

## **APPENDIX I – FUNCTIONAL REQUIREMENTS DOCUMENT**

## JOC Project Background and History

The Nebraska Joint Operations Center (JOC) project began with the initiation of the Phase 1 contract between NDOR and Kimley-Horn and Associates, Inc. The Joint Operations Center was envisioned to be a multi-agency operations center, with the primary agency partners being NDOR, NSP, NEMA and the Army National Guard. The JOC was envisioned to be constructed on the ARNG base in Lincoln, concurrent with the ARNG construction of the STARC building. Phase 1 of the Nebraska JOC project was intended to conduct the ITS planning for this project and included a number of ITS planning tasks including conducting stakeholder workshops, determining user requirements, determining functional requirements, developing an architecture for the Statewide JOC and DOC system, preparing a communications report and recommendations, developing an implementation plan for Nebraska's ITS program and summarizing all of these items in the High Level System Design Report.

With this goal in mind, Kimley-Horn and Associates, Inc. began the JOC project by conducting stakeholder workshops in each of the eight districts of NDOR, along with a ninth workshop in Lincoln focused on the features and functions of the JOC. The purpose of the stakeholder workshops were to conduct a comprehensive inventory of the ITS and non-ITS equipment and processes that were in use throughout the State of Nebraska by the stakeholders, to solicit specific input as to the issues that stakeholders frequently encounter in carrying out their day to day functions, to identify the needs (user needs) for ITS that the stakeholders have, and to prioritize their needs. The results of the Stakeholder workshops are summarized in the *Stakeholder Workshop Summary* document.

The *Stakeholder User Requirements* document was developed by Kimley-Horn and Associates, Inc. utilizing the information that was collected in the Stakeholder workshops and in subsequent follow-up conversations with various stakeholders. The *Stakeholder User Requirements* document forms the foundation for developing subsequent aspects of the planning process including developing the functional requirements for the JOC project and developing the Architecture for the JOC project. The *Stakeholder Workshop Summary* document and the *Stakeholder User Requirements* document were both finalized in November 2002. Building upon these documents, the *Draft Functional Requirements* document and the *Draft Statewide JOC/DOC System Architecture* document were submitted to NDOR in November 2002 and December 2002, respectively.

In January 2003, as the State of Nebraska governor and legislature were going through an important process of establishing budgets for the upcoming fiscal year, the Governor pulled the state's portion of the funding for the Joint Operations Center out of the capital facilities portion of the state budget. This action meant that the soonest that funding for the JOC could be included in the capital facilities budget would be in approximately two years, for Fiscal Year 2006, and the window of opportunity for constructing the JOC along with the ARNG's STARC building closed.

However, it is important to understand that the entire ITS planning process that had been going on during the previous nine months is still entirely valid, in that the needs of the users have been identified, and the resulting functional requirements and architecture under development are for the most part still valid. The primary aspect that changed was that the opportunity for co-locating NDOR, NSP, NEMA and ARNG in the same physical building could not occur, but the agency relationships and responsibilities by and large are still the

same and will continue whether the agencies are co-located in the same physical building, or whether they are linked virtually.

Hence, the planning efforts continued, appropriate modifications were made to the Functional Requirements, Architecture, and Communications documents to address the change in course that had occurred, and to reflect the new concept of having a Statewide Operations Center in the Omaha metropolitan area that will serve the same NDOR functions as the JOC in Lincoln was originally envisioned to serve.

In the interest of forging ahead with the project planning process, and not significantly delaying the project by restarting the planning process, it was decided by NDOR and Kimley-Horn and Associates, Inc. that the *Stakeholder Workshop Summary* and the *Stakeholder User Requirements* documents would not be “revised” to reflect the deletion of JOC terminology and replacement by Statewide Operations Center (SOC) terminology, but rather that this JOC project background and history write-up would be included at the front of these two documents to explain how the project transitioned from a “Joint Operations Center” focus to a “Statewide Operations Center” focus.

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# 1. INTRODUCTION

## 1.1 Purpose

The Nebraska Department of Roads (NDOR) has developed a statewide vision for the deployment of Intelligent Transportation Systems (ITS). This vision has identified the implementation of District operations centers, a statewide center for activity coordination and freeway management systems within the larger metropolitan areas as high priorities.

NDOR has determined that overall statewide transportation system effectiveness can be enhanced through centralized activity coordination, centralizing state programs and implementing a 24/7 operations schedule. In order to implement these enhanced measures the concept of a Statewide Operations Center (Statewide OC) supporting coordination, operational consistency and providing the “after hours” operational support of the District Operations Centers (DOC) was developed.

It is the intent of this document to transfer information developed during earlier ITS planning efforts, including the Statewide Joint Operations Center (JOC)/DOC Needs Assessment process, the District ITS Work Plans and other ITS planning efforts into a set of functional requirements for a Statewide OC. These earlier planning efforts also identified the need for an Omaha (District 2) Freeway Management System (FMS). The FMS deployment will address urban area congestion, incident management and safety issues. The Statewide OC will be collocated with the Omaha FMS in the District 2 Operations Center/Traffic Management Center (TMC).

In December 1998, NDOR completed the *Nebraska Statewide ITS Strategic Plan*. The statewide plan recommended projects to improve the safety, mobility, security, and economic well being of Nebraska. The Plan also identified the near-term need for a center to coordinate statewide transportation service activities, facilitate the integrated deployment of statewide ITS elements and centralize system monitoring, data collection, processing, storage and dissemination.

In December 1995, the Omaha Metropolitan Area Planning Agency (MAPA) completed a Strategic Deployment Plan for ITS technologies. This study recommended deployment of ITS elements and systems for the Omaha metropolitan area. A third study undertaken by the Nebraska State Patrol (NSP), Nebraska ITS/CVO Business Plan, was completed in August 1998. The Commercial Vehicle Operations (CVO) Business Plan identified as its top priority Nebraska’s participation in the national Commercial Vehicle Information Systems and Networks (CVISN) program. Participation by all states in CVISN is the critical step in the nationwide deployment of ITS/CVO capabilities.

## 1.2 Contents of Report

This report contains the functional requirements for both the District 2/Statewide OC, Omaha FMS and the DOCs. Each function is further described in the System Architecture report and will be refined during the detailed ITS field and system design processes. This report subdivides the NDOR functional requirements into two principal groups. The first group (Section 2.2) describes the Statewide OC and the statewide transportation requirements. The second group (Section 2.3) presents the Omaha FMS requirements. Section 2.4 presents the functions envisioned for the NSP Communications Centers. Included within the Statewide OC requirements are NDOR statewide transportation program functions such as the Advance Traveler Information and Archived Data Management Systems previously identified for

implementation within the Statewide JOC. The primary Omaha FMS functions include Traffic Management and Incident Management. Also contained within the report are NSP communication center functional requirements as they relate to deployments statewide of the DOCs and other freeway management system components.

The final set of functions, including the associated user service requirements (USR) and process specification (P- specs) supporting each function are included in this document for the Statewide functions. Further development of user service requirements and process specifications will be developed during the Phase 2 Design for the Omaha FMS functions as this was not included in the Phase 1 Scope of Services. Each of the descriptive statements within this document was tailored to fit the Statewide OC, District deployment of ITS devices and systems and the Omaha FMS. In order to match the stakeholder need with the above categories and align the need with descriptive terminology used by the National ITS Architecture the author has modified and combined stakeholder input without loss of intent.

### 1.3 System Design Approach

The System Functional Overview contains a high level description of the system hardware and software required to support the functional requirements identified for the Statewide OC. Additional field equipment and central system elements not covered in this document may be required as the deployments within the District 1, 3-8 and the Omaha FMS are further defined during Phase 2. Each system design description will consist of a central system component, a field component, and a communication system component. The communication system component links the central system component to deployed field components and to other central systems. The central component will consist of the central system software elements, central system network servers, databases, operator workstations, archive storage devices, and associated support equipment located at the Omaha facility and other DOC facilities. The communication system component will consist of the hardware devices and software located within the operations centers and at remote sites interfacing with the central system component, including any software associated with field component devices or other central systems required for communication. The field component will consist of the various hardware field devices used to monitor and control traffic, such as CCTV cameras, dynamic message signs (DMS), or traffic flow detectors on the freeway. Final design for central control, field device and communication system components will be developed during the detail design, system specification and procurement document preparation phases.

### 1.4 Acronyms

The following list of acronyms will be used throughout the Project and are provided for reference.

24/7	24 hours a day, 7 days a week
A	Annual
ADAH	Automatic Data Historical Archive
ADUS	Archived Data User Service
ADMS	Archived Data Management System
AM	Amplitude Modulated
AMS	Arterial Management System
ARNG	Army National Guard



ATIS	Advanced Travel Information System
ATMS	Arterial Transportation Management System
ATS	Automatic Train Stop
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
CCTV	Closed Circuit Television
CMS	Changeable Message Sign
CPU	Central Processing Unit
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
D2/Statewide OC	District 2/Statewide Operations Center
DIV	Data Input Verification
DMS	Dynamic Message Sign
DMSS	DMS Software
DOC	District Operations Center
DWD	Data Warehouse Distribution
E	Essential
EOC	Emergency Operations Center
FD	Future Deployment
FMS	Freeway Management System
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HAZMAT	Hazardous Material
HCRS	Highway Closure and Restriction
HDA	Historical Data Archive
HLSD	High Level System Design
HRI	Highway Rail Intersection
HSR	High Speed Rail
ID	Initial Deployment
ITS	Intelligent Transportation System
JOC	Joint Operations Center
LAN	Local Area Network
MCO	Maintenance and Construction Operations
MCOC	Maintenance/Construction Operations Center
MVFM	Maintenance Vehicle Fleet Management
NA	National Architecture

NDOR	Nebraska Department of Roads
NEMA	Nebraska Emergency Management Agency
NITSA	National ITS Architecture
NSP	Nebraska State Patrol
O&M	Operations and Maintenance
O	Optional
OC	Operations Center
ODC	Operational Data Control
OWS	Operator Workstation Software
P1	Phase 1 Deployment
P2	Phase 2 Deployment
P3	Phase 3 Deployment
P-specs	Process Specifications
RWIS	Road Weather Information System
RWM	Roadway Management
STARC	State Area Command Readiness Center
TM	Traffic Management
TMC	Transportation Management Center
TMS	Transportation Management System
TOC	Traffic Operations Center
TSI	Traveler Services Information
US	User Service
USR	User Service Requirement
VDW	Video Display Wall
V-GS	Video-Graphics Control Software
VID	Video Image Detector
WAN	Wide Area Network
WIM	Weigh-in-Motion
WZMS	Work Zone Management and Safety

## 2. STAKEHOLDER IDENTIFIED FUNCTIONS

During the stakeholder workshops and meetings with NDOR partners, stakeholders discussed the desired functions of a statewide center, its role and the corresponding functional requirements. This section of the document lists high level functions and identifies applicable Statewide OC, District Operation Center, Omaha FMS and local entity functions identified by stakeholders during the project workshops. The detailed functions listed in Sections 2.2 – 2.4 represent a summary and consolidation of individual needs/functions expressed by stakeholders. The statements are grouped by User Service to more clearly identify and separate the desired functions for the Statewide OC, DOCs, FMS and local entities.

The functional requirements have been separated into four subgroups; Section 2.2 – Statewide OC Functions, Section 2.3 – Urban Freeway Management System Functions, Section 2.4 – Local and District Functions and Section 2.5 – Nebraska State Patrol (NSP) Communications Center Functions. Each of the functional requirements originated from the eight District stakeholder workshops, meetings with NDOR partner agencies and/or were previously identified in planning documents listed in Section 1.1.

### 2.1 Statewide High Level Functionality

The high level functions summarize needs identified during the stakeholder workshops and partner agency meetings. During those meetings the concept of a statewide center, its role and functions were discussed. A critical element to the Statewide Operations Center, success will be the formation of partnerships and the level of transportation system coordination implemented. The following list of high-level functions was recommended for inclusion within the District 2/Statewide OC:

- Implemented system shall support integration and interoperability between the Statewide OC and each District operations center, each DOC shall be separately configured to manage district ITS field and central equipment and system needs.
- The Statewide OC shall provide secondary control/backup and “after hours” operational support maintaining 24/7 operations on a statewide basis.
- Coordinated interstate, statewide, and interregional manpower and equipment response needs.
- Operate and maintain the Omaha metropolitan area freeway management system and other deployed ITS elements within District 2.
- Support Homeland Security through deployed ITS devices/systems and statewide transportation system coordination activities.
- Facilitate the transfer of data/information between statewide agencies, emergency response, local jurisdictions and other transportation service providers.
- Maintain center-to-center communications with the DOCs statewide and NEMA, ARNG and NSP Headquarters Troop Area Communications Center located in the State Area Command Readiness Center (STARC) facility in Lincoln, NE.
- Provide statewide incident/emergency response and notification support.
- Provide statewide center for the collection, fusion and dissemination of traveler information (PioneerNet and 511) including both real-time and static information.
- Serve as the statewide center for the archival of transportation information/data including collection, storage and access capability.
- Provide real-time traffic information to NSP Troop Area A communications center.

- Provide real-time traffic information to Omaha metropolitan area transportation service providers, media outlets and Information Service Providers (ISP).
- Facilitate shared use of agency equipment, staff resources and deployed infrastructure for data collection, system monitoring and control and coordination.

## **2.2 Statewide OC Functions**

The Statewide OC has will have two primary functions. The first is to serve as the NDOR statewide transportation services coordination center and clearinghouse and second to serve as the state's DOC backup and "after hours" operations center.

The second Statewide OC function will require implementation of an integrated central system incorporating DOC functionality and Omaha FMS functionality. Deployment of an integrated system can be enhanced through statewide procurement of ITS devices and systems. A single software package could be developed to be implemented statewide to accommodate the specific needs of each district. The recommended design would cover the comprehensive requirements of all districts. All system functions would therefore be available to all districts; however, each district would only use the functions and features applicable to its area. The system hardware configuration implemented within a particular district would be specifically tailored to the needs of that district.

### ***2.2.1 Function 1: Statewide Traveler Information***

- Provide the centralized location for the collection and fusion of statewide traveler information. Real-time traveler information will be disseminated through the statewide ATIS, PioneerNet (internet based), and 511 (telephone based) and HAR.
- System will provide an ability to collect, process, disseminate, and exchange traffic and system status information with other ITS systems, transportation service providers, including access to other traveler information providers, including adjacent states.
- Information presented shall be multi-modal and contain both real-time and static data.
- Support the capability for remote condition/status input to the traveler information system.
- Provide real-time and planned condition/status information to other transportation service providers and permitting agencies.
- Provide the point of contact for information dissemination to local media, establish data exchange interfaces with media and partner ISPs.
- Provide the point of contact for public outreach and education activities.

### ***2.2.2 Function 2: Statewide Data Archival***

- Data archiving will support information collected through system monitoring, electronically input files, manual entry into operational records/data bases and contain current and historical, real-time and static data.
- System will support the following features: a process to promote data integrity, ability to import and verify data, ability to store data, ability to access and distribute data, and a user interface allowing for data retrieval.

- System design to support data collection from statewide transportation system operations, asset management and maintenance systems and other monitoring and application systems.
- Accept real-time and static data in an electronic format either from an existing database, electronic media or web based input.

### **2.2.3 Function 3: Statewide Communications**

- Establish center-to-center communications links with NDOR HQ, each DOC, NSP Troop Area A communications center (Omaha metro area), STARC Center (NEMA/ARNG and NSP Headquarters Troop Area communications center) and other partner agencies in support of transportation system management.
- Support shared use communication network(s) partnerships with other state and local agencies, emergency response and law enforcement agencies and private partners for purposes of data exchange, collection, and system monitoring. (Possible example could be support for Lifelink programs through deployed ITS technologies and wireless communications systems capable of receiving and transmitting voice/data/video).

### **2.2.4 Function 4: Statewide Incident Coordination**

- Provide incident management capabilities include detection, verification, and response capability utilizing ITS field devices and systems.
- Provide intra- and inter- district and statewide incident notification capability, interaction and agency coordination including with other state and local agencies, NEMA, ARNG, NSP, Nebraska Department of Environmental Quality (NDEQ), local emergency response and law enforcement agencies.
- Provide assistance and coordination to the Nebraska Motorists Assist Program.
- Maintain a statewide local emergency response agency contact list and a list of public agency and a private industry contractors “call out list” of equipment resources.
- Support development, implementation and periodic review of public outreach and education programs focusing on emergency and incident situations, assist with development of statewide standards/policies for incident coordination, response and data exchange.

### **2.2.5 Function 5: Statewide Traffic Management**

The following Statewide Traffic Management functions summarize stakeholder input from the eight District workshops and District work plans. An individual District may implement some or all of the functions identified within Section 2.2.5, District functions carried over from the Statewide JOC project are listed in Section 2.4. Each District deployed system will have similar capabilities as the Statewide OC.

- Provide primary operational control of District 2 ITS field device and systems. (The table lists ITS field devices common to both rural and urban deployments, as the table indicates there is considerable overlap. Differences and/or similarities will be identified and considered during the design process, the items to be considered shall include primary and secondary control, system monitoring, operation and maintenance functions.)



Representative Urban Field Device Deployments	Representative Rural Field Device Deployments
<ul style="list-style-type: none"> <li>▪ Ramp Meters</li> <li>▪ Lane Control Signs</li> <li>▪ Dynamic Message Signs (permanent/portable)</li> <li>▪ Traffic Flow Measurement</li> <li>▪ Closed-Circuit Television Cameras</li> <li>▪ Supporting Communications Infrastructure</li> <li>▪ RWIS (permanent/portable)</li> <li>▪ Smart Work Zone Monitoring Equipment</li> <li>▪ Bridge/Roadway Anti-Icing Systems</li> <li>▪ Highway Advisory Radio (permanent/portable)</li> <li>▪ Automated Ramp Closure Systems</li> <li>▪ RR Advance Warning Systems</li> <li>▪ Trailblazers</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dynamic Message Signs (permanent/portable)</li> <li>▪ Traffic Flow Measurement</li> <li>▪ Closed-Circuit Television Cameras</li> <li>▪ Supporting Communications Infrastructure</li> <li>▪ RWIS (permanent/portable)</li> <li>▪ Smart Work Zone Monitoring Equipment</li> <li>▪ Bridge/Roadway Anti-Icing Systems</li> <li>▪ Highway Advisory Radio (permanent/portable)</li> <li>▪ Automated Ramp/Highway Closure Systems</li> <li>▪ RR Advance Warning Systems</li> <li>▪ Trailblazers</li> </ul>

- Support integration and development of standard procurement specifications for deployed ITS field devices and systems providing intra- and inter-district and sub-regional traffic management.
- Manage traffic control response to district, regional and statewide incident and special events. Provide interaction/coordination with local jurisdiction, emergency response and law enforcement agencies.
- Support En-Route Traveler Information through District deployed devices and systems.
- Support shared use of ITS field devices and systems with partner agencies. Provide secondary field device access and control, provide capability to log user agency operations.
- Support collocation of DOCs, NSP Troop Area communications centers and other traffic management functions within the same facility.
- Implement capability to operate 24/7.
- Provide NSP, NEMA, and ARNG real-time statewide roadway system monitoring and system status information.
- Coordinate development, implement and periodically review appropriate statewide operational standards/policies for ITS systems and programs. Develop operational and technical training needs.

### 2.2.6 *Function 6: Statewide Maintenance and Construction*

- Provide vehicle fleet management and tracking capability using GPS/AVL or other advanced technologies.
- Support in-vehicle safety systems, driver notification, smart snow plow and other ITS technologies.
- Support roadway infrastructure that monitors, operates and maintains the physical condition of the transportation system.
- Support Work Zone systems assisting with management and operation of maintenance/construction activities/traffic management.
- Support coordination of traffic operation and work zone plans with other agencies.
- Support road weather data collection, pavement forecasting and management systems.

**Figure 1** indicates the deployment phasing stakeholders indicated during the eight District workshops. The relative importance of each function was identified in the User Requirements document completed previously in the planning phase of this project. The deployment phasing is classified as **A** for Annual, **P1** for Initial deployment or Phase 1, **P2** for Phase 2, and **P3** for Phase 3. The time frame for each phase is provided below:

- Annual – Projects that could be implemented on an annual basis;
- Phase 1 Deployment – Current/initial deployment to June 2006;
- Phase 2 Deployment – July 2006 to June 2013 (end of 10 fiscal years from present); and
- Phase 3 Deployment – July 2013 to June 2017 (beyond 10-year deployment horizon).



**Figure 1 – Statewide Operations Center Functions**

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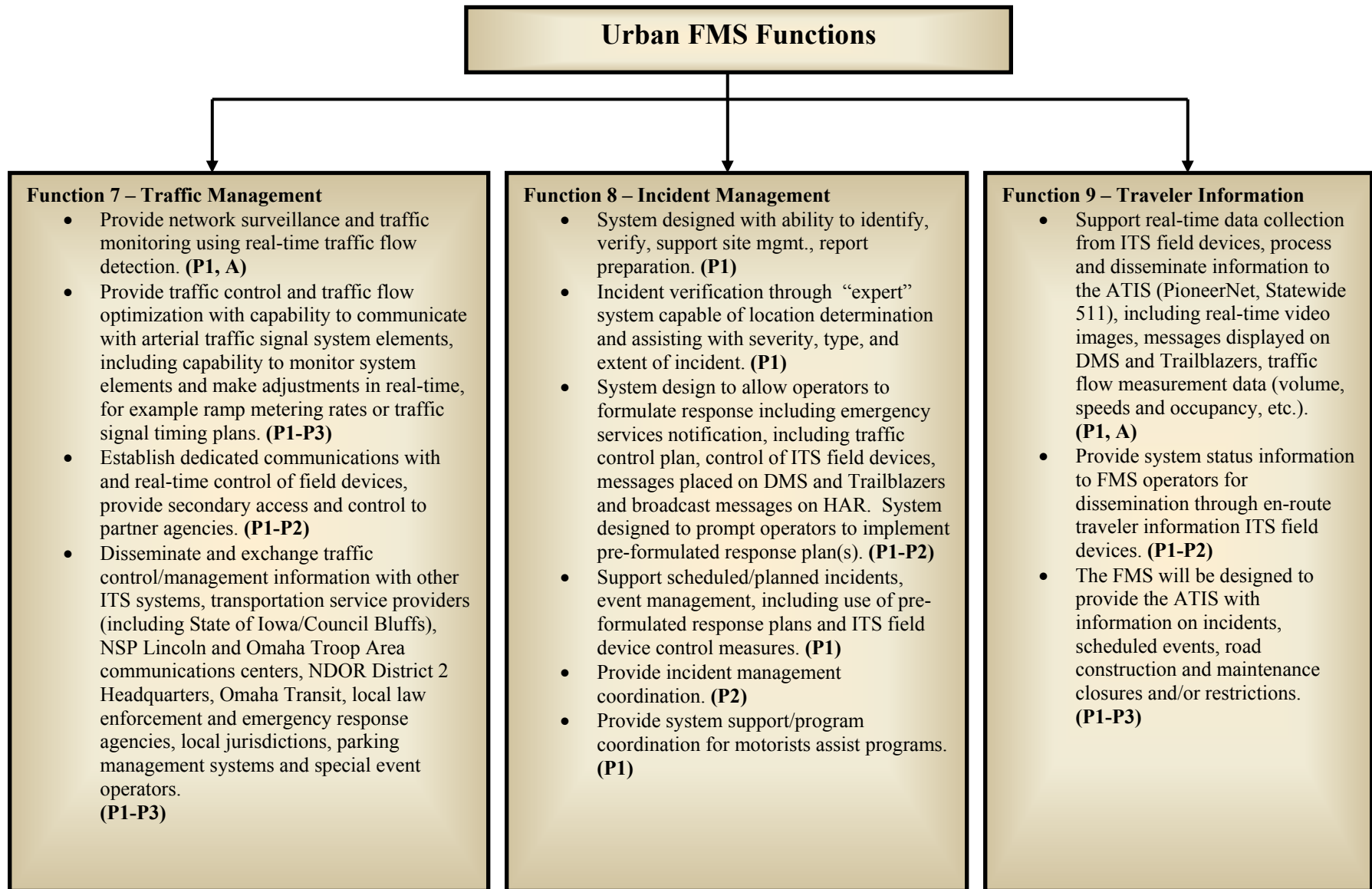
**Figure 1**



### 2.3 Urban Freeway Management System Functions

District 2 staff and other stakeholders have identified functionally those elements for inclusion into Urban Freeway Management Systems. Although most of the input focused primarily on Omaha and Lincoln the concepts put forward could apply to any areas within the state. Functional requirements have been identified within the Traffic Management, Incident Management and Traveler Information User Service groups. Many of the FMS functions are included within the six functions describing the Statewide OC and are not repeated below. Each of the functions contained within sections 2.2 and 2.3 should be considered during the FMS design process.

In combination with the Statewide OC the following additional functions apply to the urban freeway management systems. The District 2/Omaha FMS will cover approximately 100 plus centerline miles of urban freeways including I-80, I-480, I-680 US 6, and US 75. All of these roadways would benefit from the deployment of ITS systems. The system implemented could also provide traffic management on other routes supporting and being supported by the Statewide OC and FMS functions. **Figure 2** graphically depicts the urban FMS system functions and the associated deployment phasing of various elements.



**Figure 2 – Urban Freeway Management System Functions**

### **2.3.1    *Function 7: Urban Traffic Management***

- Provide traffic control and traffic flow optimization with capability to communicate with arterial traffic signal system elements, including capability to monitor system elements and make adjustments in real-time, for example ramp metering rates or traffic signal timing plans.
- Provide network surveillance and traffic monitoring using real-time traffic flow detection.
- Establish dedicated communications with and real-time control of field devices, provide secondary access, and control to partner agencies.
- Disseminate and exchange traffic control/management information with other ITS systems, transportation service providers (including State of Iowa/Council Bluffs), NSP Lincoln and Omaha Troop Area communications centers, NDOR District 2 Headquarters, Omaha Transit, local law enforcement and emergency response agencies, local jurisdictions, parking management systems and special event operators.

### **2.3.2    *Function 8: Urban Incident Management***

- Identify and verify incidents, support incident site management, and incident report preparation.
- Incident verification shall be through an “expert” system capable of location determination and assisting with assessing severity, type, extent of the incident.
- System will be designed to have the ability to allow operations staff to formulate a response to include emergency services notification. Response formulation will be allowed to include a traffic control plan, including control of ITS field devices, messages placed on DMS and Trailblazer signs and broadcast messages on HAR. System will be designed to prompt operators to implement the appropriate pre-formulated response plan(s).
- Support scheduled/planned incidents, event management, including use of pre-formulated response plans and ITS field device control measures.
- Provide incident management coordination.
- Provide system support/program coordination for motorists assist programs.

### **2.3.3    *Function 9: Urban Traveler Information***

- Support real-time data collection from ITS field devices, process and disseminate information to the statewide ATIS (PioneerNet, Statewide 511), including real-time video images, messages displayed on DMS and Trailblazers, traffic flow measurement data (volume, speeds and occupancy, etc.).
- Provide system status information to FMS operators for dissemination through en-route traveler information ITS field devices.
- The FMS will be designed to provide the ATIS with information on incidents, scheduled events, road construction and maintenance closures and/or restrictions.

## 2.4 District Operations Center and Local Functions

During the Phase 1 stakeholder workshops, a non-prioritized list summarizing the stakeholder view on the role and/or functions of the local entities and DOCs was created. The consensus was that the primary monitoring/control/operation of NDOR ITS field devices and systems were a District responsibility. Sections 2.4.1 – 2.4.3 include technical, policy and procedural functions to be performed within the DOCs. Depending upon the needs of the individual District, the DOC functions may include:

### 2.4.1 *DOC Function 1: Manage District Traffic Operations*

- Primary operational control of smart work zone system deployments.
- Primary operational control of Traffic Management System, ITS field device deployments.
- Collocation of NDOR/NSP and traffic management functions within the same center.

### 2.4.2 *DOC Function 2: Provide Operation Coordination and Voice/Data Links between Agencies*

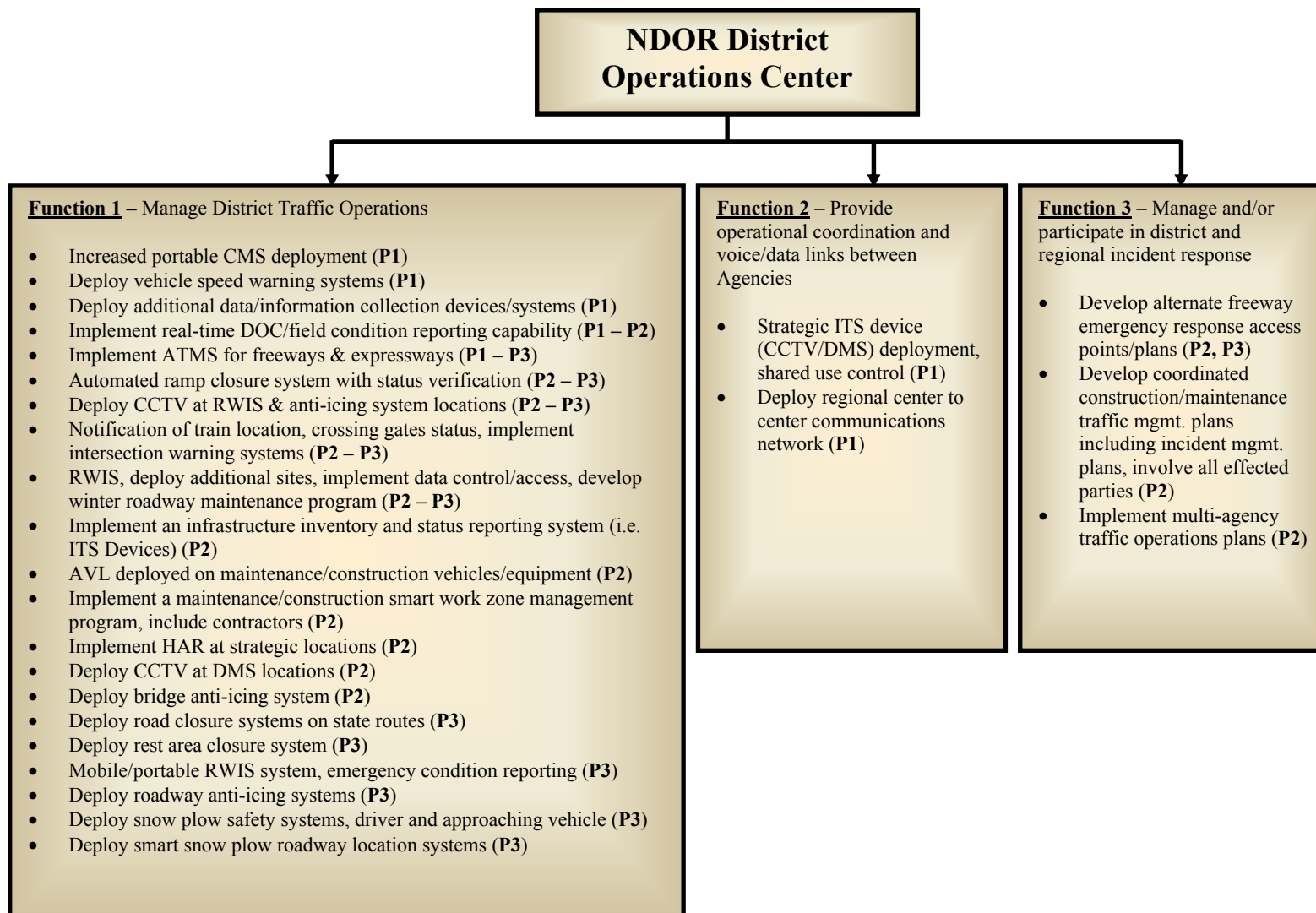
- Provide intra-district, sub-regional and adjacent state weather data exchange, traffic response/management and emergency/incident coordination
- Responsibility for interaction/coordination with local emergency response and law enforcement agencies.
- Maintaining a local emergency response contact list of staff and equipment resources.
- Support intra-district multi-agency communications network.
- Primary responsibility for center-to-center communications with local transportation management systems, emergency response, and law enforcement agencies.

### 2.4.3 *DOC Function 3: Manage and/or Participate in District and Regional Incident Response*

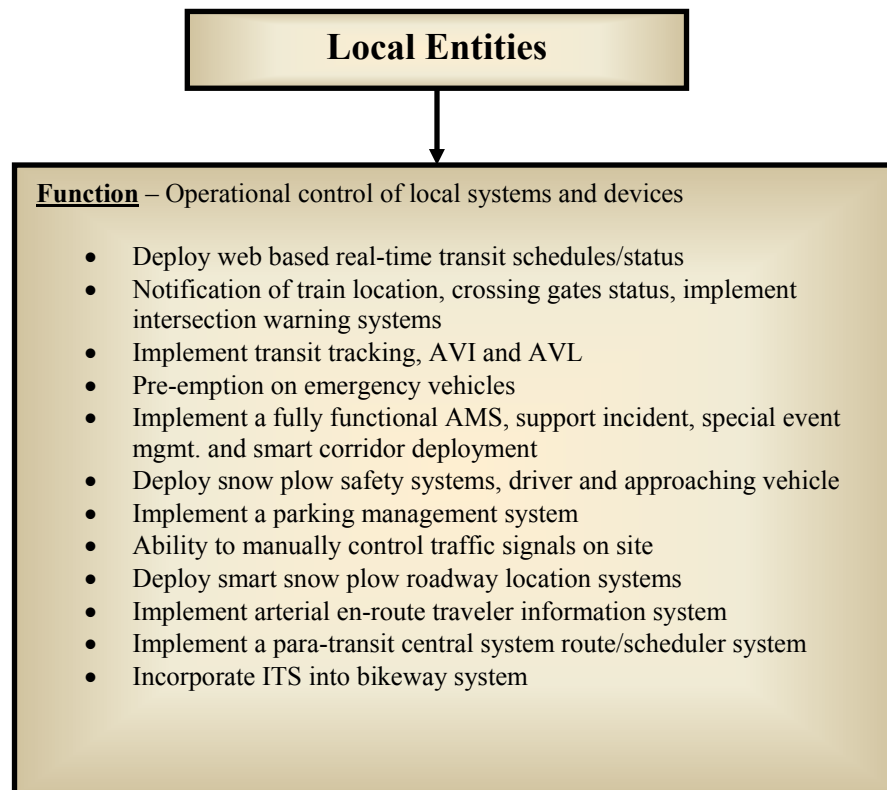
- Point of contact for local media outreach/education activities.

The stakeholder DOC functions with deployment phasing as identified in the Phase 1 User Requirements document are shown in **Figure 3**.

The local entity (i.e., transit, city and county agencies) functions are primarily operational control of local devices and systems as well as dissemination of local information to travelers. The stakeholder functions identified in the Phase 1 User Requirements document are shown in **Figure 4**. The phasing will be determined by the responsible agency/jurisdiction.



**Figure 3 – NDOR District Operations Center Functions**



**Figure 4 – Local Entity Functions**

## **2.5 NSP Communications Centers Functions**

### **2.5.1 Function 10: NSP Communications Centers**

- Serve as communications center for the NSP Troop-Area A command.
- Provide back-up state agency intra/inter-regional and statewide communications needs.
- Provide roadway incident and status information including notification and updates to the Statewide OC.
- Provide coordination and assistance to the Nebraska Motorists Assist Program.
- Operate 24/7/365.

### 3. FUNCTIONAL REQUIREMENTS

Phase 1 of the Statewide JOC project produced a final *Stakeholder User Requirements* and a *DRAFT Functional Requirements* document. The user services incorporated in the document covered each of the stakeholder needs/functions identified in the stakeholder workshops and individual agency meetings. The functional requirements document identified functions and corresponding User Services (US), User Service Requirements (USR) and process specifications (P-specs) that were applicable to the Statewide JOC, agency partners (NEMA, NSP, and ARNG), District Operations Centers and local entities. The Statewide OC functional requirements document has carried some of the Statewide JOC needs/functions forward and others were not. Section 2 summarizes those functions brought forward into the Statewide OC document. The following US from the National Architecture will be required to support those functions identified by the stakeholders for the NDOR District 2/Statewide OC, Urban FMS and DOC implementation.

- Pre-Trip Travel Information (US 1.1);
- En-route Driver Information (US 1.2);
- Traveler Services Information (US 1.5);
- Traffic Control (US 1.6);
- Incident Management (US 1.7);
- Highway Rail Intersection (US 1.10);
- Emergency Vehicle Management (US 5.2);
- Archived Data Function (US 7.1); and
- Maintenance and Construction Operations (US 8.1).

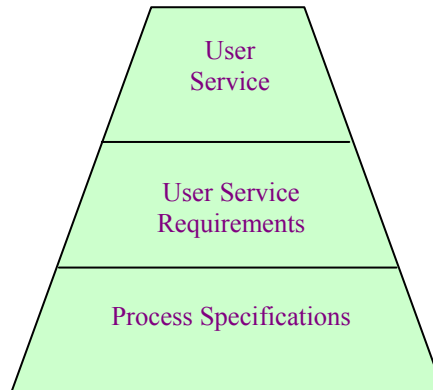
The remaining user services identified within the *Stakeholder User Requirements* document are not applicable to the deployment of the District 2/Statewide OC, Urban FMS and/or District Operations Center functions and therefore are not being carried forward in this document. These user services are:

- Travel Demand Management (US 1.8);
- Public Transportation Management (US 2.1);
- En-route Transit Information (US 2.2);
- Personalized Public Transit (US 2.3);
- Commercial Vehicle Electronic Clearance (US 4.1);
- Commercial Vehicle Administrative Processes (US 4.4);
- Hazardous Material Incident Response (US 4.5);
- Longitudinal Collision Avoidance (US 6.1).

From these user services various layers of user service requirements and their corresponding process specifications (P-specs) were developed. User Service Requirements and P-specs are components of the National Architecture that represent varying levels of functional requirements. User Service Requirements are the basic building blocks of the logical architecture, defining what the system should do, not where the functions reside or how they are accomplished. P-specs are more detailed functional requirements required to satisfy USR. The National Architecture is structured similar to the diagram in **Figure 5**. Each US is supported by multiple USR. Each USR



may be supported by multiple P-specs. Section 3 follows the National Architecture structure, each function is identified by the corresponding US, corresponding USR(s) and applicable P-specs. P-specs often correspond to multiple USRs resulting in a single P-spec being listed in several places. A list of each P-specs, an overview and functional requirements, included in this document are attached to the document in **Attachment A**.



**Figure 5 – National Architecture Structure Diagram**

Included with each USR and P-specs selected, a corresponding deployment phase and level of importance, respectively, were identified. These priorities were developed based on the following assumptions:

- Field device implementation will be designed for incremental deployment allowing field elements to be deployed in phases, and the central system in modules; and
- The initial field device design and central system deployment will focus on Traffic Management, Traveler Information (both Pre-Trip and En-Route), Incident Management/coordination, Statewide Communications, Maintenance and Construction and Data Archival.

The National Architecture USR for the District 2/Statewide OC, Urban FMS and DOC were classified under two levels of deployment as identified below.

- **ID (Initial or Phase 1 Deployment)** – These functions and USR are considered important and should be included in the initial deployment.
- **FD (Future or Phase 2/3 Deployment)** – These functions and USR are considered advantageous and should be included over the long-term.
- The supporting P-specs were then classified under two levels of importance for implementation:
- **E (Essential P-Spec)** – These P-specs are considered essential and should be included in the initial deployment.
- **O (Optional P-Spec)** – These P-specs are considered advantageous or enhancements and may be included over the long-term.



During the classification of the USR and P-specs, there is a certain level of subjectivity inherent in rating each of the requirements. Based on the criteria listed above and input from the stakeholders, several iterations were performed by project team members resulting in the priority levels listed with each requirement in this document.

### 3.1 Statewide Traveler Information (Function 1)

The NDOR Advanced Travel Information System (ATIS), PioneerNet and 511, will be the clearinghouse for traveler information collection and dissemination. The ATIS will collect information from both the District ITS systems and freeway management components as well as selected information from other electronic sources. Ultimately, the ATIS will have the ability to exchange information with other private and public partner agencies. The collection and dissemination from multiple sources will maximize the information content and exposure to the traveler. The Statewide OC will serve as the NDOR statewide collection, fusion and centralized location for traveler data/information dissemination.

Four user services have been identified to support the Statewide Traveler Information function including Pre-trip Travel Information (US 1.1), En-route Driver Information (US 1.2), Traveler Services Information (US 1.5) and Maintenance and Construction Operations (US 8.1).

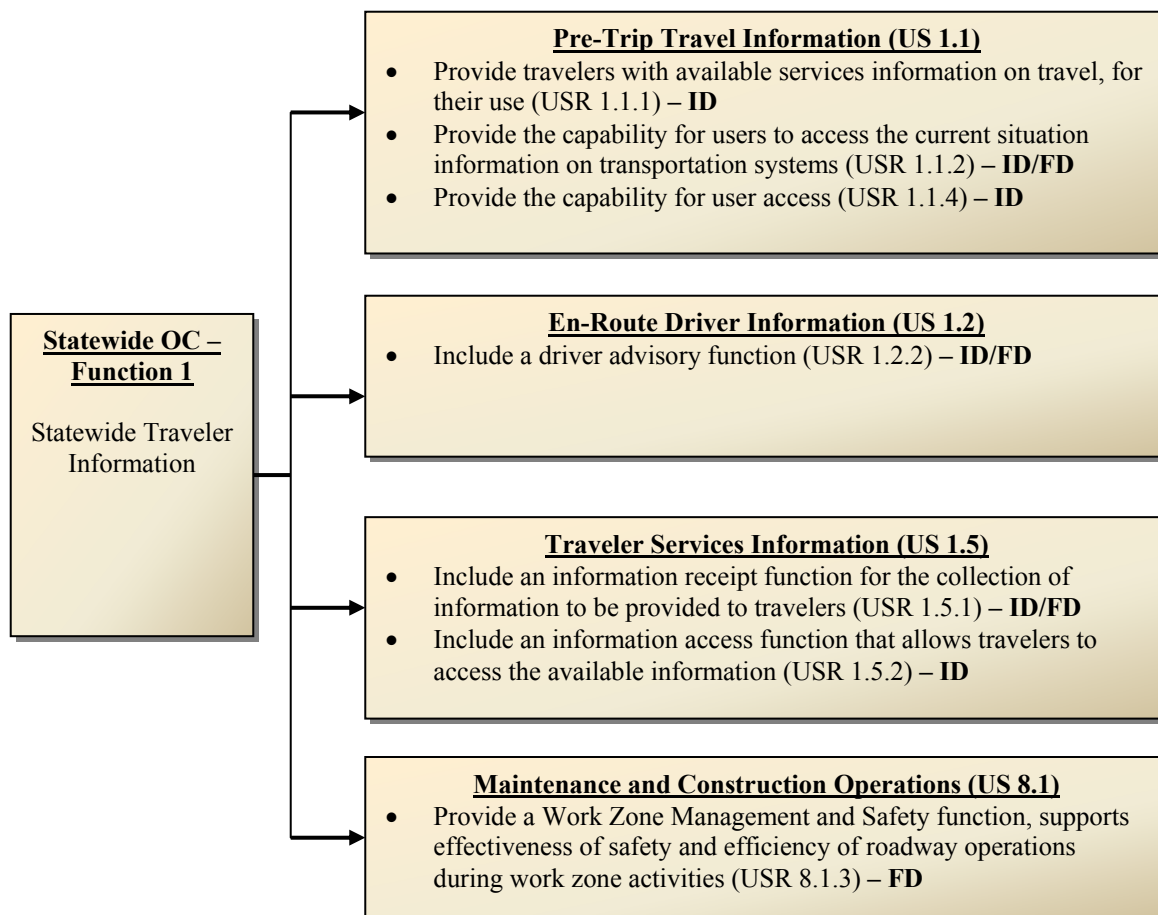


Figure 6 – Statewide OC Function 1 Schematic

### 3.1.1 Pre-Trip Travel Information (US 1.1)

Pre-Trip Travel Information shall have the following functions:

- Provide travelers with available services information on travel, both static and dynamic information (USR 1.1.1). The function shall:
  - Provide users with available services information that is timely (USR 1.1.1.1) – **ID**

*P-specs:* Provide Trip Planning Information to Traveler (6.1.1) – **O** Inform  
Traveler (6.3.2) – **E**

- Provide the capability for users to access the current situation information on transportation systems (USR 1.1.2). The function shall include:
  - The latest available information on the current status of transportation services (USR 1.1.2.1) – **ID**
  - Real-time information include the current status of any accidents or incidents (USR 1.1.2.1.2) – **ID**
  - Real-time information include the current condition of any road construction (USR 1.1.2.1.3) – **ID**
  - Real-time information shall include any currently recommended alternate routes (USR 1.1.2.1.4) – **ID**
  - Real-time information shall include the current speeds on specific routes (USR 1.1.2.1.5) – **FD**
  - Real-time information shall include the schedules for any current or soon to start events (USR 1.1.2.1.7) – **FD**
  - Real-time information shall include the current weather situation (USR 1.1.2.1.8) – **ID**

*P-specs:* Provide Media System Traffic Data Interface (1.1.4.5) – **O**  
Provide Trip Planning Information to Traveler (6.1.1) – **O**  
Inform Traveler (6.3.2) – **E**  
Collect and Update Traveler Information (6.5.1) – **E**  
Provide Traveler Event Information (6.5.4) – **O**

- Provide the capability for user access (USR 1.1.4). The information shall:
  - Provide the capability for users to access the system from multiple distributed locations(USR 1.1.4.1), include home (USR 1.1.4.1.1), work place (USR 1.1.4.1.2), major trip generation sites (USR 1.1.4.1.3) – **ID**
  - Provide the capability for users to access the system over multiple types of electronic media (USR 1.1.4.2.) – **ID**

*P-specs:* Provide Traffic Data Retrieval Interface (1.1.4.6) – **E**  
Provide Trip Planning Information to Traveler (6.1.1) – **O**  
Update Traveler Display Map Data at Kiosk (6.3.4) – **O**

### 3.1.2 *En-route Driver Information (US 1.2)*

En-route Driver Information shall have the following functions:

- Include a driver advisory function (USR 1.2.2.). The information shall:
  - Include the ability to provide information to travelers within the limited area of deployment in the short term (USR 1.2.2.1) – **ID**
  - Provide information to travelers required for them to avoid areas of congestion (USR 1.2.2.1.2) – **FD**
  - Include the ability to provide information to travelers within all geographic areas of the ITS deployment in the long term (USR 1.2.2.2) – **ID**
  - Provide the capability to customize warning messages (USR 1.2.3.2.2.1) – **ID**

*P-specs:* Collect Traffic Data for Advisory Messages (6.2.1.1) – **E**  
 Provide Traffic Advisory Messages (6.2.1.2) – **O**  
 Provide Traffic Broadcast Messages (6.2.1.4) – **E**  
 Provide ISP Operations Broadcast Parameters Interface (6.2.1.5) – **E**  
 Collect Yellow Pages Data (6.2.4) – **O**  
 Provide Yellow Pages Data (6.2.6) – **O**

### 3.1.3 *Traveler Services Information (US 1.5)*

Traveler Services Information shall have the following functions:

- Include an information receipt function for the collection of information to be provided to travelers (USR 1.5.1.). The function shall:
  - Provide and maintain a database of local area services available to travelers (USR 1.5.1.1) – **ID**
  - Provide the capability to acquire current information relating to traveler services available in the local area (USR 1.5.1.2) – **ID**
  - Include information on the availability of local motorist services (USR 1.5.1.2.4) – **FD**
  - Provide information on the status of local traveler services (USR 1.5.1.2.5) – **FD**
  - Include the capability to have interactive connectivity between users, sponsors, and providers of services. (USR 1.5.1.5) – **ID**

*P-specs:* Provide Traffic Advisory Messages (6.2.1.2) – **O**  
 Provide Traffic Broadcast Messages (6.2.1.4) – **E**  
 Provide Yellow Pages Data (6.2.6) – **O**  
 Collect and Update Traveler Information (6.5.1) – **E**  
 Provide Traveler Yellow Page Information (6.5.2) – **O**

- Include an information access function that allows travelers to access the available information (USR 1.5.2.). The function shall:
  - Provide the capability for travelers to request and receive general information about the local area (USR 1.5.2.1) – **ID**
  - Provide the capability for travelers and centers to request and receive information about the location of facilities (USR 1.5.2.2) to include but, not be limited to,

lodging information (USR 1.5.2.2 a), parking information (USR 1.5.2.2 c), tourist activities information (USR 1.5.2.2 e), daily or special events information (USR 1.5.2.2 f), and local shelter/medical facility availability information (USR 1.5.2.2 g) – **ID**

- Provide the capability for all travelers to access information regardless of their particular mode of travel (USR 1.5.2.4) – **FD**
- Provide the capability for travelers to access the traveler services information (USR 1.5.2.5) via any of, but not limited to highway advisory radio (USR 1.5.2.5 a), dial-up telephone lines (USR 1.5.2.5 b), computers at home (USR 1.5.2.5 c), computers in the office (USR 1.5.2.5 d), in-vehicle computers (USR 1.5.2.5 e), public area kiosks (USR 1.5.2.5 f), and personal portable devices (USR 1.5.2.5 g.) – **ID**
- Provide the capability for travelers to access traveler service information from public kiosk locations (USR 1.5.2.6) which include, but not limited to rest areas (USR 1.5.2.6 a), activity centers (USR 1.5.2.6 b), tourist attractions (USR 1.5.2.6 c), and airports (USR 1.5.2.6 e.) – **FD**

*P-specs:*    Output Roadway Information Data (1.2.4.4) – **E**  
                   Device Interface to Other Roadway Devices (1.2.7.8) – **E**  
                   Process Roadway Information Data (1.2.7.9) – **E**  
                   Collect Traffic Data for Advisory Messages (6.2.1.1) – **E**  
                   Provide Traffic Advisory Messages (6.2.1.2) – **O**  
                   Provide Traffic Broadcast Messages (6.2.1.4) – **E**  
                   Collect Yellow Pages Data (6.2.4) – **O**  
                   Provide Yellow Pages Data (6.2.6) – **O**  
                   Provide Traveler Kiosk Interface (6.3.3) – **O**  
                   Update Traveler Display Map Data at Kiosk (6.3.4) – **O**  
                   Collect and Update Traveler Information (6.5.1) – **E**  
                   Provide Traveler Event Information (6.5.4) – **O**

### 3.1.4 Maintenance and Construction Operations (US 8.1)

Maintenance and Construction Operations shall support Traveler Information with the following functions:

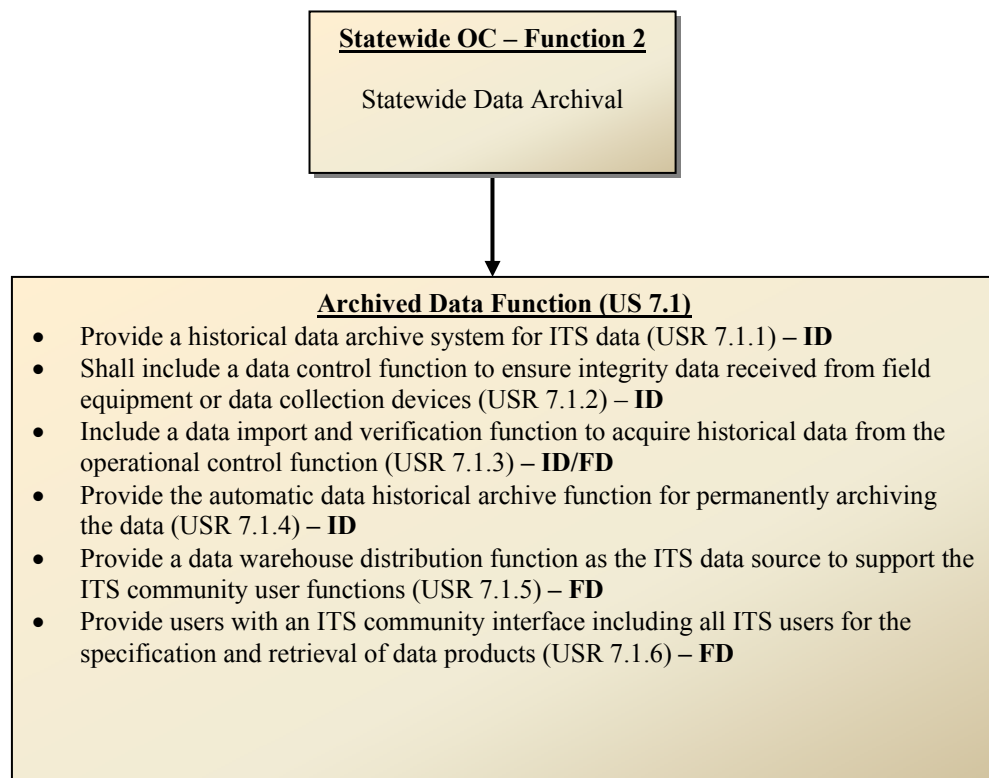
- Provide a Work Zone Management and Safety (WZMS) function, which provides support for the effectiveness, safety, and efficiency of roadway operations during all work zone activities (USR 8.1.3). The function shall:
  - Provide systems that communicate reliable, accurate, and timely traveler information (USR 8.1.3.3) including: location and lane closure information (USR 8.1.3.3 (a)), alternate route/detour (USR 8.1.3.3 (b)), work zone speed limit (USR 8.1.3.3 (c)), delay (USR 8.1.3.3 (d)) – **FD**

*P-specs:*    Process Roadway Information Data (1.2.7.9) – **E**  
                   Operate Work Zone Devices (9.3.1.1) – **E**  
                   Generate Work Zone Information for Distribution (9.3.2.3) – **O**

### 3.2 Statewide Data Archival (Function 2)

The Archived Data User Service (US 7.1) provides functionality for the control and archiving of data/information. The six major elements or processes involved in archiving data/information are listed below. The Statewide OC shall provide the centralized location for the collection, archiving and distribution of collected data. The archived data will be both static or dynamic information. Data collected dynamically may have a storage size limitation and/or period of time for which the files are stored; for example, traffic monitoring data may contain the last 3 years of data stored on a first-in-first-out basis (FIFO).

- Historical Data Archive System function (USR 7.1.1);
- Operational Data Control function manages operations data integrity (USR 7.1.2);
- Data Import and Verification function acquires historical data from the Operational Data Control function and other agencies (USR 7.1.3);
- Automatic Data Historical Archive function permanently archives the data (USR 7.1.4);
- Data Warehouse Distribution function integrates and processes data products for the planning, safety, operations, and research communities (USR 7.1.5); and
- User Interface provides a common interface to all users for data products specification and retrieval (USR 7.1.6).



**Figure 7 – Statewide OC Function 2 Schematic**



- The Archived Data Function shall provide a Historical Data Archive (HDA) system for ITS data (USR 7.1.1). The function shall:
  - Include repositories of operational data received from field equipment or data collection devices (USR 7.1.1.1) – **ID**
  - Provide permanent historical data repositories (USR 7.1.1.2) – **ID**
  - Include repositories for all meta-data and meta-attributes repositories (USR 7.1.1.3) – **ID**
  - Provide data system security, capable of (USR 7.1.1.4), employing security solutions (USR 7.1.1.4.1), preventing data loss (USR 7.1.1.4.2), preventing unauthorized access to data repositories (USR 7.1.1.4.3), providing a secure interface for online support of the user interface (USR 7.1.1.4.4) – **ID**
  - Support online analytical functions to enable users to analyze data across multiple sources or acquire data for their off-line applications (USR 7.1.1.5) – **ID**

*P-specs:* Get Archive Data (8.1) – **E**  
 Manage Archive (8.2) – **E**  
 Manage Archive Data Administrator Interface (8.3) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Analyze Archive (8.6) – **E**

- The Archived Data Function shall include an Operational Data Control (ODC) function to ensure integrity of operational data as received from field equipment or data collection devices (USR 7.1.2). The function shall be:
  - Capable of receiving and storing all operational data, as received (USR 7.1.2.1) – **ID**
  - Capable of ensuring operational data is in proper format (USR 7.1.2.1.1) – **ID**
  - Capable of maintaining the meta data schema for all operational data entering the system (USR 7.1.2.1.2) – **ID**
  - Capable of assigning the following meta attributes, when available, to operational data during the archive process (USR 7.1.2.1.3), equipment used to collect data (USR 7.1.2.1.3 (a)), set conditions under which data were collected (USR 7.1.2.1.3 (b)), check status of equipment at time of the collection (USR 7.1.2.1.3 (c)) – **ID**
  - Capable of applying user-defined quality control verification on operational data and annotating results in the appropriate meta files (USR 7.1.2.1.4) – **ID**
  - Capable of assigning meta-attributes to the data (USR 7.1.2.1.5), summarize and aggregation (USR 7.1.2.1.5 (a)), Transformations (i.e. reconstructing original data or constructing new data elements) (USR 7.1.2.1.5 (b)) – **ID**
  - Capable of collecting user-selected data (USR 7.1.2.2), – **ID**
  - Capable of archiving in data repositories operational data as received from field equipment or data collection devices (USR 7.1.2.3) – **ID**
  - Capable of maintaining the integrity of all received operational data (USR 7.1.2.4) – **ID**





- Capable of disseminating data replicates to operational users in near real-time (USR 7.1.2.5) – **ID**
- Capable of performing data fusion on replicated data for operational users in near real-time (USR 7.1.2.6) – **ID**

*P-specs:* Get Archive Data (8.1) – **E**  
 Manage Archive Data Administrator Interface (8.3) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Analyze Archive (8.6) – **E**  
 Process on Demand Archive Requests (8.7) – **E**  
 Manage Roadside Data Collection (8.9) – **E**

- The Archived Data Function shall include a Data Import and Verification (DIV) function to acquire historical data from the Operational Data Control function (USR 7.1.3). The function shall be:
  - Capable of importing selected operational data from operational repositories (USR 7.1.3.1) – **ID**
  - Capable of importing freeway operations data (USR 7.1.3.1.1), freeway traffic flow surveillance data (USR 7.1.3.1.1 (a)), ramp meter pre-emptions (USR 7.1.3.1.1 (b)), ramp meter operational data (USR 7.1.3.1.1 (c)), TMC generated freeway flow metrics (USR 7.1.3.1.1(e) – **ID**
  - Capable of importing FMS Incident Management data (USR 7.1.3.1.5), incident characteristics (USR 7.1.3.1.5 (a)), train arrivals at highway rail intersections (USR 7.1.3.1.5 (b)), emergency vehicle dispatch data (USR 7.1.3.1.5 (c )), emergency vehicle location data (USR 7.1.3.1.5 (d)), construction and work zone identification (USR 7.1.3.1.5 (e)), emergency request data (USR 7.1.3.1.5 (f)), emergency response (USR 7.1.3.1.5 (h)) – **ID/FD**
  - Capable of importing environmental data (USR 7.1.3.1.7), weather data (USR 7.1.3.1.7 (b)) – **ID**
  - Capable of importing vehicle and traveler data (USR 7.1.3.1.8), commercial, non-commercial vehicle probe data (USR 7.1.3.1.8 (a)), DMS message set data (USR 7.1.3.1.8 (b)), parking data (USR 7.1.3.1.8 (e)) – **ID/FD**
  - Capable of importing data on physical characteristics of transportation infrastructure (USR 7.1.3.1.9), roadway network attributes (USR 7.1.3.1.9 (a)), transportation facilities (USR 7.1.3.1.9 (c)), GIS map of network (USR 7.1.3.1.9 (e)), infrastructure maintenance data (USR 7.1.3.1.9 (f)) – **ID/FD**
  - Capable of importing Parking Management data (USR 7.1.3.1.10) – **FD**
  - Capable of importing Intermodal Operational data (USR 7.1.3.1.11) – **FD**
  - Capable of accepting pre-defined data inputs from users (USR 7.1.3.2) – **ID**
  - Capable of applying pre-defined quality control verification on the imported data and annotating results in the appropriate meta files (USR 7.1.3.3) – **ID**
  - Capable of formatting the data to conform to the archive schema (USR 7.1.3.4) – **ID**
  - Capable of cleansing imported data (USR 7.1.3.5) – **ID**
  - Include the removal of source privacy attributes (USR 7.1.3.5.1) – **ID**



- Capable of assigning unique system-developed anonymous identifiers to data during archiving (USR 7.1.3.5.2) – **ID**
- Capable of performing pre-defined data mining functions to import data (USR 7.1.3.6) – **ID**
- Capable of performing pre-defined data fusion on imported data near real time (USR 7.1.3.7) – **ID**
- Capable of assigning meta attributes to operational data if data modification is required during the historical archive process (USR 7.1.3.8) – **ID**
- Capable of notifying source system owners of potential data or equipment errors (USR 7.1.3.9) – **ID**

*P-specs:* Manage Data Collection and Monitoring (1.1.1.4) – **E**  
 Manage Traffic Archive Data (1.1.4.7) – **E**  
 Exchange Data with Other Traffic Centers (1.1.5) – **E**  
 Determine Indicator State for Road Management (1.2.2.2) – **E**  
 Manage Parking Archive Data (1.2.5.5) – **O**  
 Maintain Traffic and Sensor Static Data (1.2.6.1) – **E**  
 Provide Static Data Store Output Interface (1.2.6.2) – **E**  
 Manage Transit Archive Data (4.2.4) – **O**  
 Manage Emergency Services Data (5.6) – **O**  
 Manage Traveler Info Archive Data (6.1.6) – **E**  
 Calculate Vehicle Probe Data for Guidance (6.6.2.6) – **O**  
 Get Archive Data (8.1) – **E**  
 Export Static Data (8.3) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Analyze Archive (8.6) – **E**  
 Manage Roadside Data Collection (8.9) – **E**

- The Archived Data function shall provide the Automatic Data Historical Archive (ADHA) function for permanently archiving the data (USR 7.1.4). The function shall:
  - Provide an archive schema for all data entering the archives (USR 7.1.4.1) – **ID**
  - Provide an archive schema to preclude the possibility of identifying or tracking either individual citizens or private firms (USR 7.1.4.1.1) – **ID**
  - Strip all identifiers of individual citizens or private firms from all data before archiving (USR 7.1.4.1.2) – **ID**
  - Be capable of assigning unique system-developed anonymous identifiers to data during archiving (USR 7.1.4.1.3) – **ID**
  - Manage historical data archiving processes for all functional (USR 7.1.4.2), format data to archive schema conformance (USR 7.1.4.2 (a)), maintain a centralized meta-schema to specify how data is archived (USR 7.1.4.2 (b)), maintain data quality meta-attributes (USR 7.1.4.2 (c)), schedule archiving of data (USR 7.1.4.2 (d)) – **ID**
  - Permanently store historical archives and only provide data replicates to users (USR 7.1.4.3) – **ID**
  - Be capable of supporting user-specified data archiving procedures (USR 7.1.4.4), when specified by a user, archive operational data as received in the user's storage files (USR 7.1.4.4 (a)), when specified archive edited data in the user's storage





files (USR 7.1.4.4 (b)), when specified by a user, perform pre-defined data fusion before archiving in user's storage files (USR 7.1.4.4 (c)) – **ID**

- Be capable of assigning meta attributes to data if data modification is required during the historical archive process (USR 7.1.4.5) – **ID**

*P-specs:* Get Archive Data (8.1) – **E**  
 Manage Archive (8.2) – **E**  
 Export Static Data (8.3) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Process on Demand Archive Requests (8.7) – **E**

- The Archived Data Function shall provide a Data Warehouse Distribution (DWD) function as the ITS data source to support the ITS community user functions (USR 7.1.5). The function shall:
  - Be capable of supporting generation of data products for users (USR 7.1.5.1), planning (USR 7.1.5.1 (a)), operations (USR 7.1.5.1 (b)), safety (USR 7.1.5.1 (c)), research (USR 7.1.5.1 (d)) – **ID**
  - Include a User Data Products (UDP) function (USR 7.1.5.2) – **ID**
  - Include an online analytical functionality to generate pre-defined data products for users (USR 7.1.5.2.1), reports (USR 7.1.5.2.1 (a)), analyses (USR 7.1.5.2.1 (b)), aggregations or summaries (USR 7.1.5.2.1 (c )), user defined archiving of data concepts (USR 7.1.5.2.1 (d)) – **ID**
  - Be capable of recreating data formats from the historical archives (USR 7.1.5.2.2) – **ID**
  - Be capable of providing user defined mining functions on data sources (USR 7.1.5.2.3) – **ID**
  - Be capable of performing user defined data fusion functions on data extracted from the archives (USR 7.1.5.2.4). – **ID**
  - Be capable of supporting the Federal data system with user-defined data products, when the necessary data is available (USR 7.1.5.2.5), Highway Performance Monitoring System (HPMS) (USR 7.1.5.2.5 (a)), Fatal Accident Reporting System (FARS) (USR 7.1.5.2.5 (d)) – **ID/FD**
  - Have the single point of administration for the archived data system (USR 7.1.5.3) – **ID**

*P-specs:* Manage Archive (8.2) – **E**  
 Manage Archive Data Administrator Interface (8.3) – **E**  
 Coordinate Archives (8.4) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Analyze Archive (8.6) – **E**  
 Prepare Government Reporting Inputs (8.8) – **O**



- The Archived Data Function shall provide users with an ITS Community Interface (ICI) including all ITS users for the specification and retrieval of data products (USR 7.1.6). The function shall:
  - Be the common data interface for all users to access the data archives (USR 7.1.6.1) – **ID**
  - Provide users' systems with the data interface functionality (USR 7.1.6.1.1) – **ID**
  - Manage user access and security across the interface (USR 7.1.6.2) – **ID**
  - Be capable of cleansing data to remove source privacy attributes before archiving data (USR 7.1.6.2.1) – **ID**
  - Be capable of cleansing data to remove source privacy attributes before exporting data to users (USR 7.1.6.2.2) – **ID**
  - Provide a user-interface functionality to existing data warehouse data schema for users to define their data products (USR 7.1.6.3) – **ID**
  - Permit users to select online analytical functions to produce their data products (USR 7.1.6.3.1) – **ID**
  - Permit users to select online analytical functions to produce their data products (7.1.6.3.2) – **ID**
  - Permit the user to view sample data products (USR 7.1.6.3.3) – **ID**
  - Provide the user interface (USR 7.1.6.4) – **ID**
  - Provide information for the following planning functions (USR 7.1.6.4.1), Metropolitan Planning Organizations (MPO) and state transportation planning (USR 7.1.6.4.1 (a)), transportation system monitoring (USR 7.1.6.4.1 (b)), air quality analysis (USR 7.1.6.4.1 (c)), transportation administration and policy analysis (USR 7.1.6.4.1 (f)) – **ID**
  - Provide for the following operations functions (USR 7.1.6.4.2), traffic management (USR 7.1.6.4.2 (a)), construction and maintenance (USR 7.1.6.4.2 (c )) – **ID**
  - Include the following safety agencies (USR 7.1.6.4.3), safety planning (USR 7.1.6.4.3 (a)), commercial vehicle operations (USR 7.1.6.4.3 (b)), emergency management (USR 7.1.6.4.3 (c )) – **ID**
  - Include research agencies (USR 7.1.6.4.4) – **ID**

*P-specs:* Get Archive Data (8.1) – **E**  
 Manage Archive (8.2) – **E**  
 Manage Archive Data Administrator Interface (8.3) – **E**  
 Coordinate Archives (8.4) – **E**  
 Process Archived Data User System Requests (8.5) – **E**  
 Analyze Archive (8.6) – **E**  
 Process on Demand Archive Requests (8.7) – **E**  
 Prepare Government Reporting Inputs (8.8) – **E**

### 3.3 Statewide Communications (Function 3)

The Statewide Communications function will be supported through the implementation of other User Services. Center-to-center communication links will be established for system operational control and for the exchange of data/information between the Statewide OC, DOCs, NSP Troop Area A Communications Center in Omaha, and the NSP Headquarters and STARC Centers in Lincoln. Establishment of communications links will facilitate the DOC secondary “after hours” operational control and aid overall statewide coordination between the NDOR Districts the Statewide OC. In addition, a statewide system of communications between the Statewide OC and partner agencies is critical for operational coordinated including response to incidents and special events and data collection and information sharing.

The implementation of four US will support the communications function. They include Pre-trip Travel Information (1.1), Travel Services Information (US 1.5), Traffic Control (US 1.6) and Incident Management (US 1.7).

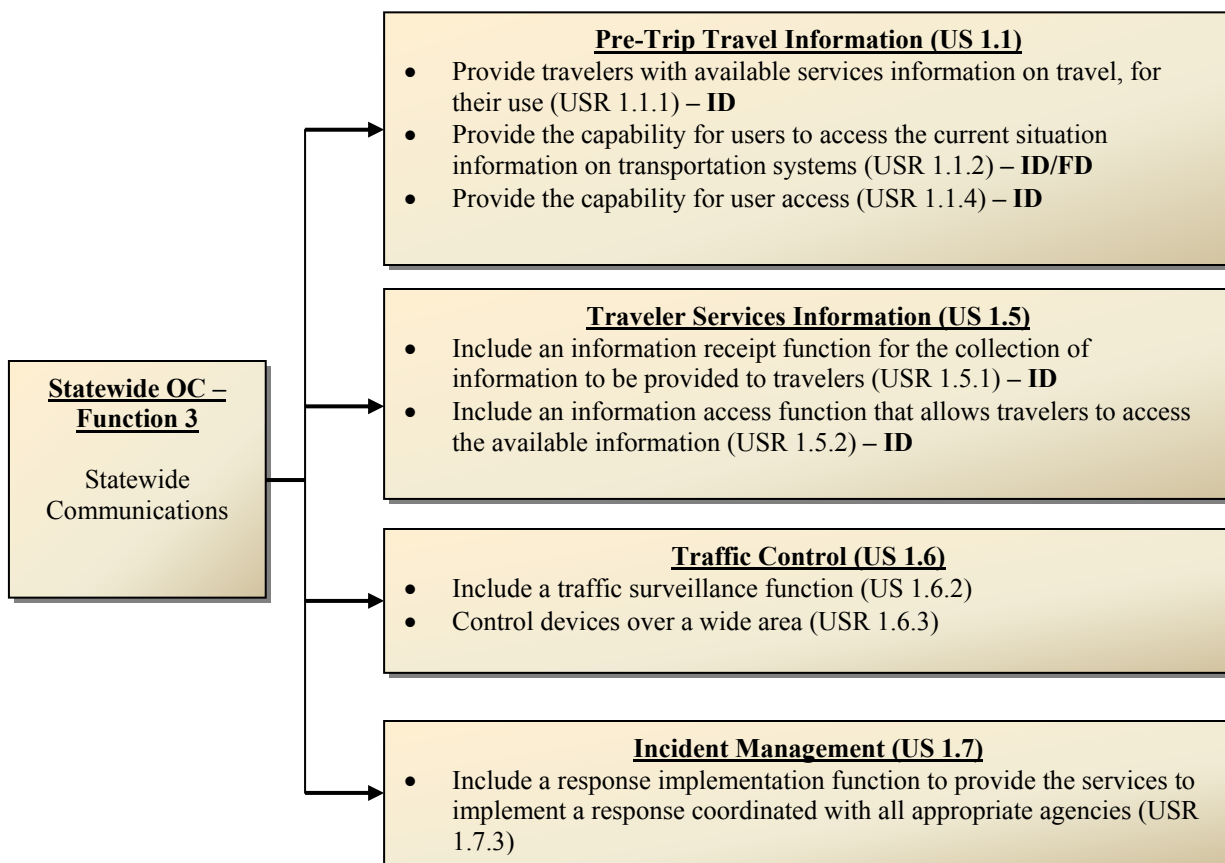


Figure 8 – Statewide OC Function 3 Schematic

### 3.3.1 Pre-Trip Travel Information (US 1.1)

Pre-Trip Travel Information shall support statewide communications through the following:

- Provide travelers with access to available services information on travel, for their use (USR 1.1.1.) – **ID**

*P-specs:* Inform Traveler (6.3.2) – **E**

- Provide the capability for users to access the current situation information on transportation systems (USR 1.1.2.) – **ID**

*P-specs:* Provide Media System Traffic Data Interface (1.1.4.5) – **O**  
Collect and Update Traveler Information (6.5.1) – **E**

- Provide the capability for user access (USR 1.1.4). The function shall:
  - Provide the capability for users to access the system from multiple distributed locations(USR 1.1.4.1.), including homes (USR 1.1.4.1.1), work places (USR 1.1.4.1.2), major trip generation sites (USR 1.1.4.1.3), personal portable devices (USR 1.1.4.1.4) – **ID**
  - Provide the capability for users to access the system over multiple types of electronic media (USR 1.1.4.2.) – **ID**

*P-specs:* Provide Traffic Data Retrieval Interface (1.1.4.6) – **E**  
Update Traveler Display Map Data at Kiosk (6.3.4) – **O**  
Provide Traveler Personal Interface (6.8.3.3) – **O**

### 3.3.2 Traveler Services Information (US 1.5)

Traveler Services Information shall support statewide communications through the following functions:

- Include an information receipt function for the collection of information to be provided to travelers (USR 1.5.1). The function shall:
  - Information Receipt provides the capability to acquire current information relating to traveler services available in the local area. (USR 1.5.1.2) – **ID**

*P-specs:* Provide Traffic Broadcast Messages (6.2.1.4) – **E**

- Include an information access function that allows travelers to access available information (USR 1.5.2.). The function shall:
  - Provide the capability for centers to request and receive information about the location of facilities (USR 1.5.2.2) to include but, not be limited to, parking information (USR 1.5.2.2 (c )), and daily or special events information (USR 1.5.2.2 (f)) – **ID**
  - Provide the capability for access the information (USR 1.5.2.5) via any of, but not limited to highway advisory radio (USR 1.5.2.5 (a)), dial-up telephone lines (USR 1.5.2.5 (b)), computers at home (USR 1.5.2.5 (c)), computers in the office (USR

1.5.2.5 (d)), public area kiosks (USR 1.5.2.5 (f)), and personal portable devices (USR 1.5.2.5 (g).) – **ID**

*P-specs:* Output Roadway Information Data (1.2.4.4) – **E**  
 Device Interface to Other Roadway Devices (1.2.7.8) – **E**  
 Process Roadway Information Data (1.2.7.9) – **E**  
 Collect Traffic Data for Advisory Messages (6.2.1.1) – **E**  
 Provide Traffic Advisory Messages (6.2.1.2) – **O**  
 Provide Traffic Broadcast Messages (6.2.1.4) – **E**  
 Collect Yellow Pages Data (6.2.4) – **O**  
 Provide Yellow Pages Data (6.2.6) – **O**  
 Provide Traveler Kiosk Interface (6.3.3) – **O**  
 Update Traveler Display Map Data at Kiosk (6.3.4) – **O**  
 Collect and Update Traveler Information (6.5.1) – **E**  
 Provide Traveler Event Information (6.5.4) – **O**

### 3.3.3 Traffic Control (US 1.6)

Traffic Control shall support statewide communications through the following functions:

- The traffic control shall have a traffic surveillance function (USR 1.6.2). The function shall:
  - Include a wide-area surveillance capability to include several jurisdictions (USR 1.6.2.3) – **FD**

*P-specs:* Process Traffic Sensor Data (1.1.1.1) – **E**  
 Process Traffic Data (1.1.2.1) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**

- The control function shall control devices over a wide area (USR 1.6.3). The function shall:
  - Control over multiple jurisdictions (USR 1.6.3.2) – **ID**

*P-specs:* Retrieve Traffic Data (1.1.4.1) – **E**  
 Provide Traffic Operations Personnel Traffic Data Interface (1.1.4.2) – **E**  
 Update Traffic Display Map Data (1.1.4.4) – **E**  
 Provide Traffic Data Retrieval Interface (1.1.4.6) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**  
 Determine Indicator State for Road Management (1.2.2.2) – **E**  
 Output Control Data for Roads (1.2.4.1) – **E**  
 Output Control Data for Freeways (1.2.4.2) – **E**  
 Output Roadway Information Data (1.2.4.4) – **E**  
 Provide Device Interface to Other Roadway Devices (1.2.7.8) – **E**  
 Process Roadway Information Data (1.2.7.9) – **E**

### 3.3.4 Incident Management (US 1.7)

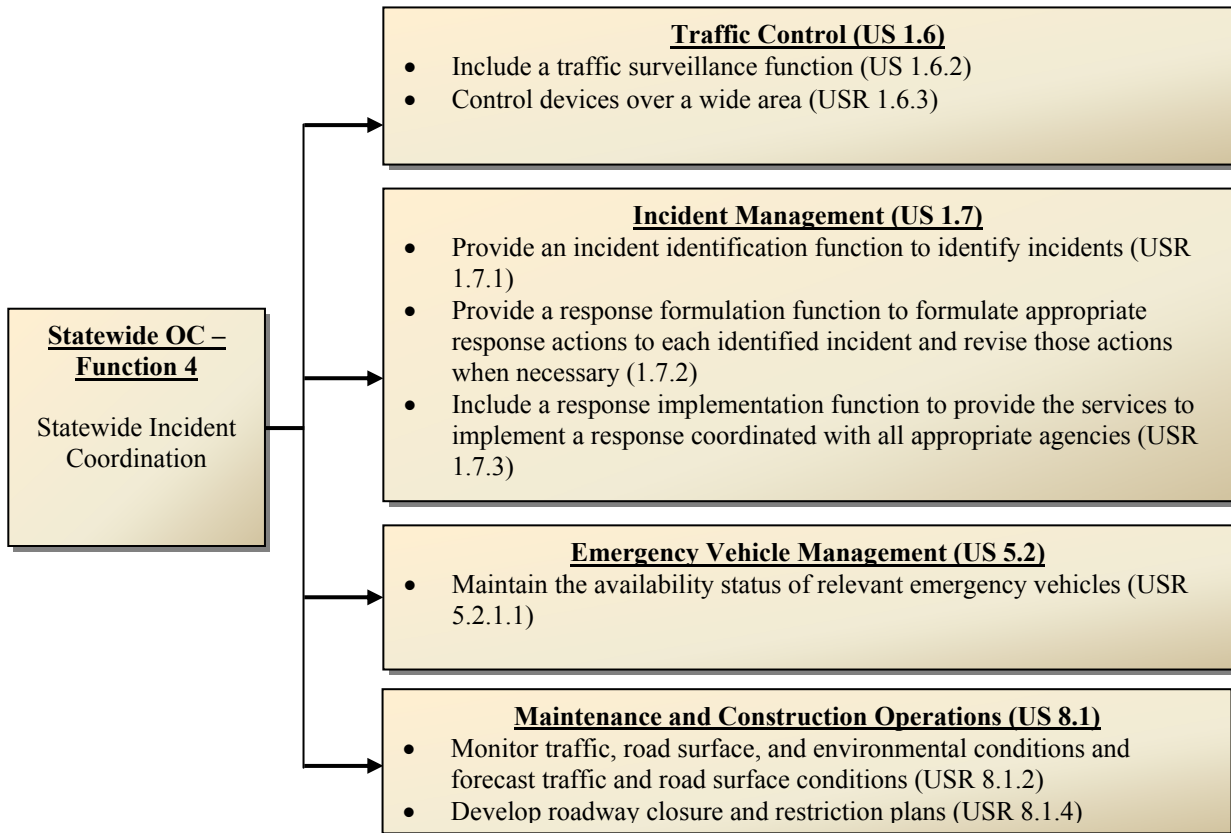
The statewide communications function shall be supported through the Incident Management US by the following:

- Include a response implementation function to provide the services to implement a response coordinated with all appropriate agencies (USR 1.7.3.). The function shall:
  - Provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions (USR 1.7.3.1) – **ID**
  - Allow coordinated selection/determination of the procedures, including alternate routes, needed for resolution of each incident and provide the procedures to those agencies responding to the incident. (USR 1.7.3.1 a) – **ID**
  - Provide the status of all resources needed for incident resolution to those agencies responding to the incident. (USR 1.7.3.1 b) – **ID**
  - Provide a link between Incident Management and all other user services necessary to implement incident response actions. (USR 1.7.3.2) – **ID**
  - Provide the capability to disseminate information relating to response status to other agencies and user services. (USR 1.7.3.3) – **ID**

*P-specs:* Provide Direct Media Traffic Data Interface (1.1.4.3) – **O**  
Respond to Current Incidents (1.3.3) – **E**  
Provide Traffic Operations Personnel Incident Data Interface  
(1.3.4.2) – **E**  
Manage Resources for Incidents (1.3.4.5) – **E**

### 3.4 Statewide Incident Coordination (Function 4)

The following functions are necessary to support and coordinate incident, event and emergency response measures statewide. Four US have been identified to support this function including Traffic Control (US 1.6), Incident Management (US 1.7), Emergency Vehicle Management (US 5.2) and Maintenance and Construction Operations (US 8.1).



**Figure 9 – Statewide OC Function 4 Schematic**

#### 3.4.1 Traffic Control (US 1.6)

Traffic Control US shall support Incident Coordination through the following USRs:

- The traffic control shall have a traffic surveillance function (USR 1.6.2). The function shall:
  - Include a vehicle detection function with the capability of accurately detecting vehicles in a real-time fashion (USR 1.6.2.1) – ID
  - Shall include a wide-area surveillance capability to include several jurisdictions (USR 1.6.2.3) – FD





- The wide-area surveillance shall gather speed and flow information (USR 1.6.2.3.1) – **ID**
- The wide area surveillance shall acquire sufficient data to provide the system with the knowledge of the existing conditions (USR 1.6.2.5) – **FD**

*P-specs:* Process Traffic Sensor Data (1.1.1.1) – **E**  
 Process Traffic Data (1.1.2.1) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**

- The control function shall control devices over a wide area (USR 1.6.3). The function shall:
  - Control over multiple jurisdictions (USR 1.6.3.2) – **FD**
  - Communicate control data (USR 1.6.3.4), information signs (USR 1.6.3.4 (c )), and human operator support (USR 1.6.3.4 (e)) – **ID**
  - Provide the operator with the capability to manually override the system's automatic controls (USR 1.6.3.5) – **ID**
  - Provide the operator the capability to adaptively change system response in order to provide a response that is coordinated with other TMCs responding to incidents (USR 1.6.3.6) – **ID**

*P-specs:* Retrieve Traffic Data (1.1.4.1) – **E**  
 Provide Traffic Operations Personnel Traffic Data Interface (1.1.4.2) – **E**  
 Update Traffic Display Map Data (1.1.4.4) – **E**  
 Provide Traffic Data Retrieval Interface (1.1.4.6) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**  
 Select Strategy (1.2.1) – **E**  
 Determine Indicator State for Freeway Management (1.2.2.1) – **E**  
 Determine Indicator State for Road Management (1.2.2.2) – **E**  
 Output Control Data for Roads (1.2.4.1) – **E**  
 Output Control Data for Freeways (1.2.4.2) – **E**  
 Output Roadway Information Data (1.2.4.4) – **E**  
 Process Indicator Output Data for Roads (1.2.7.1) – **E**  
 Process Indicator Output Data for Freeways (1.2.7.5) – **E**  
 Provide Device Interface to Other Roadway Devices (1.2.7.8) – **E**  
 Process Roadway Information Data (1.2.7.9) – **E**  
 Dispatch Vehicle (5.3.2) – **E**  
 Provide Emergency Vehicle Route (5.3.7) – **O**

### 3.4.2 Incident Management (US 1.7)

Incident Management shall support Incident Management through the following functions:

- Provide an incident identification function to identify incidents (USR 1.7.1). The function shall:
  - Include the capability to identify existing (both planned and unplanned) incidents (USR 1.7.1.2) – **ID**





- Use information from the following types of sources to identify existing incidents (USR 1.7.1.2.1), traffic flow sensors (USR 1.7.1.2.1 (a), environmental sensors (USR 1.7.1.2.1 (b), public safety sources (USR 1.7.1.2.1 (c), media sources (USR 1.7.1.2.1 (d), weather information sources (USR 1.7.1.2.1 (e), transportation providers (USR 1.7.1.2.1 (f), travelers (USR 1.7.1.2.1 (g) – **ID**

*P-specs:* Process Traffic Sensor Data (1.1.1.1) – **E**  
 Process Environmental Sensor Data (1.1.1.3) – **E**  
 Provide Sensor Interface to Other Roadway Devices (1.1.1.5) – **E**  
 Process Traffic Data (1.1.2.2) – **E**  
 Analyze Traffic Data for Incidents (1.3.1.1) – **E**  
 Maintain Static Data for Incident Management (1.3.1.2) – **E**  
 Process Traffic Images (1.3.1.3) – **E**  
 Review and Classify Possible Incidents (1.3.2.2) – **E**  
 Review and Classify Planned Events (1.3.2.3) – **E**  
 Respond to Current Incidents (1.3.3) – **E**  
 Retrieve Incident Data (1.3.4.1) – **E**  
 Provide Media Incident Data Interface (1.3.4.3) – **E**  
 Manage Resources for Incidents (1.3.4.5) – **E**  
 Collect and Update Traveler Information (6.5.1) – **E**

- Provide a response formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary (USR 1.7.2.). The function shall:
  - Assist and facilitate the appropriate scheduling of those predicted incidents that can be scheduled to minimize incident potential, incident impacts, and/or the resources required for incident management (USR 1.7.2.1) – **ID**
  - Propose and facilitate the appropriate dispatch of emergency response vehicles to an incident (USR 1.7.2.2) – **ID**
  - Propose and facilitate the appropriate dispatch of service vehicles to an incident (USR 1.7.2.3) – **ID**
  - Propose and facilitate the appropriate dissemination of incident related information to travelers and potential travelers (USR 1.7.2.4) – **FD**

*P-specs:* Store Possible Incident Data (1.3.2.1) – **E**  
 Respond to Current Incidents (1.3.3) – **E**  
 Provide Traffic Operations Personnel Incident Data Interface (1.3.4.2) – **E**

- Include a response implementation function to provide the services to implement a response coordinated with all appropriate agencies (USR 1.7.3.). The function shall:
  - Provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions (USR 1.7.3.1):
    - Coordinated selection/determination of the procedures, including alternate routes, needed for resolution of each incident and provide the procedures to those agencies responding to the incident. (USR 1.7.3.1 (a)) – **ID**

- Provide the status of all resources needed for incident resolution to those agencies responding to the incident. (USR 1.7.3.1 (b)) – **ID**
- Provide a link between Incident Management and all other user services necessary to implement incident response actions. (USR 1.7.3.2) – **ID**
- Provide the capability to disseminate information relating to response status to other agencies and user services. (USR 1.7.3.3) – **ID**

*P-specs:* Provide Direct Media Traffic Data Interface (1.1.4.3) – **O**  
 Respond to Current Incidents (1.3.3) – **E**  
 Provide Traffic Operations Personnel Incident Data Interface (1.3.4.2) – **E**  
 Manage Resources for Incidents (1.3.4.5) – **E**

### 3.4.3 *Emergency Vehicle Management (US 5.2)*

The Emergency Vehicle Management user service shall support the Incident Management through the following functions:

- Emergency Vehicle Management System shall maintain the availability status of relevant emergency vehicles (USR 5.2.1.1) – **FD**

*P-specs:* Manage Emergency Response (5.1.4) – **E**  
 Track Vehicle (5.3.3) – **E**  
 Maintain Vehicle Status (5.3.6) – **E**

### 3.4.4 *Maintenance and Construction Operations (US 8.1)*

Maintenance and Construction Operations shall support Incident Management through the following functions:

- Roadway Management (RWM) function will monitor traffic, road surface, and environmental conditions and forecast traffic and road surface conditions (USR 8.1.2). The function shall:
  - Support a number of different services (USR 8.1.2.1), winter maintenance (plowing, treating, anti-icing, de-icing, etc.) (USR 8.1.2.1(a)), hazard removal (removing trash, animals, etc.) (USR 8.1.2.1(b)), emergency activities (incident response, planning, alternate routing, etc.) (USR 8.1.2.1(c)), routine maintenance activities (cleaning, cutting, etc.) (USR 8.1.2.1 (d)), other weather related activities (USR 8.1.2.1 (f)) – **FD**

*P-specs:* Collect Infrastructure Sensor Data (1.1.1.6) – **E**  
 Collect Indicator Fault Data (1.2.8.1) – **O**  
 Provide Device Fault Interface for M and C (1.2.8.3) – **O**  
 Manage Resources for Incidents (1.3.4.5) – **E**  
 Status Current M&C Activities (9.2.2) – **O**  
 Manage M&C Resource Needs (9.2.3.4) – **E**  
 Collect Roadside Equipment Status (9.2.3.5) – **E**  
 Operate Infrastructure Monitoring Devices (9.2.6.3) – **E**

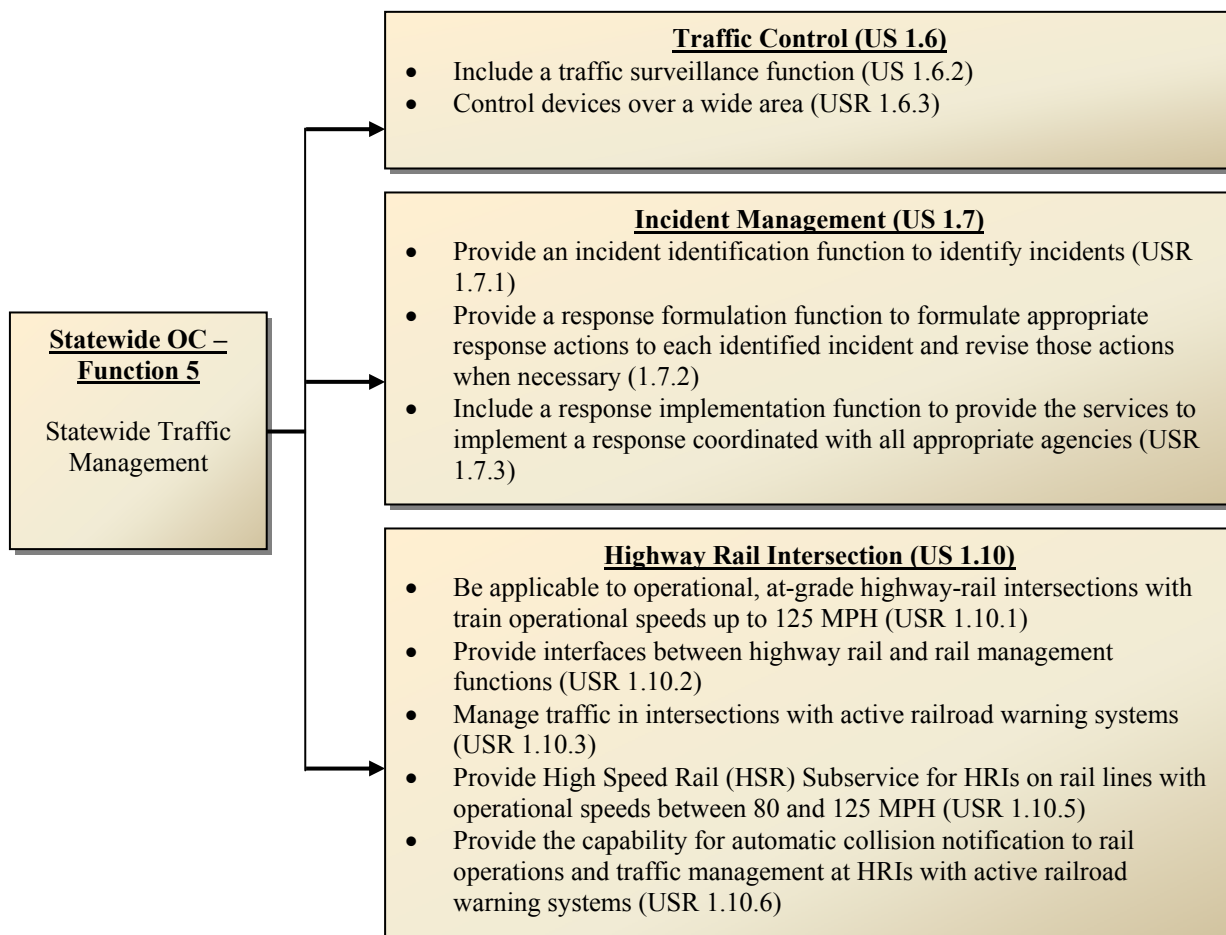


- Develop roadway closure and restriction plans that respond to planned and un-planned incidents. Provide intra- and inter-agency coordination of incidents. These plans would be similar to construction and maintenance plans. This function includes interactions among Traffic Managers, Supervisors, Planning Agencies, Public Safety Organizations, and Information Service Providers. (USR 8.1.4). The function shall:
    - Coordinate information on planned and up-planned closures and restrictions such as inclement weather responses, so that routing, scheduling, and resource allocation can be accomplished (USR 8.1.4.1) – **ID**
    - Support inter-agency coordination of response and scheduling of resources for significant events with broad impact, like natural disasters, major incidents, and large planned or seasonal events (USR 8.1.4.2) – **FD**
    - Coordinate information with other transportation agencies (USR 8.1.4.3), including but not limited to public safety (USR 8.1.4.3 (a)), emergency medical management (USR 8.1.4.3 (b)), transit (USR 8.1.4.3 (c)), traffic management (USR 8.1.4.3 (d)), railroads (USR 8.1.4.3 (e)), airports (USR 8.1.4.3 (f)), and information service providers (USR 8.1.4.3 (g)) – **FD**
- P-specs:* Determine Coordinated Response Plan (5.1.2) – **E**  
 Manage Emergency Response (5.1.4) – **E**  
 Schedule M&C Activities (9.2.1) – **E**  
 Status Current M&C Activities (9.2.2) – **O**  
 Manage M&C Resource Needs (9.2.3.4) – **E**

### 3.5 Statewide Traffic Management (Function 5)

The Statewide OC will perform several key traffic management functions. The operations center will manage District 2 ITS Systems and provide secondary control of the statewide ITS systems. The secondary and/or “after hours” management of statewide systems will benefit overall roadway safety and dissemination of motorist information essential during incidents and/or special events. During the “after hours” operation the Statewide OC will maintain primary control of the DOC ITS systems. The Statewide OC responsibilities will also provide coordination for interregional/statewide traffic operations. The centers coordination function would be “top-level” providing assistance rather than direction.

Three US have been identified to support this function and include Traffic Control (US 1.6), Incident Management (US 1.7) and Highway Rail Intersection (US 1.10).



**Figure 10 – Statewide OC Function 5 Schematic**

### 3.5.1 Traffic Control (US 1.6)

The Traffic Control function shall include the following:

- Include a traffic surveillance function (USR 1.6.2.). The function shall:
  - Include a vehicle detection function with the capability of accurately detecting vehicles in a real-time fashion (USR 1.6.2.1) – **ID**
  - Include a data collect function to provide the capability to collect data for determining traffic flow and prediction (USR 1.6.2.2) – **ID**
  - Include a wide-area surveillance capability to include several jurisdictions (USR 1.6.2.3) – **ID**
  - Provide surveillance to gather speed and flow information (USR 1.6.2.3.1) – **ID**
  - Provide surveillance to cover a large number of roadway segments (USR 1.6.2.3.2) – **ID**
  - Provide the capability to acquire detailed traffic measures at specific locations (USR 1.6.2.4) – **ID**
  - Acquire sufficient data to provide the system with the knowledge of the existing conditions (USR 1.6.2.5) – **ID**

*P-specs:* Process Traffic Sensor Data (1.1.1.1) – **E**  
 Process Traffic Data for Storage (1.1.2.1) – **E**  
 Process Traffic Data (1.1.2.2) – **E**  
 Update Data Source Static Data (1.1.2.3) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**  
 Output Control Data for Roads (1.2.4.1) – **E**  
 Output Control Data for Freeways (1.2.4.2) – **E**

- Include a device control function (USR 1.6.3.). The function shall:
  - Include a “real-time” traffic-adaptive control capability (USR 1.6.3.1) – **FD**
  - Be an area wide control to include several jurisdictions (USR 1.6.3.2) – **FD**
  - Provide the capability to exercise control over those devices utilized for traffic control (USR 1.6.3.3) – **FD**
  - Have the capability to dynamically control traffic signing (USR 1.6.3.3.2) – **ID**
  - Communicate control data (USR 1.6.3.4) to traffic signals (USR 1.6.3.4 (a)) – **FD**
  - Communicate control data (USR 1.6.3.4) to information signs (USR 1.6.3.4 (c )), and human operator support (USR 1.6.3.4 (e)) – **ID**
  - Surveillance shall include a data process function to process the traffic data which are acquired (USR 1.6.3.4.1) – **ID**
  - Provide the operator with the capability to manually override the system’s automatic controls (USR 1.6.3.5) – **ID**

- Provide the operator the capability to adaptively change system response in order to provide a response that is coordinated with other TMCs responding to incidents (USR 1.6.3.6) – **FD**

*P-specs:* Retrieve Traffic Data (1.1.4.1) – **E**  
 Provide Traffic Operations Personnel Traffic Data Interface (1.1.4.2) – **E**  
 Update Traffic Display Map Data (1.1.4.4) – **E**  
 Provide Traffic Data Retrieval Interface (1.1.4.6) – **E**  
 Exchange data with Other Traffic Centers (1.1.5) – **E**  
 Select Strategy (1.2.1) – **E**  
 Determine Indicator State for Freeway Management (1.2.2.1) – **E**  
 Determine Indicator State for Road Management (1.2.2.2) – **E**  
 Output Control Data for Roads (1.2.4.1) – **E**  
 Output Control Data for Freeways (1.2.4.2) – **E**  
 Output Roadway Information Data (1.2.4.4) – **E**  
 Process Indicator Output Data for Roads (1.2.7.1) – **E**  
 Process Indicator Output Data for Freeways (1.2.7.5) – **E**  
 Provide Device Interface to Other Roadway Devices (1.2.7.8) – **E**  
 Process Roadway Information Data (1.2.7.9) – **E**  
 Dispatch Vehicle (5.3.2) – **E**  
 Provide Emergency Vehicle Route (5.3.7) – **O**

### 3.5.2 Incident Management (US 1.7)

Incident Management function shall include the following:

- Provide an incident identification function to identify incidents (USR 1.7.1). The function shall:
  - Include the capability to identify existing (both planned and unplanned) incidents (USR 1.7.1.2) – **ID**

*P-specs:* Process Traffic Sensor Data (1.1.1.1) – **E**  
 Process Environmental Sensor Data (1.1.1.3) – **E**  
 Provide Sensor Interface to Other Roadway Devices (1.1.1.5) – **E**  
 Process Traffic Data (1.1.2.2) – **E**  
 Analyze Traffic Data for Incidents (1.3.1.1) – **E**  
 Maintain Static Data for Incident Management (1.3.1.2) – **E**  
 Process Traffic Images (1.3.1.3) – **E**  
 Respond to Current Incidents (1.3.3) – **E**  
 Retrieve Incident Data (1.3.4.1) – **E**  
 Provide Media Incident Data Interface (1.3.4.3) – **E**  
 Manage Resources for Incidents (1.3.4.5) – **E**  
 Provide Trip Planning Information to Traveler (6.1.1) – **O**  
 Collect and Update Traveler Information (6.5.1) – **E**

- Provide a response formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary (USR 1.7.2.). The function shall:

- Propose and facilitate the appropriate dissemination of incident related information to travelers and potential travelers (USR 1.7.2.4) – **FD**

*P-specs:* Respond to Current Incidents (1.3.3) – **E**  
Provide Traffic Operations Personnel Incident Data Interface (1.3.4.2) – **E**

- Include a response implementation function to provide the services to implement a response coordinated with all appropriate agencies (USR 1.7.3). The function shall:

- Provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions (USR 1.7.3.1):

- Coordinated selection/determination of the procedures, including alternate routes, needed for resolution of each incident and provide the procedures to those agencies responding to the incident. (USR 1.7.3.1 (a)) – **ID**
    - Provide a link between Incident Management and all other user services necessary to implement incident response actions. (USR 1.7.3.2) – **ID**
    - Provide the capability to disseminate information relating to response status to other agencies and user services. (USR 1.7.3.3) – **ID**

*P-specs:* Provide Direct Media Traffic Data Interface (1.1.4.3) – **O**  
Respond to Current Incidents (1.3.3) – **E**  
Provide Traffic Operations Personnel Incident Data Interface (1.3.4.2) – **E**  
Manage Resources for Incidents (1.3.4.5) – **E**

### 3.5.3 Highway Rail Intersection (US 1.10)

Depending on the availability of supporting technology in the marketplace and the implementation costs associated with that technology, the Highway-Rail Intersection (HRI) function shall control highway and rail traffic at-grade crossings. The implementation of many of these functions will also be dependent on the close cooperation and joint participation of the railroad owners and operators in the projects that design and/or implement these functions.

- The HRI function shall be applicable to operational, at-grade highway-rail intersections with train operational speeds up to 125 MPH (USR 1.10.1). The function shall:

- Include freight and intercity passenger trains approaching and crossing (USR 1.10.1.3) – **FD**
  - Include highway vehicles approaching and crossing (USR 1.10.1.4) – **FD**
  - Include motor vehicle operators, bicyclists and pedestrians approaching and crossing (USR 1.10.1.5) – **FD**
  - Include rail maintenance and inspection vehicles approaching and crossing (USR 1.10.1.7) – **FD**



*P-specs:* Detect Roadway Events (1.6.1.1) – **E**  
 Control HRI Traffic Signals (1.6.1.2.1) – **E**  
 Generate Alerts and Advisories (1.6.1.4.1) – **E**  
 Close HRI on Detection (1.6.1.6.1) – **E**  
 Interact with Wayside Systems (1.6.3.1) – **E**  
 Provide ATS Alerts (1.6.3.3) – **E**

- HRI shall provide interfaces between highway and rail management functions (USR 1.10.2). The function shall:
  - Provide information management interfaces between highway and rail to coordinate traffic, demand and schedules (USR 1.10.2.1) – **FD**
  - Be capable of interacting with traffic management functions (USR 1.10.2.1.2) – **FD**
  - Provide the capability to interface with traffic management functions for highway traffic coordination (USR 1.10.2.2.2) – **FD**
  - Provide the capability to interface with trains approaching and crossing the HRI for traffic coordination (USR 1.10.2.2.3) – **FD**

*P-specs:* Detect Roadway Events (1.6.1.1) – **E**  
 Provide Closure Parameters (1.6.1.4.2) – **E**  
 Exchange Data with Rail Operations (1.6.2.1) – **E**  
 Manage Alerts and Advisories (1.6.2.2) – **E**  
 Interact with Wayside Systems (1.6.3.1) – **E**  
 Manage HRI Closures (1.6.4.1) – **O**  
 Exchange Data with Traffic Management (1.6.4.2) – **E**  
 Provide Interactive Interface (1.6.5.1) – **E**  
 Maintain HRI Closure Data (1.6.5.3) – **E**

- HRI shall manage traffic in intersections with active railroad warning systems (USR 1.10.3). The function shall:
  - HRI shall be capable of augmenting the intersection with standard highway traffic signal devices (USR 1.10.3.1) – **FD**
  - HRI shall include an automated collision avoidance function for highway vehicles approaching crossings (USR 1.10.3.2) – **FD**
  - HRI shall provide an Intelligent Intersection Controller (IIC) function to manage highway and rail traffic in the intersection (USR 1.10.3.3) – **FD**
  - IIC shall control active highway traffic signal devices and manage highway traffic (USR 1.10.3.3.1) – **FD**
  - IIC function shall control active railway warning devices, including flashing lights and physical barriers for highway and walkway lanes (USR 1.10.3.3.2) – **FD**
  - IIC function shall provide an intersection surveillance system to derive the real-time status of traffic in the intersection (USR 1.10.3.3.3) – **FD**
  - IIC function shall report real-time HRI equipment status (USR 1.10.3.3.4) – **FD**





- IIC function shall report real-time HRI traffic status as advisories or alerts (USR 1.10.3.3.5) – **FD**

*P-specs:* Output Control Data for Roads (1.2.4.1) – **E**  
Process Indicator Output Data for Roads (1.2.7.1) – **E**  
Detect Roadway Events (1.6.1.1) – **E**  
Control HRI Traffic Signals (1.6.1.2.1) – **E**  
Control HRI Warnings and Barriers (1.6.1.2.2) – **E**  
Perform Equipment Self-Test (1.6.1.3) – **E**  
Report Alerts and Advisories (1.6.1.4.3) – **E**  
Detect HRI Hazards (1.6.1.5) – **E**  
Detect Imminent Vehicle/Train Collision (1.6.1.6.2) – **E**  
Control Traffic Volume at Active HRI (1.6.1.7.1) – **E**  
Provide ATS Alerts (1.6.3.3) – **E**  
Determine HRI Status (1.6.5.2) – **E**

- HRI shall provide a High Speed Rail (HSR) Subservice for HRIs on rail lines with operational speeds between 80 and 125 MPH (USR 1.10.5). The function shall:
  - Include active roadside message devices to provide highway closure information at HSR HRIs (USR 1.10.5.1) – **FD**
  - Provide special safety features to enhance safety (USR 1.10.5.2) – **FD**

*P-specs:* Output Control Data for Roads (1.2.4.1) – **E**  
Process Indicator Output Data for Roads (1.2.7.1) – **E**  
Provide HSR Device Controls (1.6.1.2.4) – **E**  
Report HRI Status on Approach (1.6.1.4.4) – **E**  
Close HRI on Detection (1.6.1.6.1) – **E**  
Close HRI on Command (1.6.1.7.2) – **E**  
Manage Alerts and Advisories (1.6.2.2) – **E**  
Provide ATS Alerts (1.6.3.3) – **E**

- At HRIs with active railroad warning systems, HRI shall provide the capability for automatic collision notification to rail operations and traffic management (USR 1.10.6) – **FD**

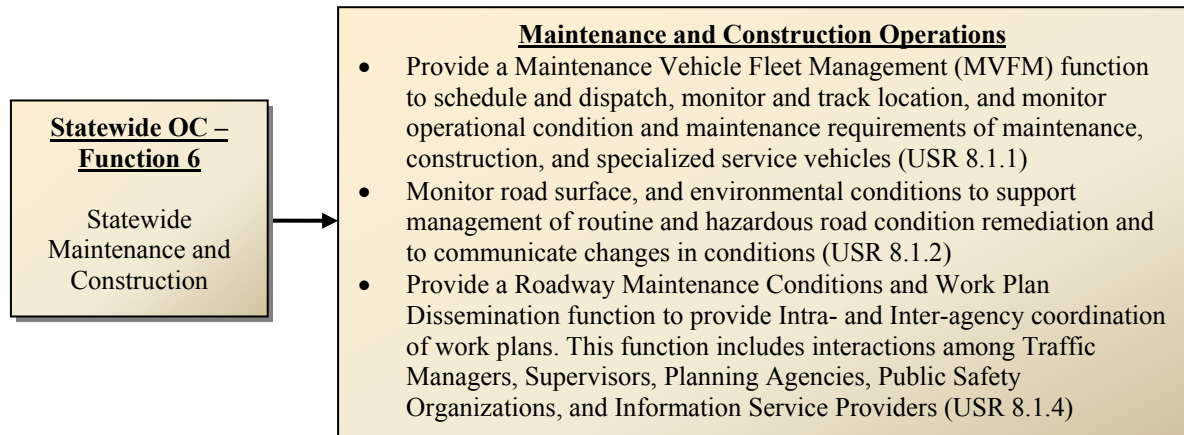
*P-specs:* Detect HRI Hazards (1.6.1.5) – **E**

### 3.6 Statewide Maintenance and Construction (Function 6)

The Statewide OC shall support the Maintenance and Construction Operations (US 8.1) functions. The Maintenance and Construction Operations (MCO) functions support monitoring, operating, maintaining, improving, and managing the physical condition of roadways, the associated infrastructure equipment, and the required resources. The MCO utilizes ITS systems and processes to support interchange of information among diverse groups of users improving efficiency and effectiveness of operational, maintenance, and managerial activities. The MCO consists of four major functions:

- The Maintenance Vehicle Fleet Management function monitors and tracks locations and conditions of fleets of maintenance, construction, and specialized service vehicles;
- The Roadway Management function monitors and forecast conditions and manage treatment of roadways during various travel conditions;
- The Work Zone Management and Safety function supports effective and efficient roadway operations during work zone activities, included in statewide function 1; and
- The Roadway Maintenance Conditions and Work Plan Dissemination function coordinates work plans and communicates conditions.

Depending on the availability of supporting technology in the marketplace and the implementation costs associated with it, the Maintenance and Construction Operations function could include the following elements.



**Figure 11 – Statewide OC Function 6 Schematic**

- Maintenance and Construction Operations shall provide a Maintenance Vehicle Fleet Management (MVFM) function to schedule and dispatch, monitor and track location, and monitor operational condition and maintenance requirements of maintenance, construction, and specialized service vehicles. (USR 8.1.1). The function shall be:
  - Capable of monitoring and tracking the locations of fleets of maintenance, construction, and specialized service vehicles to provide current location information (USR 8.1.1.1.1) – **FD**

- Capable of using on-board vehicle sensors to monitor roadway conditions (USR 8.1.1.5) – **FD**

*P-specs:* Process Vehicle On-board Data (3.1.3) – **E**  
Track Vehicle (5.3.3) – **E**  
Maintain Vehicle Status (5.3.6) – **O**  
Collect Environmental Data (5.3.8) – **E**  
Collect Environmental Probe Data (6.2.1.6) – **E**  
Process Vehicle Location Data (6.7.2.2) – **E**  
Track M&C Vehicles and Equipment (9.1.3) – **E**  
Manage M&C Map Data (9.2.4) – **O**

- The Roadway Management (RWM) function shall monitor road surface, and environmental conditions to support management of routine and hazardous road condition remediation and to communicate changes in conditions (USR 8.1.2). The function shall:
  - Support a number of different services (USR 8.1.2.1), winter maintenance (plowing, treating, anti-icing, de-icing, etc.) (USR 8.1.2.1(a)), hazard removal (removing trash, animals, etc.) (USR 8.1.2.1(b)), emergency activities (incident response, planning, alternate routing, etc.) (USR 8.1.2.1(c)), routine maintenance activities (cleaning, cutting, etc.) (USR 8.1.2.1 (d)), other weather related activities (USR 8.1.2.1 (f)) – **FD**
  - Support provision of efficient and effective roadway operations during normal and severe weather or adverse travel conditions (USR 8.1.2.2) – **FD**
  - Monitor, manage, and control remotely located, automated systems, that affect the roadway surface (e.g. de-icing/anti-icing applications) (USR 8.1.2.9) – **ID**
  - Archive data for use in performance monitoring activities (USR 8.1.2.10) – **ID**

*P-specs:* Process Environmental Sensor Data (1.1.1.3) – **E**  
Provide Sensor Interface to Other Roadway Devices (1.1.1.5) – **E**  
Collect Infrastructure Sensor Data (1.1.1.6) – **E**  
Collect Indicator Fault Data (1.2.8.1) – **O**  
Provide Device Fault Interface for M and C (1.2.8.3) – **O**  
Manage Resources for Incidents (1.3.4.5) – **E**  
Manage M&C Systems On-Board (9.1.1) – **E**  
Status Current M&C Activities (9.2.2) – **O**  
Manage M&C Resource Needs (9.2.3.4) – **E**  
Collect Roadside Equipment Status (9.2.3.5) – **E**  
Operate Roadway Automated Treatment System (9.2.6.1) – **E**  
Control Roadway Automated Treatment System (9.2.6.2) – **E** Operate  
Infrastructure Monitoring Devices (9.2.6.3) – **E**  
Manage M&C Archive Data (9.2.7) – **E**

- Provide a Roadway Maintenance Conditions and Work Plan Dissemination function to provide Intra- and Inter-agency coordination of work plans. This function includes interactions among Traffic Managers, Supervisors, Planning Agencies, Public Safety Organizations, and Information Service Providers (USR 8.1.4). The function shall:
  - Coordinate information on planned maintenance and construction activities, including work zone information, and unplanned remediation activities, such as inclement weather responses, so that routing, scheduling, and resource allocation can be accomplished (USR 8.1.4.1) – **ID**
  - Support inter-agency coordination of response and scheduling of resources for significant events with broad impact, like natural disasters, major incidents, and large planned or seasonal events (USR 8.1.4.2) – **ID**
  - Coordinate information with other transportation agencies (USR 8.1.4.3), including but not limited to public safety (USR 8.1.4.3 (a)), emergency medical management (USR 8.1.4.3 (b)), transit (USR 8.1.4.3 (c )), traffic management (USR 8.1.4.3 (d)), railroads (USR 8.1.4.3 (e)), airports (USR 8.1.4.3 (f)), and information service providers (USR 8.1.4.3 (g).) – **ID**

*P-specs:* Determine Coordinated Response Plan (5.1.2) – **E**  
 Manage Emergency Response (5.1.4) – **E**  
 Schedule M&C Activities (9.2.1) – **E**  
 Status Current M&C Activities (9.2.2) – **E**  
 Manage M&C Resource Needs (9.2.3.4) – **E**

### 3.7 Urban Freeway Traffic Management (Function 7)

The freeway traffic management functional requirements may apply in whole or in part to any urban freeway management system (FMS) deployment in Nebraska. The District 2, Omaha FMS traffic management functions will be designed to both monitor and control traffic. The traffic-monitoring component will require automated detection of traffic conditions using intrusive and/or non-intrusive detection technology. Visual verification of conditions may be made possible through the use of closed-circuit television (CCTV) cameras. Traffic control may be achieved through the use of ramp meters, lane use control signs (where applicable) and coordination with arterial and ramp traffic signals. Compliance with the National Transportation Communications for ITS Protocol (NTCIP) has been recommended for dynamic message signs (DMS), traffic signals and ramp meters.

**A complete detailed description of the Urban Freeway Traffic Management Function description will be completed during the Phase 2 design process.**

### 3.8 Urban Incident Management (Function 8)

The urban incident management component will provide for the detection, verification, user defined response formulation and site management of incidents. The system will aid in the implementation of a coordinated effort among NDOR, local jurisdictions, law enforcement and emergency response agencies. The coordination will provide numerous benefits to overall transportation management agencies and motorists by reducing the time involved in detecting an incident, determining the location and type of incident, determining the proper response of personnel and equipment, and permitting active site management through knowledge of traffic

demands throughout the incident area. Active management will result in less delay, faster clearance and restoration of capacity and reduce the potential for secondary incidents.

**A complete detailed description of the Urban Incident Management Function description will be completed during the Phase 2 design process.**

### **3.9 Urban Traveler Information (Function 9)**

The urban freeway traveler information system will provide that functionality required when deploying En-route Driver Information and Pre-trip Travel Information. The FMS will collect and provide Pre-trip information to travelers through PioneerNet (Internet), dial-up telephone (511) and to local radio and TV media outlets. Real-time map displays from the D2/Statewide OC showing travel speeds can be displayed on the Internet along with video images from deployed CCTV cameras. This information will allow travelers to optimize their choice of mode, route, or departure time.

The En-route function will provide motorists with information during their trip to allow them to make informed decisions regarding route selection. Information will be provided to motorists via highway advisory radio (HAR), DMS on freeway and Trailblazers on arterials and general radio broadcasts provided by the media. Information such as incident existence, location, and estimated duration, time of expected clearance, information on recurring congestion and predicted congestion related to special events or maintenance and construction activities will be relayed to motorists so they can choose an alternate route.

**A complete detailed description of the Urban Travel Information Function description will be completed during the Phase 2 design process.**

### **3.10 NSP Communications Center (Function 10)**

Function 10 identifies activities that may be performed by the NSP Troop-Area A communications center in support of the Statewide/District 2 Operations Center and the Omaha FMS. The communications center will operate 24 hours per day 7 days per week. The NSP communications center can aid with “top-level” statewide coordination of activities between the Statewide OC and the NSP Troop-Area offices located statewide. Additionally the communications center can aid with the statewide collection of information from NSP resources. The NSP statewide communications system provides a back-up wireless capability.

**A complete detailed description of the NSP Communications Center Function description will be completed once NSP’s role and functions in the D2/Statewide OC are finalized during Phase 2.**

## 4. SYSTEM FUNCTIONAL OVERVIEW

At its inception, the mission of this project was to develop a conceptual design for a Statewide Joint Operations Center. During the project, it was determined that NDOR would be the sole participant in the development of the operations center from a funding perspective. The *joint operations* focus of the project had to therefore be curtailed; however, prior to the change of project direction, a User Requirements document outlining user service requirements for a JOC was completed. Based on that User Requirements document, this report defines system functional requirements but in the context of a District 2/Statewide Operations Center (OC) vs. a statewide Joint Operations Center (JOC) with multiple agencies involved. This functional requirements document therefore takes the next logical high-level system design step by defining techniques (processes) and technologies to be deployed to satisfy the JOC User Requirements but in the context of a District 2/Statewide OC.

This report section presents an overview of the system that must operate in the District 2/Statewide OC to carry out the previously identified statewide functions.

The system that will operate in the Statewide OC will facilitate statewide coordinated traffic control on urban freeways and rural highways; and management of incidents, events, emergencies and dissemination of traveler information throughout the state. The goal is to assist stakeholders throughout the state in their response to incidents and emergencies so that the negative impact of these incidents and emergencies on the safety and efficiency of Nebraska's transportation system is mitigated. The District 2/ Statewide OC will have two major functions 1) to serve as a statewide central hub for data collection, storage, dissemination and archival and 2) to provide traffic control functionality for District 2 in Omaha as well as DOCs throughout the state.

The system to be implemented and operated from the District 2/ Statewide OC will collect traveler-related data provided by various sources including traffic and transportation agencies, public safety agencies and the public. The District 2/ Statewide OC system will disseminate this pre-trip and/or en-route traveler information to the public via various distribution channels to assist travelers in selecting modes of transportation, estimating travel time, and selecting among alternate routes at an appropriate time.

### 4.1 Hardware Functional Elements

#### 4.1.1 Central System Hardware

The District 2/Statewide OC operational system will incorporate a client/server-based architecture and will comprise hardware and computer operating system software available in the marketplace. To the greatest extent practical, this hardware platform will be compliant with established NDOR IT department standards. The computer hardware deployed will be expandable to accommodate system growth through the addition of processing power both inside and outside the main CPU chassis. Servers will fully support standard network connections to operator workstation and other required computers. A minimum of two central system servers will be incorporated as part of the District 2/ Statewide OC central system design to provide for system backup in the event of a single server failure.

Though the actual number and type of computers required to achieve the required functionality will be determined during the final design, from a high-level functional



perspective, the following computer system hardware is envisioned in addition to the server computers:

- Operator Workstation Computers – These computers will serve as the primary interface between the District 2/Statewide OC central system and system operators. Each workstation will allow operators (including remote users) to interact with every functional aspect of the central system permitted at their user access level. Operator workstation may be equipped with a second monitor to display real-time CCTV images without interfering with the other activities being performed by operators. These workstations permit operators to control camera movements, switch between different cameras, and route camera video images.
- District 2/Statewide OC Video Graphics Server- CCTV surveillance cameras are used to provide visual images used to identify and verify the occurrence of an incident. They provide these images to District 2/Statewide OC Central Server and to the District 2/Statewide OC Video Graphics server used to control the images displayed on the video display wall (VDW).
- Archived Data User Services (ADUS) Server – The ADUS control computer supports the long-term data archive and retrieval operations.
- Computer Network Equipment – The District 2/Statewide OC central computer equipment will be designed to accommodate inter-networked communications in both the local and wide area network contexts. Local area network (LAN) will be established to facilitate communication between the computers in the District 2/Statewide OC building. A minimum of two LANs should be established; one for office automation and one dedicated to the District 2/Statewide OC operational application system. District 2/Statewide OC network equipment should also be designed to support a wide area network (WAN) to support communication via the Internet. Due to the potentially vast amount of data that may have to be transmitted via these networks, each LAN and WAN will be required to support very high bandwidth communications via its backbone.
- Network Links to Partner Agencies – A second WAN would be used to communicate with District 2/Statewide OC field elements and operations centers statewide. Due to the potentially vast amount of data that may have to be transmitted via this network, the WAN will be required to support very high bandwidth communications via its backbone.

#### **4.1.2 Field Hardware Elements**

Field hardware elements typically utilized to support the envisioned District 2/Statewide OC functions are listed below:

- Traffic Flow Detector Stations;
- Roadway Weather Information Stations (RWIS);
- CCTV Cameras;
- Dynamic Message Signs (DMS);
- Highway Advisory Radio (HAR) Transmitters; and
- Communications Equipment.

Additional field hardware elements are typically required to support the control of traffic on the roadways of the various districts throughout the state. These will be determined as the requirements for the District 2/ Statewide OC are further defined during Phase 2 of the project.

#### 4.1.2.1 Traffic Flow Detector Stations

The primary objective of detector stations will be to support the automatic detection of abnormal traffic flow that may be an indication of the existence of incidents in progress. Detector stations typically provide real-time information to the District 2/ Statewide OC operations center regarding lane volume, density, occupancy, speed, and truck counts. Detectors may include a mix of conventional inductive loops, Video Image Detectors (VIDs), radar-based detectors and/or other proven means of traffic flow detection. If a mix of detection technologies is used, the data collected must be processed in the field such that all detector data is sent back to central in a common format. The detector controller will provide detector station status messages back to the Central System.

#### 4.1.2.2 Road Weather Information Stations (RWIS)

RWIS technology is used to sense weather conditions such as wind speed, type and rate of precipitation and icing conditions. These weather conditions can occur suddenly and may significantly impact roadway conditions and traveler safety.

#### 4.1.2.3 CCTV Cameras

CCTV cameras are generally used to provide visual confirmation of suspected/reported incidents and to provide visual information in real-time to manage congestion on the roadway network and/or receive a visual image of existing weather conditions. A secondary function of these cameras is to support the remote monitoring of field devices such as DMS; therefore, whenever practical, a CCTV camera will typically be placed so that a District 2/ Statewide OC operator may view a nearby DMS. CCTV cameras will be designed to allow remote pan, tilt, and zoom commands to be issued from District 2/ Statewide OC operator workstations. The controller will return CCTV video and camera and controller status messages to the Central System.

#### 4.1.2.4 Dynamic Message Signs (DMS)

DMS are real-time traveler information displays used for traffic alerts, routing and management. Messages displayed on DMS will be composed to influence motorist behavior and improve the flow of traffic by providing timely information that may reduce motorist travel time. The DMS will be used to provide information to motorists regarding a variety of conditions, including congestion advisory, diversion, general-guidance information, maintenance, and construction work site advisories. Vendor-supplied controllers for DMS will provide the local intelligence needed to control the associated DMS and establish and maintain communication with the Central System. DMS will be located upstream of diversion path opportunities and, when possible, within view by a CCTV camera to permit District 2/ Statewide OC operators to visually verify correct DMS operation. DMS controllers will provide DMS status messages, and controller status messages back to the Central System.



#### 4.1.2.5 HAR Transmitters

HAR transmitters are low power devices that broadcast travel advisory messages within a predefined travel area. They typically use a lower frequency amplitude modulated (AM) signal to accomplish their purpose. HAR beacons and signage are typically deployed within the transmission reception area and used to notify travelers that a HAR broadcast containing information relevant to the traveler is being broadcast.

#### 4.1.2.6 Communications Equipment

Due to its statewide focus, District 2/Statewide OC field devices may be connected to the District 2/Statewide OC via multiple types of communication media. For instance, fiber optic cable may be utilized to connect a DMS that is installed in close proximity to the District 2/Statewide OC but some form of wireless communication may be used for a DMS that is installed several hundred miles away; however, dial-up or leased, land-based phone lines may be used wherever reliable phone service is available.

## 4.2 Software Functional Elements

Software modules will be implemented at the District 2/Statewide OC to allow the system operators to control and/or monitor devices installed in the field. Application software will also be included as necessary to support the Internet and 511 dissemination channels. Given the complement of equipment described above the following functional software elements will be required.

As stated above, additional field hardware elements (to be defined during Phase 2) are typically required to support the control of traffic at the district level statewide. Likewise, as additional traffic control functional requirements are defined for the District 2/Omaha FMS, the list of functional software elements described below will also be expanded.

### 4.2.1 *Traffic Flow Data Processing Software*

Software will be provided that will receive, process, store, and disseminate the traffic flow data collected via the traffic flow detector stations. This data will be converted from its raw state to congestion information useful for the traveler for decision-making. This traffic flow information will be available for display on a web-based map and dissemination via 511.

### 4.2.2 *Road Weather Information System Software*

RWIS software will also be provided. Similar in function to the traffic flow data processing software, the RWIS software will process RWIS data to convert it into formats required for storage and dissemination via the web and 511.

### 4.2.3 *Dynamic Message Sign Software*

Formulation and transmission of messages and commands to the DMS will be accomplished via central DMS software (DMSS). Sign status data will be returned from the sign and maintained at central for analysis as required. Abnormalities will be automatically reported to the operations staff and output to the error log for investigation by the maintenance staff.

The operations staff will be able to request sign message display adjustments via the operator workstation. The operator will define the desired display state via the operator workstation. This request will be routed via the DMSS for actual implementation. The DMSS will retrieve the desired message text from its library of messages, and forward the requested message to the sign.

Messages displayed on signs will change to alert upstream motorists of incidents and advise them of the best way to avoid incident locations. Each DMS will have an associated database with pre-arranged combinations of text messages suitable for a wide variety of conditions. The DMSS will be designed to allow the operator to preview and approve the selected message prior to displaying it on a sign. The operator will have the ability to select, via the GUI, alternative messages from a predefined message library for that segment of the freeway.

#### ***4.2.4 Operator Workstation Software***

The Operator Workstation software (OWS) will be the primary client software provided as part of the District 2/ Statewide OC operational system. The OWS provided will comprise a Graphical User Interface (GUI) and run on all operator workstation computers. An OWS software usage license sufficient to cover all initial and future operator workstations statewide will be negotiated during Phase 2 to provide the District 2/ Statewide OC system users a common user interface no matter where an operator workstation is to be deployed. The GUI will incorporate pull down menus, “push buttons”, icons, dialogue boxes, and lists boxes as per the final design to be completed during Phase 2 of this project.

Area wide map graphics will be displayed on the operator workstation. All operator workstation graphics displays will be based upon a common set of master graphics data files. These master files will be maintained on the system server discs. The available map graphics to be displayed on the Operator workstation will include an area-wide system status display as well as more detailed displays of pre-selected roadway segments.

#### ***4.2.5 CCTV Control Software***

Control of the pan, tilt, and zoom functions of each CCTV camera installed in the field will be via the CCTV central software. This software is also typically capable of managing preset camera settings for pan, tilt, zoom and focus within the central system database. Preset positions, to be manually invoked, may also be defined which will facilitate the observation of the associated variable message signs.

#### ***4.2.6 Video-Graphics Software***

Defined District 2/Statewide OC functionality dictates that the display of video images within the operations center be accommodated. Depending on final design criteria, these images may be displayed on video display monitors at each operator workstation console, on a large array of monitors (typically referred to as a video display wall) or, in both places. These display monitors typically support not only the display of CCTV images, but also alternately the display of computer-generated graphics.

Video-graphics control software (V-GS) will be provided to support operator control of routing of CCTV video image through the video switcher and the managed display of video and/or graphics images on the video display monitors. This software will be used to direct the display of a particular camera’s image on a particular video display monitor or set of

video display monitors and to arbitrate between the display of video and graphics on a particular monitor.

#### 4.2.7 *Web Site Software*

A primary District 2/Statewide OC traveler information dissemination channel will be the Internet; therefore, software will be included in the District 2/ Statewide OC operational system that will serve this function. This web site software will comprise two major components, a data base server and the web pages that the Internet-based user will see. The data base server will store data provided to it by the other software modules above. This data will be stored in a manner conducive to rapid retrieval in response to user queries via the Internet. The web pages will make users aware of the available information and allow the users to obtain the information they need in a quick, efficient, user-friendly manner.

At initial start-up the District 2/ Statewide OC web site should be designed to support the statewide dissemination of the following information in real-time:

- Incidents;
- Road Closures;
- Lane Restrictions;
- Road Maintenance;
- Hazardous Obstructions;
- Road Conditions;
- Inclement Weather;
- High Winds;
- Environmental Conditions;
- Temperature;
- Planned Events; and
- Alert Conditions.

Much of this information (such as alert conditions that may affect homeland security) will have to be detected, confirmed, authorized for dissemination and entered into the system manually. By default, this information will be presented to the web site users on a map of the entire state of Nebraska. An option could be provided that will allow the user to view information in more detail via maps that zoom into a smaller area.

## 5. SUMMARY

The District 2/ Statewide OC will be a National ITS Architecture (NITSA) modeled system that implements the NITSA specified system resources (User Services). The Statewide ITS system will include the following major functional components:

- ITS Field Elements and Systems;
- Central system hardware and software;
- Archive Data User Service (ADUS) Subsystem;
- ATIS/511 Subsystem;
- Communication elements; and
- District 2/ Statewide OC and remote operations centers (i.e. DOC).

The functions, user requirements, and process specifications identified within this document will be used during the statewide system software design phase. A similar process will be followed during design of the ADUS and ATIS subsystems. Techniques and technologies to be deployed for the field element and communication system will be addressed in other documents. The communications system functional requirements are addressed in the Communication Plan. ITS field elements and system deployment will be further defined in the Implementation Plan.

During Phase 2 of the Design Process, the content of this document must be expanded to include user services, requirements and process specifications required to support Urban FMS high-level control functions identified within this document.



## **ATTACHMENT A – NATIONAL ITS ARCHITECTURE PROCESS SPECIFICATION (*P-SPECS*)**



P-Spec	Name	Overview	Functional Requirements
1.1.1.1	<b>Process Traffic Sensor Data</b>	This process shall be responsible for collecting traffic sensor data. This data shall include traffic parameters such as speed, volume, and occupancy, as well as video images of the traffic. The process shall collect pedestrian images and pedestrian sensor data. The process shall collect multimodal crossing and high occupancy vehicle (HOV) lane sensor data. The process shall provide sensor status and fault indications. Where any of the data is provided in analog form, the process shall be responsible for converting it into digital form and calibrating. The converted data shall be sent to other processes for distribution, further analysis and storage.	This process shall: (a) continuously monitor the solicited data input flows; (b) where necessary convert the data obtained in (a) from analog to digital form, and calibrate the data; (c) periodically send all of the surveillance data to other processes in the Manage Traffic function via the solicited output data flows; (d) complete a full scan of all inputs and generate the outputs in less than the time interval between successive activations.
1.1.1.3	<b>Process Environmental Sensor Data</b>	This process shall be responsible for collecting and monitoring data obtained from environmental sensors. The process shall output sensor status and fault indications. The process shall receive sensor control data from other processes. Where any of the data is provided in analog form, the process shall be responsible for converting it into digital form and calibrating. The converted data shall be sent to other processes for distribution, further analysis and storage.	This process shall: (a) continuously monitor the solicited data input flows; (b) where necessary convert the data obtained in (a) from analog to digital form, and calibrate the data; (c) periodically send all of the surveillance data to other processes in the Manage Traffic function via the solicited output data flows; (d) complete a full scan of all inputs and generate the outputs in less than the time interval between successive activations.
1.1.1.4	<b>Manage Data Collection and Monitoring</b>	This process shall collect and monitor sensor data from the roadside. The process shall collect the sensor data including sensor status and sensor faults from roadside equipment and distribute it to the Manage Archive Data function. The process shall run when a request for data is received from an external source.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any of the unsolicited inputs shown above are received, the process shall immediately generate the solicited output; (c) data shall only be sent to the source from which the data request originated.
1.1.1.5	<b>Provide Sensor Interface to Other Roadway Devices</b>	This process shall provide the interface between roadway sensors and other roadway devices (considered to be contained in the Other Roadway terminator) for the exchange of data, status, and control. The other roadway devices can be adjacent geographically, under control of a different jurisdiction, or part of a more complex hierarchy. The data input to this process shall include sensor data from the sensors such as the following- traffic, environmental, and work zone intrusion detection. Additionally status and fault indications from the sensors shall be input to the process and passed along to the Other Roadway terminator. Control data shall come from the Other Roadway terminator into the process that shall output the control information to the correct sensor process. This process supports the collection of data locally on surface streets or freeways that might be needed to update nearby dynamic message signs with, for example, messages regarding road conditions or individual vehicle speed. This process and its companion process, Provide Device Interface to Other Roadway Devices, support autonomous traffic information dissemination without the need for direct control from a Manage Traffic Function.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) where necessary convert the data obtained in (a) from analog to digital form, and calibrate the data; (c) periodically send all of the surveillance data to other processes in the Manage Traffic function via the solicited output data flows; (d) complete a full scan of all inputs and generate the outputs in less than the time interval between successive activations.



P-Spec	Name	Overview	Functional Requirements
1.1.1.6	<b>Collect Infrastructure Sensor Data</b>	This process shall use roadside sensors to monitor the condition of pavement, bridges, tunnels, culverts, signs, and other transportation-related infrastructure and report the results to the center and vehicle in the Manage Maintenance and Construction function. This process shall also receive sensor control data from both the center and vehicle. Infrastructure sensor equipment fault status and configuration data shall be generated by this process and returned to another process for inventory update and repair if deemed necessary.	None.
1.1.2.1	<b>Process Traffic Data for Storage</b>	This process shall receive data from other processes and store the data into the long term and current data stores. The data shall comprise sensor data, both smoothed and unsmoothed: processed sensor surveillance data, data sent to control indicators (output devices e.g. intersection controllers, pedestrian controllers, ramp metering equipment), parking lot management data and other street equipment, the status data received from the indicators, plus current traffic conditions, planned events, current incidents, parking lot states, freeway ramp states, link travel times, roadway conditions provided by vehicle probes, and selected traffic control strategy. The data stored by the process in the current data store shall be the values collected over a relatively short period of time. The data stored in the long term data store shall be retained for a longer period. The data retained in the long term data store may be aggregated so as to reduce the storage requirements for long historical records, the amount of aggregation to be an implementation decision.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) maintain the store of current data in such a way that it contains data obtained over a limited time window, so that it presents a rolling picture of the current status and traffic conditions in the network, which is continually updated in real time; (c) maintain the store of long term data in such a way that it contains the data from the current data store (optionally aggregated) to provide a complete historical record of the state of the system over a longer time window; (d) the process shall be responsible for the maintenance of both current and long term data stores.
1.1.2.2	<b>Process Traffic Data</b>	This process shall receive and process data from sensors (both traffic and environmental) at the roadway. The process distributes data to Provide Device Control processes that are responsible for freeway, highway rail intersections, parking lot, and surface street management. It also sends the data to another Provide Traffic Surveillance process for loading into the stores of current and long term data. This process distributes environmental sensor data to other processes in Manage Traffic as well as the process that is responsible for monitoring vehicle speed. Information about the various sensors to aid in this processing and distribution of data is accessed from the data store 'static_data_for_sensor_processing'.	This process shall: (a) run whenever any of the unsolicited input data flows are received; (b) use the data store 'static_data_for_sensor_processing' to analyze sensor data and determine how to allocate the received data to the various solicited output flows and send them to the appropriate processes in the Provide Device Control facility; (c) analyze the input data to detect congestion and to pass this through the solicited output flow 'unusual_data' to the Manage Incidents facility; (d) read data from the static data store 'static_data_for_sensor_processing'.



P-Spec	Name	Overview	Functional Requirements
1.1.2.3	Update Data Source Static Data	This process shall be responsible for the maintenance of the store of static data used in the processing of sensor data. This sensor data shall be used to provide traffic surveillance information for use by other processes within the Manage Traffic function. The store shall contain data showing the relationship between sensors and the freeways, surface street and rural roadways, i.e. where they are located, to which part(s) of the network their data applies, the type of data, etc. It shall also hold information about the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network which shall be used by processes involved in exchanging surveillance information (and optionally control) with other Manage Traffic functions.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) on receipt of 'link_data_update' or 'new_sensor_static_data' the process shall update the store of static data using the 'static_data_for_sensor_processing' flow. (c) on receipt of 'request_sensor_static_data', the process shall send the contents of the 'static_data_for_sensor_processing' store on the 'existing_sensor_static_data' flow.
1.1.2.6	Process Collected Vehicle Smart Probe Data	This process shall be responsible for the processing of vehicle smart probe data. The process receives data from vehicles and processes the data to estimate type and level of roadway conditions and hazards. The process shall send the road condition and hazard estimates to the Provide Device Control facility for output to future passing vehicles. It shall send this data, together with the fixed unit identity and fixed location to the traffic data storage process for loading into the current and long term data stores.	This process shall: (a) continuously monitor for receipt of the unsolicited data flow 'vehicle_smart_probe_input_data'; (b) when the data flow in (a) is received, use it to estimate road conditions and hazards; (c) send the processed road condition and hazard estimate data to the vehicle smart probe data output process in the Provide Device Control facility; (d) combine the road condition and hazard estimate data with the fixed unit identity and location and send it to the traffic data storage process; (Fixed unit identity and location shall be initialized when the process is initiated.)
1.1.4.1	Retrieve Traffic Data	This process shall distribute traffic data and environmental sensor data to other functions within ITS and to other terminators on the boundary of the architecture. The process shall retrieve data from the data stores managed by other processes in the Provide Traffic Surveillance facility of the Manage Traffic function. The process shall respond to requests for data that originate from traffic operations personnel, the media, the Manage Transit function, the Manage Emergency Services function, the Manage Demand facility within the Manage Traffic function, and the Provide Driver and Traveler Services function. The process shall provide environmental sensor data to the Manage Maintenance and Construction function as well as the Weather Service and Surface Transportation Weather Service terminators. The process shall also generate traffic data for output by other processes to in-vehicle signage functions.	This process shall: (a) continuously monitor for receipt of the unsolicited input data flows; (b) when any of the flows in (a) are received, retrieve data from the current, long term and predictive model data stores, using the solicited input data flows listed above; (c) generate and issue the solicited output flow listed above that corresponds to the input flow, loading into it the data appropriate to the recipient; (d) periodically or on an event driven basis generate the data flow sent to the traffic control process responsible for sending data to processes that broadcast to in-vehicle signage equipment; (e) periodically or on an event driven basis generate the environmental data flows sent to the Weather Service, the Surface Transportation Weather Service, and the Manage Maintenance and Construction function; (f) periodically or on an event driven basis generate the traffic data and incident image data flows provided to the Manage Emergency Services function; (g) the process shall retrieve data from the stores of current, long term and predictive data as needed to support its other processing requirements.





P-Spec	Name	Overview	Functional Requirements
1.1.4.2	<b>Provide Traffic Operations Personnel Traffic Data Interface</b>	This process shall provide the interface through which traffic operations personnel can obtain access traffic data, traffic video images, and weather information. The personnel can access data stored by other processes in the Provide Traffic Surveillance facility of the Manage Traffic function. The personnel can set up the parameters that govern the data that is available to non-traffic operations people via a separate process to the media. This stored data shall comprise current and long term (historic) data on traffic conditions, weather conditions and roadside equipment activity, plus prediction estimates of traffic conditions. The data shall apply to some or all of the freeways, surface street, and rural roadways served by the specific instance of the Manage Traffic function. Where appropriate and/or requested by the traffic operations personnel, the process shall provide the data output in the form of an overlay onto a map of the relevant part(s) of the freeways, surface street and rural roadways served by the instance of the function. The process shall obtain the map from a local data store, which it shall enable the traffic operations personnel to update as and when required.	This process shall meet the following functional requirements: (a) continuously monitor the input data flows and provide acknowledgment of receipt through a human interface of those from traffic operations personnel; (b) be capable of carrying out its own verification of input data received from traffic operations personnel and generating the correct solicited output data flow as a result of input data being received; (c) as part of the output generation process, carrying out checks for data out of range, missing or containing spurious values and requesting re-input where required; (d) be capable of simultaneously handling multiple independent input/output data channels, i.e. supporting access by more than one traffic operations personnel; (e) providing all output to traffic operations personnel in a form that is readily understood by a human operator; (f) only generate the outputs listed above as a result of receiving inputs from the traffic operations personnel or other processes;
1.1.4.3	<b>Provide Direct Media Traffic Data Interface</b>	This process shall be responsible for providing the interface between the media and the process responsible for obtaining data from the stores of traffic data maintained by other processes within the Provide Traffic Surveillance facility of the Manage Traffic function. The process shall enable the media to request and be provided with current, long term (historic) and predicted traffic data. The data may be provided in one or more formats: as a data stream, as processed and displayed to Traffic Operations Personnel (e.g. graphical summaries of link speeds), or as a display (with data included on a map of relevant part(s) of the road and freeway served by the Manage Traffic function. The media shall only be able to request and see displayed that data that the traffic operations personnel have made available, through the use of the definition in the traffic data media parameters.	This process shall meet the following functional requirements: (a) continuously monitor the input data flows and provide acknowledgment of receipt of those from the media; (b) be capable of accepting input from the media in audio or other forms, where the latter may comprise input from any combination of keyboards or other forms of push-button devices, pointing devices, etc.; (c) be capable of carrying out its own verification of input data received from the media and generating the correct solicited output data flow as a result of input being received; (d) as part of the output generation process, carrying out checks for data out of range, missing or spurious values and requesting re-input where necessary; (e) be capable of simultaneously handling a large number of independent input/output data channels, i.e. supporting very many media, some of whom may be remote; (f) providing all output to the media in a form that is readily understood by a human operator and which may be in audio or visual form, with the latter being available in a variety of formats, e.g. displays, or hardcopy (paper) output; (g) only generate the outputs listed above as a result of receiving inputs from the media or the other processes; (h) the use of the digitized map display shall be automatic and shall be at a resolution best suited to the quantity and scope of data being displayed, i.e. the map shall be to the largest possible scale.



P-Spec	Name	Overview	Functional Requirements
1.1.4.4	<b>Update Traffic Display Map Data</b>	This process shall provide updates to a store of digitized map data when a request is received from traffic operations personnel via their interface process. The map data shall be for use as the background for displays of traffic data requested by traffic operations personnel and the media through their respective interface processes. This process shall obtain the new map data from either a specialized data supplier or some other appropriate data source.	This process shall: (a) continuously monitor for the receipt of the unsolicited data flow; (b) when the data flow 'request_traffic_map_display_update' is received, generate the 'tmup-request_traffic_display_update' output data flow and continuously monitor for receipt of the solicited input data flow 'fmup-traffic_display_update'; (c) when the flow 'fmup-traffic_display_update' is received, prepare and output the 'map_data_for_traffic_display' data flow;
1.1.4.5	<b>Provide Media System Traffic Data Interface</b>	This process shall provide the interface through which traffic and incident data can be output to the Media. The output shall comprise traffic and incident data that is suitable for output to the Media System as determined by traffic managers. This interface is only for the output of data that has been requested by the Media.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the 'information_for_media' data flow; (b) when received convert information_for_media into a form for output to the media.
1.1.4.6	<b>Provide Traffic Data Retrieval Interface</b>	This process shall provide customized sets of traffic data for broadcast, advisories, and personalized data to travelers, traveler information data archive, commercial vehicle fleets, and the media. This process shall also provide to travelers maintenance and construction data, including scheduled maintenance and construction work activities and work zone activities. This process shall use the parameters in the data store 'traffic_data_retrieval_parameters' to define exactly what data shall be retrieved as a result of each request. The process shall select the appropriate subset of traffic data or maintenance and construction data which will be sent to each ITS function that is requesting data. The process shall accept traveler profiles for use in determining what personalized data to send to the traveler. The process shall send kiosk and personal traffic requests to the archival process.	This process shall:(a) continuously monitor for receipt of any of the unsolicited input data flow;(b) when the flow received in (a) is a request for data, send the request to the data retrieval process and data archival process using the request solicited output data flow;(c) when the response to the request flow in (b) is received, assemble the data for output according to the data in the 'traffic_data_retrieval_parameters' data store;(d) when (c) is complete, send the retrieved data to the requesting process in the corresponding solicited output flow;(e) if the data flow in (a) contains new data for the store of traffic data retrieval parameters, load it into the 'traffic_data_retreival_parameters' data store.
1.1.4.7	<b>Manage Traffic Archive Data</b>	This process shall collect traffic data and AHS operational data to distribute to the Manage Archive Data function. The process shall run when a request for data is received from an external source, or when fresh data is received.	None.



P-Spec	Name	Overview	Functional Requirements
1.1.5	Exchange data with Other Traffic Centers	<p>This process shall exchange data the Other TM terminator. This represents the exchange of data between peer Manage Traffic functions (e.g between peer Traffic Management Centers (TMC)). The other TMC can be adjacent geographically, under control of a different jurisdiction, or part of a more complex hierarchy. The exchange of data may be triggered by a request to (or from) the Other TM. or the exchange of data may be initiated without a specific request. This data shall include both traffic information and traffic control data. Some examples of these exchanges are: traffic control preemption for vehicle routes which pass through the local network but have a destination in an area served by another remote TMC; data about an incident that has an impact on the traffic conditions in the network served by a remote TMC; or control data for the Manage Traffic function to control video cameras under the jurisdiction another traffic management organization. The data received from remote TMCs could be used to vary the current traffic control strategy to give signal preemption to emergency vehicles or enable the passage of commercial vehicles with unusual loads, or as input to the local traffic predictive model estimation process.</p>	<p>This process shall:</p> <ul style="list-style-type: none"><li>(a) continuously monitor for receipt of the unsolicited input flows;</li><li>(b) when either 'cv_incidents_for_other_TMC' or 'emergency_data_for_other_TMC' unsolicited inputs are received, generate the 'totc-identity' and 'totc-transfer_data' solicited output data flows (and issue them to the other TM terminator);</li><li>(c) when the 'fotc-data_request' and 'fotc-identity' unsolicited input data flows are received, and if requested in those data flows, read the data from the long term data store that is relevant to the requesting TMS, and generate the 'totc-identity' and 'totc-transfer_data' solicited output data flows, (and issue them to the other TM terminator);</li><li>(d) when the 'fotc-identity' and 'fotc-transfer_data' unsolicited input data flows are received, generate those of the 'other_current_incidents', 'other_planned_events', 'other_TMC_cv_incidents' or 'other_TMC_emergency_data' solicited output data flows for which data has been provided and send them to their receiving processes, or in the case of the 'other_TMC_emergency_data' flow load the data into the store containing other traffic center data;</li><li>(e) when any of the 'request_other_TMC_data', 'request_other_current_incidents_data' or 'request_other_planned_events_data' unsolicited input data flows is received, generate the 'totc-data_request' and 'totc-identity' solicited output data flows and send them to the other TM terminator; (f) the process shall be responsible for the maintenance of the store of data from other TMC's for use by the predictive modeling process.</li></ul>



P-Spec	Name	Overview	Functional Requirements
1.2.1	Select Strategy	<p>This process shall select the appropriate traffic control strategy to be implemented over a road and/or freeway section served by the specific instance of the Manage Traffic function. The strategy shall be selected by the process from a number that are available, e.g., adaptive control, fixed time control, local operations. The selected strategy shall be passed by the process to the actual control processes for implementation according to the part of the network to which it is to be applied, i.e., surface roads, freeways (i.e., limited access roads), ramps and/or parking lots. The definition of strategy can be extended to include a strategy for the operations of sensors such as video cameras used to provide traffic surveillance data. The process shall make it possible for the current strategy selection to be modified to accommodate the effects of such things as incidents, emergency vehicle preemption, the passage of commercial vehicles with unusual loads, equipment faults and overrides from the traffic operations personnel. The strategy for control of freeways and parking lots is through use of DMS signs and lane indicators. The strategy for control of ramps is through the timing plans for ramp meters. The selected strategy shall be sent to the process within the ProvideTraffic Surveillance facility responsible for maintaining the store of long term data.</p>	<p>This process shall:(a) continuously monitor for receipt of the unsolicited input flows;(b) determine the traffic control strategy that provides the best possible traffic conditions within the road network served by the Manage Traffic function. The definition of 'best' shall be a local policy decision. (An example might be a strategy that minimizes stops and delays thus reducing 'stop-start' travel and fuel consumption and the environmental impact of travel.);(c) in determining the strategy, the process shall be able to use data provided as input from other parts of the Manage Traffic function, unless countermanded by input from the traffic operations personnel, or the default strategy in the store of static data, as well as the fault state of all indicator equipment;(d) if no input is available from other parts of the Manage Traffic function, then the strategy defined in the store of static data shall be used;(e) if in (d) no strategy is specified, the process shall allow all controlled equipment to operate under local control, setting all variable (dynamic) message sign (DMS) outputs to 'blank face' indicating that there is no message;(f) where the inputs from other parts of the Manage Traffic function lead to conflicts in the required strategy to be selected, the process shall observe a locally determined order of priority. For example, the following order of priority might be followed: emergency vehicle route, incident strategy override, multimodal crossing inputs, operator strategy override, demand strategy override, low traffic volume route, commercial vehicle route, analysis of the road network use and background strategy selection from the store of static data; (g) data for emergency and commercial vehicle routes sent from other the Manage Traffic function shall be given the same level of importance as those that originate locally (unless locally overridden); (h) the process shall automatically cancel strategies selected by traffic operations personnel at a locally determined time and/or period after they were imposed, if they have not been canceled previously, to avoid unintended effects on the traffic control strategies for other days;(i) when a new strategy has been determined, it shall be sent to other processes in the Manage Traffic function for implementation;(j) the output in (i) shall only be sent to those processes that serve equipment specified in the new strategy;(k) changes in the current strategy must always be immediately sent to another part of the Manage Traffic function for loading into the long term data store.</p>



P-Spec	Name	Overview	Functional Requirements
1.2.2.1	<b>Determine Indicator State for Freeway Management</b>	<p>This process shall implement selected traffic control strategies and transit vehicle overall priority on some or all of the indicators covering the freeway network served by the Manage Traffic function. It shall implement the strategies only using the indicators (e.g. dynamic message signs (DMS)) specified in the implementation request and shall coordinate its actions with those of the process that controls the road network. The process shall also be capable of monitoring the extra inputs that will arise where tunnels are involved, including the detection of fire and the consequent requirement to re-route traffic.</p>	<p>This process shall meet the following functional requirements:</p> <ul style="list-style-type: none"><li>(a) continuously monitor for receipt of the unsolicited input flows;</li><li>(b) immediately implement any strategy requests only using the indicators specified in the request;</li><li>(c) it shall be possible for the strategy request to require implementation on one, some or all the indicators that are available (and not faulty) in the freeway network served by the Manage Traffic function;</li><li>(d) strategy implementation must make use of the freeway sign sequences to ensure that signs are set in a manner that is safe for all freeway users;</li><li>(e) requests for high occupancy vehicle (hov) and transit priority shall be executed immediately but not take precedence over emergency vehicle routes;</li><li>(f) special consideration must be given to conditions in tunnels and in particular to the need to automatically implement alternative traffic management strategies to route traffic away from fires or similar extreme hazards that may be detected;</li><li>(g) the process shall use the strategy data input to monitor the effects of the currently selected strategies and make small adjustments which will further improve the efficiency of the current traffic flow;</li><li>(h) transit priority shall be implemented on the indicators covering the requested route(s) and its confirmation of its implementation shall be sent back to the requesting process in the Manage Transit function;</li><li>(i) the process shall implement any changes in control in a safe manner that does not in any way endanger vehicles and/or their drivers, pedestrians or operators of non-motorized vehicles;</li><li>(j) send each change in strategy to another process in the Manage Traffic function for loading into the store of long term data;</li><li>(k) send the required indicator state to another process in the Manage Traffic function for output to the roadside equipment that drives the indicators.</li></ul>



P-Spec	Name	Overview	Functional Requirements
1.2.2.2	<b>Determine Indicator State for Road Management</b>	<p>This process shall implement selected traffic control strategies and transit priority on some or all of the indicators covering the road (surface street) network served by the Manage Traffic function. It shall implement the strategies only using the indicators (intersection and pedestrian controllers, dynamic message signs (DMS), etc.) that are specified in the implementation request and shall coordinate its actions with those of the processes that control the freeway network and the ramps that give access to the freeway network.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the unsolicited input flows;</li> <li>(b) immediately implement any strategy requests only using the indicators specified in the request;</li> <li>(c) control all indicators that are intersection and pedestrian controllers using a methodology which responds to vehicles and pedestrians in a locally determined manner;</li> <li>(d) where vehicle and pedestrian responsive control cannot be implemented, or is not specified in the strategy request, the following traffic control methodologies shall be available to the process for implementation within some or all of the controlled network: fixed time control sequences (usually referred to as fixed time plans), the automatic selection of the most appropriate fixed time plan on the basis of current real time traffic data, the selection of special fixed time plans to cover such things as bridges opening when requested by the specific data input and the ability of one or more device(s) to operate under its own (local) control;</li> <li>(e) the process must be capable of implementing the required control strategy on one, some or all the indicators that are available (and not faulty) in the road network;</li> <li>(f) traffic control preemption shall be capable of being implemented for emergency or special priority vehicles;</li> <li>(g) requests for high occupancy vehicle (hov) and transit priority shall be executed immediately but not take precedence over emergency vehicle routes;</li> <li>(h) the process shall use the strategy data input to monitor the effects of the currently selected strategies and make any small adjustments which will further improve the efficiency of the traffic flow;</li> <li>(i) transit priority shall be implemented on the indicators covering the requested route(s) and confirmation of its implementation shall be sent back to the requesting process in the Manage Transit function;</li> <li>(j) the process shall implement any changes in control in a safe manner that does not in any way endanger vehicles and/or their drivers, pedestrians or operators of non-motorized vehicles;</li> <li>(k) send each change in strategy to another process in the Manage Traffic function for loading into the store of long term data;</li> <li>(l) send the required indicator state to another process in the Manage Traffic function for output to the roadside equipment that drives the indicators.</li> </ul>



P-Spec	Name	Overview	Functional Requirements
1.2.4.1	Output Control Data for Roads	This process shall transfer data to processes responsible for controlling equipment located at the roadside within the road (surface street) network served by the Manage Traffic function. Data for use by in-vehicle signage equipment shall be sent to another process for output to roadside processes. All data shall be sent to this process by processes within the Manage Traffic function. This process shall also be responsible for the monitoring of input data showing the way in which the indicators are responding to the data that they are being sent, and the reporting of any errors in their responses as faults to the Collect and Process Indicator Fault Data facility within the Manage Traffic function. All output and input data shall be sent by the process to another process in the Manage Traffic function to be loaded into the store of long term data.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any change occurs to the input data, change the appropriate indicator output data; (c) as a result of (b), update the vehicle signage data, adding the location and identity of the route segments from which the indicator data can be seen from the static data for DMS allocation; (d) maintain communication with all indicators so that they will continue to obey the data contained in the data that is being sent to them; (e) immediately report all indicators that fail to respond to the commands in the data that they have been sent to the processes responsible for fault management.
1.2.4.2	Output Control Data for Freeways	This process shall transfer data to processes responsible for controlling equipment located at the roadside within the freeway network served by the Manage Traffic function. Data for use by in-vehicle signage equipment shall be sent to another process for output to roadside processes. All data shall have been sent to this process by processes within the Manage Traffic function. This process shall also be responsible for the monitoring of input data showing the way in which the indicators are responding to the data that they are being sent, and the reporting of any errors in their responses as faults to the Collect and Process Indicator Fault Data facility within the Manage Traffic function. All output and input data shall be sent by the process to another process in the Manage Traffic function to be loaded into the store of long term data.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any change occurs to the input data, change the appropriate indicator output data; (c) as a result of (b), update the vehicle signage data, adding the location and identity of the route segments from which the indicator data can be seen from the static data for DMS allocation; (d) maintain communication with all indicators so that they will continue to obey the data contained in the data that is being sent to them; (e) immediately report all indicators that fail to respond to the commands in the data that they have been sent to the processes responsible for fault management.
1.2.4.4	Output Roadway Information Data	This process shall transfer data to processes responsible for controlling roadway information devices such as dynamic message signs (DMS) and highway advisory radio (HAR) located at the roadside. The data contains outputs used to control and monitor the status of DMS and HAR. This process shall also be responsible for the monitoring of input data showing the way in which the roadway information devices are responding to the data that they are being sent, and the reporting of any errors in their responses as faults to the Collect and Process Indicator Fault Data facility within the Manage Traffic function. This process is also responsible for defining messages for DMS and HAR and sending configuration changes (i.e. blanking sign).	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any change occurs to the input data, change the appropriate indicator output data; (c) as a result of; (d) maintain communication with all indicators so that they will continue to obey the data contained in the data that is being sent to them; (e) immediately report all indicators that fail to respond to the commands in the data that they have been sent to the processes responsible for fault management.
1.2.5.5	Manage Parking Archive Data	This process shall obtain parking lot availability and charge data and distribute it to the Manage Archive Data function. The process shall run when a request for data is received from an external source.	This process shall meet the following functional requirements; (a) continuously monitor for receipt for the unsolicited input flows; (b) when any of the unsolicited inputs shown above are received, the process shall immediately generate the solicited output; (c) data shall only be sent to the source from which the data request originated.





P-Spec	Name	Overview	Functional Requirements
1.2.6.1	<b>Maintain Traffic and Sensor Static Data</b>	This process shall maintain the store of static and link data used by other processes within the Manage Traffic function. Link data shall also be sent to the Provide Driver and Traveler Services function to enable it to obtain data about links that are not in the geographic area which it serves.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) communicate with other processes in the Manage Traffic function to obtain their current static data and to provide updates to that data; (c) when new static data is received and it has been successfully loaded into the store, output the static_data_store_updated data flow so that other processes can receive new copies of the data.
1.2.6.2	<b>Provide Static Data Store Output Interface</b>	This process shall provide updates of static data to other processes in the Provide Traffic Control facility of the Manage Traffic function. An update of the data shall only be provided when this process has been notified by another process that the contents of the store of static data has been changed. This process shall provide updates to the map update provider about changes to the static data of a particular region.	This process shall: (a) continuously monitor for receipt of the unsolicited input flow 'static_data_store_updated'; (b) when the flow in (a) has been received, read the data from the store of static data and send the solicited output flows;
1.2.7.1	<b>Process Indicator Output Data for Roads</b>	This process shall implement the indicator output data generated by other processes within the Manage Traffic function for use on the roads (surface streets) served by the function. It shall perform the functions needed to provide control at intersections or pedestrian crossings, or provide the interface for data to be sent to the units (or systems) that manage multimodal crossings or highway-rail intersections. This process shall monitor the status of the indicator equipment and provide fault status to the Manage Maintenance and Construction function to help that process determine whether the indicator is operating correctly or a repair is needed.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) provide output data in a form which is easily understood by drivers and/or travelers, appears in a safe sequence, is unambiguous and does not provide conflicting instructions to drivers and travelers that are likely to result in circumstances which are life threatening; (c) all output must be maintained for a time period which is sufficient to enable them to be read, understood and reacted to, but not so long that they cause any new indication to be ignored; (d) if no input of control data is received for a continuous period of time to be locally determined, the process shall start to change its outputs based on local sensor data; (e) the outputs to the multimodal crossings shall be maintained for as long as the appropriate control signal is received from other processes, and if no such signals are being received shall be set to null, i.e., the multimodal crossing equipment is not expected to take any action.





P-Spec	Name	Overview	Functional Requirements
1.2.7.5	<b>Process Indicator Output Data for Freeways</b>	This process shall implement the indicator output data generated by other processes within the Manage Traffic function for use on freeways served by the function. It shall perform the functions needed to output control data to ramp metering controllers or provide the interface for data to be sent to the units (or systems) that manage multimodal crossings. This process shall monitor the status of the indicator equipment and provide fault status to the Manage Maintenance and Construction function to help that process determine whether the indicator is operating correctly or a repair is needed.	This process shall: (a) continuously monitor for receipt of the input flows; (b) provide output data in a form which is easily understood by drivers and/or travelers, appears in a safe sequence, is unambiguous and does not provide conflicting instructions to drivers and travelers that are likely to result in circumstances which are life threatening; (c) all output must be maintained for a time period which is sufficient to enable them to be read, understood and reacted to, but not so long that they cause any new indication to be ignored; (d) if no input of control data is received for a continuous period of time to be locally determined, the process shall start to change its outputs based on local sensor data; (e) the outputs to the multimodal crossings shall be maintained for as long as the appropriate control signal is received from other processes, and if no such signals are being received shall be set to null, i.e., the multimodal crossing equipment is not expected to take any action.
1.2.7.8	<b>Provide Device Interface to Other Roadway Devices</b>	This process shall provide the interface between roadway devices and other roadway devices (considered to be contained in the Other Roadway terminator) for the exchange of data, status, and control. The Other Roadway can be adjacent geographically, under control of a different jurisdiction, or part of a more complex hierarchy. The devices described by ITS processes that will send data and status to the Other Roadway terminator (and receive control signals from the Other Roadway terminator) include controllers (arterial or freeway), roadway information systems (e.g. dynamic message signs), roadway auto-treatment systems, and work zone intrusion alert systems. This process supports autonomous traffic information dissemination without the need for direct control from a Manage Traffic function. This process also supports the interconnection of controllers (e.g. intersection or ramp meter) in peer or hierarchical arrangements.	This process shall: (a) continuously monitor for receipt of the input flows; (b) provide output data in a form which is easily understood by drivers and/or travelers, appears in a safe sequence, is unambiguous and does not provide conflicting instructions to drivers and travelers that are likely to result in circumstances which are life threatening; (c) all output must be maintained for a time period which is sufficient to enable them to be read, understood and reacted to, but not so long that they cause any new indication to be ignored; (d) if no input of fresh control data is received for a locally determined continuous period of time, the process shall start to change its outputs based on local sensor data, and shall clear (blank) the outputs containing advisory message texts.
1.2.7.9	<b>Process Roadway Information Data</b>	This process shall implement the presentation of roadway information data to drivers on the roads (surface streets) and highways served by the function. It shall generate the output for dynamic message signs (DMS) and highway advisory radios (HAR). The DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close). The process shall accept device control commands from other processes and shall provide status and fault data to the processes that originate control.	None.



P-Spec	Name	Overview	Functional Requirements
1.2.8.1	<b>Collect Indicator Fault Data</b>	This process shall collect data about faults in the operation of indicators (e.g., signals, DMS, HAR) that have been detected by processes in other parts of the Manage Traffic function. It shall be possible for the faults to be detected locally at the indicators, or centrally through communications links with the indicators.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows listed above; (b) when any of the data flows in (a) are received, pass the data on to another process for storage and the activation of fault reporting processes.
1.2.8.3	<b>Provide Device Fault Interface for M and C</b>	This process shall provide an interface for the exchange of data between the Manage Traffic and Manage Maintenance and Construction functions concerning the status of field equipment. This data will then be used by another process to schedule equipment repairs. This process shall send data containing details of new equipment faults, and to receive clearances when the faults are cleared.	None.
1.3.1.1	<b>Analyze Traffic Data for Incidents</b>	This process shall analyze traffic sensor data, vehicle probe data, or video images for anomalies that could indicate occurrence of an incident, including video images at work zones. The data may be collected from roads (surface street) and/or highways served by the Manage Traffic function. The process shall pass on any anomalies that it detects to another process in the Manage Incidents facility as possible detected incidents.	This process shall: (a) run whenever any of the unsolicited data flows is received; (b) analyze the unsolicited data and identify any anomalies and their location which indicate that traffic is not flowing as expected; (c) when anomalies in the traffic flow are detected in (b), report them as possible incidents using the solicited output data flow 'possible_detected_incidents' and 'reversible_lane_status'.
1.3.1.2	<b>Maintain Static Data for Incident Management</b>	Overview: This process shall maintain the store of static data (data about the location and features of the road or highway links in the transportation network). This data store is used by another process within the Manage Incidents facility to identify and locate incidents. The static data shall be input to this process from another process and it shall be possible for that process to request a copy of the current static data.	This process shall: (a) run when either the unsolicited data flow is received; (b) as updates are made to the incident static data, load the contents into the output data flow current_incident_static_data; (c) when the 'supply_incident_static_data' unsolicited data flow is received, load the contents into the store of static data, overwriting any data already present;
1.3.1.3	<b>Process Traffic Images</b>	This process shall process raw traffic image data received from sensors located on the road (surface street) and freeway network served by the Manage Traffic function. The process shall transform the raw data into images that can be sent to another process for incident or work zone intrusion detection. It shall also act as the control interface through which the images of traffic conditions can be changed by the traffic operations personnel and maintenance and construction center personnel, who shall also be supplied with images for viewing. This process shall also provide sensor equipment fault information to other processes in the Manage Traffic and Manage Maintenance and Construction functions that are monitoring the health of field equipment so that repairs can be scheduled by those other processes if deemed necessary.	This process shall: (a) continuously monitor for receipt of the unsolicited input flow 'trf-traffic_images'; (b) transform the data in (a) into a form in which it can be sent for analysis by another process; (c) send the data generated in (b) to the data analysis process using the solicited output flow 'traffic_image_data'; (d) at the same time as the data in (c) is output, generate the incident image data flow and send it to the traffic operations personnel interface and maintenance and construction center personnel interface process; (e) when the video camera control data flow is received, implement the data it contains to effect the required changes to the system operational parameters.



P-Spec	Name	Overview	Functional Requirements
1.3.2.1	<b>Store Possible Incident Data</b>	This process shall receive data on possible incidents from other processes within the Manage Incidents function and from other ITS functions. The process shall receive observation and forecast data from the Weather Service and Surface Transportation Weather Services terminators. The process shall receive event information from the Event Promoter terminator. The process shall load all data that it receives into the store of possible incidents. Types of incidents that could be received include special vehicle routes, work zone activity, road weather information, pollution incidents, as well as traffic incidents. As part of the loading activity, the process shall enter the data into the relevant parts of the standard format for incident data, and shall assign a level of confidence (e.g. related to the source of the data or time of its detection) to that data. Once data is loaded into the store an update notification is sent to another process to review and classify the possible incidents.	This process shall: (a) run whenever any of the unsolicited data inputs listed above is received; (b) be capable of receiving the input data in a variety of formats and converting it into a single format suitable for use with the store of possible_incidents data; (c) when possible_incident data is being stored, a level of confidence must be attached to it so that the accuracy of the data can be rated according to its source;
1.3.2.2	<b>Review and Classify Possible Incidents</b>	This process shall review input data about possible incidents and provide verification of the incident. The process shall have the capability of using algorithms to automatically identify and verify an incident. The process shall have the capability to classify an incident as a current incident or a planned event (such as a multimodal crossing) and shall output that potential incident data to another process for storage. The process shall report any incidents that it is unable to verify or classify to the traffic operations personnel for manual verification and classification. The process shall allow the traffic operations personnel to request all possible incidents and carry out the verification and classification process manually. This process shall provide feedback on proposed maintenance and construction work plans and proposed event plans.	This process shall: (a) run when any of the unsolicited data flows described above is received; (b) be capable of automatically determining which possible incidents can be converted into real incidents (i.e., are not false alarms) and further classifying the real incidents as planned events or current incidents; (c) the incident classification process shall use the level of confidence data attached to each set of possible incident data; (d) if the classification cannot be done automatically with a locally determined level of confidence, send the data to the Traffic Operations Personnel via the 'possible_incidents_data_output' output data flow, for manual classification; (e) where necessary, format the data for a possible incident into the standard form, adding in any missing fields if necessary, and adding in the traffic impact data field; (f) when a possible incident has been classified: output it to another process for storage in the planned events or current incidents data stores, send data flows to activate the process responsible for reviewing either planned events or current incidents, and send the appropriate message to other parts of the ITS; (g) new data read from the store of possible_incidents which is found to complement data already in the planned events or current incidents data stores, will be merged, with any additional data items in the new data shall be output for storage by another process. (h) review the current and planned incidents, and provide feedback regarding event plans and This process shall: (a) run when any of the unsolicited data flows described above is received; (b) be capable of automatically determining which possible incidents can be converted into real incidents (i.e., are not false alarms) and further classifying the real incidents as planned events or current incidents;



P-Spec	Name	Overview	Functional Requirements
1.3.2.2 (continued)	Review and Classify Possible Incidents (continued)	(continued)	<p>(c) the incident classification process shall use the level of confidence data attached to each set of possible incident data;</p> <p>(d) if the classification cannot be done automatically with a locally determined level of confidence, send the data to the Traffic Operations Personnel via the 'possible_incidents_data_output' output data flow, for manual classification;</p> <p>(e) where necessary, format the data for a possible incident into the standard form, adding in any missing fields if necessary, and adding in the traffic impact data field;</p> <p>(f) when a possible incident has been classified: output it to another process for storage in the planned events or current incidents data stores, send data flows to activate the process responsible for reviewing either planned events or current incidents, and send the appropriate message to other parts of the ITS;</p> <p>(g) new data read from the store of possible_incidents which is found to complement data already in the planned events or current incidents data stores, will be merged, with any additional data items in the new data shall be output for storage by another process.</p> <p>(h) review the current and planned incidents, and provide feedback regarding event plans and maintenance and construction work plans.</p>
1.3.2.3	Review and Classify Planned Events	<p>This process shall receive updates of planned events and review the complete list of them to determine when an incident should be reclassified from planned event to current incident. It shall carry out the re-classification process automatically either upon receiving notice that the store of planned events has been updated, or at some periodic rate. The criteria for reclassifying an incident could be that the planned start time of the event has passed. The process shall request details of planned events from the process that manages their data store and shall send details of any new (re-classified) current incidents to the process that manages their data store. It shall also provide updates of planned events and current incidents to other ITS functions, and details of any new planned events to the process responsible for the output of data to vehicle signage functions.</p>	<p>This process shall:</p> <p>(a) continuously monitor for the unsolicited input data flows listed above;</p> <p>(b) carrying out the incident re-classification process on receipt of either the 'reclassify_incidents', 'incident_data_update' or 'incident_response_status' data flows, or when planned events are expected to become current, or in the absence of any inputs on a regular (locally determined time interval) basis;</p> <p>(c) when the 'incident_data_update' unsolicited input data flow indicates that a new planned event has been found, send the incident details to the process that outputs data to roadside signage processes, using the 'planned_event_data_for_vehicle_signage' solicited output data flow;</p> <p>(d) when the 'incident_data_update' unsolicited input data flow indicates that a new current incident has been found, request the current incidents data and output that for the new incident to the process responsible for providing incident responses;</p> <p>(e) automatically re-classify incidents from planned events to current incidents based on the time at which the incident is expected to take place;</p> <p>(f) when an incident is re-classified from planned event to current incident, send out the data for the new current incident to other parts of ITS, and the data flow to activate the process responsible for responding to incidents.</p>



P-Spec	Name	Overview	Functional Requirements
1.3.3	<b>Respond to Current Incidents</b>	<p>This process shall provide responses, including roadside advisories and notification of other agencies, to incidents that become current, i.e. active. Three general strategies for response to incidents can be supported by the process: 1) Operator enters a response (there is no set of predetermined responses), 2) the operator selects a response from a set of predetermined responses (possibly modifying the response), and 3) the process automatically accesses and implements a response from a set of predetermined responses (while informing the operator of the actions taken). Where predetermined responses are utilized, the operator shall have the capability to view, modify, or override the predetermined response. The predetermined response to each type of incident shall be defined for the process in the store defined_responses_data. If the process cannot find a predetermined response for a particular incident, it shall send the details of the incident to the traffic operations personnel so that they can provide an update to the store of predetermined responses. The process shall output the predetermined responses to an incident when it receives notification from another process in the Manage Incidents function that a new current incident has occurred. At the same time it shall also output the incident data to the process responsible for providing broadcast data to roadside processes and to the Manage Maintenance and Construction process for coordination with its activities. The other process in the Manage Incidents function shall also provide details of incidents that have ceased to be current (terminated) so that this process can send out data to clear the actions requested and broadcast such information to the roadside.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the unsolicited input flow 'current_incidents_data_output';</li> <li>(b) analyze the current incident data against the data in the store of defined responses to determine the appropriate response;</li> <li>(c) generate the appropriate solicited output flows listed above as a result of determining the appropriate defined response to an incident;</li> <li>(d) generate the appropriate clearance data in the solicited output flows listed above when the duration of an incident expires;</li> <li>(e) if a defined response is not found for any incident, then the process shall send data about the incident to the Provide Traffic Operations Personnel Incident Data Interface process and take no further action;</li> </ul>
1.3.4.1	<b>Retrieve Incident Data</b>	<p>This process shall retrieve incident data from the stores of planned events and current incidents that are managed by other processes in the Manage Incidents facility of the Manage Traffic function. The process shall retrieve data as the result of a request which may come from the traffic operations personnel or the media. The output shall be returned to the source of the request.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the unsolicited input data flows 'request_incident_operations_data' and 'request_incident_media_data';</li> <li>(b) when either of the flows in (a) is received, request the required incident data from the appropriate store interface process using solicited output data flows 'current_incidents_request' or 'request_possible_incidents_data';</li> <li>(c) when the appropriate solicited input data flow is received in response to (b), integrate the stored map_data_for_incident_display with the incident data if necessary;</li> <li>(d) when (c) is completed, send the data to the process from which the data flow in (a) was received.</li> </ul>



P-Spec	Name	Overview	Functional Requirements
1.3.4.2	<b>Provide Traffic Operations Personnel Incident Data Interface</b>	<p>This process shall provide the interface between the traffic operations personnel and the Manage Incidents facility of the Manage Traffic function. It shall enable the personnel to request and amend details of current incidents, planned events, and predetermined incident responses. This shall allow the personnel to obtain and control incident video image data and manually re-classify incidents as possible or current or a planned event. It shall also output to the traffic operations personnel incident details to which no predetermined response currently exists. The process shall support inputs from and outputs to the traffic operations personnel. Where appropriate and/or requested by the traffic operations personnel, the process shall provide the output 'display' in a form incorporating a map of the relevant part(s) of the freeways, surface street and rural roadways served by the function. The process shall obtain the map from a local data store, which it shall request to be updated by another process as and when required.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor the input data flows and provide acknowledgement of receipt of those from Traffic Operations Personnel;</li> <li>(b) be capable of accepting input from Traffic Operations Personnel;</li> <li>(c) be capable of carrying out its own verification of input data received from Traffic Operations Personnel and generating the correct solicited output data flow as a result of data being received;</li> <li>(d) as part of the output generation process, checking for data out of range, missing or spurious values and requesting re-input where required;</li> <li>(e) provide output to Traffic Operations Personnel in a form that is readily understood by a human operator;</li> <li>(f) only generate the outputs listed above as a result of receiving inputs from the Traffic Operations Personnel or other processes;</li> <li>(g) when the request for changes to the parameters affecting the operation of the sensor systems (e.g. closed circuit television) responsible for providing sensed images of incidents (including but not limited to video) are received from traffic operations personnel (ftop-incident_camera_action_request), generate the incident_video_image_control data flow to the image processing facility;</li> <li>(h) when video images of incidents are received (incident_video_image), output them as ttop-incident_video_image_output to the traffic operations personnel;</li> <li>(i) the use of the digitized map display shall be automatic and shall be at a resolution best suited to the quantity and scope of data being displayed, i.e. the map shall be to the largest possible scale.</li> </ul>
1.3.4.3	<b>Provide Media Incident Data Interface</b>	<p>This process shall provide the interface between the Media and the Manage Incidents facility. It shall enable the media to request details of incidents and shall allow transmission of incident information to the media. The media shall also provide raw input data on possible incidents. The process shall enable the output to incorporate a map of the area to which the incidents relate.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor the input data flows and acknowledge receipt of those from the Media;</li> <li>(b) be capable of accepting input from the Media;</li> <li>(c) be capable of carrying out its own verification of input data received from the Media and generating the correct solicited output data flow as a result of the input data being received;</li> <li>(d) as part of the output generation process, carry out checks for data out of range, missing or spurious values and request re-input where necessary;</li> <li>(e) use the 'media_incident_data_updates' solicited output data flow to send data on a possible incident when this possible incident data is received from the Media in 'fm-incident_information';</li> <li>(f) provide all output to the Media in a form that is readily understood;</li> <li>(g) only generate the outputs listed above as a result of receiving inputs from the Media or the other processes;</li> <li>(h) the use of the digitized map display shall be automatic and shall be at a resolution best suited to the quantity and scope of data being displayed, i.e. the map shall be to the largest possible scale.</li> </ul>





P-Spec	Name	Overview	Functional Requirements
1.3.4.5	<b>Manage Resources for Incidents</b>	This process shall provide the capability for the Manage Traffic function to generate and receive requests for resources in responding to incidents. The process shall provide the capability for traffic operations personnel to request resources from the Manage Maintenance and Construction function to provide equipment and support for incident response and clean up. The process shall be able to receive resource requests from the Manage Emergency function and respond with the status of the response by Maintenance and Construction or the traffic operations personnel.	None.
1.6.1.1	<b>Detect Roadway Events</b>	This process is responsible for monitoring local sensor data obtained from traffic surveillance and then determining and reporting the current state of all traffic in the HRI vicinity. The process provides triggers for other processes within Manage HRI Traffic Volume. It also monitors the device controls as they are initiated by the Activate HRI Device Controls process.	None.
1.6.1.2.1	<b>Control HRI Traffic Signals</b>	This process is responsible for interpreting the hri_control message and safely directing the activation of the appropriate devices. This process will both directly command devices at the HRI and will disseminate necessary control information to the Process Indicator Output Data for Roads function to allow integrated control of adjacent traffic signals. Data will also be sent to SSR and/or HSR Device Control functions to control these specialized devices at the crossing. When sensor data indicates an approaching train this process notifies the Process Indicator Output Data for Roads function to allow the signal timing to be adjusted and dynamic message signs, if available, to be updated. This allows the traffic signals in the area adjacent to an HRI to be used to clear the Storage Area in advance of an approaching train and to manage traffic around the intersection.	None.
1.6.1.2.2	<b>Control HRI Warnings and Barriers</b>	This process is responsible for initiating the activation of HRI barriers at active vehicular and pedestrian grade crossings. When a request is sent to activate the HRI barriers perhaps because of a detection of an oncoming train, this process sends the device control signal to the Manage Device Controls process to activate the barriers. This process also returns state information to the Maintain Device State process concerning the commands that have been initiated by this process.	None.





P-Spec	Name	Overview	Functional Requirements
1.6.1.2.4	<b>Provide HSR Device Controls</b>	This process is responsible for initiating the activation of HRI devices, barriers and other special safety features for High Speed Rail at active vehicular and pedestrian grade crossings. This process responds to requests sent by the Control HRI Traffic Signals process based on detection of an oncoming train. This process sends command information to the Manage Device Control containing control signals and commands that are unique to the HSR functions, such as trapped vehicle detection. State information is also sent to the Maintain Device State process to monitor the last known state of the controls commands being processed.	None.
1.6.1.3	<b>Perform Equipment Self-Test</b>	This process is responsible for performing real-time equipment checks and reporting the status of the equipment associated with an active grade crossing. Based on receipt of the sensor data of the surrounding highway and rail traffic and receipt of any near term events this process can execute a real-time check of the equipment and determine the relative health and status of the active grade crossing equipment. The output is sent onto the Monitor HRI Status process for further processing with other diagnostic data.	None.
1.6.1.4.1	<b>Generate Alerts and Advisories</b>	This process is responsible for generating the messages to advise and protect motorists, travelers and train crews approaching and crossing railroad grade crossings. Based on the severity of the hazard condition sent by the Detect HRI Hazards process this process will either send an hri_advisory command for non-time critical data or an hri_alert command for time critical data to the Report Alerts and Advisories. These users that will receive these messages include drivers, bicyclists, and pedestrians.	None.
1.6.1.4.2	<b>Provide Closure Parameters</b>	This process is responsible for providing the HRI predicted time to closure to be used in broadcast message alerts to approaching vehicles. This time is calculated from data provided by the Detect HRI Hazards process.	None.
1.6.1.4.3	<b>Report Alerts and Advisories</b>	This process is responsible for reporting real-time HRI traffic volume advisories and real-time highway traffic alerts. Depending on the input received from the Generate Alerts and Advisories process, this process sends alerts or advisories to a train to describe the operational status of the intersection and alerts about any hazards. This process also sends the commands to Output Control Data for Roads process that will control the dynamic message signs in the area of an HRI to display the appropriate alert or advisory. Messages for local beacon broadcast are processed and sent to the Report HRI Status on Approach process.	None.



P-Spec	Name	Overview	Functional Requirements
1.6.1.4.4	<b>Report HRI Status on Approach</b>	This process is responsible for providing real-time HRI status to vehicles as they approach an HRI. It must discriminate between vehicles near, but not approaching, the HRI (e.g. on parallel side streets, etc.). This process develops the message to be broadcast to nearby vehicles by receiving time_to_closing data and the hazard_condition signal and calculating the appropriate window of time to display the message. The message is built from the approach_warning data received from the Report Alerts and Advisories process.	None.
1.6.1.5	<b>Detect HRI Hazards</b>	This process is responsible for detecting real-time HRI blockages or collisions in the vicinity of an HRI that create a blockage or other hazard at the HRI. Based upon information received from the Provide Advance Warnings process this process can send a request to the Control Traffic Volume at Active HRI that the local signal strategy be preempted. A hazard condition message can also be sent to the Generate Alerts and Advisories process for further action or the Provide Closures Parameters process to possibly adjust the time to closing.	None.
1.6.1.6.1	<b>Close HRI on Detection</b>	This process is responsible for protecting highway vehicles approaching and crossing railroad grade crossings by initiating the closure up to 3 minutes before train arrival. This process receives the near term status of the crossing including any approaching trains or trapped vehicles. With this information along with the local control plan data the predicted HRI state is computed and sent to the Detect Imminent Vehicle/Train Collision process. If a HRI_predicted_collision message is returned then this process sends out an hri_hazard message to the Detect HRI Hazard which will in turn result in a change to the device control strategy. This process also receives rail operations advisories for processing along with the state and control plan data. As needed this process will output any rail_operations_message data to the Interact with Rail Operations process.	None.
1.6.1.6.2	<b>Detect Imminent Vehicle/Train Collision</b>	This process is responsible for detecting imminent collisions between vehicles and trains at railroad grade crossings. Using the data contained in the predicted_hri_state message this process performs the necessary calculations to determine whether a collision is imminent. If so, this process returns a hri_predicted_collision message to the Close_HRI_on_Detection process.	None.



P-Spec	Name	Overview	Functional Requirements
1.6.1.7.1	<b>Control Traffic Volume at Active HRI</b>	This process is responsible for controlling vehicular traffic at an active HRI by controlling the operation of traffic control devices in accordance with a predetermined local control plan. The local control plan is communicated to the Close HRI on Detection process. This local control plan can be preempted by a strategy preemption message from the Detect HRI Hazards process or by such inputs as an event notice from the Detect Roadway Events process or HRI traffic surveillance data. The outputs of this process include the command messages to close the HRI, requests for information from the Manage Traffic function, and information about the current HRI traffic data.	None.
1.6.1.7.2	<b>Close HRI on Command</b>	This process is responsible for closing the HRI to vehicular traffic, either on command from the Control Traffic Volume at Active HRI process, or from direct command from rail operations (as an override). Upon receipt of the inputs to close the HRI or from rail operations this process shall send an HRI control message to close the intersection.	None.
1.6.2.1	<b>Exchange Data with Rail Operations</b>	This process is responsible for exchanging routine data with rail operations. Such data being sent to the rail operators includes event schedules, requests for information from the Rail Operators, incident notification based on rail operations messages received from Close_HRI_on_Detection process and hri_priority_message data received from the Manage Alerts and Advisories process. This process receives maintenance schedules, train schedules, and incident notifications from the rail operators. This information is used to develop the rail operations update data that is passed onto the Manage Rail Traffic Control Data process and the rail operations priority data that is sent to the Manage Alerts and Advisories process.	None.
1.6.2.2	<b>Manage Alerts and Advisories</b>	This process is responsible for acquiring HRI advisory or alert data from rail operations and for providing HRI status to rail operations. The data managed by this process may be time critical, as in the case of alerts or priority messages, or not time critical, as in the case of advisories.	None.
1.6.3.1	<b>Interact with Wayside Systems</b>	This process is responsible for interfacing to railroad owned and maintained wayside equipment, such as Wayside Interface Units, Crossing Gate Controllers, etc. All these devices are expected to provide real-time information to the HRI about approaching trains and their own health. In addition, advanced implementations will make use of a communications path back to approaching trains provided by the railroad's equipment.	None.



P-Spec	Name	Overview	Functional Requirements
1.6.3.3	Provide ATS Alerts	This process is responsible for automatically protecting commuter, intercity, transit and freight trains as they approach and cross grade crossings. It also reports HRI rail traffic advisories to traffic management and rail operations. It is responsible for verifying and reporting overall HRI status to approaching trains so that crews can act within safe service braking distances. It provides for notification of Automatic Train Stop systems (ATS, PTS, etc) with sufficient advance warning to allow emergency brake application time to stop a train before it encounters an HRI hazard. Finally, it provides automatic status indications about the HRI to the crews of approaching trains.	None.
1.6.4.1	Manage HRI Closures	This process is responsible for coordination and managing of HRI closures at the Traffic management Center. It interfaces with Manage Incidents process to provide incident information and to receive strategy overrides as required by the larger incident management function.	None.
1.6.4.2	Exchange Data with Traffic Management	This process is responsible for interacting with traffic management processes. It collects data from processes that are within the HRI elements located at the roadside and forwards the data as needed to other processes within traffic management. It also acts as the interface between rail operations and traffic management processes through its interface with the Interact with Rail Operations process.	None.
1.6.5.1	Provide Interactive Interface	This process is responsible for initiating reports of the health status of the HRI to both Traffic Management and Rail Operations. In addition the process initiates reporting of the health status of the HRI to the wayside interface equipment (and ultimately to the train when the advanced HRI functionality is in place).	None.
1.6.5.2	Determine HRI Status	This process is responsible for monitoring critical HRI functions and merging them into a single coherent picture of the state of the HRI. It also is responsible for assuring that the HRI always reverts to the safest possible operating condition in the event of any operational malfunctions.	None.
1.6.5.3	Maintain HRI Closure Data	This process is responsible for managing a log of the HRI operation for use in strategy planning, demand management and traffic management.	None.
3.1.3	Process Vehicle On-board Data	This process shall be responsible for processing data received as input to sensors located on-board a vehicle. The process shall continuously analyze these inputs and produce data from which safety, environmental, and/or position warnings and actions can be produced by another process. It shall also analyze the data to check for hazardous roadside conditions such as flooding, ice, snow, etc. and if detected shall output this data to processes in the Manage Traffic, Manage Maintenance and Construction, Manage Emergency Services, and Provide Driver and Traveler Services functions.	This process shall meet the following functional requirements: (a) continuously generate the outputs list above, using data scanned from the inputs also listed above; (b) complete a full scan of all inputs and generate the outputs in a timeframe consistent with the safe operation of vehicle control systems regardless of the number of inputs to be scanned and the number of outputs generated; (c) the vehicle probe data shall contain details of the type of hazard found on the road around the vehicle, or be blank if there are none; (d) be capable of accepting input data in a variety of formats, both digital and analog.



P-Spec	Name	Overview	Functional Requirements
4.2.4	<b>Manage Transit Archive Data</b>	This process shall obtain transit passenger and deployment data, transit user payment transaction data, transit emergency data, transit security data, maintenance and personnel data, and distribute it to the Manage Archive Data function. The process shall run when a request for data is received from an external source, or when fresh data is received.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any of the unsolicited data inputs shown above is received, the process shall store them in the data store along with meta data (data attributes about the data), and update the catalog; (c) when the unsolicited input from the transit system operator is received, the process shall update the data store accordingly; (d) when the request for transit archive data is received, the process shall immediately generate the solicited output shown above from the data store and send the data to the Manage Archived Data function; (e) the process should then receive the transit archive status solicited input and send this status to the transit system operator; (f) if the status received in (e) was bad, the process shall attempt to correct the data and re-send it to the Manage Archived Data function; (g) data shall only be sent to the source from which the data request originated; (h) before output, the process shall put the data into a format that is easily read and interpreted by external processes and can also be read by travelers and transit users with the minimum of further processing.
5.1.2	<b>Determine Coordinated Response Plan</b>	This process shall determine the appropriate response for a verified emergency. This process shall classify, prioritize, and respond to verified emergencies accordingly. This process shall also determine the appropriate response plan. In the case of personal vehicle security this process shall support the activation of remote controlled functions requested by a vehicle. A detailed description of the emergency, and any request for remote controlled emergency system activity, and any suggested response plan shall be sent to other processes for implementation. The same information shall also be forwarded to other emergency center processes for information and possible action. This process shall send feedback to the Manage Maintenance and Construction process to coordinate the response to an emergency with the actions taken by maintenance and construction.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flow; (b) when the input is received, the response will be determined from the data requested from the interface process that manages the store of emergency service allocation criteria and any functions requested by a vehicle shall be activated; (c) when (b) is complete, the data shall be sent to both the emergency management and communications processes.



P-Spec	Name	Overview	Functional Requirements
5.1.4	Manage Emergency Response	This process shall enable existing emergency centers to receive emergency calls, determine response requirements to the extent necessary to route the information, route distress calls and emergency information to predesignated responding agencies and vehicles, and request additional resources. All identified emergency information shall be provided by the process in a standard format as required. The process shall also communicate with commercial fleet managers to obtain details of cargo and other vehicle data where this will affect the response of the emergency services, e.g., in the case of a vehicle carrying a HAZMAT load. The current status of all emergency service responses shall be stored by the process in an action log, for access by the communications process. This process shall receive roadway maintenance status, work zone status, and work plan information from the Manage Maintenance and Construction function, and provide feedback regarding the work plan to that function. This process shall identify and request maintenance actions and resources from that same function. The process shall also request and receive environmental information from the Weather Service and Surface Transportation Weather Service.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when the input of emergency response plan data is received, generate the output data flows, and create an initial entry in the emergency response action log data store; (c) when other inputs are received, update the data for the emergency to which they relate in the emergency service action log data store; (d) if the emergency vehicle dispatch status indicates a failure, send the data to the action log and to the emergency services operator interface process; (e) manage the data in the store of the emergency service action log.
5.3.2	Dispatch Vehicle	This process shall direct selected emergency vehicles and drivers to respond to an incident, receive acknowledgment that they will in fact respond, and provide them with the location and details of the incident that was pre-calculated and sent to this process. If called for, the process shall send details to the Manage Traffic function to request a traffic control preemption be provided for the vehicle(s) if that mode of preemption is available and chosen. The data for the emergency vehicle driver shall be sent to the driver interface process.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the dispatch and status data input flows; (b) when the flows in (a) are received, generate the outputs identified above to request the emergency vehicle route and provide the driver with information about the incident, monitoring for the receipt of any reply data; (c) when the emergency vehicle route data is received, generate the emergency traffic control request data and send it to the Manage Traffic function.
5.3.3	Track Vehicle	This process shall manage information about the location of all emergency vehicles available for dispatch and that have been dispatched, and the ETA for vehicles en route. The process shall send this data to the store of emergency vehicle status data. If the vehicle is on its way to an emergency, as indicated by the received vehicle status, the process shall also send data to processes in the Manage Traffic function that will enable the vehicle to have whatever level and mode of preemption is available and granted at traffic signals.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the input data flows listed above; (b) when the location flow is received and if it is different from the previous value, generate the data flow to the emergency vehicle status store interface process, adding the current date and time to the received location data; (c) when the status flow is received, if it shows that the vehicle is on its way to an emergency incident, then simultaneously with (b) output the data flow requesting local vehicle preemption to the indicator control processes in the Manage Traffic function.



P-Spec	Name	Overview	Functional Requirements
5.3.6	<b>Maintain Vehicle Status</b>	This process shall maintain a data store of the current status of all emergency vehicles available for dispatch and that have been dispatched. It shall provide data from the store on request from other processes and shall update the contents of the store with new data received from other processes. This process shall output probe data, either traffic information or environmental readings to the Manage Traffic function. The process shall output the status of a vehicle to the process responsible for vehicle tracking for as long as it is on its way to an incident, to update ETA estimates and enable local vehicle preemption to be given at intersections, if that mode of preemption is chosen and granted.	This process shall meet the following functional requirements: (a) continuously monitor for the receipt of the input flows listed above; (b) when either the data request or data needed flows is received, read the requested data from the store and send it to the requesting process; (c) when either of the data flows containing updated or changed vehicle status data is received, load the new data into the data store, overwriting the existing data for the vehicle; (d) when the new status data shows that a vehicle is on its way to an incident, output the vehicle status data to the processes responsible for vehicle tracking and vehicle dispatch; (e) when the new status data shows that a vehicle is no longer on its way to an incident, output the status data to the process responsible for vehicle tracking, but do not send any further status updates until the condition in (d) is again satisfied; (f) manage the data in the store of emergency vehicle status data, retrieving or writing individual records for one or more emergency vehicles, as required.
5.3.7	<b>Provide Emergency Vehicle Route</b>	This process shall calculate and assign emergency vehicle routes for incident assistance upon request. This process shall provide an interface to the care facilities to which emergency vehicles may be routed. This care facility interface shall be used to decide which care facility is open and ready to receive patients. This process shall interface with a map update provider to maintain an accurate digital map for routing purposes. Once the route is calculated the route is provided to the dispatch function and a record of the assigned route is provided to the assessment function.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the request for a route; (b) when the flows in (a) are received, and the requested route involves a care facility generate an outputs to request the status of the care facility, monitoring for the receipt of any reply data; (c) when the care facility status data is received, generate the emergency vehicle route and send it back to the requesting function and send a notification of the assigned route to the assessment function; (d) periodically request and receive updates to the digital map used to generate the routes.
5.3.8	<b>Collect Environmental Data on Emergency Vehicle</b>	This process shall be responsible for collecting environmental and road condition data obtained from environmental sensors which are on-board the emergency vehicle. The process shall collect data quality information to facilitate data validation by other processes. The process shall be capable of providing status of the sensors on the emergency vehicle. When any of the data is provided in analog form, the process shall be responsible for converting it into digital form and calibrating. The converted data shall be sent to other processes for distribution, further processing and analysis, and storage.	None.





P-Spec	Name	Overview	Functional Requirements
5.6	<b>Manage Emergency Services Data</b>	This process shall collect emergency service data, emergency vehicle management data, emergency vehicle data, and incident data. It shall distribute this data to the Manage Archive Data Request where it can be archived and accessed upon request or upon receipt of fresh data. All inputs to this process are unsolicited, and all outputs are solicited, except that the 'em_archive_status' is a solicited input.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when any of the unsolicited data inputs shown above is received, the process shall store them in the data store along with meta data (data attributes about the data), and update the catalog; (c) when the unsolicited input from the emergency system operator is received, the process shall update the data store accordingly; (d) when the request for emergency archive data is received, the process shall immediately generate the solicited output shown above from the data store; (e) the process should then receive the emergency archive status solicited input and send this status to the emergency system operator; (f) data shall only be sent to the source from which the data request originated; (g) before output, the process shall put the data into a format that is easily read and interpreted by external processes and can also be read by travelers and users with the minimum of further processing.
6.1.1	<b>Provide Trip Planning Information to Traveler</b>	This process shall obtain all the information needed to fulfill the traveler's request for a trip. The process shall support the request for trips that require the use of one or more modes of transport, and shall use the preferences and constraints specified by the traveler in the trip request, plus data from the store of trip planning parameters, to select the most appropriate modes. It shall send details of the trip requirements to the specialized processes that provide route information for the different modes of transport. When route data is received back from these processes, this process shall ensure that the whole trip is covered by one coherent route for which all the data such as costs, arrival times, and modal change points are known. The information provided to the traveler by the process shall be sufficient to enable the traveler to understand the routing, modes and cost of the trip. The trip information shall be stored for possible use in subsequent trip confirmation. The process also includes parking lot data. This data is used in transactions requiring electronic payment of parking lot services, as well as for a traveler making a parking lot reservation. This process shall exchange all input and output data from and to the traveler with the appropriate traveler interface process. The traveler shall send parking lot data, traveler trip requests, and traveler current condition requests to the archival process.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the traveler trip request input flow; (b) when the input flow in (a) is received, output data flows to the data archival process and other processes requesting various types of routes, rideshare information, demand responsive trip requests, according to the preferences and constraints in the traveler's trip request and the parameters governing trip selection contained in the read only data store; (c) when the data has been returned, construct the trip and ensure that there are no breaks, i.e. where mode changes are involved, each segment begins and ends at a valid modal interchange point; (d) if any of the segments do not join up, change the preferences and constraints and repeat (b) until a correct match is produced; (e) in parallel with (c) and (d) compute the total cost of the trip, including all tolls, parking lot charges, transit fares, and other costs; (f) when all calculations are complete, store the trip information in the local store for use if the traveler decides to confirm and then send the trip data to the process that provides the traveler interface using the traveler trip information output flow; (g) when a traveler requests current conditions or parking lot data in the data store is updated, output this information to the data archival process.



P-Spec	Name	Overview	Functional Requirements
6.1.6	<b>Manage Traveler Info Archive Data</b>	This process shall accept traveler information service requests and confirmations, parking management information, payment transaction data, rideshare requests, commercial and non-commercial probe data, route guidance data, and origin/destination data, and store it in its local traveler info data archive data store, together with a catalog to describe the data. When requested by the Manage Archive Data function, this information will be sent to that function. The process shall also provide a control interface to the ISP Operator, responding with the status received from the requester of the archive. The process shall run when a request for data or a catalog is received from an external source, when a command is received from the ISP Operator, or when fresh data is received.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of any of the input flows; (b) when data to be archived is received, write the data to the traveler_info_data_archive and append its attributes; (c) when a request for the archive catalog is received, read the traveler_info_data_archive for the catalog and output it to the Manage Archive function; (d) when a request for the archive data is received, read the traveler_info_data_archive and output the data requested to the Manage Archive function; (e) when archive status is received, output the status to the ISP Operator; (f) when a command is received from the ISP Operator, process the data in the traveler_info_data_archive as directed.
6.2.1.1	<b>Collect Traffic Data for Advisory Messages</b>	This process shall collect and fuse traffic data that will be used to create broadcast or advisory messages to travelers. The input data for this process shall consist of historical, current, and predicted traffic and planned event data. The process shall extract from the data those elements appropriate for advisory or broadcast messages and load it into the store of 'traveler_traffic_information_data'. The data can be provided to the process either via direct request from the process or as a result of periodic (unrequested) updates.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the input flows listed above containing prediction data and planned events data; (b) at locally determined times, generate the data output flows to processes in this and other functions, as listed above, including traffic information for advisory and broadcast messages; (c) collect the data returned as a result of (b) and load it with that received in (a) into the data store of traveler traffic information, fusing it with the data already present, deleting old data, e.g., that relating to incidents that are completed, etc.
6.2.1.2	<b>Provide Traffic and Transit Advisory Messages</b>	This process shall provide advisory data to users in vehicles (drivers or transit users) as a result of a request from the driver or transit user. (e.g., This process supports a request/response type of exchange with the user.) The advisory information is extracted from the data stores of traveler traffic and transit information by other processes, then sent to this process. This process shall have the capability to filter the advisory data and store it so that the output only contains data that is relevant to the current location of the vehicle from which the request was made. When the user requests location specific data, the vehicle's location shall be provided to the process in the request message. Advisory data requests shall be sent to the data archival process.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the input flow requesting advisory data; (b) when the input in (a) is received, read the requested data from the store sent from the processes identified above, send the request to the data archival process, and generate the advisory data output.
6.2.1.4	<b>Provide Traffic and Transit Broadcast Messages</b>	This process shall receive advisory data from stores of traveler traffic and transit information extracted by other processes at locally determined intervals and send it out to drivers or transit users in vehicles as wide area broadcast messages. The broadcast information is extracted from the data stores of traveler traffic and transit information by other processes, then sent to this process. The content and rate of these messages shall be based upon parameters from the broadcast_parameters_data' store, which is managed by the ISP operator.	This process shall: (a) at locally determined intervals read the data from the stores sent from the processes identified above and generate the broadcast data output flow; (b) the data flow in (a) shall be generated using the filter parameters set up by the ISP operator and retained in a local data store.



P-Spec	Name	Overview	Functional Requirements
6.2.1.5	<b>Provide ISP Operator Broadcast Parameters Interface</b>	This process shall provide the interface through which the ISP operator can manipulate data in the 'broadcast_parameters_data' store. The data in this store shall be used by another process to define the scope and rate of wide area broadcast messages to vehicles. The process shall provide the ISP operator with the ability to request parameter data output and/or update the data store with new parameter values.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when the first input is received, read the data from the store of parameters and generate the second solicited output flow; (c) when the second input is received, update the data in the store of parameters and send the new broadcast data to another process that provides broadcast messages to travelers, using the first solicited output flow.
6.2.1.6	<b>Collect Environmental Probe Data</b>	This process shall collect environmental data (such as air temperature, wind speed, surface temperature, etc.) from vehicle-based sensors or vehicle control systems, aggregate it with measurements from other vehicles, and forward it to the Manage Maintenance and Construction function. This process shall tag all data with quality attributes. When any of the data is provided in analog form, the process shall convert it to digital form and calibrate it.	None.
6.2.4	<b>Collect Yellow Pages Data</b>	This process shall collect and fuse data about yellow pages (including non-motorized transportation) services in order to provide information to users in vehicles. The process shall fuse all the received yellow pages data into a coherent set and loaded into the yellow_pages_information_data store for access by processes in response to requests from users in vehicles.	This process shall meet the following functional requirements: (a) at locally determined intervals, generate the data output flow to request other (yellow pages) services data; (b) collect the data returned as a result of (a) and load it into the local data store, fusing it with the data already present.
6.2.6	<b>Provide Yellow Pages Data and Reservations</b>	This process shall extract data from the yellow_pages_information_data store upon request for data from the driver or a transit user in a vehicle. The data read from the store may be filtered, by the process, so that output only contains that which is relevant to the current location of the vehicle. The process shall also enable the user to make reservations for yellow pages services from a vehicle. Yellow pages advisory requests shall be sent to the data archival process. Data Flows: The input data flow requesting advisory information is unsolicited. All output flows and the other input flows are solicited with the exception of the following: (a) 'yellow_pages_output' data flow - which contains data stored by another function.	This process shall: (a) continuously monitor for receipt of the input flow requesting advisory data; (b) when the input in (a) is received, read the requested data from the store, generate the advisory data output flow identified above, and output the advisory request to the data archival process.



P-Spec	Name	Overview	Functional Requirements
6.3.2	Inform Traveler	This process provides the traveler (located at a kiosk) with data about all requested trip, traffic, transit, yellow pages services or event information, confirmation of any requested reservations, and payments made as part of confirmed trip plans. The data is sent by the process to an interface process that is responsible for its actual output to the traveler. This data may include digitized map data to act as the background to the output when the data is to be shown in a suitable format. This process may request data from other ITS functions or data may be sent to this process as a result of requests from another process.	This process shall: (a) continuously monitor for receipt of the input flows that are not details of transit services, traffic data and the display map data; (b) when any of the flows in (a) are received, retrieve the relevant digitized display map data from the local store and send the combined data to the traveler interface process; (c) when the flow received in (a) contains a request for transit or traffic data, send the request to the relevant process in the Manage Transit or Manage Traffic function; (d) the input data received as a result of (c) shall be combined with the relevant digitized display map data from the local store and sent to the traveler interface process; (e) all input and output flows must be encrypted in such a way that it is not possible to determine the payment information being transmitted, using any form of digital or analog techniques.
6.3.3	Provide Traveler Kiosk Interface	This process shall provide an interface at a kiosk through which travelers can input data and can receive data. The functions that the traveler can perform include plan and confirm trips, obtain current traffic and transit information, and declare emergencies. The process shall support the inclusion of yellow pages (including non-motorized transportation) services such as lodging, restaurants, theaters, bicycle facilities and other tourist activities as a part of trip planning and confirmation. The process shall be able to store frequently used data, such as the kiosk location, to reduce the amount of input needed by the traveler for each request. The process shall also carry out input data verification and require input confirmation before passing any of the traveler data to other processes (except when an emergency is being declared). The traveler's payment information shall be obtained by this process from another process specially designed for that purpose. The process shall support traveler inputs in manual or audio form, and shall provide its outputs in audible or visual forms consistent with a kiosk. These forms shall include those that are suitable for travelers with hearing or vision physical disabilities. The process shall enable viewing of data that has been previously output. Where it is appropriate, the process shall use the kiosk's location to filter data being displayed to only show information relevant to the kiosk's location, or to a specific location requested by the user.	This process shall: (a) continuously monitor for receipt of the input flows from the traveler; (b) when any of the inputs in (a) are received, check for content and if necessary utilize data from the local store; (c) generate the output identified above and load the requested data into the local data store; (d) continually monitor the data in the local store and compare it with that being input by travelers, deleting any data from the store which is not frequently used; (e) all input and output flows must be encrypted in such a way that it is not possible to determine the payment information being transmitted using any form of digital or analog techniques.



P-Spec	Name	Overview	Functional Requirements
6.3.4	<b>Update Traveler Display Map Data at Kiosk</b>	This process shall provide updates to the digitized map data used as the background for displays of trip, traffic and transit information. This data shall be suitable for use in kiosk displays. The process shall obtain the new data from map data suppliers or some other appropriate data source.	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) send out the request for new data from the specialized digital map data supplier at periodic intervals (e.g. once per month) automatically so as to provide an up to date map display using the unsolicited output data flow;</li> <li>(b) as a result of the output of the data flow in (a) continuously monitor for receipt of the solicited input data flow;</li> <li>(c) when the flow in (b) is received, output the second solicited output data flow;</li> <li>(d) be capable of receiving the input data in a variety of formats and converting it into a single format suitable for use with the store of digitized map data.</li> </ul>
6.5.1	<b>Collect and Update Traveler Information</b>	This process shall collect and update data about incidents, road construction, weather, events and yellow pages data (including non-motorized transportation). This data shall be obtained by the process from other ITS functions and from outside sources such as weather services, yellow pages service providers and the media. The process shall load the data into a local store for use by the process that provides yellow pages information and reservations.	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the unsolicited input flows;</li> <li>(b) when either of the weather service inputs are received, load the data into the store of tourist information using the solicited output flow;</li> <li>(c) when either of the yellow pages or event information data flows are received in (a) send the yellow pages or event information data request shown above in the list of unsolicited;</li> <li>(d) when the response to (c) is received in the solicited yellow pages or event information input flow, load the data into the store of tourist information using the solicited output flow shown above;</li> <li>(e) before loading data into the store of tourist information, read the current data from the store and amalgamate it with the new data;</li> <li>(f) be responsible for the management of the data in the store of tourist information, using the most appropriate mechanism(s) such as a relational database, for storing the data;</li> <li>(g) use the most appropriate mechanism(s) such as relational database , to read data from the store of information and service provider data.</li> </ul>



P-Spec	Name	Overview	Functional Requirements
6.5.2	<b>Provide Traveler Yellow Pages Information and Reservations</b>	This process shall provide information and reservation services obtained from yellow pages service providers. The process shall provide the information and reservation data so that it can easily form part of a traveler's information request or trip planning activities. The process shall be able to request additional yellow pages information if the process cannot find the required data in the tourist_information data store. The process shall send requests for payment to a process in the Provide Electronic Payment Services function for action, and shall send the response back to the process from which the payment request was received. The traveler's yellow pages requests shall be sent to the data archival process.	This process shall: (a) continuously monitor for receipt of the unsolicited input flows; (b) when the inputs are received, generate the solicited outputs as described below; (c) unsolicited inputs (a) and (b) together generate solicited outputs (a) and (e), which in turn generate solicited inputs (b) and (a), which then generate solicited output (b); (d) unsolicited inputs (c) and (e) will each generate solicited outputs (a) and (f), which in turn generate solicited inputs (b) and (a), which then generate solicited output (b); (e) unsolicited inputs (f) and (g) generate solicited input (c), then the solicited outputs (d) and (e) respectively; (f) unsolicited input (h) generates solicited input (c), then the solicited output (g); (g) if in (e) or (f) the required data is not in the solicited input, then generate solicited output (f) and repeat the read of the input data; (h) all input and output flows must be encrypted in such a way that it is not possible to determine the payment information being transmitted, using any form of digital or analog techniques; (i) unsolicited inputs (c), (e), (f), and (g) will each generate solicited output (h), which in turn will be sent to the data archival process.
6.5.4	<b>Provide Traveler Event Information</b>	This process shall provide information obtained from event promoters. The process shall provide the information so that it can easily form part of a traveler's information request or trip planning activities. The process shall be able to request additional event information if the process cannot find the required data in the tourist_information data store maintained by another process. The traveler's event information requests shall be sent to the data archival process.	This process shall: (a) continuously monitor for receipt of the input flows from the traveler; (b) when the input in (a) is received, send the request data flow to another process to obtain the event information, and then return the information to the traveler.
6.6.2.6	<b>Calculate Vehicle Probe Data for Guidance</b>	This process shall calculate route segment travel times from vehicle probe data. The probe data shall be accepted by the process from a variety of sources including toll collection points and vehicles receiving on-line infrastructure based guidance. The process shall be responsible for combining the data obtained from these sources and producing one set of route segment travel times or route segment speeds. The process shall indicate route segments for which no data, or insufficient data, is available (this indication could be by setting the link time or speed to zero). Vehicle guidance probe data shall be sent to the data archival process.	This process shall: (a) continuously monitor for receipt of the unsolicited input data flows listed above; (b) when either of the input data flows is received, recalculate the route segment travel time for which the data applies, using an appropriate smoothing factor to remove any sudden fluctuations; (c) periodically send the amalgamated route segment travel times calculated in (b) to the process that provides vehicle route calculation data; (d) when new vehicle guidance probe data is received, the output data will in turn be sent to the data archival process.



P-Spec	Name	Overview	Functional Requirements
6.7.2.2	Process Vehicle Location Data	<p>This process shall provide the vehicle's current location. It shall calculate the location from one or more sources of position data such as GPS, DGPS, odometer and differential odometers, and shall refine its calculations using techniques such as map matching, etc. Location data (intended for use by in-vehicle navigation, tracking systems, guidance systems, and emergency notification systems) should be provided by the process in a manner that is as precise as is practical within cost and technology constraints. Location data intended for transit vehicles and driver advisories may be less precise.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the input flows listed above;</li> <li>(b) continuously compute the vehicle's most probable current location using the data in the input flows, refinement and/or filtering algorithms (e.g. dead reckoning, map-following, etc).</li> <li>(c) provide the vehicle location to other processes in the Provide Driver and Traveler Services, Manage Commercial Vehicle, Manage Transit, Manage Maintenance and Construction, and Manage Emergency Services functions using output flows as identified above;</li> <li>(d) it shall be possible for the process to compute the location from as many sources of data as are simultaneously available to it, and to apply filtering and/or map matching algorithms as may be appropriate to consolidate or to choose among locations calculated from the various sources of data;</li> <li>(e) vehicle location determination for transit and driver advisories may be of lesser precision than locations intended for navigation and route guidance processes.</li> </ul>
6.8.3.3	Provide Traveler Personal Interface	<p>This process shall provide an interface in a personal device through which travelers can plan and confirm trips, as well as obtain current traffic and transit information. The process shall support trip planning and confirmation of other (yellow pages or non-motorized) services such as lodging, restaurants, theaters, bicycle facilities and other tourist activities. The process shall be able to load in the traveler_personal_regular_data store frequently used information such as traveler identity (the owner of the personal device), home and work locations, etc. This will reduce the amount of input needed by the traveler for each trip request.</p> <p>The process shall also carry out input data verification and require input confirmation, with the traveler, before passing the data to other processes. The traveler's payment information and location (when traveler is using a portable device) shall be obtained by this process from other processes. The process shall support inputs from the traveler in both digital and audio form, and shall provide its outputs in audible and visual forms that are consistent with a personal device. This process shall include forms suitable for travelers with hearing and vision physical disabilities. The process shall display data for as long as required by the traveler and must enable viewing of previously output data. When used with a portable device, the process shall provide the traveler the option to filter the data (to be displayed) relevant to the travelers current location.</p>	<p>This process shall:</p> <ul style="list-style-type: none"> <li>(a) continuously monitor for receipt of the input flows from the traveler listed above;</li> <li>(b) when any of the inputs in (a) are received, check for content, accuracy, consistency and out of range values, utilizing data from the local store identified above if necessary;</li> <li>(c) generate the output identified above and load the requested data into the local data store;</li> <li>(d) continually monitor the data in the local store and compare it with that being input by travelers, deleting any data from the store which is not frequently used;</li> <li>(e) be responsible for the management of the data in the store of regularly used data, using the appropriate mechanism(s) such as a relational database, for storing the data;</li> <li>(f) all input and output flows must be encrypted in such a way that it is not possible to determine the payment information being transmitted, using any form of digital or analog techniques.</li> </ul>





P-Spec	Name	Overview	Functional Requirements
8.1	Get Archive Data	<p>This process shall collect data from each major function within ITS and external sources for archive purposes that may not exist within current ITS data sources. This process shall respond to requests from the Manage Archive Data Administrator Interface process to import data or data catalogs. This process shall send requests for data or a catalog of available data to the other functions and terminators, either a subscription for data or a one-time request. This process shall receive meta-data along with the data to describe the conditions under which the data was collected or any other information about the operational data. When data is received this process shall perform quality checks such as range validation or reformat the data as necessary to meet the archive schema. This process shall execute methods on the incoming data such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive. Any changes made to the data shall be recorded in the meta-data stored in the archive to assist in the reconstruction of the original data if possible. This process shall receive inputs from the Manage Archive Data Administrator Interface that contain the parameters for managing the processing on the data. This process forwards the collected onto the Manage Archive function along with updated meta-data and a record of any methods applied to the incoming data. This process shall also support the notification of the operational source functions of any errors that may be present in the data that could be caused by equipment failures or a transmission error.</p>	<p>This process shall meet the following functional requirements:</p> <ul style="list-style-type: none"><li>(a) continuously monitor for receipt of the unsolicited input flows;</li><li>(b) when the unsolicited data input import_administration_request is received, the process shall generate the solicited output flow of the form xxx_archive_request where xxx is the source for the data requested;</li><li>(c) when the data xxx_archive_data is received, either unsolicited as part of a subscription arrangement or solicited in response to the request issued in (b), the process shall received the data and format it per the information contained in the import_administration_request flow received in (b);</li><li>(d) when the input data has been formatted the process shall send the data to the Manage Archive function;</li><li>(e) the process shall update the meta data of the received data to describe any formatting steps performed in (c);</li><li>(f) the process shall generate the solicited output import_administration_status to inform the Manage Archive Administrator Interface function of the status of the import process and to include the catalog of data requested and available from the source function;</li><li>(g) when data is received from an input source, the process shall generate solicited output xxx_archive_status to notify the source of any errors in the received data.</li></ul>



P-Spec	Name	Overview	Functional Requirements
8.2	Manage Archive	<p>This process shall store the collected and formatted data in a permanent archive data store. This process shall receive the formatted data from the Get Archive Data function accompanied by any updates to the meta data that would describe the formatting operations performed on the data as it was imported. This process shall respond to requests from the administrator interface function to maintain the schema of the archive data, set update frequencies, backup schedules, user authentication schemes, cleansing algorithms. This process shall provide the administrator interface function with status of the data quality in the archive, frequency reports on use of the archive, updates to the measure of the volume of the data and other data archive metrics. This process shall receive inputs from the Coordinate Archives function to provide data and information about the archive schema to other archives. In turn the process shall receive data and schema of other archives to use to build a global schema. The process shall use the global schema to support requests from user systems for data that may be spread across multiple archives. The process shall maintain the access privileges information for the data held in the archive to maintain the security of the archive. The process shall employ such techniques as necessary to maintain the integrity of the data and ensure no data is lost from the archive. The process shall respond to requests for data to support user data products, user analysis, and inputs to government reporting systems. The process shall respond to such request by authenticating the originator of the request and providing the data that is available. The process shall also be capable of providing a sample or catalog of data contained within the archive to support the user requests.</p>	<p>This process shall meet the following functional requirements:</p> <ul style="list-style-type: none"><li>(a) continuously monitor for receipt of the unsolicited input flows;</li><li>(b) when the unsolicited data input retrieved_archive_data is received, the process shall update the data store;</li><li>(c) when the unsolicited data input for administration_request is received, the process shall respond with the solicited data output administration_status;</li><li>(d) when the input flows requesting data from the archive are received, the process shall authenticate the user can access to the data, determine the location of the data, whether local or in another archive, and generate the requested data output.</li></ul>



P-Spec	Name	Overview	Functional Requirements
8.3	<b>Manage Archive Data Administrator Interface</b>	<p>This process shall interface with the Archive Data Administrator terminator and receive inputs from the administrator concerning the management and administration of the archive. The process shall establish user authentication controls for the archive and send the information to the Manage Archive function. The process shall maintain the schema of the archive, including the data and meta data contained within the archive data. Updates to the schema shall be distributed to the Manage Archive function as well as the Get Archive Data function. The process shall send the parameters and requests to the Get Archive Data function to control what data is imported into the archive and how the data is to be formatted when it is received. The parameters sent shall include such things as the schema, data format, methods to apply to the data, cleansing parameters, quality metrics, and checking specifications. The process shall send requests to the Get Archive Data function for new data or a catalog of data that may be available. The process shall respond to requests from the Manage On Demand Archive Requests function by making requests of the Get Archive Data function to establish the source and identity of the data that may exist in ITS or non-ITS sources. Then the process shall respond to the user request with the confirmation that the request can be satisfied and specifications about the data once it is imported. In cases where the Manage Archive function will be managing a roadside data collection function, this process shall initiate and control the function by sending commands and requests to the Manage Roadside Data Collection function. This process receives the status from the other functions within Manage Archived Data and presents them to the administrator.</p>	<p>This process shall meet the following functional requirements:(a) continuously monitor for receipt of the unsolicited input flow;(b) when the input is received from the administrator, generate the appropriate output data flow;(c) when the input is received from the on demand request function, generate the output to the Get Archive Data function;(d) when status flows are received, generate the output for the administrator;(e) all input and output flows regarding the security of the archive must be encrypted in such a way that it is not possible to determine the user identity or password authentication methods for any user.</p>
8.4	<b>Coordinate Archives</b>	<p>This process shall coordinate the information exchange between different Manage Archived Data functions represented through the Other Archives terminator. This process shall allow other archives to share data collected by other archive functions to share the data in response to local requests from users systems. This process shall use data collected from different archives to build a set of global schema which the data archive definitions for the local archive plus any archives known to the local archive. This process shall provide the global schema to the local Manage Archive function. This process shall receive the schema of the local archive to share with other archive functions. This process shall provide data to those other archives when requested. This process shall support analysis, data fusion, and data mining of archived information across geographically dispersed archives.</p>	<p>This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when the input in (a) is received, send the data flow to the other archive to request data be provided in response to a local user systems request or to the Manage Archive function in response to the other archives request; (c) when are response to the request in (b) is received, forward the data from other archives to the Manage Archive function and forward the local data to the other archives; (d) when local schema arrives from the Manage Archive function update the other archives with the definition of the local archive schema; (e) when schema about other archives is received update the Manage Archive function with the global_schema flow.</p>



P-Spec	Name	Overview	Functional Requirements
8.5	<b>Process Archived Data User System Requests</b>	This process shall monitor the archive data user systems interface for requests for data from the archive. This process shall support requests from users involved in planning, research, safety, as well as operations of transportation functions. This process shall receive requests for data and catalogs of data that may be contained in the archive. This process shall translate the requests into a format that can be understood by the Manage Archive function to retrieve data from the archive. When data or a catalog of data is received from the archive, this process shall generate the requested data product for the users systems. For archive data requiring financial payment this archive process the financial requests and manages an interface to a Financial Institution.	This process shall satisfy the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when a request is received from a user system, generate the request output to forward the request to the Manage Archive function; (c) when the data is received from the archive, either the catalog of data, the data itself, or meta data; immediately generate the output to the user system; (d) before output, the process shall put the data into a format that is easily read and interpreted by external processes.
8.6	<b>Analyze Archive</b>	This process shall support the interface with Archive Data User Systems for requests for analysis of the archive data. This process shall support analysis products that can provide users with the ability to perform activities such as data mining, data fusion, summarizations, aggregations, and recreation from archive data. This process shall receive the users systems requests and develop the request that the Manage Archive function can process to retrieve the data from the archive. This process shall be able to respond to users systems requests for a catalog of the analysis products available. When data and meta data are returned from the archive and the analysis is performed this process shall produce the output for the Archive Data User Systems terminator. For archive data requiring financial payment this archive process the financial requests and manages an interface to a Financial Institution.	This process shall satisfy the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when a request is received from a user system, generate the request output to forward the request to the Manage Archive function; (c) when the data is received from the archive, either the catalog of data, the data itself, or meta data; immediately perform the analysis requested and generate the output to the user system; (d) before output, the process shall put the data into a format that is easily read and interpreted by external processes.
8.7	<b>Process On Demand Archive Requests</b>	This process shall receive requests for data to be imported into the archive that is not already in the archive. The process shall forward the request to the Manage Archive Data Administrator Interface function for the administrator to handle the user request. The process shall receive the response from the administrator and forward the information to the Archive Data User System.	This process shall satisfy the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flows; (b) when a request is received from a user system, generate the request output to forward the request to the Manage Archive Data Administrator Interface function; (c) when the response is received from the administrator, generate the output to the user system; (d) before output, the process shall put the data into a format that is easily read and interpreted by external processes.
8.8	<b>Prepare Government Reporting Inputs</b>	This process shall support the preparation of inputs to reporting systems of the federal or state governments that require data from the ITS archive. This process shall respond to requests from the Government Reporting Systems terminator for data from the archive and generate the request in a form understood by the Manage Archive function. The data and any meta data necessary shall be returned from the Manage Archive function. This process shall receive the data and format it as requested and send it to the Government Reporting Systems terminator where it may be combined with other data before final submission.	This process shall satisfy the following functional requirements: (a) continuously monitor for receipt of the unsolicited input; (b) upon receipt of the input listed in (a), generate the data request to the Manage Archive function to provide the data required from the archive; (c) upon receipt of the returned data requested in (b), generate the output to the Government Reporting Systems terminator.



P-Spec	Name	Overview	Functional Requirements
8.9	Manage Roadside Data Collection	This process shall manage the collection of archive data directly from collection equipment located at the roadside. This process shall collect traffic information as well as environmental or other information that may be collected by roadside devices. This process shall respond to requests from the Manage Archive Data Administer Interface process to input the parameters that control the collection process. The request for data and control parameters shall be sent to the Manage Traffic function where the information is collected and returned. This process shall forward the data onto the Get Archive Data function for import into the archive. The Get Archive Data function shall be able to return status about the imported data. This process shall use the status information to adjust the collection function and report back to the administrator function.	This process shall meet the following functional requirements: (a) continuously monitor for receipt of the unsolicited input flow; (b) when the input is received from the administrator, generate the appropriate output data flow; (c) when data is received from the roadside_archive_data, check the data for errors and forward the data to the Get Archive Function on output collected_roadside_data; (d) update the collection_administration_status upon receipt of the archive data and the status from the Get Archive Data function.
9.1.1	Manage M&C Systems On-Board	This process shall use on-board vehicle sensors to monitor roadway infrastructure conditions (e.g. pavement cracks) and vehicle operational functions, including operating status (e.g. materials stored, materials usage, plow blade up/down etc.). It shall receive control information from the vehicle operator. It shall also receive control information from the Manage M&C Vehicle Fleet function to allow remote operation of the on-board vehicle systems. These systems shall include winter maintenance equipment for plowing, treating, and anti-icing, and routine maintenance equipment for cutting, repairs, hazard removal, etc. This process shall communicate status information to other maintenance, construction, or specialized service vehicles.	None.
9.1.3	Track M&C Vehicles and Equipment	This process shall track public and contracted fleets of maintenance, construction, and specialized service vehicles and associated equipment. Based upon the vehicle location data received as input, this process shall generate current and past vehicle locations, vehicle speed information, and location analysis data (e.g. average speed). This data provides the Manage M&C Vehicle Fleet function a complete view of the fleet locations and speeds. This data, together with similar location and status data about maintenance and construction equipment, shall be provided to the maintenance and construction center personnel. The types of vehicles and equipment tracked include roadway maintenance or construction trucks and motorized equipment, snow plows, salt/sand trucks, bucket trucks, vegetation control and grass cutting equipment, traffic control vehicles, street and drainage cleaning vehicles, among others.	None.



P-Spec	Name	Overview	Functional Requirements
9.2.1	<b>Schedule M&amp;C Activities</b>	This process shall generate new maintenance, construction, and work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes with other ITS functions. This process shall also schedule assets for use in maintenance activities and work zone activities. The process shall use parameters and input data set up by the maintenance center personnel, roadway network information, data gathered from the roadway, data input from the maintenance vehicle fleet management, and knowledge of assets within the infrastructure. The process shall also respond to requests from the Determine M&C Needs function. The process shall send its output to other functions in the Manage Maintenance and Construction function for archival, fleet dispatch and routing, and coordination of work plans with other agencies.	None.
9.2.2	<b>Status Current M&amp;C Activities</b>	This process shall assess the current status of all maintenance and construction activities and provide the information to center personnel, other agencies, and functions within Manage Maintenance and Construction to support the vehicle fleet manager and maintenance needs assessment. This status shall include actual work activities performed, current locations and operational conditions of M&C vehicles, asset inventories, materials and equipment inventories, field equipment status, environmental information, work zone status, etc. Asset usage restrictions, such as height, width, or weight requirements, whether permanent or temporary due to maintenance and construction activity, shall be gathered from Asset Management and communicated to other agencies. Incident information gathered by this function shall be forwarded to emergency and traffic management functions.	None.
9.2.3.4	<b>Manage M&amp;C Resource Needs</b>	This process shall coordinate resources with other ITS functions, including Manage Traffic, Manage Emergency Services, and other Manage Maintenance and Construction processes based on scheduled M&C work activity plans, and equipment, materials, and vehicle availability. Equipment availability and status from the Storage Facility, Equipment Repair Facility, and Asset Management shall be collected by this process, and equipment and materials resupply requests to the Maintenance and Construction Administrative Systems shall be submitted and tracked. This process shall also output information on M&C resources available to assist other Manage Maintenance and Construction processes that address M&C personnel and equipment needs, including work zones. Resource requests shall be sent on to Center Personnel for concurrence. This process shall output information on available resources to the Provide M&C Maintenance Decision Support function, and receive inputs on recommendations for road maintenance actions. A record of maintenance needs shall be output to another process for archival.	None.



P-Spec	Name	Overview	Functional Requirements
9.2.3.5	<b>Collect Roadside Equipment Status</b>	This process shall collect the status and fault data from roadside equipment, such as traffic, infrastructure, and environmental sensors, highway advisory radio and dynamic message signs, automated roadway treatment systems, cameras, traffic signals and override equipment, ramp meters, beacons, etc., and provide a cohesive view of equipment repair needs to another maintenance and construction function to arrange repair. A record of the fault information shall also be sent to the Manage Archived Data function for archival.	None.
9.2.4	<b>Manage M&amp;C Map Data</b>	This process shall provide updates to the store of digitized map data used as the background for displays of maintenance and construction activity status including work zone activities, routing maps, and vehicle fleet and equipment locations produced by processes in the Manage Maintenance and Construction function. The process shall obtain the new data from a specialist data supplier or some other appropriate data source. The process shall be able to request a map update from a specialist data supplier or some other appropriate data source.	None.
9.2.6.1	<b>Operate Roadway Automated Treatment System</b>	This process shall remotely monitor and manage automated road treatment systems, including environmental sensor equipment and dynamic message signs (DMS) used to inform travelers of road conditions. Fault information about the automated road treatment equipment shall be collected and forwarded to another process for equipment repair. Operational status, including activation occurrences of roadway treatment equipment shall be collected from the roadside devices, and forwarded to other processes to inform center personnel and to assist in scheduling M&C activities. The information will also be forwarded to another process for archival.	None.
9.2.6.2	<b>Control Roadway Automated Treatment System</b>	This process shall automatically treat a roadway section based on environmental or atmospheric conditions as determined from environmental sensors under its control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc. This process shall send treatment information to another function for roadway information device (e.g. dynamic message signP) display to drivers. Control information for the environmental sensor and automated treatment equipment is received from another process, and automated treatment operational status (activation occurrences and fault data) is returned to that same process.	None.





P-Spec	Name	Overview	Functional Requirements
9.2.6.3	<b>Operate Infrastructure Monitoring Devices</b>	This process shall remotely monitor and manage infrastructure sensors located both on the roadway and the maintenance and construction vehicle. Control information shall be issued to the sensor equipment, while data and status shall be collected. Sensor data, both raw and processed, detailing roadway infrastructure conditions shall be forwarded to another process which schedules repair. Similar information shall be sent to the Managed Archived Data function for archival, and to Asset Management for their records. Fault information about the sensors themselves shall be forwarded to another process to arrange field or vehicle sensor equipment repair.	None.
9.2.7	<b>Manage M&amp;C Archive Data</b>	This process shall process requests for maintenance and construction archive data and provide that data gathered from the roadway, traffic, and other maintenance and construction sources. Archived maintenance and construction data shall include work zone data, automated treatment system data, data about maintenance and construction resource requests and needs, activity schedules and status, and field device status. This process shall receive and respond to requests from the Manage Archived Data process for either a catalog of the data contained within the M&C data stores or for the data itself. Additionally, this process shall be able to produce sample products of the data available. As data is received into this process, quality control metrics shall be assigned. The appropriate meta-data shall be generated and stored along with the data. The process shall run when a request for data is received from an external source, or when fresh data is received. Data from this process shall also be sent to Asset Management to assist in maintaining a current record of transportation assets.	None.
9.3.1.1	<b>Operate Work Zone Devices</b>	This process shall monitor, operate, and control work zone devices located at or alongside the roadway. The devices operated include driver information devices (e.g. dynamic message signs and highway advisory radio), imaging devices (e.g. closed circuit television), and work zone intrusion detection and alert devices.	None.
9.3.2.3	<b>Generate Work Zone Information for Distribution</b>	This process shall process and format the work zone data into information suitable for distribution to terminators and other processes outside the maintenance and construction management function, as directed by the M&C center personnel. These include the media and other maintenance and construction management as well as processes in Manage Traffic, Manage Transit, Manage Emergency Services, and Provide Driver and Traveler Services. The process shall send work zone video images to traffic management, media, and other maintenance and construction management. Information shall also be sent to other processes for output to drivers via roadside information equipment such as dynamic message signs.	None.