Systems Engineering Analysis Report

US Highway 90 Restoration Projects

Version 1.0

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MDOT ITS Mission Statement:

"MDOT will use ITS technologies to improve the quality of life for State residents and visitors by providing more reliable, informative, safer, and flexible passenger and freight multi-modal transportation services."

Document Control

Date	Version	Description
4/15/08	0.1	Draft for first internal team review.
5/14/08	0.2	Draft for final internal team review.
5/28/08	0.3	Version for MDOT review.
12/17/08	1.0	First final version.

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1.0 Purpose

This *Systems Engineering Analysis (SEA) Report* documents the systems engineering analysis for the US Highway 90 (Hwy 90) Restoration Projects, which is an emergency-aid set of projects initiated as a result of the devastation on the Gulf Coast caused by Hurricane Katrina. Consistent with the Federal Highway Administration's (FHWA) Rule 940, the Mississippi Department of Transportation (MDOT) has adopted an ITS Project Life Cycle framework that incorporates systems engineering into the traditional project development process. This *SEA* follows the recommended ITS project development process and fulfills the minimum SEA requirements as outlined in the current version of MDOT's *Systems Engineering Management Plan (SEMP)*.

The Hwy 90 Restoration Projects involve the installation of a wireless Ethernet communications system to interconnect 54 traffic signals along Hwy 90 and Mississippi State Route 603 (MS 603) on the Gulf Coast from Ocean Springs to Waveland. Additionally, video detection systems (VDS) will be installed at each signalized intersection and pan-tilt-zoon (PTZ) and fixed closed circuit television (CCTV) cameras will be installed at key intersections along Hwy 90 and MS 603 within the project limits.

2.0 Project Description

The Hwy 90 Restoration Projects are part of a regional effort to restore roadway, signal and communications infrastructure lost due to the devastation of Hurricane Katrina. These projects involve the installation of a wireless Ethernet communications system and ITS field devices for the purpose of providing data collection, advanced traffic management and incident management capabilities along a 60 mile section of Hwy 90 and MS 603 along the Gulf Coast. The 60 mile corridor runs 40 miles on Hwy 90 from Biloxi Bay to Waveland and 20 miles north on MS 603 from Waveland to Mississippi State Route 43 (MS 43). The project consists of the following five phases which involve construction in Jackson, Harrison and Hancock Counties:

- Hancock County (US Hwy 90/SR 43/603) (Project No.: ER-0003-01(109) / 104569307 & NH-003-01(109) / 104569312
- East Biloxi (Project No.: ER-NH-0003-01(108) / 104569306 & 308
- West Biloxi (Project No.: ER-NH-0003-01(106) / 104569304 & 309
- Gulfport (Project No.: ER-NH-0003-01(104) / 104569302 & 310
- Long Beach / Pass Christian (Project No.: ER-NH-0003-01(103) / 104569301 & 311

These projects will provide functionality for traffic signal coordination, real-time traffic monitoring and data collection on Hwy 90/MS 603 by installing a wireless communications system spanning approximately 60 miles as well as VDS and CCTV cameras. The data and camera images will be transmitted to the MDOT Gulf Regional TMC, which has center-to-center communications with the MDOT Statewide TMC in Jackson and the MDOT Hattiesburg Regional TMC.

Construction for the project is currently underway. Phase 1 is being constructed in Hancock County and is expected to be complete in Summer 2008. Phases 2 through 5 are expected to be complete by the end of January 2009.

The general information for this project is summarized in **Table 1**. A map of the general project area is shown in **Figure 1**.

Table 1: General Project Information

General Project Information	
Project Location / Limits	Hwy 90 along the Gulf Coast from Biloxi Bay to Waveland and MS 603 from Waveland to MS 43. The project spans a distance of approximately 60 miles.
Funding Source	The design and construction for this project will both utilize Federal Emergency-Aid funds, with a 20% state match in certain cases.
Nature of Work	• Work will consist of the installation of a wireless Ethernet communications system and ITS devices along 60 miles of Hwy 90 and MS 603. • 54 traffic signals will be interconnected by the wireless system. Additionally, the system will provide communication for the VDS and CCTV cameras installed as part of this project as well as for ITS field devices installed in the future. • The wireless communications system will provide communications back to the MDOT Gulf Regional TMC, which has center-to-center communications with the Hattiesburg Regional TMC and the Statewide TMC.
Relationship to Other Projects / Phases	This project is part of the restoration projects initiated as a result of Hurricane Katrina.
Type of Equipment to be Installed	• Wireless communications network to support an Ethernet topology • Ethernet-ready traffic controllers • CCTV Cameras • Video Detectors (VDS) with data collection and reporting capabilities
Period of Performance	This project is currently in the construction phase. Construction of Phase 1 should be complete in Summer 2008. Phases 2-5 are estimated for completion by the end of January 2009.

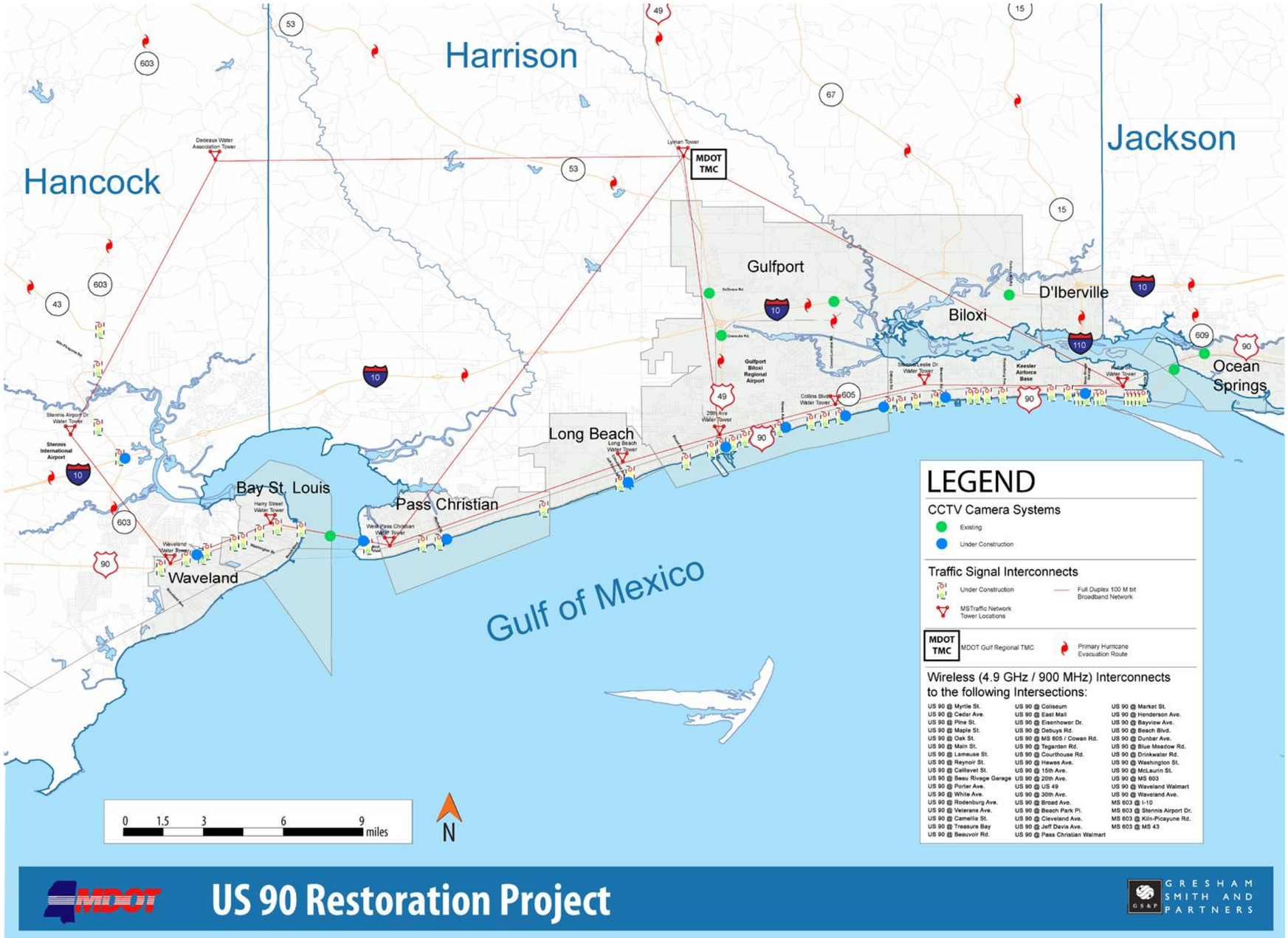


Figure 1: Project Area

3.0 Compliance with the Regional ITS Architecture

Compliance with Mississippi's Gulf Region ITS Architecture (RITSA) was evaluated. It was determined that this project is consistent with the "County and City Signal System Upgrades" project listed in Table 9-1 in the RITSA. It is stated in the RITSA that this type of project allows for the interconnection of signals through a corridor to facilitate more efficient movement of traffic, particularly during peak travel times. It should be noted that this project was initiated by the devastation of Hurricane Katrina and is replacing existing infrastructure that was damaged by the storm.

Moreover, the Hwy 90 Restoration Projects satisfy the following goals and objectives set forth by the Gulf Regional Planning Commission as stated in the RITSA:

Goal: *Enhance accessibility, mobility, and general traffic flow of the transportation system for persons and all modes on the Mississippi Gulf Coast.*

Objectives

1. Relieve traffic congestion and decrease travel time on Gulf Coast roadways.
2. Improve performance and efficiency of the transportation system.
3. Maximize emergency vehicle efficiency and access.

Goal: *Support the connectivity and economic vitality of the Mississippi Gulf Coast region.*

Objectives

1. Promote improvements serving regional needs.
2. Support the transportation needs of local governments.

Goal: *Protect the environment; improve aesthetics, and increase safety for the region through comprehensive transportation planning.*

Objectives

1. Provide for safer travel on the Mississippi Gulf Coast.
2. Decrease mobile emissions in the region.

Goal: *Maintain and preserve existing facilities by promoting efficient system management as well as alternative and technologically advanced mitigation measures.*

Objective

Promote the use of Intelligent Transportation System (ITS) projects and strategies to improve traffic flow.

Market Packages were identified in the RITSA that are being implemented as part of this project. Each Market Package addresses a specific service and is often an assimilation of several different subsystems, equipment packages, terminators, and architecture flows that provide the desired service.

Table 2 contains a listing of the ITS Market Packages and their associated elements that were identified in the RITSA and are being implemented as part of this project. The enabling elements of the project (i.e., elements that will be performing the primary project system functions once the system is implemented) are shown in **bold type** and are directly related to the project functional requirements, which are defined in **Section 5** of this *SEA Report.*

Table 2: ITS Market Packages and Associated Elements

Category	Market Package	Market Package Name	Associated Element
Advanced Traffic Management Systems (ATMS)	ATMS01	Network Surveillance	**- City of Biloxi TOC** **- City of Biloxi TOC Roadside Equipment** **- City of Gulfport TOC** **- City of Gulfport TOC Roadside Equipment** - Local City/County TOCs - Local City/County TOCs Roadside Equipment **- Gulf Regional TMC** **- MDOT District 6 Video Surveillance Equipment**
	ATMS03	Surface Street Control	**- City of Biloxi TOC** **- City of Biloxi TOC Roadside Equipment** **- City of Gulfport TOC** **- City of Gulfport TOC Roadside Equipment** - Local City/County TOCs - Local City/County TOCs Roadside Equipment **- Gulf Regional TMC** **- MDOT District 6 Traffic Signal Systems** **- MDOT District 6 Video Surveillance Equipment**
	ATMS07	Regional Traffic Control	**- City of Biloxi TOC** **- City of Gulfport TOC** - Local City/County TOCs **- Gulf Regional TMC** - MDOT Statewide TMC
	ATMS08	Traffic Incident Management System	- City of Biloxi Emergency Vehicles - City of Biloxi Public Affairs **- City of Biloxi TOC** **- City of Biloxi TOC Roadside Equipment** **- City of Gulfport TOC** **- City of Gulfport TOC Roadside Equipment** - City of Gulfport Emergency Vehicles - City/County 911 Dispatch Centers - City/County Emergency Vehicles - Coast Transit Authority - County Emergency Operations Center - Local City/County TOCs - MDOT District 6 Maintenance and Construction Offices **- MDOT District 6 Video Surveillance Equipment** **- Gulf Regional TMC** **- MDOT MSTraffic.com**

The utilization of the Market Packages listed in **Table 2**, with their subsystems and equipment packages, provides for the later utilization of the National ITS Architecture process specifications as a basis for the development of the project functional requirements.

The following individual Market Package diagrams (**Figures 3-6**), excerpted from the *MDOT ITS Concept of Operations*, have been tailored to meet MDOT needs. The diagrams define the major system components, interconnection between these components, and interfaces to external systems that are most important to the operation of the Market Package. Additionally, the diagrams were modified for this *SEA Report* in order to indicate the specific Equipment Packages that are being implemented as part of the Hwy 90 Restoration Projects. The Equipment Packages are directly related to the functional requirements identified in **Section 5** of this report.

Figure 2 shows the basic elements of the Market Package diagrams.

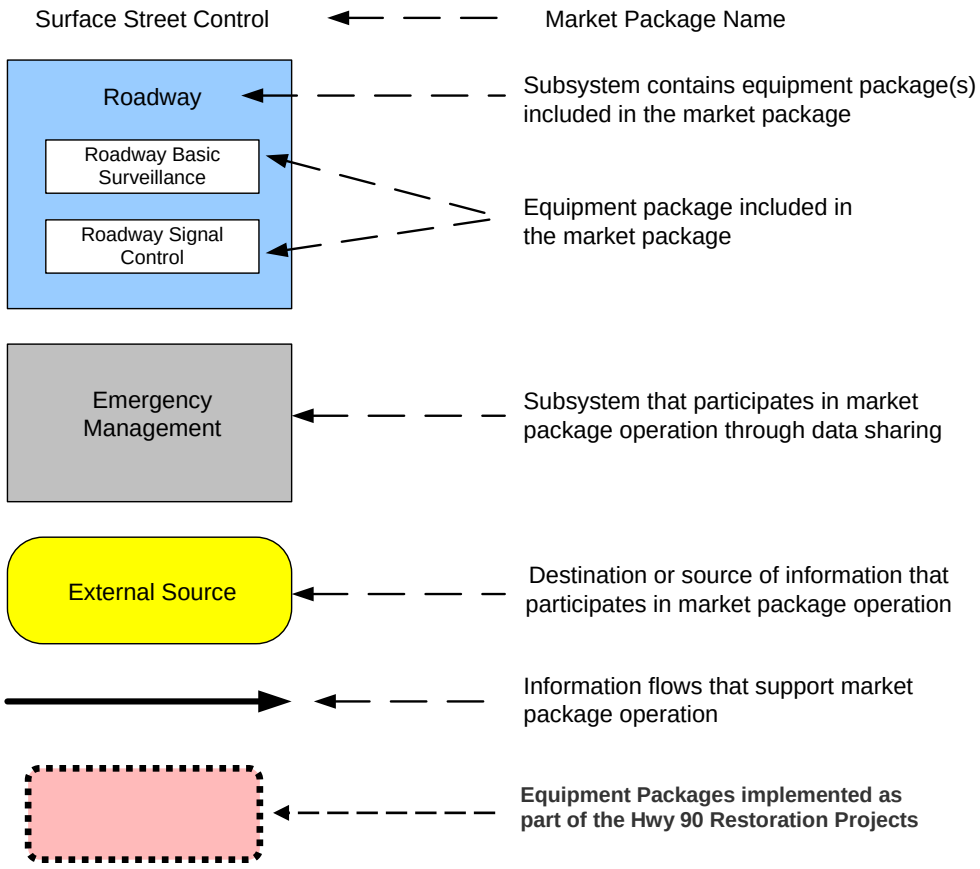
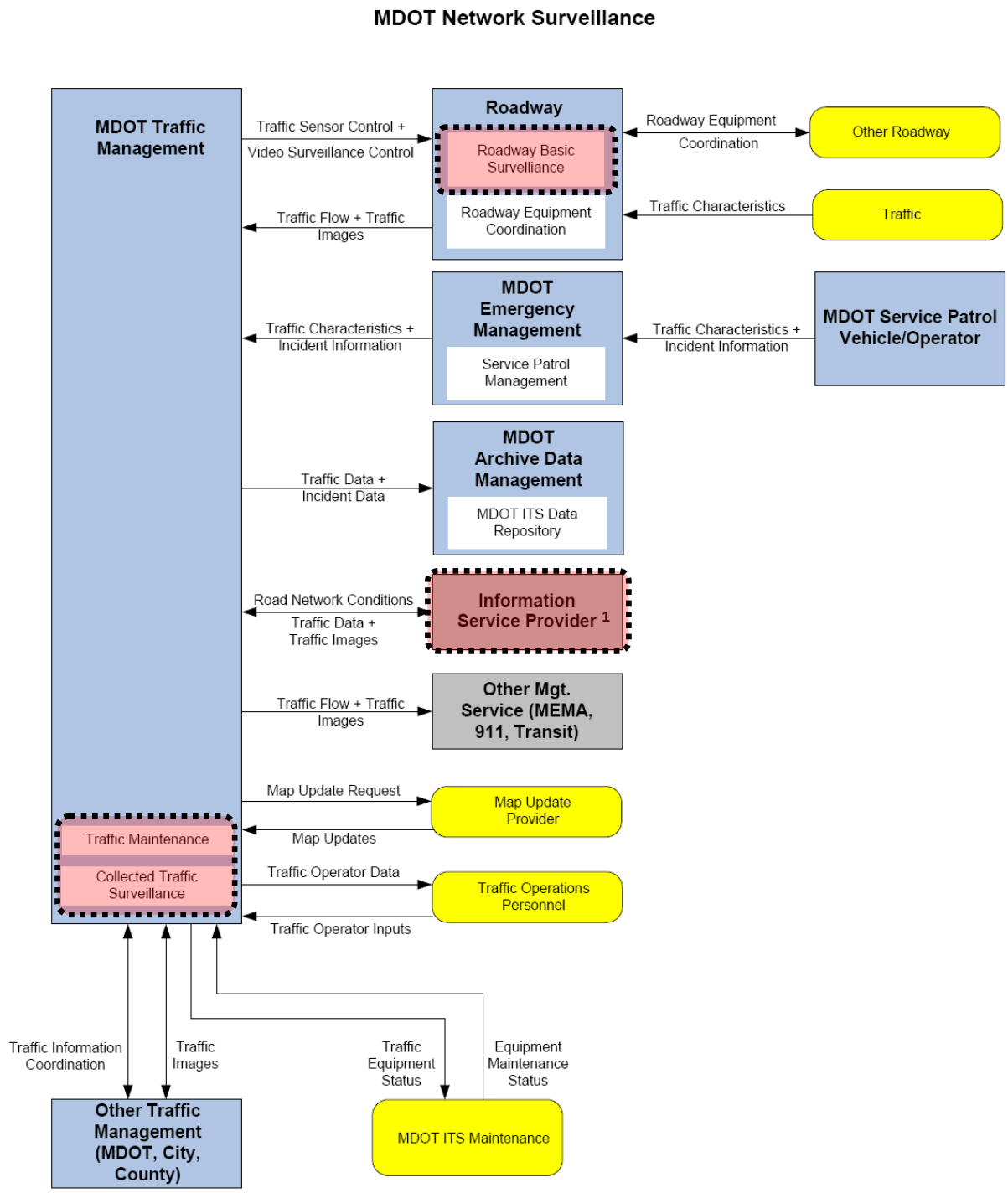


Figure 2: Basic Elements of a Market Package Diagram



[1] Road network conditions, streaming traffic images and traffic data will be available on a website maintained by Econolite.

Figure 3: MDOT Network Surveillance Market Package Diagram

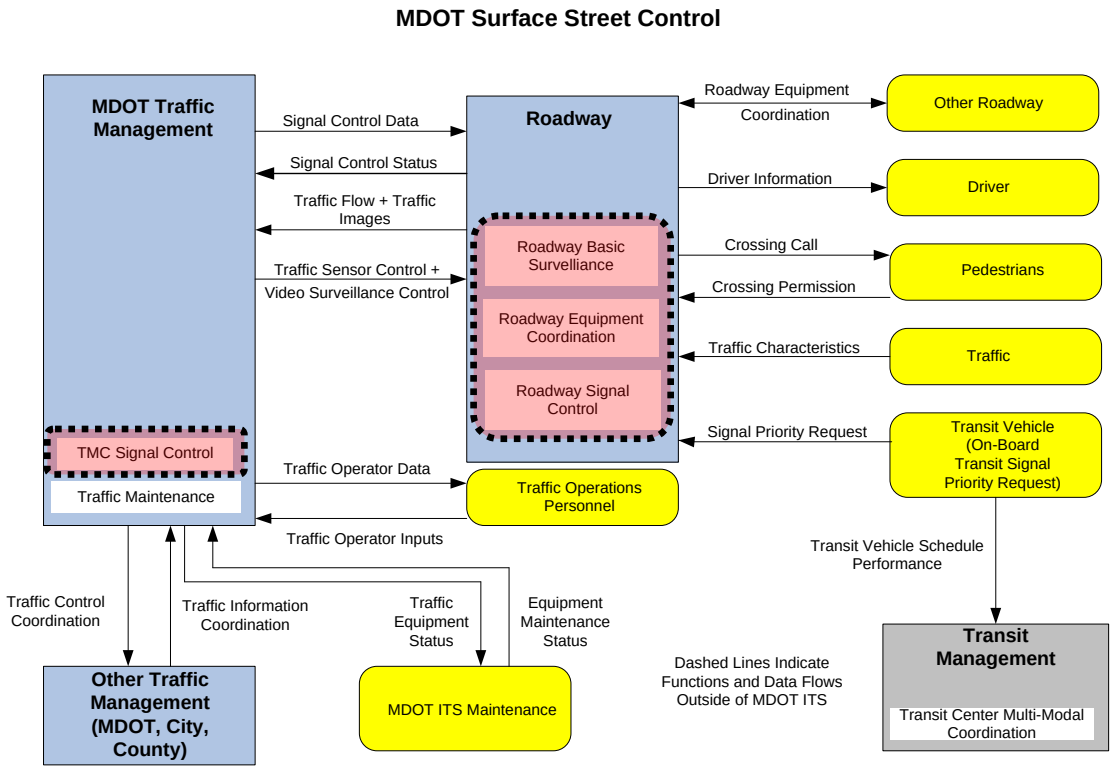


Figure 4: MDOT Surface Street Control Market Package Diagram

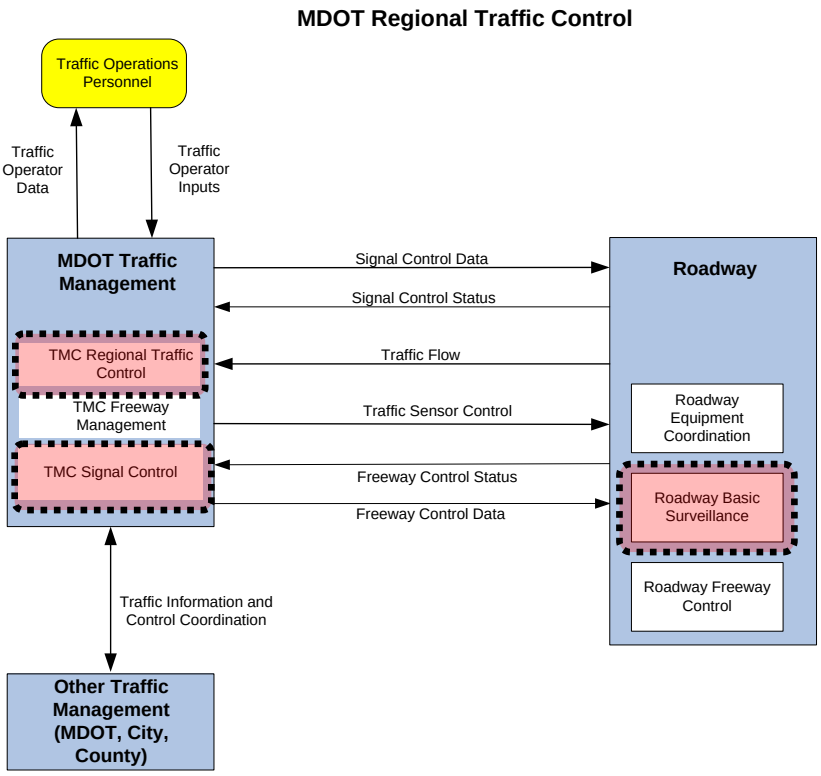


Figure 5: MDOT Regional Traffic Control Market Package Diagram

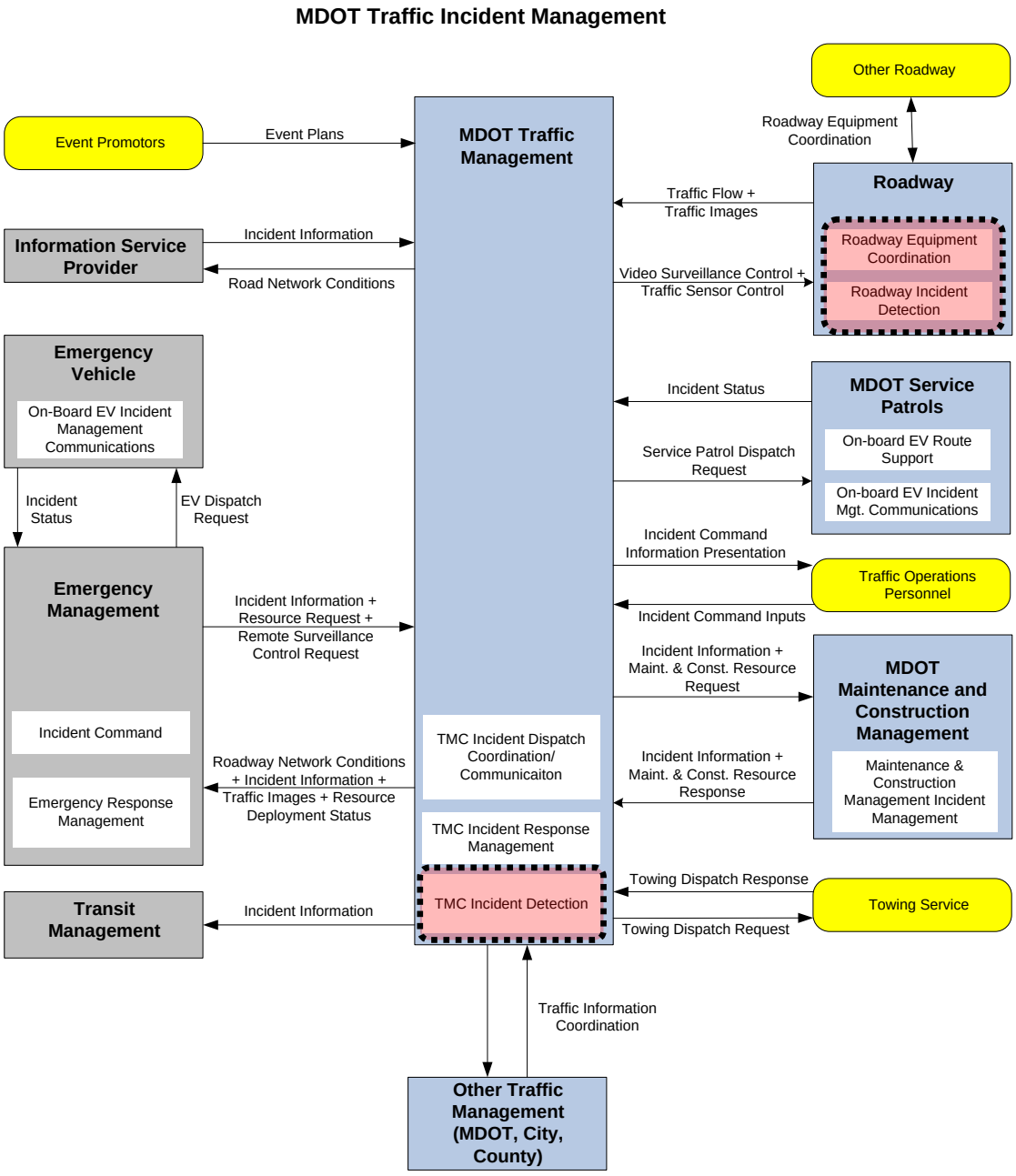


Figure 6: MDOT Traffic Incident Management Market Package Diagram

4.0 Identification of Participating Agencies' Roles and Responsibilities

The roles and responsibilities of the involved stakeholders documents their key responsibilities with regard to the implementation and operation of the ITS system. The primary stakeholders and their associated roles and responsibilities are listed in **Table 3**.

Table 3: Primary Stakeholder Roles and Responsibilities

Agency Name	Role / Responsibility
Mississippi Department of Transportation	• Lead agency in the design, construction, and operation of this project. • Review and approve project tasks, plans, budget and schedules. • Fund the project. • Manage and control ITS field equipment. • Manage and control traffic signals in cities with population less than 20,000. • Perform incident verification through video surveillance. • Coordinate incident response, road closures and detours with local incident response agencies. • Provide traffic, emergency, and incident information to the public, other agencies and between TMCs. • Maintain the ITS system. • Maintain traffic signals in cities with population less than 20,000.
MDOT Gulf Regional TMC (District 6 TOC)	• Perform incident verification through video surveillance. • Maintain traffic signals in cities with population less than 20,000. • Coordinate incident response, road closures and detours.
MDOT Hattiesburg Regional TMC	• Perform incident verification through video surveillance. • Coordinate incident response, road closures and detours.
Cities of Ocean Springs, Long Beach, Pass Christian and Bay St. Louis	• Facilitate use of water tower structures for mounting antennae for wireless communications network.
Cities of Gulfport and Biloxi	• Manage and control traffic signals. • Maintain traffic signals. • Facilitate use of water tower structures for mounting antennae for wireless communications network.
Municipal Water Districts	• Facilitate use of water tower structures for mounting antennae for wireless communications network.

5.0 Requirements Definitions

Functional project-level requirements that support the Hwy 90 Restoration Projects are listed in **Table 4**. A complete listing of the functional requirements for Gulf Region ITS System is available in Appendix B of the Gulf Region ITS Architecture.

Table 4 includes the following information for each functional requirement:

- **Element:** Name of the system that will be performing the function
- **Entity:** Describes the National ITS Architecture subsystem to which the element is mapped
- **Functional Area:** Description of the function performed by the element
- **Requirement:** High-level functional requirement to be performed by the element supporting the functional area

It should be noted that functional requirements for the Statewide TMC and the Gulf Regional TMC (listed as Elements in Table 4 and denoted with an asterisk) were not included in the Gulf Region ITS Architecture. These functional requirements will be added to the RITSA during the next architecture update.

The Entities and Functional Areas listed in **Table 4** are essentially the Subsystems and Equipment Packages that are being implemented as part of this project. The Subsystems and Equipment Packages are directly related to the Market Packages listed in **Table 2** and the Market Package diagrams included in **Section 3**.

Table 4: Functional Requirements

Element	Entity	Functional Area	Requirement
City of Biloxi TOC	Traffic Management	TMC Regional Traffic Control	The center shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans and real-time signal control information.
			The center shall exchange traffic control information with other TMCs, including remote monitoring and control of traffic management devices (e.g., sensors, signals, cameras, etc.)
		TMC Incident Detection	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.
			The center shall provide road network conditions and traffic images to emergency management centers to support detection, verification and classification of incidents.
			The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.
		Collect Traffic Surveillance	The center shall monitor, analyze and distribute traffic images from CCTV systems under remote control of the center.
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.
		TMC Signal Control	The center shall remotely control traffic signal controllers.
			The center shall collect traffic signal controller operational status and compare against the control information sent by the center.
			The center shall collect traffic signal controller fault data from the field.
			The center shall implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, etc.
		Traffic Maintenance	The center shall collect and store CCTV surveillance system operational status.
			The center shall collect and store CCTV surveillance system fault data and send to the maintenance center for repair.
			The center shall exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when faults are cleared.
City of Biloxi TOC Roadside Equipment	Roadway Subsystem	Roadway Basic Surveillance	The field element shall collect, process, digitize, and send traffic sensor data to the center for further analysis and storage, under center control.
			The field element shall collect, process, and send traffic images to the center for further analysis and distribution.
			The field element shall return sensor data and CCTV system operational status to the controlling center.
			The field element shall return sensor and CCTV system fault data to the controlling center for repair.
		Roadway Signal Controls	The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.

Element	Entity	Functional Area	Requirement
			The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.
			The field element shall return traffic signal controller operational status to the controlling center.
			The field element shall return traffic signal controller fault data to the maintenance center for repair.
		Roadway Equipment Coordination	The field element shall include devices (such as arterial or freeway controllers) that provide data and status information to other field element devices (such as traffic controllers on adjacent intersections), without center control.
			The field element shall include devices (such as arterial or freeway controllers) that receive control information from other field element devices (such as traffic controllers on adjacent intersections), without center control.
City of Gulfport TOC	Traffic Management	Collect Traffic Surveillance	The center shall monitor, analyze and distribute traffic images from CCTV systems under remote control of the center.
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor surveillance data to other centers.
			The center shall maintain a database of surveillance and sensors and their location, to which part(s) of the network their data applies, the type of data, and the ownership of each link in the network.
		TMC Signal Control	The center shall remotely control traffic signal controllers.
			The center shall collect traffic signal controller operational status and compare against the control information sent by the center.
			The center shall collect traffic signal controller fault data from the field.
			The center shall implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, etc.
		TMC Regional Traffic Control	The center shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans and real-time signal control information.
			The center shall exchange traffic control information with other TMCs, including remote monitoring and control of traffic management devices (e.g., sensors, signals, cameras, etc.)
		TMC Incident Detection	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.
			The center shall provide road network conditions and traffic images to emergency management centers to support detection, verification and classification of incidents.
			The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.
City of Gulfport TOC Roadside Equipment	Roadway Subsystem	Roadway Basic Surveillance	The field element shall collect, process, digitize, and send traffic sensor data to the center for further analysis and storage, under center control.
			The field element shall collect, process, and send traffic images to the center for further analysis and distribution.

Element	Entity	Functional Area	Requirement
			The field element shall return sensor data and CCTV system operational status to the controlling center.
			The field element shall return sensor and CCTV system fault data to the controlling center for repair.
		Roadway Signal Controls	The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.
			The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.
			The field element shall return traffic signal controller operational status to the controlling center.
			The field element shall return traffic signal controller fault data to the maintenance center for repair.
		Roadway Equipment Coordination	The field element shall include devices (such as arterial or freeway controllers) that provide data and status information to other field element devices (such as traffic controllers on adjacent intersections), without center control.
			The field element shall include devices (such as arterial or freeway controllers) that receive control information from other field element devices (such as traffic controllers on adjacent intersections), without center control.
* Gulf Regional TMC (Lyman Project Office)	Traffic Management	Collect Traffic Surveillance	The center shall monitor, analyze and distribute traffic images from CCTV systems under remote control of the center.
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor surveillance data to other centers.
			The center shall maintain a database of surveillance and sensors and their location, to which part(s) of the network their data applies, the type of data, and the ownership of each link in the network.
		TMC Signal Control	The center shall remotely control traffic signal controllers.
			The center shall collect traffic signal controller operational status and compare against the control information sent by the center.
			The center shall collect traffic signal controller fault data from the field.
			The center shall implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, etc.
		TMC Regional Traffic Control	The center shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans and real-time signal control information.
			The center shall exchange traffic control information with other TMCs, including remote monitoring and control of traffic management devices (e.g., sensors, signals, cameras, etc.)
		TMC Incident Detection	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.
			The center shall provide road network conditions and traffic images to emergency management centers to support detection, verification and classification of incidents.
			The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.

Element	Entity	Functional Area	Requirement
		Traffic Maintenance	The center shall collect and store CCTV surveillance system operational status.
			The center shall collect and store CCTV surveillance system fault data and send to the maintenance center for repair.
			The center shall exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when faults are cleared.
Hattiesburg Regional TMC	Traffic Management	Collect Traffic Surveillance	The center shall monitor, analyze and distribute traffic images from CCTV systems under remote control of the center.
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor surveillance data to other centers.
			The center shall maintain a database of surveillance and sensors and their location, to which part(s) of the network their data applies, the type of data, and the ownership of each link in the network.
		TMC Signal Control	The center shall remotely control traffic signal controllers.
			The center shall collect traffic signal controller operational status and compare against the control information sent by the center.
			The center shall collect traffic signal controller fault data from the field.
			The center shall implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, etc.
		TMC Regional Traffic Control	The center shall exchange traffic information with other TMCs, including incident information, congestion data, traffic data, signal timing plans and real-time signal control information.
			The center shall exchange traffic control information with other TMCs, including remote monitoring and control of traffic management devices (e.g., sensors, signals, cameras, etc.)
		TMC Incident Detection	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.
			The center shall provide road network conditions and traffic images to emergency management centers to support detection, verification and classification of incidents.
			The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.
		Traffic Maintenance	The center shall collect and store CCTV surveillance system operational status.
			The center shall collect and store CCTV surveillance system fault data and send to the maintenance center for repair.
			The center shall exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when faults are cleared.
MDOT District 6 Traffic Sensors	Roadway Subsystem	Roadway Basic Surveillance	The field element shall return sensor and CCTV system operational status to the controlling center.
			The field element shall return sensor and CCTV system fault data to the controlling center for repair.

Element	Entity	Functional Area	Requirement
MDOT District 6 Traffic Signal Systems	Roadway Subsystem	Roadway Signal Controls	The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.
			The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.
			The field element shall return traffic signal controller operational status to the controlling center.
			The field element shall return traffic signal controller fault data to the maintenance center for repair.
		Roadway Equipment Coordination	The field element shall include devices (such as arterial or freeway controllers) that provide data and status information to other field element devices (such as traffic controllers on adjacent intersections), without center control.
			The field element shall include devices (such as arterial or freeway controllers) that receive control information from other field element devices (such as traffic controllers on adjacent intersections), without center control.
MDOT District 6 Video Surveillance Equipment	Roadway Subsystem	Roadway Basic Surveillance	The field element shall collect, process and send traffic images to the center for further analysis and distribution.
			The field element shall return sensor and CCTV system operational status to the controlling center.
			The field element shall return sensor and CCTV system fault data to the controlling center for repair.
		Roadway Incident Detection	The field element shall collect, process and send traffic images to the center for further analysis and distribution.
			The field element's video devices shall be remotely controlled by a traffic management center.
			The field element shall provide operational status and fault data for the incident detection devices to the traffic management center.
* MDOT Statewide TMC (Jackson)	Traffic Management	TMC Regional Traffic Control	The center shall exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
			The center shall exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g., signs, sensors, signals, cameras, etc.)
		Collect Traffic Surveillance	The center shall monitor, analyze and distribute traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.
			The center shall monitor, analyze and distribute traffic images from CCTV systems under remote control of the center.
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor surveillance data to other centers.
			The center shall maintain a database of surveillance and sensors and the freeways, surface streets, e.g. where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link in the network.
		TMC Incident Detection	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.
			The center shall provide road network condition and traffic images to emergency management centers to support the detection, verification, and classification of incidents.

* Functional requirements to be added to the Gulf Regional Architecture during the next architecture update.

6.0 Analysis of Alternative System Configurations

This project involves the installation of a wireless Ethernet communications network, which will provide communications to 54 traffic signals and ITS field devices on Hwy 90 and MS 603 along the Gulf Coast. The installation of a wireless communications system was selected for the following reasons:

- The conditions of the roadways along the Gulf Coast post Hurricane Katrina readily pointed out the fallacy of assuming underground fiber would be best solution for this area. Also, buried beach front fiber is extremely susceptible to storm surges of future hurricanes, which makes traditional buried communications less desirable.
- Fiber optic cable takes longer to deploy when compared to wireless and leased line networks.
- The option of leased line communications was dismissed primarily due to the fact that Hurricane Katrina damaged the communications networks of all private carriers in the Gulf Coast region.
- Additionally, there is a high recurring cost with leased lines and the use of Federal Funds is not applicable.
- The advantages and benefits of the broadband wireless network for this project are that it is faster to deploy, is independent of leased line annual expense and availability, easier to scale, does not interfere with construction activities, provides multi-path redundancy for communications, and is less expensive than the in-ground fiber solution.

The CCTV cameras implemented as part of this project will be the same as or compatible with the existing MDOT CCTV camera equipment in the region, which will provide for a consistent system that is easier to operate and maintain. This is the first project to deploy the selected type of VDS, which includes functionality for data collection and reporting; however, the selected VDS is compatible with future design and integration efforts.

7.0 Procurement Options

MDOT used a traditional construction contract with competitive bidding for implementation of the Hwy 90 Restoration Projects. However, instead of using consultant services for the engineering/design portion of the project, MDOT provided general project design requirements and requested that the contractors produce a detailed design to meet the requirements.

The design and construction for this project utilize Federal Emergency-Aid funds, with a 20% state match in cases where new technology/functionality is being implemented. For example, a 20% state match was required for the wireless Ethernet communications network. Although a legacy communications system existed before the storm, it was not comparable to the new system that is being deployed.

8.0 Agreements / Integration

MDOT used Standard Resource Sharing Agreements with all municipalities and associations involved, which allowed for a common agreement to be used in all instances with appendices tailored for specific devices. Additional devices may be added to the appendices of the agreements, which will save time and money (do not have to create another agreement).

Memorandum of Agreements (MOA) were executed between MDOT and the following entities: Biloxi, Gulfport, Long Beach, Pass Christian, Waveland, Bay St. Louis, Hancock County Port and Harbor Commission, Dedeaux Water Association and the Gulf Regional Planning Commission.

Federal Communications Commission (FCC) approval was required for the wireless system based on the use of a restricted near line of sight frequency. Additionally, Wireless Communications Commission (WCC) approval was required since they are responsible for wireless communication oversight in Mississippi.

9.0 Applicable ITS Standards

ITS standards define how ITS systems, products, and components can interconnect, exchange information and interact to deliver services within a transportation network. ITS standards are not design standards, however, the use of standards gives transportation agencies confidence that components from different manufacturers will work together.

Although stand-alone ITS applications create benefits, most ITS systems are comprised of multiple applications integrated together. These integrated systems result in the greatest efficiencies and provide the most benefit to the user. ITS standards are a critical piece to the successful integration of multiple disparate ITS technologies into a fully functioning ITS system across many geographic areas through the use of a common communications interface. To this end, ITS standards should make the sharing of video and data between MDOT and other municipalities a relatively seamless connection.

Table 5 contains of listing of the ITS standards that are applicable to the Hwy 90 Restorations Projects.

Table 5: Applicable ITS Standards

ITS Standards			
National ITS Architecture Interface Class	**Standards Application Area**	**Associated Standards (Status)***	
Center-to-Center	Incident Management	• NTCIP 1102 (P) • NTCIP 1104 (A) • NTCIP 1201 (P) • NTCIP 1211 (A) • NTCIP 1402 (P) • NTCIP 2104 (P) • NTCIP 2202 (P) • NTCIP 2303 (P) • NTCIP 2304 (P)	• NTCIP 2306 (U) • IEEE 1512-2006 (P) • IEEE 1512.1-2006 (P) • IEEE 1512.2-2004 (P) • IEEE 1512.3-2006 (P) • ITE TM 1.03 (A) • ITE TM 2.01 (A) • SAE J2266 (P) • SAE J2353 (P) • SAE J2369 (P)
	Traffic Management	• NTCIP 1102 (P) • NTCIP 1104 (A) • NTCIP 1201 (P) • NTCIP 1211 (A) • NTCIP 1210 (U) • NTCIP 2104 (P) • NTCIP 2202 (P) • NTCIP 2303 (P) • NTCIP 2304 (P) • NTCIP 2306 (U)	• IEEE 1512.1-2006 (P) • ITE TM 1.03 (A) • ITE TM 2.01 (A) • SAE J2266 (P) • SAE J2353 (P) • SAE J2354 (P) • SAE J2540 (P) • SAE J2540-1 (P) • SAE J2540-2 (P) • SAE J2540-3 (P) • SAE J2369 (P)
	Traveler Information	• NTCIP 1102 (P) • NTCIP 1104 (A) • NTCIP 2104 (P) • NTCIP 2202 (P) • NTCIP 2303 (P) • NTCIP 2304 (P) • NTCIP 2306 (U)	• SAE J2266 (P) • SAE J2353 (P) • SAE J2354 (P) • SAE J2540 (P) • SAE J2540-1 (P) • SAE J2540-2 (P) • SAE J2540-3 (P)
Center to Roadside	Data Collection/Monitoring	• NTCIP 1101 (P) • NTCIP 1102 (P) • NTCIP 1201 (P) • NTCIP 1204 (P) • NTCIP 1205 (P) • NTCIP 1206 (P) • NTCIP 1208 (P) • NTCIP 1209 (P) • NTCIP 2101 (P)	• NTCIP 2102 (P) • NTCIP 2103 (P) • NTCIP 2104 (P) • NTCIP 2201 (P) • NTCIP 2202 (P) • NTCIP 2301 (P) • NTCIP 2302 (P) • NTCIP 2303 (P) • SAE J2266 (P)
	Traffic Signals	• NTCIP 1101 (P) • NTCIP 1102 (P) • NTCIP 1201 (P) • NTCIP 1202 (P) • NTCIP 1209 (P) • NTCIP 1210 (U) • NTCIP 2101 (P)	• NTCIP 2102 (P) • NTCIP 2103 (P) • NTCIP 2104 (P) • NTCIP 2201 (P) • NTCIP 2202 (P) • NTCIP 2301 (P) • SAE J2266 (P) • SAE J2369 (P)
	Vehicle Sensors	• NTCIP 1101 (P) • NTCIP 1102 (P) • NTCIP 1201 (P) • NTCIP 1205 (P) • NTCIP 1206 (P) • NTCIP 1208 (P) • NTCIP 1209 (P) • NTCIP 2101 (P) • NTCIP 2102 (P)	• NTCIP 2103 (P) • NTCIP 2104 (P) • NTCIP 2201 (P) • NTCIP 2202 (P) • NTCIP 2301 (P) • NTCIP 2302 (P) • NTCIP 2303 (P) • SAE J2266 (P)
	Video Surveillance	• NTCIP 1101 (P) • NTCIP 1102 (P) • NTCIP 1201 (P) • NTCIP 1205 (P) • NTCIP 1208 (P) • NTCIP 2101 (P) • NTCIP 2102 (P) • NTCIP 2103 (P)	• NTCIP 2104 (P) • NTCIP 2201 (P) • NTCIP 2202 (P) • NTCIP 2301 (P) • NTCIP 2302 (P) • NTCIP 2303 (P) • SAE J2266 (P) • SAE J2369 (P)

* Status as of February 25, 2008
(P) = Published: Standards that are available for purchase
(A) = Approved: Standards that have passed all necessary ballots and have been approved by a standards development organization, yet not yet published.
(U) = Under Development: Standards that are being written, but are not yet ready for a formal ballot.

10.0 Operations and Maintenance Plan

Operations and maintenance (O&M) planning should occur incrementally during system implementation and be updated during the on-going operation of the system. The O&M plan should describe resource organization, responsibilities, and MDOT policies and procedures. It is critically important that the O&M plan provide sufficient information for the system to be effectively operated and maintained in the event of complete staff turnover. The following information should be identified and documented:

- Personnel responsible for operation and maintenance
- Resources (staff, tools, etc.) needed for operation and maintenance
- Funding source for on-going operations and maintenance
- Procedure for training new operations and maintenance personnel
- Safety and security of the system
- Configuration Management (how changes, repairs and upgrades will be handled and documented)
- Preventative maintenance and reactive maintenance

Operations

The first phase of the Hwy 90 Restoration Project is currently under construction with a projected completion date in April 2008. The full system should become operational sometime around the beginning of 2009 (i.e., start of 6 month burn-in period). MDOT will be responsible for the overall operation of the system, however, the cities of Gulfport and Biloxi will be responsible for operating the traffic signals in their jurisdiction.

Maintenance

The existing ITS Maintenance staff for MDOT consists of an ITS Maintenance Manager with a limited number of ITS Maintenance and Network Specialists. The ITS Maintenance Manager and ITS Maintenance Specialists have responsibility for the existing ITS communications and field equipment statewide. Additionally, there is an ITS Maintenance Specialist dedicated to resolving equipment issues in District 6. The existing maintenance staff track network performance and provide emergency equipment repairs and maintenance. Warranty-level support and maintenance for the wireless communications system will be provided by product vendors and maintenance contractors under contract to the Traffic Engineering Office of MDOT.

Field equipment including the network, communications infrastructure and cameras will be maintained by the MDOT ITS maintenance staff with support from the equipment vendors. Repair parts support is accomplished through the statewide parts contract and by vendor warranty repair of parts procured through this contract.

MDOT will maintain the traffic signals that do not fall within the jurisdiction of the cities of Gulfport or Biloxi, who will be responsible for their own signal maintenance.