Concept of Operations (ConOps) for I-95 PD&E at US-1

DRAFT

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List of Acronyms and Abbreviations

ARC-IT ..... Architecture Reference for Cooperative and Intelligent Transportation
AST ..... Agency for State Technology
ATSPM ..... Automated Traffic Signal Performance Measures
CARs ..... Crash Analysis Reporting
CAV ..... Connected and Automated Vehicle
CCTV ..... Closed Circuit Television
ConOps ..... Concept of Operations
CV ..... Commercial Vehicle Operations
DDI ..... Diverging Diamond Interchange
DM ..... Data Management
DMS ..... Dynamic Messaging Sign
FAC ..... Florida Administrative Code
FDOT ..... Florida Department of Transportation
FHP ..... Florida Highway Patrol
FHWA ..... Federal Highway Administration
FOC ..... Fiber Optic Cable
FON ..... Fiber Optic Network
FTE ..... Florida's Turnpike Enterprise
ITS ..... Intelligent Transportation Systems
LED ..... Light-Emitting Diode
LRTP ..... Long-Range Transportation Plan
MOT ..... Maintenance of Traffic
MOU ..... Memorandum of Understanding
MPA ..... Metropolitian Planning Area
NITSA ..... National ITS Reference Architecture
O-D ..... Origin-Destination
OpsCon ..... Operational Concept
PD&E ..... Project Development and Environment
PM ..... Parking Management
PS ..... Public Safety
PSEMP ..... Project Systems Engineering Management Plan
R2CTPO ..... River to Sea Traffic Planning Organization
RCTO ..... Regional Concept for Transportation Operations
RITSA ..... Regional ITS Architecture

RTVM ..... Requirements Traceability Verification Matrix
R/W ..... Right-of-Way
SEA ..... Systems Engineering Analysis
SELS ..... Statewide Express Lanes Software
SITSA ..... State ITS Architecture
SMART Signals ..... Systematic Monitoring of Arterial Road Traffic Signals
SIS ..... Strategic Intermodal System
SOP ..... Standardized Operations Procedures
TM ..... Traffic Management
TMC ..... Transportation Management Center
TMS ..... Traffic Monitoring Sites
TPAS ..... Truck Parking Availability System
TS ..... Traveler Safety
TSM&O ..... Transportation Systems Management and Operations
TTC ..... Temporary Traffic Control
USDOT ..... United States Department of Transportation
WAN ..... Wide Area Network

1. Overview

The first section of the Concept of Operations (ConOps) document provides six elements: system identification, purpose and audience, an overview of the document, a high-level overview of the proposed system, stakeholders, and references. These elements are described in the following sections.

1.1 Identification

Project Name: I-95 PD&E at US-1
Financial Project Identification: 419772-2-22-02
Federal Aid Project Number: N/A

1.2 Purpose and Intended Audience

The purpose of this ConOps document is to:

- Document existing Transportation Systems Management and Operations (TSM&O) solution sets and background.
- Identify stakeholders and elaborate on system needs.
- Define expected TSM&O system enhancements within the project limits to assist in final design.
- Garner support from identified stakeholders regarding the proposed TSM&O solution sets.

The intended audience for this ConOps document is for:

- Non-technical program management inclusive of the Florida Department of Transportation (FDOT) and Local Stakeholder decision-makers.
- Technical management of participating local stakeholders.
- Technical and non-technical parties engaged in the final design phase of the project.
- Individuals engaged in project oversight.

1.3 Document Overview

This ConOps document describes the existing system or operation, the shortcomings or unmet needs, proposed changes that would address the needs, and the final system after the changes are made to the system or operation, based on the assumption that all systems modifications proposed in this document are adopted during the final design phase.

1.4 High-Level System Overview

TSM&Os are vital to the success of the I-95/US-1 Project Development and Environment (PD&E) process by providing a system of processes to identify existing systems and services and proposed opportunities to enhance services and capacity conducive to stakeholder goals accommodating all transportation system user groups. This holistic approach to the planning process aims to preserve and enhance capacity, safety, and reliability for stakeholders. The overarching goals addressed in

the US-1 and I-95 interchange redesign are focused on accommodating future transportation demands and enhancing safety for all users.

The TSM&O program for the subject project serves the core purpose of providing insight into existing key transportation technologies that contribute to overarching goals focused on safety and efficiency and casts light on the performance of these activities by analyzing collision history. It addresses engineering and planning needs by identifying improvement opportunities and coordinating stakeholder buy-in prior to the design phase, the TSM&O process positions the project in a holistic manner to address safety concerns for a variety of users.

1.5 Stakeholders

Table 1: Stakeholders

Stakeholder	Project Role
Federal Highway Patrol (386) 736-5350 FHP@flhsmv.gov	Stakeholder – Provide insight into the needs of the Florida Highway Patrol
FDOT District 5 Jeremy Dilmore (386) 943-5360 Jeremy.dilmore@dot.state.fl.us	Stakeholder – Provide insight into the needs of the District
FDOT District 5 Kenneth Shiver (850) 410-5608 Kenneth.shiver@dot.state.fl.us	Stakeholder – Provide insight into the needs of the District
HNTB Scott Zornek (407) 805-0355 szornek@hntb.com	Subcontractor – Work with the Contractor and Stakeholders
River 2 Sea TPO Stephan Harris: Transportation Planner – Project Manager (386) 226-0422 ext. 20248 Sharris@r2ctpo.org	Stakeholder – Provide insight into the needs of the TPO
RS&H Nathan Silva (407) 893-5800 Nathan.silva@rsandh.com	Prime Consultant for PD&E overall development
Votran Elizabeth Suchsland: Assistant General Manager (386) 761-7700	Stakeholder – Provide insight into transit needs
Volusia County Tadd Kasbeer (386) 257-3874 tkasbeer@volusia.org	Stakeholder – Provide insight into the needs of the County

Stakeholder	Project Role
Volusia County Emergency Services Aubrie Austin: Emergency Management Planner (386) 254-1500 ext. 11625 alaustin@volusia.org	Stakeholder – Provide insight into the needs of the Volusia County Emergency Services
Volusia County Sheriff (386) 323-3502	Stakeholder – Provide insight into the needs of the Volusia County Sheriff

1.6 Referenced Documentation

List of References used in developing this ConOps:

Table 2: Referenced Documentation

Document Name	ID, Revision, Date, etc.	Link, or Contact Info to Obtain
Florida Department of Transportation Intelligent Transportation Systems Master Plan – District 5	Published October 31, 2016 Accessed September 26, 2022	https://cflsmartroads.com/docs/District%205%20ITS%20Master%20Plan_FINAL.pdf
Florida Department of Transportation TSM&O, 2017 Strategic Plan	Published August 17, 2017 Accessed September 26, 2022	https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/traffic/doc_library/pdf/2017-tsm-and-o-strat-plan-aug-24-2017-final.pdf?sfvrsn=d38c3054_0
River to Sea 2040 Long Range Transportation Plan	Published June 2019 Accessed January 17, 2023	https://www.r2ctpo.org/planning-studies/long-range-transportation-plan/
River to Sea Connected and Automated Vehicle Readiness Study – Technology Transition Plan	Published June 2020 Accessed September 26, 2022	https://cflsmartroads.com/docs/R2CTPO_CAV-Technology-Transition-Plan_FINAL_June2020.pdf
River to Sea Intelligent Transportation Systems Master Plan – Phase 1	Published August 2016 Accessed September 26, 2022	https://cflsmartroads.com/docs/R2CTPO%20ITS%20Master%20Plan%20Phase%201.pdf
Systems Engineering and ITS Architecture Procedure 750-040-003	2019	FDOT Forms Management/Procedures https://pdl.fdot.gov/
Note: River to Sea Intelligent Transporation Systems Master Plan – Phase II was unpublished at time of development		

2. Current System Situation

2.1 Background, Objectives, and Scope

The **I-95 at US-1** project required the redesign of a partial cloverleaf interchange (exit 273) consisting of two separate single-lane off-ramps and two separate single-lane on-ramps. Economic factors required efficient use of resources and led to a succinct assessment applied through three primary strategies: initial planning, concept analysis, and stakeholder engagement. By performing initial planning, an overall assessment of the project's impact on the social, economic, cultural,

natural, and physical environment resulted in developing the location and design concept of the project in accordance with FDOT policy, procedures, and requirements. Analysis was performed to identify existing systems and services and proposed opportunities to enhance services and capacity to stakeholder goals accommodating all transportation system user groups.

Attributes are overarching processes and procedures typical of a specific Intelligent Transportation Systems (ITS) project. They include evaluation of operational and safety needs, stakeholder coordination for regional technical specifications and preferences of service packages, educational augmentation for overall operational improvements, and development of resources to expedite economic considerations.

2.2 Operational Constraints

The River to Sea Transportation Planning Organization (R2CTPO) ITS Master Plan – Phase 1 noted opportunities for improved network architecture configurations with FDOT and R2CTPO subsidiaries. Challenges exist for the stakeholders to effectively transmit data between agencies. Agencies are unable to share Closed-Circuit Television (CCTV) camera footage with one another limiting partnering management functions. Data that can be mined to facilitate effective management of congestion and leveraged for initiatives to enhance driver safety has also been observed.

Enhancement of data processing techniques has provided stakeholders to effectively collect, store, manage, mine, and interpret large datasets not previously possible. These enhancements have translated to stakeholders requesting more precise data collection standards and the supporting infrastructure necessary to process larger sample sizes. Implementing efforts to coalesce in Automated Traffic Signal Performance Measures (ATSPM) and Systematic Monitoring of Arterial Road Traffic (SMART) Signals systems deployed at signalized intersections will aid in the collection of a myriad of standard and new data sets otherwise historically gathered through resource-intensive legacy practices.

2.3 Description of the Current System or Situation

The US-1 interchange is located within the unincorporated limits of Ormond Beach located west of the Addison Blockhouse Historic State Park and north of the Ormond Beach Municipal Airport. This interchange is vital to distributing drivers to the beach, airport, and parks within the area.

TSM&O considers a myriad of subsystems that contribute to the function of diversion route management. It involves the use of vehicle detection systems upstream and downstream of US-1, which monitor traffic congestion and trigger predetermined diversion routes developed by operations management.

I-95 and US-1 each have two (2) dynamic messaging signs within the vicinity of the interchange. These signs are used to convey information to drivers regarding emergency services, changes in traffic patterns, hazardous conditions, and travel time in addition to event-specific messaging.

Effective communication with drivers supports desired traffic behavior to real-time changes in conditions. Decisions that appropriately address dynamic needs require a complex integration of a number of subsystems that ultimately coordinate the dissemination of information. Typically, arterial roadways do not have Dynamic Messaging Sign (DMS) signs to divert traffic during congestion, however, adding additional DMS signs upstream of the US-1 interchange on the arterials will guide drivers, further enhancing traffic congestion mitigation strategies.

Volusia County monitors 35 CCTV cameras throughout the county with several positioned throughout the interchange and are monitored by two Traffic Monitoring Centers (TMC) located in DeLand and Holly Hill. The cameras are used to identify incidents and to determine the proper procedure needed. The County's fiber optic network (FON) includes 72 strand single-mode and 24/12 strand hybrid backbone for a total length of approximately 52 miles. Unfortunately, the only data shared between the FDOT District 5 Operations Office and the Volusia County DeLand TMC is some of the CCTV video feeds.

FDOT District 5 uses probe vehicle detectors to detect speed data and travel times for certain roadways and can perform automatic vehicle identification. This information can be matched to the same vehicle at other detection locations and can be used along with traffic data vehicle detectors to identify incident detection, maintenance of traffic performance measuring, origin-destination research, and travel time predictions. Refer to Section 2.5 for supplementary information.

A concept for a Diverging Diamond Interchange (DDI) has been designed for the I-95 and US-1 interchange along US-1. DDIs have fewer conflict points compared to a conventional interchange and make wrong-way entry onto ramps very difficult. A study completed on a recently finished DDI showed a 60% reduction in crashes over a five-month period compared to the former interchange. During the construction of the DDI, consideration should be given to using the existing DMSs to inform drivers about the changeovers at the I-95 and US-1 interchange. This will alert drivers to the shifting road and be extra cautious when approaching the interchange.

2.4 User Class Profiles

The R2CTPO oversees urban transportation planning and programming efforts for the metropolitan planning area (MPA) that includes Volusia County and portions of Flagler County. They document existing conditions and are responsible for the planning of growth for the region. TSM&O projections and goals are found in the latest ITS Master Plan (2016) and the Long-Range Transportation Plan (LRTP) (2019).

As the largest stakeholder in the region, FDOT maintains a myriad of infrastructure elements supporting the core goals and needs of the adopted TSM&O program. Existing conditions of infrastructure providing the data, user interfaces, and decision-making tools along with regional transportation-related projections of future demands all fall within the umbrella of their vast responsibilities.

Volusia County, a key subsidiary in the R2CTPO, operates and maintains an ITS separate from FDOT, and provides County-specific elements of the TSM&O program. County system functionality leverages DOT data expanding their system with supplemental functionality such as transportation monitoring via access to Department CCTV, various data metrics, and a host of other backend and user-interface uses.

2.5 Support Environment

R2CTPO performs community outreach, analysis, and planning with their regional partners and are the primary vehicle with which larger-order TSM&O activities are directed in the area.

Much of the FDOT's TSM&O program goals, priorities, and funding allocations are documented in the FDOT ITS Strategic Plan (2017). Specifically for this study, included are fiber optic cable (FOC) trunklines for data communications, four (4) DMS signs to convey information to local drivers, and numerous CCTV cameras to monitor traffic flows and congestion as planned deployments to enhance operations, expand coverage, and provide infrastructure for Wide Area Network (WAN) integration of the local partners. Seven (7) existing network-connected intersections and microwave vehicle detection systems provide an array of data characteristics to Regional and Local TMC to aid in the overall management of the transportation system operations.

Volusia County possesses an independently owned FOC providing the primary medium through which regional communications are transferred, and leverages FDOT FOC in various locations to establish redundancy for system efficiency and security. Volusia County has both system connections to subsystem elements (e.g. traffic signals) and FOC WAN with FDOT. Volusia County maintains a separate system of other ITS-related subsystems throughout the County such as CCTV cameras, DMS, and Travel Time (TT) that are also shared with FDOT in support of TSM&O regional partnering practices. While the networks provide the opportunity to communicate between FDOT and Volusia County ITS networks, limitations in selected network architectures greatly reduce the level of communication. As such, Volusia County cannot access the FDOT CCTV camera feeds to monitor conditions along I-95 that have a direct impact on the operations of the County roadway network.

3. Change Justification

3.1 Justification for Changes

Being located within the unincorporated limits of Ormond Beach, west of Addison Blockhouse Historic State Park, and north of the Ormond Beach Municipal Airport, the I-95 at US-1 interchange is vital to distributing drivers to the beach, airport, and parks within the area. Additionally, the projected increase in local demand for various services will increase freight volume. Last-mile management has become a priority focus of planning efforts involving the consideration of innovation to leverage the industry shift to adopting next-generation technologies.

The increase in freight along the corridor anticipated with the projected growth of the region's population will require approaches to system solutions integrating with the industry trends of major market providers. Models of operations for supply delivery of these market providers have planned for last-mile solutions ranging from automated vehicle and drone transport. Infrastructure and roadway network planning considers the requirements of such systems supporting local stakeholders' projected modes by which their systems will adapt to and integrate with the developing technology. Due to economic factors including limited Right-of-Way (R/W), expansion of truck parking facilities is not a feasible solution to address increased parking demands. As such, effective TSM&O solutions to the issue must effectively allocate the available resources throughout the region lending to the planning of solutions leveraging the trends of the freight industry.

The R2CTPO Connected and Automated Vehicle (CAV) Readiness Study discusses opportunities to incorporate initiatives that would improve government services using different technology applications. Technology is constantly changing and R2CTPO is continuously updating and adopting new programs such as adding parking management as a pilot program. The addition of parking management systems would monitor parking availability and share with drivers the location of available parking via mobile apps or wayfinding signs, which would reduce the travel time for drivers.

3.2 User Needs

Application of the TSM&O planning approach provides a way to effectively focus on potential operational and technical advancements that assist in supporting stakeholder goals. Evaluation of opportunities to preserve and enhance safety, traffic congestion, event management, and data collection efforts are compared to the project's overall benefit/cost ratio for determination of appropriate applicability within economic constraints. The TSM&O approach to incorporating improvements baselines innovation selection through coordination with stakeholders to identify and/or verify concerns previously recorded in the various supporting documents.

The following solution sets will be shared for consideration and refined to enhance the TSM&O goals of this project. All proposed improvements have established network workflows as defined in the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) Version 9.0 of the federal architecture. Each is to be identified for feasibility and applicability while further guiding discovery in the latest direction of each stakeholder's initiatives to align TSM&O processes at the State, Regional, and Local Project levels. Service packages fall under the main areas of Data Management (DM), Parking Management (PM), Public Safety (PS), Commercial Vehicle Operations (CV), Traffic Management (TM), and Traveler Safety (TS) and may be further explored at the following website (https://www.arc-it.net/html/servicepackages/servicepackages-areaspsort.html).

Table 3: User Needs

User Need ID	User	Need
UN001	R2CTPO, FDOT, Volusia County	Data Management
UN002	R2CTPO, FDOT, Volusia County	Parking Management
UN003	R2CTPO, FDOT, Volusia County	Public Safety
UN004	R2CTPO, FDOT, Volusia County	Commercial Vehicle Operations
UN005	R2CTPO, FDOT, Volusia County	Traffic Management
UN006	R2CTPO, FDOT, Volusia County	Traveler Safety

4. Concepts for the Proposed System

4.1 Background, Objectives, and Scope

Base data such as speed, volume, and occupancy are now processed at the "edge" of newer systems for reporting of next-level data metrics such as turning movements, travel time, and Origin-Destination (O-D) paths, amid a host of other valuable traffic management performance measurement categories. ATSPM and SMART Signals include standardized practices such as monitoring of intersections via CCTVs and automating data evaluation. These subsystems contribute to the safety, mobility, efficiency, and longevity of signalized intersections, level of service, and regional assessment tools such as modeling and projection.

Implementing additional dynamic messaging signs upstream of US-1, wrong-way driving detection on the off-ramps, ramp metering, and constructing a DDI along US-1 would improve the overall safety and efficiency of the interchange. The installation of subsystems such as wrong-way driving and ramp metering will also generate a broader range of new datasets to enhance various performance metrics evaluation techniques. Similarly, the enhancement of the overall system provides for an opportunity to fulfill the requisitioning by local partners for enhanced network integration systems between the stakeholders. Doing so will enhance the performance in culminating, interpreting, and comparing data and facilitate improved collaboration between the agencies.

4.2 Operational Policies and Constraints

Operational policies in place are the adopted practices of FDOT D5 and the regional partners Volusia County. Each agency provides access to their adopted policies via their agency websites. Various contributing documents contribute to the overall operating policies of each agency. General management for collaborative cross-jurisdictional operations is practiced through FDOT D5's TSM&O department. Links to each agency's department is provided below:

Table 4: Agency Departments

Department	Link
FDOT D5 TSM&O	https://www.fdot.gov/traffic/its/tsmo.shtm
Volusia County - Development Engineering	https://www.volusia.org/services/public-works/engineering-and-construction/development-engineering/

4.3 Description of the Proposed System

The overall proposed system is the enhancement and augmentation of the existing system currently deployed within the project limits and as described in early sections. The improvements to the existing system fall under two categories: enhancements to existing or addition of new subsystems. Enhancements would be applied to all existing subsystems where replacement and or upgrades would support the regular practice of maintaining best practices of operation and maintenance standards. Additional subsystems for consideration support the TSM&O program goals of D5 which include ramp metering and wrong way driving subsystems.

Effective communication of applicable system operations elements such as messaging to drivers, email notification to managers, alerts to law enforcement and other established stakeholders, and actuation of alerting subsystems, such as specific DMS messages, remains a complex modality undergoing an ever-improving process. Maximizing the effectiveness of interoperations, logistics, and decision-making is one of the primary functions of the TSM&O program. Ensuring system augmentation and enhancements integrate into the reliable FON is critical to success. Likewise, the complexities of communications reliability require the proper coordination and design of the fiber optic cable infrastructure and associated network hardware

Effective communication to drivers of congestion and highlighting alternative routes significantly improves the management of regional traffic operations. TSM&O considers a myriad of subsystems that contribute to the function of diversion route management. It involves the use of vehicle detection systems upstream and downstream of the system which monitors traffic conditions. Triggers of predetermined system settings automate associated system reactive processes and workflows for various pre-programmed conditions such as diversion routes developed by management and operations.

Similarly, installation of vehicle detection systems at off-ramps are proposed to monitor traffic flow for the presence of vehicles traveling in the wrong direction. Identification of wrong-way vehicles is actuated with Light-Emitting Diode (LED), reflective “Wrong-Way” signs to alert drivers while simultaneously issuing alert notices to various TSM&O responsible personnel. These include emergency responders, law enforcement, and traffic management operations. Additional personnel defined in the Standardized Operations Procedures (SOP) are also programmed into the system, which is configurable and adjustable as a standard practice. Construction of Wrong-Way Driving systems is now required at all off-ramps within the State in support of the Target Zero Program. A relatively newer subsystem of ITS, D5 has design guidance that has been developed through regional-partner coordination with enhancements that are under consideration to further

increase its proven beneficial functionality. Constructing a DDI with reflective "Wrong-Way" subsystems would further enhance the preventative performance of the project.

Installation of ramp metering at all on-ramps are proposed to enhance management of traffic behavior in unsafe queuing and weaving conditions. The number of vehicles entering the freeway from the on-ramps are throttled when the mainline is experience volume to capacity ratios known to create unsafe queuing and weaving conditions. Vehicles are released from the on-ramp queue at a rate determined by the mainline volume and speed conditions. Throttling on-ramp volume eliminates ramp platooning which removes the merge condition such that disruption to mainline flow is reduced.

Enhancement of existing subsystems includes CCTV cameras throughout the project limits, which aids in the monitoring of the traffic, environment, and situational conditions. CCTV systems assist the TSM&O management and operations departments in monitoring real-time conditions and are critical to the successful implementation of emergency management directives. Similarly, messages to drivers via DMS, as well as informing truck drivers of available parking nearby via the Truck Parking Availability System (TPAS) are information dissemination subsystems standard to TSM&O. Enhancement of these subsystems through design for maximum effectiveness using the newest available hardware and software ensures the functionality meets the latest standards of the industry. Finally, the development of a Network Integration Plan and design would address the noted preferences of local stakeholders to improve system communications supporting data exchange between the agencies.

Table 5: Desired Changes

Change Type	Change	Priority
Capability	*Reduce head-on collisions due to wrong-way drivers on off-ramps with the implementation of vehicle detection systems.*	10
System Processing	*Provide a broader spectrum of traffic data with the implementation of more CCTV cameras throughout the interchange.*	5
Interface	*Allow for intercommunication among the different stakeholders by implementing network integration.*	8
Personnel	*More TSM&O responsible personnel will be needed to aid in the increased amount of footage coming from the addition of extra CCTV cameras.*	4
Environment	*With the implementation of route notification via the DMS, alternate routes can be suggested to drivers when traffic volumes become too high.*	6
Operations	*Less traffic should be expected after the implementation of diversion routes.*	6
Support	*An increased amount of maintenance will be required due to the addition of more signs.*	3
Other	*Less time spent from trucks on the interchange due to TPAS.*	2
Considered	*More law enforcement support could be necessary due to the higher level of surveillance in the area.*	1

4.4 Modes of Operation

TSM&O solutions to address event management include notification of upcoming events to drivers, development of specific timing patterns, deployment of Temporary Traffic Control (TTC) designs, coordination of law enforcement personnel, real-time monitoring from traffic management centers, and response efforts inevitably encountered during events. Enhancements consider emergency services response time, diversion routes, a collaboration of business, public, and private agencies, and stakeholders' efficiencies amongst an evolving solution set of developing technologies produced to address a range of factors from specific detection devices for special conditions to regional management software ingesting, displaying, and facilitating real-time decision making.

4.5 User Involvement and Interaction

TMC and other responsible personnel will interact with the system by monitoring live feed coming from the various CCTV cameras throughout the interchange. In addition to this, they will be responsible for displaying corresponding messages via the DMS for the correct course of action to be taken by the drivers, as well as any important information to aid them about oncoming traffic conditions.

In a wrong-way driving scenario, responsible personnel are to oversee the vehicle detection systems and confirm it is in fact a wrong-way driver. Preceding this, they should contact emergency responders, law enforcement, and traffic management, as well as display to oncoming traffic via the DMS (if possible) to not take the ramp involving the incident.

4.6 Assumptions and Constraints

Potential DMS locations could be constrained by the Right-of-Way, which in turn introduces an unfavorable scenario. For example, the driver's sight distance could be obstructed by an obstacle, or the placement of the sign is not far enough from the incident for the driver to make an optimal decision.

Incorrect monitoring of truck parking could also be a potential concern. To resolve this, FDOT should review truck parking accuracy upstream and downstream prior to pushing the system enhancements to drivers and make any necessary modifications at the truck parking locations.

4.7 Risks

Potential project risks are listed below in Table 6.

Table 6: Risk Register

Risk #	Risk Owner	Description of Risk and Impact	Likelihood (1-4)	Impact (1-4)	Rating (L + I) (2-8)	Mitigation Strategy	Status
1	FDOT	Incorrect monitoring of truck parking	3	3	6	Review truck parking accuracy upstream and downstream prior to pushing the system enhancements to drivers, and make any modifications necessary at the truck parking locations	Not started
2	FDOT	DMS sign location's R/W not optimal for driver sight lines and decision-making processes	1	4	5	Review preliminary placement of the DMS signs during the PD&E study to determine idealized locations and review R/W adequacy	Not Started

4.8 Support Environment

The TMC would be responsible for monitoring video coming in from the CCTV cameras throughout the project area. In scenarios, like wrong-way drivers, they would assess the situation and, if necessary, contact emergency responders, law enforcement, and traffic management operations as well as notify oncoming traffic via the DMS.

In other situations, like congested traffic, TMC responsible personnel would notify drivers via the DMS well before they have reached the congestion with any corresponding route notifications and possible diversion routes they could take to avoid the congestion.

5. Operational Scenarios

Installation of vehicle detection systems at off-ramps that monitor for the presence of vehicles traveling in the wrong direction brings more involvement and interaction from various TSM&O responsible personnel. When such presence is detected, the mentioned personnel must react expeditiously in assessing the situation and alert emergency responders, law enforcement, and traffic management operations, as well as oncoming traffic with the use of DMS.

The installation of ramp metering at on-ramps will break up the platoons of vehicles that typically make it difficult to merge into traffic and will be used only when the mainline is near or at capacity. Vehicles will queue on the on-ramp, stopping at a signal, and will be released individually depending on mainline vehicle speed and volume.

With the use of CCTV cameras, TSM&O responsible personnel are also involved in monitoring the traffic nearby the interchange and communicating any possible congestion, alternate routing,

accidents, etc., that may be a concern to drivers. This communication is conveyed via the DMS from a TMC by letting the drivers know of the location and any immediate alternate routes that can be taken.

TPAS provides notification of available spaces at nearby parking locations. Monitoring truck volumes in and out of parking areas provide information to help direct drivers on the appropriate course of action.

5.1 Normal Operations Scenario(s)

Network-integrated CCTV cameras throughout the interchange display a live feed of the current scenario in the area, indicating to various TSM&O responsible personnel the severity of the situation. Whether the condition results in congestion, an accident, etc., this in turn allows them to digest the information and enact appropriately; alerting emergency responders, stating there is traffic congestion on the dynamic messaging signs, etc.

5.2 Maintenance Scenario(s)

Maintenance is imperative in keeping all implemented systems up and running properly. All DMS, CCTV cameras, and on-ramp metering signals should always be operational for proper system operations. All subsystem components have maintenance schedules managed and performed by the maintenance contractors. Similarly, the FON communication subsystem is constantly monitored, and any sub-standard conditions are addressed by the maintenance contractor at pre-determined response and correction times depending on the scenario. Regular system maintenance occurs during nonpeak hours to maximize safety and minimize impacts to drivers.

Implementing additional CCTV cameras along the interchange and surrounding area would increase the amount of video that will be surveilled. This results in a need for an increase in TMC staff, hardware, software, and hours of operation. However, more surveillance is vital in the detection of accidents and provides the ability to notice potential fatalities as early as possible. This, in turn, would produce a need for more law enforcement and emergency responders to respond to the scene in an emergency scenario.

5.3 Failure Scenario(s)

A malfunction in any of the subsystem equipment, whether it be a CCTV camera watching for congestion or a microwave vehicle detection system monitoring for wrong-way drivers, could result in a failure in performance of the overall system. It is critical for TSM&O responsible personnel to have a reliable functioning system. Severity of a failure in the system ranges from a low impact such as a lapse in traffic data records collection to high such as affecting real-time emergency response capabilities. For example, the failure of a CCTV would impact management personnel from quickly recognizing an accident's location and conditions which may make the difference in emergency response arrival time to save a life. In all failure scenarios, trained professionals are equipped with SOPs to guide sufficient and efficient resolution.

6. Summary of Impacts

The following is a list of user impacts created by implementing the proposed system:

- Additional DMS signs will inform drivers earlier of wrong-way drivers, construction that requires extra caution, or traffic head with alternate diversions
- Implementing wrong-way driving signs will provide extra information to drivers to prevent confusion at the interchange
- Installing ramp metering will reduce congestion during peak hours and the number of crashes
- Additional CCTV cameras will alert TMC staff to crashes located throughout their corridor where they can then alert emergency personnel required
- Additional CCTV cameras will require an increased number of TMC staff to monitor and emergency personnel to respond to emergencies
- Constructing the DDI will reduce the number of crashes with fewer conflict points

7. Analysis of the Proposed System

7.1 Alternatives

Some alternatives include using Bluetooth Travel Time Sensors to monitor travel time through the corridor. They have been installed in DeLand and in other counties, but have not yet been implemented in Volusia County. There are also wireless magnetometers that could be used for vehicle detection in place of microwave detection. However, the magnetometers would need to be installed into the roadway and calibrated while microwave detection is located on the side of the road. The magnetometers tend to move out of alignment over time and would need to be replaced, unlike microwave detection.

Another alternative is using fiber optic cable to connect the LED wrong-way sign directly to the TMC. This would guarantee connectivity between the signs and the TMC, however, it would be very costly compared to using wireless communications. Additionally, the wrong-way signs could be solar-powered instead of using line power from the closest service point, but with the unpredictable Florida weather, there is a small chance of the signs not working when they are needed. The wrong-way signs do not need to be implemented with the proposed DDI, however, constructing them provides additional signs to prevent wrong-way driving from occurring.

7.2 Cost, Schedule, and Procurement Options

Cost, schedule, and procurement options will be better described later in the process.

7.3 Systems Engineering Plan

The guidance provided in this document will illustrate an in-depth description of the workings behind the new technology opportunities implementation. It characterizes the details of the technologies, describes the capabilities of their functionality, and states the benefits, repercussions,

and potential data that can be gathered with its addition. This document captures the concepts of preferred system solutions and contemplates the enhancement and augmentation of the overall system through assessment of ramp metering, wrong-way driving, network integration between stakeholders, ATSPM, SMART Signals, route notification and diversion, TPAS, Arterial DMS, and travel time.

Highlighting the methods to support the importance of safety for the public, drivers, and all involved personnel remains the highest priority of the Department. Safety is the overarching primary goal of all the technology opportunities mentioned in this document. Guidance and direction for the concepts herein are fully supportive of the Statewide Target Zero initiative.

7.4 Performance Measurement for System Validation

The Statewide Target Zero Program is the paramount motivation for implementing the wrong-way driving safety feature. The distinguished success of the vehicle detection systems currently installed throughout various off-ramps across the state exhibit the importance of such a system, and the need for it everywhere. An improvement in Traveler Safety (TS) can be recognized through FDOT's Crash Analysis Reporting (CARs) data by utilizing existing crash reports at the US-1 interchange and comparing them to future data.

Seeing an improvement in Traffic Management (TM) and Commercial Vehicle Operations (CV) will also be witnessed following the implementation of the additional DMS, CCTV cameras throughout the interchange, and ramp metering. By utilizing previously gathered queuing data from FDOT's Traffic Monitoring Sites (TMS) the change in traffic volumes can be accurately deduced.

8. Notes

This section will be annotated, as needed, with changes to the approved ConOps document made over the course of the project. There are no notes at this time.

9. Appendices

This section will be annotated, as needed, with changes to the approved ConOps document made over the course of the project. There are no appendices at this time.

10. Glossary

National ITS Reference Architecture (NITSA): The National ITS Reference Architecture, also known as the "*Architecture Reference for Cooperative and Intelligent Transportation*" or simply "ARC-IT", provides a common framework for planning, defining, and integrating intelligent transportation systems. ARC-IT is a reference architecture providing a common basis for planners and engineers with differing concerns to conceive, design and implement systems using a common language as a basis for delivering ITS, but does not mandate any particular implementation. The

National ITS Reference Architecture is maintained by the United States Department of Transportation (USDOT).

Operational Concept: A component of a regional architecture that identifies the roles and responsibilities of participating agencies and stakeholders in the existing and planned systems. The operational concept (or OpsCon) designs the institutional and technical vision for the region and describes how ITS will work at a very high level, frequently using operational scenarios as a basis.

Regional ITS Architecture (RITSA): A regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

SMART Signals: A system that is able to collect and archive event-based traffic signal data simultaneously at multiple intersections.

DOCUMENT REVISION HISTORY			
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