ENTERPRISE Transportation Pooled Fund Study TPF-5 (231)

ENTERPRISE

Model Advanced Transportation Management System (ATMS) CONCEPT OF OPERATIONS AND REQUIREMENTS

FINAL

Prepared by

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The cover page photo is provided courtesy of the Minnesota Department of Transportation.

Project Champion

Shari Hilliard, Kansas Department of Transportation (KDOT), was the ENTERPRISE Project Champion for this effort and served as the overall lead for the project.

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The ENTERPRISE Board consists of a representative from each of the following member entities of the program:

- Illinois Department of Transportation
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1.0 Background and Introduction

Transportation agencies typically use an Advanced Traffic Management System (ATMS) for activities such as monitoring conditions (e.g. through detectors, cameras, and third-party data) and managing traffic (e.g. through dynamic message signs (DMS), lane use signs, ramp metering). As technology changes and systems age, agencies may purchase or upgrade their ATMS. The process of procuring a new or upgraded ATMS typically involves a systems engineering approach of defining needs, developing a concept of operations, then developing detailed requirements that can be used in procurement.

Agencies generally share a common, core set of similar needs, operational concepts, and requirements for ATMS software solutions. The purpose of this ENTERPRISE Pooled Fund Study project was for members to collaboratively develop a set of common needs, concepts, and requirements to serve as model systems engineering documents. This resulting document was not intended to be inclusive of all possible ATMS capabilities, but rather a baseline of common capabilities to be used by the member agencies to support their systems engineering process and ATMS procurement.

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This document includes a Model ATMS Concept of Operations (ConOps) that provides a user-oriented view of the ATMS. It describes the ATMS operation in relation to how different stakeholders will use and experience the system. The ConOps is a key element of the Systems Engineering process, as illustrated in **Figure 1**. The ConOps is a direct input into the development of system requirements also included in this document, which define the required high-level functionality of the ATMS. The ConOps is also used to validate that the deployed ATMS performs the expected operations and meets the needs of the ATMS stakeholders, while the system requirements are used to verify the deployed ATMS meets the required specifications.

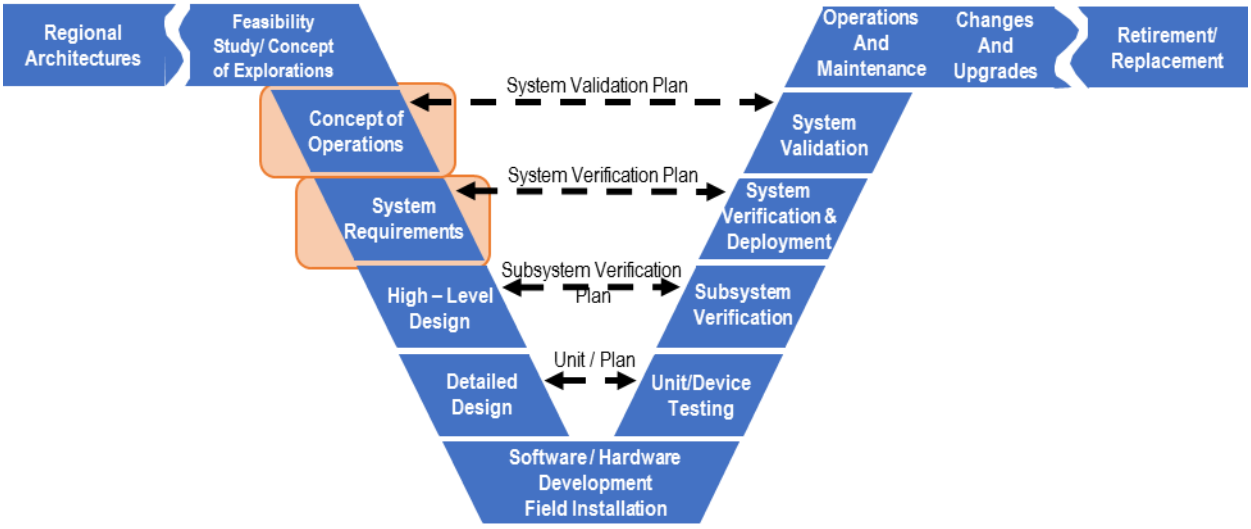

Figure 1: Systems Engineering "V" Diagram

This Model ATMS ConOps and Requirement document contains:

- 2.0 Model ATMS Concept of Operations
  - 2.1 Services
    Provides a high-level understanding of the services an ATMS will provide.
  - 2.2 Stakeholders
    Defines common stakeholders who will interact with the ATMS.
  - 2.3 System Concept
    Describes the capabilities envisioned of the ATMS.
  - 2.4 Operational Concept
    Provides an overview of how stakeholders typically interact with and use the ATMS.
  - 2.5 Stakeholder Needs
    Describes stakeholder needs commonly addressed by an ATMS.
  - 2.6 Operational Scenarios
    Provides common scenarios of how the ATMS will be used by the stakeholders.
- 3.0 Model ATMS Requirements
  Provides requirements that are considered common among agencies to meet the stakeholder needs, in each of the following areas:
  - 3.1 User Interface
    Provides common aspects of the ATMS User Interface which is the primary access point for users of the ATMS.
  - 3.2 Agency Field Devices
    Provides common agency field devices owned and operated by the agency operating the ATMS.
  - 3.3 Agency Systems
    Provides common agency systems owned and operated by the agency operating the ATMS.
  - 3.4 Third-Party Field Devices and Third-Party Systems
    Provides common third-party device and systems that are owned and operated by an entity outside of the agency operating the ATMS.
  - 3.5 Traffic Management Support
    Provides common traffic management support functions of ATMS functionality.
  - 3.6 Communication Protocols
    Provides common communication protocols to facilitate the transfer of data in and out of the ATMS and to facilitate communication among ATMS users.
  - 3.7 System Management
    Provides common system management aspects of the ATMS that enable secure, controlled access to the system.
  - 3.8 Analysis and Reporting
    Provides common analysis and reporting functionality for users to extract raw and post-processed data from the ATMS.
  - 3.9 Other Agency-Specific ATMS Requirement Categories
    Provides a placeholder to add requirements that are unique to each agency.

2.0 Model ATMS Concept of Operations

This section provides a user-oriented view of the ATMS. It describes the ATMS operation in relation to how different stakeholders will use and experience the system.

2.1 Services

The purpose of an ATMS is to integrate and interface with multiple other transportation systems in order to manage the transportation network and improve its efficiency and safety. Those transportation systems may include:

- Agency systems (e.g. asset management and road condition reporting systems)
- Agency field devices (e.g. portable and permanent cameras and DMS)
- Third-party systems (e.g. Law enforcement Computer-Aided Dispatch (CAD) and transit management)
- Third-party field devices (e.g. cameras and DMS)

An ATMS may be used to support six functional categories. Those categories are shown in **Table 1**.

Table 1: ATMS Functional Categories

Category	Description
Monitor (MO)	The ATMS provides capabilities to collect data from field devices and other systems to monitor traffic, work zones, and road and weather conditions.
Control (CO)	The ATMS provides capabilities to control field devices that are used to direct and monitor traffic and provide traffic information.
Manage (MA)	The ATMS provides capabilities to manage planned special events, incident and emergency response, traffic, and maintenance and construction activities.
Communicate (CM)	The ATMS provides capabilities to communicate information about the transportation network within the agency that operates the ATMS, and with the traveling public, regional partners, and third-party transportation services.
System Management (SM)	The ATMS provides capabilities to manage its functionality, user access and interfaces with other systems and devices. System management also describes the ability of the ATMS to monitor its own health, the communication network, and the devices to which it is connected.
Analysis and Reporting (AR)	The ATMS provides capabilities to analyze the performance of the transportation network using data collected and processed through the ATMS.

2.2 Stakeholders

There are many stakeholders who may interact with the ATMS. The exact stakeholders will vary by agency, however a description of common stakeholders, and their typical interaction with the ATMS is as follows. **Agencies should review the common ATMS stakeholders and add, delete, and /or modify as appropriate for the individual agency.**

- ***Transportation Management Center (TMC) Operators*** – TMC Operators interact with the ATMS. Their responsibilities include monitoring and managing traffic on the agency roadways. TMC Operators are the primary stakeholders who interact with the ATMS on a daily basis.

- ***ATMS Managers*** – ATMS Managers are responsible for overseeing the overall operation of the ATMS. This may include managing ATMS system updates, overseeing the development of new system functionality, and evaluating the performance of the ATMS in terms of staff interaction and effectiveness as a traffic management tool.

- ***ATMS System Administrators*** – ATMS System Administrators provide technical and programming services to add and remove ITS field devices to the ATMS, configure ATMS functionality, establish and manage access credentials for ATMS users, manage data storage and archiving, and ensure system security.

- ***Regional Partners*** – Regional Partners include public and private entities external to the DOT that may interact with the ATMS. Regional partners could include law enforcement, transit providers, commercial vehicle administrators, third-party traveler service providers, and the media.

- ***Advanced Traveler Information System (ATIS) Staff*** – ATIS Staff often utilize data collected by devices in the field, ingested into the ATMS, and stored or post-processed by the ATMS. This data is used to provide information to motorists (e.g. incidents, travel times, construction information) via traveler information dissemination mechanisms such as 511 websites, mobile apps, or social media feeds. Some agencies' ATIS Staff enter data into a Road Condition Reporting System (RCRS), while other agencies may have automated data exchanges between the ATMS and the RCRS.

- ***Transportation Planners/Analysts*** – Transportation Planners/Analysts conduct analyses of archived data collected and processed by the ATMS. These stakeholders apply performance management techniques to optimize traffic conditions and plan for future scenarios. Stakeholders in this group may include DOT transportation planners/analysts, traffic operations managers, work zone and construction managers, and external partners (e.g. researchers, consultants) that may benefit from archived data available from the ATMS.

- ***Field Staff*** – Field Staff may interact with the ATMS to monitor traffic and control field devices (e.g. cameras, highway advisory radio (HAR), DMS) for event-specific purposes. Field Staff may remotely access the ATMS and have more limited use of its capabilities than TMC Operators will have. Field staff can include DOT staff (e.g. maintenance, construction), local agency personnel, or external partners (e.g. contractors).

2.3 System Concept

The ATMS System Concept describes the capabilities envisioned of the ATMS. The ATMS is a software solution that integrates multiple traffic operation functions into a single user interface with logic and data collection to support optimal traffic management decision making. The ATMS is easy to use and provides intuitive tools for users to perform traffic management functions.

The Concept of the ATMS for each Functional Category is as follows:

- ***Monitor*** – The ATMS will provide users with a map interface to show the location and operational status of both permanent and portable devices. The ATMS will allow users to view streaming video and still images from one or more selected cameras. The map display will show current traffic conditions on all monitored roadways, including the location of incidents and details about those incidents.

  The ATMS may also ingest and aggregate information from agency systems, field devices, and external sources. The ATMS will aggregate and process data from multiple sources into information the users can easily understand.

- ***Control*** – The ATMS will provide a single interface and easy access to the control of permanent and portable field devices. The ATMS will have consistent controls for devices. For example, cameras, regardless of manufacturer, can be controlled using the same commands. The ATMS will also provide positive verification that devices have responded to control.

- ***Manage*** – The ATMS will provide the ability to manage, for example, incidents and work zones through its user interface. The ATMS will allow users to create, edit, and implement plans and templates for specific events or types of incidents. The ATMS will also have decision support and recommend appropriate response strategies. The ATMS will provide communication capabilities and contact information to support incident management and coordinating Field Staff and Regional Partners.

- ***Communicate*** – The ATMS will be able to provide traffic information to the public through field devices such as DMS and HARs, as well as by sharing it with other systems such as ATIS, for public dissemination. The ATMS will support the role of the TMC as a communications hub during incident response coordination. The ATMS will provide messaging functionality to allow its users to exchange information and alerts about events and incidents.

- ***System Management*** – The ATMS will allow for easily managing users, data, and system configuration. The ATMS will allow different levels of ATMS access to different users, and to add and delete users. The ATMS will allow for adding and removing interfaces to devices and other systems, including the ability to add new data sources or device types. The ATMS will provide configurable controls for storing and retrieving different data types, such as video, detector data, and event records.

  The ATMS will also allow authorized users to identify system health and operations, and it will flag potential security risks and subsystem failures. The ATMS will allow users to attempt to restart or reconnect to field devices and other systems.

- ***Analysis and Reporting*** – The ATMS will provide a clear and simple dashboard to represent transportation system performance and analyze the performance and health of the transportation network using data collected and processed through the ATMS. The ATMS will respond to queries for data and have reporting tools. The ATMS will also make its data available to external reporting and analysis tools, such as the agency's existing reporting tools or an agency data warehouse.

Figure 2 provides a high-level representation of how the typical ATMS will logically interact with other systems and devices. This diagram reflects common ATMS interactions, but is not intended to be comprehensive. **Agencies should review the diagram (Figure 2) and identify systems and devices to add or delete, as well as change names to those the agency uses for each.** Note that the diagram is logical and not physical and shows elements by owner, not physical location. In practice, an agency may operate many of these systems from different locations, including the cloud or remote hosting.

This document highlights common ATMS interactions between systems and devices. It is not intended to be comprehensive.

Figures 3 to 5 provide descriptions of the information flow of those common devices and systems that interact with the ATMS. For example, the ATMS controls an agency camera, and the camera provides images and operational status to the ATMS (See **Figure 4**).

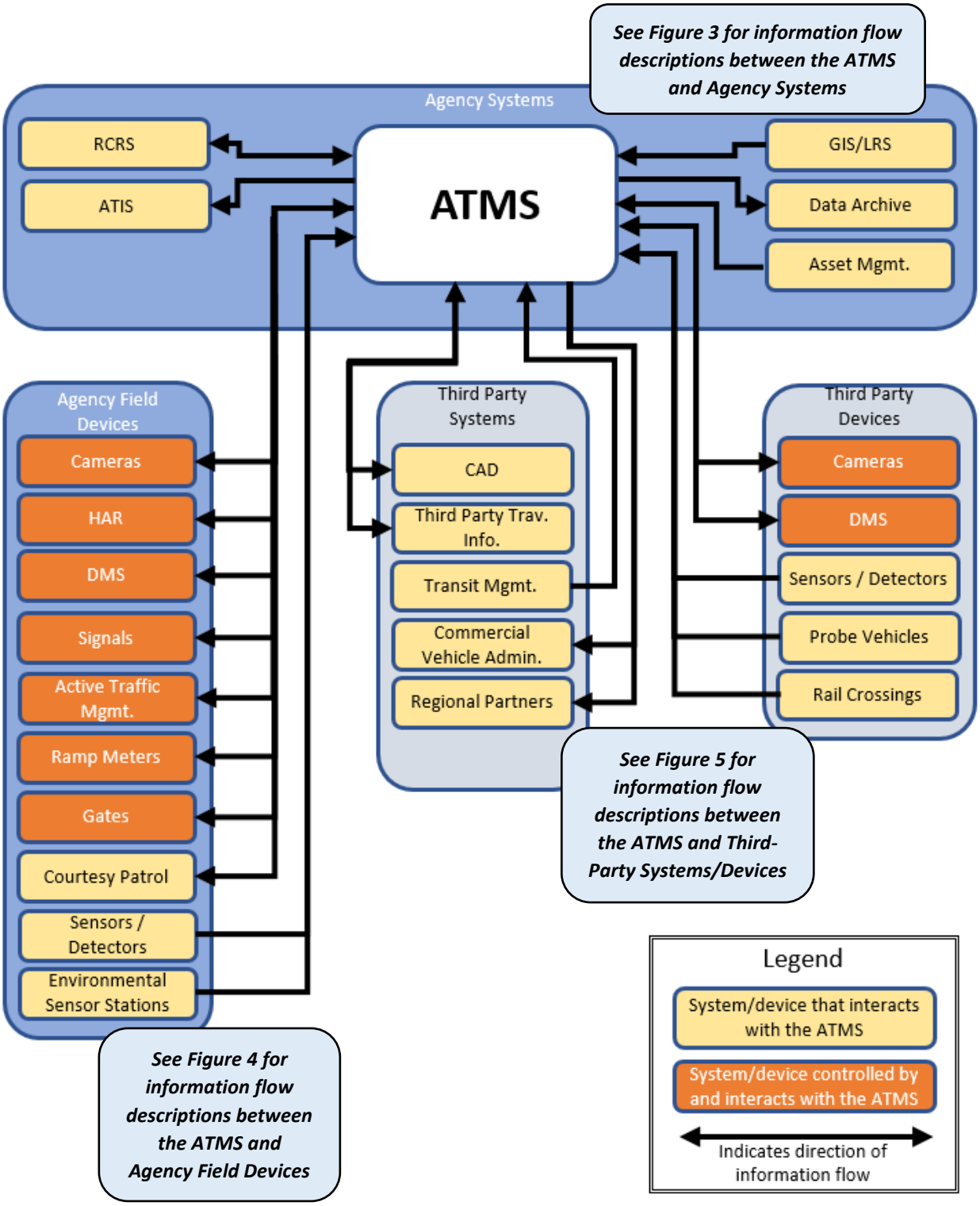

Figure 2: Common ATMS Interaction Concept

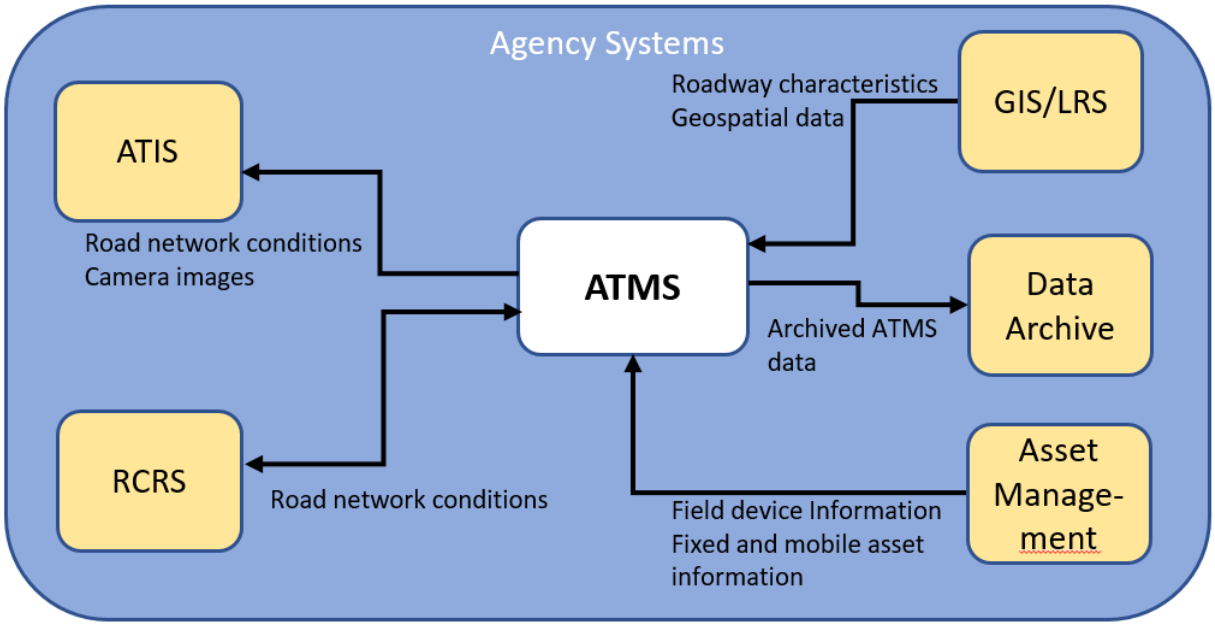

Figure 3: Common Agency Systems and Interaction with ATMS

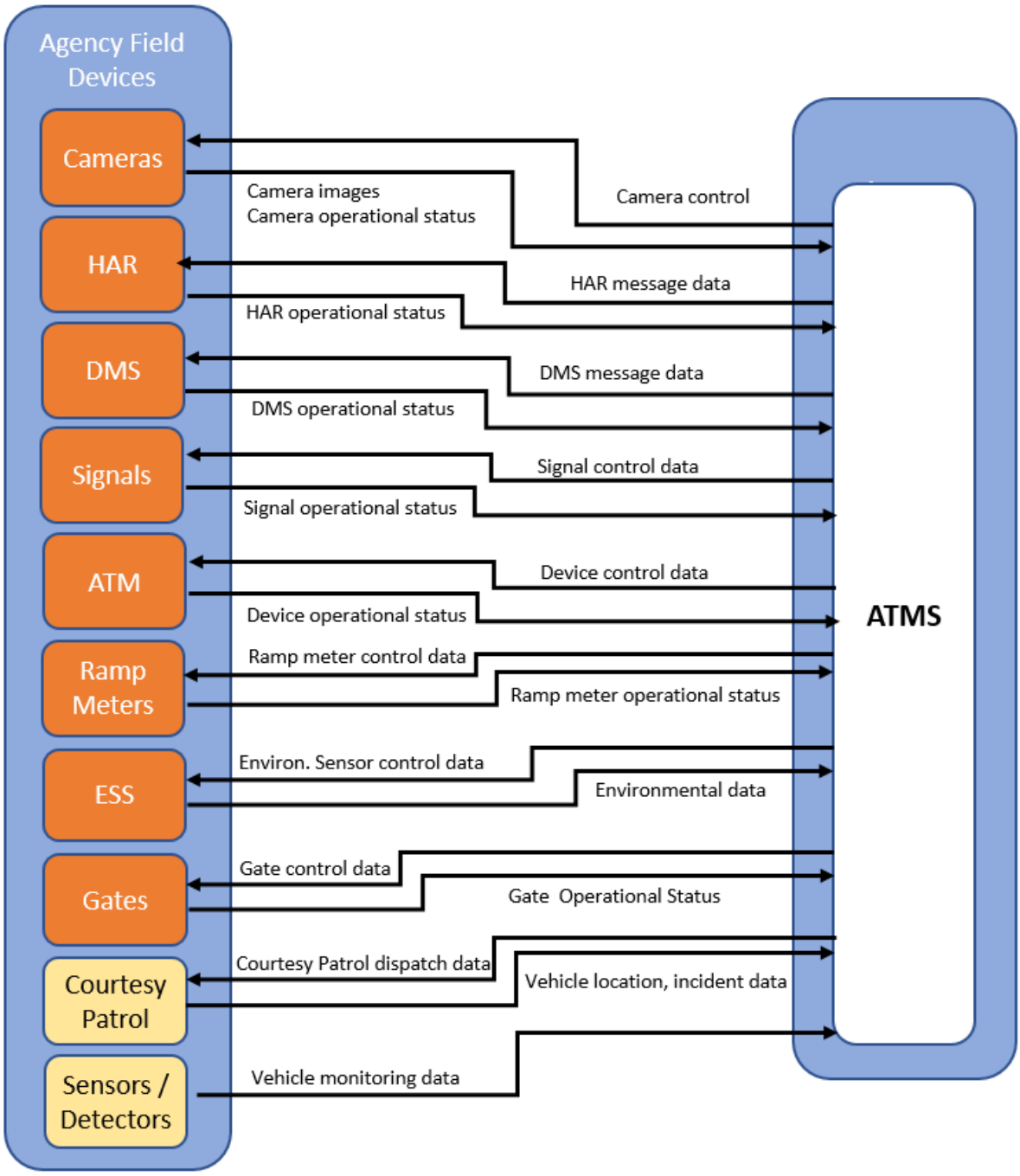

Figure 4: Common Agency Field Devices and Interaction with ATMS

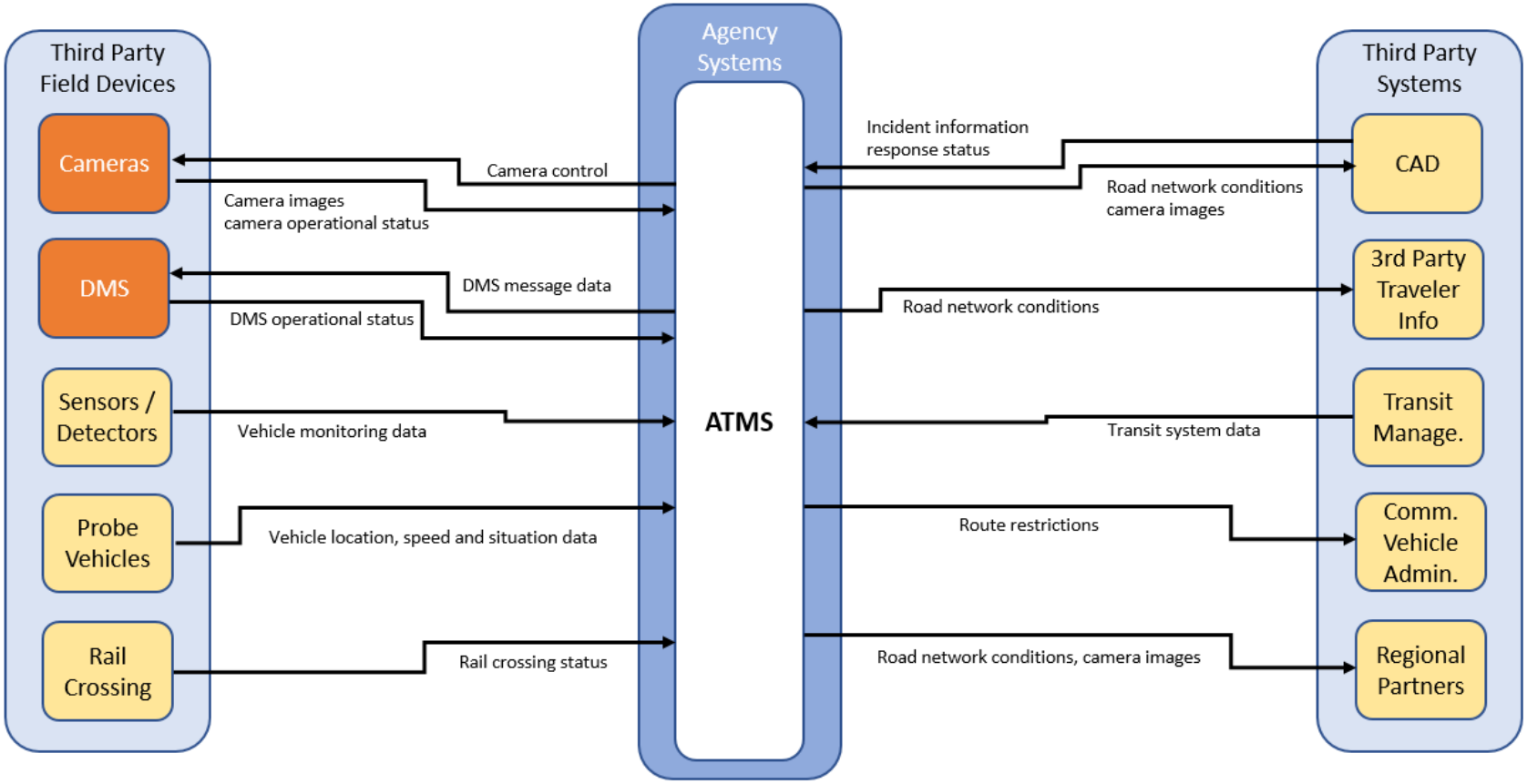

Figure 5: Common Third-Party Field Devices/Systems and Interaction with ATMS

2.4 Operational Concept

The operational concept in **Table 2** provides an overview of how stakeholders typically interact with and use the ATMS. When possible, the stakeholders' use and interaction with the ATMS are described by the ATMS functional categories (Monitor, Control, Manage, Communicate, System Management, Analysis and Reporting). Note that the operational concept only discusses the stakeholders' use and interaction with the ATMS, and is not intended as a full description of the stakeholders' jobs.

The interactions and use of the ATMS help define the scenarios in Section 2.6, and ultimately to support definition of the requirements for the ATMS as described in Section 3.0.

Table 1: Common ATMS Operational Concept

Stakeholder	Perspective (Use and Interaction) of the ATMS
TMC Operators	*TMC Operators will interact with the ATMS on a daily basis and use it as the primary system for managing traffic on the agency's roads. TMC Operators will rely on the ATMS to be a reliable system that is responsive to the TMC Operators' actions and that provides accurate transportation information.* **Monitor**: TMC Operators will use the ATMS to access images and data provided by field devices such as cameras, detectors, and environmental sensor stations to monitor traffic, road, and weather conditions. TMC Operators will monitor the status and connection to field devices and other systems connected to the ATMS. TMC Operators may receive alerts from the ATMS regarding potential incidents, scheduled maintenance activities, and planned special events in which the ATMS will help manage traffic. **Control**: TMC Operators will use the ATMS to control field devices such as cameras, DMS, HAR, and Active Traffic Management (ATM). Control may include such things as: posting messages to DMS or HAR, controlling the pan/zoom of cameras, activating ramp meters, opening/closing lanes, and updating Variable Speed Limits (VSL). **Manage**: TMC Operators will use the ATMS to manage traffic by implementing the strategies defined by the ATMS Managers, coordinating incident responses, and scheduling device actions for planned special events. **Communicate**: TMC Operators will use the ATMS to share data and information with travelers, Field Staff, and Regional Partners. TMC Operators will use the ATMS communicate information to travelers through field devices. TMC Operators will use the ATMS to gather information to support coordination of incident response with Field Staff and Regional Partners. **System Management**: TMC Operators will use the ATMS to configure device monitoring and control, to support ATMS System Administrators in identifying and resolving system faults and errors, and to perform diagnostics and tests on the system and field devices. **Analysis and Reporting**: TMC Operators will use the ATMS to view real-time and recent information on the performance of the transportation system.

Stakeholder	Perspective (Use and Interaction) of the ATMS
ATMS Managers	*The ATMS Managers are typically responsible for managing the contract with the ATMS provider and ensuring the ATMS meets the agency's operational needs. The ATMS Manager will be responsible for planning the use of the ATMS at present and in the future, including considering how the ATMS can expand to support new strategies for managing the transportation system, and identifying the optimum interfaces with other systems and devices. Note: Often the ATMS Manager is also a TMC Operator and would use the ATMS as the TMC Operators do, however this description refers to their role as the ATMS Manager.* **System Management**: ATMS Managers will monitor the health of the ATMS and the status of connections to the transportation network. ATMS Managers identifies the systems and devices the ATMS must interface with, and how information will be exchanged though the system. ATMS Managers will identify the roles and system access of other ATMS stakeholders. ATMS Managers will be responsible for identifying how data will be stored, collected and used. **Analysis and Reporting**: The ATMS Manager will use data from the ATMS to report on transportation system performance, and to perform analysis of strategies and activities performed through the ATMS. The reports will be used to plan future operation of the ATMS. The ATMS Manager will also generate reports to be consumed by executive-level staff and to justify funding for ITS.
ATMS Systems Administrators	*The ATMS Systems Administrator will be responsible for maintaining the operational status of the ATMS, its network and interfaces to other agency and external systems and devices. The ATMS Systems Administrators will be responsible for ensuring the system is accessible to the appropriate stakeholders and is reliable, operational, and providing the required functionality.* **System Management**: ATMS Systems Administrators will manage access to the ATMS by all stakeholders. ATMS Systems Administrators will manage the interfaces to other systems and to devices, including supporting adding new systems and devices. The ATMS Systems Administrator will also use the ATMS user interface to monitor and manage its security, protecting it from threats from other systems and individuals. The ATMS System Administrator will be responsible for managing data generated and used by the ATMS and the stakeholders. **Analysis and Reporting**: ATMS Systems Administrators will view system performance reports to help identify any issues that limit functionality.

Stakeholder	Perspective (Use and Interaction) of the ATMS
Regional Partners	*Regional Partners will interact with and possibly use the ATMS to support their own operations, such as goods movement, transit operations, emergency response, and information dissemination. Regional Partners may access the ATMS directly, or the systems and software they operate might exchange data with the ATMS.* **Monitor**: Some Regional Partners will use the ATMS to monitor traffic, road, and weather conditions, as well as event and incident information in order to manage their systems or to coordinate management across agencies. **Control**: Some Regional Partners will have limited control of field devices through the ATMS in order to support coordinated responses to incidents and traffic management. For example, a state and county might share control of a DMS or camera. **Manage**: Some Regional Partners will work with TMC Operators to respond to and manage incidents. Some Regional Partners will also work with ATMS Managers to develop regional incident management strategies that will be entered into the ATMS to be consistent with local plans. **Communicate**: Some Regional Partners will use the ATMS to share information from their systems, such as CAD. Some Regional Partners will also share information about the movement of oversize and overweight loads and hazardous materials through the ATMS. Some Regional Partners will ingest output from the ATMS for use in third-party traveler information services or in other regional TMC and planning tools. **System Management**: Regional Partners will work with ATMS Systems Administrators to manage their access to the ATMS and the interface of Regional Partners' systems and devices with the ATMS. **Analysis and Reporting**: Some Regional Partners will use data from the ATMS to complement their own data sources to report on transportation system performance and the impact of various transportation strategies.
ATIS Staff	*The ATIS Staff (and their managers) are responsible for ensuring that accurate and complete information is provided to the public regarding incident, traffic, and road condition information. The ATIS Staff rely on the ATMS as one source of the information that they then communicate to the traveling public.* **Monitor**: The ATIS Staff will use the ATMS to identify congestion, incidents, and events, as well as to provide data that might populate map displays or reports that will be disseminated to the public. **Communicate**: The ATIS Staff will determine the format and mediums for communicating information from the ATMS to the traveling public, such as via phone, website, or social media. **Analysis and Reporting**: The ATIS Staff will use data from the ATMS to measure the effectiveness of traveler information dissemination.

Stakeholder	Perspective (Use and Interaction) of the ATMS
Transportation Planners / Analysts	*Transportation Planners / Analysts ingest data that is available from the ATMS and process it to perform analysis and generate reports to assess and determine overall agency transportation management strategies and to improve current operations.* **Analysis and Reporting**: Transportation Planners / Analysts will use the ATMS to generate the data and information they need for analyses they perform.
Field Staff	*Field Staff use the ATMS remote functionality to support field operations, including work zones, managing incidents, and monitoring field device operations.* **Monitor**: Field Staff may remotely interface with the ATMS to monitor road and weather conditions using cameras, detectors, and entries by other ATMS users. Field Staff may also use the ATMS to monitor the operations of field devices and identify faults and errors. **Control**: Field Staff may control field devices through remote interface to the ATMS. Field device control may include permanent and portable cameras DMS, HAR and ATM. **Manage**: Field Staff may remotely interface to the ATMS to coordinate incident response, including communicating with the TMC Operators to determine the resources available from Regional Partners. Field Staff will also use the ATMS in their management of work zones to view conditions and reports, and to follow recommended plans. **Communicate**: Field Staff may remotely interface with the ATMS to report observed road and weather conditions. Field Staff often work with TMC Operators to communicate with other Regional Partners in managing incidents and events.

2.5 Stakeholder Needs

In order to allow the stakeholders to perform their roles relative to the ATMS, the ATMS must address needs in each service category (Monitor, Control, Manage, Communicate, System Management, Analysis and Reporting). **Table 3** describes those needs, defined by service category and indicating which stakeholders may have each need.

Please note that **Table 3** has a separate column to represent each common stakeholder that may use or interact with the ATMS. As a model concept of operations, this is intended to allow each agency to adjust this table to delete or add stakeholders as needed. Similarly, each need is represented as a separate row to enable agencies to delete those needs that do not apply to their agency. For example, Need N-MO-8 is the need to monitor the status of at-grade rail crossings. This is an example of a need that may be only for those agencies where emergency response or services are located on one side of a railroad with limited crossings.

Table 3: Common Stakeholder ATMS Needs

Ref #	Needs	Stakeholder						
		TMC Operators	ATMS Managers	ATMS Sys Admin	Regional Partners	ATIS Staff	Transp. Planners/ Analysists	Field Staff
MONITOR (MO)								
N-MO-1	Need to monitor traffic conditions (e.g. traffic speeds, travel times, signals, queues) to understand the current state of the traffic system and determine management strategies.	●			●			●
N-MO-2	Need to monitor road and weather conditions (e.g. road surface conditions, visibility) to identify potential safety concerns and determine management strategies.	●			●			●
N-MO-3	Need to monitor the status of, and actions taken by Regional Partners on, active incidents to coordinate incident response.	●			●			●
N-MO-4	Need to know the location of and monitor the status and operability of permanent field devices.	●			●			●
N-MO-5	Need to monitor the location, status, and operability of portable field devices, (e.g. location, whether messages are posted, whether a connection is established).	●			●			●
N-MO-6	Need to monitor multiple real-time camera streams and images using video walls, workstations and remote devices.	●			●			●
N-MO-7	Need to retrieve and review recorded camera streams and images.	●						
N-MO-8	Need to monitor the status of rail crossing activity that might impact traffic on the transportation network.	●			●			●
N-MO-9	Need an integrated interface that can represent information from various sources in a geospatial presentation.	●			●		●	●
N-MO-10	Need accurate real-time data for monitoring conditions, initiating appropriate actions, and disseminating traffic information, including: – Data ingested from other agency systems – Data ingested from field devices – Data ingested from third-party devices and systems – Data entered into the ATMS by TMC operators, Field Staff, and Regional Partners – Data that is post-processed by the ATMS. (e.g. speed/congestion maps, incident clearance times).	●			●	●		
N-MO-11	Need automated incident and congestion detection functionality, with alerts based on configurable thresholds.	●			●			

Ref #	Needs	Stakeholder						
		TMC Operators	ATMS Managers	ATMS Sys Admin	Regional Partners	ATIS Staff	Transp. Planners/ Analysists	Field Staff
CONTROL (CO)								
N-CO-1	Need a mechanism for camera control (e.g. pan, tilt, zoom).	●			●			●
N-CO-2	Need a mechanism for pre-configuring and scheduling camera control.	●						
N-CO-3	Need a mechanism for HAR control (e.g. create messages, send messages).	●						
N-CO-4	Need a mechanism for creating, storing and managing consistent HAR messages.	●						
N-CO-5	Need a mechanism for DMS control (e.g. create messages, send messages).				●			●
N-CO-6	Need a mechanism for pre-configuring and scheduling DMS actions.	●						
N-CO-7	Need a mechanism for implementing traffic signal timing plans.	●						
N-CO-8	Need a mechanism for VSL control (e.g. entering a speed limit)	●			●			
N-CO-9	Need a mechanism for configuring and scheduling VSL actions.	●						
N-CO-10	Need a mechanism for Lane Use Sign (LUS) control (e.g. activating a message that a lane is opened or closed).	●						●
N-CO-11	Need a mechanism for configuring and scheduling LUS actions.	●						
N-CO-12	Need a mechanism for Ramp Meter control (e.g. implementing ramp metering plan).	●						
N-CO-13	Need a mechanism for configuring and scheduling Ramp Meter actions.	●						
N-CO-14	Need a mechanism for controlling the opening and closing of roadway access gates.	●						●
N-CO-15	Need a mechanism to control third-party cameras.	●			●			●
N-CO-16	Need to have same ability to control of portable field devices as permanent device control.	●						●
N-CO-17	Need to know who has control of a field device.	●			●			●
N-CO-18	Need a mechanism for managing the priority of control of field devices.			●				

Ref #	Needs	Stakeholder						
		TMC Operators	ATMS Managers	ATMS Sys Admin	Regional Partners	ATIS Staff	Transp. Planners/ Analysists	Field Staff
MANAGE (MA)								
N-MA-1	Need to create, locate, select, and edit "events" (e.g. incidents, roadwork, lane and road closures, restrictions, and road condition statuses).	●			●			●
N-MA-2	Need to classify events by type and enter only information necessary for each type.	●			●			●
N-MA-3	Need to log and view all user and system activity related to an incident as part of the event record.	●	●		●			●
N-MA-4	Need decision support tools that recommend actions to help respond to events and incidents.	●						●
N-MA-5	Need the ability to schedule and coordinate the actions of devices for planned events (e.g. coordinate the actions of devices for planned events that are likely to generate traffic congestion or require detours).	●			●			●
N-MA-6	Need to configure algorithms and data for automating actions of field devices.	●						
N-MA-7	Need to override planned and automated field device actions.	●						●
N-MA-8	Need a mechanism to create, edit, store, and implement event and emergency response plans.	●						●
N-MA-9	Need a mechanism to support contacting and coordinating incident response resources and efforts with Regional Partners.	●			●			●
N-MA-10	Need a mechanism for notifying regional entities of incidents that may impact their transportation systems based on location, impacted modes and systems and other criteria.	●						●
N-MA-11	Need to manage and coordinate event traffic management and traffic information dissemination.	●			●			●
N-MA-12	Need a mechanism to dispatch freeway incident response teams (e.g. courtesy patrol).	●						●
N-MA-13	Need a mechanism for TMC operators to be informed of standard operational procedures throughout the TMC coverage area.	●			●		●	●

Ref #	Needs	Stakeholder						
		TMC Operators	ATMS Managers	ATMS Sys Admin	Regional Partners	ATIS Staff	Transp. Planners/ Analysists	Field Staff
COMMUNICATE (CM)								
N-CM-1	Need to communicate in real-time with other ATMS users, to coordinate traffic management activities.	●		●	●			●
N-CM-2	Need to disseminate event and traffic information through field devices and agency systems.	●			●	●		●
N-CM-3	Need to share real-time traffic information with Regional Partners and third-party systems.	●			●			
N-CM-4	Need to configure and control access to real-time and archived data feeds.		●					
N-CM-5	Need to communicate with Courtesy Patrols for incident response.	●						●
SYSTEM MANAGEMENT (SM)								
N-SM-1	Need to interface and efficiently exchange data with other systems.			●				●
N-SM-2	Need the ability to manage ATMS users (e.g. adding, deleting, and managing user permissions to ATMS capabilities).			●				
N-SM-3	Need the ability to configure ATMS user interface preferences (e.g. display settings, alerts).	●		●	●		●	●
N-SM-4	Need to view users that are logged into ATMS and their activities.			●				
N-SM-5	Need to view a historical log of system errors, communication failures, and device malfunctions, to troubleshoot issues that impact the overall performance of the ATMS.			●				
N-SM-6	Need the ability to manage the storing and archiving of ATMS data.			●				
N-SM-7	Need the ability to restore system after system failure.	●		●				
N-SM-8	Need the ability to restore communications to individual field devices after a connection is lost.	●		●				
N-SM-9	Need the ability to monitor network communications and identify software, network and hardware failures.			●				
N-SM-10	Need the ability to add, delete and manage interfaces to devices and other systems.			●				
N-SM-11	Need the ability to identify and prevent security risks.			●				
ANALYSIS AND REPORTING (AR)								
N-AR-1	Need basic data analytics capability to assist with performance management and planning.	●	●		●		●	
N-AR-2	Need a mechanism to query for and access archived data, for planning and performance management.	●	●		●		●	
N-AR-3	Need to generate customized and canned reports using real-time and archived data.	●	●		●		●	
N-AR-4	Need to view system performance in real-time.	●	●	●				
N-AR-5	Need to view transportation network performance in real-time.	●	●		●		●	●

2.6 Operational Scenarios

This section presents a set of common scenarios that illustrate how the ATMS may be used by stakeholders. For illustrative purposes, the three scenarios highlight various aspects of the ATMS operation. The intent of the scenarios is not to describe all possible situations, but rather to demonstrate common functions of the system.

Scenario 1: Rural Winter Weather Causing Freeway Closure

A winter storm passes through the northwest region of a rural area and impacts road conditions. The ATMS is used to monitor roadways and disseminate information.

Table 4: Scenario 1 – Rural Winter Weather Causing Freeway Closure

Ref #	Scenario Step	Need(s)
S1.1	At 9:00 AM, a winter storm arrives with extreme cold and snow in the northwest region of the state. TMC Operators and Field Staff may monitor the road and weather conditions through the ATMS in the area hit by the winter storm through: • Agency field devices (e.g. cameras, environmental sensor stations); • Third-party systems (e.g. third-party traveler information); and/or • Third-party devices (e.g. cameras, sensors).	N-MO-2, 5, 6, 10 N-CO-1, 2, 15
S1.2	At 10:00 AM, a TMC Operator is alerted through the ATMS that a camera in the area of the storm is not connected. The TMC Operator connects to the camera through the ATMS and resets the connection. The connection to the camera is restored and the camera resumes reporting conditions.	N-MO-4 N-CO-2 N-SM-5, 8, 9
S1.3	By 1:30 PM, the winter storm creates low visibility, snow drifts, and icy conditions on the Interstate. The transportation agency with authority closes the Interstate in both directions for a five-mile stretch. The road closure may be entered into the ATMS by the TMC Operator or via a data feed from the RCRS to the ATMS.	N-MA-1, 2 N-SM-1
S1.4	At 1:35 PM messages are posted on agency field dissemination devices (e.g. DMS, HAR) in the area to advise travelers of the closure through recommendations from the decision support function of the ATMS (TMC Operator reviews the devices, locations and messages recommended by the ATMS, accepts the recommendations, and the ATMS posts the messages) or through communication with ATMS Stakeholders (TMC Operators work with ATMS Stakeholders to identify which devices to post messages to, creates the message, and post the messages).	N-MA-3, 4, 6, 7, 11 N-CM-1, 2 N-CO-3, 4, 5, 6
S1.5	At 1:35 PM, Regional Partners are alerted of the Interstate closure by receiving notifications (e.g. email, phone) from TMC Operators or by receiving automated notifications (e.g. email, text) generated by the ATMS.	N-MA-9, 10 N-CM-3
S1.6	By 6:00 PM, the winter storm has ended. The transportation agency with authority determines that the Interstate can reopen. The TMC Operator updates the information in the ATMS to reflect the Interstate has reopened (e.g. the ATMS decision support function recommends field dissemination devices (e.g. DMS and HAR) locations and messages to be removed, the TMC Operator reviews the recommendations from the ATMS and accepts the request) or the TMC Operator removes the field dissemination device messages.	N-MA-3, 4, 6, 7, 11 N-CM-1, 2 N-CO-3, 4, 5, 6

S1.7	At 6:10 PM, Regional Partners are alerted of the Interstate reopening by receiving notifications (e.g. email, phone) from TMC Operators or by receiving automated notifications (e.g. email, text) generated by the ATMS. The ATMS may send an automated feed to the agency's ATIS communicating a status change due to the reopening.	N-MA-9, 10 N-CM-3 N-SM-1
S1.8	The day's ATMS data is stored and available for a debrief of the winter storm event with stakeholders, and then archived for later analysis by Transportation Planners and Analysts.	N-SM-6 N-AR-1, 2, 3

Scenario 2: Major Crash

A northbound vehicle collides with another northbound vehicle on a two-lane highway. The two vehicles are disabled and block the northbound lane and shoulder. Almost immediately, cellular 911 calls are placed from nearby observers and Law Enforcement dispatch is made aware of the crash. The ATMS is used to monitor roadways and disseminate information.

Table 5: Scenario 2 – Major Crash

Ref #	Scenario Step	Need(s)
S2.1	At 1:10 PM, TMC Operators are notified by Law Enforcement Dispatch of an incident on the highway through: • Colocation of the TMC operators with law enforcement; • Email/text/phone communication from Law Enforcement to the TMC Operators; or • The crash information automatically reaches the ATMS through automated CAD to ATMS integration.	N-MO-3 N-MA-9, 10 N-SM-1
S2.2	At 1:10 PM, TMC Operators use cameras to identify and verify the location and extent of the incident. The TMC Operators create an incident event in the ATMS to document the crash location or the event may be entered in the RCRS connected to the ATMS.	N-MO-4, 5, 6 N-CO-1, 15 N-MA-1, 2 N-SM-1
S2.3	At 1:15 PM, TMC operators post messages on agency field dissemination devices (e.g. DMS, HAR) in the area to advise travelers of the incident through recommendations from the decision support function of the ATMS (TMC Operator reviews the devices, locations, and messages recommended by the ATMS, accepts the recommendations, and the ATMS posts the messages). The decision support system also reminds the operator to contact the neighboring state DOT since the incident is within 10 miles of the state boundary) or through communication with ATMS Stakeholders (TMC Operators work with ATMS Stakeholders to identify which devices to post messages to, creates the message, and post the messages).	N-MO-4, 5 N-CO-3, 4, 5, 6 N-MA-3, 4, 7, 8, 9, 10, 11 N-CM-1, 2
S2.4	At 1:15 PM, Regional Partners are alerted of the incident by receiving notifications (e.g. email, phone) from TMC Operators or by receiving automated notifications (e.g. email, text) generated by the ATMS.	N-MA-9, 10 N-CM-3
S2.5	At 1:30 PM, the TMC Manager views the performance of the transportation network during the crash using a real-time ATMS "dashboard" and determines that the current incident management plan is appropriate and no changes are required.	N-MO-1, 6, 9, 10
S2.6	At 4:00 PM, maintenance Field Staff and Regional Partners clear the roadway and return the roadway to normal operation. TMC Operators	N-MO-3, 6, 10 N-CO-1, 15

	monitor the activity using field devices (e.g. cameras, sensors) to verify when the lanes are cleared.	
S2.7	At 4:05, PM TMC Operators update the incident event information in the ATMS and remove the field dissemination device messages.	N-MA-1, 3, 7 N-CM-1, 2
S2.8	The day's ATMS data is stored and available for a debrief of the incident with stakeholders, and then archived for later analysis by Transportation Planners and Analysts.	N-SM-6 N-AR-1, 2, 3

Scenario 3: Daily Commute

The daily weekday afternoon commute in an urbanized area includes congestion and incidents. The ATMS is used to monitor roadways and disseminate information.

Table 6: Scenario 3 – Daily Commute

Ref #	Scenario Step	Need(s)
S3.1	At 3:00 PM, TMC Operators may begin to monitor afternoon commuter traffic conditions in an urban area by analyzing: • Agency field devices (e.g. cameras, sensors/detectors); • Third-party systems (e.g. third-party traveler information); and/or • Third-party devices (e.g. cameras, sensors/detectors).	N-MO-1, 6, 9, 10 N-CO-1, 2, 15
S3.2	At 3:45 PM, the ATMS detects congestion by monitoring data from field monitoring devices and third-party data providers. The ATMS assesses that the congestion is within the pre-determined threshold for normal commuter congestion. The ATMS automatically estimates travel times on various highway segments and sends travel time messages to be displayed on DMS throughout the metro area. The ATMS shares travel times with the agency's ATIS through a data feed.	N-MO-10, 11 N-CO-5, 6 N-MA-6 N-CM-2, 3 N-SM-1
S3.3	At 4:45 PM, the ATMS may use data from field monitoring devices and third-party data providers to identify an area of significant congestion on the highways, and alerts the TMC Operators of this congestion location. TMC Operators use cameras to view the congestion location and see that a car is stalled in the westbound left lane of an urban four-lane Interstate.	N-MO-4, 5, 6, 10, 11 N-CO-1, 15 N-CM-1
S3.4	At 4:45 PM, TMC Operators create an incident event in the ATMS to log the stalled vehicle and its location (highway designation, lane location, and milepost or intersecting roadway). The ATMS recommends messages to be displayed on upstream DMS. The area upstream of the incident includes a series of signs over individual lanes that collectively are used for ATM. For these, the ATMS has determined recommended speeds to be posted on the variable speed limit (VSL) signs to slow traffic as it approaches the queue that is now forming. The TMC Operator accepts the recommendations and the ATMS posts the messages to the appropriate signs.	N-CO-5, 6, 8, 9 N-MA-1, 2, 3, 4, 6, 7 N-CM-1, 2
S3.5	At 4:45 PM, the TMC Operators contact a courtesy patrol to move the stalled vehicle from the roadway. The TMC Operators provide the location of the stalled vehicle to the courtesy patrol. TMC Operators edit the event in the ATMS for the stalled vehicle that includes the action of dispatching courtesy patrol.	N-MA-1, 3, 12 N-CM-5

S3.6	At 5:00 PM, TMC Operators observe through cameras and ATMS notifications that the stalled vehicle has backed up traffic for over a mile. TMC Operators update information on the DMS to alert travelers upstream of the queue.	N-MO-6 N-CO-1, 5, 15 N-MA-3, 7 N-CM-2
S3.7	At 5:15 PM, the courtesy patrol notifies the TMC Operators that the stalled vehicle has been moved to the shoulder. TMC Operators verify that the vehicle has moved by using the ATMS to control nearby cameras and view the camera images). TMC Operators remove DMS messages and the ATM displays are removed automatically by the ATMS as the queue dissipates and speeds return to normal.	N-MO-6 N-CO-1, 5, 8, 15 N-MA-3, 6, 7, 11 N-CM-1, 2, 5
S3.8	The ATMS stores the afternoon peak information for analysis and reporting by the TMC Manager, and then archives the data for later analysis by Transportation Planners and Analysts.	N-SM-6 N-AR-1, 2, 3

3.0 Model ATMS Requirements

This section details model requirements for ATMS systems. The requirements are considered common among agencies to define the system requirements that meet the common stakeholder needs detailed in the Model Concept of Operations, Section 2.5 of this document. The model common ATMS requirements are intended to be customized by agencies to reflect their needs and preferences, and to be augmented with non-system requirements, such as those for performance and customer support.

The model requirements are organized into ***Categories*** of ATMS systems, devices, and functions. Each category is further sub-dived into ***Modules*** within the ATMS that agencies can choose to include or eliminate. For example, in the category of Agency Field Devices, an agency may have cameras and DMS operated by their ATMS, but not HAR. Agencies can choose only those modules that are applicable to their ATMS. **Table 7** provides a listing of Categories and Modules of model ATMS requirements contained in this section. **Table 8** provides a high-level description of the requirements included in each module. **Table 9** shows an example of how requirements are organized by Category and Module.

Table 7: Categories and Modules of Model ATMS Requirements

Categories	Modules	
Section 3.1 User Interface - The primary access point for users of the ATMS.	• Map/Appearance • Data Entry • Logic	• Selection • Query • Templates/Copying
Section 3.2 Agency Field Devices - Devices that are owned and operated by the agency that is operating the ATMS.	• Cameras • Highway Advisory Radio (HAR) • Dynamic Message Signs (DMS) • Signals	• Active Traffic Management (ATM) • Ramp Meters • Gates • Courtesy Patrol • Sensors/Detectors • Environmental Sensor Stations
Section 3.3 Agency Systems - Systems that are owned and operated by the agency operating the ATMS.	• Road Condition Reporting System • Global Information System (GIS)/Linear Referencing System (LRS)	• Data Archive • Asset Management
Section 3.4 Third-Party Field Devices and Systems - Devices and systems that are owned and operated by an entity outside of the agency operating the ATMS.	• Third-Party Cameras • Third-Party DMS • Third-Party Sensors/Detectors • Probe Vehicles	• Rail Crossings • Computer Aided Dispatch • Third-Party Traveler Information • Transit Management
Section 3.5 Traffic Management Support - ATMS functionality that supports traffic management operations.	• Event/Incident Management • Data Synthesis	• Decision Support • Work Zone Management
Section 3.6 Communication Protocols - Protocols to facilitate the transfer of data into and out of the ATMS, and to facilitate communication among ATMS users.	• Data Feed • Video Feed	• User-to-User Communication

Categories	Modules	
Section 3.7 System Management - Refers to aspects of the ATMS that enable secure, controlled access to the system.	• System Security • User Management • User Permissions	• Data Management and Storage • Interfaces
Section 3.8 Analysis and Reporting - This functionality allows users to extract raw and post-processed data from the ATMS.	• Canned Reports • Ad Hoc Reports • Report Configuration	• Dashboards • Output Types
Section 3.9 Other Agency-Specific Requirements - Provides a placeholder to add requirements unique to each agency.	• ADA or State Accessibility	• Agency Software/Hardware Policies

Table 8: High Level Requirement Descriptions of Modules

Category: Section 3.1 User Interface Module Descriptions	
Map/Appearance	**Data Entry**
• Graphical user interface that: - Presents system data geospatially - Displays traffic congestion, flow, and speed on its map - Displays events • Functionality for each user • View standard operating procedures relevant to each event type • Notify users through visual and audible notifications	• Permission to manage data (adding, deleting, and editing) • Enter a location • Enter free text • Administrative users to define min and max values for data fields • Notify users of incorrect data entry
Logic	**Selection**
• Configurable logic that supports and guides user actions • Configurable hard stops • Enforce configurable data validation rules • Configure thresholds • Undo previous steps in a data entry process	• Select map Elements within an area, at a point or along a roadway, or by element type • Selection from the digital map or by entering selection criteria • Displayed icons and map elements to access related system functionality
Query	**Templates/Copying**
• Ad hoc queries of stored information • Common queries from a configurable list • Expose all objects in its databases to queries with admin permission • Query criteria (IF, AND, and OR)	• Create and store templates of common data entry • Manage templates (adding, deleting, naming, editing) • Copy active and stored events

Category: Section 3.2 Agency Field Devices Module Descriptions	
Cameras	**Highway Advisory Radio**
• View real-time video and control camera capabilities • Manage control by multiple parties and schedules • Prevent video from selected cameras from being viewed by selected users in real-time • Record, store and playback video • Integrate with existing management solution or manage a solution to store and manage video • Manage the display of images and video • Select cameras to share with the public • Log user camera actions as part of the event • Identify closest cameras to an event location • Add and delete cameras • Mechanism to restore and restart cameras • Associate recorded images and video to be retrievable as part of the event record	• Monitor and control agency's HAR • Recommend stored HAR messages based on incident or event details • Broadcast multiple messages through a single HAR • Schedule HAR operation as part of planned special events • Schedule HAR messages by time of day, day of week, and season • Add and delete HAR devices • Mechanism to restore connections and restart HAR devices • Log user HAR action as part of the event
Dynamic Message Signs	**Signals**
• Monitor and control agency's DMS • Enter DMS messages and images through a display that shows the message as it will appear on the DMS • Include DMS message and images library that users can access • Add and delete DMS devices • Manage access to DMS • Schedule DMS messages by time of day, day of week, and season • Schedule DMS operation as part of planned special events • Automatically post travel times for road segments ahead of the DMS location • Mechanism to restore connections and restart DMS • Log user DMS action as part of the event	• Monitor and control agency's traffic signals • Store timing plans within the system • Select and implement stored timing plans • Manage timing plans based on priority • Schedule implementation of timing plans as part of planned special events • Schedule implementation of timing plans by time of day, day of week, and season • Add and delete traffic signals • Mechanism to restore connections with signals • Log user signals action as part of the event

Active Traffic Management	Ramp Meters
• Monitor and control Variable Speed Limit signs • Monitor and control Dynamic Lane Use signs	• Monitor and control ramp meters • Store ramp metering plans • Select and implement ramp metering plans • Manage ramp metering plans based on priority • Schedule ramp metering plans as part of a planned special event • Schedule ramp metering plans by time of day, day of week and season • Mechanism to restore connections with ramp meters • Log user Ramp Metering action as part of the event
Gates	**Courtesy Patrol**
• Monitor and control gates and associated signs that restrict roadway access • Open or close automated gates through the user interface • Control signs including overriding current status • Manage status of gates that are manually opened and closed or do not have gate position sensors • Schedule operation of automated gates for planned special events • Schedule operation of automated gates and associated signs by time of day, day of week and season • Set default positions for automated gates • Override scheduled operation of an automated gate • Mechanism to restore connections with gates • Log each user gate action as part of the event	• View real-time location and status of Courtesy Patrol vehicles • View features of each Courtesy Patrol vehicle • Interface with Courtesy Patrol Vehicle Mobile Data Terminals (MDT) for data exchange • Ingest and display images sent from Courtesy Patrol vehicle MDTs • Ingest images sent from field staff and allow users to view them • Log Courtesy Patrol vehicle data and images as part of the event
Sensors/Detectors	**Environmental Sensor Stations**
• Monitor traffic sensors/detectors • Ingest and process location-based traffic sensor/detector data • Store traffic data collected by the sensors /detectors • Mechanism to restore connections with the sensors/detectors • Use sensor/detector data in algorithms to automate system actions	• Monitor ESS and control ESS cameras • Allow users to control and display ESS cameras • Allow for ESS camera control to be consistent with control priority • Use ESS data in decision-making and automated operation capabilities • Alert users to actions taken by the system based on ESS data • Mechanism to restore connections with ESS • Log all actions taken by the system based on ESS data

Category: Section 3.3 Agency Systems Module Descriptions	
Road Condition Reporting System	**Global Information System (GIS)/Linear Referencing System (LRS)**
• Ingest and use road network condition information provided by RCRS • Automatically create events from road network condition information • Allow users to create events using road network condition information • Indicate through the display events created from road network condition information from the RCRS • Classify road network condition information by event type • Associate ingested road network condition information with events and include in event logs based on time and proximity	• Ingest and use roadway characteristics and geospatial data provided by agency GIS/LRS
Data Archive	**Asset Management**
• Store raw and processed data • Transmit raw and processed data stored within the system since the previous transmission • Automatically remove select stored raw and processed data following confirmation that it has been archived	• Ingest asset data provided by agency asset management system
Category: Section 3.4 Third-Party Field Devices and Systems Module Descriptions	
Third-Party Cameras	**Third-Party DMS**
• View real-time video and control pan/tilt/zoom/record/ playback capabilities of third-party cameras • Comply with the camera management strategies established by third-party camera owners • Log user third-party camera actions as part of the event • Identify and recommend the closest cameras to an identified event location	• Monitor and control third-party DMS • Enter DMS messages and images through a display that shows the message as it will appear on the third-party DMS • Allow users to use DMS message and images library • Add and delete third-party DMS devices • Comply with DMS management strategies by third-party DMS owners • Log each user third-party DMS action

Third Party Sensors/ Detectors	**Probe Vehicles**
• Monitor third-party traffic sensors/detectors • Integrate third-party sensor/detector data into algorithms used to automate system actions • Configure data collection to comply with third-party rules for ownership and use	• Access traffic information from third-party probe vehicles • Ingest and process location-based traffic sensor/detector data • Conflate third-party probe vehicle data segments with agency-defined segments • Restrict what segments of third-party probe vehicle data are visible to operators, based on data quality • Prioritize the data sources for speed on each given segment • Store third-party probe vehicle data
Rail Crossings	Computer Aided Dispatch
• View locations of railroad crossings and the status of active railroad crossings • Automatically display locations and status of railroad crossings located near incidents • Log crossing status activity for crossings near incidents as part of event logs • Send alerts and notifications of incidents near railroad crossings to identified contacts	• Ingest and use CAD information provided by law enforcement agencies • Classify CAD reports by event type • Associate CAD reports with system events based on location and time and include in event logs
Third-Party Traveler Information	**Transit Management**
• Ingest and use information provided by third-party traveler information systems • Classify third-party traveler information by event type • Associate third-party traveler information with events and include in event logs	• Ingest and use transit data • Associate transit information with system events based on location, time, and real-time transit vehicle location information and include in event logs

Category: Section 3.5 Traffic Management Support Module Descriptions	
Event/Incident Management	**Data Synthesis**
• Provide a mechanism to manage events entered into the ATMS • Create pre-defined event types • Define event fields to describe each pre-defined event • Mechanism to create and enter new events • Mechanism to edit events	• Aggregate and synthesize datasets from multiple sources • Generate real-time travel times using synthesized system data • Automatically detect incidents and congestion
Decision Support	**Work Zone Management**
• Process active events against internal logic to create and edit Action Plans that recommend actions • Include control of Field Devices on system Action Plans • Prompt communication to Regional Partners on system Actions Plans • Provide a mechanism to review, edit and implement the actions presented in Action Plans • Perform automated actions, without manual intervention • Provide Actions Plans that include standard operating procedures based on type and location of event	• Add and delete mobile and temporary field devices • Ingest information from mobile and temporary field devices • Monitor and control mobile and temporary field devices • Define limits of work zone areas • Retrieve stored contact information and generate automated notifications to users
Category: Section 3.6 Communication Protocols Module Descriptions	
Data Feed	**Video Feed**
• Provide data collected, generated, and stored by the system in real-time • Limit access to feeds based on authorized users or systems	• Provide a real-time video feed for third parties to view • Provide video feed to third parties without negatively impacting performance for system users
User-to-User Communication	
• Allow users to communicate with each other from within the system • Store and make contact information of other users available to users with permission • Log all user messages	

Category: Section 3.7 System Management Module Descriptions	
System Security	**User Management**
• Comply with all agency security policies • Utilize agency's Active Directory to allow staff to access roles through existing usernames and password or have login and user account security consistent with the agency policies • Allow account creation and maintenance rules for users external to the agency • Manage interfaces to new systems and devices • Encrypt all data that is at rest • Use secure API-based methods for encrypting data in transit to accommodate data exchange outside the agency firewall • Generate and make available security information (e.g. logs of connection errors) • Remote monitoring of all vital system components • Notify users when the system identifies a security risk • Have a disaster recovery plan for operation continuation in case of catastrophic system failure • Support failover redundancies and swapping of critical solution components and critical data of all solution components • Be FedRAMP certified	• Manage user accounts • Log and make available all user management activity • View user historic and real-time activity by user • Limit a user's permission based on parameters • Capable of having a minimum of 200 user accounts at any time • Have 50 users logged in and active in the system simultaneously • Manage individual's user account and preferences for display, notification and contact
User Permissions	**Data Management and Storage**
• Grant access to any system functionality • Assign users to pre-defined user types with preconfigured permissions • Add or remove permissions to individual users • Allow a user to have permissions from one or more user types	• Use a relational database • Store data that is collected by the system, entered into the system by users and generated by the system • Make stored data available to users • Manage stored data within the system • Include detailed database design documentation • Directly query system database • Store data generated/collected for a configurable period of time • Allow data storage from third-party systems in compliance with third-party licensing

Interfaces	
• Interface with existing agency systems or provide a data transformation tool • Allow for direct database interface to other authorized systems • Identify and log faults and errors with interface systems that prevent successful data exchange • Notify users when an interface fails to successfully exchange data • Support industry standards for interfacing with other systems • Add and delete interfaces to other systems to allow data exchange • Identify and reject data that does not conform to system rules • Mechanism to notify users of interface failures	
Category: Section 3.8 Analysis and Reporting Module Descriptions	
Canned Reports	**Ad Hoc Reports**
• Access and generate standard operational and management reports about the roadway network, route, or specific events	• Access and generate customizable ad hoc reports from system data
Report Configuration	**Dashboards**
• Configure the presentation and format of canned and ad hoc reports	• Display dynamic graphical and tubular reports as a “dashboard” within its user interface
Output Types	
• View a report of errors in the system • View a report on user access and usage, including queries and actions	

Category: Section 3.9 Other Agency-Specific Requirements Module Descriptions	
ADA or State Accessibility	**Agency Software/Hardware Policies**
• Be compliant with Section 508 of the Work Rehabilitation Act and the agency's policy for accessibility by people with disabilities • Test and verify system accessibility using an agency-provided tool	• Hosted by the state, externally, or a hybrid of state and external hosting and meet all relevant security requirements. • Operate in most recent version of Windows Server used by the agency • Allow for the addition of functionality or customizations through "modules" offered by the vendor • Provide a solution with load balancing and synchronization • Have separate environments for development, testing and production • Perform all data exchange in the production environment • Have fully functional web tools in the most recent version of an approved web browser • Update the user interface and all functionality remotely and without disruption of system operation • Provide all functionality through the system an agency's workstation • Limit functionality through the user interface for remote users • Include a mobile application/optimized user interface capable of providing limited functionality • Clearly define a version control process and code management system

Table 9: Example of Requirements Tables, Organized by Category and Module

Model ATMS Requirements – Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Cameras (CA)				
Highway Advisory Radio (HAR)				
Dynamic Message Signs (DMS)				

***Category*: Agency Field Devices**

***Modules*: An agency may choose requirements for "Cameras" and "Dynamic Message Signs," but not "Highway Advisory Radio (HAR)."**

The model ATMS requirements are presented in a tabular format, sorted by Category. The tables are comprised of the following five headings, with a brief description of each, with associated nomenclature.

- **Module**: Denotes specific devices or functions that can be included or eliminated. After a Module is chosen, agencies can customize the tables by adding, deleting, or modifying requirements.
- **Requirement ID**: Designates a unique identifying number for each requirement. Nomenclature for Requirement ID is as follows:
  - High-Level Requirement ID: "Category-Module-Number"
    - Example: AFD-CA-01 is the 1st high-level requirement for Agency Field Devices (AFD), Cameras (CA)
  - Sub-Requirement ID: "Category-Module-Number.Sub-number"
    - Example: AFD-HAR-02.03 is the 3rd sub-requirement under the 2nd high-level requirement for Agency Field Devices (AFD), Highway Advisory Radio (HAR)
  - Options: Options for customizing requirements based on considerations are denoted in alphabetical order following the requirement number
    - Example: AFD-HAR-02a AFD-HAR-02b, AFD-HAR-02c lists 3 separate options (a, b, and c) for requirement AFD-HAR-02.
- **Requirement**: Denotes the model ATMS requirement.
- **Need(s)**: Denotes one or more stakeholder needs addressed by the requirement. Needs correspond to high-level requirements and all applicable sub-requirements. The designated need(s) map back to stakeholder needs as provided in Section 2.5.
- **Considerations**: Indicates key considerations to assist agencies with customizing requirements.

Table 10 shows an example table with Requirement IDs, Requirements, Need(s), and Considerations. The tables are designed to be flexible not only to pick and choose modules, but to add or delete rows of requirements, especially as guided by the considerations noted.

Table 10: Example Table with Requirement ID, Requirement, Need(s) and Considerations

Model ATMS Requirements – Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Cameras (CA)	**AFD-CA-01**	**The system shall allow users with permission to view real-time video from and control the pan/tilt/zoom/record/playback capabilities of cameras controlled by the ATMS.**	N-MO-1, 2, 4, 5, 6, 7, 10 N-CO-1, 2, 16	
	AFD-CA-01.1	• The system shall allow users to select one or more camera(s) from the graphical user interface or by entering a device ID to view real-time video and/or to control the camera(s).		
	AFD-CA-01.2	• The system shall allow users to view real-time images from cameras that the user does not control.		
	AFD-CA-05a	**The system shall integrate with the agency's existing video management solution for storing and managing video.**		If an agency has a video management system determine if camera control goes through that system or directly from the ATMS to camera.
	AFD-CA-05b	**The system shall include a video management solution for recording, storing and managing video captured from the agency's cameras.**		

High-Level Requirement

Need(s): Correspond to the high-level requirement and sub-requirements.

Sub-Requirements

Options: An agency will choose AFD-CA05a or AFD-CA-05b, based on considerations from the far-right column.

Considerations

The following sections, Section 3.1 through Section 3.9, provide the model ATMS requirements.

3.1 User Interface

The ATMS User Interface is the primary access point for users of the ATMS. **Table 11** outlines model ATMS requirements for the User Interface, including:

- Map/Appearance;
- Data Entry;
- Logic;
- Selection;
- Query; and
- Templates/Copying.

Table 11: Model ATMS Requirements – User Interface

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Map/ Appearance (MA)	**UI-MA-01**	**The system shall have a graphical user interface that presents system data geospatially.**	N-MO-3, 9	Determine whether the vendor will use a GIS map provided by the DOT, a common map such as OpenStreets or Google, or be allowed to select its own map.
	UI-MA-01.1	• The system user interface shall allow the user to navigate the digital map using standard function such as panning and zooming.		
	UI-MA-01.2	• The system user interface shall use consistent graphics and icons to depict information on the digital map and provide a legend to define iconography.		
	UI-MA-01.3	• The system user interface shall provide information in layers that can be turned on and off by the user. For example, traffic cameras and transit information will each be on separate layers.		

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	UI-MA-01.4	• The system user interface shall allow each user to configure and save map preferences. For example, a user's default setting may include a preferred scale, center of map, and preferred layers.		
	UI-MA-01.5	• The system user interface shall be able to automatically reduce or combine detail on the digital map based on zoom level to minimize clutter.		
	UI-MA-01.6	• The system user interface shall increase the amount of detail as the user zooms in on a map area.		
	UI-MA-02	**The system user interface shall graphically display traffic congestion, flow, and speed on its map.**	N-MO-1 N-AR-4, 5	
	UI-MA-03	**The system user interface shall graphically display events on its map.**	N-MA-3	
	UI-MA-03.1	• The system user interface shall inform users of events that may be related. For example, the system will indicate to the user when congestion on a roadway may be the result of a nearby crash.		
	UI-MA-03.2	• The system user interface shall identify and inform users of events that are occurring at the same time in close geographic proximity.		
	UI-MA-03.3	• The system user interface shall inform users of the priority assigned to displayed events.		
	UI-MA-04	**The system shall provide system functionality for each user through a single user interface.**	N-SM-2, 3	Determine if there will be only a browser-based interface, or an application-based user

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				interface, or a hybrid of the two. If a hybrid, determine and define what functionality will be expected of each.
	UI-MA-04.1	• The system shall provide all system functionality through the user interface on workstations.		
	UI-MA-04.2	• The system shall limit access to functionality for different users through configurable permissions.		
	UI-MA-04.3	• The system user interface shall allow the user to simultaneously run other applications on the same device. For example, a TMC Operator may have an e-mail application open on the same workstation as the system user interface.		
	UI-MA-04.4	• The system user interface shall allow the user to have multiple system windows simultaneously open.		
	UI-MA-04.5	• The system shall allow users to access functionality from remote locations. For example, Field Staff may log in from a maintenance office or the roadside.		Determine if remote use should be through a web browser or installed software, and whether an agency wants all functions to be available remotely, or only a subset of the functions.
	UI-MA-05	**The system shall provide users the ability to view agency standard operating procedures relevant to each event type.**	N-MA-13	Determine if the agency has documented standard operating procedures

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				that can be linked to or included in the system.
	UI-MA-06	**The system shall notify users through visual and audible notifications and alerts.**	N-MO-1, 2, 3, 4, 5, 8, 11	
	UI-MA-06.1	• The system shall notify users of traffic conditions and events, including the start of planned special events.		
	UI-MA-06.2	• The system shall alert users of system status, such as loss of connection to a device, or faulty data received.		
	UI-MA-06.3	• The system shall allow users to configure the thresholds and filters for when to be notified including event type, priority, geographical area, and time of day.		
	UI-MA-06.4	• The system shall allow users to create and schedule notifications for themselves or other users. User-created notifications shall be associated with event records.		
Data Entry (DE)	**UI-DE-01**	**The system shall allow users with permission to manage data in the system, including adding, deleting and editing.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
	UI-DE-01.1	• The system shall automatically guide the user's data entry based on the type of data being entered. For example, a user entering an incident will only be required to enter data needed for incidents.		
	UI-DE-01.2	• The system shall allow users to enter data using pull-down menus, lists, and tables where appropriate. For example, when creating an event, the user can select the type from a pull-down menu of defined event types.		

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	UI-DE-02	**The system shall allow users to enter a location by selecting points, road segments, and areas on the digital map, or by entering coordinates, location names, or road name and mile marker.**	N-MO-9	
	UI-DE-03	**The system shall allow users to enter free text into appropriate data entry fields.**	N-MA-1, 2, 8, 9 N-CO-3, 4, 5	
	UI-DE-04	**The system shall allow users with administrative permissions to define minimum and maximum values for data fields where appropriate. For example, the system may only allow entry of a variable speed limit from 15 to 75 miles per hour.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
	UI-DE-05	**The system shall notify users of data entry that is incorrect and describe the error to the user. For example, if a user enters a variable speed limit that is outside the acceptable values, the system will tell the user the value is too high or too low.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
Logic (LO)	**UI-LO-01**	**The system shall have configurable logic that supports and guides user actions.**	N-MA, 4, 5, 6, 7, 8, 9, 10, 11	Consider whether your agency wants to go beyond these requirements and include logic components such as configurable workflows, the ability to have quality review in the workflow and more detailed “wizard” type guidance for user processes.
	UI-LO-02	**The system shall have configurable hard stops that prevent the user from proceeding in a data**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		entry process beyond the point of a user error. For example, the system will not let a user enter event details without selecting an event type.		
	UI-LO-03	**The system shall enforce configurable data validation rules.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
	UI-LO-04	**The system shall allow users to configure thresholds that trigger automated processes and recommendations. For example, a user may set a threshold speed at which a certain DMS message is recommended or automatically sent to a DMS.**	N-MA-4, 6	
	UI-LO-05	**The system shall allow users to undo previous steps in a data entry process.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
Selection (SE)	**UI-SE-01**	**The system user interface shall allow users to select map elements within an area, at a point or along a roadway, or by element type, and highlight the element when it is selected.**	N-MO-9	
	UI-SE-02	**The system user interface shall allow users to select map elements from the digital map or by entering selection criteria. For example, the user may select to see all road construction within a district by selecting a district and the construction event type.**	N-MO-9	
	UI-SE-03	**The system's map interface shall allow users to select displayed icons and map elements to access related system functionality. For example, clicking on a camera icon may provide the user with a display of images from the camera and the ability to control the camera.**	N-MO-9	
Query (QU)	**UI-QU-01**	**The system shall allow users to perform ad hoc queries of information stored in the system based on geospatial, temporal, and event criteria.**	N-MO-9, 10 N-AR-2	Consider the types of queries that may be performed by all stakeholder types. Also

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				consider how robust real-time query functionality is for your agency. Many queries are for planning purposes and can be performed from archived data through other tools such as Crystal Report and Tableau.
	UI-QU-02	**The system shall allow for users to perform queries using a configurable list of common queries. For example, a user may select a query for the status of all DMS on a major highway instead of writing the query each time the user wants to view the statuses.**	N-MO-9, 10 N-AR-2	
	UI-QU-03	**The system shall expose all objects in its databases to queries by users with administrative permission.**	N-MO-9, 10 N-AR-2	Consider data ownership and the location of databases, whether in-house or hosted. In hosted environments, there may be limitations to what an agency owns within a database used to provide ATMS service to the agency.
	UI-QU-04	**The system shall allow for query criteria to be combined in IF, AND and OR queries.**	N-MO-9, 10 N-AR-2	

Model ATMS Requirements – User Interface (UI)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Templates / Copying (TC)	**UI-TC-01**	**The system shall allow users to create and store templates of common data entry to be used when creating new events.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
	UI-TC-02	**The system shall allow users to manage templates, including adding, deleting, naming and editing stored templates.**	N-CO-3, 4, 5, 8, 9, 10, 11 N-MA-1, 2, 3, 5, 6, 8	
	UI-TC-03	**The solution shall allow users to copy active and stored events to create new events.**	N-MA-1	

3.2 Agency Field Devices

Agency Field Devices are owned and operated by the agency that is operating the ATMS. **Figure 6** shows common Agency Field Devices and typical interactions with the ATMS. **Table 12** outlines model ATMS requirements for common Agency Field Devices including:

- Cameras;
- Highway Advisory Radio;
- Dynamic Message Sign;
- Signals;
- Active Traffic Management;
- Ramp Meters;
- Environmental Sensor Stations;
- Gates;
- Courtesy Patrol; and
- Sensors/Detectors.

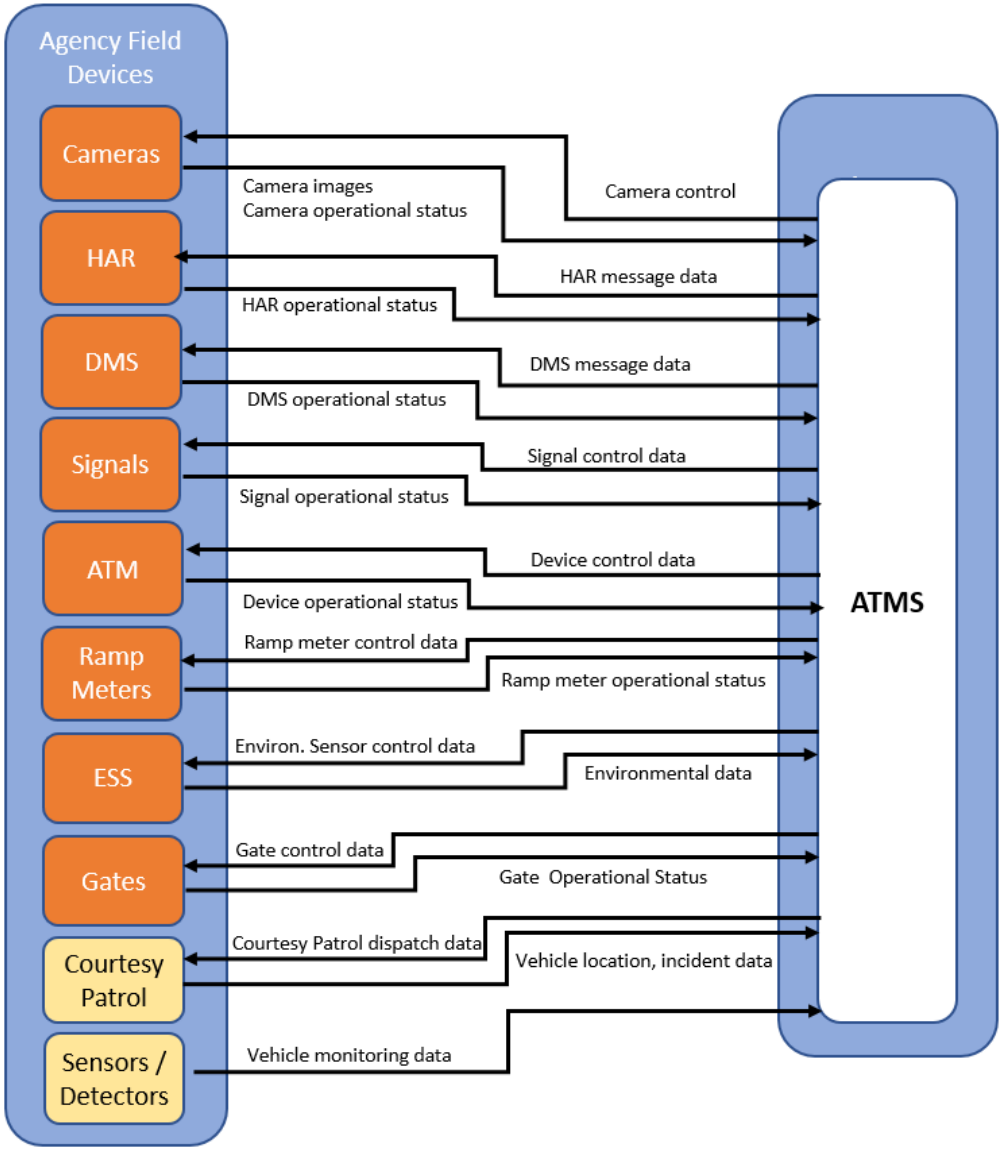

Figure 6: Common Agency Field Devices and Interaction with ATMS

Table 12: Model ATMS Requirements – Common Agency Field Devices

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Cameras (CA)	**AFD-CA-01**	**The system shall allow users with permission to view real-time video from and control the pan/tilt/zoom/record/playback capabilities of cameras controlled by the ATMS.**	N-MO-1, 2, 4, 5, 6, 7, 10 N-CO-1, 2, 16	If the agency currently has multiple interfaces for different cameras, determine if the new ATMS will require integration so that all cameras (both digital and analog) can be controlled through the ATMS's single user interface. Let potential bidders know the brand of cameras used and interface details.
	AFD-CA-01.1	• The system shall allow users to select one or more camera(s) from the graphical user interface or by entering a device ID to view real-time video and/or to control the camera(s).		
	AFD-CA-01.2	• The system shall allow users to view real-time images from cameras that the user does not control.		Identify if there are any fixed cameras. If all cameras are controllable, this requirement is unnecessary.
	AFD-CA-01.3	• The system shall allow the user to select the cameras to display at their workstation, device or to a video wall connected to the ATMS and manage the layout and size of		If video management software is currently used to manage images on a video wall the

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		multiple video streams in the graphical user interface.		ATMS will need to interface with that video management software.
	AFD-CA-01.4	• The system shall allow users to define and implement pre-set camera pan/tilt/zoom schedules, such as by time of day, day of week and season. For example, a camera may be set to view a bridge that ices over only in the winter.		
	AFD-CA-01.5	• The system shall allow users to define and view "tours" of images from multiple cameras such that the user selects the cameras, camera pre-sets and duration the video from each camera will be displayed.		
	AFD-CA-02	**The system shall manage the control of cameras by multiple parties and schedules.**	N-MO-6, 7 N-CO-1, 2, 17, 18	
	AFD-CA-02.1	• The system shall allow an administrator to assign different control priority levels to different camera users. For example, TMC operators may have the highest priority of all users to control the agency cameras.		
	AFD-CA-02.2	• The system shall grant control of a camera to the user with the highest priority.		
	AFD-CA-02.3	• The system shall inform users of which user currently controls a camera.		The controlling user may be within the agency or a third-party user with control permission.
	AFD-CA-02.4	• The system shall manage conflicts between pre-set camera schedules and indicate which schedule is implemented.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-CA-03	**The system shall allow users with permission to prevent video from selected cameras from being viewed by selected users in real-time.**	N-SM-2	
	AFD-CA-04	**The system shall allow users with permission to record, store and playback video.**	N-MO-7 N-SM-6	
	AFD-CA-04.1	• The system shall be configurable to enter how long recorded video will be stored.		
	AFD-CA-04.2	• The system shall allow users to search and retrieve recorded video using search criteria such as camera, time of day, day of year and by selecting events.		
	AFD-CA-05a	**The system shall integrate with the agency's existing video management solution for storing and managing video.**	N-MO-6, 7	If an agency currently has a video management system determine if camera control goes through that system or directly from the ATMS to the camera. Also, video storage, recording and retrieval requests will go to the video management system.
	AFD-CA-05b	**The system shall include a video management solution for recording, storing and managing video captured from the agency's cameras.**	N-MO-6, 7	
	AFD-CA-06	**The system shall allow users with permission to manage the display of images and video from agency cameras.**	N-MO-6, 7	
	AFD-CA-07	**The system shall allow users with permission to select the cameras from which the videos will be shared with the public.**	N-MO-6, 7	
	AFD-CA-08	**The system shall log user camera actions as part of the event for which the camera action is taken.**	N-MA-3	

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-CA-09	**The system shall identify and recommend to users the closest cameras to an identified event location.**	N-MA-4	
	AFD-CA-10	**The system shall allow users with permission to add and delete cameras that can be monitored and controlled through the system.**	N-SM-10	
	AFD-CA-11	**The system shall have a mechanism for users to restore connections and restart cameras that are not responding.**	N-SM-5, N-SM-8	This functionality is dependent upon the camera having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-CA-12	**The system shall be able to associate recorded images and video captured by cameras with event logs so that recorded video or images shall be retrievable as part of the event record.**	N-MA-3 N-SM-6 N-AR-2	
Highway Advisory Radio (HAR)	**AFD-HAR-01**	**The system shall allow users with permission to monitor and control the agency's HAR.**	N-MO-4, 9 N-CO-3, 4 N-MA-4 N-CM-2 N-SM-6	Let potential bidders know the brand(s) of HAR used and interface details.
	AFD-HAR-01.1	• The system graphical user interface shall allow users to view the locations and statuses of HAR controlled by the system. For example, the HAR icons may appear different depending on whether they are currently broadcasting a message.		
	AFD-HAR-01.2	• The system shall allow users to select HAR from the graphical user interface or by entering a device ID and listen to any message		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		currently broadcast from the selected HAR. The system shall also allow the user to view the message as text.		
	AFD-HAR-01.3a	• The system shall allow users to select one or more HAR(s) from the graphical user interface or by entering device IDs and generate a message for the selected HAR(s) by entering text that is automatically converted to voice by the HAR system.		Identify if an agency's system is text-to-voice only, or also allows for voice recording of messages for the HAR system.
	AFD-HAR-01.3b	• The system shall allow users to select one or more HAR(s) from the graphical user interface or by entering device IDs and generate a message for the selected HAR(s) by recording a voice message to be transmitted to the HAR system for broadcast.		
	AFD-HAR-01.4a	• The system shall allow users to store template HAR messages as text that the user can select and edit to generate new messages to broadcast through selected HAR(s).		This option allows for building a library of standard HAR messages. It is for systems that convert text-to-voice.
	AFD-HAR-01.4b	• The system shall allow users to store recorded voice messages that the user can select to broadcast through selected HAR(s).		This option allows for building a library of recorded messages. It is for systems that use recorded messages.
	AFD-HAR-01.5	• The system shall allow users to activate any flashing beacons associated with a selected HAR that is connected to the system.		
	AFD-HAR-01.6	• The system shall allow users to preview HAR messages as voice messages and edit them before broadcast.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-HAR-02	**The system shall be able to recommend stored HAR messages based on incident or event details.**	N-CO-4 N-MA-4	
	AFD-HAR-03	**The system shall be able to broadcast multiple messages through a single HAR.**	N-CO-4 N-CM-2	
	AFD-HAR-03.1	• The system shall allow users to assign a priority to each message.		
	AFD-HAR-03.2	• The system shall allow users to create "playlists" for each HAR by selecting multiple messages to be played.		
	AFD-HAR-03.3	• The system shall manage the frequency and order of broadcast of multiple messages based upon message priority.		
	AFD-HAR-03.4	• The system shall inform the user of the length of time needed to play all messages in a playlist.		Knowing the length of a string of messages is important in order for the user to be certain all messages will be heard by travelers passing the HAR.
	AFD-HAR-04	**The system shall allow users with permission to schedule HAR operation as part of planned special events.**	N-MA-5	
	AFD-HAR-05	**The system shall allow users with permission to schedule the messages for HAR by time of day, day of week and season.**	N-MA-5	
	AFD-HAR-06	**The system shall allow users with permission to add and delete HAR devices that can be monitored and controlled through the system.**	N-SM-10	
	AFD-HAR-07	**The system shall have a mechanism for users to restore connections and restart HAR devices that are not responding.**	N-SM-5, 8	This functionality is dependent upon the camera having existing

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-HAR-08	**The system shall log user HAR action as part of the event for which the HAR action is taken.**	N-MA-3	
Dynamic Message Signs (DMS)	**AFD-DMS-01**	**The system shall allow users with permission to monitor and control the agency's DMS.**	N-MO-4, 5, 10 N-CO-5, 16, 17, 18 N-CM-2	Let potential bidders know all of the brand(s) of DMS used and interface details.
	AFD-DMS-01.1	• The system graphical user interface shall allow users to view the locations and statuses of DMS controlled by the system. For example, the DMS icons may appear different depending on whether they are currently active.		
	AFD-DMS-01.2	• The system shall allow for monitoring and controlling connected DMS using the NTCIP 1203 standard.		
	AFD-DMS-01.3	• The system graphical user interface shall allow users to view all parameters describing the DMS as defined in NTCIP Object Definition for all agency DMS controlled by the system.		
	AFD-DMS-01.4	• The system shall allow users to select DMS from the graphical user interface or by entering a device ID and view any message currently displayed as it appears on the selected DMS.		
	AFD-DMS-01.5	• The system shall allow users to select one or more DMS(s) from the graphical user		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		interface or by entering device IDs and generate a message for the selected DMS(s) by entering the message to be displayed by the DMS(s).		
	AFD-DMS-1.6	• The system shall periodically poll capable DMS for the value of the NTCIP 1203 object pixelFailureTableNumRows and generate a notification to users if the percentage of failed pixels on a DMS device exceeds a configurable threshold.		
	AFD-DMS-02	**The system shall allow users with permission to enter DMS messages and images through a display that shows the message as it will appear on the DMS, including color and images when available.**	N-CO-5	
	AFD-DMS-02.1	• The system shall allow users to select font size, font color, image size and image color for the message and image to be displayed on a DMS.		
	AFD-DMS-02.2	• The system shall limit the user's entry based on the capabilities of the DMS. For example, for a DMS that does not allow multiple colors or font sizes, the system will not allow the user to select color and font size.		
	AFD-DMS-03	**The system shall have a DMS message and images library that users with permission can access when creating a DMS messages.**	N-CO-5	
	AFD-DMS-03.1	• The system shall allow users to manage the message in the DMS library, including editing, adding, and deleting messages.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-DMS-03.2	• The system shall allow users to manage the DMS images including editing, adding and deleting images.		
	AFD-DMS-03.3	• The system shall allow users to select messages from the library to display on the selected DMS(s).		
	AFD-DMS-03.4	• The system shall allow users to select images from the library to display on the selected DMS(s).		
	AFD-DMS-03.5	• The system shall allow users to edit a message from the library prior to display on selected DMS(s).		
	AFD-DMS-03.6	• The system shall allow users to edit images from the library to display on the selected DMS(s).		
	AFD-DMS-04	**The system shall allow users with permission to add and delete DMS devices that can be monitored and controlled through the system.**	N-SM-10	
	AFD-DMS-05	**The system shall manage the access by multiple parties to DMS that can be controlled through the system.**	N-SM-2, 4	This is a consideration for DMS that an agency allows other agencies to control.
	AFD-DMS-05.1a	• The system shall grant control of a DMS to the user with the highest priority. For example, TMC operators may have the highest priority of all users to control the agency DMS.		Option (a) is for a system that does not have automated DMS messages, such as travel time messages. Option (b) is for a system that does have DMS messages posted by automated ATMS operations.
	AFD-DMS-05.1b	• The system shall grant control of a DMS to the user or ATMS operation with the highest priority. For example, TMC operators may have the highest priority of all users to control the agency DMS and can replace a		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		message generated by an ATMS operation, such as a travel time message.		
	AFD-DMS-05.2	• The system shall inform users of which user currently controls a sign.		
	AFD-DMS-05.3	• The system shall notify a user when control of a DMS has been taken away from that user.		
	AFD-DMS-06	**The system shall allow users with permission to schedule the messages for DMS by time of day, day of week and season.**	N-CO-6 N-MA-6	
	AFD-DMS-07	**The system shall allow users with permission to schedule DMS operation as part of planned special events.**	N-MA-5, 7	
	AFD-DMS-08	**The system shall be able to automatically post travel times generated by the ATMS for road segments ahead of the DMS location.**	N-CO-6 N-MA-6 N-CM-2	These requirements are only valid if corresponding requirements for ATMS data processing for travel times are included.
	AFD-DMS-08.1	• The system shall allow users with permission to control when travel times are displayed on a DMS.		
	AFD-DMS-08.2	• The system shall allow users with permission to manage the priority of travel time messages on DMS		
	AFD-DMS-9	**The system shall have a mechanism for users to restore connections and restart DMS that are not responding.**	N-SM-5, 8	This functionality is dependent upon the HAR having existing tools to remotely restore and restart devices. Verify that this functionality exists and

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				provide information in device details.
	AFD-DMS-9.1	• The system shall provide a notification to users if a requested, scheduled, or automated message is unable to be posted on a DMS that includes the reason the message was not posted. For example, the DMS may have rejected the request because a higher priority message is displayed, the user does not have priority or permission, or the DMS is not responding.		
	AFD-DMS-10	**The system shall log user DMS action as part of the event for which the action is taken.**	N-MA-3	
Signals (SIG)	**AFD-SIG-01**	**The system shall allow users with permission to monitor and control the agency's traffic signals.**	N-MO-1, 4, 10 N-CO-7	Determine the signal control system(s) your agency will interface with and that all will allow for external interface and control.
	AFD-SIG-01.1	• The system shall interface with the existing traffic signal control systems.		
	AFD-SIG-01.2	• The system graphical user interface shall allow users to view the locations and statuses of traffic signals controlled by the system. For example, the individual signals may appear differently depending upon their current phase.		
	AFD-SIG-01.3	• The system graphical user interface shall allow users to view the locations and statuses of traffic signals controlled by the system. For example, the individual signals may appear		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		differently depending upon their current phase.		
	AFD-SIG-01.4	• The system shall allow users to select one or more signals from the graphical user interface or by entering device IDs and view the status and characteristics. For example, selecting an intersection will show the phase of signals for each movement, as well as the timing plan currently implemented.		
	AFD-SIG-02	**The system shall allow users with permission to store timing plans within the system that apply to one or more signals.**	N-MA-6, 8	This requirement is only to load timing plans, but not create them. Consider whether your agency wants the system users to be able to create timing plans within the system.
	AFD-SIG-03	**The system shall allow users with permission to select and implement stored timing plans.**	N-CO-7 N-MA-8	
	AFD-SIG-04	**The system shall manage timing plans assigned to signals based on priority.**	N-MA-6	
	AFD-SIG-05	**The system shall allow users with permission to schedule the implementation of timing plans as part of planned special events.**	N-MA-5	
	AFD-SIG-06	**The system shall allow users with permission to schedule the implementation of timing plans by time of day, day of week and season.**	N-MA-5	
	AFD-SIG-07	**The system shall allow users with permission to add and delete traffic signals that can be monitored and controlled through the system.**	N-SM-10	

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-SIG-08	**The system shall have a mechanism for users to restore connections with signals that are not responding.**	N-SM-5, 8	This functionality is dependent upon the signal controllers having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-SIG-09	**The system shall log user signals action as part of the event for which the action is taken.**	N-MA-3	
Active Traffic Management (ATM)	**AFD-ATM-01**	**The system shall enable users with permission to monitor and control Variable Speed Limit Signs (VSL).**	N-MO-1, 4, 5, 10, 11 N-CO-8, 9 N-MA-3, 4, 5, 6, 7 N-CM-2 N-SM-5, N-SM-8	
	AFD-ATM-01.1	• The system graphical user interface shall allow users to view the locations and statuses of VSL controlled by the system. For example, the VSL icons may appear different depending on whether they are currently displaying the regular speed limit.		
	AFD-ATM-01.2	• The system shall allow users to set defaults for VSL display. For example, a default display may be for a VSL to be blank or to show a default speed limit.		
	AFD-ATM-01.3	• The system shall allow users to configure limits for minimum and maximum speed to be displayed.		
	AFD-ATM-01.4	• The system shall be able to automatically calculate and display a recommended speed for each VSL using an algorithm that is configurable by a user with permission.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-ATM-01.5	• The system shall be able to automatically post system-calculated speeds to VSLs.		
	AFD-ATM-01.6	• The system shall allow users to override default and automatically calculate speeds for display on VSLs.		
	AFD-ATM-01.7	• The system shall allow users with permission to schedule the display on VSL as part of planned special events.		
	AFD-ATM-01.8	• The system shall allow users with permission to schedule the display on VSL by time of day, day of week and season.		
	AFD-ATM-01.9	• The system shall have a mechanism for users to restore connections and restart VSL that are not responding.		This functionality is dependent upon the VSL having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-ATM-01.10	• The system shall log each user VSL action as part of the event for which the action is taken.		
	AFD-ATM-02	**The system shall enable users with permission to monitor and control Dynamic Lane Use Signs (DLUS).**	N-MO-1, 4, 10, 11 N-CO-10, 11 N-MA-3, 4, 5, 6, 7 N-CM-2 N-SM-5, 8	
	AFD-ATM-02.1	• The system graphical user interface shall allow users to view the locations and statuses of DLUS controlled by the system. For example, the DLUS icons may appear different depending on whether they are currently showing a lane is open or closed.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-ATM-02.2	• The system shall allow users to select DLUS from the graphical user interface or by entering a device ID and view any information currently displayed as it appears on the selected DLUS.		
	AFD-ATM-02.3	• The system shall allow users to manage DLUS default schedules such as information displayed by time of day, day of week and season.		
	AFD-ATM-02.4	• The system shall allow users to override default information, and manually change the display of selected DLUS.		
	AFD-ATM-02.5	• The system shall be able to automatically manage DLUS based on rules that may be configured by a system administrator.		
	AFD-ATM-02.6	• The system shall allow users with permission to schedule the display on DSUL as part of planned special events.		
	AFD-ATM-02.7	• The system shall allow users with permission to schedule the display on DSUL by time of day, day of week and season.		
	AFD-ATM-02.8	• The system shall have a mechanism for users to restore connections and restart DSUL that are not responding.		This functionality is dependent upon the DSUL having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-ATM-02.9	• The system shall log each DSUL action as part of the event for which the action is taken.		
Ramp Meters (RM)	**AFD-RM-01**	**The system shall allow users to monitor and control the agency's ramp meters.**	N-MO-1, 4, 10 N-CO-12, 13	
	AFD-RM-01.1	• The system graphical user interface shall allow users to view the locations and statuses of all agency ramp meters controlled by the system. For example, the ramp meter icons may appear different depending on whether they are currently active.		
	AFD-RM-01.2	• The system shall allow users to select ramp meter(s) from the graphical user interface or by entering a device ID and to manage ramp metering parameters such as minimum and maximum metering rate and metering algorithms.		
	AFD-RM-01.3	• The system shall allow users to implement ramp metering plans at selected ramp meter(s).		
	AFD-RM-01.4	• The system shall allow users to override ramp metering plans.		
	AFD-RM-02	**The system shall allow users with permission to store ramp metering plans within the system.**	N-MA-6, 8	
	AFD-RM-03	**The system shall allow users with permission to select and implement ramp metering plans.**	N-CO-12 N-MA-8	
	AFD-RM-04	**The system shall manage ramp metering plans assigned to signals based on priority.**	N-CO-13 N-MA-6	
	AFD-RM-05	**The system shall allow users with permission to schedule ramp metering plans as part of planned special events.**	N-CO-13 N-MA-5	

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-RM-06	**The system shall allow users with permission to schedule the ramp metering plans by time of day, day of week and season.**	N-CO-13 N-MA-5	
	AFD-RM-07	**The system shall have a mechanism for users to restore connections with ramp meters that are not responding.**	N-SM-5, 8	This functionality is dependent upon the ramp meters having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-RM-08	**The system shall log each user Ramp Metering action as part of the event for which the Ramp Metering action is taken.**	N-MA-3	
Gates (GA)	**AFD-GA-01**	**The system shall enable users with permission to monitor and control gates and associated signs that restrict roadway access.**	N-MO-1, 4, 10 N-CO-14	Determine whether your agency has automated gates whose opening or closing can be controlled remotely, or if you have gates that are manually opened and closed. Know how many gates of each type you have. Also consider what staff type will control gates. It may be field staff or TMC Operators. If field staff, they may annually

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				close gates and enter status into the ATMS.
	AFD-GA-01.1	• The system graphical user interface shall allow users to view the location, characteristics and status of gates, both automated or manually operated.		
	AFD-GA-01.2	• The system shall allow users to select one or more gate from the graphical user interface or by entering a device ID.		
	AFD-GA-02	**The system shall allow users with permission to open or close automated gates through the user interface.**	N-CO-14	This set of requirements is for automated gate systems, not manually activated systems.
	AFD-GA-02.1	• The system shall notify the user of the result of their actions to open or close a gate. For example, the system will confirm that the gate an Operator acted to close is actually closed.		
	AFD-GA-02.2	• The system shall notify the user of the status of signs associated with the gate the user took an action on. For example, the system will tell the user if a beacon has been activated or the message displayed on a DMS when the gate opens or closes.		
	AFD-GA-03	**The system shall allow the user to control signs, including overriding their current status. For example, if a sign indicates the road is open but a user cannot confirm the associated gate is open, the user can control the sign to say the road is closed.**	N-CO-5 N-CM-2	
	AFD-GA-04	**The system shall allow the user to manage the status for gates that are manually opened and**	N-MA-1	This requirement is for indicating the status of manual gates. If your

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		closed or that do not have gate position sensors.		agency will not have manual gates, this requirement is not needed.
	AFD-GA-05	**The system shall allow users with permission to schedule the operation of automated gates as part of planned special events.**	N-CO-14 N-MA-5	
	AFD-GA-06	**The system shall allow users with permission to schedule the operation of automated gates and their associated signs by time of day, day of week and season.**	N-CO-14 N-MA-5	
	AFD-GA-07	**The system shall allow users with permission to set default positions for automated gates.**	N-CO-14	
	AFD-GA-08	**The system shall allow users with permission to override the scheduled operation of an automated gate.**	N-CO-14 N-MA-7	
	AFD-GA-09	**The system shall have a mechanism for users to restore connections with gates that are not responding.**	N-SM-5, 8	This functionality is dependent upon the gates having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-GA-10	**The system shall log each user gate action as part of the events for which the gate action is taken.**	N-MA-3	
Courtesy Patrol (CP)	**AFD-CP-01**	**The system shall allow users to view the real-time location and status of Courtesy Patrol vehicles. For example, an available vehicle and one currently assisting a traveler would be**	N-MO-1, 10	The agency should consider whether it can see vehicle location information and

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		shown differently and allow the user to identify which is local to an incident and available.		whether that data will come directly from the vehicle or from a data feed that aggregates the vehicle information.
	AFD-CP-02	**The system shall allow users to view the features of each Courtesy Patrol vehicle (e.g. whether it can tow a vehicle or clean up HazMat spills).**	N-MO-1	
	AFD-CP-02.1	• The system shall allow users to manage the list of Courtesy Patrol vehicles and their features, including adding, editing and deleting vehicles.		
	AFD-CP-02.2	• The system shall allow users to select Courtesy Patrol vehicle(s) from the graphical user interface or by entering a vehicle ID and view its status, vehicle features and contact information.		TMC Operators may use radio or cell to communicate with courtesy patrol drivers.
	AFD-CP-03	**The system shall interface with Courtesy Patrol Vehicle Mobile Data Terminals (MDT) for data exchange.**	N-MO-10 N-MA-1 ,2, 3, 12 N-CM-5	This requirement is for agencies that will directly communicate with courtesy patrols through an existing Mobile Data Terminal (MDT) or mobile application – note that MDT is used here for either device. It will require defining the interface for the data exchange. The agency should inform bidders
	AFD-CP-03.1	• The system shall allow users to send dispatch information to Courtesy Patrol vehicle MDTs, including incident type, assistance needed and location.		
	AFD-CP-03.2	• The system shall ingest data sent from Courtesy Patrol vehicle MDTs regarding vehicle locations, statuses and activities.		
	AFD-CP-03.3	• The system shall be able to automatically create and end events using data ingested from Courtesy Patrol vehicle MDTs.		

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				of the MDT data exchange format and content. This assumes a mobile app for courtesy patrol already exists and is not part of your agency's ATMS procurement.
	AFD-CP-04	**The system shall ingest images sent from Courtesy Patrol vehicle MDTs and display them for users.**	N-MO-10 N-MA-3 N-CM-5	This requirement also assumes an MDT is associated with each vehicle.
	AFD-CP-04.1	• The system shall associate the images with the vehicle, vehicle location, time and any event the sending Courtesy Patrol vehicles is associated with at the time.		
	AFD-CP-04.2	• The system shall allow users to enter information provided by Courtesy Patrol drivers into event logs.		
	AFD-CP-05	**The system shall be able to ingest images sent from field staff, such as those operating Courtesy Patrol vehicles, and allow users to view them. For example, a Courtesy Patrol driver may take a picture of a material spill with his cell phone and send it to the ATMS.**	N-MO-10 N-MA-3 N-CM-5	This requirement assumes Courtesy Patrol vehicles do not have MDTs but allow for Courtesy Patrol staff to take pictures with phones or other Internet-enabled devices and send them to the ATMS.
	AFD-CP-05.1	• The system shall record the location images are taken and the time.		
	AFD-CP-05.2	• The system shall allow users to associate images with events.		
	AFD-CP-06	**The system shall log Courtesy Patrol vehicle data and images as part of the event for which the Courtesy Patrol is associated.**	N-MA-3	

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Sensors/ Detectors (SD)	**AFD-SD-01**	**The system shall allow users with permission to monitor traffic sensors/detectors.**	N-MO-1, 4, 5, 10	
	AFD-SD-01.1	• The system graphical user interface shall allow users to view the locations and statuses of sensors/detectors connected to the system. For example, the detector icons may appear different when connected to the ATMS than when not connected.		
	AFD-SD-01.2	• The system graphical user interface shall allow the user to select traffic sensor/detector(s) and view device parameters and real-time data generated by the devices.		
	AFD-SD-01.3	• The system shall graphically display real-time traffic speeds and volumes by direction, lane, and average speed of all lanes in each direction at the location of sensor/detectors.		
	AFD-SD-02	**The system shall ingest and process location-based traffic sensor/detector data.**	N-MA-6	
	AFD-SD-03	**The system shall store traffic data collected by the sensor/detectors for a length of time that can be configured by a system administrator.**	N-CM-4 N-SM-6	
	AFD-SD-04	**The system shall have a mechanism for users to restore connections with sensor / detectors that are not responding.**	N-SM-5, 8	This functionality is dependent upon the sensor/detectors having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AFD-SD-04.1	• The system shall deem a sensor to be inoperable when a configurable number of failures occur within a configurable time period.		
	AFD-SD-05	**The system shall use sensor/detector data in its algorithms used to automate system actions. For example, speed and volume data may be used in the algorithm used to implement ramp metering.**	N-MO-11 N-MA-4, 6	
Environmental Sensor Stations (ESS)	**AFD-ESS-01**	**The system shall enable users with permission to monitor ESS and control cameras that are part of ESS.**	N-MO-1, 2, 4, 5, 6, 10 N-CO-1	
	AFD-ESS-01.1	• The system shall allow users to select one or more ESS from the graphical user interface or by entering a device ID to view real-time video, environmental data, and/or to control the camera(s).		
	AFD-ESS-01.2	• The system shall allow users to view real-time environmental data from selected ESS.		
	AFD-ESS-02	**The system shall allow the user to control and display ESS cameras consistent with the Requirements AFD-CA, including pan/tilt/zoom, scheduling, presets and display configuration.**	N-MO-1, 2, 4, 5, 6, 7, 109 N-CO-1, 2, 16, 17, 18	Determine whether a video management software is used to manage images on a video wall, and if it will be integrated with the ESS cameras.
	AFD-ESS-03	**The system shall allow for ESS camera control priority through the ATMS consistent with control priority by the ESS system.**	N-MO-6, 7 N-CO-1, 2, 17, 18	Identify whether the ESS is a system operated outside the ATMS, such as the maintenance division. Details of any camera

Model ATMS Requirements – Common Agency Field Devices (AFD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				control priority strategies or rules they have and that must be complied with should be provided with the requirements.
	AFD-ESS-04	**The system shall be able to use ESS data in its decision-making and automated operation capabilities.**	N-MO-11 N-MA-4, 6	
	AFD-ESS-05	**The system shall alert users to actions taken by the system based on ESS data. For example, if ESS data is used to automate the operation of an "Ice on Bridge" beacon, the system will notify users of the beacon activity.**	N-CM-1	
	AFD-ESS-06	**The system shall have a mechanism for users to restore connections with ESS that are not responding.**	N-SM-5, 8	This functionality is dependent upon the ESS having existing tools to remotely restore and restart devices. Verify that this functionality exists and provide information in device details.
	AFD-ESS-07	**The system shall log all actions taken by the system based on ESS data.**	N-MA-3	

3.3 Agency Systems

Agency Systems are owned and operated by the agency that is operating the ATMS. **Figure 7** shows common Agency Systems and typical interactions with the ATMS. **Table 13** outlines model ATMS requirements for Agency Systems including:

- Road Condition Reporting System;
- Global Information System/Linear Referencing System;
- Data Archive; and
- Asset Management.

***Note**: It is anticipated that the ATIS and RCRS needs for data from the ATMS are satisfied by the Data Feed and Video Feed requirements in **Section 3.6 Communications Protocol**. Therefore, there are no specific requirements for ATIS, and RCRS requirements only describe data being sent from the RCRS to the ATMS.*

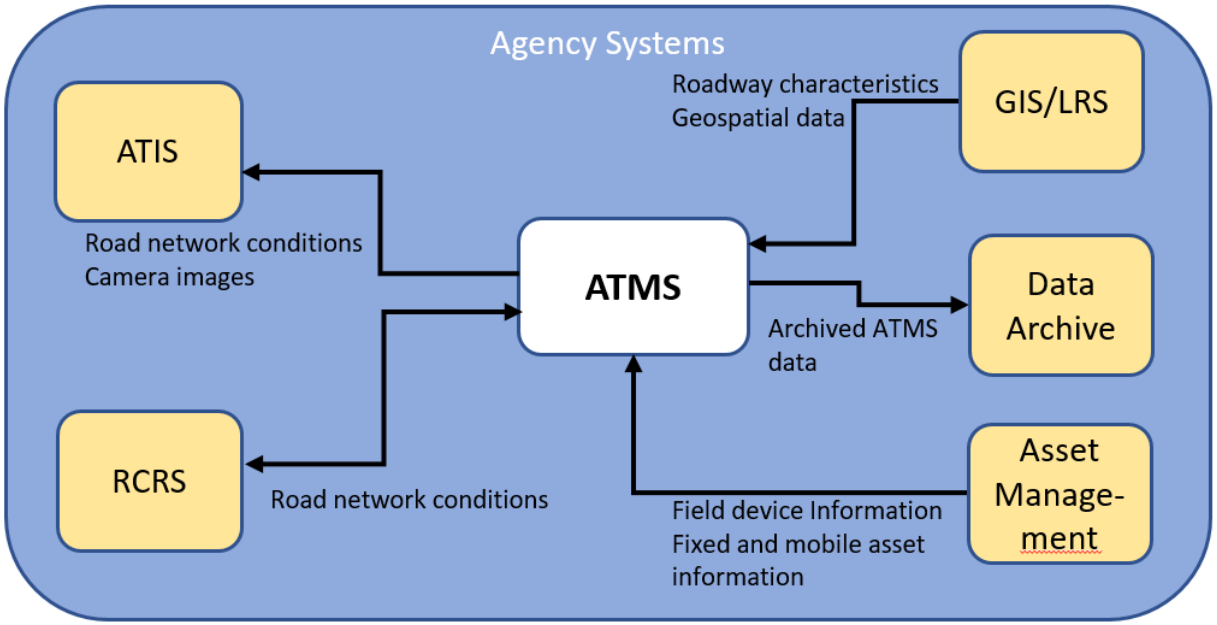

Figure 7: Common Agency Systems and Interaction with ATMS

Table 13: Model ATMS Requirements – Common Agency Systems

Model ATMS Requirements – Common Agency Systems (AS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Road Condition Reporting System (RCRS)	**AS-RCR-01**	**The system shall be able to ingest and use road network condition information provided by the RCRS.**	N-MO-10 N-SM-1	
	AS-RCR-01.1	• The system shall allow users with permission to view road network condition information from the RCRS.		
	AS-RCR-01.2a	• The system shall automatically receive updated road network condition information from the RCRS as that information becomes available.		Determine the level of automation and frequency needed by the agency for receiving updates from the RCRS. It is possible that data will need to be real-time.
	AS-RCR-01.2b	• The system shall automatically receive updated road network condition information from the RCRS at pre-determined intervals (e.g. 5 minutes).		
	AS-RCR-01.2c	• The system shall receive updated road network condition information from the RCRS when requested by the system user.		
	AS-RCR-01.3	• The system shall be able to display road network condition information from the RCRS at the reported locations.		
	AS-RCR-02	**The system shall be able to automatically create events from road network condition information from the RCRS.**	N-MO-10 N-MA-1, 2	
	AS-RCR-02.1	• The system shall allow a user with permission to configure the types of road condition information that automatically becomes events.		
	AS-RCR-02.2	• The system shall notify users when an event has been created from road condition information from the RCRS.		

Model ATMS Requirements – Common Agency Systems (AS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AS-RCR-03	**The system shall allow users to create events using road network condition information from the RCRS.**	N-MO-10 N-MA-1	
	AS-RCR-04	**The system shall be able to indicate through the display events created from road network condition information from the RCRS.**		
	AS-RCR-04.1	• The system shall be able to use road network condition information from the RCRS for system processes such as data synthesis and decision support.		
	AS-RCR-05	**The system shall be able to classify road network condition information from the RCRS by event type.**	N-MA-2	
	AS-RCR-06	**The system shall be able to associate ingested road network condition information from the RCRS with events and include road network condition information in event logs based on time and proximity.**	N-MA-1	
Global Information System (GIS) / Linear Referencing System (LRS)	**AS-GIS-01**	**The system shall be able to ingest and use roadway characteristics and geospatial data provided by the agency GIS/LRS.**	N-MO-9 N-SM-1, 9	Note that depending on agency, this information may be held in GIS or LRS, or a combined system. Agencies should determine where roadway characteristic information is located and whether there is unique detail in the agency system that

Model ATMS Requirements – Common Agency Systems (AS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				would be necessary for an ATMS.
	AS-GIS-01.1	• The system shall be able to ingest and conflate roadway information provided in industry-standard open data standards, including geospatial data formats.		
	AS-GIS-01.2	• The system shall be able to display and use roadway information ingested from the GIS / LRS.		
Data Archive (DA)	**AS-DA-01**	**The system shall be able to store raw and processed data that is ingested and logged within the system for a configurable period of time.**	N-SM-1, 6	Identify and review laws in the jurisdiction regarding historic record preservation. Also consider, the time and frequency that system data gets transmitted to the data archive, e.g. daily at 2 a.m.
	AS-DA-01.1	• The system shall allow users to view historic data that has expired, but not yet been archived.		
	AS-DA-01.2	• The system shall be configurable to change the maximum duration that various data elements are stored.		Understand and adhere to data licenses of third-party data. The agency may not be allowed to retain some data.
	AS-DA-01.3	• The system shall be configurable in how stored data are formatted.		

Model ATMS Requirements – Common Agency Systems (AS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	AS-DA-01.4	• The system shall be able to limit the inclusion of third-party data in data archives based on the agency's permission to store third-party data.		Consider licenses with third-party data providers in determining how third-party data is stored and used post-ATMS.
	AS-DA-02	**The system shall transmit raw and processed data that has been stored within the system since the previous transmission on a configurable schedule.**	N-SM-6	
	AS-DA-02.1	• The system shall be configurable to change allow users with permissions to define the raw and processed data elements to be archived.		Consider that the need may be for some data to only be retained for a short period but not archived. Or, some data may only need to be retained as part of a synthesized or aggregated data set.
	AS-DA-03	**The system shall be configurable to automatically remove select stored raw and processed data following confirmation that it has been archived.**	N-SM-6	
Asset Management (AM)	**AS-AM-01**	**The system shall be able to ingest asset data provided by the agency Asset Management (AM) system.**	N-MO-4, 9 N-SM-1, 9	Note that the Asset Management requirements assume Asset Management information will be provided on a sporadic basis, and as a data file for the system to ingest. Understand

Model ATMS Requirements – Common Agency Systems (AS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				that this process may be a manual process done by the vendor or state staff, but it is not commonly done as an automated process.
	AS-AM-01.1	• The system shall be able to ingest asset information provided in industry-standard open data standards, including geospatial data formats.		Determine the level of automation and frequency for receiving updates from the AM system.
	AS-AM-01.2	• The system shall be able to display and use asset information ingested from the AM.		

3.4 Third-Party Field Devices and Third-Party Systems

Third-Party Field Devices are devices that are owned and operated by an entity outside of the agency that operates the ATMS. Third-Party Systems are systems that are external to the agency that is operating the ATMS. **Figure 8** shows common Third-Party Field Devices and Third-Party Systems, along with typical interactions with the ATMS.

Table 14 outlines model ATMS requirements for common Third-Party Devices including:

- Third-Party Cameras;
- Third-Party DMS;
- Third-Party Sensors/Detectors;
- Probe Vehicles; and
- Rail Crossings.

Table 15 outlines model ATMS requirements for common Third-Party Systems including:

- Computer Aided Dispatch;
- Third Party Traveler Information; and
- Transit Management;

***Note**: It is anticipated that the Commercial Vehicle Administration and Regional Partner data needs are satisfied by the Data Feed and Video Feed requirements in **Section 3.6 Communications Protocol**. Therefore, there are no specific requirements for Commercial Vehicle Administration or Regional Partners.*

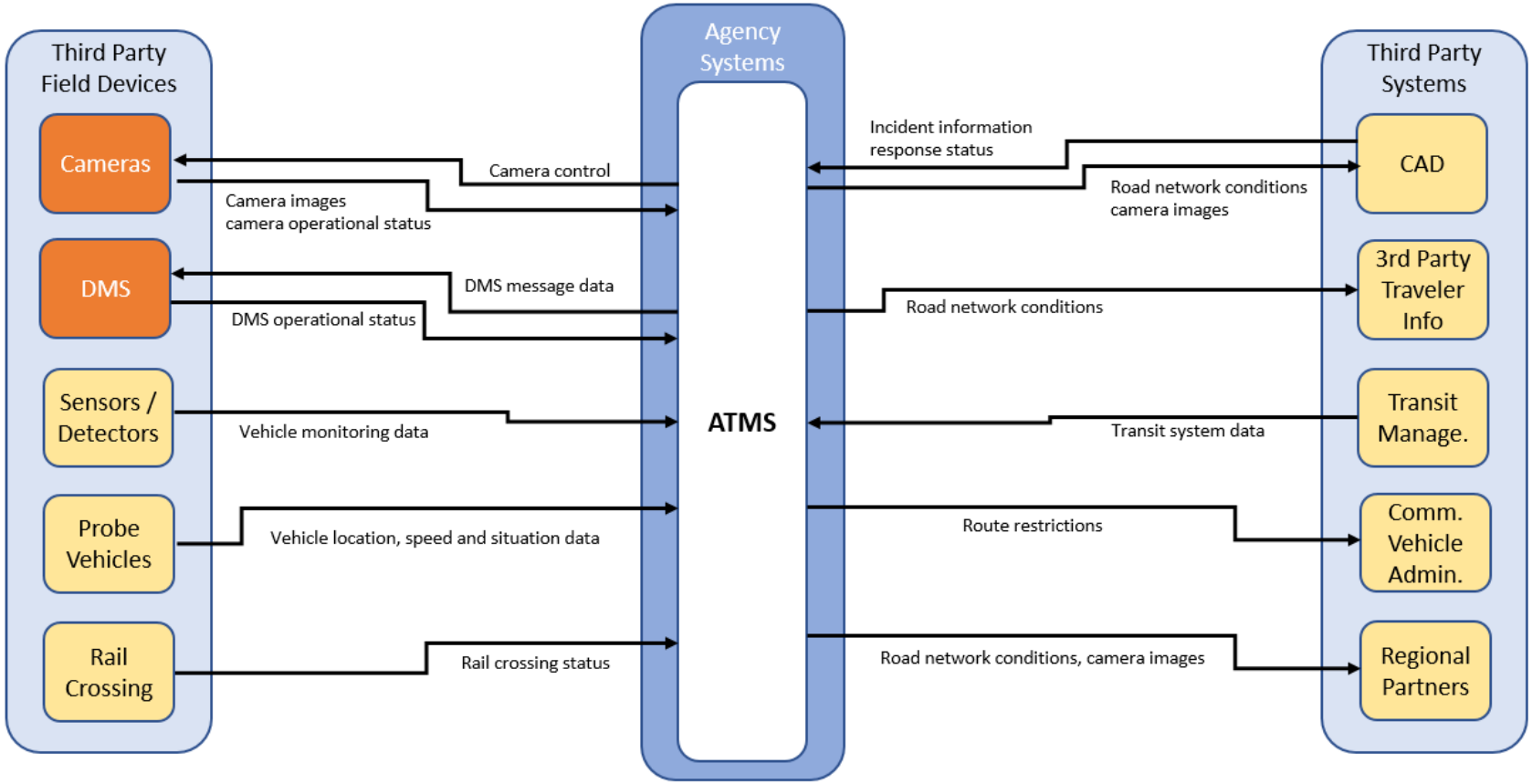

Figure 8: Common Third-Party Field Devices/Systems and Interaction with ATMS

Table 14: Model ATMS Requirements – Common Third-Party Devices

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Third-Party Cameras (3CA)	**3DD-3CA-01**	**The system shall allow users with permission to view real-time video from and control the pan/tilt/zoom/record/playback capabilities of third-party cameras connected to the system and granted control by the owning third party.**	N-MO-1, 2, 4, 5, 6, 7, 10 N-CO-1, 2, 15, 16	A key consideration is the interface and technology of third-party cameras. Before requiring control or access, be aware of any differences in protocols, or network restrictions that would prevent access to third-party cameras.
	3DD-3CA-01.1	• The system shall allow users to select one or more third-party camera(s) from the graphical user interface or by entering a device ID to view real-time video and/or to control the camera(s).		
	3DD -3CA-01.2	• The system shall allow users to view real-time images from third-party cameras that the user does not control.		
	3DD -3CA-01.3	• The system shall allow the user to select the third-party cameras to display at their workstation, device or to a video wall connected to the ATMS and manage the layout and size of multiple video streams in the graphical user interface.		
	3DD -3CA-01.4	• The system shall allow users to define and view “tours” of images from multiple cameras, including third-party cameras, including allowing the user to select the		

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		cameras and duration the video from each camera will be displayed.		
	3DD-3CA-02	**The system shall comply with the camera management strategies established by third-party camera owners.**	N-CO-1, 2, 15, 17, 18 N-MA-13	
	3DD-3CA-02.1	• The system shall allow users to control third-party cameras when granted control by the third-parties.		
	3DD-3CA-02.2	• The system shall allow and block images and video as desired by the third-party camera owners.		
	3DD-3CA-02.3	• The system shall inform users of the user's priority and of which user currently controls a third-party camera.		
	3DD-3CA-03	**The system shall log user third-party camera actions as part of the event for which the third-party camera action is taken.**	N-MA-3	
	3DD-3CA-04	**The system shall identify and recommend to users the closest cameras, including third-party cameras, to an identified event location.**	N-MA-4	
Third-Party Dynamic Message Signs (3DM)	**3DD-3DM-01**	**The system shall allow users with permission to monitor and control third-party DMS connected to the system and granted control by the owning third party.**	N-MO-4, 5, 10 N-CO-5, 6, 16, 17, 18 N-CM-2	
	3DD-3DM-01.1	• The system graphical user interface shall allow users to view the locations and statuses of third-party DMS.		
	3DD-3DM-01.2	• The system shall allow for monitoring and controlling third-party DMS using the NTCIP 1203 standard.		

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	3DD-3DM-01.3	• The system graphical user interface shall allow users to view all parameters describing the third-party DMS as defined in NTCIP Object Definition.		
	3DD-3DM-01.4	• The system shall allow users to select third-party DMS from the graphical user interface or by entering a device ID and view any message currently displayed as it appears on the selected DMS.		
	3DD-3DM-01.5	• The system shall allow users to select one or more third-party DMS(s) from the graphical user interface or by entering device IDs and generate a message for the selected DMS(s) by entering the message to be displayed by the DMS(s).		
	3DD-3DM-02	**The system shall allow users with permission to enter DMS messages and images through a display that shows the message as it will appear on the third-party DMS, including color and images when available.**	N-CO-5	
	3DD-3DM-03	**The system shall have a DMS message and images library that users with permission can access when creating DMS messages.**	N-CO-5	This requirement relates to the DMS message library described under the agency DMS requirements. If there will be no message library, then this requirement should not be used.
	3DD-3DM-04	**The system shall allow users with permission to add and delete third-party DMS devices that can**	N-SM-10	

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		be monitored and/or controlled through the system.		
	3DD-3DM-05	**The system shall comply with the DMS management strategies established by third-party DMS owners.**	N-CO-5, 6, 17, 18 N-MA-13	This is a consideration for DMS that an agency allows other agencies to control.
	3DD-3DM-05.1	• The system shall allow users to control third-party DMS when granted permission by the third-parties.		
	3DD-3DM-05.2	• The system shall inform users of their priority and of which user currently controls a third-party sign.		
	3DD-3DM-06	**The system shall log each user third-party DMS action as part of the event for which the action is taken.**	N-MA-3	
Third-Party Sensors/ Detectors (3SD)	**3DD-3SD-01**	**The system shall allow users with permission to monitor third-party traffic sensors/detectors.**	N-MO-1, 4, 5, 10	
	3DD-3SD-01.1	• The system graphical user interface shall allow users to view the locations and statuses of third-party traffic sensors/detectors.		
	3DD-3SD-01.2	• They system graphical user interface shall allow the user to select third-party traffic sensor/detector(s) and view device parameters and real-time data generated by the devices.		
	3DD-3SD-01.3	• The system shall graphically display real-time traffic speeds and volumes by direction, lane, and average speed of all lanes in each direction at the location of third-party sensor/detectors.		

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	3DD-3SD-02	**The system shall be able to integrate third-party sensor/detector data into its algorithms used to automate system actions. For example, speed and volume data may be used in the algorithm used to implement ramp metering.**	N-MO-11	
	3DD-3SD-03	**The system shall allow users with permission to configure third-party sensor/detector data collection to comply with third-party rules for ownership and use. For example, third-party devices may allow for the extemporaneous use of data by the agency, but not storing or saving it.**	N-MA-13 N-CM-4	
Probe Vehicles (PV)	**3DD-PV-01**	**The system shall allow users with permission to access traffic information from third-party probe vehicles.**	N-MO-1, 10	
	3DD-PV-01.1	• The system graphical user interface shall allow users to view the current speed of each segment on the transportation network for which third-party probe vehicle data is provided. For example, the segment colors may appear different colors based on pre-defined ranges of percentages of the current speed compared to free flow speed, or the percentages of the current speed compared to typical speeds for the time of day and day of week.		A key consideration is whether the third-party probe vehicle data is procured and determined to be of sufficient quality to display only on select roadways, all interstate roadways, some or all U.S. highways, some or all state and local roadways, etc.
	3DD-PV-01.2	• They system graphical user interface shall allow the user to select a segment and view detailed parameters regarding the real-time data, e.g. confidence score regarding quality and mix of historical versus real-time data.		

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	3DD-PV-02	**The system shall ingest and process third-party probe vehicle data.**	N-MO-1, 4, 5, 10	
	3DD-PV-03	**The system shall allow a user with permission to conflate third-party probe vehicle data segments to be consistent with agency-defined segments.**	N-SM-1	
	3DD-PV-04	**The system shall allow a system administrator to restrict what the segments of received third-party probe vehicle data that is visible to operators, based on data quality.**	N-CM-4 N-SM-2	A key consideration is the confidence score and analyses that are conducted to confirm data quality on low-volume rural roadways or urban arterials, e.g.
	3DD-PV-05	**The system shall allow a system administrator to prioritize the data sources for the speed displayed each given segment on the graphical user interface.**	N-SM-3	In some locations, one third-party probe vehicle data source may be better than another source. Segments with deployed sensors may display that data source on the speed data layer.
	3DD-PV-06	**The system shall store third-party probe vehicle data for a length of time that can be configured by a system administrator.**	N-MA-13 N-CM-4	A key consideration is that storage of third-party probe vehicle data may not be permitted by the contract.
Rail Crossings (RC)	**3DD-RC-01**	**The system shall allow users with permission to view the locations of all railroad crossings and the status of active railroad crossings.**	N-MO-1, 8, 10	A consideration for agencies is if they have a database of grade crossing information that can be imported

Model ATMS Requirements – Common Third-Party Devices (3DD)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				into the system. Also, determine whether crossing status can be collected in real-time, and the source of such data.
	3DD-RC-01.1	• The system shall allow users to select one or more rail crossings from the graphical user interface or by entering a crossing ID to view the details and status of the crossings.		
	3DD-RC-01.2	• The system shall provide the crossing type, including number of tracks, railroad ownership and contact information, passive or active, presence of gates, presence of flashing lights.		
	3DD-RC-01.3	• The system shall provide the status for active crossings in real-time. Status may include gates open or closed, flashing lights on or off.		
	3DD-RC-02	**The system shall automatically display for users the locations and status of railroad crossings located near incidents.**	N-MA-4	
	3DD-RC-03	**The system shall log crossing status activity for crossings near incidents during the incidents as part of event logs.**	N-MA-3	
	3DD-RC-04	**The system shall be able to send alerts and notifications of incidents near railroad crossings to the identified contacts for those crossings.**	N-MA-9, 10	

Table 15: Model ATMS Requirements – Common Third-Party Systems

Model ATMS Requirements – Common Third-Party Systems (3DS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Computer-Aided Dispatch (CAD)	**3DS-CAD-01**	**The system shall ingest and use CAD information provided by law enforcement agencies.**	N-MO-3, 10 N-SM-1	
	3DS-CAD-01.1	• The system shall allow users with permission to view reports entered by law enforcement agencies through their CAD systems.		
	3DS-CAD-01.2	• The system shall display CAD information at the locations reported.		
	3DS-CAD-01.3	• The system shall allow users to create events using CAD information.		
	3DS-CAD-02	**The system shall classify CAD reports by event type.**	N-MA-2	
	3DS-CAD-03	**The system shall associate CAD reports with system events based on location and time and include associated CAD reports in event logs.**	N-MA-3	
Third-Party Traveler Information (3TI)	**3DS-3TI-01**	**The system shall ingest and use information provided by third-party traveler information systems.**	N-MO-1, 2, 3, 10 N-SM-1	The agency should be clear on which data sources will be ingested, as well as any licensing agreements and limitations the agency may have. 3rd party sources may be Waze, Google or others.
	3DS-3TI-01.1	• The system shall allow users with permission to view information from third-party traveler information sources.		
	3DS-3TI-01.2	• The system shall display information from third-party traveler information sources at their reported locations.		

Model ATMS Requirements – Common Third-Party Systems (3DS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	3DS-3TI-01.3	• The system shall allow users to create events using third-party traveler information sources.		
	3DS-3TI-01.4	• The system shall use third-party traveler information for system processes such as data synthesis and decision support.		
	3DS-3TI-01.5	• The system shall be configurable to limit third-party traveler information to be used in accordance with the permissions granted by the third party.		
	3DS-3TI-02	**The system shall classify third-party traveler information by event type.**	N-MA-2	
	3DS-3TI-03	**The system shall associate third-party traveler information with events and include traveler information in event logs based on time and proximity.**	N-MA-3	
Transit Management (TRM)	**3DS-TRM-01**	**The system shall ingest and use transit data.**	N-MO-1, 3, 10 N-SM-1, 10	Determine if regional transit providers generate GTFS and GTFS RealTime feeds, the number of providers and where their feeds are available.
	3DS-TRM-01.1	• The system shall ingest transit data in both static and real-time General Transit Feed Specification (GTFS) format.		
	3DS-TRM-01.2	• The system shall allow users with permission to view static and real-time transit information.		

Model ATMS Requirements – Common Third-Party Systems (3DS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	3DS-TRM-01.3	• The system will ingest contact information for transit providers from GTFS data.		
	3DS-TRM-01.4	• The system shall allow users with permission to manage GTFS data feeds in order to point the system to where data feeds are available, and to add or delete GTFS feeds.		
	3DS-TRM-02	**The system shall associate transit information with system events based on location and time and real-time transit vehicle location information and include transit information in event logs, based on time and proximity.**	N-MA-3	

3.5 Traffic Management Support

Traffic Management Support includes ATMS functionality that supports traffic management operations. **Table 16** outlines model ATMS requirements for Traffic Management Support functions, including:

- Event/Incident Management;
- Data Synthesis;
- Decision Support; and
- Work Zone Management.

Table 16: Model ATMS Requirements – Traffic Management Support

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Event/Incident Management (EIM)	**TMS-EIM-01**	**The system shall provide a mechanism for users with permission to manage events (e.g. incidents, construction, roadwork, etc.) that are entered into the ATMS.**	N-MA-1, 3	
	TMS-EIM-01.1	• The system shall store and provide users with access to event information as entered in the ATMS.		
	TMS-EIM-02	**The system shall allow users with permission to create pre-defined event types.**	N-MA-2	
	TMS-EIM-02.1	• The system shall allow users to create a "Traffic" event type, to enter current traffic conditions for selected roadway segments.		Agencies to choose from pre-defined event types from those listed, and add other pre-defined event types as needed.
	TMS-EIM-02.2	• The system shall allow users to create a "Incident" event type, to enter information about incidents that impact traffic such as crashes, debris in road, and other lane obstructions.		
	TMS-EIM-02.3	• The system shall allow users to create a "Travel Times" event type, to enter current and forecasted travel times for selected roadway segments.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-EIM-02.4	• The system shall allow users to create a "Road Work" event type, to describe planned and unplanned road work such as lane striping, road repairs, debris removal, etc.		
	TMS-EIM-02.5	• The system shall allow users to create a "Planned Special Event" event type, to enter information about planned events that are expected to impact traffic, such as major events or major construction projects.		
	TMS-EIM-02.6	• The system shall allow users to create an "Emergency" event type, to provide notices about emergencies that directly impact traffic.		
	TMS-EIM-02.7	• The system shall allow users to create an "Evacuation" event type, to provided information about evacuations.		
	TMS-EIM-02.8	• The system shall allow users to create an "AMBER Alert" event type, to enter information in compliance with federal guidelines: https://www.amberalert.gov/guidelines.htm.		
	TMS-EIM-02.9	• The system shall allow users to create a "Commercial Vehicle Restrictions" event type, to enter information about commercial vehicle weight or height restrictions for selected roadway segments.		
	TMS-EIM-02.10	• The system shall allow users to define new event types.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-EIM-03	**The system shall allow users with permission to define the event fields (e.g. location, start time, end time, etc.) to describe each pre-defined event.**	N-MA-2	
	TMS-EIM-03.1	• The system shall allow users to configure each event field to define the type of data entry, such as free text, drop-down options, or other type of entry.		
	TMS-EIM-03.2	• The system shall allow users to choose whether event fields are required to be populated when an event is created.		
	TMS-EIM-04	**The system shall provide a mechanism for users with permission to create and enter new events.**	N-MA-1, 2	
	TMS-EIM-04.1	• The system shall provide a mechanism for users to create new events.		
	TMS-EIM-04.2	• The system shall provide the option for users to select from pre-defined event types.		
	TMS-EIM-04.3	• The system shall allow users to enter only information necessary for each pre-defined event type.		
	TMS-EIM-04.4	• The system shall provide the option for users to enter free text to describe an event that has not been pre-defined.		
	TMS-EIM-04.5	• The system shall provide a mechanism for users to specify the location of the event.		
	TMS-EIM-04.6	• The system shall provide a mechanism for users to enter the start and end time of the event.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-EIM-04.7	• The system shall allow event start times in the future.		
	TMS-EIM-04.8	• The system shall allow users to designate an event as active or inactive.		
	TMS-EIM-05	**The system shall provide a mechanism for users with permission to edit events.**	N-MA-1, 3	
	TMS-EIM-05.1	• The system shall provide a mechanism for users to edit events created by any user in the system.		
	TMS-EIM-05.2	• The system shall allow users to edit events received by the ATMS from external systems.		
	TMS-EIM-05.3	• The system shall provide a mechanism for users to edit events, regardless of the source of the event.		
	TMS-EIM-05.4	• The system shall allow users to change an event status from active to inactive.		
	TMS-EIM-05.5	• The system shall allow users to edit the event location, start time, end time, and other event fields.		
Data Synthesis (DAS)	**TMS-DAS-01**	**The system shall be capable of aggregating and synthesizing datasets from multiple sources.**	N-MO-1, 10 N-SM-1	
	TMS-DAS-01.1	• The system shall allow users with permission to define which datasets will be aggregated and synthesized.		Agencies to define datasets (e.g. traffic volumes, speeds, incidents, etc.) for aggregation and synthesis.
	TMS-DAS-01.2	• The system shall allow users with permission to define datasets by unique identifier and data source.		Data sources might include agency detectors and/or

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-DAS-01.3	• The system shall distinguish and display the source of the data by unique identifying and data source.		third-party systems such as Waze or Google.
	TMS-DAS-01.4	• The system shall aggregate datasets of the same type from multiple sources.		
	TMS-DAS-01.5	• The system shall aggregate datasets from sources both internal to the ATMS and as ingested from external sources.		
	TMS-DAS-01.6	• The system shall allow users to designate the datasets to be aggregated and synthesized.		
	TMS-DAS-01.7	• The system shall allow users to prioritize datasets to be aggregated and synthesized.		
	TMS-DAS-01.8	• The system shall synthesize datasets of the same type and recommend a chosen dataset based on pre-determined thresholds.		
	TMS-DAS-01.9	• The system shall be configurable by users with permission, based on user-defined thresholds for each dataset.		
	TMS-DAS-02	**The system shall be capable of generating real-time travel times using synthesized system data.**	N-MO-1, 10 N-MA-6	
	TMS-DAS-02.1	• The system shall generate travel times that are within 10% of actual travel times when they are displayed or reported.		Agencies to determine whether 10% is appropriate based on their needs and/or per contractual requirements with third-party data providers of travel times, and adjust this value as needed.

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-DAS-02.2	• The system shall use archived data and real-time data together with predictive algorithms to generate travel forecasts for display to users.		
	TMS-DAS-02.3	• The system shall use synthesized system data to automatically post real-time travel time messages on specified DMS at pre-defined times.		
	TMS-DAS-03	**The system shall automatically detect incidents and congestion.**	N-MO-1, 10, 11	
	TMS-DAS-03.1	• The system shall detect incidents and congestion based on one or more data sources.		
	TMS-DAS-03.2	• The system shall allow users to define levels of confidence for detecting incidents by data source.		
	TMS-DAS-03.3	• The system shall use levels of confidence in detecting and verifying incidents.		
Decision Support (DS)	**TMS-DS-01**	**The system shall process active events against internal logic to create and edit Action Plans that recommend actions to be completed by the ATMS, by a user with permission, or both. This includes ongoing processing for recommended updates and new actions as active events evolve and end.**	N-MA-4, 6, 7	
	TMS-DS-01.1	• The system shall provide a mechanism for users to create Action Plans for a variety of event types.		Agencies to specify all event types for which Action Plans will be generated.
	TMS-DS-01.2	• The system shall provide a mechanism for users to edit Action Plans.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-DS-01.3	• The system shall support Action Plans that include both automated and manual actions (automated actions are performed by the ATMS without manual intervention; manual actions are displayed to be performed by users).		Agencies to configure criteria and thresholds.
	TMS-DS-01.4	• The system shall allow users to change the method in which an action is performed, changing it from an automated action to a manual action.		
	TMS-DS-01.5	• The system shall provide Action Plans that evaluate events against pre-defined criteria and thresholds, and recommend one or more actions to users.		
	TMS-DS-01.6	• The system shall provide a mechanism for users to configure the criteria and thresholds that control all recommendations for Action Plans.		
	TMS-DS-01.7	• The system shall allow Action Plan thresholds to be adjustable based on time of day, day of week, and time of year settings.		
	TMS-DS-02	**The system Action Plans shall be able to include control of Field Devices.**	N-CO-2, 4, 6, 9, 11, 13 N-MA-6, 7	
	TMS-DS-02.1	• The system shall enable cameras to change position, angle, and display (i.e. pan, tilt, zoom) based on event attributes and camera pre-sets.		Agencies to choose the field devices for which Action Plans will implement field device control.
	TMS-DS-02.2	• The system shall recommend messages to be displayed on DMS based on event attributes.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-DS-02.3	• The system shall recommend HAR messages based on event attributes.		
	TMS-DS-02.4	• The system shall recommend updates to ramp metering timing based on event attributes.		
	TMS-DS-02.5	• The system shall recommend messages to be displayed on dynamic lane use signs based on event attributes.		
	TMS-DS-02.6	• The system shall recommend variable speed limit displays based on event attributes.		
	TMS-DS-03	**The system Action Plans shall include actions that prompt communication to Regional Partners.**	N-MA-9, 10	
	TMS-DS-03.1	• The system shall retrieve stored contact information for Regional Partners and recommend notifications based on pre-determined event type, location, and other criteria as configured by users.		
	TMS-DS-03.2	• The system shall allow users to configure automated notifications to Regional Partners based on pre-determined event type, location and other criteria as configured by users.		
	TMS-DS-04	**The system shall provide a mechanism for users with permission to review, edit and implement the actions presented in Action Plans.**	N-MA-4, 6, 7	
	TMS-DS-04.1	• The system shall provide a mechanism for users to review all recommended actions before implementation.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-DS-04.2	• The system shall provide a mechanism to edit and/or override entire Action Plans.		
	TMS-DS-04.3	• The system shall provide a mechanism for users to accept or decline the actions recommended for users to complete.		
	TMS-DS-04.4	• The system shall perform the actions that are recommended and accepted (with or without editing) by users.		
	TMS-DS-05	**The system shall perform the automated actions, without manual intervention, as pre-determined in the Action Plans.**	N-MA-6, 7	
	TMS-DS-06	**The system shall provide Actions Plans that include standard operating procedures for users to follow, based on the type and location of the event.**	N-MA-13	Agencies to provide agency-developed Standard Operating Procedures, as available.
Work Zone Management (WZ)	**TMS-WZ-01**	**The system shall allow users with permission to add, modify, and delete mobile and temporary field devices that can be monitored and/or controlled through the system for work zone management. These devices may include agency and third-party portable DMS, portable cameras, portable VSLs, or temporary sensors.**	N-SM-10	Devices may be owned and/or operated by the agency or contractor.
	TMS-WZ-02	**The system shall able to automatically ingest information from mobile and temporary field devices that are being used for work zone management. These devices may include agency and third-party portable DMS, portable cameras, portable VSLs, or temporary sensors.**	N-MO-1, 5, 10	
	TMS-WZ-03	**The system shall allow for monitoring and controlling mobile and temporary field devices**	N-MO-1, 5, 10 N-CO-16, 17, 18 N-MA-7	Devices may be owned and/or operated by the agency or contractor.

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		that are established by system users and construction staff.		
	TMS-WZ-03.1	• The system shall comply with the device control priorities established by the device owners.		
	TMS-WZ-03.2	• The system shall automatically ingest information from mobile and temporary field devices that are being used for work zone management to allow users to view the location of these devices on a map.		
	TMS-WZ-03.3	• The system shall allow users to view mobile and temporary field device information alongside information from other data sources, including permanent devices, to facilitate work zone management and improved decision making.		
	TMS-WZ-03.4	• The system shall allow users to view the operational status, programmed application parameters for operations, and outputs, as applicable, of mobile and temporary field devices that are being used for work zone management.		Portable DMS, portable VSLs, and cameras may include applications and functions that can be programmed or overridden by system users.
	TMS-WZ-03.5	• The system shall allow users to control field devices, as applicable, being used for work zone management when granted permission. This includes automated functions based on established parameters, such as dynamic messaging regarding alternate routes, queue warning, travel times, merging, vehicle enter/exit notifications, and VSLs.		

Model ATMS Requirements – Traffic Management Support (TMS)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	TMS-WZ-03.6	• The system shall allow users to override mobile and temporary field device functions as programmed in the field, as applicable, when granted permission to improve work zone management.		
	TMS-WZ-03.7	• The system shall inform users of their priority and of which user currently controls a mobile and temporary field device.		
	TMS-WZ-04	**The system shall allow users to define the limits of work zone areas in the ATMS.**	N-MA-1, 2	
	TMS-WZ-04.1	• The system shall allow users to define the limits of a work zone area and associate temporary field devices within those limits.		
	TMS-WZ-04.2	• The system shall allow users to assign a unique name to each work zone area.		
	TMS-WZ-05	**The system shall retrieve stored contact information and generate automated notifications to users, including agency and contractor staff in the field as desired, based on pre-defined parameters and locations for improved work zone management and response. For example, work zone managers may want to receive a notification when speeds through a work zone drop below 35 mph.**	N-MA-11 N-CM-1, 2	

3.6 Communication Protocols

Table 17 outlines model ATMS requirements for ATMS Communication Protocols. Communication Protocols are needed to facilitate the transfer of data in and out of the ATMS, and to facilitate communication among ATMS users. Communication Protocols include:

- Data Feed;
- Video Feed; and
- User-to-User Communications

Table 17: Model ATMS Requirements – Common Communication Protocols

Model ATMS Requirements – Common Communication Protocols (CP)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Data Feed (DF)	**CP-DF-01**	**The system shall provide in real-time data collected, generated and stored by the system for use by third parties and other systems.**	N-CM-3, 4	Determine if specific feeds and formats must be created to work with existing legacy systems.
	CP-DF-01.1	• The system shall include locations for all location-specific data the system provides to third parties and other systems.		
	CP-DF-01.2	• The system shall generate data in industry-standard, non-proprietary formats including, at a minimum, XML.		
	CP-DF-01.3	• The system shall generate feeds containing both static and real-time data.		
	CP-DF-01.4	• The system shall allow users with permission to create and configure feeds to define their content.		
	CP-DF-01.5	• The system shall limit the inclusion of third-party data in data feeds based on the agency's permission to share third-party data.		
	CP-DF-02	**The system shall allow users with permission to limit access to feeds based on authorized users or systems.**	N-SM-2 N-CM-4	

Model ATMS Requirements – Common Communication Protocols (CP)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Video Feed (VF)	**CP-VF-01**	**The system shall provide a real-time video feed that can be viewed by third parties.**	N-CM-3, 4	
	CP-VF-01.1	• The system shall allow users with permission to temporarily block video from the feed available to third parties.		
	CP-VF-01.2	• The system shall allow users with permission to select the cameras to include in the video feed available to third parties.		
	CP-VF-02	**The system shall provide the video feed to third parties without negatively impacting the performance of video streaming to system users.**	N-CM-3, 4	
User-to-User Communica-tions (U2U)	**CP-U2U-01**	**The system shall allow users to communicate with each other from within the system.**	N-MO-11 N-CM-1	
	CP-U2U-01.1	• The system shall have a mechanism for users to exchange messages in real time.		
	CP-U2U-01.2	• The system shall have a mechanism for sending messages to individual other users, multiple users, or groups of users. For example, all users that are Field Staff may be identified as a group and a user can select the Field Staff group to send a message to all of them.		
	CP-U2U-01.3	• The system shall have a mechanism for users to share event information with other users.		
	CP-U2U-01.4	• The system shall have a mechanism for users to share digital map views with other users.		
	CP-U2U-01.5	• The system shall have a mechanism for users to signify the priority of messages.		
	CP-U2U-01.6	• The system shall notify users of messages received from other users.		

Model ATMS Requirements – Common Communication Protocols (CP)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	CP-U2U-02	**The system shall store and make available to users with permission the contact information of other users.**	N-MA-11 N-CM-1	
	CP-U2U-03	**The system shall log all user messages.**	N-MA-3, 9, 10, 11, 12 N-CM-1, 3, 5	

3.7 System Management

Table 18 outlines model ATMS requirements for System Management. System Management refers to aspects of the ATMS that enable secure, controlled access to the system, including:

- System Security;
- User Management;
- User Permissions;
- Data Management and Storage; and
- Interfaces.

Table 18: Model ATMS Requirements – System Management

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
System Security (SS)	**SM-SS-01**	**The system shall comply with all agency security policies.**	N-SM-11	Determine and identify agency policy for security for remote and on-site users, as well as if there are different security rules for third-parties to access agency systems.
	SM-SS-02a	**The system shall use single sign-on, utilizing the agency's Active Directory for agency staff to allow authorized staff to access their roles through existing usernames and password.**	N-SM-11	Determine if the new system will integrate with existing agency security so that users can use their existing names and passwords.
	SM-SS-02b	**The system shall have login and user account security consistent with the agency policies, such as password strength and frequency for new password.**	N-SM-11	
	SM-SS-03	**The system shall allow for creating and maintaining accounts for users external to the agency that may have separate security rules.**	N-SM-11	Determine how external users will be treated and what agency security policies apply. They may not have the same security

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				requirements or be part of the agency Active Directory.
	SM-SS-04	**The system shall be configurable to allow users with permission to manage interfaces to new systems and devices, including access via VPN or through secure protocols.**	N-SM-1, 11	
	SM-SS-05	**The system shall encrypt all data that is at rest.**	N-SM-11	
	SM-SS-06	**The system shall use secure API-based methods for encrypting data in transit to accommodate data exchange outside the agency firewall.**	N-SM-11	
	SM-SS-07	**The system shall generate and make available to users with permission security information such as logs of connection errors, distributed denial of service attacks, suspected attempted connections by unknown systems and users, duration of connections and data transmission failures.**	N-SM-5, 9, 11	This requirement is for state-hosted solutions. Determine whether detecting intrusions is a function of the agency's existing firewall and not specific to this system.
	SM-SS-08	**The solution shall allow for remote monitoring of all vital system components.**	N-SM-11	
	SM-SS-09	**The system shall notify users with permission when the system identifies a security risk such as a DDOS attack or access by an unauthorized system or user.**	N-SM-11	This requirement is for state-hosted solutions. Consider whether detecting intrusions is a function of the agency's existing firewall and not specific to this system.
	SM-SS-10	**The system shall have a disaster recovery plan for operation continuation in case of catastrophic system failure.**	N-SM-7, 11	

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	SM-SS-11	**The system shall support failover redundancies and swapping of critical solution components and critical data of all solution components.**	N-SM-11	
	SM-SS-12	**Elements of the system hosted by a service external to the agency shall be FedRAMP certified.**	N-SM-11	This security requirement is for hosted system elements only. www.fedramp.gov is the federal security requirements for hosted solutions.
User Management (UM)	**SM-UM-01**	**The system shall allow users with administrative permissions to manage user accounts.**	N-SM-2	
	SM-UM-01.1	• The system shall allow users to create and delete user accounts.		
	SM-UM-01.2	• The system shall allow users to suspend and restore accounts.		
	SM-UM-01.3	• The system shall allow users to configure user permissions for each user.		
	SM-UM-02	**The system shall log and make available to users with permission all user management activity.**	N-SM-4	
	SM-UM-03	**The system shall allow users with permission to view user historic and real-time activity by user.**	N-MA-3 N-SM-4	
	SM-UM-04	**The system shall allow a user's permission to be limited based on parameters such as geographic location, entity the user works for, or event type. For example, a maintenance staff member in a district may be limited to only entering road conditions, or controlling devices in that district.**	N-SM-2	

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	SM-UM-05	**The system shall be capable of having a minimum of 200 user accounts at any time.**	N-SM-2	The number provided is arbitrary, and the correct number of accounts for your agency and other users should be considered, including staff at the TMC, field staff and external users, plus the potential for future expansion.
	SM-UM-06	**The system shall be capable of having 50 users logged in and active in the system simultaneously.**	N-SM-2, 4	The number of simultaneous users provided is arbitrary, and the correct number of simultaneous users should be considered, including staff at the TMC, field staff and external users, plus the potential for future expansion.
	SM-UM-07	**The system shall allow each user to manage the individual's user account, including the user profile, and preferences for display, notification and contact.**	N-SM-3	Determine the number of users your agency will need, both at the TMC, remote and external users. Fifty is listed here as a general estimate. The agency may determine total users based on whether there is a user license or system license.
User Permissions (UP)	**SM-UP-01**	**The system shall grant access to any system functionality only to users with permission to perform the function.**	N-SM-2	

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	SM-UP-02	**The system shall have pre-defined user types with preconfigured permissions to which a user with administrative permissions can assign users. For example, a TMC Operator user type may have permission to perform all functions related to traffic management.**	N-SM-2	The following sub-requirements list typical user types based on this common Concept of Operations. Agencies should identify the typical user types they envision using their ATMS.
	SM-UP-02.1	• The system shall have an "Operator" user type with permission to perform system operations at a center.		
	SM-UP-02.2	• The system shall have a "Manager" user type with permission to view activity logs, security information, system diagnostics and system performance information.		
	SM-UP-02.3	• The system shall have an "Administrator" user type with permission to manage the system and users, and monitor system health.		
	SM-UP-02.4	• The system shall have a "Partner" user type with permission to perform limited system operations from remote locations.		
	SM-UP-02.5	• The system shall have an "Analyst" user type with permission to generate and view reports.		
	SM-UP-02.6	• The system shall have a "Field Staff" user type with permission to perform limited system operations related to traffic control from remote locations.		
	SM-UP-02.7	• The system shall allow users to create additional user types and define the functionality permitted.		

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	SM-UP-03	**The system shall allow a user with administrative permission to add or remove permissions to individual users.**	N-SM-2	
	SM-UP-04	**The system shall allow a user to have permissions from one or more user types.**	N-SM-2	
Data Management and Storage (DS)	**SM-DS-01**	**The system shall use one of the following relational databases:** - **SQL Server; or** - **Oracle 10g.**	N-SM-6	Determine which database types the agency will allow. If the vendor hosts the solution, decide if the database type is still important.
	SM-DS-02	**The system shall store data that is collected by the system, entered into the system by users and generated by the system.**	N-MO-7 N-MA-3 N-SM-6	
	SM-DS-03	**The system shall make stored data available to users.**	N-MO-7 N-MA-3 N-SM-6 N-AR-2, 3	
	SM-DS-04	**The system shall have mechanisms for users with permissions to manage data stored within the system.**	N-SM-6	
	SM-DS-04.1	• The system shall notify specified users when data the data stored reaches the system's capacity.		
	SM-DS-04.2	• The system shall have a mechanism that allows users to select data and purge that data from storage based on criteria such as data type and age.		
	SM-DS-05	**The system shall include detailed database design documentation, including database**	N-SM-6	

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		schemas, data dictionaries and interface control documents.		
	SM-DS-05.1	• Design documents shall be maintained to accurately describe the system as it is updated or changed.		
	SM-DS-06	**The system shall allow users with permission to directly query the system database.**	N-MO-7 N-MA-3 N-SM-6 N-AR-2, 3	
	SM-DS-07	**The system shall store data generated or collected by the system for a configurable period of time.**	N-MO-7 N-MA-3 N-SM-6	
	SM-DS-07.1	• The system shall allow users to configure the length of time and how data is stored by data classification.		
	SM-DS-07.2	• The system shall use stored data as appropriate for reporting, decision support and data synthesis.		
	SM-DS-08	**The system shall be configurable to allow data storage from third-party systems in compliance with third-party licensing.**	N-SM-6	
Interfaces (IF)	**SM-IF-01**	**The system shall interface with existing agency systems or provide a data transformation tool that enables data exchange between the system and agency systems.**	N-SM-1	Identify the existing systems (e.g. RCRS, GIS, etc.) and provide potential bidders the details of how your agency envisions data exchange happening. Also. be aware if any legacy systems will be changing in the near future so that the staff in charge of the change

Model ATMS Requirements – System Management Support (SM)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				is aware of the ATMS's need for data exchange.
	SM-IF-02	**The system shall allow for direct database interface to other authorized systems.**	N-MO-10 N-SM-10	
	SM-IF-03	**The system shall identify and log faults and errors with interface systems that prevent successful data exchange.**	N-SM-5	
	SM-IF-04	**The system shall notify users when an interface fails to successfully exchange data.**	N-SM-1, 9	
	SM-IF-05	**The solution shall support industry standards such as REST and SOAP API's for interfacing with other systems.**	N-SM-1, 5	
	SM-IF-06	**The system shall allow users with permission to add and delete interfaces to other systems to allow data exchange.**	N-SM-1, 10	
	SM-IF-07	**The system shall have quality review processes to identify and reject data that does not conform to system rules.**	N-MO-10	
	SM-IF-08	**The system shall have a mechanism to notify users with permission of interface failures such as loss of connection or data not received by the system when expected.**	N-SM-8, 9	
	SM-IF-08.1	• The system shall allow users to define thresholds for defining an interface failure. For example, an external that typically exchanges data in real-time may be deemed failed after ten minutes of no connectivity.		
	SM-IF-08.2	• The system interface failure notification shall allow users to configure the thresholds for notification and frequency of notification.		

3.8 Analysis and Reporting

Table 19 outlines model ATMS requirements for Analysis and Reporting. Analysis and Reporting functionality allows users to extract raw and post-processed data from the ATMS, including:

- Canned Reports;
- Ad Hoc Reports;
- Report Configuration;
- Dashboards; and
- Output Types.

Table 19: Model ATMS Requirements – Analysis and Reporting

Model ATMS Requirements – Analysis and Reporting (AR)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Canned Reports (CR)	**AR-CR-01**	**The system shall allow users with permission to access and generate standard operational and management reports about the roadway network, route, or specific events from system data using pre-defined queries based on select parameters.**	N-AR-1, 2, 3	
	AR-CR-01.1	• The system parameters available to users to generate reports shall be based on spatial, temporal, event criteria, and groupings of event criteria.		
	AR-CR-01.2	• The system shall allow the system administrator to configure the parameters available to users that automate the data queries necessary to generate canned reports.		
	AR-CR-01.3	• The system shall allow users to generate pre-defined performance measures, such as those related to system performance regarding mobility and operator workflow activity during incident response.		

Model ATMS Requirements – Analysis and Reporting (AR)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Ad Hoc Reports (AH)	**AR-AH-01**	**The system shall allow users with permission to access and generate customizable ad hoc reports from system data.**	N-AR-1, 2, 3	
	AR-AH-01.1	• The system shall allow the user to input configured data queries based upon spatial, temporal, event criteria, and groupings of event criteria. For example, the solution will be able to generate a query that shows summed values for all cities as a group.		
	AR-AH-01.2	• The system shall expose all objects within the system database to users for ad hoc queries.		
	AR-AH-01.3	• The system shall merge specific event attributes based upon route hierarchy. For example, users will be able to query events on the primary route or concurrent route with the corresponding route mileage.		
Report Configuration (RC)	**AR-RC-01**	**The system shall allow users with permission to configure the presentation and format of canned and ad hoc reports.**	N-AR-1, 3	
	AR-RC-01.1	• The system shall allow a system administrator to restrict the length of report outputs to reduce data processing demands. For example, report outputs of non-summarized, detailed data may be restricted for the number of days or routes.		
	AR-RC-01.2	• The system shall allow users to export reports as graphical and/or tabular data in common file formats, including csv, pdf, jpg, xml and xls.		Determine the formats that best suit your agency's reporting needs.

Model ATMS Requirements – Analysis and Reporting (AR)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Dashboards (DB)	**AR-DB-01**	**The system shall display dynamic graphical and tabular reports as a "dashboard" within its user interface.**	N-AR-1, 2, 3, 4, 5	
	AR-DB-01.1	• The system shall allow a user to configure the data presented in the user's dashboard, limited by the user's permission to access data. For example, a user with operator permissions may view traffic speeds, events and system messages.		
	AR-DB-01.2	• The system shall allow a user with administrator permissions to configure the data presented in the user's dashboard to display system health, device status, user information and other administrative information. .		
Output Types (OT)	**AR-OT-01**	**The system shall allow users with permission to view a report of errors in the system that includes a description of the error, and indicates the time, the user, and the component within the system where the error occurred**	N-SM-5, 9	
	AR-OT-01.1	• The system shall report information that describes the error, indicate the time, the user and the component within the system where the error occurred		
	AR-OT-02	**The system shall allow system administrators to view a report on user access and usage, including queries and actions.**	N-MA-3 N-SM-4	

3.9 Other Agency-Specific ATMS Requirement Categories

Table 20 outlines model ATMS requirements for Agency Specific Requirement Categories. Agency Specific Requirement Categories provides a placeholder to add requirements that are unique to each agency, including:

- Accessibility; and
- Software/Hardware Policies.

Table 20: Other Agency-Specific ATMS Requirements

Model ATMS Requirements – Agency -Specific Requirements (ASF)				
Module	Requirement ID	Requirement	Need(s)	Considerations
Accessibility (AC)	**ASF-AC-01**	**The system shall be compliant with Section 508 of the Work Rehabilitation Act and the agency's policy for accessibility by people with disabilities. Reference the Accessibility requirements on the agency web site.**	N-SM-3	Determine whether your agency has specific accessibility requirements, whether Section 508 compliance will suffice, or if, because it is not a public-facing system, if there are any accessibility requirements.
	ASF-AC-02	**The system accessibility shall be tested and verified using an agency-provided tool.**	N-SM-9	Determine whether the agency has an accessibility tool, or has a commercial tool that it uses.
Software / Hardware Policies (SH)	**ASF-SH-01**	**The system shall be hosted by the state, externally, or a hybrid of state and external hosting and meet all relevant security requirements.**		Determine if the agency has a preference for a state-hosted, cloud hosted or hybrid system. The key may be that the system's components meet the corresponding security requirements of the agency (e.g. cloud

Model ATMS Requirements – Agency -Specific Requirements (ASF)				
Module	Requirement ID	Requirement	Need(s)	Considerations
				elements meet cloud hosting security requirements).
	ASF-SH-02	**The system shall operate any servers located at the agency in the most recent version of Windows Server used by the agency at the time of implementation.**	N-SM-1	Determine the current server environment for the agency. If the system will be hosted, determine whether the agency wants to specify the server environment.
	ASF-SH-03	**The system shall have a modular design that allows for the addition of functionality through "modules" offered by the vendor, or through customizations developed by the vendor.**	N-SM-1	
	ASF-SH-04	**If the system requires more than one central server to achieve the system performance targets, the vendor shall provide a solution with load balancing and synchronization.**	N-SM-1	
	ASF-SH-05	**The system shall have separate environments for development, testing and production.**	N-SM-1	
	ASF-SH-05.1	• The system development environment shall be used solely for system development purposes. All solution development shall be conducted in the development environment before being moved to other environments.		
	ASF-SH-05.2	• The system test environment shall be used for testing and demonstrating solution functionality.		
	ASF-SH-05.3	• The system production environment shall be used for traffic operations. The production environment shall be the most recent version		

Model ATMS Requirements – Agency -Specific Requirements (ASF)				
Module	Requirement ID	Requirement	Need(s)	Considerations
		of all the functionality that has successfully been tested and accepted by the agency.		
	ASF-SH-05.4	• The system shall use the production environment for training with a separate training data set. The training data set shall only be used for training and not for traffic operations.		Determine if the training will take place in the testing or production environment. Or if the agency would prefer a separate environment just for testing.
	ASF-SH-06	**The system shall perform all data exchange with other systems in the production environment.**	N-SM-1	
	ASF-SH-07	**The system's web tools shall be fully functional in the most recent version of the following web browsers approved for use by the agency:** - **Chrome** - **Microsoft Edge** - **Firefox**	N-SM-1	Determine the browsers and versions that are acceptable to the agency.
	ASF-SH-08	**The system shall be able to update the user interface and all functionality remotely.**	N-SM-1	Determine if the agency wants a system that offers all functionality through a web browser interface. Consider this requirement in the workplan for system implementation regarding notification of planned disruptions, and allowable amount of time system can be down.

Model ATMS Requirements – Agency -Specific Requirements (ASF)				
Module	Requirement ID	Requirement	Need(s)	Considerations
	ASF-SH-09	**The system shall provide all functionality through the system at an agency's workstation.**	N-MO-10	
	ASF-SH-10	**The system shall provide limited functionality through the user interface used by remote users. Limited functionality includes all functionality necessary for stakeholders not at the TMC.**	N-MO-6	Determine if the agency wants full functionality through a workstation-installed application, and limited functionality through a web browser or mobile application interface.
	ASF-SH-11	**The system shall include a mobile application or mobile-optimized user interface capable of providing limited functionality.**	N-MO-6	Determine if the agency wants a mobile app. If so, determine its role, such as just for condition reporting, or for work zone management, full functionality.
	ASF-SH-12	**The system shall have a clearly-defined version control process and code management system including development, test and production environments and the ability to perform full "roll back" to previous version capabilities.**	N-SM-7	