Technical Memorandum No. 3

ITS Logical Architecture:

ITS Corridor Master Plans for Florida's Principal Limited-Access FIHS Corridors

Prepared for:

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List of Acronyms

ADMS ..... Archive Data Management Subsystem
AFD ..... Architectural Flow Diagram
AHS ..... Automated Highway System
APTS ..... Advanced Public Transportation System
ATIS ..... Advanced Traveler Information System
ATMS ..... Advanced Traffic Management System
AVC ..... Automatic Vehicle Classification
AVI ..... Automatic Vehicle Identification
AVL ..... Automated Vehicle Location
AVLS ..... Automatic Vehicle Location System
AVSS ..... Advanced Vehicle Safety System
CAD ..... Computer-Aided Dispatch
CCTV ..... Closed-Circuit Television
CVO ..... Commercial Vehicle Operations
DFD ..... Data Flow Diagram
DMS ..... Dynamic Message Sign
DMV ..... Department of Motor Vehicles
DSRC ..... Dedicated Short-Range Communications
E-911 ..... Enhanced 911
EM ..... Emergency Management
EMC ..... Emergency Management Center
EPS ..... Electronic Payment System
ETC ..... Electronic Tolls Collection
ETI ..... Evacuation Travel Information
EVS ..... Emergency Vehicle Subsystem
FDOT ..... Florida Department of Transportation
FIHS ..... Florida Intrastate Highway System
GPS ..... Global Positioning System
HAR ..... Highway Advisory Radio
HAZMAT ..... Hazardous Materials

HOV ..... High Occupancy Vehicle
HPMS ..... Highway Performance Monitoring System
HRI ..... Highway-Rail Intersection
ICC ..... Interstate Commerce Commission
IMS ..... Incident Management System
ISP ..... Information Service Provider
ITS ..... Intelligent Transportation Systems
IVR ..... Interactive Voice Response
MCO ..... Maintenance and Construction Operations
MPH ..... Miles Per Hour
NITSA ..... *National ITS Architecture*
OIC ..... Officer in Charge
P-Specs ..... Process Specifications
PIAS ..... Personal Information Access Subsystem
PMS ..... Parking Management Subsystem
PSAP ..... Public Safety Answering Point
PTTI ..... Pre-Trip Travel Information
RF ..... Radio Frequency
RR Service Patrols ..... Road Rangers Service Patrols
RTMC ..... Regional Traffic Management Center
RWIS ..... Road Weather Information System
SITSA ..... *Statewide ITS Architecture*
SUL ..... Special-Use Lanes
TDM ..... Travel Demand Management
TiRN ..... Traveler Information Radio Network
TMC ..... Traffic Management Center
USDOT ..... United States Department of Transportation
USR ..... User Service Requirements
VMT ..... Vehicle-Miles Traveled
WIM ..... Weigh-in-Motion

1. Overview

The logical framework is a key component to the intelligent transportation systems (ITS) solutions model for the Florida Department of Transportation's (FDOT) *ITS Corridor Master Plans*. This ITS logical architecture addresses five major limited-access corridors of the Florida Intrastate Highway System (FIHS): Interstate 4 (I-4), Interstate 10 (I-10), Interstate 75 (I-75), Interstate 95 (I-95), and Florida's Turnpike. The logical framework is defined as the most logical grouping of processes to achieve the concept of operations for ITS.

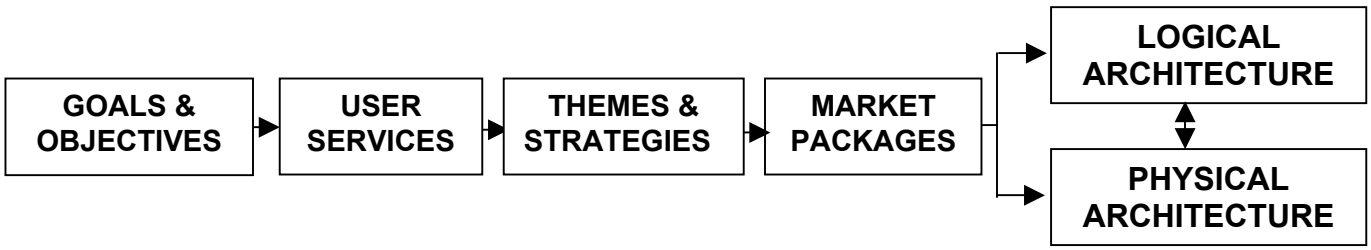
The deployment of ITS within the state of Florida will impact many stakeholders, some who are familiar with ITS and some who are not familiar with ITS. Since the potential target audience will include non-ITS professionals, a decision was made early on in the project to present the ITS deployments in Florida along the major corridors in terms of a mission, vision, and five primary goals to carry out the mission. Associated with each goal are a number of objectives for implementation. These goals are as follows:

- Move people and goods safely;
- Preserve and manage the system;
- Enhance economic competitiveness;
- Enhance quality of life and the environment; and
- Deploy an integrated, effective system.

These goals and objectives have guided the identification of specific user services, themes and strategies, and market packages that are driving the logical framework (i.e., architecture).

This document is a companion document to *Technical Memorandum No. 3.4 – ITS Physical Architecture*. Both documents have evolved using a structured approach to ITS. Figure 1.1 overviews the process.

Figure 1.1 – Process Overview



The development of the logical framework provided by this document is an important step in the determination of the optimum grouping of processes and data flows. The logical framework has been developed independently of any consideration of hardware or software, thus ensuring the most effective groupings of work processes is defined.

This logical framework provides a detailed description of the processing and data flows that have to be carried out and supported if FDOT's ITS objectives are to be satisfied. To develop the most appropriate logical framework, the system developer puts on a set of blinders and completely ignores the institutional or organizational arrangements that are currently in place. The goal of the system developer is to develop a "perfect" logical framework that:

- Describes the processing to be carried out;
- Identifies the most logical place to carry out the processing; and
- Defines the data flows required to allow the whole framework to operate as a single entity.

The products of the logical architecture analysis are FDOT project-specific reports, tables, and diagrams that are of sufficient detail to provide significant guidance to the system developer.

1.1 Document Organization

This section is intended to provide a basic orientation to the contents of this document via a characterization of the intended audience. It is assumed that some of the readers may be familiar with ITS and others not. Some may be non-technical; others' roles may be highly technical. To accommodate the range of FDOT personnel that need to become familiar with ITS concepts, the order in which you may wish to read this document is recommended in this text. This section is designed to support the following two goals:

- Make the investment of time spent reading this document more productive; and

- Provide pointers to specific sections of the document. These pointers are based on various FDOT roles including management, operations, business, finance, and customer service staff.

To this end, the content of each section is briefly described and Table 1.1 (Readers' Matrix) is provided to guide the reader through the document.

Table 1.1 – Readers' Matrix

Section	Executive Management	Senior Management/ Supervisors	Operations Staff	Technical Staff	Business Staff
1 – Overview	✓	✓	✓	✓	✓
2 – Overview of *ITS Needs Model*		✓	✓	✓	✓
3 – Functional Processes		✓	✓	✓	✓
4 – Logical Framework		✓	✓	✓	
5 – Technical Analysis		✓		✓	
6 – Summary		✓	✓	✓	✓

This document is organized into six major sections as follows:

- Section 1 presents an overview and document organization information;
- Section 2 provides an overview of *Technical Memorandum No. 2 – ITS Needs Model* and introduces FDOT's ITS goals and objectives, user services, themes and strategies, and market packages.
- Section 3 contains an overview of the functional FDOT ITS processes.
- Section 4 contains a high-level view of the logical framework. This section also presents the necessary background information required to understand the concepts behind the logical framework. The logical framework is the most logical grouping of processes to achieve the concept of operations for ITS.
- Section 5 presents the technical details of FDOT's ITS logical framework. The technical analysis contains the highly technical detailed information on the logical framework, such as data flow diagrams (DFDs), definitions of process specifications (P-Specs), and data flows. The technical details are presented in the form of tables and diagrams contained in the appendices.
- Section 6 provides a short summary.

2. Overview of ITS Needs Model

The objective of the ITS needs model is to assist in establishing the foundation for further ITS architecture development and deployment. Several components establish the foundation for the development of the FIHS that meets today's needs and the needs for the future. This section provides an overview of the ITS needs model and is based on information and data presented in the *Technical Memorandum No. 2 – ITS Needs Model*. This memorandum is intended to characterize and reflect current thinking and includes the following components:

- Goals and objectives;
- User services;
- Themes and strategies; and
- Market packages.

2.1 Goals and Objectives

The logical framework is a key component to the ITS solutions model for FDOT. The logical framework is defined as the most logical grouping of processes to achieve the concept of operations for ITS.

ITS deployments within the state of Florida will impact many stakeholders, some who are familiar with ITS and some who are not familiar with ITS. Since the potential target audience will include non-ITS professionals, a decision was made early on in the project to present the ITS deployments in Florida along the major corridors in terms of a mission, vision, and five primary goals to carry out the mission. Associated with each goal are a number of objectives for implementation. These goals are as follows:

- Move people and goods safely;
- Preserve and manage the system;
- Enhance economic competitiveness;
- Enhance quality of life and the environment; and
- Deploy an integrated, effective system.

To achieve FDOT's mission, the following sub-sections have guided the identification of specific user services and market packages that are driving the logical framework (i.e., architecture).

2.1.1 Move People and Goods Safely

The following goals and objectives are recommended:

1. Reduce accident rates.
   - 1.1 Reduce accident rates caused by driver errors and the severity of accidents.
   - 1.2 Reduce accident rates and severities in construction work zones.
   - 1.3 Reduce accident rates at highway-rail grade crossings.
2. Reduce queuing on mainlines.
   - 2.1 Reduce queues on limited-access roadways from highway-rail grade crossings.
   - 2.2 Reduce queues at weigh and inspection stations along the corridors.
   - 2.3 Reduce queues at intermodal facilities that impact corridor operations.
3. Improve the safety of commercial vehicle operators in rest areas.
4. Provide evacuation coordination services and emergency management.
   - 4.1 Provide pre-trip planning information for evacuation conditions.
   - 4.2 Provide traffic management during evacuation conditions.
   - 4.3 Manage demand through communication with shelters and other safe harbors.
   - 4.4 Provide route guidance information and information on traffic/travel conditions and weather including winds, rainfalls, and storm surges.
   - 4.5 Support remote configuration management of highways during evacuation conditions or other emergencies.
   - 4.6 Provide accurate and timely traveler information regarding incidents on evacuation routes and updated weather information.
   - 4.7 Share emergency information among local and regional traffic management centers (TMCs) and emergency management facilities.
   - 4.8 Detect, verify, respond to, and clear incidents and manage traffic around accidents, emergencies, and other incidents.
   - 4.9 Support infrastructure security through surveillance at critical structures and interchanges.

2.1.2 Preserve and Manage the System

The following goals and objectives are recommended:

1. Enhance mobility and efficiency.
   - 1.1 Improve travel times along the corridors.
   - 1.2 Improve predictability and reliability of travel times.
   - 1.3 Reduce accidents and other incidents during normal flows that result from congestion and delays that are caused by "rubber-necking" during incidents.
   - 1.4 Reduce congestion-related delays by decreasing queues and spillback from other facilities.
   - 1.5 Reduce delays caused by congestion in construction work zones.
   - 1.6 Manage traffic accessing these major corridors at interchanges to improve mainline throughput and traffic flow.
   - 1.7 Reduce unnecessary delays at tollbooths.
   - 1.8 Reduce unnecessary delays at the gates of intermodal facilities.

1.9 Provide traveler information services with route and mode choice information.

2. System Preservation
   - 2.1 Improve enforcement of illegally overweight vehicles.

3. Incident Management
   - 3.1 Improve ability to detect, verify, respond to, and clear incidents.
   - 3.2 Improve incident-related traveler information.
     - 3.2.1 Predict delays and clearance times.

4. Manage Special-Use Lanes (SULs)
5. Provide Data Archiving and Warehousing
   - 5.1 Conduct system evaluation and alternative analysis
   - 5.2 Support and supplement other statewide data collection programs
   - 5.3 Support highway operational performance reporting, modeling simulation and other techniques for operations and management of the system.
   - 5.4 Develop before and after studies for ITS deployments.

2.1.3 Enhance Economic Competitiveness

The following goals and objectives are recommended:

1. Ensure efficient landside access to intermodal, port, airport, and truck terminal facilities.
2. Ensure efficient intermodal transfer of people and goods.
3. Promote safe and efficient access of vehicles to markets.
4. Expedite permitting and clearance of commercial vehicles at weigh and agricultural inspection sites to keep commerce moving.
5. Ensure efficient access to major activity centers such as tourist attractions, state parks, and other areas of interest.
6. Provide safe and efficient tourist travel and reduce vehicle-miles traveled (VMT) through the provision of accurate and timely traveler information.
7. Support the designation of corridors as strategic intermodal corridors and funding for ITS deployments.

2.1.4 Enhance Quality of Life and the Environment

The following goals and objectives are recommended:

1. Provide efficient statewide ITS services with autonomy for decision-making to support local needs and regional cooperation to promote efficiency and support regional and statewide goals.
2. Improve interoperability of ITS services through the development of statewide uniform device standards and specifications.
3. Support integration of ITS into local planning processes, programs, and capacity projects.
4. Provide name recognition of key ITS-related services through branding that will instill trust and confidence in traveler information services, roadside assistance, electronic payment services, and other strategic services.
5. Provide easy access and data mining capabilities for transportation planning and design for all partners to support decision-making.

6. Provide accurate real-time data to technology, business and operational users for effective and responsive transportation operations.
7. Reduce air-quality emissions from mobile sources.
8. Reduce the potential for impacts from hazardous materials' (HAZMAT) incidents.
   - 8.1.1 Improve HAZMAT response systems.
   - 8.2.1 Improve the availability of traveler, weather, and shelter information during man-made and natural disasters.
   - 8.3.1 Provide safe routes for HAZMAT that avoid densely populated areas.

2.1.5 Deploy an Integrated, Effective System

The following goals and objectives are recommended:

1. Provide research and development for technologies to support deployments.
2. Develop statewide standards and specifications for ITS field devices.
3. Develop statewide standards for TMC software.
4. Develop a communications architecture and backbone for statewide deployment.
5. Develop standard procedures for operations and management.
6. Develop statewide information exchange network standards and criteria.
7. Brand all critical statewide services such as traveler information, interactive voice response (IVR) systems (511 or 1-800 services), Road Ranger (RR) Service Patrols, ***SunPass***®, Pre-Pass, etc.
8. Standardize performance measures and archive data to produce a history of trends and establish benchmarks.
9. Develop statewide procurement guidelines.
10. Develop a statewide systems engineering process for design, integration, and testing that includes regular updates and enhancements of statewide architecture.
11. Develop statewide procurement contracts to leverage economies of scale.
12. Develop an ITS asset management program to track and program replacement parts, migrate legacy systems, and manage the life-cycle of deployments.
13. Establish a statewide-managed funding program for ITS with project decision recommendations made by the ITS Office.
14. Dedicate a percent of all FDOT funds, statewide-managed and district-allocated, for operations and management of ITS deployments.
15. Update work program instructions to develop traceability with the *Statewide ITS Architecture (SITSA)*.
16. Increase the professional capacity of the public and private sector in Florida to support planned deployments.
17. Promote public-public partnerships to leverage financial and human resources.
18. Promote public-private partnerships to leverage financial and human resources.

2.2 User Services

ITS User Services are the core of requirements definitions and document what ITS services should do from a user's perspective. A user might be the public, a public system operator, or a private system operator. In the *National ITS Architecture* (*NITSA*) development effort, the United States Department of Transportation (USDOT) and ITS America, with significant stakeholder input, have defined 31 user services to date. A number of functions are required to accomplish each of these user services. To reflect this, each of the user services was broken down into successively more detailed functional requirements, called User Service Requirements.

Table 2.1 identifies the applicable near-term and future big picture deployment of the user services. The future big-picture user services represent full ITS deployments along the corridors that are likely to be implemented over the next twenty years and the near-term user services represent those ITS deployments that are likely to occur in the next few years, given the legacy ITS deployments and the corridors' programmed transportation improvements. These users services, except the Evacuation Coordination User Service, were derived from the *NITSA* and the *SITSA*.

In addition, an Evacuation Coordination User Service has been added that provides the capability to efficiently manage an evacuation and provide evacuees with information they need during the evacuation, as well as reentry. It consists of five major functions:

- Evacuation Guidance;
- Evacuation Travel Information;
- Evacuation Traffic Management;
- Evacuation Planning Support; and
- Evacuation Resource Sharing.

For further information regarding the Evacuation Coordination User Service, an issue paper is contained in Appendix A. In addition, the USDOT issued a Maintenance and Construction Operations (MCO) User Service in February 2001 that will be evaluated for use in these corridors. Detailed documentation of this new user service is contained in Appendix B.

The purpose of the Maintenance and Construction Operations User Service is to effectively manage, monitor, operate, and improve the physical condition of the roadways, associated infrastructure equipment on the roadways, and the available resources to conduct these activities. It consists of five major functions:

- Maintenance Vehicle Fleet Management;
- Roadway Management;
- Work Zone Management and Safety (similar to smart work zones);
- Roadway Maintenance Conditions and Work Plan Dissemination; and
- Roadway Weather Information Data Collection, Processing, and Distribution.

To ensure that the selected user services are consistent with the previously identified system goals and objectives, a traceability matrix was prepared which maps one element to the other. Goal Number 5 – Deploy an Integrated, Effective System – can be mapped to each of the user services. This goal represents high-level ITS policy initiatives that will eventually be implemented by FDOT as a comprehensive, statewide ITS Plan that addresses all long-term ITS Plan needs.

Table 2.1 – Timing of Deployments of User Services

User Services		Applicable (Big Picture)	Applicable (Near-term)
1.0	**Travel and Traffic Management**		
1.1	**Pre-Trip Travel Information**		
1.1.1	Travel Services	✓	✓
1.1.2	Current Conditions	✓	✓
1.1.3	Trip Planning	✓	✓
1.1.4	User Access	✓	✓
1.2	**En-Route Driver Information**		
1.2.2	Driver Advisory	✓	✓
1.2.3	In-Vehicle Signing		
1.3	**Route Guidance**		
1.3.1	Provide Directions	✓	
1.3.2	Static Mode	✓	
1.3.3	Real-Time Mode	✓	
1.3.4	User Interface	✓	
1.4	**Ride Matching and Reservation**		
1.4.1	Rider Request (Demand)	✓	
1.4.2	Transportation Provider Services (Supply)	✓	
1.4.3	Information Processing (Marrying Supply and Demand)	✓	
1.5	**Traveler Services Information**		
1.5.1	Information Receipt	✓	✓
1.5.2	Information Access	✓	✓
1.6	**Traffic Control**		
1.6.1	Traffic Flow Optimization	✓	✓
1.6.2	Traffic Surveillance	✓	✓
1.6.3	Control Function	✓	✓
1.6.4	Provide Information	✓	✓
1.7	**Incident Management**		
1.7.1	Incident Identification	✓	✓
1.7.2	Response Formulation	✓	✓
1.7.3	Response Implementation	✓	✓
1.7.4	Predict Time and Location of Hazardous Conditions	✓	✓
1.8	**Travel Demand Management (TDM)**		
1.8.1	Increase Efficiency of Transportation System	✓	✓
1.8.2	Provide Wide Variety of Mobility Options	✓	✓
1.9	**Emissions Testing and Mitigation**		
1.9.1	Wide Area Pollution Monitoring	✓	
1.9.2	Roadside Pollution Assessment	✓	
1.10	**Highway-Rail Intersection (HRI)**		
1.10.1	Standard Rail Subservice (<80 MPH Trains)	✓	✓
1.10.2	High Speed Rail Subservice (80 to 125 MPH Trains)	✓	
2.0	**Public Transportation Management**		
2.1	Public Transportation Management		
2.1.1	Operation of Vehicles and Facilities	✓	✓
2.1.2	Planning and Scheduling Services	✓	✓
2.1.3	Personnel Management		
2.1.4	Communications	✓	✓

Table 2.1 – Timing of Deployment of User Services

User Services		Applicable (Big Picture)	Applicable (Near-term)
2.2	**En-Route Transit Information**		
2.2.1	Information Distribution	✓	✓
2.2.2	Information Receipt	✓	✓
2.2.3	Information Processing	✓	✓
2.3	**Personalized Public Transit**		
2.3.1	Rider Request		
2.3.2	Vehicle Assignment		
2.3.3	Data Collection		
2.3.4	Information Processing		
2.3.5	Communications		
2.4	**Public Travel Security**		
2.4.2	Security Sensors Function	✓	✓
2.4.3	Personal Sensors Items		
2.4.4	Security Management and Control	✓	✓
3.0	**Electronic Payment**		
3.1	**Electronic Payment Services**		
3.1.1	Electronic Toll Collection (ETC)		
3.1.2	Electronic Fare Collection	✓	
3.1.3	Electronic Parking Payment		
3.1.4	Electronic Payment Systems (EPS) Integration		
3.1.5	Roadway Pricing	✓	
4.0	**Commercial Vehicle Operations (CVO)**		
4.1	**Commercial Vehicle Electronic Clear**		
4.1.1	Fixed Facility	✓	✓
4.1.2	Vehicle System	✓	
4.2	**Automated Roadside Safety Inspection**		
4.2.2	Roadside Facility	✓	✓
4.2.3	Vehicle System	✓	
4.3	**On-Board Safety Monitoring**		
4.3.1	Fixed Facility		
4.3.2	Vehicle System		
4.4	**Commercial Vehicle Administrative Processes**		
4.4.1	Electronic Purchase of Credentials	✓	✓
4.4.2	Automated Mileage and Fuel Reporting and Auditing	✓	✓
4.4.3	International Border Electronic Clearance		
4.5	**HAZMAT Incident Response**		
4.5.1	HAZMAT Incident Notification	✓	✓
4.5.2	Operational Focal Point	✓	✓
4.5.3	Communications	✓	✓
4.6	**Commercial Fleet Management**		
4.6.1	Real-Time Routing		
4.6.2	Real-Time Communications		

Table 2.1 – Timing of Deployment of User Services

User Services		Applicable (Big Picture)	Applicable (Near-term)
5.0	**Emergency Management**		
5.1	**Emergency Notification and Personnel**		
5.1.1	Driver and Personal Security (Manual)	✓	✓
5.1.2	Automated Collision Notification	✓	✓
5.2	**Emergency Vehicle Management**		
5.2.1	Fleet Management	✓	✓
5.2.2	Route Guidance	✓	✓
5.2.3	Signal Priority	✓	✓
5.3	**Evacuation Coordination**		
5.3.1	Evacuation Guidance	✓	✓
5.3.2	Evacuation Travel Information	✓	✓
5.3.3	Evacuation Traffic Management	✓	✓
5.3.4	Evacuation Planning Support	✓	✓
5.3.5	Evacuation Resource Sharing	✓	✓
6.0	**Advanced Vehicle Safety Systems (AVSS)**		
6.1	**Longitudinal Collision Avoidance**		
6.1.1	Rear-End		
6.1.2	Backing		
6.1.3	Head-On/Passing		
6.2	**Lateral Collision Avoidance**		
6.2.1	Lane Change/Merge		
6.2.2	Single Vehicle Roadway Departure		
6.3	**Intersection Collision Avoidance**		
6.3.1	Advisory System		
6.3.2	Driver Action System		
6.3.3	Automatic Control System		
6.4	**Vision Enhancement for Crash Avoidance**		
6.4.1	Enhanced Vision System	✓	
6.5	**Safety Readiness**		
6.5.1	Driver Monitor		
6.5.2	Vehicle Condition		
6.5.3	Infrastructure Condition		
6.6	Pre-Crash Restraint Deployment		
6.6.1	Automatic Activation System		
6.7	Automated Vehicle Operation		
6.7.1	Automated Highway System (AHS)		
6.7.2	Partially Automated Highway System (PAHS)		

Table 2.1 – Timing of Deployment of User Services

User Services		Applicable (Big Picture)	Applicable (Near-term)
7.0	**Information Management**		
7.1	Archived Data		
7.1.1	Historical Data Archive	✓	✓
7.1.2	Operational Data Control	✓	✓
7.1.3	Data Import and Verification	✓	✓
7.1.4	Automatic Data Historical Archive	✓	✓
7.1.5	Data Warehouse Distribution	✓	✓
7.1.6	ITS Community Interface	✓	✓
8.0	**Maintenance and Construction Operations (MCO)**		
8.1	Maintenance Vehicle Fleet Management		
8.2	Roadway Management	✓	✓
8.3	Roadway Maintenance Conditions and Work Plan Dissemination	✓	✓
8.4	Smart Work Zones	✓	✓

2.3 Themes and Strategies

Based on these goals and objectives, the following themes and strategies summarize the desired outcomes of the ITS deployments along the five principal FIHS limited-access corridors. These themes and strategies are intended to describe the desired outcomes in non-technical terms that stakeholders can understand and may not follow strict technical definitions.

2.3.1 Coordinated Operations

- Facilitate, support, and enhance the coordination and implementation of interagency efforts in response to the needs of intercity travel, major incidents or special events of regional significance along the corridor, and the security of the transportation infrastructure.

- Promote coordination and cooperation among all organizations involved in incident management including state, county, and local transportation departments, toll road authorities, law enforcement agencies, emergency service providers, and other operating agencies within the corridor.

- Foster and facilitate continued development and implementation of regional incident management initiatives and educate the public and responders to the benefits of incident management.

- Encourage technology and resource sharing by coordinating the development of training programs to support member agencies' incident management programs and activities.

- Demonstrate and evaluate the application of innovative procedures and technologies to enhance incident management activities.

- Provide regional solutions for serving intercity travel by promoting the through movement of vehicles.

- Provide procedures and coordination during evacuation and other emergency situations to make the best use of system resources.

- Promote coordination among agencies in the notification and implementation of maintenance and construction.

2.3.2 Active Facilities Management

- Support traffic management along all facilities in a coordinated way.

- Support incident management for the detection of, response to, and clearance of accidents and other major incidents such as freeway service patrols and Mayday / E-911 support,

development of incident response scenarios and traffic diversion plans, incident response centers or command posts, and traffic surveillance technologies.

- Provide transit management, including bus, commuter rail, and park-and-ride facilities, as well as other transit-related activities and manage SULs, such as high-occupancy toll or other value pricing, reversible lane control for high occupancy vehicle (HOV) facilities, and transit or emergency vehicle signal preemption systems.

- Improve the ability to monitor, schedule, and dispatch maintenance, construction, special services, or other public/community transportation fleets.

- Manage traffic flow and safety during evacuations related to hurricanes, fires, and other emergencies.

- Serve commercial vehicle operations (CVO), such as electronic screening systems, to verify the compliance of motor carriers with size, weight, safety and credentials regulations, and emergency response systems.

- Promote the use of electronic toll collection (ETC) and electronic payment systems (EPS) to improve traffic flow efficiencies and reduce infrastructure requirements.

- Implement procedures and systems that cost-effectively manage work zone activities.

- Manage lane closure prediction and scheduling.

- Collect/Maintain data on work zone locations and delay and alternate routing for mainlines and standard diversion or evacuation routes.

- Automate speed enforcement and variable speed limits in work zones.

- Support advanced traveler information systems (ATIS).

- Provide evacuation guidance that includes basic information to assist potential evacuees in determining whether evacuation is necessary. Once the decision is made to evacuate, the services will also assist evacuees in determining destination routes to shelters and other lodging options. This function will also provide guidance for returning to evacuated areas, information regarding clean up, and other pertinent information to be distributed from federal, state, and local agencies.

- Provide evacuation travel information that will benefit evacuees in planning their evacuation trip once that decision has been made. This function will also allow travelers to change course during the trip based on route and destination conditions.

- Provide evacuation traffic management to assist evacuation coordination personnel in the management of evacuation operations on the transportation network.

- Provide evacuation planning to support the evacuation process by providing information, current and historical, to emergency management planning personnel.

- Promote evacuation resource sharing to allow information and resource sharing between agencies involved in the evacuation including transportation, emergency management, law enforcement and other emergency service agencies.

- Improve the coordination of construction activity and other roadway activities with maintenance.

- Provide infrastructure security against terrorist attacks.

2.3.3 Information Sharing

- Coordinate data collection and information processing, management, and distribution.

- Coordinate data collection programs and sensor installation/operations.

- Inform and exchange data through coordinated operations.

- Centralize information processing, management, and storage.

- Open access to information delivery and use.

- Coordinate information report development.

- Coordinate transportation management strategy development.

2.4 Market Packages

Table 2.2 exhibits the standard market packages from the *NITSA* and those selected as applicable for the five major corridors statewide. These market packages, grouped into eight general categories, will support ITS deployments for the five major corridors over the long-term.

Table 2.2 – Recommended Market Packages for the *ITS Corridor Master Plans* from Version 3.0 of the *NITSA*

MP NO.	Market Package Name	Applicable
Advanced Public Transportation Systems (APTS)		
APTS1	Transit Vehicle Tracking	✓
APTS2	Transit Fixed-Route Operations	✓
APTS3	Demand Response Time Operations	N/A
APTS4	Transit Passenger and Fare Management	✓
APTS5	Transit Security	✓
APTS6	Transit Maintenance	N/A
APTS7	Multi-Modal Coordination	✓
APTS8	Transit Traveler Information	✓
Advanced Traveler Information Systems (ATIS)		
ATIS1	Broadcast Traveler Information	✓
ATIS2	Interactive Traveler Information	✓
ATIS3	Autonomous Route Guidance (ARG)	N/A
ATIS4	Dynamic Route Guidance (DRG)	N/A
ATIS5	ISP-Based Route Guidance	N/A
ATIS6	Integrated Transportation Management/Route Guidance	N/A
ATIS7	Yellow Pages and Reservations	✓
ATIS8	Dynamic Ridesharing	✓
ATIS9	In-Vehicle Signing	N/A
Advanced Traffic Management Systems (ATMS)		
ATMS01	Network Surveillance	✓
ATMS02	Probe Surveillance	✓
ATMS04	Freeway Control	✓
ATMS05	HOV Lane Management	✓`
ATMS06	Traffic Information Dissemination	✓
ATMS07	Regional Traffic Control	✓
ATMS08	Incident Management System (IMS)	✓
ATMS09	Traffic Forecast and Demand Management	✓
ATMS10	Electronic Fare Collection	✓
ATMS11	Emissions Monitoring and Management	N/A
ATMS12	Virtual TMC and Smart Probe Data	N/A
ATMS13	Standard Railroad Grade Crossing	✓
ATMS14	Advanced Railroad Grade Crossing	✓
ATMS15	Railroad Operations Coordination	✓
ATMS16	Parking Facility Management	✓
ATMS17	Reversible Lane Management	✓
ATMS18	Road Weather Information System (RWIS)	✓
ATMS19	Regional Parking Management	N/A
FL ATMS20	Speed Management	✓

Table 2.2 (Continued)

MP NO.	Market Package Name	Applicable
Advanced Vehicle Safety Systems (AVSS)		
AVSS01	Vehicle Safety Monitoring	N/A
AVSS02	Driver Safety Monitoring	N/A
AVSS03	Longitudinal Safety Warning	N/A
AVSS04	Lateral Safety Warning	N/A
AVSS05	Intersection Safety Warning	N/A
AVSS06	Pre-crash Restrain Deployment	N/A
AVSS07	Driver Visibility Improvement	N/A
AVSS08	Advanced Vehicle Longitudinal Control	N/A
AVSS09	Advanced Vehicle Lateral Control	N/A
AVSS10	Intersection Collision Avoidance	N/A
AVSS11	Automated Highway System (AHS)	N/A
Commercial Vehicle Operations (CVO)		
CVO01	Fleet Administration	N/A
CVO02	Freight Administration	✓
CVO03	Electronic Clearance	✓
CVO04	CV Administrative Process	✓
CVO05	International Border Electronic Clearance	N/A
CVO06	Weigh-In Motion (WIM)	✓
CVO07	Roadside CVO Safety	✓
CVO08	On-Board CVO Safety	✓
CVO09	CVO Fleet Maintenance	✓
CVO10	HAZMAT Management	✓
Emergency Management (EM)		
EM1	Emergency Response	✓
EM2	Emergency Routing	✓
EM3	Mayday Support	✓
FL EM4	Evacuation Management	✓
Archived Data and Management (AD)		
AD1	ITS Data Mart	✓
AD2	ITS Data Warehouse	✓
AD3	ITS Virtual Data Warehouse	✓
Maintenance and Construction Operations (MCO)		
FL MCO1	Maintenance and Construction Management	✓

Note: N/A – Not Applicable

To ensure that the selection of specific market packages adequately addresses the statewide ITS needs, market packages were mapped to the system themes, strategies, and user services. The selected user services characterize the needs, issues, problems, and objectives of the system and must be directly and specifically addressed by the selected market packages. Table 2.3 illustrates the relationship between market packages and themes. These represent a logical grouping of selected ITS solutions.

Table 2.3 – Market Packages Mapped to Themes

Market Packages		Themes		
MP No.	Market Package Name	Coordinated Operations	Active Facilities Management	Information Sharing
APTS1	Transit Vehicle Tracking		•	
APTS2	Transit Fixed-Route Operations		•	
APTS4	Transit Passenger and Fare Management		•	
APTS5	Transit Security		•	
APTS7	Multi-Modal Coordination	•	•	
APTS8	Transit Traveler Information		•	•
ATIS1	Broadcast Traveler Information			•
ATIS2	Interactive Traveler Information			•
ATIS7	Yellow Pages and Reservations			•
ATIS8	Dynamic Ridesharing		•	•
ATMS01	Network Surveillance		•	
ATMS02	Probe Surveillance		•	
ATMS04	Freeway Control		•	
ATMS05	HOV Lane Management		•	
ATMS06	Traffic Information Dissemination	•	•	•
ATMS07	Regional Traffic Control	•	•	
ATMS08	Incident Management System (IMS)	•	•	
ATMS09	Traffic Forecast and Demand Management		•	•
ATMS10	Electronic Fare Collection	•	•	•
ATMS13	Standard Railroad Grade Crossing		•	
ATMS14	Advanced Railroad Grade Crossing		•	
ATMS15	Railroad Operations Coordination	•	•	
ATMS16	Parking Facility Management	•	•	
ATMS17	Reversible Lane Management	•	•	
ATMS18	Road Weather Information System (RWIS)		•	•
FL ATMS20	Speed Management		•	
CVO02	Freight Administration		•	
CVO03	Electronic Clearance	•	•	•
CVO04	CV Administrative Process	•	•	
CVO06	Weigh-In-Motion (WIM)		•	
CVO07	Roadside CVO Safety		•	
CVO08	On-Board CVO Safety		•	
CVO09	CVO Fleet Maintenance		•	
CVO10	HAZMAT Management	•	•	
EM1	Emergency Response	•	•	
EM2	Emergency Routing	•	•	
EM3	Mayday Support	•	•	
FL EM4	Evacuation Management	•	•	•
AD1	ITS Data Mart			•
AD2	ITS Data Warehouse			•
AD3	ITS Virtual Data Warehouse			•
FL MCO1	Maintenance and Construction Management	•	•	•

2.4.1 Market Package Descriptions

This section addresses the market package benefits for end-users of ITS services. End-users may include the traveling public, technical operations and support, and the business community. The following text includes a description of each selected market package as detailed in the *NITSA*.

2.4.1.1 Advanced Public Transit Systems

APTS1 Transit Vehicle Tracking

This market package provides for an automated vehicle location (AVLS) system to track the transit vehicle's real-time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle [i.e., through a global positioning system (GPS)] and relayed to the infrastructure or by the communications infrastructure directly. A two-way wireless communications link with the Transit Management Subsystem (TRMS) is used for relaying vehicle position and control measures. Fixed-route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The TRMS processes this information, updates the transit schedule, and makes real-time schedule information available to the Information Service Provider (ISP) Subsystem via a wireline link.

APTS2 Transit Fixed-Route Operations

This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data and is implemented through data processing and information display at the TRMS. This data is exchanged using the existing wireline link to the ISP Subsystem where it is integrated with that from other transportation modes (i.e., rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

APTS4 Transit Passenger and Fare Management

This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card. This package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the TRMS using existing wireless infrastructure.

APTS5 Transit Security

This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (i.e., stops, park-and-ride lots, stations) are also monitored. Information is communicated to the TRMS using the existing or emerging wireless (vehicle-to-center) or wireline (area-to-center) infrastructure. Security related information is also transmitted to the Emergency Management (EM) Subsystem when an emergency is identified that requires an external response. Incident information is communicated to the ISP Subsystem.

APTS7 Multi-Modal Coordination

This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Intermodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.

APTS8 Transit Traveler Information

This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.

2.4.1.2 Advanced Traveler Information Systems (ATIS)

ATIS1 Broadcast Traveler Information

This market package provides the user with a basic set of ATIS services; its objective is early acceptance. It involves the collection of traffic conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real-time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (i.e., FM subcarrier, cellular data broadcast). Different from the market package ATMS06 (Traffic Information Dissemination), which provides the more basic highway advisory radio (HAR) and dynamic message sign (DMS) information capabilities, ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles, and other sources.

ATIS2 Interactive Traveler Information

This market package provides tailored information in response to traveler requests. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, transit services, ride-share/ride-match, parking management, and pricing information. A range of two-way wide-area, wireless and wireline communications systems may be used to support the required digital communications between the traveler and the ISP Subsystem. To access information prior to a trip or en-route, a variety of interactive devices including phones, kiosks, personal digital assistants (PDAs), personal computers, and a variety of in-vehicle devices may be used by the traveler. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles, or other means.

ATIS7 Yellow Pages and Reservations

This market package enhances the Interactive Traveler Information Market Package by making infrastructure provided yellow pages and reservation services available to the user. The same basic user equipment is included. This market package provides multiple ways for accessing information either while en-route in a vehicle using wide-area wireless communications or pre-trip via wireline connections.

ATIS8 Dynamic Ridesharing

This market package enhances the Interactive Traveler Information Market Package by adding an infrastructure provided dynamic ride-share/ride-match capability. In terms of equipment requirements, ATIS8 is similar to ATIS7.

2.4.1.3 Advanced Traffic Management System (ATMS)

ATMS01 Network Surveillance

This market package includes traffic detectors, other surveillance equipment, supporting field equipment, and wireline communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely [i.e., when a closed-circuit television (CCTV) system sends data back to the Traffic Management Subsystem]. The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long-range planning. The collected data can also be analyzed and made available to users and the ISP Subsystem.

ATMS02 Probe Surveillance

This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and ISP Subsystem are used to communicate current vehicle location and status and 2) dedicated short-range communications (DSRC) between the vehicle and roadside is used to provide equivalent information back to the Traffic Management Subsystem. The first approach leverages wide area communications equipment that may already be in the vehicle to support personal safety and advanced traveler information services. The second approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short-range communications applications identified within the architecture. The market package enables traffic managers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users and private information providers. It requires one of the communications options identified above, roadside beacons and wireline communications for the short-range communications option, data reduction software, and utilizes wireline links between the Traffic Management and ISP Subsystems to share the collected information. Both "opt out" and "opt in" strategies are available to ensure the user has the ability to turn off the probe functions to ensure individual privacy. Due to the large volume of data collected by probes, data reduction techniques are required in this market package that include the ability to identify and filter out-of-bounds or extreme data reports.

ATMS04 Freeway Control

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of ramp meters are included as part of this market package. This package is consistent with typical urban traffic freeway control systems. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a TMC; however, developments might allow for point detection with roadway equipment. For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en-route.

ATMS05 HOV Lane Management

This market package manages HOV lanes by coordinatin0g freeway ramp meters and connector signals with HOV lane usage signals. Preferential treatment is given to HOV lanes using special bypasses, reserved lanes, and exclusive rights-of-way that may vary by time of day. Vehicle occupancy detectors may be installed to verify HOV compliance and to notify enforcement agencies of violations.

ATMS06 Traffic Information Dissemination

This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as DMS or HAR. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a TMC to the media (for instance via a direct tie-in between a TMC and radio or television station computer system), transit management center, emergency management center (EMC), and ISP.

ATMS07 Regional Traffic Control

This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control. This market package provides for the sharing of traffic information and control among TMCs to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies that are coordinated between allied TMCs. Several levels of coordination are supported from the sharing of information through the sharing of control between TMCs.

ATMS08 Incident Management System (IMS)

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the Freeway Control Market Package and through regional coordination with other TMCs and EMCs, weather service entities, and event promoters supported by this market package. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package provides the Traffic Management Subsystem the equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information Dissemination Market Package. The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a computer-aided dispatch (CAD) system or through other communications with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel.

ATMS09 Traffic Forecast and Demand Management

This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation and real-time assessments and forecasts of the roadway network performance. This includes the prediction of travel demand patterns to support better link travel time forecasts. The source data would come from the Traffic Management Subsystem itself as well as other TMCs and forecasted traffic loads derived from route plans supplied by the ISP Subsystem. In addition to short-term forecasts, this market package provides longer-range forecasts that can be used in transportation planning. This market package provides data that supports the implementation of TDM programs, and policies managing both traffic and the environment. Information on vehicle pollution levels, parking availability, usage levels and vehicle occupancy is collected by monitoring sensors to support these functions. Demand management requests can also be made to the Toll Administration, Transit Management, and Parking Management Subsystems.

ATMS10 Electronic Toll Collection (ETC)

This market package provides toll operators with the ability to collect tolls electronically and detect and process violators. Variations in the fees that are collected enable implementation of demand management strategies. DSRC between the roadway equipment and the vehicle is required as well as wireline interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Vehicle tags of toll violators are read and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional, and ultimately national, interoperability for these services. The population of toll tags and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.

ATMS13 Standard Railroad Grade Crossing

This market package manages highway traffic at HRIs where operational requirements do not dictate more advanced features (i.e., where rail operational speeds are less than 80 miles per hour). Both passive (i.e., the crossbuck sign) and active (i.e., flashing lights and gates) warning systems are supported. (Note that passive systems exercise only the single interface between the Roadway Subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to HRI activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the Traffic Management Subsystem. Similar interfaces and services are provided for other types of multi-modal crossings (i.e., draw bridges).

ATMS14 Advanced Railroad Grade Crossing

This market package manages highway traffic at HRI's where operational requirements demand advanced features (i.e., where rail operational speeds are greater than 80 MPH). This market package includes all capabilities from the Standard Railroad Grade Crossing Market Package and augments these with additional safety features to mitigate the risks associated with higher rail speeds. The active warning systems supported by this market package include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard Railroad Grade Crossing Market Package, the HRI equipment is activated on notification by wayside interface equipment that detects or communicates with the approaching train. In this market package, the wayside interface equipment also provides additional information about the arriving train so that the train's direction of travel, its estimated time of arrival, and the estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This market package also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

ATMS15 Railroad Operations Coordination

This market package provides an additional level of strategic coordination between rail operations and TMCs. Rail operations provide train schedules, maintenance schedules, and any other forecast events that will result in HRI closures. This information is used to develop and forecast HRI closure times and durations which may be used in advanced traffic control strategies or to enhance the quality of traveler information.

ATMS16 Parking Facility Management

This market package provides enhanced monitoring and management of parking facilities. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This is performed by sensing and collecting current parking facilities' status, sharing the data with ISPs and traffic operations, and automatic fee collection using short-range communications with the same in-vehicle equipment utilized for ETC.

ATMS17 Reversible Lane Management

This market package provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this market package includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This market package also includes the equipment used to electronically reconfigure intersections and manage rights-of-way to address dynamic demand changes and special events.

ATMS18 Road Weather Information System (RWIS)

This market package monitors current road and weather conditions and forecasts the same using a combination of weather service information and data collected from environmental sensors deployed on and about the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions, dense fog and approaching severe weather fronts. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers using the Traffic Information Dissemination Market Package.

FL ATMS20 Speed Management

This market package will collect roadside weather and incident and construction information, and provide dynamic speed limit displays to warn drivers of upcoming speed zones in construction areas and other critical roadway segments.

2.4.1.4 Commercial Vehicle Operations (CVO)

CVO02 Freight Administration

This market package tracks cargo and the cargo condition. This information is communicated with the Fleet and Freight Management Subsystem via the existing wireless infrastructure. Interconnections are provided to intermodal shippers and intermodal freight depots for tracking the cargo from source to destination.

CVO03 Electronic Clearance

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration Subsystem over wireline to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This package allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and DSRC to the roadside. The roadside check facility may be equipped with automatic vehicle identification (AVI), weighing sensors, transponder read/write devices, and computer workstation processing hardware, software, and databases.

CVO04 CV Administrative Processes

This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in the electronic clearance program provided by a separate market package that allows commercial vehicles to be screened at mainline speeds at commercial vehicle checkpoints. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Subsystem and snapshots of this database are made available to the commercial vehicle check facilities at the roadside to support the electronic clearance process.

CVO06 Weigh-In-Motion (WIM)

This market package provides for high speed WIM with or without AVI attachment. Primarily this market package provides the roadside with additional equipment, either fixed or removable. If the equipment is fixed, it is thought to be an addition to the electronic clearance and would work in conjunction with the AVI and automatic vehicle classification (AVC) equipment in place.

CVO07 Roadside CVO Safety

This market package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the Commercial Vehicle Check Roadside Element. The capabilities for performing safety inspections are shared between this market package and the On-Board CVO Safety Market Package that enables a variety of implementation options. The basic option, directly supported by this market package, facilitates the safety inspection of vehicles that have been pulled in, perhaps as a result of the automated screening process provided by the Electronic Clearance Market Package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure that is used to support the safety inspection and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations, supported by the On-Board CVO Safety Market Package, utilize additional vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

CVO08 On-Board CVO Safety

This market package provides for on-board commercial vehicle safety monitoring and reporting. It is an enhancement of the Roadside CVO Safety Market Package and includes roadside support for reading on-board safety data via tags. This market package uses the same communications links as the Roadside CVO Safety Market Package and provides the commercial vehicle with a wireless link (data and possibly voice) to the Fleet and Freight Management and the EM Subsystems. Safety warnings are provided to the driver as a priority with secondary requirements to notify the Fleet and Freight Management and Commercial Vehicle Check Roadside Elements.

CVO09 CVO Fleet Maintenance

This market package supports maintenance of CVO fleet vehicles through close interface with on-board monitoring equipment and AVL system capabilities within the Fleet and Freight Management Subsystem. Records of vehicle mileage, repairs, and safety violations are maintained to assure safe vehicles on the highway.

CVO10 HAZMAT Management

This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The EM Subsystem is notified by the commercial vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

2.4.1.5 Emergency Management (EM)

EM1 Emergency Response

This market package provides the CAD systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between EM Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the EM Subsystem and an emergency vehicle to enable an incident command system to be established and supported at the emergency location. The EM Subsystem would include hardware and software for tracking the emergency vehicles. Public safety, traffic management, and many other allied agencies may each participate in the coordinated response managed by this package.

EM2 Emergency Routing

This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s). The ISP Subsystem supports routing for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles. In this market package, the ISP Subsystem would typically be integrated with the EM Subsystem in a public safety communications center. The emergency vehicle would also optionally be equipped with DSRC for local signal preemption.

EM3 Mayday Support

This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the EM Subsystem to locate the user and determine the appropriate response. The EM Subsystem may be operated by the public sector or by a private sector provider. The request from the traveler needing assistance may be manually initiated or automated and linked to vehicle sensors. The data is sent to the EM Subsystem using wide area wireless communications with voice as an option. Providing user location implies either a location technology within the user device or location determination within the communications infrastructure.

FL EM4 Evacuation Management

This market package involves systems to efficiently operate and manage evacuation processes and to provide evacuees with real-time information for both pre- and post-disaster assistance. This market package includes real-time information dissemination for routing to emergency shelters, lodgings, and other destinations and includes information regarding clean-up, security, and road closures for evacuees returning to disaster areas. It also encompasses systems that assist and support evacuation coordination and emergency management personnel to better manage evacuation operations and share resources between agencies.

2.4.1.6 Archived Data

AD1 ITS Data Mart

This market package provides a focused archive that houses data collected and owned by a single agency, district, private-sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy and meta data management common to all ITS archives and provides general query and report access to archive data users.

AD2 ITS Information Sharing

This market package includes all the data collection and management capabilities provided by the ITS Data Mart and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and central data warehousing features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart Market Package.

AD3 ITS Virtual Data Warehouse

This market package provides the same broad access to multi-modal, multidimensional data from varied data sources as in the ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse Market Package are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

2.4.1.7 Maintenance and Construction Operations (MCO)

FL MCO1 Maintenance and Construction Management

This market package involves systems that monitor maintenance and construction vehicle locations, support enhanced routing/schedule and dispatching functions, and use on-board diagnostic systems to assess vehicle operation and maintenance activities. Additionally, this market package includes systems that disseminate maintenance and construction activity information and coordinate work plans to affected personnel, public agencies, and private sector firms.

3. Functional Processes

The logical framework consists of processes and data flows. There are eight major process trees included in the *NITSA*. These process trees are further broken down into over a thousand P-Specs. The eight major processes are described below and the P-Specs are presented in the technical analysis.

The eight process trees are designed to provide a comprehensive response to the User Services identified for FDOT's ITS Plan. The process tree functions are described in the following sub-sections.

3.1 Manage Traffic

The functions performed by this process tree are needed for the management of traffic on the road and highway network. Included are traffic surveillance, traffic control, incident management, demand management, and all associated capabilities. The Traffic Surveillance and Traffic Control Functions include facilities for the management of turnpikes, access to parking lots (i.e., directing vehicles to those that currently have spaces), and the notification of faults with roadside equipment.

The traffic surveillance, traffic control, and incident management facilities work closely together to both detect incidents from traffic data (and highway rail intersections) and minimize their impact on the flow of traffic in the network. A link is provided to the Manage Emergency Services Function so that detected incidents can be reported for action by the appropriate emergency service. The ITS User Services included in this process tree are:

- Traffic Control;
- Incident Management; and
- Travel Demand Management (TDM).

3.2 Manage Commercial Vehicles

The functions performed by this process tree are management functions that are concerned with the efficient management of commercial vehicles, e.g., electronic credentials, tax filing, safety checking, and the movement of freight. Although the movement of vehicles is confined to the surface transportation system, interfaces are provided to enable freight to be moved by this and any other means (e.g., specialist carries using air or sea transport). Interactions with other functions are provided to convey information to the Commercial Vehicle Driver Function in support of the User Services Requirements. Those that are included in this functional process tree are:

- Commercial Vehicle Electronic Pre-Clearance;
- Automated Roadside Safety Inspection; and
- HAZMAT Incident Response.

3.3 Manage Transit

The functions performed by this process tree are applied to fixed-routed transit services, plus the provision of the flexibly routed transit service (demand responsive transit). Information is provided to the transit driver and transit user directly through this function, but for the traveler, trip planning and guidance is provided through the Provide Driver and Traveler Services Functions.

Interactions with the Manage Traffic Function are provided to support priority at signalized intersections and freeway ramps, and to reflect the overall coordination between transit and traffic management services. This function includes provision for transit vehicle location data to be passed to traffic management as probe information. Interaction is also provided with the Provide Electronic Payment Services Function to enable the advanced payment of transit fares and other services. The User Services Requirements that are included in this functional process tree are as follows:

- Public Transportation Management;
- En-Route Transit Information; and
- Public Travel Security.

3.4 Manage Emergency Services

The functions performed by this process tree are management functions needed for dispatch and control of emergency services responding to incidents and the activation of law enforcement agencies to pursue payment and pollution violators. It therefore interacts with the Manage Traffic, Provide Vehicle Monitoring and Control, Manage Transit, and Provide Driver and Traveler Services Functions for the detection and deployment of emergency services and law enforcement agencies.

An interface is also provided to the Manage Traffic Function for the coordination of incident management functions (including resource coordination between traffic management and emergency management) and to provide priority for emergency vehicles at signalized roadway intersections and freeway ramps. The processes also perform coordination of the incident between incident commanders in the field, emergency services, and allied emergency management agencies. The User Services Requirements that are included in this functional process tree are as follows:

- Emergency Notification and Personal;
- Emergency Vehicle Management; and
- Evacuation Coordination.

3.5 Provide Driver and Traveler Services

The functions performed by this process tree are multi-modal trip planning, route guidance, and advisory functions for all types of travelers and drivers. It also enables a confirmation and payment for yellow pages services and provides personal emergency notification functions. The driver interface to the Provide Vehicle Monitoring and Control Functions is provided. The driver interface also can enable advisory information to be output to both drivers and travelers. The multi-modal trip planning function enables trips to include private car and regular transit modes, plus ridesharing, demand responsive transit, and other modes such as walking, cycling, etc.

Links are also provided to multi-modal transportation service providers so that travelers may use modes such as heavy rail and airlines as part of their trips. Both centralized dynamic and autonomous modes of on-line guidance are provided for drivers and travelers, with drivers also being able to use current link journey times as part of the autonomous vehicle guidance. The User Services Requirements that are included in this functional process tree are as follows:

- Pre-Trip Travel Information;
- En-Route Driver Information;
- Ride Matching and Reservation; and
- Traveler Services Information.

3.6 Provide Electronic Payment Services

The functions performed by this process tree are responsible for the collection and management of tolls and parking lot charges, in both real time and as advanced charges. It also collects charges for yellow pages services and has an interface to the Manage Transit Function for the management of fare collection plus advanced payment of fares and other services. The User Services Requirement that is included in this functional process tree is the Electronic Payment Services Function.

3.7 Manage Archived Data

The functions performed by this process tree manage the flow of operational data into an archive of ITS and non-ITS data. Functions include the import of data, cleansing and formatting the data for the archive format, and attaching the appropriate sets of meta-data to the incoming archive data. The Manage Archived Data Function coordinates data sharing between archives. The function that interfaces to the administrator contains the settings on the data acquisition process, security of the archive, formatting of the data, and produces the necessary administration reports.

Archived data users systems interface with the archive to either access data for retrieval or to analyze the data using central data warehousing, fusion, or aggregation functions. These functions can also produce reports that can be formatted for input to a government reporting system. The User Services Requirement that is included in this functional process tree is the Archived Data Function.

3.8 Provide Evacuation Coordination

The functions performed by this process tree are to manage ITS services during natural disasters that required the public to evacuate their homes. The Evacuation Coordination Functions provide the capability to efficiently manage an evacuation and provide evacuees with information they need during the evacuation, as well as reentry. This process tree interacts with all eight processes described above. It gathers data from the ITS functions above and processes the data to target the needs during an evacuation. It consists of five major functions: (1) Evacuation Guidance, (2) Evacuation Travel Information, (3) Evacuation Traffic Management, (4) Evacuation Planning Support, and (5) Resource Sharing.

4. Logical Framework(s)

The logical framework is a tool used by system developers and transportation engineers to define the processes and data flows for ITS. A logical framework is a technology-independent view of the final architecture. It indicates the data and information processing that is required to satisfy all of the user services and highlights the data flows that should be supported between processes to ensure that the whole system works as a single harmonious unit. It also specifies the most efficient grouping of work processes, maximizing the ability to exploit specialization in work procedures and tools. This assists in organizing the functional processes and data flows of a system and is a valuable step towards the definition of a physical architecture.

Understanding why a logical framework has been developed will assist FDOT stakeholders in grasping the abstract concepts of a logical framework. The following items further define the usefulness of the logical framework.

- Defining the processes and data flows provides for initial identification and description of the key system interfaces required to support the system.

- A well-defined logical framework makes it easier to envision the required physical devices and communications media to support the proposed system.

- A logical framework serves as a platform for modular, robust software development.

- The logical framework identifies the processes and data flows that are exchanged between the processes. This can serve as a basis for determining the required institutional/organizational agreements.

- The functional requirements defined in a logical framework can be traced back to the requirements needed to meet user needs and services.

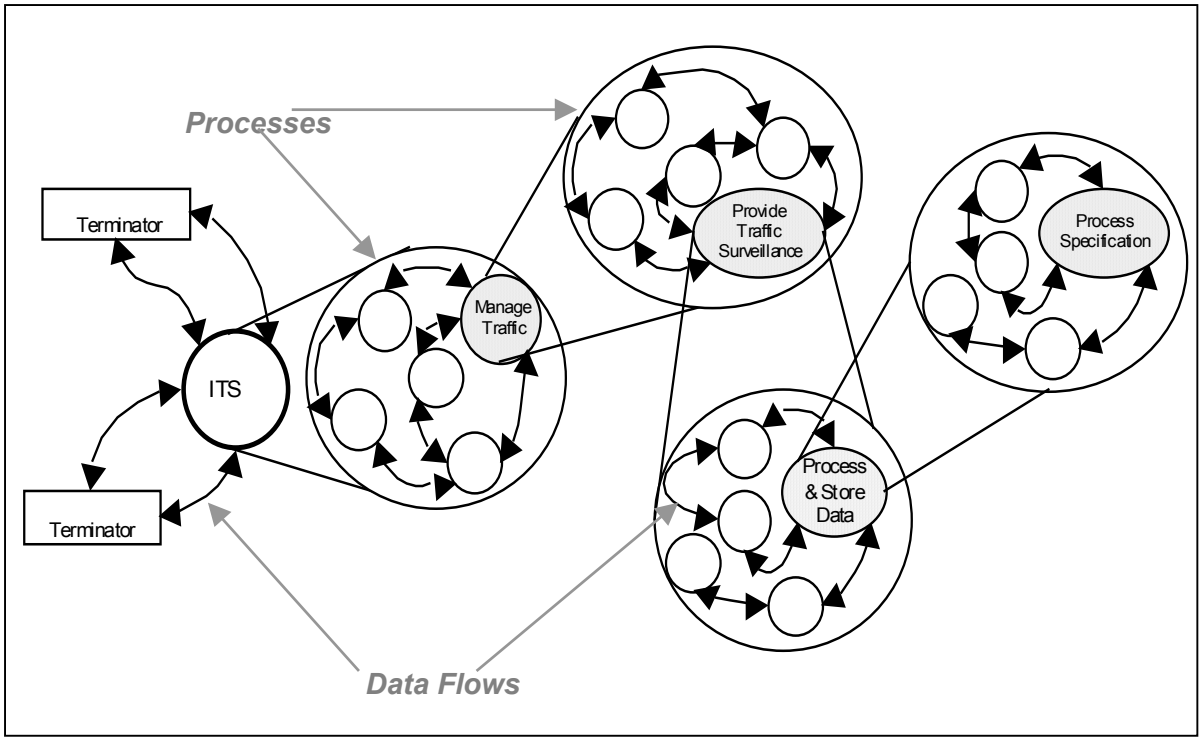
- These requirements support the most efficient use of data that enters the system and groups the processes to optimize system operations.

- The data flow requirements and interfaces identified in the logical framework serve as a basis for the development of standards.

In short, the development of a logical framework is the basis for a structured ITS solution.

Figure 4.1 is a graphical view of a generic section of the FDOT ITS logical architecture. They are often referred to as DFD or simply “bubble charts”. The bubble labeled ”ITS” is known as a process. A process is defined as the work required to convert data flows into the bubble, into data flows out of the bubble. Processes and data flows are grouped to form particular transportation management functions, which break down into several levels of detail.

Figure 4.1 – Generic Section of FDOT's ITS Logical Architecture



A P-Spec is a succinct summary of the processing that takes place inside the bubble. The curved arrows are data flows. These data flows can flow into and out of the processes or bubbles. The rectangles are called terminators and represent interaction and data flows between the ITS under consideration and the rest of the regional transportation context. Terminators represent other systems and entities that the FDOT ITS has to relate to, but over which they have no design control. Terminators are the external entities that communicate data from and to the ITS functional process. The *NITSA* groups the terminators into four categories:

- **Users** – This category includes personnel, operators, and travelers.
- **Systems** – Non-ITS centers that interact with ITS, such as government agencies, traditional signals and sensors, and braking and steering systems are included in this category.
- **Environment** – Category includes air quality, weather, etc.
- **Other Subsystems** – Other subsystems are included to represent the interaction among multiple similar subsystems exist, such as center-to-center communications).

4.1 Coordinated Operations

Figure 4.2 presents a high-level view of the major processes, data flows, and terminators required to achieve coordinated operations. Coordinated operations are a series of "linked hubs" that will be developed to provide corridor and statewide coordination. The logical framework will guide ITS deployments in various sub-regions along the corridor. This figure depicts the exchange of information among the major processes in a sub-region and their counterparts, which are depicted as terminators. For example, each hub in Tallahassee and in Tampa will contain the Manage Traffic Process. The figure shows that the Manage Traffic Process in Tallahassee (Sub-Region) will need to share information with the Manage Traffic Process in Tampa (Other Traffic Management Subsystem) to achieve coordinated operations.

4.2 Active Facilities Management

ITS will be deployed along FIHS corridors to enable transportation agencies to operate and manage these facilities more effectively. The logical framework for active facilities management is depicted in Figure 4.3. The exception is that evacuation coordination is not included within this diagram but is included as Figure 4.4.

4.3 Information Sharing

Communications networks and protocols will be developed to enable data sharing among agencies and jurisdictions in the corridor, either through the creation of central databases or through links among existing databases and systems. The logical framework for information sharing is depicted in Figure 4.5.

Figure 4.2 – Logical Framework for Coordinated Operations

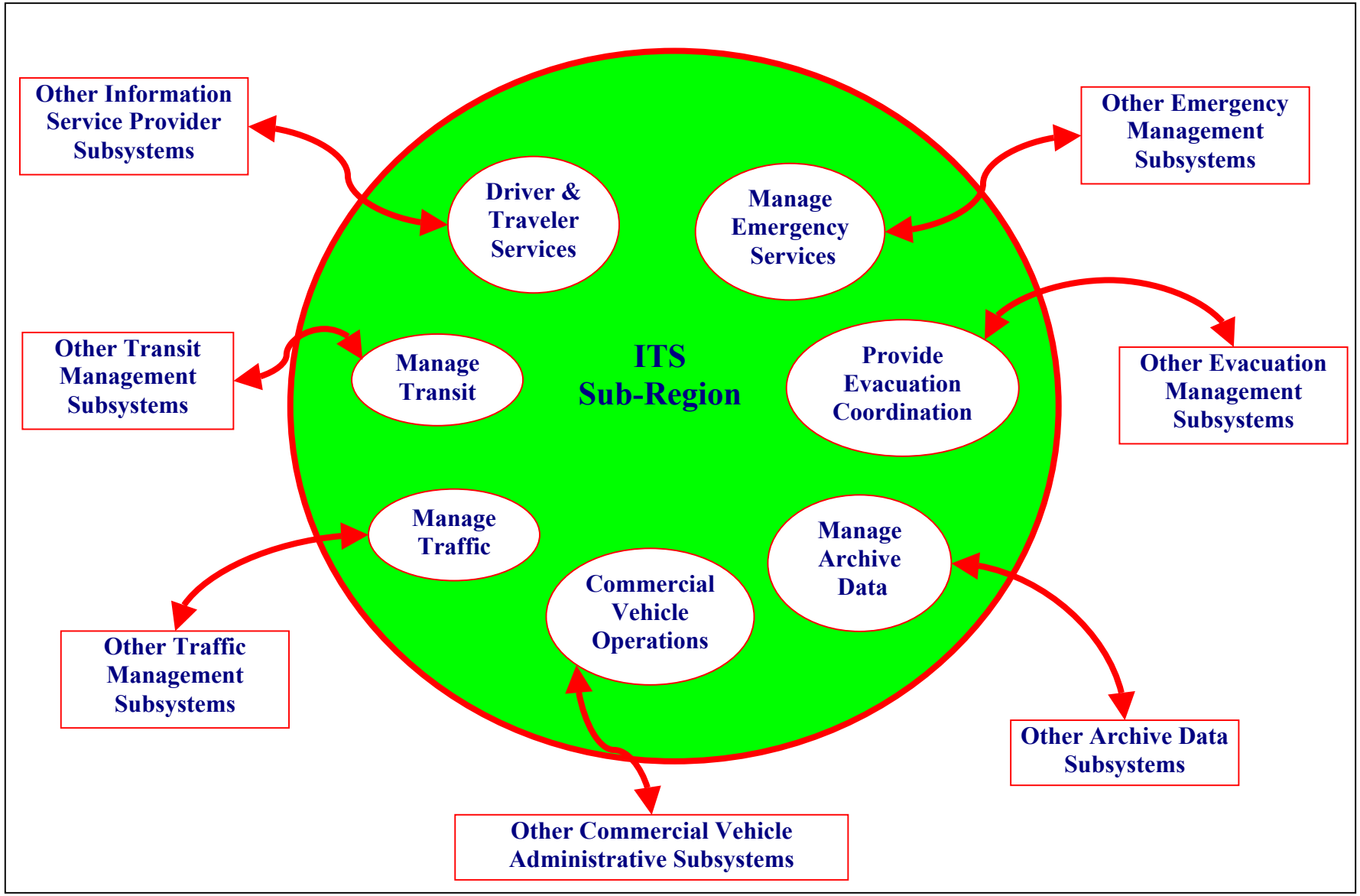


Figure 4.3 – Logical Framework for Active Facilities Management (Except Evacuation Coordination)

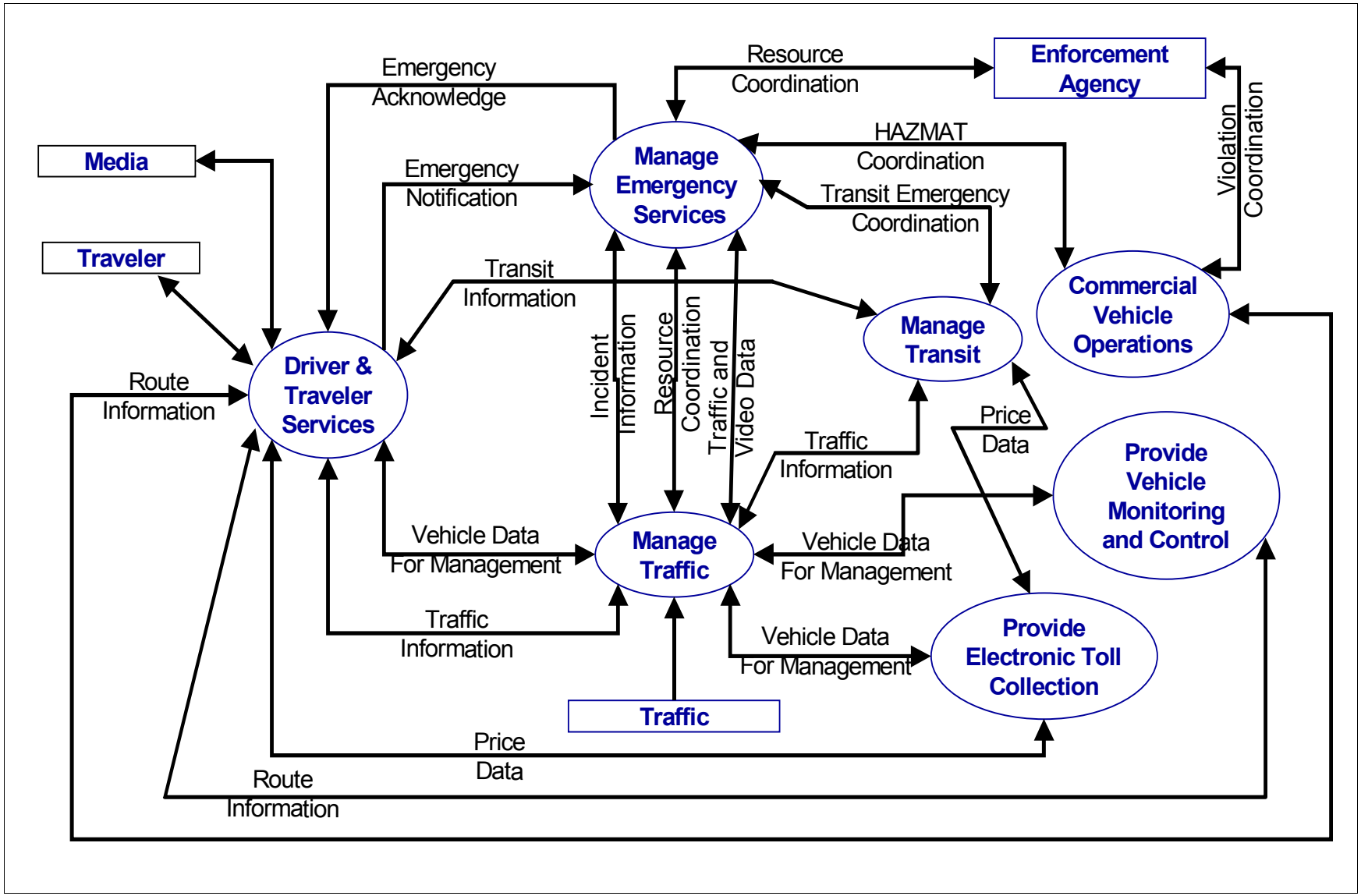


Figure 4.4 – Logical Framework for Evacuation Coordination

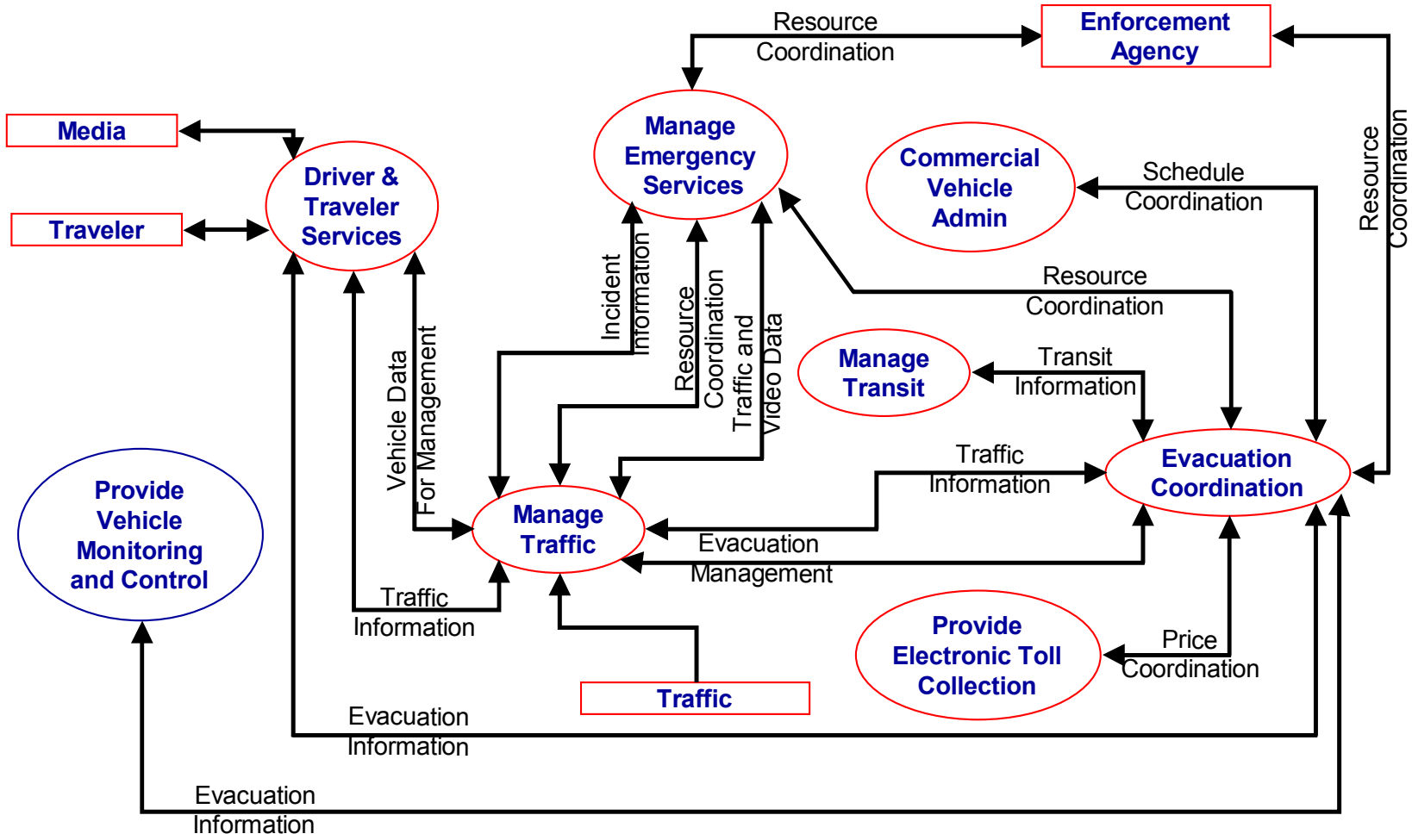
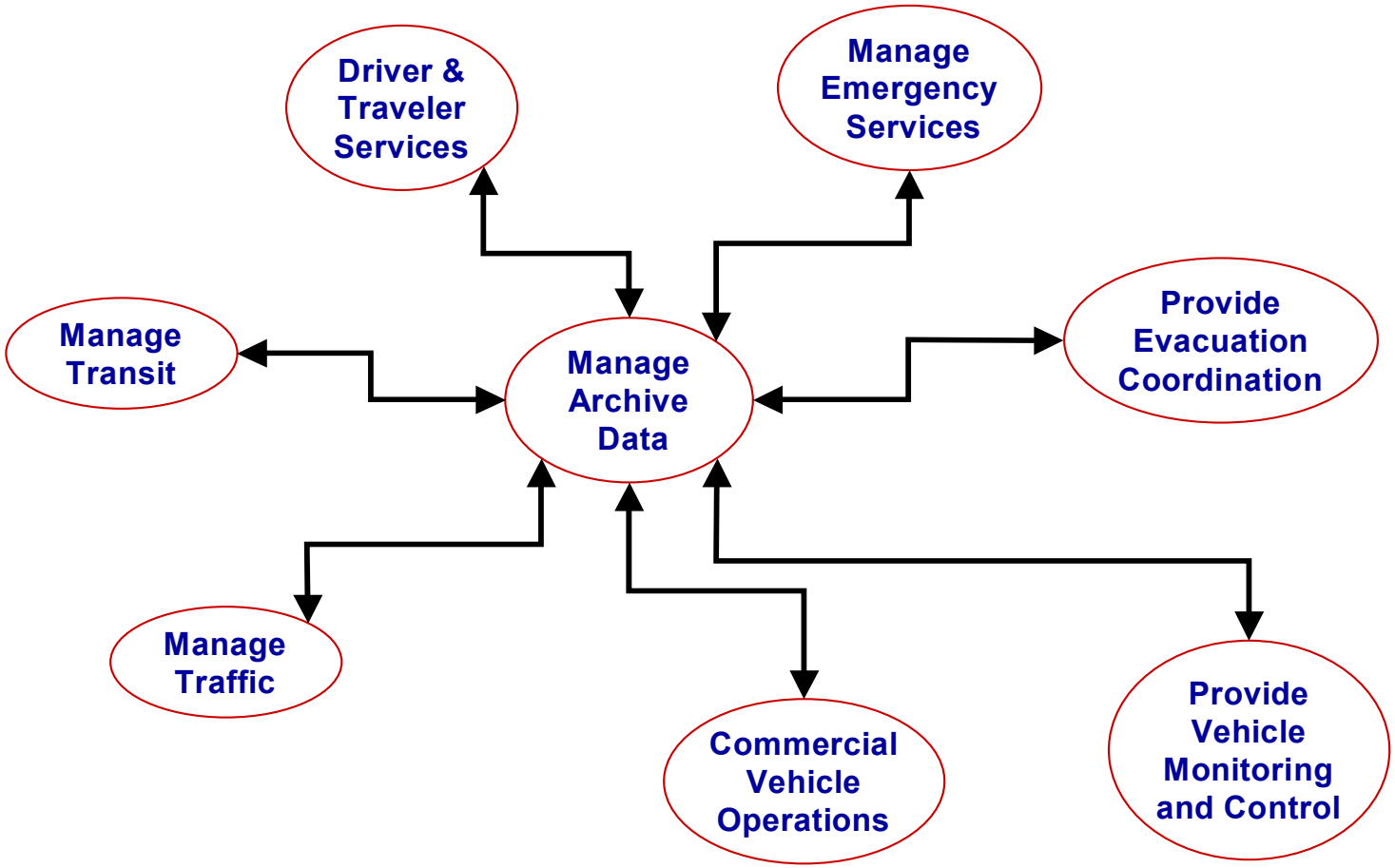


Figure 4.5 – Logical Framework for Information Sharing



5. Technical Analysis

This section of the report references the technical details of FDOT's ITS logical framework contained in the appendices. The purposes of the appendices are to establish the completeness and effectiveness of the *NITSA* at the logical level.

The technical details are presented in the form of tables and diagrams. These appendices and a brief description of their purposes are as follows:

5.1 User Service Requirements (USR)

Appendix C represents the highest-level of requirements specifications for FDOT's ITS program. All program requirements are defined and tracked, including the addition of a new User Service entitled Evacuation Coordination. This service was identified in *Technical Memorandum No. 2 – ITS Needs Model* and is included for completeness.

Appendix C presents columnar elements, including:

- User Service Requirements (USRs) identification numbers. These numbers directly relate to the *NITSA*.
- Descriptions of the USRs.
- Status of the USRs. All IDs are identified as "original" and will provide a requirements tracking mechanism. For example, as requirements are changed (i.e., added, deleted, or modified) Appendix C will reflect both the changes and the authority for the change.

5.2 Process Specifications (P-Specs)

Appendix D expands and details the USRs into a set of logical processes defined in the P-Specs. The ITS Plan P-Specs were selected based on relationships defined by the *NITSA*. More specifically, the USRs' relationships to P-Specs' relationships are identified. This approach produced records that need further refinement, which would result in a restructuring effort of the *NITSA*-defined relationships between USRs and P-Specs. The *NITSA*-defined relationships were not restructured to maintain consistency.

This Appendix provides a trace from each USR to its supporting P-Spec(s). Appendix D presents columnar elements, including:

- **USR Identification Numbers** – These numbers directly relate to the *NITSA*.
- **P-Spec Identification Numbers** – These numbers directly relate to the *NITSA*.

- **Description of the P-Spec** System – This column identifies the specific system that supports a particular P-Spec. These systems and their abbreviations include:

    - Archive Data Management Subsystem – ADMS;
    - Emergency Management Subsystem – EM;
    - Emergency Vehicle Subsystem – EVS;
    - Information Service Provider Subsystem – ISP;
    - Personal Information Access Subsystem – PIAS;
    - Parking Management Subsystem – PMS;
    - Remote Traveler Subsystem – RTS;
    - Roadway Subsystem – RS;
    - Toll Administration Subsystem – TAS;
    - Toll Collection System – TCS; and
    - Traffic Management Subsystem – TMS.

5.3 Program Data Flows

Appendix E is a tabulation of all logical data flows for the FDOT project that have been derived from USR data. Appendix E provides the specific data flow name based on the Data Dictionary developed by the *NITSA*. Appendix E's Source and Destination columns provide both P-Spec identification numbers and terminators (i.e., terminators are external entities with which the system must interact with such as drivers, vehicles, financial institutions, parking management, transit management, etc.). Terminators are enclosed in parentheses for ease of reading. Note that some entries will only have a terminator.

Table 5.1 contains descriptions of each terminator used in FDOT's logical architecture. These terminators and their descriptions were selected to provide the most rigorous, yet flexible, system boundary acceptable within the constraints of the ITS requirements.

Table 5.1 – Terminator Descriptions

NAME	DESCRIPTION
Archived Data Administrator	This terminator represents the human operator who provides overall data management, administration, and monitoring duties for the ITS data archive. Unlike the manager of the operational databases, the archive data administrator's role is focused on the archive and covers areas such as establishing user authentication controls, monitoring data quality, and initiating data import requests.
Archived Data User Systems	This terminator represents the systems users employ to access archived data. The general interface provided from this terminator allows a broad range of users (e.g., planners, researchers, analysts, and operators) and their systems (e.g., databases, models, analytical tools, and user interface devices) to acquire data and analyses results from the archive.
Basic Vehicle	This terminator represents the basic vehicle platform that interfaces with and hosts ITS electronics. The Basic Vehicle Terminator provides an interface to drive train, driver convenience and entertainment systems, and other non-ITS electronics on-board the vehicle. This interface allows general vehicle systems (e.g., the stereo speaker system) to be shared by ITS and non-ITS services. It also allows monitoring and control of the vehicle platform for advanced vehicle control system applications.
Construction and Maintenance	This terminator represents the information systems that are used to manage and track construction and maintenance of the roadway infrastructure. Roadway maintenance personnel, roadway construction personnel, or other work crew personnel assigned to highway construction and maintenance use these construction and maintenance systems. Coordination with these systems allows the ITS architecture to rapidly correct deficiencies noted through its advanced surveillance capabilities and also improves the quality and accuracy of information available to travelers regarding closures and other roadway construction and maintenance activities.
DMV	This terminator represents a specific (state) public organization responsible for registering vehicles, e.g., the Department of Motor Vehicles (DMV). The DMV Terminator is a special case of the Government Administrators Terminator but in some areas is identified separately to emphasize the specific nature of the data being exchanged, i.e., vehicle identification.

Table 5.1 (Continued)

NAME	DESCRIPTION
Driver	This terminator represents the human entity that operates a licensed vehicle on the roadway. Included are operators of private, transit, commercial, and emergency vehicles where the data being sent or received is not particular to the type of vehicle. Thus, this external terminator originates driver requests and receives driver information that reflects the interactions that might be useful to all drivers, regardless of vehicle classification. The Driver Terminator is the operator of the Basic Vehicle Terminator. Information and interactions that are unique to drivers of a specific vehicle type (e.g., fleet interactions with transit, commercial, or emergency vehicle drivers) are covered separately.
Emergency Personnel	This terminator represents personnel that are responsible for police, fire, emergency medical services, towing, and other special response team activities (e.g., HAZMAT clean-up) at incident sites. These personnel are associated with the EVS during dispatch to the incident site, but often work independently of the EVS while providing their incident response services. Emergency personnel may include an officer in charge (OIC) and a crew. When managing an incident following standard incident command system practices, the on-site emergency personnel form an organizational structure under the auspices of an incident commander.
Emergency System Operator	This terminator represents the human entity that monitors all ITS emergency requests, (including those from the E-911 operator) and sets up pre-defined responses to be executed by an emergency management system. The operator may also override predefined responses where it is observed that they are not achieving the desired result. This terminator includes dispatchers who manage an emergency fleet (e.g., police, fire, ambulance, HAZMAT, etc.) or higher order emergency managers who provide response coordination during emergencies.
Emergency Telecommunication System	This terminator represents the telecommunications systems that connect a caller with a public safety answering point (PSAP). These systems transparently support priority wireline and wireless caller access to the PSAP through E-911 and other access mechanisms like seven-digit local access numbers and motorist aid call boxes. The calls are routed to the appropriate PSAP, based on caller location when this information is available. When available, the caller's location and callback number are also provided to the PSAP by this interface.
Enforcement Agency	This terminator represents an external entity which receives reports of violations detected by various ITS facilities (e.g., individual vehicle emissions, toll violations, CVO violations, etc).

Table 5.1 (Continued)

NAME	DESCRIPTION
Environment	This terminator is the operational setting in which the ITS interfaces and operates. This setting consists of weather effects such as snow, rain, fog, pollution, dust, temperature, humidity, solar radiation, and man-made electromagnetic radio frequency (RF) effects. Environmental conditions must be monitored by the ITS architecture so that travelers may be informed and control strategies can reflect adverse environmental conditions in a timely fashion.
Event Promoters	This terminator represents external special event sponsors that have knowledge of events that may impact travel on roadways or other modal means. Examples of special event sponsors include sporting events, conventions, motorcades/parades, and public/political events. These promoters interface to the ITS to provide event information such as date, time, estimated duration, location, and any other information pertinent to traffic movement in the surrounding area.
Financial Institutions	This terminator represents the organization that handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service. The functions and activities of financial clearinghouses are subsumed by this entity.
Government Administrators	This terminator represents those public organizations responsible for regulating CVO, e.g., the Interstate Commerce Commission (ICC), state commerce offices, state DMVs, state Departments of Revenue, and Departments of Transportation.
Government Reporting Systems	This terminator represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g., the highway performance monitoring system (HPMS) or the fatal analysis reporting system, using data collected by ITS services. This terminator represents a system interface that would provide access to the archived data that is relevant to these reports. In most cases, this terminator would manually combine data collected from the ITS archives with data from non-ITS sources to assemble and submit the required information.
ISP Operator	This terminator is the human entity that may be physically present at the ISP to monitor the operational status of the facility and provide human interface capabilities to travelers and other ISP Subsystems.
Map Update Provider	This terminator represents a third-party developer and provider of digitized map databases used to support ITS services. It supports the provision of the databases that are required exclusively for route guidance (navigable maps) as well as those that are used exclusively for display by operators and at traveler information points, e.g. kiosks (display maps).

Table 5.1 (Continued)

NAME	DESCRIPTION
Media	This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, television (TV), and other media. Traffic and travel advisory information that are collected by ITS are provided to this terminator. It is also a source for traffic flow information, incident and special event information, and other events that may have implications for the transportation system.
Other Archives	This terminator represents distributed archived data systems or centers whose data can be accessed and shared with a local archive. The interface between the Other Archives Terminator and the Archived Data Management Subsystem allows data from multiple archives to be accessed on demand or imported and consolidated into a single repository.
Other Data Sources	This terminator represents the myriad systems and databases containing data not generated from subsystems and terminators represented in the *NITSA* that can provide predefined data sets to the ITS archive. The terminator can provide economic, cost, demographic, land use, law enforcement, and other data that is not collected by ITS and would otherwise be unavailable within an ITS data archive.
Other EM	Representing other EMCs, systems or subsystems, this terminator provides a source and destination for ITS data flows between various communications centers operated by public safety agencies as well as centers operated by other allied agencies and private companies that participate in coordinated management of highway-related incidents. The interface represented by this terminator enables emergency management activities to be coordinated across jurisdictional boundaries and between functional areas. In the physical architecture, this terminator is a reciprocal EM Subsystem implying the requirements for general networks connecting many allied agencies. The interface between this terminator and the EM Subsystem supports coordination of incident management information between many different centers providing PSAPs (both public or private sector implementations), public safety dispatches, emergency operations, and other functions that participate in the detection, verification, response, and clearance of highway incidents. This terminator also supports interface to other allied agencies like utility companies that also participate in the coordinated response to selected highway-related incidents.
Other ISP	Representing other distinct ISPs, this terminator is intended to provide a source and destination for ITS data flows between peer information and service provider functions. It enables cooperative information sharing between providers as conditions warrant. In the physical architecture, this terminator is a reciprocal ISP Subsystem.

Table 5.1 (Continued)

NAME	DESCRIPTION
Other Parking	Representing another parking facility, system or subsystem, this terminator provides a source and destination for information that may be exchanged between peer parking systems. This terminator enables parking management activities to be coordinated between different parking operators or systems in a region. In the physical architecture, this terminator is a reciprocal PMS.
Other TM	Representing another TMC, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g., inter-regional) traffic management functions. It enables traffic management activities to be coordinated across different jurisdictional areas. In the physical architecture, this terminator is a reciprocal TMS.
Other TRM	Representing another transit management center, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) transit management functions. It enables traffic management activities to be coordinated across geographic boundaries or different jurisdictional areas. In the physical architecture, this terminator represents a reciprocal TRMS.
Other Vehicle	This terminator represents a vehicle (of any four vehicle types) that is neighboring the basic vehicle, where the basic vehicle is equipped to support vehicle-to-vehicle communications and coordination. These features are associated with advanced vehicle safety user service implementations. These high-end vehicle control services may involve vehicles coordinating their activities.
Parking Operator	This terminator is the human entity that may be physically present at the parking lot facility to monitor the operational status of the facility.
Payment Instrument	This terminator represents the entity that enables the actual transfer of funds from the user of a service to the provider of the service. This terminator can be as abstract as an account number in the logical architecture, or as real as the electronic tag in the physical architecture.
Pedestrians	This terminator provides input (e.g., a request for right-of-way at an intersection) from a specialized form of the traveler, who is not using any type of vehicle (including bicycles) as a form of transport. Pedestrians may comprise those on foot and those in wheelchairs.
Potential Obstacles	Any object that possesses the potential of being sensed and struck thus possesses physical attributes. Potential obstacles include roadside obstructions, other vehicles, pedestrians, infrastructure elements, or any other element that is in a potential path of the vehicle. These external elements represent the physical obstacles that possess properties which enable detection using sensory functions included as part of the ITS architecture. These physical attributes are represented as data input to the system.

Table 5.1 (Continued)

NAME	DESCRIPTION
Roadway	This terminator represents the physical conditions and geometry of the surface on which vehicles travel from an origin to a destination. Roadways can vary in type, such as surface streets, arterials, multi-lane highways, two-lane rural roads, expressways, tollways, freeways, or any other vehicle-traveled surface. The condition of the roadway must be monitored by the architecture to enable corrective action and information dissemination regarding roadway conditions that may adversely affect travel. Roadways can also depict travel networks, such as surface street networks, arterial networks, or freeway networks. The roadway interface to the system carries the physical condition and geometry attributes that must be sensed, interpreted, and processed by functions internal to the system to achieve ITS user service functionality.
Roadway Environment	This terminator represents the physical conditions surrounding the roadway itself. These may include emissions, fog, ice, snow, rain, etc., that will influence the way in which a vehicle can be safely operated on the roadway.
Secure Area Environment	This terminator comprises public access areas that transit users frequent during trips. Areas include bus stops, park-and-ride facilities, at kiosks, and other transit transfer locations. These environments are monitored as part of the ITS architecture functions to promote transit safety.
Toll Administrator	The Toll Administrator Terminator is the human entity that manages the back office payment administration systems for an electronic toll system. This terminator monitors the systems that support the electronic transfer of authenticated funds from the customer to the system operator. The terminator monitors customer enrollment and supports the establishment of escrow accounts depending on the clearinghouse scheme and the type of payments involved. The terminator also establishes and administers pricing structures and policies.
Toll Operator	The Toll Operator Terminator is the human entity that may be physically present at the toll plaza to monitor the operational status of the plaza.
Traffic	The Traffic Terminator represents the collective body of vehicles that travel on surface streets, arterials, highways, expressways, tollways, freeways, or any other vehicle travel surface. Traffic depicts the vehicle population from which traffic flow surveillance information is collected (average occupancy, average speed, total volume, average delay, etc.), and to which traffic control indicators are applied (intersection signals, stop signs, ramp meters, lane control barriers, variable speed limit indicators, etc.). All sensory and control elements that interface to this vehicle population are internal to ITS.

Table 5.1 (Continued)

NAME	DESCRIPTION
Traffic Operations Personnel	This terminator represents the human entity that directly interfaces with vehicle traffic operations. These personnel interact with traffic control systems, traffic surveillance systems, IMS, work zone management systems, and TDM systems to accomplish ITS services. They provide operator data and command inputs to direct systems' operations to varying degrees depending on the type of system and the deployment scenario. All functionality associated with these services that might be automated in the course of ITS deployment is modeled as internal to the architecture.
Traveler	This terminator represents any individual (human) who uses transportation services. At the time that data is passed to or from the terminator, the individual is neither a driver, pedestrian, or transit user. This means that the data provided is that for pre-trip planning or multi-modal personal guidance and includes their requests for assistance in an emergency. Subsequent to receipt of pre-trip information, a traveler may become a vehicle driver, passenger, transit user, or pedestrian.
Weather Service	This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides current information and forecasts weather data that is collected and derived by the National Weather Service, private sector providers, and various research organizations. The interface provides formatted weather data products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.
Yellow Pages Service Providers	This terminator represents the individual organizations that provide any service oriented towards the traveler. Example services that could be included are gas, food, lodging, vehicle repair, points of interest, and recreation areas. The service providers may pay a fee to have their services advertised to travelers. The interface with the service provider is necessary so that accurate, up-to-date service information can be provided to the traveler and to support electronic reservation capabilities included in the ITS user services.

Key to the ITS process is the traceability from user requirements to P-Specs (Appendix D) to program data and their associated flows (Appendix E). The FDOT logical architecture is defined in a table in Appendix E and in a graphical representation in Appendix F.

5.4 Architectural Flow Diagrams (AFDs)

Appendix F presents a logical view (i.e., AFDs) in the form of a graphical notation used to illustrate the flow of data and processing to be carried out within the systems and subsystems. AFDs are comprised of three components. These are:

- **Processes** – These are the "bubbles" that represent the actions required to convert data input to the bubble to data output from the bubble.

- **Data Flows** – These are the arrows representing the flow of data around the various components of the system. Data flows can be either data inputs to processes or data outputs from processes. Data flows can be either one-way or two-way flows of data.

- **Terminators** – These are the external entities with which the system must interact.

6. Summary

The development of FDOT's logical framework provided by this document is an important step in the determination of the optimum grouping of processes and data flows. The logical framework has been developed independently of any consideration of hardware or software, thus ensuring the most effective groupings of work processes is defined.

This logical framework provides a detailed description of the processing and data flows that have to be carried out and supported if FDOT's ITS objectives are to be satisfied. To develop the most appropriate logical framework, the system developer puts on a set of blinders and completely ignores the institutional or organizational arrangements that are currently in place. The goal of the system developer is to develop a "perfect" logical framework that:

- Describes the processing to be carried out.
- Identifies the most logical place to carry out the processing.
- Defines the data flows required to allow the whole framework to operate as a single entity.

The products of the logical architecture analysis are FDOT project-specific reports, tables, and diagrams that are of sufficient detail to provide significant guidance to the system developer.