I-595 RFP Volume II - Technical Requirements

Division II, Section 3, Attachment 1 - ITS Deployment Requirements

Florida Department of Transportation
District 4

To Design, Build, Finance, Operate and Maintain

The I-595 Corridor Roadway Improvements Project

Final Version for Execution

Financial Project Number: 420809-3-52-01
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Contract Number: E4J69

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Definitions, Acronyms, and Abbreviations

ACU	Access Control Unit
APL	Approved Product List
ATMS	Advanced Traffic Management System
ASCII	American Standard Computer Information Interface (a text file format)
BPS	Bits per Second
CCTV	Closed Circuit Television
CDPD	Cellular Digital Packet Data
CMS	Changeable Message Sign
CODEC	Coder/ Decoder
COMM	An abbreviation for "communication(s)"
COTS	Commercial Off-The-Shelf
DMS	Dynamic Message Sign
ETC	Electronic Toll Collection
FHP	Florida Highway Patrol
FDOT	Florida Department of Transportation
FTE	Florida's Turnpike Enterprise
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HDPE	High-density polyethylene
HVAC	Heating-ventilation-air-conditioning
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ITMS	Interim Traffic Management System
ITS	Intelligent Transportation System
JPEG	Joint Photographic Experts Group (an image file format)
KBPS	Thousand Bits Per Second
LAN	Local Area Network
LAYER 2 SWITCHING	Ethernet switching performed at data link layer (MAC hardware addressing)
LAYER 3 SWITCHING	Ethernet switching performed at the network layer (logical addressing) providing internetwork routing at higher performance switching speeds.
LCS	Lane Control Signal
LED	Light Emitting Diodes
LDP	Label Distribution Protocol
MAC	Media Access Control
MBPS	Million Bits per Second
MFES	Managed Field Ethernet Switch
MOT	Maintenance of Traffic
MPEG	Motion Photographic Experts Group
MVDS	Microwave Vehicle Detection System
MUTCD	Manual on Uniform Traffic Control Devices
NEMA	National Electrical Manufacturers Association
NITSA	National ITS Architecture
NTCIP	National Transportation Communication for ITS Protocol
NTP	Notice To Proceed
OSPF	Open Shortest Path First
PLC	Programmable Logic Circuit

PWS	Portable Workzone System
QPL	Qualified Product List
RFP	Request For Proposal
RS232	Recommended Standard – 232C (a standard serial interface)
SEMP	*System Engineering Management Plan*
SIRV	Severe Incident Response Vehicle
SOG	Standard Operation Guidelines (SOG)
SQL	Structured Query Language
TCP/IP	Transmission Control Protocol/Internet Protocol
TEA-21	*Transportation Equity Act of the 21st Century*
TIM	Traffic Incident Management
TMC	Transportation Management Center
VLAN	Virtual Local Area Network
RSTP	Rapid Spanning Tree Protocol
UDP	User Datagram Protocol
UPS	Uninterruptible Power Service
WGU	Wire Grounding Units

1. ITS DEPLOYMENT SYSTEM REQUIREMENTS

The Concessionaire shall be responsible for the design, construction, finance, integration, operation, and maintenance of the new and permanent I-595 corridor Intelligent Transportation Systems (ITS) deployment to support traffic management and operations of the express lanes and the general purpose lanes. This deployment shall include a fiber optic communication network subsystem, a Reversible Express Lanes Access Control subsystem, a Closed Circuit Television (CCTV) camera traffic monitoring subsystem, a Dynamic Message Sign (DMS) subsystem, Changeable Message Sign (CMS) subsystem, a Highway Advisory Radio (HAR) subsystem, a Microwave Vehicle Detection Station (MVDS) subsystem, and an Electronic Toll Collection (ETC) subsystem infrastructure including all ancillary components within the I-595 Project corridor.

The Concessionaire shall be responsible for the design, construction, and integration of a CCTV camera traffic monitoring subsystem and a MVDS subsystem along Turnpike/SR 91 at the I-595/SR 91 interchange from north of Peters Road (Station 47+00) to south of Griffin Road (Station 49+50). The Concessionaire shall also be responsible for the removal and replacement of two existing freeway DMS and CCTV subsystems currently installed on SR 91 between north of Peters Road to south of Griffin Road; to include but limited to new DMS's and CCTV's, structures and foundations, communication and power infrastructure, and guardrail. These subsystems will be integrated into the existing Florida's Turnpike Enterprise (FTE) SunNav^{SM} ITS system currently deployed along Turnpike/SR 91. The Concessionaire shall be responsible for returning all existing ITS devices and salvageable structures to the FTE. The Concessionaire shall be responsible for bringing any existing ITS devices to remain up to current FDOT ITS Specifications.

The Turnpike/SR 91 ITS devices will be a part of FTE's existing SunNav^{SM} ITS system and will not be used to support the Express Lanes system along I-595. All ITS devices to be deployed along Turnpike/SR 91 shall be spliced into the existing FTE 96-strand backbone currently installed along the southbound Turnpike/SR 91. The Concessionaire shall turn these subsystems over to FTE upon the completion of construction and acceptance by the Department and FTE. Conceptual plans for this area are provided in the Reference Documents. Any additional ITS devices needed along Turnpike/SR 91 to support the Express Lanes system shall be the responsibility of the Concessionaire to design, build, finance, integrate, operate, and maintain. All ITS devices supporting the Express Lanes system along Turnpike/SR 91 shall be spliced into its own fiber optic cable to be installed by the Concessionaire to provide connectivity to the I-595 backbone.

The FTE shall provide and install all toll equipment, including toll equipment rack(s). Exception to this is the toll communication rack, which is the responsibility of the Concessionaire. The Concessionaire shall provide all necessary infrastructures to support the FTE tolling equipment. This includes but is not limited to: Gantries for toll equipment, shelters (Hubs) for toll equipment, generator, power and any other utilities required for the full operation of the toll system. The functional requirements for the Electronic Toll Collection (ETC) systems are specified in the Division II, Section 3, Attachment 2, *FTE's Tolling Infrastructure Support Requirements*.

The Concessionaire shall ensure that all ITS field devices and ancillary components comply with FDOT's Approved Product List (APL) / Qualified Product List (QPL) and the existing list of devices and components supported within the SunGuide^{SM} software, unless otherwise approved by the Department. The Concessionaire shall ensure all ITS field devices and ancillary components to be installed along Turnpike/SR 91, to be turned over to FTE, comply with the existing list of devices and components supported within the SunNav^{SM} software unless otherwise approved by the Department. All initial ITS devices and supporting infrastructure shall comply with the current FDOT's ITS Standard Specifications.

The Concessionaire shall understand that the ITS system requirements specified in this document represent the minimum functional requirements for the initial system deployments. Due to the prospect of the continuous technology evolution, the needs for new ITS standards and substantial revisions of existing ITS standards are likely to arise. If any time the Department revises and/or adopts new ITS standards and reflects such changes in the Department's ITS Standards and/or ITS architecture, the Concessionaire shall update, upgrade, replace or change the ITS devices and infrastructures, as necessary, to comply with the Department's new or revised ITS Standards and/or ITS architecture. Any such future deployments, also referenced herein as System Renewals, shall subject to the system testing, warranty and maintenance requirements specified in this document unless otherwise directed by the Department.

All subsystem devices and ancillary components shall be new production products with the latest version of hardware and software (at the time of installation). Neither untried nor prototype units shall be approved or accepted by the Department. The Concessionaire shall not use reconditioned equipment. All subsystem devices and ancillary components shall be commercial off-the-shelf (COTS) products, unless otherwise approved by the Department.

For the purposes of this document the term DMS refers to the electronic freeway message signs along I-595 mainline, Turnpike/SR 91 mainline, and arterial message signs along SR 84. The freeway DMS is typically 8'x28' in size and mounted on an overhead truss structure. The DMS is capable of displaying 18" characters, 24 characters per line, three lines, and full matrix messages. The arterial DMS is typically capable of displaying 15" character, 15 characters per line, two lines and full matrix messages. The term CMS refers to single line electronic signs that will be utilized in conjunction with the static signs to display Express Lanes status and variable toll rate information for the I-595 Project.

1.1 Systems Engineering Management Plan (SEMP)

The Concessionaire shall be responsible for developing the ITS Conceptual Design Plan (System Integration Plan) and Preliminary Corridor ITS Master Plan as part of Concessionaire's I-595 Technical Proposal Package. These documents and plans shall follow the requirements specified in these *ITS Deployment Requirements*.

The Concessionaire shall be responsible for developing the *Project System Engineering Management Plan (Project SEMP)* for the I-595 ITS Project within 120 days of NTP 1. The *Project SEMP* shall comply with Federal Title 23 CFR 940 and Florida Statewide and regional ITS Architecture per Florida Procedure No. 750-040-003. The Concessionaire shall submit the Project SEMP to Department within 120 days after NTP 1 for Department's review and approval. The Concessionaire shall adhere to and meet or exceed all requirements, rules, and regulations outlined in the approved *Project SEMP,* including all applicable appendices, throughout the Term.

1.1.1 Compliance with Title 23, Part 940, of the Code of Federal Regulations

Section 5206(e) of the *Transportation Equity Act of the 21st Century* (*TEA-21*)[1] was enacted June 9, 1998, and requires ITS projects that are funded through the Highway Trust Fund to conform to the *National ITS Architecture* (*NITSA*).[2] It further requires the *NITSA* to be used to develop a local implementation plan called a regional architecture. *TEA-21* became effective on February 7, 2001 and the project development requirements took effect April 8, 2001.

[1] PUB.L.NO. 105-178, 112 STAT. 457, *Transportation Equity Act for the 21st Century* (*TEA-21*) (June 1998).

[2] United States Department of Transportation, *National ITS Architecture*, *Version 5.0*. Available online at http://www.iteris.com/itsarch.

Federal Rule 940 requires that systems engineering shall include, at a minimum:

- Identification of portions of the regional architecture being implemented;
- Identification of participating agencies' roles and responsibilities;
- Requirements definition;
- Analysis of alternative system configurations and technology options to meet requirements;
- Procurement options;
- Identification of applicable standards and testing procedures; and,
- Procedures and resources necessary for operations and management of the system.

1.2 Existing Conditions

From the I-75/Sawgrass Expressway interchange to the I-595/I-95 interchange, current I-595 ITS components include CCTV cameras typically spaced at one-mile intervals and located along the eastbound travel direction of the corridor west of the Florida Turnpike and located along the westbound I-595 travel direction east of the Florida Turnpike. Non-intrusive MVDS are also installed along the corridor and are spaced at one-half-mile intervals on either side of the corridor.

DMS are currently installed and operational on overhead sign structures on both the westbound and eastbound travel directions on I-595 and SR 84. The ten overhead sign structures located within the Project limits are located at:

Table 1.1: Existing DMS along I-595/SR 84 Corridor

Sign ID#	Location
I-595 Mainline	
595WB02	WB before Hiatus Rd
595EB02	EB before Nob Hill Rd
595EB05	EB after University Dr
595EB10	EB before I-95
SR 84	
84WB08	WB before SR 7/441
84WB05	WB before University Dr
84WB04	WB before Nob Hill Rd
84EB01	EB after Flamingo Rd
84EB03	EB after Nob Hill Rd
84EB04	EB after Pine Island Rd

In addition, there are two arterial DMS currently deployed on both the northbound and southbound travel directions of SR 7 approaching the I-595 on ramps. Both of the SR 7 DMS are connected to the existing fiber optic communication network along I-595.

The existing one 96-strand single mode fiber optic cable running along I-595 is generally located along the eastbound travel direction of I-595 west of the Florida Turnpike and located along the westbound I-595 travel direction east of the Florida Turnpike. FTE currently has one 96-strand single mode fiber optic cable that runs along the southbound right-of-way of Turnpike/SR 91 and one 96-single mode fiber optic cable that runs along both sides of SR 869 Sawgrass Expressway. At no time shall FTE's fiber optic backbone be impacted by Construction Work related to the Project. If impacts can not be avoided, the Concessionaire shall be responsible for relocating the fiber optic backbone without the introduction of any additional splice points. The new fiber optic backbone shall be installed and tested prior to cut-over to reduce the impact to FTE's fiber optic communications. Cut-over must take place during off peak hours. It is the Concessionaire's responsibility to protect these cables throughout the Term.

FTE also has one 12-strand single mode fiber optic interconnect cable connecting FTE's backbone along Turnpike/SR 91 to the District 4's TMC; near the Turnpike/SR 91/I-595 interchange. FDOT District 4 currently has one 96-strand single mode fiber optic cable that runs along the I-75 and I-95 corridors. The

existing I-595 communication network consists of three Cisco Layer 3 modular switches located in the existing communication hubs in or adjacent to the Project limits. The communication hubs are interconnected utilizing two strands of fiber optic via the existing fiber optic backbone along I-595 and act as the interface between the ITS field devices and the SMART SunGuide TMC. Figure 1-1 depicts the existing ITS backbone fiber optic communication network for the region. The Concessionaire shall be responsible for creating a redundant fiber optic communications path through the use of existing and proposed fiber optic infrastructure to support the I-595 tolling gantry equipment; Path 1 shall be via I-595 fiber optic backbone west to FTE's SR 869 Sawgrass Expressway fiber optic backbone; Path 2 shall be via I-595 fiber optic backbone east to FTE's SR 91 Turnpike Mainline fiber optic backbone.

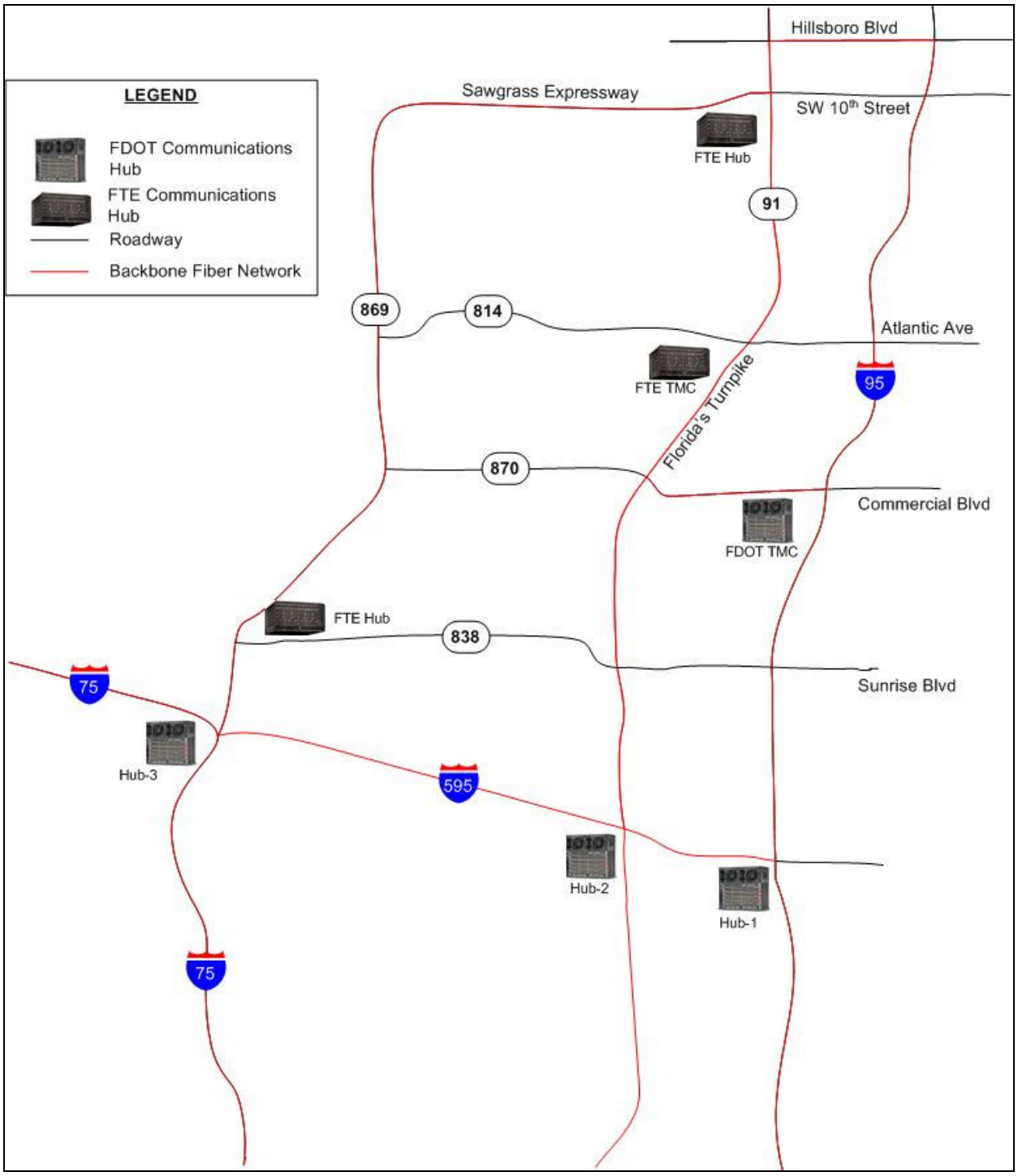


Figure 1-1 the Existing ITS Backbone Fiber Optic Network

Not only does the existing I-595 fiber optic backbone provide the Ethernet communication network for the ITS field devices on the I-595 corridor to the SunGuide TMC, it also provides a communication gateway for the existing ITS devices deployed along I-75 from the Miami-Dade County Line to the Collier County Line, to communicate with the SMART SunGuide TMC.

The Department currently has three field communication hubs strategically located along the I-595 corridor: Hub-1 at the I-95/I-595 interchange area, Hub-2 at the I-595/SR 91 interchange area and Hub-3 at the I-75/I-595 interchange area. Each of the three existing hubs consists of a layer 3 distribution switch, fiber distribution panels, UPS and other ancillary components contained in ground mounted cabinet with air conditioning.

Hub-1 is located near the southeast quadrant of I-95/I-595 Interchange area. Hub-1 is the communication concentration point for the existing ITS devices along I-95 south of I-595 and ITS devices along I-595 east of I-95. Hub-1 is interconnected with the SMART SunGuide TMC via the fibers along the I-95 mainline north of I-595. This interconnection and the physical hub cabinet are located out of the Project Limits and are expected to stay operational throughout the Construction Period.

Hub-1 is also interconnected with Hub-2 near the I-595/Turnpike interchange area and the FTE TMC at the Pompano Beach Toll Plaza via the fiber optic path along I-595 and Florida Turnpike mainline. This interconnection will be disabled during the I-595 Construction Period. The Concessionaire shall be responsible for restoring this interconnection with the new permanent ITS infrastructure that will be deployed as part of the Project.

Hub-2 is located under the Turnpike/SR 91 overpass at I-595 and currently interconnects the existing I-595 fibers with the Florida Turnpike's fiber optic network. This interconnection provides the vital fiber optic connection from the I-595 tolling equipment to the FTE Tolling Processing Center as well as provides a redundant communication path through fibers along the Florida Turnpike's mainline. This redundant communications path runs parallel to the communication paths along both I-95 and I-75/Sawgrass Expressway. These redundant communication paths connect the ITS field elements to the SMART SunGuide TMC.

Hub-3 is located near the southwest quadrant of I-75/I-595/Sawgrass Expressway interchange area. Hub-3 is the communication concentration point for the existing ITS devices along I-75 from Miami-Dade County Line to Collier County Line. Hub-3 acts as the intermediary between the ITS devices and the SunGuide TMC. Hub-3 is interconnected with Hub-2 and the SMART SunGuide TMC via the existing fiber optic backbone along I-595 mainline. This interconnection will be disabled during the I-595 construction. The Concessionaire shall be responsible for restoring this interconnection with the new permanent ITS infrastructure that will be deployed as part of the Project. This new interconnect will serve as the redundant fiber optic connection for the tolling equipment as well as a data link for Turnpike tolling and ITS equipment located in the southwest part of the State. In the interim, the Concessionaire shall provide an independent connection from the distribution level layer 3 switch located at Hub-3 to District 4's SMART SunGuide TMC with Bellsouth, or Department approved equal data circuit service provider, prior to disconnecting the existing I-595 fiber optic communication network due to the impact from the Project Design and Construction. The circuit size shall be 1 Gb Metro Ethernet (minimum), or equivalent. The Concessionaire shall be responsible for verifying the BellSouth location, coordinating with BellSouth, and paying any and all connection and monthly service fees for the interim "leased line".

In addition, Hub-3 provides the communication interface between District 4's ITS field devices along the Sawgrass Expressway south of Sunrise Boulevard and SMART SunGuide TMC. Hub-3 is connected with the ITS devices along Sawgrass Expressway via the underground fiber optic path that is running north-south in parallel with the existing northbound I-75 to Sawgrass Expressway Connector. The Concessionaire shall be responsible for protecting the existing communication link between Hub-3 and ITS devices along the Sawgrass Expressway as well the Turnpike Sawgrass backbone fiber optic. If this communication link is damaged by the Concessionaire, it is the responsibility of the Concessionaire to repair or replace the damaged communications equipment (fiber optic cable, conduit, pull boxes, splice cabinets, hubs, etc.) within four hours. Damaged fiber optic cable may be temporarily fusion spliced

within the four-hour period to temporarily restore communications; however, any damaged fiber optic cable will be replaced from termination point to termination point with the same type of cable within 90 days. At the sole discretion of the Department, the Department may facilitate the repair or replacement of any devices or infrastructure using the Department's existing ITS Maintenance contracts. If the Department decides to utilize these contracts to enact the repairs, the Concessionaire will make payment to the Department's representative within 30 days after receiving an invoice. All materials, equipment and labor costs will be included in the invoice and will be borne by the Concessionaire.

The Department is in the process of deploying an Incident Management facility from the existing Florida Highway Patrol (FHP) Building located between I-595 mainline and westbound SR 84 just west of SW 136th Avenue. This facility will be connected with the SMART SunGuide TMC through the redundant communication network consisting of wireless Ethernet radio and fiber optic infrastructures. The Concessionaire shall be responsible for maintaining the communication connection between the FHP building and the SMART SunGuide TMC throughout the Construction Period. The Concessionaire shall provide one 24-strand fiber optic drop to the FHP Building from the new I-595 fiber optic backbone as part of the permanent I-595 ITS infrastructure.

The Department currently has full ITS coverage along the I-595 corridor Project area. The Project improvements will inevitably disrupt the normal ITS operation and impact the existing ITS communications network and field subsystems along the I-595/SR 84 corridor. Moreover, during the Construction Period it is expected that congestion will increase due to lane closures and other construction related activities. This will in turn cause an increase in delays and incidents along the highway. The Concessionaire shall try to maintain the existing ITS infrastructure and communication network as long as possible so that the impact to the District 4's existing ITS operations can be minimized.

All ITS elements removed from the existing ITS system shall be the property of the Department. The Concessionaire shall promptly return the reusable existing ITS components to the Department's ITS staff. The reusable existing ITS components include, but are not limited to, DMS sign assembly, CCTV camera assembly, MVDS assembly, switches , Uninterrupted Power Services (UPS), cabinets and generators.

1.3 Interim Traffic Management System

The Concessionaire shall assume the responsibilities of all of the existing ITS operations on I-595 corridor within the Project limits from the date of NTP-2. The ITS operations shall include, but not be limited to, the Concessionaire's I-595 TMC operations located at the SMART SunGuide TMC, the Road Ranger Service Patrols, the Severe Incident Response Vehicles (SIRV) and the Broward County Freeway Traffic Incident Management (TIM) Team.

It is the Concessionaire's responsibility to maintain the complete ITS coverage during all phases of construction. At a minimum, the Concessionaire shall provide traveler information through the use of DMS, CCTV, and MVDS devices as well as the new or existing fiber optic or wireless communication connectivity between the devices and FTE and SMART SunGuide TMCs. Complete DMS, CCTV, and MVDS coverage through the Project limits is required. When it becomes no longer feasible to operate the existing I-595 ITS infrastructure due to the impacts from the Design Work and Construction Work, the Concessionaire shall deploy a portable work zone and wireless communication based Interim Traffic Management System (ITMS) during the construction.

The Concessionaire shall be responsible for the design, construction, integration, operation, and maintenance of an ITMS as an integral part of the work-zone traffic control during the period of the I-595 construction. The system's main goal will be to provide the public with accurate real-time information on current traffic conditions along I-595 during the construction. The Concessionaire shall ensure that the

entire I-595 ITMS is operational prior to decommissioning the existing I-595 ITS systems due to the impact from Design Work and Construction Work. The Concessionaire shall draft and submit the ITMS Standard Operation Guidelines (SOG) to the Department for review and comment at least 28 days prior to the commencement of I-595 ITMS.

The ITMS will be used to augment the construction maintenance of traffic (MOT) throughout the Construction Period by providing a means to evaluate traffic conditions and provide information to motorist on and approaching I-595. The information will facilitate traffic management by providing travelers with positive guidance to alternate routes. The ITMS will also help with incident management by identifying problems and allowing the operating staff to assess the situational needs and then implement the necessary response. The main goal of the ITMS is the dissemination of accurate real-time information to the traveling public during the Construction Period.

1.3.1 Portable Work Zone System

The I-595 ITMS shall be based on the use of Portable Work Zone Systems (PWS) that consist of four major components: CCTV, DMS, MVDS and wireless communication bridges. The PWS should be a complete, self contained, portable traffic management system, designed to gather traffic data, monitor and manage traffic flow, and update drivers with real-time information. The PWS shall incorporate video, sensors, wireless communications, and DMS throughout the work zone. The PWS shall give the Concessionaire's TMC operators the ability to monitor changing traffic patterns and weather-related road conditions and immediately inform motorists via the DMS. The PWS can be used to monitor and regulate work zone traffic remotely, greatly reducing the need for on-site supervision. The majority of the devices are expected to operate on a wireless communication system; interconnecting with the Department's existing fiber optic system within Broward County.

The Concessionaire shall design, construct, install and integrate PWS with cameras placed no greater than 1 mile apart, while maintaining 100% video, DMS and MVDS coverage of the I-595 Project Corridor during the I-595 construction. The ITMS CCTV camera shall deliver the industry standard Moving Picture Experts Group (MPEG) 4 streaming video to the SMART SunGuide TMC at the minimum rate of 1 mbps.

The Concessionaire shall deploy two PWS, as part of the ITMS, to provide travelers on Turnpike/SR 91 from both northbound and southbound directions approaching I-595 with real time traffic information on I-595 and corresponding traffic advisories. The Concessionaire shall ensure the two Turnpike/SR 91 PWS are compatible with the Turnpikes SunNav^{SM} system to allow for complete operational control from the Pompano and Turkey Lake TMC's. It is the Concessionaires responsibility to ensure that the PWS wireless communication system does not interfere with FTE's electronic tolling systems.

The PWS are expected to operate on a wireless Ethernet communication system; interconnecting with the existing Department's fiber optic system along the adjacent freeways. The Concessionaire shall design and deploy the ITMS wireless communications network such that it does not load the I-595 and Turnpike/SR 91 communications subsystem's bandwidth beyond 40% expected load on any network device or network link of any segment of the network.

The ITMS DMS shall be capable of displaying a 2-line message with 12" character, 11 characters per line. The Concessionaire shall be responsible for developing the DMS message library that conforms to the FDOT State and District's standard message library.

The Concessionaire shall provide the wireless communication to the two existing arterial DMS on SR 7, as part of the ITMS, to provide travelers on SR 7 approaching I-595 with positive guidance to alternate routes.

The CCTV, DMS and MVDS shall conform to the requirements of Section 781 to Section 786 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

The mobile nature of these devices will allow their rapid deployment and repositioning as traffic conditions dictate. The ITMS is to be an interim system that will be utilized throughout the reconstruction, widening and resurfacing of I-595 during which new permanent ITS components will also be installed.

1.4 Permanent Subsystems

1.4.1 The Concessionaire's TMC

The Concessionaire shall establish a Transportation Management Center (TMC) for I-595 ITS operations within the Department's SMART SunGuide TMC, located at 2300 W Commercial Blvd, Fort Lauderdale, FL 33309. The Concessionaire can have up to three (3) operator consoles in the Control Room (Room#140). In addition, the Concessionaire can have up to four (4) office work stations in any one of the following four work areas: Training Room (#142), Media Room (#102), Lobby (Room #104) or back of the lounge area (Room#150). Each of the work area is capable of accommodating four or more office work stations. These areas (Room #140, 142, 102, 104 and 150) are marked in orange as shown in the Figure 1-2 SMART SunGuide TMC Floor Plan. The Concessionaire shall discuss with the Department if any additional office work stations are needed in the SunGuide TMC.

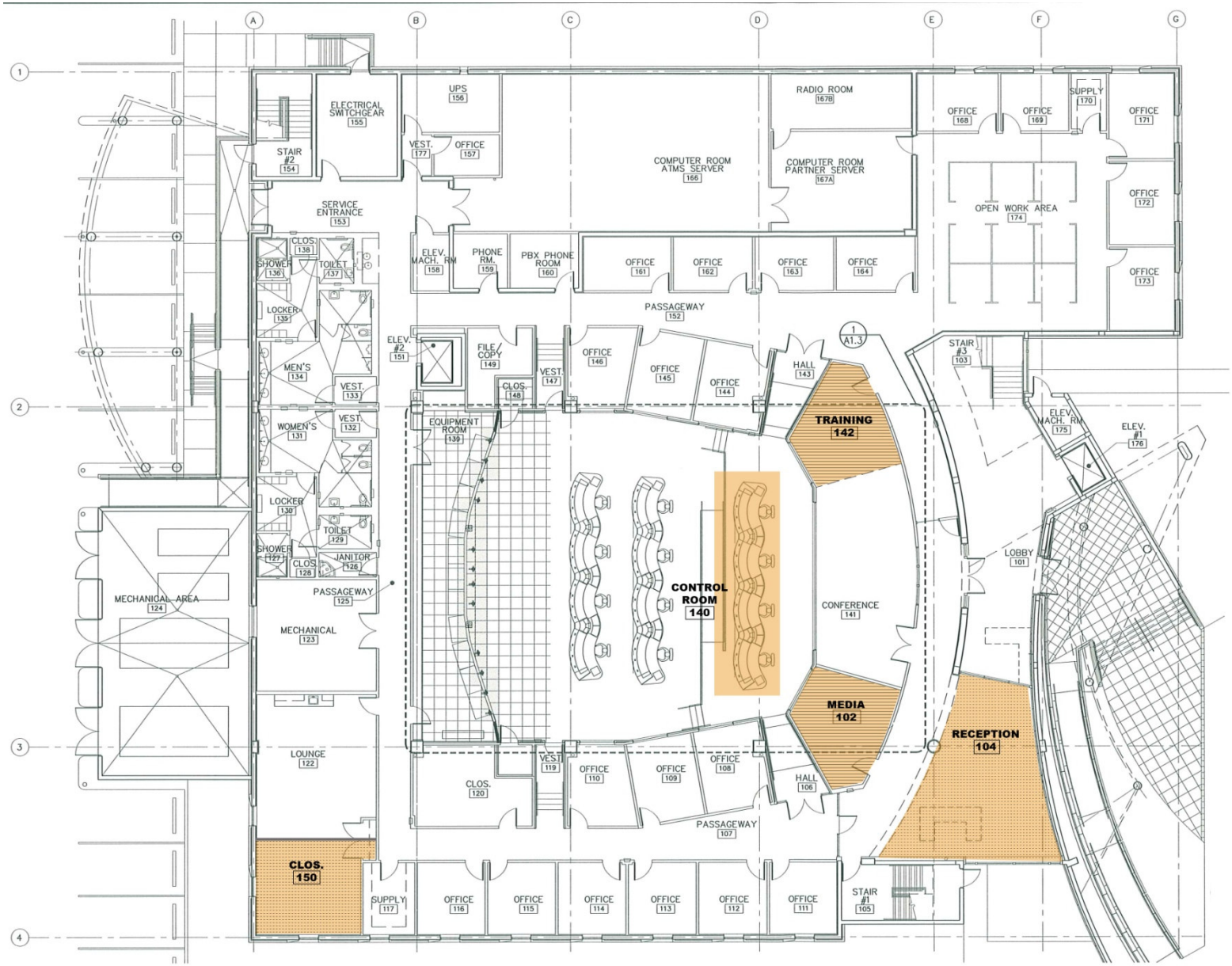
The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the TMC as set forth in Table 4.1A and Table 4.2 of Division II Section 4.

The Concessionaire shall be fully responsible for evaluating, modifying or partitioning the spaces as necessary; designing, engineering, furnishing, installing and integrating the infrastructure, hardware and software elements for the TMC that will be essential to the successful operations of I-595 ITS per the requirements specified in this document. The Department will provide the Concessionaire with one rack space in the existing Computer Server Room. The Concessionaire shall furnish and install the equipment rack to host I-595 ITS computer server(s), fire walls and communication equipment, etc.

The SMART SunGuide TMC shall be the nerve center of the I-595 transportation management system, where real time information about the I-595 transportation network is collected and combined with other operational and control data to manage the transportation network and to produce traveler information. The SMART SunGuide TMC shall link various elements of ITS such as express lanes access control system, communication network, changeable/dynamic message signs, closed circuit video equipment, vehicle detection system, highway advisory radio, and roadside count stations, etc., enabling Concessionaire's operation staff to identify and react to an incident in a timely manner based on real-time data.

The Concessionaire shall ensure that all operations associated with the I-595 ITS be located at SMART SunGuide TMC. The Concessionaire shall provide the Department with real-time, unrestricted access to any and all data and video collected by ITS devices located on the I-595 corridor, SR 84 and the Express Lanes. The Department shall have the right to disseminate any and all data and video collected by ITS devices located on the I-595 corridor, SR 84 and the Express Lanes. The Concessionaire shall be responsible for providing the communication interconnection between the I-595 field distribution switches to Department's field distribution switches. The Concessionaire shall utilize the fiber optic backbones for these interconnections.

Figure 1-2 SMART SunGuide TMC Floor Plan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SERVICE ENTRANCE 153
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PHONE RM. 159
PBX PHONE ROOM 160
OFFICE 161
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OFFICE 163
OFFICE 164
OFFICE 173
LOCKER 135
PASSAGEWAY 152
ELEV. #2 151
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OFFICE 146
OFFICE 145
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OFFICE 111
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1.4.2 Express Lanes Access Control Subsystem

The Project shall include the Express Lanes Access Control Subsystem to provide the Express Lanes operators with the ability to safely manage the Express Lanes system.

The Project shall include a comprehensive suite of software that will enable the Express Lanes operator to operate, through the use of a fully integrated Graphical User Interface (GUI), the Express Lanes system in such a manner that at no time will a motorist be granted authorization to enter the Express Lanes when system configuration conditions exist which would endanger the safety of Express Lanes travelers. The Express Lanes TMC System Control Software shall control the opening and closing of the Express Lanes gates and ensure safe Express Lanes operating conditions.

The Express Lanes software to be developed by the Concessionaire shall provide the GUI for the Express Lanes operators to request and authorize changes to Express Lanes operations. The software shall include checklists that are completed with each operation and it shall provide error logs as well as graphics depicting real-time Express Lanes operations and the functional status of the communication segments. The Express Lanes Software will be a subsystem and shall be fully integrated with SunGuide^{SM} Software, so that the SunGuide^{SM} Software shall launch the associated Express Lanes Software. The Concessionaire shall be responsible for any upgrade and maintenance of Express Lanes Software and compatibility with SunGuide^{SM} during the Term. The Concessionaire shall turn the latest version of the Express Lanes Software Code over to the Department upon final system acceptance and throughout the Term. The Concessionaire shall coordinate with FTE regarding controlling the reversibility of the toll collection equipment; details are specified in the Division II, Section 3, Attachment 2, *FTE's Tolling Infrastructure Support Requirements.*

There shall be five necessary access control components required to safely operate the Express Lanes system: Status CMS, Lane Control Signals (LCS), Warning Gates, Barrier Gates and CCTV Cameras dedicated to monitor the Express Lanes access control systems. These components shall be integrated with the Access Control Unit (ACU) controller and the Express Lanes TMC System Control Software to form a cohesive system that controls access to, and traffic flow on, the Express Lanes. The Express Lanes TMC Software shall include the proper control sequence, verification of device status, and interlocking necessary to guarantee safe operation.

In addition to the access control components, the system shall contain surveillance cameras located in the vicinity of each ACU and at other strategic locations along the Express Lanes. During an operational mode change, Express Lanes system operators shall use the surveillance cameras, in conjunction with road patrols, to ensure that appropriate portions of the Express Lanes are clear of traffic, disabled vehicles, and debris and to verify that all access control components are functioning properly.

The system shall contain at least one ACU for each Express Lanes ingress location. Each ACU shall include a complement of the aforementioned components. Each ACU shall operate in one of two states: Open or Closed.

When an ACU is commanded to the Closed state, the Status CMS shall be commanded to display the 'Closed' message, the LCS shall be commanded to display red "X", the Warning Gates shall be commanded to a closed (to traffic) position, and the Barrier Gates shall be commanded to lower.

Conversely, when an ACU is commanded to the Open state, the Barrier Gate shall be commanded to raise, the Warning Gates shall be commanded to an open (to traffic) position, the Status CMS shall be

commanded to display the 'Open' message and the LCS shall be commanded to display green down arrow.

If communication is lost to an ACU or if the ACU does not respond properly to an OPEN or CLOSED command from the Express Lanes software, the automatic operation shall be terminated and the Express Lanes operator shall work with an Express Lanes technician in the field to complete the action manually from the ACU.

Should any access control elements, i.e., Warning Gate, Barrier Gates, and/or CMS and LCS fail to respond properly to a command from an ACU, the Express Lanes operator and field staff will complete the action manually at each device.

The Express Lanes ITS will also possess a backup communication and power system for all Warning Gates, Barrier Gates, CMS and LCS that control access to the Express Lanes. The backup system can be utilized in the event of a power outage, damaged fiber optic cable, or communications equipment failure. In addition, it will be possible to operate all Warning Gates and Barrier Gates by hand in the event that backup power or communication is not available.

The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the maintenance and operations of the Express Lanes as set forth in Table 4.1A and Table 4.2 of Division II, Section 4.

1.4.2.1 Access Control Unit

Each Express Lanes ingress location will be controlled through an ACU. Each ACU is comprised of a group of Warning Gates, Status CMS, LCS and Barrier Gate.

Each ACU will be managed by an ACU controller. All of the access control components at an ACU will be controlled by Programmable Logic Circuit (PLC) outputs and monitored by PLC inputs. Remote ACU control from the TMC and the transmission of data collected by the ACU controller to the TMC will be accomplished via the new I-595 communication network in conjunction with Department's existing fiber optic networks along I-95, Florida's Turnpike and the Sawgrass Expressway. Each ACU controller will communicate with the TMC using Transmission Control Protocol/Internet Protocol (TCP/IP) via the Ethernet switch located in the ACU enclosure.

The ACU controller, in conjunction with Express Lanes ITS software, will enforce all aspects of the safe and orderly operation of the access control components when under control of a TMC operator. This includes the proper control sequence, verification of device status, and interlocking necessary to guarantee safe operation.

1.4.2.2 Changeable Message Sign

The Concessionaire shall design, furnish, install and integrate an operational CMS system in support of Express Lanes operations for the Project. The CMS system shall be compatible with the SunGuide^{SM} Software platforms and the existing communications protocols used by the FDOT District 4 SMART SunGuide TMC.

The Express Lanes ITS will utilize CMS in two major applications: Status CMS to provide the travelers with the Express Lanes status – OPEN or CLOSED; and Tolling Rate CMS to provide tolling rate information. Both Express Lanes Status CMS and Tolling Rate CMS shall be strategically placed starting in advance so they can be observed by motorists approaching any of the Express Lanes entrances.

Express Lanes status messages will be displayed on each Status CMS at all times to inform motorists of the current status of the Express Lanes. The Express Lanes Status CMS shall be an access control component which will be integrated with the access control warning gate system and the access control barrier gate system to form a comprehensive access control system. The Tolling Rate CMS shall be commanded to display the current tolling rate information by the SunGuide Software Tolling Subsystem from the SMART SunGuide TMC.

Each entrance to the Express Lanes shall be controlled with a series of three to five Status CMS and two to four Tolling Rate CMS depending on the geometric configuration of the entrance.

The CMS system shall use Full Matrix, Light Emitting Diode (LED) technology and be capable of displaying Express Lanes status – OPEN or CLOSED, when a command is sent from the TMC Central Computer. The Toll CMS shall be capable of displaying the I-595 Express Lanes toll pricing information when a command is sent from the Department's SunGuide TMC.

The CMS display panel used to display Express Lanes status shall be capable of displaying, at a minimum, 18 characters per line. The CMS display panel used for toll pricing information shall be capable of displaying six characters per line. All CMS display characters shall be of the same height, with a minimum height of 18" and a minimum width of 9".

The CMS messages shall be legible within a distance range of 150 to 900 feet from the display face under the following conditions:

- Whenever the CMS is displaying alphanumeric text that is 18" high and 9" wide.
- Viewed within the minimum 15 degree cone of vision centered around the optical axis of the pixel. The cone perimeter shall be defined by its 50% intensity points.
- Twenty-four hours per day and in most normally encountered weather conditions.
- During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the CMS.

The CMS controller cabinet shall be installed at a distance in advance of the CMS structure such that maintenance personnel performing work from the controller cabinet shall be able to view and confirm the text being displayed on the CMS. For easy access and maintenance, the CMS controller cabinet shall be installed on the roadside and be placed out of the clear zone or behind guardrail per FDOT requirements.

The Concessionaire shall furnish and install CMS of the type and minimum size as defined in this document and shall conform to the requirements of Section 781 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition). This specification establishes the minimum material, operational, functional and installation requirements that the DMS/CMS modules mounted onto static signs shall meet.

The Concessionaire shall design, construct, install and integrate a CMS system attached to the static signs wherever possible. The Concessionaire shall design and build a sign support structure for each proposed static sign and CMS assembly capable of meeting all State and governing standards.

Construction of the CMS housing shall be designed with sign mounting support locations for attachment to static signs installed on the cantilever or overhead truss structures. The points of attachment shall be located to minimize vibration or deflection of the sign housing, and/or its structural members, and allow ease of field attachment to the intended structure.

The Concessionaire shall design the location of static and CMS sign support structure, in relation to sight distance, as per the standards within the Manual on Uniform Traffic Control Devices (MUTCD), latest

edition. The Concessionaire shall coordinate with the on-going I-95 Managed Lanes Project so that the methodology and appearance of the signs will be consistent to the travelers in the region.

1.4.2.3 Access Control Warning Gate

Access control Warning Gates are intended to warn traffic that the Express Lanes entrance they are approaching is CLOSED. Warning Gates are intended to be used in combination with Barrier Gates, CMS and DMS to provide a complete guidance and information system to travelers that the Express Lanes entrance is either OPEN or CLOSED. The gate arm will contain lights to create better visibility to approaching motorists in low light/visibility conditions. Warning Gates do not, however, provide an impenetrable barrier and thus are not able to physically prevent a vehicle from entering the Express Lanes roadway when closed.

Each entrance to the Express Lanes roadway will be controlled with a series of gates depending on the geometric configuration of the entrance. In addition, there will be an access control Barrier Gate located between a pair of warning gates at each entrance ramp.

Warning Gates will be configured with horizontal swing arms. The length of each gate shall be customized for each location. Gate arms shall be covered on both sides with alternating red and white engineering grade reflectorized sheeting. In addition, gate arms shall have alternating red and amber lights on top of the gate that flash when the gates are moving and are illuminated when the gates are closed. When open, these gates shall be invisible to the motorists. When closed, they will be clearly visible due to the combination of red/white reflective tape and red/amber lights illuminated on top of the gate arm.

The Warning Gates shall be controlled by the TMC Express Lanes ITS software. If a Warning Gate does not respond properly to an OPEN or CLOSED command from the central software, the automatic operation will cease and the Express Lanes Operator and field technician will be required to complete the command manually from the ACU. Should this fail, the Express Lanes operator and field technician will complete the command manually at each device.

1.4.2.4 Access Control Barrier Gate

Barrier Gates are intended to physically prevent a car from using an entrance when it is closed. The Barrier Gate shall be designed for use as a penetration resistance barrier and shall be suitable for use as a warning barrier on wide spans. A Barrier Gate is fixed at both ends and is intended to stop a moving vehicle. The barrier is intended to prevent a severe head-on high-speed collision between a vehicle entering a CLOSED entrance and a vehicle on the Express Lanes traveling in the opposite direction. Because the Barrier Gate is a physical obstacle it shall be placed behind three or more Warning Gates. In addition, there will be several DMS and CMS present to warn motorists.

The operating mechanism and main control components shall be contained in a weatherproof housing. The barrier arm shall pivot in the vertical plane via a mechanical linkage. The linkage shall utilize cranks keyed to the main arm shaft and transmission shaft and an adjustable connecting rod between a pair of self-aligning spherical rod ends. The barrier shall be fixed to a suitable foundation, as specified by a Registered Structure Engineer in Florida. Each Barrier Gate shall be provided with a hand-crank and a drill crank to facilitate manual operation.

The Barrier Gates shall be controlled by the Express Lanes direction control feature of the Express Lanes ITS software. If a Barrier Gate does not respond properly to an OPEN or CLOSED command from TMC software, the operation will cease and the Express Lanes operator and field technician will be required to

complete the command manually. As determined by observation or system alarms, an impacted Barrier Gate will need to be replaced immediately. Each gate is custom designed for each location and the replacement needs to be exactly as originally constructed to ensure the Gate will provide the crash impact resistance originally intended.

1.4.2.5 Lane Control Signals

The Concessionaire shall design, furnish, install and integrate an operational LCS system in support of Express Lanes operations for the Project. The Concessionaire shall design, construct, install and integrate an LCS subsystem, above each of the Express Lanes entrance lanes, including all ancillary equipment, co-located on select static sign structures, freeway DMS support structures, and/or tolling gantry structure(s) along the Project corridors.

The TMC Express Lanes ITS software shall determine lane status and route information to each ACU controller for proper "ARROW" or "X" display. The LCS subsystem shall be capable of operator manual override for ARROW or X display if the LCS fails to respond correctly to the commands from TMC and/or ACU.

The LCS subsystem shall be installed overhead above each Express Lanes entrance lane and wired directly to a roadside controller and capable of displaying the symbols listed in the following table:

Table 12.4-1 – LCS Subsystem Symbols and Definitions

Signal Name	Meaning to Motorist
Green Down Arrow	The lane is open; it is safe to proceed in this lane.
Red X	The lane is closed; do not enter the lane, or leave it if you are in it.

Each LED LCS shall conform to the following minimum requirements:

1.4.2.5.1 Light Emitting Diodes

The LEDs that make up the LCS display modules shall be high luminosity T –1 ¾ package lamps. The LEDs shall have an ultraviolet light inhibitor in a clear epoxy dome package and be of a production type already tested for use in high vibration commercial traffic environments and climate of the southeastern United States.

- Red LEDs
    1. All Red LED's shall be high intensity AllnGaP II type, as manufactured by Agilent Technologies or approved equal.
    2. The light emitted shall be red conforming to ITE specifications with an average wavelength centered at 630nm plus or minus 10 nanometers.
    3. The typical luminous intensity Iv (mcd) @ I(f)=20 mA shall range between 1650 and 6300.
    4. The minimum viewing angle (one-half on-axis intensity value) of the discrete LEDs shall be a cone of 30 degrees, centered about the optical axis of the lamp.

- Green LEDs
    1. All Green LED's shall be high intensity GaInN type as manufactured by Nichia model number NEPE510S, or approved equal.

2. The light emitted shall be bluish-green, conforming to ITE specifications. The LED shall meet the following specifications defined in the tables below:

Electrical/Optical Characteristics (Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	Vf	If=7[mA]	-	3.4	3.9	V
Reverse Current	Ir	Vr-5[V]	-	-	50	μA
Luminous Intensity (Rank IE3)	Iv	If=7[mA]	1400	3920	-	mcd

Color Rank (If=7mA, Ta=25°C)

	Rank IE3			
X	0.03	0.03	0.17	0.17
Y	0.44	0.70	0.70	0.44

3. The minimum viewing angle (one-half on-axis intensity value) of the discrete LED's shall be a cone of 30 degrees, centered about the optical axis of the lamp.

1.4.2.5.2 **Construction Features**

The LCS shall be capable of displaying an 18 inch square red X and a green arrow. Signal lamps shall be mounted in standard polycarbonate signal heads, modified with square faceplates to accommodate the square LED lamp inserts.

The LCS units shall be constructed with modular components in order to allow easy maintenance and quick troubleshooting. The LCS enclosures shall be designed for easy removal to allow for quick replacement of an entire LCS unit.

The full graphic display of the LCS shall be clearly visible and legible from in-vehicle viewing distances of 900 feet to 75 feet from the signal face under clear daylight and night time conditions with the signal face positioned in the roadway line of sight configuration. The LCS units shall be designed so that an illuminated "X" or arrow can be seen when the sun is in the background of the LCS. Each LCS unit shall be equipped with a backplate making the unit visible when the sun is in the direct background of the unit.

The signal display shall be arranged from a sufficient number of individual LEDs to form the required "X" and downward arrow shapes and meet the legibility, luminosity and viewing angle requirements as specified herein. As a minimum the "X" and arrow shapes shall consist of two separately circuited strings of LED's. The failure of anyone string shall not result in more than 50% loss of displayed light with the "X" or arrow shapes still being fully viewable.

The LCS shall operate over the full temperature and humidity ranges specified in National Electrical Manufacturers Association (NEMA) TS-2.

The final display character layout, arrangement of modules, the quantity and arrangement of pixels per module and the quantity and arrangement of LEDs per pixel shall be submitted to the Department for review and approval.

The LCSs shall be designed to be integrated in to the Express Lanes access control systems, via ACU controllers or similar 120V AC switched based interfaces. The electrical interface shall allow the LCS to be wired as a direct replacement for a standard incandescent traffic signal. The LCS control interface shall consist of one 120 V AC switched input. When power is applied to the input, the signal shall turn on and remain illuminated for as long as the power is applied.

For improved nighttime visibility, dimming shall be provided.

1.4.2.5.3 Signal Enclosures

The LCS shall have a weatherproof housing. The LCS shall meet the requirements for TYPE 3R enclosures according to NEMA Standard Publication 250.

All serviceable components shall be modular, interchangeable and removable from within the sign enclosure. The sign design shall allow unobstructed and convenient access to all serviceable components within the sign enclosure and between the sign display and the sign display cover.

All hinged doors shall have continuous hinges with locking struts designed to hold the doors open. Automatic opening type struts shall not be used. Access doors shall be designed to allow for opening by a single person. The release of door latches shall be by hand or require only simple, common hand tools. If bolts or screws are used for securing access doors, they shall be captive type, to prevent them dropping onto the roadway below when removed.

The LCS shall have a Lexan faceplate with matte finish, 0.177" thick, minimum, over the LED display. The sign face shall be flat black.

The performance and stability of the signal shall not be impaired due to vibration, wind, vacuum, pressure or other normally encountered forces created by the effects of traffic.

1.4.3 Emergency Access Gates

The Concessionaire shall provide an Emergency Access Gate (EAG) Subsystem to provide emergency responders with additional accessibility to the Express Lanes from the I-595 General Purpose Lanes.

The EAG Subsystem shall consist of five independently controlled retractable barrier gates. The location of each EAG is detailed in VII DII Section 3.

The Concessionaire shall implement appropriate warning signs and warning devices at each EAG location. Each EAG shall be capable of opening independently and with primary control by the TMC.

1.4.3.1 EAG hardware

Each EAG shall provide a continual crashworthy longitudinal barrier between the Express Lanes and the I-595 General Purpose Lanes. Each EAG shall be retractable to provide a minimum 42 ft opening for controlled access. The gate shall be fully tested to meet the recommended structural adequacy, occupant risk, and vehicle trajectory criteria set forth in the National Cooperative Highway Research Program Report 350 for the Test Level 3 length of need and transition (TL-3 LON/T).

Each EAG shall be electrically operated from the SMART SunGuide TMC. Each EAG shall be equipped with a NEMA 4 rated electrical control system which provides electrically powered locking/unlocking and opening / closing gate movements. The control system shall sense gate stall conditions and shut

down safely. The electronic operation to open or close the gates shall be less than 90 seconds. Each EAG shall also include the manually operated drive system as a means of operating the gate in the event of loss of electrical power and the backup power system, or loss of communication to TMC.

- Each EAG shall include four assemblies of dual flashing beacons utilizing 12 inch signal heads (one above and one below regulatory signage) to provide visual feedback of the gate operation when the EAG is not in a state of close.
    - The two dual flashing beacon assemblies nearest each EAG shall be back to back and shall be on either side of the EAG, 50' from the EAG.
    - The two dual flashing beacon assemblies in advance of the EAG shall be approximately 550' from the EAG.
    - Upon opening of an EAG, three dual flashing beacon assemblies shall operate per direction of travel and shall service the Express Lanes traffic and the I-595 General Purpose Lanes.
    - Flashing beacons shall only operate for the applicable direction of travel.
- Each EAG shall contain an infrared safety sensor to reverse gate closure when blocking is detected.
- Each EAG shall be designed to maximize the shoulder widths at the EAG to facilitate the emergency vehicle's negotiation of the opening in the direction of traffic.
- Additional traffic gates shall be used to close the Express Lanes shoulder in advance of the EAG to prohibit the unauthorized use of the EAG.

1.4.3.2 EAG control software

The Concessionaire shall provide the EAG control software that will enable the Express Lanes operator in SMART SunGuide TMC to control the opening and closing of each emergency access gate and appurtenances. The software shall include a fully integrated Graphical User Interface (GUI) that will display the current status of each EAG simultaneously. The EAG control software shall include the proper control sequence, verification of device status, and interlocking necessary to guarantee safe operation.

The EAG control software to be developed by the Concessionaire shall provide the GUI for the Express Lanes operators to request and authorize changes to emergency access gate operations. The software shall include checklists that are completed with each operation and it shall provide error logs as well as graphics depicting real-time EAG operations and the functional status of the communication segments. The EAG control Software will be a subsystem and shall be fully integrated with SunGuide^{SM} Software, so that the SunGuide^{SM} Software shall launch the associated EAG control software. The Concessionaire shall be responsible for any upgrade and maintenance of EAG control software and compatibility with SunGuide^{SM} during the Term. The Concessionaire shall turn the latest version of the EAG control software Code over to the Department upon final system acceptance and throughout the Term.

1.4.4 Communications Subsystem

For the purposes of these ITS Deployment Requirements, the term "redundancy", refers to the physical connection between the FDOT, FTE and I-595 fiber optic communications systems through the use of fiber optic cable splicing or network switching equipment to allow multiple communications paths from ITS and toll field devices to the TMCs and FTE toll processing center. The term "connectivity" refers to the physical connection between the ITS field devices with the communications backbone. The term

"interconnectivity" refers to the connection between any two fiber optic communications backbone systems.

The communications subsystem shall be an open-architecture, non-proprietary, real-time multimedia communications network, which is a digital fault-tolerant, redundant routed communication network.

The Concessionaire shall design and deploy the I-595 communications network such that it does not load the I-595 communications subsystem's bandwidth beyond 40% of the expected load on any network device or network link of any segment of the network.

The Concessionaire shall design and integrate a 3-tiered hierarchical network design which includes the following three layers:

- The core layer that is comprised of the core Layer 3 switch in the TMC
- The distribution layer consisting of new Layer 3 switches located in the new field communication hub(s) to provide policy based connectivity
- The local-access layer that provides workgroup/user access to the network through the managed hardened Layer 2 Ethernet switches in the ITS device cabinets and ACU cabinets

The I-595 ITS communications subsystem shall consist of a Backbone Network and an Access Network utilizing 96-strand single-mode, fiber optic cables and will utilize the TCP/IP network communication protocol and the Ethernet physical layer protocol.

The Concessionaire shall deploy three new Standalone Environmentally Controlled Concrete Shelter Buildings at the following locations: I-595/I-95 interchange area, I-595 /Turnpike SR 91 interchange area and I-595/I-75/Sawgrass Expressway interchange area. The shelter building shall be approximately 19' x 14' in size. The shelter building shall be partitioned into two equal sized rooms and each room shall be provided with its own door and lock. One room shall be used by the Concessionaire to host the I-595 distribution switch and the other room shall be provided to Department to accommodate the Department's field distribution switch. These new shelters shall be in addition to the existing 3 hubs.

The Concessionaire shall be responsible for designing, engineering, furnishing, and installing the shelter building and communication infrastructures per the requirements specified herein. The Concessionaire shall furnish, install and integrate the I-595 distribution layer 3 switches in the Concessionaire room of the shelter building and make operational the I-595 fiber optic based Internet Protocol (IP) network as required herein. The Department will be responsible for the "cutover" of the distribution switches and network connections from the existing field communication Hub-1 and Hub-3 to the Department's portion of the shelter buildings. In the new Hub-2 at I-595/Turnpike SR 91, the Department will furnish, install and integrate a layer 3 switch and establish the necessary connections to implement the ring topology for the Department's ITS backbone network. Figure 1-3 below depicts the conceptual configurations for the distribution switches in three communication shelter buildings.

While the Concessionaire shall be responsible for the full operation and control of the I-595 ITS field elements, the Concessionaire shall provide the Department with real-time, unrestricted access to any and all data and video collected by ITS devices located on the I-595 corridor, SR 84 and the Express Lanes.

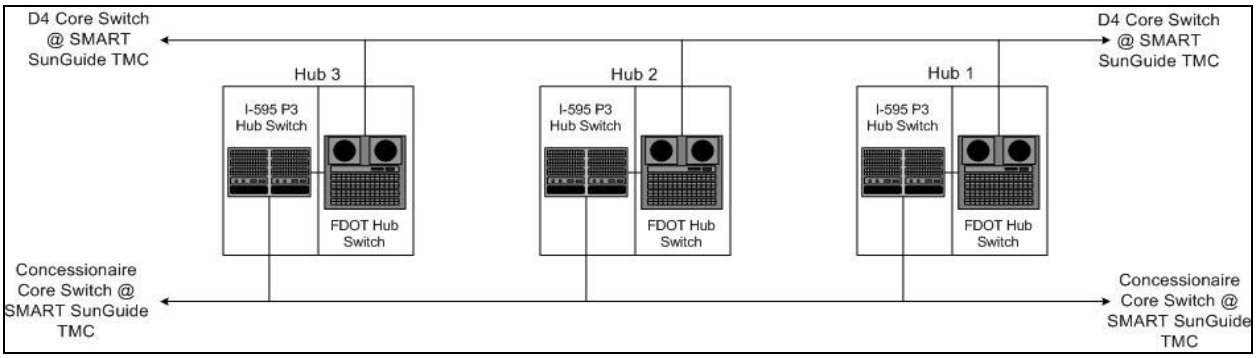

Figure 1-3 Conceptual Configurations for Communication Shelter Buildings

The interconnected core Ethernet switch in the TMC will be connected to the Ethernet switches in the field device cabinets via the optical fiber backbone and field communication hubs in a daisy-chain fashion. The Concessionaire shall create a ring topology that contains redundant, physically diverse routes from the TMC to each I-595 distribution switch and field device. The Concessionaire shall implement the Open Shortest Path First (OSPF), an interior gateway routing protocol for core and distribution switches in the I-595 IP networks based on the shortest path first or link-state algorithm. The layer 3 switches shall use link-state algorithms to send routing information to all nodes in an inter-network by calculating the shortest path to each node based on topography of the network constructed by each node. Each switch sends that portion of the routing table (keeps track of routes to particular network destinations) that describes the state of its own links, and it also sends the complete routing structure (topography).

The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the maintenance and operations of the fiber optic communications as set forth in Table 4.1A, Table 4.2 and Table 4.3 of Division II, Section 4.

1.4.4.1 The Backbone Architecture

The Concessionaire shall develop and integrate the Backbone Network based on 1 Gigabit Ethernet. The Gigabit Ethernet network shall support all video, data, and voice transmittal between the Project subsystems and the TMC. The physical fiber optic connection shall be completely redundant to allow for signal survivability if one of the existing or proposed 96-strand fiber optic cables is severed. At no time shall FTE fiber communications along the Sawgrass Expressway and the Florida's Turnpike be disrupted. Any communication loss shall be reestablished within four (4) hours and is subject to liquidated damages.

The core switch in the TMC will provide load balancing and fast convergence for data packets between interconnected distributed layers. The Concessionaire shall be responsible for integrating the I-595 ITS network distribution layers with the access layer and core switch in the TMC.

The communication backbone for I-595 ITS will consist of three new Distribution Level Layer 3 switches, one at each of the aforementioned field communication hubs (See Figure 1-3): Hub-1 at the I-95/I-595 interchange area, Hub-2 at the I-595 / Turnpike SR 91 Interchange area and Hub-3 at the I-75/I-595/ Sawgrass Expressway interchange area. These switches will act as an intermediary between the core and access layers. The Layer 3 switches shall interconnect to the adjacent distribution switch and/or the core layer and will communicate with the TMC through Gigabit Ethernet fiber optic ports. The distribution layer of the network shall serve as the demarcation point between the access and core layers and helps to define and differentiate the core. The purpose of this layer is to provide boundary definition

and is the place at which packet manipulation can take place. The distribution layer includes the routing methods, Virtual Local Area Network (VLAN) routing, network securities and access control policies, and routing protocols to the access layer.

The Concessionaire shall ensure that the Backbone Network possesses, at a minimum, the following characteristics:

- All hub sites and/or TMCs must be linked together on dedicated, directly connected fiber optic pairs at a minimum of 1 Gb connection. No individual ITS field devices shall be connected to the backbone network fiber optic pairs.
- The Concessionaire shall only use devices that employ industry standard Ethernet components complying with Institute of Electrical and Electronics Engineers (IEEE) standards for communications on the I-595 ITS Project network.

1.4.4.2 The Distribution Architecture

The Concessionaire shall deploy a new optical fiber conduit and cable subsystem, consisting of a 96-strand single-mode fiber optic cable, along the westbound side of I-595 within the Project limits, to support the distribution layer. The Layer 2 Managed Field Hardened Ethernet switch (MFES) shall provide the access layer for the ITS field devices. The Concessionaire shall develop and deploy the access layer network based on 10/100 Megabit Ethernet.

Each MFES shall have two independent fiber optic connections. Each MFES shall be independently and simultaneously connected to both a Layer 3 distribution switch and another MFES at the second device cabinet, hence forming a “daisy chain” configuration for those two MFES. The Concessionaire shall implement all access layer MFES connections such that one device cabinet is connected to the distribution switch at one hub site (either directly or via another MFES) while simultaneously being connected to a second device cabinet which is connected to the distribution switch at a different hub site. This design will result in multiple daisy chained segments utilizing separate fiber pairs between the Distribution Network hub sites. The Figure 1-4 depicts the typical distribution and local access communication network.

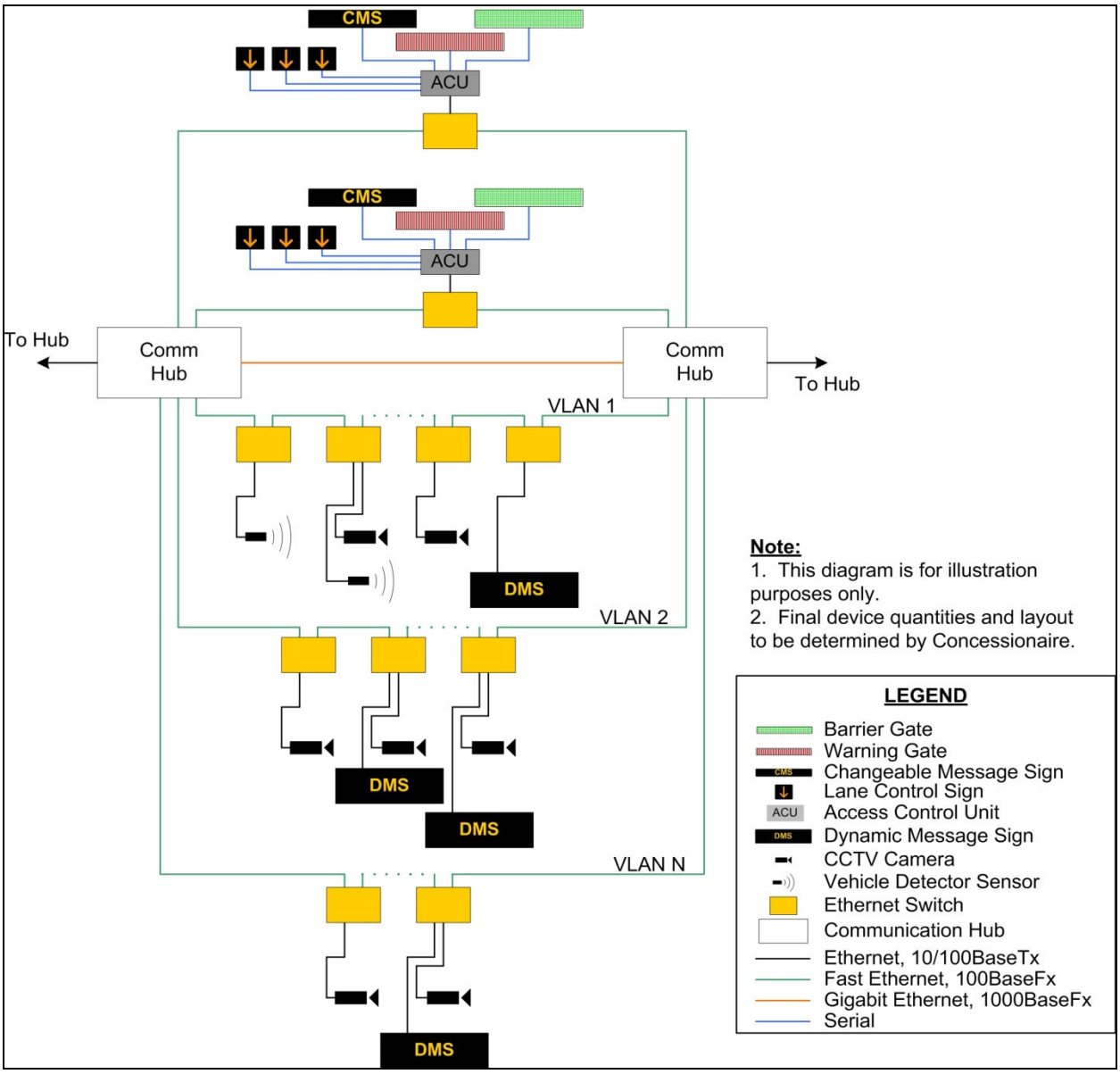

Figure 1-4 Typical Distribution and Local Access Communication Network

The Concessionaire shall design and deploy multiple VLANs to segment ITS field devices into logical workgroups. These VLANs shall terminate on layer three switches as they will be routed via virtual interfaces. The Concessionaire shall implement the Rapid Spanning Tree Protocol (RSTP) for the switches at the distribution and access layer networks. The RSTP supported in the Ethernet switches will prevent infinite looping situations. RSTP defines a tree that spans all switches in a VLAN link by forcing certain redundant paths in the network into a blocked state. If a link that previously forwarded traffic becomes unavailable, RSTP dynamically reconfigures the network to redirect traffic flow by activating the standby link.

1.4.4.3 Field Communication Shelter (Hub)

The Concessionaire shall design, engineer, furnish, and install three Standalone Environmentally Controlled Concrete Shelter Buildings at the following locations: I-595/I-95 interchange area, I-595 /Turnpike SR 91 interchange area and I-595/I-75/Sawgrass Expressway Interchange area. The shelter building shall be approximately 19' x 14' in size, and partitioned to two equal sized rooms with separate doors and locks.

The Hub shall include communications equipment, standard 19" racks, power supply, fiber optic patch panels with splice trays, and any necessary ground and surge suppression protection, conduit, conduit fittings, horizontal and vertical cable management trays and wiring.

The Concessionaire shall be responsible for all permitting requirements to furnish and install the shelter buildings. The Concessionaire shall ensure the Standalone Environmentally Controlled Concrete Shelter Buildings are consistent and meet the requirements set in Section 785 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition). The Hubs shall be furnished and installed with the following minimum or better requirements:

- Hurricane Category 5 rated environmentally controlled equipment shelter enclosure
- Heating-ventilation-air-conditioning (HVAC) unit equipped with lead/lag control unit to periodically switch between primary and secondary unit as required for the Hub size and housed equipment
- Off road parking spaces with access for a minimum of two full size vans
- Four switched exterior 120v, 20 amp outlets to supply power to systems located in the maintenance vehicles
- Ability for a minimum of two persons to simultaneously work inside of the hub
- Uninterruptible Power Supply (UPS)
- Generator and Automatic Transfer Switch
- Fire extinguisher
- Pre-wired for power and data requirements
- Overhead cable/wiring trays
- Interior/Exterior lighting
- Electronic door access
- Access to external power and communications pull boxes to and from the I-595 fiber optic backbone

The Hub shall be provided with an electronic alarm system capable of detecting and reporting the following alarms back to a central monitoring station located at the TMC:

- Intrusion alarm
- Smoke alarm

- High humidity
- High temperature
- Low temperature
- Commercial power failure
- Low humidity

The Concessionaire shall furnish all tools, equipment, materials, supplies, hardware, and equipment integration necessary to provide a complete, fully operational Hub site.

The Hubs shall be placed in relatively flat areas away from potential ponding water locations. The elevation of the hubs shall be, at a minimum, one foot above the 500-year design floodplains for the Interstate system. The hubs shall be located within the Project Right of Way outside of the clear zone in areas that are safe from vehicles. The Hubs shall be accessible by a maintenance vehicle. The Components in the Hubs shall be protected from harsh environmental conditions. All doors and conduit openings shall be suitably protected and sealed to prevent the ingress of water, moisture, dust and wind driven rain. A safety and security remote alarm system capable of being monitored from the TMC shall be designed, furnished and installed with the Hub.

1.4.4.4 Core/Distribution Switch Requirements

The Concessionaire shall design and build the Layer 3 Core and Distribution Switches such that they shall use 1 Gigabit Ethernet technology. The L3 switch will be upgradeable to 10Gigabit Ethernet and shall support line rate communication on all ports simultaneously (including 10 Gigabit) in accordance with RFC-2544 specifications.

The Core/Distribution Switch architecture shall be hardware-based distributed switching and routing that increases the availability of network bandwidth to accommodate the next generation of applications based on data and voice integration, multicast-based video, and other emerging technologies.

The Core/Distribution Switch shall perform full Layer 3 functions including OSPF, Label Distribution Protocol (LDP) and be scaleable, reliable, and both backward and forward compatible to existing Department communications network.

The Core/Distribution Switch shall include, but not be limited to, the following components and features:

- A backplane with at least 256 Gbps bandwidth;
- A chassis with minimum seven slots;
- Number of power supply slots integrated into the chassis;
- Fully redundant power supply units with load sharing;
- A multi fan cooling system integrated into the chassis;
- Fully redundant configuration of management/control, server, and I/O modules;
- Multi power feeds.

1.4.4.4.1 Core/Distribution Switch Architecture

The Concessionaire shall design-build every Core/Distribution Switch such that it shall support the following:

- A distributed architecture;
- Packet switching rate shall be greater than or equal to 96,000,000 packet per second (64-byte packet);
- Minimum fabric switching rate shall be 128 Gbps;
- Backplane bandwidth shall be 256 Gbps;

- Hardware-based IP switching and routing;
- Low network latency;
- Delivered with a unique Media Access Control (MAC) address;
- MAC address shall be derived from an address space of 10,000 sequential addresses;
- Shall support non-blocking and switch traffic at wire-speed operation for all ports simultaneously using the maximum port flow available (10 Gigabit Ethernet).

1.4.4.5 Fiber Optic Cable

The Concessionaire shall design and build an underground optical fiber conduit and cable subsystem consisting of two 96-count, single-mode fiber optic cables placed in two separate conduits within the Project Right of Way, along the westbound side of I-595 and parallel to the interstate. The Concessionaire shall utilize 96-count, single-mode fiber optic cable to facilitate connectivity of the Ethernet switches that form the I-595 ITS communication system. The second 96-count, single-mode fiber optic cable shall be reserved for the utilization by the Department for the center to center communications, tolling communications and future needs and expansions. In addition, the Concessionaire shall deploy a 48-count, single-mode fiber optic cable in the third conduit between University Drive and I-95. The 48-count fiber optic will be utilized by Broward County for the County Advanced Traffic Management System (ATMS).

The Concessionaire shall utilize one 96-count, single-mode fiber optic cable for backbone and inter-connect fiber optic installations. The Concessionaire shall install 2-96 strand interconnections between I-595/I-75/Sawgrass, I-595/Turnpike Mainline, and I-595/I-95 fiber optic networks as part of the permanent I-595 ITS deployment. These interconnections shall provide fiber optic connectivity from the I-595 tolling and ITS equipment to the FTE Tolling Processing and the SMART SunGuide TMC through a redundant fiber optic communication path along the Florida Turnpike's mainline (SR 91), Sawgrass Expressway (SR 869), I-95, and I-595.

The Concessionaire shall utilize 12-strand single-mode fiber optic cable drops to facilitate connectivity between the I-595 backbone fiber optic and the proposed ITS devices along I-595 corridors. The Concessionaire shall utilize 12-strand single-mode fiber optic cable drops to facilitate connectivity between the existing Turnpike/SR 91 backbone fiber optic and the proposed FTE ITS devices along Turnpike/SR 91 corridor. The Concessionaire shall utilize 24-stand single-mode fiber optic cable drops to facilitate connectivity between the I-595 backbone fiber optic and the proposed Toll Equipment.

The Concessionaire shall utilize 24-strand single-mode fiber optic cable drops to facilitate the connectivity between I-595 backbone fiber optic and the proposed ITS devices on Turnpike/SR 91 ROW that are required for the safe operations of I-595 Express Lanes to/from Turnpike/SR 91. These devices include, but are not limited to, access control units, warning gates, barrier gates, status CMS, toll rate CMS, and CCTV cameras dedicated to monitor the I-595 Express Lanes access control systems on Turnpike/SR 91.

The Concessionaire shall dedicate two (2) 12-strand buffer tubes in all 96 strand backbone and interconnect fiber optic cable runs for FTE ITS and Toll use only. These fiber optics are in addition to the fiber optics already required for the I-595 ITS and Tolling deployments.

The Concessionaire shall submit detailed network diagrams depicting the interconnections of the fiber optic cable for the Backbone Network and Access Network with the required plans submittals for the interconnection of the subsystems described herein. At a minimum, diagram(s) shall include:

- Brand name, model, and type of switch used at each location

- Port counts and types of all switches
- Buffer tube and fiber optic strand usage

The Department and/or their representative/designee shall be provided the opportunity to be present and witness all installation and testing activities. The Department shall have the right to make inspections and test the conformance of the fiber optic cable, in accordance with the I-595 ITS Project requirements, manufacturer specifications, applicable standards, and the Contract Documents, without notification to the Concessionaire.

The Concessionaire shall test the fiber optic cable on-site and while it is still on the reel prior to installation in the ground as to the conformance of the fiber optic cable, in accordance with the I-595 ITS Project requirements, manufacturer specifications, applicable standards, and the Contract Documents. The Concessionaire shall submit to the Department the results of the on-reel test along with the manufacturer's factory test for review and approval prior to installing any fiber optic cable in the ground. The Department shall have the right to reject any defective cable. The Concessionaire shall replace any rejected fiber optic cable and re-conduct the on-site, on-reel testing on the new reel of fiber optic cable as described herein.

Fiber optic access points, such as splice boxes and pull boxes, shall provide access to the fiber optic conduit system and shall be used in the installation, operation, and maintenance of fiber optic cable along the backbone and to ITS devices. All splice boxes and pull boxes shall come with reinforced concrete aprons to protect the integrity of the box.

The Concessionaire shall ensure that the fiber optic cable, components, splice boxes and pull boxes are conformed to performance requirements of Section 635 and 783 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.4.6 Conduit

The Concessionaire shall utilize six High-density polyethylene (HDPE) conduits along the westbound side of I-595 within the I-595 Project Corridor. Two 2" conduits shall be used for the two 96-count fiber-optic cables, one 2" conduit for each cable. One 2" conduit shall be used for the 48-count fiber optic cable between University Drive and I-95. One 2" conduit shall be used for the power distribution subsystem. Two 2" conduits shall be used as spares for future needs and expansion.

The Concessionaire shall utilize two 2" HDPE conduits for lateral drops to ITS devices and Toll Equipment infrastructure. One 2" conduit shall be used for the 12 and 24-count fiber-optic cable. One 2" conduit shall be used as a spare.

The Concessionaire shall place trace wire equipped with Wire Grounding Units (WGU) in all conduit runs containing fiber optic cable. The WGU shall be housed in its own pull box. The Concessionaire shall furnish and install HDPE conduit that is suitable for underground use in an ambient temperature range of -30° F to 130° F without degradation of material properties.

The conduit furnished shall be resistant to benzene, calcium chloride, ethyl alcohol, fuel oil, gasoline, lubricating oil, potassium chloride, sodium chloride, sodium nitrate and transformer oil, and shall be protected against degradation due to oxidation and general corrosion.

The Concessionaire shall furnish and install HDPE conduit of the type specified in this document and conform to performance requirements of Section 783 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.4.7 Managed Field Hardened Ethernet Switches

The Concessionaire shall furnish and install field-hardened MFES that shall be industrial-grade Ethernet switches to provide connectivity from the remote ITS device installations to the communication hub sites.

The Department shall be able to manage each MFES individually or as a group/cluster for switch configuration, performance monitoring, and troubleshooting.

This Layer 2+ requirement shall provide architecture standardization, open connectivity (interoperability), bandwidth management, rate limiting, security filtering, and general integration management of an advanced Ethernet switching architecture.

Each MFES shall be fully compatible and interoperable with the distribution and core switches used in the Backbone Network.

The Concessionaire shall install a MFES connection for each ITS field device.

Each MFES shall be rack mountable in a device control cabinet without the need for special environmental requirements. The MFES shall be field-hardened at the component level, fully managed Layer 2+ Ethernet switches and shall provide a minimum of six 10/100BaseTX full-duplex local ports for connecting multiple MPEG-2 video encoders and other Ethernet devices. The MFES shall provide a minimum of four 100BaseFX full-duplex uplink ports for communications with the hub switch and for redundant fiber optic connections.

Each MFES shall conform to the requirements of Section 784 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.4.8 Device Servers

The Device Server shall convert serial data (EIA-232/422/485) to Ethernet and shall allow for the connection of a minimum of two serial devices to the Ethernet network. The Device Server shall be environmentally hardened in accordance with NEMA TS 2 (latest edition) standard.

The Device Servers shall deliver universal, high-performance Serial-to-Ethernet connectivity, which is required when a particular ITS device needs COM ports, serial tunneling, or where Transmission Conrol Protocol (TCP) Socket, User Datagram Protocol (UDP) Socket, or UDP Multicast functionality is being utilized and the ITS device only has Serial Data as an output.

The Device Server shall be able to support local and remote configuration and management, which includes access to all user-programmable features, device monitoring, diagnostic utilities, and security functions.

Each Device Server shall conform to the requirements of Section 784 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.5 Dynamic Message Signs Subsystem

The Concessionaire shall design, furnish and install an operational DMS system for the proposed Project. This will include the designing, furnishing and installing new sign structure and foundations as well as new power and communications infrastructure.

DMS will be used to provide motorists with visual information dissemination about changing highway conditions in order to improve operations, reduce accidents and inform travelers.

The Concessionaire shall furnish and install DMS of the type and minimum size as defined in this RFP and conform to requirements of Section 781 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition). This specification establishes the minimum material, operational, functional and installation requirements that the DMS shall meet.

The Concessionaire shall deploy, at a minimum, eight freeway DMSs, four on each direction of travel, along I-595 mainline lanes within the Project limits as well as two freeway DMS's along S.R 91. The two freeway DMS's along S.R 91 are to replace the two existing DMS's that are to be removed. Four of the eight freeway DMSs, two on each direction of travel, shall be deployed along I-595 Express Lanes. The freeway DMS display panel used for I-595 and Turnpike/SR 91 mainline traffic shall be full matrix LED signs capable of displaying three-line messages with 18" height characters, 24 characters per line.

The Concessionaire shall deploy, at a minimum, six arterial DMSs, three on each direction of travel, along SR 84 within the Project limits. The arterial DMS display panel used for SR 84 traffic shall be full matrix LED signs capable of displaying two line messages with 15" characters, 15 characters per line.

The Concessionaire shall adhere to the requirements herein for the design, installation, integration, training, documentation, and warranty requirements for full-matrix, LED DMS assemblies. Each sign assembly shall include but not be limited to the sign case, sign controller and UPS unit, controller cabinet, environmental control and monitoring system, cabling, conduits, electrical service, surge suppression, and hardware associated with a complete installation. DMS locations must be approved by the Department.

The DMS controller cabinet shall be installed at a distance in advance of the DMS structure such that maintenance personnel performing work from the controller cabinet shall be able to view and confirm the text being displayed on the DMS. For easy access and maintenance, the DMS controller cabinet shall be installed on the roadside and be placed out of the clear zone or behind guardrail per FDOT requirements.

The Concessionaire shall design the location of DMS sign support structures, in relation to sight distance, as per the standards within the MUTCD, latest edition.

The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the maintenance and operations of the dynamic message signs subsystem as set forth in Table 4.1A and Table 4.2 of Division II, Section 4.

1.4.5.1 Sign Support Structures

The Concessionaire shall design and build a sign support structure for each proposed DMS assembly capable of withstanding all State and governing standards.

Each Freeway and Arterial DMS sign support structure shall be designed and constructed with a walkway (catwalk) and safety railings to accommodate access for maintenance without the need for lane closures. Both the catwalk and railing shall fully extend from the outer edge of the sign support structure to the access door of the DMS to provide safe continuous access to the DMS. The floor of the walkway (catwalk) shall be level with the bottom of the DMS to provide clearance for the DMS access door to open and swing freely over the walkway (catwalk).

The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the maintenance and operations of the sign support structures as set forth in Table 4.1A and Table 4.2 of Division II, Section 4.

1.4.6 Highway Advisory Radio Subsystem

HAR shall be used as the Concessionaire's redundant means for freeway information dissemination for the I-595 corridor. The information will be used to warn motorists, via their car radio, of such incidents as construction and maintenance activities, special events, adverse weather conditions, roadway closures/lane blockages, traffic crashes, and regional emergencies and evacuations.

The Concessionaire shall design, procure, furnish, install, wire, test, integrate, and make operational a HAR subsystem consisting of a minimum of two fixed transmitting stations and a minimum of six HAR advisory signs with actuated flashing lights for 100% coverage of the I-595 Project corridor with synchronized continuous deployment, and, a central control unit at the SMART SunGuide TMC.

The Concessionaire shall provide the same frequency for the HAR subsystem as other HAR deployments within the District.

The Concessionaire shall provide an HAR system with a minimum of six highway signs with remotely operated flashing lights (beacon) to notify motorists of active HAR broadcasts.

The Concessionaire shall ensure that all components are modular and fit in a rack-mounted chassis. The Concessionaire shall use HAR subsystems and components that are programmable remotely via the SunGuide^{SM} software and a laptop computer with manufacturer's software when connected in the field.

The Concessionaire selected HAR station locations shall have no physical obstructions such as high-tension power lines, tall buildings and trees. The sites shall be located a minimum of 100 feet. from overhead power lines and commercial radio transmitter sites. Antenna sites shall be located away from any potential re-radiating structure.

The HAR system shall conform to the requirements of Section 781-2 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

The Concessionaire is subject to meet the minimum requirements for the maintenance and operations of the HAR as set forth in Division II, Section 4.

1.4.7 Closed Circuit Television Cameras Subsystem

A video surveillance system will be installed to provide TMC staff with the ability to use CCTV cameras to monitor the new I-595 corridor as well as the existing Turnpike/SR 91 corridor. The Concessionaire shall design, construct, install and integrate a CCTV camera subsystem with cameras placed no greater than 0.5 miles apart, while maintaining 100% video coverage of the I-595 Project Corridor and no greater than 1 miles apart, while maintaining 100% video coverage of the Turnpike/SR 91 Project Corridor. The video surveillance system shall provide full motion video to the TMC through CCTV cameras installed along I-595 and Turnpike/SR 91. The CCTV cameras will possess full pan, tilt, and zoom (PTZ) capability and will be protected from the environment. The camera locations within the limits of the Project shall provide:

- 100% view of the express lanes, general purpose lanes and auxiliary lanes within the Project limits.
- 100% view of all access control system elements.
- 100% verification of information on all LCS, CMS and DMS.
- 100% view of ingress and egress points along the reversible lanes.

- 100% view of enforcement areas.
- The controller cabinet shall be pole-mounted.
- The poles shall be accessible for maintenance vehicles by maintenance personnel.

The CCTV cameras with auto focus zoom lens shall be placed at a minimum mounting height of 45 feet above highest elevation of any portion of the I-595 mainline lanes roadway surface that falls within the 0.5 miles of mainline coverage area for that camera location.

The CCTV camera subsystem includes the TMC head-end equipment, which receives, decodes, and disseminates streaming images and data from the field and commands the control and display infrastructure at the SMART SunGuide TMC. The Florida Turnpike (SR-91) CCTV camera subsystem shall include SunNav™ TMC head-end equipment, which receives, decodes, and disseminates streaming images and data from the field and commands the control and display infrastructure at the FTE TMC. The Concessionaire shall coordinate the deployment of these devices with FTE ITS staff.

The Concessionaire shall ensure that the CCTV camera subsystem design creates multicast video streams that shall be able to be shared with other TMCs in accordance with current industry standards.

The Concessionaire shall ensure any CCTV installation on elevated roadway or bridge structure incorporates an anti-vibration/dampening design.

Each CCTV camera shall conform to the requirements of Section 782 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

The Concessionaire is subject to Construction O&M Violations and Operations O&M Violations resulting from the failure to meet the minimum requirements for the maintenance and operations of the CCTV as set forth in Table 4.1A and Table 4.2 of Division II, Section 4.

1.4.7.1 Camera Lowering Devices

The CCTV camera shall be attached to the CCTV pole via a camera lowering device (CLD).

The Concessionaire shall design, build and integrate the CCTV poles with CLDs such that personnel operating the CLD mechanism are not standing directly beneath the CCTV assembly.

The Concessionaire is subject to meet the minimum requirements for the maintenance and operations of the camera lowering devices as set forth in Division II, Section 4.

1.4.7.2 Digital Video Encoders

There shall be one Digital Video Encoder (DVE) for each CCTV camera assembly location. The I-595 CCTV cameras shall be compatible with the existing Barco© Argus display controller located at the SMART SunGuide TMC. The Florida Turnpike (SR-91) CCTV cameras shall be compatible with both the Barco© Argus display controller located at the Pompano TMC and the Christy© display controller located at the Turkey Lake and FHP TMC's. A DVE shall be connected to each analog CCTV camera for conversion of the video to MPEG streaming video facilitating transmission to the TMC, the SMART SunGuide TMC and FTE TMC's. Each DVE shall use MPEG-2 video compression at rates of 1.544 megabits per second (Mbps) and above. These devices shall encode (i.e., digitize) analog video at the CCTV remote site with a DVE and deliver the streaming video, as well as the duplex and bidirectional data sub-channels, to the chosen remote/local network interface device (i.e., the Ethernet switch) which

shall transmit and receive data steams to and from the communications hub and/or the TMC, which are known collectively as the head-end.

1.4.8 Microwave Vehicle Detection Station Subsystem

The MVDS will provide volume, lane occupancy and speed information in multiple detection zones in the I-595 reversible lanes as well as the I-595 and Florida Turnpike (SR-91) general purpose lanes (including auxiliary lanes). The Concessionaire shall evaluate set-back distance requirements and the effect of the barrier wall separating the reversible lanes from the general purpose lanes. The setback and mounting height must follow the manufacturer's recommended criteria in order to meet the performance requirements described in this RFP. Each reversible lane and general purpose lane must be detected in an individual detection zone. Detection zones shall be placed on reversible lanes and general purpose lanes at spacing intervals specified herein along the Project limits on I-595.

The Concessionaire shall design, construct, install, calibrate, integrate, test and make fully operational a non-intrusive MVDS utilizing above the ground, side-fire detectors placed on new concrete poles or new camera poles no greater than 0.5 mile apart along both sides of I-595. The MVDS shall be utilized to collect and process volume, speed, and occupancy data on a lane-by-lane basis for the I-595 traffic, including reversible lanes, general purpose lanes and interchange off-ramps and on-ramps, for up to 10 lanes of travel. The MVDS units shall be self calibrating and have a minimum detection range of 250 feet.

The SunGuide^{SM} Software in the District 4 SMART SunGuide TMC and the SunNav^{SM} Software in the FTE TMC use vehicle speed detection algorithms to sense anomalies in traffic speed and provides an alert when a potential incident is suspected. The incident is then verified with CCTV cameras and appropriate action is taken by the TMC operators located at the TMC.

Each MVDS shall conform to the requirements of Section 786 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.9 Cabinets

The Concessionaire shall ensure that all cable terminations and connecting terminal blocks are contained in a weather-proof aluminum enclosure that shall meet the applicable requirements for a NEMA 3R rated cabinet, as specified in Section 785 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition), as it relates to the physical requirements of the cabinet, door and lock operations, and weatherproofing. The Concessionaire shall furnish and install an ITS field cabinet for housing ITS equipment and network devices including, but not limited to, MFES, device servers, DVE, fiber optic cable patch panels, UPS, and equipment racks for MVDS.

1.4.10 Grounding, Lightning, and Surge Protection

The ITS components of Project shall be protected from damage caused by lightning strikes, transient voltage surges, and induced current. The Concessionaire shall design, install and test all grounding, lightning protection, and transient voltage surge suppression (TVSS) subsystems in accordance with Underwriters Lab (UL) 96A specifications.

The Concessionaire shall furnish and install surge protectors for all cables and conductors (power, video, and data). All I-595 Project ITS subsystems, devices and ancillary components with electrical interconnects shall be protected from voltage surges caused by lightning, transient voltage surges, and external electromagnetic fields at the time of installation of each device. The Concessionaire shall

provide a system to protect field devices and electronic equipment from lightning and surge protection using TVSS technology and standards, as specified in Section 785 of the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.4.11 Power Subsystem

Reliable power sources are a critical part of the Project. No solar power should be utilized as a power solution for the Project. To enhance power reliability, the Concessionaire shall design, construct, install and integrate a power distribution and backup system consisting of, at a minimum, underground power conduits, transformers, generators, automatic transfer switches and UPS. The power backup system shall supply electrical power in event of commercial power supply failure for all Express Lanes access control system components, CMS, communication hub(s), and necessary communication components and ancillaries along I-595.

The Concessionaire is responsible for meeting the minimum requirements for the maintenance and operations of the power subsystem as set Division II, Section 4.

1.4.11.1 Generators

The Concessionaire shall design, construct, install and integrate a diesel fuel generator at selected commercial power supply locations, within the Project Right of Way, as a redundant power supply with 48/72 continuous hours of runtime at full/half load for the critical ITS and communication elements. These devices include, but not limit to, Express Lanes access control units, warning gates, barrier gates, status CMS, toll rate CMS, toll equipments, toll enforcement equipments, communication hub(s) and necessary communication components and ancillaries. The generator shall be adequately sized and connected to each power feeder transformer via the automatic transfer switch (ATS). A PC based ATS remote monitoring and control system shall be provided to communicate between TMC and ATSs located in remote sites. The system shall communicate with TMC and/or other designated remote locations through the Ethernet IP network. The ATS monitoring and control system shall be capable of transmitting email/page message that an alarm has occurred with one or more of the transfer switches.

The Concessionaire is responsible for meeting the minimum requirements for the maintenance and operations of the generators as set Division II, Section 4.

1.4.11.2 Uninterruptible Power Supply

The Concessionaire shall install a UPS at each new ITS device cabinet and communication hub. Each UPS shall supply all electronic components housed in and associated with its device cabinet with uninterrupted power for a minimum of four hours in the event of commercial power loss. Each UPS shall be sized according to the maximum expected load for that cabinet to meet the power requirements of the combined group of electrical components for the required run time.

The Concessionaire shall supply an Ethernet network management interface to determine operational status of the UPS, the internal UPS temperature and the external temperature as recorded by a remote sensor mounted elsewhere in the cabinet. All UPS shall be designed to email events such as power loss, battery levels, and power returned to the Department**.**

The Concessionaire is responsible for meeting the minimum requirements for the maintenance and operations of the UPS systems as set Division II, Section 4.

1.5 Industry Standards

The materials used by and workmanship completed by the Concessionaire for the initial deployment and System Renewals shall be in accordance with reasonable best industry standards. All materials, equipment, supplies, installations and testing shall comply with the I-595 ITS Project requirements, the latest editions of the applicable Governing Regulations referenced in I-595 RFP Volume II, Division 2, Section 2- Project Requirements and provisions for Work, as well as the following standards, and all other future applicable standards and requirements for the future System Renewals. The following list is not meant to be all inclusive.

- The FDOT Minimum Specifications for Traffic Control Signals and Devices (MSTCD)
- The American Society of Testing and Materials standards (ASTM)
- Institute of Electrical and Electronic Engineers (IEEE) standards
- International Standards Organization standards
- The American National Standards Institute (ANSI)
- The National Electrical Manufacturer Association (NEMA)
- The Underwriters' Laboratories Inc. (UL)
- The National Board of Fire Underwriters
- The Electrical Testing Laboratories (ETL)
- Bellcore Technical Advisories and technical requirements
- The Electronic Industries Association (EIA)
- The National Electrical Code (NEC)
- The Joint Electronic Device Engineering Council (JEDEC)
- The Radio-Electronics-Television Manufacturers Association (RETMA)
- The Lightning Protection Institute (LPI)
- The Rural Electrification Administration (REA)
- The International Radio Consultative Committee (CCIR)
- The International Telephone and Telegraph Consultative Committee (CCITT)
- The American Standard Code for Information Exchange (ASCII)
- The National Television Systems Committee (NTSC)
- The International Telecommunications Union (ITU)
- The Motion Picture Experts Group (MPEG)
- The Bureau of Radiological Health – Optical Radiation Hazard specifications
- National Transportation Communications for ITS Protocol (NTCIP)
- The Telecommunications Industries Association (TIA)
- The Federal Aviation Administration (FAA)
- The Federal Communications Commission (FCC)

1.6 SunGuide℠ Software

The Concessionaire shall design, construct, and integrate the I-595 ITS Project such that the Concessionaire shall be able to monitor and operate the subsystems, ITS devices and ancillary components described herein from the TMC.

The Concessionaire shall design, build, and integrate the subsystems and ITS devices described herein such that the subsystems (including Express Lanes access control software), ITS devices and ancillary components shall be integrated with the Department's current version of the SunGuide℠ Software.

The Concessionaire shall be responsible for procuring, installing, configuring, operating, maintaining and supporting its own (a separate) SunGuide℠ Software installation, including all hardware required by that SunGuide℠ Software installation, within the TMC. The SunGuide℠ Software will be

made available for use by the Concessionaire at no cost and annual maintenance fees will be paid for by the Department.

The Department is currently developing the pricing/tolling subsystem of the SunGuide^{SM} Software under a separate contract. This software module will provide the automated variable pricing for the Open Road Tolling application for the ongoing I-95 Managed Lanes Project in Miami/Ft Lauderdale region. The Department will provide the Concessionaire with the pricing subsystem as part of the SunGuide Software that will be used and managed for I-595 ITS by the Concessionaire.

1.7 NTCIP Compliance

The Concessionaire shall implement fully National Transportation Communications Intelligent Transportation System Protocol (NTCIP) compliant subsystems for the I-595 ITS Project.

The Concessionaire shall utilize the FDOT Management Information Base (MIB) definitions and objects for the Project. The latest FDOT MIB definitions and objects can be found at the following Internet link:

- http://www.dot.state.fl.us/trafficoperations/fdot_dms_info.htm

1.8 IP Addressing Schema

The Concessionaire shall utilize the FDOT Standard IP Addressing Schema to create an I-595 ITS Project specific list for all new/existing ITS devices that are installed/reconfigured as part of the I-595 ITS Project.

The Department shall provide the Concessionaire with up to 128 multicast IP addresses for the CCTV video streams and up to 2048 IP addresses for the remaining needs.

The Concessionaire shall be required to submit a document listing all IP addresses utilized in the I-595 ITS Project in a format easily understood depicting at a minimum, the following information:

- Page Number (from Plans)
- Mile Post (MP)
- Global Positioning System (GPS) coordinates
- Device
- IP Address

The Concessionaire shall not use any IP addressing schema or IP addresses other than those provided by the Department. The Department shall review and approve the Concessionaire's IP Addressing Schema submittal prior to the Concessionaire's implementation of the schema. FTE will provide the Concessionaire with the IP addressing schema for the ITS devices along Turnpike/SR 91.

1.9 Field Device Installation

The Concessionaire shall perform site preparation and other site upgrades required for subsystem devices and ancillary components installations. Examples of these upgrades include, but are not limited to, ground leveling, concrete leveling pads, and/or addition of retaining walls. Field device installations shall meet all applicable clear zone requirements. Additional installation requirements that are subsystem specific are included in the subsystems and ITS device requirements described herein, and specified in the FDOT 2007 Standard Specifications for Road and Bridge Construction (online edition).

1.10 Environmental Requirements

All subsystem devices and ancillary components, while housed in their associated environmental enclosures, shall, at a minimum, comply with all applicable NEMA TS 2 (latest edition) environmental specifications.

All enclosures, structures, poles, and mounts shall be designed to withstand sustained wind loads and gust wind factors in accordance with all appropriate standards.

All subsystem devices and ancillary components shall have complete protection from moisture and airborne contaminants, blowing rain at storm rates, wind, blowing sand, blowing dust, temperature, humidity, roadside pollutants, vandalism and theft of equipment.

Fatigue, corrosion, and fungal growths shall not affect the performance of the I-595 ITS Project.

The Concessionaire shall provide appropriate enclosures to prevent pests from attacking and damaging the subsystem devices and ancillary components.

1.11 Testing Requirements

All subsystems, ITS devices, and ancillary components furnished by the Concessionaire for the initial deployment and any future System Renewals shall be tested to determine conformance with I-595 ITS Project requirements, manufacturer specifications and applicable standards.

The Concessionaire shall develop detailed testing documents, including test plans, test procedures, test data forms and any other material required to perform the various tests, along with detailed test cases and associated configuration diagrams for each subsystem, ITS device and ancillary component described or listed in this RFP.

The testing plans shall detail a step-by-step outline of the test sequence to be followed, showing a test of every function for each subsystem, ITS device and ancillary component to be tested with expected result/data forms for each test. The Concessionaire shall submit the detailed testing documents to the Department for review and approval at least 45 calendar days prior to scheduling any tests. The Concessionaire shall not begin any tests until the Department has approved the testing documents.

At a minimum, the tests shall include Standalone Tests, Subsystem Tests, and the System Tests, as described below.

When the detailed testing documents are approved, the Concessionaire shall submit a testing schedule to the Department in accordance with the requirements of this RFP, perform the tests, document the results, and supply all necessary test equipment.

1.11.1 Standalone Tests

Following the initial and each System Renewal field installations, but prior to connection with the rest of a subsystem, the Concessionaire shall conduct the Standalone Test.

The test shall exercise all stand-alone (non-network) functional operations of the ITS device and ancillary component installed and demonstrate conformance with the Project requirements, manufacturer specifications, applicable standards, and the Contract Documents.

If any ITS device or ancillary component fails to pass its Standalone Test more than twice, it shall be replaced by the Concessionaire with a new ITS device or ancillary component of same make and model, and the entire Standalone Test shall be repeated until proven successful.

The Standalone Tests shall be performed on each and every ITS device and ancillary component, including, but not limited to the following:

- Portable Work Zone System (PWS) Assembly (ITMS)
- MVDS Assembly
- CCTV Camera Assembly
- DMS Assembly
- CMS Assembly
- HAR Assembly
- Access Control Warning Gate
- Access Control Barrier Gate
- Lane Control Signal
- Access Control Unit
- Device Controllers;
- Communication Subsystem and Nodes;
- Core/Distribution Switches
- MFES;
- Wireless Radio Equipment;
- Generator and Automatic Transfer Switch
- UPS
- Any future System Renewal Component

1.11.2 Subsystem Tests

The Concessionaire shall perform all Subsystem Tests for all initial and future deployed Subsystems.

During the Subsystem Test, the Concessionaire shall provide qualified personnel to support the diagnosing and repair of subsystem ITS devices and ancillary components. These personnel shall be available for this support within 24 hours of notification of the need for their services.

The Subsystem Test shall verify that all Project functional requirements and design specifications have been met. Each Subsystem Test shall be performed utilizing the installed ITS devices and ancillary components in conjunction with the communications subsystem utilizing SunGuide^{SM} software or the Department's future standard TMC software.

The Subsystem Test shall demonstrate full control of the ITS devices from the TMC utilizing SunGuide^{SM} software or the Department's future standard TMC software via communications channels as well as the functionalities of local/remote trouble shooting/diagnostic specified in the specific subsystem functional requirements.

Substantial Completion will be achieved upon the successful completion of all I-595 ITS subsystem tests.

1.11.3 System Tests

The System Test shall consist of I-595 ITS subsystems (including the Express Lanes Access Control Subsystems on FTE/SR 91) integrated with SunGuide^{SM} software or the Department's future standard

TMC software and operable from the TMC; operating continuously for a period of 30 consecutive calendar days without failure of any subsystem, ITS device, or ancillary component.

For the ITS devices and infrastructures (other than the Express Lanes Access Control Subsystem) deployed by the Concessionaire along FTE/SR 91 between Peters Road and Griffin Road, the system test will occur at FTE's TMC at Pompano Plaza. The tests shall prove valid communications between the FTE TMC, distribution and backbone network equipment, local hubs, DMS, CCTV, and VDS field devices utilizing the SunNav^{SM} software where possible, and other FTE approved software where it is not.

The Concessionaire shall notify the Department in writing the scheduled date of the System Test 30 calendar days prior to the commencement of said System Test.

In the event a subsystem, ITS device, or ancillary component failure, with the exception of consumable items such as fuses, the I-595 ITS shall be shutdown for purposes of testing and correcting identified deficiencies (System Shutdown). System Shutdown is defined as any condition, which due to work performed by the Concessionaire and /or its designee, results in the *I-595* ITS, or any subsystem, ITS device or ancillary component thereof to cease operation.

For each period of System Shutdown, and after the identified deficiency has been corrected and met all applicable tests as per this ITS Deployment Requirements, the System Test shall be restarted for a new 30 consecutive calendar days and shall be extended for one additional consecutive day.

If the total number of System Shutdowns exceeds three due to the same subsystem, ITS device, or ancillary component, the Concessionaire shall:

- Remove and replace the subsystem, ITS device or ancillary component with a new and unused unit as per the requirements of this RFP;
- Perform all applicable Standalone and Subsystem Tests; and
- Restart the System Test for a new 30 consecutive calendar-day period.

The System Test steps described herein shall be repeated as many times as deemed necessary by the Concessionaire to satisfy the requirements of this document.

1.11.4 **Final Acceptance**

The Concessionaire shall provide certificate of final acceptance of the Work associated with the I-595 ITS after satisfactory completion of the required 30 consecutive calendar-day System Test Period for the initial deployment and each future System Renewal, on the basis of the final inspection of the entire I-595 ITS, and as deemed by the Department and Concessionaire.

Upon Final Acceptance, the ITS devices and infrastructures (other than the Express Lanes Access Control Subsystem) deployed by the Concessionaire along FTE/SR 91 between Peters Road and Griffin Road, shall be turned over to and become the property of FTE.