



Software and System Specifications

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1. Glossary

ATMS – Advanced Transportation Management System

COTS – Commercial Off-the-Shelf

CRC – Cyclical Redundancy Check

ITS – Intelligent Transportation System

LAN – Local Area Network

NTCIP – National Transportation Communications for ITS Protocol

PTZ – Pan/Tilt/Zoom

SMS – Short Message Service (text messaging for cellular phones)

TOD/DOW – Time-of-Day/Day-of-Week

TRO – Traffic Responsive Operation

TSP – Transit Signal Priority

TWP – Twisted-Wire-Pair copper interconnect

VOS – Volume/Occupancy/Speed

VPN – Virtual Private Network

2. Introduction

2.1. System Software Overview

- 2.1.1. The system shall be a Commercially-available Off-the-Shelf (COTS), National Transportation Communication for ITS Protocol (NTCIP) compliant, Advanced Transportation Management System (ATMS) software application.
- 2.1.2. The software shall provide, as a base, an intersection control and traffic management software platform, from which additional ITS applications can be integrated.
- 2.1.3. All additional ITS features and functionalities shall be modular and integrated seamlessly into a single user interface.
- 2.1.4. The system shall utilize the following Microsoft® products for each aspect of the system:
 - 2.1.4.1. Core Database: SQL 2008 or SQL Express
 - 2.1.4.2. Server OS: Server 2003 or newer
 - 2.1.4.3. Workstation OS: XP or Vista
 - 2.1.4.4. Laptop OS: XP or Vista

2.2. System Software Standards

- 2.2.1. NTCIP 1201 and 1202 communications protocol standard shall be implemented in such a manner that the system can adapt to changes in technology and increase functionality over time with minimal impact on individual system components. The system developer and the controller manufacture shall verify that the system and controller firmware are NTCIP compliant and compatible.
- 2.2.2. The primary communications standards shall be NTCIP 1202 and 1202 based for communicating from Center-to-Field (C2F) and the developer shall document the standards to which the systems level of conformity of each standard is developed.
 - 2.2.2.1. However, if necessary proprietary protocols shall be used only when necessary to communicate to legacy and third party devices that do not support NTCIP communications protocols.
- 2.2.3. The server-workstation communications interface shall be designed to minimize its network bandwidth utilization as:
 - 2.2.3.1. Real-time status information shall be transmitted from the server to workstations automatically, once the workstation's subscription to the server is authenticated by the server.
 - 2.2.3.2. Complete system-state status transmission shall only be provided upon workstation initialization and specific workstation request for full system status refresh.

2.3. System Software Architecture

- 2.3.1. The system shall use client/server architecture and distributed processing to achieve a flexible and scalable design.
- 2.3.2. System data processing shall be distributed across multiple servers and applications such that system functions are most effectively accomplished considering cost, communications implications, security/redundancy, process loading, and network interface capabilities.

2.3.3. System Modularity shall provide the user the capability to add or modify functionality with little or no impact on currently installed modules or functionality.

2.4. System Software Scalability

2.4.1. The system shall be modular and scalable at all levels, using a distributed processing architecture. High system performance shall be maintained when the system is expanded; system software processes shall be distributed across additional system processor components if needed.

2.4.2. The system software architecture shall not require a single central processor to perform all real-time functions, protecting the agency's systems hardware/software investment and allowing the system to be readily and incrementally expanded to handle any functions and features that may not be anticipated at this time.

2.5. System Device Integration

2.5.1. Any device shall be added or deleted from the system without the use or requirement of .ini or editable text files.

2.5.2. Devices shall communicate through communications servers utilizing device manager software to translate data being transmitted between the central system and field devices.

2.5.3. The communications servers shall be configured to communicate via specific protocols for each dedicated communications channel.

2.5.4. Devices shall be added or deleted from the system by right-clicking on the main map display or entity tree and selecting the proper menu item.

2.5.5. Properties of one device shall be able to be copied to other devices of like make and model in the entity tree. Not all properties of every device shall be required to be transferrable.

2.5.6. When adding a device, a dialog box shall be used to enter all the required and optional parameters to allow the device to be integrated into the system and all displays.

2.5.7. Each device shall be configured to communicate through a communications server and allowed to be on-line or off-line to reduce failures and alerts for devices not currently connected to the system.

3. Traffic Management Center (TMC) and Local Area Network (LAN)

3.1. Local Area Network (LAN) of servers and workstations

3.1.1. The system shall include all software and hardware to provide full access to and control of the installed field devices. The computer hardware specification, at a minimum, shall include all of the following (approved equals may be substituted):

3.1.2. File/Application (Core) server:

Processor:	Dual Quad Core Intel Xeon L5410, 2x6MB Cache 2.33GHz, 1333MHz FSB, PE2950
Memory:	4GB 667MHz (2x2GB), Dual Ranked DIMMs
Hard Drive:	4 each - 146GB SAS, 3.5-inch, 15K RPM Hard Drive
Hard Drive Controller:	PERC6i SAS RAID Controller, 2x4 Connectors, Int, PCIe, 256MB cache, x6 Bkpl
Floppy Disk Drive:	No Floppy Drive for x6 Backplane
Operating System:	Windows Server 2003 R2 Standard Edition with SP2 Includes 5 CALs
NIC:	ONBOARD BROADCOM 5708 1GBE NETWORKING

Specification

CD-ROM or DVD-ROM Drive:	24X IDE CD-RW/DVD ROM Drive
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3.1.3. Communications Server / Terminal Services Server:

Processor:	Dual Quad Core Intel Xeon E5410 2x6MB Cache 2.33GHz, 1333MHz FSB, PE1950
Memory:	4GB 667MHz (4X1GB), Dual Ranked Fully Buffered DIMMs
Hard Drive:	2 EACH - 72GB 15K RPM Serial-Attach SCSI 3Gbps 3.5-in HotPlug Hard Drive
Hard Drive Controller:	PERC6i SAS RAID Controller 2x4 Connectors, Int, PCIe 256MB Cache
Operating System:	Windows Server 2003 R2 Standard Edition with SP2 Includes 5 CALs
NIC:	Dual Embedded Broadcom NetXtreme II 5708 Gigabit Ethernet NIC
CD-ROM or DVD-ROM Drive:	24X IDE CD-RW/DVD ROM Drive for All OS

3.1.4. Computer Rack and Server Accessories

Rack:	72" Enclosed Rack (72"x19"x36") w/ 55cfm fan, Plexiglas front door, louvered rear door, castors
UPS:	MS Standard - 3000 VA 120V
Ethernet Switch:	16 port 10/100 LAN Managed Switch
Keyboard/Video Switch:	8 Port KVM Switch with Server Interface Pods
Telephone Surge Protector:	Telephone Surge Prot. 4-port
Keyboard/Monitor Console:	15FP, 1U Rack Console with Rapid Rails, 15" TFT LCD, 83 key mini-keyboard, U.S.

3.1.5. Workstations

Processor:	Mini Tower, Quad Core Xeon Proc E5405, 2.00GHz, 2X6MB L2 Cache1333MHz
Memory:	2GB, DDR2 ECC SDRAM Memory 667MHz, 2X1GB
Keyboard:	Entry Level, USB, No Hot Keys keyboards
Monitor:	Flat Panel with Height Adjustable Stand,19.0 Inch VIS
Video Card:	Dual nVidia,Quadro FX 570 256MB dual DVI, Graphics Card
Hard Drive:	160GB SATA 3.0Gb/s, 7200RPM Hard Drive with 8MB Data Burst Cache
Hard Drive Controller:	C1 All SATA Hard Drives Non- RAID for 1 Hard Drive
Floppy Disk Drive:	3.5inch,1.44MB,Floppy Drive
Operating System:	WINDOWS XP PRO SP2 with Windows Vista Business License
Mouse:	USB 2 Button Optical Mouse with Scroll
NIC:	Broadcom NetXtreme 10/100/1000Gigabit Ethernet controller PCI Express
CD-ROM/DVD-ROM Drive:	16XDVD AND 16XDVD+/-RW, Data Only
	Roxio Creator Dell Edition,9.0
	Cyberlink Power DVD 8.0,with Media

3.1.6. Laptop Computers

Processor:	Intel Core 2 Duo T8300, 2.40GHz, 800Mhz 3M L2 Cache, Dual Core
Memory:	2GB, DDR2-667 SDRAM Memory 667MHz, 2X1GB
Keyboard:	Internal English Keyboard
Monitor:	14.1 inch Wide Screen WXGA RGDLCD
Video Card:	Intel Integrated Graphics Media Accelerator
Hard Drive:	80GB Shock Mounted Hard Drive 9.5MM, 4200RPM
Hard Drive Controller:	C1 All SATA Hard Drives Non- RAID for 1 Hard Drive
Floppy Disk Drive:	3.5inch,1.44MB,Floppy Drive
Operating System:	WINDOWS XP PRO SP2 with Windows Vista Business License
Mouse:	Touchpad with UPEK fingerprint reader
NIC:	Broadcom NetXtreme 10/100/1000Gigabit Ethernet controller
CD-ROM/DVD-ROM Drive:	8X DVD+/-RW
	Roxio Creator Dell Edition,9.0
	Cyberlink Power DVD 8.0,with Media

3.1.7. The network hardware shall be configurable to be gateway-interfaced in the future with the agency's IT Department's existing LAN (if and when desired by the agency).

3.1.8. The system shall allow the core server applications and the communications server applications to be combined on the core server for the first fifty (50) devices. Over fifty (50) devices, the server applications shall reside on separate servers.

- 3.1.9. The system shall support multiple communications servers for inter-jurisdictional systems or for systems with a large number of devices. For each two hundred fifty (250) devices, a separate communications server shall be utilized.
 - 3.1.9.1. Workstation (rich client) application software shall be interchangeable, on desktop or laptop computers.
 - 3.1.9.2. Client applications shall connect to the server applications using the agency's existing LAN.
 - 3.1.9.3. Remote access to the servers shall be available via secure Virtual Private Network (VPN) connection
 - 3.1.9.4. The VPN connection shall have the option of using terminal services connections to access the system.
 - 3.1.9.5. If multiple simultaneous terminal service connections are required, a terminal service server shall be provided.
 - 3.1.9.6. Client application software on the remote computer shall not be required for a terminal service connection.
- 3.1.10. The central software shall incorporate a means for client workstations to be automatically updated with new versions that are installed on the server. Upon attempting to login to the server, the client shall determine if a newer version is available at the server installation. If not, the client shall complete the login normally. If there is a newer version the user shall be given the option to have it automatically downloaded, installed, and run with no additional action required by the user.
 - 3.1.10.1. All updates will be included during the first year of operation as part of the standard warranty period (see section 10.5 – Warranty)
 - 3.1.10.2. Subsequent updates shall be provided automatically as part of an annual software maintenance agreement, through which any and all upgrades during the maintenance agreement period will be included.

4. System Functions

4.1. Center-to-Field Communications

- 4.1.1. The system shall communicate to the field devices using Ethernet or serial communications, using the agency's LAN, licensed band or spread-spectrum radios, private twisted-wire-pair copper (TWP), or fiber-optic cabling.
- 4.1.2. The system shall communicate with field devices using NTCIP protocols, or established proprietary protocols.
- 4.1.3. The system shall be capable of controlling, receiving status and data from, uploading and downloading field data, and applicable control parameters to and from each device.
- 4.1.4. The system shall maintain a copy of each field device's database of applicable operational parameters.

4.2. Database Administration, Security, and System Access

- 4.2.1. The system shall provide, at the top level, the ability to manage the ATMS and all device databases to monitor and control all field devices from one central location and optional remote facilities.

- 4.2.2. Each system client workstation or laptop shall require a username and password for any user, this is assigned by the system administrator. The username and password may be the same as that used by the operating system, but shall be required to be entered for each new system session.
- 4.2.3. The system shall allow for user and group privileges to be defined and assigned by the Administrator.
- 4.2.4. Operating privileges should be available for the following:
- 4.2.4.1. System Administrator Configuration – full access to all system functions
 - 4.2.4.2. Inter-jurisdictional control – full access, partial access, read-only access to other agencies field devices, status, and logs.
 - 4.2.4.3. User Profile Configuration – full access or read-only access to functions below (at a minimum), regardless of device type:
 - Device configuration – adding, editing, deleting devices, and properties
 - Device control – sending commands and instructions to devices
 - Database configuration – access to modifying or editing segments (all or portions) of existing device databases
 - Database maintenance – backup, restore, archiving, etc
 - Database report creation and generation – includes standard and custom reports
 - Map display characteristics– base map controls and intersection display editing
 - GUI settings and editing – modifying desktop settings
 - Communications configurations – modifying communications to the field

4.3. Database Management

- 4.3.1. Traffic Signal Controller Database
- 4.3.1.1. Database management shall allow programming of the intersection controller databases.
 - 4.3.1.2. Each device shall have separate database programming pages. These pages shall contain all the programming options unique to each device.
 - 4.3.1.3. Programming entries shall primarily consist of numerical or text values, YES/NO or ON/OFF entries, or appropriate values for each type of device. Check boxes shall be used for flags as appropriate. Hexadecimal or binary code shall not be used as entry values unless the data is represented in a similar encoded form on the controller’s front panel display.
 - 4.3.1.4. During program entry, the new data shall overwrite the old data. If the data entered is out of range, changes shall not be permitted and an error message shall alert the user.
 - 4.3.1.5. When a user is editing data for a specific device, that database shall be “locked” and unavailable for edit by other users.
 - 4.3.1.6. Standard industry accepted traffic engineering terminology shall be used throughout the programming displays.
 - 4.3.1.7. Mnemonic usage shall be minimized and limited to recognized traffic engineering terms.

4.4. Database Upload/Download

- 4.4.1. Upload/download shall transfer the programmable database from/to the selected device.
- 4.4.2. All upload/download data shall be verified for integrity using CRC techniques.
- 4.4.2.1. Non-verified data shall cause termination of the upload/download with no further data transfer taking place. Previously downloaded blocks that have been verified shall be

retained by the controller.

- 4.4.3. Following an upload, it shall be possible to compare the database of the field device to the database on file.
- 4.4.3.1. The compare function shall identify if differences exist between uploaded and file data.
- 4.4.3.2. It shall be easy to identify which segments of the database are different by viewing the tabs for each segment, and fields or dropdown displays within the tab. Only the segments and fields that are different shall be marked.
- 4.4.3.3. The system shall provide the ability for users to schedule a database comparison. Based on operator command or TOD/DOW schedule, the system shall automatically upload databases from devices and compare to database versions stored in the central database. The results of this comparison shall be available in a device comparison log. The log shall contain the following information on a per controller basis:
- Device number
 - Status (upload failed, databases differ, databases match, no upload present)
 - Date and time of last database comparison
- 4.4.3.4. It shall be possible to switch between the uploaded data and the central data with a simple menu selection. The differences shall be highlighted on the uploaded data.
- 4.4.4. The system's device database management shall provide an operator menu selection interface that is similar to the controller's menu selections.
- 4.4.5. When the operator of the ATMS selects either an upload or a download of a field device database, it shall be possible for the operator to select only the segments of the database to upload or download provided the field device can accept data transfer in this manner.

4.5. Maintenance and Malfunction Notification

- 4.5.1. At a minimum, the system shall be capable of automatically sending alphanumeric messages (SMS – text messaging) to cellular telephones and email addresses upon detecting problems with the system or from any device.
- 4.5.2. Malfunctions notifications shall also appear as a pop-up alarm, or similar notification, on each workstation logged into the system, provided a user has been configured to receive pop-up alarms, and that user is logged onto the system.
- 4.5.2.1. An audible alert shall be associated with a pop-up alarm, and configurable by the user.
- 4.5.2.2. The visual pop-ups and audible alerts shall be configurable to stay up only for a specified time period or to stay up indefinitely until closed by the user.
- 4.5.3. Malfunction notifications shall consist of at least three (3), user configurable, priority levels, to include “informational” (low priority), “warning” (medium priority) and “critical” (high priority) alerts.
- 4.5.4. Acknowledgements of incoming malfunction alarms shall be required for all medium and high priority on-screen notifications. Low priority alarm notifications shall not require acknowledgements.
- 4.5.5. Malfunction alerts shall be sent via text (SMS) or email notifications and shall be configurable by TOD/DOW, allowing recipients to be selected based upon severity or priority of event and to issue text/email messages sent to multiple devices or addresses.
- 4.5.6. Notifications shall allow a confirmation to assure that the malfunction has been acknowledged.

- 4.5.7. If no acknowledgement is received upon expiration of a user programmable time-out period, subsequent notifications shall be configurable to be sent (or escalated) to alternate devices.
- 4.5.8. The system shall log all malfunction notifications, retries, and acknowledgements with time and date stamps. The first acknowledgement shall be recorded; all others shall be ignored.

4.6. System Analysis and Engineering Tools

- 4.6.1. The system shall include engineering and analysis tools, providing users the ability to comparatively evaluate current system and field operation, historical operation, or proposed changes to operation. These tools shall include, but not limited to:
 - 4.6.1.1. Interface to third party traffic plan optimization software
 - 4.6.1.2. Time-space diagrams
 - 4.6.1.3. Split monitor displays
 - 4.6.1.4. Traffic system and operational analysis reports
 - 4.6.1.5. Standard CCTV (*Autoscope*[®]) Viewer

5. System Graphical User Interface

5.1. General Display Features

- 5.1.1. The main application window and the majority of other configuration, status, and control windows shall be implemented using Microsoft Windows[®] Presentation Foundation and XAML encoding.
- 5.1.2. The main application window shall be divided into multiple rectangular areas or “containers”. It shall be possible to drag and drop most status windows into one of these container areas.
 - 5.1.2.1. Upon being dropped, the window shall automatically resize to fill the area and be contained or docked within that area.
 - 5.1.2.2. It shall be possible to click on the title bar of a window that has been contained and drag it out of the container where it will become a non-contained, floating window.
 - 5.1.2.3. It shall also be possible to float or re-contain windows by clicking a button in the window’s title bar.
 - 5.1.2.4. Docked windows shall remain in their respective container areas when the main application window is moved or resized.
 - 5.1.2.5. It shall be possible to drop multiple windows into any container area.
 - 5.1.2.6. When this occurs, the container area shall present a tabbed layout for the container with a tab for each contained window such that clicking on a tab will bring the associated window into view in the container.
- 5.1.3. It shall be possible to open multiple application windows, each of which shall include container areas as previously described for the main application window.
 - 5.1.3.1. If the workstation computer hardware supports multiple monitors, it shall be possible to drag these application windows to separate monitors.
 - 5.1.3.2. The system shall allow container windows on as many monitors as supported by Windows[®] multi-monitor functionality and hardware.
- 5.1.4. It shall be possible for the user to select different arrangements or numbers of container areas in the main application windows.

- 5.1.5. It shall be possible to change the size of container areas by clicking and dragging the border between container areas.
- 5.1.6. The system shall implement “auto-hide” or “sliding” windows to include more container areas.
- 5.1.6.1. When added to the user interface, an auto-hide window shall normally be hidden with only a tab appearing along the left, right or bottom edge of the main application window.
 - 5.1.6.2. When the mouse is hovered over the tab, the auto-hide window will slide out from the appropriate edge of the main window.
 - 5.1.6.3. This auto-hide window will include container areas and allow windows to be dropped or contained within them in the same manner as described for container windows above.
 - 5.1.6.4. As long as the mouse remains over the auto-hide window, it shall remain visible and the contents shall be accessible.
 - 5.1.6.5. When the mouse is moved off of the auto-hide window, the window shall slide back to the edge and be hidden again with only the tab visible.
 - 5.1.6.6. It shall be possible to add multiple auto-hide windows to the left, right, and bottom sides of the main application window.
- 5.1.7. The number of application windows, the placement of the windows on the desktop, the number of container areas within each application window, and the size and arrangement of the container areas shall all be saved in the user preference set and restored upon restarting the client.
- 5.1.7.1. Users shall be able to save multiple display preference sets and the display shall be restored to its last known state when the user logs into the system and opens a preference set.
 - 5.1.7.2. The restoration of a user’s last known display configuration shall be independent of the most recent workstation used by the user.
- 5.1.8. At a minimum, the system shall include but not be limited to, all the displays stated below in the remainder of this section.

5.2. Main Map Display

- 5.2.1. The system shall incorporate an agency-wide map as the major portion of the main graphics display.
- 5.2.1.1. The main map shall be displayed in any or all of the available “containers” simultaneously.
 - 5.2.1.2. Each event of the map display shall be configured independently, to be utilized as individual sub-area displays.
 - 5.2.1.3. The map displays shall have pan and zoom capabilities.
 - 5.2.1.4. Zoom level ranges shall be configurable.
 - 5.2.1.5. At each zoom level range, the display of different dynamic status and real-time status data shall be configured. Standard zoom level details include:
 - 5.2.1.5.1. Intersection Status only – coordinated, free, flash, transition, preempted, comm fail, off line, etc.
 - 5.2.1.5.2. Intersection Status, plus main line (through phase) signal colors
 - 5.2.1.5.3. Intersection Status, main line colors and pattern number
 - 5.2.1.5.4. Intersection Status, pattern number and up to eight (8) phase colors
 - 5.2.1.5.5. Intersection level graphics with all signal phases, overlaps, pedestrian indications, detection, preemption, alarms and status
 - 5.2.1.5.6. For each currently opened map, each user’s map configuration including zoom level and position, shall be saved as part of the user’s interface profile and shall be

restored to the last known zoom and position when the user logs into the system

5.2.2. The system shall include a utility to import and generate maps, and allow the maps to be updated whenever new source files are available.

5.2.2.1. The map shall use standard GIS based data, and at a minimum ESRI .SHP files.

5.2.2.2. The map shall use a multi-layered technique for displaying different categories of system data or devices, based upon device selection and/or zoom level.

5.2.3. The main map and intersection graphics display shall be an integrated part of the system and shall not be a stand-alone application

5.2.4. The system shall update the status of all devices on all map display at least once per second, with no more than four seconds latency, once data is retrieved from a field device.

5.3. Scheduler

5.3.1. A means shall be provided by which a user can schedule events and functions to be implemented or terminated by TOD/DOW, and shall include means by which the events can be called with the following frequencies:

5.3.1.1. Daily – includes ability to repeatedly call an event or function by any or all days of the week

5.3.1.2. Weekly – provide the ability to repeatedly call an event once a week

5.3.1.3. Annually – provide the ability to repeatedly call an event once annually

5.3.1.4. Seasonally – provide the ability to repeatedly call a daily or weekly event for a portion of a year

5.3.1.5. Holidays (floating and fixed) – provide the ability to repeatedly call an event on special days

5.3.1.6. Special – provide the ability to repeatedly call an event for any situation not described above (IE. sporting events, concerts, festivals, etc.)

5.3.1.7. One-Time Event – provide the ability to run an event once and only once.

5.3.2. Events shall be configurable for controlling individual field devices, groups of devices, sections, or system-wide implementation. Combining devices, groups, and sections shall be allowed for a single event or function, providing dynamic grouping of all devices by TOD/DOW.

5.3.3. These events shall include, but not be limited to the following (where applicable):

5.3.3.1. Upload and compare databases

5.3.3.2. Synchronize time

5.3.3.3. Upload logs

5.3.4. The scheduler shall provide a means by which alerts can be configured to be delivered to different individuals via email or text (SMS) messages by TOD/DOW.

5.3.5. The scheduler shall provide a means by which reports can automatically be printed by TOD/DOW.

5.4. Manual Commands

5.4.1. Manual commands shall offer the same functionality for initiating or terminating events and functionality as the Scheduler, but with the following exceptions:

5.4.1.1. Manual commands shall override any normally scheduled event.

5.4.1.2. Manual commands shall be implemented using the following modes:

- 5.4.1.2.1. Immediate and full manual – command is implemented without delay and remains in effect until user releases command
- 5.4.1.2.2. Immediate with limited duration – command is implemented without delay and remains in effect for a user defined period.
- 5.4.1.2.3. Scheduled with limited duration – command is scheduled to begin and terminate using user defined start and stop dates and times.

5.5. Additional Displays

5.5.1. The system shall allow additional displays, each of which can be opened or closed at any time, and float or be docked into a container. The system shall include the following displays, at a minimum:

5.5.2. Entity Tree

- 5.5.2.1. All devices configured in the system shall be displayable on an “entity tree”.
- 5.5.2.2. The entity tree shall allow the user to sort and filter by device type, allowing the user to easily locate any device.
- 5.5.2.3. The user shall be able to add any device to the entity tree by right-clicking in the window and selecting the appropriate device type to add.
- 5.5.2.4. The device shall then be added to the main map by clicking on the device in the entity tree and dragging and dropping the device onto the main map display. The device does not have to be placed on the main map to be useable.
- 5.5.2.5. The Entity Tree shall list all the installed devices on the system, and shall be common across all workstations.

5.5.3. Device Status

- 5.5.3.1. The current status of devices shall be displayable in real time.

5.5.4. Current Users

- 5.5.4.1. A list of current users, logged into the system, shall be displayable in real time.

5.5.5. Alerts

- 5.5.5.1. The system shall provide an alert indicator which is always visible on the main window, providing real-time details on the number of open alerts and the criticality of each alert.
- 5.5.5.2. The system shall provide an alerts window, displaying all alerts from the system or field devices, along with specific details including alert aging.
- 5.5.5.3. This display shall be updated in real time with the event details, along with a time and date stamp and any acknowledgement information.
- 5.5.5.4. Alerts shall provide three levels of user-definable criticality:
 - 5.5.5.4.1. Critical (highest level)
 - 5.5.5.4.2. Warning (medium level)
 - 5.5.5.4.3. Information (lowest level)
- 5.5.5.5. The alert window shall provide a means by which users can acknowledge, un-acknowledge, and close individual critical and warning alerts. Users shall only need to close information alerts.
- 5.5.5.6. All acknowledgements, un-acknowledgements, and closures shall be time and date stamped with the user’s credentials upon change of status.

5.5.6. Favorites

- 5.5.6.1. The system shall provide a display where devices shall be placed for quick and convenient

- 5.5.6.2. Any device shall easily be added to this display by dragging and dropping the device from the entity tree to the Favorites Window.

5.5.7. Intersection Display

- 5.5.7.1. The system shall provide a display where intersection timings, phase details, and ring information is presented in graphical form.
- 5.5.7.2. Any intersection display shall easily be accessed by selecting the device on the main map or device tree and double-clicking over the selection. The intersection display shall then float over the containers or be attached to a container by dropping it into the container of the user's choice.
- 5.5.7.3. The intersection display, when floating, shall be able to be stretched to any size for better visibility, and all components of the display shall resize accordingly without pixilation (shall employ vector drawing).
- 5.5.7.4. The intersection display shall consist of two parts:
 - 5.5.7.4.1. The first part shall consist of a pre-configured display that provides phase, detection and overlap details, controller timings, coordination information, status, and alarms.
 - 5.5.7.4.2. This first part shall also provide the ability to send vehicle and pedestrian calls to any or all enabled phases.
 - 5.5.7.4.3. The database manager shall also be invoked from the first part of the intersection display, using a toolbox tab.
 - 5.5.7.4.4. The second part shall provide for an optional graphical display of the intersection.
 - 5.5.7.4.5. This second part shall allow the user to place vehicle and pedestrian signal heads, phase indication arrows, vehicle, pedestrian and preemption detectors, and status indicators on a map or user-created graphical image of the intersection.
- 5.5.7.5. Phase indication arrows shall be programmable for up to 16 phases, including protected/permissive movements and overlaps.
- 5.5.7.6. Protected/permissive indications shall be configured as one of the following: MUTCD flashing left turn yellow arrow, 5 section left prot/perm left turn, or Canadian Fast-Flash left turn
- 5.5.7.7. All intersection-level graphics shall be placed on a zoomed-in portion of the main map or graphical image of the intersection by selecting the graphic from a menu and dropping it on the intersection.
- 5.5.7.8. All intersection-level graphics shall be associated with a phase, overlap, or function (preemption, status, alarms, etc.), and shall change color or appearance upon change of status at the intersection.
- 5.5.7.9. Intersection graphics configurations shall be transferrable from one intersection to another.
- 5.5.7.10. Animations of some display components shall be provided for better visibility, recognition, and attention.
- 5.5.7.11. Users shall be able to place a remote vehicle and/or pedestrian call to any enabled phase through controls placed on the Intersection Display Window.

5.6. Device Access

- 5.6.1. Devices shall be accessed (control or status dialogs) through multiple means. For example, the intersection display shall be accessed by selecting an intersection from the Entity Tree, Main Map icon, or selecting from the Favorites Window.
- 5.6.2. Multiple instances of each display shall be active at the same time.

5.7. Device Grouping

- 5.7.1. All devices shall be added and configured within a common Entity Tree. Any device shall be allowed to be assigned as a stand-alone entity, not associated with any other entity or device, System, Section, Subsection or Group.
- 5.7.2. Any device in the Device Tree, shall be assigned to one of the following static groups:
 - 5.7.2.1. System – associated with an agency or jurisdiction. System events shall have the lowest priority control over all other scheduled events.
 - 5.7.2.2. Section – associated with a portion of a system. Section events shall have higher priority than System Events, but lower priority than events scheduled on Subsections.
 - 5.7.2.3. Subsection – associated with a portion of a Section. Sub-section events have higher priority than events scheduled on Sections, but lower priority than those scheduled for flexible Grouped intersections.
- 5.7.3. Any device in the Device Tree shall also be included into one or more flexible groupings. These Groups shall allow users to associate entities with common requirements for TOD scheduling, action plan control or manual command operation, and placed into their own unique grouping. Group commands override System, Section or Subsection events. Events scheduled on Groups have higher priority than all the groupings in the section above, but lower priority than a Stand-alone device.
- 5.7.4. Devices shall also be capable of being added to the entity tree as a Stand-alone device, not associated with any Static or Flexible Grouping. Scheduled events to these devices have highest priority of all, over all other scheduled events.
- 5.7.5. Devices, Systems, Sections, Subsections and Groups shall also be capable of being dynamically grouped by TOD schedule or by manual commands. Any static group, flexible group, device, or combination thereof shall be configured into a single scheduled event, action plan, or manual command and operate as a single entity.
- 5.7.6. Manual commands shall follow the same prioritization as above for scheduled events with respect to grouping, but they shall override any currently scheduled event for the devices being commanded.

6. Intersection Control Functions

6.1. Intersection Controller Access

- 6.1.1. Access to the intersection controllers shall be controlled by privileges associated with system user logon IDs.
- 6.1.2. Any field located intersection controllers, connected to the system shall be capable of being represented by objects on the system map.
- 6.1.3. *Centrac*s shall provide database management and control to Econolite *ASC/2*, *ASC/3* controllers, 2070 controllers running the Econolite *ASC/2070*, *ASC/3 2070* or Eagle EPAC 300 (M40 ver. 4.01D)

controllers using NTCIP 1202 communications protocols, or *Oasis*[™] firmware, controllers and 170 controllers running Wapiti W4IKS, rev. 55a (6800) or 15 (HC11) using Econolite ACT protocols.

6.2. Intersection Status and Operational Details

6.2.1. At a minimum, at all zoom levels the agency-wide map display shall dynamically identify the following status for each traffic signal, in real or near-real time:

- 6.2.1.1. Free Operation
- 6.2.1.2. Coordinated Operation
- 6.2.1.3. Transitioning between Free and Coordinated or from one Coordination pattern to another
- 6.2.1.4. Flash
- 6.2.1.5. Preemption
- 6.2.1.6. Transit Signal Priority (TSP) Service
- 6.2.1.7. Loss of Communications

6.2.2. When zooming in, the main map shall automatically provide a greater level of detailed information, at user-set and configured zoom levels, including, but not limited to:

- 6.2.2.1. Signal colors or overlaps (green, yellow, red)
- 6.2.2.2. Active Coordination pattern (if in Coordination Operation)
- 6.2.2.3. Active Preemption plan (in Preemption only)
- 6.2.2.4. Signal colors for all pedestrian phases in use
- 6.2.2.5. Graphical representation of demand on vehicle phases and pedestrian phases
- 6.2.2.6. Graphical representation of active special function outputs
- 6.2.2.7. The current zoom level of each map shall be associated with the user's display profile and shall be restored to its last known state when the user logs into the system regardless of the workstation used.
- 6.2.2.8. Detailed timing and controller information to include (when zoomed to intersection level):
 - Coordination Status
 - Programmed and actual cycle length
 - Programmed and actual offset
 - Programmed and actual phase timings
 - Alarm status
 - Overlap timings and status
 - Phase Next

6.3. Intersection Control Modes

6.3.1. Traffic-Responsive (TR) - A controller shall be considered to be in the TR mode when it is operating on-line under central supervision and responding to system commands for plan selection based on the traffic-responsive algorithm.

6.3.2. Time-of-Day (TOD) - A controller shall be considered to be in the TOD mode when the controller is operating in a pre-determined timing plan based on a TOD schedule stored in the central database.

- 6.3.2.1. Controller TOD scheduling shall be performed based on plan data stored locally at the controller and updated by periodic upload/download operations.
- 6.3.2.2. The TOD mode shall be implemented from a central schedule managed by the system and shall instruct the controller to activate/deactivate plans or functionality.
- 6.3.2.3. The TOD scheduler shall provide a means by which fixed or floating holidays can be

- accommodated, providing the ability to override normal TOD/DOW plan selection when user-specified holidays occur.
- 6.3.2.4. The system shall not be limited to the number of TOD events which can be entered or configured.
- 6.3.3. Manual - A controller shall be operating under the MAN mode when it is responding to system commands for plan selection issued from central control using manual override. From the perspective of the controller, this mode shall be identical to TR or TOD.
- 6.3.4. Failed - A controller shall be deemed “Failed” when the controller fails one or more monitoring checks. Once failed, a controller shall be in the failed mode until the problem has been corrected and the failure state has been cleared by periodic system retry commands.
- 6.3.5. Local - A controller shall be in the LOCAL mode when the local intersection controller makes the plan selection decision. The central system can command a local intersection to run in LOCAL mode, or LOCAL mode may result from manual command at the intersection. Communication of detector data and other status information shall continue even when in LOCAL mode.
- 6.3.6. Flash - Flash mode status shall be logged for each entry or exit from flash. The system shall have the following flash mode capabilities (assuming the controller is able to discriminate between them and report its mode):
- 6.3.6.1. Central Flash - individual intersections and sections shall be capable of being placed on flash by operator command or schedule entry.
 - 6.3.6.2. Technician Flash - cabinet flash mode shall be indicated when a controller enters flash via manual selection at the cabinet.
 - 6.3.6.3. Conflict/MMU Flash - conflict flash shall result for a tripped conflict/MMU monitor at the local intersection. Conflict/MMU flash shall be considered a failure by the central system.

6.4. Time Synchronization

- 6.4.1. The system shall be able to receive clock updates from an external time synchronization source.
- 6.4.2. The system shall broadcast, unicast, or use a combination of both to send time updates to controllers on a user-configurable schedule. The user shall be able to configure how often the broadcast is performed, the hour at which the broadcast begins, the number of times the broadcast is repeated, and the time period between repeated broadcasts.
- 6.4.3. The system shall provide a means of monitoring the time drift of clocks on controllers, provided the controller supports this functionality.
- 6.4.3.1. For each controller that supports this functionality, the system shall allow checking controller clock times on a user-specified interval.
 - 6.4.3.2. The system shall display the time the controller’s clock was last checked and the difference between that controller clock and the system time reference.
 - 6.4.3.3. The system shall also provide the ability to automatically synchronize a controller’s clock if the time drift exceeds a user-specified threshold.
- 6.4.4. The system shall provide a means to synchronize controller clocks with the system time reference upon user command.
- 6.4.4.1. This functionality shall be provided in addition to the scheduled time broadcasts previously specified.

7. System Analysis and Engineering Tools

7.1. Trafficware Synchro[®] Interface

- 7.1.1. The system shall support an interface to the Synchro signal timing software. This interface shall provide the ability to transfer controller phase and coordination data to/from Synchro.
- 7.1.2. The system shall provide the ability to save controller phasing and timing data in the Universal Traffic Data Format (UTDF). Once saved in this format, the data can be opened in the Synchro application for off-line analysis and optimization.
- 7.1.3. The system shall provide the ability to import Synchro timing plan data saved in the UTDF format into the native *ASC/2*, *ASC/3*, *ASC/2070*, *ASC/3-2070*, EPAC 300 (M40 ver. 4.01D), *Oasis*, and W4IKS controller format, for use within the system.

7.2. Time/Space Diagrams

- 7.2.1. The system shall allow the operator to display time-space diagrams. At a minimum, the operator shall be able perform the following:
 - 7.2.1.1. Display time-space diagrams for both programmed and real-time coordination timings.
 - 7.2.1.2. Display sloping progression bands for each direction of travel on the same time-space diagram.
 - 7.2.1.3. Display horizontal or vertical color bands continuous through a series of intersections that represent progression bands.
 - 7.2.1.4. Dynamically adjust programmed (not real-time) offsets by “clicking” on an intersection’s time bars and “dragging” the bars in either direction.
 - 7.2.1.5. Display the current offset as a numeric value next to each intersection.
 - 7.2.1.6. Select the phases and/or overlaps for progression phases.
 - 7.2.1.7. Display single direction time-location diagrams.

7.3. Split Monitor

- 7.3.1. The system shall include a real-time split monitor that provides, at a minimum, the following functionality:
 - 7.3.1.1. It shall be possible to present the operator with an analysis of the splits of an intersection per phase to include, but not be limited to:
 - 7.3.1.1.1. The system user shall be able to view and process both programmed and actual real-time data.
 - 7.3.1.1.2. Programmed timing data for each phase shall be obtained from the current database of controller timings stored in the central system.
 - 7.3.1.1.3. Actual real-time data for each phase shall be obtained by monitoring the controller status on a second-by-second basis.
 - 7.3.1.1.4. Number of cycles analyzed.
 - 7.3.1.1.5. It shall be possible to select the period for which the data shall be displayed by start and stop time and date, day of week, the last occurrence of a plan, or the last X minutes (where X is defined by the operator).
 - 7.3.1.1.6. Actual splits shall be grouped together in “bins” and histograms used to graphically show the distribution of timings over the data collection period.
 - 7.3.1.1.7. It shall be possible to compare the actual splits with the programmed timings to

determine the effective average actual split.

7.4. System and Operational Reports

7.4.1. The system shall provide a list of reports, providing information compiled from data retrieved from the system and any field device capable of logging data. These reports shall include, but not be limited to the following:

- Alerts Log Report
- Communications Status
- Detector VOS Data
- Device Communications Configuration Report
- Device Configuration Report
- Entity Hierarchy Report
- Events Log Report
- Links Data Report
- Scheduler Report
- Signal Changes Report
- Signal Detector Events Report
- Split Monitor Report
- System Activity Report
- System Events Report
- Time Drift Report
- Upload and Compare Report
- User Login Report
- Detector VOS Reports
 - Daily
 - Hourly
 - Multi-date / Hourly
 - Multi-date / Daily

7.4.2. The system shall also provide a means by which user-specific reports can be created and added to the Reports menu item without the requirement of additional 3rd party software or custom development work by the software provider.

7.4.2.1. Microsoft® SQL 2008 Report Services shall be provided as the custom report generating tool.

7.5. Standard CCTV Viewer

7.5.1. The ATMS software shall provide an integrated means of viewing digitized CCTV video through an Ethernet connection to cameras or encoders, without additional modules or software.

7.5.1.1. The system shall allow clients to connect to digitized video streams from IP-based cameras and encoders and display the streams in video player windows.

7.5.1.2. The CCTV system shall use only unicast video streams.

7.5.1.3. The CCTV system shall support Axis cameras and encoders or *Autoscope* VIDS cameras directly (*Terra*) or through an Axis encoder (*Solo Pro*).

7.5.1.4. CCTV cameras shall be represented as devices on the system maps and in the system control tree view.

- 7.5.1.5. The operator shall be able to double-click on a camera object in a map or tree to open the player window.
- 7.5.1.6. It shall be possible to drag and drop the camera viewer window into a system container area.
- 7.5.1.7. The system shall support multiple, concurrent clients, each capable of opening multiple CCTV video player windows. The number of concurrent users and video player windows may be limited by hardware and communications infrastructure and by the number of licensed clients.
- 7.5.1.8. The CCTV system shall support limited simultaneous views (less than 3) per camera.
- 7.5.1.9. The video player window shall provide mouse gestures to pan, tilt, and zoom a PTZ camera. It shall be possible to zoom the camera by using the mouse scroll wheel.
- 7.5.1.10. Quality of video (image size and frame rate) shall not be directly configurable from the ATMS software, but may be configured in the camera or encoder via the camera or encoder's configuration tools. Quality may be limited by the bandwidth of communications and number of simultaneous users.
- 7.5.1.11. The integrated standard CCTV system shall support only limited security and access, limiting user access through general user privileges on the system.
- 7.5.1.12. The integrated CCTV system does not support priority management of PTZ control.

8. Traffic Responsive (TR) Control

8.1. General Description

- 8.1.1. The system shall utilize a V+kO (volume plus scaled occupancy) algorithm developed by the US Department of Transportation for traffic-responsive operations.
- 8.1.2. System detector data shall provide the basis for all TR plan selections by the system.
- 8.1.3. The system shall utilize a threshold-based algorithm, utilizing computational channels to evaluate system congestion and traffic flows.
- 8.1.4. The TR operation shall automatically select the timing plans for which traffic flow parameters have been defined that exceed the user-defined threshold of traffic. The TR mode shall be selected by a manual user command or on a TOD basis.
- 8.1.5. TR database shall identify the system detectors that are to be used for TR plan selection for each section.
 - 8.1.5.1. The detector data shall have smoothing factors to configure importance of most recent data vs. historical data
 - 8.1.5.2. The detector data shall have scaling factors to accommodate loop placement and redundancy as well as establish ratio of detectors used to establish computational channel. A separate weighting factor is used for each detector but each shares the same "k" value.

8.2. Plan Implementation Techniques

- 8.2.1. Plans shall be selected for implementation using the following process sequence:
 - 8.2.1.1. Process vehicle volumes and occupancies from defined system detectors.
 - 8.2.1.2. Calculate weighted sum of volumes plus a factor of occupancies (V+KO).
 - 8.2.1.3. Compare the V+KO value with the programmed thresholds.
 - 8.2.1.4. Select the plan with the closest match to the calculated value and that satisfies the user

- configured change threshold.
- 8.2.1.5. The selected timing plan shall be transmitted to the controllers. The plan will be invoked provided that it is available at each controller in the applicable section or system.
- 8.2.2. The duration of each TR sampling period shall be operator-selectable.
- 8.2.3. TR operation shall be capable of being overridden by manual selection.
- 8.2.4. System detectors shall provide volume and occupancy data for archived storage and analysis purposes.
- 8.2.5. Plan changes shall be implemented under TR only if the minimum change threshold has been exceeded.
- 8.2.6. Plan changes shall be implemented under TR only if the user-specified percentage of valid detection is met or exceeded.

9. Optional Modules

9.1. Advanced CCTV Module

- 9.1.1. The ATMS software shall provide an advanced CCTV video monitoring system as an optional module (in addition to the Standard CCTV viewer).
 - 9.1.1.1. The CCTV system shall be IP-based and provide for network-based switching of digitized video streams.
 - 9.1.1.2. The CCTV system shall be capable of supporting unicast video streams
 - 9.1.1.3. The CCTV system shall be capable of supporting multicast video streams, depending on the capabilities of the network switches and routers.
 - 9.1.1.4. The CCTV system shall support multiple camera types and manufacturers.
 - 9.1.1.5. The CCTV system shall support any number of multiple users or clients, based upon number of licenses provided
- 9.1.2. *CCTV Cameras and Encoders*
 - 9.1.2.1. The system shall support IP cameras that directly generate digital IP video streams.
 - 9.1.2.2. The system shall support analog video cameras attached to video encoders that encode the video into a digital IP video stream.
 - 9.1.2.3. The system shall support configuration of camera or encoder image size, quality, and frame-rate where supported by the hardware.
 - 9.1.2.4. Depending on the capability of the attached cameras or encoders, the system shall support Motion JPEG, MPEG4 Part 2 and MPEG4 Part 10 (H.264).
 - 9.1.2.5. The system shall support both fixed and PTZ cameras.
 - 9.1.2.6. The system shall be extensible to allow at least 1000 attached cameras or encoders. Additional licensing fees may be required.
 - 9.1.2.7. The number of simultaneous video streams shall be limited only by the installed hardware, network bandwidth, and number of licensed cameras.
- 9.1.3. *CCTV Clients*
 - 9.1.3.1. The system shall support both rich-client and web browser means to view and control the cameras in the advanced CCTV option (i.e. for police or city use).
 - 9.1.3.2. The system shall support multiple, concurrent clients, each capable of opening multiple CCTV video player windows.
 - 9.1.3.3. The video player window shall provide mouse gestures to pan, tilt and zoom a PTZ

- 9.1.3.4. camera. It shall be possible to zoom the camera by using the mouse scroll wheel. CCTV cameras shall be represented as devices on the system map or maps and in the system control tree view.
- 9.1.3.5. The operator shall be able to double-click on a camera object in a map or tree to open the player window.
- 9.1.3.6. It shall be possible to drag and drop the camera viewer window into a system container area.
- 9.1.3.7. The client video player window shall support PTZ presets for cameras that support this feature. The player shall support as many presets as the camera supports up to a maximum of 255 presets.
- 9.1.3.8. The client video player window shall support tours or timed switching between programmed cameras and presets. The system shall support at least 64 tours and at least 64 camera presets per tour. The dwell time for each camera preset or stop shall be configurable in seconds.
- 9.1.3.9. The client player window shall provide the ability to stop the video stream and then restart the stream.
- 9.1.3.10. The client player shall provide the ability to save a “snapshot” of the video image as a jpeg or bmp file.

9.1.4. CCTV Wall Monitors

- 9.1.4.1. The CCTV system shall provide a means to display video images on a wall monitor or video wall.
- 9.1.4.2. It shall be possible to send camera tours (as described under the CCTV clients section above) to the wall.
- 9.1.4.3. A single video signal sent to a wall monitor shall be capable of displaying multiple video streams in tiled windows.

9.1.5. CCTV Security and Access

- 9.1.5.1. Access to the CCTV system shall be controlled by privileges associated with user login names and passwords. Privileges shall exist to allow or disallow direct PTZ control of a camera, to allow or disallow playing of a predefined camera tour, and to allow or disallow creation of camera tours.
- 9.1.5.2. Each user shall have a priority setting to control which user has priority if more than one user attempts to access the PTZ control of a camera at the same time. Once a user has taken over the PTZ control of a camera, that user shall maintain control of the camera from any equal or lower priority user until a PTZ inactivity timer has expired (without any PTZ movement) at which point control will be relinquished.

9.1.6. CCTV Recording (Option)

- 9.1.6.1. A separate video recording option (not included in the Standard CCTV system or Optional CCTV Module) shall exist to allow recording of video streams.
- 9.1.6.2. It shall be possible to start and stop recording from the client video player window.
- 9.1.6.3. It shall be possible to configure the CCTV system to record video based on a TOD schedule.

10. Administrative and Support Requirements

10.1. Training

10.1.1. General

- 10.1.1.1. Formal classroom training and “hands-on” operations training shall be provided for personnel designated by the agency.
- 10.1.1.2. System training shall be provided by experienced instructors and shall include all training material for formal classroom and hands-on work.
- 10.1.1.3. The training shall cover both operation and maintenance of the system software.
- 10.1.1.4. Copies of course materials shall be supplied to and be retained by the agency.

10.1.2. Hands-On Training

- 10.1.2.1. Hands-on training shall be provided to the agency personnel assigned to the project. The training shall consist of at a minimum:
 - System operation, system performance analysis, and revision of system operating parameters based on the analysis
 - Familiarity with construction details of central office equipment (disconnect locations, cable routing, etc.)
 - Operation and control of all devices
 - Generation and editing of device databases
 - Uploading/downloading of device databases
 - Explanation of the communication system
 - Basic troubleshooting procedures to isolate malfunctions

10.2. Licensing

- 10.2.1. Econolite shall provide a software license to agency for its use. The licensing arrangement shall address access to the systems by agencies other than the purchasing agency.
- 10.2.2. The supplier shall not carry out work that will infringe on the licensing of third party hardware and software.

10.3. Documentation

- 10.3.1. Manuals shall be supplied for all equipment and components of the system.
- 10.3.2. Documentation shall be supplied explaining the operation of all system features. In addition, hard copies of all handouts provided during user training shall be supplied.

10.4. Installation and Testing

10.4.1. Project Management

- 10.4.1.1. Upon contract award, the system supplier shall assign a Project Manager to oversee the development of the system implementation schedule and to serve as the main point of contact between the purchasing agency and the supplier.
- 10.4.1.2. The Project Manager shall have proven experience in managing traffic management system projects of the size outlined in this specification. The Project Manager shall develop a Microsoft Project (or compatible) schedule detailing the tasks required to furnish the specified system. This schedule shall form the basis of all system project

milestones.

10.4.2. *Project Engineering*

- 10.4.2.1. The system supplier shall assign a Project Engineer to oversee the design, assembly, and testing of the system hardware and software. Upon completion of the system design, the Project Engineer shall assemble all central system hardware and software into a working system.
- 10.4.2.2. The Project Engineer shall then complete a standard factory acceptance test on the assembled system hardware and software. A copy of the completed factory acceptance test shall be provided to the purchasing agency upon request.
- 10.4.2.3. After completion of the factory acceptance test the system shall be disassembled, packed, and shipped to the purchasing agency. A member of the supplier's systems engineering team shall arrive on-site to unpack, assemble, and perform initial tests on the new system. On site system integration shall include, at a minimum, testing and verification of the installed interconnect infrastructure by actually communicating to a representative sample of the initial controllers connected to the system, and perform the following functions:
 - Full Database Upload
 - Full Database Download
 - Manual Command to Free
 - Manual Command to Plan
 - Send Vehicle and Pedestrian Call to Phase
 - Observe proper intersection status
- 10.4.2.4. Upon completion of initial testing the system supplier shall perform a formal acceptance test of the system using a standard acceptance test provided by the system supplier. This acceptance test shall include an operational demonstration of all major software components of the system.

10.5. *Warranty*

- 10.5.1. The system software shall be warranted for one (1) year from system acceptance. Software corrections or required modifications for proper system operation per these specifications shall be furnished to the agency at no additional cost during the warranty period. The system supplier shall provide both phone and email support for the system during the warranty period at no additional cost. This support shall be available during normal business hours.
- 10.5.2. The system supplier shall provide an optional annual tiered software maintenance agreement to extend support of the system software after the warranty period.
 - 10.5.2.1. Level 1 tier – All remote support. On-site support shall be provided as a time and material option.
 - 10.5.2.2. Level 2 tier – One day on-site support. The agency shall receive one full day (8 hours) of on-site support.
 - 10.5.2.3. Level 3 tier – Three day on-site support. The agency shall receive three full days (24 hours) of on-site support.
- 10.5.3. All tiers shall provide the following features:
 - 10.5.3.1. The maintenance agreement tier level shall be adjustable from one year to the next.
 - 10.5.3.2. The maintenance agreement shall be renewable and offered in multiple one year periods.
 - 10.5.3.3. During this software maintenance period, the system supplier shall provide continuing remote and telephone support for the system.

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- 10.5.4. All system software updates during the maintenance period shall be provided. In the case of Level 1 tier contracts, the software upgrades shall be done remotely; the other tier levels shall have the option of remote (as released) or on-site (annual) upgrades.
- 10.5.5. On-site support shall be limited to supporting the system software and computers provided with the system; third party software and equipment support shall be excluded.
- 10.5.6. On-site support shall be used for system upgrades, overhauls and training, as customer requires and time permits.
- 10.5.7. Third party hardware and software warranties shall be passed to the agency at the time of purchase.