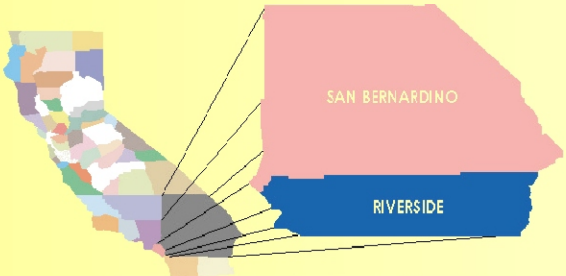

Inland Empire Regional Intelligent Transportation Systems (ITS) Architecture Project

Final Report

June 2003

Submitted by:

ITERIS

J99-0495

INLAND EMPIRE
INTELLIGENT TRANSPORTATION SYSTEMS (ITS) ARCHITECTURE PROJECT

FINAL REPORT

PROJECT INITIATED BY A JOINT PARTNERSHIP OF :
CITY OF FONTANA
SAN BERNARDINO ASSOCIATED GOVERNMENTS (SANBAG)
RIVERSIDE COUNTY TRANSPORTATION COMMISSION (RCTC)
CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)
FEDERAL HIGHWAY ADMINISTRATION (FHWA)

Submitted by

ITERIS, INC.

June 30, 2003

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EXECUTIVE SUMMARY

This report represents the final product of the Inland Empire Regional Intelligent Transportation Systems (ITS) Architecture Project. This architecture was prepared by Iteris, Inc. for the Stakeholders of the Inland Empire (Riverside and San Bernardino counties) of Southern California.

ITS refers to the use of electronics and communications systems for collecting, processing, disseminating, or acting on information in real time to improve the operation, safety, or convenience of the transportation system. This definition encompasses a broad range of systems and technologies and has created many new opportunities for transportation professionals to respond proactively to increasing demand for effective transportation services. Many of these new opportunities are predicated upon effective coordination between organizations, at both the institutional and technical level. To encourage this coordination, the U.S. Department of Transportation (USDOT) has developed the National ITS Architecture and related tools.

An "architecture" is a concept from the field of systems engineering that defines the framework within which a system can be built, the functionality of the pieces of the system, and the information that is exchanged between the components of the system. An architecture is functionally oriented and not technology specific. This feature allows an architecture to remain in effect over time and not become obsolete as technology evolves. Applying this definition to ITS, the National ITS Architecture defines the inter-related systems that work together to deliver transportation services and the interconnections and information exchanges between these systems.

The National ITS Architecture is a general framework for planning, defining, and integrating ITS and is available as a resource for any region. The National ITS Architecture offers many advantages as the basis for creating a regional ITS architecture, including providing the tools to identify and exploit opportunities for cost-effective regional cooperation. A regional ITS architecture is a specific regional framework for ensuring institutional agreement and technical integration of the ITS projects in the region.

Architecture development in the Inland Empire followed the federal guidelines as provided for in the *National ITS Architecture Guidance, Developing, Using, and Maintaining an ITS Architecture for Your Region"*, dated October 12, 2001. As a result, this Architecture sets forth the regional needs, applicable ITS user services and market packages, operational concepts, functional requirements, system interconnects and information flows, potential agency agreements, relevant standards, projects required for architecture build-out, and a plan for maintaining the architecture. Founded on Stakeholder participation and consensus, **Figure ES-1** represents the overall conceptual view of the ITS applications considered within the Inland Empire Regional ITS Architecture.

This Final Report provides great detail on the specifics of the Inland Empire regional architecture development process, the resulting decisions, and the plan for the future. The Stakeholders have requested that this Executive Summary be used to provide an overall guide for use of this document, as detailed in the following paragraphs.

As an ITS project is deployed in the Inland Empire, the project architecture must proceed based on consistency with the Inland Empire Regional ITS Architecture. For example, if an agency wanted to build a Traffic Operations Center for their signal system incorporating other ITS devices, such as CCTV cameras and electronic signs, the process would proceed as follows (a similar process would be used if a transit system or a traveler information system or any other ITS project were of interest):

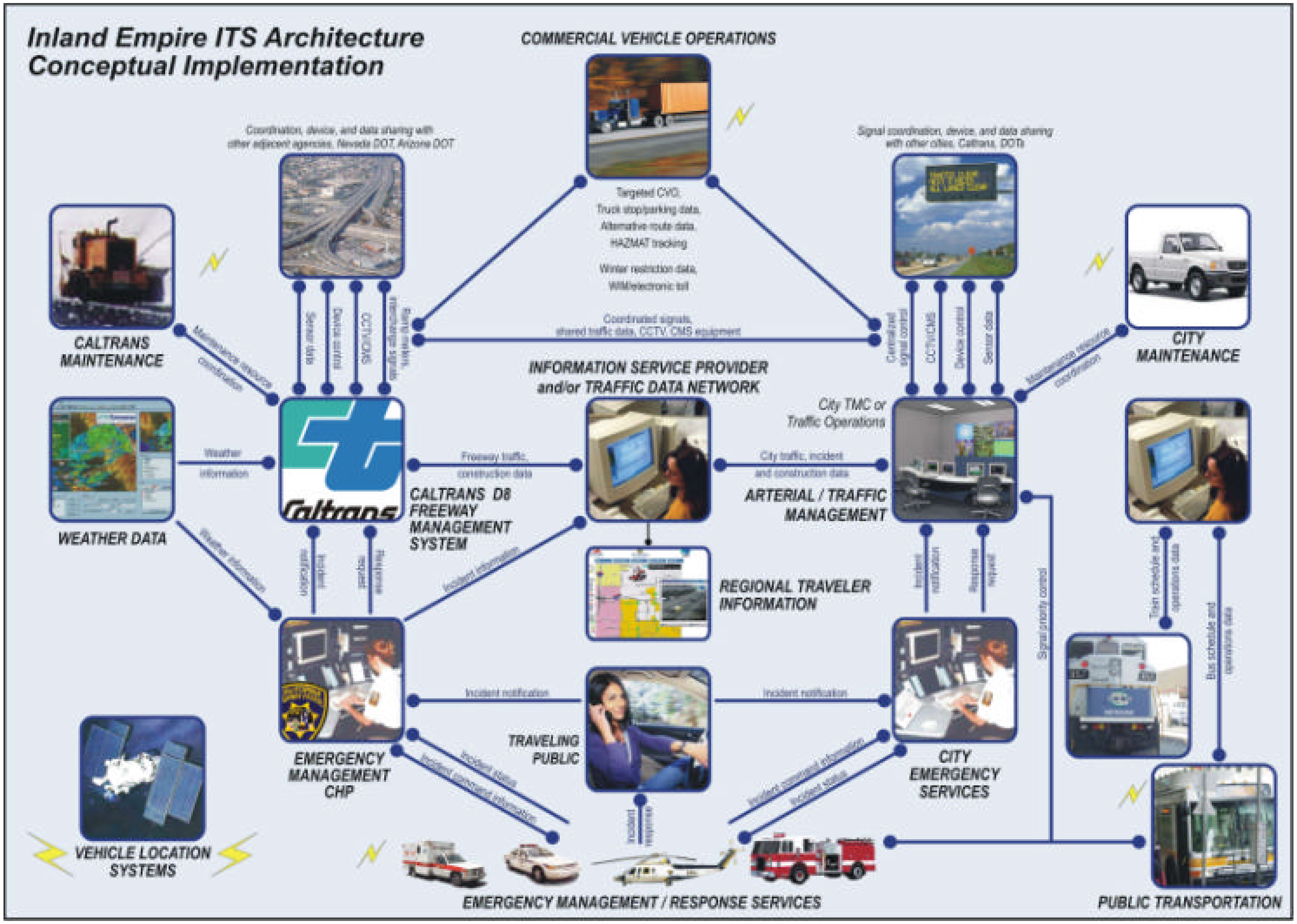
1. Consult the Regional ITS Architecture (this document) to see if the project had been previously captured under existing inventory in **Chapter 3** or in the projects list from **Appendix G**.
2. If the project has been recorded, then find the related:
    - Operational Concepts in **Chapter 4.3**
    - Functional Requirements in **Chapter 5.1**
    - System Interconnects and Architecture Flow Diagrams in **Appendix F**
    - Recommended and Appropriate Standards from **Appendix I**
3. Review these items and decide which interfaces and flows the current project must accommodate.
4. Contact the Stakeholders referenced in the flow diagrams and coordinate the data to be exchanged and the standards to be used as a starting point.
3. Determine whether an agreement is required for the purpose of system integration and data exchange and other relevant terms. **Chapter 7** offers a list of potential agency agreements from which to start and **Appendix H** has some sample agreement templates that could be used.
4. Include these aspects in any subsequent Request for Proposal and specifications for the project. Follow systems engineering process in project deployment. (If this process is unfamiliar, FHWA has support documentation and can provide training and guidance.)
5. Bring the project particulars before the Architecture Maintenance Team for assessment of consistency with the Regional Architecture, as noted in **Chapter 8**.

If the project has not been previously identified in the Regional Architecture, then a systems engineering process should be executed by the Stakeholder that mimics the Regional Architecture process and modifies the regional architecture needs, services, operational concepts, functional requirements, system interconnects, agreements and information flows so that they include the new ITS project being considered for deployment. It is up to the FHWA representative within the region whether this information would need to be modified immediately in the regional architecture or whether it could be incorporated into the Regional Architecture during a routine maintenance cycle.

If the preferred design within that Project Architecture is not consistent with the Regional Architecture, then the Regional Architecture needs to be modified so that the two are consistent. Regional Architecture changes need to be coordinated with other stakeholders through the Architecture Maintenance Team so that all stakeholders who are affected by the change are notified and included in the process.

Once this architecture is put to use, there will be evidence that the Inland Empire has complied with the Federal guidelines and thus they will qualify for future Federal funding of ITS improvements in the region. More importantly, the Inland Empire will have a common framework that will serve as a shared vision, an organizing vehicle, and a planning instrument that will serve the region for years to come.

Figure ES-1: Inland Empire Operational Concept



1.0 INTRODUCTION

This report represents the final product of the Inland Empire[*] Regional Intelligent Transportation Systems (ITS) Architecture Project. This architecture was prepared for the Stakeholders of the Inland Empire of Southern California.

ITS refers to the use of electronics and communications systems for collecting, processing, disseminating, or acting on information in real time to improve the operation, safety, or convenience of the transportation system. This definition encompasses a broad range of systems and technologies and has created many new opportunities for transportation professionals to respond proactively to increasing demand for effective transportation services. Many of these new opportunities are predicated upon effective coordination between organizations, at both the institutional and technical level. To encourage this coordination, the U.S. Department of Transportation (USDOT) has developed the National ITS Architecture and related tools.

An "architecture" is a concept from the field of systems engineering that defines the framework within which a system can be built, the functionality of the pieces of the system, and the information that is exchanged between the components of the system. An architecture is functionally oriented and not technology specific. This feature allows an architecture to remain in effect over time and not become obsolete as technology evolves. Applying this definition to ITS, the National ITS Architecture defines the inter-related systems that work together to deliver transportation services and the interconnections and information exchanges between these systems.

The National ITS Architecture is a general framework for planning, defining, and integrating ITS and is available as a resource for any region. The National ITS Architecture offers many advantages as the basis for creating a regional ITS architecture. A regional ITS architecture is a specific regional framework for ensuring institutional agreement and technical integration of the ITS projects in the region.

1.1 Project Background

The Inland Empire ITS Strategic Plan, developed in 1998, was a joint effort of the local transportation agencies to develop an approach for integration of regional ITS opportunities and projects. Since the development of that Plan, the Federal Highway Administration (FHWA) published a Rule (ITS Standards and Architecture) and Federal Transit Administration (FTA) published a companion Policy to implement Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21). This Rule/Policy seeks to foster regional integration by requiring that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and appropriate standards. "Conformance" is defined as using the National ITS Architecture to develop a regional ITS architecture tailored to address the local situation and ITS investment needs, and the subsequent adherence of ITS projects to the regional ITS architecture. The Inland Empire ITS Strategic Plan preceded the Rule/Policy and was, therefore, in need of modifications in order for the region to continue on a path to conformance.

In the Inland Empire, the City of Fontana had been proceeding with the design, development, and integration of an Advanced Transportation Management and Information System (ATMIS). The project was nearing completion when residual budget was identified. This budget would have been applied to

[*] The "Inland Empire" is the moniker for the Counties of Riverside and San Bernardino in California.

specific functionality tied to integration with the Southern California ITS Showcase Network (see Section 3.2.5 for a description of this project). Due to the state of suspension of the Showcase Project, integration was at risk for completion.

The City of Fontana offered, and the regional transportation planning agencies agreed, to apply a portion of the remaining ATMIS Project funds to the development of an Inland Empire Regional ITS Architecture. The consultant for the Fontana ATMIS Project, and, subsequently, for the Inland Empire Regional ITS Architecture, was Iteris, Inc.

Iteris, Inc. performed the work as authorized by the City of Fontana, the Federal Highway Administration (FHWA), the San Bernardino Associated Governments (SANBAG), the Riverside County Transportation Commission (RCTC), and the District 8 Offices of the California Department of Transportation (Caltrans D8). The official Notice to Proceed for this work was received and dated as of December 12, 2002, with a project completion date scheduled and achieved by June 30, 2003.

1.2 Project Advisory Committee

The project was conducted under the guidance and auspices of a Project Advisory Committee, comprised of participants from the regional planning organizations. **Table 1.2-1** presents the composition and role of the member agencies.

Table 1.2-1: Project Advisory Committee

Entity	Project Role	Responsibility	Main Contact/ Project Title
California Dept. of Transportation District 8	Project Manager and Project Advisory Committee Chair	Perform project management and consultant oversight. Provide leadership for Project Advisory Committee.	Bill Mosby Project Manager
Federal Highway Administration (FHWA)	Project Oversight and Project Advisory Committee Member	Provide overall project guidance. Participate on Project Advisory Committee.	Jesse Glazer Project Advisory Committee Member
San Bernardino Associated Governments (SANBAG)	Project Advisory Committee Member	Participate on Project Advisory Committee.	Michelle Kirkhoff Project Advisory Committee Member
Riverside County Transportation Commission (RCTC)	Project Advisory Committee Member	Participate on Project Advisory Committee.	Marilyn Williams Project Advisory Committee Member
City of Fontana	Contract Manager and Project Advisory Committee Member	Approve consultant invoices and manage contract terms. Participate on Project Advisory Committee.	Paul Balbach Contract Manager

1.3 Organization of Report

Each of the written deliverables for the Inland Empire Regional ITS Architecture Project was introduced to the Stakeholders as an individual Chapter of the overall project documentation set. This Report is a culmination of those chapters into one comprehensive document concerning the ITS Architecture development as well as other associated activities. After receiving Stakeholder comments on each Chapter, a disposition of comments was released detailing the individual comments and how they were dealt with in modifying the Chapter under review.

Following is a summary listing of the Chapters and Appendices that, in total, make up the complete documentation set for the Inland Empire Regional ITS Architecture Project. The use of acronyms was minimized in this report wherever possible, but please refer to Appendix A for assistance in this area.

- Chapter 1: Introduction
- Chapter 2: Regional Boundaries
- Chapter 3: ITS Inventory
- Chapter 4: ITS User Needs, Services, and Operational Concepts
- Chapter 5: Functional Requirements and Interface Definitions
- Chapter 6: Project Sequencing
- Chapter 7: Agency Agreements
- Chapter 8: Architecture Maintenance Plan
- Chapter 9: Relevant ITS Standards
- Chapter 10: Regional Perspectives
- Chapter 11: Miscellaneous/Future Updates
- Appendix A: List of Acronyms
- Appendix B: List of Stakeholders
- Appendix C: Inventory by Stakeholders
- Appendix D: Inventory by Architecture Entity
- Appendix E: ITS Needs Survey Form
- Appendix F: Interconnect Diagrams and Architecture Flow Diagrams
- Appendix G: Inland Empire ITS Projects
- Appendix H: Sample Agency Agreements
- Appendix I: Inland Empire ITS Standards

2.0 REGIONAL BOUNDARIES

Regional ITS architecture efforts begin with a focus on the boundaries of the study. The focus areas considered by the Inland Empire region concerned timing, locale, and Stakeholders.

2.1 Timeframe

According to the FHWA guidelines, the regional ITS architecture should look far enough into the future so that the efficient integration of ITS services can be guided over time. The Inland Empire ITS architecture planning horizon was chosen to be 10 years, which is long enough to include most of the system integration opportunities as anticipated by the regional Stakeholders.

2.2 Locale

The regional boundaries used for this project are contiguous with Riverside and San Bernardino Counties within the state of California, as noted in **Figure 2.2-1**. This geographic arrangement is typically referred to as the Inland Empire in Southern California. The locale also coincides with the geographic boundaries of the District 8 region of the California Department of Transportation (Caltrans).

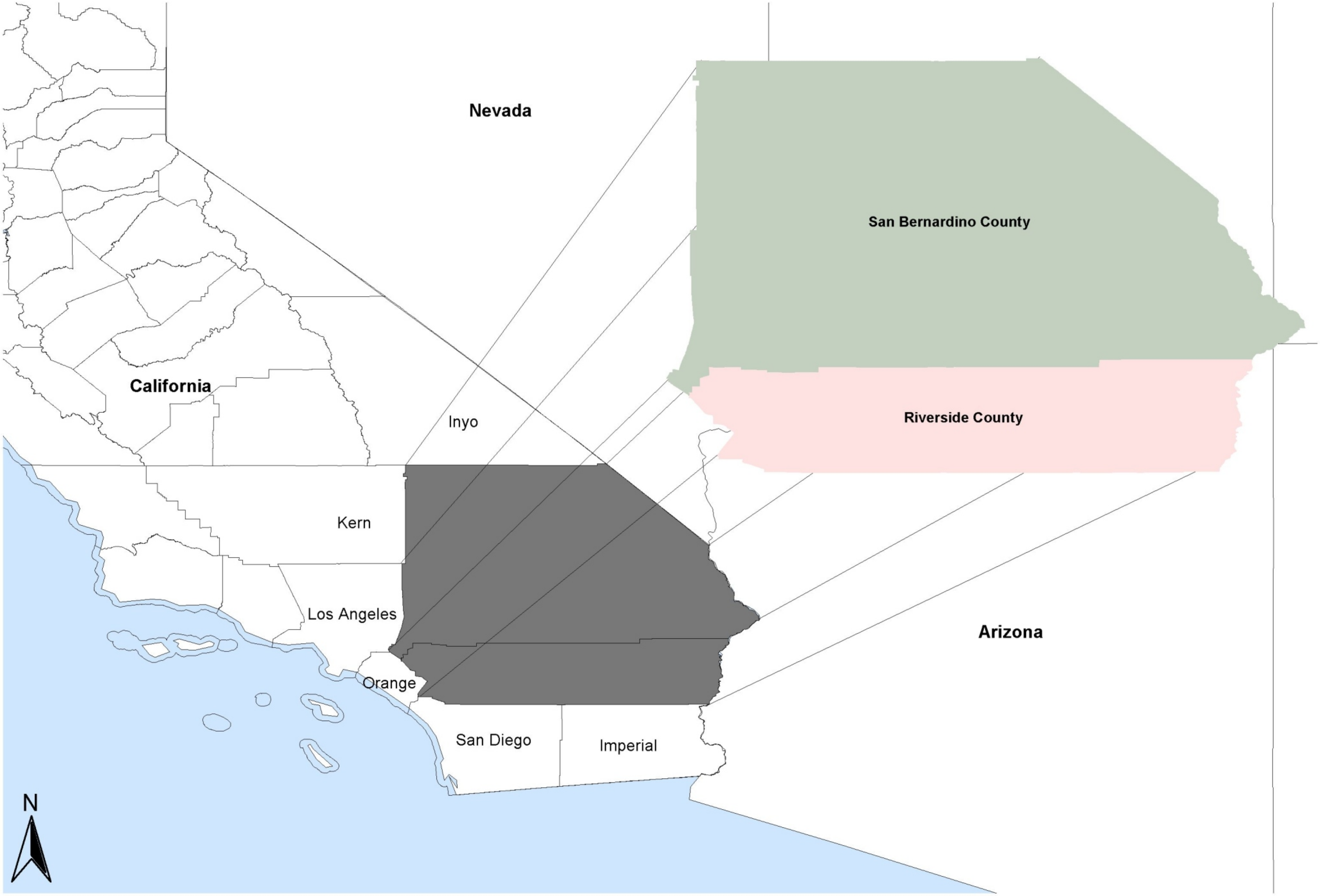
The Inland Empire is a very large and geographically diverse region, consisting of boundaries with two other states (Arizona and Nevada), with three other thriving urban counties (Los Angeles, Orange County, and San Diego), with two more rural counties (Kern and Inyo), and including 48 cities (as listed in **Table 2.2-1**).

Generally speaking, the western portion of both counties is the most populous and urbanized area of the Inland Empire Region. The San Bernardino and San Jacinto Mountains separate the western portions of the region from the desert areas. Within the mountains themselves are located a handful of small to medium sized communities. The areas north and east of the San Bernardino Mountains are commonly referred to as the high desert. East of the San Jacinto Mountains are the low desert areas known as the Coachella Valley and Morongo Basin. In the extreme eastern portion of the Region, on the California/Arizona border, there are two incorporated cities, Needles and Blythe. Much of the rest of the region north and east of Barstow and between the Coachella Valley and the Needles/Blythe area is characterized by vast rural desert and mountain geography. **Figure 2.2-2** maps the entire study area. Additional and more detailed maps of the region are presented in Chapter 3 during a discussion of ITS inventory.

Table 2.2-1: Incorporated Cities of the Inland Empire*

Western Riverside Area	Western San Bernardino Area	Eastern San Bernardino and Riverside Area	High Desert Area and Morongo Basin Area	Coachella Valley
Banning	Big Bear Lake	Blythe	Adelanto	Cathedral City
Beaumont	Chino	Needles	Apple Valley	Coachella
Calimesa	Chino Hills		Barstow	Desert Hot Springs
Canyon Lake	Colton		Hesperia	Indian Wells
Corona	Fontana		Victorville	Indio
Hemet	Grand Terrace		Twenty-Nine Palms	La Quinta
Lake Elsinore	Highland		Yucca Valley	Palm Desert
Moreno Valley	Loma Linda			Palm Springs
Murrieta	Montclair			Rancho Mirage
Norco	Ontario			
Perris	Rancho Cucamonga			
Riverside	Redlands			
San Jacinto	Rialto			
Temecula	San Bernardino			
	Upland			
	Yucaipa			

* There are many more communities contained within the counties, too numerous to identify.



ITERIS

Inland Empire ITS Architecture Project
Statewide Perspective

Figure 2.2-1

ITERIS

Inland Empire ITS Architecture Project
Project Study Area

Figure 2.2-2

2.3 Stakeholders

The success of a regional ITS architecture depends on participation by a diverse set of regional Stakeholders. In the context of this project, Stakeholders are defined as a core set of public agencies with transportation-related oversight, responsibility, and/or duties in the Inland Empire area. When it comes to transportation issues in the region, there are certainly numerous other entities, agencies, and concerned, affected groups that may have an interest in a project such as this. But, using Federal Highway Administration (FHWA) guidelines[*], it is often best to start with a core Stakeholder group and add participants over time.

Within the Inland Empire region, there are numerous transportation system Stakeholders, including cities, counties, the Riverside County Transportation Commission (RCTC), the San Bernardino Associated Governments (SANBAG), the California Department of Transportation (Caltrans), the California Highway Patrol (CHP), transit agencies, and other special purpose agencies. **Appendix B** is a listing of the Stakeholder agencies that were utilized during architecture development.

Early in the development of the Inland Empire Regional ITS Architecture, it became evident that certain Stakeholders had similar information and systems. Since every ITS element in the region is required to be maintained in the Regional ITS Architecture it became obvious that addressing these systems from a generic point of view, until such time as a Stakeholder becomes unique in the service it is providing the region, was the most efficient process. This general approach was utilized for the following systems:

- local city and county signal systems
- local police and sheriff department systems
- local and other fire department systems
- municipal and small transit agency systems

In addition to the identification of Stakeholders, the guidelines for applying the National ITS Architecture to a regional ITS architecture process recommend the identification of the regional architecture champion. The champion is one or more key persons leading the regional ITS architecture development, is also a Stakeholder, and is proactive in the field of ITS. The champion must understand the subject at hand, have knowledge of local ITS systems and projects, and have a vision for interconnectivity, partnership, and regional integration. The champion for this project is the Project Advisory Committee as previously identified in Section 1.2.

The participation of local Stakeholders was critical to the development of the Inland Empire ITS Architecture and the accompanying documentation. Input was specifically requested of and received from Stakeholders at all stages of architecture development. Many tools were used to facilitate communications, such as:

- Conducted five Project Workshops and Stakeholder Meetings to solicit project input. A summary of Stakeholder participation in workshops is presented in **Table 2.3-1**.
- Developed project flyers for further understanding of project and for ease of dissemination.

[*] "National ITS Architecture Guidance, Developing, Using, and Maintaining an ITS Architecture for Your Region", dated October 12, 2001

- Distributed draft deliverables for review and comment by Stakeholders by e-mail and fax. (approximately 20 emails were sent out to Stakeholders during the project notifying them of newly delivered work products, upcoming workshops, and general project updates; email distribution list for the project was 118 individuals, representing approximately 65 entities)
- Made project presentations at RCTC and SANBAG Transportation Technical Advisory Committee (TAC) meetings, which included city and county staff.
- Hosted a project web site at www.iteris.com/inlandempire-its to disseminate project information. The project website was updated approximately 20 times with the following items:
  - preliminary "Save The Date" meeting information
  - workshop agendas and location information
  - other meeting material and handouts
  - newly delivered work products
  - deadline information regarding Stakeholder comment submittal

Table 2.3-1: Workshop Participation

	Total Attendees	**Cities/ Counties**	**Transit Agencies**	**Caltrans**	**County Commissions and SCAG**	**Public Safety**	**FHWA**	**Other**
Workshop #1, 2/5/03 County of Riverside	26	9	6	4	4	2		1
Workshop #2, 3/4/03 Caltrans District 8	15	5	3	4	2	1		
Workshop #3, 4/8/03 County of Riverside	9	4	1	2	2			
Workshop #4, 5/7/03 Fontana City Hall	25	15	1	3	5		1	
Workshop #5, 6/10/03 Caltrans District 8	19	6	4	4	4		1	

3.0 ITS INVENTORY

As defined in the FHWA Rule, and for purposes of this report, an ITS inventory is a list of ITS elements and the elements that interface with them. An element is then defined as the name used by Stakeholders to describe an ITS system or piece of a system. Thus, the focus of this section is on identifying Intelligent Transportation Systems and their related elements, both existing and planned, within the Inland Empire. In association with the ITS inventory, it is important to identify the ITS owners and/or operators, the presence of operation centers, and the connections (communication links and data flows) internally between various system elements and externally to other systems. Identifying technological aspects of the ITS inventory is not necessary; rather, assessing the function and capabilities of the various systems is vital. Furthermore, the total number of various ITS elements (such as signals, CCTV cameras, busses with automatic vehicle locators, etc.) that exist, and the location of all these elements, is not critical with respect to developing a Regional ITS Architecture.

The participation of local Stakeholders was critical to the development of the Inland Empire ITS Architecture and the accompanying documentation. Their input was specifically requested at many different stages of the project and, most important to this Chapter, to develop the ITS inventory. **Appendix C** is a listing of the Project Stakeholder Agencies and their ITS elements, whereas **Appendix D** offers the same information sorted by architecture entity. These lists were updated and modified periodically throughout the life of the project.

3.1 Methodology

The methodology used to compile an ITS inventory for the Inland Empire consisted of distributing a survey to appropriate Stakeholders, making phone calls, conducting a workshop, and reviewing documents that provided additional information concerning existing ITS elements in the region. The survey used to develop the ITS inventory for the Inland Empire was sent to Caltrans, SANBAG, RCTC, and SCAG; whereas, modified versions (created by removing irrelevant portions of the general survey) were sent to the Cities, Counties, Transit Agencies and other implementing agencies throughout the Inland Empire. Telephone calls were made approximately one to two weeks after sending out the survey in order to supplement the information obtained from the survey.

The importance of compiling an ITS inventory in developing a Regional ITS Architecture was explained during a workshop conducted for the Stakeholders. During the course of this workshop another effort was made to solicit ITS inventory information from the Stakeholders that attended. Finally, the following documents provided additional information about ITS inventory within the Inland Empire:

- *Intelligent Transportation Systems Strategic Plan for the Inland Empire*, 1998
- *Corridor-wide ATIS and ATMS Inventory, Compliance And Deployment* documents for the Southern California ITS Priority Corridor, dated September 6, 2001
- *San Bernardino Valley Coordinated Traffic Signal System Plan, Final Report*, dated October, 2000

3.2 Inland Empire ITS Inventory

3.2.1 Overview

As indicated in Chapter 2 of this Report, the Inland Empire is a very large, geographically diverse area. Not surprisingly, the extent of ITS within this region is directly related to the level of urbanization that has occurred. The State of California owns and operates some fairly advanced systems and is currently planning upgrades so that the State Transportation Management Center (TMC) in this region will have capabilities similar to those that are found in much larger urban areas, such as in Los Angeles and Orange Counties. Although the State has ITS infrastructure throughout the Inland Empire, a significant majority resides in the urbanized areas of western Riverside and San Bernardino Counties. The metropolitan planning organization (SCAG) and the county transportation commissions (SANBAG, and RCTC) in the Inland Empire own and/or operate relatively few ITS assets, but they do play, and have played, a significant role in planning and programming ITS. Likewise, other than operating a small number of traffic signals in the unincorporated areas of the respective counties, and coordinating signal timing with local agencies, Riverside and San Bernardino Counties are not directly operating ITS.

The ITS capabilities of cities varies widely throughout the Inland Empire. Some small cities/towns do not operate traffic signals located in their jurisdiction, such as Big Bear Lake and Adelanto, where all of the traffic signals are operated by the State. On the other hand, the City of Fontana has recently deployed an advanced traffic management system, which includes the ability to monitor, operate and control traffic signals and CCTV cameras, determine traffic counts and speeds, and change signal timing plans based on real-time traffic conditions – all from a central location. A significant number of other cities currently have, or plan to have, the ability to monitor and operate traffic signals from a central location. Corona and Temecula are planning on upgrading their systems so that they have capabilities similar to those in Fontana. As a general rule, many cities within metropolitan areas have plans to coordinate and centrally control their traffic signal systems as part of an on-going congestion and traffic management strategy.

Transit service providers in the Inland Empire are as varied as the geographic areas that they serve. In the Inland Empire Region there are two relatively large bus transit operators (Omnitrans and Riverside Transit Agency (RTA)), a medium size bus transit operator (SunLine) and a handful of small bus transit operators. Omnitrans operates primarily in the San Bernardino Valley area, RTA operates primarily in the western Riverside area and SunLine operates primarily in the Coachella Valley area. Most of the smaller bus transit operators are "municipal" operators that operate as a transit department of a city and serve primarily within their own city limits. The remaining bus transit operators are small joint powers agencies made up of a single city and/or the County and operate very much like the municipal operators. Metrolink provides commuter rail transit between the Inland Empire and Los Angeles and Orange Counties. This is a significant, fast growing and important service for Inland Empire commuters traveling to and from Los Angeles and Orange Counties.

As a general rule, transit management systems have not been considered to be as mature as other forms of traffic management systems. However, this perception is fast changing. With more widespread deployment and increasing interest by transit agencies in deploying technology to better manage field assets, the field is rapidly maturing. Furthermore, many agencies are looking for ways to better integrate traffic systems and transit systems to more effectively and efficiently share information with one another.

The existing intelligent transportation systems within the Inland Empire appear to map to the following National ITS Architecture Subsystem categories:

- *Centers: Traffic Management, Emergency Management, Commercial Vehicle Administration, Maintenance and Construction Management, Information Service Provider, Transit Management, and Archived Data Management*
- *Roadside: Roadway, Parking Management, and Commercial Vehicle Check*
- *Vehicles: Emergency Vehicle, Commercial Vehicle, Transit Vehicle, and Maintenance and Construction Vehicle*
- *Travelers: Personal Information Access*

More detailed information about regional systems, city systems, and transit systems are provided in the following sections.

3.2.2 Regional Systems

The State of California (i.e. Caltrans and the California Highway Patrol (CHP)) is the primary owner/operator of regional intelligent transportation systems (ITS) within the Inland Empire; however, SANBAG, RCTC, SCAG, San Bernardino County, and Riverside County are also involved with some regional systems. The Caltrans District 8 region coincides with the two-county, Inland Empire region. **Tables 3.2.2-1 and 3.2.2-2** provide a listing of regional systems along with a brief description of the systems.

Table 3.2.2-1: Regional ITS Owned/Operated by Caltrans or CHP

System	Description
Freeway Management Systems • Traffic Management Center (TMC) • Advanced Traffic Management System (ATMS) • Vehicle Detection Systems • Closed Circuit Television (CCTV) Surveillance • Environmental Sensor Stations (also known as road weather information systems (RWIS)) • Changeable Message Signs (CMS) • Highway Advisory Radio (HAR) • Ramp Metering System • High Occupancy Vehicle (HOV) Lanes	Caltrans and CHP jointly operate a TMC located in San Bernardino. With the use of ATMS computer software and hardware, Caltrans receives, and is able to view, real-time traffic data and information from vehicle detection systems (inductive loops and radar detectors) and CCTV systems. In addition, the ATMS provides control of CCTV and CMS field elements. The TMC also receives information from environmental sensors stations located on highways in the mountainous and desert regions. Caltrans provides roadway/traffic advisories using CMS and HAR. Caltrans also manages and operates a ramp metering system and HOV lanes as part of the freeway management system. The vast majority of ITS field elements are located in the urbanized Western Riverside/San Bernardino area; however there are some CMS and environmental sensor stations located in other areas of the Inland Empire.

System	Description
Arterial Traffic Management • Traffic Signals • Real-Time Traffic Adaptive Control of Ramp-Metering Signals (planned) • Signal Preemption for Emergency Vehicles (planned) • Signal Priority for Transit Vehicles (planned) • Highway-Rail Signal Coordination • Data Shared with other Traffic Management Centers (planned)	Caltrans owns and operates traffic signals throughout the Inland Empire. The majority of traffic signals are operated as isolated intersections or small coordinated systems. Coordinated systems are often operated by, local agency traffic signal systems. Some system upgrades are currently planned that will allow real-time adaptive control of ramp-metering signals based on traffic conditions, signal preemption for emergency vehicles, and signal priority for transit vehicles. Traffic signals located near highway-rail intersections are interconnected with active crossing devices so that the signal timing is automatically adjusted to avoid vehicle entrapment. There are currently plans to enable sharing traffic data with City TMCs and other State TMCs, particularly CCTV images, congestion data, and incident or event data.
Emergency Management • CHP CAD System • Incident Response System • Incident Detection System (planned) • Portable Traffic Control • Freeway Service Patrol	CHP operates a computer aided dispatch (CAD) system that facilitates emergency response to incidents on state highways by law enforcement, fire departments, and ambulance operators. CHP also manages the Freeway Service Patrol (administered by SANBAG and RCTC), which assists drivers experiencing problems with their vehicles and clears vehicles from the highway that were involved in an accident. Caltrans can monitor incidents, and the related impact on traffic, with CCTV cameras and vehicle detectors. Based on the nature of the incident, Caltrans can dispatch the Traffic Management Team to provide portable traffic control and monitor the incident in the field as it is being cleared.
Regional Traveler Information	In addition to providing traffic/roadway information to travelers using CMS and HAR, Caltrans and CHP provide information to the media and to the public via an internet web page containing traffic speeds, incident data, planned roadway construction or maintenance, and roadway/weather conditions.
Archive Data Systems	The Caltrans ATMS archives vehicle speed and traffic count data that is provided by the vehicle detection system. The CHP CAD system also archives data related to highway incidents and emergency response.
Commercial Vehicle Operations (CVO)	Public sector systems for managing ITS/CVO are typically undertaken at a statewide level. One of the primary CVO/ITS efforts currently underway in California is the deployment of a suite of systems and capabilities that make up the Commercial Vehicle Information Systems & Networks (CVISN). CVISN is a national program administered by the Federal Motor Carrier Safety Administration (FMCSA). CVISN Level 1 focuses on using technology in the areas of Safety Information Exchange, Credentials Administration and Electronic Screening. PrePass is a private company that implements an automated vehicle identification (AVI) technology on trucks and works with weigh-in-motion technologies at weigh stations to verify compliance of credentials and safety regulations. If a commercial vehicle operator is given a “bypass” signal, that vehicle is allowed to bypass the weigh station without stopping. This is seen as a great operating efficiency for most commercial vehicle operators. There are three functioning PrePass sites in the Inland Empire, with others operating in close proximity to the borders of the Inland Empire.

There are plans to build a new Caltrans/CHP Traffic Management Center (TMC) in Fontana within the next three to five years. The new TMC building will be designed to meet seismic standards that will allow the TMC to operate as an emergency operating center. Currently, CHP dispatching activities for the Inland Empire are operated by four CHP Communications Centers located in San Bernardino, Barstow, Indio and San Diego. There is no current CHP dispatching co-location with Caltrans, at the interim TMC. It is anticipated that when construction of the new TMC is complete, some of the CHP dispatching personnel from the above-mentioned CHP communication centers will be located at the TMC. In addition to housing all of the pertinent CHP and Caltrans personnel at one location, the new TMC will be staffed 24 hours per day, every day of the week, rather than the current hours of 5:00 a.m. to 8:00 p.m., Monday through Friday. The ITS elements located in, or operated from, the new TMC will be consistent with those described in the above table.

Table 3.2.2-2: Regional ITS Owned/Operated by Local Agencies

System	Owner/Operator	Description
Call Box Program	RCTC in Riverside County and SANBAG in San Bernardino County	Call boxes are located along freeways throughout the Inland Empire for motorists to use as appropriate. Calls are answered by a private call-answering center. Emergency calls are routed to one of four CHP communication centers for appropriate action. Non-emergency calls are routed to either an emergency road service company, family member, or friends for further assistance (CHP is advised of calls through a remote message to the appropriate communications center).
Smart Call Boxes	RCTC and SANBAG	A vehicle detection system is connected to some call boxes, which transmit traffic data (speed and traffic counts) to the Caltrans TMC. This augments the existing vehicle detection system that Caltrans owns and operates as described in Table 1.4.2-1.
Freeway Service Patrol (FSP)	RCTC (existing) and SANBAG (planned)	RCTC and SANBAG administer the FSP program in the Inland Empire, in cooperation with the Caltrans and CHP. Caltrans and the Counties provide funding for FSP and CHP handles day to day operations, including supervision of the tow trucks.
Traffic Signal Systems	Riverside and San Bernardino Counties	Both counties own and operate some traffic signals on county roadways within the Inland Empire. The majority of traffic signals are coordinated with, and often operated by, local agency traffic signal systems.
Advanced Traveler Information Systems	Various public and private sector entities	A handful of public and private sector entities provide traveler information (roadway congestion, incidents, closures, etc.) via Internet websites and other media outlets for the Southern California area, which includes the Inland Empire.
Archived Data User Service (ADUS)	SCAG	Various transportation and transit data is collected and archived by SCAG to satisfy various federal and state performance monitoring and data reporting requirements for the Region.

3.2.3 City Systems

Intelligent transportation systems owned and operated by cities in the Inland Empire are summarized in **Tables 3.2.3-1 through 3.2.3-4**. The geographic locations of the cities, along with the location of traffic management centers, are illustrated in **Figures 3.2.3-1 through 3.2.3-4**. A brief description of each system referred to in the tables is provided below.

Traffic Signal System – Any traffic signal system operated by the city. In some cases, such as Big Bear Lake and Adelanto, traffic signals are present within the city limits but they are owned and operated by the State.

Vehicle Detection System – Most traffic signal systems are linked to vehicle detectors consisting of inductor loops or video imaging processors. In most cases these vehicle detectors have the capability to count vehicles and determine speeds; however, they are generally not used in this matter unless a city has implemented an advanced traffic management system.

Emergency Vehicle Traffic Signal Preemption – Provides the ability for emergency vehicles to change a red light to green as they approach an intersection.

Signal Priority for Transit Vehicles – Signal timing is adjusted based on location of transit vehicle in order to reduce signalization delays.

Changeable Message Signs (CMS) – Electronic display devices located along the roadside that can display text messages to en-route travelers. These are generally operated from a traffic management center (TMC). [Changeable Message Sign, or CMS, are standard conventions used by Caltrans in California. CMS are also known by various other names around the country, primarily Variable Message Sign (VMS) and Dynamic Message Sign (DMS).]

Closed Circuit Television (CCTV) Roadway Surveillance – CCTV cameras mounted along the roadside to send images of traffic conditions to a TMC, which is where the cameras are operated, monitored, and controlled.

Advanced Traveler Information Systems (ATIS) – Provide real-time traffic/traveler information to the public via a range of communication techniques, such as broadcast radio, the internet, or cable TV.

Transportation Management Center (TMC) – Sometimes referred to as a traffic management center, or in some cases a traffic operations center (TOC) broadly defined to include any center that has the capability to monitor, operate, or control a field device, such as a traffic signal or CCTV camera.

Advanced Traffic Management System (ATMS) - The application of ATMS is generally considered one of the more robust areas of ITS design and deployment, as it is very mature in terms of both number of system elements and their characteristics. For purposes of this inventory, ATMS is an integrated area-wide system, which includes the ability to control and coordinate traffic signals, perform roadway surveillance, and automatically (or prompt operator to) adjust signal timing plans based on real-time traffic conditions. ATMS may also include data/video/control sharing among more than one agency.

Advanced Rail/Roadway Intersection Technologies – Any system or element that does more than provide basic control of traffic at rail crossings. This could include modifying signal timing plans, video surveillance, electronic surveillance other than video, electronic traffic violator devices, etc.

Incident Response System – A system that notifies appropriate traffic management and emergency response personnel when an incident is detected.

Incident Detection System – An advanced vehicle detection and/or roadway surveillance system that has the ability to identify the location of a probable incident and provide an appropriate warning to the system operator.

The San Bernardino Valley Coordinated Traffic Signal System Plan, prepared in October 2000, for SANBAG and its member agencies provided a roadmap to interconnect and coordinate approximately 1,200 signals on regionally significant arterials in the San Bernardino Valley. Of the four-tiered coordinated signal system plan, SANBAG is proceeding with implementation of Tiers 1 and 2. The Tier-1 project, with 290 signalized intersections, is currently under design and will be implemented in early 2004. Work on the Tier-2 project, with approximately 300 signals, is expected to begin in Summer 2003.

The Tier 1 and 2 projects together form one of the largest on-going deployments of ITS elements in the Inland Empire. The goal of the project is to coordinate signals so as to minimize stops and delays to motorists. The project relies on using existing interconnect, where available, and adding hardwire, spread spectrum or telephone interconnect for the missing links. The project provides for limited new communications, as the funding emphasis is to achieve signal coordination at minimum cost.

SANBAG will monitor the coordination of project traffic signals by expanding existing central systems, such as, QuicNet, Econolite ARIES, or Naztec systems, employed by many of the agencies in the project area. For instance, the expanded QuicNet signal system for Model 170 controllers will integrate interconnected signals from Caltrans District 8, Colton, Highland, Loma Linda, Montclair, City of San Bernardino, Upland and the County of San Bernardino. This system alone would comprise several hundred signals in the valley.

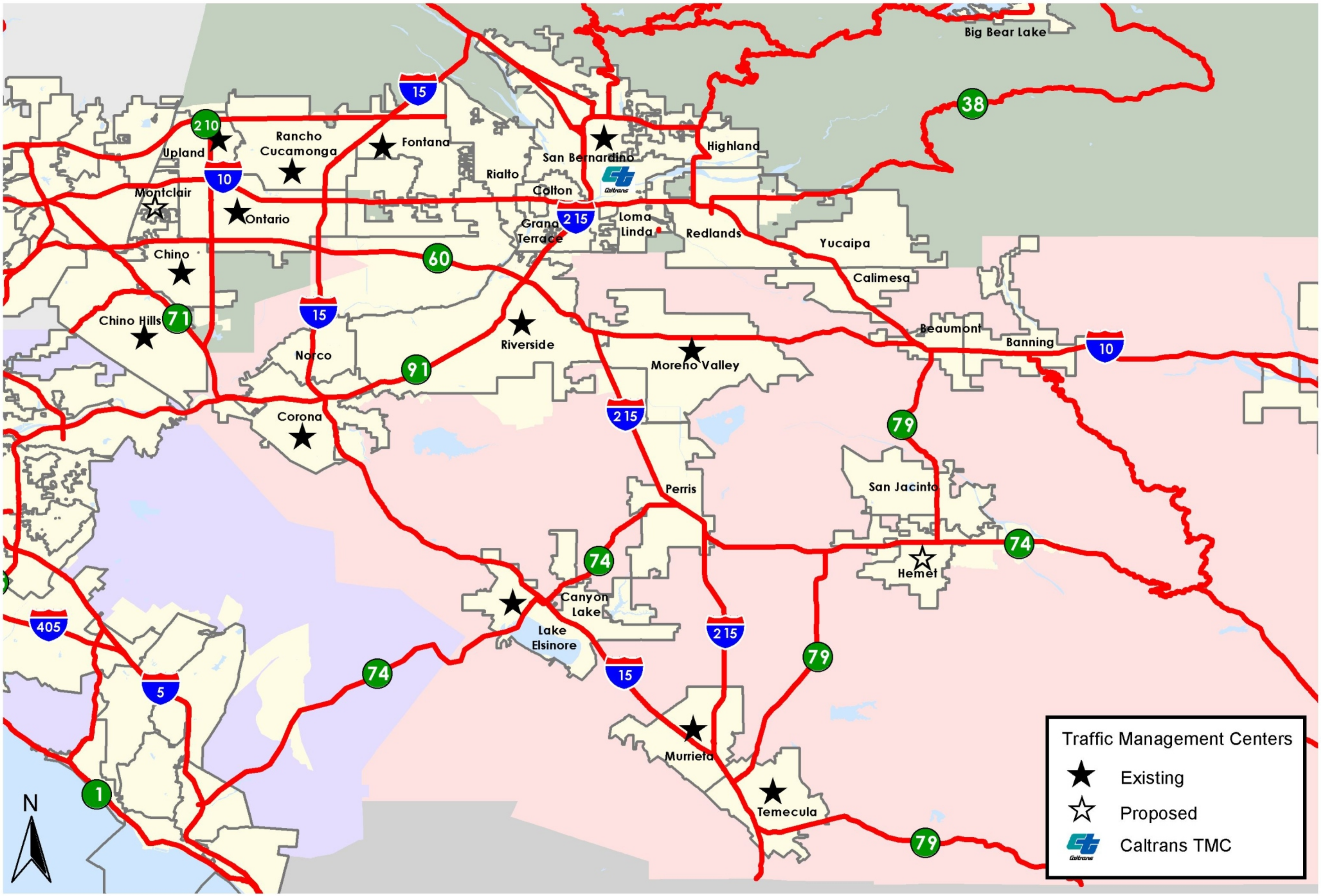
Future associated work includes:

- Implementation of Tiers 3 and 4 of the coordinated system plan.
- Continued monitoring of coordinated traffic signals.
- Replace/upgrade valleywide communications systems to enhance signal monitoring and support other ITS elements.
- Replace the multiple control systems with one or two new systems capable of controlling the multitude of different controller types.
- Gradually convert all controllers to a uniform type for more efficient monitoring, maintenance and control.
- Implementation of a small number of local agency traffic operations centers (TOCs).
- Periodically (every 2-3 years) completely retime the system(s) to account for area growth and general traffic redistribution due to freeway upgrades and/or transit expansion.

Table 3.2.3-1: ITS Inventory for Cities in the Western Riverside and San Bernardino Valley Area

	Traffic Signal System	Vehicle Detection System	Emer. Veh. Traf. Signal Preemption	Signal Priority for Transit Vehicles	Changeable Message Signs	CCTV Roadway Surveillance	Advanced Traveler Info. System	Traffic Management Center	Advanced Traffic Management Sys.	Adv. Rail/Road Intersection Tech.	Incident Response System	Incident Detection System
Banning	E	E										
Beaumont	E	E										
Big Bear Lake	No ITS											
Calimesa	E	E										
Canyon Lake	E	E										
Chino	E	E						E				
Chino Hills	E	E						E				
Colton	E											
Corona	E	E	E		P	P	P	E	P	P		
Fontana	E	E	E	E		E	E	E	E	E		
Grand Terrace		E	P									
Hemet	E	E	E					P	P			
Highland	E	E										
Lake Elsinore	E	E						E				
Loma Linda	E	E										
Montclair	E	E	E					P				
Moreno Valley	E	E	E					E				
Murrieta	E	E	E					E				
Norco	E	E										
Ontario	E	E	E					E				
Perris	E	E										
Rancho Cucamonga	E	E				P		E				
Redlands	E	E										
Rialto	E	E	E						P			
Riverside	E	E	E					E		E		
San Bernardino	E	E	E					E				
San Jacinto		E										
Temecula	E	E	E		P	P	P	E	P		P	P
Upland	E	E	E					E	E			
Yucaipa	E	E										

Note: 'E' and 'P' indicate Existing and Planned systems, respectively.



ITERIS

Inland Empire ITS Architecture Project
Western Riverside and San Bernardino Valley Areas

Figure 3.2.3-1

Table 3.2.3-2: ITS Inventory for Cities in the Coachella Valley Area

	Traffic Signal System	Vehicle Detection System	Emer. Veh. Traf. Signal Preemption	Traffic Management Center	Advanced Traffic Management Sys.
Cathedral City	E	E	E	P	
Coachella	E	E	E		
Desert Hot Springs	E	E			
Indian Wells	E				
Indio	E	E	E		
La Quinta	E	E	E		
Palm Desert	E	E	E	E	P
Palm Springs	E	E	E	E	
Rancho Mirage	E	E	E		

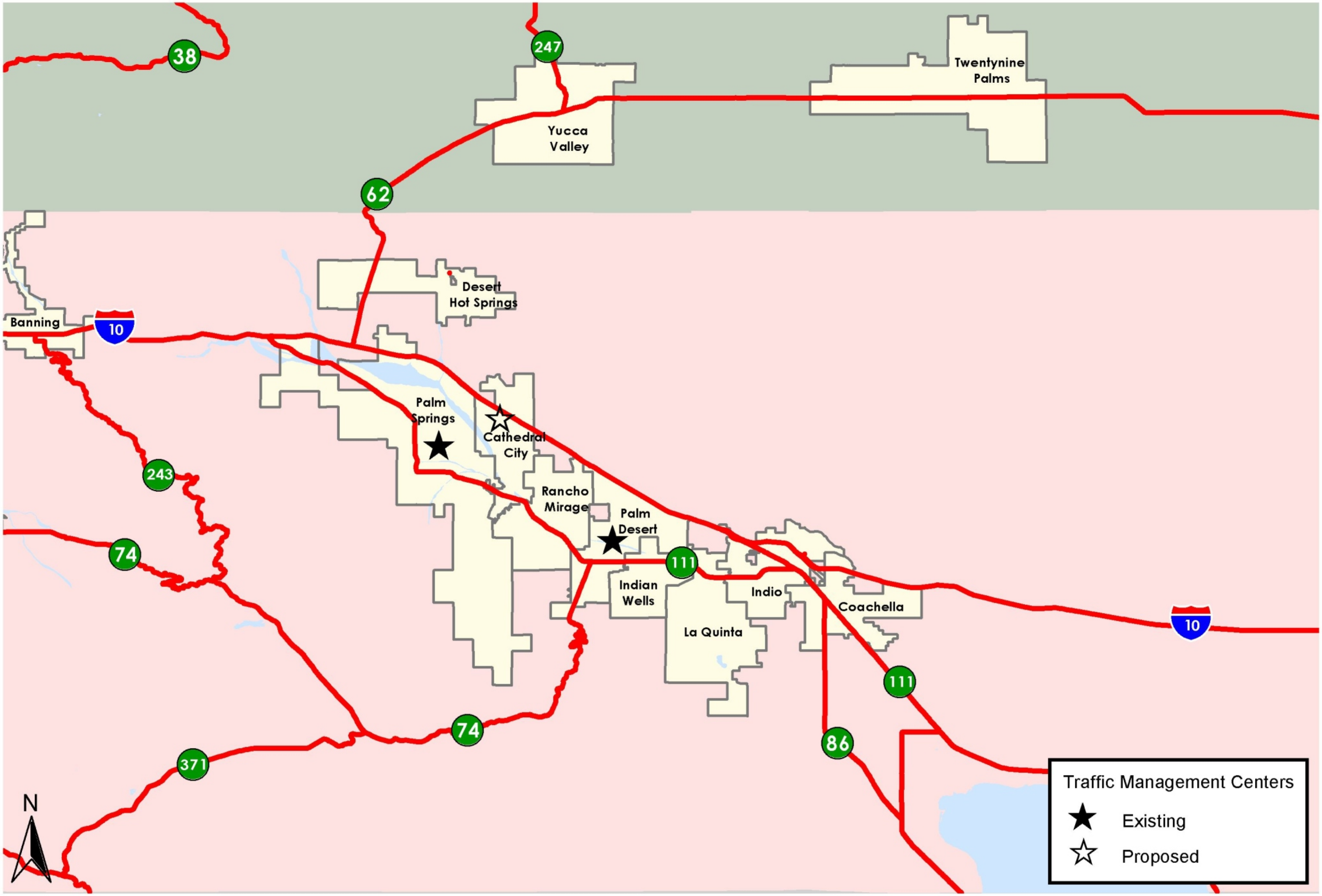
Note: ‘E’ and ‘P’ indicate Existing and Planned systems, respectively.

Table 3.2.3-3: ITS Inventory for Cities in the High Desert Area

(Including the Morongo Basin Area)

	Traffic Signal System	Vehicle Detection System	Emer. Veh. Traf. Signal Preemption	Traffic Management Center	Advanced Traffic Management Sys.
Adelanto	No ITS				
Apple Valley	E	E			
Barstow	E	E	E		
Hesperia	E	E	E	E	
Victorville	E	E	E	E	
Twenty-Nine Palms	E	E			
Yucca Valley	E	E			

Note: ‘E’ and ‘P’ indicate Existing and Planned systems, respectively.



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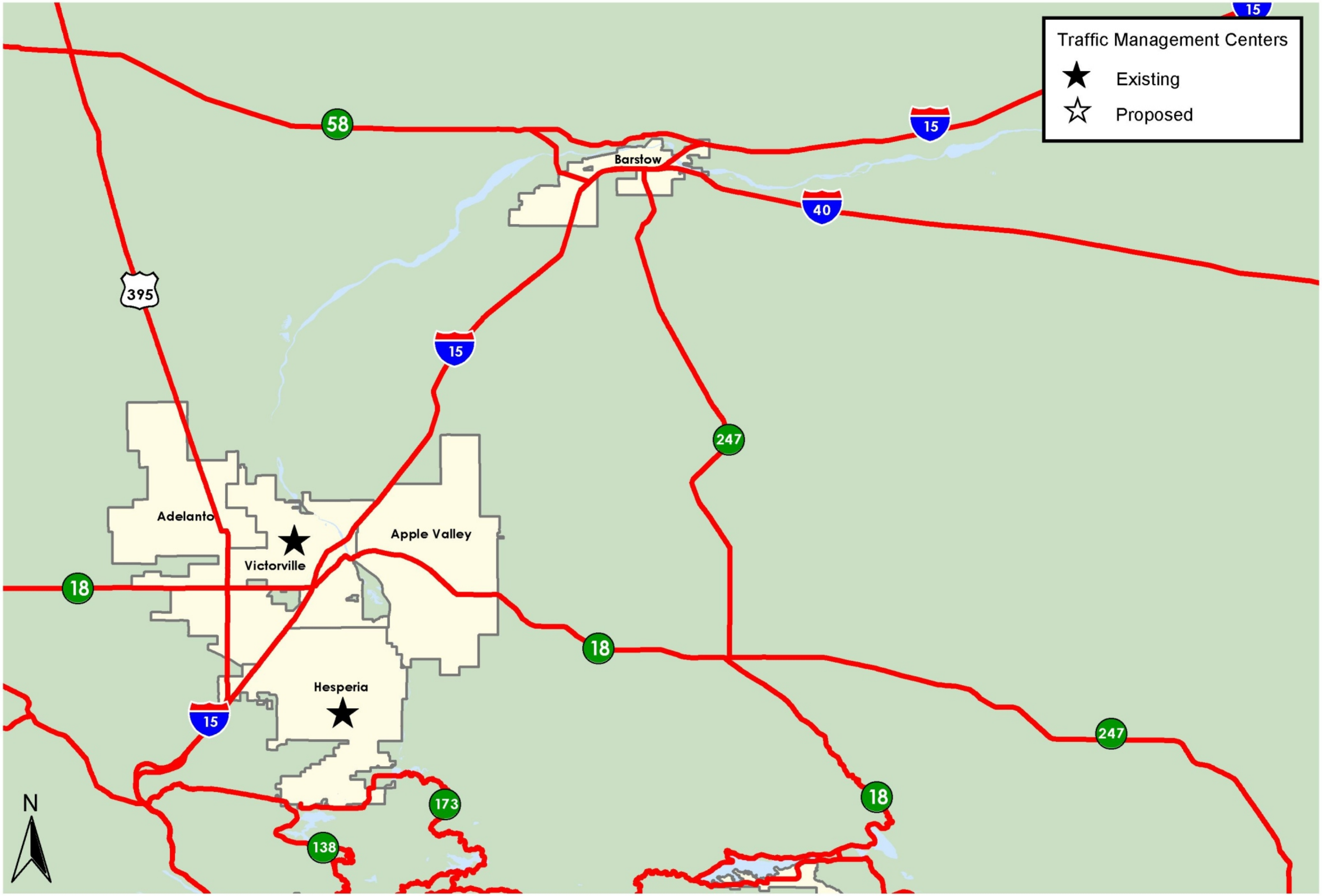
Inland Empire ITS Architecture Project
Coachella Valley and Morongo Basin Areas

Figure 3.2.3-2



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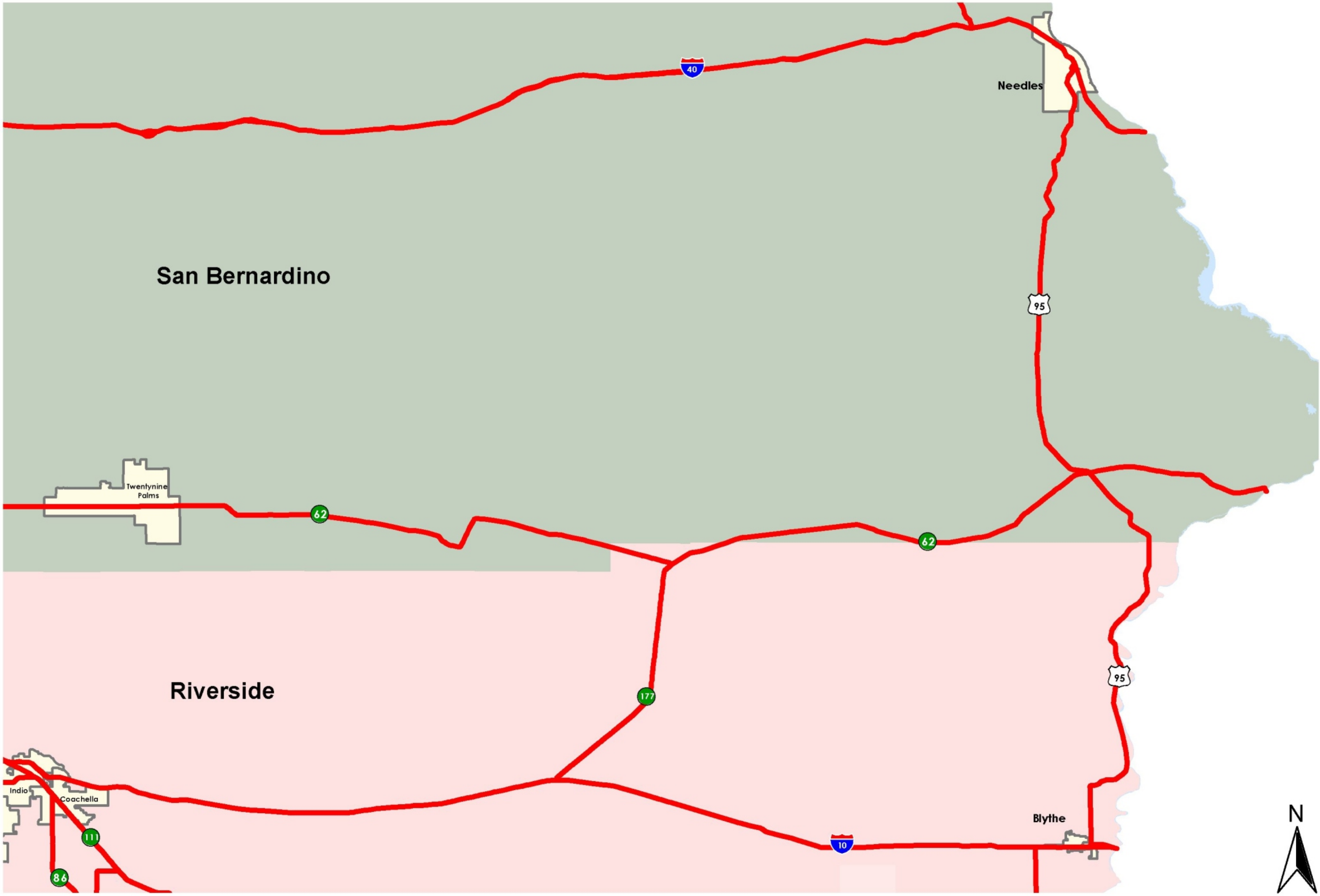
Inland Empire ITS Architecture Project
High Desert Area

Figure 3.2.3-3

Table 3.2.3-4: ITS Inventory for Cities in the Eastern Inland Empire Area

	Traffic Signal System	Vehicle Detection System	Emer. Veh. Traf. Signal Preemption	Traffic Management Center	Advanced Traffic Management Sys.
Blythe	E	E	P		
Needles	E	E			



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Inland Empire ITS Architecture Project
Eastern Riverside and San Bernardino Area

Figure 3.2.3-4

3.2.4 Transit Systems

Transit agencies use various technologies to better manage their assets in the field and to provide enhanced customer service and traveler information. Following is a summary of common transit ITS technologies that are in use in the Region and about which the transit agencies were asked in the survey process.

Automated Vehicle Location (AVL) systems: - These are systems that typically allow a dispatcher to view vehicle location in real time or near real time. Occasionally, an AVL system is deployed that does not report in real time but uploads an entire day's worth of location information at the end of the day for later viewing and/or analysis. The most common vehicle location technologies utilize global positioning system (GPS) technology, coupled with a wireless data communications medium to transmit the location data back to the dispatch center.

En-route Transit Traveler Information systems: - These are systems that disseminate transit traveler information in real time (or near real time) to users of the transit system. This information is usually disseminated at bus stops, transfer centers, train stations and other major activity centers with transit activity. The information may include such elements as vehicle location and status and next bus/train arrival times. An operational AVL system is usually essential to the function of capability.

Pre-trip Transit Traveler Information systems: - Pre-trip transit traveler information has traditionally been disseminated via telephone, by customer service operators. Transit customers would typically tell the operator the beginning and ending points of their desired trip and the operator would give a travel itinerary. The advent of the Internet has provided another dissemination channel for this type of traveler information. Standard information typically provided includes static schedule and route information and helpful hints and rules for using the transit system. More sophisticated transit traveler information Internet websites now allow a user to enter the starting and ending points of their trip and an itinerary is automatically generated.

In-vehicle Monitoring systems: - In-vehicle monitoring systems refer to two separate and distinct functions. One function is the monitoring of mechanical systems, including: engine and transmission, cooling systems, heating and air conditioning systems, hydraulics and air controlled systems (most commonly, brakes). For monitoring mechanical systems the data is most typically saved on board the vehicle and retrieved at the end of the day by maintenance and material management systems and analyzed by maintenance personnel. Metrics that indicate potential mechanical malfunctions or failures are flagged for follow-up inspection and servicing. Some transit agencies are now deploying monitoring systems that detect potential mechanical systems problems and notifying the driver, dispatcher and maintenance personnel in real time to reduce the risk of catastrophic mechanical failures in the field.

The other function of in-vehicle monitoring is safety and security. Similar to the mechanical systems monitoring, safety and security monitoring data and information is most typically retrieved at the end of the workday. However, with the advent of new broadband wireless data systems, safety and security system data such as audio and video can now be transmitted in real time to give emergency responders more information regarding the nature of an emergency before arrival on the scene. For some systems the default is for data to be retrieved at the end of the workday unless there is an emergency. If the vehicle operator can safely trigger an alarm, then the vehicle can be monitored in real time as needed.

Electronic Fare Payment systems: - The most basic fare payment systems for transit are simple “gravity fed” fare boxes, where a fare is deposited into a farebox and upon verification that the fare is correct, it then drops into a lock box located below the fare box. Advances in fare collection include electronic fare boxes that accept paper currency and can compare operator inputs to determine if the correct fare has been inserted. Most of the new fareboxes now include an “expansion slot” to allow the addition of a fare card reader.

In performing the inventory, most of the transit operators mentioned that they were aware of a Smart Card project currently underway, led by Caltrans. Most of those properties mentioned that they are interested in the outcome but were unsure at this time of how they would participate, if at all.

Data/Information Sharing With Other Centers: - Many transit agencies see value in sharing operational and vehicle status data with other entities such as emergency responders and traffic management centers. The most common information a transit property would share with another agency is transit vehicle location data. A valuable bit of information a transit operator could receive in return is traffic condition information. This would allow the transit operator to better manage vehicles in the field based on real time traffic conditions.

Table 3.2.4-1: ITS Inventory for Transit Operators in the Inland Empire

	Automated Vehicle Location (AVL) System	En-route Transit Traveler Information	Pre-trip Transit Traveler Information	In-vehicle Security/Monitoring Systems	Electronic Fare Payment System	Data/Information Sharing With Another Center
Banning – Transit	P		P	E		
Barstow Area Transit (BAT)						
Beaumont – Transit	P		E			
Corona Cruiser and Dial-a-Ride (City of Corona)	P	P	E			P
Morongo Basin Transit Authority (MBTA)	P		P			
Mountain Area Regional Transit Authority (MARTA)			P			
Needles Area Transit (NAT)						

	Automated Vehicle Location (AVL) System	En-route Transit Traveler Information	Pre-trip Transit Traveler Information	In-vehicle Security/Monitoring Systems	Electronic Fare Payment System	Data/Information Sharing With Another Center
Omnitrans	P	P	E	E	E	P
Palo Verde Valley Transit Agency						
Riverside Special Services (City of Riverside)	E		E	P		
Riverside Transit Agency (RTA)	P	P	E	E	E	P
Southern California Regional Rail Authority (Metrolink)	P	P	E		E	
SunLine Transit Agency	P	P	E	P	E	P
Victor Valley Transit Authority (VVTA)	P		E	E	E	

Note: 'E' and 'P' indicate Existing and Planned systems, respectively.

3.2.5 Other Systems

When considering other potential influences on the Inland Empire Regional ITS Architecture, it is important to make note of system inventories beyond the borders of the Inland Empire or beyond the boundaries of ITS. Some of the most notable items to be considered include:

- Southern California Priority ITS Corridor Showcase Project
- MTA's Transit Trip Planning database and software
- RidePro Regional Rideshare database and software (ridematching information)
- Adjoining ITS Architectures

Each of these items is described below.

The Southern California Priority ITS Corridor Showcase Project was conceived as an integrated system of systems providing transportation management and traveler information services within the geographic region that includes most of Southern California, including the Inland Empire. The Showcase Project developed an ITS architecture and a physical network that was planned to support integration of a series of regional ITS projects across jurisdictional boundaries. For a variety of reasons, the current status of the Showcase Project can be considered dormant, with the result that the intended over-arching nature of Showcase has been shifted to each Southern California region to proceed as they see fit in creating a sub-regional ITS architecture. The Inland Empire ITS Architecture effort will incorporate and/or recognize future decisions relating to Showcase as well as efforts by the regional Metropolitan Planning Organization (MPO), SCAG, to compile the Southern California sub-regional ITS architectures.

Transit trip planning systems allow the retrieval of transit itineraries for travel in Southern California, and include all bus, rail and Amtrak schedules for the Inland Empire, as well as Los Angeles, Orange and Ventura counties. These systems rely primarily on static transit schedule data, but there is a potential to provide these systems with real-time dynamic data to provide even more accurate trip plans. The primary system currently in operation and supported by the county commissions and transit operators is the Los Angeles County Metropolitan Transportation Authority's (MTA's) Transit Trip Planner. This system is not considered an Inland Empire ITS element and is not currently part of the architecture results.

For the past several years SCAG has performed Rideshare services for the counties within the SCAG Region, including Riverside and San Bernardino Counties. Currently, the County Transportation Commissions within the SCAG Region are transitioning to a new model for providing rideshare services at the local level, while working cooperatively to maintain a regional ridematching database. A ridematching software package called RidePro is being configured to operate on a Wide Area Network (WAN) allowing all of the County Transportation Commissions to be individually responsible for the collection, maintenance and distribution of commuter ridematching data. As part of this new paradigm for providing ridematching services, individual users will also have access to on-line ridematching services at a new Internet website, www.RideMatch.info. This system is not an ITS element and therefore, is not currently part of the architecture results.

The Inland Empire borders the counties of San Diego, Imperial, Orange, Los Angeles, Kern and Inyo in California and the states of Arizona and Nevada. Each of these adjacent regions is developing or has developed a regional ITS architecture with certain systematic assumptions of the ability to transmit ITS data across boundaries. These system interfaces are also part of the Inland Empire ITS inventory and will be addressed in the architecture schema.

4.0 ITS USER NEEDS, SERVICES AND OPERATIONAL CONCEPTS

ITS inventory for the Inland Empire consisted of existing and planned (near term) systems owned and / or operated by Inland Empire ITS Stakeholders. The next step in the process of developing a Regional ITS Architecture was determining the needs of the Stakeholders in the region. The needs were then compared to the inventory to determine which needs are currently being met with existing ITS, will be met in the near future with planned ITS, or are not being met at all.

In this chapter, the ITS services provided by these systems to address regional needs are identified. This is the first step in determining what the system should do tomorrow that it doesn't do today. It provides each agency an opportunity to look at the region's transportation system from the highest level and confirm that their goals and desires are consistent with the rest of the transportation community as everyone shares their own system information.

ITS services provided by integrated transportation systems within the boundaries of the Inland Empire and surrounding area improve the efficiency, safety, and convenience of the regional transportation system through better information, advanced systems, and new technologies. After needs for the region are determined and services are assessed that meet those needs, this chapter also explains existing and planned roles and responsibilities or "operational concepts" for the systems for both implementation and operation of those systems.

4.1 Inland Empire ITS Needs

Before ITS services can be prioritized for the region, the problems with the regional transportation system and the associated needs of the operators, maintainers, and users of the system must be understood. Needs were not formally documented in one place, so surveys were developed for the operators, maintainers, and users of the various regional ITS systems in order to understand the region's needs. Needs were identified by collecting this information from existing documents and supplementing this information with Stakeholder input.

Both ITS plans and traditional transportation plans were reviewed for needs and services information. Transportation long-range plans discussing economic and social trends and how the infrastructure should be built to meet the region's needs were reviewed. Understanding documented long-term policies and goals, where they were available, were directly related to the needs and services that guide a regional ITS architecture.

In order to determine the ITS needs of the Inland Empire Region a "strawman" or candidate list of ITS needs was developed. The strawman list was developed based on knowledge of the Inland Empire Region as well as experience in developing Regional ITS Architectures in other regions of California and nationally.

The project Stakeholders then provided input using the surveys referred to above as a tool to determine a set of needs that were consistent with documented regional plans and the planning process already approved for the Inland Empire. During the survey process, the Stakeholders also provided input on the relative priorities for responding to the identified ITS needs. This input was taken at a Project Workshop and through survey documentation and analysis, which was collected from the entire project Stakeholder group. The Needs Survey that was distributed to the Stakeholder group is shown in **Appendix E**.

The needs have been broken into categories, similar to the manner in which the Inventory Survey Forms were categorized. In the strawman list of ITS needs, there were several needs that applied to more than one category. Appropriately so, those needs were listed more than once.

In assembling the needs input from the Stakeholder group, along with the relative priorities, the Needs List was condensed as much as possible. **Table 4.1-1** shows the resulting condensation of ITS Needs as well as the summation of relative priorities collected from the Stakeholder group.

Table 4.1-1: Inland Empire ITS Needs

ITS Category		H=High, M=Medium, L=Low	
Arterial / Traffic Management		**Needs**	**Relative Priority**
Examples: Signal Coordination, Centralized Control, Vehicle Detection Systems, Video Systems, Adaptive Signal Control, Traffic Management Systems / Centers, Highway Rail Intersection Technologies	1	Improve system operation monitoring	H
	2	Improve signal optimization	H
	3	Improve traffic flow monitoring	H
	4	Improve signal control and timing	H
	5	Improve/implement ability to remotely modify signal timing	H
	6	Improve inter-jurisdictional continuity	H
	7	Upgrade signal hardware	H
	8	Remote monitoring of signal system status / operations by public safety agencies	H
	9	Reduce vehicle traffic delays at grade crossings	H
	10	Better coordinate grade crossing operations with signals	H
	11	Provide more widespread centralized computer control	M
	12	Improve hardware issues in interconnecting signal systems between agencies	M
	13	Reduce emergency vehicle delays at signals	M
	14	Reduce transit vehicle delays at signals	M
	15	Better balance signal timings favoring local traffic over through traffic	M

ITS Category		H=High, M=Medium, L=Low	
Freeway Management		**Needs**	**Relative Priority**
Examples: *Vehicle Speed Detection Systems, Video Systems, Ramp Metering, Variable Message Signs, Highway Advisory Radio, Traffic Management Systems/Centers*	16	Deploy additional vehicle detection coverage	H
	17	Improve information exchange between Caltrans District 8 and other Caltrans Districts	H
	18	Improve information exchange between Caltrans and Nevada DOT and Arizona DOT	H
	19	Improve information exchange between Caltrans District 8 and other local agencies	H
	20	Improve collection of traffic demand data	H
	21	Improve incident response, especially in rural areas	M
	22	Implement additional field device interconnect	L
	23	Better manage periods of high traffic demand in poor roadway conditions	L

ITS Category		H=High, M=Medium, L=Low	
Public Transportation Management		**Needs**	**Relative Priority**
Examples: *Public Transportation Management, En-route Transit Information, Personalized Public Transit, Public Traveler Safety, Traveler Service Information, Ride Matching and Reservations, Smart Card Payment/Transaction Systems*	24	Improve transit transfers within and between systems and modes to improve service delivery	H
	25	Enable transit agencies to locate bus fleet (AVI/AVL)	H
	26	Improve information exchange between/among transit agencies	H
	27	Disseminate better rail information and arrival times (connectivity issues)	H
	28	Improve regional and interregional trip planning	M
	29	Improve patron safety (in-vehicle and at stations / waypoints)	M
	30	Provide transit priority at signals	M
	31	Implement bus queue jump lanes	M
	32	Enable dissemination / display of bus arrival times	M
	33	Enable emergency information dissemination to transit operators	M
	34	Improve information exchange between transit agencies and freeway / arterial management centers	L

ITS Category		H=High, M=Medium, L=Low	
Emergency Management		**Needs**	**Relative Priority**
Examples: Incident Detection, Incident Management, Hazardous Materials Response and Handling, Emergency Notification and Personal Security, Emergency Vehicle Management, Advanced Dispatching and Response Systems	35	Increase use of portable traffic control equipment (CMS, HAR, etc.)	H
	36	Reduce response delays at signals	M
	37	Improve response to weather events	M
	38	Improve incident response coordination between agencies	M
	39	Improve incident detection	M
	40	Improve incident response times	M
	41	Improve communications in mountain and rural areas of the region	M
	42	Improve traffic management during wildfires (evacuation, response, suppression, etc.)	M
	43	Improve response to hazardous materials spills / incidents (better manage resulting traffic congestion, improve clean-up time)	M
	44	Provide better information dissemination regarding diversion of traffic and alternative routing	M

ITS Category		H=High, M=Medium, L=Low	
Maintenance and Construction Operations		**Needs**	**Relative Priority**
Examples: Advanced Work Zone Management and Traffic Control, Vehicle Detection Systems, Video Systems, Vehicle / Speed Detection Systems, Variable Message Signs, Highway Advisory Radio, Integration with Traffic Management Systems / Centers, Advanced Dispatching and Routing Systems, Advanced Vehicle Tracking Systems, Fleet Maintenance and Management Systems	45	Improve coordination on construction notification and information distribution	H
	46	Improve / enhance work zone traffic handling plans	M
	47	Improve detection and removal of falling rocks, snow, mud and trees on roadways	M
	48	Coordinate traffic control plans between jurisdictions	M
	49	Increase use of portable traffic control equipment (CMS, HAR, etc.)	M
	50	Provide automated vehicle location systems for maintenance and construction operations vehicles	L
	51	Improve fleet information / management (maintenance schedules, mileage accumulations, tracking snow removal vehicles w/AVL)	L
	52	Provide signal preemption for some maintenance fleet vehicles	L

ITS Category		H=High, M=Medium, L=Low	
Traveler Information		**Needs**	**Relative Priority**
Examples: En-route Traveler Information, Pre-trip Traveler Information, Portable Event Management Systems, In-vehicle Route Guidance, Variable Message Signs, Highway Advisory Radio, Internet, Media, Tourist Information Systems	53	Provide quality real time congestion related information	H
	54	Improve method of disseminating Caltrans delay and incident data	H
	55	Provide timely, accurate information on road conditions	H
	56	Provide better road construction information and notification	H
	57	Expand traveler information delivery methods	M
	58	Improve quality and timeliness of communications	M
	59	Provide better notification of recreational routes closed in winter	M
	60	Develop interstate / inter-region traveler information covering a wide area (targeted to CVO)	M
	61	Provide more data source locations for the National Weather Service	M
	62	Provide information distribution to private/commercial information service providers (ISPs)	M
	63	Improve traveler information/directions (suggested routing for travelers not familiar with the region)	M
	64	Use public access cable television to disseminate traffic and weather information	L
	65	Improve targeted traveler information for tourists and recreation travelers at visitor information areas / rest stops, etc.	L
	66	Provide weather and road info access at rest stops	L

ITS Category		H=High, M=Medium, L=Low	
Commercial Vehicle Operations		**Needs**	**Relative Priority**
Examples: *Commercial Vehicle Electronic Clearance, Automated Roadside Safety Inspection, On-board Safety Monitoring, Commercial Vehicle Administration Processes, Hazardous Material Incident Response, Commercial Vehicle Fleet Management*	67	Provide interstate / inter-region traveler information covering a wide area (targeted to CVO)	M
	68	Disseminate better information regarding limited alternative routes	M
	69	Improve congestion management during seasonal/local events	M
	70	Improve truck storage / parking information (during major road closures)	M
	71	Provide tracking of hazmat vehicles	L
	72	Provide better information dissemination of winter vehicle restrictions (Chain control issues (ON/OFF))	L

ITS Category		H=High, M=Medium, L=Low	
Electronic Payment Systems		**Needs**	**Relative Priority**
Examples: *Electronic Toll Collection Systems, Electronic Transit Fare Payment Systems (Smart Cards)*	73	Improve transit fare payment systems	M
	74	Deploy Universal Fare Card (transit)	M
	75	Deploy Universal Payment Card (parking / tolls)	L

ITS Category		H=High, M=Medium, L=Low	
Advanced Vehicle Control and Safety Systems		**Needs**	**Relative Priority**
Examples: *Longitudinal Collision Avoidance, Lateral Collision Avoidance, Intersection Collision Avoidance, Vision Enhancement for Crash Avoidance, Safety Readiness, Pre-crash Restraint Deployment, Automated Highway System*	76	Reduce red light running	H
	77	Deploy advanced warning signs for road icing, excess speed, etc.	M
	78	Provide snow plow tracking project	L

ITS Category		H=High, M=Medium, L=Low	
Integration		**Needs**	**Relative Priority**
Examples: Integration of Systems, Integration With Traffic Management Centers, Central vs. Distributed Control, Communications Infrastructure, Integration of Agencies, Institutional Issues	79	Improve information sharing among agencies	H
	80	Improve communication limitations	M
	81	Reduce dependency on proprietary systems	M
	82	Provide central information clearinghouse	M
	83	Reduce impacts of different operating systems for signal control	M
	84	Develop integrated GIS for Region	M
	85	Develop political agreements (MOUs)	M
	86	Improve system compatibility	M

4.2 ITS Services

The National ITS Architecture contains many different concepts and is rich in industry terms and acronyms that depict integrated systems. One of the strengths of National ITS Architecture is the fact that it introduces a consistent "language" that can be spoken by both planners and operators nationally, to assure that everyone is "on the same page" with systems implementation, integration, and operation. But if consistent terms and acronyms is a strength, it has an equal challenge in that this language is often new to everyone. Like any new language, the language or dialect of "National Architecture-ease", is a often awkward to use and understand. One of these new concepts in the National ITS Architecture framework is Market Packages.

Market Packages provide accessible, deployment-oriented, integrated "services" from the framework of the National ITS Architecture that respond directly to regionally identified "needs". Once a region has identified specific needs, Market Packages that correlate most directly to those needs can be "pulled out of the National ITS Architecture" to serve as a beginning point of discussion for a project deployment. Market Packages are tailored to fit, separately or in combination, with real world local transportation problems and needs identified during the survey process in the Inland Empire.

While Market Packages are a good place to start, it would be a mistake to limit the ITS service choices to the list of predefined Market Packages, since some services that are important to the region may not be defined in the Market Packages.

Stakeholder input on each of these choices was actively solicited through a brainstorming session at a workshop. Every ITS service selected for the region was associated with one or more regional systems that supports or will be supporting that service and was approved by Stakeholders associated with the regional systems. This association between ITS services and organizations served as a starting point for operational concepts, which is discussed later.

The functions that occur within regional ITS deployments are identified with National ITS Architecture boxes called "Subsystems" or "Terminators". For example, the Fontana Traffic Management Center (TMC) is identified with a Subsystem in the National ITS Architecture known as "Traffic Management Center" because this is the box or Subsystem where these functions take place. The cameras, signals, and other field equipment that gather information for the Fontana TMC are identified with a Subsystem in the National ITS Architecture called "Roadside". While Subsystems are not "brick and mortar" themselves, the physical place where the transportation functions occur can be a building like the Fontana TMC. In fact, the building itself also houses website information that is defined as "Fontana Traveler Information", another Subsystem called "Traffic Information".

The difference between a Subsystem and a Terminator is that Terminator functions, unlike Subsystems, cannot be defined by the transportation industry. An example of a Terminator is a banking institution that may be utilized during the purchase of fare cards for transit. The banking institution subscribes to their own industry standards, but they are critical to parking management, toll collection, fare card payment, and other services provided in a region. Market Packages are made up of three things:

1. Subsystems and Terminators that the regional Stakeholders can identify or "map" local systems
2. Information Flows (called Architecture Flows in the National ITS Architecture) that go between systems and show the types of information that will be exchanged between Stakeholders' systems
3. Equipment Packages

As a recap and more detailed description of Market Packages, the three components of a Market Package are described in more detail below.

Subsystems & Terminators – Subsystems are not "brick and mortar" entities. Each Subsystem is a cohesive set of functional definitions with required interfaces to other Subsystems. Subsystems are defined functionally, not physically.

Example – A regional implementation may include a single physical "brick and mortar" center that collocates the capabilities from several Subsystems. The example of Fontana Traffic Management Center was provided above. A single building may be identified or "mapped to" numerous Subsystems or functionalities. On the other hand, a single Subsystem may be replicated in many different physical "brick and mortar" TMCs. An example of this would be the fact that the Inland Empire is host to the Caltrans D-8 TMC, Corona TMC and many Local City and County Signal Systems, all identified or "mapped" to the National Architecture as Traffic Management Subsystems. Multiple traffic management Subsystems may be implemented in a region reflecting distinct State freeway and local arterial management centers.

Terminators are on the outside of what a region defines as transportation, but are frequently used by transportation to accomplish a mission or perform specific functions.

Example – Weather services are used on a daily bases to determine if weather related problems are going to impact traffic. These weather services are called Terminators because the transportation industry does not define their functions or how that information will be provided, it just uses their information. It is a "take it or leave it" proposition and that makes weather services a commonly used Terminator to the Inland Empire Stakeholders.

<u>Architecture Flows</u> – Architecture Flows or "information flows" are simply defined as the information and data exchange between and among various Stakeholders systems that have been mapped to Subsystems and/or Terminators. The Architecture Flows allow for a coordinated overall system operation by following pre-defined interfaces between Subsystems which may be deployed by different procuring and operating sectors.

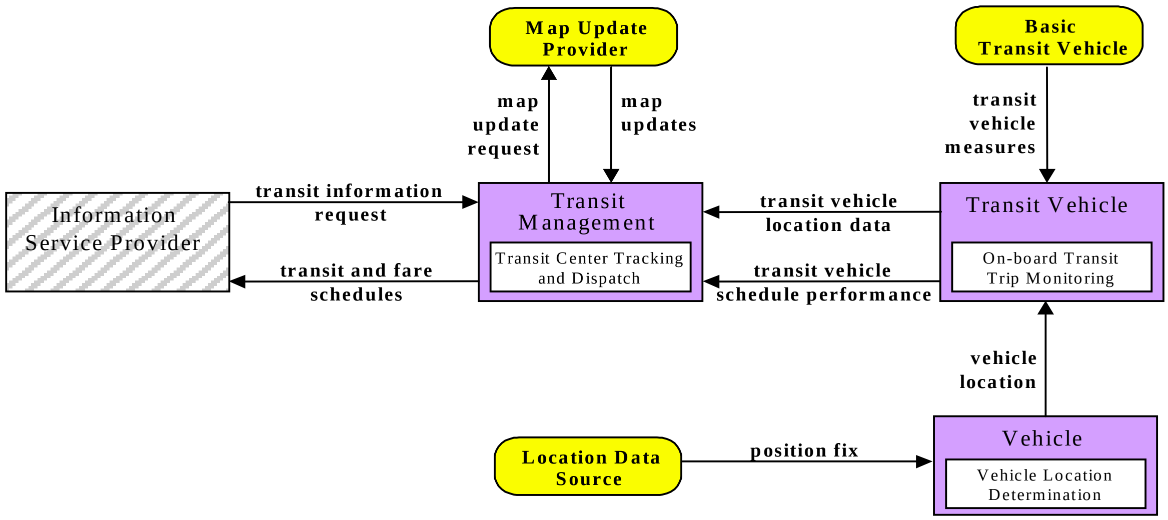
<u>Equipment Package</u> – A Market Package is implemented with a combination of interrelated equipment. An Equipment Package represents a set of equipment/capabilities that are likely to be purchased by an end-user as a component to an overall system. This equipment often resides in several different Subsystems within the Architecture Framework and may be operated by different Stakeholders.

<u>Example</u> – The Transit Vehicle Tracking Market Package includes vehicle location equipment in the Transit Vehicle Subsystem and a base station element in the Transit Management Subsystem. In this example, all Market Package elements are owned and operated by the same transit Stakeholder. In other cases, the Market Package elements are owned and operated by different Stakeholders. Many of the Traveler Information Market Packages require equipment in the Information Service Provider Subsystem that is owned and operated by a public or private information provider and equipment that is acquired and operated by the consumer as part of the Vehicle Subsystem or Personal Information Access Subsystem. Since equipment in different Subsystems may be purchased and operated by different end-users, these Subsystem-specific components may encounter varied deployment.

Equipment Packages break up Subsystems into bite-size pieces for project implementation. They are the building blocks of National ITS Architecture. Equipment Packages group similar process of a particular Subsystem together into an implementable package.

Market Packages bring together one or more Equipment Packages that must work together to deliver a given transportation service as well as the Architecture Flows or information that flows between Subsystems inside a region and those that connect them to other important external systems. In other words, they identify the pieces of the Physical Architecture that are required to implement a particular transportation service. A common example of a transit vehicle tracking Market Package or service is depicted in **Figure 4.2-1**.

Figure 4.2-1: APTS1 – Transit Vehicle Tracking



Market Packages represent services in a region that responds to a specific identified need and is:

A series of relatively detailed groupings of Subsystems, Equipment Packages, and data flow definitions, which can be logically and incrementally deployed over-time to provide increasing capabilites and levels of integration.

Equipment Packages like those in the diagram above were assembled into Market Packages that are models of what an agency or company might deploy to provide a given ITS user service.

To provide another visual understanding of a Market Package, **Figure 4.2-2** shows another Market Package diagram, and **Figure 4.2-3** is a Legend to assist in understanding the diagram. In general, only the most salient elements from the Architecture definition (e.g., directly involved Subsystems, system Terminators, and the highest level information or Architecture Flows are depicted in each graphic to ensure clarity.

The National ITS Architecture Market Packages are broken down into eight groups with a ninth for security soon to be added. **Table 4.2-1** contains a summary listing of all current National ITS Architecture Market Packages, by group. Each of the Market Packages is described in the National ITS Architecture documentation and has an accompanying diagram. To further review the National ITS Architecture Market Package diagrams and descriptions, please refer to http://itsarch.iteris.com/itsarch/.

Figure 4.2-2: Sample Market Package Diagram

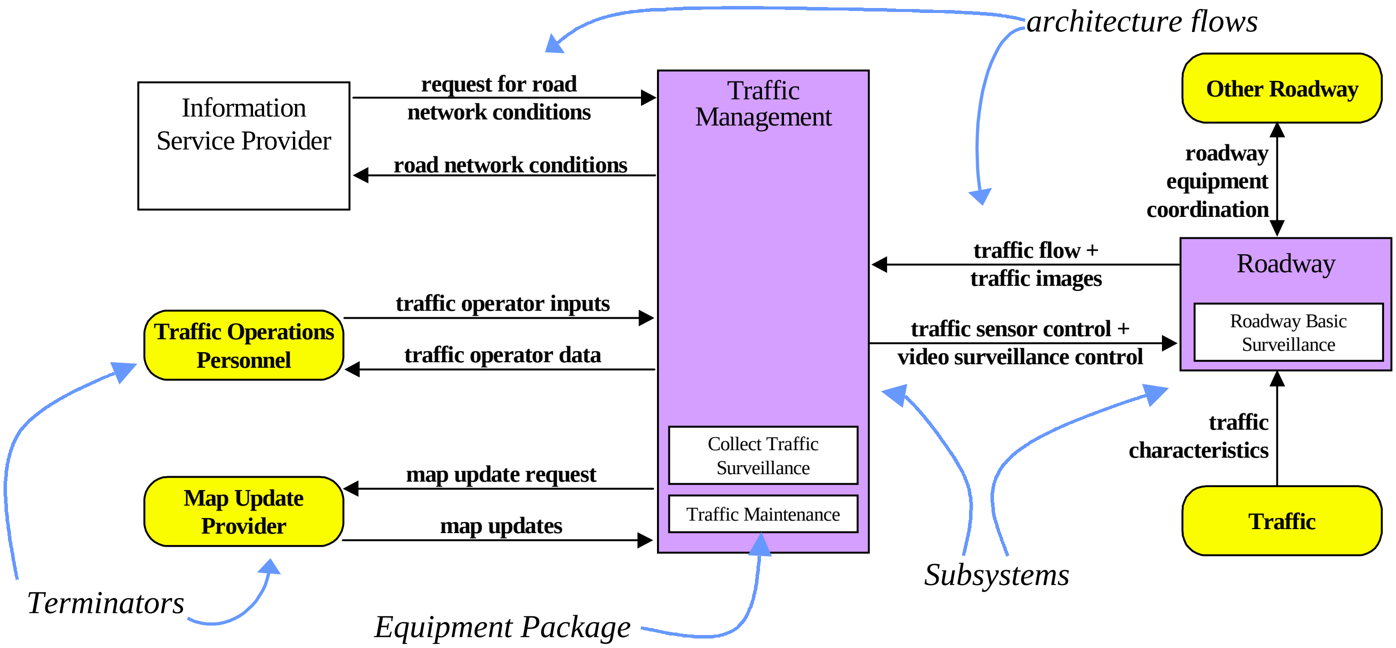


Figure 4.2-3: Market Package Diagram Legend

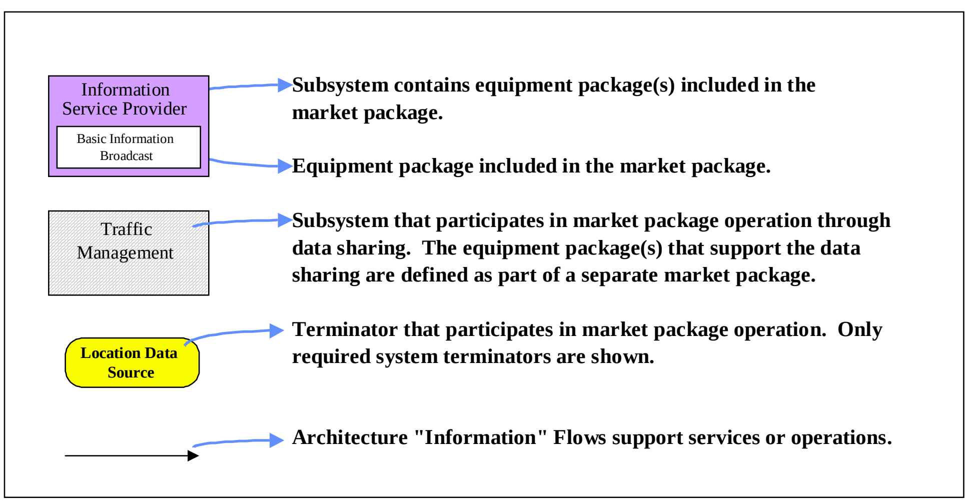


Table 4.2-1: Summary Listing of National ITS Architecture Market Packages

ARCHIVED DATA MANAGEMENT

Archived Data (AD)

AD1	ITS Data Mart
AD2	ITS Data Warehouse
AD3	ITS Virtual Data Warehouse

PUBLIC TRANSPORTATION

Advanced Public Transportation Systems (APTS)

APTS1	Transit Vehicle Tracking
APTS2	Transit Fixed-Route Operations
APTS3	Demand Response Transit Operations
APTS4	Transit Passenger and Fare Management
APTS5	Transit Security
APTS6	Transit Maintenance
APTS7	Multi-modal Coordination
APTS8	Transit Traveler Information

TRAVELER INFORMATION

Advanced Traveler Information Systems (ATIS)

ATIS1	Broadcast Traveler Information
ATIS2	Interactive Traveler Information
ATIS3	Autonomous Route Guidance
ATIS4	Dynamic Route Guidance
ATIS5	ISP Based Route Guidance
ATIS6	Integrated Transportation Management/Route Guidance
ATIS7	Yellow Pages and Reservation
ATIS8	Dynamic Ridesharing
ATIS9	In Vehicle Signing

TRAFFIC MANAGEMENT

Advanced Transportation Management Systems (ATMS)

ATMS01	Network Surveillance
ATMS02	Probe Surveillance
ATMS03	Surface Street Control
ATMS04	Freeway Control
ATMS05	HOV Lane Management
ATMS06	Traffic Information Dissemination
ATMS07	Regional Traffic Control
ATMS08	Incident Management System
ATMS09	Traffic Forecast and Demand Management
ATMS10	Electronic Toll Collection
ATMS11	Emissions Monitoring and Management
ATMS12	Virtual TMC and Smart Probe Data
ATMS13	Standard Railroad Grade Crossing
ATMS14	Advanced Railroad Grade Crossing
ATMS15	Railroad Operations Coordination
ATMS16	Parking Facility Management
ATMS17	Regional Parking Management
ATMS18	Reversible Lane Management
ATMS19	Speed Monitoring
ATMS20	Drawbridge Management

VEHICLE SAFETY

Advanced Vehicle Safety Systems (AVSS)

AVSS01	Vehicle Safety Monitoring
AVSS02	Driver Safety Monitoring
AVSS03	Longitudinal Safety Warning
AVSS04	Lateral Safety Warning
AVSS05	Intersection Safety Warning
AVSS06	Pre-Crash Restraint Deployment
AVSS07	Driver Visibility Improvement
AVSS08	Advanced Vehicle Longitudinal Control
AVSS09	Advanced Vehicle Lateral Control
AVSS10	Intersection Collision Avoidance
AVSS11	Automated Highway System

COMMERCIAL VEHICLE OPERATIONS

Commercial Vehicle Operations (CVO)

CVO01	Fleet Administration
CVO02	Freight Administration
CVO03	Electronic Clearance
CVO04	CV Administrative Processes
CVO05	International Border Electronic Clearance
CVO06	Weigh-In-Motion
CVO07	Roadside CVO Safety
CVO08	On-board CVO Safety
CVO09	CVO Fleet Maintenance
CVO10	HAZMAT Management

EMERGENCY MANAGEMENT

Emergency Management (EM)

EM1	Emergency Response
EM2	Emergency Routing
EM3	Mayday Support
EM4	Roadway Service Patrols

MAINTENANCE & CONSTRUCTION OPERATIONS

Maintenance & Construction Operations (MCO)

MC01	Maintenance and Construction Vehicle Tracking
MC02	Maintenance and Construction Vehicle Maintenance
MC03	Road Weather Data Collection
MC04	Weather Information Processing and Distribution
MC05	Roadway Automated Treatment
MC06	Winter Maintenance
MC07	Roadway Maintenance and Construction
MC08	Work Zone Management
MC09	Work Zone Safety Monitoring
MC10	Maintenance and Construction Activity Coordination

From the National ITS Architecture (v4.0)

Based on the inventory and needs information, **Table 4.3-2** presents a summary of the status of Market Package deployment in the Inland Empire. The "Existing or Planned in the Inland Empire" column identifies which Market Packages have already been deployed, or are planned for near term. Only one instance of the Market Package need be deployed, or planned, for the box to be checked. The next column, "Identified Inland Empire Need" indicates where the Stakeholder group identified a Need but no Market Package deployment to fulfill that Need was uncovered. The column titled "No Inland Empire Need" indicates Market Packages where the Stakeholder Group did not identify a particular need for that particular Market Package functionality. And finally, the column titled "Inland Empire Need Indeterminate" identifies Market Packages that fall into one or both of two categories: (1) Market Packages where the Stakeholder Group did not indicate a specific need but there may be some interest in deploying that functionality at some point in the future, and (2) Market Packages that are, or will be, largely private sector efforts, where the public sector may not necessarily participate in deployment of the Market Package.

Table 4.2-2: Inland Empire Market Package Analysis

Market Packages		Existing or Planned in the Inland Empire	Identified Inland Empire Need	No Inland Empire Need	Inland Empire Need Indeterminate
ARCHIVED DATA MANAGEMENT *Archived Data (AD)*					
AD1	ITS Data Mart	✓			
AD2	ITS Data Warehouse		✓		
AD3	ITS Virtual Data Warehouse				✓
PUBLIC TRANSPORTATION *Advanced Public Transportation Systems (APTS)*					
APTS1	Transit Vehicle Tracking	✓			
APTS2	Transit Fixed-Route Operations	✓			
APTS3	Demand Response Transit Operations	✓			
APTS4	Transit Passenger and Fare Management		✓		
APTS5	Transit Security	✓			
APTS6	Transit Maintenance	✓			
APTS7	Multi-modal Coordination		✓		
APTS8	Transit Traveler Information		✓		
TRAVELER INFORMATION *Advanced Traveler Information Systems (ATIS)*					
ATIS1	Broadcast Traveler Information	✓			
ATIS2	Interactive Traveler Information	✓			
ATIS3	Autonomous Route Guidance	✓			
ATIS4	Dynamic Route Guidance				✓
ATIS5	ISP Based Route Guidance	✓			
ATIS6	Integrated Transportation Management/Route Guidance				✓
ATIS7	Yellow Pages and Reservation				✓

Market Packages		Existing or Planned in the Inland Empire	Identified Inland Empire Need	No Inland Empire Need	Inland Empire Need Indeterminate
ATIS8	Dynamic Ridesharing	✓			
ATIS9	In Vehicle Signing				✓
TRAFFIC MANAGEMENT *Advanced Transportation Management Systems (ATMS)*					
ATMS01	Network Surveillance	✓			
ATMS02	Probe Surveillance				✓
ATMS03	Surface Street Control	✓			
ATMS04	Freeway Control	✓			
ATMS05	HOV Lane Management	✓			
ATMS06	Traffic Information Dissemination	✓			
ATMS07	Regional Traffic Control		✓		
ATMS08	Incident Management System		✓		
ATMS09	Traffic Forecast and Demand Management				✓
ATMS10	Electronic Toll Collection				✓
ATMS11	Emissions Monitoring and Management				✓
ATMS12	Virtual TMC and Smart Probe Data				✓
ATMS13	Standard Railroad Grade Crossing	✓			
ATMS14	Advanced Railroad Grade Crossing				✓
ATMS15	Railroad Operations Coordination				✓
ATMS16	Parking Facility Management	✓			
ATMS17	Regional Parking Management				✓
ATMS18	Reversible Lane Management			✓	
ATMS19	Speed Monitoring				✓
ATMS20	Drawbridge Management			✓	
VEHICLE SAFETY *Advanced Vehicle Safety Systems (AVSS)*					
AVSS01	Vehicle Safety Monitoring				✓
AVSS02	Driver Safety Monitoring				✓
AVSS03	Longitudinal Safety Warning				✓
AVSS04	Lateral Safety Warning				✓
AVSS05	Intersection Safety Warning				✓
AVSS06	Pre-Crash Restraint Deployment				✓
AVSS07	Driver Visibility Improvement				✓

Market Packages		Existing or Planned in the Inland Empire	Identified Inland Empire Need	No Inland Empire Need	Inland Empire Need Indeterminate
AVSS08	Advanced Vehicle Longitudinal Control				✓
AVSS09	Advanced Vehicle Lateral Control				✓
AVSS10	Intersection Collision Avoidance				✓
AVSS11	Automated Highway System				✓
COMMERCIAL VEHICLE OPERATIONS *Commercial Vehicle Operations (CVO)*					
CVO01	Fleet Administration	✓			
CVO02	Freight Administration				✓
CVO03	Electronic Clearance	✓			
CVO04	CV Administrative Processes	✓			
CVO05	International Border Electronic Clearance				✓
CVO06	Weigh-In-Motion	✓			
CVO07	Roadside CVO Safety				✓
CVO08	On-board CVO Safety				✓
CVO09	CVO Fleet Maintenance				✓
CVO10	HAZMAT Management				✓
EMERGENCY MANAGEMENT *Emergency Management (EM)*					
EM1	Emergency Response	✓			
EM2	Emergency Routing	✓			
EM3	Mayday Support				✓
EM4	Roadway Service Patrols	✓			
MAINTENANCE & CONSTRUCTION OPERATIONS *Maintenance & Construction Operations (MCO)*					
MC01	Maintenance and Construction Vehicle Tracking		✓		
MC02	Maintenance and Construction Vehicle Maintenance				✓
MC03	Road Weather Data Collection	✓			
MC04	Weather Information Processing and Distribution	✓			
MC05	Roadway Automated Treatment				✓
MC06	Winter Maintenance	✓			
MC07	Roadway Maintenance and Construction	✓			

Market Packages		Existing or Planned in the Inland Empire	Identified Inland Empire Need	No Inland Empire Need	Inland Empire Need Indeterminate
MC08	Work Zone Management				✓
MC09	Work Zone Safety Monitoring				✓
MC10	Maintenance and Construction Activity Coordination		✓		

4.3 ITS Operational Concepts

Operational concepts focus on a definition of each Stakeholder's role in providing the region's intelligent transportation systems and services. The operational concept process develops and documents Stakeholders' current and future roles and responsibilities in the implementation and operation of ITS based on a common regional architecture. An operational concept is one of the required components of a regional ITS architecture. In a later chapter, these roles and responsibilities form the basis for interagency agreements.

This section first presents an overall high-level conceptual representation of the Inland Empire Architecture, provided in **Figure 4.3-1**. This diagram was derived based on inventory analysis and an understanding of Stakeholder needs. Major needs categories addressed in this conceptual architecture diagram include the following:

- Arterial / Traffic Management
- Freeway Management Systems
- Public Transportation Management
- Emergency Management
- Maintenance and Construction Operations
- Regional Traveler Information
- Commercial Vehicle Operations

Operational concepts are then presented in **Table 4.3-1** detailing the projected roles and responsibilities of groupings of Inland Empire Stakeholders. The Stakeholder groupings include:

- California Highway Patrol (CHP)
- Local Police, Fire, Ambulance
- Caltrans D8
- County Emergency Agencies, Sheriff's Departments, County/Regional 9-1-1 Call Centers
- Local City and County Traffic Operations
- Transit Operators
- Commercial Vehicle Operators

Figure 4.3-1: Inland Empire Operational Concept

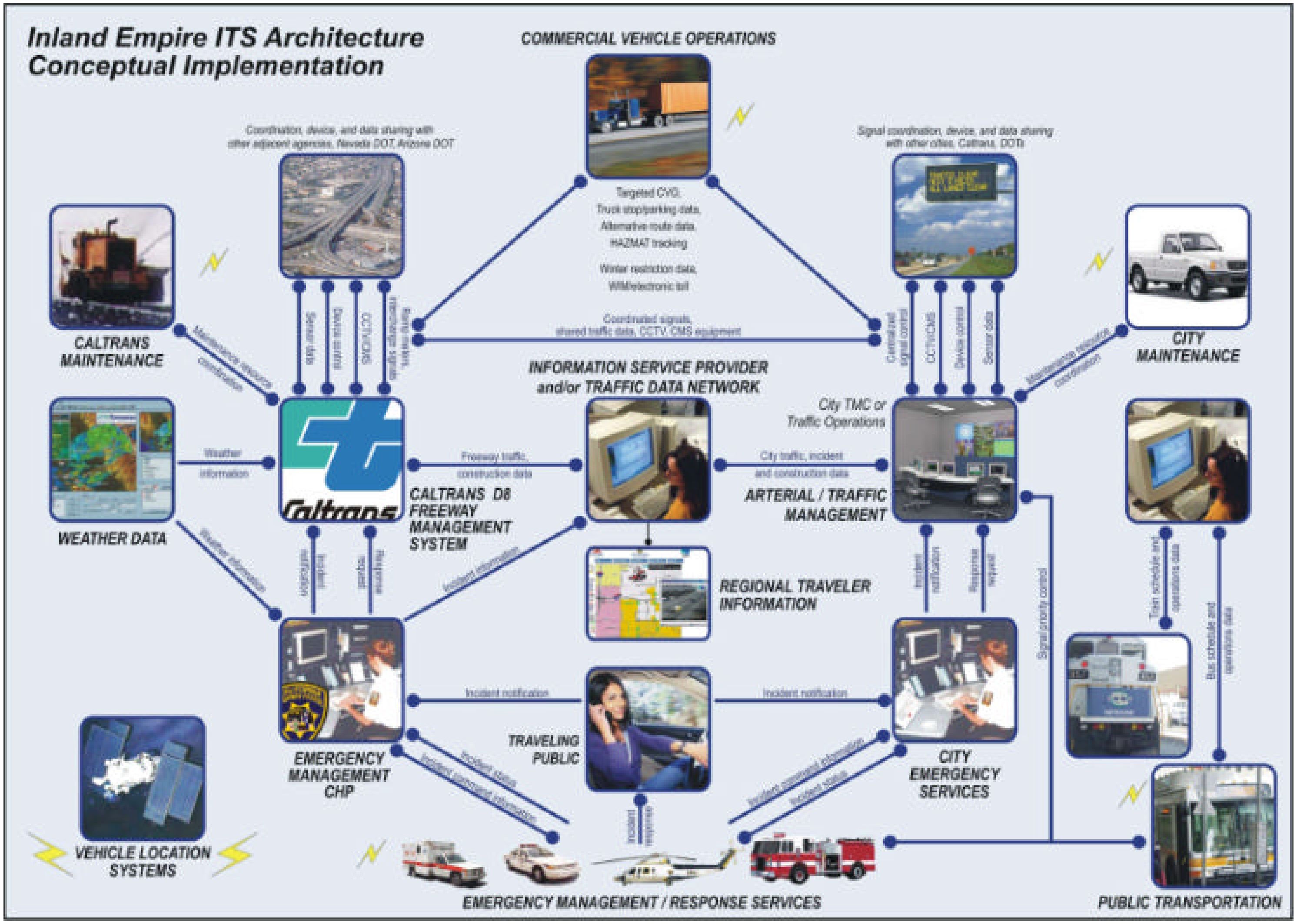


Table 4.3-1: Inland Empire Operational Concept

Operating Agency	Roles / Responsibility
California Highway Patrol	• Receive public safety calls from cellular (wireless) telephones and forward to appropriate dispatch center • Dispatch state patrol vehicles • Interface with other emergency and traffic agencies to support coordinated emergency response involving multiple agencies • Create, store, and utilize emergency response plans to facilitate coordinated response • Track and manage emergency vehicle fleets using automated vehicle location technology and two-way communications with the vehicle fleet • Use real-time traffic information received from other agencies to aide the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the most timely response • Monitor traffic on designated arterials • Provide traffic and incident information to the public • Maintain centralized emergency management systems software and systems • Perform other “non-transportation related” public safety duties • Update Information to ISP and Media Outlets (web sites, TV, etc.) and request alerts on CMS and HAR equipment • Report State Highway road closures to all agencies • Be first responder to incidents (typically) • Request Emergency Services actions taken or needed • Maintain resource database updated for others to monitor • Operate and monitor electronic credentialing and safety screening programs
Local Police, Fire, Ambulance	• Receive public safety calls from land line telephones and forward to appropriate dispatch center • Dispatch local police, fire and ambulance vehicles • Interface with other emergency and traffic agencies to support coordinated emergency response involving multiple agencies • Create, store, and utilize emergency response plans to facilitate coordinated response • Track and manage emergency vehicle fleets using automated vehicle location technology and two-way communications with the vehicle fleet

Operating Agency	Roles / Responsibility
	• Use real-time traffic information received from other agencies to aide the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the most timely response • Monitor traffic on designated arterials • Provide traffic and incident information to drivers • Maintain centralized emergency management systems software and systems • Share CCTV, CMS and HAR equipment and its control with partner agencies • Perform other "non-transportation related" public safety duties
Caltrans D8	• Manage traffic on freeway on-ramps and Caltrans controlled highways using traffic signals including preemption for emergency • Monitor traffic on freeway on-ramps and Caltrans controlled highways • Provide traffic and incident information to drivers • Implement traffic control response to incidents • Coordinate traffic control response to incidents with emergency and traffic agencies • Share traffic information with other emergency and transportation agencies • Share control of field equipment with other transportation and emergency agencies • Maintain field equipment • Provide resources when requested by emergency management agencies • Coordinate road closures with other agencies • Maintain centralized emergency management systems software and systems • Maintain centralized signal systems and software • Receive signal priority requests from transit operators (where applicable) • Provide transit signal priority requests (where applicable) • Determine maintenance vehicle locations • Send location information to agency center • Maintain vehicle status for deployment • Send status information to agency center • Maintain AVI/AVL systems for maintenance vehicles • Monitor weather conditions with available CCTV and RWIS sensors and provide road weather conditions to other agencies

Operating Agency	**Roles / Responsibility**
	• Provide snowplow operations support and availability information for other agencies (CHP, county sheriff, etc.) • Update Information to ISP and Media Outlets (web sites, TV, etc.) and issue alerts on CMS and HAR equipment • Install CCTV cameras, CMS and HAR along the freeways • Share freeway CCTV, CMS and HAR equipment and its control with partner agencies
County Emergency Agencies, County Sheriff's Departments, County / Regional 9-1-1 Call Centers (Riverside and San Bernardino Counties)	• Maintain systems • Maintain resource database updated for others to monitor • Receive public safety calls and forward to appropriate dispatch center • Dispatch emergency vehicles for various public safety agencies in the county that do not have local dedicated dispatch capabilities • Dispatch sheriff vehicles • Interface with other emergency and traffic agencies to support coordinated emergency response involving multiple agencies • Create, store, and utilize emergency response plans to facilitate coordinated response • Track and manage emergency vehicle fleets using automated vehicle location technology and two-way communications with the vehicle fleet • Use real-time traffic information received from other agencies to aide the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the most timely response • Monitor traffic on arterials • Provide traffic and incident information to the public • Perform other "non-transportation related" public safety duties • Maintain centralized emergency management systems software and systems • Report County road closures to all agencies • Request Emergency Services actions taken or needed
Local City and County Traffic Operations	• Manage traffic on arterials using traffic signals including preemption for emergency vehicles and at highway-rail intersections • Maintain centralized signal systems and software • Monitor traffic on arterials • Provide traffic and incident information to the public

Operating Agency	Roles / Responsibility
	• Install CCTV cameras, CMS, and HAR along major corridors • Maintain systems • Implement traffic control response to incidents • Coordinate traffic control response to incidents with emergency and traffic agencies • Share traffic information with other emergency and transportation agencies • Share control of field equipment with other transportation and emergency agencies • Maintain field equipment • Provide resources when requested by emergency management agency • Coordinate road closures with other agencies • Receive signal priority requests from transit operators (where applicable) • Provide transit signal priority requests (where applicable) • Determine maintenance vehicle locations for respective agency • Send location information to agency center • Maintain vehicle status for deployment • Send status information to agency center • Monitor weather conditions with available CCTV and RWIS sensors and provide road weather conditions to other agencies • Provide snowplow operations support and availability information for other agencies (CHP, county sheriff, etc.) • Initiate adverse weather event signal timing and coordination where feasible • Update Information to ISP and Media Outlets (web sites, TV, etc.) and issue alerts on CMS and HAR equipment. • Maintain resource database updated for others to monitor
Transit Operators	• Receive bus location and occupancy information from AVI/AVL system • Send bus status and location information to transit center • Maintain passenger counts • Send passenger counts to transit center • Maintain AVI/AVL system • Issue requests for traffic signal priority (where applicable) • Maintain Transit Center software and systems • Determine maintenance vehicle locations for respective agency • Send location information to agency center • Maintain vehicle status for deployment

Operating Agency	**Roles / Responsibility**
	• Send status information to agency center
Commercial Vehicle Operators	• Uses AVI / AVL system to determine vehicle location • Provide location information to Trucking Center, Caltrans and CHP (as appropriate) • Participate in electronic credentialing and safety screening programs • Maintain AVI/AVL system

5.0 FUNCTIONAL REQUIREMENTS AND INTERFACE DEFINITIONS

The development of functional requirements is the next logical step in the evolution of architecture development. To effectively deliver the ITS services in the Inland Empire region, each system must perform certain functions. A functional requirement is a task or activity that is performed by each system in the region to provide the required regional ITS services. **Appendices C and D** present the Stakeholders and ITS inventory considered for inclusion in the regional architecture. As time goes on, there are always new systems, revamped systems, and/or deleted systems to consider. Directions for addressing these issues are handled under the Architecture Maintenance Plan (Chapter 8).

5.1 Inland Empire ITS Functional Requirements

In Chapter 3 of this report, an ITS Inventory for the Inland Empire was presented that showed existing and planned (near term) systems owned and / or operated by Inland Empire ITS Stakeholders. The next step in the process was to determine the needs of the Stakeholders in the region. A categorized and prioritized list of needs was compared to the inventory to determine which needs are currently being met with existing ITS deployments, will be met in the near future with planned ITS deployments, or are not being met at all. The needs were also captured in comparison to ITS services, or Market Packages to assess which Market Packages need to be accommodated in the ultimate architecture. This process and the results are documented in Chapter 4 of this report. Also, in that chapter is a compilation of the roles and responsibilities (known as Operational Concepts) of the Inland Empire Stakeholders that provide the basis for fulfillment of the ultimate architecture.

Note that the National ITS Architecture does not require functional requirements to be developed for "Terminators". A Terminator defines a boundary of the region and generally represents people, other systems, and the general environment that interface to the regional ITS. In the case of the Inland Empire, the following entities are Terminators and therefore do not have Functional Requirements attached to them as part of this Regional ITS Architecture: the Arizona DOT ATMS, the Nevada DOT ATMS, the Riverside County Call Boxes, the San Bernardino County Call Boxes, Rail Grade Crossing Warning Equipment, and Media.

The lists below (in alphabetical order by Stakeholder) detail the primary functional requirements for the major ITS elements in the Inland Empire. These functional requirements were developed based on specific information provided by the individual Stakeholders about their respective system(s). Some of the regional ITS inventory elements include more than one Stakeholder (i.e., Local City and County Signal Systems, Local Fire, etc.). In some cases, when many Stakeholders are grouped together, certain functional requirements have been deleted or "softened" to reflect the reality that limited system or interface capabilities may exist or be planned for one or more of the Stakeholders in this element. Some capabilities may be provided at a later date, and some may never be provided, because of cost and operations and maintenance concerns. An effort has been made to ensure that systems being implemented by Inland Empire agencies should not be found inconsistent with the Inland Empire Regional ITS Architecture just because they do not include all of the capabilities listed in this document. If a Stakeholder decides to add additional functional capabilities than those reflected in a "grouping" like Local City and County Signal Systems and their system becomes unique in regional functions, when the architecture is updated during the maintenance process, that Stakeholder's element will be identified as a separate regional ITS element at that time and no longer part of a group.

Note also that the use of "shall" statements is deliberate as it sets forth a declarative statement about what a system needs to do. Functional Requirements by definition, are identified by "shall" statements. In some instances there are Stakeholders who are not actively involved in the region but, because the region uses information consistently and because the National ITS Architecture identifies them as a subsystem, we have included functional requirements for their systems. Some examples of this are: California Department of Motor Vehicles, General Public, and Commercial Vehicles. In these cases, although "shall" statements are used for consistency, it should be recognized that these functional requirements only characterize the capabilities as ones with which Inland Empire agencies may have to interface. The region has identified some of the functions that come from these systems but the region recognizes that it has no control or influence over the actual functional requirements of this system.

Stakeholder: **California Department of Motor Vehicles**
System: **DMV CVO Administration (PrePass)**

This system shall:

- provide administrative capabilities including database management and administrator-to-roadside and administrator-to-administrator interfaces.
- manage the electronic credentials database for a state and interface with roadsides performing credential checks.
- communicate and coordinate with other state commercial vehicle administrations.
- collect and store information on commercial vehicles.
- support the exchange of safety and credentials data among jurisdictions.
- support the exchange of safety and credentials data between agencies (for example, an administrative center and the roadside check facilities) within a single jurisdiction.
- ensure that safety criteria are available for automated roadside safety checks.
- collect and review carrier safety data and determine the carrier safety rating based on supplied criteria.

Stakeholder: **California Highway Patrol**
System: **CHP CAD System**

This system shall:

- receive 9-1-1 and 7-digit local access calls.
- collect available information about the caller and the reported emergency.
- forward information about emergency to other systems that formulate and manage the emergency response.
- collect and store emergency information that is collected in the course of emergency operations.
- provide emergency data to operations personnel.
- efficiently dispatch emergency vehicles to an emergency/incident.
- enhance safety and efficiency of routes based on real-time traffic information.
- enable the development and management of emergency response plans.
- manage overall coordinated response to emergencies.
- track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.

- provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

Stakeholder: **California Highway Patrol**
System: **CHP Vehicles**

This system shall:

- provide two-way communications to support coordinated response to emergencies.
- preempt signals via short range communication directly with traffic control equipment at the roadside.
- provide a direct interface between the emergency vehicle and incident management personnel.

Stakeholder: **California Department of Transportation District 8**
System: **D8 Maintenance and Construction Management System**

This system shall:

- schedule maintenance and construction (M&C) activities (including work zone activities).
- report M&C activities and status.
- enable management of M&C resource needs.
- enable management of M&C vehicle fleet.
- process road network information.
- collect roadside equipment status.
- manage M&C map data.
- operate infrastructure monitoring devices.

Stakeholder: **California Department of Transportation District 8**
System: **D8 Roadway Maintenance Vehicles**

This system shall:

- provide dispatch and routing information.
- provide two-way communications to support vehicle tracking.

Stakeholder: **California Department of Transportation District 8**
System: **Caltrans D8 Signal Ops**

This system shall:

- monitor and manage the traffic flow at signalized intersections on freeways, ramps, and conventional highways.
- monitor highway-rail intersection equipment at the roadside.
- remotely monitor and report the status of the roadside equipment.
- generate status requests and control plan updates.
- receive periodic status updates in the absence of a request or asynchronously in the event of a detected failure or other unsafe condition at the intersection.
- detect and verify incidents, as appropriate.

- analyze and reduce collected data from traffic surveillance equipment, including incidents, planned events and hazardous conditions.
- analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections.
- develop and implement control plans that coordinate signals at intersections.
- analyze, control, and optimize area-wide traffic flow.
-
- communicate with other signal systems/TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- monitor and diagnose field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.
- provide traffic data to operations personnel or other data users and archives in the region.
- monitor and diagnosis field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.

Stakeholder: **California Department of Transportation District 8**
System: **Caltrans D8 Signal Ops Roadside Equipment**

This system shall:

- monitor traffic flow.
- monitor surveillance equipment and interfaces and report detected abnormalities.
- control traffic signals.
- receive vehicle signal priority requests and send requests to traffic signal controllers accordingly, as appropriate.
- monitor the traffic signal equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.
- monitor roadside equipment and interfaces and report detected abnormalities.
- provide pre-emption of signalized intersections when activated, as appropriate.

Stakeholder: **California Department of Transportation District 8**
System: **Caltrans D8 TMC**

This system shall:

- collect, store, and provide electronic access to traffic surveillance, road weather, and incident data.
- control systems for efficient freeway management including integration of surveillance information with freeway geometry, vehicle control such as ramp metering, electronic signage, and highway advisory radio.
- interface to coordinated traffic systems for information dissemination to the public.
- detect and verify incidents.
- analyze and reduce collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.
- formulate an incident response minimizing the incident potential, incident impacts, and/or resources required for incident management.

- propose and facilitate the dispatch of emergency response and service vehicles as well as coordinate response with all appropriate agencies.
- communicate with other TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- collect and store traffic information that is collected in the course of traffic operations.

Stakeholder: **California Department of Transportation District 8**
System: **Caltrans D8 TMC Roadside Equipment**

This system shall:

- monitor traffic flow and road weather information.
- monitor surveillance and roadside equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.

Stakeholder: **California Department of Transportation - Headquarters**
System: **Caltrans CVO Administration (Pre-pass)**

This system shall:

- provide administrative capabilities including database management and administrator-to-roadside and administrator-to-administrator interfaces.
- manage the electronic credentials database for the state and interface with roadsides performing credential checks.
- communicate and coordinate with other state commercial vehicle administrations.
- collect and store information on commercial vehicles.
- make data available to other data users and archives in the region.

Stakeholder: **California Department of Transportation - Headquarters**
System: **CVO Weigh Stations**

This system shall:

- document violations and forward the information to the commercial vehicle if available and to the commercial vehicle administration for processing as part of the normal credentials processing package.
- communicate two-way with approaching properly equipped commercial vehicles at mainline speeds.
- read tags for automated vehicle identification and credential checking.
- appropriately screen all vehicles, not just those that are equipped with tags.
- process data from commercial vehicle along with database information to determine whether a pull-in message is needed.
- generate random pull-in messages with provisions for facility operators and enforcement officials to have manual override capabilities.
- automate the roadside safety inspection process including the use of hand held devices to rapidly inspect the vehicle and driver.

- automate the roadside safety inspection process including the support of automated mainline speed reading of on-board safety data to rapidly screen the vehicle and driver.
- collect, store, maintain, and provide safety data and access historical safety data after receiving identification from vehicles at mainline speeds or while stopped at the roadside.
- write the results of screening and summary safety inspection back onto a tag.
- process safety data and issue pull-in messages or provide warnings to the driver, carrier, and enforcement agencies.
- perform roadside high speed weigh in motion.

Stakeholder: **City of Corona**
System: **Corona TMC**

This system shall:

- collect, store, and provide electronic access to traffic surveillance data.
- monitor highway-rail intersection equipment at the roadside.
- remotely monitor and report the status of the roadside equipment.
- generate status requests and control plan updates.
- receive periodic status updates in the absence of a request or asynchronously in the event of a detected failure or other unsafe condition at the intersection.
- detect and verify incidents.
- analyze and reduce collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.
- formulate an incident response minimizing the incident potential, incident impacts, and/or resources required for incident management.
- analyze, control, and optimize area-wide traffic flow.
- communicate with other signal systems/TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- monitor and manage the traffic flow at signalized intersections.
- analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections.
- develop and implement control plans that coordinate signals at intersections.
- collect and store traffic information that is collected in the course of traffic operations.
- provide traffic data to operations personnel or other data users and archives in the region.
- monitor and diagnose field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.
- collect, process, store, and disseminate traveler information.
- provide media system traffic data interface.
- provide traffic data retrieval interface.
- collect traffic data for advisory messages.
- provide traffic broadcast messages.
- provide traveler kiosk interface.
- provide traveler with event information.

Stakeholder: **City of Corona**
System: **Corona Roadside Equipment**

This system shall:

- monitor traffic flow.
- monitor surveillance equipment and interfaces and report detected abnormalities.
- control traffic signals.
- receive vehicle signal priority requests and send requests to traffic signal controllers accordingly.
- monitor the traffic signal equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.
- monitor roadside equipment and interfaces and report detected abnormalities.
- manage roadway traffic at highway-rail intersections.
- provide pre-emption of signalized intersections when activated.

Stakeholder: **City of Fontana**
System: **Fontana Emergency Vehicles**

This system shall:

- provide two-way communications to support coordinated response to emergencies.
- preempt signals via short range communication directly with traffic control equipment at the roadside.
- provide a direct interface between the emergency vehicle and incident management personnel.

Stakeholder: **City of Fontana**
System: **Fontana Police Dispatch Center**

This system shall:

- receive 9-1-1 and 7-digit local access.
- collect available information about the caller and the reported emergency.
- propose and facilitate the dispatch of emergency/incident response and service vehicles as well as coordinate response with all appropriate agencies.
- collect and store incident information that is collected in the course of emergency operations.
- provide safe and efficient routes based on real-time traffic information.
- develop and execute emergency response plans.
- manage overall coordinated response to emergencies.
- track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.
- provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

Stakeholder: **City of Fontana**
System: **Fontana TMC**

This system shall:

- collect, store, and provide electronic access to traffic surveillance data.

- monitor highway-rail intersection equipment at the roadside.
- remotely monitor and report the status of the roadside equipment.
- generate status requests and control plan updates.
- receive periodic status updates in the absence of a request or asynchronously in the event of a detected failure or other unsafe condition at the intersection.
- detect and verify incidents.
- analyze and reduce collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.
- formulate an incident response minimizing the incident potential, incident impacts, and/or resources required for incident management.
- analyze, control, and optimize area-wide traffic flow.
- communicate with other signal systems/TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- monitor and manage the traffic flow at signalized intersections.
- analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections.
- develop and implement control plans that coordinate signals at intersections.
- disseminate incident related information to travelers, potential travelers, and private information service providers.
- collect and store traffic information that is collected in the course of traffic operations.
- provide traffic data to operations personnel or other data users and archives in the region.
- monitor and diagnose field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.

Stakeholder: **City of Fontana**
System: **Fontana TMC Roadside Equipment**

This system shall:

- monitor traffic flow.
- monitor surveillance equipment and interfaces and report detected abnormalities.
- control traffic signals.
- receive vehicle signal priority requests and send requests to traffic signal controllers accordingly.
- monitor the traffic signal equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.
- monitor roadside equipment and interfaces and report detected abnormalities.
- manage roadway traffic at highway-rail intersections.
- provide pre-emption of signalized intersections when activated.

Stakeholder: **City of Fontana**
System: **Fontana Traveler Information**

This system shall:

- collect, process, store, and disseminate traveler information.
- provide media system traffic data interface.

- provide traffic data retrieval interface.
- collect traffic data for advisory messages.
- provide traffic broadcast messages.
- provide traveler kiosk interface.
- provide traveler with event information.

Stakeholder: **City of Temecula**
System: **Temecula TOC**

This system shall:

- collect, store, and provide electronic access to traffic surveillance data.
- remotely monitor and report the status of the roadside equipment.
- generate status requests and control plan updates.
- receive periodic status updates in the absence of a request or asynchronously in the event of a detected failure or other unsafe condition at the intersection.
- detect and verify incidents.
- analyze and reduce collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.
- formulate an incident response minimizing the incident potential, incident impacts, and/or resources required for incident management.
- analyze, control, and optimize area-wide traffic flow.
- communicate with other signal systems/TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- monitor and manage the traffic flow at signalized intersections.
- analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections.
- develop and implement control plans that coordinate signals at intersections.
- collect and store traffic information that is collected in the course of traffic operations.
- provide traffic data to operations personnel or other data users and archives in the region.
- monitor and diagnose field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.

Stakeholder: **City of Temecula**
System: **Temecula TOC Roadside Equipment**

This system shall:

- monitor traffic flow.
- monitor surveillance equipment and interfaces and report detected abnormalities.
- control traffic signals.
- receive vehicle signal priority requests and send requests to traffic signal controllers accordingly.
- monitor the traffic signal equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.
- monitor roadside equipment and interfaces and report detected abnormalities.
- provide pre-emption of signalized intersections when activated.

Stakeholder: **General Public**
System: **User Personal Computing Devices**
This system shall:

- provide capability for travelers to receive formatted traffic advisories from their homes, place of work, major trip generation sites, personal portable devices, and over multiple types of electronic media.
- provide basic routing information and allow users to select those transportation modes that allow them to avoid congestion, or more advanced capabilities to allow users to specify those transportation parameters that are unique to their individual needs and receive travel information.
- provide capabilities to receive route planning from the infrastructure at fixed locations such as in their homes, their place of work, and at mobile locations such as from personal portable devices and in the vehicle or perform the route planning process at a mobile information access location.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Corona, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, Temecula, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Fontana, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley).*
System: **Local and Other Fire Department Systems**

This system shall:

- receive emergency calls.
- collect available information about the caller and the reported emergency.
- forward information on emergency to other systems that formulate and manage the emergency response.
- collect and store emergency information that is collected in the course of emergency operations.
- efficiently dispatch emergency vehicles to an incident.
- track emergency vehicles.
- develop and store emergency response plans.
- manage overall coordinated response to emergencies, as necessary.
- track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.
- provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Corona, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley,* *Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, Temecula, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Fontana, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley).*

System: **Local and Other Fire Vehicles**

This system shall:

- track fire vehicle and transmit location to dispatch.
- preempt signals via short range communication directly with traffic control equipment at the roadside.
- provide a direct interface between the emergency vehicle and incident management personnel.

Stakeholder: **Local Cities and Counties –** *(including the following: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley)*

System: **Local City and County Roadside Equipment**

This system shall:

- monitor traffic flow.
- monitor surveillance equipment and interfaces and report detected abnormalities.
- control traffic signals.
- receive vehicle signal priority requests and send requests to traffic signal controllers accordingly, as appropriate.
- monitor the traffic signal equipment and interfaces and report detected abnormalities.
- display traffic information on equipment along the roadway.
- monitor roadside equipment and interfaces and report detected abnormalities.
- provide pre-emption of signalized intersections when activated, as appropriate.

Stakeholder: **Local Cities and Counties –** *(including the following: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley)*

System: **Local City and County Signal Systems**

This system shall:

- collect, store, and provide electronic access to traffic surveillance data.
- remotely monitor and report the status of the roadside equipment.

- generate status requests and control plan updates.
- receive periodic status updates in the absence of a request or asynchronously in the event of a detected failure or other unsafe condition at the intersection.
- communicate with other signal systems/TMCs to receive and transmit traffic information to other jurisdictions within the region, as appropriate.
- analyze, control, and optimize area-wide traffic flow, as appropriate.
- monitor and manage the traffic flow at signalized intersections.
- analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections.
- develop and implement control plans that coordinate signals at intersections.
- collect and store traffic information that is collected in the course of traffic operations.
- provide traffic data to operations personnel.
- monitor and diagnose field equipment remotely to detect failures, issue problem reports, and track the repair or replacement of the failed equipment.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Corona, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, Temecula, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley).*
System: **Local Police and Sheriff Department Systems**

This system shall:

- receive 9-1-1 and 7-digit local access.
- transfer emergency calls to appropriate system.
- collect available information about the caller and the reported emergency.
- forward information on emergency to other systems that formulate and manage the emergency response.
- collect and store emergency/incident information that is collected in the course of emergency operations.
- efficiently dispatch emergency vehicles to an incident.
- develop and execute emergency response plans.
- provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Riverside County, Banning, Beaumont, Blythe, Calimesa, Canyon Lake, Cathedral City, Coachella, Corona, Desert Hot Springs, Hemet, Indian Wells, Indio, La Quinta, Lake Elsinore, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, Temecula, San Bernardino County, Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa and Yucca Valley).*
System: **Local Police and Sheriff Department Vehicles**

This system shall:

- provide two-way communications to support coordinated response to emergencies.
- preempt signals via short range communication directly with traffic control equipment at the roadside, as appropriate.
- provide a direct interface between the emergency vehicle and incident management personnel.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Banning Transit, Beaumont Transit, Corona Cruiser and Dial-a-Ride, Palo Verde Valley Transit Agency, Riverside Special Services, Barstow Area Transit (BAT), Morongo Basin Transit Authority (MBTA), Mountain Area Regional Transit Authority (MARTA), Needles Area Transit (NAT) and Victor Valley Transit Authority (VVTA).*

System: **Municipal and Small Transit Agency Systems**

This system shall:

- support use of a fare medium for all applicable regional surface transportation services.
- allow two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- allow fixed-route services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.
- monitor transit vehicle locations and determine vehicle schedule adherence.
- collect and store transit information that is collected in the course of transit operations.
- provide transit data to operations personnel.
- provide advanced maintenance functions for the transit property.
- collect operational and maintenance data from transit vehicles, manages vehicle service histories, and monitors drivers and vehicles.
- provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.
- automate and support the assignment of transit vehicles and drivers to enhance the daily operation of a transit service.

Stakeholder: **Local Cities and Counties –** *(including the following, and others as appropriate: Banning Transit, Beaumont Transit, Corona Cruiser and Dial-a-Ride, Palo Verde Valley Transit Agency, Riverside Special Services, Barstow Area Transit (BAT), Morongo Basin Transit Authority (MBTA), Mountain Area Regional Transit Authority (MARTA), Needles Area Transit (NAT) and Victor Valley Transit Authority (VVTA).*

System: **Municipal and Small Transit Agency Vehicles**

This system shall:

- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each bus by utilizing vehicle tracking data and storing with a trip computer.
- monitor on board the vehicle in real-time, and transmit information via two-way communication to the management center.

- support use of a fare medium for all applicable regional surface transportation services
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.
- request signal priority from roadside equipment, as appropriate.
- track transit vehicle and transmit location to dispatch.

Stakeholder: **Metrolink**
System: **Metrolink Operations Center**

This system shall:

- support use of a fare medium for all applicable regional surface transportation services.
- allow two-way voice communication between the train vehicle driver and a facility, two-way data communication between the train vehicles and a facility, sensor data to be transmitted from the train vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- allow for services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.
- use current vehicle schedule adherence and optimum scenarios for schedule adjustment.
- provide information to customers at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute.
- support schedule coordination between transit properties.
- monitor train locations and determine vehicle schedule adherence.
- collect and store vehicle information that is collected in the course of operations.
- provide train data to operations personnel.
- provide advanced maintenance functions.
- collect operational and maintenance data from vehicles, manage service histories, and monitor drivers and vehicles.
- provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.

Stakeholder: **Metrolink**
System: **Metrolink Trains**

This system shall:

- monitor on board the vehicle in real-time, and transmit information via two-way communication to the management center.
- collect data required to determine accurate ridership levels and support fare structures.
- support use of a fare medium for all applicable regional surface transportation services.
- support two-way voice communication between the train vehicle driver and a facility, two-way data communication between the train vehicles and a facility, sensor data to be transmitted from the train vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.

- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- track vehicle and transmit location to central.

Stakeholder: **Omnitrans**
System: **Omnitrans Fixed Route**

This system shall:

- support use of a fare medium for all applicable regional surface transportation services.
- allow two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- allow fixed-route services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.
- monitor transit vehicle locations and determine vehicle schedule adherence.
- collect and store transit information that is collected in the course of transit operations.
- provide transit data to operations personnel.
- provide advanced maintenance functions for the transit property.
- collect operational and maintenance data from transit vehicles, manages vehicle service histories, and monitors drivers and vehicles.
- provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.
- automate and support the assignment of transit vehicles and drivers to enhance the daily operation of a transit service.
- automate planning and scheduling by collecting data for schedule generation.
- automatically determine optimum scenarios for schedule adjustment.
- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each bus by utilizing vehicle tracking data.
- collect data required to determine accurate ridership levels and implement fare structures.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- support fleet management with automated mileage and fuel reporting and auditing.
- track transit vehicle and transmit location to dispatch.
- provide information to customers at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute.
- communicate with other TMCs to receive traffic information and transmit transit data to other jurisdictions within the region, as appropriate.

Stakeholder: **Omnitrans**
System: **Omnitrans Paratransit**

This system shall:

- track transit vehicle and transmit location to dispatch.
- manage transit vehicle operations data

- process demand responsive transit trip request.
- compute demand responsive transit vehicle availability.
- generate demand responsive transit schedule and routes.
- confirm demand responsive transit schedule and route.
- process demand responsive transit vehicle availability data.
- provide demand responsive transit driver interface automate planning and scheduling by collecting data for schedule generation.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, on-board safety sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- support fleet management with automated mileage and fuel reporting and auditing.

Stakeholder: **Omnitrans**
System: **Omnitrans Transit Vehicles**

This system shall:

- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each vehicle by utilizing vehicle tracking data.
- monitor on board the vehicle in real-time, and transmit information via two-way communication to the management center.
- collect data required to determine accurate ridership levels and implement fare structures.
- support use of a fare medium for all applicable regional surface transportation services.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- request signal priority from equipment on the roadside, as appropriate.
- transmit location to dispatch.

Stakeholder: **Partners for Advanced Transit and Highways (PATH)**
System: **Performance Monitoring System (PeMS)**

This system shall:

- collect data from multiple data sources.
- store data in a focused repository.
- perform quality checks on the incoming data, error notification, and archive to archive coordination.
- collect a focused set of data and serve a particular user community.
- collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region.
- provide advanced data analysis, predictions, summarization, and mining features that facilitate discovery of information, patterns, and correlations in large data sets.

- collect and archive traffic, roadway, and environmental information for use in off-line planning, research, and analysis.

Stakeholder: **Private Commercial Vehicle Owners**
System: **Commercial Vehicles**
This system shall:

- provide commercial vehicle driver communications.
- communicate commercial vehicle on-board data to roadside.
- collect on-board commercial vehicle sensor data.
- communicate commercial vehicle on-board data to vehicle manager.
- process vehicle location data.

Stakeholder: **Private Tow Companies**
System: **Tow Trucks (FSP)**

This system shall:

- track vehicle.
- provide emergency personnel interface.

Stakeholder: **Public/Private Information Service Providers**
System: **Regional Traveler Information Service Providers (ISP)**

These systems shall:

- provide media system traffic data interface.
- provide traffic data retrieval interface.
- collect traffic data for information service provider and advisory messages.
- provide traffic broadcast messages.
- provide traveler with event information.
- collect, process, store, and disseminate traveler information.
- provide interactive traveler information.
- send formatted traffic advisories including accurate traveling information concerning available travel options and their availability, and congestion information at kiosks.
- provide information tailored for individual users.

Stakeholder: **Railroad Operators**
System: **Rail Grade Crossing Warning Equipment**

This system shall:

- process traffic sensor data.
- control Highway Rail Intersection (HRI) traffic signals.
- control HRI warnings and barriers.
- perform equipment self-test.
- provide closure parameters.
- report HRI status on approach.
- interact with roadside systems.

- determine HRI status.
- exchange data with Traffic Management.

Stakeholder: **Riverside County Transportation Commission**
System: **North Main Corona Metrolink Parking Management System**

This system shall:

- collect and store parking information that is collected in the course of parking system operations.
- support electronic payment of parking fees.
- detect and classify properly equipped (automated fee payment) vehicles entering and exiting the parking facility, as appropriate
- maintain information on parking availability and pricing structure information.
- enable processing of financial transactions and external coordination.
- detect and classify vehicles entering and exiting the parking facility.
- measure parking facility occupancy to support parking operations and traveler information services.
- disseminate parking information to travelers, roadside equipment, and private information service providers.

Stakeholder: **Riverside County Transportation Commission**
System: **Riverside County Smart Call Boxes**

This system shall:

- collect traffic speed data.
- transmit data back to a central facility at regular intervals.

Stakeholder: **Riverside County Transportation Commission**
System: **Riverside Freeway Service Patrol**

This system shall:

- perform administrative functions such as accounting, monitoring, and receiving statistics from providers.

Stakeholder: **Riverside Transit Agency**
System: **RTA Fixed Route**

This system shall:

- support use of a fare medium for all applicable regional surface transportation services.
- allow two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- allow fixed-route services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.

- monitor transit vehicle locations and determine vehicle schedule adherence.
- collect and store transit information that is collected in the course of transit operations.
- provide transit data to operations personnel.
- provide advanced maintenance functions for the transit property.
- collect operational and maintenance data from transit vehicles, manages vehicle service histories, and monitors drivers and vehicles.
- provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.
- automate and support the assignment of transit vehicles and drivers to enhance the daily operation of a transit service.
- automate planning and scheduling by collecting data for schedule generation.
- automatically determine optimum scenarios for schedule adjustment.
- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each bus by utilizing vehicle tracking data.
- collect data required to determine accurate ridership levels and implement fare structures.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- support fleet management with automated mileage and fuel reporting and auditing.
- track transit vehicle and transmit location to dispatch.
- provide information to customers at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute.
- communicate with other TMCs to receive traffic information and transmit transit data to other jurisdictions within the region, as appropriate.

Stakeholder: **Riverside Transit Agency**
System: **RTA Paratransit**

This system shall:

- track transit vehicle and transmit location to dispatch.
- manage transit vehicle operations data
- process demand responsive transit trip request.
- compute demand responsive transit vehicle availability.
- generate demand responsive transit schedule and routes.
- confirm demand responsive transit schedule and route.
- process demand responsive transit vehicle availability data.
- provide demand responsive transit driver interface automate planning and scheduling by collecting data for schedule generation.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, on-board safety sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- support fleet management with automated mileage and fuel reporting and auditing.

Stakeholder: **Riverside Transit Agency**
System: **RTA Transit Vehicles**

This system shall:

- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each vehicle by utilizing vehicle tracking data.
- monitor on board the vehicle in real-time, and transmit information via two-way communication to the management center.
- collect data required to determine accurate ridership levels and implement fare structures.
- support use of a fare medium for all applicable regional surface transportation services.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- request signal priority from equipment on the roadside, as appropriate.
- transmit location to dispatch.

Stakeholder: **San Bernardino Associated Governments**
System: **Inland Empire Call Answering Center**

This system shall:

- receive calls from call boxes.
- collect available information about the caller and the reported emergency.
- forward information to other systems or private parties that formulate and manage the response.
- collect and store information that is collected in the course of day to day operations.
- provide data to operations personnel.
- manage overall coordinated response to call box calls.
- provide coordination between multiple allied agencies before and during emergencies and non-emergencies to implement response plans and track progress through the incident.

Stakeholder: **San Bernardino Associated Governments**
System: **Smart Call Boxes**

This system shall:

- collect traffic speed data.
- transmit data back to a central facility at regular intervals.

Stakeholder: **San Bernardino Associated Governments**
System: **San Bernardino Freeway Service Patrol**

This system shall:

- perform administrative functions such as accounting, monitoring, and receiving statistics from providers.

Stakeholder: **Southern California Association of Governments (SCAG)**
System: **Regional Archived Data Repository**

This system shall:

- collect data from multiple data sources.
- store data in a focused repository.
- perform quality checks on the incoming data, error notification, and archive to archive coordination.
- collect a focused set of data and serve a particular user community.
- collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region.
- provide advanced data analysis, summarization, and mining features that facilitate discovery of information, patterns, and correlations in large data sets.
- collect and archive traffic, roadway, and environmental information for use in off-line planning, research, and analysis.

Stakeholder: **SunLine Transit Agency**
System: **SunLine Fixed Route**

This system shall:

- support use of a fare medium for all applicable regional surface transportation services.
- allow two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- allow fixed-route services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.
- monitor transit vehicle locations and determine vehicle schedule adherence.
- collect and store transit information that is collected in the course of transit operations.
- provide transit data to operations personnel.
- provide advanced maintenance functions for the transit property.
- collect operational and maintenance data from transit vehicles, manages vehicle service histories, and monitors drivers and vehicles.
- provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.
- automate and support the assignment of transit vehicles and drivers to enhance the daily operation of a transit service.
- automate planning and scheduling by collecting data for schedule generation.
- automatically determine optimum scenarios for schedule adjustment.
- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each bus by utilizing vehicle tracking data.
- collect data required to determine accurate ridership levels and implement fare structures.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.

- support fleet management with automated mileage and fuel reporting and auditing.
- track transit vehicle and transmit location to dispatch.
- provide information to customers at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute.
- communicate with other TMCs to receive traffic information and transmit transit data to other jurisdictions within the region, as appropriate.

Stakeholder: **SunLine Transit Agency**
System: **SunLine Paratransit**

This system shall:

- track transit vehicle and transmit location to dispatch.
- manage transit vehicle operations data
- process demand responsive transit trip request.
- compute demand responsive transit vehicle availability.
- generate demand responsive transit schedule and routes.
- confirm demand responsive transit schedule and route.
- process demand responsive transit vehicle availability data.
- provide demand responsive transit driver interface automate planning and scheduling by collecting data for schedule generation.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, on-board safety sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis.
- support fleet management with automated mileage and fuel reporting and auditing.

Stakeholder: **SunLine Transit Agency**
System: **SunLine Transit Vehicles**

This system shall:

- use transit vehicle mileage data to automatically generate preventative maintenance schedules for each vehicle by utilizing vehicle tracking data.
- monitor on board the vehicle in real-time, and transmit information via two-way communication to the management center.
- collect data required to determine accurate ridership levels and implement fare structures.
- support use of a fare medium for all applicable regional surface transportation services.
- support two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.
- monitor the safety of transit vehicles using on-board safety sensors, processors and communications from on-board system.
- request signal priority from equipment on the roadside, as appropriate.
- transmit location to dispatch.

Stakeholder: **TV, Radio, and Other Media Outlets**
System: **Media**

This system shall:

- collect, process, store, and disseminate traveler information such as congestion, incidents, special events, road closure, detour routing, weather, parking, and roadway maintenance information.
- maintain a database of local area transportation services available to travelers with up-to-the-minute information.
- provide users with real-time travel related information en-route to assist the travelers in making decisions about trips.
- provide interactive traveler information.
- send formatted traffic advisories including accurate traveling information concerning available travel options and their availability, and congestion information at kiosks.
- provide the latest available information on transit routes, schedules, transfer options, fares, real-time schedule adherence, and special events.
- provide information tailored for individual users.

5.2 Inland Empire ITS Interconnects and Architecture Flows

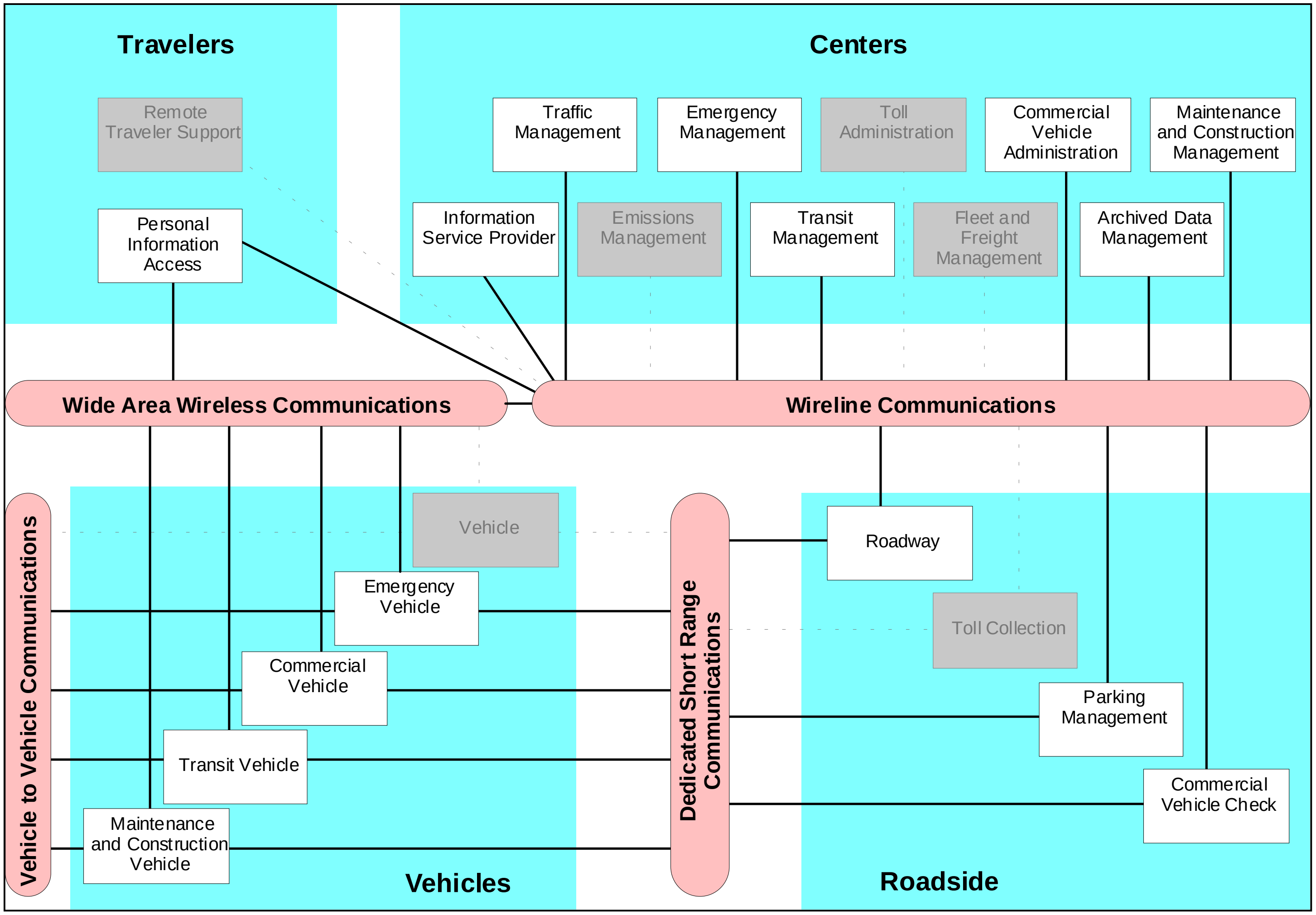
At this point in the project, ITS in the Inland Empire region has been identified and defined in terms of the functions they perform. The next step is to identify the connections between the systems, creating the framework that supports the exchange of information.

A software tool, called TurboArchitecture, was used to identify the interconnects between ITS elements in order to support the selected services (or Market Packages) for which the Inland Empire region has identified needs. Standard outputs from TurboArchitecture include lists of the region's Stakeholders and their respective ITS elements, as well as diagrams representing interconnections between ITS elements and the information flows depicted by the interconnections.

Figure 5.2-1 presents the Inland Empire ITS interconnects on a single diagram, sometimes called a "sausage diagram". The sausage diagram depicts all of the ITS Subsystems identified in the National ITS Architecture and the basic communication channels between these Subsystems. **Figure 3-1** shows the relevant Subsystems identified for the Inland Empire, noting by gray shading those Subsystems that are not part of the region's existing or planned deployment.

Each subset of the interconnects showing the connections between each Stakeholders system and the other ITS elements in the region are shown in **Appendix F** of this Report. In addition, right after each Interconnect Diagram, the relevant Architecture Flow, or information flow, which represents the information that is exchanged between the ITS elements to support the region's desired services is included.

Figure 5.2-1: Inland Empire Regional Architecture ITS Subsystems



6.0 PROJECT SEQUENCING

In moving from Regional ITS Architecture "planning" to Regional ITS Architecture "implementation", a few intermediary steps are usually followed to carryout a logical progression of ITS deployment. These steps define the series of staged projects, enabling agency agreements, and supporting ITS standards that will support progressive, efficient implementation of ITS in the region. Presentation of a series of staged ITS projects for the Inland Empire is shown in this Chapter. The needed enabling agreements, and the various possibilities for the different types of agreement needed, are provided in Chapter 7. Information in Chapter 7 is derived in some part on an analysis of the staged projects in this chapter. ITS standards that are most relevant to the Inland Empire are covered in Chapter 9.

The regional ITS architecture is implemented through many individual ITS projects and private sector initiatives that occur over years, or even decades. In this step of the Regional ITS Architecture development, a sequence, or ordering, of ITS projects that will contribute to the integrated regional transportation system depicted in the regional ITS architecture is defined.

Both the traditional planning process and the regional ITS architecture planning process have the same goal: to use local knowledge and a consensus process to determine the best sequence of projects to create a transportation network that best meets the needs of the region. Development of this project sequencing recommendation is a specific requirement of the FHWA ITS Architecture Rule and FTA Policy

The two main objectives of project sequencing are to:

- Create an efficient sequence of ITS projects based on regional needs and project readiness, and
- Build consensus around the defined project sequence

The development of the list of projects for the Inland Empire ITS Architecture was performed in an iterative process. The initial candidate project list was developed from an analysis of the interconnects and architecture flows diagrams, as detailed in **Appendix F**.

This initial list was then compared to the 1998 Inland Empire ITS Strategic Deployment Plan. Where there were projects in the Strategic Deployment Plan missing from the initial list, they were "filled-in" to the initial list for a revised version of the candidate project list.

Then, an examination of regional transportation programming information was performed to further fill-in any gaps in the initial candidate project list. Concurrent to this activity, a request was made of the Stakeholders group to provide input on plans or thoughts for further ITS deployment in the Inland Empire.

The project list was then further refined based on Stakeholder input on previously identified needs and priorities and relative readiness of planned projects. Inter-dependencies on other projects were also considered at this stage in the development and refinement of the project sequencing.

In order for the Inland Empire Stakeholders to be able to stratify the project list into something more meaningful to their respective management structures and policy boards, the overall project list was broken into three categories. First is a category called "Inland Empire Projects", generally covering two different types of projects:

1. Projects that cover a broad geographic area of the two county Inland Empire – typically Caltrans projects, and
2. Projects that have been identified as being a need in the Inland Empire but without a positively identified “champion” or Stakeholder to carryout a specific project of the type identified.

The projects in the latter category could be considered generic project descriptions that could be performed by one Stakeholder or a multitude of Stakeholder organizations.

Finally, projects more closely associated with a single county, or a specific Stakeholder within a single county and depending on their location, have been categorized as San Bernardino County Projects and Riverside County Projects, respectively.

Appendix G contains the listing of Inland Empire Projects, stratified by Inland Empire projects, Riverside County Projects, and San Bernardino County Projects. Projects may be added to these lists as they are identified by appropriate Stakeholders, as described in Chapter 8 on architecture maintenance.

7.0 AGENCY AGREEMENTS

Agreements among the different Stakeholder agencies and organizations in the Inland Empire may be required to realize the integration proposed in the regional ITS architecture. Each connection between systems in the regional ITS architecture represents cooperation between Stakeholders and a potential requirement for an agreement.

Typically, existing Stakeholder agreements that support sharing of information, funding, or specific ITS projects are reviewed and assessed to determine if they can be extended and used to support the cooperative implementation and operation of ITS. Although the Inland Empire Stakeholders have not alerted the consultant team to the existence of many agreements that could be utilized, assumptions have been made on the existence of agreements for providing current services. The list of the required Inland Empire agreements was developed based on the regional operational concepts, knowledge of the types of ITS existing or planned for implementation by the region, and the information that needs to be exchanged in order to operate those systems.

7.1 Types of Agreements

There is considerable variation between regions and among Stakeholders regarding the types of agreements that are created to support ITS integration. The FHWA Regional ITS Architecture Guidance Document presents some common types of agreements, as noted in **Table 7.1-1**:

Table 7.1-1: Agreement Types

Type of Agreement	Description
Handshake Agreement	Early agreement between one or more partners Not recommended for long term operations
Memorandum of Understanding (MOU)	Initial agreement used to provide minimal detail and usually demonstrating a general consensus Used to expand a more detailed agreement like a Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects
Interagency Agreement	Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services, or funding Documents responsibility, functions and liability, at a minimum
Intergovernmental Agreement	Between governmental agencies (e.g., agreements between State DOTs, MPOs, etc.)
Operational Agreement	Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency Identifies respective responsibilities for all activities associated with shared systems being operated and/or maintained

Type of Agreement	Description
Funding Agreement	Documents the funding arrangements for ITS projects (and other projects) Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	Standard contract and/or legal verbiage for a specific agency and serving as a master agreement by which all business is done and ca be found in the legal department of many public agencies Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one Master Agreement that uses smaller agreements (e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.) to modify or expand the boundaries of the larger agreement to include more specific language

7.2 Agreement Focus

Rather than focus on a specific technology in an agreement, the focus usually is on the scope-of-service and specific agency responsibilities for various components of the service. The agreement should also describe the high-level information that each agency needs to exchange in order to meet the goals and expectations of the other rather than defining how the delivery of that information will occur.

A simple handshake agreement may be enough for some Inland Empire activities. But, once interconnections and integration of systems begin, agencies may want to have something more substantial in place in order to document how operations will occur, who will maintain the system, and the like. A documented agreement will aid the Inland Empire agencies in planning their operational costs, understanding their respective roles and responsibilities, and in building trust for future projects. Formal agreements are necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required. **Appendix H** contains sample agreements for Inland Empire Stakeholder review and use.

7.3 List of Agreements

Table 7.3-1 presents a list of agreements. Each entry is first categorized by the ITS service delivery area. Then the involved Stakeholders, the type of agreement that is anticipated, the high-level status, and a description of the purpose of the agreement are identified. Eventually, a 5th column should be added to the table during architecture maintenance cycles which documents any issues or barriers to agreement execution as potential starting points for negotiation during the project development process.

Table 7.3-1: List of Agreements

ITS Service	Involved Stakeholders	Type of Agreement	Status	Agreement Description
Interstate Traffic Management	Caltrans and Arizona DOT (ADOT)	Intergovernmental Agreement	May exist in some form which could be amended	Provides details on exchange of data for incident management and coordination and construction zone planning.
Interstate Traffic Management	Caltrans and Nevada DOT (NDOT)	Intergovernmental Agreement	New, not pre-existing	Provides details on exchange of data for incident management and coordination and construction zone planning.
Interjurisdictional Traffic Management	Caltrans D8 and other adjacent Caltrans districts and CHP and other TBD Southern California centers	Interagency Agreement	May exist in some form which could be amended	Provides for data exchange and device control and details jurisdiction-to-jurisdiction operations and regional incident management.
Regional Traffic Management and Emergency Services	Caltrans and Local Cities and Counties and Emergency Services Providers	Memorandum of Understanding	May exist in some form which could be amended	Provides for signal operations and coordination and local incident management.
Emergency Vehicle Signal Pre-emption	Caltrans and/or Local Cities and Counties and Emergency Services Providers	Interagency Agreement	New, not pre-existing	Documents details on roles, responsibilities, and functions for emergency vehicle pre-emption at signalized intersections within a city for police, fire, ambulance, or other agency.
Transit Signal Priority	Caltrans and/or Local Cities and Counties and Transit Agencies	Interagency Agreement	New, not pre-existing	Documents details on roles, responsibilities, and functions for transit vehicle priority at signalized intersection within a city for a transit agency.

ITS Service	Involved Stakeholders	Type of Agreement	Status	Agreement Description
Railroad Grade Crossing	Caltrans and/or Local Cities and Counties and Rail Services Providers	Interagency Agreement	New, not pre-existing	Documents details on roles, responsibilities, and functions for rail grade crossing coordination and optimization at signalized intersections within a city for a rail agency.
Call Answering Service and Freeway Service Patrol	Caltrans, CHP, and RCTC Caltrans, CHP, and SANBAG	Interagency Agreement	Exists, could be amended	Documents details on roles, responsibilities, and functions for providing a call answering service and freeway service patrol activities.
Transit Fare Management	All Transit Agencies	Master Agreement	New, not pre-existing	Provides details on the usage of a common regional fare card and the requisite financial accountability methods.
Smart Call Boxes	Caltrans, RCTC and SANBAG	Memorandum of Understanding	New, not pre-existing	Documents details on roles, responsibilities, and functions for providing smart call box activities and data collection.
Traveler Information	All Agencies and Information Service Providers (media)	Memorandum of Understanding	New, not pre-existing	Documents expectations, roles, and responsibilities for the provision of transportation-related data and information to the traveling public.
Traveler Information	All Agencies and Information Service Providers (media)	Memorandum of Understanding	New, not pre-existing	Documents the policy or disclaimer for release of traveler information.
Archived Data Management	All Agencies and PeMS	Memorandum of Understanding	New, not pre-existing	Documents expectations, roles, and responsibilities for the provision of transportation-related data and information to a public archive agency.

ITS Service	Involved Stakeholders	Type of Agreement	Status	Agreement Description
Commercial Vehicle Operations Administration	To be addressed outside of region	Not applicable	Not applicable	Not applicable
Cross-Cutting (shared use of fiber infrastructure)	Multiple agencies	Interagency Agreement	New, not pre-existing	Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.

8.0 ITS ARCHITECTURE MAINTENANCE PLAN

An ITS Architecture is a blueprint for the deployment of ITS in a region and, since deployment is not static, regional architecture is also a living document. Just as one wouldn't think of building a home without consulting the framework designed specifically for the home in the blueprint, regional ITS architecture, if maintained, is just as invaluable for regional ITS deployment as a blueprint is in building a new home. This Chapter provides information on how to use the regional ITS architecture for planning, design and deployment and answers these questions:

- Who is responsible for architecture maintenance?
- What has to be maintained?
- When will the architecture be updated (how often)?
- What is the process by which architecture will be modified/changed?

8.1 Architecture Use

The success of the Inland Empire Regional ITS Architecture is dependent upon effective use of the architecture once it is completed. The Architecture should be mainstreamed into the planning and deployment processes of the Inland Empire region and is anticipated to be a valuable tool for Stakeholders to use in planning their projects to support regional and even statewide goals.

There are two critical times to use a regional ITS architecture. First, to assist in the traditional transportation planning process that occurs with the County Transportation Commissions (CTCs), such as San Bernardino Associated Governments (SANBAG) and the Riverside County Transportation Commission (RCTC), the MPO for the region, Southern California Association of Governments (SCAG), or by local planning organizations to define projects and the sequence and priority in which those ITS projects will be implemented or deployed.

The other is in design and implementation/deployment of ITS projects in the region. In order to get the most out of regional architecture, this Chapter introduces and expands on specific planning processes that already exist and how the Inland Empire Regional Architecture will be maintained to support those processes in the future.

One of the most challenging yet valuable experiences of developing a regional ITS architecture is the commingling of expertise of department of transportation operations personnel and regional transportation planners. In order for a regional ITS architecture to reflect all ITS in a region, it will cross the boundaries of ITS planning, ITS deployment, and traffic operations.

8.1.1 Using The Regional ITS Architecture in Planning

The goal of the transportation planning process is to make quality, informed decisions on the investment of public funds for regional transportation systems and services. The regional outputs of the transportation planning process are, basically, two regional plans:

- The Regional Transportation Plan (RTP) is a long-range plan with a horizon of at least 20 years and is updated every few (usually around three) years.

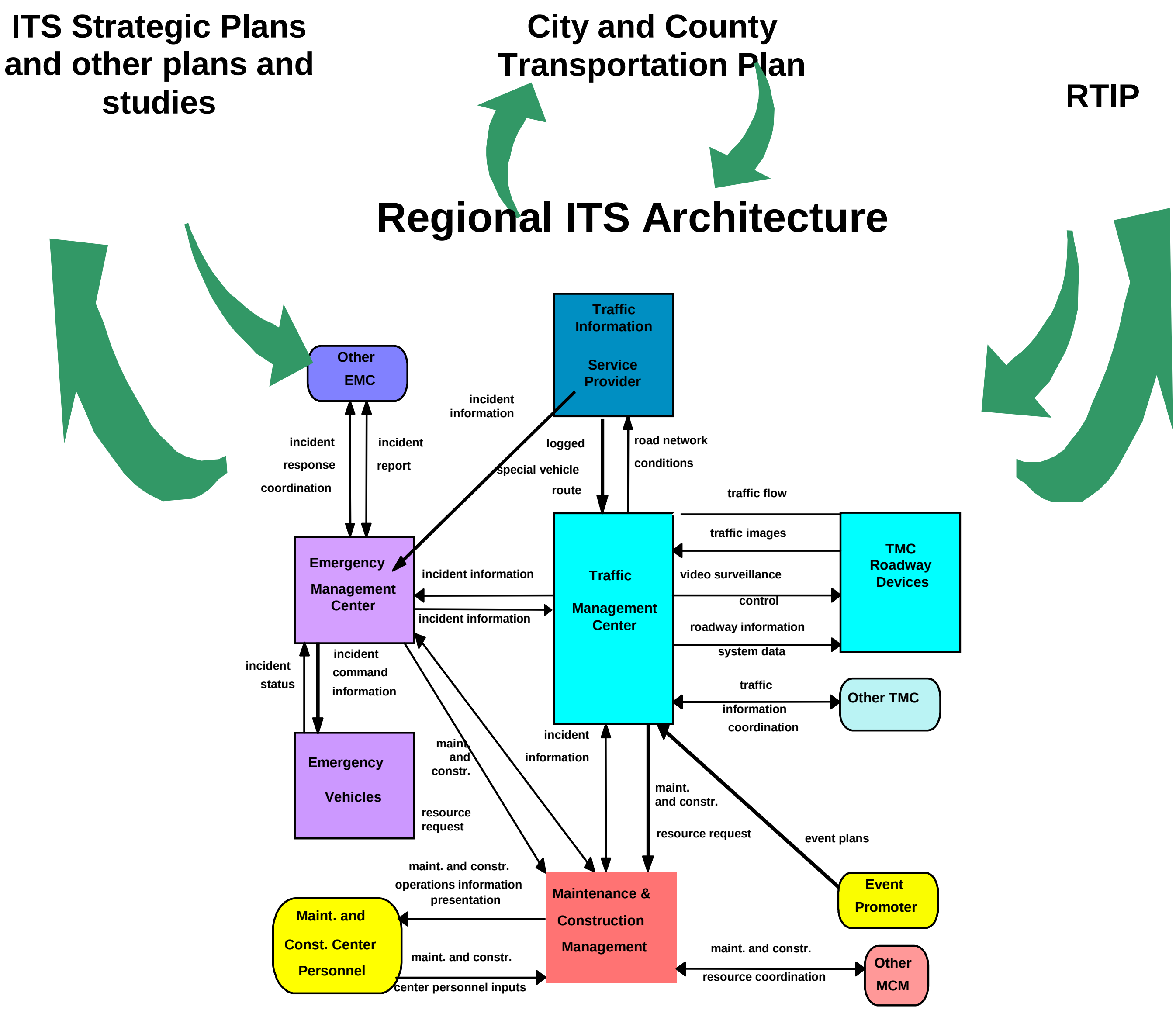
- The Regional Transportation Improvement Program/Plan (RTIP/RTP), which is a short-term plan that gets updated annually. Projects must be included in the RTIP and the RTP in order to be eligible for federal funding.

A regional ITS Architecture supports development of these two plans but it also supports ongoing updates of these plans. Previously, when the ITS inventory was being defined, regional services were being determined and operational concepts were defined, and these plans were used to feed into the development of the regional architecture. Once the regional architecture is a regionally approved document, the tables will turn and the regional architecture is a vital tool for feeding projects into development of these planning documents, as detailed in the diagram below.

The Inland Empire Regional Architecture provides a structure for deployment for projects that are identified in the RTIP/RTP. An example of an "Incident Management" project is provided in **Figure 8.1.1-1** with the arrows indicating how that project would be fed into the planning process. Since the regional ITS architecture is a "living document", one source that summarizes existing and planned ITS projects in the region, if everyone uses the same document, deployments occur in an economical and efficient manner according to funding, linkages, technology, and other regional Stakeholders priorities. New opportunities for integration are also visible once all of the projects are included; many of these opportunities already have had some regional consensus built during the architecture development process.

The Inland Empire Regional Architecture helps identify where agencies share functions, projects can be defined and integrated with regional dependencies and requirements taken into consideration.

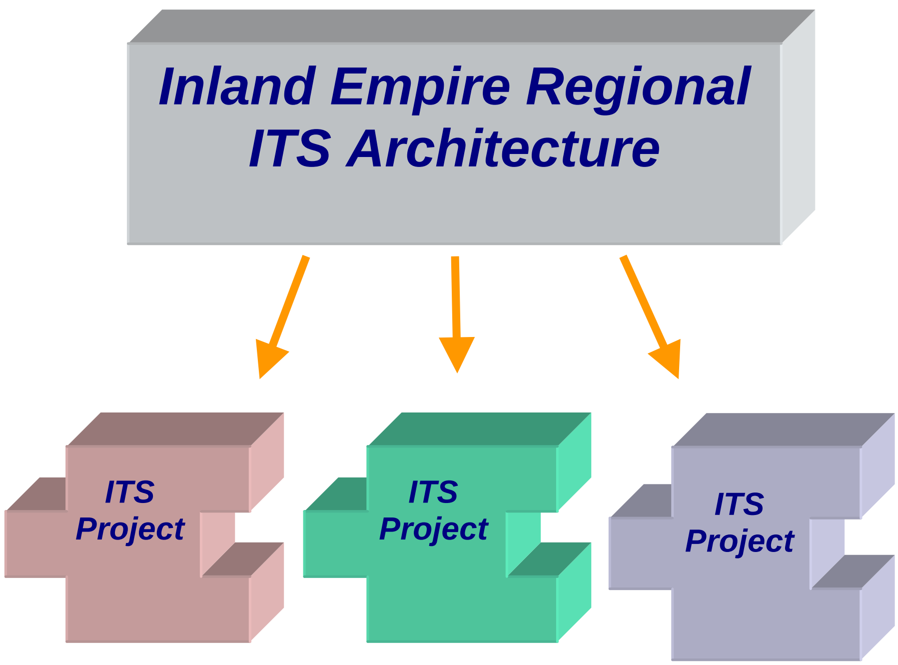
Figure 8.1.1-1: The Regional ITS Architecture In the Regional Planning Process



8.1.2 Using The Regional ITS Architecture in Design

The regional ITS architecture also assists in defining high-level requirements in ITS system design for specific project development. Because consensus is a critical part of regional ITS architecture development, regional architecture serves as a source for defining regional projects by simply "pulling projects out" of the regional architecture. Regional Stakeholders have already agreed upon and planned for these projects in future deployment. Since they have already been identified and "mapped" to the National ITS Architecture, interconnects between Stakeholders and the "information (architecture) flows" have standards, functions and Equipment Packages attached to them. In the design phase of project development, the National ITS Architecture can be used as a valuable resource to cut and paste various access databases that contain standards and functions, which can then be used in the design effort for ITS projects. **Figure 8.1.2-1** is a visual representation of the building block approach to the Regional ITS Architecture implementation process.

Figure 8.1.2-1: Regional ITS Architecture Building Blocks



8.1.3 Using The Regional ITS Architecture in ITS Deployment

The information (architecture) flows and regional services (Market Packages) included in the Inland Empire area are defined in greater detail in the National ITS Architecture. The detailed databases are a valuable resource and can be cut and pasted when writing functional requirements for ITS deployments.

Functional requirements can be used in deployment for:

- Development of requests for proposals (RFP) and/or scopes of services for various ITS projects that are going to be procured

- Market Packages can be used as operational concepts for various projects when modified to be more specific to Inland Empire ITS Projects.

8.2 Architecture Maintenance

The Inland Empire Area regional ITS architecture should be modified as plans and priorities change, ITS projects are implemented, and the ITS needs and services evolve in the region. The Inland Empire Area ITS Architecture was developed with a ten-year time horizon. As the architecture is updated, it will be extended further into the future. The goal of maintaining the architecture is to keep an up-to-date regional ITS architecture that is accessible and easily used for deploying ITS in the Inland Empire area.

The key aspects of the maintenance process, which are defined in this section are:

- Who is responsible for architecture maintenance?
- What has to be maintained?
- When will the architecture be updated (how often)?
- What is the process by which architecture will be modified/changed?

8.2.1 Who is responsible for Architecture Maintenance?

Just as a group of Stakeholders were key to the development of the Inland Empire Area Architecture, it is imperative that Stakeholders stay involved in the on-going maintenance. Once regional architecture has been completed and approved by all participating agencies, an Inland Empire Architecture Maintenance Team should be developed that has at least one representative from SANBAG, RCTC, SCAG, Caltrans Traffic Operations and Caltrans Transportation Planning, as appropriate (a mix of planning and operations personnel could serve on this Team). This Maintenance Team should make modification decisions together with each of the four agencies (SANBAG, RCTC, SCAG and Caltrans) having one vote in regional decisions for modifying the architecture. In order to ensure that the architecture stays up-to-date, the first action of this Team should be to determine which agency (SANBAG, RCTC, SCAG, or Caltrans) will take formal responsibility for making physical changes toward maintaining the architecture. This leadership role could also rotate on an annual basis for an equal share of responsibility and accountability or, if agreed upon, one agency can take responsibility for the formal database maintenance.

8.2.2 What has to be maintained?

There are several different parts and reports that make up the Inland Empire Regional Architecture. Some require more frequent updates than others, but the entire document will need a periodic review for consistency with regional vision and goals. The current version of Regional ITS Architecture will be established as the baseline Architecture and maintenance time frames identified in this Chapter will begin upon completion.

The Inland Empire Area regional ITS architecture is stored in Microsoft Access databases and is represented through a set of outputs including reports and diagrams. The most significant portions of the architecture will be maintained through updates in the electronic database using TurboArchitecture™. Additionally, the Inland Empire area regional ITS architecture contains several other documents that should be updated at regular intervals:

- Project Sequencing Report as needed
- Operational Concept as needed
- Functional Requirements as needed
- List of Agency Agreements as needed

To aid the Inland Empire in architecture version document control, the filename of the database should contain the date on which the architecture was updated. This will allow the current version to be easily identified.

The following information should be maintained in the TurboArchitecture™ databases:

- Description of the Region
- List of Stakeholders, including key contact information
- Inventory of existing and planned ITS systems in the region
- Documented regional needs and ITS services associated with supporting systems in the region (Market Packages)
- Existing and planned interconnects and information flows for the region.

Outputs such as interconnect and architecture flow diagrams, inventory lists, Stakeholders lists and other diagrams and reports can be produced by a member of the Maintenance Team from TurboArchitecture™ outputs, so they are by-products of the architecture database. These outputs can be updated as necessary for meetings or outreach activities.

8.2.3 When will the Architecture be updated (how often)?

Depending upon the outcome of the SCAG Regional Architecture efforts, the Turbo Architecture™ databases from each of the subregions could become an appendix to the RTP and, as the RTP undergoes a formal update once every three years, the architecture could undergo any major modifications at that time. This will be a natural result of the architecture being stream lined into the regional planning process to ensure that the Architecture continues to accurately represent the region.

The operational concept, system functional requirements, project sequencing list, and the list of agency agreements represent high-level views of the Inland Empire Area architecture and do not necessarily need to be modified each time a revision is made to the architecture. However, these documents will be modified as the architecture is broadened to address new needs and services or on an *as needed* basis.

8.2.4 What is the process by which the Architecture will be modified/changed?

Because changes can arise from many sources, and very likely will arise from some sources outside the technical expertise of a single agency, it is a good idea for a group of people from different Stakeholder areas to be involved in maintenance of the architecture. Representatives from traffic, transit, emergency management, and other key Stakeholders from the team that developed the architecture should provide input to the Maintenance Team for review. Each county has a Technical Advisory Committee (TAC), comprised of the City and County staff, as well as other ITS Stakeholders. These monthly meetings are an ideal place to remind agencies of the architecture, and for the TACs to be a point of contact to discuss ITS architecture updates and processes. Getting input from the Stakeholders guarantees that the architecture continues to reflect the desires of the Stakeholders in the region.

To allow Stakeholders to use the architecture for their planning and deployment activities, the current architecture database should be available from the Inland Empire Maintenance Team. For easy access, other regional Stakeholders should be notified by e-mail when the architecture database and all other current documentation has an exact location or website from which to be accessed.

In addition to maintaining the architecture, this maintenance plan should be reviewed periodically for required changes. This maintenance plan was developed during the initial development of the Inland Empire Area Regional ITS Architecture. Use of the architecture and modifications to it may differ from what was anticipated. Revising the plan will ensure that the goal of architecture maintenance is realized.

8.3 The Change Management Process

The change management process is the procedure for modifying the Architecture. It specifies how changes are identified, how often they will be made, and how the changes will be defined, reviewed, implemented and released.

8.3.1 How Changes Are Identified

The Inland Empire Area regional ITS architecture was created as a consensus view of what ITS systems the Stakeholders in the region have currently implemented and what systems they plan to implement in the future. The architecture will need to be updated to reflect changes resulting from project implementation or resulting from the planning process itself. There are many actions that may cause a need to update the architecture.

- Changes for Project Definition. When actually defined, a project may add, subtract or modify elements, interfaces, or information flows of the regional ITS architecture. Because the architecture is meant to describe not only ITS planned for the region, but also the current ITS implementations, it should be updated to correctly reflect the deployed projects.

- Multiple Agency Stakeholders. There are several generic Stakeholders in the Inland Empire Area architecture. These generic Stakeholders group multiple Stakeholders from the region. For example, small municipal transit agencies are all identified under one regional ITS element identified as "Small Municipal Transit Agencies". As Stakeholders can be better identified that are covered by these generic Stakeholders terms, the descriptions of these Stakeholders will be added to the Architecture. As their respective elements plan and deploy ITS systems, they should be added as separate elements and Stakeholders in the architecture.

- Changes for Project Addition/Deletion. Occasionally a project will be added, deleted or modified during the planning process. When this occurs, the aspects of the regional ITS architecture associated with the project have to be added, deleted or modified.

- Changes in Project Status. As projects are deployed, the status of the architecture elements, services and flows that are part of the project will have to be changed from planned to existing. Elements, services and flows will be considered to exist when they are substantially complete in that they have been turned on, tested and are currently being used.

- Changes in Project Priority. Due to funding constraints, technological changes or other considerations, a project planned of the region may be delayed or accelerated. Such changes will need to be reflected in the Inland Empire Area ITS Architecture.

- Changes in Regional Needs. Over time the needs in a region can change and the corresponding aspects of the regional ITS architecture will have to be updated. While the Inland Empire Area ITS Architecture was developed with input from several Stakeholders in the region, not all Stakeholders could or wanted to participate. As ITS deployment increases and benefits of integration are realized, additional Stakeholders will become interested in ITS, the architecture should be updated to reflect their place in the regional view of ITS. The systems they operate and their interfaces will have to be added or revised.

Additionally, the National ITS Architecture itself is a living resource of information and in order to keep a life of at least 20 years into the future, it is expanded and updated from time to time to include new user services or refine existing services. In recent years the National ITS Architecture users asked that maintenance and construction activities be included in the architecture and with national security issues that have arisen since September 11, 2001, in order to address homeland security in transportation systems new security and emergency management entities are being added. How these changes in the national "template" effect the Inland Empire Area regional ITS architecture should be considered as the Regional Architecture is updated. The National ITS Architecture may have expanded to include a user service that has been discussed in a region, but not been included in the regional ITS architecture, or been included in only a limited manner.

8.3.2 How Often Changes Are Made?

A comprehensive architecture update will be completed every three years, concurrent with the update of the RTP. The comprehensive update would include involving new Stakeholders, reviewing services planned for the area, and other items, as appropriate.

Minor revisions, such as changes in the status of an information (architecture) flow between Stakeholders, can be made as the information is known or even on an annual basis. Minor changes can be made by members of the Maintenance Team with consensus among themselves.

In future updates of the Regional Architecture for the Inland Empire Regional ITS Architecture it is recommended that the Architecture Maintenance Team consider documenting traceability between needs to market packages, operational concepts, functional requirements and projects.

8.3.3 Change Definition, Review, Implementation, and Release

Any Stakeholders in the Inland Empire region can propose a change to the regional architecture. Stakeholders should inform the Inland Empire Maintenance Team of the status of any projects with ITS aspects. To properly maintain the architecture, Inland Empire Maintenance Team should be informed not only of when projects are planned; but also when projects are completed or when changes made during design or construction impact the regional architecture.

Stakeholders should propose changes in writing to the Inland Empire Maintenance Team. Proposals should clearly define the architecture aspects to be added, deleted or revised. The reasons for proposed modifications should be given. Each proposal should include contact information for the person proposing the change so he or she can be contacted if questions arise.

Each proposed modification will be reviewed and considered by the Inland Empire Maintenance Team who at the same time, will consider timing issues as they relate to the RTP and RTIP approval update process. If the proposal for architecture modification has an impact on other Stakeholders, someone from the Team will contact the Stakeholders to confirm their agreement with the modification. If the issue warrants it, a Stakeholders meeting to discuss the modification may be held. If consensus in favor of the modification is reached, the Maintenance Team member who is identified as the "keeper of the databases" should make the revision in the architecture database.

Once the regional architecture has been modified, the Stakeholders in the region should be notified. The Inland Empire Maintenance Team should maintain a list of Stakeholders and their contact information. The Stakeholders should be notified of architecture updates and informed on how to obtain the latest version of the architecture.

9.0 RELEVANT ITS STANDARDS

ITS standards are fundamental to the establishment of an open ITS environment that achieves the goals originally envisioned by the USDOT and, as such, are an important component of the information flows in a regional ITS architecture. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve.

Establishing regional and national standards for exchanging information among ITS deployments is important not only from an interoperability point of view; it also reduces risk and cost since a region can select among multiple vendors for products and applications. Standards help create competition, better products, and lower prices.
There are currently over 80 ITS standards, but not all standards will be used in most regions. The regional ITS architecture only has to reference those standards that are applicable to the region's "pieces of the architecture" selected.

There are five different types of ITS standards that apply to transportation: communication standards, data standards, message set standards, equipment standards, and software standards.

9.1 Standards Development Organizations

The ITS community recognized the advantages of standards and encouraged Standards Development Organizations (SDOs) to create ITS standards between the most critical ITS interfaces. The following is a list of SDOs that are developing ITS standards. This list provides acronyms that show up repeatedly throughout the list of regional appropriate standards:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Electronic Industries Alliance (EIA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- Society of Automotive Engineers (SAE)
- National Transportation Communications for ITS Protocol (NTCIP)

NTCIP is a joint product of the National Electronic Manufacturers Association (NEMA), the American Association of State Highway and Transportation Officials (AASHTO), and ITE and requires special mention:

NTCIP standards provide both the rules for communicating (protocols) and the vocabulary (objects) necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system. NTCIP is the first set of standards for the transportation industry that allows traffic control systems to be built using a "mix and match" approach with equipment from different manufacturers. For example, when a buyer purchased a stereo from one manufacturer, the buyer also had to purchase speakers and attachments from the same manufacturer. Today, the stereo industry is basically "plug and play" or "mix and match". It is one of the most successful examples of effective use of standards. While at the time of development of this document there are no fully approved USDOT standards, several are very close to approval.

9.2 Stages of Development of a Standard

It's important to understand at what stage, in the typical development cycle, the standard is in, especially if a Stakeholder is considering the inclusion of specific standards in procurement specifications. Early in the cycle, there are many changes before approval or publishing -- many standards have yet to undergo testing or initial deployment.

There are numerous levels of maturity or stages of development for standards. The process includes:

- Draft Under Development. During this phase, there are significant changes likely to occur.
- Draft for Ballot or in Balloting. Standards being voted upon by a committee or working group or are undergoing other SDO procedures.
- Approved. Standards that have passed all necessary ballots and have been approved by an SDO, but have not yet published.
- Published. Standards available for purchase and use.
- Tested/Deployed Standard. Only minor changes are likely to occur in this phase of a standard development.

The maturity status of standards can be obtained from www.its-standards.net. Other information that can be obtained from this website are pointers to general information, including status charts for each ITS standard, web links, standards deployments, and standards training courses.

9.3 ITS Standards in Procurement Specifications

The use of ITS standards in procurement specifications often depends on how much risk can be afforded. There are often lots of changes to an early standard and even some risk of change in a balloted standard. Also, early deployers will likely have suggested improvements to the standard that will require an update via an amendment to the standard (amendments do typically pass through the process more quickly).

There is currently an FHWA Testing Program underway to speed up testing of ITS Standards at the website noted above. Other information also available includes:

ITS Standards Testing: shows which standards are being tested, test site information, testing approach, and status

ITS Standards Fact Sheets: one page, user-friendly, easy to understand summaries of many of the ITS standards

9.4 Decision-Making Strategy for Standards

Making the best choices for standards depends on multiple factors, including throughput (how much data must be transmitted or received on the interface), network topology (how the ITS systems are connected together), and infrastructure (fiber optic lines, leased land lines, etc.), among others. The exact process for making this decision regionally will be a function of the newly formed Architecture Maintenance Committee.

In determining when and how to incorporate ITS standards for a given interface, it's critical to understand the relative maturity of the standards. Currently, many of the exact standards for specific projects have not been decided upon, but the process for making those decisions are beginning to be developed. For each potential standard, consider asking:

- Has the ITS standard been approved or published by the SDOs?
- Has the ITS standard been adopted by multiple vendors?
- Has the ITS standard been tested, whether informally by the vendor, or through the formal ITS Standards Testing Program funded by FHWA?
- Is there an amendment to the ITS standard currently in the works, and if so, how much of the standard will change as a result?

Although the Inland Empire should create a plan to migrate toward ITS standards conformance, Stakeholders should reach consensus on an interim approach if the ITS standards applicable to the region's interfaces are not yet mature.

9.5 ITS Standards for the Inland Empire

ITS Standards address interfaces and information flows between systems. The set of standards for the Inland Empire is based on the information flows, which were developed through a Stakeholder consensus process. **Appendix I** presents the recommended standards for the Inland Empire.

In addition to the interface standards that have been discussed and are being defined for ITS, a range of other regional standards may be considered that would facilitate interoperability and implementation of the regional ITS architecture. For example, standard base maps, naming conventions, measurement and location standards, and organizational structure identifiers can all facilitate the meaningful exchange of information between systems in the region.

10.0 REGIONAL PERSPECTIVES

In the course of development of the regional ITS architecture for the Inland Empire, there were items that surfaced as important to mention. This section captures those items, as well as provides a general discussion on "what happens next, now that the regional architecture is complete".

10.1 General Discussion on Other Architecture Influences

The following items should be considered as other potential influences on the Inland Empire Regional ITS Architecture.

10.1.1 Connections and Information Flows to Los Angeles, Orange, and San Diego Counties, the Southern California Priority ITS Corridor Showcase Project, and the Southern California ITS Architecture Project

The activities of the Southern California Priority ITS Corridor Showcase Project are worth mentioning with regard to the Inland Empire. Showcase was conceived as an integrated system of systems providing transportation management and traveler information services within the geographic region that includes most of Southern California, including the Inland Empire. The Showcase Project developed an ITS project architecture and a physical network that was planned to support integration of a series of regional ITS projects across jurisdictional boundaries. For a variety of reasons, the current status of the Showcase Project can be considered dormant, with the result that the intended over-arching nature of Showcase has been shifted to each Southern California region to proceed as they see fit in creating a sub-regional ITS architecture.

At this time, the system interconnects and information flows to the adjacent regions in Southern California have not been addressed by this Inland Empire regional ITS architecture. This is a crucial aspect to eventually be planned, assessed, designed, and implemented. However, the Inland Empire Stakeholders will defer to an upcoming SCAG activity to produce a true Southern California regional ITS architecture (incorporating and/or recognizing future decisions relating to Showcase) for which the Inland Empire expects to be an active participant.

10.1.2 Statewide ITS Architecture

An effort is underway to develop a statewide ITS architecture, which pulls all of the regional architecture together at a high level to represent the state as a whole. This effort will not be redundant to the regional efforts, but instead focuses on those services that are provided at a statewide level. This includes Commercial Vehicle Operations, region-to-region interconnects, archived data management, and certain services related to rural areas not previously addressed by other regional architectures. The Inland Empire regional ITS architecture does not go into great detail in these areas and defers to the statewide effort for guidance and direction.

10.1.3 Caltrans D8 Advanced Transportation Management System Upgrade and Development of a Regional Intertie Server

A major Stakeholder in the Inland Empire is the District 8 office of Caltrans. Caltrans has plans to upgrade all of the district level ATMS deployments in the state to a common version of software, including D8. Along with that upgrade, there are plans to implement regional intertie servers that allow local agencies to exchange data with the local Caltrans district. The Inland Empire architecture has tried to incorporate these planned upgrades where possible, but, once deployment occurs, operational concepts, functional requirements, system interconnects, and information flows all may change based on the final configuration of the D8 upgrade.

10.1.4 Regional Fare Card

There are plans in Southern California to design and implement a common fare card for use on public transportation facilities. This effort is currently underway for services offered by the Los Angeles Metropolitan Transportation Authority and other Southern California agencies. There is not currently an Inland Empire champion or Stakeholder for this effort. Therefore, it is mentioned here as a placeholder for revisiting in future reviews of the architecture.

10.1.5 Miscellaneous Other Stakeholders

Ontario Airport: In future updates to the architecture, Ontario Airport should be approached for a more strategic understanding of how they fit into the regional ITS landscape.

Super Speed Train to Las Vegas: The California-Nevada Super Speed Train Commission is working towards the construction of a Las Vegas to Southern California magnetic levitation (maglev) train system which would travel through the Inland Empire. As this project progresses, the ITS architecture should be reviewed for potential interconnects and information flows related to providing traveler information regarding this service.

10.2 What Happens Now that the Regional Architecture is Complete

There was a desire expressed by the Inland Empire Stakeholders to more specifically understand the effects of this regional ITS architecture development effort and how the region should proceed differently in the future when deploying ITS. Recall that the purpose of the Inland Empire Regional ITS Architecture is to serve as an overall framework for integration between the many ITS projects that have been or will be deployed in the Inland Empire region. Once a Regional ITS Architecture is complete, it becomes the ITS framework that identifies the regional ITS elements, institutional agreements, and technical integration necessary to for an ITS project to interface with other ITS projects and systems. This Inland Empire Regional ITS Architecture serves as a culmination of all ITS projects in the Inland Empire region.

As a project is deployed, the designer must develop a Project Architecture consistent with the Regional Architecture. For example, if an agency wanted to build a Traffic Operations Center for their signal system and other ITS devices, such as CCTV cameras and electronic signs, the technical process would go something like this:

1. Consult the regional ITS architecture (this document) to see if the project had been previously captured under existing inventory in **Chapter 3** or in the projects list from **Appendix G**.
2. If so, then refer to the Inland Empire Regional ITS Architecture document and find the related:
    - Operational Concepts in **Chapter 4.3**

- Functional Requirements in **Chapter 5.1**
- System Interconnect(s) and Architecture Flow Diagram(s) in **Appendix F**
- Recommended and appropriate standards in **Appendix I.**

3. Review these items and decide which interfaces and flows the current project must accommodate.
4. Contact the Stakeholders referenced in the flow diagram(s) and coordinate the data to be exchanged and the standards to be used. **Chapter 7** offers a list of potential agency agreements from which to start and **Appendix H** has some sample agreement templates that could be used.
5. Determine whether an agreement is required for the purpose of system integration and data exchange and other relevant terms.
6. Include these aspects in any subsequent Request for Proposal and specifications for the project.
7. Follow systems engineering process in project deployment. (If this process is unfamiliar, FHWA has support documentation and can provide training and guidance.)
8. Bring the project particulars before the Architecture Maintenance Team for assessment of consistency with the Regional Architecture as noted in **Chapter 8**.

A similar process would be used if a transit system or a traveler information system or any other ITS project were of interest.

If the project has not been previously identified in the Regional Architecture, then a systems engineering process should be executed by the designer that mimics the Regional Architecture process and modifies the regional architecture needs, services, operational concepts, functional requirements, system interconnects, agreements and information flows so that they include the new ITS project being considered for deployment. It is up to the FHWA representative within the region whether this information would need to be modified immediately in the regional architecture or whether it could be incorporated into the Regional Architecture during a routine maintenance cycle.

If the preferred design within that Project Architecture is not consistent with the Regional Architecture, then the Regional Architecture needs to be modified so that the two are consistent. Regional Architecture changes need to be coordinated with other Stakeholders through the Maintenance Team so that all Stakeholders who are affected by the change are notified and included in the process.

Noted above is the technical process; there is also a local process for seeking funding approval. FHWA states that Caltrans' Local Assistance Programs is drafting a new chapter in the Local Assistance Manual (to be available in about September 2003) that includes changes required for ITS project approval. These changes add a checklist and questions that are in alignment with architecture consistency.

For example, if SANBAG submits an RTIP amendment for CMAQ funding for Phase II of the valley wide signal synchronization project, then, when the application for funding obligation is submitted to Caltrans, the Caltrans/FHWA checklist noted above will be triggered and Caltrans staff will determine if the application is consistent with the regional architecture. All major ITS projects will loop through Caltrans/FHWA for approval. As this process/checklist is finalized, the Architecture Maintenance Team will add it to the plan and will distribute to all Stakeholders.

The Inland Empire region intends to make consistency with the regional architecture a part of any federal funding Call for Projects (any future CMAQ, STIP, or other federal funding calls). In addition, each county has a Technical Advisory Committee (TAC), comprised of city and county staff, as well as other ITS and public agency Stakeholders. The monthly meeting convened by these groups is an ideal place to remind agencies of the architecture process. The region envisions adding a regular standing item, entitled "Regional ITS Architecture Issues", to the TAC meeting agendas. These discussions may also trigger amendments to the architecture, or Stakeholder meetings for discussion.

10.3 Regional Consensus

The Inland Empire Regional ITS Architecture Project Advisory Committee believes that consensus for this effort was nurtured, propagated, and achieved. To further sanction and endorse the architecture, Inland Empire Stakeholders are collaborating on producing a signature page that includes the following declaration:

The undersigned acknowledges the following:

- whereas the Federal Highway Administration published a Rule (ITS Standards and Architecture) and Federal Transit Administration published a companion Policy to implement Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21);
- and, whereas this Rule/Policy seeks to foster regional integration by requiring that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and appropriate standards;
- and, whereas "conformance" is defined as using the National ITS Architecture to develop a regional ITS architecture tailored to address the local situation and ITS investment needs and the subsequent adherence of ITS projects to the regional ITS architecture.

Then, therefore, the undersigned also acknowledges**:**

- their active participation in the Inland Empire ITS Architecture Project;
- their support of the project outcome; and
- their understanding that the architecture is an on-going and necessary activity to continue the successful deployment of ITS in the region.