

**The Emergency Transportation Operations within
the Intelligent Transportation System**

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Abstract

Every year in the United States, several thousand emergency or disaster situations occur resulting in evacuations. The ability to have an efficient and orderly evacuation is primarily focused on maintaining a working surface transportation system. The Federal Highway Administration within the Intelligent Transportation System has started an Emergency Transportation Operations initiative to ensure that the surface transportation system is operational during an emergency or disaster. Several years of research and development went into developing the ETO initiative. This paper highlights the problem areas and the potential solutions to those problems within the ETO initiative of the ITS program.

Section 1. Introduction

Section 1.A. What is the Intelligent Transportation System?

In 1991, the Federal government passed the Intermodal Surface Transportation Efficiency Act (ISTEA). One of the intentions of passing the act was to establish the Intelligent Transportation System (ITS). The ITS program was created to research, develop, and operationally test ideas to advance the nation's transportation system. ITS facilitates the development and testing of technology to enhance the efficiency, safety, and convenience of surface transportation in the United States. The results of ITS are improved transportation access, saved lives and time, and increased productivity. (1)

The ITS program was created by the United States Department of Transportation (USDOT) to focus on the development of intelligent vehicles, infrastructure, and transportation systems. To achieve a well managed and productive program, the USDOT formed an ITS Joint Program Office (JPO) to oversee the day to day operations of the ITS program. The objectives of the ITS JPO were:

1. Provide strategic leadership for ITS research, development, testing, and deployment.
2. Guide ITS policy coordination.
3. Ensure resource accountability.

JPO leadership would provide a timeline and area specific objectives for ITS activities along with managing any financial resources necessary. The ITS JPO supports all these objectives by investments in major initiatives, exploratory research, and the deployment of support programs to foster additional growth in the ITS program. (1)

In 2004, ITS management leaders decided to create nine major focus areas for the next five years. The areas of focus or concern are multimodal and aim to improve the safety, mobility, and productivity of surface transportation. Each area has several milestones built within each program to

track the progress and development within the area. It is important to track the progress of each area because of the interdependence of the focus areas. (1) The focus areas are:

1. Vehicle Infrastructure Integration (VII)
2. Next Generation 9-1-1
3. Cooperative Intersection Collision Avoidance Systems
4. Integrated Vehicle Based Safety Systems
5. Integrated Corridor Management Systems
6. Clarus
7. Emergency Transportation Operations
8. Mobility Services for All Americans
9. Electronic Freight Management (2)

Most of these areas of concern are primarily focused on developing improved communications between vehicles, infrastructure, and various transportation agencies.

Section 1.B. The Emergency Transportation Operations in ITS

The surface transportation system is vital to our nation's economy, defense, and quality of life. A major concern of the USDOT is that the surface transportation system is extremely vulnerable to attack because of its size and easy accessibility. It has been shown that all emergencies and hazardous incidents have a transportation component, and that transportation is always the primary means for response and recovery. (3) The United States experiences over 400 tropical storms, hurricanes, tornadoes, and hazardous material (hazmat) incidents per year that require emergency evacuations. Additionally, numerous winter storms, wild fires, and complex vehicle incidents require a higher level of preparedness. (4) Unless the transportation system is actively managed, the United States will not be prepared for or able to effectively respond to a disaster.

The emergency transportation operations objective is to provide programming, standards, and suggestions for local, state, and federal transportation systems in preparing for any emergency. (3) This will be achieved by addressing research in areas to provide effective traveler information during disasters, create planning and managing tools for incidents, and use ITS to monitor travel conditions. Responder procedures and practices will be improved because during disasters responders have difficulty getting the correct equipment to the right location. Advances in emergency technologies and practices will provide improved emergency response and recovery. (4)

Recent advancements in both audio and visual communication technologies will be used to provide real-time information about disaster or emergency areas. The ability for first responders to send pictures and talk to disaster relief centers quickly will provide essential data to possibly minimize the effects of any disaster. Essentially, effective real-time management of transportation systems during major incidents results in more timely response to and recovery from a disaster. The developments in the ETO will assist responders to verify the nature of the problem, identify appropriate response, and get the correct equipment to the most critical areas quickly and safely. The best way to minimize a major disaster is to provide effective management to the transportation systems. (4)

Section 1.C. Previous Events and Reasons for the Development of the ETO

The surface transportation system across the United States is used by millions of people every day. The system is expected to be operational at all times and provide for the transportation of many items from city to city. It is not realized until a large accident, terrorist action, or a hurricane that if the transportation system is interrupted in any way, it can have catastrophic impacts on people's lives. An example of this is the recent Hurricane Katrina catastrophe in the Gulf Coast Region. The lack of a plan to maintain traffic flow in and out of the urban areas along with not having an evacuation plan created several problems that could have been minimized or avoided. The federal government wants to have plans prepared ahead of time to maintain the transportation system as best as possible. (3)

Previously, the responsibility of creating an evacuation or emergency response plan was left to the city to develop. Several problems were evident in previous emergencies that the ETO initiative will attempt to solve by developing new programs and guides. Many local governments had emergency response plans, but would not coordinate those plans with neighboring cities or counties. Also, if a city did have an emergency plan it would not contain plans for a major disaster or emergency. With the current situation of global terrorism, the ETO initiative will provide strategies and technology to handle a terrorist attack, catastrophic event, or major emergency. (4)

A city or region can never be fully prepared for an emergency, but having the dynamic ability to respond to any emergency is critical. Often the magnitude and severity of an emergency can be reduced by quickly evaluating the emergency. Emergency management officials need to have the operational ability to gather information rapidly and pass the necessary information along to travelers as quickly as possible. Variable message signs and 511 traveler information systems are used to guide evacuees and travelers to the right detour and evacuation routes so that any congestion is minimized. Also, informing travelers of the proper routes to take from the affected area helps relieve congestion for the emergency officials moving equipment to and from the scene. The federal government did several studies on the World Trade Center attack, and concluded that a major problem immediately after the attack was that the transportation systems were clogged and emergency officials could not get to the scene quickly. Maintaining traffic flow and directing travelers to the right route can benefit any emergency event. (5)

Section 1.D. Objectives of the Emergency Transportation Operations Initiative

The purpose of the ETO initiative is to foster the development of tools and processes that support transportation system operations during a range of emergencies and disasters. The final result of the ETO initiative is to respond faster and be better prepared for responding to major incidents and evacuations. (6) The program will focus on four objectives for all of the research and development programs. The objectives are:

- Faster and better prepared response to major incidents.

- Shorter incident durations.
- Reduced impact of the incident.
- More rapid restoration of normal travel conditions.

Achieving guidelines to these objectives will help to provide better planning and preparation for cities and regions. (7)

The ITS program was originally developed in 1991 and funded under the ISTEA-91 transportation legislation. The passing of the Transportation Efficiency Act for the 21st Century (TEA-21) provided more than 1.3 billion dollars for transportation projects nationwide. (1) The ETO initiative receives approximately 20 million dollars a year to achieve the objectives previously shown and conduct "test" projects. (7) The funding for this portion of the ITS program is scheduled to stop by 2009 because this stage of the program will be complete.

The final conclusions and reports for the ITS ETO initiative will not be complete until 2008. Once complete, the program will provide tools, techniques, demonstrated benefits, technical guidance, and standards necessary for local, state, and private agencies to understand the best practices to handling an emergency. (7) Reducing the size and number of evacuations will be achieved by applying the standards and principles developed through this program. It is almost certain that any future catastrophe will be planned for in advance, and the transportation operations will be more organized because of the ETO initiative.

Section 2. Sources of Failures or Inconsistencies in an Emergency

Often quicker emergency response and coordination will lead to more manageable emergency situations. The ability to orchestrate an emergency response is a very difficult operation that involves several different tasks to be completed in conjunction with each other. This section will explain a few areas of emergency response that the ETO portion of the ITS program will address.

Section 2.A. Communication Systems

Communication between people becomes even more important during emergencies, and the ability to maintain communication is very critical to the success of the emergency management team. During an emergency or evacuation, landline phone communication can be cut off, and cell phone systems can become useless because of the number of people using the system. At some of the most

critical times, emergency centers can not use telephone communication to talk to their off-duty responders or field personnel. Many different communication devices could be used to inform responders of the emergency location and severity. A system needs to be developed that can provide the ability to communicate during an emergency no matter the conditions. (9)

When an emergency takes place, people must be prepared and ready to respond. Many times transportation officials or personnel can not respond to an emergency because they do not have the equipment to communicate with public safety personnel. (9) Problems have been discovered when trying to coordinate with transportation agencies to help route evacuees from an area. The public safety personnel can communicate intra-operably, but not to other agencies. Even if the agencies could communicate with each other, a major problem would be that each agency uses a different source code. In other words, each agency has their own language that other agencies do not understand. In 2006, the USDOT produced a book under the ETO initiative entitled, *The Simplified Guide to the Incident Command System for Transportation Professionals* that created a common language amongst the various agencies. (9)

The federal government has experienced many emergency situations that in the past were incorrectly managed. During the attacks on September 11, 2001, communication was not as efficient as necessary to handle the emergency. It was realized during that situation that the communication systems failures or redundancies created additional problems. The ETO initiative is drawing on the experiences of 9/11 to research and advise various agencies on how to

reinforce their communications equipment and technologies. Capital Wireless Integrated Network (CAP Win) and E-911 are examples of pilot projects that were used to develop backup operations to the communication system. Pilot projects and continuous research will provide technologies and standards to better prepare for an emergency or disaster. (9)

Section 2.B. Traffic Management

The ITS program has been used in the past to help in the coordination efforts for large traffic incidents. The system can be used in a similar capacity for coordinating an evacuation. The benefits of using the system during an evacuation can be the difference between thousands of lives saved or lost. A few examples of the benefits are faster information exchange, the ability to make adjustments to the evacuation plan in real-time, and institution wide accessibility to the system and plan during an emergency. It has been shown that a rapid and effective response along with effective evacuation management can reduce the severity of the incident. Several standards and emergency software tools will be created to reduce the size and severity of any evacuation. (8)

Another concern during an emergency or evacuation is region wide communication and planning. An emergency often does not affect just the local communities, but can spread over county and state borders. Currently, most neighboring counties and states do not have a coordinated plan for an evacuation. A common problem amongst regions is not using the same routes for an evacuation. A county will use a different highway than the neighboring county and create traffic problems for the neighboring county. This typically will create traffic congestion and an unsafe traveling environment because public safety officials will be focused on another evacuation route. A real world example of a lack of regional planning was the aftermath of Hurricane Katrina. The large metropolitan areas around the Gulf Coast did not have an evacuation plan in case one of the densely populated areas needed to be evacuated. The lack of a plan created mass confusion and wasted large amounts of time because people had no where to go. The federal government is attempting to make improvements to their plans, and one part

of that is to encourage major metropolitan areas to create a strategic plan in case of an evacuation or emergency.

A plan to maintain traffic should contain strategies for accommodating evacuation routes and evacuees. An emergency plan should also be able to maintain access to the emergency scene for additional rescue and clean-up personnel. The emergency routes will typically have to handle large volumes of heavy trucks that are hauling waste materials from the scene. Emergency routes must be planned in advance for a 'no-notice' evacuation. A 'no-notice' evacuation is a large unexpected incident that does not have any advanced warning of its onset and requires an evacuation. (9) The ability to manage traffic during an emergency will be covered in the final report of the ETO initiative.

Section 2.C. Personnel and Resource Management

Disasters can happen at anytime and often occur at unexpected times. Several key officials typically work during the day, or are out of the main office at night. A major concern when a disaster strikes is communicating to personnel that an emergency happened. It is then difficult to direct personnel where to go once they have been reached. Often, top officials are in charge of making staff decisions or deciding the plan of action, but they have difficulty getting to their office or emergency centers. Transportation agencies need to participate in scheduled training exercises and understand when they are to report during an emergency. (9)

Another concern is that some transportation agencies do not have the correct equipment for an emergency. Typically, transportation officials do not have specific uniforms or hazardous materials equipment. Emergency personnel on the scene can not identify the transportation officials because they do not have a specific uniform or they are not recognized due to not participating in training with officials at the scene. Transportation agencies are realizing this and starting to require uniforms that identify employees. Another issue is a company will contract with

a city or county to handle a specific task, like vehicle towing, during an emergency. Problems surface when a specific company has contracts with neighboring cities and both cities need their services. Not having the ability for a contractor to provide their services during an emergency can increase the length of time before the situation is contained. (9)

The best way to prepare for an emergency is to have several training sessions that all the employees can participate in to learn any necessary skills before an emergency. Yet, one of the most common problems with emergency response is a lack of training. Most agencies recognize that a major weakness is the lack of training, but the lack of time and money shortages contribute to the under training of most personnel. The transportation personnel need to have more training in handling mass casualty incidents, assessing damage, and terrorist awareness. Most transportation officials do not have experience in these areas because they typically do not encounter these situations on a daily basis. Emergency responders and public safety personnel deal with tragedy almost every day and are prepared to handle the emotions that go with an emergency. The overall goal for improving personnel and resource management is to have faster and better personnel responses to major incidents. (9)

Section 2.D. How an Emergency is Declared

Many states have different methods to determining if an emergency response is needed. In the past, several incidents have had a delayed response time because emergency officials have waited to declare an emergency. This is the result of some cities and regions not having a clear definition of when to start an emergency response. Setting rules and regulations for when an incident should be handled as an emergency is needed. (9)

In some regions, communication between the state and federal government needs to improve. Most state agencies do not have a direct communication link to the federal Homeland Security Advisory System, and if they do the states do not have the power to activate it. Communication and coordination among emergency operation centers across the various levels of government during a region wide emergency continues to be a challenge. (9)

Section 3. A Three Phase Approach to Developing the ETO Initiative

When the ITS administration decided to create an initiative to focus on emergency responses and surface transportation, it realized that a finished product would take several years to complete. The original timeline was set for research, development, and testing of the various tools and standards. The program began in 2004 with an original completion year of 2009, but after a year and a half it was decided to push the deadline forward to 2007. (5) The ETO initiative was broken down into three phases (a) reducing the size and number of evacuations; (b) improved evacuation management; and (c) standards facilitating incident response and integration. Upon completion of these three phases, several of the questions brought up in section two of this document will be answered. The final phase of the ETO initiative is close to completion with a finished comprehensive ETO report available in 2008.

Section 3.A. Phase One: Reducing Size and Number of Evacuations

The goal of phase one is to significantly improve the speed and effectiveness of response by towing and hazmat responders to provide improved management of incidents and queues. (5) It is a common belief that having a more organized and quicker response system to remove vehicles or contain hazardous materials spills will drastically reduce the size and number of evacuations. This phase of the ETO initiative was completed during 2004 and 2005, but the final results will not be published until the final report. (7) The expected benefit of phase one is faster and more efficient recovery of normal travel conditions. (8)

The ability to achieve the phase one goal will rely heavily on the ability to get first responders to the scene as quickly as possible. A focal point of phase one is an increased understanding between towing companies and public safety personnel of the need for decreased response times when the towing services are needed. Public safety personnel lose precious minutes waiting for emergency vehicles in a traffic jam upstream of the accident scene. The ETO initiative will bring to the attention of transportation and public safety officials that quickly moving wrecked vehicles will decrease the response times. Also, many public safety vehicles are involved in crashes trying to get to the emergency scene. (8) The emergency vehicles are

traveling at high speeds when they arrive at a traffic jam increasing the chance of a rear-end collision occurring. The ETO initiative will provide proper methods and strategies to have a towing company available to quickly respond to a scene and open the road to traffic. Increasing the response time of towing companies will decrease the probability of accidents around a scene, and increase the speed that emergency vehicles arrive. (7)

A pilot project was researched and developed to be used in the Washington, DC area. The project was to provide emergency responders with camera phones and training on how to use the camera phones so that pictures could be taken of the scene once they arrive. The project was called the Capital Wireless Integrated Network (Cap WIN), and is currently still being used in the Washington, DC area. The procedures used in the Cap WIN program were for the first responders to take a picture of the scene on their camera phone once they arrived, and send the image back to the operations center. (7) The picture would then be sent to various agencies to prepare for the scene before they arrive. (5) Programs similar to the Cap WIN program have been developed and tested to use standard ITS freeway equipment to remotely manipulate traffic control systems. Examples of technologies that have been used in projects are closed circuit television, loop detectors, and ramp controls. Several projects have been completed and others are still in progress to help provide quicker responses to emergency scenes. (8)

As previously mentioned, the Washington DC area has already used some of the ETO research, and has given cell phone cameras to their first responders. The ability to combine new evolving technologies with proper training on how to use the technology is a very good start. The results of this phase will combine the information received from the scene with the prior planning to quickly clean-up a scene. Quickly responding to a scene and having the correct equipment will decrease the size of evacuations and emergencies.

Section 3.B. Phase Two: Improved Evacuation Management

The goal of phase two is to provide the tools, procedures, and information that can actively manage and speed-up the safe progress of an evacuation. The ability to manage an

efficient and fast evacuation can save peoples lives and increase the safety of the evacuees. Phase two will consist of developing evacuation planning and management tools, disaster-related applications of ITS, rapid restoration of ITS, evacuations plans into rural areas, and monitoring systems. (5) The ability to plan for an evacuation before it happens can increase the chances of a safe and successful evacuation. Another added benefit of having a planning and management tool is that if a change happens during the evacuation, it can be easily handled by the software tools. During an evacuation, the evacuation managers must be prepared to instantly re-route traffic as the incident progresses. This is possible by using the ITS mechanisms already in place to provide information to the emergency management centers. The ITS system is currently being tested for the ability to operate during any type of emergency situation. The added security of an operational ITS system, prior disaster planning, and real-time data from ITS will increase the efforts to provide the best evacuation that is possible. (8)

Evacuees receive all of their information from outside sources during an evacuation. The ability to inform travelers through dynamic message signs, traveler information, and disaster management systems is especially important during an evacuation. Currently, studies are taking place to disaster proof the ITS infrastructure so that communication with the evacuees can be maintained all the time. Providing information to the areas that the evacuees are going to is essential so that shelters and hospitals are prepared for the influx of people. The ETO initiative will bring to focus the concept that the areas that will shelter the evacuees need to be prepared to handle the emergency from their neighboring community. It will be demonstrated that having a cooperative plan and open communication with neighboring communities can help improve the condition of any evacuation. (7) Once the evacuation has been started, the ITS system will be used to monitor the evacuation routes in case another route needs to be used if the conditions get worse. The ability to dynamically manage an evacuation system is integral to a successful evacuation. (8)

Section 3.C. Standards Facilitating Incident Response and Integration

The goal of this phase is to have working standards available that support integrated management of all forms of incidents, and demonstrate the value of their use. Standards will be created and tested to establish communication between the state agencies and the U.S. Department of Justice to create a link between the federal and state governments. The ability to harmonize a communication system between these two levels of government will provide for better use of the Homeland Security Standards and Security System. The ability to provide quicker disaster declaration and clean up will offset some possible negative consequences. (5)

The ITS system will have several standards brought in by the ETO initiative to improve the use of the system during an emergency. A system has already been developed and tested that creates a communication standard between the USDOT and emergency management division. An effective emergency response and recovery effort requires the ability for emergency personnel and transportation agencies to communicate. (8) Several other standards are in the process of being tested and approved for use in the upcoming final ITS ETO report. The experiences of 9/11, Hurricane Katrina, and the Northeast Blackout of 2003 have proven that standards are needed to communicate between the various government agencies during a disaster. (7)

Section 4. Conclusion

ITS management decided around the turn of the century that an emergency management component to the system was needed. That thought was reassured by the experiences that would soon follow with 9/11, Hurricane Katrina, and several other disasters in the United States. The main component of most disasters or evacuations is the ability to transfer goods or people to and from the scene. The development of the ETO initiative will provide standards and tools for managing and improving an evacuation, along with providing standards on incident and response. This program will always be changing and will never be completely fool proof because a disaster's magnitude or arrival can never be predicted.

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