SIEMENS

Deliverable For:

Gateway Cities Traffic Signal Synchronization and Bus Speed Improvement Project

I-5/Telegraph Road Corridor

Deliverable 3.3.2

Integration System

User and Functional Requirements

Final

Version 2.0

Submitted To:

Los Angeles County

Department of Public Works

Submitted By:

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Final Version 2	March 6, 2002	Incorporates comments received from LA County DPW in February 2002

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1 INTRODUCTION

1.1 Background

The County of Los Angeles Department of Public Works Traffic Signal Synchronization, Operation and Maintenance (SOM) has proven successful in creating an institutional infrastructure to coordinate the activities of the agencies responsible for traffic signal operations in the County. A key feature of this infrastructure is the Forums - groups of bordering agencies created to encourage and promote inter-agency cooperation. These Forums have enabled funding to be targeted at infrastructure improvements along arterial and arterial/freeway corridors in the County's sub-regions. Such projects are a critical part of what will eventually be a network of integrated ITS systems in Los Angeles County and in Southern California.

The I-5/Telegraph Road Corridor is one such project which will result in arterial infrastructure improvements along Telegraph Road in the Gateway Cities (South-East LA County) Forum. The Project area contains 39 intersections in 8 different jurisdictions, comprising 6 cities, the County and Caltrans.

The objective of this Project is to design, develop and deploy traffic control systems in the corridor so that the signals along I-5/Telegraph Road can be synchronized across the jurisdictional boundaries. This Project concentrates on the needs of the agencies in this Corridor with respect to signal synchronization along Telegraph Road and recommends improvements to field infrastructure (including controllers, loops, detectors, and communications) and central traffic control systems to meet those needs.

When successfully completed, each of the agencies responsible for traffic signal operations in the I-5/Telegraph Road Corridor will have full access to an Advanced Traffic Management System (ATMS) that monitors and controls the traffic signals under their jurisdiction. Agencies will be able to synchronize their signals with neighboring agencies, and exchange traffic information in real-time.

Agencies will also be able to exchange data with other agencies in the Gateway Cities region. This will allow the agencies to respond to recurrent and non-recurrent congestion in a coordinated fashion across the jurisdictional boundaries. The traffic control systems therefore form part of a larger, regional approach supporting multi-agency traffic signal operations.

A previous report of this Project (Deliverable 3.2.1) addressed the functional requirements for the ATMS's in the I-5/Telegraph Road Corridor. Following this, Deliverable 3.3.1 examined the interface between these ATMS and the higher-level systems that support the Corridor and regional operations, by defining Integration System User Requirements. Deliverable 3.4.1 developed the system design by defining the Functional Requirements based upon the User Requirements. This report presents the combined User and Functional Requirements in one document.

1.2 Requirements Process Overview

The User Requirements document represents the first layer of requirements by specifying the capabilities of the system in terms a user can understand. This generates a common understanding of the systems for both the users as well as system developers.

The second layer of requirements is the development of the Functional Requirements. Functional Requirements document identify the elements of the system that are required to implement the User Requirements. This procedure enables a systematic approach to the first level of system architecture.

1.3 Purpose of Document

This document is organized into the following Sections:

Section 1: Introduction

Presents the Project background and introduces the document.

Section 2: System Overview

Describes the Information Exchange Network (IEN) architecture and the relationship between this and other projects.

Section 3: Concept of Operations

Describes the enhancements to operations within the Corridor to be brought about by the Project and examines how the systems will support intra and inter agency operations, traveler information and system security.

Section 4: National Standards

Identifies applicable national standards and examines consistency with the National ITS Architecture.

Section 5: Requirements

Presents the high-level requirements and functions of the ATMS from the standpoint of what the users wish to achieve with the Corridor system and so defines what the integration system component must support.

1.4 Regional Area and Agencies Involved

The I-5/Telegraph Road Corridor Project encompasses several jurisdictional boundaries. Furthermore, it will be integrated, or have the ability to integrate, with many other projects and existing systems in the region through the IEN architecture. The following cities and agencies are involved in the project:

- Commerce
- Downey
- La Mirada
- Montebello
- Pico Rivera
- Santa Fe Springs
- Los Angeles County Department of Public Works
- Caltrans District 7

1.5 Referenced Documents

The following documents have been used as reference material in the preparation of this report:

- I-5/Telegraph Road Corridor Project
  - Deliverable2.1 and 2.3: Stakeholder's Operational Objectives and Individual City Reports
  - Deliverable 3.1.2: Advanced Traffic Management System (ATMS) User Requirements
  - Deliverable 3.2.1: ATMS Functional and Local Traffic Control Center Requirements
- I-105 Corridor Project
  - TSMACS User Requirements Report (Final)
  - Functional Requirements Report (Draft)
  - TMC High Level Design Definitions and Recommendations (Draft)
- San Gabriel Valley Pilot Project
  - System Design Report, Final Version 1.0
  - System Overview and Status Update (October 2000)

2 SYSTEM OVERVIEW

2.1 The Information Exchange Network Architecture

The County DPW has developed a system architecture for integrating Advanced Traffic Management Systems (ATMS) for arterial traffic control systems into a regional framework to support the above operational goals. This is the Information Exchange Network architecture (IEN) represented in Figure 2.1. This is the architecture that will be followed in the design of the I-5 Telegraph Road Project.

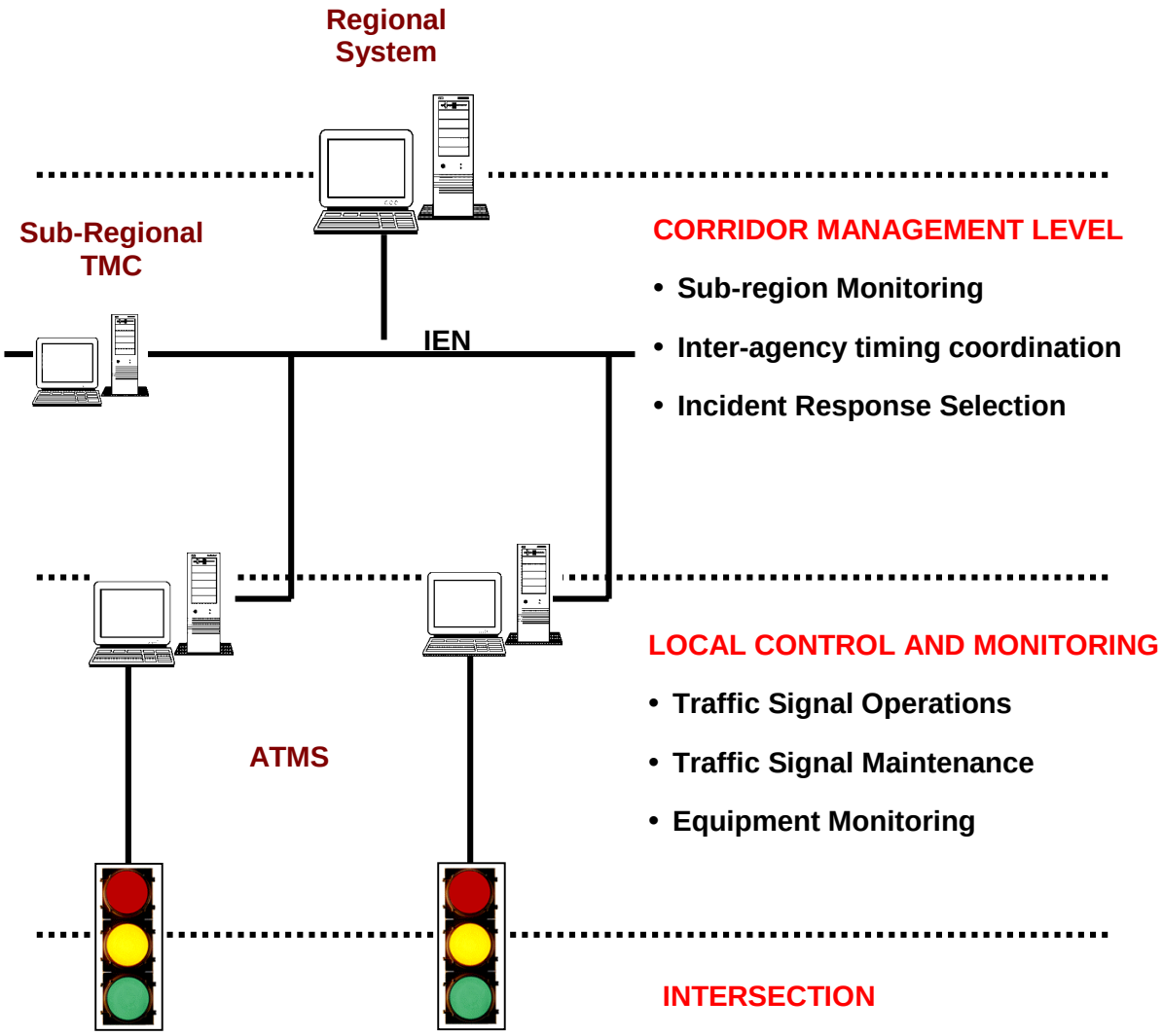

Figure 2.1: The Information Exchange Network Architecture (IEN)

The IEN architecture supports traffic signal operations in three levels. The local level comprises the day-to-day, traffic signal operations carried out by the individual agency – signal timing, maintenance and response to local traffic conditions and events. The Corridor level supports inter-agency coordination and joint signal operations – coordination across jurisdictional boundaries, exchange of local traffic data, and joint response to traffic conditions and events that affect more than one jurisdiction. The final level is the regional level. This permits the arterials of regional significance to be monitored and managed as a single entity (as Caltrans does with the freeway system). Multi-agency, cross-corridor data exchange is supported permitting a countywide response to traffic conditions and major events.

The physical elements of the architecture are ATMSs, interfaces between the ATMS and the regional system, workstations to display shared data (which may or may not be combined with the ATMS), and servers for the collection/transfer of data and to support corridor and regional functions. These components are connected via a communications network known as the Information Exchange Network (IEN). The design of the IEN is being developed as part of the East San Gabriel Valley (ESGV) Pilot Project. The initial application of this structure in the Gateway Cities region is being done under the auspices of the I-105 Corridor Project which has jurisdictions in common with the I-5/Telegraph Road Project.

2.2 IEN Implementation Projects

2.2.1 ESGV IEN Project

The County has undertaken a project to develop the IEN as part of the East San Gabriel Valley (ESGV) Pilot Project. The IEN is focused on providing real-time second-by-second data to partner agencies from multiple traffic signal control systems. As well as developing the IEN communications software, the project is also developing the following applications that will run on the (?) workstations on the IEN (see Figure 2.2):

- Incident tracking
- Incident management
- Planned Events (Scenario) Management
- Data Archiving
- Alarm Distribution
- Reporting

From the aspect of the I5/Telegraph Road project, these functional requirements for integrating systems must reflect the support of these functions.

2.2.2 I–105 Corridor Project

The I–105 Corridor Project will build a “Corridor System” over existing and future integrated ATMS’s that will be housed in a Sub-Regional TMC. The Corridor system’s purpose is to collect data from the individual local city control sites (that house local ATMS), share this data with other agencies within the system and disseminate information to public. The main goal of the corridor concept is to provide a mechanism for the local systems to act in a coordinated fashion to improve synchronization and traffic flow. Figure 2.2 illustrates the relationships between the local ATMS’s and the Corridor system.

The I-105 Corridor Project will have a "Corridor Server" located at the Sub-Regional TMC to facilitate sharing data among local city control sites and County TMC. A single "County Server" at the County TMC will manage information obtained from all the Corridor Servers including the I-105 Corridor.

The Sub-Regional TMC will act as clearinghouse for information and recommended actions to be implemented by each local city control site. The Sub-Regional TMC will recommend specific plans of action from its library of response plans that are created during inter-jurisdictional planning/coordination. A Command Data Interface (CDI) will allow each ATMS to communicate with the Sub-Regional TMC. CDI's will be used to interface the ATMS's to the Information Exchange Network (IEN) and translate existing data into the IEN format for sharing with the Corridor member cities/agencies and ultimately with the County. The architecture provides:

- CDI Definition
- Information Exchange Network (IEN)
- Corridor Server
- County Server

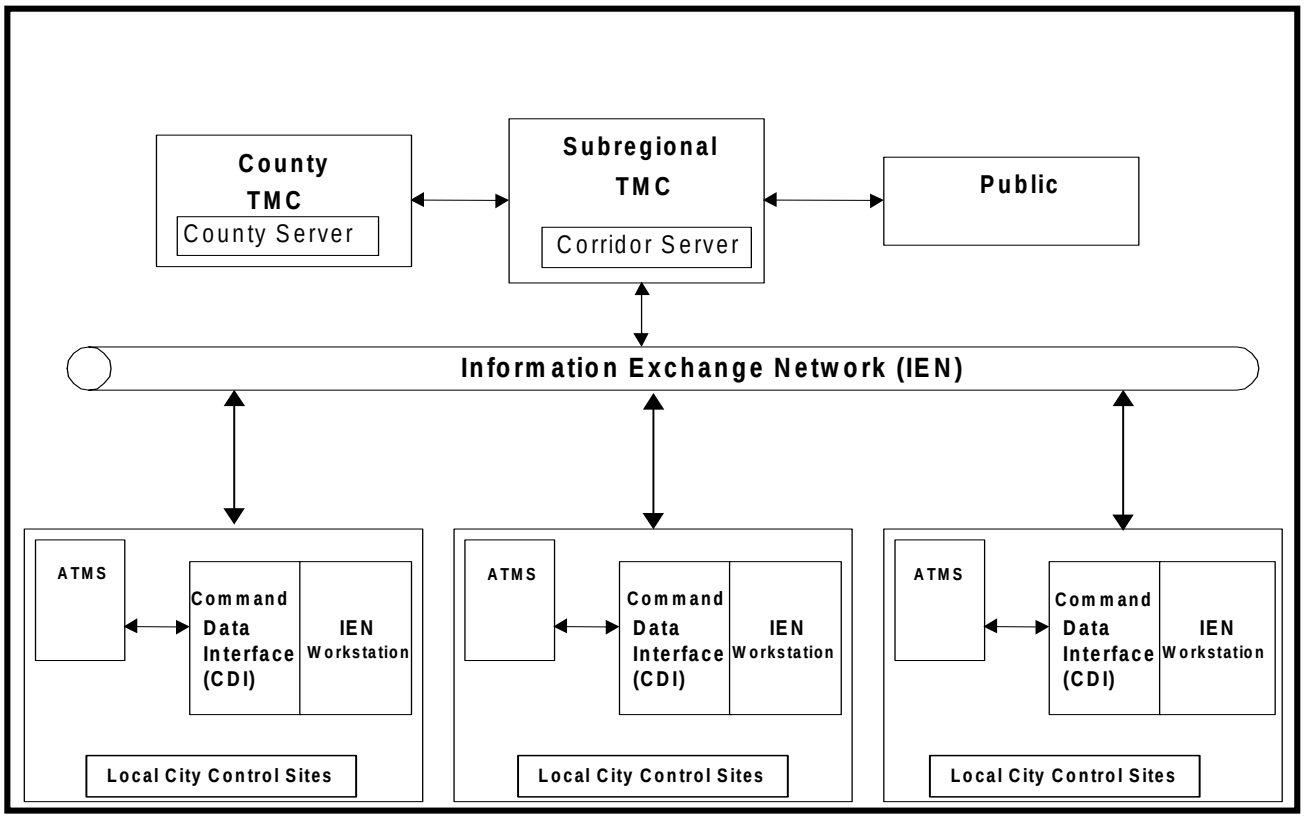

Figure 2.2: I-105 Corridor System Relations

Corridor management and control activities will be coordinated in order for traffic to move efficiently and safely between jurisdictions. This is achieved by the complementary selection of timing plans on adjacent ATMSs. The Corridor will have a WWV Clock serving as the time reference for each ATMS. The local WWV Clock at each ATMS, which, under regular operation

is synced to the Corridor clock, will act as a back-up in the event that the Corridor clock is not available.

2.2.3 I-5/Telegraph Road Project

The I-5/Telegraph Road Project assumes the availability of the IEN at the corridor and regional levels as provided by the I-105 Corridor Project. The I-5/Telegraph Road focuses upon the selection and integration of multiple ATMSs (for the Cities included in the I-5/Telegraph Road Corridor Project) using the IEN.

The eventual design will include IEN workstations at the local level and the CDI's for the individual ATMSs. These are initially being defined and implemented as part of the ESGV Pilot Project. Additional functionality supporting the Corridor Management Level tasks will be incorporated as part of the I-105 Corridor Project.

The System Integration Functional Requirements for the I-5/Telegraph Road Project, which are the subject of this report, take into account the interface of the ATMS to the IEN (i.e. the CDI) at the local level (see Figure 2.3)

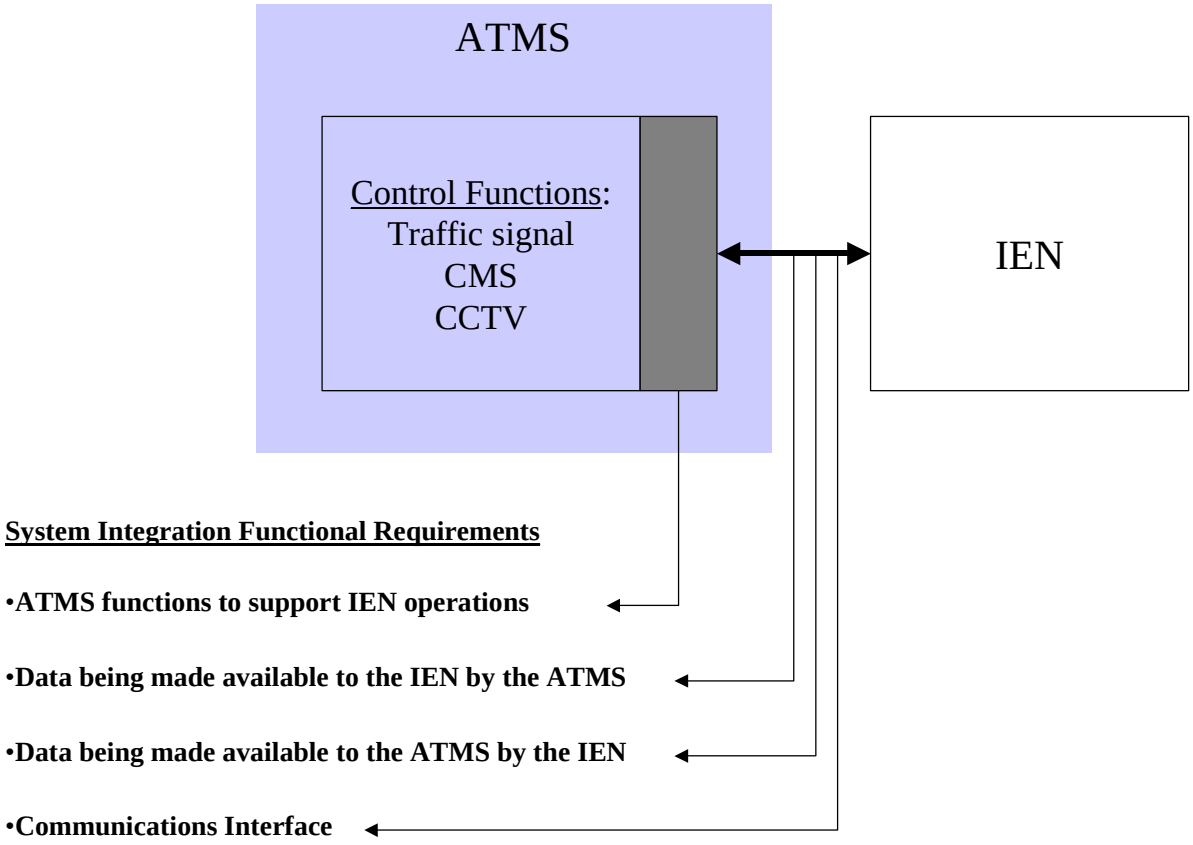

Figure 2.3: Scope of Integration System Functional Requirements

3 CONCEPT OF OPERATIONS

3.1 Operational Enhancements

The I-5/Telegraph Road Corridor System will introduce the following operational enhancements into this part of the Gateway Cities area:

- A traffic signal operations and management capability for all participating agencies.

  This will be achieved through the implementation of one or more ATMSs in the Corridor providing a centralized capability to support signal timing plan generation, implementation and management (fine tuning and other modifications), equipment monitoring and reporting, traffic conditions monitoring and reporting, response to incidents and response to equipment failures.

- Coordinated traffic signal management operations among participating agencies.

  The overall objective is to distribute demand among all roadways of the corridor so as to achieve minimum overall delay and optimum system utilization. This is particularly useful in managing incidents where the reduced capacity on one roadway is handled efficiently through increased throughput on other arterials.

- Exchanging traffic information (link volume, occupancy, incidents, delays, etc.) between the local cities, regional agencies, TMC's, and the public.

  The exchange of information will enable system managers to select proper control strategies and coordinate signals so as to achieve minimum overall delay throughout the entire corridor. The demand can be controlled through informing the public of traffic conditions and advising them of alternate arterials within the corridor. This will redistribute the demand proportionately in accordance with available freeway and arterial capacity.

- The ability to respond to Caltrans freeway management system incident data.

  This will permit the local agencies to be pro-active in managing the impact of incidents on the arterials by implementing pre-determined multi-jurisdictional coordinated signal timing.

3.2 Operational Concepts

The multi-city and agency participation in the IEN, dictate the consideration of two types of operations centers; a local city control center (LCC) and a Sub-Regional TMC. At this stage of the project, final decision of the configuration of the Sub-Regional TMC has not been reached. For the purpose of the I-5 Telegraph Road Project, the focus is on the LCC.

The potential functions that could be provided by at such a location can be divided into two categories:

- **Internal Functions.** These are functions that relate to the operation of system components within the jurisdiction of a specific city or agency. Examples include the operation of local traffic signal systems, local congestion, incident and event management using CCTV, system detection, CMS, etc. A full range of maintenance activities is also covered such as monitoring central, field and communications equipment and responding to alarms and equipment failures.

- **External Functions.** This includes the exchange of data, information, and/or video with outside users such as other cities, Caltrans, and the general public. The type of data/information exchanged with other agencies typically depends on multi-agency/city agreements and understandings that govern items such as type of data/information exchange, level of access/control, and permissions. For the general public, a key function of the ATMS is to provide information to the Sub-Regional TMC about roadway conditions, congestion, incidents, events, etc. The Local TCC may also receive information about signal problems, accidents, and other items from call-ins by the public.

These functions are illustrated in Figure 3.1 below. External Functions are enabled by the integration of ATMS through the IEN and so form the focus of the Integration Systems Requirements Definition. They are described in the following subsection.

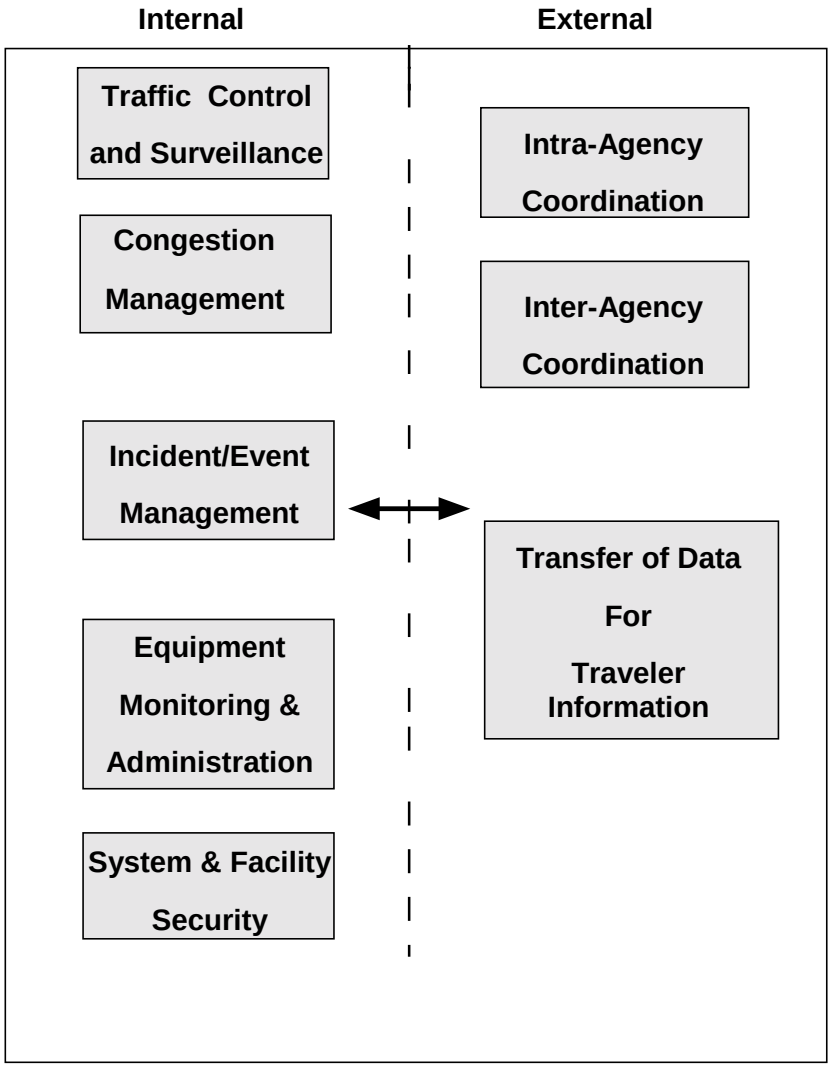

Figure 3.1: ATMS Functions

3.3 External TMC Functions

3.3.1 Intra-Agency Coordination.

The traffic-engineering department of an agency typically works closely with other internal departments such as public works, planning, maintenance and emergency services. Public works may provide input on planned roadway construction activity, unplanned events such as a water main break, and other information related to the street and utility infrastructure. Operations staff uses this information to update or create new response plans. In return, the public works department may be advised of infrastructure-related problems detected by the LCC.

System detector data provides a valuable source of traffic information for planning departments. Long term changes in urban development, and the street network, etc. impacts response plans and potentially the configuration/operation of field devices.

Maintenance staff may or may not be co-located at the LCC (more typically they are off-site at a maintenance yard or other location). An important function of the control site is to advise maintenance staff of field device malfunctions or routine maintenance functions. This may be pre-scheduled and/or the control site may have a direct dispatch facility.

Subject to the policies of the agency, there are typically links to local police, fire and other emergency services for the purpose of detecting and responding to incidents or events. Incidents detected by the system can be reported to emergency services, and they (particularly the police) may report accidents or other problems that impact traffic to the LCC.

For smaller agencies, the link with emergency services is usually by telephone or intercom. Larger TMC's (e.g. Caltrans District 7) may include an officer co-located in their Local TMC facility.

3.3.2 Inter-Agency Coordination.

A key function of the IEN is to facilitate coordination with other agencies through the exchange of data and information. Data will flow between LCC's, Sub-Regional TMC's and the County TMC. Rules for the sharing of data and information may be created on a bi-party basis, or through group agreement, depending on the organizational structure and policies of the participating agencies. The following illustrates the kind of information that may be shared between agencies, but is not intended as a recommendation or as a statement of policy. Specific rules and permissions for information sharing will need to be developed by the participating agencies as the Project progresses.

Possible types of information sharing include:

- Exchange of signal timing and other response plans to facilitate coordination at jurisdictional boundaries, or along major arterials that cross multiple jurisdictions.
- Real-time exchange of system detector data to allow one agency to implement local timing and response plans in response to changing traffic conditions in an adjacent jurisdiction.
- Sharing of CCTV video images, potentially with access control to manage who has access to what images and under what conditions.

Inter-agency coordination also extends into the area of control, under which agencies can coordinate operations to ensure that signal timings best meet the current traffic conditions, this can be:

- On a planned basis, to cope with events as diverse as sporting venues and road closures. The timing of the event is known, the impact can be anticipated and so mitigation plans can be drawn-up and programmed into the system to be implemented at the correct time.
- Automatically, on a real-time basis, using, for example, traffic responsive plan selection over a multi-jurisdictional area. This allows an ATMS to use traffic data from another agency for plan selection.
- Manually, so that an operator can request a plan for an intersection/section of an adjacent ATMS to address a particular traffic situation identified by the operator.

A specific example of this is coordinated response to freeway incidents. Freeway incident information will be received at the sub-regional TMC where it is evaluated. Should a match be found with pre-defined scenarios, and should a multi-agency response be required (e.g. the changing of arterial signal timings or displaying a dynamic message sign) then the request will be sent to the relevant systems to implement the response. The responses will be pre-defined and agreed between the agencies.

The incident information will also be passed on to the ATMS's for analysis and response. This is necessary in the event that a coordinated, multi-agency response is not required but the local agency has decided that under such conditions a response by that agency is necessary.

It should also be noted that the incident information is made available at the IEN workstations located in the agency facilities. Individual and multi-agency responses can be initiated from these workstations given the necessary access privilege.

Finally, there exists the opportunity to share control of field devices within a sub-region covered by two or more agencies for the purpose of implementing regional responses, or to allow agencies to share staffing resources, or simply to permit one agency to view the CCTV images of another and control the other agency's camera.

Specific agreements may be required for all the above types of information and control sharing, and may be subject to various operational restrictions such as time of day/hours of operation.

3.3.3 Transfer of Data for Traveler Information.

The Local ATMS collects traffic data such as volume and occupancy from field devices, aggregates the data and deduces congestion parameters such as travel times and speeds. These parameters provide a measure of mobility status on roadways that can be a useful part of an Advanced Traveler information System (ATIS). An ATIS is a means to distribute real-time information on road and traffic conditions to travelers for pre-trip planning and en-route guidance. The effectiveness of an ATIS system increases with area of coverage both geographically and functionally (across different modes). For this reason the traveler information function is typically performed at the Sub-Regional TMC or regional TMC level where data from LCC's is aggregated. Hence, the local systems provide the data to the Sub-Regional and/or Regional TMC.

3.3.4 Security

The multi-jurisdictional nature of the overall system requires that additional security measures be put in place. These go beyond the common ATMS access requirements, and extend to remote users. The local agencies will maintain the ability to define access to their own systems by remote users. This access will be definable by function, by equipment and by time of day.

4 NATIONAL STANDARDS

4.1 Conformance with the National ITS Architecture

Conformance with the National ITS Architecture is addressed in Deliverable 3.1.2: ATMS User Requirements. The deployed systems will be in conformance with the National ITS Architecture through compatibility with the Information Exchange Network (IEN).

4.2 Applicable ITS Standards

During the process of development of the requirements, applicable ITS Standards are identified. A brief discussion of the standard and its potential applicability is included below based upon the ATMS requirements definition. The observations are included in the relevant sections of the Integration System Requirements.

4.2.1 Communications Protocols

A major ITS communications standardization activity is under way in the form of the development of the National Transportation Communications Protocol for ITS (NTCIP).

At the time of writing, the NTCIP has not yet been adopted as a National Standard, so it is not necessary to specify the NTCIP in order to maintain compliance with the National ITS Architecture. However, it would be prudent to accommodate the NTCIP.

Center-to-Center Communications

The NTCIP Center-to-Center protocols are relevant to the I-5 Telegraph Road project in that they will allow agencies to exchange information, monitor conditions in other agencies' systems, and to implement coordinated responses to incidents and other changes in field conditions when needed. Such data exchange and coordinated response can be implemented either manually or automatically. One agency can monitor, and issue basic commands to (if authorized) field devices operated by another agency, even though those devices may be from a different vendor than those used by the monitoring agency.

Potential applications of interagency coordination include coordinating traffic signals across jurisdictional boundaries, providing traffic signal priority for selected (e.g., behind schedule) transit vehicles, providing real-time information to a shared traveler information center, monitoring traffic volumes on another agency's roadway, coordinating the operation of a freeway ramp meter with an adjacent traffic signal, or posting a warning message on another agency's dynamic message sign.

NTCIP Center-to-Center is covered by two standards: Datex ASN and CORBA. In addition, Message Sets for External TMC Communications is being developed. The Southern California Regional Architecture, as well as the County's IEN, is based upon the CORBA standard. This should be specified for use on this project.

4.2.2 Incident Management

Arterial incident management has been identified as a requirement by at least one of the project agencies to date. In addition, the ATMS must be capable of being part of the detection and management of incidents on a corridor and regional basis.

The latter is addressed by the I-105 Corridor Project design. Work has already been carried out as part of the SHOWCASE Early Start Projects, which has addressed certain aspects of incident management on freeways and the distribution of incident information. The I-105 design should, therefore, follow the SHOWCASE approach, which provides freeway incident information to other systems to enable them to decide on a suitable response. The Concept of Operations permits both a multi-agency response, coordinated at the corridor server/sub-regional TMC, and a response by an individual ATMS, should that ATMS have the capability.

Therefore, if it is required that a single agency provides response to freeway incidents, that agency's ATMS should be compatible with the SHOWCASE approach to freeway incident management and response.

This leaves the need for the ATMS requirements to accommodate arterial incident management. This has been addressed by the IEN development through inclusion in the Scenario Management functionality of the IEN. It is important that the Gateway Cities Projects (I-105 Corridor and I-5/Telegraph Road Corridor) are compatible with Scenario Management of the IEN. The ATMS should support the IEN Scenario Management functionality.

Incident Management is covered by three standards depending on the point of view of the user.

1. The ITE/AASHTO Advanced Traffic Management Data Dictionary (TMDD) tracks an incident from start to finish and is typically applicable to a Department of Transportation that is tracking an incident on one of its facilities. Data elements for Special Events and Roadway Construction are also defined. The relevant parts of the TMDD should be used by this project.
2. The IEEE P1512 Message Sets for Incident Management Suite of Standards enables Emergency Management Centers to track in great detail the on-site management of an incident. This is not relevant to the project.
3. NTCIP 1402 Transit Communications Interface Protocol - Incident Management (IM) Business Area Standard tracks an incident from the point of view – and needs – of the transit agency. This is not relevant to the project.

These incident management standards have been harmonized through the ITS Data Registry process which should be used as a resource for the system design.

4.2.3 Location Referencing

The Society of Automotive Engineers SAE J2374 – Location Referencing Message Specification Information Report, also known as LRMS, defines a standard mechanism for the exchange of geographic location. These include:

- Address
- Cross Streets
- LinkID
- Longitude, Latitude
- Linear Reference (e.g. Milepost)

The IEN has adopted the message profiles as specified by the SAE's Location Referencing Message Specification Information Report, so this should be specified for use on the I-5 Telegraph Road project.

REQUIREMENTS

5.1 Introduction

The requirements for functions at the sub-regional TMC have addressed as part of the I-105 Corridor Project activities, and have also been identified in the East San Gabriel Valley Pilot Project Design Report. The Integration System (IS) User and Functional Requirements have been derived from these sources.

Note the following nomenclature is used in this project:

UR IS	User Requirement for Integration Systems
FR IS	Functional Requirement for Integration Systems
UR TS	User Requirement for the ATMS to support traffic system operations
FR TS	Functional Requirement ATMS to support traffic system operations
UR CS	User Requirement for the Communications Systems in the project
FR CS	Functional Requirement for the Communications Systems in the project

5.2 Operational

5.2.1 Intra-Agency Coordination

Event Management

UR IS 1. The ATMS shall provide the ability to implement pre-calculated response plans for pre-planned and un-planned events at the request of the Sub-Regional TMC.

Functional Requirements

- See *Scenario Management* (below)

Congestion Monitoring

UR IS 2. The system shall report congestion. (For a definition of congestion see the ATMS Functional Requirements)

Functional Requirements

FR IS 1. The ATMS shall make available via the IEN congestion data, both recurrent and non-recurrent, as derived by the ATMS from detector data.

5.2.2 Inter-Agency Coordination

Data Sharing

UR IS 3. The ATMS shall provide data to support the graphics displays at the sub-regional and regional levels. (Change in User Requirements).

UR IS 4. It shall be possible to view signal timing data of an ATMS from another LCC.

UR IS 5. Exported signal timing data shall support coordination across jurisdictional boundaries and along Telegraph Road between multiple jurisdictions.

UR IS 6. It shall be possible to reference local device configuration data from the sub-regional TMC.

Functional Requirements

FR IS 2. Status, main-street greens, and cycle timer data for corridor-level maps and displays will be made available to the IEN once per second.

FR IS 3. Offset/split data for corridor-level maps and displays will be made available to the IEN once per cycle (if not running a cycle timer, will be collected once per minute).

FR IS 4. The ATMS shall aggregate detector data and events/alarms and make this data available to the IEN.

FR IS 5. The ATMS shall make alarms available for export via the IEN on a device basis.

FR IS 6. The ATMS shall make available to the IEN the following device data:

- Name
- Type
- Location (descriptive)
- Location (reference)

FR IS 7. The ATMS shall make available CMS status (including current message) to the IEN.

Video Sharing

UR IS 7. The ATMS shall make available CCTV video images for viewing at other remote locations both in the corridor and elsewhere.

UR IS 8. It shall be possible to view video images from CCTV cameras in other jurisdictions.

Functional Requirements

FR IS 8. The CCTV interface to the IEN shall support the sharing of full motion video from any of the cameras under the control of the ATMS with jurisdictions in the corridor and elsewhere.

FR IS 9. It shall be possible for all the agencies in the I-5/Telegraph Road Corridor to concurrently view any CCTV image.

FR IS 10. The CCTV interface to the IEN shall support the control of CCTV cameras by other agencies.

Signal Operations

UR IS 9. ATMS shall provide inter-agency plan selection capability. (ATMS UR 3.1.2.2)

UR IS 10. One agency will be able to request/implement plan changes in other agencies to accommodate emergency operations and/or non-recurrent congestion situations. (ATMS UR 3.1.2.4)

UR IS 11. The ATMS shall export traffic responsive plan data to enable the coordination of signal timing plans under TRPS conditions.

UR IS 12. The ATMS shall be able to use detector data from another system for its own processes such as TRPS and incident detection and management.

UR IS 13. Each agency's ATMS can reference plans and traffic conditions in neighboring agencies in order to select suitable plans.

Functional Requirements

FR IS 11. The ATMS shall make available for export via the IEN volume and occupancy on a detector basis for use in traffic responsive plan selection by another agency.

FR IS 12. The ATMS shall be able to import volume and occupancy on a detector basis via the IEN for use in its own traffic responsive plan selection.

FR IS 13. It shall be possible to request a report of all detectors of other agencies' systems used by the ATMS.

FR IS 14. The report shall include:

- Detector number
- Detector location (descriptive text)
- Current values
- Traffic responsive tables in which used

FR IS 15. The ATMS shall receive requests for plan changes on an intersection basis via the IEN.

FR IS 16. The ATMS shall respond to the IEN with a confirmation of the action taken in response to the request to implement an intersection plan.

Scenario Management

UR IS 14. The ATMS shall support the IEN Scenario Management functionality.

UR IS 15. The ATMS's will translate scenario response plans from the corridor system into the correct set of local plan changes.

UR IS 16. Scenario response plans shall include signal timing changes, changeable message signs and other devices.

UR IS 17. Each local agency can confirm, reject, or amend scenario Response Plans.

Functional Requirements

FR IS 17. The ATMS will translate Scenario Response Plans from the corridor system into the correct set of local actions.

FR IS 18. The Scenario Response Plans will include traffic signal timing plan selection for an intersection, section or system

FR IS 19. The Scenario Response Plans will include dynamic message sign selection for a sign.

FR IS 20. The ATMS shall respond with a confirmation of the action taken in response to the request to implement a response plan.

FR IS 21. Libraries of plans will be maintained so that local agencies can match plans with neighboring agencies when regional efforts are in process.

FR IS 22. The ATMS will support the viewing of locally stored plans via the IEN.

FR IS 23. The Corridor Server will maintain a list of "Scenario Response Plans" that may be implemented from the corridor level as the result of incident response. The ATMS shall provide a list of locally stored plans to the IEN.

FR IS 24. The list of locally stored plans shall comprise a plan identification and a description of the plan.

Incident Management

UR IS 18. If required to provide a single agency response to freeway incidents, the ATMS should be compatible with the SHOWCASE approach to freeway incident management and response.

UR IS 19. The system design should use the incident management standards which have been developed through the ITS Data Registry process.

Functional Requirements

- None for Integration Systems; functionality is incorporated in the IEN and the ATMS.

Time Synchronization

UR IS 20. The ATMS shall make available its current system time for reference by another system.

Functional Requirements

FR IS 25. The ATMS shall make its time available to the IEN in response to a query via the IEN

FR IS 26. The ATMS shall be able to receive and implement time synchronization via the IEN.

5.2.3 Transfer of Data for Traveler Information.

UR IS 21. The ATMS shall export real-time detector data to the IEN.

Functional Requirements

FR IS 27. Detector and congestion data for corridor-level maps and displays will be made available to the Corridor server once per cycle (if not running a cycle timer, will be collected once per minute).

FR IS 28. The ATMS shall export link-based detector data (volume, occupancy and speed) for the last data collection period.

FR IS 29. The ATMS shall export link-based congestion data for the last data collection period.

FR IS 30. The ATMS shall export dynamic message sign status (including current message).

5.2.4 Security

UR IS 22. It shall be possible to restrict access to the ATMS by remote users accessing the system via the IEN. (ATMS FR 23.1.10 *et seq.)*

UR IS 23. It shall be possible to define levels of access to users from another agency. (ATMS FR 23.1.10 *et seq.)*

Functional Requirements:

FR IS 31. The ATMS shall provide remote access via the IEN.

FR IS 32. Remote Users shall be required to provide a user name and password to connect to the network and then a separate login to the central software. (FR TS 23.1.11)

FR IS 33. The rights of the remote User will be determined and set up in the same manner as a local User. (FR TS 23.1.12)

5.3 Maintenance

Field Equipment Maintenance

FR IS 34. The ATMS shall advise maintenance staff of the need for routine maintenance.

Corridor Communications

UR IS 24. The status of the IEN communications link shall be monitored and failures reported to local and sub-regional operators as appropriate.

UR IS 25. Facilities shall be provided for the testing of the CDI to ATMS interface.

Functional Requirements

FR IS 35. The ATMS graphical user interface (GUI) shall contain a visual display of the availability of the IEN to the ATMS.

FR IS 36. It shall be possible to initiate disconnection from the IEN at the ATMS user interface.

FR IS 37. It shall be possible to initiate connection to the IEN at the ATMS user interface.

5.4 Staffing and Training

No requirements

5.5 Cost

UR IS 26. The integration of systems shall make use of software developed under parallel County projects wherever possible to avoid duplication of effort.

UR IS 27. The integration of systems shall make use of software available from other agency projects (e.g. SHOWCASE) wherever possible to reduce deployment costs.

5.6 Public Relations

No Requirements

5.7 System Requirements

Communications Protocols

UR IS 28. At a minimum, the ATMS should have demonstrated the ability to support the relevant NTCIP protocol for C2C.

UR IS 29. Where there is a high degree of commitment or reasonable degree of use of the NTCIP protocol for C2C, then it should be specified for use.

Functional Requirements

- See Center-to-Center Communications, below.

Center-to-Center Communications

UR IS 30. NTCIP Center-to-Center is covered by two standards: Datex ASN and CORBA. In addition, a Message Sets for External TMC Communications is being developed. The Southern California Regional Architecture, as well as the County's IEN, is based upon the CORBA standard. This should be specified for use on this project.

Functional Requirements

FR IS 38. The ATMS shall support an ORB compatible with the IEN.

FR IS 39. The ATMS shall use CORBA v2.2 or later compliant interfaces.

FR IS 40. The ATMS shall use the IDL's defined for the IEN. Showcase?

System Architecture

UR IS 31. The ATMS shall be consistent with the County's IEN and IEN Architecture

Functional Requirements

FR IS 41. All system components of the I5/Telegraph Road project will communicate via the IEN.

FR IS 42. Command Data Interfaces (CDIs) will be used to interface existing Traffic Control Systems to the IEN.

FR IS 43. The ATMS shall interface with the IEN's CDI for transferring and receiving data from the IEN.

FR IS 44. Protocol definitions will be documented to assist in future component additions.

Operational Requirements

FR IS 45. Access to the IEN shall be on a 24 hours per day, 7 days per week basis (excluding an acceptable down time for system maintenance, backup, etc).

FR IS 46. For systems to be integrated seamlessly, all software used for integration shall be fully modular, expandable, and upgradeable.

Location Referencing

UR IS 32. Message profiles as specified by the SAE's Location Referencing Message Specification Information Report and as adopted by the IEN should be used as the basis for location- referencing data elements.