Concept of Operations and Standard Operating Procedures
For Dynamic Detour System

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North Florida TPO
1022 Prudential Drive
Jacksonville, FL 32207
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Quality Control Tracking Information

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1. Introduction

The Dynamic Detour System (DDS) concept of operations will serve as a regional framework model on implementing detours using alternate routes on northeast Florida's major roadway system during incidents. This document will serve as a guideline for emergency responders and transportation professionals on:

- **Why:** providing system justification, corridor analysis and system capability
- **What:** identifying existing system components and their capabilities
- **Where:** identifying major corridors for the system implementation
- **Who:** identifying stakeholders and their respective responsibilities
- **When:** identifying instances when traffic diversion activities need to be performed
- **How:** identifying resources needed to design, build, operate, and maintain the system

The concept of operations is developed to improve safety of the responders, enhance coordination between different responding agencies, understand the system operation and its impact on various agencies' roles and responsibilities, and provide guidelines for actions taken during detour implementation. This concept of operations document will also provide example operational scenarios.

1.1. Definition of Standard Terms

This section provides definition of standard terms that are used in this document along with its source.

**Dynamic Detour System:** This term was coined by the Regional ITS Coalition for the concept of detouring traffic in real time based on real time traffic information. A major part of the dynamic detour system is the ITS component that collects real-time traffic information from the road network and disseminates information to travelers to help them make informed decisions on selecting an alternate or continuing on the original route.

**Decision Support System:** The decision support system is a knowledge-based system that is intended to support responders in making informed, timely, and accurate decisions.

**Integrated Corridor Management (ICM):** According to the Federal Highway Administration (FHWA), Integrated Corridor Management is the coordination of individual network operations between parallel facilities that creates an interconnected system capable of cross network travel management. In an ICM corridor, because of proactive multimodal management of infrastructure assets by institutional partners, travelers could receive information that encompasses the entire transportation network. They could dynamically shift to alternative transportation options—even during a trip—in response to changing traffic conditions. For example, while driving in a future ICM corridor, a traveler could be informed in advance of congestion ahead on that route and be informed of alternative transportation options such as a nearby transit facility's location, timing and parking availability.

**Intelligent Transportation System (ITS):** According to the FHWA, ITS encompasses a broad range of wireless and wire line communications-based information and electronics technologies. When integrated into the transportation system's infrastructure, and in vehicles themselves, these technologies relieve congestion, improve safety, and enhance individual productivity.

**ITS Project:** According to the FHWA, an ITS project is any project that in whole, or in part, funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture.

**ITS Architecture:** According to the FHWA, the National ITS Architecture provides a common framework for planning, defining, and integrating ITS. It is a mature product that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.). The architecture defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS.
- The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
- The information and data flows that connect these functions and physical subsystems together into an integrated system.
System: According to the FHWA, a system is a combination of interacting elements organized to achieve one or more stated purposes.

Systems Engineering: According to the FHWA, systems engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem.

Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

Signal System: Signal system can be defined as a group of traffic signals that are coordinated to achieve the maximum throughput.

Traffic Pacing: According to FDOT Standard Index 655, traffic pacing is a traffic control technique to slow but not stop traffic to facilitate short duration work operations without an elaborate and difficult detour or diversion. Traffic control officers pace or slow the traffic to a speed that provides approximately 20-30 minutes to perform the overhead construction. The department has frequently used this technique for setting bridge beams, overhead sign structures, and replacing overhead sign panels.

List of Acronyms

CCTV: Closed Circuit Television or traffic cameras
DDS: Dynamic Detour System
DMS: Dynamic Message Signs
EOC: Emergency Operations Center
EMS: Emergency Medical Services
FDOT: Florida Department of Transportation
FHP: Florida Highway Patrol
FHWA: Federal Highway Administration
ITS: Intelligent Transportation System
ICM: Integrated Corridor Management
JSO: Jacksonville Sheriff’s Office
JFRD: Jacksonville Fire and Rescue Department
LED: Light Emitting Diode
MUTCD: Manual of Uniform Traffic Control Devices
MOT: Maintenance of Traffic
TMC: Traffic Management Center
USDOT: United States Department of Transportation
2. Purpose

The purpose of this project is to prepare an evaluation and assessment of active facility management strategies for ITS priority corridors in the North Florida Transportation Planning Organization (TPO) ITS Master Plan. These strategies include dynamic detouring and traveler information using trailblazers and other technologies as needed to support regional mobility goals. Specifically, this project will also consider the effects of major construction projects on I-95 and how use of ITS and parallel routes can mitigate the regional impact of these construction programs. The ultimate aim of the project is to achieve congestion mitigation and improved travel time for drivers through congested areas in the northeast Florida region.

Several significant construction projects are planned for the I-95 corridor in the North Florida TPO region over the next five years. These projects will have a significant impact on regional traffic and transportation and are summarized below:

- I-95 Widening and Reconstruction: International Golf Parkway to SR 9A/I-295
- I-95 Rigid Pavement Rehabilitation: SR 9A/I-295 to Atlantic Boulevard
- I-95 Overland Bridge Replacement: Atlantic Boulevard to Fuller Warren Bridge

In addition to these major transportation projects, the need to provide dynamic detouring of traffic from major facilities to alternate routes during traffic incidents and other non recurring forms of congestion is an important element of an active facilities management strategy. These strategies can also be used to inform drivers to make better route decisions to minimize their travel time, thereby, reducing air quality emissions and improving the quality of life in North Florida.

This project will establish the alternate routes for drivers during traffic incidents as well as during recurring congestion scenarios. The concept of operations is a critical planning stage where the stakeholders play a key role in defining the needs of the project and its outcome. Stakeholders are involved at various stages of the project from defining and specifying the needs of the project to integration and verification of the system in the field. This concept of operations document has been developed by the North Florida TPO, in association with regional transportation and public works agencies such as, the Florida Department of Transportation (FDOT), county and city public works departments, emergency operation centers, regional law enforcement agencies, fire and rescue departments, and emergency medical services.

2.1. Systems Engineering “V”

The concept of operations has been developed to be consistent with the FHWA’s system engineering “V” for the ITS system deployment. The “V” consists of two distinct sides as shown in Figure 1. The left side consists of updating the regional ITS architecture, concept exploration, developing the concept of operations, synthesizing the design for the overall system, and starting implementation in the field. The right side consists of testing, implementation, operation, and maintenance of the overall system. The central core of the “V” connects the two sides of “V” by implementing the system validation plan, device testing plan, and system verification. The systems engineering “V” covers the entire project life cycle ranging from the need definition to the system operation and maintenance.
The FHWA defines system engineering as an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem.

Systems engineering integrates all disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs. Systems engineering processes identify the role of stakeholders as the key aspect in the project life cycle.

2.2. Document Outline

The concept of operations will act as a reference document for the stakeholders to provide details on how the system will behave and interact with the end users. Following is the sectional outline of this document:

Section 3. System Overview: Project definition and scope and existing system background will be discussed in this section.

Section 4. State of Practice Review: Nationwide state of the practice summary on similar projects will be discussed in this section.

Section 5. Dynamic Detour System Incident Management Process: The traffic incident management process during detour implementation such as, detection, verification, notification, response, clearance, recovery, traveler information, traffic management, and after action review will be discussed briefly in this section.

Section 6. Event and Incident Types: In this section the planned and unplanned events will be discussed briefly along with the type of incidents such as, catastrophic, major, intermediate, and minor.

Section 7. Stakeholders’ Roles and Responsibilities: The stakeholders’ roles and responsibilities are discussed in detail in this section as it pertains to their roles in dynamic detour system implementation.

Section 8. Operational and Support Environment: The institutional and technical environment in which the device operates are discussed in detail in this section including, traffic management center, road ranger program, and existing ITS network.
Section 9. System Deployment: The following areas will be discussed in detail in this section:

9.1. Device considerations
9.2. Corridor considerations
9.3. Cost considerations
9.4. Power supply considerations
9.5. Device communication considerations
9.6. Arterial signal timing modification considerations
9.7. System interface considerations

Section 10. Operational Scenarios: This section outlines the three operational scenarios that have been considered for detour operation, which includes single segment impact, multiple segment impact and corridor impact.

Section 11. Standard Operating Procedures: This section outlines the various aspects of the dynamic detour system operation that includes implementation plan overview, responder orientation and coordination, system and resource deployment, decision support system, escalation and de-escalation procedure, and after action review.

Section 12. I-95 Case Study: This section outlines the system plan for the I-95 segment between International Golf Parkway and Fuller Warren Bridge.
3. System Overview

3.1. Project Definition and Scope

The scope of the project is limited to the North Florida TPO service area that falls within the FDOT District 2 boundary. This project is focused on limited access highways within the North Florida TPO service area, which includes all of Duval County and portions of Clay, Nassau and St. Johns, Counties. Figure 2 shows the North Florida TPO service area map. This area encompasses 1,838 square miles and a population of 1.2 million. Included within the boundary are the cities of Atlantic Beach, Neptune Beach, Jacksonville, Jacksonville Beach and the Town of Baldwin, in Duval County; Fernandina Beach and the Town of Callahan in Nassau County; St. Augustine and St. Augustine Beach in St. Johns County; and Green Cove Springs and the Town of Orange Park in Clay County.

Figure 2. North Florida TPO Service Area Map

The four major limited access highways in the project region are I-95, I-10, I-295/SR 9A and SR 202. Diversion route maps have been prepared by the FDOT District 2 Traffic Operations Office for these limited access highways, except for SR 202, which is under consideration for development of diversion routes. Copies of diversion route maps for I-95, I-10 and I-295/SR 9A are provided in Appendix A.

3.2. System Background

In April 2006, the North Florida TPO, then called the First Coast Metropolitan Planning Organization, in partnership with the Jacksonville Transportation Authority (JTA), FDOT District 2, the City of Jacksonville, and other members of the First Coast ITS Coalition, developed a Regional ITS Master Plan to:

- Establish the region's vision and goals for intelligent transportation systems
- Determine the steps needed to achieve those goals
- Guide the Coalition in coordinating, integrating, and prioritizing projects

The study area encompassed four counties within the North Florida TPO boundary - Clay, Duval, Nassau, and St. Johns, as well as neighboring counties - Alachua, Baker, Bradford, Flagler, Putnam and Union. An updated regional ITS Master Plan was completed in July, 2010. This update included a review on milestones achieved
from the time the original master plan was developed and set new ITS milestones for five- and ten-year implementation plans. The updated Regional ITS Master Plan was divided into the following six parts:

- **Review of Existing ITS** in the region, which identified the extent of ITS deployment in the northeast Florida region and reviewed it with the stakeholders involved with ITS deployment. The review was conducted on the five year plan, which classified previous ITS milestones into programmed, ongoing, and completed ITS projects.

- **Individual Systems Evaluation** was performed to identify ITS elements deployed on each major roadway in the region. This section identified the ITS coverage of the region and listed the operating and maintaining agencies of the deployed fiber optic network in the region.

- **Programmed ITS Projects** identified programmed ITS projects in the northeast Florida region. Some of the projects include freeway and arterial management systems, ITS signal controllers, cameras, transit signal priority, a commuter service program, Road Ranger services, road weather information systems, and a regional traffic management center.

- **Priority Corridors for ITS Deployment** identified priority corridors for ITS deployment in the region. The priority corridors for ITS deployment were developed by the stakeholders on a map identifying roadway sections that could benefit from ITS deployment. These priority corridors include additional sections of the roadways with ITS, additional deployment along ITS corridors, and new roadway systems with no ITS system in place.

- **ITS Needs and Cost Estimates** identified ITS corridors that would need ITS coverage in the northeast Florida region and the cost estimates for funding of the projects.

- **ITS Maintenance** included the forms that should be completed by the stakeholders for each priority and needs corridor project. The ITS maintenance form can be filled out at the following website location: [http://www.northfloridatpo.com/its-form/](http://www.northfloridatpo.com/its-form/).

This project builds on the work completed as a part of the Regional ITS Master Plan to develop a concept of operations document for a dynamic detour system within the North Florida TPO service area.

The following table briefly summarizes the ITS coverage available in the North Florida TPO service area on four limited access highways that are envisioned to be equipped with dynamic detour systems:

**Table 1. ITS Communication Coverage**

<table>
<thead>
<tr>
<th>Roadway</th>
<th>ITS Coverage</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-95</td>
<td>Partial</td>
<td>I-295 south interchange to Duval County line</td>
</tr>
<tr>
<td>I-10</td>
<td>Partial</td>
<td>I-95 to Chaffee Road</td>
</tr>
<tr>
<td>I-295/SR 9A</td>
<td>Partial</td>
<td>Southwest Quadrant I-10 to I-95</td>
</tr>
<tr>
<td>SR 202</td>
<td>None</td>
<td>-</td>
</tr>
</tbody>
</table>

Other corridor segments with existing ITS communication infrastructure within the North Florida TPO service area are listed below:

- McDuff Avenue: between Beaver Street and Roosevelt Boulevard
- US 10/Atlantic Boulevard: between Beach Boulevard and SR A1A
- SR 152/Baymeadows Road: between San Jose Boulevard and SR 9A
- SR 115/Southside Boulevard: between SR 202 and Philips Highway
- US 17/Roosevelt Boulevard: between I-295 and Kingsley Avenue
- Central Business District (CBD): Downtown Jacksonville CCTVs on State, Union and Bay Streets

A detailed discussion on existing, programmed, and ongoing ITS deployment in the North Florida TPO service area is provided in the later sections of this document.
4. State of Practice Review

A state of the practice literature review was conducted to understand how other states handle similar concept of detouring traffic for traffic incident management. This concept falls under the category of the United States Department of Transportation (USDOT) Integrated Corridor Management (ICM) ITS program. Published papers, agency studies and unpublished reports chronicle national approaches towards managing and operating traffic during incidents using ICM strategies.

4.1. Regional Existing State of Practice

This strategy is not implemented fully at this time in the northeast Florida region. However, FDOT District 2 has prepared detour maps for several major highways within the District 2 boundary. These detour maps are updated every six months and are shared with the traffic incident management team in CD form. The detour maps provide alternate routes based on exit numbers and roadway segments. After reviewing the detour maps, no major concerns were noted. The maps are well designed to serve the purpose of a dynamic detour plan. These detour maps considered schools, hospitals, traffic signals, police stations, etc. within the alternate route corridors. Also, these detour routes are set for periodic review and renewal as needed. Enhancement opportunities that would increase the support from local authorities on wide use of these alternate routes include:

1. Consider establishing a minimum and maximum timelines of detour activities that are communicated to the stakeholders. For example, a detour route will be implemented after specified time duration of lane closure and/or congestion build up; similarly, detour activity should be lifted when congestion is eased and the open road policy timeline is met.

2. Consider options to guide motorists back to their original path. This concept of operation document will provide some options for this.

3. Consider conducting periodic meetings with local stakeholders specifically for detour maps. This meeting will provide an opportunity for the lead agency to establish communication and relationships with local authorities and responders; as well as provide feedback or critique on the choice of detour route.

4. Consider periodically referring to FHWA’s “Alternate Route Handbook” for any updates or before selecting or modifying a detour route.

The current state of practice by the law enforcement agencies and other traffic incident responders is to divert traffic based on information available at hand during traffic incident, or block traffic flow until an incident is cleared from the roadway. The information at hand includes the physical and geographical knowledge of the roadway segment where the incident occurred, institutional knowledge and experience, jurisdictional boundary information, information from the TMC, local 511, etc.

The FDOT District 2 uses Dynamic Message Signs (DMS), where available, to disseminate information to motorists about the incident on the freeway being travelled. The incident information is also disseminated via local 511 calls. However, no alternate route information is disseminated through any of these sources at this time.

4.2. Florida DOT’s Arterial DMS

FDOT District 4 installed 34 arterial DMS in Broward County, Florida along arterial corridors intersecting with the I-75 and I-95 corridors. These arterial DMS display incident information to let drivers know about lane blockages on arterial roads as well as on freeways. The advantage of these arterial DMS signs is the drivers are alerted ahead of time before approaching the freeway system, which will allow sufficient time to choose an alternate route. Like freeway DMS, these arterial DMS are installed in advance of the major intersection which may serve as an alternate route. These signs are also used for message posting during special events such as the Super Bowl. These arterial DMS are smaller profile signs with two lines of twelve 16-inch characters.
4.3. FHWA’s Alternate Route Handbook

In May 2006 FHWA published an Alternate Route Handbook that describes what alternate traffic routes are and how traffic and highway agencies can implement them. This handbook describes the need for discussing the alternate route with the stakeholders that participate or get involved in the process of detouring traffic using an alternate route. The scenarios when the alternate routes can be implemented and their impacts on traffic flow are provided in Table 2 below:

<table>
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<th>Event Type</th>
<th>Effect on Road Capacity</th>
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<tr>
<td><strong>Planned Event</strong></td>
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<tr>
<td>Major roadway construction and maintenance</td>
<td>- Closes travel lane(s) or road segments.</td>
</tr>
<tr>
<td></td>
<td>- Creates side friction, reducing traffic speed and capacity.</td>
</tr>
<tr>
<td>Planned special events</td>
<td>- Closes travel lane(s) or road segments to stage event (typically street use events).</td>
</tr>
<tr>
<td><strong>Unplanned Event</strong></td>
<td></td>
</tr>
<tr>
<td>Traffic incident (e.g., crash, disablement, spilled load, debris)</td>
<td>- Blocks travel lane(s) or road segments.</td>
</tr>
<tr>
<td>Emergency road work</td>
<td>- Blocks travel lane(s) or road segments.</td>
</tr>
<tr>
<td>Adverse weather (e.g., snow, ice, fog, heavy rain, sun glare)</td>
<td>- Reduces vehicle operating speeds and increases headways, thus reducing capacity.</td>
</tr>
<tr>
<td>Emergency (e.g., severe weather, natural disaster, human-caused incident)</td>
<td>- Renders road segments impassable (potentially).</td>
</tr>
</tbody>
</table>
This handbook categorizes the alternate route planning phases into the following three steps:

1. Alternate route selection: choosing an optimal alternate route from the list of candidate routes.
2. Alternate route plan development: developing information to incorporate in the alternate route plan, including information on alternate route implementation.
3. Traffic management planning: planning for information to be disseminated to motorists during implementation and for traffic control, including capacity enhancements needed to accommodate traffic to, from and on the alternate route.

The alternate route handbook highlights the following list of criteria for alternate route selection to be considered when optimizing the list of candidate corridors:

- Proximity of alternate route to closed roadway
- Ease of access to/from alternate route
- Safety of motorists on alternate route
- Height, weight, width, and turning restrictions on alternate routes
- Number of travel lanes/capacity of alternate route
- Congestion induced on alternate route
- Traffic conditions on alternate routes
- Number of signalized intersections, stop signs, and unprotected left turns on alternate route
- Travel time on alternate route
- Pavement and bridge conditions on alternate route
- Type and intensity of residential development on alternate route
- Existence of schools and hospitals on alternate route
- Percentage of heavy vehicles (e.g., trucks, buses. RVs) on route from which traffic is to be diverted
- Grades on alternate route
- Type and intensity of commercial development on alternate route
- Availability of fuel, rest stops, and food facilities along alternate routes
- Noise pollution
- Transit bus accommodation
- Air quality
- Ability to control timing of traffic signals on alternate route
- Ownership of road
- Availability of ITS surveillance equipment on alternate route
- Availability of ITS information dissemination equipment on alternate route

The alternate route handbook is a useful tool to help narrow down the alternate route selection as well as defining the roles of different stakeholders during the alternate route selection processes.

4.4. USDOT’s Integrated Corridor Management Program

The USDOT had selected eight “Pioneer Sites” across the country to act as test sites for Integrated Corridor Management (ICM) strategy deployment and testing in co-operation with the respective state departments of transportation. The eight pioneer ICM sites are listed below:

1. Dallas, Texas (US 75)
2. Houston, Texas (I-10 and US 290)
3. Minneapolis, Minnesota (I-394)
4. Montgomery County, Maryland (I-270)
5. Oakland, California (I-880) 
6. San Antonio, Texas (I-10) 
7. San Diego, California (I-15) 
8. Seattle, Washington (I-5) 

These sites were selected based on USDOT’s belief that they contain the characteristics that represents many other corridors across the nation and all possess infrastructure assets that can enable ICM. For example, real time signal control, high occupancy vehicle and value pricing, bus rapid transit, etc. The figure below shows the existing infrastructure assets integrated in ICM.

**Figure 1. Corridor Assets Integrated in ICM**

![Corridor Assets Integrated in ICM Diagram]

The USDOT ICM program is underway and is in its third and final stage (fiscal year 2010 to 2012) of demonstration and evaluation at the selected pioneer sites. The analysis, modeling and simulation (AMS) results from San Diego, CA, Dallas, TX, and Minneapolis, MN were completed as a part of second stage of the program in fiscal year 2009 to 2010. The following corridor performance measures were used to conduct modeling:

1. Travel time 
2. Travel delay time and predictability 
3. Incident duration and frequency 
4. Fuel consumption and pollution reduction 
5. Corridor capacity utilization (vehicle and traveler throughput) 

The benefit-cost analysis for high demand major incidents is shown in Figure 2.
The numbers on the bars represent the benefits to cost ratio after ICM implementation. All the numbers are positive for the high demand and major incident type scenario. The figure shows that highway traveler information, transit traveler information and signal coordination result in a positive return of investment during high demand and major incident type of scenario. The following figure shows the overall ICM benefit under different operational scenarios.

**Figure 3. Overall ICM Benefit under Different Operational Conditions**

The dollar amount in the figure represents cost savings due to ICM implementation. Figure 3 indicates that there is a large amount of cost saving per incident type. The greater traffic demand and incident severity the greater the benefit.

4.5. Minnesota DOT’s I-494 Integrated Corridor Management

This project was started in 1994 by forging a partnership between Minnesota DOT, Hennepin County and the cities of Bloomington, Richfield, and Edina to test the concept of ICM across jurisdictional boundaries. This project was implemented on an 8-mile segment of I-494 encompassing four parallel streets and seven perpendicular arterial streets crossing five jurisdictional boundaries. This project involved the application of several ITS technologies including adaptive ramp metering, adaptive traffic signals, motorist information, and traffic surveillance. These deployed technologies were used to better leverage the parallel street capacity to augment freeway capacity during major incidents. Several benefits were identified in the following four areas:
1. Institutional benefits: this project synergized the institutional and organizational relationships, cooperation and coordination; and contributed to enhancing the overall transportation system in the area.

2. System performance: this project provided the stakeholders with valuable infrastructure elements and resources for enhanced traffic management and operations. It also paved a way for a paradigm shift on adaptive signal control among the stakeholders. With some challenges in the unstable communication network at that time, some of the adaptive signal control technologies did not function as desired. However, with all the technological breakthroughs in the recent past, this limitation can be overcome.

3. System deployment: the project technology deployment spanned a five year period and faced several deployment challenges. This formed a base of strong lessons learned and deployment advice pertaining to integrated inter-jurisdictional application of different ITS technologies.

4. System impacts: the overall system impact due to deployed technologies on this project includes improved traffic operation and use of underutilized roadways within the region to augment capacity in congested corridors. This project also forged partnerships across inter-jurisdictional boundaries and integrated inter-jurisdictional traffic management strategies.

4.6. Michigan DOT’s I-75 Integrated Corridor Management

The Michigan DOT implemented an ICM project to optimize capacity of over 25 mile long I-75 corridor between M-102 and Baldwin Road. This project was led by the Michigan DOT in collaboration with many local stakeholders, including the Road Commission for Oakland County, Road Commission of Macomb County, Southeast Michigan Council of Governments, Suburban Mobility Authority for Regional Transportation, Michigan State Police, City of Auburn Hills, City of Troy, local police departments, and other local jurisdictions. This project forged partnerships between these jurisdictions to integrate freeway and arterial corridors for incident and non-incident conditions. The purpose of the project was to create a steady, constant traffic flow throughout the corridor. This project is still underway and the analysis of project outcomes is still pending. However, it has already forged a strong inter-jurisdictional partnership that works towards a common goal of integrating arterial and freeway capacities for better transportation system management and operation.

4.7. Simulation Studies

Several simulation studies have been conducted to analyze the benefits of ICM strategies on the transportation system. Two such studies require special mention due to their findings related to benefits of alternate routes during incident scenarios.

The fist simulation study was conducted in Anaheim, California in 2001 by USDOT. The simulation results indicated that using a decision support tool to select alternate traffic control plans during non-recurring congestion in the Disneyland area could reduce travel time by 2 to 29 percent and decrease stop time by 15 to 56 percent. This simulation study used the Dynasmart (Dynamic Network Assignment Simulation Model for Advanced Road Telematics) simulation model to measure average and total network travel time and stop time for before and after implementation scenarios. Actual traffic count data was input in the simulation model to calculate baseline saturation flow rates of the corridor and rank them into three categories of severity, low, medium, and high. A symbolic pattern was used to match the current network condition with previously defined typical traffic activity in the network. The simulation results were most effective during medium levels of saturation than low and high levels of saturation. The reason is the demand/capacity ratio was harder to balance when the network demand was close to saturation, and had limited effects when network demand was very small.

The second simulation study was conducted in San Francisco, California, in 2009 by USDOT. The simulation model results indicated that the ICM strategies promoting integration among freeways, arterials, and transit systems can help balance traffic flow and enhance corridor performance. Also, the simulation model indicated that the benefit to cost ratio of the integrated strategies ranges from 7:1 to 25:1. This simulation study is a part of USDOT’s “Pioneer Sites” for ICM implementation on a 34-mile segment of I-880 corridor. An analysis framework was developed to evaluate the potential impact of independent and combined ICM strategies. That framework is called the Analysis, Modeling, and Simulation framework. Overall, the model calculated a 10-year benefit of approximately $570 million with approximately half of that attributed to the ICM applied during high demand major incident scenarios.
5. Dynamic Detour System Incident Management Process

The traffic incident management process describes the user oriented process for dynamic detour implementation. Dynamic detour system management is similar to traffic incident management in operation and process implementation of detour activities. The process is described by the similar eight elements: detection, verification, notification, response, traveler information, traffic management, recovery, and after action review. Each of these elements is described in the following sections geared towards dynamic detour system implementation. Figure 4 outlines the process order.

![Figure 4. Standard Operating Processes](image)

5.1. Detection

The detection process is the first step in identifying the problem location that requires attention from the response agencies. The first symptom is the traffic slowdown on the roadway, followed by the congestion that ultimately leads to delay on the original route. On major roadways, FDOT has installed traffic detectors and cameras that provide continuous real-time traffic information and video feeds to the TMC operators. These devices are used to determine delay and travel-time on the original and detour routes. The traffic slowdown or congestion may be alerted to the TMC operators automatically or through regular roadway surveillance. There are several other ways in which traffic congestion and incidents can be detected by the TMC operators, for example, phone calls from traveling public, patrolling officer, Road Rangers, media, etc.

5.2. Verification

Once the congestion incident is detected by the TMC operators, they should immediately switch to a verification process either by cross verifying information using camera feeds or using patrolling officers or Road Rangers in the vicinity. The travel time and delay information should also be verified to proceed on to next step to respond to incidents. The verification process is a vital step in initiating a proper response plan for the incident. Detailed incident information verification would allow response agencies to be prepared for the response activity.

There are two types of incident verifications:

1. Location verification – involves identifying the geographic and physical location of the incident
(mainline, ramp, intersection), direction of travel, nearest mile markers, etc.

2. Incident detail verification — involves identifying the reason for congestion, determining travel time delay and assessing the segment impacted.

5.3 Notification

The notification process is similar to the traffic incident management notification process in that the verifying agency should pull out the contact list of the response agencies that would be needed to implement detour activities. Congestion incident notification is the process of informing the proper response agencies about the incident with the details collected in the detection and verification processes. The need to notify an agency typically depends on the extent of congestion and delay experienced by the motorist. The notification to the responsible agencies depends on the jurisdictional boundary and roadway operational and maintenance responsibility. An early and proactive notification to all the responding agencies is the key for a quick response.

5.4 Response

Transportation agencies and local public works departments should coordinate with the law enforcement agencies responsible for the roadway to implement the detour plan for the segment of impact. It is important for the local agencies that operate and maintain the traffic signals in the region to make available an alternate traffic signal plan for detour activities. Depending on the nature of congestion, other agencies may respond for assistance upon the law enforcement agency’s request. Once the responding agency is notified, it is their responsibility to assess and solicit required resources to implement detour operation. The response plan should consider the current physical and traffic condition of the detour route before implementing a detour. Detour plans can be implemented by manually turning on the detour signs with flashing messages or under the response personnel guidance where signs are unavailable.

As a part of the response activity and depending on congestion severity the detour should be implemented in such a way that it provides motorists an alternate route to get around the congestion and back to the original path with less delay and travel time. A decision should be made at this point if the detour needs to be activated based on the travel time and delay information collected from the original and detoured routes. If a proper agency memorandum of understanding is in place, the alternate traffic signal timing for the detour route should be implemented at this time to accommodate additional demand due to detour activity.

5.5 Clearance

The clearance process is essentially a traffic incident management process and has a passive impact on the detour lifting process. However, it is an important process which incorporates all activities that facilitate returning roadway conditions to normal. The main objective of the clearance process is to clear the roadway of any hindrance to normal traffic flow and open travel lanes to the traveling public as quickly as possible. The detour route advisory should continue to display during this process until the recovery process of the original route is started.

5.6 Recovery

The recovery process begins immediately after the clearance activity is completed. For the detour operation, the recovery process includes estimating delay and travel time from the inception of detour operation to the time when congestion starts to ease on the freeway. If there is a significant improvement in travel time and reduction in delays, then the detour operation should be lifted and all the detour signs should be deactivated. In addition, the traffic signal plans should revert back to the normal time of day operation. This stage of detour operation is a combined effort between different jurisdictions, hence efficient coordination and cooperation is desired to avoid any further delay. For traffic incident management, the recovery efforts include re-opening travel lanes to the motorists as well as performing shoulder clean up and damage repair work. If the damage to the roadway is major and requires lane closure for a longer duration, then consider performing repair work during non-peak travel, preferably during night time, after safely securing the damaged roadway from the travelling public. The recovery work is mostly done by law enforcement officers or transportation office personnel.

5.7 Traffic Management

Traffic management is facilitated by providing timely traveler information and providing acceptable alternate routes. A pre-planned detour route, where available, should be implemented to divert traffic away from problem area on an alternate route leading back to the original route. In order to do this, the detour messages should be provided well in advance of the diversion point using dynamic massage signs, where
available and by using simple message or through signs or simple hand gestures by on-scene personnel. Traffic control devices such as dynamic message signs, portablechangeable message signs, traffic cones, warning signs, etc. should be utilized to forewarn drivers of the congestion well in advance of the exit.

Detour maps should be made available to the general public through a website or other means of public information dissemination. Where the detour maps are not available, the agency implementing detour plans during emergencies should study the detour route beforehand to ensure that the facility is capable of handling additional traffic volume, and coordinate with the local traffic operations office. Another important aspect of traffic management during the detour process is preparing an alternate traffic signal timing plan for the detour activity to accommodate additional traffic in the region. The signal timing should be designed in such a way that the detoured traffic is given priority to reduce stop times and delay.

5.8. Traveler Information

Traveler information is the process of notifying the traveling public of the roadway conditions in advance of approaching the problem areas. This is an active process of detour activity, which provides drivers a timely and up to the minute travel time information to aid them in making an en-route decision to detour off the freeway. Timely traveler information could help reduce traffic congestion on the impacted roadway. Responders can be assigned along the detour roadway without ITS coverage to feed traffic information to the traffic management center to disseminate traveler information to the public via portable changeable messages signs, dynamic message signs, 511 and local media. Emergency operation centers perform this role through the traffic management center when activated during emergencies.

Traveler information should be up-to-date and should display accurate, timely information about travel time comparisons between original and detour route. For this purpose, the in-field responder or traffic cameras should be used at the problem location to generate updates on traffic incidents for traveling public. Whenever a reduction in travel time on the original route occurs, the information should be disseminated to the traveling public. The availability of dynamic message signs may be limited to only certain roadways. In those cases, use of static signs with flashers, 511, or local radio stations should be utilized.

5.9. After Action Review

It is important for each agency to participate in the after action review process to provide feedback on past detour operation. This platform should be used for open discussion and sharing responders’ points of view to improve coordination and cooperation for future incidents. Northeast Florida responders meet bi-monthly to discuss traffic incident management. This meeting can also be used to discuss or re-address the detour route(s) for any changes and to review standard operating procedures for successful implementation. The benefit of the after action review process is to facilitate open dialogue among the responders and address any suggestions and feedback that may be received.
6. Event and Incident Types

This section describes different events and incidents when dynamic detours may be implemented based on event and incident types.

6.1. Event Types

Two different types of incidents are identified, which may or may not require alternate route activation. Following are the descriptions of these events.

6.1.1. Planned Events

Planned events include, but are not limited to:
- Major roadway construction and maintenance
- Planned special events

These planned events need greater coordination beforehand, essentially inter-jurisdictional, depending on the extent of event impact on traffic, which may or may not require initiating a detour plan based on the event duration.

6.1.2. Unplanned Events

Unplanned events include, but are not limited to:
- Traffic incidents
- Emergency road work
- Adverse weather
- Emergencies

These unplanned events require spontaneous coordination between different agencies to respond to the incident and may or may not require initiating the detour plan depending on the event duration.

6.2. Incident Types

Four different traffic incident types have been identified for the traffic incident management scenarios in Northeast Florida region as described below. Each of these incident types triggers different response plans. The incident types that may trigger implementation of an alternate route or detour are catastrophic and major incidents that run over 90 minutes. Intermediate incidents may or may not require alternate route activation depending on the incident.

6.2.1. Catastrophic Incident

Catastrophic incidents are natural or man-made disasters that include lane closures with an extended duration typically ranging from 12 hours to several days. Catastrophic incidents may require attention from agencies such as the State Warning Point, Florida Department of Environmental Protection, Homeland Security, HAZMAT contractors, and others. Incidents of this nature would require alternate route activation. Catastrophic incidents may be caused by, but not limited to:
- Major bridge damage
- Wildfire-related closures
- Weather-related closures such as major storm or hurricane
- Crashes that have a significant environmental impact, such as a significant HAZMAT spill
- Acts of terrorism or vandalism

6.2.2. Major Incident

Major incidents have an expected duration ranging from 90 minutes to 12 hours and require coordination between different agencies including federal agencies. Major incidents are long-duration incidents and typically require setting up a complete traffic incident management area. Incidents of this nature would require alternate route activation. Major incidents may be caused by, but not limited to:
- Chain-reaction crashes
- Severe injury and/or fatal crashes
- Environment-related crashes such as a fuel spill
- Weather-related closures such as fog or major storm

6.2.3. Intermediate Incident

Intermediate incidents have an expected duration between 30 and 90 minutes that may not require alternate route activation. The upper time limit conforms to the State of Florida’s open road policy, which sets a goal of clearing all incidents within 90 minutes. Intermediate incidents usually require setting up a proper traffic incident management area. Intermediate incidents may be caused by, but not limited to:

- Major roadway debris
- Overturned vehicles
- Non-rollover multiple vehicle crashes
- Rollover and/or multi-vehicle crashes
- Commercial carrier crashes

6.2.4. Minor Incident

Minor incidents involve events with duration less than 30 minutes. They are the most commonly occurring incident type. Typically, only Road Rangers or a law enforcement officer on patrol respond to the incident scene and assist victims in clearing the incident scene. These incidents require minimum coordination between responding agencies. Minor incidents may be caused by, but not limited to:

- Minor property damage
- Disabled vehicle
- Roadway debris
7. Stakeholders' Roles and Responsibilities

This section outlines the roles and responsibilities of the regional stakeholders involved during dynamic detour system development. The following table provides the list of stakeholders as it applies to the North Florida TPO region and their involvement in each phase of the dynamic detour system for alternate route planning.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Detour Route Selection</th>
<th>Detour Route Plan Development</th>
<th>Traffic Management Planning</th>
<th>Implementation</th>
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<tr>
<td>Planning organization (North Florida TPO)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Transportation/public works agency (FDOT, County and City)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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<td>Law enforcement (FHP, JSO, etc.)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Fire department</td>
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<td>Yes</td>
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<td>No</td>
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<td>Emergency medical service</td>
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</tr>
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<td>State emergency operations center</td>
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</tr>
<tr>
<td>Transit agency (Jacksonville Transportation Authority)</td>
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<td>Yes</td>
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<td>Private towing companies</td>
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<tr>
<td>Media</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Source: Modified from Alternate Route Handbook

7.1. Planning Organization - North Florida TPO

The North Florida TPO may act as a lead stakeholder to establish mutual agency agreements between different stakeholders. They can apply the knowledge about the region as a whole (not just a single jurisdiction) and help establish the inter-jurisdictional agreement efficiently leveraging their ongoing relationships with the local agencies. They can facilitate stakeholder meetings to establish the alternate route criteria or may defer it to transportation or public works agencies. In either case, the planning organization should participate in the stakeholder meetings, sign off on the selected alternate routes, and assure all involved agencies sign off on the selected plan of action. The North Florida TPO should ensure that the focus of detour route planning should be to relieve traffic congestion, travel time, and delay within the region.

The planning agency may also provide access to resources, such as the GIS database and demand models, which may not be available with other agencies to use in developing detour routes. The planning agency provides the information about major roadway in the region and information on prior performed studies that may be useful in determining the feasibility of an alternate route. A sample memorandum of understanding is provided in Appendix B.

7.2. Transportation/Public Works Agency

The FDOT District 2 Traffic Engineering and Operations Office consists of two traffic management centers (TMC) operating 24 hours a day, seven days a week. The TMCs are operated by a group of trained and qualified personnel, who help in managing traffic incidents as well as disseminating timely traveler information using dynamic message signs and using traffic cameras to monitor roadway congestion, incidents and delay. However, not all roadways within the northeast Florida region have ITS devices such as traffic cameras, radar detectors, etc. to monitor traffic congestion and incidents. This office also includes the Road Ranger program, which is a free motorist assistance program on FDOT operated roadways. Road Rangers can assist responders in implementing detours and diversions using various traffic control devices such as, traffic cones, message boards, etc. The goal of the transportation and public works agency is to constantly monitor congestion on the freeway and local roads, and to compare travel time and delay between the original route and detour route. They should help implement the detour route based on an informed decision and provide timely information to motorists.

The FDOT Maintenance Office and county and local public works departments play an important role in implementing alternate signal plans, property damage repairs, as well as providing manpower to law enforcement officers in setting up lane closures and managing detours. The FDOT Maintenance Office and public works department supply necessary traffic control devices such as traffic cones, message boards, and
warning signs during traffic detours and travelers information dissemination. The following list outlines the regional transportation and public works agencies.

- FDOT District 2
- City of Jacksonville Department of Public Works
- City of Jacksonville Traffic Engineering Division
- Clay County Public Works Department
- Clay County Public Works Traffic Control Division
- Nassau County Public Works Department
- St. Johns County Public Works Department
- St. Johns County Traffic and Transportation Department
- City of Jacksonville Beach Public Works Department
- City of Atlantic Beach Public Works Department
- City of Fernandina Beach Public Works Department
- City of Green Cove Springs Public Works Department
- City of Neptune Beach Public Works Department
- City of St. Augustine Public Works Department
- Town of Baldwin Public Works Department
- Town of Orange Park Public Works Department

Following are the roles and responsibilities of the transportation and public works agencies in the dynamic detour system from inception to implementation:

- Serve as a lead agency as they are in charge of the roadway system to and from which traffic is diverted. Also, apply the knowledge of local roadway and traffic in the area to develop detour routes.
- Set up or participate in the meetings where the detour route criteria are laid out. In this meeting, invite local authorities and transportation agencies that are responsible for the operation and maintenance of the roadway corridor where traffic is diverted. At this forum, discuss the issues or restrictions each agency may have about adding traffic to their systems as well as requiring their commitment in developing and implementing detour route plan.
- Assure that all transportation agencies involved signed off on the selected detour route and subsequent detour route implementation.
- Share plans and maps that are available for the benefit of the group. Share detour routes, if available, and technical data that is required to support this effort.
- Constantly monitor the congestion and incident conditions on the affected roadways and determine travel time and delay information between the original route and detour route. The travel time information should be disseminated to the motorist to make an informed en-route decision.
- Share and/or exchange the ITS and traffic data with other agencies for an appropriate plan of action. The ITS data could be the traffic camera feeds, DMS information, traffic detector data, etc., where available.
- Monitor traffic conditions on alternate routes if surveillance is available. Otherwise, send and assign field personnel to conduct site visits at frequent intervals during and after the detour route implementation and document details on roadway and traffic patterns along the detour route.
- Establish strategic locations for detour signs for drivers’ information and to bring them back to the original route.
- Determine time period restrictions based on traffic conditions and time of day as to when the road may be used as an alternate route and terminate the detour route plan when these conditions are not met.
- Generate and maintain the contact list of all responsible stakeholders in the region participating in the traffic incident management and detour activity. Provide responder contact information for
inclusion in the detour route plan.

- Provide TMC and Road Ranger support for the system operation and maintenance where ITS and Road Ranger service coverage is available.
- Operate and maintain the dynamic detour system in the region. The responsibility is shared between state and local agencies.
- Assist the law enforcement agency in making an informed decision to implement the detour plan per implementation protocol.
- Adjust and modify traffic signal timing based on traffic demand. Coordination between local agencies that operate and maintain the traffic signals in the region is desired to develop an alternate signal timing plan to accommodate additional traffic on local roads.
- Determine traveler information dissemination modes and messages, and issue press releases.
- Mitigate traffic conditions in the area using all available resources during detour route implementation.

7.3. Law Enforcement and Public Safety Agencies

The following list identifies the local law enforcement and public safety agencies in northeast Florida region. The fire and rescue and emergency medical service (EMS) departments are considered as one unit and classified under public safety agencies in the northeast Florida region.

- Florida Highway Patrol
- FDOT Motor Carrier Compliance Office
- Florida Department of Highway Safety and Motor Vehicles
- Jacksonville Sheriff’s Office
- Jacksonville Fire and Rescue Department
- Clay County Sheriff’s Office
- Clay County Public Safety Department
- Nassau County Sheriff’s Office
- Nassau County Fire and Rescue Administration
- St. Johns County Sheriff’s Office
- St. Johns County Fire and Rescue Department
- City of Jacksonville Beach Police Department
- City of Jacksonville Beach Fire Department
- City of Atlantic Beach Police Department
- City of Fernandina Beach Police Department
- City of Fernandina Beach Fire and Rescue Department
- City of Green Cove Springs Police Department
- City of Neptune Beach Department of Public Safety
- City of Neptune Beach Police Department
- City of St. Augustine Department of Public Safety
- City of St. Augustine Police Department
- City of St. Augustine Beach Police Department
- Town of Orange Park Department of Public Safety
- Town of Orange Park Police Department

Following are the roles and responsibilities of the law enforcement and public safety departments:

- Access and integrate the dynamic detour system into their decision support system to notify federal,
state and local agencies.

- Participate in stakeholder meetings to discuss and sign off on their roles and responsibilities.
- Have the authority to implement detour routes when needed, in coordination with transportation and public works agencies.
- Establish contact with the local transportation agencies to activate the dynamic detour system and follow the implementation protocol based on informed decisions. The implementation protocol should coincide with the transportation and public works agencies, detour plans to mitigate congestion and reduce travel time and delays on roads involved.
- Provide support to the detour operation with numerous traffic control officers serving either a traffic control and/or monitoring role in the field.
- Participates in all four steps of dynamic detour system route planning and implementation of the detour route system.
- Fire and rescue departments may not participate in the traffic management planning process of the dynamic detour system. While EMS only participates and provides their input in detour route plan development.
- Determine safety criteria related to traffic operations/enforcement personnel safety and safety of motorists and pedestrians along the detour route.
- Set criteria on detour route choice based on the extent to which their response time may be affected. For example, heavy traffic on the alternate route may impede ingress and egress of response vehicles from their stations or dispatch facility adjacent to the roadway, which may negatively impact their response time.
- Share locations of their stations and dispatch facilities and routes they typically use for response, which will help avoid the selection of alternate routes that negatively impact their response time.
- Evaluate the safety of the detour route as a part of an after action review and recommends team on alternate route choice, if safety becomes an issue.
- Coordinate with transportation agencies to deploy the dynamic detour system during special events and natural disasters.
- Report issues with the equipment in the field to the maintaining agencies such as the state and local maintenance departments.

7.4 State and Local Emergency Operation Center

The following list identifies the state and local emergency operation centers in the northeast Florida region. State and local emergency management departments play a vital role in operating and maintaining the dynamic detour system during emergency and catastrophic events. The emergency management functions are carried out by various local, state, and federal responding agencies, such as:

- Florida Department of Emergency Management
- City of Jacksonville Emergency Management
- Clay County Emergency Management
- Nassau County Emergency Management
- St. Johns County Emergency Management

County emergency management departments or emergency operations centers are activated during hurricanes and other major events such as tornadoes and major thunderstorms with hurricane like wind force. The roles and responsibilities of FDOT and county emergency management departments include, but are not limited to:

- Participate in the meetings where stakeholders select preferred alternate routes and signs off on the selected detour routes and subsequent alternate route plans.
- May have the authority to implement alternate routes based on informed decisions and implementation protocols set by the stakeholders.
- Access and integrate the dynamic detour system into their decision support system to notify federal, state and local agencies.
- Report issues with the equipment in the field to the maintaining agencies such as the state and local maintenance departments.
- Play an important role in disseminating public information to the local media.

7.5. Transit Agency

The local transit agency in the northeast Florida region is Jacksonville Transportation Authority (JTA). The following are the roles and responsibilities of the transit agencies:

- Participate in the meetings where stakeholders select preferred detour routes and sign off on the selected detour routes and subsequent alternate route plans.
- Provide transit schedules to the transportation agencies to include in the detour route selection activity.
- Evaluate transit performance during detour operation and determine when transit vehicles will cease operating on the detour route.
- Develop an expanded schedule to accommodate the additional traffic demand. Also, review and adjust scheduled operations due to primary route closure when the detour route is implemented.
- Disseminate information on transit operators and passengers as well as provide passengers with the information on expanded schedule.
- Participate in the discussion of traffic control measures necessary for efficient transit operation on detour routes. For example, transit agency may specify a minimum travel time.
- Provide information on bus routes and bus stations in addition to specific detour routes that may be suitable or not suitable for transit routes.

7.6. Private Towing Companies

Private towing companies have no role to play in planning and finalizing of detour route. However, they participate in the dynamic detour system operation during its implementation and provide tow service to remove the wrecked vehicles from travel lanes and eventually off the roadway system. They also participate in the after action review to provide feedback on system performance and express their concerns, if any.

7.7. Elected Officials and Community Groups

Elected officials, and the citizens’ advisory committees and the technical coordination committee promote criteria for detour route selection and implementation that minimizes community impact. They participate in the meetings where stakeholders select preferred detour routes and sign off on the selected detour routes and subsequent alternate route plans. They should help the lead agency select the detour route that, when implemented, would create negligible impact on community lifestyle. Citizens may provide first-hand knowledge on the detour route that may be useful for the lead agency.

7.8. Local Media

The local media plays an important role in disseminating public information during the dynamic detour system traffic management process. Local media can also establish contact with the traffic management centers or emergency operations centers, as applicable, to keep informed of the happenings on the detour activities.
8. Operational and Support Environment

The operational and support environment provides information on region's capability of embracing new traffic management and operations concepts or technology by utilizing existing resources with minimal enhancement or supplementing the existing resources. The following sections describe the region's support and operational environment in detail.

8.1. Institutional Environment

The boundary of North Florida TPO includes all of Duval County and portions of Clay, Nassau, and St. Johns Counties. Included in these boundaries are the cities of Atlantic Beach, Neptune Beach, Jacksonville, Jacksonville Beach and the Town of Baldwin in Duval County; Fernandina Beach and the Town of Callahan in Nassau County; St. Augustine and St. Augustine Beach in St. Johns County; and Green Cove Springs and Town of Orange Park in Clay County. The total North Florida TPO jurisdiction covers 1,838 square miles of land area. These different entities operate and maintain several local roadway systems in the region, many of which cross jurisdictional boundaries.

In addition to these local jurisdictions, the North Florida TPO boundary makes up a major portion of FDOT District 2. FDOT District 2 serves 18 counties and seven major cities, which include Gainesville, Jacksonville, Lake City, Palatka, Perry, St. Augustine, and Starke. The district is responsible for operation and maintenance of Interstates and state roadways within their service area. There are two local FDOT maintenance facilities within the North Florida TPO service area; one is located in Edison and the other in St. Augustine. In addition to the maintenance operations, there is a local FDOT Jacksonville Bridge Office. This institutional environment will provide manpower, material and operational resources to support the new concept when needed.

8.1.1. Traffic Management Center

The FDOT District 2 Traffic and ITS Operations Office is at the FDOT Jacksonville Urban Office just west of downtown. The other is located at the Florida Highway Patrol Troop G's Jacksonville Regional Communications Center (JRCC).

The TMCs perform routine regional surveillance on major roadways outfitted with fiber optic communications and scores of video cameras deployed for this purpose. They also disseminate traveler information concerning roadway closures via 511 and dynamic message signs. They assist in dispatching Road Ranger help upon request or for routine surveillance purposes. The TMC maintains the stakeholder contact list in case a detour is implemented and the local jurisdictions are contacted to implement detour plans on their respective roadway systems.

8.1.2. Road Ranger Program

The FDOT Road Ranger program is a free service to motorists that is currently deployed on five major roadways in the northeast Florida region. The Road Ranger service could be requested by the law enforcement agencies through a traffic management center to assist in setting up detours and warning signs along with other services during dynamic detour implementation. The regional coverage area for the Road Ranger program is along 127 one way centerline miles, which extends to the five major roadways as shown below:

1. I-95: from San Marco Boulevard to Pecan Park Road and from Old St. Augustine north to College Street
2. I-295: from I-95 south to Pulaski Road
3. I-10: from San Marco Boulevard (Fuller Warren Bridge) to SR 200 (US 301)
4. J. T. Butler Boulevard or SR 202: from I-95 to SR A1A
5. SR 9A: from Pulaski Road to I-95 southbound

Currently, the hours of operation of the Road Ranger program are between 6:30 AM and 6:30 PM, Monday through Friday. Although, the routes covered by the Road Ranger program are all freeway segments, they can service the arterial system upon request. Motorists can access Road Ranger services through a toll-free cellular number, *FHP (*347).
8.2. Technical Environment

8.2.1. Existing ITS Network

The existing ITS network is comprised of traffic cameras, traffic detectors and dynamic message signs along I-95, I-10 and I-295. The coverage on I-295 is partial and is part of an ongoing project which would install CCTV and DMS along the entire loop of I-295/SR 9A. In addition, the ITS coalition of northeast Florida developed an ITS master plan update to cover the majority of major freeways and arterials within the North Florida TPO service area.

There are 77 traffic cameras installed to cover: I-95 between Pecan Park Road and I-295 south interchange; I-295 southwest quadrant; and I-10 between I-95 and Chaffee Road. These cameras are used for surveillance, detection, and verification of traffic incidents.

Dynamic message signs, where available, are an efficient outlet for disseminating traveler information on roadway closures. The dynamic message signs can substitute for the need to install warning signs or dedicating additional personnel at or near the scene for traveler information. Where the dynamic message signs are not available, portable changeable message signs or foldable static signs should be used where appropriate.

Figure 5 shows the locations of all existing traffic cameras and dynamic message signs within the northeast Florida region.
Figure 5. Existing ITS Coverage

*Source: Florida 511 website*
9. System Deployment

Several considerations related to environmental, technical, and institutional aspects of the system deployments are discussed in this section. This section is intended to provide suggestions to the agencies that deploy, operate, and maintain the dynamic detour system.

9.1. Device Considerations

Two types of systems should be considered for dynamic detour system deployment in the northeast Florida region, as shown in the following sections.

9.1.1. Arterial Dynamic Trailblazer Sign

The arterial dynamic trailblazer sign consists of regular static trailblazer signs with ITS LED display sub panel components. The dynamic trailblazer sign assembly typically consists of:

1. Action message light emitting diode (LED) panel that is used to convey action message, such as “Detour”, “Delay”, “Closure”, “Congestion”, etc. and their approved abbreviations as standard language by the operating agency.
2. Cardinal message LED panel that is used to show the cardinal information such as North, South, East and West.
3. Route shield panel is a typical static route shield panel.
4. Directional arrow LED panel which includes arrow showing thru, left and right arrows.

The action message panel can be used in place of additional flashing lights. These sign assemblies should conform to 2009 Manual of Uniform Traffic Control Device (MUTCD) Chapter 4L for installation locations and other requirements for flashing beacon signs. The location of these signs should be selected such that clear visibility is maintained for the motorists. Figure 6 below shows a sample flashing beacon trailblazer sign assembly.

![Figure 6. Arterial Dynamic Trailblazer Sign](image)

Figure 7 below shows the conceptual layout for arterial trailblazer sign placement in a corridor.
Figure 7. Arterial Dynamic Trailblazer Sign Concept Layout
The arterial trailblazer option includes deployment of static or dynamic trailblazer signs at the cross street level on parallel and cross streets at major intersection points, as shown in Figure 7. Drivers are notified ahead of time before entering the cross street leading to freeway. The dynamic trailblazer option provides flexibility to choose between freeway directions that are impacted whereas, in the static trailblazer option, this flexibility not available. In either case, the ITS communications network coverage is needed to activate flashing beacons remotely.

9.1.2. Arterial Dynamic Message Signs

Arterial DMS may substitute for arterial trailblazer signs. This is a more expensive alternative compared to the trailblazer option, but provides additional flexibility to the system operator in terms of information dissemination. The arterial DMS are smaller in size compared to freeway DMS with two to three lines of texts. Figure 8 below shows a sample arterial DMS.

Figure 8. Arterial DMS

*Figure 8. Arterial DMS at Blanding Boulevard/SR 21*

The arterial DMS messages should be short and to the point providing action messages to drivers before entering the cross street intersecting and leading to freeway. A few sample messages that could be considered for display are shown below:

1. TRAVELTIME/I-95 <XX> MIN, US 1 <XX> MIN
2. FREEWAY CONGESTION / USE <ROAD NAME> <DIRECTION>
3. <ROAD NAME> CONGESTED / USE <ROAD NAME>
4. FREEWAY CONGESTION / DETOUR ACTIVATED
5. USE 511 FOR DRIVER INFORMATION
6. DETOUR ACTIVATED / FOLLOW <ROAD NAME> <DIRECTION>
7. <ROAD NAME> CONGESTED / USE DETOUR

If the message is long, then the DMS should be run in flashing mode and the information can be displayed in two phases. Use of 2009 MUTCD Chapter 2L is recommended for DMS message display and all other DMS requirements.

Figure 9 below shows the concept layout of the arterial DMS.
Figure 9. Arterial DMS Concept Layout
The choice of device depends on various factors and the needs of the study area. The following table provides the list of advantages and disadvantages of the two concepts:

### Table 4. List of Advantages and Disadvantages of Arterial Trailblazer and DMS Concepts

<table>
<thead>
<tr>
<th>Arterial Trailblazer</th>
<th>Arterial DMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantage</strong></td>
<td><strong>Disadvantage</strong></td>
</tr>
<tr>
<td>1. Easier to install</td>
<td>1. Message is restricted to detour only</td>
</tr>
<tr>
<td>2. Lower cost option</td>
<td>2. Less flexibility to choose action message</td>
</tr>
<tr>
<td>3. Lower maintenance and operating cost</td>
<td>3. Lower life cycle</td>
</tr>
<tr>
<td>4. Simpler structural support</td>
<td>4. Lower visibility</td>
</tr>
<tr>
<td>5. Lower power requirement</td>
<td>5. Increased number of signs needed</td>
</tr>
</tbody>
</table>

### 9.2. Corridor Consideration

Four major corridors in the northeast Florida region are being considered for the dynamic detour system deployment. Table 5 below provides the information on number of interchanges on the corridor and ITS coverage on mainline and cross streets.

<table>
<thead>
<tr>
<th>Freeway</th>
<th>No. of Interchanges (On Ramps)</th>
<th>Mainline ITS Coverage</th>
<th>Cross Street ITS Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-95 (St. Johns County line to GA State line)</td>
<td>35</td>
<td>Partial</td>
<td>Partial</td>
</tr>
<tr>
<td>I-295/SR 9A (entire loop)</td>
<td>30</td>
<td>Partial</td>
<td>None</td>
</tr>
<tr>
<td>I-10 (US 301 to I-95)</td>
<td>12</td>
<td>Partial</td>
<td>None</td>
</tr>
<tr>
<td>SR 202/JTB (US 1 to SR A1A)</td>
<td>11</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

SR 202 or J. Turner Butler Highway does not have any existing ITS coverage. In addition, various cross streets in the northeast Florida region have ITS coverage and the ITS coverage is limited to ITS signal controller deployment. Only a few cross streets have CCTV deployed and none of the cross streets have DMS deployed in the region. In order for a dynamic detour system to be fully functional and effective, ITS coverage on the major cross street level is required.

### 9.3. Cost Considerations

The following table shows the approximate costs of system installation and operations and maintenance. Based on the information provided in the table, arterial dynamic trailblazers with LED sub-panels are relatively lower cost compared to the arterial DMS option. A further analysis would be needed to do the benefit-cost analysis of the two options as well as the amount of message dissemination flexibility needed in the region. The arterial dynamic trailblazer option is limited in its flexibility of providing different messages to the motorists unlike the DMS option. However, priority should be given to the need of the region considering the needs are different for the urban region compared to rural region. A mix of arterial trailblazer and arterial DMS systems could also be considered to save cost as well as meeting the needs of the dynamic detour system.

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1 Installation of arterial DMS is currently underway on SR 21 and US 17 in Clay County.
### Table 6. System Cost Table

<table>
<thead>
<tr>
<th>Freeway</th>
<th>No. of Interchanges</th>
<th>Capital Cost</th>
<th>O&amp;M Cost (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Dynamic Trailblazer*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-95</td>
<td>35</td>
<td>$3,500,000.00</td>
<td>$140,000.00</td>
</tr>
<tr>
<td>I-295/SR 9A</td>
<td>30</td>
<td>$3,000,000.00</td>
<td>$120,000.00</td>
</tr>
<tr>
<td>I-10</td>
<td>12</td>
<td>$1,200,000.00</td>
<td>$48,000.00</td>
</tr>
<tr>
<td>SR 202/JTB</td>
<td>11</td>
<td>$1,100,000.00</td>
<td>$44,000.00</td>
</tr>
<tr>
<td><strong>Option I Total</strong></td>
<td>$8,800,000.00</td>
<td><strong>$352,000.00</strong></td>
<td></td>
</tr>
<tr>
<td>Arterial DMS**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-95</td>
<td>35</td>
<td>$8,050,000.00</td>
<td>$402,500.00</td>
</tr>
<tr>
<td>I-295/SR 9A</td>
<td>30</td>
<td>$6,900,000.00</td>
<td>$345,000.00</td>
</tr>
<tr>
<td>I-10</td>
<td>12</td>
<td>$2,760,000.00</td>
<td>$138,000.00</td>
</tr>
<tr>
<td>SR 202/JTB</td>
<td>11</td>
<td>$2,530,000.00</td>
<td>$126,500.00</td>
</tr>
<tr>
<td><strong>Option II Total</strong></td>
<td>$20,240,000.00</td>
<td><strong>$1,012,000.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Arterial trailblazer cost is $50,000 each with an O&M cost of $2,000 per unit per year; assuming two trailblazers per interchange.

**DMS: Dynamic Message Signs; assumed two DMS per interchange at $115,000 each with O&M cost of $5,700 per unit per year.

### 9.4. Power Supply Considerations

The system power supply should be designed in such a way that there is no single point of failure during system communication and operation. This can be obtained by seamlessly designing the entire system with a power backup option. Due to the high power requirement of the LED and DMS concepts, at least a two hour battery backup should be provided for emergency.

### 9.5. Device Communication Considerations

Communication between devices and responding agencies can be done through various methods that are currently available:

- Hard wired communication using fiber optics, copper wires, or telephone line network
- Wireless communication
- Radio frequency communication
- Microwave communication
- Satellite communication

Communications other than hard wired communication are successfully implemented by the following states:

- The New Jersey Turnpike and the City of Aurora, Colorado use cellular digital packet data technology to communicate with the ITS devices.
- The Oklahoma environmental monitoring system utilizes Oklahoma Law Enforcement Telecommunication System (OLETS) leased telecom lines for the system communication.
- The City of Palo Alto, California transmits the water level sensor data to the Supervisory Control and Data Acquisition (SCADA) system via the City's telephone and radio communication networks.
- The California Oregon Advanced Transportation System (COATS) utilizes radio communication between wind sensors and static and dynamic message signs to automatically activate the flashing signs and dynamic message sign message.
9.6. Arterial Signal Timing Modification Considerations

Arterial signal timing modification is an important step towards a successful dynamic detour system implementation to reduce delay and improve travel time on the arterial network. When the traffic is diverted onto the local roadways, traffic is added to its capacity and it is important to have a policy and a backup signal timing plan in place to help move traffic smoothly through the arterial corridors. This may require a multi-jurisdiction coordination as there might be more than one jurisdiction that controls the signals along the local roadways. The regular time-of-day signal timing plan may not be sufficient to handle additional traffic on local roadways due to detour activities.

In addition, signal system coordination is needed to operate traffic with minimum delays and stops. Traffic signal coordination occurs when a group of two or more traffic signals are working together so that the cars make it through these signals with a minimum number of stops possible. A few things that should be considered for the traffic signal timing modification are:

- Minimum pedestrian clearance times based on the roadway characteristics.
- Minimum left turn green time should be allotted, possibly in each cycle, to clear heavy left turn traffic.

9.6.1. Traffic Signal System and Capabilities

When traffic is diverted to detour routes, it is advantageous to have the capability of adjusting traffic signal timing along arterial corridors to accommodate detoured traffic. The coordination of signal timing along detour routes is dependent on the capabilities of the traffic signal control system that is in place. Different types of traffic signal systems are available for this purpose including:

1. Traffic Responsive System: Traffic-responsive control systems select a signal timing plan from a library of pre-established timing plans. The plan selected by a traffic responsive system is usually based on prevalent traffic conditions. Traffic conditions are determined based upon field measured traffic demand using vehicle detection. The primary benefits of traffic responsive systems include central monitoring capabilities and automatic downloading of signal timing plans to provide timings that more closely match prevalent traffic conditions. Communications from a central control facility to each intersection controller is a common characteristic of traffic responsive systems. TMC operators may override current timing plans based on traffic conditions, hardware or software malfunctions, or during events (e.g., traffic incidents, special events, roadway construction, weather emergencies, road closures, police actions, etc.).

2. Closed-loop Systems: Closed loop systems include a group of interconnected signals in a master-slave configuration. The master controller dictates the timing of other traffic signals in the closed loop system. The master controller usually includes communications (wired, wireless, or dial-up) capabilities, allowing the operating agency to download timing plans, monitor the signal timing and make adjustments as needed. Communications between the master controller and other controllers in the closed loop may be provided by wire line or wireless media. Generally, closed loop systems operate predetermined timing plans which are selected based upon either time of day or varying traffic conditions. However, like traffic responsive systems, operations personnel may override current timing plans based on traffic conditions, hardware or software malfunctions, or during events (e.g., traffic incidents, special events, roadway construction, weather emergencies, road closures, police actions, etc.).

3. Adaptive Traffic Signal Control System: Traffic adaptive traffic control systems are the most advanced and complex types of systems. The primary difference between an adaptive control system and a responsive control system is that adaptive control systems do not have set timing plans and make timing adjustments based upon gathering real-time traffic data. Instead, high and low thresholds for splits, offsets and cycle lengths are established, and the traffic signal will adapt in real time within those thresholds.

Any of these three traffic signal system types will work in a dynamic detour environment. Of these signal systems, adaptive traffic signal control offers the most flexibility. The following section outlines the different adaptive control systems currently in operation.
9.6.2. Adaptive Traffic Signal Control System

The real-time adaptive traffic signal control is an emerging technology that requires communication infrastructure to support the remote control of the traffic signal system. Other than manually adjusting the green time, wherever possible, traffic adaptive signal coordination should be implemented to provide real-time signal system coordination based on real-time demand. The following is a list of examples of adaptive signal control systems:

- Sydney Coordinated Adaptive Traffic System (SCATS)
- Split Cycle Offset Optimization Technique (SCOOT)
- Real-Time Traffic-Adaptive Control Software (RT-TRACS)
- Real-Time Hierarchical Optimized Distributed and Effective System (RHODES)
- Optimization Policies for Adaptive Control (OPAC)
- Urban Traffic Optimization by Integrated Automation (SPOT/UTOPIA)
- Adaptive Traffic Control System (ATCS)
- Method for the Optimization for Traffic Signals in On-line Controlled Networks (MOTION)
- Streetwise
- QuicTrac
- InSync® System

9.7. System Interface Considerations

Once the ITS systems in the region are identified and functionality defined, the existing and planned interfaces between these systems are defined. Once the connections between the systems are identified, then the information that will be exchanged on each of the interfaces is defined. The FDOT’s SunGuide® software is used to integrate the existing and proposed interfaces into the regional ITS architecture. The dynamic detour system is new to the region and would require a new interface and update to the SunGuide® software to integrate within the existing architecture. However, the interface should not be much different than the existing interface for the mainline DMS.

In addition to the dynamic detour system interface considerations, traffic signal system integration with the existing SunGuide® system should also be explored for the implementation of detour and response plans. This would require an interagency agreement to establish operational responsibilities or to allow regional TMCs to operate local traffic signals after hours. In the absence of an interface between the SunGuide® system and the traffic signal control system, communications between TMC operators and local agency staff is required.
10. Operational Scenarios

The following three operational scenarios describe the concept of operations for the dynamic detour system implementation.

10.1 Single Segment Impact

**Scenario:** A truck rolled over on a six-lane freeway blocking two northbound lanes on the freeway during morning peak hour. Responders arrived at the incident scene and secured the incident scene and activated the traffic management process. Traffic is starting to build up and only one lane is open from which the traffic is allowed to release. This crash occurred on a freeway segment between two interchanges that is connected to a parallel road with several signals. The parallel road is a four lane roadway.

**Action Plan:**

The following list outlines the action plan for the single segment impact incident scenario:

1. When congestion starts to build and traffic starts moving slowly, the TMC should pull up the traffic cameras and detector system information for verification.
2. The TMC determines the segment of impact and considers disseminating motorist information for alternate route choice at the upstream interchange. They should compare the travel time on the original route with that of the detoured route. If the difference in travel time on freeway is greater than arterial road, then the detour activities should be initiated.
3. The TMC activates the freeway dynamic message sign upstream of the incident to disseminate traveler information. It also coordinates with the local 511 office and media to disseminate traveler information.
4. The TMC, in association with the local jurisdictions, activates the dynamic detour system signs at the key decision points to provide motorists guidance on returning back to their original path downstream of the incident segment.
5. The TMC coordinates with law enforcement agencies, local transit agency, fire and rescue and emergency medical service to inform about the detour activation in their region of impact. The TMC should designate the start and end exit numbers of the freeway impact upstream and downstream of the problem area and provide to these agencies.
6. Law enforcement and the TMC also coordinate with the local jurisdictions to activate response plans to support additional traffic in their system. Signal system coordination should be activated.
7. The dynamic detour system signs at key decision points should be activated only between the two interchanges to direct traffic around the network to get back on their original path.
8. The detour activity is coordinated with the mainline traffic activity. Once the congestion is cleared from the freeway and travel time difference between original route and detour route falls below the established threshold values, all involved agencies should be coordinated to de-escalate the detour activity for the segment.
9. When the detour system is de-activated, the traffic signal timing and coordination should be returned to normal operational condition.
10. Finally, the involved agencies should be coordinated for an after action review. The issues could be discussed during regular after action review or, if the issue is major, then an incident review meeting can be conducted. This effort should be led by local transportation agencies.

The following Figure 10 shows the concept layout of the single segment impact and the key decision points of the concept layout.
Figure 10. Single Segment Impact - Concept Layout
10.2. Multiple-Segment Impact

**Scenario:** A multiple car crash occurred on a six-lane freeway blocking two northbound lanes during evening peak hour. This crash backed up traffic between two interchanges. Responders arrived at the incident scene and secured the incident scene, and activated the traffic management process. Traffic is starting to build up and there is only one lane open from which the traffic is allowed to release. This crash occurred on a freeway segment with two interchanges impacted and blocked due to the incident. The interchanges are connected to a parallel road with multiple signals. The parallel road is a four lane roadway.

**Action Plan:**
The following list outlines the action plan for the multiple-segment impact incident scenario:

1. When congestion starts to build and traffic starts moving slowly, the TMC should pull up the traffic cameras and detector system information for verification. This detection mainly ranges between multiple interchanges, depending on the extent of congestion and slow down.

2. The TMC determines the segment of impact and considers disseminating motorist information for alternate route choice at the upstream interchange. They should compare the travel time on the original route with that of the detoured route. If the difference in travel time on freeway is greater than arterial road, then the detour activities should be initiated.

3. The TMC activates the freeway dynamic message sign upstream of the congestion area to disseminate traveler information. It also coordinates with the local 511 office and media to disseminate traveler information.

4. The TMC, in association with the local jurisdictions, activates the dynamic detour system signs at the key decision points to provide motorists guidance on returning back to their original path downstream of the incident segment.

5. The TMC coordinates with law enforcement agencies, local transit agencies, fire and rescue, and emergency medical services about the detour activation in their region of impact. The TMC should designate the start and end exit numbers of the freeway impact upstream and downstream of the problem area and provide to these agencies.

6. Law enforcement and the TMC coordinates with the local jurisdictions to activate response plans to support additional traffic in their system. The local jurisdiction should be made aware of the extent of incident impact on the freeway to prepare a proper response plan. The signal timing and system coordination plan should be activated for the detour operation.

7. The key decision points should be activated between the interchanges of impact to direct traffic around the network. Traffic should not be directed to the freeway in between the segment impacted.

8. The detour activity is coordinated with the mainline traffic activity. Once the congestion is cleared from the freeway and travel time difference between original route and detour route falls below 15-20 minutes, all involved agencies should be coordinated to de-escalate the detour activity for the segment.

9. When the detour system is de-activated, the traffic signal timing and coordination should be returned to normal operational condition.

10. Finally, the involved agencies should be coordinated for an after action review. The issues could be discussed during regular after action review or, if the issue is major, then an incident review meeting can be conducted. This effort should be led by local transportation agencies.

The following Figure 11 shows the concept layout of the multiple-segment impact and the key decision points of the concept layout.
Figure 11. Multiple-Segment Impact - Concept Layout
10.3. Corridor Impact

**Scenario:** Major construction activities are underway on a section of freeway that will reduce capacity and require lane closures or traffic pacing operations by the law enforcement agency. The construction is anticipated to have a major impact on traffic flow on the corridor level.

**Action Plan:**
The following list outlines the action plan for the corridor impact incident scenario:

1. When congestion starts to build and traffic starts moving slowly, the TMC should pull up the traffic cameras and detector system information for verification. This detection mainly ranges between several interchanges, depending on the extent of congestion and slow down, which is sometimes corridor wide.

2. The TMC determines the segment of impact and considers disseminating motorist information for alternate route choice at the upstream interchange. They should compare the travel time on the original route with that of the detoured route. If the difference in travel time on freeway is greater than arterial road, then the detour activities should be initiated.

3. The TMC activates the freeway dynamic message sign upstream of the congestion area to disseminate traveler information. It also coordinates with the local 511 office and media to disseminate traveler information.

4. The freeway traffic is diverted upstream at the tail of the congestion to the local roadway. In this scenario, the congestion may cover a longer stretch of freeway with multiple interchanges. The traffic is diverted to the local roadway network that also has local traffic accessing the freeway.

5. The TMC coordinates with the local jurisdictions to activate response plans to support additional traffic on their system. The local jurisdiction should be made aware of the extent of the incident impact on the freeway to prepare an appropriate response plan. The signal timing and system coordination plan should be activated to support the detour activity. In this roadway closure the need for signal system coordination is extensive and may require the involvement of multiple operating agencies.

6. Law enforcement and the TMC coordinate with the local jurisdictions to activate response plans to support additional traffic on their system. The local jurisdiction should be made aware of the extent of incident impact on the freeway to prepare a proper response plan. The signal timing and system coordination plan should be activated for the detour operation.

7. The transit agency and area schools should consider rescheduling or rerouting their buses along an alternate route. In addition, the fire and rescue, EMS and law enforcement stations in the impacted region should consider re-routing their response vehicles to avoid delay and congestion.

8. The TMC should designate the exit numbers of freeway impact from start to finish and provide to the local jurisdictions to quickly scope out the area of impact.

9. The congestion impact on the freeway should be quickly estimated to identify the impact on multiple jurisdictions operating and maintaining the signal systems and area roadways.

10. Dynamic signage at key decision points should be activated between the interchanges of impact to direct traffic around the network.

11. Detour activity should be coordinated with the mainline incident activity. Once the incident is cleared from the freeway all the agencies should be coordinated to de-escalate the detour activity in the corridor segment.

12. The detour system is de-activated and traffic signal coordination is returned to normal operational condition.

13. Finally, the involved agencies should be coordinated for an after action review. The issues could be discussed during regular after action review or, if the issue is major, then an incident review meeting can be conducted. This effort should be led by local transportation agencies.

The following Figure 12 shows the concept layout of the corridor impact and the key decision junctions of the concept layout.
Figure 12. Corridor Impact - Concept Layout
11. Standard Operating Procedures

The operational scenarios described in the earlier section require defining a set of standard operating procedures to establish a coordinated and consistent approach for an efficient traffic management system during congestion and incidents on arterials and freeways. In order to implement the dynamic detour system in the northeast Florida region, a study area has been defined and equipment locations were identified at the key decision points on maps. This section will define the implementation plan and provide the information on equipment and resource usage, equipment functionality and cost comparison, responder orientation and coordination, decision support framework, and escalation and de-escalation procedures of the dynamic detour system.

11.1. Implementation Plan Overview

The implementation of the dynamic detour system on the local roadway system and freeways requires extensive multi-jurisdictional coordination and institutional support to synergize the use of man power and equipment resources between state and local agencies. The general concept of a dynamic detour system includes defining the detour segment and assigning detour routes and identifying the key decision points in the detour segment for device or equipment placement. This concept requires systematic coordination among responders and extensive use of technology during implementation. However, the responders should be oriented to the new system in case needed to provide additional support as and when needed for traveler information and traffic detour activities. A decision support framework should be designed to aid in making informed decisions for detour implementation. A brief discussion on decision support system is provided below.

The corridor selection to implement detour operation depends on agency priority, and material and resource availability in the region. Four major highways were identified for detour operation. They are I-95, I-295/SR 9A, I-10 and SR 202. The dynamic detour system can be designed to work in an autonomous manner, but may require human intervention in cases where engineering judgment is required. Coordination among agencies is generally required. Thus, the level of control and automation will be dependent on the level of manpower available, but also on the interaction required among agencies.

11.2. Responder Orientation and Coordination

The following bullets outline the need for responder orientation and coordination:

1. **Field Visits:** Responders should make themselves familiar with the detour route as well as its general vicinity to gather firsthand information on the detour region and understand its complexity. Field visits should me made frequently and notes should be made for any changes that may have occurred. Responders should provide comments and feedback on the detour maps by participating in the meetings that are specifically geared towards the map updates.

2. **TIM Processes:** Responders should be familiar with their roles and responsibilities listed in this document and should be trained in the traffic incident management processes. The National Unified Goal (NUG) for incident response for responder safety, safe and quick clearance, and prompt, reliable, and interoperable communications should be followed for the detour operation.

3. **Contact Lists:** A contact list should be prepared and maintained by the traffic management center of all stakeholders’ key personnel involved in the detour operation. This list should be shared with all responding agencies.

4. **Annual Review:** Responders should re-convene for an annual review of the detour maps and go over the proposed changes and modifications that may be required due to field operational or physical changes. This assessment is required for an efficient operation of the detour route. In addition, an annual review should be performed with the responders for a comprehensive performance measures assessment of the detour operation during the last year and lessons learned should be noted to learn from the previous experiences.

11.3. System and Resource Deployment

In this concept of operation document, there are two types of systems identified for use in the dynamic detour system. First is the arterial trailblazer system and second is the arterial DMS system. The arterial trailblazer system is a combination of both ITS and static sign assembly that provides detour information with limited flexibility for message changes. The arterial DMS provide considerably more flexibility for traveler information dissemination. However, the use of either system depends on the ITS coverage available, but in either case, these devices should be operated in coordination with the regional TMCs. The
system deployed at the key decision points should be activated for traveler information on detour route.

The dynamic detour system requires cross-jurisdictional coordination and support, where the state agency is responsible for TMC coordination and providing traffic monitoring information to local agency. Local agencies are responsible for signal coordination when requested for detour operation. The TMC also coordinates with other responding agencies for the detour system deployment and operation. The following figure outlines the typical system and resource coordination between multiple jurisdictions.

![Figure 13. System and Resource Coordination Diagram](image)

Apart from the interagency coordination, a center to center (C2C) interface should be established between the regional TMC and local agencies to operate and control the traffic signal systems, especially after hours, when the local agencies are closed. In such cases, the regional TMCs may operate and control the traffic signals, if the detour is activated. An interagency agreement would be required to carry out this operation and sharing the responsibility. Another vital aspect of this C2C communication would be the integration of signal system interface into the FDOT's SunGuide® software. Currently, this capability is not available in the SunGuide® software; therefore, an alternate way to establish communication with the local agency’s traffic signal system interface should be researched until the SunGuide® integration is complete. Manual procedures, including phone calls and faxes, between agencies can be employed effectively for this purpose if operational guidelines are in place.

11.4. Decision Support System

The decision support system provides foundational support information for informed decision making during dynamic detour system implementation. Although, the ultimate decision falls upon the law enforcement agency designated as responsible for a particular roadway system, the input of the TMC and other local transportation as well as public safety agencies is paramount. The primary objective of the detour system is to relieve congestion during incidents while providing drivers a route choice to make an informed decision. The following flow chart shows two critical decision points, if the difference in travel time on freeway is greater than the arterial road, then the detour should be activated. When it drops lower, the detour operation should be lifted.
11.5. Escalation Procedure

1. **Preparation**: The TMC and law enforcement agencies should coordinate with the local transportation and public safety agencies to solicit support in activating the dynamic detour system. This plan, agency directives, county plans, and regional plans should be available to decision makers.

2. **Information**: Appropriate channels of communication must be opened ahead of recurring or non-recurring congestion periods. Traffic camera and detector information should be accessed at regular intervals to assess the impacts of congestion. All stakeholder agencies should work together to promote sound decision making and accurate information for the motorists.

3. **Staging Law Enforcement Personnel**: Law enforcement personnel should be assigned to monitor each detour route. In the absence of ITS coverage along the arterial roads, law enforcement and transportation agency personnel should monitor detour operation continuously until the freeway condition returns to normal. When freeway travel time drops below arterial travel times, the law enforcement officers should be alerted to be prepared to de-escalate detour operation.
4. **Staging Maintenance of Traffic (MOT):** FDOT, local public works departments, and their private contractors should be available to deploy MOT with temporary traffic control devices that may be necessary to implement the detour operation. Portable changeable message signs, portable barricades, and traffic cones should be deployed as needed to provide information, and to close lanes or ramps. Agencies may also need to manually control the detour signs based on traffic conditions monitored along the route.

5. **Preparing Detour Systems:** The TMC should initialize the process of displaying appropriate traveler information on the freeway DMS upstream of the congestion. The message should target motorists in giving an alternate route choice instead of a compulsory detour. Portable changeable message signs may be used to guide motorists and should be made available by the transportation agencies and/or their private contractors, when needed.

6. **Detour Decision:** The decision to activate a detour is based on the type of segment impact due to congestion. The law enforcement agency responsible for the particular roadway in coordination with the TMC will initiate the detour operation based on information received from local agencies and ITS systems, such as traffic cameras and detectors.

7. **Implementation Directive:** The law enforcement agency responsible for the roadway system in coordination with the TMC will guide and direct all resources required for detour activities.

11.6. **De-escalation Procedure**

1. **Opening Decisions:** The decision to deactivate a detour route is made based on improvement in freeway traffic conditions, essentially when the freeway travel time is less than the arterial travel time. In all cases, the TMC will confirm if the conditions on the freeway have improved to support the decision-making process.

2. **Opening Directive:** The law enforcement agency in coordination with the TMC will direct field units from all participating entities to open the roadway.

11.7. **After Action Review**

Anytime the detour is activated, there should be an after-the-fact review of the operation. The purpose of the review is to refine the process and ensure that intended communication and coordination is present. This review can be held in conjunction with the FDOT traffic incident management (TIM) meetings, held bi-monthly at the FDOT office in Jacksonville, Florida.

11.8. **Public Information Campaign**

The Federal Highway Administration (FHWA) published the Work Zone Safety and Mobility Rule (the Rule) on September 9, 2004 in the Federal Register (69 FR 54562). Per the Rule, the Interstate System projects in a Transportation Management Area that occupies a location for more than three days and has either intermittent or continuous lane closures shall comply with the rule. For significant projects, a Transportation Management Plan (TMP) must be developed and implemented. The TMP must include public information and outreach strategies to inform those affected by the project of expected work zone impacts and changing conditions. The FHWA provides a guide to Work Zone Public Information and Outreach Strategies located at [http://ops.fhwa.dot.gov/wz/info_and_outreach/index.htm](http://ops.fhwa.dot.gov/wz/info_and_outreach/index.htm).

The basic steps outlined for developing a public information and outreach campaign are:

- Determine the Appropriate Size and Nature of the Campaign
- Identify Resources
- Identify Partners
- Identify Your Target Audiences
- Develop the Campaign Message(s)
- Determine Communication Strategies
- Determine When to Communicate
- Evaluate Effectiveness

More information on public information campaign and some examples are provided in Appendix C.
12. I-95 Case Study

As a pilot test study of this concept of operation document, a portion of I-95 between International Golf Parkway and Fuller Warren Bridge has been selected. US 1 runs parallel to I-95 and may serve as an alternate route considering its proximity to I-95 and the number of lanes it serves in each direction. The reason for selection this section of I-95 is the several significant construction projects that are planned over the next five years. These projects will have a significant impact on the traffic operations within the region. There may be periodic lane closures and shifts in traffic pattern to complete the construction activities in this section. The following three construction projects are adjacent to each other and are programmed to be constructed in the next five years:

- I-95 Widening and Reconstruction - between International Golf Parkway and SR 9A/I-295
- I-95 Rigid Pavement Rehabilitation - between SR 9A/I-295 and Atlantic Boulevard
- I-95 Overland Bridge Replacement - between Atlantic Boulevard and Fuller Warren Bridge

12.1. Options Consideration

Following are the two types of dynamic detour system options that are considered to be deployed in the pilot study area, assuming there will be fiber optic network coverage available along the arterial corridors too:

1. **Arterial Dynamic Trailblazer Option**: This option consists of a composite trailblazer sign that includes LED sub-panels to display action messages and cardinal directions with arrow and static signs panels. There are a maximum three LED sub panels that may be required to form a complete sign assembly in addition to the static sign panels. This option may require a higher number of signs and has a limitation in providing flexibility for displaying action messages. In addition to the existing freeway DMS within the study area, 11 mainline freeway DMS are proposed in this option to support the operation.

2. **Arterial Dynamic Message Sign Option**: This option consists of a combination of arterial dynamic trailblazer and arterial dynamic message signs. The arterial DMS is a smaller size DMS with 12-14” characters with two lines of text. This option provides maximum flexibility for information dissemination. In addition to the existing freeway DMS within the study area, 11 mainline freeway DMS are proposed in this option to support the operation.

Either of the two options would require SunGuide® software modification to integrate the functionality of operating and controlling the detour system. In addition, as discussed earlier, the center to center communication between regional TMCs and local agencies would also be required to operate the signal system.

12.2. Study Area

The DDS implementation study area includes approximately 30 miles of I-95 between International Golf Parkway and Fuller Warren Bridge. US 1 runs parallel to I-95 in the study area and is used as the alternate route to I-95 for this detour operation. There are several ITS devices that are deployed along these two routes to implement the detour operation. These ITS devices are a combination of arterial DMS and trailblazers. The study area is divided into three major segments where the detour routes are available:

1. **Urban Segment**: Includes the portion of I-95 between the US 1 south interchange and the Fuller Warren Bridge. In 2009, this segment served a maximum average annual daily traffic of 140,000 vehicles. This segment has eight partial and full interchanges to be outfitted for detour operation.

2. **Suburban Segment**: Includes the portion of I-95 between Race Track Road and Philips Highway south interchange. In 2009, this segment served a maximum average annual daily traffic of 116,000 vehicles. This segment has three interchanges including the US 1 interchange to be outfitted for detour operation.

3. **Rural Segment**: Includes the portion of I-95 between International Golf Parkway and Race Track Road. In 2009, this segment served a maximum annual average daily traffic of 73,000 vehicles. There are no other interchanges within this segment and the general vicinity of the corridor serves mostly residential traffic.

The concept layout of arterial DMS and trailblazer options are shown in Figures 15 through 22.
I-95 CASE STUDY LAYOUT
ARterial DMS OPTION

SEGMENT
1. PHILIPS SOUTH TO PHILIPS NORTH

LEGENDS:
- Designated Detour Route
- Proposed Dynamic Message Sign
- Existing Dynamic Message Sign
- Single Post ITS Trailer/Sign

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12.3. Escalation Procedure

1. The TMC detects the slow down or congestion on any portion of the I-95. This information can be collected through various sources.

2. The TMC should verify the information using traffic cameras and detectors that are available on I-95. Followed by notification to the law enforcement agencies that controls the portions of the highway and local roads.

3. The TMC and law enforcement agencies should coordinate with the local transportation and public safety agencies to solicit support in activating the dynamic detour system. This plan, agency directives, county plans, and regional plans should be available to decision makers.

4. The TMC should assess the impact of congestion on the freeway and should consider single segment, multiple segment or corridor impacts. This action should be immediately followed by collecting detector information from the arterial road considered for detour as well as on I-95 to calculate travel time and delay. If the travel time difference is 20 minutes between freeway and arterial roadway, then the detours should be activated and the agencies should continue monitoring the detector information.

5. Appropriate channels of communication must be opened ahead of the recurring or non-recurring congestion period. Traffic camera and detector information should be accessed on a continuous basis to assess the impacts of congestion. All stakeholder agencies should work together to promote sound decision making and accurate information for the motorists.

6. The decision is made on the type of segment impact due to congestion - urban, suburban or rural. The law enforcement agency responsible for the particular roadway in coordination with the TMC will initiate the detour operation based on information received from local agencies and ITS systems, such as traffic cameras and detectors.

7. The TMC should initialize the process of displaying appropriate traveler information on the freeway DMS upstream of the congestion tail. The message should target motorists in giving an alternate route choice instead of a compulsory detour. Portable changeable message signs may be used to guide motorists and should be made available by the transportation agencies and/or their private contractors, when needed.

8. In an absence of ITS coverage along the arterial roads, law enforcement and transportation agency personnel should monitor detour operation continuously until freeway traffic conditions return to normal. When the freeway travel time is less than arterial travel time, the law enforcement officers should be alerted to be prepared to de-escalate detour operation.

9. Transportation agencies and their private contractors should be available to deploy MOT with temporary traffic control devices such as portable changeable message signs, portable barricades, and traffic cones to implement the detour operation. Manual operation of the detour signs may be required.

10. The law enforcement agency responsible for the roadway system in coordination with the TMC will guide and direct all resources required for detour activities.

12.4. De-escalation Procedure

1. The TMC should continuously monitor traffic camera and detector information from the onset of detour activity.

2. The decision to deactivate the detour route should be made based on improvement in freeway traffic conditions, essentially when the freeway travel time is less than arterial travel time.

3. In all cases, the TMC should confirm if the conditions on I-95 have improved to return traffic operation back to normal to support the decision-making process.

4. The law enforcement agency in coordination with the TMC will direct field units from all participating entities to open the roadway.

12.5. After Action Review

An after action review should be held with all the stakeholders involved immediately after the detour activity or on a mutually agreed time and day. The FDOT traffic incident management team should lead this effort and convene all stakeholders at one place. This review can also be combined with the FDOT traffic incident management (TIM) meetings, held bi-monthly at the FDOT office in Jacksonville, Florida, if time permits.
12.6. Preliminary Cost Estimates and Number of Devices Used

The preliminary cost estimates are derived from the number of ITS systems shown in the detour concepts plans in Figures 15 thru 20. The cost estimates are divided into the two options: arterial dynamic trailblazer and arterial dynamic message sign. The following table provides the information on the number of devices used and preliminary cost estimate of each option.

<table>
<thead>
<tr>
<th>Devices</th>
<th>Arterial Dynamic Trailblazer Option</th>
<th>Arterial DMS Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Trailblazer</td>
<td>52</td>
<td>17</td>
</tr>
<tr>
<td>Arterial DMS</td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>Mainline DMS</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total System Cost</strong></td>
<td><strong>$7,777,730.26</strong></td>
<td><strong>$11,342,965.62</strong></td>
</tr>
</tbody>
</table>

The source of this preliminary cost estimate is FDOT historical bid costs, listed in the 12/08/2010 master pay item list.

Based on the preliminary cost estimates, the arterial DMS option will cost approximately $3.6 million more than the arterial dynamic trailblazer option. Appendix D provides the detailed preliminary cost estimate for the two concepts.

12.7. I-295/SR 9A Loop Alternate Route Concept

In addition to previous three segments, the other alternate route to I-95 through traffic is the I-295/SR 9A loop. This loop connects to all major roadways that also intersect with I-95 such as I-10, Baymeadows Road, SR 202/Butler Boulevard, Beach Boulevard, Atlantic Boulevard, Heckscher Drive, etc. Hence, it becomes a natural route of choice to carry additional traffic between the south and north I-295/SR 9A interchanges with I-95.

I-95 mainline has several existing freeway DMS signs in advance of the I-295/SR 9A north and south interchanges. In addition, there are several existing freeway DMS along the southwest quadrant of I-295. Also, the remaining portion of the I-295/SR 9A loop will soon have mainline DMS at critical junctions in the ongoing freeway management systems projects in Northeast Florida. Figure 21 shows the concept detour operation between these interchanges.
13. References


2. *Integrated Corridor Management Analysis, Modeling, and Simulation Results for the Test Corridor Report*, Federal Highway Administration publication #FHWA-JPO-09-001 EDL 14440, pp. 1-117, June 2008 (PDF 2.0 MB).


