Appendix A

Issue Paper:
Evacuation Coordination User Service

INTERSTATE 4 ITS CORRIDOR FRAMEWORK PHASE II

WORKING PAPER #1

EVACUATION COORDINATION USER SERVICE DEVELOPMENT

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INTERSTATE 4 ITS CORRIDOR FRAMEWORK PHASE II
Evacuation Coordination User Service Development

SECTION 1.0: INTRODUCTION

The developers of the National ITS Architecture identified a three-level structure for defining the requirements of any ITS system: ITS User Service Bundles, ITS User Services, and ITS User Service Requirements.

User Service Bundles are at the highest level of this structure. Thirty-one (31) user services were packaged into 7 groups, or User Service Bundles, which categorize the user services logically by stakeholder area.

ITS User Services are the core of requirements definition and document, at a lower level than User Service Bundles, what an ITS system should do from a user's perspective. A user might be the public, a public system operator or a private system operator. In the National ITS Architecture development effort, the U.S. DOT and ITS America, with significant stakeholder input, have defined 31 user services to date.

And finally, a number of functions are required to accomplish each of these user services. To reflect this, each of the user services was broken down into successively more detailed functional requirements, called User Service Requirements.

A subset of the National ITS User Services was selected for implementation along the I-4 Corridor ITS in Phase I of this project. This subset was selected based on input from the Corridor stakeholder input. In addition, the I-4 corridor stakeholders for the corridor identified several new user services, not currently defined in the National ITS Architecture. These services are:

- Evacuation Coordination,
- Emergency Management Coordination,
- Weather Information Applications,
- Intermodal Freight, and
- Work Zone/Construction Traffic Management.

The I-4 Corridor stakeholders decided to take the lead in developing the Evacuation Coordination user service, while monitoring any future development of the other four new user services and potential in the future development. The proposed Evacuation Coordination user service would fit appropriately under the Emergency Management User Service Bundle.

This technical memorandum outlines the problems, needs and user service requirements associated with the Evacuation Coordination user service.

SECTION 2.0: PROBLEMS AND NEEDS

I-4 is the major evacuation route between east, central and west Florida. The traffic demands, which must be accommodated by the corridor during Hurricane evacuation, create a major challenge to the agencies involved in the evacuation process.

In 1999, Hurricane Floyd skirted the East Coast of Florida making landfall in North Carolina. Over 3 million people were evacuated as a result of the hurricane. This evacuation resulted in overloading of evacuation routes, causing several hours of delays and exposing evacuees to personal risk. In South Carolina, in-state trips took six times longer than normal. Reports of 16 to 18-hour trips from Charleston to Columbia were commonplace. This drive normally takes less than two-hours. In Florida, Interstate 10 motorists traveling out of Jacksonville reported traveling just 35 miles in seven hours.

Citizens and government officials expressed their dissatisfaction with the management of the evacuation process and the lack of information regarding travel conditions and services along the routes and at evacuation destinations.

In this study, several needs were identified for the I-4 evacuation process based on information gathered from meetings organized by the Florida Governor's Task Force on Hurricane Evacuation in November 1999 and also based on what was reported in the media in the aftermath of Hurricane Floyd. These include:

- Better management of the evacuation process is needed. Strategies to reduce the demand must be considered including building shelters near evacuation origins and perform the evacuation in shifts rather than all at once.
- Better management of evacuation routes is needed to accommodate various levels of evacuation (for different storm categories, storm time frame and affected areas). The capacity of evacuation routes shall be increased and efficiently utilized to reduce the potentials for operational failures during evacuation. As stated above, operational failures during recent evacuation operations caused gridlock, long hours of delays, overheated cars, frustrated travelers and significant risks to the evacuees.
- There is a need for better management of the local streets that provide access to and from evacuation routes. The capacity of these streets need to be increased and efficiently utilized to prevent creating bottlenecks at the access points. In recent evacuation operations, queues from surface streets extended to limited access facilities resulting in a decrease in the capacities of evacuation routes.
- It is necessary to provide travelers with real-time information regarding the services available at the evacuation destinations and routes. In recent evacuation operations, motorists were frustrated with the unavailability of information regarding hotel rooms, gas, bathrooms, eateries, and shelters.
- It is necessary to provide travelers with real-time information regarding the evacuation route conditions such as the expected travel time to their destinations, incidents, road closures, lane closures, weather, the route to a certain destination, and the availability of

alternative routes. In recent evacuation operations, motorists were left without information regarding what to expect on their trips while waiting for hours in traffic.

- There is a need to provide real-time information to evacuees regarding the conditions expected at their selected destination. In hurricane Floyd evacuation, evacuees spent hours finding rooms, shelters and/or services after reaching their destinations. In addition, evacuees were not informed about accommodations for people with special needs (e.g., disabled, elderly and pets).
- Alternative evacuation destinations need to be provided to evacuees that request this information. In Hurricane Floyd evacuation, many motorists left their homes without knowing where they are going.
- It is necessary to provide coordination between various evacuation agencies (such as transportation, emergency management and law enforcement agencies) at the county, multi-county, and multi-state levels. This coordination must include the evacuated counties (evacuation origins), host and response counties (evacuation destinations and counties that provide assistance in the evacuation process) and counties on evacuation routes. Counties must work as a team during evacuation. Multi-state response is also important to ensure that evacuees from one state do not compound evacuation problems in another state.
- Evacuation route designs need to be examined and modified if necessary to accommodate evacuation management strategies. For example, reversible lane operations and the use of shoulders as an additional lane might require modifications to interchange designs.
- The efficiency of detecting, responding to and clearing incidents on evacuation routes must be maximized. The drop in evacuation route capacities due to incidents could result in the failure of the evacuation process even if the analysis performed during the hurricane evacuation planning indicates that the routes can accommodate the traffic in non-incident conditions.
- It is important to provide information to evacuees at evacuation destinations regarding conditions at their counties. This has been a problem because the media at evacuation destinations is not normally interested in broadcasting information about counties which are not in their coverage areas.
- It is necessary to ensure efficient, safe and secure reentry of the evacuees to their counties. This includes preventing people that are not authorized to enter a hurricane-damaged area, clearing dangerous debris and restoring electricity. The reentry decisions shall balance safety and security with the public's desires to return home.
- There is a need to reduce the time required for implementing and setup of various evacuation strategies due to the short time period available for evacuation. For example, lane reversal might not be a feasible alternative if it takes a long time to setup the operation.

- There is a need for the development of evacuation plans at the county, state and multi-state levels. Data must be collected and archived for the development of these plans and to ensure the validation of the models used in developing the plans. The data shall include items such as traffic flow, speed, occupancy, traveler behavior, and log of events.
- Policies need to be established regarding the lifting of the toll fees. During Hurricane Floyd evacuation, delays in lifting the toll fees in South Carolina increased the dissatisfaction of the evacuees.
- There is a need to provide safe and secure re-entry after evacuation.

SECTION 3.0: EVACUATION COORDINATION USER SERVICES

Based on the problems and needs identified above, the Evacuation Coordination User Service was developed and added to the Emergency Management User Service Bundle. Following the same structure as the National ITS Architecture, user service requirements were developed to define system functions that are required to provide the Evacuation User Service. They are presented below.

3.0 ITS shall provide an Evacuation Coordination (EC) service. EC provides the capability to efficiently manage an evacuation and provide evacuees with information they need during the evacuation, as well as reentry. It consists of five major functions: (1) Evacuation Guidance, (2) Evacuation Travel Information, (3) Evacuation Traffic Management, (4) Evacuation Planning Support and, (5) Resource Sharing.

3.1. EC shall include an Evacuation Guidance (EG) function. This function is provided to benefit the public. EG will provide basic information to assist potential evacuees in determining whether evacuation is necessary. Once the decision is made to evacuate, the EG will also assist evacuees determine destination, routes to shelters and other lodging options. This function will also provide guidance for returning to evacuated areas, information regarding clean-up, and other pertinent information to be distributed from Federal, State, and Local agencies.

3.1.1. EG shall be accessible to users from multiple distributed locations, including, but not limited to, (a) homes, (b) media, (c) public buildings, (d) evacuation shelters, (e) other evacuation destinations, (f) rest areas along evacuation routes, (g) hotels, (h) restaurants, (i) airports and other mode terminals, and (j) wireless devices.

3.1.2. EG shall provide shelter-in-place information if evacuation is not necessary.

3.1.3. EG shall provide a list and graphical depiction of mandatory and voluntary evacuation zones and the categories of people to be evacuated in each zone.

3.1.4. EG shall provide a list of alternative evacuation destinations upon request.

3.1.4.1. EG shall provide alternative evacuation destinations based on historical evaluation of the services available at the destinations.

3.1.4.2. EG shall provide alternative evacuation destinations based on current and forecast conditions at the destinations.

3.1.4.3. EG shall provide alternative evacuation destinations based on current and forecast availability of services at destinations and along the routes to these destinations.

3.1.4.4. EG shall provide alternative evacuation destinations based on traveler specified parameters including the general location of the destinations and the desired services.

3.1.4.5. EG shall provide alternative evacuation destinations based on the current and forecast conditions on evacuation routes.

3.1.5. EG shall provide recommended evacuation and reentry route(s) for user-selected evacuation origin and destination pairs.

3.1.5.1. Recommended routes shall be based on an evaluation of historical operational characteristics of the alternative routes.

3.1.5.2. Recommended routes shall be based on real-time and forecast route conditions.

3.1.5.3. Recommendation of routes shall be based on traveler-specified route parameters.

3.1.6. EG shall provide the recommended evacuation and reentry start time for user-selected evacuation origin and destination pairs.

3.1.6.1. The recommended start time shall be based on the travel time required for the trip, given existing and forecast conditions on those routes.

3.1.6.2. The recommended start time shall take into account the capability of the evacuation network to handle evacuation demands based on a historical evaluation of the network and current and future network conditions.

3.1.6.3. The recommended start time shall be based on the existing and forecast conditions at evacuation origin.

3.1.6.4. The recommended start time shall be based on the existing and forecast conditions at evacuation destination.

3.1.6.5. The recommended reentry time shall ensure the safety and security of travelers and their properties.

3.1.7. EG shall provide information regarding evacuation shelters in areas specified by users.

3.1.7.1. EG shall provide the locations of evacuation shelters.

3.1.7.2. EG shall provide the time at which evacuation shelters are in operation.

3.1.7.3. EG shall provide the occupancy levels at evacuation shelters.

3.1.7.4. EG shall provide the facilities available at evacuation shelters, including those shelters that will accommodate people with special needs, such as pets, disabilities and elderly.

3.2. EC shall provide an Evacuation Travel Information (ETI) function. This function will benefit evacuees in planning their evacuation trip once that decision has been made. This function will also allow travelers to change course during the trip based on route and destination conditions.

3.2.1. ETI shall provide the capability for users to access information from multiple distributed locations, including, but not limited to, (a) homes, (b) vehicles, (c) rest areas along evacuation routes, (c) evacuation shelters, (d) hotels, (e) restaurants, (i) airports and other mode terminals, and (j) wireless devices.

3.2.2. ETI shall provide information about traffic conditions on evacuation routes.

3.2.2.1. ETI shall provide the current speed/travel time on evacuation routes.

3.2.2.2. ETI shall provide an estimate of future speed/travel time on evacuation routes, taking into consideration current evacuation decisions and traveler behavior.

3.2.2.3. ETI shall provide information regarding incident conditions on evacuation routes.

3.2.2.4. ETI shall provide real-time road, bridge and lane closure information.

3.2.2.5. ETI shall provide a list of roads that should be avoided due to hazardous conditions, such as flooding, malfunctioning traffic signals, debris and falling objects.

3.2.3. ETI shall provide the current and forecast weather conditions for evacuation origins, destinations and routes.

3.2.4. ETI shall provide information regarding transportation modes including buses, airlines, trains and ships.

3.2.4.1. ETI shall provide information regarding the availability of transportation mode services.

3.2.4.2. ETI shall provide arrival and departure information, including location, for those services available.

3.2.5. ETI shall provide general evacuation guidance information to travelers, including guidance/tips for trip preparation, trip duration and trip return.

3.2.6. ETI shall provide information regarding lodging available along evacuation routes and at evacuation destinations.

3.2.6.1. ETI shall provide the capability for travelers to request and receive information regarding lodging, including (a) room availability, (b) facilities, (c) conditions, and (d) pricing information.

3.2.7. ETI shall provide information regarding services available along evacuation routes, at evacuation origins and at evacuation destinations.

3.2.7.1. ETI shall provide real time information relating to (a) the conditions, (b) status, and (c) availability of traveler services described in this section.

3.2.7.2. ETI shall provide the capabilities for travelers to request and receive information regarding restaurants and stores, including (a) hours of operation and any changes to these hours, (b) availability of special items (such as water, non-perishable foods, wood, and batteries), and (c) pricing information.

3.2.7.3. ETI shall provide the capabilities for travelers to request and receive information regarding local hospitals and other medical services.

3.2.7.4. ETI shall provide the capabilities for travelers to request and receive information regarding gas stations, including (a) location, (b) operation status, (c) pricing information, and (d) the expected waiting time.

3.2.7.5. ETI shall provide information regarding rest areas, telephone and restroom availability.

3.2.8. ETI shall provide information regarding school and office closures.

3.3. EC shall provide an Evacuation Traffic Management (ETM) function. This function will assist evacuation coordination personnel manage evacuation operations on the transportation network.

3.3.1. ETM shall have a real-time data collection process to assist in the selection of evacuation strategies and to monitor the operations of the selected evacuation strategies.

3.3.2. ETM shall have a demand forecasting function that takes into consideration current traffic flows, current and historical evacuation trends, the size of the area to be evacuated and expected human responses.

3.3.3. ETM shall include a strategy selection function that maximizes efficiency during evacuation and reentry operations.

3.3.3.1. The strategy shall integrate the control of freeways and surface streets.

3.3.3.2. The strategy selection function shall consider traffic movement over the entire evacuation network.

3.3.3.3. The strategy selection function shall be responsive to current demand as well as the forecast demand.

3.3.3.4. The strategy selection function shall optimize the movement of emergency and law enforcement vehicles.

3.3.3.5. The strategy selection function shall allow easy access of emergency and law enforcement vehicles to traffic on evacuation routes.

3.3.3.6. The strategy selection function shall consider the operation of the access to and from the evacuation routes.

3.3.3.7. The strategy selection function shall consider the impacts to local traffic along evacuation routes.

3.3.3.8. The strategy selection function shall consider the time available for evacuation, time required for evacuation and time required for implementing the evacuation strategy.

3.3.3.9. The strategy selection function shall consider the availability of the resources required for the evacuation strategy.

3.3.3.10. The strategy selection function shall consider the severity of the expected disaster and the size of the area affected by the disaster.

3.3.3.11. The strategy selection function shall consider the feasibility of using transit and school bus fleet during mandatory evacuations.

3.3.4. ETM shall provide the control of devices as required by the evacuation management plan, including: (a) traffic signals, (b) dynamic message signs, (c) ramp meters, (d) reversible lane signs, (e) turning restriction signs, (f) road closure devices, (g) lane closure devices, (h) HAR, (i) TiRNd, (j) shoulder use signs.

3.3.5. ETM shall provide the operator with the capability to manually override the system automatic control.

3.3.6. ETM shall have an incident management function for evacuation routes.

3.3.7. ETM shall have the capability to eliminate tolls upon command.

3.3.8. ETM shall have a lane reversal management function.

3.3.8.1. It shall be possible to collect real-time data for traffic moving in all traveling lanes, with and without lane reversal.

3.3.9. ETM shall have archiving capabilities.

3.4. EC shall provide an Evacuation Planning Support (EPS) function. This function will support the evacuation planning process by providing information, current and historical, to emergency management planning personnel.

3.4.1. EPS shall provide archived evacuation data, such as traffic flows, travel speed, vehicle occupancy, road closures, network geometry, traveler behavior, travel origins, travel destinations and evacuation traffic management strategies.

3.4.2. EPS shall support the development of regional and multi-regional evacuation plans.

3.4.3. EPS shall assist in identifying required modifications to transportation network geometry to accommodate evacuation strategies.

3.4.4. EPS shall assist in defining the required resources for evacuation strategies.

3.5. EC shall provide a Resource Sharing (RS) Function. This function shall allow information and resource sharing between agencies involved in the evacuation including transportation, emergency management, law enforcement and other emergency service agencies.

3.5.1. RS shall allow information sharing between agencies.

3.5.1.1. RS shall facilitate information sharing between various agencies at local, state and federal levels.

3.5.1.2. RS shall provide communication capabilities among personnel of the agencies involved in the evacuation and between these personnel and the agency centers.

3.5.1.3. RS shall provide coordination and information sharing between agencies from all states affected by the evacuation.

3.5.1.4. RS shall provide information to assist evacuation management personnel in making evacuation decisions.

3.5.1.5. RS shall provide information to assist evacuation management personnel in making decisions regarding shelter operations.

3.5.2. RS shall assist evacuation management personnel in making decisions regarding deployment of resources and sharing of resources based on existing and forecast demand for these resources.

3.5.2.1. RS shall identify the resources required for the current and forecast evacuation scenarios.

3.5.2.2. RS shall identify the resources required to implement alternative evacuation management strategies.

3.5.2.3. RS shall identify the resource deployment stages, in time and space, for each evacuation scenario.

3.5.2.4. RS shall assist local, state and multi-state agencies in sharing resources between agencies.

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3.5.2.6. RS shall assist local, state and multi-state agencies in sharing resources between agencies.