US HIGHWAY 49 ITS PROJECT
HATTIESBURG, MS
SYSTEMS ENGINEERING ANALYSIS

Prepared for:

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US Highway 49 ITS Project
Systems Engineering Analysis

1.0 Purpose

This Systems Engineering Analysis (SEA) is intended to document the development process that was followed to meet the FHWA minimum systems engineering requirements outlined in Title 23 – Code of Federal Regulations, Section 940. This SEA will document the following:

1. Identification of the portions of the regional ITS architecture being implemented.

2. Identification of participating agencies roles and responsibilities.

3. Requirements definitions.

4. Analysis of alternative system configurations and technology options to meet requirements.

5. Procurement options.

6. Identification of applicable ITS standards and testing procedures.

7. Procedures and resources necessary for operations and management of the system.

2.0 Description of Project

The US Highway 49 ITS Project includes the installation of twelve CCTV cameras, six traffic signal interconnects and related communications equipment along US Highway 49. The purpose of the project is to provide for improved incident management, safety, and traffic control.

The Traffic Signal interconnects will allow for expanded control through the ACTRA server that is currently utilized at the MDOT Regional Transportation Management Center (TMC) in Hattiesburg. At both the Statewide TMC in Jackson and Regional TMC in Hattiesburg, operators will monitor traffic flow along the roadways using existing cameras in Hattiesburg and the proposed CCTV cameras within this project. When incidents occur, the operators will be able to notify the appropriate personnel more rapidly, effectively reducing response time.

The communications system from the Traffic Signals and CCTVs to the TMCs will consist of a combination of different communication modes. The CCTVs and Traffic Signal Controllers will communicate over a fiber optic network to the MDOT Regional TMC in Hattiesburg. Communications from the Hattiesburg Regional TMC to the Statewide TMC in Jackson will be facilitated by a leased line connection.

This CCTV system will be operated utilizing the existing 360 Surveillance software installed at the MDOT Statewide TMC and Hattiesburg Regional TMC. This software will be used to control CCTV cameras as well as the Dynamic Message Signs. This software is a server-client software that supports center to center communications. If another public agency or TMC needs to monitor or control portions of this system, MDOT will be able to provide that agency with a

copy of the 360 Surveillance software and that location can function just as another workstation on the MDOT system. It is likely that multiple agencies may be given access to view and control the CCTV cameras.

As funds become available, future projects will include additional CCTV for better camera coverage along major routes. These future projects will also likely include Dynamic Message Signs and Radar Detection Sites along US Highway and Interstate Roadways that will facilitate the posting of real-time traffic information. The proposed fiber installation in this project will provide for expansion of communications with future ITS facilities.

3.0 Identification of the Portions of the Regional ITS Architecture Being Implemented.

This project was initially started in 2001 and is implementing specific portions of the current Mississippi Statewide Architecture that was completed in 2002. These elements are also consistent with the National ITS Architecture and include the following market packages for this project:

MARKET PACKAGE	KEY FUNCTIONS
Network Surveillance	• Monitor traffic and road conditions • Process, update, and retrieve traffic surveillance data for traffic strategy development • Identify and verify incidents
Incident Management System	• Provide incident detection capabilities via roadside surveillance devices • Direct incident response personnel to incident locations • Monitor incident status while the response arrives
Regional Traffic Control	• Provide sharing of traffic information among traffic management centers • Provide communication links between various jurisdictions • Implement traffic management strategies that are coordinated between allied traffic management centers

The information and data flows related to the market packages above are being implemented between the following entities:

- MDOT Regional TMC to and from the MDOT Field Elements
- MDOT Regional TMC to and from the City of Hattiesburg TMC
- MDOT Statewide TMC to and from the MDOT Regional TMC

4.0 Identification of Participating Agencies Roles and Responsibilities

4.1 Mississippi Department of Transportation

MDOT is the lead agency in the design, construction and operation of the US Highway 49 ITS Project. MDOT is funding the project and will have overall responsibility for all elements including the operation and maintenance of the system. MDOT will coordinate with and share information with the City of Hattiesburg regarding response to incidents verified through the system. Traffic Signal Communications will also be conveyed first through the Regional TMC and then on to the City of Hattiesburg TMC.

4.2 City of Hattiesburg

As defined previously in the Project Description section of this SEA, the City of Hattiesburg TMC and the MDOT TMCs can be integrated and interoperable by installing a client version of the 360 Surveillance Software and ACTRA Software at the City of Hattiesburg TMC. This would allow that location to have the same functions and capabilities as a workstation within the MDOT TMCs.

5.0 Requirements Definitions

In the National ITS Architecture, User Services describe what the system will do from the user's perspective. To date, thirty-three User Services have been jointly developed by US DOT and ITS America with substantial stakeholder input. A set of requirements covering each of these User Services are the basis for the National ITS Architecture definition.

The project team conducted a review of the functional requirements contained in the thirty-three User Services contained in the National Architecture to determine which of those requirements were applicable to the US Highway 49 ITS Project. Specifically, the Travel and Traffic Management User Service Bundle contains the high-level functional requirements, or User Service Requirements, applicable to this Project.

Within the Travel and Traffic Management User Service Bundle, there are two User Services that contain requirements applicable to this project. These are as follows:

1. Traffic Control.
2. Incident Management.

The first User Service Requirement, Traffic Control, is described as follows:

> "ITS shall include a Traffic Control (TC) function. Traffic Control provides the capability to efficiently manage the movement of traffic on streets and highways. Four functions are provided, which are, (1) Traffic Flow Optimization, (2) Traffic Surveillance, (3) Control, and (4) Provide Information. This will also include control of network signal systems with eventual integration of freeway control."

For the US Highway 49 ITS Project, the specific high-level Traffic Control requirements as stated in the National ITS Architecture, are as follows:

- Traffic Control shall include a Traffic Surveillance Function.
  - Traffic Surveillance shall include a wide-area surveillance capability to include several jurisdictions.
  - The wide area surveillance shall acquire sufficient data to provide the system with the knowledge of the existing conditions.
- Traffic Control shall include a Device Control function.
  - Device control shall communicate control data to the traffic signal interconnects and surveillance cameras.
  - Device control shall provide the operator with the capability to manually override the system's automatic controls.

The second User Service Requirement, Incident Management, is described as follows:

> "ITS shall include an Incident Management (IM) function. Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Four major functions are provided, which are, (1) Incidents Identification, (2) Response Formulation, (3) Response Implementation, and (4) Predict Hazardous Conditions."

For the US Highway 49 ITS Project, the high-level Incident Management requirements are as follows:

- Incident Management shall provide an incident identification function to identify incidents.
  - The incident identification function shall use information from the following types of sources, where available to identify probable incidents: cameras, public safety sources, public cell phone inquiries, media sources, etc.
  - Incident Management shall provide a response formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary.
- Incident Management shall include a response implementation function to provide the services to implement a response coordinated with all appropriate agencies.
  - The response implementation function shall provide decision support capabilities needed to implement coordinated incident response actions by all participating institutions.
  - The response implementation function shall provide the capability to disseminate information related to response status to other agencies and user services.

These high-level requirements represent the general functions as defined in the National ITS Architecture to be performed by the Intelligent Transportation System that is to be deployed by the US Highway 49 ITS Project. It should also be noted that this specific project is for the installation of the Traffic Signal Interconnects, CCTV, and communication system that connects to the Transportation Management Centers.

6.0 Analysis of Alternative System Configurations and Technology Options to Meet Requirements

6.1 Communication System Alternatives

- Fiber vs. Wireless vs. Leased Line

In past ITS projects, leased line connections were found to be less reliable than that of fiber optics communication. Wireless communications tend to be less reliable, especially in the windy conditions of hurricanes and tropical storms that are indicative of the coastal plain areas. Due to the high level of reliability, fiber optic communication was determined to be the optimum mode of communication between field devices and the Regional TMC in Hattiesburg.

6.2 Software Alternatives

- Existing Software vs. New Software

MDOT has procured 360 Surveillance software for controlling existing CCTV cameras. This software also has the necessary drivers to control NTCIP compliant Dynamic Message Signs and Radar Detection Systems that look to be used in future projects. This software is a client-server software and provides capabilities for center to center communications through multiple software site licenses. MDOT will be able to provide licenses of this software package to other public agencies or TMCs which would then be able to function as another workspace on the MDOT system (provided they have sufficient communication links in place). This software configuration assures complete integration and interoperability between the MDOT Statewide TMC and other TMC's within the Region or State that may need to control or coordinate with this system.

ACTRA server software is also presently utilized at the Statewide and Regional TMCs with Hattiesburg's Regional TMC containing the centralized database for the area. Center to center communications are attainable through multiple software licenses, facilitating the dissemination of intersection data from/to a local controller at any workstation to/from the centralized database. Administrative control and password protected system log-in allow user access to be defined by data type, in addition to a multi-jurisdictional security feature.

7.0 Procurement Options

This project is a construction project and will therefore be procured through MDOT's normal low-bid construction process. General and project specific specifications have been written to ensure proper installation and configuration of all equipment, communication facilities, and software.

8.0 Identification of Applicable ITS Standards and Testing Procedures

8.1 Standards

The CCTVs are required to meet the latest approved National Transportation Communications for ITS Protocols (NTCIP) standards. Conformance to NEMA, ICEA-NEMA, EIA, IES, ITE, ASTM and UL requirements are also to be applied in the construction of the projects facilities and equipment.

8.2 Testing

The payment terms for the project are tied directly to the successful completion of a testing program to ensure complete compliance with the specifications and project requirements.

9.0 Procedures and Resources Necessary for Operations and Management of the System

9.1 Operations

The system will be operated from the MDOT Regional TMC in Jackson. MDOT currently has operators in place to run the system. The exact hours of operation, staffing requirements and operational procedures are defined in detail in the TMC Policy Manual and TMC Operations Manual. It is anticipated that at least one full time operator will be at the TMC at all times during the normal hours of operation. Part time personnel may be used to supplement during peak hours and during major events. The ITS manager will be responsible for overseeing the TMC staff.

9.2 Maintenance

Dictated by the general and project specific specifications, it is incumbent on the contractor to provide and coordinate training for MDOT personnel in the operation and maintenance of all equipment and software installed on the US Highway 49 ITS Project.