emergency Response Center subsystem: • Emergency Response Hardware: $8K-$10K • Emergency Response Software: $68K-$146K • Emergency Management Communications Software: $5K-$10K • Emergency Response Labor: $73K-$240K (annually) Emergency Vehicle On-Board subsystem: • Communications Interface: $0.3K-$2K • Signal Preemption Emitter: $0.5K-$2.1K Transportation Management Center subsystem: • Integration for Traffic Information Dissemination: $83K-$101K • Labor for Regional Control: $214K-$262K (annually)	

LESSONS LEARNED

(*Continued from previous page.*)

In 2003, Mississippi sponsored a conference on emergency management practices called the EmTech.Com Symposium, and representatives from multiple State and Federal agencies attended. The consensus among participants was that meetings helping to coordinate across state and agency boundaries were very important.

- Educate the public about contraflow operations.

The Georgia DOT expanded its traveler information and its traveler assistance programs during evacuations and implemented a public education campaign creating maps, posters, and information sheets.[394]

Response and Recovery: Emergency Traveler Information

Integration with traffic and transit management systems enables emergency information to be shared between public and private agencies and the traveling public. This communication and cooperation also enables the use of the variety of ITS information dissemination capabilities to provide emergency traveler information.

Response and Recovery—Emergency Traveler Information
Costs
Unit Costs Data Examples (See Appendix A for more detail)
Roadside Information subsystem: • Dynamic Message Sign: $48K-$119K • Dynamic Message Sign—Portable: $18.6K-$24K • Highway Advisory Radio: $15K-$35K • Highway Advisory Radio—Sign: $5K-$9K Emergency Response Center subsystem: • Emergency Response Hardware: $8K-$10K • Emergency Response Software: $68K-$146K • Emergency Management Communications Software: $5K-$10K • Emergency Response Labor: $73K-$240K (annually) Transportation Management Center subsystem: • Integration for Traffic Information Dissemination: $83K-$101K • Labor for Regional Control: $214K-$262K (annually)
Sample Costs of ITS Deployments
Pennsylvania: The Pennsylvania Turnpike Commission expanded its statewide advanced traveler information system to better inform motorists of traffic, weather, and emergency conditions along the turnpike. The overall project cost was **$8.2 million**.[395]

LESSONS LEARNED

Utilize traveler information services to alert the public of disaster events and reduce public panic.

Advanced traveler information systems (ATIS), such as 511, are essential decision support systems that enable travelers to make informed decisions to manage their trip details. ATIS and 511 enable emergency management and transportation data to be integrated, providing richer real-time content to emergency service managers. Providing traveler information services helps improve the safety and mobility of travelers.

Site-specific traveler information devices, such as dynamic message signs and highway advisory radio, are becoming more common. ATIS, 511 telephone, and the Internet offer "on demand" information critical for calming a panicked public. In addition, ATIS and 511 coupled with automated feeds to the media allow broadcasters to provide approved vital information from emergency operations center managers to the public.

- Automate information integration using intelligent systems such as ATIS and 511.

Dissemination of public information is often time-consuming and, if not planned properly, drains resources from the immediate emergency management efforts. Pre-event planning helps agencies identify how to better manage the information collection and distribution processes. ATIS and 511 strive to provide accurate, real-time information not only to residents with access to broadcast media, but also to truckers, tourists, and others in the impacted area.[396]

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