

I-4 Ultimate Managed Lanes Concept of Operations

FDOT D5 Approval	Signature	Date
Rick Morrow		
FHWA Approval	Signature	Date
Kris Milster		

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1. Introduction

The I4 ultimate managed lanes project consists of three primary elements as follows

- Electronic toll collection
- Pricing
- Intelligent transportation systems

This concept of operations addresses each of the three elements listed above.

2. Purpose of this document

This Concept of Operations document is designed to support the following purposes:

- Confirm FDOT D5 needs issues problems and objectives related to the application of advanced transportation technologies in the I-4 Ultimate Managed lanes project
- Provide an information source that can be used by a future contractor or concessionaire to guide the detailed design and implementation of the advanced technology elements of the project
- Satisfy federal requirements for structured systems engineering best practices to be applied to advanced technology projects in receipt of federal funding
- Document the total environment and use of the system to be developed in a non-technical and easy-to-understand manner and present this information from multiple viewpoints
- Provide a bridge that links the identified needs to the system level requirements for the project

The document addresses what is to be done, but not how it will be implemented. That will be determined later during later detailed design stages and be the responsibility of the concessionaire.

3. Objectives

The primary objectives for the I-4 Ultimate Managed lanes ETC and ITS systems are as follows:

1. The delivery of a dynamic tolling system that can adapt toll charges based on the current traffic conditions and provide a congestion management facility for future traffic conditions that improves journey time reliability. This includes support for a range of flexible pricing strategies that meet current and future needs with respect to I-4 operations. Pricing strategies to be developed from current industry best practice, based on the needs of Florida dot District 5 and with the ability to achieve the dual operating objectives of congestion management and revenue generation, taking full account of the value of drivers time and the travel time saved by using the managed lanes.
2. The ability to inform drivers regarding the toll for each segment. This will empower drivers

to make effective route choices.

3. The ability to support a range of different operating conditions including normal operation, incident operation, the evacuation operation, a total system failure
4. An effective interface between the Florida Department Transportation District 5 pricing system and Florida's turnpike enterprise SunPass statewide electronic toll collection system
5. Fair effective secure system operations and toll violation enforcement that are perceived by users as equitable
6. Regional intelligent transportation systems coordination and information exchange
7. The ability to take full advantage of the existing SunPass electronic toll collection system capabilities to provide a secure and reliable electronic toll collection system
8. Effective integration between the pricing system the electronic toll collection system and regional intelligent transportation systems to provide operational management possibilities
9. Historical data storage to enable operations to be analyzed in retrospect and to gain information that can be used to guide future operations and establish future tolling strategies.
10. An intelligent transportation systems infrastructure that can be used to underwrite the quality of the user experience in terms of traffic management, congestion management and traveler information

4. I4 Ultimate Managed Lanes Project Vision

The vision for the I-4 Ultimate Managed lanes system is the creation of a facility that will harness the full power of advanced transportation technologies within a robust organizational framework to deliver dynamic tolling, congestion management and regional transportation management capabilities. The system will enable FDOT D5 and Florida's Turnpike Enterprise to establish and manage a partnership that will combine the very best capabilities in each organization to support the operation of an advanced congestion management system along a critical section of the I-4 corridor in Central Florida.

Drivers using the I-4 corridor will experience a state of the art open road tolling system, supported by advanced traffic management and traveler information. FTE's expertise and experience in electronic toll operations will be brought to bear on the project to ensure that the dynamic tolling system effectively manages congestion and maintains pre agreed levels of service along the corridor by adjusting the pricing for each segment. This will also include the use of FTE experience in customer service, enforcement, transaction processing and enforcement management to deliver a system that is easy to use and understand from the driver's perspective and is considered a fair and effective congestion management tool by the residents of Central Florida.

The congestion management abilities of the system will be integrated with regional traffic management and traveler information approaches to ensure that the operating policies of the Managed Lanes are implemented in a manner that is coordinated and in harmony with wider regional systems. Data from the Managed Lanes sensors will be used to supplement the existing sensor and data collection network. Messages on the I-4 traveler information dynamic message signs will be fully consistent and compatible with the existing regional DMS network. Information regarding current operating conditions on the I-4 Managed lanes and the estimated cost of travel and travel time between the range of entry and exit points will be made available on the regional and statewide traveler information systems. Estimates of time savings through use of the I-4 Managed lanes will also be made available. The vision for the project can also be explained in terms of the impact that it will have on a number of key user groups:

- Managed lanes Driver
- General Use Lanes Driver
- Enforcement Officer
- FTE CSC Operator
- FDOT D5 Traffic Operations staff

These are described as follows:

4.1 Managed Lanes Driver

Jane is a regular week day commuter on the I-4. She works as a project manager in Longwood and lives in Orlovista Park so on most weekdays she commutes along the East West Expressway to the I4 and then to Longwood. Occasionally, she works from home as part of her employer's telecommuter program. So that she can drop her child off at day care in the morning on the way to work, she has chosen a day care center in Longwood. It is also close to her office, making it easy for her to respond to any emergencies. On this particular day, she was working from home as part of her employers telecommuting program and had been involved in an extended teleconference. She was now faced with the prospect of getting to the day care in long wood before the pick up deadline of 4:00 PM. It was now 3:30 pm and to ensure that she got there on time she decided to take a look at the I-4 Ultimate managed lanes option. She already knew from the various marketing and publicity efforts that the lanes in the center of the new I-4 corridor offered a more reliable journey time in return for the payment of a toll. She also knew that FDOT District 5 would vary the toll for each segment of her journey from time to time to ensure that traffic keeps moving slowly. She quickly found the I-4 Ultimate web site using her browser and zoomed in on the page that provides travel time and cost estimates. The page information helped her to determine the estimated time and cost for making her journey to Longwood on the managed lanes or on the general use lanes. It showed a journey time estimate of 25 minutes for an estimated toll of \$5 on the Managed Lanes and an estimated journey time of 40 minutes on the general use lanes (traffic is heavy at this time of the evening in downtown Orlando. If she took the managed lanes option she would arrive at the day care in time to avoid a \$15 fine for being late to collect her child. Spend \$5 to save \$15, no brainer thought Jane.

4.2 General Use Lanes Driver

Tom is a basketball fan. He and his son have just been to a Magic game at the Amway center and are now headed home to Windermere. Tom checked his smart phone in the parking lot before they set off for home and noticed that Google maps was showing the I-4 managed lanes as the fastest way home given current traffic. However, he noticed that the alternative route along the I-4 managed lanes was showing an estimated journey time just 10 minutes longer than the managed lanes option. Although this journey time estimate may not be as reliable as the managed lanes, they decide to take the general use lanes and spend the \$5 toll they saved on some ice cream on the way home. The I-4 managed lanes are cool, but when you're not in a hurry, ice cream is cooler.

4.3 Enforcement Officer

Bo is a trooper with the local enforcement agency. For the past few weeks he has been assigned to toll enforcement duties associated with the I-4 managed lanes. Bo patrols the section of the I-4 from Kirkman to Longwood and he is on the lookout for drivers who are trying to violate or evade the electronic toll collection system on the managed lanes. Only private cars, buses and emergency vehicles are allowed on the managed lanes so the first thing that Bo looks for are trucks and non-allowed vehicles. Bo also has special equipment in his vehicle that enables him to check transponder operation and also check the balance in the prepaid accounts. Each morning before he leaves the station both downloads the latest account information into his mobile enforcement system. The mobile enforcement system consists of two components – a database of account information and a mobile transponder reader. The database of account information is supported by a special piece of software that allowed board allows both retrieve information based on license plate data. The mobile transponder reader is very similar to those attached to the roadside unit's roadside gantries and enables both the check that the transponder is operating properly. This would reveal that the transponder had been tampered with in any way or if it's simply a case of low battery requiring replacement or incorrect installation of the transponder

4.4 FTE Customer Service Center (CSC) Operator

Cathy is a customer service operator within the FTE SunPass team. Her job is to answer telephone calls and conduct online chat sessions with customers who have questions and issues. Today she has answered 50 telephone calls and conducted 25 online chat sessions. The issues to be resolved vary from drivers who feel that they were charged the wrong toll, to faulty transponders to account managed issues. Cathy has access to the SunPass administration system that enables her to see customer account information and transaction history. She can also retrieve video images of the dynamic tolling dynamic message signs for any time of the day. She can use this to verify the toll displayed at a particular time of day. There is nothing like a picture to convince people that the system is working properly. Seeing is believing, as they say.

4.5 FDOT D5 Traffic Operations Supervisor

James is the supervisor for the I4 ultimate managed lanes pricing system based in the regional traffic management center. He works with a sophisticated dashboard that allows him to get information on and send instructions to the FDOT District 5 dynamic tolling system. Today he is working on testing a new algorithm that could be deployed later on the I4 ultimate project. The testing work involves running the algorithm with the simulation system that depicts traffic

conditions of the I4 and shows James how traffic conditions will change with the introduction of the new algorithm.

The algorithm makes use of traffic flow and traffic speed data coming from sensors on the Managed Lanes and parallel general-use lanes. This data is then taken as the basis for a traffic flow density calculation and all three parameters are used to determine the appropriate toll for the next time period.

Another of James's duties is to supervise the Managed Lanes pricing system to check that the tolls that should be charged for a given segment for a given time of day have actually been implemented by the Florida's Turnpike Enterprise SunPass system. He does this by taking a random sample of the tolls that are being charged for any given time, and compares this to the tolls that should have been charged. He can also check the video records to show what toll rate was displayed to the drivers at any given time during the day and use this information to confirm that the correct toll was being charged. James also has the authority to go back and make retrospective changes to the toll rates should that be warranted based on his investigation.

James will also coordinate with his colleagues in the regional traffic management center regarding current traffic conditions on the entire Central Florida road network. James can move the pricing system to a different mode of operation if required. For example in the event of an emergency evacuation situation James can switch the pricing system to evacuation mode taking all toll rates to zero for a specified time, while the facility remains in full operation.

5. Operational Philosophies

Operational philosophies define the way in which the system will be operated in terms of participant roles and overall policies to be implemented. The participant roles are defined in overview in this section and detailed under specific operating scenario conditions later in the document.

5.1 Project Delivery – Planning, design, implementation

The project owner, FDOT D5 will engage other public sector and significant private sector resources in the design, implementation and operation of the I-4 Managed lanes facility. Florida's Turnpike Enterprise (FTE) will be engaged to deliver and operate the electronic dynamic tolling system that will be required for congestion management. As we have considerable experience in the implementation of public-private partnership projects, a private sector concessionaire or design build operate contractor will also be engaged to deliver and operate the Managed Lanes infrastructure under the auspices of a Public Private Partnership or Design, Build, Operate, Manage (DBOM) agreement.

The FTE incumbent electronic toll system integrators, Raytheon HTMS and Transcore Inc. will provide dynamic tolling system hardware and software design and implementation services

Both the successful concessionaire and the FTE electronic toll systems integrators will be expected to comply with the system engineering management plan and be guided by the requirements document Incorporated into this concept of operations

5.2 Operations

Making use of the capabilities of the SunPass electronic toll collection system District 5 will operate a truly dynamic electronic tolling system on the managed lanes. The objective will be to vary the tolls in a fashion that allows District 5 to preserve target levels of service on the managed lanes. There are many policy decisions that will have to be incorporated into the operating characteristics of the system and many of these policy decisions will influence the exact detailed design of the dynamic toll system. In particular the algorithm used to calculate the price at any given time for any given vehicle will take account of these policy decisions. This policy decisions are incorporated into a separate pricing policy document [1]. While the detailed design of the pricing algorithms will be developed later in the project, the following section provides an overview of the concept of operations for the pricing system. The I4 ultimate Managed Lanes project consists of four Managed Lanes and six general use lanes. There will be two Managed Lanes in each direction and three general use lanes in each direction along the 22 mile corridor. Drivers will be offered a choice between the use of the Managed Lanes and the general use lanes. The managed lanes will offer a higher quality of service in trip time reliability implemented by a dynamic toll. The toll will be varied according to traffic flow conditions on the Managed Lanes. The general use lanes will be toll free offering drivers an alternative. At decision points close to the entrances to the Managed Lanes System dynamic message signs will advise drivers of the current toll for the next segment of the Managed Lanes. At subsequent decision points along the I4 Managed Lanes additional dynamic message signs will inform drivers of the cost of subsequent segments and empower them to make a travel choice to use the managed lanes or the general use lanes.

FDOT District 5 is responsible for the pricing algorithms and for the determination of the price at any given time of day on any section of the Managed Lanes for a given vehicle. The FDOT District 5 dynamic tolling system will then communicate the appropriate charge for each vehicle and each segment to the FTE SunPass system. In return the SunPass system will send a confirmation message back to the FDOT District 5 dynamic tolling system confirming that the appropriate charge has been implemented. The dynamic tolling system will be developed on the foundation of the basic economic theory relating demand to price as shown in the following diagram.

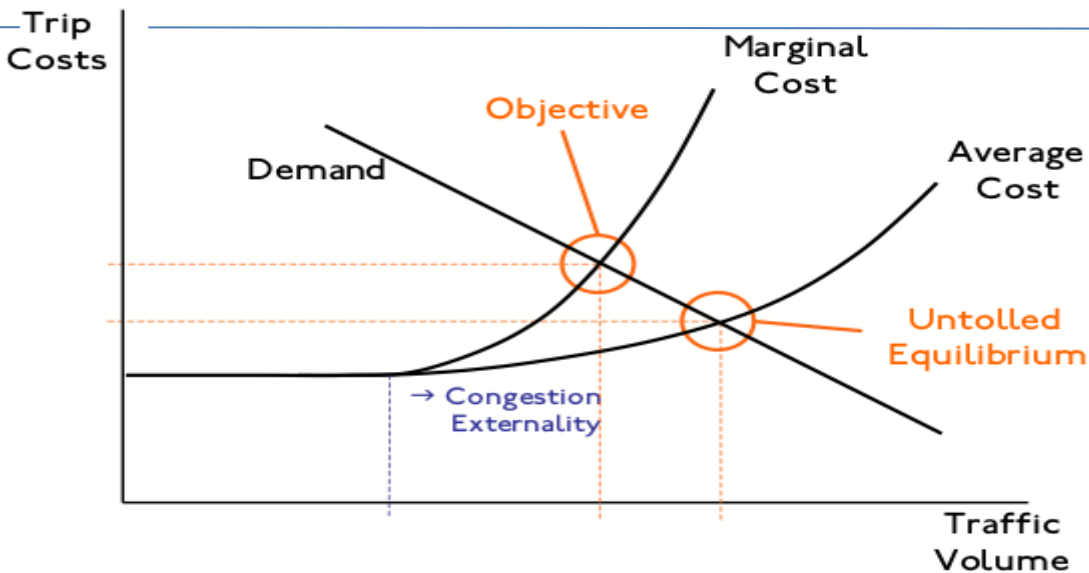


Figure 1: Cost/Volume Curve

5.3 Dynamic Pricing Principle

The principle is very simple: the volume or the demand for travel is reduced as the cost of the trip is increased. For example, in the figure, as trip cost is increased from average cost to marginal cost by imposing a toll or user fee, then traffic volume drops from the untolled equilibrium to the objective traffic volume. The relationship between volume and price with respect to pricing and tolling for congestion is referred to as elasticity. In economic terms elasticity is defined as change in demand or volume divided by the change in price. Elasticity can also be defined as the slope of the straight-line shown in the diagram above.

Dynamic tolling makes use of sensors in the roadway that are used to continuously monitor traffic flow. Incremental adjustments of the toll are then made to correspond to changes in the traffic flow. One approach to this is to install sensors in the Managed Lanes and adjust the toll in order to preserve a specific level of service on those lanes. Another approach involves the installation of sensors on both the Managed Lanes and parallel general use lanes. Travel times on both facilities are then computed and the toll charged on the basis of the travel time-saving experienced by drivers on the Managed Lanes. The I-4 Ultimate System will be designed to accommodate either approach providing District 5 with flexibility for future operational management.

Dynamic tolling approaches make use of a special purpose algorithm that takes traffic data as input and varies one or more of the following key parameters to achieve a traffic performance objective:

- Speed (miles per hour)
- Flow (vehicles per hour)
- Flow Density (vehicles per mile per lane)

- Headway (feet)
- Elasticity of demand (ratio)
- Toll adjustment interval (minutes)
- Toll adjustment increment (cents)
- Minimum toll (dollars)
- Maximum toll (dollars)

The District 5 system will attempt to preserve a level of service on the Managed Lanes. The level of service is defined as an average speed on the Managed Lanes or as a Level of Service (LoS) as defined in The Highway Capacity Manual and the American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets (often referred to as the "Green Book"). Levels of service are defined in the table.

Level of Service (LOS)	Description	Detailed traffic conditions
A	Free flow	Traffic flows at or above the posted speed limit and all motorists have complete mobility between lanes. The average spacing between vehicles is about 550 ft. (167m) or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. An example of LOS A occurs late at night in urban areas, frequently in rural areas, and generally in car advertisements.
B	Reasonably free flow	Free flow (LOS A) speeds are maintained, maneuverability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 330 ft. (100m) or 16 car lengths. Motorist still have a high level of physical and psychological comfort.
C	Stable flow	Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 220 ft. (67m) or 11 car lengths. At LOS C most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect but localized service will have noticeable effects and traffic delays will form behind the incident. This is the targeted LOS for some urban and most rural highways.
D	Approaching unstable flow	Speeds slightly decrease as the traffic volume slightly increases. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 160 ft. (50m) or 8 car lengths. Minor incidents are expected to create delays. Example of LOS D is perhaps the level of service of a busy shopping corridor in the middle of a weekday, or a functional urban highway during commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require a prohibitive cost and societal impact in bypass roads and lane additions.
E	Unstable flow	Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths; however speeds are still at or above 50 mi/h (80 km/h). Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Driver's level of comfort becomes poor. LOS E is a common standard in larger urban areas, where some roadway congestion is inevitable.
F	Forced or breakdown flow	Flow is forced; every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Technically, a road in a constant traffic jam would be at LOS F. This is because LOS does not describe an instant state, but rather an average or typical service. For example, a highway might operate at LOS D for the AM peak hour, but have traffic consistent with LOS C some days, LOS E or F others, and come to a halt once every few weeks. However, LOS F describes a road for which the travel time cannot be predicted. Facilities operating at LOS F generally have more demand than capacity.

Table 1: Levels of Service Definitions

Through empirical observation, the different Levels of Service are linked to different toll levels. The elasticity parameter discussed previously can also be used to related traffic flow or flow density to price.

The dynamic tolling calculation makes use of traffic data sensors on the Managed Lanes to provide data regarding the prevailing traffic conditions. Then the special-purpose algorithm is used to determine how the tolls must be raised or lowered to maintain the target level of service on the Managed Lanes. In some cases traffic sensors are also placed in the general use lanes alongside the Managed Lanes. The travel time difference between the Managed Lanes and the general use lanes is then taken into account in determining the current toll. The rate at which tolls are altered is usually constrained by the minimum and maximum toll increment in order to ensure stable pricing and smooth transitions between tolls.

The figure below shows the overall flow for The 95 Managed lanes pricing algorithm using the Managed Lanes level of service approach.

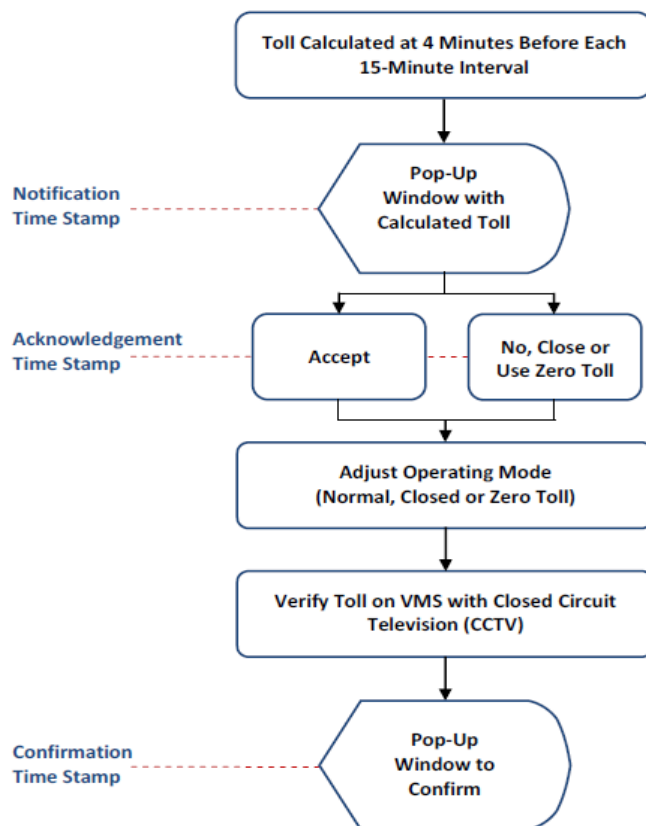


Figure: 2 95 Express Lanes Toll Calculation Flow Diagram

For the 95 Managed lanes implementation the toll is calculated at 15 minutes intervals. The toll calculation is initiated 4 minutes before each 15 minute interval begins to allow time for the new toll to be calculated, the operator to validate the new toll and for it to be communicated to drivers via dynamic message signs. The system also has “closed” and “zero toll” modes. These are used

when an incident requires that Managed Lanes be closed to traffic (close mode) or when an evacuation scenario requires the toll to be removed completely for a period of time to facilitate evacuation (zero toll mode).

At the entry points to the Managed Lanes drivers are informed of the current charge for the Managed Lanes through the use of dynamic message signs. It will be necessary to be able to confirm that these dynamic message signs display the correct toll. This is achieved through the use of closed circuit TV cameras trained on the dynamic message signs so that a tolls operator can verify that the correct toll is being displayed. Images from the CCTV system are also recorded on a DVR system enabling historic records to be retrieved if a particular toll is questioned. If for some reason an incorrect toll is displayed the pricing operator has the ability to retrospectively alter the toll.

FDOT D5 will have a system performance dashboard that will support the following functions:

- Retrieval of the history of toll displays at each DMS
- Ability to pull up CCTV verification of toll display on each DMS
- Ability to sample and reconcile trips

Tolls will be displayed and charged on a segment by segment basis with DMS displays providing information to drivers before each decision point. This preserves the flexibility to alter tolling rates fast enough to influence demand within a reasonable time period.

All dynamic tolling parameters will be selectable by menu from the dashboard for the pricing system

5.4 Maintenance

Maintenance responsibilities for the project will be assigned according to function. For maintenance activities associated with the upkeep of infrastructure such as pavement, structures, telecommunications, power and roadside devices (except ETC), the selected concessionaire will be responsible. For roadside devices associated with the electric toll collection and pricing systems, FTE and its incumbent system integrator will take responsibility. On telecommunications maintenance activities, the demarcation line shall be the lane controllers at the foot of each toll zone gantry. The concessionaire will be responsible for all power and telecommunications equipment up to and including the connection to the lane controllers. FTE and its incumbent system integrator shall be responsible for the telecommunications facilities between the lane controller, the remainder of the toll zone equipment and the FTE back office.

The roles and responsibilities for each project participant with regard to each element of the system can be summarized in the following tables.

Responsibility	Electronic Toll Collection	Pricing	Intelligent Transportation Systems
Planning	FDOT D5/FTE	FDOT D5	FDOT D5
Design	FTE	FDOT D5	Concessionaire
Implementation	FTE	FDOT D5	Concessionaire
Operations	FTE	FDOT D5	FDOT D5
Maintenance	FTE	FDOT D5	Concessionaire

Table 2: Overview

The table above provides an overview of the responsibilities of each participant by stage of project and regarding each element of the system.

Responsibility	Account Management	Transaction Processing	Enforcement	Billing	Customer Service
Planning	FDOT D5/FTE	FDOT D5/FTE	FDOT D5/FTE	FDOT D5/FTE	FDOT D5/FTE
Design	FTE	FTE	FTE	FTE	FTE
Implementation	FTE	FTE	FTE	FTE	FTE
Operations	FTE	FTE	FTE/Local enforcement agency	FTE	FTE
Maintenance	FTE	FTE	FTE	FTE	FTE

Table 3: ETC

The table above provides additional detail regarding the electronic toll collection elements of the system.

Responsibility	data collection	pricing calculation	pricing communication	communication verification	operating mode selection	software and strategy development
Planning	FDOT D5	FDOT D5	FTE/FDOT D5	FTE	FDOT D5	FDOT D5
Design	Concessionaire	FDOT D5	FTE/FDOT D5	FTE	FDOT D5	FDOT D5
Implementation	Concessionaire	FDOT D5	FTE/FDOT D5/Concessionaire	FTE	FDOT D5	FDOT D5
Operations	FDOT D5	FDOT D5	FTE/FDOT D5/Concessionaire	FTE	FDOT D5	FDOT D5
Maintenance	Concessionaire	FDOT D5	FTE/FDOT D5/Concessionaire	FTE	FDOT D5	FDOT D5

Table 4 Dynamic Tolling

The table above shows detailed roles and responsibilities for each project participant with regard to the dynamic tolling system.

Responsibility	Sensors	CCTV	Dynamic Message Signs	Road Ranger	data collection	pricing calculation	pricing comms	verification	operating mode selection	software and strategy development	RTMC	Web	IVR	Telecom
Planning	FDOT D5	FDOT D5	FDOT D5	FDOT D5	FDOT D5	FDOT D5	All	FTE	FDOT D5	FDOT D5	FDOT D5	CO	CO	All
Design	Concession.	Concession.	Concession.	FDOT D5	FDOT D5	FDOT D5	All	FTE	FDOT D5	FDOT D5	FDOT D5	CO	CO	All
Implementation	Concession	Concession.	Concession.	FDOT D5	FDOT D5	FDOT D5	All	FTE	FDOT D5	FDOT D5	FDOT D5	CO	CO	All
Operations	FDOT D5	FDOT D5	FDOT D5	FDOT D5	FDOT D5	FDOT D5	All	FTE	FDOT D5	FDOT D5	FDOT D5	CO	CO	All
Maintenance	Concession	Concession.	Concession.	FDOT D5	Concession.	FDOT D5	All	FTE	FDOT D5	FDOT D5	FDOT D5	CO	CO	All

Table 5 Intelligent Transportation Systems

The table above defines participant roles and responsibilities with respect to intelligent transportation systems and the various stages of project.

6. Project Support Environment

The I4 ultimate project will fit within an existing project support environment. The support environment includes the following existing systems. These include systems that don't currently exist but will have been developed by the time of I-4 the Managed Lanes inception in 2020.

The systems have been defined in two tiers. The first tier is operated by those agencies that operate transportation facilities that are connected or adjacent to the I-4 Managed Lanes facility:

6.1 Florida DOT District 5 Regional ITS and Traveler Information System – SunGuide

All ITS devices and services will be supported through the existing SunGuide software located at the D5 Regional TMC

6.2 Florida DOT District 5 Dynamic Tolling System

The toll to be charged for each segment of the managed lanes facility for each time segment and for each class of vehicle shall be calculated by the FDOT D5 dynamic tolling system. The relevant toll information shall be communicated to the FTE SunPass system.

6.3 Florida's Turnpike Enterprise SunPass electronic toll collection system

The existing SunPass system will be operated by FTE to collect tolls specified by the FDOT D5 Dynamic Tolling System. Enforcement and customer service will be supported by FTE as part of their statewide role

6.4 Lynx Transit Management Center

The FDOT D5 Regional Traffic Management Center will support two way communications with the Lynx transit management center especially with regard to BRT service operation on the I-4 Managed Lanes facility.

6.5 Seminole County TMC

The FDOT D5 Regional Traffic Management Center will support two way communications with the Seminole County TMC especially with regard to incident management and the operation of traffic signals on parallel routes for incident diversion.

6.6 RITIS (Regional Integrated Transportation Information System (RITIS))

The FDOT D5 Regional Traffic Management Center will support two way communications with the MetroPlan regional data collection system for the purposes of providing and making use of data to/from the system.

6.7 City of Orlando

The FDOT D5 Regional Traffic Management Center will support two way communications with the City of Orlando Regional Computerized Signal System (RCSS) for the purposes of providing and making use of data to/from the system and coordination between managed lane operations and surface street traffic control.

6.8 Orange County Traffic Management Center

The FDOT D5 Regional Traffic Management Center will support two way communications with the Orange County TMC especially with regard to incident management and the operation of traffic signals on parallel routes for incident diversion.

The second tier of traffic management centers are operated by those agencies identified in the Central Florida Regional ITS Architecture and not already identified above. The FDOT D5 Regional Traffic Management Center will support two way communications with these other traffic management centers operated by cities and counties, for the purposes of regional traffic and incident management. These TMCs are as listed as follows:

- City of Daytona Beach Traffic Management Center
- City of Melbourne Traffic Operations Center
- City of Ocala Traffic Management Center
- City of Orlando Traffic Management Center
- City of Winter Park Traffic Operations Center
- Disney Traffic Operations Center
- OCEA Traffic Management Server
- Brevard County Traffic Operations Center
- Lake County Traffic Operations Center
- Marion County Traffic Management Center
- Osceola County Traffic Operations Center
- Seminole County Traffic Action Center (SEMTAC)
- Volusia County Traffic Management Center
- Palm Coast
- Flagler County

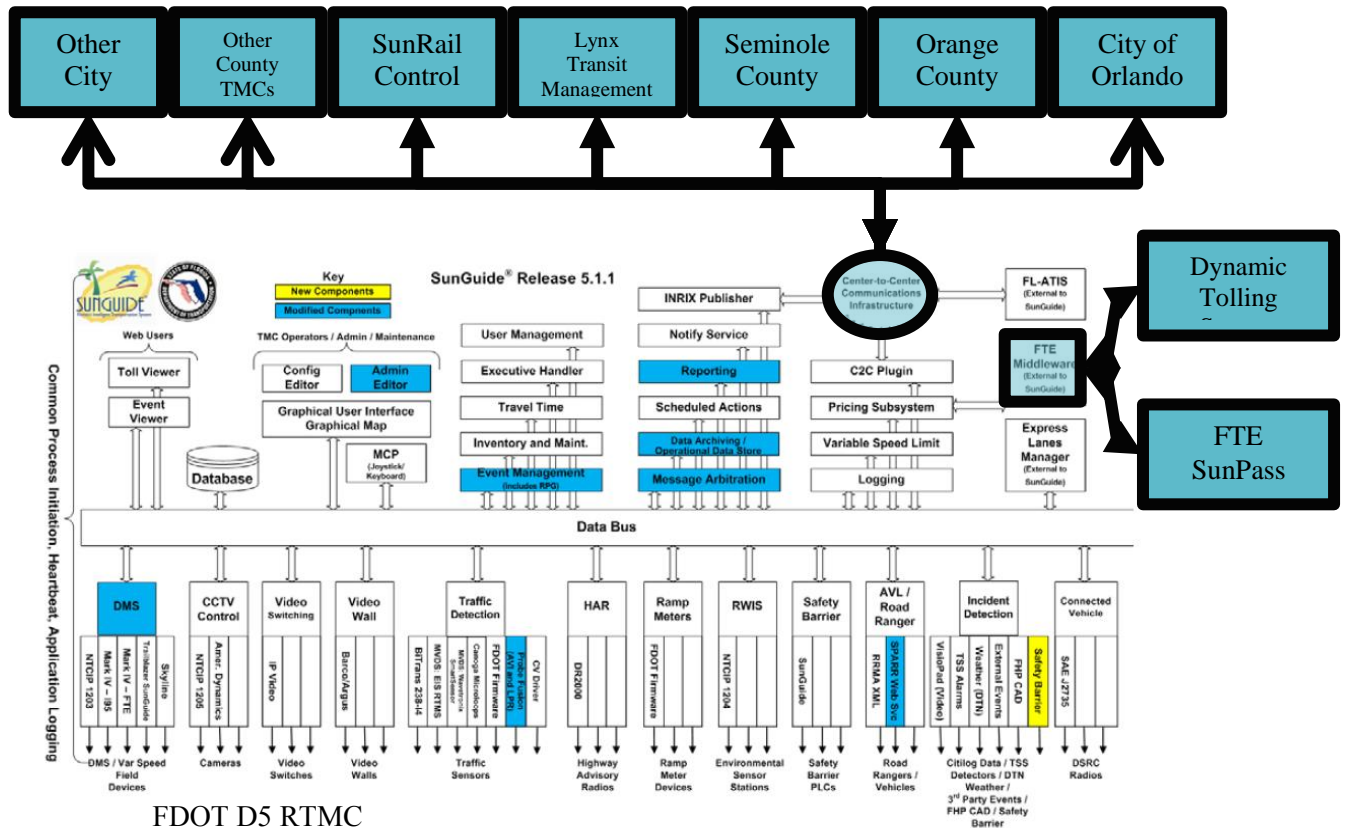


Figure 3: Major interfaces between the I4 ultimate toll collection and pricing system

The figure shows how the I4 ultimate system connects to regional Intelligent Transportation Systems and the project support environment.

7. Operational Scenarios

A number of operational scenarios have been defined. The purpose of the operational scenarios is to highlight the roles and responsibilities for each partner in the project under certain operating conditions. The following scenarios to be chosen to illustrate operational responsibilities:

7.1 Routine System Operation

The team system operation is expected to be the normal operational scenario that will prevail for the majority of the time during operations. Under this scenario it is assumed that all equipment is functional including electronic toll collection, pricing and intelligent transportation systems. It is also assumed that the support environment systems including the regional Intelligent Transportation Systems and the FTE SunGuide system are also fully operational.

7.2 Incident Operation

Under incident conditions it is assumed that a major incident at a given location on the Managed Lanes has caused the Managed Lanes to be closed. Under this scenario roles and responsibilities for incident detection, resource dispatch, incident clearance and traffic management, resource dispatch traffic management are defined.

7.3 Evacuation or Special Event Operation

Under the evacuation or special event scenario the I4 managed lanes have been opened up as a free facility to speed traffic flow away from the evacuation area or to manage the special event conditions. Under this scenario all tolls are being removed from the managed lanes and regional intelligent transportation systems resources have been dedicated to evacuation management.

7.4 DMS or Traffic Sensor System Failure

Under this unlikely scenario a DMS or traffic sensor system failure has occurred. This would involve the loss of the ability to display the current toll to the drivers using the managed lanes or the ability to determine tolls based on traffic flows. This scenario deals with transitional arrangements for applying historical tolls while the system elements are inoperable and describes roles and responsibilities for each partner in returning the system to normal operation.

In order to make the concept of operations simple to understand for all parties involved it was decided to seek a graphical or visual method for presenting the concept of operations. After some research it was decided to use a process mapping approach. A process map defines each activity to be supported in sequence and also lists the parties responsible for supporting the activity. Each of the operational scenarios as described above are presented in the following section in the former process maps. Swim lane diagrams are contained in an online version. Work is continuing to develop a web-based approach to enable a larger audience to view these process maps.

8. Operational System Characteristics

The operational characteristics of the system are described from two different perspectives. Firstly, a high level description of system features and functions is provided in the overview system requirements document contained in appendix L of the System Engineering Management Plan and is reproduced in this document as Appendix A, for reading convenience. Secondly, Appendix B of this document contains a traceability matrix that has been developed to show the connection between the initial objectives stated at the beginning of this document and the overview system requirements. Another way to explain the operational system characteristics is to list the intelligent transportation system market packages that are delivered by the system. The following table shows a list of market

packages from the central Florida regional intelligent transportation systems architecture indicating those market packages that are delivered as part of the I4 Ultimate Project.

Central Florida Regional ITS Market Packages	Delivered by I-4 Ultimate
D2 - ITS Data Warehouse	
AD3 - ITS Virtual Data Warehouse	
ATIS1 - Broadcast Traveler Information	
ATIS2 - Interactive Traveler Information	
ATMS02 - Probe Surveillance	●
ATMS07 - Regional Traffic Control	●
ATMS08 - Traffic Incident Management System	●
ATMS10 - Electronic Toll Collection	●
ATMS11 - Emissions Monitoring and Management	
ATMS16 - Parking Facility Management	
ATMS20 - Drawbridge Management	
CVO03 - Electronic Clearance	
CVO04 - CV Administrative Processes	
CVO05 - International Border Electronic Clearance	
CVO06 - Weigh-In-Motion	
CVO07 - Roadside CVO Safety	
CVO08 - On-board CVO and Freight Safety & Security	
CVO10 - HAZMAT Management	
EM01 - Emergency Call-Taking and Dispatch	
EM02 - Emergency Routing	
EM03 - Mayday and Alarms Support	
EM05 - Transportation Infrastructure Protection	
EM06 - Wide-Area Alert	
EM07 - Early Warning System	
EM08 - Disaster Response and Recovery	
EM09 - Evacuation and Reentry Management	
EM10 - Disaster Traveler Information	
MC01 - Maintenance and Construction Vehicle and Equipment Tracking	
MC02 - Maintenance and Construction Vehicle Maintenance	
MC03 - Road Weather Data Collection	●
MC04 - Weather Information Processing and Distribution	
MC07 - Roadway Maintenance and Construction	
MC08 - Work Zone Management	
MC09 - Work Zone Safety Monitoring	
MC10 - Maintenance and Construction Activity Coordination	

Table 6 Central Florida Intelligent Transportation Systems Architecture Market Packages

9. System Constraints and Limitations

It is important to recognize that the I4 ultimate project is essentially an electronic toll collection, pricing and intelligent transportation system. There is no attempt made to deliver all of the market packages defined in the central Florida intelligent transportation systems architecture. The project delivers only five out of the total of 35 market packages defined in the table above. The project also does not deliver traffic management or traveler information on a regional basis. The overall design of the system is such that regional traveler information and regional traffic management functions are assumed to be provided by the existing SunGuide system.

The project also relies heavily on the existing FTE SunPass system. While the dynamic tolling calculations will be supported by some special purpose software developed as part of this project, the basic electronic toll collection system functions will be provided by FTE. This will enable the electronic toll collection to fit under a statewide umbrella and make sole leverage of prior investments in the SunPass system. The SunPass system will provide account management, transaction processing, billing, enforcement and customer service functions using existing system hardware software and organizational arrangements. The services will be provided under the auspices of a memorandum of understanding between FTE and FDOT D5.

10. Institutional Issues

Successful operation of the I4 ultimate Managed Lanes system requires close cooperation between Florida DOT District 5 and Florida's Turnpike Enterprise. Is that overall operational management principle Florida's Turnpike Enterprise will be responsible for the electronic toll collection process. They will make use of the existing SunPass system for this purpose. Florida DOT District 5 has responsibility for the determination of the price to be charged on any given segment at any given time on the I4 Managed Lanes corridor. System interfaces will be developed to enable the Florida DOT District 5 pricing system to communicate with the SunPass system. Successful operation of this interface will also require the establishment of a memorandum of understanding and possibly a service level agreement between Florida DOT District 5 and Florida's Turnpike Enterprise. [2].

With respect to enforcement associated with the electronic toll collection and pricing process it will be necessary to develop a separate agreement with the local enforcement agency. This will define the enforcement services to be provided and the level of quality for each service. [3]

11. Training needs

The relative roles and responsibilities of the project participants are defined in the "who does what" tables shown earlier. Based on these roles and responsibilities a series of training needs have been identified as shown in the table below.

Project Stage	Electronic Toll Collection	Pricing	Intelligent Transportation Systems
Planning	FDOT D5/FTE	District 5 staff may require some background training in lessons learned and practical implementation experiences gained on prior deployments of dynamic tolling technology	None
Design	District 5 staff may require some background training on the operational procedures used in the SunPass system	District 5 staff may require information from previous implementers regarding the detailed design of algorithms	The concessionaire may require some background training with regard to legacy systems and District 5 operating procedures
Implementation	None	District 5 staff may require the ability to taste implementation procedures and specific algorithms in an off-line simulator	The concessionaire may require some training on Florida Department of Transportation implementation procedures
Operations	FTE customer service representatives may require training on the new aspects of the system related to dynamic tolling	Training will be required in new operating procedures related to the dynamic tolling system	None
Maintenance	None	FDOT D5	The concessionaire may require some training in Florida Department of Transportation preferred maintenance procedures

Table 7: Training Needs

It is assumed that a detailed training plan based on the above information will be developed by the concessionaire as part of the detailed design process for the project.

12. References

- [1] FDOT D5 Dynamic Tolling Pricing Policy (to be developed)
- [2] FDOT D5 and FTE MOU (to be developed)
- [3] I-4 Ultimate Managed Lanes Enforcement Agreement (to be developed)
- [4] I-4 Ultimate Managed Lanes Training Plan (to be developed)