Pomona Valley ITS Project

Project Deliverable 5.2.2
ATMS Functional Requirements Report

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PROJECT DESCRIPTION

The County of Los Angeles, in cooperation with the cities within the Pomona Valley, has determined that development of an Intelligent Transportation System (ITS) in the Pomona Valley would help to reduce congestion, enhance mobility, provide traveler information during non-recurring and event traffic congestion, and manage event traffic. The Pomona Valley Intelligent Transportation Systems (PVITS) project was conceived as a recommendation from the Pomona Valley ITS Feasibility Study completed by the LACMTA in 1995. The ultimate objectives of the Project are to:

- Improve mobility by optimizing traffic management on arterials and freeways;
- Enhance Route 60 capacity by better coordinating freeway traffic with parallel arterials;
- Improve agency efficiency by coordinating management of operations and maintenance efforts among and between agencies; and
- Increase agency staff productivity by providing low-maintenance, high-quality communications and computational tools to assist in daily management and coordination activities.

Phase 1 of the PVITS project is the development of a conceptual design that defines solutions to enhance capacity, reduce congestion, and improve traveler information in the Pomona Valley.

1.0 BACKGROUND

1.1 Purpose of Report

The Advanced Traffic Management System(s) (ATMS) for the Pomona Valley is a system (or systems) that will provide agencies in the Pomona Valley with tools for managing traffic within the Forum. The ATMS will operate traffic signals, CCTV cameras, Dynamic Message Signs (DMS), and Trailblazers, and provide information to other systems (such as a subregional Pomona Valley Advanced Traveler Information System [ATIS]) and other stakeholders.

The ATMS is being designed to meet the needs of both the local and subregional roles in the Forum. The system will be designed for application in any city in the Pomona Valley, the County unincorporated area, and the subregional TMC.

A key component of the architecture for the Pomona Valley is the Information Exchange Network (IEN). The IEN is a county-wide communication network that has been designed by LA County as a part of the San Gabriel Valley pilot project. The IEN will act as the primary communication network for exchange of data between systems (center-to-center) and sharing of monitoring and potential sharing of control of field devices. Since the IEN has not been designed to carry video (this functionality may be designed into the IEN in the future) a second communication network is designed into the architecture that will allow the agencies to share video center-to-center.

Each system, in order to connect to the IEN will require a command/ data interface (CDI), which is a piece of software that essentially translates from an existing/ planned system to the IEN "language." A new system (as opposed to existing) may have this CDI resident on the same server as the system itself, integrated into the software. A legacy system would require likely have the CDI resident on a separate machine connected to the legacy system and to that agency's router to enable communication with the rest of the Forum and County.

This document identifies the functional requirements for the Pomona ATMS to meet the users' needs and objectives. The functional requirements have been defined by translating the user requirements documented in **Deliverable 5.1.2 - ATMS User Requirements Report** into explicit functional details. The focus of the information in this report is to define in unambiguous terms, the elements required to implement all of the defined user requirements.

The ATMS functional requirements defined in this report will provide the baseline requirements for development of the concept of operations/area architecture, alternative analysis and conceptual design for PVITS. These requirement definitions describe the capabilities of the system and will be translated into specifications for design purposes. It should be noted that ITS standards and specifications for construction are not part of this document and should be defined through the subsequent civil, electrical and structural design stage.

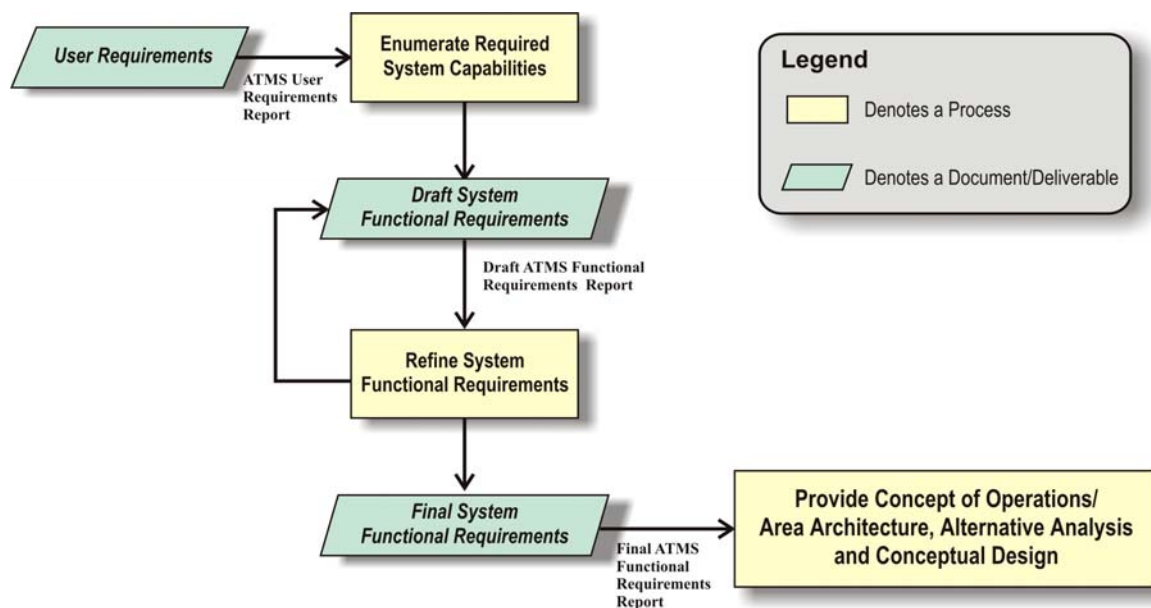## 1.2 Methodology

In order to design a system which fulfills the needs and objectives of all users, it is necessary to define what the Pomona ATMS needs to be functionally capable of doing. The process utilized for the development of ATMS functional requirements for PVITS is iterative in nature. The preliminary ATMS functional requirements are first defined by taking the user requirements and

mapping them into specific functional statements or requirements. These requirements are then continually refined until matured for design.

The functional requirements essentially describe the system functional specifications, on which the conceptual design and system architecture is based. They are defined in a way such that acceptance test procedures can be developed to verify that the implemented design (under test) satisfies the defined functional requirements in accordance with the specified test criteria. Each iteration of the definitions will be reviewed in order to select the most appropriate required functions, and operational features and the implementations needed to meet the user requirements.

The methodology adopted for the development of Pomona ATMS functional requirements is illustrated in the following flowchart:

Figure 1-1 Functional Requirements Development Methodology Flowchart

This methodology is consistent with the approach of the National ITS Architecture, a nationally-standardized and required approach to ITS planning. Ensuring that a project is consistent with the National Architecture better positions the project for future funding and helps to ensure interoperability on a local level. The National ITS Architecture's approach starts with the identification of user needs and objectives. These needs and objectives are those that will be addressed through the implementation of various ITS applications and will be mapped to various user services.

User services present what ITS applications can be provided to address a particular user need or objective and what these ITS applications will do from the users' perspectives. It is an encapsulation of needs that must be satisfied if the ITS application is going to be considered successful by the user.

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The identified ATMS elements represent the ITS applications that will be provided to fulfill the identified user services. The capabilities of each identified ATMS element and its associated operational aspects are defined in the functional requirements. Together, the user and functional requirements for the Pomona ATMS provide an accessible and deployment-oriented perspective of the National Architecture.

A specific example of the relationship between needs and objectives, user services, ATMS elements, user requirements, and functional requirements is provided in **Table 1-1**.

Table 1-1 Example of User Services, User and Functional Requirements

Needs and Objectives	User Services	ATMS Elements	User Requirements	Functional Requirements
Implement a central traffic control system to improve mobility	Traffic Control	Traffic Control and Monitoring System	• The system shall provide centralized traffic control and monitoring capabilities to efficiently manage the movement of traffic on streets and highways. This will also include control of network signal systems.	• Administrators shall be able to monitor and control all signals within their jurisdiction via the ATMS.
			• The system shall be able to collect data to support traffic control at both local and interjurisdictional levels.	• The ATMS shall be capable to collect and maintain all data required for once-per-second monitoring and displays from all intersections at all times.

1.3   Report Organization

The information in this report is presented in the following sections:

Section 1 - This section provides an overview of the PVITS project and introduces the report's purpose, approach, and identifies where this deliverable fits into the overall project work effort.

Section 2 - This section describes the various design considerations, including upgrades to existing vehicle detection systems, for the Pomona ATMS

Section 3 - This section provides detailed information about what and how the ATMS functional requirement statements were defined.

Section 4 - This section provides a summary of the functional requirement definition process.

2.0 DESIGN CONSIDERATIONS

In defining the ATMS functional requirements for PVITS, the following design factors were considered:

1. System Performance

2. Technology

3. Flexibility

4. Interoperability

5. Portability and Scalability

6. Expandability

7. Reliability

8. National and International Standards

9. Proposed Vehicle Detection Systems

The following paragraphs describe these design considerations in more detail.

2.1 System Performance

The PVITS ATMS should be capable of accessing and displaying real-time data, such as traffic signal and CCTV video data. Real-time performance of the system will be dependent upon the system architecture, communication media, communication bandwidth, and hardware specifications.

2.2 Technology

Availability of the technology or equipment is a major factor that needs to be considered when defining functional requirements, because some functional requirements are technology dependent. It is impractical to define a function that no technology or equipment can support. For example, a functional requirement that requires the ATMS to provide real-time uploading of traffic data will require the use of software, hardware and communication media that support real-time communications. If such technology and equipment are not available, this requirement cannot be satisfied.

2.3 Flexibility

Flexibility is the capability to adapt to the changing environment, which include changes in user needs, equipment, and technology. A flexible system allows maximized data access and will enable the users to readily absorb new and more effective technologies. A flexible system can be enhanced easily. Therefore, the ATMS functional requirements should be defined to provide for a flexible system. For example, in this functional requirement, *"The ATMS shall be capable of storing three or more timing plans,"* no upper limit is set for the timing plan storage capacity. Therefore, if the technology that allows the ATMS to store more than three timing plans is available during the detail design phase, this functional requirement will allow for that enhanced capability.

2.4 Interoperability

Interoperability is the seamless access of data across hardware platforms and software products. It allows the ATMS to operate across the lines of the applications, functional areas, and users. In order to achieve interoperability, functional requirements must be developed based upon common standards for data translation and exchange. The ultimate goal for interoperability is to enable all related applications to read and use each other's data without the need for data translation.

2.5 Portability and Scalability

Portability is the ability to move applications from one operating system environment to another without the need to radically modify the system. Portable systems can be easily installed and tested on different computing platforms and hardware in a convenient and cost effective manner. Portability can be achieved by requiring the system to use a standardized software operating system and programming languages. Therefore, developed software applications can be isolated from the hardware and therefore ported to other open system platforms. The benefit of portability is the opportunity to reduce deployment time and cost by reusing, refining, and sharing libraries of open applications within an organization.

Scalability is similar to portability. It is the ability to deploy a system without modification on larger or smaller models. Scalability can be achieved by requiring the system to use system components and architecture, which are compatible to each other.

2.6 Expandability

The ability to incorporate and support future ITS technologies and system expansion must be a part of the ATMS design. The technologies, hardware and software required to support a particular function of the ATMS should promote system expandability without major redesign. For example, instead of saying "*All data required for display and monitoring will be maintained to permit 10BaseT Ethernet access,*" the requirement should say "*All data required for display and monitoring will be maintained to permit high speed access.*" This approach allows the system to expand and avoid the use of obsolete technologies.

2.7 Reliability

The ATMS must be reliable in terms of system availability. Additionally, traffic signal data and CCTV video images that form the basis of the ATMS must be accurate and reliable. To achieve the reliability requirement, the PVITS ATMS should include at least the following three capabilities:

- Failure Management – this is the ability to test and annotate data as to its validity
- Data Normalization – this is the ability to standardize data so that there is analogous interpretation across all applications
- Data Calibration – this is the ability to automatically calibrate parameters used by various applications

The ATMS must have mechanisms to accommodate and process suspected, abnormal and missing data appropriately. In addition, in order to minimize service disruption, the ATMS should employ partially or fully redundant technologies and system components. The redundancy, either in the subsystems or the communication network, will allow the system as a whole to continue operating

even if one subsystem or part of a communication network fails. A communication network may have redundancy built into the configuration of the network, such that is the line is cut in one location, the data can travel a different path around the loop and still maintain communication. A software subsystem may have a duplicate subsystem on a separate server, such that if one server crashes, the system can switch to the secondary server up and the subsystem will remain on-line.

Redundancy in communications and software is a direct function of cost/ benefit. Full redundancy in any case can be very expensive to implement for little benefit. Since the operations from the ATMS is not life sustaining, it is not critical for it to remain operational all of the time. It is likely that partial redundancy will be built in to the system, meaning that some subsystems and some parts of the communication network will have some redundancy designed in.

2.8 National and International Standards

The ATMS should minimize or entirely preclude the use of proprietary system components and equipment. It is desirable to design a system that will comply with adopted national and international industry standards. Adherence to adopted national and international industry standards has several advantages such as flexibility, interoperability, portability, scalability, and reliability.

One example of a national standard is the National Transportation Communications for ITS Protocol (NTCIP). NTCIP as a whole has been adopted by the Federal Highway Administration (FHWA) while its individual standards are being developed and approved to ensure that inter-network connectivity is manifested through industry standard interfaces. NTCIP standards intend to reduce the need for reliance on specific equipment vendors and customized one-of-a-kind software. As per the DOT final rule, projects shall use applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the DOT.

2.9 Vehicle Detection Systems

Traffic signal systems that react to changing traffic conditions are important to improving transportation system efficiency. These systems can range from locally controlled with time-of-day adjustments, to regionally controlled and coordinated systems, to centralized systems with adaptive control. Vehicle detection systems provide the real-time traffic data needed for these various traffic signal control strategies.

All signals on regionally significant arterials have presence and advanced detection installed. In order to support area-wide surveillance and control of traffic signals and traveler information services in the Pomona Valley region, it is recommended that system detectors be installed at all signalized intersections on regionally significant arterials in the Pomona Valley region.

3.0 SYSTEM FUNCTIONAL REQUIREMENTS

This section presents the system functional requirements for the PVITS ATMS that are necessary in order to satisfy the user requirements documented in the ATMS User Requirements Report. The ATMS functional requirements describe a system that could be implemented in multiple agencies for local control and monitoring and also meets the need of the subregional system (one of the local systems will act as the subregional system).

Los Angeles County, one of the major PVITS stakeholders, has been a leader in the development of this collaboration and has previously identified functional requirements for traffic control systems through the San Gabriel Valley Pilot Project and the South Bay Traffic Signal Synchronization and Bus Speed Improvement Project. These requirements, which were developed as a result of the detailed analysis and design effort, assume the use of national and regional ITS standards for communications and system architecture.
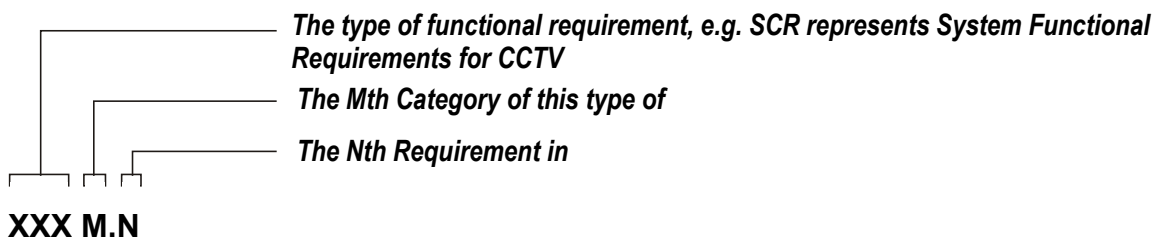
3.1 Types of System Functional Requirements

The capabilities required by the user requirements (defined in **Deliverable 5.1.1 - ATMS User Requirements Report**) can be described by the following five types of system functional descriptions:

- General ATMS Elements (SAR) – functional requirements that are common for all identified ATMS elements
- Traffic Control and Monitoring (STR) – functional requirements for traffic control and monitoring
- CCTV Surveillance (SCR) – functional requirements for CCTV surveillance
- Vehicle Detection (SVR) – functional requirements for vehicle detection
- System Supplementary Requirements (SSR) – functional requirements for user supplementary requirements

3.2 Requirements Tracking

All functional requirements are uniquely numbered so that they can be tracked during all phases of the project. Requirements tracking is necessary because it is anticipated that the functional requirements for the Pomona ATMS will continue to evolve during the course of the project. Changes in functional requirements can occur when users desire additional system capabilities based on new information that had not come to light during an earlier stage of the project, or perhaps the recognition that satisfying a particular requirement is not technically feasible. These requirement numbers also allow the functional requirements to be related to the user requirements that were identified in **Deliverable 5.1.1 - ATMS User Requirements Report**. The following numbering convention is adopted in this document with regards to the requirement numbers:

The type of functional requirement, e.g. SCR represents System Functional Requirements for CCTV

The Mth Category of this type of

The Nth Requirement in

XXX M.N

For example, SCR 2.3 represents the 3rd requirement in category 2 of the System Functional Requirements for CCTV

The requirements tracking process will be utilized through the design, implementation, and testing phases of the project. By establishing and maintaining a relationship between the requirements,

design, implementation, and test plans for the system, the impact of any changes to the requirements can be immediately identified and assessed.

3.3 Definitions

The following are definitions for terms used throughout this document:

- "System" is defined as the PVITS ATMS. System elements are the ATMS elements, which can be controlled and operated by the system, which include traffic control and monitoring system, CCTV surveillance system, and vehicle detection system.

- "Users" of the system are the PVITS project stakeholders. It should be noted that not all users may have the operational responsibilities and authority for control and operations of the ATMS.

- "Administrators" are defined as users who maintain ultimate authority on system control, operations and maintenance of the system and system elements over their own jurisdictions.

- "Other Users" are defined as users who have no operational responsibilities and also have no authority for control or operations of the system and/or the system elements.

The control and operations of the ATMS must be governed by system hierarchy levels, priorities, operating policies, and Memorandum of Understandings (MOUs) among the Pomona Valley agencies (including LA County). These issues should be addressed during detail design for final agreement by all project stakeholders.

3.4 Requirement Descriptions

Traffic Control and Monitoring, CCTV Surveillance, and Vehicle Detection are the three ATMS elements identified by the project stakeholders and the consultant team. **Tables 3-1** through **3-4** summarize the functional requirements for each of the three ATMS elements.

The first column on each of the tables refers to the ATMS element category mentioned in **Section 3.1**. The second column of the tables refers to the system functional requirement number. The numbering convention is described in **Section 3.2**. The third column refers to the user requirement number, which is defined in **Section 4.0** of the ATMS User Requirements Report.

The fourth column refers to the operational categories. Operational requirements are organized into the following operational categories to ensure that all required capabilities for these ATMS elements are addressed.

1. Data Collection
2. System Control
3. Information Exchange
4. Level of Control
5. Modes of Operation
6. Security/Access

8. Interjurisdictional
9. Traffic Control and Monitoring Functions
10. CCTV Functions
11. System Detection Functions
12. Database Services
13. Advanced Features

Requirements for system alarm monitoring are also covered under each of the above categories as applicable.

The fifth and sixth columns identify the requirement statements. The fifth column shows the name of each requirement statement, while the sixth column describes the requirement statement.

Table 3-1 summarizes the system functional requirements for all ATMS elements.

Table 3-1 System Functional Requirements for All ATMS Elements

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
General ATMS Elements	SAR 1.01	UFR 1.4	Data Collection	IEN	Accept commands from and provide data to external systems via the IEN interface.
General ATMS Elements	SAR 1.04	UOR 1.3	Data Collection	CCTV	The ATMS will be capable of interfacing with the existing/planned CCTV cameras at the local and regional level.
General ATMS Elements	SAR 1.05	UOR 1.3	Data Collection	Vehicle Detection System	The ATMS will be capable of interfacing with the existing/planned vehicle detection at the local and regional level.
General ATMS Elements	SAR 1.06	UOR 1.3	Data Collection	Expandability	The ATMS will be capable of interfacing with the future ATMS elements at the local and regional level without extensive software modification.
General ATMS Elements	SAR 2.01	UOR 2.1	System Control	Multiple Users	Provide for operation of the ATMS through multiple users/ operators within the "owning" jurisdiction and from other, secondary jurisdictions.
General ATMS Elements	SAR 3.01	UOR 3.1	Information Exchange	Network Management	Off-the-shelf (OTS) network management software will be provided to manage the Local Area Network (LAN) and Wide Area Network (WAN).
General ATMS Elements	SAR 3.02	UOR 3.4 UIR 1.7	Information Exchange	Command Data Interface (CDI)	Develop a CDI for each planned system in the Pomona Valley region so that each system can share data via the IEN.
General ATMS Elements	SAR 6.01	UOR 6.1	Security/Access	Operations and Control	Users will be able to control and operate the system if they have the proper privileges.
General ATMS Elements	SAR 6.02	UOR 6.2	Security/Access	User Access Level	Each user will be assigned an access level for each system resource.
General ATMS Elements	SAR 6.03	UOR 6.2	Security/Access	User Name	Administrators will assign a unique name to each user. User name will be unique across all systems county-wide.
General ATMS Elements	SAR 6.04	UOR 6.2	Security/Access	User Password	Each user on the system will have an individual password.
General ATMS Elements	SAR 6.05	UOR 6.2	Security/Access	User Access Logging	The system will log all user actions that modify its behavior. The log entry will include user name, action, time, and date of action.

Table 3-1 System Functional Requirements for All ATMS Elements

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
General ATMS Elements	SAR 6.06	UOR 6.2	Security/Access	Password Protection	No user will gain access to the system without entering a valid user name and password. Unauthorized casual users may be granted visitor level (read-only) access to selected parts of the system by the Administrator.
General ATMS Elements	SAR 6.07	UOR 6.2	Security/Access	User Profile Administration	Administrators and users will create and maintain profiles of information and capabilities for each user.
General ATMS Elements	SAR 6.08	UOR 6.2	Security/Access	Multiple Read Access	Multiple users may monitor the same data item if they have been granted read access to that data item.
General ATMS Elements	SAR 6.09	UOR 6.2	Security/Access	Administrator Access	Authorized users may create new users and add new pieces of equipment to the system.
General ATMS Elements	SAR 6.10	UOR 6.1	Security/Access	Map Display: Editable	A user with the correct security privileges can edit the base map displays, and textual or graphical information in them.
General ATMS Elements	SAR 6.10	UOR 6.2	Security/Access	Multiple levels of Access	Administrators may grant different users different levels of access to the system.
General ATMS Elements	SAR 7.01	UOR 7.1	GUI	Graphical User Interface	All user accessible software will use a common GUI.
General ATMS Elements	SAR 7.02	UOR 7.1	GUI	GUI Operating System	The GUI will run on a workstation running the Windows system.
General ATMS Elements	SAR 7.03	UOR 7.1	GUI	GUI Workstation	The GUI will run on a PC-compatible workstation
General ATMS Elements	SAR 7.04	UOR 7.1	GUI	Menus	The graphic display area shall be capable of being displayed on workstation monitors and the video wall with a minimum resolution of 1280x1024 pixels and support a simultaneous display of at least 65,536 colors.
General ATMS Elements	SAR 7.05	UOR 7.1	GUI	Interactive Controls	The GUI shall use interactive screens, multiple windows, pull down or pop-up menus, tool bars, and dialogue boxes in accordance with the Microsoft Windows interface standards.

Table 3-1 System Functional Requirements for All ATMS Elements

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
General ATMS Elements	SAR 7.06	UOR 7.1	GUI	Menus	Pull down or pop-up menus shall provide access to the entire functionality of the System.
General ATMS Elements	SAR 7.07	UOR 7.1	GUI	Mouse Support	The GUI will allow the use of a mouse to access user functions.
General ATMS Elements	SAR 7.08	UOR 7.1	GUI	Menus	The user input shall include, but not be limited to, mouse clicking and dragging, text input, button actions, and menu command actions.
General ATMS Elements	SAR 7.09	UOR 7.1	GUI	Menus	In functions where configuration or modification of System or equipment parameters is necessary, a graphical user interface must be provided to allow for modifications.
General ATMS Elements	SAR 7.10	UOR 7.1	GUI	Multiple Workstations	The system will support a variable number of user workstations for the system as a whole and at individual TMCs.
General ATMS Elements	SAR 7.11	UOR 7.1	GUI	Integrated Control	Provide integration control and operations with all existing/planned ATMS Elements.
General ATMS Elements	SAR 7.12	UOR 7.1	GUI	Geographic Map Displays	The user interface will provide geographically accurate maps of the Pomona Valley region and LA County.
General ATMS Elements	SAR 7.13	UOR 7.1	GUI	Clickable Map Areas	Clickable areas on the maps will allow switching to more detailed views of the Pomona Valley region, jurisdictions, sections, or intersections.
General ATMS Elements	SAR 7.14	UOR 7.1	GUI	Display On Multiple Workstations	The ATMS and its map display can be run on multiple workstations and each can display data from the same or different intersections simultaneously.
General ATMS Elements	SAR 7.15	UOR 7.1	GUI	Map Display: Decluttering	Objects on the map can be programmed to turn on or off at different zoom levels. Text labels shall be comparable in size between different zoom levels.
General ATMS Elements	SAR 7.16	UOR 7.1	GUI	Map Zooming and Planning	Users may zoom maps to more detailed views in less than 5 seconds. Once zoomed, they may pan the view through different areas of the map.
General ATMS Elements	SAR 8.01	UIR 1.1	Interjurisdictional	Seamless Boundaries	The objective of inter-jurisdictional coordination is to achieve seamless traffic flow between jurisdictions.

Table 3-1 System Functional Requirements for All ATMS Elements

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
General ATMS Elements	SAR 8.02	UIR 1.2 UIR 1.3 UIR 1.4 UIR 1.5 UIR 1.6	Interjurisdictional	Agencies Involved	Include at least the following agencies: • City of Claremont • Diamond Bar • Industry • La Verne • Pomona • San Dimas • Walnut • LACDPW • Fairplex • LACMTA • Caltrans • ACE • Cal Poly Pomona University • Foothill Transit • Mount San Antonio College • Raging Waters
General ATMS Elements	SAR 8.04	UIR 1.8	Interjurisdictional	Standard Compliance	As per the DOT final rule, all systems shall use applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the DOT.
General ATMS Elements	SAR 8.05	UIR 1.9 UIR 1.10	Interjurisdictional	Architecture Compliance	Provide consistency with National ITS Architecture and compatibility with the IEN and Southern California Priority "Showcase" requirements for potential center-to-center intertie. The system should be capable of performing multi-agency coordination with other agencies such as LACDPW and Caltrans systems.

Table 3-2 describes the system functional requirements for CCTV surveillance.

Table 3-2 System Functional Requirements for CCTV Surveillance

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
CCTV Surveillance	SCR 1.01	UOR 1.4	Data Collection	CCTV Latency	The latency of control signals sent from the ATMS to the CCTV cameras shall not exceed one second. Controls will be by discrete key presses, and not by "press and hold" actions. Latency of control signals means the delay between when an operator presses a keyboard key or moves a joystick to when the signal reaches the camera and is implemented (e.g., the camera begins to move).
CCTV Surveillance	SCR 1.02	UOR 1.3	Data Collection	Camera and Video Equipment Compatibility	The ATMS must be capable of supporting various types of video equipment including cameras, monitors, video walls, video switches, and video recording equipment.
CCTV Surveillance	SCR 1.03	UOR 1.6	Data Collection	Camera In-use Status	Provide users the camera in-use status. If there is no pan, tilt, zoom, focus, or image adjust operation perform on a camera within the user-selected (nominally, five-minute) time frame, that camera is defined as "not-in-use."
CCTV Surveillance	SCR 10.01	UFR 2.3	CCTV Functions	Camera Operation Status	The ATMS shall have the capability to inform users of the time, date, and name of the user of the most recent camera operation.
CCTV Surveillance	SCR 10.02	UFR 2.1 UFR 2.2 UFR 2.3	CCTV Functions	CCTV Control	CCTV control functions shall include at least the following: • Select and switch monitors and cameras manually • Adjust the image brightness by the iris control manually • Adjust the image quality by the focus control manually • Perform pan, tilt, and zoom manually • Digital Signal Processing (DSP) • Switch cameras continuously through a predefined sequence at a user-defined interval until disabled or overridden by another camera function
CCTV Surveillance	SCR 10.03	UFR 2.1	CCTV Functions	View Preset	Users shall be able to preset and name viewing locations and view preset locations through the GUI module.

Table 3-2 System Functional Requirements for CCTV Surveillance

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
CCTV Surveillance	SCR 10.04	UFR 2.3	CCTV Functions	Time-out Feature	Camera viewing time for external agencies shall be controlled by the time-out feature of the CCTV control module.
CCTV Surveillance	SCR 10.05	UFR 2.1 UFR 2.2	CCTV Functions	Expandability	The ATMS shall be capable of communicating with future cameras without any extensive software modification.
CCTV Surveillance	SCR 10.06	UFR 2.4	CCTV Functions	CCTV Integrated Control	The ATMS shall be developed to interface with the CCTV cameras or the camera vendor-supplied control program to provide, as a minimum, the same capabilities or better. However, integration of the CCTV subsystem with the ATMS shall be transparent to users.
CCTV Surveillance	SCR 4.01	UOR 4.1 UOR 4.2 UOR 4.3	Level of Control	Priority Scheme	Process simultaneous requests for the same camera so that only one user can control a given camera at one time. Along with this mechanism, a camera access-prioritizing scheme should be implemented. As a result, conflicts of camera usage can be resolved. However, the user shall have the capability to override the prioritizing scheme.
CCTV Surveillance	SCR 4.02	UOR 4.1 UOR 4.2 UOR 4.3	Level of Control	Priority Operating Mode	Provide normal and priority operating mode.

Table 3-3 illustrates the system functional requirements for Traffic Control and Monitoring.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 1.01	UOR 1.1	Data Collection	Real-Time Data Collection	Collect and maintain all data required for real-time monitoring and displays from all intersections at all times.
Traffic Control and Monitoring	STR 1.02	UOR 1.1 UOR 1.3	Data Collection	WWV Time Reference	Use WWV as system time reference. Local controller time will serve as backup if communication is lost.
Traffic Control and Monitoring	STR 1.03	UOR 1.1 UOR 1.3	Data Collection	Time-of-day Synchronization	Provide time-of-day synchronization of controllers. The controller's time-of-day clock shall be updated at least once a day by the central system, which shall be automatically synchronized with the "WWV" clock.
Traffic Control and Monitoring	STR 1.04	UOR 1.1 UOR 1.3 UOR 1.4	Data Collection	Preemption Processing	Provide processing of preempt/priority vehicles, such as fire and emergency.
Traffic Control and Monitoring	STR 1.05	UOR 1.2	Data Collection	Detector Data	The detector data collected and/ or calculated by the ATMS will include volume, occupancy, and speed.
Traffic Control and Monitoring	STR 1.06	UOR 1.3	Data Collection	Once Per Second Communications	The ATMS will communicate with each controller once per second.
Traffic Control and Monitoring	STR 1.07	UOR 1.5	Data Collection	Field Configuration of New Data Types	New data types available from existing or new controllers will be able to be displayed by the system without code recompilation. Once the new data is configured on the local ATMS, it will be available to the rest of the system without further configuration.
Traffic Control and Monitoring	STR 1.08	UOR 1.4	Data Collection	LACO Format	System will support LACO – I, III, and IV.
Traffic Control and Monitoring	STR 12.01	UFR 1.2 UOR 1.6	Database Services	Detection Information Comparison	Offer opportunities for comparing detection information with historical plans in database and update for forecasting purposes.
Traffic Control and Monitoring	STR 12.02	UOR 1.4 UOR 1.3	Database Services	Data Processing	Provide processing of data from local intersections.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 12.03	UOR 1.5	Database Services	Relational Database Management System (RDMS)	All data collected will be maintained using an off-the-shelf Relational Database Management System (RDMS) accessible via Sequential Query Language (SQL).
Traffic Control and Monitoring	STR 12.04	UOR 1.5	Database Services	Queries	Local database will be stored in a RDMS allowing Sequential Query Language (SQL) based queries.
Traffic Control and Monitoring	STR 12.05	UOR 1.6	Database Services	Alarm Reporting	The ATMS will provide a means of reporting system alarms to users.
Traffic Control and Monitoring	STR 12.06	UOR 1.6	Database Services	Alarms: Disk Storage	Provide automatic archiving of alarm log on disk.
Traffic Control and Monitoring	STR 12.07	UOR 1.6	Database Services	Alarms: Logging	Place alarm data in log file.
Traffic Control and Monitoring	STR 12.08	UOR 1.6	Database Services	Approved Plans	Libraries of approved timing plans will be available to assign to intersection controllers.
Traffic Control and Monitoring	STR 12.09	UOR 1.6	Database Services	Backups	Static database will be backed up on a removable backup medium such as magnetic tape or writeable CD-ROM.
Traffic Control and Monitoring	STR 12.10	UOR 1.6	Database Services	Data Storage	Provide for comprehensive database(s) for detector data, system activity and signal operation. This should include capacity for all configuration and timing parameters, storage for at least 100 different system timing plans, graphics and geometrics.
Traffic Control and Monitoring	STR 12.11	UOR 1.6	Database Services	Detector Percentage Availability Reports	Generate reports on detector percentage availability at an approach level, an intersection level, or an area level.
Traffic Control and Monitoring	STR 12.12	UOR 1.6	Database Services	Event Creation	The user can add informational events to the system event log.
Traffic Control and Monitoring	STR 12.13	UOR 1.6	Database Services	Intersection Capability	Database scaleable to at least 400 intersections for the local system(s). Database scaleable to at least 2,500 intersections for subregional system.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 12.14	UOR 1.6	Database Services	Logging	Provide for automated logging and report at the TMCs, local city traffic control sites and maintenance shops. This should include detection of all "malfunctions," providing alarms as scheduled by the user.
Traffic Control and Monitoring	STR 12.15	UOR 1.6	Database Services	Permanent Archival Data Storage	Provide for automated permanent archival data storage of malfunction event logs.
Traffic Control and Monitoring	STR 12.16	UOR 1.6	Database Services	Periodic Archiving	Users may select periodic archiving of certain dynamic data into the static database or onto a backup medium such as magnetic tape or writeable CD-ROM.
Traffic Control and Monitoring	STR 12.17	UOR 1.6	Database Services	Printing	User will be able to print out full or partial database reports with formatted layouts.
Traffic Control and Monitoring	STR 12.18	UOR 1.6	Database Services	System Backup	Users will be able to copy enough of each major system component to a backup medium to restore that component after a system failure.
Traffic Control and Monitoring	STR 13.01	UFR 1.3	Advanced Features	Adaptive Traffic Control	Provide capabilities for real-time adaptive traffic control for special events.
Traffic Control and Monitoring	STR 13.02	UFR 1.1 UFR 1.2	Advanced Features	Transit	Provide for transit interface, such as bus priority opportunities.
Traffic Control and Monitoring	STR 13.03	UFR 1.1 UFR 1.2	Advanced Features	Synchro Interface	Ability to export volume and timing plan data to Synchro, import resulting timing plan data.
Traffic Control and Monitoring	STR 13.08	UFR 1.1 UFR 1.2	Advanced Features	Time/Space Diagram (TSD): Export to CAD Software Package	Save time/space diagrams in either AutoCAD (.dwg) or MicroStation (.dgn) format. The exact format of the time/space diagram files is to be determined during software implementation phase.
Traffic Control and Monitoring	STR 2.01	UOR 2.1	System Control	Alarm Routing by Time of Day (TOD)	The ATMS shall have the capability to change alarm routing to different user stations and/or pagers by time of day.
Traffic Control and Monitoring	STR 2.01	UOR 2.1	System Control	Upload/Download Services	Provide services to upload and download local controller databases.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 2.02	UOR 2.1	System Control	Communications Server Events	Collect events from the communications server regarding intersection communications status as they occur.
Traffic Control and Monitoring	STR 2.02	UOR 2.1	System Control	Dynamic Change Of Subgroups	Provide "dynamic change of subgroups" to allow different cycle lengths for different subareas.
Traffic Control and Monitoring	STR 2.03	UOR 2.1	System Control	Controller Time/Data Broadcast	Maintain time for system and broadcast time to all controllers. Local controller time will serve as back up if communication is lost.
Traffic Control and Monitoring	STR 2.04	UOR 2.1	System Control	Coordinate Fully Actuated Controllers	Fully actuated intersection operation under a coordinated background cycle.
Traffic Control and Monitoring	STR 2.05	UOR 2.1	System Control	Download Plan Data	Download plan data to local controller.
Traffic Control and Monitoring	STR 3.01	UOR 3.1	Information Exchange	LAN Capability	Provide for local area network capability so that several workstations could simultaneously access the system and database.
Traffic Control and Monitoring	STR 3.02	UOR 3.1	Information Exchange	Adjacent Timing Plans and Traffic Conditions Monitoring	Each agency can reference timing plans and traffic conditions in neighboring agencies in order to select suitable timing plans.
Traffic Control and Monitoring	STR 3.03	UOR 3.2	Information Exchange	Inter-Agency Plan Selection	One agency will be able to request plan changes from other agencies to accommodate non-recurring congestion situations.
Traffic Control and Monitoring	STR 3.04	UOR 3.2	Information Exchange	Inter-Jurisdictional Plan Requests	The user interface will allow jurisdictions to request neighboring agencies to implement certain plans.
Traffic Control and Monitoring	STR 3.05	UOR 3.2 UOR 3.3	Information Exchange	Adjacent Operations Monitoring	Local agencies will be able to monitor the operation of signals in adjacent jurisdictions.
Traffic Control and Monitoring	STR 4.01	UOR 2.1 UOR 4.1	Level of Control	Equipment Status Monitoring	LACDPW will be able to monitor the equipment status of all signals that it maintains in the Pomona Valley region.
Traffic Control and Monitoring	STR 4.02	UOR 2.1 UOR 4.1	Level of Control	Local Operation Control and Monitoring	Local agencies will have operational control of signals and be able to monitor the operation and equipment status of signals within their jurisdiction.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 4.03	UOR 4.1	Level of Control	Synchronized Time Based Clocks	The time-based clocks for each user's traffic control system will be synchronized with the entire system to coordinate adjacent intersections in different jurisdictions.
Traffic Control and Monitoring	STR 4.04	UOR 4.2 UOR 4.3	Level of Control	Delegation of Control Authority	Local agencies, (e.g., those that do not have full-time staff), may delegate control authority to another agency by time of day.
Traffic Control and Monitoring	STR 4.05	UOR 4.2 UOR 4.3	Level of Control	Equipment Status Monitoring	Local agencies will be able to delegate equipment status monitoring function to other agencies in the Pomona Valley region.
Traffic Control and Monitoring	STR 4.06	UOR 4.1 UOR 4.2 UOR 4.3	Level of Control	Local Authority of Scenario Response Plans	In order to maintain local authority, each local agency will have the ability to confirm, reject, or amend actions within its jurisdiction caused by the implementation of a scenario response plan from another agency.
Traffic Control and Monitoring	STR 4.07	UOR 4.1	Level of Control	Scenario Response to Incident Support	The user interface will allow designated lead agencies to implement scenario response plans that cross jurisdictional boundaries.
Traffic Control and Monitoring	STR 4.08	UOR 4.2 UOR 4.3	Level of Control	Geographical Distribution of Workstations	Users at any system workstation will have the ability to control any intersection in the system if they have been granted that privilege. Control will be limited to plan selection and possibly mode selection depending upon the capability of the native system and the interface.
Traffic Control and Monitoring	STR 5.01	UOR 5.1	Modes of Operation	Operator Plan Selection	Manual plan selection overrides Time of Day/Traffic Responsive Signal Plan (TOD/TRSP), by system, group, and intersection.
Traffic Control and Monitoring	STR 5.02	UOR 5.1	Modes of Operation	TOD/DOW (Day of Week) Tables	TOD/DOW plans may be specified via system-wide, group, and individual intersection, with command hierarchy.
Traffic Control and Monitoring	STR 5.03	UOR 5.1	Modes of Operation	Traffic-responsive Mode	Provide a traffic-responsive mode of operation. This approach selects timing plans by comparing system detection thresholds for which the plan has been developed to the real-time traffic conditions in the field.
Traffic Control and Monitoring	STR 5.05	UOR 5.2	Modes of Operation	Plan and Mode Changes	Issue plan and mode changes to local controller.
Traffic Control and Monitoring	STR 5.06	UOR 5.2	Modes of Operation	Plan Compliance Monitoring	Monitor intersection operation to verify compliance with the selected timing plan.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 5.07	UOR 5.2	Modes of Operation	Plan Selection	Provide plan selection capability, both scheduled such as special event plan and by user determination.
Traffic Control and Monitoring	STR 5.08	UOR 5.2	Modes of Operation	Traffic Responsive Signal Plan (TRSP)	Specify parameters for traffic responsive signal plans by Time of Day.
Traffic Control and Monitoring	STR 5.09	UOR 5.2	Modes of Operation	Support Multiple Timing Plans	Capable of storing nine or more timing plans per intersection.
Traffic Control and Monitoring	STR 5.10	UOR 5.2	Modes of Operation	Holiday Exception Tables	Fixed and "floating" holiday exception tables may be provided. Holidays may override the standard TOD/DOW control tables.
Traffic Control and Monitoring	STR 6.01	UOR 6.1	Security/Access	Intersection Timing Modification Access	Authorized users may modify intersection timing on certain intersection controllers.
Traffic Control and Monitoring	STR 6.02	UOR 6.1	Security/Access	Involuntary Ending of Write Access	The system will support the capability for System Administrators to assign/change user write access to the controller.
Traffic Control and Monitoring	STR 6.03	UOR 6.1	Security/Access	Modify Safety Timings at Intersections	Authorized users may modify yellow and red clearance intervals for certain intersection controllers.
Traffic Control and Monitoring	STR 6.04	UOR 6.1	Security/Access	Plan Modification Access to Controller	Authorized users may modify timing plans stored in a traffic control system.
Traffic Control and Monitoring	STR 6.06	UOR 6.1	Security/Access	Alarm Routing	Administrator of the ATMS shall be able to configure the system to deliver various alarms to multiple destinations by time of day.
Traffic Control and Monitoring	STR 6.07	UOR 6.1	Security/Access	Override	Provide an "override" capability by users. This should include preparation of several security levels for various users to access and perform various functions.
Traffic Control and Monitoring	STR 6.08	UOR 6.1	Security/Access	Critical Function Warnings	The system will warn users when they perform actions that may violate pre-defined critical signal timing parameters such as minimum greens, all red etc.
Traffic Control and Monitoring	STR 6.09	UOR 6.1	Security/Access	Plan Selection Access to Controller	Authorized users may select the timing plan in use on certain intersection controllers.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 6.10	UOR 6.1	Security/Access	Remote Access to Controller Data	Jurisdictions may grant certain outside users or locations monitoring and control access to some or all of the jurisdiction's intersection controllers.
Traffic Control and Monitoring	STR 6.11	UOR 6.2	Security/Access	Supervisor Access	Authorized users may resolve conflicting requests for write access to particular intersection controllers.
Traffic Control and Monitoring	STR 6.12	UOR 6.2	Security/Access	Single Write Access	Only one user at a time may modify behavior of an intersection controller.
Traffic Control and Monitoring	STR 6.13	UOR 6.3	Security/Access	Intersection Group Protection	Jurisdictions may define intersection groups and grant access to a group in a single operation.
Traffic Control and Monitoring	STR 6.14	UOR 6.3	Security/Access	Read Access to Pomona Valley Region Data	All PVITS project stakeholders will have read access to all equipment status and congestion data in the Pomona Valley region.
Traffic Control and Monitoring	STR 7.01	UOR 1.6 UOR 7.1	GUI	User Interface	Provide for real-time display of intersection operation.
Traffic Control and Monitoring	STR 7.02	UOR 7.1	GUI	On-Screen Display	The system will provide full GUI display of database tables.
Traffic Control and Monitoring	STR 7.03	UOR 7.1	GUI	Display Conflict Monitor Status	Display status of conflict monitor.
Traffic Control and Monitoring	STR 7.04	UOR 7.1	GUI	Display Coordination Details	Display details of coordination at a controller (i.e., coordination timers), such as permissive period.
Traffic Control and Monitoring	STR 7.05	UOR 7.1	GUI	Display Coordination Status	Display status of coordination at each controller
Traffic Control and Monitoring	STR 7.06	UOR 7.1	GUI	Display Occupancy	Display detector occupancy (%).
Traffic Control and Monitoring	STR 7.07	UOR 7.1	GUI	Display Pedestrian Push Button calls	Display the pedestrian push button calls in real-time.

Table 3-3 System Functional Requirements for Traffic Control and Monitoring

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 7.08	UOR 7.1	GUI	Display Speed	Display average speed over detector.
Traffic Control and Monitoring	STR 7.09	UOR 7.1	GUI	Display Timing Intervals	Display indication of which interval currently timing on each controller.
Traffic Control and Monitoring	STR 7.10	UOR 7.1	GUI	Display Vehicle Detector Calls	Display vehicle detector calls.
Traffic Control and Monitoring	STR 7.11	UOR 7.1	GUI	Display Volume	Display detector volume counts.
Traffic Control and Monitoring	STR 7.12	UOR 7.1	GUI	TSD Display	Based on current intersection/timing plan database, the ATMS shall have the capability to display a real-time green-band time-space display on Operator Interface.
Traffic Control and Monitoring	STR 7.13	UOR 7.1	GUI	TSD On-Screen Editing	Allow Operator Interface to modify a subset of the intersection timing plan database items (typically offset or green splits) via a time/ space diagram editor.
Traffic Control and Monitoring	STR 7.14	UOR 7.1	GUI	TSD Printing	Provide printout of time/ space diagram, either to graphics printer or text printer, in "TRANSYT" type text format.
Traffic Control and Monitoring	STR 8.01	UIR 1.1 UIR 1.2	Interjurisdictional	Joint Agency Planning	The ATMS will provide methods to facilitate joint agency planning for coordinated timing plan implementation.
Traffic Control and Monitoring	STR 8.02	UIR 1.1 UIR 1.3	Interjurisdictional	Coordination Between Groups	Provide standard time reference for coordination across jurisdictional boundaries.
Traffic Control and Monitoring	STR 8.03	UIR 1.3	Interjurisdictional	Communication between ATMS	The ATMS will be able to reference data including: traffic conditions, device status, current timing plan information (plan number, cycle, offset) from other ATMS as part of the plan selection decisions.
Traffic Control and Monitoring	STR 9.01	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	Initiate download from field	The system shall have the ability to allow a maintenance person to initiate a full download of the controller database from central to the field, initiated from the field.

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 9.02	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	Off-line Capability	Provide "off-line" capability for signal controllers so that they automatically revert to internal time-based coordination (TBC) operation during any communication failures or user "override."
Traffic Control and Monitoring	STR 9.03	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	Off-line preparation of timing plans	Provide for off-line preparation of timing plans (using off-line optimization models such as Synchro) and easy interface with database. Using detector data and timing data, database should automatically be updated.
Traffic Control and Monitoring	STR 9.04	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	Timing Plan Download/ Upload	Provide for download/upload capability, allowing the user to perform this function for individual and/or appropriate subsets of controller database parameters at selected schedules, or as desired.
Traffic Control and Monitoring	STR 9.05	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	Scenario Response Plans	The ATMS shall have the ability to translate Scenario Response Plans from the Subregional system into the correct set of local plan changes.
Traffic Control and Monitoring	STR 9.06	UFR 1.1 UFR 1.2	Traffic Control and Monitoring Functions	System Shutdown	Provide for graceful system shutdowns, when necessary, and local and remote unattended system restart capability.
Traffic Control and Monitoring	STR 9.07	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Cabinet Door Open	Alert user when controller detects cabinet door open.
Traffic Control and Monitoring	STR 9.08	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Conflict Flash	Alert user when the controller is in conflict flash.
Traffic Control and Monitoring	STR 9.09	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Controller Status	Alert user when controller reports operating status change.
Traffic Control and Monitoring	STR 9.10	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Pedestrian Indication Out	Alert user when controller detects pedestrian indication out.
Traffic Control and Monitoring	STR 9.11	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Police Panel Open	Alert user when controller detects police panel door open.
Traffic Control and Monitoring	STR 9.12	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Power Fail/Recovery	Alert user during controller power failure or recovery.
Traffic Control and Monitoring	STR 9.13	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Timing Sheet Data Charged	Alert user when controller reports local database changed.

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Traffic Control and Monitoring	STR 9.14	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Tipped Cabinet	Alert user when controller detects tipped cabinet.
Traffic Control and Monitoring	STR 9.15	UFR 1.5	Traffic Control and Monitoring Functions	Alarm: Vehicle Indication Out	Alert user when controller detects vehicle indication out.
Traffic Control and Monitoring	STR 9.16	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: 2 Levels	The alarm feature shall have at least two priority levels -one level associated with those events that do, and one that don't require immediate attention.
Traffic Control and Monitoring	STR 9.17	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: Add New Alarms or Events	The system shall have the capability to add new alarms or events to one component of the system without rebuilding any other part of the system.
Traffic Control and Monitoring	STR 9.18	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: Automatic Routing and Time Stamping	Provide automatically time stamp and/or pager alarm and route to specific user station.
Traffic Control and Monitoring	STR 9.19	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: Ignore	Provide users the capability to turn on or off each type of alarm separately. However, alarms will still be logged.
Traffic Control and Monitoring	STR 9.20	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: Immediate Reporting	Provide immediate display of alarms as they occur.
Traffic Control and Monitoring	STR 9.21	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: Printing	Provide automatic printing of user-selectable alarms on designated log printer.
Traffic Control and Monitoring	STR 9.22	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: User-Selectable Delay	Provide user-selectable delay for each type of alarm.
Traffic Control and Monitoring	STR 9.23	UFR 1.5	Traffic Control and Monitoring Functions	Alarms: User-Selectable Priority	Provide user-selectable priority for each type of alarm.

Table 3-4 displays the system functional requirements for Vehicle Detection System.

Table 3-4 System Functional Requirements for Vehicle Detection System

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
Vehicle Detection System	SVR 1.01	UOR 1.2	Data Collection	Detector Data Collection	System detectors will gather and/ or calculate volume, occupancy, and speed data independent of local actuation and detection functions.
Vehicle Detection System	SVR 11.01	UFR 3.1	System Detection Functions	Monitor Detector Operation	Provide the ability to monitor detector operation, identify detector failure and prepare reports with user-definable consequences.
Vehicle Detection System	SVR 11.02	UFR 3.2	System Detection Functions	Alarm: Detector Constant Call	Alert user when detectors are experiencing constant calls for user-set time period.
Vehicle Detection System	SVR 11.03	UFR 3.2	System Detection Functions	Alarm: Detector No Calls	Alert user when detectors are experiencing no calls for user-set-time period.
Vehicle Detection System	SVR 11.04	UFR 3.2	System Detection Functions	Alarm: Detector Overcounting	Alert user when detectors are experiencing excessive calls (user set).
Vehicle Detection System	SVR 12.01	UOR 1.6	Database Services	Data Storage	Provide for comprehensive database(s) for vehicle system detector data, system activity and signal operation.
Vehicle Detection System	SVR 12.02	UOR 1.4 UOR 1.3	Database Services	Data Processing	Provide processing of data from system detectors.
Vehicle Detection System	SVR 12.03	UOR 1.4 UOR 1.3	Database Services	Data Processing (Other)	Provide processing of data from other data collection devices, such as "image processing" detectors.

Table 3-5 displays the system functional requirements for Dynamic Message Sign and Trailblazer system.

Table 3-5 System Functional Requirements for Dynamic Message Sign and Trailblazer System

ATMS Element Category	Functional Requirement No.	User Requirement No.	Category	Name	Requirement Statement
DMS and Trailblazer System	SDR 1.01	UOR 1.2 UOR 1.3 UOR 2.2 UFR 1.1 UFR 1.2	Sign Operation	Operate and Monitor Status	The system shall operate the signs and monitor the status of all sign hardware.
DMS and Trailblazer System	SDR 1.02	UOR 2.2	Sign Operation	Message Display	The system shall be capable of displaying static messages, flashing messages, and two alternating messages formed by two static or flashing messages. The time required to display a new message shall not exceed 0.8 second from a blank state, and 2.0 seconds from any non-blank state.
DMS and Trailblazer System	SDR 1.03	UOR 2.2	Sign Operation	Erase Old Message	The system shall erase the previous message prior to the writing of a new message.
DMS and Trailblazer System	SDR 1.04	UOR 2.2	Sign Operation	Display Time Selection: 2-phase Messages	The system shall, for alternating (two-phase) messages, provide selection of the display time for each phase and the blank-out time between messages in tenths of a second.
DMS and Trailblazer System	SDR 1.05	UOR 2.2	Sign Operation	Display Time Selection	The system shall provide selectable message display time, including unlimited display time for each message.
DMS and Trailblazer System	SDR 2.01	UOR 1.6 UOR 1.7	Database Services	Data Storage	Provide for comprehensive database(s) for DMS/ Trailblazer messages.
DMS and Trailblazer System	SDR 3.01	UFR 1.5	System testing	Diagnostic Routines	The system shall provide diagnostic routines that report failures and malfunctions in the sign and controller upon inquiry from the central control system. Detected failure conditions shall be automatically returned to the central control system.

3.5 System Supplementary Requirements

Functional requirement descriptions were provided for supplementary categories to ensure that all required capabilities of the ATMS were addressed.

- Operations and Maintenance (O&M)
- Cost

Table 3-6 presents the functional statements, which were defined with respect to these user supplementary requirements.

Table 3-6 System Supplementary Requirements

Functional Requirement No.	User Requirement No.	Supplementary Category	Name	Requirement Description
SSR 1.01	USR 1.1	O&M	Operator-Free Operation	Provide for "operator-free" operation so that the system performs all minimally necessary control and monitoring processes unattended.
SSR 1.02	USR 1.2	O&M	Menus	The GUI shall provide on-line context-sensitive help for the entire functionality for the system as well as on-line instructions for each command in the system. The GUI shall have the capability to send these help screens and instructions to designated printers.
SSR 1.03	USR 1.4	O&M	User Interface	The ATMS user interface shall be graphical and intuitive.
SSR 3.01	USR 3.1	Cost	Cost	Offer opportunities, techniques and methods for short-term and long-term cost savings in system implementation and capital cost.
SSR 3.02	USR 3.1	Cost	Measures of Effectiveness (MOEs)	Provide off-line and, if possible, on-line calculation of measures of effectiveness (MOEs) such as stop, delay and speed for intersection and system performance.

4.0 SUMMARY

Based on the user requirements documented in **Deliverable 5.1.1 - ATMS User Requirements Report**, complete functional requirements were defined for the PVITS ATMS. The ATMS functional requirements will form the basis for the conceptual design of the ATMS and be used to provide the design specifications of the ATMS.

LIST OF ACRONYMS

ACE	Alameda Corridor East Construction Authority
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
CAMS/IEN	Los Angeles County Countywide Arterial Management System/ Information Exchange Network
Caltrans	California Department of Transportation
CCTV	Closed Circuit Television
CDI	Command Data Interface
DMS	Dynamic Message Sign
DOW	Day of Week
GUI	Graphical User Interface
ITS	Intelligent Transportation System(s)
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACMTA	Los Angeles County Metropolitan Transportation Authority
LACO	Los Angeles County
LAN	Local Area Network
MOE	Measures of Effectiveness
MOU	Memorandum Of Understanding
NTCIP	National Transportation Communications for ITS Protocol
O&M	Operations and Maintenance
OTS	Off-the-shelf
PC	Personal Computer
PTZ	Pan, Tilt and Zoom
PV Forum	Pomona Valley Forum
PVITS	Pomona Valley Intelligent Transportation System
RDMS	Relational Database Management System (RDMS)
SAR	System Functional Requirements for All ATMS Elements
SCR	System Functional Requirements for CCTV Surveillance
SQL	Sequential Query Language
SSR	System Supplementary Requirements
STR	System Functional Requirements for Traffic Control and Monitoring
SVR	System Functional Requirements for Vehicle Detection

LIST OF ACRONYMS (CONT'D)

TBC	Time-based Coordination
TMC	Traffic Management Center
TOD	Time of Day
TRSP	Traffic Responsive Signal Plan
TSD	Time/Space Diagram
UFR	User Functional Requirements
UIR	User Interjurisdictional Requirements
UOR	User Operational Requirements
USR	User Supplementary Requirements
WAN	Wide Area Network
WWV	National Institute of Standards and Technology Time & Frequency shortwave radio station that broadcast accurate real-time