

SPECIFICATION FOR ADVANCED TRANSPORTATION MANAGEMENT SOFTWARE (ATMS)

1. INTRODUCTION

The client intends to provide Advanced Transportation Management Software to be able to monitor and control the ITS equipment deployed in their organization. This discussion paper is a contribution towards establishing the requirements for the software system.

System Description

The Advanced Transportation Management System (ATMS) shall be a state-of-the-art, off the shelf software application designed to assist in the collection, dissemination, and management of transportation systems and information. It shall have a scalable architecture, which can be customized to meet unique operational environments and be adaptable for small and large scale Intelligent Transportation System (ITS) deployments.

The ATMS shall include a modular ITS software architecture in which the system is configured based on the customer's desired system modules. In turn, the system shall then be priced based on the modules selected, the specific feature set of these modules and the level of customization (if any) that may be required.

The system will comprise of web-based operators interface that has a set of capabilities that operators use on a day to day basis. The browser-based User Interface (UI) shall provide a feature-rich application easily accessible from the Intranet or the Internet. The browser windowing system shall empower each user to configure and display command-and-control interfaces that meet dynamic operational needs. A highly detailed geographical map with ten or more zoom levels shall be provided as standard with all systems installations for viewing roadway information. The dynamic map shall update the display information in real time.

The system will also have a thick client device management diagnostics and programming interface that will be used for detailed configuration of the ATMS system. This interface will be used for detailed device management operations and will allow for more advanced features for diagnostics and programming of devices in the field. This system also provides some of the more complex capabilities that need a thick client configuration to control Traffic Signals and VMS signs.

1.1. ATMS SYSTEM REQUIREMENTS

1.1 GENERAL REQUIREMENTS

- The ATMS server software shall be capable of being installed in a system Virtual Machine (VM) environment allowing the sharing of the underlying physical machine resources.
- The ATMS operators interface shall launch and operate within a standard Internet Browser, Microsoft Internet Explorer Version 7 or equivalent.
- The ATMS operators interface shall launch and operative natively within a web browser and shall not utilize any 3rd party remote web access, web application delivery or virtual networking tools to achieve/simulate a web application.
- The system shall be capable of operating using different relational database solutions including current versions of MS SQL Server or Oracle RDBMS.

- The ATMS shall not require any Commercial-off-the-shelf software (COTS) products, with the exception of a database management system for operation of the ATMS.
- The system shall provide utilities to optimize any database management system storage used.
- The ATMS shall be designed and built in a modular fashion consisting of a base system and optional, functional components that are licensed individually.
- The system shall be customizable to allow modification of any existing features, installation of new system drivers or external system interfaces, or the design of new system modules.
- The system shall be scalable making it suitable for installation as a small application (a single municipality), a large installation (a statewide ATMS), as well as supporting multistate systems management deployments.
- The system should be fault tolerant and designed for full redundant failover and operations (99.9% uptime)
- The system should be open architecture and follow open industry standards, architecture and design standards.
- The system should be based on the open NTCIP standards.
- The system should be designed to be easily integrated into existing proprietary systems.
- Administration and configuration screens shall be displayed in a client user interface.
- The user interface should be capable of being translated into a foreign language.

1.2 SYSTEM FUNCTIONAL REQUIREMENTS

The system shall have available the following modules/subsystems:

- Interactive Geographical Information System (GIS) Map User Interface
- System Administration
- System Security
- Dynamic Message Sign (DMS)
- Video/Closed-Circuit Television (CCTV)
- Vehicle Detection System (VDS)/Congestion Monitoring
- Environmental Sensor System (ESS)
- Highway Advisory Radio (HAR)
- Ramp Metering
- Traffic Signal System
- Event Management (EM)
- Response Plans
- Automatic Incident Detection (AID)
- Data Archiving and Reporting (DAR)
- Congestion Signing/Travel Times
- Center-to-Center (C2C)
- Advanced Traveler Information System (ATIS)/511
- AVL/GPS Equipped Vehicle Tracking

1.3 NTCIP REQUIREMENTS

The client is committed to the use of the NTCIP standards to facilitate the deployment of a wide variety of ITS devices in their organization. In order to provide NTCIP consistency throughout the application, the ATMS shall:

- Support NTCIP communications for signs, sensors, environmental sensor stations and any other type of NTCIP device.
- Use NTCIP data structures (MIBS) in the database to define the attributes of the Device Types in NTCIP terms.
- Store logged data in database tables in the NTCIP format, so that fields are defined in terms of the NTCIP Object names, and the values are stored in NTCIP units.
- Use NTCIP object identifiers for internal communication between system components (e.g. between clients and servers) so that any new applications can be established with these components, using Properties, Methods and Events that use NTCIP object identifiers as parameters.

1.4 COMMUNICATION REQUIREMENTS

The client will be using a variety of communication sub-systems to monitor and control the ITS devices contemplated. These include wireless, network, dial up and serial connections. The ATMS shall support as a minimum the following communication channels:

- Ethernet connections, using both TCP/IP and UDP/IP transport, including support for wireless modems
- Serial connections, using PMPP transport.
- Ethernet connections, with PMPP serial embedded within either TCP/IP or UDP/IP.
- Dial up connections using either PMPP or PPP protocols.
- Support for a modem array, where a bank of dial up modems is supported, using PMPP.
- The ATMS shall maintain communication statistics for each device, so that the number of dropped packets and other communication errors can be readily determined.
- It shall be possible to establish log polling to each device, with the following parameters configurable:
 - The frequency of polling shall be adjustable between 1 minute and 24 hours. It shall also be possible to disable log polling of selected devices.
 - As part of the polling process, it shall be possible to cause the ATMS to synchronize the time in the device controller to the server time of the ATMS.
- It shall be possible to establish real-time polling to each device, with the following parameters configurable:
 - The user, for each device type, shall be able to select which NTCIP objects are to be included in each real time poll.
 - It shall be possible to configure NTCIP STMP (Dynamic Objects) for real time polling, and the ATMS shall automatically manage the refresh of these objects to ensure correct STMP operation.

2. Web Based Operator Interface

2.1 GIS MAPPING AND USER INTERFACE

The ATMS shall support Geographical Information System (GIS) mapping, as part of the user interface. This support of GIS shall include the following:

- The primary interface for the GUI shall be an interactive map that displays current status of the roadway network and traffic field devices.
- The map shall be GIS based using standard GIS files (e.g. .shp files or other equivalent) to render a geographically accurate, to-scale map.
- The map shall include the capability to zoom in and out with up to 10 different zoom levels. The zoom operation shall be enabled via zoom buttons and rectangle/window zoom features.
- The map shall include the capability to pan in any direction with a smooth transition. Panning the map will be accomplished via clicking and dragging the map in the desired direction, including simultaneous movement of both x- and y-axis.
- A default view shall be incorporated into the map so that the user can set the initial view when the map is first started, based on user login level settings.
- The map shall allow for selection of any graphically represented device or event via multiple means including:
 - Clicking on an icon from the map
 - Clicking on an icon from a list window
 - Clicking and dragging an icon from the map to viewer dialog window
 - Selecting a device from dialog pull down menu lists
- The map interface shall provide a current selection status area that provides the most commonly utilized information for the selected device(s) or event(s).
- The map interface shall provide for basic control of devices through the current selection area of the screen. Quick control commands within the current selection area include:
 - Pan, tilt, and zoom a CCTV
 - Change the message on a DMS
 - Implement a new timing plan at a controller
 - Enable/disable lane control signals
 - Change the message on a HAR station
 - Change the metering mode and rate of a ramp meter
- The map shall support the opening of device or event viewer windows for the following:
 - Detailed device status and control
 - Event data entry and control
 - System configuration
 - Device configuration
- The GUI shall be capable of receiving and displaying data from the local systems, as well as any other systems connected via a standard center-to-center interface, over the internet or other private connection.
- The map shall display all major freeways and streets within the region's boundaries with distinct graphical representation for each roadway classification.
- The map shall display real-time traffic conditions using a standard color coding of green for uncongested conditions through yellow and amber for moderate congestion to red for high congestion on freeways located within the region's base map.

- The map shall provide a unique icon for all ITS devices in the system.
- The map should provide a toggle layer for each type of ITS device identified as part of system.
- The system shall have a hideable legend that allows view of all the system icon types, colors, statuses and definitions

2.2 Administration and Security

The ATMS shall support multi-level User Level security levels, as follows:

- The ATMS should provide rules-based administration for access and security at all levels of system use.
- The system administrator shall be capable of creating new user accounts and assigning access privileges to users based on their user group assignments.
- The system administrator shall be able to assign unique user accounts and passwords to each individual user.
- The system administrator shall be able to delete user accounts.
- The system administrator shall be able to modify an existing user's password and access privileges.
- Users shall be automatically be notified via e-mail when new accounts are created. The notification shall include the user's login name and password.
- Users shall automatically be notified via e-mail when changes are made to existing account information, including changes to a person's login name and password.
- The System Administrator shall be able to add/modify/delete agency and group parameters.
- The system shall allow user with the required privileges to view and set multiple system threshold values in one operation.
- The system shall allow users with the required privileges access to modify global system properties and domains from the web-based user interface.
- The system shall allow users with the required privileges access to modify the VDS color thresholds.
- The system shall allow users with the required privileges to modify congestion signing parameters.
- The system shall provide a method to log system, device and security activity for online reporting and archival storage.
- The System Administrator shall be able to add/modify/delete agency and group parameters.
- The System Administrator shall have the capability to assign separate user capabilities/privileges to all user groups. This includes the capability to allow or disallow access to:
 - View CCTV Cameras
 - Control CCTV Cameras
 - View DMS Status
 - Control DMS Signs
 - View Ramp Meter Status
 - Control Ramp Meters
 - View Traffic Signal Status
 - Control Traffic Signals
 - View HAR Status
 - Control HAR stations
 - Create/delete/modify user accounts

- Create/delete/modify user groups
 - Set system configuration parameters
 - Change database/inventory information
- The system shall allow user with the required privileges to view and set multiple system threshold values in one operation.
- The system shall allow users with the required privileges access to modify global system properties and domains from the web-based user interface.
- The system shall allow users with the required privileges access to modify the VDS color thresholds.
- The system shall allow users with the required privileges to modify congestion signing parameters.
- The system shall provide a method to log system, device and security activity for online reporting and archival storage.

2.3 Dynamic Message Sign

- The user shall have the capability to manually poll a DMS in order to view/confirm current sign messages, test communications and obtain other sign/controller status information including system failures.
- The system shall automatically poll all DMS at user configurable intervals to view/confirm current sign messages, test communications and obtain other sign/controller status information including system failures.
- The user shall have the capability to manually compose a message for a DMS and then send/post it to a single sign or multiple signs at once.
- The user shall have the capability to manually blank a single DMS or multiple DMS at once.
- The user shall have the capability to send a message to a single sign or multiple signs based on messages recommended by the response plan subsystem.
- The user shall be able to send a message stored in the DMS message library to a DMS.
- The user shall remove a message displayed on any DMS.
- The user shall be able to add a message stored in the DMS message library to a DMS's priority message queue.
- The user shall remove a message from a DMS's priority message queue.
- The user shall have the capability of editing a message prior to displaying or queuing it.
- The user shall be able to preview a message as it would appear on a targeted DMS before displaying the message on the DMS.
- The user shall have the ability to display, in a single operation, one message on multiple DMS.
- The user shall have the ability to remove, in a single operation, one message from multiple DMS.
- The user shall have the ability to blank, in a single operation, multiple DMS.
- The user shall review messages stored in the message queue of a DMS.
- The highest priority slot in a DMS message queue shall be the override priority.
- The user shall have the capability to display a message at manual priority.
- The user shall have the capability to display a message at override priority.
- The user shall have the capability to disable a DMS from system access.
- The user shall have the capability to enable a DMS for system access.

- The user shall view detailed DMS operational status.
- The user shall be able to browse the operational status of each DMS.
- The user shall be able to create a single phase message in the DMS message library.
- The user shall be able to create a multi-phase message in the DMS message library.
- The user shall be able to store library messages in a variety of different message library categories.
- The user shall be able to expand the number of message library categories by creating and naming new categories.
- The user shall be able to open a message stored in the DMS message library.
- The user shall be able to save over an existing message to the DMS message library.
- The user shall save a message to the DMS message library under a new name.
- The user shall delete a message stored in the DMS message library.
- The user shall set the display time for phases of a message.
- The user shall have the capability to relocate portable DMS.
- The DMS subsystem shall alert the System Alarm Manager that the system has lost communications with a DMS.
- The DMS subsystem shall log a message to the System Action Logger whenever a DMS is manipulated. The message shall contain the date, time, operator name, DMS, and message number.
- The DMS subsystem shall alert the user with an error message when an action cannot be performed on a DMS.
- The DMS subsystem shall alert the user when a DMS has detected an internal malfunction.
- The user shall be able to generate a report indicating which DMS has malfunctioned. The report shall contain the DMS's operational status, the type of malfunction or error detected and the time it was detected.
- The DMS subsystem shall support text messages, graphic messages, and a hybrid of the two.
- The DMS subsystem shall support monochrome and color messages.
- The DMS subsystem shall support sending messages with different font types, font styles and font sizes.
- The DMS subsystem shall support formatting of test messages to support left, center, right and full justification.
- The DMS subsystem shall support fixed and portable DMS.
- The DMS system shall have a simulator to allow testing and operations of the system via simulation mode.
- The DMS subsystem shall enable external agencies to display messages stored in the DMS message library on DMS.
- The DMS subsystem shall enable external agencies to remove messages from DMS.
- The DMS System shall support interfaces for a wide variety of DMS and PDMS vendors including:
 - Daktronics
 - Ledstar
 - Mark IV
 - Adaptive

- Skyline
 - Addco
 - Wanco
 - Adaptive
 - Display Solutions
 - National Signal
 - Vermac
 - Precision Solar
 - American Signal
 - Daktronics
 - K&K Systems
 - Telegra
 - SATT
 - Solar Tech
 - McCain
 - Imago
 - SES
- The DMS system shall support the NTCIP 1203 protocol for permanent and portable DMS of all typical sizes.
 - The DMS shall support proprietary DMS control protocols, as required.
 - There shall be a DMS Scheduler that allows scheduling of DMS messages for a single sign or multiple signs for up to one month in advance of actually sign activation.
 - The DMS Scheduler display shall show the current active DMS messages on the selected signs.
 - The DMS Scheduler shall allow for different messages to be scheduled at different times on a single or multiple signs.
 - The DMS Scheduler shall allow a current active message to return after a scheduled message at user option.
 - The DMS Scheduler shall display messages on the signs automatically without user interaction.

2.3 Video/Closed Circuit Television

- The operator shall be able to select and control any available camera in the system.
- The Operator shall be able to select a camera from the CCTV viewer pull down menus or GUI map
- The user shall have the capability to poll a camera in order to test communications and other device status information.
- The system shall automatically poll all CCTV cameras at user configurable intervals to view/confirm current system operations, test communications and obtain other status information including system failures.
- The CCTV subsystem shall be capable of controlling camera pan, tilt, zoom, focus, presets, patterns and iris adjustments from the workstation.
- The system shall have the capability for “hover/drag/slide” pan and tilt control of a camera by placing the mouse cursor over the video image and dragging the mouse to the desired camera location/position.
- The CCTV system shall allow the setup and selection of preset camera positions. A minimum of 8 presets up to a maximum of 64 presets shall be configurable.

- The CCTV subsystem shall be capable to change the presets positions and preset names.
- The CCTV subsystem shall support all preset camera positions available to operators.
- The CCTV subsystem shall be capable to set and play video tours. These tour capabilities shall allow operators to select any number of cameras and/or camera preset positions to be “rotated” for viewing within a single viewer window at regular timed intervals.
- Users shall have the capability to independently name each video tour.
- The CCTV subsystem should be capable of at least four independent camera tours per workstation.
- Users should be able to pause tour operation within any tour window and then resume the same tour operation at any time.
- Activation of a camera control should stop the automatic tour operation.
- The CCTV subsystem shall prioritize users by providing different capabilities.
- The CCTV subsystem shall allow for selection and routing of video to auxiliary monitors or display devices, such as large screen projection displays, external ports to other agencies, and local television feeds.
- The CCTV subsystem shall interface with the video wall controller to allow the display of video images on the large screen projector wall.
- The CCTV subsystem shall allow users to lock control a camera. During this period of time, other users with lower access privilege shall not be allowed to control the locked camera. The user shall be able to unlock or release the camera.
- The CCTV subsystem shall indicate the owner of a locked camera.
- The camera locking feature shall have timeout to unlock any camera at a user configurable timeout period.
- The workstation shall be capable of displaying digital video that is encoded using standard or common video compression algorithms. These include:
 - MJPEG
 - MPEG1
 - MPEG2
 - MPEG4
 - H.262/263
 - Quicktime
 - Microsoft Windows Media
 - Real Video
- System users shall be able to display up to eight (8) simultaneous streaming video images on a single user workstation, using any combination of video decoding standards.
- The system shall support PTZ control interfaces for a wide variety of camera interfaces including:
 - Any NTCIP 1205 supported cameras (Pelco, Cohu, Bosch, etc)
 - Pelco cameras using the Pelco-D or NTCIP 1205 protocol
 - Cohu cameras using the Cohu, Pelco-D or NTCIP 1205 protocols
 - Bosch cameras using the NTCIP 1205 protocol
 - American Dynamics cameras using the NTCIP 1205 protocol
- The workstation application shall display the camera location information, e.g. camera ID, camera location, preset position, and status.

- The CCTV subsystem shall capture snapshot video images (JPEG) from available cameras.
- The snapshot video images shall be periodically updated.
- The operator shall have the ability to preclude specific cameras from being exported to external systems (e.g. websites, thc media, etc.)
- The CCTV subsystem shall log the user ID when a camera is being accessed.
- The CCTV subsystem shall log all alarms, including the loss of communications between a camera and the video subsystem.
- The CCTV subsystem shall enable external agencies to see a video stream and have PTZ control capabilities.
- The CCTV subsystem shall control the distribution of all traffic images for internal and external use on the public website
- The CCTV subsystem should collect and report current camera status, e.g. communication, image status, and PTZ status.
- The CCTV subsystem should provide a selectable preset time-out feature which is a programmable interval in which the camera must automatically return to a preset default position after a preset timeout interval is reached.

2.3 Vehicle Detection System (VDS)/Congestion Monitoring

- The VDS subsystem shall provide a map display that allows operators to manage and view a summary of information from roadway sensors to easily see and understand the congestion status of the entire roadway network.
- The system shall automatically poll all VDS devices at regular intervals to obtain roadway traffic congestion information (e.g. vehicle detector volume, occupancy and speed information) and well as sensor status information.
- The VDS subsystem shall have a configurable polling rate.
- The system shall be able to interface with a variety of VDS sensors including:
 - Inductive Loops
 - Remote Traffic Microwave Sensors
 - Wavetronix Microwave Sensors
 - Speedinfo Sensors
 - 3M Microloops
 - Autoscope Video Image Detectors
 - Trafficon Video Image Detectors
 - Sensys Networks magneto resistive sensors
 - Infrared Sensors
- The System shall display VDS/congestion information using a minimum of three different color coded congestion levels which are user configurable.
- VDS/Congestion data shall be capable of being displayed in point (dot) format or segments (congestion bands).
- The VDS system shall have the capability of interface with sensors conforming with the NTCIP 1209 protocol
- The VDS system shall be capable of obtaining traffic congestion data from GPS or cell probe data systems/brokers (e.g. Inrix)
- The VDS subsystem shall collect VDS operational status from sensors.
- The VDS subsystem shall collect station traffic data.
- Traffic data shall include, but not be limited to, volume, occupancy, speed, and travel time (if available)
- The VDS subsystem shall collect lane-by-lane traffic data, if available

- Lane-by-lane data shall be aggregated into station data.
- Lane-by-lane data shall be published to other subsystems.
- Station data shall be published to other subsystems.
- The user shall have the capability to disable a VDS from system access.
- The user shall have the capability to enable a VDS for system access.
- The user shall view detailed VDS operational status.
- The user shall be able to browse the operational status of each VDS.
- The VDS subsystem shall have a system alarm that communications has been lost with a VDS.
- The VDS subsystem shall have an alarm when a VDS has detected an internal malfunction.
- The VDS subsystem should display vehicle classification information, when available.

2.4 Environmental Sensor Stations

- The ESS shall be able to poll data from the environmental sensor stations at a minimum of every 5 minutes.
- The ESS polling rate shall be configurable by the system users with the correct access privileges.
- ESS weather data shall be viewable with various different weather data layers on the map user interface using different color coded icons. These ESS data layers include:
 - Surface Conditions
 - Precipitation Type
 - Air Temperature
 - Surface Temperature
 - Subsurface Temperature
 - Bridge Surface Temperature
 - All Surface Temperature
 - Average Wind Speed and direction
 - Wind Gust Speed and direction
- The user shall be able to view ESS data by air temperature.
- The user shall be able to view ESS data by wind speed.
- The user shall be able to view ESS data by wind direction.
- The user shall be able to view ESS data by wind gust speed.
- The user shall be able to view ESS data by surface temperature.
- The user shall be able to view pavement conditions (dry above freezing, dry below freezing, wet above freezing, wet below freezing, or frozen).
- The user shall be able to view ESS data by precipitation type.
- The user shall be able to view dew point and/or relative humidity.
- The user shall be able to view chemical type.
- The user shall be able to view subsurface temperature.
- The user shall be able to view subsurface moisture.
- The user shall be able to view precipitation occurrence (yes/no).
- The user shall be able to view precipitation type (rain, snow, sleet).
- The user shall be able to view precipitation intensity.
- The user shall be able to view precipitation accumulation.
- The user shall be able to view snow depth.
- The user shall be able to view visibility.

- The user shall be able to view atmospheric pressure.
- The user shall be able to view all ESS data from a single site.
- The user shall be able to view multiple sites and their respective data simultaneously.
- The user shall be able to simultaneously view any single data type from multiple sites.
- Data shall be able to be represented by color coded icons
- Sites with a fault at a specific sensor shall display “bad sensor” for that field and be represented by an icon of a different color (e.g. black).
- Data time stamps shall be displayed with the data.
- ESS Sites shall be able to be geo-coded.
- The ATMS should enable viewing of ESS cameras, when available.
- The ATMS should support daily automated diagnostics for field ESS devices, including alarm generation based on certain ESS thresholds, e.g. excessive wind speed.
- The system shall be capable of providing weather alerts of pending weather situations that require operator attention.
- The system shall be capable of interfacing with the National Weather Service to obtain pertinent weather alert and forecast information.

2.5 Highway Advisory Radio (HAR)

- The system should have the ability to record and transmit messages to roadside HAR devices and initiate and terminate the transmission of those messages by the roadside HAR devices.
- The system shall have the capability to do an audible preview of the composed HAR message before sending the message to the HAR station
- The system should retrieve status information from roadside HAR devices including activation times, any configurable parameters, device failures, and communication failures and log status to user activity logs.
- The system should be able to manually create a HAR message.
- The system should provide graphic objects on the traffic GUI map indicating HAR location and real-time status.
- The system should have interfaces with digital HAR systems via central control software, where applicable.
- The system shall have interface with the Highway Information Systems (HIS) DR2000 Platinum software.
- The system shall have the capability to activate HAR beacon signs.
- The user shall have the capability to poll a HAR in order to test communications.
- The user shall have the capability to disable a HAR from system access.
- The user shall have the capability to enable a HAR for system access.
- The user shall view detailed HAR operational status.

2.6 Ramp Metering

- The ATMS shall have a ramp metering module which allows the control, configuration and monitoring of freeway ramp metering systems.
- From the ramp metering subsystems, users shall be able to set ramp metering stations into different metering modes including Manual, Time of Day (TOD), Local Mainline Responsive (LMR) and System-Wide Adaptive Ramp Metering (SWARM) modes.

- The user shall have the capability to poll a Ramp Meter Controller (RMC) in order to test communications.
- The system shall automatically poll ramp metering controllers at user configurable intervals to obtain traffic detector information, obtain ramp meter status data, test communications and obtain status information including system failures.
- The user shall have the ability to download timing plans to a ramp meter controller.
- The user shall have the ability to upload timing plans from a ramp meter controller.
- The user shall have the capability for sending a metering rate to a ramp meter controller.
- The user shall have the ability to activate timing plans at a ramp meter.
- The user shall be able to preview a timing plan before downloading the timing plan to the ramp meter controller.
- The user shall have the ability to download, in one operation, a single timing plan to multiple ramp meter controllers.
- The user shall have the ability to remove, in one operation, a single timing plan from multiple ramp meter controllers.
- The user shall have the ability to send a metering mode, in one operation, to multiple ramp meter controllers.
- The user shall have the ability to send a metering rate, in one operation, to multiple ramp meter controllers.
- The user shall have the ability to turn on, in one operation, multiple ramp meter controllers.
- The user shall have the ability to turn off, in one operation, multiple ramp meter controllers.
- The user shall have the ability to set the clocks, in one operation, in multiple ramp meter controllers.
- The user shall review timing plans stored on a ramp meter controller.
- The user shall have the capability to disable a ramp meter controller from system access.
- The user shall have the capability to enable a ramp meter controller for system access.
- The user shall view current metering mode, metering rate, and timing plan description.
- The user shall view detailed ramp meter controller operational status.
- The user shall be able to browse the operational status of each ramp meter controller.
- The user shall be able to view ramp detector volume and occupancy by lane.
- The RMC subsystem shall periodically collect traffic data from ramp lanes.
- The system shall be capable of system wide adaptive ramp metering/corridor wide adaptive ramp metering that automatically adjusts ramp metering rates and modes based on forecasted local or system-wide traffic conditions.
- The system should allow configuration of all system side adaptive ramp metering parameters

2.7 Traffic Signals

- The system shall have an Urban Traffic Signal Control (UTCS) module used for the monitoring and control of Urban Traffic Signal Control Systems (UTCS)
- The user shall have the capability to poll an intersection via the traffic signal system module.

- The user shall have the capability to view intersection configuration data via the UTCS. This includes intersection name, controller type, communication type, detector type, phase parameters, configured phases, timing patterns, alarms, and warnings)
- The user shall have the capability to view intersection communication configuration data via the UTCS.
- The user shall have the capability to view intersection group configurations via the UTCS.
- The user shall have the capability to view intersection group status via the UTCS.
- The user shall have the capability to view intersection group timing plan schedules via the UTCS.
- The user shall have the capability to view intersection group system detector data via the UTCS. (5-minute updates)
- The user shall have the capability to view intersection status via the UTCS.
- The user shall have the capability to view log reports via the UTCS (e.g. controller event, communication, system event, system detector, user, traffic responsive performance).
- The user shall have the capability to view UTCS time and date.
- The user shall have the capability to view the operational mode of intersections or groups via the UTCS.
- The user shall have the capability to email and page unique notification lists based on UTCS alarm type and intersection group.

2.8 Event Management

- The Event Management (EM) system shall track unplanned events (accidents, incidents, hazards), planned events (construction activities, work zones) and special situation events (VIP visit, ball game, etc).
- The system shall allow creating of multiple different event types including:
 - Incidents
 - Road closures
 - Construction
 - Road Restrictions
 - Road Conditions
 - Hazards
 - Special Events
- There shall be unique icons for each event type. Each event icon/event type shall be capable of being toggled on or off independently on the map UI.
- The EM system shall automatically log detected events and notify the user for further verification and processing of the event.
- The EM system shall be capable of detecting incidents on all roadway segments for which data is available.
- The EM system shall allow users to create, modify, and terminate incidents.
- The EM system shall allow event records to be modified by only a single user at a time.
- The Event Management shall allow recording of a variety of event related parameters in the event dialog. This includes:
 - Event Duration
 - Event Severity
 - Lane Blockage Pattern
 - Number of vehicles involved

- Number of Cars Involved
- Number of Trucks Involved
- Number of injuries
- Number of fatalities
- Road Conditions
- Event Location
- Roadway type and direction
- Freeform Comment field
- The EM system shall archive all event records, including time/date stamps for every modification to the event record throughout the life of the event.
- The EM System shall have interfaces with third party Computer Aided Dispatch (CAD) Systems to automatically receive, display and store event information. The system shall allow generation of response plans against these events.
- The EM System shall have the capability to receive events from other third party systems via the system C2C interface to display and store event information. The system shall allow generation of response plans against these events.

2.9 Event Response Plans

- The EM system shall provide a means for automatic response plan generation for scheduled and unscheduled events.
- The response plan system shall be rules-based with the logic to recommend operation actions, DMS messages, HAR messages, web messages and event notifications based on a matrix of policies and methods entered by incident response operators.
- The EM system shall generate an automated plan in response to an unscheduled event that can be implemented, in part or in whole, by a system user. In addition, the user can modify the generated plan with all modifications associated with the event.
- The EM system shall automatically track and undo any implemented response actions when an event is terminated.
- The EM system shall generate automatic response actions for the following:
 - Recommended dynamic message signs to use in response to an event
 - Recommended messages for DMS
 - Recommended Highway Advisory Radio (HAR) sites to use in response to an event
 - Recommended messages for HAR stations
 - Public messages for web distribution
 - Recommendation for electronic notifications of staff via e-mail, text message, pager, phone or fax.
- The EM system shall provide a mechanism to create, store, modify and implement response plans for special events.

2.10 Automatic Incident Detection (AID)

- The EM system shall be capable of detecting events through the implementation of the Automatic Incident Detection (AID) algorithms.
- The EM system shall be capable of detecting events via the interface with existing vehicle detection system that provide incident detection capabilities (e.g. Trafficon sensors)
- The AID algorithm shall be configurable by the user to allow tuning of the system parameters based on local conditions and the enable the most accurate AID detection rates.

- The system shall have an AID simulator to all the testing and modeling of the incident detection system.

2.11 Data Archiving and Reporting

- The system shall provide historical logging/archiving for all pertinent traffic and event information received by the system.
- The archiving and reporting module shall accept traffic data, events, and congestion information from other system modules.
- The archiving and reporting module includes the timestamp when data was collected and includes support for geographic locations (latitude and longitude) for each event and piece of traffic information.
- Access to the archiving and reporting module is managed by user and group level security to ensure trusted access.
- The system shall support logging of historical traffic and event information using multiple choices of off-the-shelf database systems including Oracle, Microsoft SQL Server and MySQL.
- The system shall support the use of multiple third party report writing tools/systems including Crystal reports, Jasper reports and MS reports.
- Systems reports include the following:
 - VDS Traffic Data Report
 - 30-Second Traffic Data Report
 - 15-minute Traffic Data Report
 - Hourly Traffic Data Report
 - Daily Traffic data Report
 - DMS Message History
 - DMS Status
 - CCTV Activity
 - Event Summary
 - ESS Report
 - ESS History
 - User Activity
 - Inventory Audit
- The system shall support printing for all reports types.
- The system shall accommodate retrieval and report generation for archived data covering a period of up to one year without impact to existing on-line data storage.

2.12 Congestion Signing/Travel Times

- The congestion signing/travel times subsystem system shall detect and monitor all areas of congestion within the geographical limits of the system.
- The congestion signing subsystem shall be capable of generating travel time information for any roadway segment within the geographical limits of the system.
- The congestion signing subsystem shall automatically generate messages in terms of both travel time and congestion level for display on DMS and distribution to the public and media via the Internet.
- The congestion signing subsystem shall be capable of being enabled/disabled for use by a system administrator.
- The congestion signing subsystem system shall be configurable for tuning the congestion detection algorithm.

- The congestion signing subsystem shall allow the selection to targets/landmarks for which travel times will be displayed on DMS, e.g. “Travel Time to XXXX location: 20 minutes.”
- The congestion signing subsystem shall have scheduling capabilities set the times of day/and days of week during which travel times will automatically be posted to dynamic message signs.

2.13 Center-to-Center (C2C) Interface

- The ATMS shall have a Center-to-Center (C2C) interface to allow the exchange of traffic and event information within the system via a web service using eXtensible Markup Language (XML) based on the NTCIP 2306 and TMDD standards.
- The ATMS shall provide security for data exchange of all data type so that certain types of data (e.g. Event Data) can be selectively included or excluded from transfer to an external agency
- The system should provide a mechanism for automatically publishing data and video images from multiple sources to various traveler information web sites at specific intervals
- The C2C Interface shall be a web service interface.
- The C2C Interface shall be national ITS standards based.
- The C2C Interface shall support C2C standard data types and transmission protocols.
- The C2C Interface shall support input and output of data based on the TMDD.
- The C2C Interface shall support a 511 system interface.
- The C2C Interface shall support legacy systems’ proprietary communication interfaces.
- The C2C Interface shall restrict access by external agencies and applications to the ATMS data and field devices

2.14 Advanced Traveler Information System (ATIS)/511

- The system shall have an ATIS/external traffic data website module to allow viewing of filtered traffic conditions and traveler information by the public.
- The ATIS should provide a graphical map of the state or selected region for displaying the ITS devices and select summary and status information suitable for Internet display compatible with common web browsers.
- The ATIS map should display for Internet distribution all major freeways and streets within the region’s boundaries with distinct graphical representation for each roadway classification.
- The ATIS should display near real-time traffic speeds using a standard color coding of green for uncongested conditions through yellow and amber for moderate congestion to red for high congestion on freeways located within the state.
- The ATIS should allow selection of numerical limits associated with each display color for each type of traffic measurement by a user with sufficient authorization. These parameters should be applied to display generation for the website.
- The ATIS Internet map display should provide map navigation tools (zoom in/out icons, panning, layer control toggles, status of equipment).
- The ATIS should display for Internet distribution the appropriate information being supplied by corresponding ITS devices including at minimum video images from cameras, sign display from DMS, and weather measurements from ESS
- The ATIS should display condition and measurement data for Internet distribution with no longer than 5 minutes of data latency.

- The ATIS should provide to each Internet user a menu to select which ITS devices to display (layer controls)
- The ATIS should provide a legend to each Internet user to explain which ITS devices are being displayed.
- The ATIS map should provide a legend to each Internet user to explain the near real-time traffic speed colors being display.
- The ATIS shall support the capability for quick zoom to pre-selected geographic areas.

2.15 Automatic Vehicle Location (AVL)

- The ATMS shall have the capability to track vehicles and portable ITS devices in real-time using AVL/Geographical Positioning System (GPS) data and display the locations of these devices on the ATMS map UI.
- AVL/GPS Data shall be time stamped with the time the AVL/GPS received.
- Data shall be displayed with the new unique ID and the GPS/AVL location.
- ATMS users shall have the capability to click on AVL/GPS tracked vehicles to obtain detailed information regarding the vehicle. This information including vehicle ID, latitude/longitude information and other data specific to the vehicle type.
- ATMS shall have the ability to track maintenance support vehicles. Eg. snow removal equipment

2.16 System Alarms

- The system shall provide a single integrated interface available from any PC workstation that allows operators to set threshold conditions for various devices or other user definable conditions such that when threshold conditions are met or exceeded, alarms will be generated notifying the operator of the presence of such conditions. At a minimum, data elements available for alarm generation will include traffic measurements, weather measurements, and device status.
- The system shall provide a System Alarm user interface that will display the alarm conditions the system has encountered and require user interaction.
- System alarms shall be displayed visually in an alarm window that lists the alarms chronologically by order of occurrence.
- The alarm display shall allow the user to click, sort and filter the alarm list based on different parameters such as alarm type, date/time, alarm parameter, location, etc.
- The system shall come configured with the following standard alarms:
 - CCTV Device or Communications Failure
 - DMS Device or Communications Failure
 - VDS Device or Communications Failure
 - RWIS Device or Communications Failure
 - HAR Device or Communications Failure
 - Average station speed
 - Wind Gust Speed
 - Wet Below Freezing
- The system shall allow operators to set alarm thresholds, e.g., adjust the average station speed that will cause a system alarms to appear.

3. Thick Client Device Management Diagnostics & Programming Tools Interface

This thick client device management interface provides the following modules:

- Access Levels and Admin Security
- GIS Mapping
- Audit Trail
- User Groups
- Thresholds and Alarms
- Device Scheduling
- Data Archiving and Reporting
- VDS / Real time Graphing
- Environmental Sensor Stations
- AVL/GPS Equipment Vehicle Tracking
- Dynamic Message Sign (DMS) Management
- Traffic Signals Management
- Maintenance Management
- Parking Management

3.1 Access Levels and Admin Security

- A User Name and Password shall be required before being able to access any device manager function
- The password shall be encrypted in the database.
- It shall be possible for an administrator to see which users are logged on to device manager, and on which computers (client workstations) they are logged on.
- It shall be possible for an administrator to force a log off of any device management user.
- An inactivity timer shall cause an inactive user to be logged off after a configurable time.

3.2 GIS Mapping

The device manager shall support Geographical Information System (GIS) mapping, as part of the user interface. This support of GIS shall include the following:

- The ability to access the client supplied ESRI shape files for GIS data.
- The ability to provide configurable “zoom-based detail” for shapes and labels independently.
- The ability to configure the render colors, shapes, labels, fonts, size and all other render attributes.
- All Devices shall be geo-located. The appearance of devices on a particular map view shall be controlled by a combination of zoom control and layer control.
- Devices that include GPS units, where the latitude and longitude are returned as part of the polling process, shall automatically update their geo-locations on the maps. It shall be possible to configure a “bread crumb” trail on the GPS, to show the recent path of moving devices.

- When a device is moved on a map display (perhaps for aesthetic reasons, to make an area of the map less crowded) the device shall indicate its actual geo-location with a line (a “rubber band”) from the device icon to the actual geo-location.

The overall “look and feel” of the GIS interface shall make it possible for an operator to navigate around the maps, and select devices, based on their position, and then navigate to that device using right-click menus or similar.

3.3 Audit Trail

All user activity shall be logged for audit trail purposes, as follows

- Any changes to configuration, or operation, shall be logged
- All logs shall include a User Name, Device ID and a Date Timestamp of user activity.

It shall be possible to view and print reports of User Activity, filtered by Date and/or User and/or Device

3.4 User Groups

It shall be possible to assign devices to groups as defined by the Administrator, as outlined below:

- These groups shall only be accessible based on the security level of the user groups that are defined.
- It shall be possible to assign read/write, read only or not accessible permissions to groups.

So, for example, a “North Sign Group” shall be controllable by the “North Operators”, but only viewable by the “South Operators” and a “South Sign Group” shall be controllable by the “South Operators”, but only viewable by the “North Operators”.

The System Administrator shall have the capability to assign separate user capabilities/privileges to all user groups. This includes the capability to allow or disallow access to:

- View CCTV Cameras
- Control CCTV Cameras
- View DMS Status
- Control DMS Signs
- View Ramp Meter Status
- Control Ramp Meters
- View Traffic Signal Status
- Control Traffic Signals
- Create/delete/modify user accounts
- Create/delete/modify user groups
- Set system configuration parameters
- Change database/inventory information

3.5 Thresholds and Alarms

Thresholds are expected to be measured as to whether a level or limit has been either exceeded or fell below a certain point. These thresholds should be configurable by using:

- Comparative measures such as greater than, less than or equal to, as well as comparing two values.
- Binary comparatives

Alarms shall have the ability to notify users if a device is not operating properly when the status is measured. The alarms feature should include:

- User defined parameters that alarms will use to trigger and display for the operator when an alarm threshold is reached. For example: low battery voltage warning for portable signs, pixel failure, etc.
- A diagnostic display (grid) shall be opened for each sign showing current failures and/or current status etc.
- Alarms will be raised if a fault is detected by the system during the polling process and the fault will be displayed on the grid in red, and if desired with an audible warning, to focus the attention of the operator.
- Diagnostic alarms can also be reported by e-mail to designated users on the system.
- The system shall provide a single integrated interface available from any PC workstation that allows operators to set threshold conditions for various devices or other user definable conditions such that when threshold conditions are met or exceeded, alarms will be generated notifying the operator of the presence of such conditions. At a minimum, data elements available for alarm generation will include traffic measurements, weather measurements, and device status.
- The system shall provide a System Alarm user interface that will display the alarm conditions the system has encountered and require user interaction.
- System alarms shall be displayed visually in an alarm window that lists the alarms chronologically by order of occurrence.
- The alarm display shall allow the user to click, sort and filter the alarm list based on different parameters such as alarm type, date/time, alarm parameter, location, etc.
- The system shall come configured with the following standard alarms:
 - CCTV Device or Communications Failure
 - DMS Device or Communications Failure
 - VDS Device or Communications Failure
 - RWIS Device or Communications Failure
 - HAR Device or Communications Failure
 - Average station speed
 - Wind Gust Speed
 - Wet Below Freezing
 - The system shall allow operators to set alarm thresholds, e.g., adjust the average station speed that will cause a system alarms to appear.

3.6 Device Scheduling

The device manager shall have the ability to schedule messages for deployment at specific times (start and end times). It shall be possible for scheduling to be done from a central location and store the schedules in the devices. This means that if the central goes down the schedules can still be run from the device controller. Scheduling can also be done for selected groups. The actions scheduled shall be set at predetermined date and time that are configurable by day, day of week, month or any combination thereof. The types of actions that will be available for scheduling includes:

- Activate a selected message or sequence of messages
- Activate a scenario

- Activate a Standard Operating Procedure (SOP)
- Activate an ASC Timing Plan
- Activate a manual polling process
- Activate a camera preset
- Blank a Sign
- Download and Activate a changeable message
- Download new event logs and append to an event log table

A log of current activity for each schedule should be available. Schedules should be easily editable, including adding actions to and removing actions from a previously saved schedule.

3.7 Data Archiving and Reporting

The device manager shall support the polling of devices, to monitor their status, value, health and user configurable reports. This logging shall include:

- The ability to configure the logging period for each device, from 30 seconds to 12 hours.
- The ability to configure, for each device type, which objects are logged into the database at each poll.
- The ability to configure, for each Device Type, the length of the logs that are to be kept in the database, before the oldest logs are overwritten.
- This report writer shall be Microsoft Access, or equivalent, and shall support connection to the main ATMS SQL Server database
- The report writer shall support the display of tables, graphs and any other data that is located in the ATMS database.
- The device manager shall provide as standard filters for date ranges, device types, devices and users so that any or all reports can be filtered with these parameters.

All user activity shall be logged for audit trail purposes, as follows

- Any changes to configuration, or operation, shall be logged
- All logs shall include a User Name, Device ID and a Date Timestamp of user activity.

It shall be possible to view and print reports of User Activity, filtered by Date and/or User and/or Device

3.8 VDS / Real-Time Graphing

The device manager shall provide real-time graphing of sensor information, as follows:

- Line graphs that depict speed, volume and occupancy shown real-time at a user-definable polling period.
- Scatter graphs that chart out volume versus speed real-time at user-definable intervals.
- It shall be possible to aggregate the volume (sum), speed (weighted average) and occupancy (average) across a user definable number of lanes.
- It shall be possible to aggregate the sensor graph. All lane detail shall continue to be logged for analysis purposes. For example, so that one NTCIP Sensor device can be configured to aggregate for displaying north bound lanes separately from South bound.
- A graphical widget shall be displayed on the maps where a recent history of speed, volume and occupancy can be displayed. These displays shall be

updated dynamically on an event driven basis, as new detector data is received. It shall be possible to:

- configure the graphical parameters to modify the time range of “recent history”
- Display Speed, Volume and Occupancy as three different color traces versus Time, or
- Display Speed versus Volume.

3.9 Environmental Sensor Stations

The device manager shall support NTCIP Environmental Stations, as follows:

- It shall be possible to configure the ESS MIB in device manager to support the actual instrumentation deployed on the ESS.
- It shall be possible, at a configurable period, to poll an ESS for a configurable set of data and the device manger shall then log the results of this poll, including any errors, in the database.
- The device manager shall be able to display the weather data on the GIS map, using a set of configurable icons to reflect the current weather.
- The device manager shall be able to display the current weather data in a grid format.
- The device manager shall be able to display the current and recent historical weather data in a graphical format for each ESS device on the Map so that trends in weather data can be observed in real-time.
- This real-time weather data can be factored into any incident algorithm or travel time algorithm through the ATMS system.
- The device manager shall support the retrieval and display of traffic speed, volume and occupancy from radar traffic detectors located at the ESS site. The device manager shall support NTCIP 1209 data elements in this regard.
- The device manager shall support the retrieval, archive and display of static JPEG images from cameras located at the ESS site. device manager shall use HTTP protocol to retrieve these images.

3.10 AVL/GPS Equipment Vehicle Tracking

The device manager shall support NTCIP and proprietary communications with Mobile Data Collectors (MDC), Mobile Data Terminals (MDT), Global Positioning System (GPS) Receivers, and GPS enabled modems. These devices, which can be installed in any unit that needs to be tracked and monitored, are configured to support the client’s MIB for all devices.

- It shall be possible to configure the device MIB in the device manager to support the actual instrumentation deployed on the device.
- It shall be possible, at a configurable period, to poll the device for a configurable set of data, and the device manager shall then log the results of this poll, including any errors, in the database.
- The device manger shall support the “store and forward” scheme for data logging on the device. The device may be out of wireless communication range for a period, but will store the poll data while it is out of communication range. The device manager shall then “burst poll” the device when communications is established, so that the stored data can be retrieved, and then normal polled communication re-established.
- The ATMS shall be able to display the current device data in a grid format,
- AVL/GPS Data shall be time stamped with the time the AVL/GPS received.

- Data shall be displayed with the new unique ID and the GPS/AVL location.

3.11 Dynamic Message Sign (DMS) Management

The device manager shall include the ability to select any one of the available signs and control it through the use of a user interface that includes the following:

- Current data for the sign selected will be displayed on the interface.
- All the available pre-programmed or changeable messages will be displayed, depending on which message type is selected.
- Ability to check the content of these messages, change, remove and/or download them to the sign and DMS priority message queue for future or current display.
- Ability to manually poll a DMS in order to view/confirm current sign messages, test communications and obtain other sign/controller status information including system failures.
- Ability to display a message at manual and override priority.
- Ability to disable a DMS from system access.
- Ability to browse the operational status of each DMS.
- Ability to relocate portable DMS
- Set the display time for phases of a message

The DMS Signs user interface should include the ability to:

- Preview the message that is being edited in a WYSIWYG (what you see is what you get) format.
- Change a message on multiple signs at the same time.
- Send messages out to the sign; be displayed on the sign or both.
- Blank a sign.
- Set the priority and duration for the sign message.
- Limit the words used on a sign to those available on a pre-determined approved word list.
- Sequence more than one message on a sign and set the display rate for each page
- Specific rich graphical elements, such as WYSIWYG shall be displayed in a client user interface.
- Automatically poll all DMS at user configurable intervals to view/confirm current sign messages, test communications and obtain other sign/controller status information including system failures.
- Send a message stored in the DMS message library to a DMS and to a DMS priority message queue.
- Expand the number of message library categories by creating and naming new categories.
- Open a message stored in the DMS message library, save over an existing message to the DMS message library, and delete a message stored in the DMS message library
- Set the display time for phases of a message
- Support text messages, graphic messages, and a hybrid of the two.
- Support fixed and portable DMS.
- To allow testing and operations of the system via simulation mode.

- Enable external agencies to display and remove messages stored in the DMS message library on DMS.
- Support the NTCIP 1203 protocol for permanent and portable DMS of all typical sizes.
- Support proprietary DMS control protocols, as required.

When a message is edited, the following options shall be available:

- Font selection with any number of fonts that the DMS supports
- Line Justification
- Page Centering (Top, Bottom, Middle)
- Page Breaks
- Flashing
- Timers
- Background / Foreground Color
- Moving Text
- Insert date, time, speed or temperature information
 - Word checking capabilities shall include the ability to offer an approved list of words and/or a disapproved list of words.
- The device manager shall enable the user to modify the list of signs and the selected message(s) prior to display. A mechanism shall also be included to terminate a message and restore the next highest priority message that was previously displayed until the duration time of said message expires. The opportunity to select a different message will also be provided.
- The device manager shall display the highest priority message when multiple messages are being requested for display on the same sign at the same time. The message shall continue to be displayed until a higher priority message is requested, the message is terminated or the message duration time expires.
- Prior to expiration of the message duration time, the device manager system shall notify the user of the imminent expiration of the message duration time and allow the user to extend the message display or extinguish the message.
- The device manager will retain the current message up to 10 minutes beyond the expiration duration time while waiting for the operator's response before extinguishing a message with an expired duration time or sooner if the operator indicates that the message can be extinguished.
- Once the operator terminates the message or when it is overridden by a higher priority message, the device manager shall display the highest priority message competing for display on the sign.

The DMS System shall support interfaces for a wide variety of DMS and PDMS vendors including:

- Daktronics
- Ledstar
- Mark IV
- Adaptive
- Skyline
- Addco
- Wanco
- Adaptive
- Display Solutions

- National Signal
- Vermac
- Precision Solar
- American Signal
- K&K Systems
- Telegra
- SATT
- Solar Tech
- Imago
- McCain
- SES

There shall be a DMS Scheduler that allows scheduling of DMS messages for a single sign or multiple signs for up to one month in advance of actually sign activation.

- The DMS Scheduler display shall show the current active DMS messages on the selected signs.
- The DMS Scheduler shall allow for different messages to be scheduled at different times on a single or multiple signs.
- The DMS Scheduler shall allow a current active message to return after a scheduled message at user option.
- The DMS Scheduler shall display messages on the signs automatically without user interaction

The device manager shall also include the ability to create scenarios or Amber Alerts that can be activated immediately on one or more signs or that can be scheduled at pre-determined dates / times. Scenarios or alerts shall include:

- Pre-prepared procedures that can be implemented, providing extensive and accurate incident management.
- Permissions for the administrator to set up the pre-prepared procedures so that operators will be able to activate the correct messages on the correct signs for any given scenario.
- Selecting messages from those prepared using the Sign interface.
- Capacity to verify a scenario before sending it out to the signs
- Ability to cancel a scenario
- Capability to add any number of Standard Operating Procedures as part of the scenario
- Creation of a log of the scenario actions.

The device manager shall include the ability to manage a Message Queue for each sign device on the system.

- The intention is to provide Travel Time messages as the default message on the system.
- In the event of an incident, it shall be possible to display incident messages, which as a higher priority message will displace the lower priority Travel Time message on the sign, for the duration selected.
- When the duration of the message, is set to expire, the device manager shall, 10 minutes before the expiry time, alert the operator that the message is due to expire. The operator may elect to extend the message duration.

- If the message is allowed to expire, then the message queue shall remove the message from the sign, and replace it with the next highest priority, non-expired message that is on the Message Queue.
- It shall be possible to manage the message queue, by deleting messages, changing duration, or changing the sequence of messages of the same priority.
- The operator shall be alerted when a message that the operator tries to display will not be displayed as there is a higher priority message already on the sign.

The operator shall be prompted to resolve the conflict that occurs when a message is placed on the queue, where there are already messages of the same priority. The operator shall be allowed to place the message at the front of the queue, the back of the queue, or allow the device manager to auto-resolve based on user defined auto-resolution rules previously configured. The operator shall be able to generate a report indicating which DMS has malfunctioned. The report shall contain the DMS's operational status, the type of malfunction or error detected and the time it was detected.

3.12 Traffic Signals Management

The device manager shall support the display of graphical representations of signal intersections, as follows:

- It shall be possible to configure the graphical representation of a device, so that the device status can be readily determined. This shall include arrows of different colors, stop bars, detector indicators, pedestrian signal indicators and any user defined graphical representation of a device feature.
- The visibility of each of these graphical indicators shall be associated with the state of an NTCIP object.
- The graphical indicators of the device state shall be superimposed on a drawing, graphic or photograph of the intersection.
- It shall be possible to fully configure the appearance of this graphical representation, at a minimum of four different zoom levels.
- The graphical representation of an intersection shall respond to the results of real-time polling, and log polling, as described elsewhere.
- It shall be possible to use this general purpose graphical device representation tool to represent any device that can be described in NTCIP terms, including Lane Control Signals, Mobile Emergency Vehicles and Snow Plows.

The device manager shall support the upload and download of configuration data to traffic signal controllers and any NTCIP device, as follows:

- It shall be possible to configure a series of upload/download screens for each device type, where the screens can be configured to correspond to data stored in the device.
- Using these screens, it shall be possible to upload any data to, or download any data from, any NTCIP conformant device.
- It shall be possible to configure this utility to use to NTCIP Block objects for increase communications efficiency.
- It shall be possible to retrieve data from the database, and sent to a device. It shall be possible to retrieve data from a device, and save to the database.
- It shall be possible to copy the data from one device to another, and save in the database.
- It shall be possible to configure the text enumeration of enumerated values.

- The user shall be offered a list of enumeration from which to select, for enumerated items.
- The color background of cells shall change to indicate that the user has changed a value, and not yet sent to the device, or has retrieved a value from the device which is different to the value saved in the database.

3.13 Status and Health

The health of ITS devices is important to the client; therefore, the ability to monitor the status and health of said equipment is vital to their operation. The device manager shall be able to monitor equipment using alarms, communication statistics, as well as diagnostic grids. The monitoring can be done on a polling or real time basis. The status can be viewed in one of three ways: viewing the status grid, displaying device objects on a map view or running a statistical or activity log report.

Alarms can be set for any number of NTCIP compliant objects and thresholds established for them as outlined under the Thresholds and Alarms section previously stated. Once the alarms have been established, monitoring will begin and shall include:

- Raising an alarm automatically when a threshold has been exceeded.
- Allowing the operator to respond to the alarm by acknowledging the alarm, queuing it up for a certain amount of time or resetting it.
- Masking alarms for certain days and/or times of day.
- Automatically activating applicable Standard Operating Procedures for the alarm.
- Logging of all alarms and subsequent actions taken for said alarm.

Communication Failures shall be handled through the polling of devices either as scheduled (log polling) or on a real time basis. Communication failures shall be dealt with in the following manner:

- The configuration parameters shall be set by the user so that when a device misses a certain number of polls, the device goes to a marginal state (reduced frequency polling) and then finally offline.
- When a device fails to respond to a poll for the configured timeout and after the configured number of retries, an alarm shall be raised.
- The occurrence of an online, marginal or offline state shall raise appropriate alarms in the client so that the status and health of these devices shall be readily displayed, monitored and reported.
- Communication alarms shall be viewable on the map view of the devices.
- A log shall be kept of all communication failures.
- Diagnostic grids shall be configurable for all devices and shall visually show the health and status of said devices. These grids shall include:
 - Any applicable NTCIP object
 - Thresholds for these objects that will be used as the trigger for any alarms needed.

Once the grids have been configured, they shall be available for display on the map view and will alert the operator by beeping, flashing and/or color coding of the grid that a threshold has been reached. This is essentially the same as having an alarm go off and should be dealt with in the same way as described above.

3.14 Maintenance Management

The device manager shall support sophisticated maintenance management, as follows:

- The device manager shall include the capability to schedule maintenance and support, both routine and on-demand on the infrastructure of the road network. The infrastructure comprises the ESS with traffic detectors and cameras, variable message signs, communications network, MDC equipment, and any equipment installed in the Traffic Control Room.
- Schedule and carry out planned maintenance.
- Initiate and carry out remedial maintenance.
- Initiate and carry out emergency repairs.
- Update and improve maintenance systems and procedures.
- Keep records and provide an audit trail of all scheduled and unscheduled maintenance.
- In order to achieve this, device manager shall provide the following minimum functions and capabilities:
 - An asset management database with spatial display capabilities.
 - A planned maintenance scheduling system.
 - A job card/work order system for the carrying out of scheduled and unscheduled repair and maintenance.
 - A maintenance record keeping and reporting system linked to the asset management database.
- Additional database tables, linked to the device table, shall provide information on manufacturer, model numbers, references to documentation, and reference to maintenance instructions. This capability provides linkage to the documentation from the original equipment supplier.
- Each maintenance activity shall be an entry in the Maintenance Table. The status of each entry shall be maintained (e.g. scheduled, held, in process, completed) and shall be managed through the Maintenance Management form.
- Virtual devices (e.g. System Database, communication system, etc.) shall be created in the maintenance system.
- Maintenance management is provided in the following areas:
 - Routine or Scheduled maintenance
 - Remedial Maintenance
 - Maintenance Alarms
 - Maintenance Manager
- Devices shall inherit the geo-location of the Device from ATMS GIS. This means that the Devices shall be displayed on the GIS map in ATMS, and that the user can “drill down” into the Maintenance Table, and maintenance activities, from the GIS user interface.
- The application shall be configurable so that communication failures from devices, as well as the devices going offline, shall automatically trigger the creation of an unconfirmed maintenance incident.

3.15 Parking Management System

General

- Intelligent Parking System will have the ability to be installed as a stand-alone system or in a client server environment whereby multiple users can log in across

a network and depending on their access level, either view information, do configuration changes or print reports.

- IPGS will be a fully soft configurable and allow future system expansion, such as the addition of more parking zones, sensors or variable message signs, as well as the addition of entire new parking areas, merely through system configuration. No hard coding or source code changes should be necessary.
- IPGS will as a minimum run on an SQL database.
- The Software will operate on a Windows 2003 Server Operating System or later.

User Interface

The Parking Management System shall support the display of information as Map Displays. This support of Map Display shall include the following:

- The ability to access the client supplied files for Map background, including aerial photographs.
- All Devices shall be geo-located. The appearance of devices on a particular map view shall be controlled by a combination of zoom control and map display.
- When a Device is moved on a map display (perhaps for aesthetic reasons, to make an area of the map less crowded) the Device shall indicate its actual geo-location with a line (a “rubber band”) from the Device icon to the actual geo-location.
- The overall “look and feel” of the Map Display interface shall make it possible for an operator to navigate around the maps, and select devices, based on their position, and then navigate to that device using right-click menus or similar.
- The map display shall include the capability for showing levels of parking availability, congestion, and sign display with graphical widgets that respond to real time data returned from field devices, including traffic and parking sensors.
- The Map view should replicate the actual top view on the parking area. This should include an accurate view of the Bay layouts so as to help the operator recognize the exact area he or she is looking at.
- The Map view should be an accurate real time representation of the parking area. Giving a real time over view of the current parking status in the facility. Each Parking bay should have a color indicator which represent real in real time the status of the sensor monitoring that’s specific parking bay in the parking facility. E.g. a green dot in the parking bay will represent an open bay. A green and blue dot in the parking bay will represent an open disabled Bay. Conversely a red dot will denote an occupied bay and a blue and red dot will denote an occupied disabled bay.
- All bay sensor states will be capable of being shown real time on the user interface in the appropriate color. This will include a sensor failure being depicted as a gray dot in the respective bay on the user interface.

The Central Control System will have a dashboard view which is fully configurable to show the overall parking status in all parking areas as well as 24 hour parking trends. This Dashboard will be configurable to show multiple parking areas if necessary. The Dashboard will also give an overview of the overall system health and status which will include the current status as well as the status for the past 30 days.

Acronym Table of Contents

- API - Application Programming Interface
- ATIS - Advanced Traveler Information System
- ATM - Active Traffic Management
- ATMS - Advanced Transportation Management System
- AVL - Automatic Vehicle Location
- C2C - Center-to-Center
- CCTV - Closed-Circuit Television
- COTS - Commercial-off-the-Shelf
- DAR - Data Archiving and Reporting
- DMS - Dynamic Message Sign
- DSS - Decision Support System
- ESS - Environmental Sensor System
- GIS - Geographical Information System
- HAR - Highway Advisory Radio
- IDLA - Inductive Loop Detector Application
- ITS - Intelligent Transportation System
- LCS - Lane Control Signs
- LMR - Local Mainline Responsive
- NTCIP - National Transportation Communications of ITS Protocol
- PDA - Personal Data Assistant
- QEW - Queue End Warning
- RMS - Ramp Metering System
- SCADA - Supervisory Control and Data Acquisition
- SWARM - System Wide Adaptive Ramp Metering
- TMC - Traffic Management Control
- TMS - Tunnel Management Systems
- UI - User Interface
- VDS - Vehicle Detection System
- VMS - Variable Message Signs
- VSLS - Variable Speed Limit Signs
- WYSIWIG - What You See Is What You Get