SOUTHERN CALIFORNIA

ASSOCIATION of GOVERNMENTS

SOUTHERN CALIFORNIA REGIONAL ITS ARCHITECTURE

Phase 2.1 –Imperial County Regional ITS Architecture

Final Draft Version 4.0

March 2005

Prepared by:

NET

In Association With:

URS Corporation
ITS Consensus
Franklin Hill Group
Amelia Regan, Ph.D.
Albert Grover & Associates
Transportation & Energy Solutions

FUNDING

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views of policies of SCAG or U.S. DOT. This report does not constitute a standard, specification or regulation.

CONTRACT INFORMATION

This document is produced as the deliverable for Phase 1 of a series of documents divided into four phases that collectively represent the Southern California ITS Regional ITS Architecture. The value of the contract, Agreement No. 07A1670 is as follows:

Table 1-1: Contract and Sub-Consultants

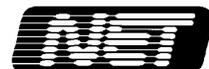| Consultant Team	Contract
Prime Consultant – NET	$315,674
Sub Consultant – URS	$112,973
Sub Consultant – Transportation & Energy Solutions	$44,729
Sub Consultant – Albert Grover Associates	$32,004
Sub Consultant – Franklin Hill Group	$14,952
Sub Consultant – ITS Consensus	$14,040
Sub Consultant – Amelia Regan	$8,100
Total Consultants	$542,472

Table 1-2: Document Revision Table

Version No.	Date Submitted	Comments
Draft 1.0	January 13, 2005	
Draft 2.0	January 28, 2005	
Draft 3.0	February 11, 2005	
Draft 4.0	March 24, 2005	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

APPENDIX A: ACRONYMS AND TERMS

APPENDIX B: CITY TRAFFIC SIGNAL MAPS

APPENDIX C: STAKEHOLDER CONTACT INFORMATION

APPENDIX D: STAKEHOLDER REPORT

APPENDIX E: DISPOSITION OF STAKEHOLDER COMMENTS

APPENDIX F: ITS ISSUES AND NEEDS IDENTIFICATION AND DISCUSSION LIST

APPENDIX G: MEETING AGENDAS, ATTENDEES AND MINUTES

APPENDIX H: INVENTORY REPORT

APPENDIX I: ITS INTERCONNECTS

APPENDIX J: ITS INTERCONNECT DIAGRAMS

APPENDIX K: INFORMATION FLOW DIAGRAMS

APPENDIX L: EXAMPLES OF INTERAGENCY AGREEMENTS
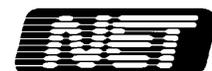
1 INTRODUCTION

1.1 Project Purpose and Background

A regional Intelligent Transportation System (ITS) architecture is an organized view of the world of transportation technology. In the case of Imperial County, which has little previous investment in ITS technology, the Imperial County Regional ITS Architecture provides a framework that includes a vision for the future deployment of ITS applications in Imperial County.

A regional ITS architecture incorporates the existing and planned ITS projects to provide a path to be followed as new projects are conceived, designed and deployed. The Imperial County Regional ITS Architecture is a document but it should also be viewed as a process that will be maintained, revised and validated as needed over the years. This Imperial County Regional ITS Architecture encompasses freeway and arterial traffic management, transit management, security and emergency services management, traveler information and management systems for the Ports of Entry (POE).

The purpose of this document is to describe the introductory system architecture on which future ITS projects in Imperial County will be based. It creates a system inventory, stakeholder lists and a sequence of projects relating to ITS. The document also establishes an agreement for a continuous plan for future architecture implementation and maintenance.

The Federal Highway Administration (FHWA) published a rule (National ITS Architecture and Standards) and the Federal Transit Agency (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 (including transit projects funded from the Mass Transit Account) be in conformance with the National ITS Architecture and appropriate standards. The Imperial County Regional ITS Architecture uses the current National ITS Architecture Version 5.0 and the latest version of the software tool Turbo Architecture version 3.0 for guidance.

1.2 Project Time Frame

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 Imperial County ITS architecture planning horizon was chosen to be twenty years, which is long enough to include most of the system integration opportunities as anticipated by the regional stakeholders.
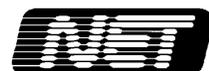
1.3 The Southern California Regional ITS Architecture

The Southern California Association of Governments (SCAG) is the Metropolitan Planning Organization (MPO) for six counties in Southern California. By virtue of its MPO status, SCAG is responsible for building consensus on the Southern California Regional ITS Architecture. This is composed of five county level architecture documents, which represent local stakeholder needs and interests and a separate document that deals with multi county issues of importance to the Southern California region. The Imperial County Regional ITS Architecture is one of the five regional county level architectures, which are as follows:

- Imperial County Regional ITS Architecture
- Inland Empire (i.e. San Bernardino & Riverside Counties) Regional ITS Architecture
- Los Angeles County Regional ITS Architecture
- Orange County Regional ITS Architecture
- Ventura County Regional ITS Architecture

The six county region is illustrated in Figure 1-1. In each case, the local Regional ITS Architecture belongs to the stakeholders who are also responsible for the maintenance and updates to the plan.

1.4 Organization

Following is a summary listing of the chapters and appendices that make up the complete documentation set for the Imperial County Regional ITS Architecture Project. Please refer to Appendix A for a listing of acronyms that are very common in the transportation and technology fields. The document is organized in the following sections that cover all of the federal requirements for regional ITS architecture to be considered consistent with the Rule/Policy:

- Introduction
- Regional Description
- Regional Stakeholders
- ITS Inventory
- ITS User Needs and Services
- Operational Concept
- Functional Requirements
- ITS Interconnects and Information Flows
- Project Sequencing
- Identification of Required ITS standard
- Architecture Maintenance
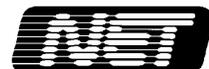
- Interagency Agreements

Appendices:
- Acronyms and Terms
- City Traffic Signal Maps
- Stakeholder Contact Information
- Stakeholder Report
- Disposition of Stakeholder Comments
- ITS Issues and Needs Identification and Discussion List
- Meeting Agendas, Attendees and Minutes
- Inventory Report
- ITS Interconnects
- ITS Interconnect Diagrams
- Information Flow Diagrams
- Examples of Interagency Agreements
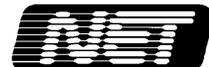
SCAG Region

Figure 1-1: The Six County SCAG Region
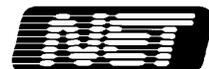
2 REGIONAL DESCRIPTION

This section describes the general demographic, geographic and transportation system characteristics of Imperial County. It is within this context that the Imperial County Regional ITS Architecture will be developed. The Imperial County map in Figure 2-1 shows the major highways and boundaries with the adjacent counties.

2.1 Imperial County

Imperial County has a population of 150,000 and is the smallest of the six SCAG counties by population. Imperial County's geographic area is 4,597 square miles, which is approximately equivalent to Los Angeles County and less than a quarter of the size of San Bernardino County. Imperial County is bordered to the south by the international border with Mexico, to the north by Riverside County, to the east by the State of Arizona and to the west by the San Diego County.

Imperial County is a large, rural and geographically diverse region. Generally speaking, the central and southern portion of Imperial County is the most populous and urbanized area. Only seven cities are incorporated within Imperial County: Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial and Westmorland (see Figure 2-1). The Coyote, Chocolate and Palo Verde Mountains are in marked contrast with the mostly desert region which includes the Algodones Dunes sand dune region to the south of the Chocolate Mountains. Imperial County also contains California's largest inland lake, the Salton Sea, which is a tourist attraction. Imperial County is primarily an agricultural region. Imperial County has no ITS elements or systems. Imperial County has some isolated signals and some are maintained by Caltrans District 11.

Imperial County has a growing tourist industry, based on the attractions of the Imperial Sand Dunes Recreation Area in the eastern portion of Imperial County. There are approximately 51,800 jobs in Imperial County, mostly with agricultural, retail and local government positions. Imperial County has a $2.7 billion Gross County Product, which is low for all counties in California. In 2003, the median family income in Imperial County was about $30,000 while the national average for the same period is $56,500 (U.S. Department of Housing and Urban Development). Imperial County can be characterized as remote and rural, but beginning to show the impacts of development both in terms of increasing traffic across the border with Mexico and commuter pressure from residents from San Diego in search of lower property prices. One recent major project is the Imperial County Mall located in El Centro.
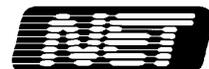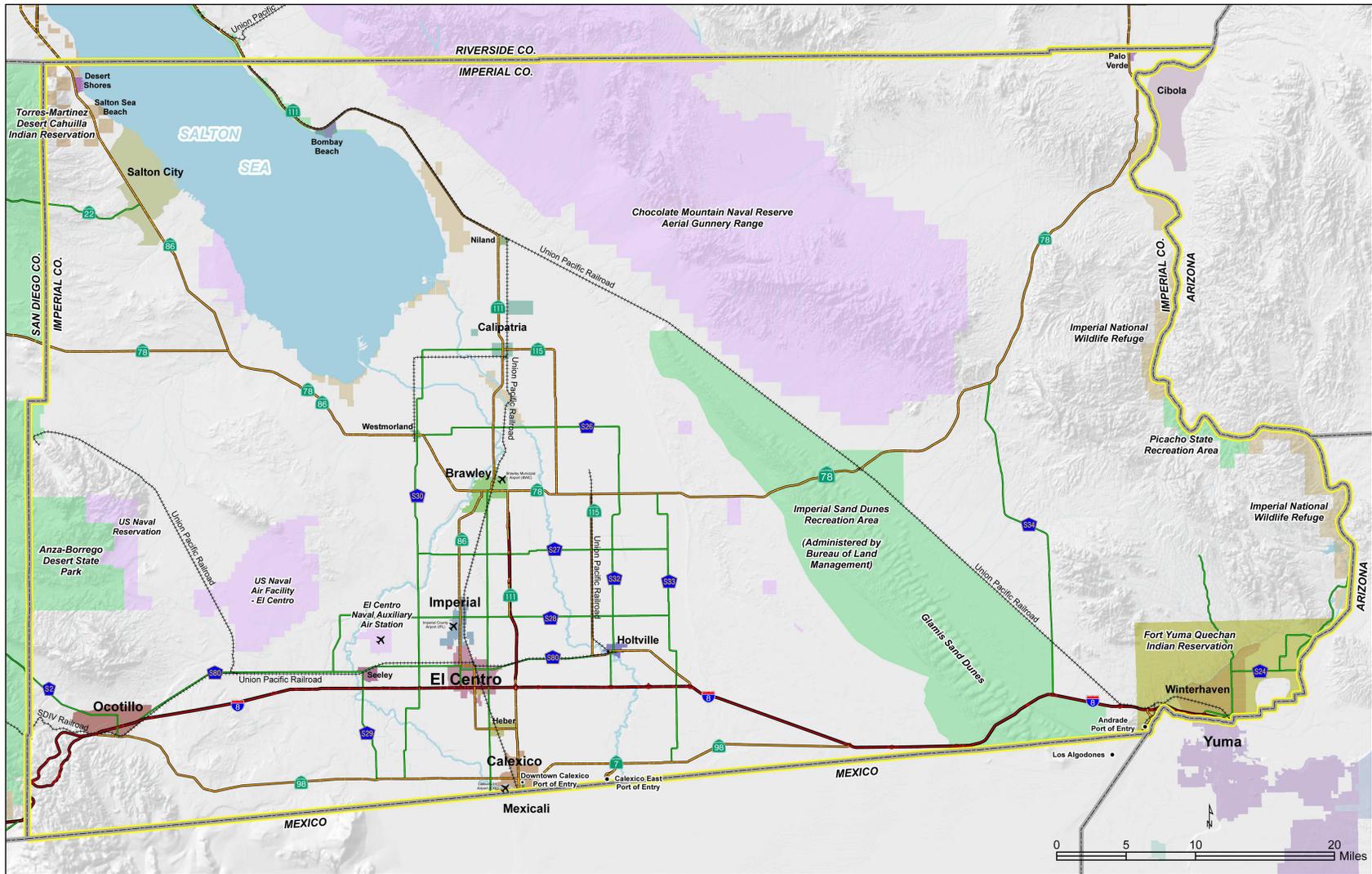
Figure 2-1: Imperial County Map
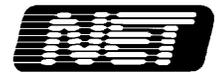
2.2   Transportation Systems

Imperial County is a typical rural county with limited ITS elements outside of the State Department of Transportation, Caltrans. Caltrans District 11 covers both San Diego County and Imperial County, as shown in Figure 2-2. Caltrans District 11 operates and manages the freeway system in Imperial County. Interstate 8 is the only interstate in Imperial County. Seven state highways crisscross District 11's boundaries, mostly in central and southern Imperial County. In addition to Caltrans District 11, Imperial Valley Transit (IVT) is Imperial County's primary transportation agency. Its major service programs include fixed route bus service and paratransit, which operate throughout Imperial County.

Figure 2-2: Caltrans District 11 Map

2.2.1 Major Roadways

Table 2-1 and Table 2-2 summarizes the freeway and major highway systems in Imperial County. The system is currently comprised of one interstate route and seven state highways that serve a mix of transportation functions including international, interregional, intra regional goods movement and commuter traffic.

Definitions of the highway type abbreviations are given below. The facility classifications for the roadways are as follows:

ICES

- Intermodal Corridors of Economic Significance (ICES) provide access between major freight intermodal facilities and serve freight traffic with the NAFTA countries of Canada and Mexico, as well as the Pacific Rim and other U.S. trade markets.

IRRS

- Inter Regional Road System (IRRS) is a series of interregional state highway routes outside the urbanized areas that provides access to and links between, the California's economic centers, major recreational areas and urban and rural regions.

Lifeline

- Statewide List of Lifeline Routes. A lifeline route is a route that is deemed so critical to emergency response/life saving activities of a region or the State that it must remain open immediately following a major earthquake, or for which preplanning for detour and/or expeditious repair and reopening can guarantee through movement of emergency response activities.

NAFTA NET

- The North American Free Trade Agreement (NAFTA) Network consists of transportation corridors that link POE and international border regions to the existing transportation system. These corridors will be the principle conduits for movement of people and goods as the overall demand for transportation increases in and out of California and the United States.

NHS

- National Highway System (NHS) purpose is to provide an integrated national highway system that serves both urban and rural America; to connect major population centers, international border crossings, ports, airports, public transportation facilities and other major travel destinations;
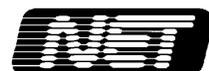
to meet national defense requirements; and to serve interstate and interregional travel

Scenic
- California Scenic Highway System.

STAA
- State Highway Terminal Access Route connecting trucks to the National Network as per the Surface Transportation Assistance Act (STAA), a route system federally designated for use by larger trucks.

Table 2-1: Caltrans District 11 Interstates

Roadway	Classification	Description
I – 8	NAFTA NET, IRRS, NHS	Interstate 8 traverses Imperial County connecting San Diego to Arizona and beyond. Average daily traffic reaches a high of 29,500 in Imperial County. I – 8 serves as an important route for goods, services and people.

Table 2-2: Caltrans District 11 State Highways

Roadway	Classification	Description & Daily Traffic Volume
SR – 7	NAFTA NET, IRRS, ICES, Lifeline	SR – 7 is the only north/south roadway connector to the Calexico East POE, that processes virtually all of the commercial goods movement through the international border from Mexicali to Imperial County and to markets in the Los Angeles area and beyond. Average daily traffic for the constructed portion is 10,000 with a 2020 estimate of 43,000. The portion under construction (to be complete mid 2005) is projected to carry a volume of 38,000 in the year 2020.
SR – 78	NAFTA NET, Scenic	SR – 78 traverses Imperial County connecting San Diego to the Arizona border and provides the only other east/west route besides I – 8.
SR – 86	STAA, IRRS, NAFTA NET, ICES	SR – 86 provides a major conduit for the movement of goods from Mexicali and Imperial County to markets in Los Angeles and beyond.
SR – 98	ICES, IRRS, NAFTA NET, NHS	SR – 98 serves as an alternate east/west route to I – 8 for a portion of Imperial County. Average daily volumes range from 21,900 at the junction of SR – 98/ SR – 111 to 9,300 at the intersection with SR – 7.
SR – 111	IRRS, SHELL,	SR – 111 expressway connects Imperial County with markets
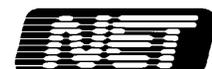
Roadway	Classification	Description & Daily Traffic Volume
	STAA, NHS, ICES, NAFTA NET	in Los Angeles and beyond. SR – 111 connects to the Calexico/Mexicali Port of Entry (POE). This route carries a high volume of goods produced both in Mexicali and Imperial County.
SR – 115	IRRS, NHS, STAA, ICES, NAFTA NET	SR – 115 serves as an alternate north/south route from I – 8 to SR – 78 for both goods movement and regional traffic.
SR – 186	IRRS, STAA	SR – 186 connects the Andrade POE within Imperial County to I – 8. Although only two miles in length, this route carries a high volume of traffic, especially during the winter months for travelers to Mexico for medical, dental and pharmaceutical purposes.

2.3 Imperial County Commuting

A recent change in commuting patterns has occurred in Imperial County. Due to the rising cost of homes and land in the San Diego County region, Imperial County home sales and residential growth have increased substantially, with some new homeowners commuting to San Diego for employment. However, San Diego is 118 miles away from Imperial County. For commuters from Imperial County, there are only two main roadway choices: I – 8 or SR – 78. SR – 78 is mainly a two lane road crossing through the mountainous areas and is not a time efficient route. I – 8 is the logical route for commuters. I – 8 increases in congestion and delay as commuting volumes increase. To gain statistical data, there is interest in studying commuting patterns and their development further.

2.4 Airports

Imperial County has three main airports: Brawley Municipal Airport, Calexico International Airport and Imperial County Airport. There is also the Cliff Hatfield general aviation field in the City of Calipatria.

Brawley Municipal Airport (BWC) is the primary agricultural airport in Imperial County. It is owned and operated by the City of Brawley. Calexico International Airport (CXL) is the primary international commercial airport in Imperial County. It is owned and operated by the City of Calexico and is considered an international POE. Imperial County Airport (IPL) is the primary commercial airport in Imperial County. It is owned and operated by the County of Imperial.

The Naval Air Facility – El Centro (NAF) is located west of the cities of El Centro and Imperial. Figure 2-1 shows NAF – El Centro along with the El Centro Auxiliary Air
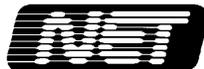
Station. Because military bases are federal installations, NAF – El Centro maintains its own Public Works Department, along with emergency management services and an independent Fire Department. The Air Force Blue Angles are stationed at NAF – El Centro and provide a popular tourism trip generator for the annual air show. Waiting at the security gates for entrance into NAF – El Centro for this event typically takes several hours with the amount of residents and visitors attending.

2.5   Rail

Imperial County has no passenger rail service at this time. There is planned to be limited passenger train service on the Carrizo Gorge Railway. Union Pacific Railroad is the main commercial railroad in Imperial County for goods movement along with San Diego/ Eastern Railroad in the southwest portion of Imperial County.

2.6   Transit

Imperial County provides limited bus service through Imperial Valley Transit (IVT) and commercial bus operations, such as Greyhound bus service to the cities of Brawley, Calexico, El Centro, Imperial and Westmorland, along with service to the Salton Beach area. User request services includes Dial a Ride, which is IVT's shared ride service for people meeting the Americans with Disabilities Act (ADA) eligibility criteria.   At this time, one of the key uses of the Dial a Ride services is to gain access to healthcare services at local medical clinics and pharmacies.

2.7   Imperial County Cities

There are seven incorporated cities in Imperial County. Their population, size and the level of transportation services are essentially similar as described in Table 2-3. The traffic through Imperial County is fairly significant considering the relatively small populations of each of the cities. This section provides a brief description to each city. Maps for each of the cities are included in Appendix B along with locations of city and Caltrans District 11 traffic signals.

The cities are approximately 120 miles east of San Diego, the nearest metropolitan area in California. The main north – south corridor that these cities are located is a gateway for NAFTA between the ever growing corridor of commerce between Mexico to Los Angeles and beyond.
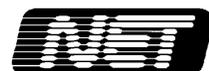
Table 2-3: Imperial County City Descriptions

City	Square Miles	Population	Location	Brief Description
Brawley	7	23,800	Central Imperial County, north of City of Imperial and south of Calipatria, 26 miles north of the Mexican border. Brawley is located at the intersection of SR – 78, SR – 86 and SR – 111, close to SR – 115.	Because Brawley is located in the center of the seven incorporated cities in Imperial County, increased traffic volumes occur as travelers generate trips through Brawley on their way to their destination, including trips between San Diego County, Riverside County, Arizona and Mexico. Brawley is currently the second busiest produce shipping point in California.
Calexico	6	32,600	Central Imperial County, adjacent to City of Mexicali in Mexico. Calexico is located at the intersection of SR – 98 and SR – 111. Calexico is also close to SR – 86 and SR – 7.	Calexico is a gateway to the U.S. Mexican border. Calexico West (downtown) is one of the three international POE for Imperial County. Calexico East is six miles east of Calexico, is located on SR – 7 and is one of the other international POE for Imperial County. Calexico generates substantial trips for Imperial County, especially international border crossing trips.
Calipatria	2	7,850	Central Imperial County, north of Brawley and south of Salton Sea, 33 miles north of the Mexican border.	The population of Calipatria includes a prison population of approximately 4,000.
El Centro	12	40,500	Central Imperial County and location of County seat, south of City of Imperial, 10 miles north of the Mexican border. El Centro is located at the intersection of I – 8 and SR – 86.	Because El Centro is the location of the Imperial County seat, many educational, recreational, governmental and business activities take place that generate substantial traffic locally. El Centro generates traffic from population and employment centers, such as the new federal courthouse that is anticipated to generate substantial traffic for El Centro and the U.S. Border Patrol sector headquarters that is located in El Centro. Emergency services and emergency vehicular traffic is high in El Centro

City	Square Miles	Population	Location	Brief Description
				because El Centro contains the largest hospital and most of the regional medical facilities in Imperial County. An important transportation project for the City of Brawley is the SR – 78 / SR – 111 Brawley Bypass. Due to a shortfall in funding, the project is not expected to be complete until 2020.
Holtville	1	5,825	Eastern Imperial County, east of El Centro and west of Winterhaven, 16 miles north of the Mexican border. Holtville is located on SR – 115 and is also close to I – 8 and SR – 111.	Travelers often generate trips through Holtville between Brawley and Yuma, Arizona.
Imperial	8	9,425	Central Imperial County, north of El Centro and south of Brawley, 15 miles north of the Mexican border. Imperial is located on SR – 86 and is close to I – 8 and SR – 78.	Travelers often generate trips through Imperial on trips between Brawley and El Centro. The City of Imperial is the headquarters of the Imperial Irrigation District (IID), one of the largest irrigation districts in the world and the sixth largest power utility company in California.
Westmorland	1	2,250	Western Imperial County, west of Brawley and south of Salton Sea, 30 miles north of the Mexican border. Westmorland is located on SR – 78, close to SR – 86 and SR – 111.	Travelers often generate trips through Westmorland when traveling to Riverside County, San Diego County and the western Salton Sea area.
Unincorporated Cities		34,300	See Figure 2-1	Including Bombay Beach, Desert Shores, Glamis, Heber, Niland, Octotillo, Palo Verde, Salton City, Salton Sea Beach, Seeley, Winterhaven, etc.
Total Imperial County	4,597	156,550		
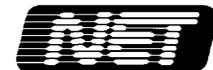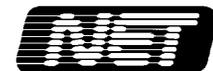
2.8   Imperial County Traffic Signal Summary

Caltrans District 11 has fifty three signals that they operate and maintain in Imperial County. The seven incorporated cities in Imperial County collectively have twenty five signals within city limits. The cities of Brawley and Calexico collectively have nineteen planned additional signals. Imperial County has four current county signals and four planned additional signals. As the cities in Imperial County continue to experience growth and expansion, they may consider options for coordinating their signals and may ultimately even consider centrally controlling their signals. The objective will be to improve traffic management to enhance traffic flow and safety. The traffic signals of the cities of Imperial County as well as Imperial County listed in Table 2-4.

Table 2-4: Traffic Signals in Imperial County

City	City/County Signals	Caltrans Signals	Total Traffic Signals	Planned Additional Signals
Brawley	0	13	13	4
Calexico	3	12	15	15
Calipatria	0	0	0	0
El Centro	21	15	36	0
Holtville	0	0	0	0
Imperial	1	3	4	4
Westmorland	0	0	0	0
County of Imperial	4	10	14	4
Total	29	53	82	29

2.9   Emergency Management Services

This section provides a high level description without many details of the Emergency Management Services (EMS) within Imperial County.   This includes agencies responsible for law enforcement, incidents response, fire and rescue services.

2.9.1   California Highway Patrol

The California Highway Patrol (CHP) provides legal enforcement, traffic patrols and response to incidents and emergencies on California highways. Their area of jurisdiction is all freeways, all state routes and some roadways in Imperial County's unincorporated areas.
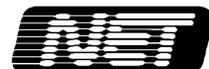
The CHP dispatch center is located in the City of Imperial. CHP staff take 911 calls and gathers other information such as status reports, traffic flow data and weather data from Caltrans and disseminates it to the field staff. The field staff includes CHP officers, allied agencies such as local agency police or public works and private firms with contracts to clean up potential hazardous material spills.

2.9.2 Imperial County Sheriff and Fire Departments

Imperial County has a Sheriff Department and Fire Department that provide law enforcement, fire protection and emergency management services in unincorporated areas of Imperial County as well as to certain city jurisdictions, as needed. These departments are dispatched through Imperial County 911 centers that are equipped with Computer Aided Dispatch (CAD) systems, which allow dispatchers to initiate emergency response through radio dispatch communications and then track response activities performed by field personnel.

The Imperial County Fire Department has county staff and also reserve firefighters. Imperial County shares one fire truck with the City of Brawley. All other fire trucks belong to Imperial County. Imperial County firefighters co-locate with the City of Imperial Fire Department staff.

2.9.3 City EMS Departments

All incorporated cities have their own police departments, which handle law enforcement and emergency management services for their jurisdictions. The City of Brawley is a Public Safety Answering Point (PSAP) that handles the emergency dispatch for Brawley, Calipatria and Westmorland. Calexico and Holtville are a PSAP for themselves. The City of El Centro is a PSAP for El Centro and the City of Imperial.

All incorporated cities have their own fire departments, except for the City of Westmorland, which has volunteer firefighters. City fire departments handle fire protection and emergency management services for their jurisdictions. The City of Calipatria has volunteer/reserve firefighters in addition to city fire department staff. The City of Holtville has volunteer firefighters in addition to city fire department staff. The City of Imperial has city fire department staff and also co-locates with Imperial County firefighters. The City of Brawley maintains one Imperial County fire truck at their facility.

2.10 Imperial County Tourism

Due in part to the mild winter climate, Imperial County is a popular destination for winter visitors and tourists from many different places. Tourism is an important part of the Imperial County economy. It is estimated that the Imperial County receives more than
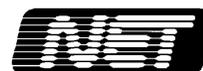
$261 million annually in tourism dollars. This figure translates into almost $76 million in annual payroll and 5,300 jobs.

The tourism related sector accounts for the fifth largest number of people employed, following government, agriculture, retail and services. A variety of events and attractions draw visitors to the Imperial County, including:

- Brawley Cattle Call – Approximately 50,000 tourists annually
- California Mid Winter Fair
- El Centro Snowbird Breakfast
- Holtville Carrot Festival
- Naval Air Facility – El Centro Air Show
- Niland Tomato Festival
- Imperial San Dunes and desert regions which offer off-roading, camping and historical heritage opportunities
- The Colorado River, offering recreation and history
- The Salton Sea and Salton Sea Bird Festival which offer opportunities for bird watching and fishing
- The University of California Desert Research Station which offers tours of the Imperial Valley, highlighting the area's different types of crops and agricultural methods

The Salton Sea in the northwestern part of Imperial County is the largest inland lake in California and is considered a substantial tourism and trip generator for Imperial County. The Salton Sea Recreation Area hosts hundreds of thousands of visitors each year. Up until the mid 1980s, the Salton Sea State Park hosted more visitors annually than Yosemite. Besides fishing, the tourism industry has offered boating, camping, use of personal watercraft and picnicking for outdoor and water based recreation seekers. The following agencies provide oversight of recreational areas in Imperial County.

2.10.1 Bureau of Land Management

With an estimated 12,000–15,000 winter visitors staying in Imperial County each year, an adequate number of places to stay becomes important. Imperial County has a number of recreational vehicle (RV) parks with approximately 2,700 available spaces for vehicles. The Bureau of Land Management (BLM) has roughly 5,000–6,000 spaces in the unincorporated areas of Imperial County. In addition, an area outside of Niland offers trailer spaces and the NAF – El Centro has 92 spaces, mostly for retired military.

Imperial Sand Dunes Recreation Area is the largest mass of sand dunes in California. This dune system extends for more than 40 miles along the eastern edge of the Imperial County agricultural region in a band averaging five miles in width. It is roughly bordered
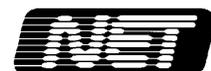
on the west by the Coachella Canal that delivers Colorado River water to the fertile agricultural valley to the north. A major east/west route of the Union Pacific Railroad traverses the eastern edge.

The Imperial Sand Dunes Recreation Area is a growing tourist attraction that generates many recreational trips, particularly on holiday weekends, illustrated in Table 2-5. Visitors come from all over California and the U.S., with many from San Diego County, Los Angeles County and Arizona. This results in traffic problems and accidents on rural access roads. Most visitors have their own RV or camp and typically do not utilize Imperial County hotel accommodations. Unfortunately, visitors overall contribute little to the local economy or to the upkeep and maintenance of the park or the access roads.

The BLM currently manages the Imperial Sand Dunes Recreation Area along with providing limited traveler information, mostly in the form of brochures and tourism information. Weekend and holiday use of the Imperial Sand Dunes Recreation Areas is very popular with tourist volume listed in Table 2-5. This excessive crush of visitors leads to traffic incidents and congestion that are beyond the resources of the local agencies to control or manage.

Table 2-5: Weekly Imperial San Dunes Tourist Volume

Holiday	Weekly Tourist Volume
Easter	40,000
Martin Luther King, Jr. Day	60,000
President's Day	65,000
Halloween	70,000
New Years	130,000
Thanksgiving	160,000

2.10.2 Native American Tribes

Two Native American tribes are located in Imperial County, the Torres – Martinez Desert Cahuilla Indian tribe in the northeast area of Imperial County (shared with Riverside County) and the Quechan – Fort Yuma Indian tribe in the southeast area of Imperial County (shared with Yuma, Arizona). Figure 2-1 shows the location of reservation areas for both Native American tribes in Imperial County. Because Native American tribes in California offer gaming casinos as a form of tourism and revenue,
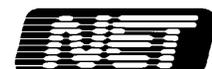
transportation projects and access to current and planned casino locations is important to the success of Native American activities.

2.11 U.S. Department of Customs and Border Protection

In March 2003, the U.S. Department of Homeland Security (DHS) formed absorbing the former agencies of U.S. Coast Guard, Customs Service, Border Patrol, Immigration and Naturalization Service, Transportation Security Administration and others. Collectively, these public agencies are responsible for protecting our nation's transportation systems and supervising the entry of people and goods into the U.S. DHS is responsible for protecting the movement of international trade across U.S. borders, maximizing the security of the international supply chain and for engaging foreign governments and trading partners in programs designed to identify and eliminate security threats before they arrive at U.S. ports and borders.

The U.S. General Services Administration (GSA) owns and administers the three POE in Imperial County. Any physical improvements in technology or infrastructure to the POE are approved and coordinated through the facilities division of the GSA.

2.11.1 Border Patrol

The U.S. Border Patrol is the mobile uniformed law enforcement arm of the DHS. The U.S. Border Patrol has 20 sectors responsible for detecting, interdicting and apprehending those who attempt to illegally enter or smuggle people, including terrorists, contraband or weapons, across U.S. borders between official POE. Border Patrol in Imperial County patrols all of the Mexico – California border between San Diego County and Arizona, excluding the three POE.

Over the past 25 years, there has been a significant increase of illegal migration to the U.S. The U.S. Border Patrol responded with increases in manpower and the implementation of modern technology, including ITS elements in the 1980s and 1990s. Infrared night vision scopes, seismic sensors and a modern computer processing system helped Border Patrol locate, apprehend and process those crossing into the U.S. illegally.

In general, homeland security became a primary concern of the U.S. after 2001. Border security became a topic of increased interest politically. Funding requests and enforcement proposals were reconsidered as lawmakers began reassessing how our nation's borders must be monitored and protected sometimes utilizing ITS elements.
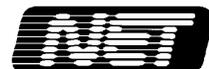
2.11.2 Ports of Entry

The U.S. Department of Homeland Security, Customs and Border Protection Division oversees the operations of Port(s) of Entry (POE). The three POE for Imperial County are Downtown Calexico West (passengers only), Calexico East (passengers and cargo) and Andrade. The three POE in Imperial County are illustrated in Figure 2-1. The three POE in Imperial County are considerable traffic point sources, as many commercial vehicles and goods enter from Mexico through the POE to Imperial County. Individuals seeking entry into the U.S. are inspected at POE to determine their admissibility. POE controls and guards the boundaries and borders of the U.S. against the illegal entry of people and goods.

Calexico has considerable traffic management issues in relation to the international POE. In addition to congestion for Calexico and obstructing normal traffic flow, the POE traffic affects air quality, limits economic development by altering access to business in Calexico and impedes emergency services and law enforcement responsibilities. Approximately 37,000 vehicles pass through the Calexico West (downtown) POE on a daily basis. By 2020, it has been calculated that traffic passing through this POE will double. Average queue times are between 40 – 90 minutes to cross into Mexico from Calexico. Queues are expected to increase due to growth in traffic and may be affected by the implementation of national security programs such as the U.S. VISIT that will affect traffic both entering and leaving the U.S. It is generally agreed that additional POE gates will be instrumental in relieving congestion at the POE, such as reusing a 1996 closed commercial POE.

Table 2-6 indicates the 2004 volume of persons and conveyances at the Calexico West (downtown), Calexico East and Andrade POE. These 2004 values are based on the fiscal year of July 1, 2003 through June 30, 2004, rather than the calendar year of 2004.
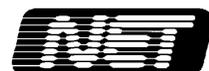
Table 2-6: 2004 Imperial County POE Traffic Volumes

Mode of Transportation	Calexico West (Downtown) POE	Calexico East POE	Andrade POE
Persons Total	**15,950,571**	**6,991,620**	**3,628,255**
Pedestrians on Foot	5,339,244	3,195	1,953,513
Passengers in Vehicles	10,590,421	6,587,376	1,667,227
In Commercial Trucks	0	390,154	5,824
In Buses	13,572	9,131	1,691
In Trains	0	1,764	0
In Private Aircraft	7,334	0	0
Vehicles Total	**5,657,189**	**3,538,023**	**765,525**
Passenger Vehicles	5,652,330	3,228,938	762,815
Commercial Trucks	0	300,041	2,670
Buses	1,621	404	40
Trains	0	252	0
Rail Containers	0	8,388	0
Private Aircraft	3,238	0	0

2.11.3 ITS Projects for Ports of Entry

The POE and Caltrans District 11 are the primary owners and operators of all ITS elements in Imperial County. The POE is a federal agency with many ITS projects and elements currently in use or planned as part of future POE expansions. The POE currently has a website (http://apps.cbp.gov/bwt) that displays real time wait and crossing times at the POE for commercial vehicles and passenger vehicles. Additional ITS projects that have been or are in the process of deployment are listed below. These ITS projects are related to local projects proposed as part of the Regional ITS Architecture but are covered more specifically in the National ITS Architecture.

ITS projects for the POE include SENTRI (for U.S. and Mexico) and FAST Programs (for commercial shipments). Secure Electronic Network for Travelers Rapid Inspection (SENTRI) is the world's first automated dedicated commuter lane that was initiated in San Diego County. SENTRI uses ITS technology with advanced Automatic Vehicle Identification (AVI) technology to meet the stringent law enforcement needs at the border and reduce congestion by providing efficient traffic management. SENTRI is a
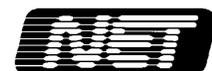
border management process that accelerates the inspections of pre-enrolled travelers at the POE. SENTRI identifies travelers, verifies their identification and screens approved participants and their vehicles every time they enter the U.S.

For a vehicle at a POE, concrete barriers create a chute that captures the SENTRI traffic and puts it under an inspector's zone of control. At the entrance of the zone, an in ground inductive loop and a free standing light curtain sense the vehicle and enable the SENTRI AVI system. The AVI antennae communicates with a transmitter located on the enrolled participant's vehicle. Once alerted, a computer locates data about the vehicle and its authorized travelers and stores the data for ready access and display.

As a vehicle continues through the chute and approaches the inspector's booth, a second set of AVI equipment activates and sends the information (generated by the first AVI reader) to a computer screen in the inspector's booth. The inspector's color panel contains information the inspector needs for validation of both the vehicle and its occupants. The screen shows the vehicle information as well as digitized pictures of the approved SENTRI participants with their name and citizenship. Upon reaching the booth, the driver stops, reaches out the window and swipes an electronically coded PortPass card through a magnetic stripe card reader. If both the inspector and the SENTRI electronic equipment compare the information and approve, the traffic light turns green, the exit gate raises, the tire shredders retract and the traveler can drive into the U.S. A combination of electric gates, tire shredders, traffic control lights, fixed iron bollards and popup pneumatic bollards ensure physical control of the border crosser and their vehicles.

Free and Secure Trade (FAST) is the first complete paperless cargo release mechanism initiated by the DHS. This paperless processing is achieved through transponder technology and advanced electronic transmission of information, including registration of manufacturer, importer, carrier and commercial vehicle driver to carry a FAST Commercial Driver Card. Future FAST modifications will expand eligible electronic cargo release methods. The FAST processing of Pre-Arrival Processing System (PAPS) is currently in use in Calexico and will commence at locations along the U.S. and Mexico border. FAST is most important for its pre-clearance aspects. The Customs Trade Partnership Against Terrorism (CT-PAT) program allows only trusted secured carriers to participate to enroll, making the process faster for secure, known shippers.

2.12 Institutional Complexity of Imperial County

Like any other county, Imperial County has many different groups of stakeholders. Stakeholders often have only a peripheral interest in transportation and little if any knowledge of Intelligent Transportation Systems. Imperial County is severely limited by funding and staff allocation. In Imperial County, there is no formal forum to exchange
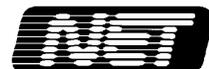
views on transportation projects and initiatives suffer from limited resources and lack of knowledge and advanced transportation skills necessary to support the pursuit of funding. The institutional complexity of Imperial County is illustrated by a summary of the public agencies that participate in the planning, implementation, operation, management and maintenance of the transportation system. These agencies and their brief descriptions are summarized in Table 2-7.

Table 2-7: 2004 Transportation Agencies in Imperial County

Agency	Responsibility and Authority
Brawley Municipal Airport	Brawley Municipal Airport (BWC) is the primary agricultural airport in Imperial County. It is owned and operated by the City of Brawley.
Calexico International Airport	Calexico International Airport (CXL) is the primary international commercial airport in Imperial County. It is owned and operated by the City of Calexico and is considered an international POE.
Caltrans District 11	Caltrans District 11 is responsible for the design, construction, maintenance and operation of the highway system in Imperial County. Caltrans District 11 produced the 2002 Imperial County Regional Transportation Plan.
California Highway Patrol	California Highway Patrol (CHP) enforces traffic laws and regulations on the freeways in Imperial County. CHP constantly monitors the network through data provided by Caltrans District 11 and the public and responds quickly by dispatching emergency vehicle and field staff to take control of incidents and manage congestion.
Cities of Imperial County	There are seven incorporated cities in Imperial County and their size, population and transportation network complexity varies marginally. With respect to transportation operation and maintenance, no cities at this time are equipped with their own Transportation Management Center (TMC). Most signals within cities are operated and maintained by Caltrans District 11.
Imperial County	Imperial County is responsible for the operation and maintenance of Imperial County's unincorporated areas and at the Imperial County airport. Imperial County provides funding mechanisms for the regional transportation systems and Imperial Valley Transit (IVT).
Imperial County Airport	Imperial County Airport (IPL) is the primary commercial airport in Imperial County. It is owned and operated by the County of Imperial.
Imperial County Fire Department	Imperial County Fire Department assists the CHP in clearing accidents on highway that have fire and or explosive hazards.

Agency	Responsibility and Authority
Imperial Valley Association of Governments	Imperial Valley Association of Governments (IVAG) is a member of the Southern California Association of Governments (SCAG) and represents the interests of Imperial County.
Imperial Valley Transit	Imperial Valley Transit (IVT) is Imperial County's only transportation agency. IVT operates the transit system and plans and coordinates regional transportation systems.
Southern California Association of Governments (SCAG)	The Southern California Association of Governments (SCAG) prepares and updates the regional transportation planning documents including the Regional Transportation Plan (RTP) and Regional Transportation Improvement Plan (RTIP). Projects in receipt of state and federal funding must be included in the RTIP process.
Union Pacific Railroad	Union Pacific Railroad is the only national rail service provider. Union Pacific Railroad only accommodates cargo at this time.
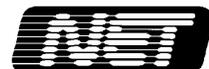
3   REGIONAL STAKEHOLDERS

The process of a regional ITS Architecture development is a process of consensus building. The participation and agreement in principal of a diverse set of local stakeholders is critical to the success of Imperial County's ITS Architecture. In the context of this project, stakeholders are defined as a core set of public agencies with transportation related management, oversight and responsibility in Imperial County.

Agencies that were contacted and invited to participate in the project include county, state, federal agencies and private sector members, as listed in Table 3-1. Additional stakeholders will be identified and contacted throughout the life of the project.

In addition to this core group, the participation of all local stakeholders with their input and involvement was encouraged at all stages of the architecture development. Many tools were used to facilitate communication and expand stakeholder outreach, including a project website, stakeholder interviews, meetings and workshops. The detailed contact information is listed in Appendix C. The complete stakeholder report is included in Appendix D.

3.1   Project Website

The project website at www.nateng.com/scagarch provides project deliverables and other project related materials such as meeting agendas and minutes, project contacts and workshop presentations for downloading. The project website greatly facilitated and expedited the communication with the stakeholders and the documentation of their feedback. The disposition of stakeholder comments and feedback to the project is located in Appendix E.

The project website will be transferred from the current NET site to the SCAG website after the project completion, approximately May 2005. Stakeholders will be notified via email of the exact website location for the project and are encouraged to visit www.scag.ca.gov to check for new information regarding Imperial County.
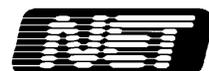
Table 3-1: Initial Stakeholders Involved

Agency	Department
California Highway Patrol	Dispatch Center
Caltrans – District 11	TMC, Construction, Imperial County Field Equipment, ITS, Planning, Signal Operations
City of Brawley	City Manager, Chamber of Commerce, Mayor, Planning, Police, Public Works
City of Calexico	Airport, City Manager, Chamber of Commerce, Fire, Police, Public Works
City of Calipatria	City Manager, Chamber of Commerce, Fire, Police, Public Works,
City of El Centro	City Manager, Chamber of Commerce, Police, Public Works
City of Holtville	City Manager, Chamber of Commerce, Police, Public Works
City of Imperial	City Manager, Chamber of Commerce, Planning, Public Works
City of Westmorland	Public Works
Federal Highway Administration	International Transportation Programs, ITS
Federal Transit Administration	ITS
The Holt Group	Planning
Imperial County	Administration, Airport, Health, Planning, OES, Public Works, Sheriff
Imperial Irrigation District	Board of Directors
Imperial Valley Association of Governments	Elected officials
Imperial Valley Emergency Communications Authority	Appointed officials
Imperial Valley Transit	Laidlaw International
Quechan – Fort Yuma Indian Tribe	Economic Development Administration
Torres – Martinez – Desert Cahuilla Indian Tribe	Roads Management
U.S. Customs and Border Protection	Border Patrol, POE
U.S. Dept of the Interior	Bureau of Land Management
U.S. General Services Administration	Border Station
Union Pacific Railroad	Industry & Public Projects
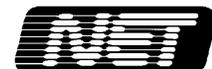
3.2 Stakeholder Interviews

Interviews with Imperial County stakeholders were conducted to gather a complete and up to date ITS inventory. These meetings were also an opportunity to discuss well as the needs, vision, ideas and planned transportation projects of the stakeholders. A questionnaire based on the National ITS Architecture Turbo Architecture software was administered with approximately 90 questions covering arterials, freeways, transit, traveler information, emergency management and maintenance and construction for transportation elements. The issues and needs identification and discussion handout can be found in Appendix F. In person interviews were conducted whenever possible and phone calls, emails and faxes were used as follow up.

The stakeholders agencies interviewed include:

- Brawley Municipal Airport
- Bureau of Land Management
- Calexico International Airport
- California Highway Patrol
- Caltrans District 11
- The seven incorporated cities of Imperial County, including Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial and Westmorland
- Imperial County
- Imperial County Airport
- Imperial County Fire Department
- Imperial County Office of Emergency Services
- Imperial County Sheriff Department
- Imperial Valley Association of Governments
- Imperial Valley Emergency Communications Authority
- Imperial Valley Transit
- Native American Tribe – Quechan – Fort Yuma Indian Tribe
- Native American Tribe – Torres – Martinez Desert Cahuilla Indian Tribe
- Naval Air Facility – El Centro – Public Works and Fire Departments
- Union Pacific Railroad
- U.S. Customs and Border Protection – Border Patrol
- U.S. Customs and Border Protection – Port of Entry
- U.S. General Services Administration

3.3 Meetings and Workshops

The project team has conducted twelve stakeholder meetings and workshops between November 2004 and March 2005. The dates and major objectives of each meeting are
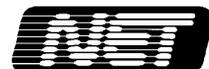
given in Table 3-2. Meeting agendas, meeting attendee list and meeting minutes for each meeting can be found in Appendix G.

Table 3-2: Imperial County Stakeholder Meetings

Date	Purpose
11 / 02 / 2004	Stakeholder meeting to discuss IVAG issues
11 / 03 / 2004	Meeting with Caltrans District 11 on highway system inventory, issues, plans and suggestions
11 / 03 / 2004	Stakeholder meeting to discuss city and county issues
11 / 22 / 2004	Stakeholder meeting to discuss city and county issues
11 / 29 / 2004	Stakeholder meeting to discuss city and county issues
12 / 08 / 2004	Project Kick – Off Meeting including regional description, stakeholders, inventory status, planned meetings, introduction to the inventory survey, status building and call for suggestion on deliverables
01 / 12 / 05	Initial presentation to the Management Committee of Imperial County Association of Governments (IVAG)
01 / 13 / 05	Project meeting including user needs, concept of operations, functional requirements, an outline of project sequencing, progress and status report, suggestion and feedback collection
01 / 20 / 05	Meeting with Union Pacific Railroad on rail issues, plans and suggestions for projects in Imperial County
02 / 17 / 05	Project meeting including interface flows and interface requirements, standards, full project sequencing, architecture review and maintenance
03 / 09 / 05	Final presentation to the Management Committee of Imperial County Association of Governments (IVAG)
03 / 23 / 05	SCAG Presentation to the full Regional Council of the Imperial County Association of Governments (IVAG)
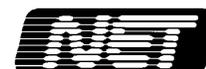
4 ITS INVENTORY

As defined in the FHWA Rule, 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. The focus of this section is on identifying ITS related elements, both existing and planned, within Imperial County. It is important to identify the ITS owners and/or operators, the operation centers and the connections (communication links and data flows) between elements and to other systems. The total number of various ITS elements (such as signals and CCTV cameras, etc.) that exist, their locations and the specific technologies applied are not critical in developing the Imperial County Regional ITS Architecture.

The methodology used to compile an ITS inventory for the Imperial County consisted of distributing survey questionnaires, exchanging phone calls and emails, conducting meetings and workshops and reviewing documents that provide additional information concerning existing ITS elements in the Imperial County. After the complete data collection, the Imperial County ITS system was organized and presented at the county level. The county level inventory includes all systems whose stakeholder are county level agencies, such as Caltrans District 11 and IVT.

Imperial County is primarily rural and agricultural with very limited advanced transportation technology. At this time, only Caltrans District 11 is equipped with sophisticated and comprehensive ITS systems for freeway operations. However, the majority of ITS elements that Caltrans District 11 utilize resides in the more urbanized San Diego County, which is adjacent to Imperial County. The complete ITS inventory report is located in Appendix H. The cities and Imperial County operate basic traffic signals.

4.1 City Level Systems

The ITS capabilities of the cities vary little through Imperial County. Table 4-1 lists the ITS systems that exist in all the cities in the Imperial County, along with Imperial County information. These cities have a few signals with interconnects but are not equipped to communicate. Those signals that have communication have dial up service. Most cities have a goal of upgrading their current system and eventually using 170/2070 or a NEMA based system. Improved signal coordination will likely be included as projects of importance in the future. For reference purposes, Appendix B includes city maps with the current signal locations identified.

Signal preemption does not exist but is desired for future functionality in Imperial County. For emergency services, most cities have their own police and fire department, whose responsibilities include call taking, dispatching emergency vehicles with computer aided dispatch (CAD). Table 4-1 lists the ITS systems for the cities in
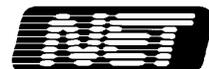
Imperial County including signal pre-emption, signal coordination and emergency services.

Table 4-1: ITS Systems in Cities in Imperial County

City/County	Signal System					Emergency Service	
	# Of Signals	Signal Coordination	Signal Preemption	Operator	Maintainer	City Police Department	City Fire Department
Brawley	13	N	N	Caltrans	Caltrans	Y	Y
Calexico	15	N	N	Caltrans & Self	Caltrans & Self	Y	Y
Calipatria	0	N	N	-	-	Y	Y
El Centro	36	N	N	Caltrans & Self	Caltrans & Self	Y	Y
Holtville	0	N	N	-	-	Y	Y
Imperial	4	N	N	Caltrans, County & Self	Caltrans & Self	Y	Y
Westmorland	0	N	N	-	-	Y	Y
County of Imperial	14	N	N	Caltrans & Self	Caltrans & Self	Y	Y

4.2   County Level Systems

Table 4-1 lists the ITS systems in Imperial County including signal pre-emption, signal coordination and emergency services.

4.2.1 Caltrans District 11

Center
- Caltrans District 11 TMC is located at 7183 Opportunity Road, San Diego, CA 92111. It controls, monitors and maintains all freeway systems and their field devices (if applicable) in Imperial County.

Maintenance/Construction
- Caltrans District 11 provides maintenance services by dispatching vehicles, managing work zone activity, receiving weather information, controlling work zone traffic and vehicle speeds, alerting on work zone intrusion and sharing these data with other agencies.
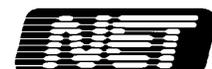
Roadside Equipment
- VDS, CCTV, CMS, HAR are all connected to the center.

Signals
- Caltrans District 11 maintains most of the signals within Imperial County that are mostly isolated intersections along state highways. These traffic signals and controllers are maintained and operated locally in Imperial County by Caltrans staff assigned as Local Assistance Engineers.

Traveler Information
- Caltrans District 11 currently uses Web and cable TV. Caltrans District 11 plans to add In Vehicle Signing (IVS), email and personal data devices.

4.2.2 California Highway Patrol

Center
- CHP dispatching center in Imperial County is located at 2331 Highway 86, Imperial, CA 92251. CHP is in charge of emergency response on Imperial County freeways, responsibilities include detecting all kinds of disasters, receiving incident data from public calls or other centers, dispatching with computer aid, notifying all responding agencies, alerting public about severe events or potential disasters, providing related traveler information to the public and supporting disaster evacuation, reentry and recovery.

4.2.3 Imperial County

Emergency Management
- Imperial County has both a County Sheriff Department and Fire Department. Imperial County Fire Department is co-located with the City of Imperial Fire Department.
- The Office of Emergency Services (OES) is a department within Imperial County. There is a new 800 MHz radio system shared between Imperial County staff and Imperial Valley Emergency Communications Authority (IVECA). OES dispatches maintenance vehicles, control automated maintenance scheduling, collect road and weather info, monitor work zone traffic and activities and share maintenance information with other agencies.
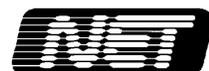
Signals
- Imperial County currently has four county signals that it operates and maintains. Imperial County currently has ten signals operated and maintained by Caltrans District 11. These signals use closed loop control and don't have signal preemption for emergency vehicles at this time. An additional four signals are planned for Imperial County.

Security Monitoring Field Equipment
- Imperial County may have future ITS elements in coordination with U.S. Border Patrol and U.S. POE field equipment.

4.2.4 U.S. Border Patrol

Security Monitoring Field Equipment
- U.S. Border Patrol covers the entire southern international border of Imperial County with Mexico outside of the three physical POE.
- The U.S. Border Patrol have ITS elements and projects regulated by the federal government.

4.2.5 U.S. Ports of Entry

Inspection Facility
- U.S. POE has jurisdiction over the three physical POE in Imperial County at Calexico West (downtown), Calexico East and Andrade.

Security Monitoring Field Equipment
- The U.S. POE have ITS elements and projects regulated by the federal government.

4.3 Transit Systems – Imperial Valley Transit (IVT)

Center
- Imperial Valley Transit operation center is located at 1101 Airport Road # H, Imperial, CA 92251. Responsibilities include fixed route bus and traditional paratransit service and maintenance, including radio to vehicle dispatching. Advanced transit ITS technologies are not currently applied to IVT. A contractor provides all services of IVT in Imperial County.
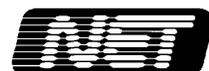
5   ITS USER NEEDS AND SERVICES

User needs and services analyze the needs of the stakeholders in Imperial County. The needs analysis helps identify the gaps between existing systems and future needs. The needs were first identified through surveys, interviews, meetings and local knowledge. To help with organized project development, ITS User Services are used to categorize these needs.

5.1   Freeway Management System

Table 5-1 through Table 5-6 illustrate the user needs that can be met with the associated market packages from the National ITS Architecture.

Table 5-1: Freeway Management System Needs

ITS Category	User Needs
Freeway Management Systems Examples: • Highway Advisory Radio (HAR) • Ramp metering • Traffic management systems/centers • Variable message signs • Vehicle speed detection systems • Video systems	Access to on facility video images
	Access to speed/congestion data
	Advanced warning signs for commercial vehicle excess speed
	Better management of high traffic demand in poor roadway conditions
	Deploy additional vehicle detection coverage
	Disseminate more timely incident information
	Implement additional field device interconnect
	Improve collection of traffic demand data
	Improve information exchange between Caltrans District 11 and other local agencies
	Improve interagency coordination
	Improve roadside weather information and dissemination capabilities
	Increase number of roadside call boxes for traveler access and information
	POE coordination and traffic management
	Provide quality real time congestion related information
	Recreational traffic and tourism management and information
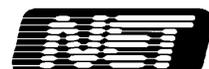
5.2 Incident Emergency Management

Table 5-2: Incident Emergency Management Needs

ITS Category	User Needs
Incident Emergency Management Examples: • Advanced dispatching and response system • Emergency notification and personal security • Emergency vehicle management • Hazardous materials response and handling • Incident detection • Incident management	Annual update of county wide street network in GIS format
	Emergency preemption devices on signals
	Emergency Vehicle Personnel /ITS interconnect
	Improve emergency vehicle circulation at rail crossings and alternate routes for emergency vehicles
	Improve incident detection, response and management
	Improve response to hazardous material incidents
	Improve traveler information during incidents
	Increase broad understanding of existing incident management procedures
	Increase call box locations
	Up to date info to review closures, congestion, incidents

5.3   Maintenance and Construction

Table 5-3: Maintenance and Construction Needs

ITS Category	User Needs
Maintenance and Construction Operations Examples: • Advanced work zone management and traffic control • Changeable message signs • Fleet management and maintenance systems • Highway advisory radio • Integration with traffic management centers • Vehicle/Speed detection systems	Annual update of county wide street network in GIS format
	Coordinate traffic control plans between jurisdictions
	Improve coordination of construction notification and information distribution
	Improve tracking of maintenance vehicles information and management
	Improve work zone and safety
	Increase use of portable control devices
	Need to both receive and disseminate advanced notice of construction and maintenance projects, closures and other issues that affect drivers
	Need to monitor construction progress with weather and impacts of weather
	Up to date (via web site) information to review closures, congestion, incidents, etc.

5.4 Public Transportation Management

Table 5-4: Public Transportation Management Needs

ITS Category	User Needs
Public Transportation Management Examples: • Enroute transit information • Personalized public transit • Public transportation management • Public traveler safety • Ride matching and reservations • Smart card payment system • Traveler service information	Enable dissemination /display of bus arrival times
	Improve central dispatching system
	Improve efficiency and safety of transit system
	Improve patron safety (in vehicle and at stations)
	Improve cost efficiency report production for transit and paratransit services
	Improve regional and interregional transit services
	Transit vehicles AVL for emergency notification

5.5 Traffic Management

Table 5-5: Traffic Management Needs

ITS Category	User Needs
Arterial/Traffic Management Examples: • Adaptive Signal Control • Centralized Control • Highway Rail Intersection Technologies • Signal Coordination • Traffic Management Systems/Centers • Vehicle Detection Systems • Video System	Better information dissemination regarding diversion of commercial trucks
	Better management of congestion at signals
	Continued operations and maintenance of signal system
	Improve emergency vehicle preemption systems, including faster return to coordination
	Improve ability to remotely modify signal timing and signal optimization
	Improve rail grade crossing and traffic management
	Improve regional facilities for traveler and tourism information
	Improve traffic flow monitoring
	Improve traffic management for special events
	Provide system wide arterial management strategies

5.6   Traveler Information Services

Table 5-6: Traveler Information Needs

ITS Category	User Needs
Regional Traveler Information Examples: • Enroute traveler information • Highway advisory radio • In vehicle route guidance • Internet • Media • Portable event management systems • Pre Trip traveler information • Tourists information	Better road construction information
	Better assistance for goods movement and commercial vehicles
	Better assistance for through travelers
	Establish procedure to disseminate information
	Establish procedure to obtain information from Caltrans District 11
	Expand traveler information delivery methods
	Focal point to refer all citizens on evacuations, fire, road closures
	Improve coordination of traveler information at POE
	Improve traffic information via phone and cellular phone
	Improve tourism and traveler information
	Provide enroute traveler information
	Roadside weather information to all travelers
	Seek opportunities to extend District 11 potential 511 project to Imperial County

5.7   User Needs Compared with User Services

As part of the effort to develop the Regional Architecture for Imperial County, local stakeholders were surveyed to identify the transportation user needs of the region. These needs were categorized by ITS market package and then compared to the current conditions in Imperial County to determine the timing or priority of development of the particular ITS project deployments. For Imperial County, the user needs have been stated as follows:

- Additional call boxes
- Better management and information on events and recreational uses
- Commercial truck speed notification
- Communications and coordination with Union Pacific Railroad
- Communications upgrades
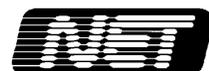
- Construction information and work zone safety
- HAZMAT information for EMS
- Improved communications with Caltrans District 11
- Improved emergency response using 911 service
- Improved security and POE control
- Improve traffic management on major commercial vehicle routes
- Improved transit efficiency
- Maintenance management and response
- Real time traveler and trip information
- Tourist information
- Traffic information and dissemination
- Traffic signal management and communications
- Transit and traveler information
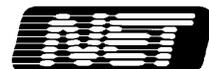
6 OPERATIONAL CONCEPT

The stakeholder inventory identified the stakeholders that are associated with each system in the region. The operational concept itemizes each stakeholder's current and future roles and responsibilities in the implementation and operation of the regional systems as they are defined in more detail. The operations concept is similar to an executive summary view of the way the region's systems will work together to provide ITS services. The operational concept should be used as a useful indication of roles and responsibilities rather than a stringent commitment to requirements.

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 ITS Architecture. An operational concept is one of the required components of the Imperial County Regional ITS Architecture. These roles and responsibilities can be used to indicate areas of content for interagency agreements when future interagency projects are planned.

As background to ITS, commonly used market package and architecture flow terms are defined below:

Architecture Flows
- Architecture flows are the information and data exchange among various equipment packages and subsystems.

Equipment Package
- Equipment packages represent a set of equipment/capabilities that are likely to be incorporated by an end user as a component to an overall system.

Subsystem
- A subsystem is a cohesive set of functional definitions with required interfaces to other subsystems. There are four ITS subsystems, namely center, vehicle, field and traveler.

Terminators
- Terminators define the boundary of an architecture, i.e. the people, systems and general environment that interface to ITS.

6.1 Market Packages

The National ITS Architecture contains many different concepts for transportation including industry technical language and abbreviations. One of the ITS concepts is
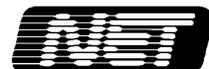
known as market packages. A market package is a series of relatively detailed groupings of subsystems, equipment packages and data flow definitions, which can be logically and incrementally deployed over time to provide increasing capabilities and levels of integration. Market packages provide an accessible, deployment oriented perspective to the National ITS Architecture. Market Packages are tailored to fit, separately or in combination, real world transportation problems and needs. Market packages identify the pieces of the physical architecture that are required to implement a particular transportation service.

A typical market package contains subsystems, equipment packages, architecture flows and supporting logical architecture elements. The brief definition of these concepts are listed below and more detailed description and examples can be found in the National ITS 5.0 located on http://itsarch.iteris.com/itsarch.

Table 6-1 represents a listing of market packages that apply to the current and future needs identified for Imperial County. The market packages reflect long term needs of Imperial County and provide an ultimate list for future consideration. The list and sequencing of ITS projects reflect the prioritization effort that was undertaken and provide a list of projects to be considered within the next twenty years. Potential Imperial County projects reflect the level of maturity in ITS deployment in Imperial County and do not cover all of the market packages established in the tables below.
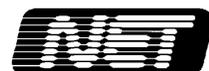
Table 6-1: Market Packages Classified by Need

ITS Market Package				Imperial County ITS Elements	
				Existing/ Planned	Identified Need
Public Transportation	Advanced Public Transportation Systems (APTS)	APTS2	Transit Fixed Route Operations	●	
		APTS3	Demand Response Transit Operations	●	
		APTS4	Transit Passenger and Fare Management	●	
		APTS6	Transit Maintenance	●	
		APTS8	Transit Traveler Information		●
Traveler Information	Advanced Traveler Info. Systems (ATIS)	ATIS1	Broadcast Traveler Information		●
Traffic Management	Advanced Transportation Management Systems (ATMS)	ATMS01	Network Surveillance		●
		ATMS03	Surface Street Control		●
		ATMS04	Freeway Control		●
		ATMS06	Traffic Information Dissemination		●
		ATMS07	Regional Traffic Control		●
		ATMS08	Traffic Incident Management System		●
		ATMS13	Standard Railroad Grade Crossing	●	
		ATMS15	Railroad Operations Coordination		●
		ATMS16	Parking Facility Management		●
		ATMS17	Regional Parking Management		●
Commercial Vehicles Operations	Commercial Vehicle Operations (CVO)	CVO03	Electronic Clearance	●	
		CVO05	International Border Electronic Clearance	●	
		CVO06	Weigh In Motion	●	
		CVO10	HAZMAT Management		●
		CVO12	CV Driver Security Authentication	●	
Emergency Management	Emergency Management (EM)	EM01	Emergency Call Taking and Dispatch	●	
		EM02	Emergency Routing	●	
Maintenance & Construction Operations	Maintenance & Construction Operations (MCO)	MC02	Maintenance and Construction Vehicle Maintenance	●	
		MC03	Road Weather Data Collection	●	
		MC04	Weather Information Processing and Distribution	●	
		MC07	Roadway Maintenance and Construction	●	
		MC08	Work Zone Management	●	
		MC10	Maintenance and Construction Activity Coordination	●	
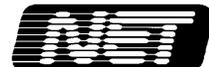
6.2 Roles and Responsibilities

The market packages of relevance to the Imperial County ITS Architecture have been identified from the needs analysis and the inventory of systems. These market packages become the basis for the operational concepts that link market packages to stakeholders and their roles and responsibilities within the operation.

Operational concepts focus on the definition of each stakeholder's role in providing the Imperial County's ITS services. The operational concept process develops and documents stakeholders' current and future roles and responsibilities in the implementation and operation of ITS based on the Imperial County Regional ITS Architecture. An operational concept is one of the required components of a common regional ITS architecture.

Table 6-2 through Table 6-18 outline roles and responsibilities that will be useful when stakeholders are considering specific project architectures and wish to identify the necessary stakeholders to include. These tables are also helpful when considering agreements that will be necessary to implement projects that impact multiple stakeholders.

Table 6-2: APTS 02 – Transit Fixed Route

Market Package	Contents	Operating Agency	Roles and Responsibilities
APTS 02 Transit Fixed Route Operations	Vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed route and flexible route transit services	IVT	• Disseminate up to date schedules and route information to other centers for fixed and flexible route services • Maintain vehicle status and send status information to transit centers • Plan and manage transit system • Receive and archive bus occupancy information
		Cities	• Coordinate road closures with other agencies

Table 6-3: APTS 03 - Demand Response Transit System

Market Package	Contents	Operating Agency	Roles and Responsibilities
APTS 03 Demand Response Transit System	Vehicle routing and scheduling as well as automatic operator assignment and monitoring for demand responsive transit services	IVT	• Coordinate with other transit operators to achieve inter jurisdictional service • Disseminate up to date schedules and route information to other centers for fixed and flexible route services • Receive ride request • Schedule and dispatch vehicle in a systematic manner

Table 6-4: APTS 08 - Transit Traveler Information

Market Package	Contents	Operating Agency	Roles and Responsibilities
APTS 08 Transit Traveler Information	Provides transit users at transit stops and onboard transit vehicles with ready access to transit information	IVT	• Disseminate up to date schedules and route information to other centers for fixed and flexible route services • Provide transit schedule and route information through website, telephone services and other ISP
		CHP	• Report highway road closure to all agencies

Table 6-5: ATIS 01 - Broadcast Traveler Information

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATIS 01 Broadcast Traveler Information	Collects traffic conditions, advisories, general public transportation, incident information, roadway maintenance and construction information, weather information and broadly disseminates this information through existing infrastructures	Caltrans District 11	• Provide traffic and incident information to drivers • Share traffic information with other emergency and transportation agencies • Update information to ISP and media outlets (websites, TV, etc.)
		CHP	• Keep resource database updated • Provide traffic and incident information to agencies and the public • Report highway road closure to all agencies • Update information to ISP and other media outlets (websites, TV, etc.)
		Cities	• Have access to arterial traffic and incident information • Have access to updated information to ISPs and media outlets (websites, TV, etc.)
		Fire, Police and Other Emergency Services	• Communicate with other agencies to coordinate emergency response when necessary • Maintain resource database updated
		Other Regional Agencies	• Provide arterial traffic and incident information to the public • Update information to ISPs and media outlets (websites, TV, etc.)

Table 6-6: ATMS 01 - Network Surveillance

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 01 Network Surveillance	Traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communication to transmit the collected data back to the Traffic Management Subsystem	Caltrans District 11	• Install CCTV cameras, CMS and HAR along the freeways • Maintain field equipment • Maintain centralized ramp metering signal systems and software • Maintain AVI/AVL systems for maintenance vehicles
		County	• Assist local cities in installing and maintaining the surveillance equipment on surface street network • Install and maintain the surveillance equipment on surface street network in the contracted cities, the airport and unincorporated areas • Share control of field equipment with other transportation and emergency agencies

Table 6-7: ATMS 03 - Surface Street Control

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 03 Surface Street Control	Central control and monitoring equipment, communication links and the signal control equipment that support local surface street control and/or arterial traffic management	Caltrans District 11	• Maintain field equipment
		Cities	• Coordinate traffic control responding to incidents which involve emergency and traffic agencies • Monitor traffic on arterials • Share control of field equipment with other transportation and emergency agencies (if desired) • Share real time traffic information with Caltrans District 11 and adjacent jurisdictions
		Fire, Police and Other Emergency Services	• Monitor traffic on designated arterials

Table 6-8: ATMS 04 - Freeway Control

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 04 Freeway Control	Communication and roadside equipment to support ramp control, lane controls, interchange control and incident detection for freeways	Caltrans District 11	• Install CCTV, CMS and other freeway detection devices • Maintain field equipment • Maintain freeway control systems and software • Monitor and manage traffic for Caltrans District 11 controlled highways • Monitor and manage traffic for freeway on ramps, control their signals to include preemption for emergency • Share freeway CCTV, CMS and HAR equipments use (not control) with partner agencies

Table 6-9: ATMS 06 - Traffic Information Dissemination

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 06 Traffic Information Dissemination	Driver information using roadway equipment such as changeable message signs or highway advisory radio	Caltrans District 11	• Install and maintain the traffic information dissemination equipment along freeways • Send alerts on CMS and HAR equipment
		Cities and County	• Install and maintain the traffic information dissemination equipment on surface street network • Provide arterial traffic and incident information to the public • Send alerts on CMS and HAR equipment
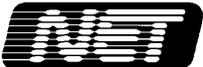
Table 6-10: ATMS 07 - Regional Traffic Control

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 07 Regional Traffic Control	Sharing of traffic information and control among traffic management centers to support a regional control strategy and also adding the communication links and integrated control strategies that enable integrated inter-jurisdictional traffic control	Caltrans District 11	• Assist with in locating funding for regional projects • Develop policies and agreements between and among local agencies to connect and share the use of conduit, if applicable • Participate in and contribute to the integration process
		Cities and County	• Assist with in locating funding for regional projects • Develop policies and agreements between and among local agencies to connect and share the use of conduit, if applicable • Participate in and contribute to the integration process

Table 6-11: ATMS 08 - Traffic Incident Management System

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 08 Traffic Incident Management System	Managing both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized	Caltrans District 11	• Collect incident data and confirm incident time and location • Coordinate road closure with other agencies • Coordinate the development and maintenance of disaster response and evacuation plans • Implement traffic control responding to incidents • Provide resources when requested by emergency agencies • Provide traffic and incident information to drivers
		CHP	• Communicate with other emergency and traffic agencies to support coordinated emergency response when necessary • Dispatch state patrol vehicles • Enforce traffic violations on highways • Provide incident status information • Receive public safety calls and forward them to appropriate dispatch center • Report freeway road closure to all agencies • Respond to incident by coordinating with field staff
		Cities	• Provide resources when requested by emergency agency
		Fire, Police and Other Emergency Services	• Enforce traffic violations on arterial streets • Maintain centralized emergency management systems software and systems • Monitor traffic on designated arterials • Report road closure to all agencies
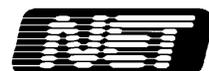
Table 6-12: ATMS 13 - Standard Railroad Grade Crossing

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 13 Standard Railroad Grade Crossing	Manages highway traffic at highway rail intersections where operational requirements do not dictate more advanced features Both passive and active warning systems are supported	Railroad Operators	• Operate rail service by the requirements listed in the railroad crossing plan
		Caltrans District 11	• Install and maintain the railroad crossing equipments for detections and warning
		Cities	• Install and maintain the railroad crossing equipments for detections and warning

Table 6-13: ATMS 15 - Railroad Operations Coordination

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 15 Railroad Operations Coordination	Strategic coordination between freight rail operations and traffic management centers for highway-rail intersection (HRI) coordination.	Railroad Operators	• Interface to the traffic control and information distribution center. • Provide strategic coordination between rail operations and traffic management centers.
		Caltrans District 11	• Communicate with rail operations and interface to the traffic control and information distribution capabilities • Develop forecast HRI closure times and durations that may be applied in advanced traffic control strategies or delivered as enhanced traveler information. • Provide strategic coordination between rail operations and traffic management centers. • Receive train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures from Rail Operations.

Table 6-14: ATMS 16 - Parking Facility Management

Market Package	Contents	Operating Agency	Roles and Responsibilities
ATMS 16 Parking Facility Management	Provides enhanced monitoring and management of parking facilities	Cities	• Collect parking capacity and status data • Share data with ISP and other agencies
		ISP	• Disseminate parking capacity and status data
		IVT	• Provide transit connection related parking information

Table 6-15: CVO 10 - HAZMAT Management

Market Package	Contents	Operating Agency	Roles and Responsibilities
CVO 10 HAZMAT Management	Incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.	Railroad Operators	• Assist local agencies with field incidents • Coordinate response to emergency management incident based on cargo manifests • Provide cargo manifests pertaining to hazardous materials to local agencies prior to field incidents
		Fire, Police and Other Emergency Services	• Assist railroad with field incidents • Receive cargo manifests from railroad and disseminate to local agencies • Respond to any field incidents based on cargo manifests

Table 6-16: EM 01 - Emergency Call Taking and Dispatch

Market Package	Contents	Operating Agency	Roles and Responsibilities
EM 01 Emergency Call Taking and Dispatch	Basic public safety call taking and dispatch services	Caltrans District 11	• Assume a leading role in traffic diversion and implementation of traffic management schemes under circumstances of severe incidents and disasters • Coordinate the development and maintenance of disaster response and evacuation plans • Provide resources when requested by emergency agencies • Share traffic information with other emergency and transportation agencies

Market Package	Contents	Operating Agency	Roles and Responsibilities
		CHP	• Assume a leading role in handling and clearance of incidents on highways • Create, store and utilize emergency response plans to facilitate coordinated response • Dispatch patrol vehicles • Perform other non transportation related public safety duties • Receive public safety calls and forward them to appropriate dispatching center
		Cities	• Coordinate road closures with other agencies • Coordinate traffic control responding to incidents which involve emergency and traffic agencies • Implement traffic control responding to incidents • Provide resources when requested by emergency agency
		Fire, Police and Other Emergency Services	• Create, store and utilize emergency response plans to facilitate coordinated response • Dispatch fire, police, ambulance and other emergency vehicles • Maintain centralized emergency management systems software and systems • Receive public calls and forward them to appropriate dispatch centers • Report road closure to all agencies
		Service Authority for Freeway Emergencies (SAFE)	• Dispatch fire, police, ambulance and other emergency vehicles • Maintain centralized emergency management systems software and systems • Receive public calls and forward them to appropriate dispatch centers
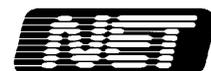
Table 6-17: EM 02 - Emergency Routing

Market Package	Contents	Operating Agency	Roles and Responsibilities
EM 02 Emergency Routing	Automated vehicle location and dynamic routing of emergency vehicles	Caltrans District 11	• Coordinate road closure with other agencies • Coordinate traffic control responding to incidents which involve emergency and other transportation agencies • Provide traffic and incident information to drivers
		CHP	• Communicate with other emergency and traffic agencies to support coordinated emergency response when necessary • Received real time traffic from other agencies to optimize the emergency dispatching in selecting the emergency vehicles and routes
		Fire, Police and Other Emergency Services	• Communicate with other agencies to coordinate emergency response when necessary • Receive real time traffic information to optimize emergency vehicle dispatching • Track and manage emergency vehicle fleets using AVL and two way communications with the vehicle fleet

Table 6-18: MC 04 - Weather Information Processing and Distribution

Market Package	Contents	Operating Agency	Roles and Responsibilities
MC 04 Weather Information Processing and Distribution	Processes and distributes the environmental information to detect environmental hazards such as icy road conditions, high winds, dense fog, etc.	Caltrans District 11	• Improve roadside weather information and dissemination capabilities • Installation of Roadside Weather Information Systems at key locations on state highway system that require improved weather related information for Caltrans and motorists • Roadside weather information to all travelers
		CHP	• Improve roadside weather information and dissemination capabilities • Roadside weather information to all travelers
		Fire, Police and Other Emergency Services	• Improve roadside weather information and dissemination capabilities • Manage incident responses based on current environmental hazards

7 FUNCTIONAL REQUIREMENTS

Previously, an ITS inventory for Imperial County was presented showing existing and planned systems owned or operated by Imperial County ITS stakeholders. The development of functional requirements is the next logical step in the evolution of architecture development. To effectively deliver the ITS services in Imperial County, 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. Most of the systems described could transmit their data or output to the public or to the media if this was an identified need for Imperial County.

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. A good example of this is the POE projects mentioned earlier.

The lists below detail the primary functional requirements for the future ITS elements in Imperial County.

7.1 Caltrans District 11 MCO Dispatch Center

Stakeholder: Caltrans District 11
System: Caltrans District 11 MCO Dispatch Center

This system shall:
- Control traffic in work zones by providing remote control of changeable message signs and Highway Advisory Radio (HAR) systems located in or near the work zone.
- Dispatch and route maintenance and construction vehicle drivers and support them with route specific environmental, incident, advisory, threat, alert and traffic congestion information.
- Disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers and the media.
- Exchange information with administrative systems to support the planning and scheduling of maintenance activities. This information includes: equipment and consumables supply purchase request status, personnel qualifications including generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators and for information coordination purposes.
- Maintain an interface with asset management systems to track the inventory, restrictions, repair needs and status updates of transportation
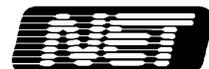
assets (pavement, bridges, signs, etc.) including location, installation and materials information.

- Provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays and closures.
- Respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair and other roadway maintenance.
- Track the status of roadway maintenance and construction activities by monitoring collected data from the dispatched vehicles and equipment.

7.2 Caltrans District 11 MCO Management System

Stakeholder: Caltrans District 11
System: Caltrans District 11 MCO Management System

This system shall:
- Collect roadside equipment status.
- Manage maintenance and construction map data.
- Manage maintenance and construction resource needs.
- Manage maintenance and construction vehicle fleet.
- Operate infrastructure monitoring devices.
- Process road network information.
- Report maintenance and construction activities and status.
- Schedule maintenance and construction activities (including work zone activities).

7.3 Caltrans District 11 MCO Vehicles

Stakeholder: Caltrans District 11
System: Caltrans District 11 MCO Vehicles

This system shall:
- Monitor, operate and control work zone devices located at or alongside the roadway. The devices operated on board the vehicle include driver information devices (i.e. changeable message signs) and work zone information.
- Provide an interface for field personnel to input status of their work zone activities.
- Provide dispatch and routing information.
- Provide two way communications to support vehicle tracking.
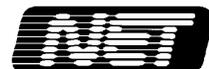
- Respond to dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.

7.4 Caltrans District 11 Signal Operations

Stakeholder: Caltrans District 11
System: Caltrans District 11 Signal Operations

This system shall:
- Analyze and reduce the collected data from traffic surveillance equipment and develop and implement control plans for signalized intersections detected failure or other unsafe condition at the intersection.
- Develop and implement control plans that coordinate signals at intersections.
- Monitor and diagnose field equipment remotely to detect failures, issue problem reports and track the repair or replacement of the failed equipment.
- Monitor and manage the traffic flow at signalized intersections.
- Monitor highway rail intersection equipment at the roadside.

7.5 Caltrans District 11 Signal Operations Roadside Equipment

Stakeholder: Caltrans District 11
System: Caltrans District 11 Signal Operations Roadside Equipment

This system shall:
- Control traffic signals.
- Display traffic information on equipment along the roadway.
- Monitor roadside equipment and interfaces and report detected abnormalities.
- Monitor surveillance equipment and interfaces and report detected abnormalities.
- Monitor the traffic signal equipment and interfaces and report detected abnormalities.
- Monitor traffic flow.
- Provide preemption of signalized intersections when activated.

7.6 Caltrans District 11 TMC

Stakeholder: Caltrans District 11
System: Caltrans District 11 TMC
Subsystem: Maintenance and Construction Management
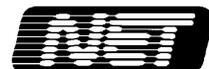
This system shall:

- Analyze, control and optimize area wide traffic flow.
- Collect and store traffic flow and image data from the field equipment to detect and verify incidents.
- Collect and store traffic information that is collected in the course of traffic operations.
- Collect operational status for the driver information systems equipment (CMS, HAR, etc.).
- 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 electronic signage and Highway Advisory Radio (HAR).
- Detect and verify incidents.
- Distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.
- Distribute traffic data to maintenance and construction centers, transit centers, emergency management centers and traveler information providers.
- Distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.
- Exchange incident and threat information with emergency management centers as well as maintenance and construction centers, including notification of existence of incident and expected severity, location, time and nature of incident.
- Formulate an incident response minimizing the incident potential, incident impacts and/or resources required for incident management.
- Implement control strategies, under control of center personnel, on some or all of the freeway network devices (i.e. mainline metering and lane controls), based on data from sensors monitoring traffic conditions upstream.
- Interface to coordinated traffic systems for information dissemination to the public.
- Monitor and diagnosis field equipment remotely to detect failures, issue problem reports and track the repair or replacement of the failed equipment.
- Monitor, analyze and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.

- Provide road network conditions and traffic images to emergency management centers to support the detection, verification and classification of incidents.
- Remotely control changeable messages signs for dissemination of traffic and other information to drivers.
- Remotely control driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.
- The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers and traveler information service providers.

7.7 Caltrans District 11 TMC Roadside Equipment

Stakeholder: Caltrans District 11
System: Caltrans District 11 TMC Roadside Equipment

This system shall:
- Collect, process and send traffic images to the center for further analysis and distribution.
- Collect, process, digitize and send traffic sensor data (speed, volume and occupancy) to the center for further analysis and storage, under center control.
- Display traffic information on equipment along the roadway.
- Monitor surveillance and roadside equipment and interfaces and report detected abnormalities.
- Monitor traffic flow and road weather information.

7.8 CHP Emergency Operation Center

Stakeholder: California Highway Patrol (CHP)
System: CHP Emergency Operation Center

This system shall:
- Collect current traffic and road condition information from traffic management centers for emergency vehicle route calculation.
- Coordinate response to incidents with other emergency management centers to ensure appropriate resources are dispatched and utilized.
- Coordinate with other agencies and store emergency response plans.
- Dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
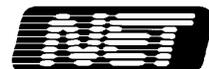
- Forward the verified emergency information to the responding agency based on the location and nature of the emergency.
- Provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied agencies.
- Provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.
- Receive emergency call information from 911 services and present the possible incident information to the emergency system operator.
- Receive emergency call information from motorist call boxes, other public safety agencies, transit systems, commercial vehicles/check stations and present the possible incident information to the emergency system operator.
- Relay location and incident details to the responding vehicles.
- Store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- Track the availability of resources (including vehicles, roadway cleanup, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- Update the incident information log once the emergency system operator has verified the incident.

7.9 CHP Emergency Operations Center System

Stakeholder: California Highway Patrol
System: CHP Emergency Operations Center System

This system shall:
- Collect and store emergency information that is collected in the course of emergency operations.
- Collect available information about the caller and the reported emergency.
- Develop and execute emergency response plans.
- Efficiently dispatch emergency vehicles to an emergency/incident.
- Forward information about emergency to other systems that formulate and manage the emergency response.
- Manage overall coordinated response to emergencies.
- Provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.
- Provide safe and efficient routes based on real time traffic information.
- Receive 911 and seven digit local access calls.
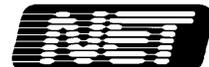
- Track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.

7.10 CHP Emergency Vehicles

Stakeholder: California Highway Patrol (CHP)
System: CHP Emergency Vehicles
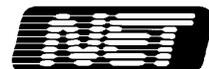
This system shall:
- Provide a direct interface between the emergency vehicle and incident management personnel.
- Provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc.
- Provide two way communications to support coordinated response to emergencies.
- Receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road and weather conditions along with hazardous material information.
- Receive incident details and a suggested route when dispatched to a scene.
- Send requests to traffic signal control equipment at the roadside to preempt the signal.
- Send the current enroute status (including estimated time of arrival) and requests for emergency dispatch updates.
- Send the vehicle's location and operational data to the center for emergency management and dispatch.

7.11 Call Boxes

Stakeholder: Service Authority for Freeway Emergencies (SAFE), Caltrans District 11
System: Call Boxes

This system shall:
- Receive distress signals from pedestrians and motorist requesting assistance.
- Transmit data back to a central facility at regular intervals.

## 7.12 Imperial County and Emergency Services

Stakeholder: County and Cities Fire and Police Departments
System: County and Emergency Services (City Fire & Police Departments)

This system shall:
- Collect and store emergency/incident information that is collected in the course of emergency operations.
- Collect available information about the caller and the reported emergency.
- Coordinate, correlate and verify all emergency inputs, including those identified based on external calls and internal analysis of security sensor and surveillance data and assign each a level of confidence.
- Develop, store and execute emergency response plans.
- Dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- Efficiently dispatch emergency vehicles to an incident.
- Forward information on emergency to other systems that formulate and manage the emergency response.
- Manage overall coordinated response to emergencies, as necessary.
- Provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.
- Receive emergency call information from 911 services and present the possible incident information to the emergency system operator.
- Receive event scheduling information from event promoters.
- Receive traffic information, including closures, traffic conditions, etc. from traffic management centers.
- Relay location and incident details to the responding vehicles.
- Track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.
- Track the location and status of emergency vehicles responding to an emergency and update the incident status based on information from the emergency vehicle.
- Update the incident information log once the emergency system operator has verified the incident.

7.13 Imperial County and Emergency Services Dispatch Centers

Stakeholder: County and Cities Fire and Police Departments
System: County and Emergency Services Dispatch Centers (City Fire & Police Departments)
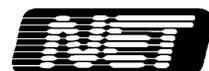
This system shall:
- Collect and store incident information that is collected in the course of emergency operations.
- Collect available information about the caller and the reported emergency.
- Develop and execute emergency response plans.
- Manage overall coordinated response to emergencies.
- Propose and facilitate the dispatch of emergency/incident response and service vehicles as well as coordinate response with all appropriate agencies.
- Provide coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.
- Provide safe and efficient routes based on real time traffic information.
- Receive 911 and seven digit local access.
- Track the availability of resources and assist in the appropriate allocation of resources for a particular emergency response.

7.14 Imperial County and Emergency Vehicles

Stakeholder: County and Cities Fire and Police Departments
System: County and Emergency Vehicles (City Fire & Police Departments)

This system shall:
- 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.
- Provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc.
- Provide two way communications to support coordinated response to emergencies.
- Receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road and weather conditions, hazardous material information and the current status of resources that have been allocated to an incident.

7.15 Media

Stakeholder: Radio, TV and Other Media Outlets
System: Media
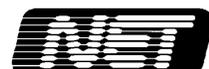
This system shall:
- Collect, process, store and disseminate traveler information such as congestion, incidents, special events, road closure, detour routing, weather, parking and roadway maintenance information.
- Provide information tailored for individual users.
- Provide interactive traveler information.
- Provide the latest available information on transit routes, schedules, transfer options, fares, real time schedule adherence and special events.
- Provide users with real time travel related information enroute to assist the travelers in making decisions about trips.
- Send formatted traffic advisories including accurate traveling information concerning available travel options and their availability and congestion information at kiosks.

7.16 Parking Management Systems

Stakeholder: Imperial County and Cities
System: Parking Management Systems

This system shall:
- Collect and store parking information that is collected in the course of parking system operations.
- Detect and classify properly equipped vehicles entering and exiting the parking facility.
- Disseminate parking information to travelers, roadside equipment and private information service providers.
- Enable processing of financial transactions and external coordination.
- Maintain information on parking availability and pricing structure information.
- Measure parking facility occupancy to support parking operations and traveler information services.

7.17 Railroad Grade Crossing Warning Equipment

Stakeholder: Union Pacific Railroad
System: Railroad Grade Crossing Warning Equipment

This system shall:
- Control Highway Rail Intersection (HRI) traffic signals.
- Control HRI warnings and barriers.
- Determine HRI status.
- Exchange data with traffic management.
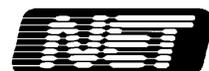
- Interact with roadside systems.
- Perform equipment self test.
- Process traffic sensor data.
- Provide closure parameters.
- Report HRI status on approach.

7.18 Transit Agency Systems

Stakeholder: IVT
System: Transit Agency Systems

This system shall:
- Allow fixed route services to develop, print and disseminate schedules and automatically update customer service operator systems with the most current schedule information.
- 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.
- Automate and support the assignment of transit vehicles and drivers to enhance the daily operation of a transit service.
- Collect and store transit information that is collected in the course of transit operations.
- Collect operational and maintenance data from transit vehicles, manages vehicle service histories and monitors drivers and vehicles.
- Monitor transit vehicle locations and determine vehicle schedule adherence.
- Provide information to proper service personnel to support maintenance activities and records and verify that maintenance work was performed.
- Provide transit data to operations personnel.

7.19 Transit Operation (Bus Base)

Stakeholder: Imperial Valley Transit
System: Transit Operation (Bus Base)
Subsystem: Transit Management
Subsystem: Information Service Provider

This system shall:
- Collect monitoring data from onboard systems including transit vehicle mileage, fuel usage, passenger loading, availability, etc.
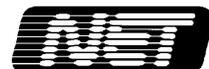
- Collect operational and maintenance data from transit vehicles.
- Collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.
- Collect transit operational data for use in the generation of routes and schedules.
- Determine adherence of transit vehicles to their assigned schedule.
- Disseminate up to date schedules and route information to other centers for fixed and flexible route services.
- Exchange information with maintenance and construction operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.
- Generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, operational data on current routes and schedules and digitized map data.
- Generate transit vehicle availability listings, current and forecast, to support transit vehicle assignment planning based, in part, on the transit vehicle maintenance schedule.
- Generate transit vehicle maintenance schedules, includes what and when the maintenance or repair is to be performed.
- Provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to provide transit operational data to traveler information service providers.

7.20 Transit Vehicles

Stakeholder: IVT
System: Transit Vehicles

This system shall:
- Calculate the estimated times of arrival (ETA) at transit stops.
- Monitor on board the vehicle in real time and transmit information via two-way communication to the management center.
- Provide passenger loading and fare statistics data to the center.
- Receive transit route information for its assigned route including transit service instructions, traffic information, road conditions and other information for the operator.
- 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
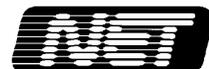
facility and data transmission from individual facilities to a central facility for processing/analysis if desired.

- Track transit vehicle and transmit location to dispatch.
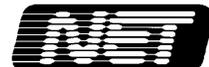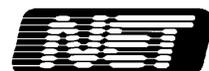
8 ITS INTERCONNECTS AND INFORMATION FLOWS

8.1 Potential System Interconnects

The development of the Imperial County Regional ITS Architecture has now reached a point where the actual information can be defined that will need to flow between the region's ITS systems in order to support the needed ITS services. Listed below is a physical depiction of the architecture, which shows the connections that can be established between the systems at the very highest level. The diagram used is often referred to as the sausage diagram or ITS physical architecture interconnects, as illustrated in Figure 8-1. The sausage diagram is first generated in the National ITS Architecture software tool Turbo Architecture and has then been customized to reflect the systems of the Imperial County region. The connections shown in Figure 8-1 should not be interpreted as having already been implemented. Instead, they show the current physical architecture and the potential for connections that could be made in the future. Appendix I contains a full listing of the ITS interconnects for Imperial County. Appendix J illustrates the ITS interconnects for Imperial County for both existing and planned ITS elements.

8.2 Potential Data Flows

There are many ways to represent the depiction of the potential data flows between systems. The primary approach used is customized market packages. This is one of the alternative methods discussed in the 2001 U.S. DOT National ITS Architecture guidance document. The flows identified are still at a high level and represent bundles of information that could be exchanged in the future as systems mature. Information data flows are illustrated in Appendix K.

Figure 8-2 through Figure 8-18 illustrate the market packages that are relevant to Imperial County and the potential transportation projects discussed in section 9 and outlined in Table 9-1.
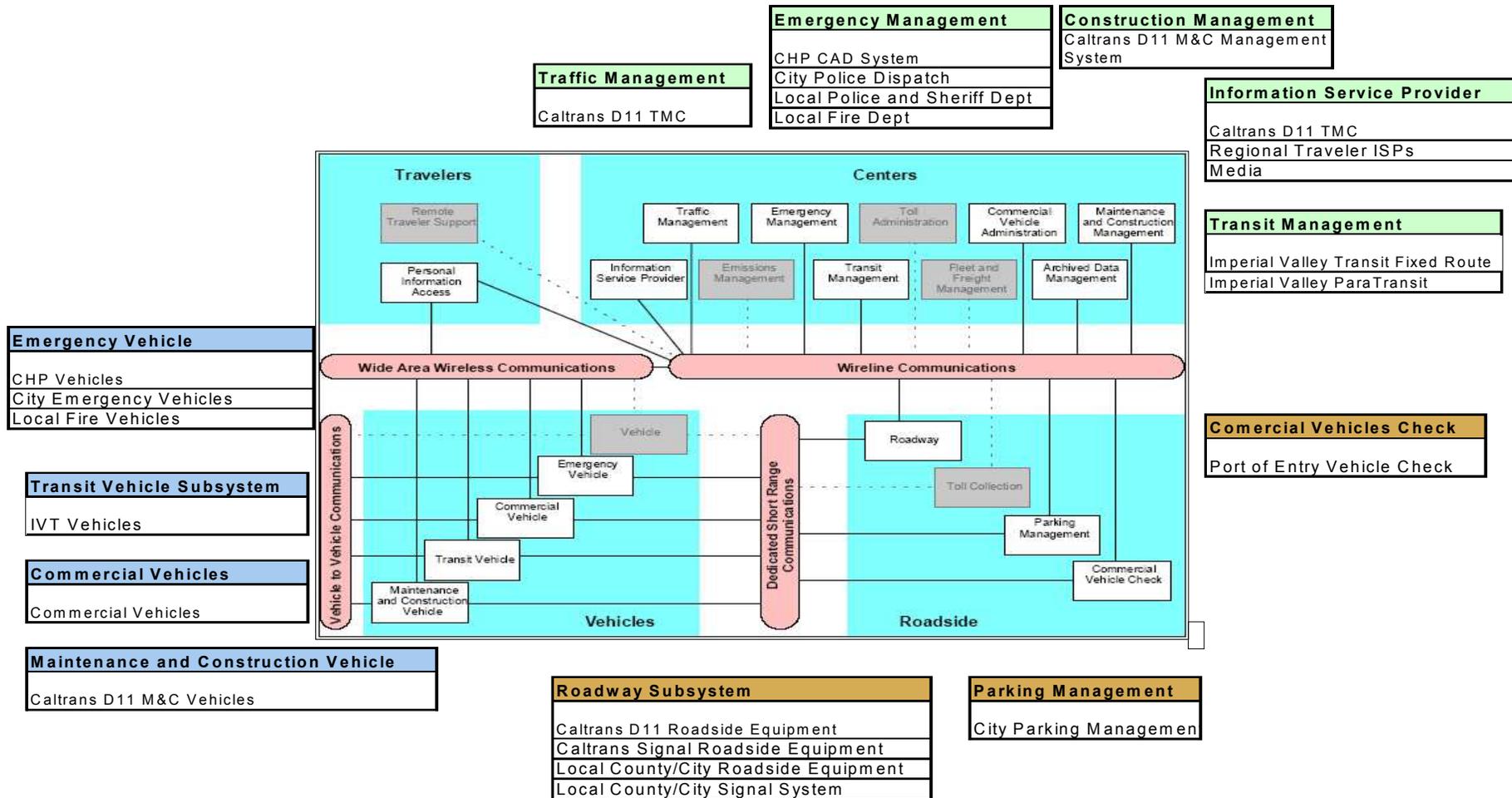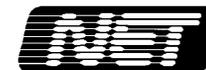
Emergency Management

CHP CAD System
City Police Dispatch
Local Police and Sheriff Dept
Local Fire Dept

Construction Management

Caltrans D11 M&C Management System

Traffic Management

Caltrans D11 TMC

Information Service Provider

Caltrans D11 TMC
Regional Traveler ISPs
Media

Transit Management

Imperial Valley Transit Fixed Route
Imperial Valley ParaTransit

Emergency Vehicle

CHP Vehicles
City Emergency Vehicles
Local Fire Vehicles

Comercial Vehicles Check

Port of Entry Vehicle Check

Transit Vehicle Subsystem

IVT Vehicles

Commercial Vehicles

Commercial Vehicles

Maintenance and Construction Vehicle

Caltrans D11 M&C Vehicles

Roadway Subsystem

Caltrans D11 Roadside Equipment
Caltrans Signal Roadside Equipment
Local County/City Roadside Equipment
Local County/City Signal System

Parking Management

City Parking Managemen

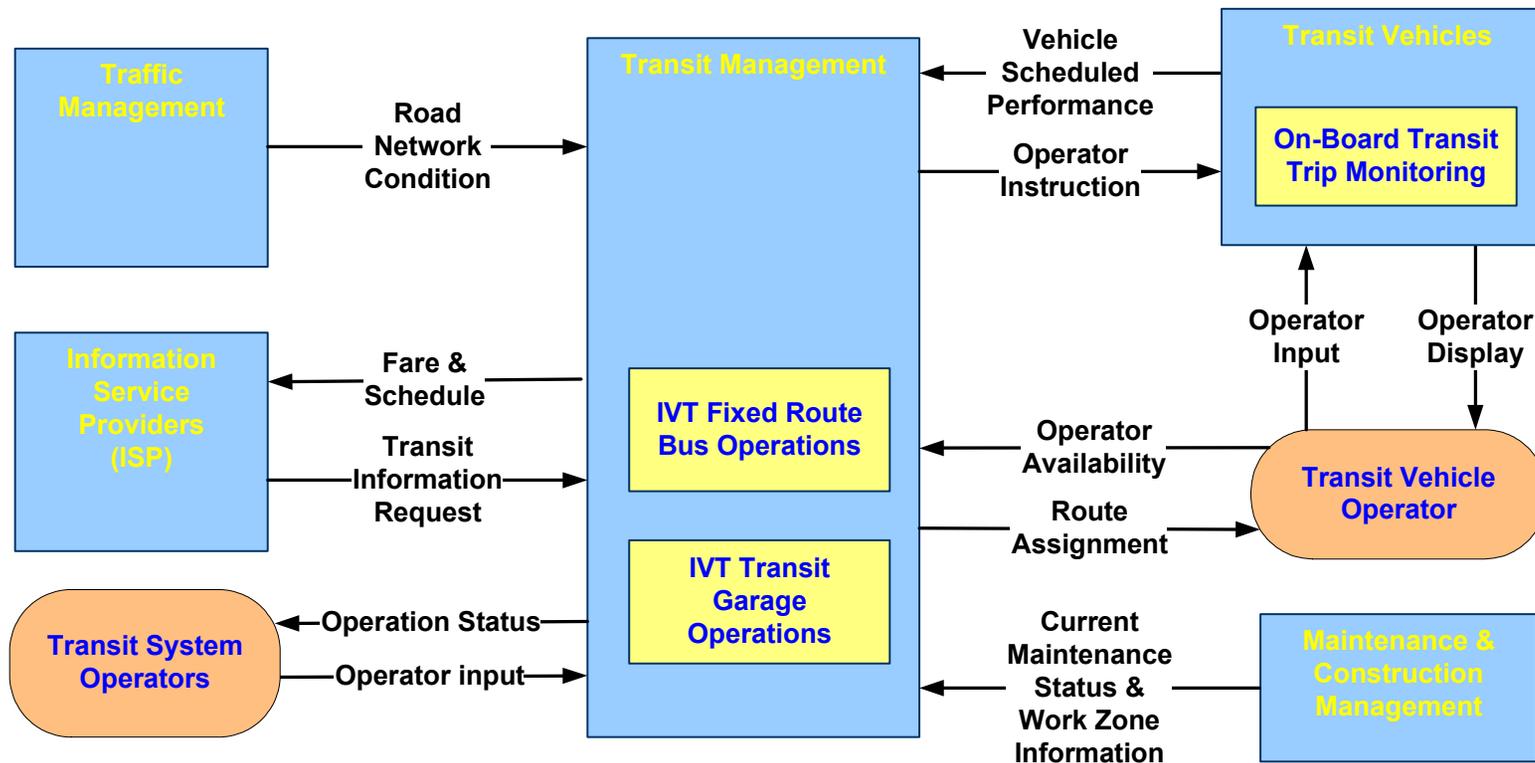**Figure 8-1: Imperial County ITS Physical Architecture Interconnects**

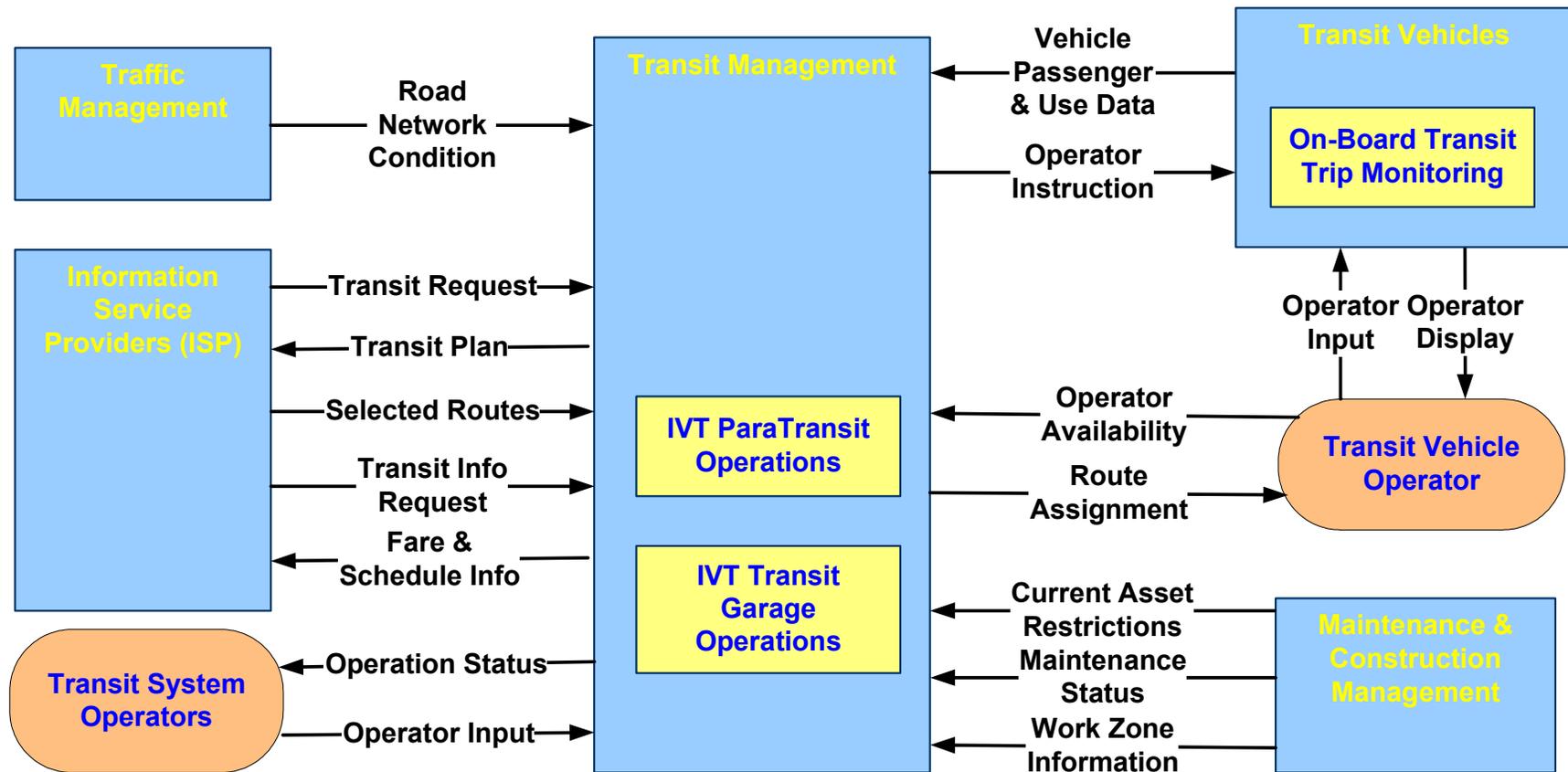**Figure 8-2: APTS 02 - Transit Fixed Route Operations**

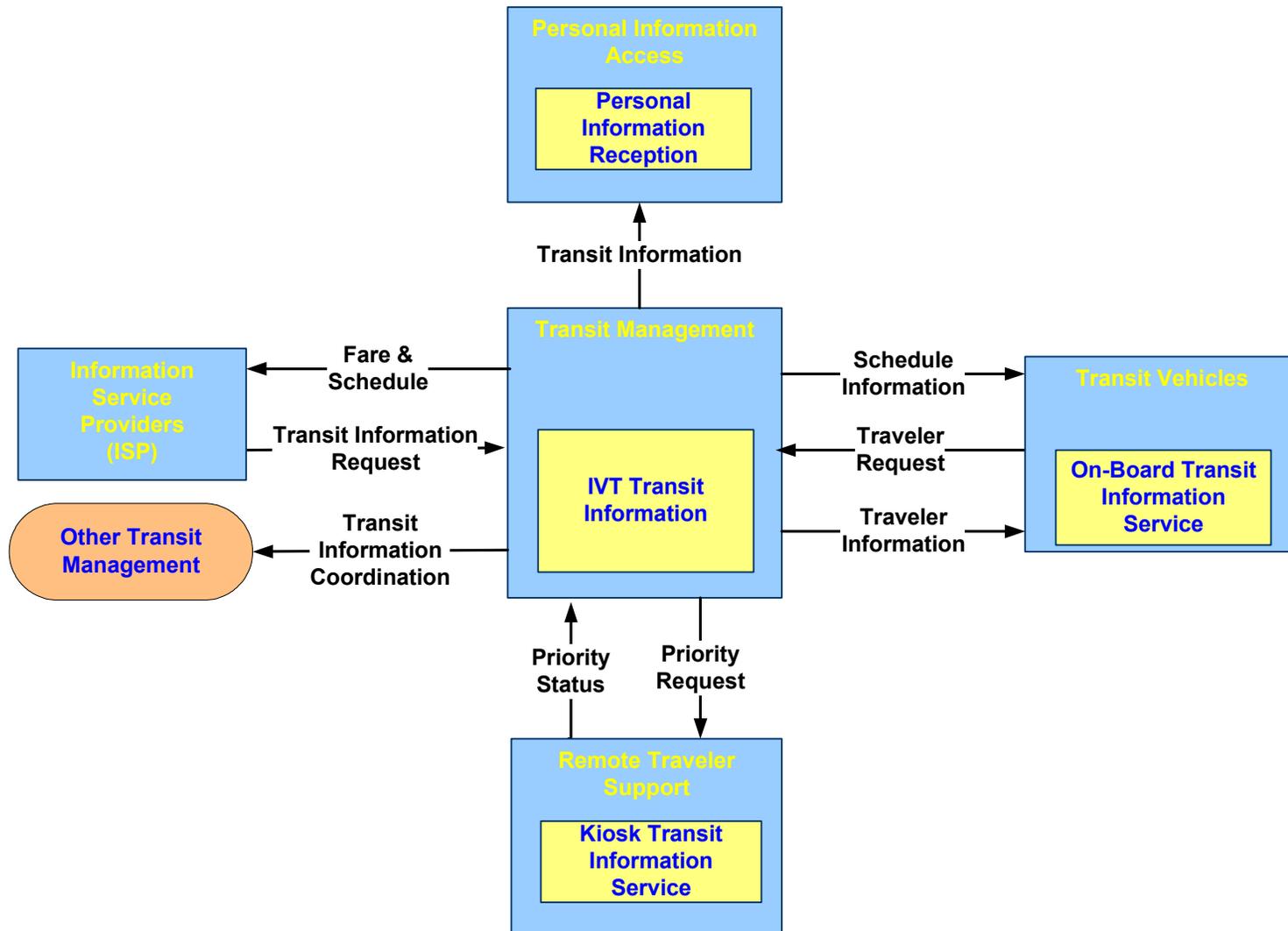**Figure 8-3: APTS 03 - Demand Responsive Transit System**
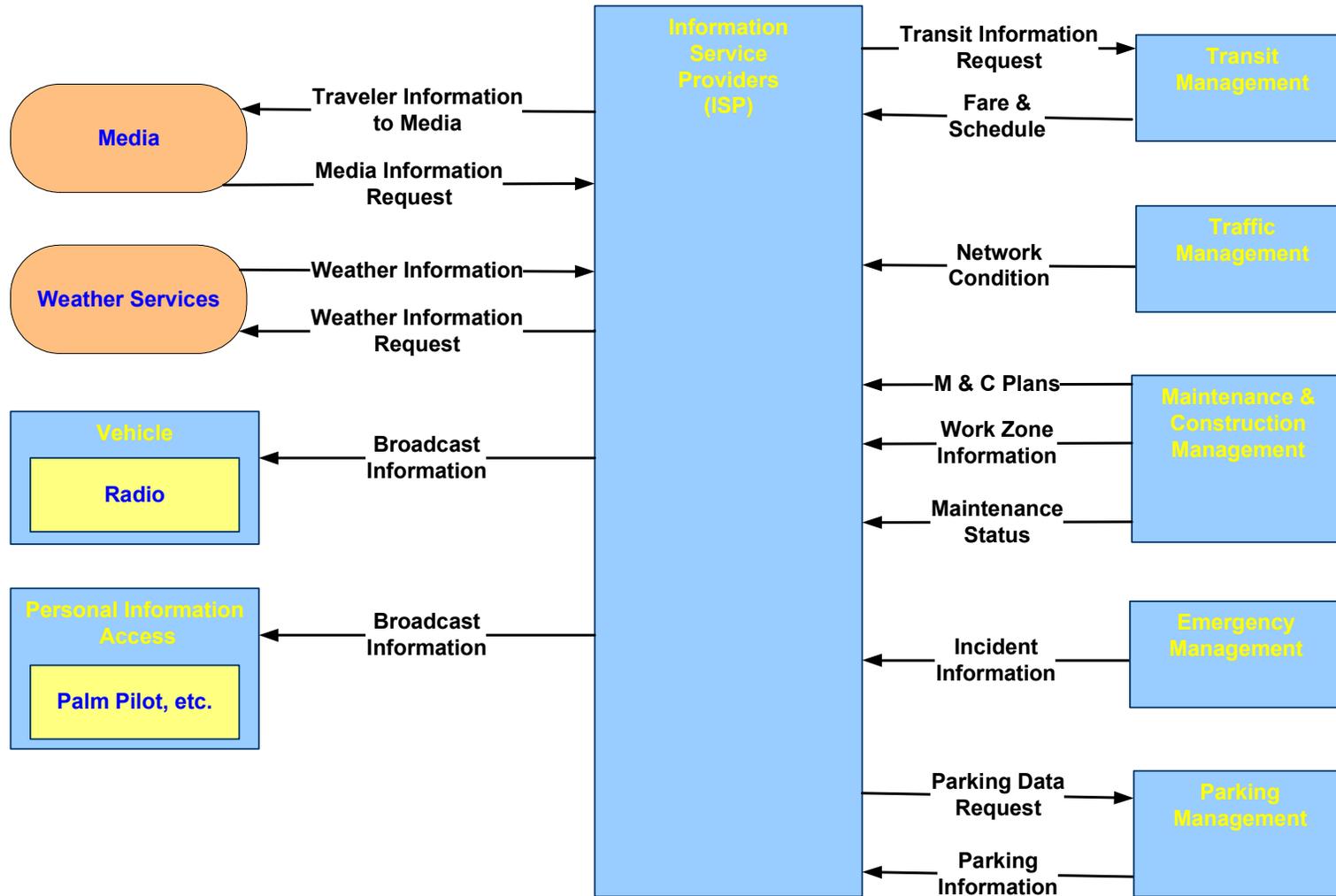
Figure 8-4: APTS 08 - Transit Traveler Information

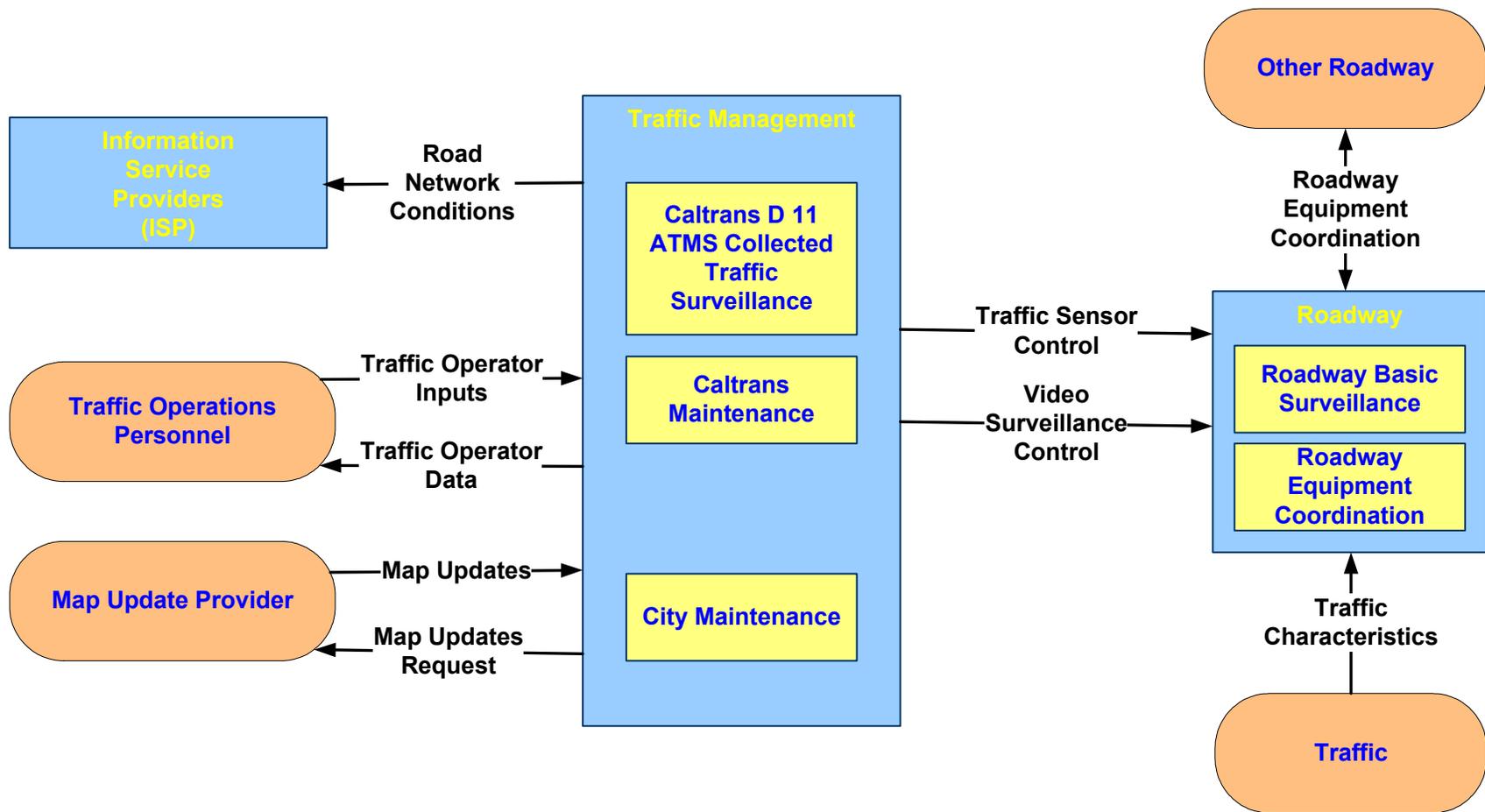**Figure 8-5: ATIS 01 - Broadcast Traveler Information**
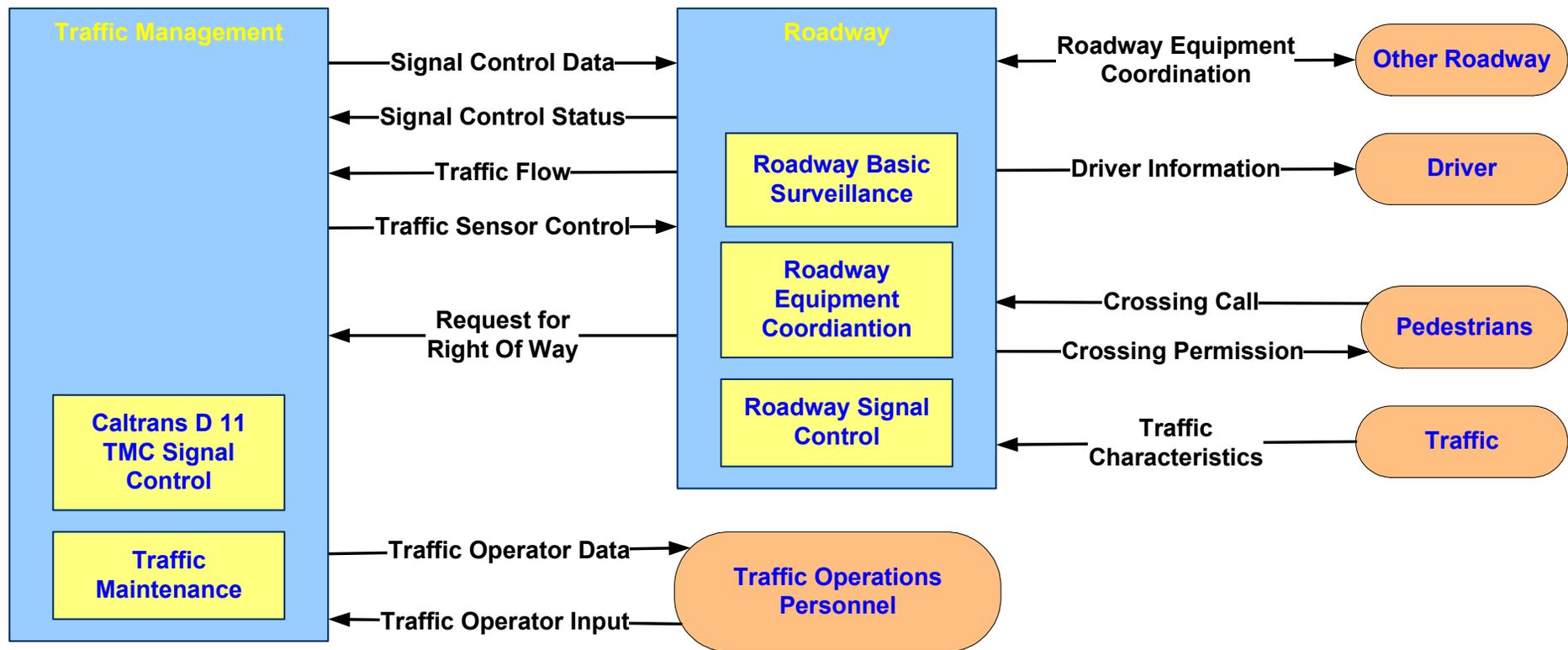
Figure 8-6: ATMS 01 - Network Surveillance
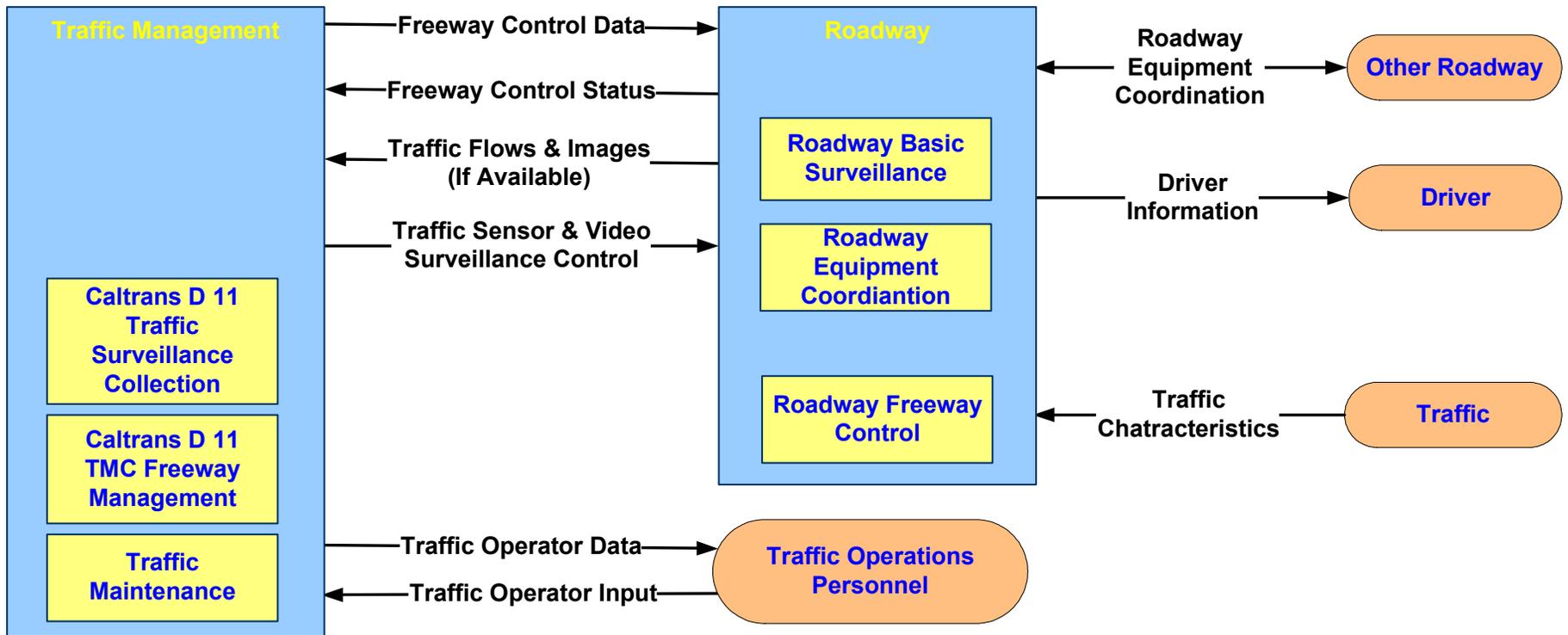
Figure 8-7: ATMS 03 - Surface Street Control

Traffic Management

Traffic Management

Freeway Control Data →

← Freeway Control Status

← Traffic Flows & Images (If Available)

Traffic Sensor & Video Surveillance Control →

Caltrans D 11 Traffic Surveillance Collection

Caltrans D 11 TMC Freeway Management

Traffic Maintenance

Traffic Operator Data →

← Traffic Operator Input

Roadway

Roadway

Roadway Basic Surveillance

Roadway Equipment Coordiantion

Roadway Freeway Control

Roadway Equipment Coordination ←→ **Other Roadway**

Driver Information → **Driver**

← Traffic Chatracteristics **Traffic**

Traffic Operations Personnel

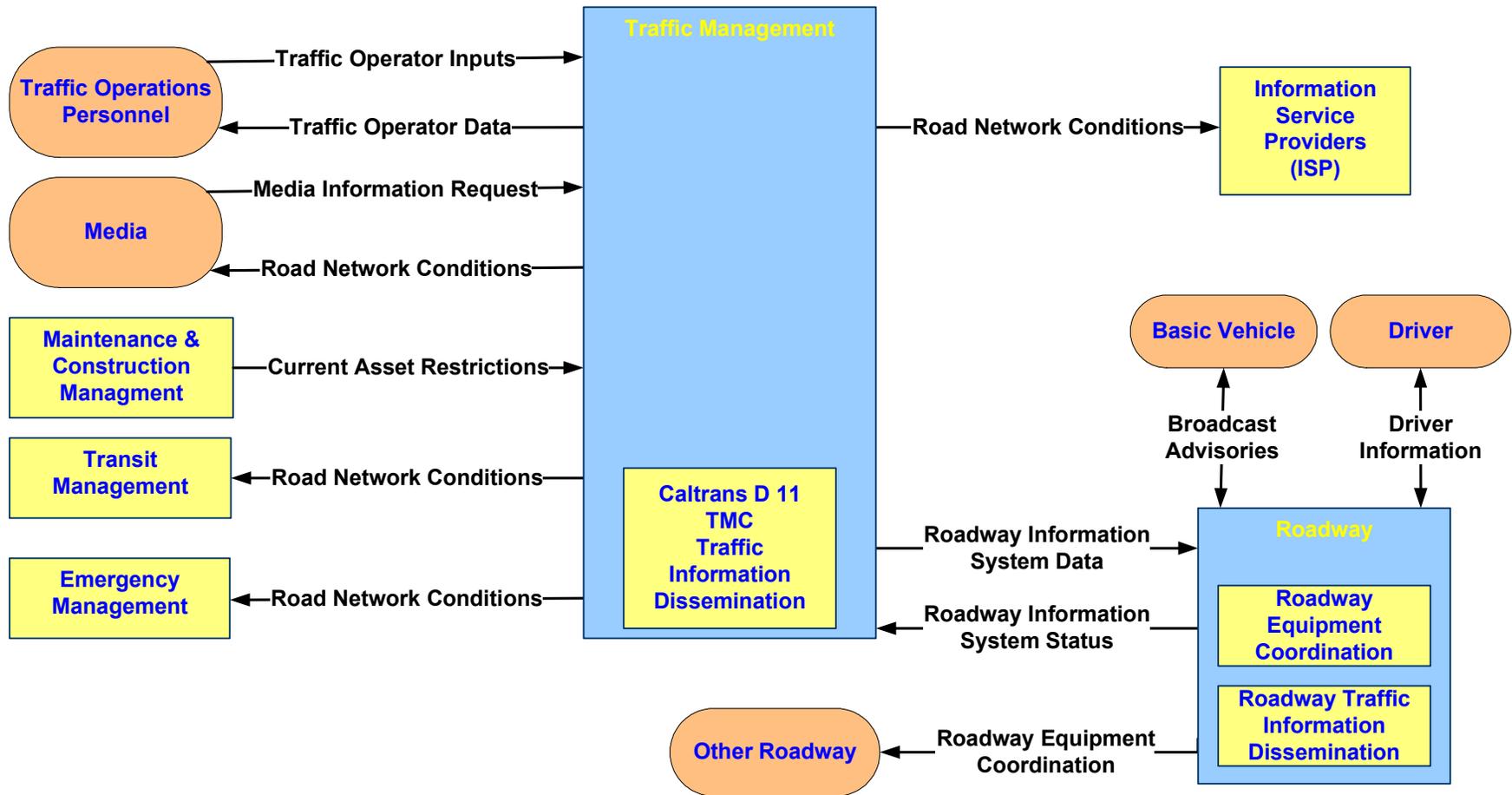**Figure 8-8: ATMS 04 - Freeway Control**

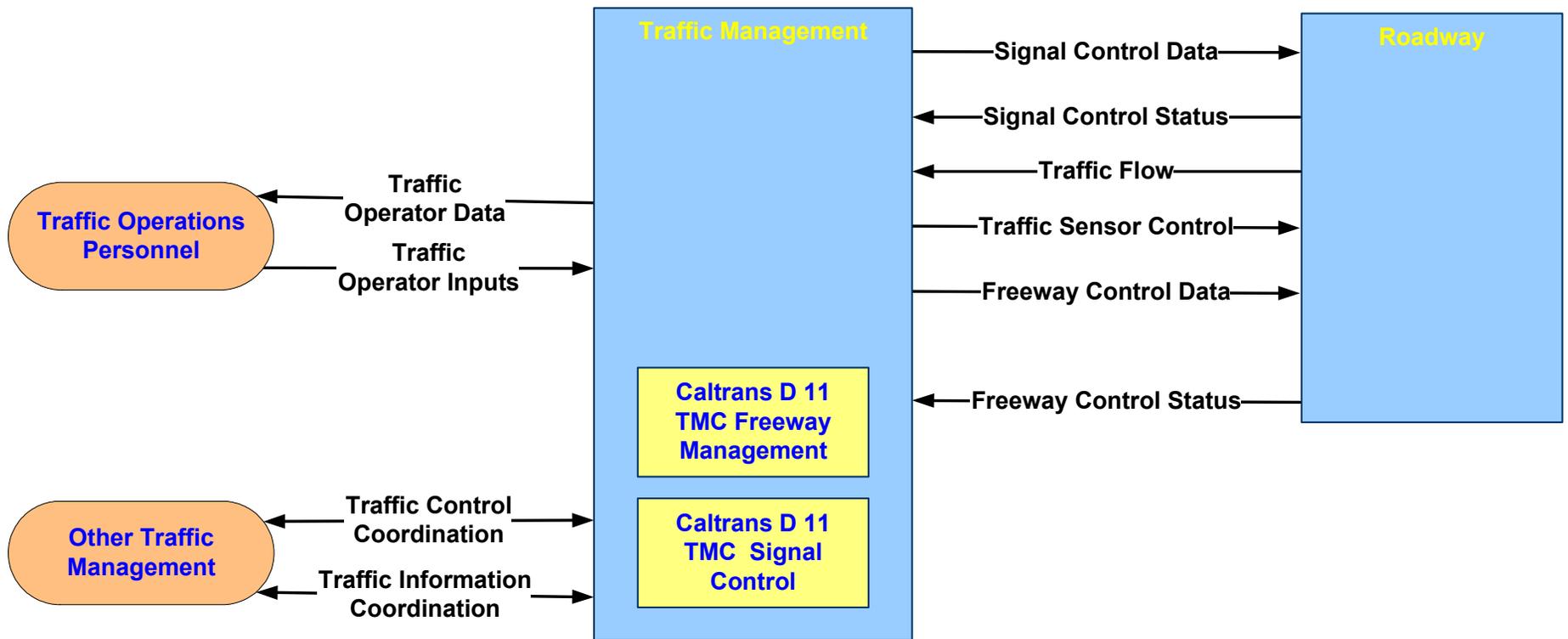**Figure 8-9: ATMS 06 - Traffic Information Dissemination**

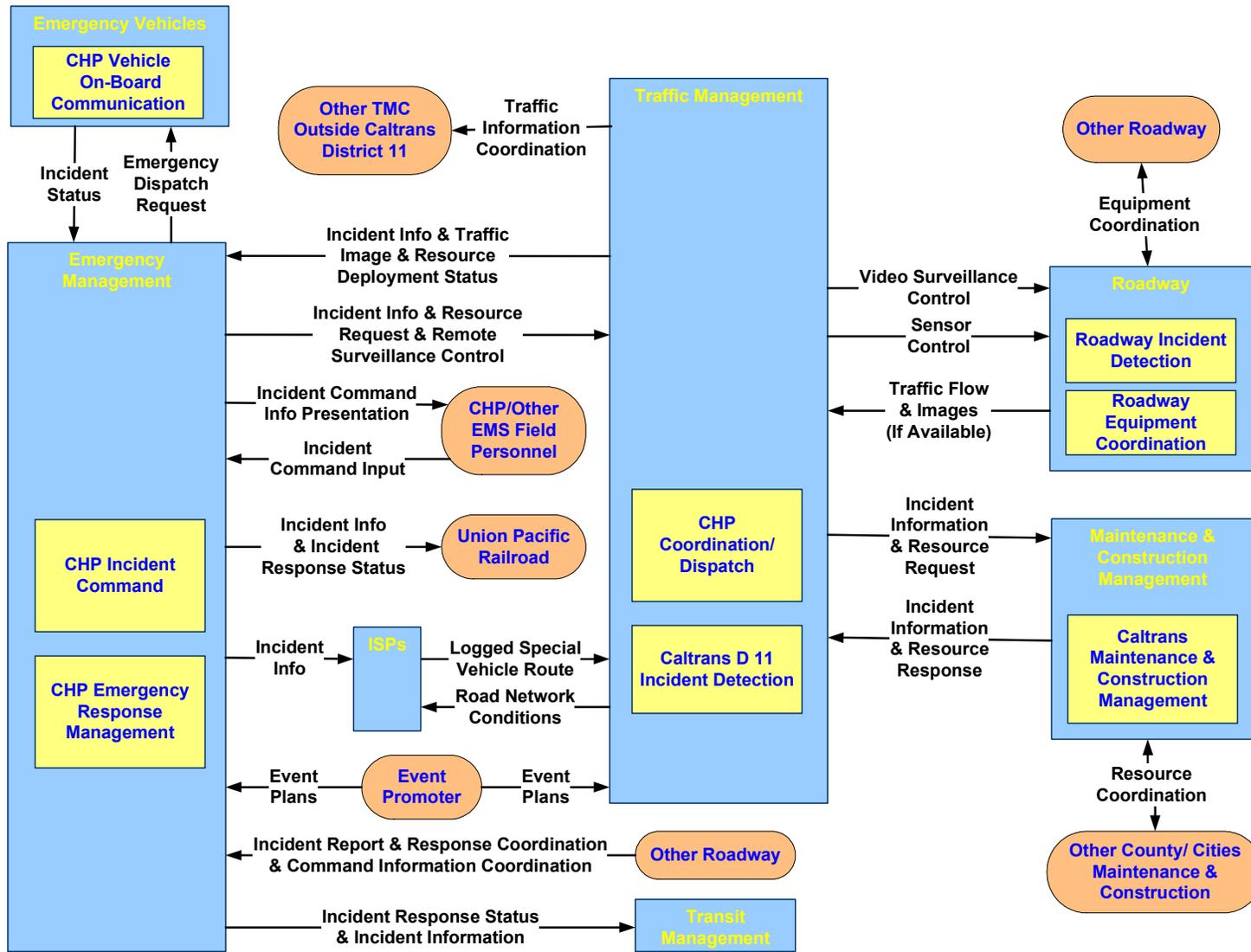**Figure 8-10: ATMS 07 - Regional Traffic Control**

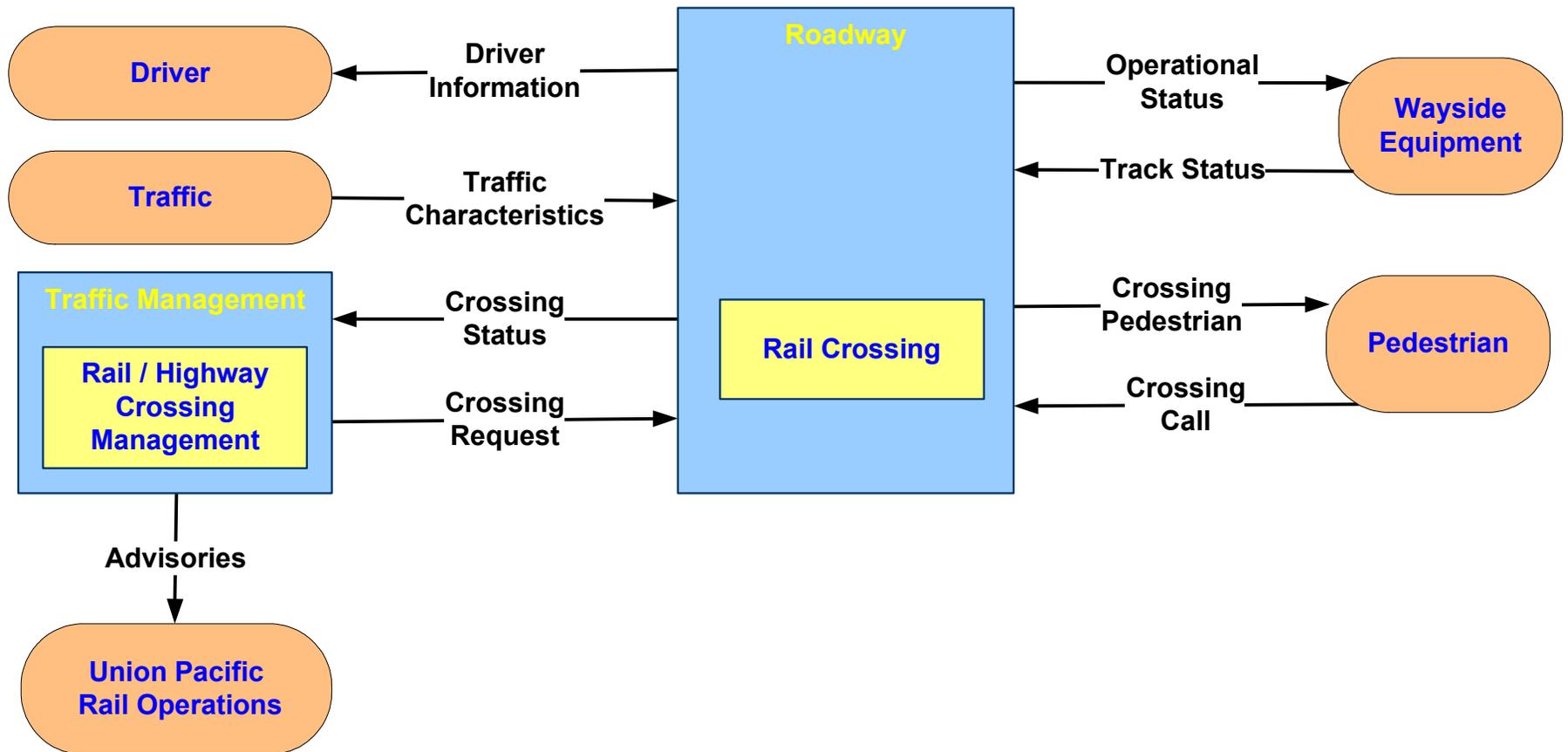**Figure 8-11: ATMS 08 - Traffic Incident Management System**

Figure 8-12: ATMS 13 - Standard Railroad Grade Crossing
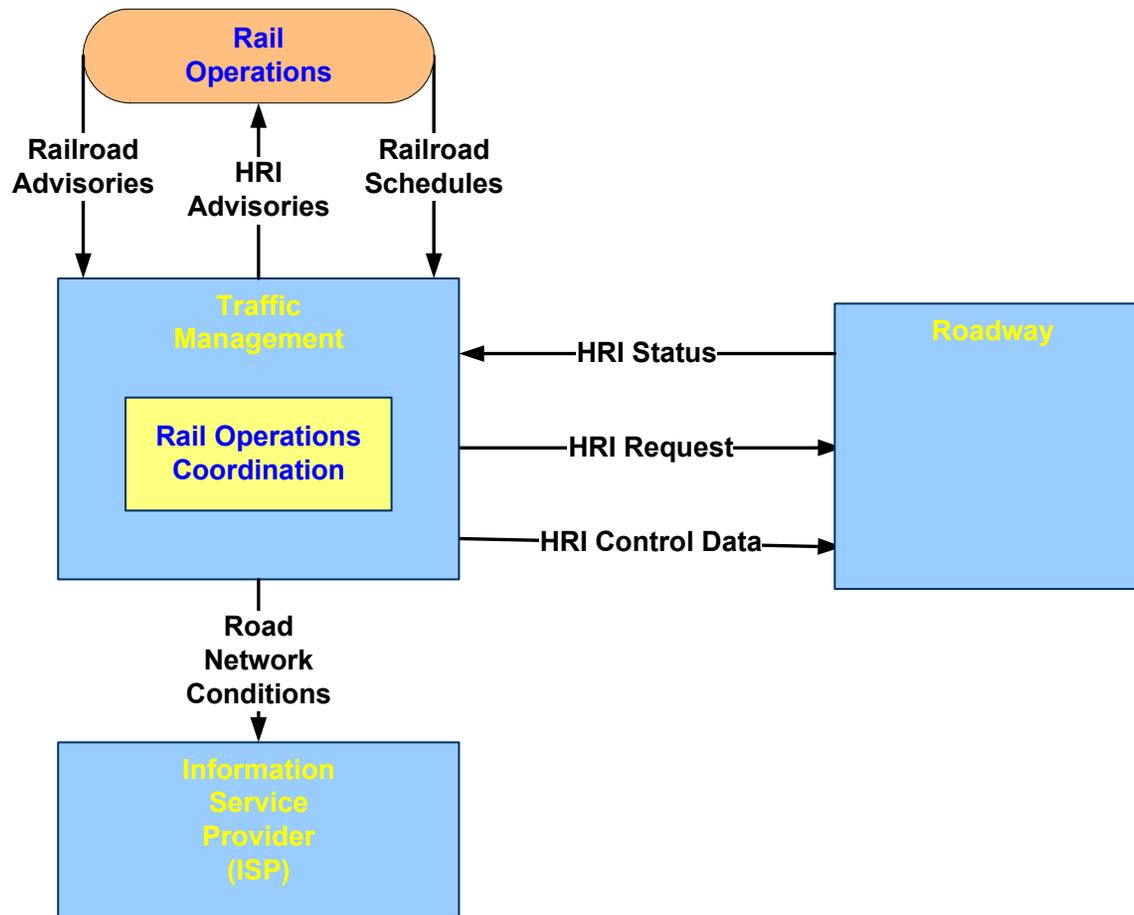
Figure 8-13: ATMS 13 - Railroad Operations Coordination
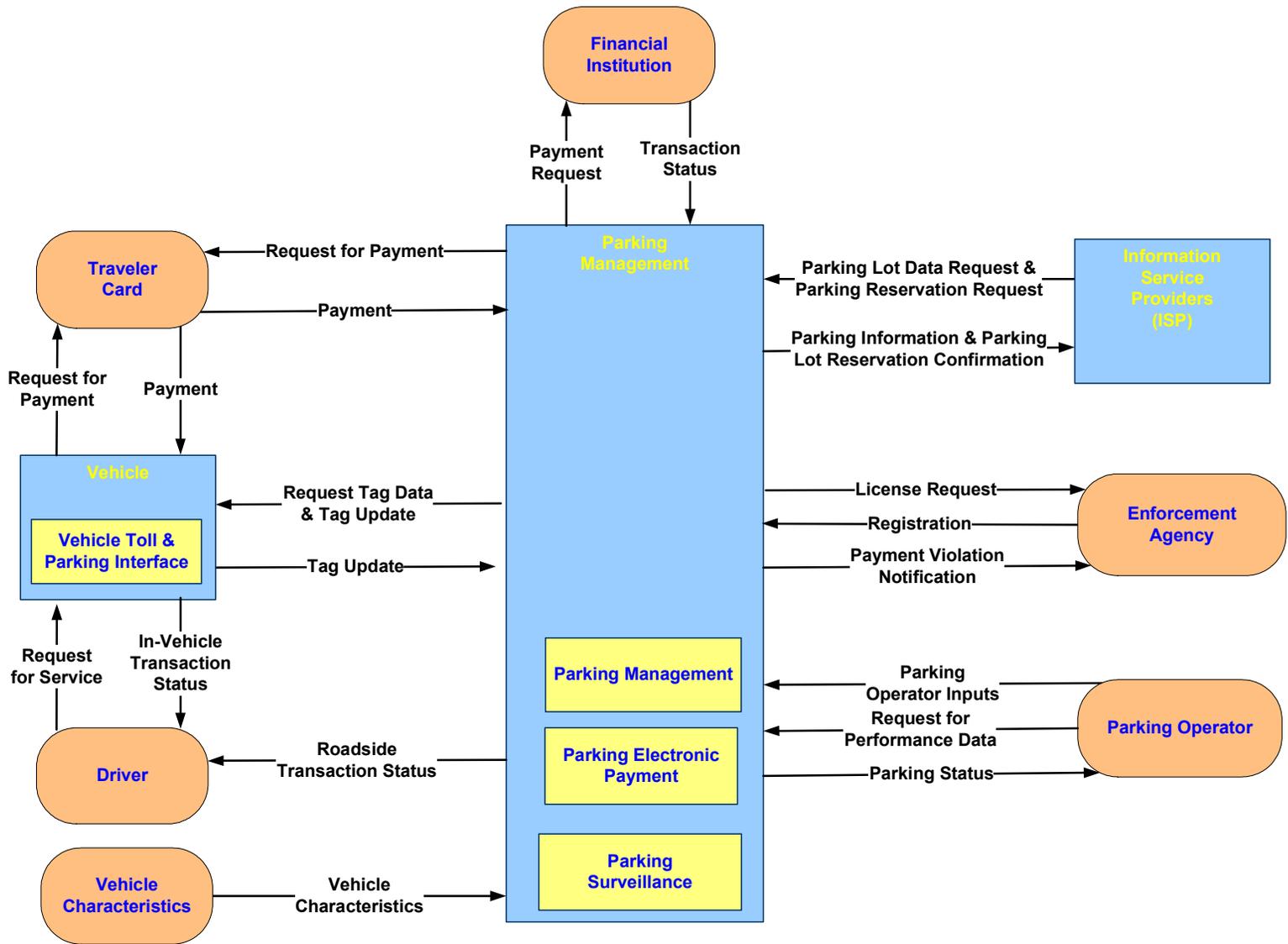
Figure 8-14: ATMS 15 - Parking Facility Management
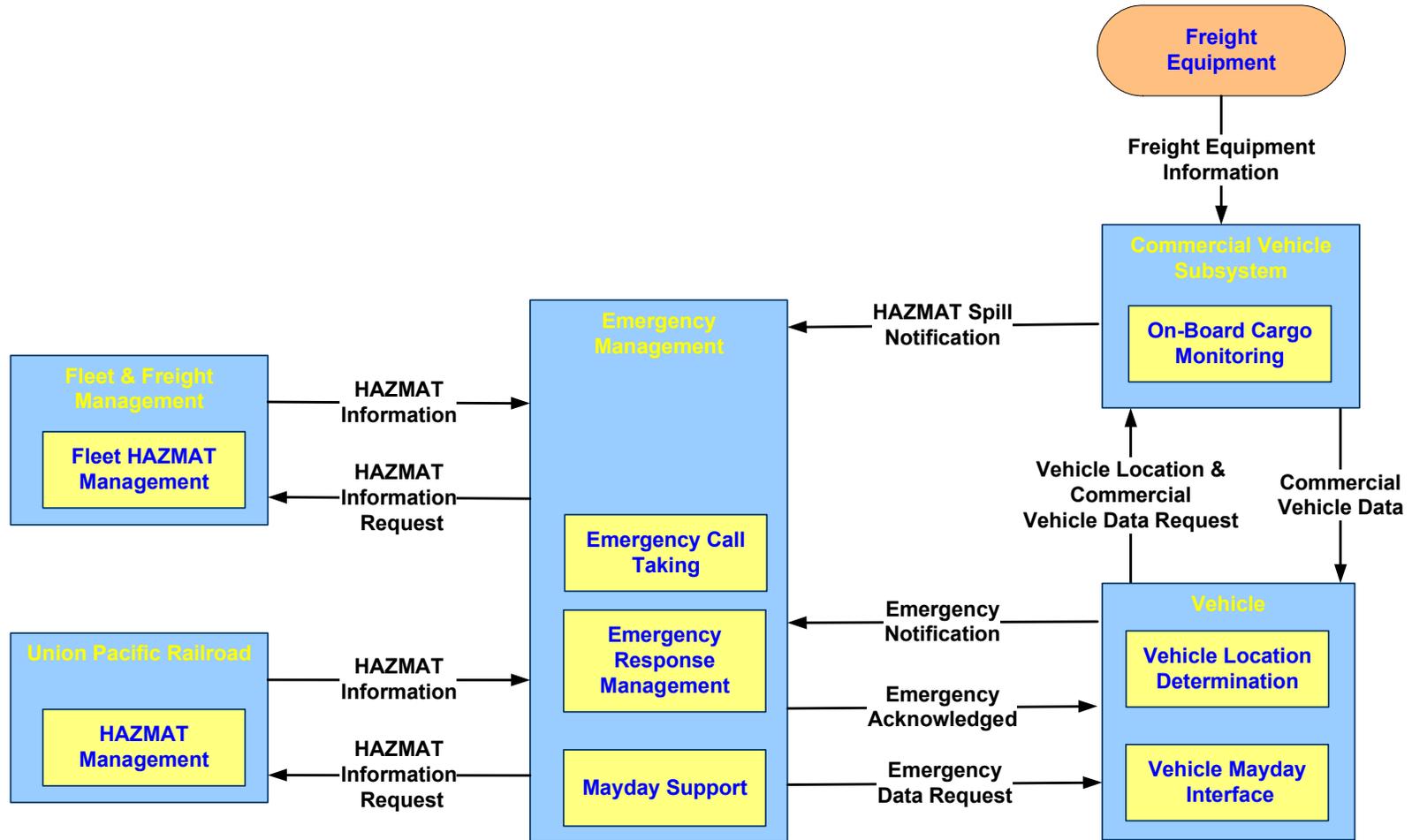
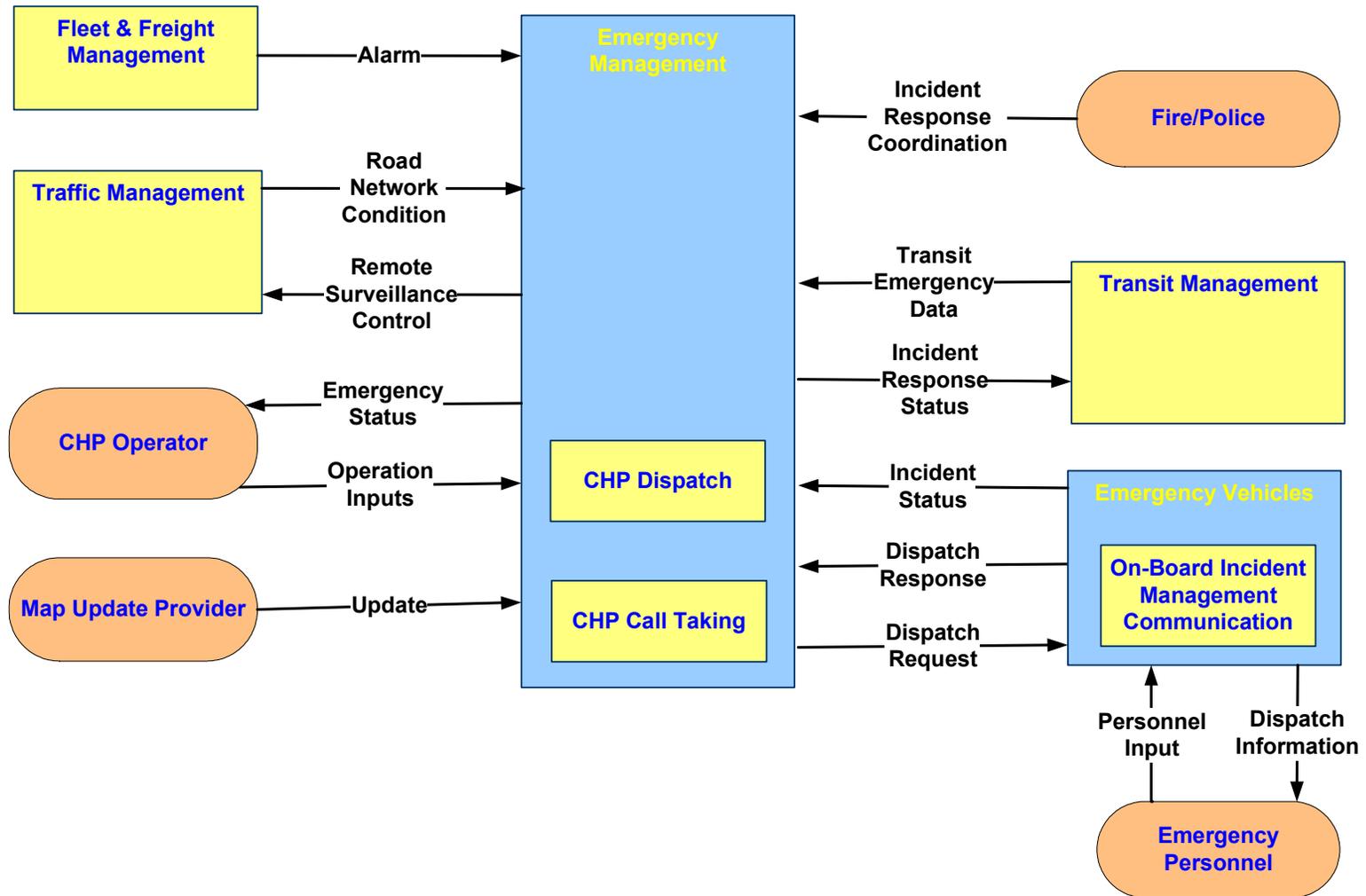**Figure 8-15: CVO 10 - HAZMAT Management**

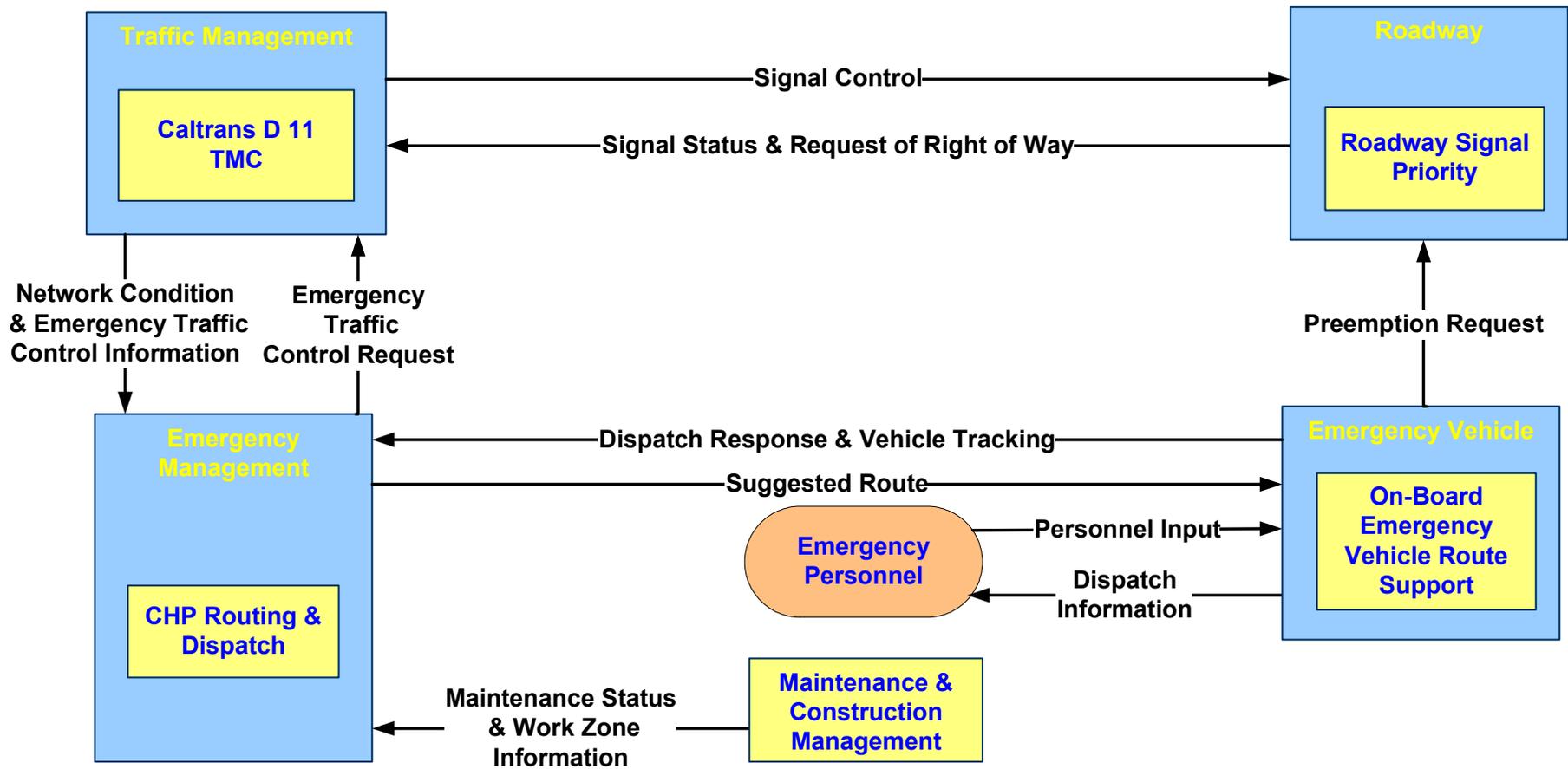**Figure 8-16: EM 01 - Emergency Call Taking and Dispatch**

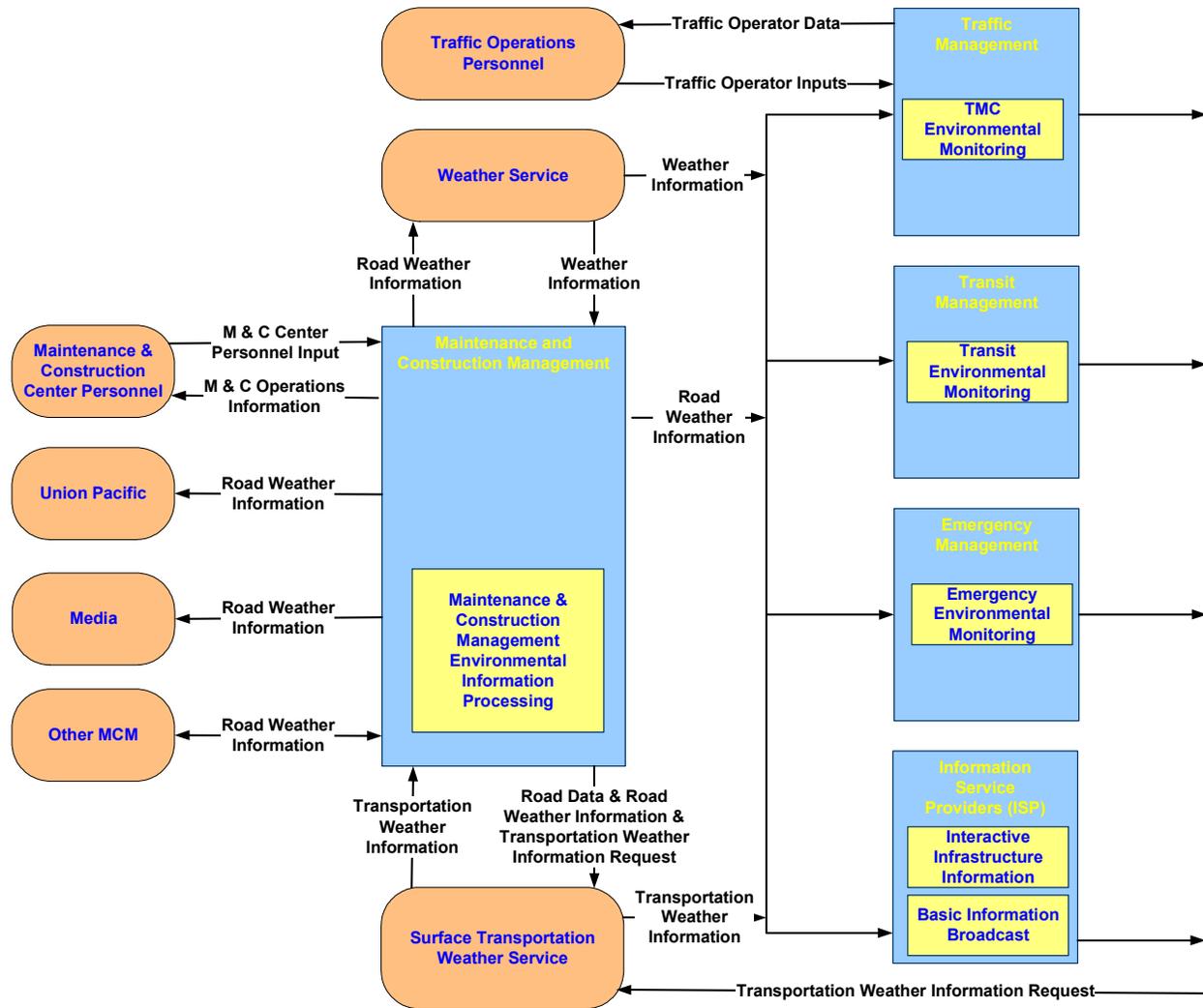**Figure 8-17: EM 02 - Emergency Routing**

Figure 8-18: MC 04 - Weather Information Processing and Distribution

9   PROJECT SEQUENCING

The Imperial County Regional ITS Architecture is implemented through many individual ITS projects that may be implemented over an extended period of time. The staging of projects begins with primary field elements such as signals and detection, weather sensors and portable message signs.   Over time, agencies may acquire more centralized control and be able to communicate with those field devices. The highest stage of development is when data is exchanged between agency systems using interfaces that enable the data to flow between them. This is commonly referred to as integration of ITS systems.

An ITS project is defined by FHWA as:

 "*Any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of ITS user services.*"

A sequence of ITS projects that will contribute to the integrated regional transportation system is identified in Table 9-1. As will be seen from the list of projects in Table 9-1, many of the projects for Imperial County involve the deployment of primary field elements. As mentioned earlier, Figure 8-2 through Figure 8-18 illustrate the market packages that are relevant to the potential transportation projects discussed in this section and outlined in Table 9-1.

9.1   Imperial County Transportation Project Determination

The list of projects for the Imperial County Regional ITS Architecture was developed from stakeholder interviews and consensus building.   At interviews and at project meetings, a request was made of the stakeholders group to provide input on plans or thoughts for potential ITS projects in Imperial County. The project list was then further refined based on stakeholder input on previously identified needs and priorities and relative readiness of planned projects. Interdependencies on other projects were also considered at this stage in the development and refinement of the project sequencing.

9.2   Categories of ITS Projects

A generic project category is a description that could be performed by any agency without a positively identified ITS champion or stakeholder to carryout a specific project of the type identified. These projects are used as placeholders for yet to be defined projects. Specific projects are the second category. These project ideas have been developed by the project team based on previous stakeholder discussions.
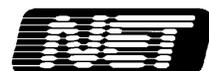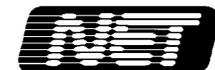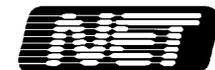
## Table 9-1: Imperial County Project Sequencing

Name of Project	Market Packages	Stakeholders	Project Description
Union Pacific HAZMAT Train Manifest Sharing	CVO 10: HAZMAT Management	Union Pacific Railroad, All Cities, Imperial County EMS	Union Pacific receives their cargo manifest the day cargo is shipped. Union Pacific would share this cargo manifest data with the cities and Imperial County within 24 hours of receiving this manifest data. This way, if emergency management were needed, the responders to the incident would know what cargo was on board prior to assisting in the emergency, such as HAZMAT requirements. Sharing of this data would require some form of communications, such as email.
Traffic Signal Systems Upgrade	ATMS 3: Surface Street Control	All Cities, Imperial County, Caltrans District 11	Upgrade traffic signal systems and communications
State Highway Call Box Project	ATMS 4: Freeway Control	Imperial County, Caltrans District 11	Installation of call boxes at critical locations along SR – 78 and SR – 86, including some traffic data collection capabilities utilizing wireless communications.
State Highway RWIS Project	ATMS 4: Freeway Control MC 4: Weather Information Processing & Distribution	Caltrans District 11	Installation of Roadside Weather Information Systems (RWIS) at key locations on state highway system that require improved weather related information for Caltrans and motorists.
Calexico Parking Management	ATMS 16: Parking Facility Management	City of Calexico, U.S. POE, U.S. Border Patrol	Decrease congestion due primarily to commercial vehicles near the international border in the City of Calexico. Implement parking structure, fee implementation, parking

Name of Project	Market Packages	Stakeholders	Project Description
			management plan, etc. that can be conveyed to the public with a CMS or other device.
Calexico Port of Entry – Brawley CVO Corridor Traffic Management System	ATMS 1: Network Surveillance ATMS 3: Surface Street Control	City of Brawley, Calexico, El Centro & Imperial, Caltrans District 11, U.S. Border Patrol	This project would deploy ITS traffic management technologies such as system detection, advanced signal control, CCTV cameras and traffic management systems to monitor and manage truck traffic along state highways through the region.
GIS Integration	ATMS 7: Regional Traffic Control	All Cities, Imperial County, Caltrans District 11, CHP, SCAG	Integrate the GIS used by all agencies with accurate mapping for more communications and data sharing.
Grade Crossing Installation	ATMS 13: Standard Railroad Grade Crossing	All Cities, Imperial County, Union Pacific Railroad, Public Utility Companies	Installing grade crossings at identified arterials for improved vehicle safety along the Niland to Calexico corridor. Dispatcher will know location of trains, increase speed and increase safety. Public Utilities Commission (PUC) has all authority over grade crossings.
Grade Crossing Installation	ATMS 13: Standard Railroad Grade Crossing	All Cities, Imperial County, Union Pacific Railroad, Public Utility Companies,	Installing grade crossings at identified arterials for improved vehicle safety along Calexico to western portion of Imperial County corridor - Plaster City. Union Pacific dispatcher will know location of trains, increase speed and increase safety. Public utilities have all authority over grade crossings.

Name of Project	Market Packages	Stakeholders	Project Description
I – 8 Corridor ITS Gap Closure project	ATMS 1: Network Surveillance ATMS 4: Freeway Control	Caltrans District 11	Install Traffic Operations System (TOS) elements and communications media to provide surveillance of state highway for roadside weather and traffic conditions from the Caltrans District 11 TMC.
Multi jurisdictional Traffic Signal Coordination and Maintenance Project	ATMS 3: Surface Street Control ATMS 7: Regional Traffic Control	All Cities' Traffic Staff, Caltrans District 11	Installation of improved communications and control equipment to allow for the more efficient monitoring and operation of traffic signals along major highways.
Rail & Highway Intersection Improvements	ATMS 13: Standard Railroad Crossing	All Cities, Imperial County, Union Pacific Railroad, Caltrans District 11	Improve highway/rail intersections along the far east and far west portions of I – 8, along with SR – 111, SR – 115 and SR – 80.
Recreational Area ATIS	ATMS 6: Traffic Information Dissemination	Imperial County, Caltrans District 11, BLM	Provide traffic information to motorists at the Imperial Sand Dunes Recreation Area and Salton Sea recreational areas of Imperial County.
Signal Circuitry Improvement	ATMS 13: Standard Railroad Grade Crossing	All Cities, Imperial County, Union Pacific Railroad	Install new signal circuitry to improve performance of gates. The gate signal circuitry detects the speed of the train and the distance to the gate in order to lower the gate in time (26 seconds is fastest time).
Train Location Sharing	ATMS 15: Railroad Operations Coordination	Union Pacific Railroad	Share real time Union Pacific train location data with cities and Imperial County.
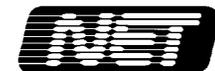
10 IDENTIFICATION OF REQUIRED ITS STANDARDS

ITS standards are fundamental to the establishment of an open ITS environment that achieves the goals originally envisioned by the U.S. DOT. ITS standards are an important component of the information flows in the Imperial County Regional ITS Architecture. ITS standards facilitate deployment of interoperable systems at local, regional and national levels without impeding innovation as technology advances and new approaches evolve.

There are five different types of ITS standards that apply to transportation:
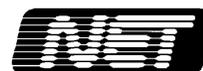
- Communication Standards
- Data Standards
- Message Set Standards
- Equipment Standards
- Software Standards

Establishing regional and national ITS standard 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. ITS 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 Imperial County Regional ITS Architecture only has to reference those ITS standard that are applicable to the region's pieces of the architecture selected.

10.1 ITS standard Development Organization

The Standards Development Organizations (SDOs) created ITS standards between the most critical ITS interfaces. The following is a list of SDOs that are developing ITS standards:

- American Association of State Highway and Transportation Officials (AASHTO)
- 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)
- National Electronic Manufacturers Association (NEMA)
- National Transportation Communications for ITS Protocol (NTCIP)
- Society of Automotive Engineers (SAE)

NTCIP is a joint product of the National Electronic Manufacturers Association (NEMA), the American Association of State Highway and Transportation Officials (AASHTO).

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 ITS standard. There are no fully approved U.S. DOT standards currently, but several are very close to approval.

10.2 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 ITS standard in procurement specifications. Early in the development cycle, there are many changes before approval or publishing.

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

Draft Under Development
- During this phase, there are significant changes likely to occur.

Tested/Deployed Standard
- Only minor changes are likely to occur in this phase of a standard development.
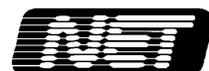
Draft for Ballot (or in Balloting)
- Standards being voted upon by a committee or working group or are undergoing other SDO procedures.

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.

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

10.3 ITS Standards in Procurement Specifications

The use of ITS standards in procurement specifications often depends on how much risk is acceptable. There are often lots of changes to an early standard and even some risk of change in a balloted standard. Agencies that deploy ITS in the early stages will likely have suggested improvements to the standard that will require an update via an amendment to the ITS standard. Amendments 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 Fact Sheets
- One page, user friendly, easy to understand summaries of many of the ITS standards

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

10.4 Decision Making Strategy in ITS standard

Making the best choices for ITS standard 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 discussed and agreed upon in Imperial County.

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 ITS standard for specific projects have not been decided upon, but the process for making those decisions are beginning to be developed. For each potential ITS standard, consider:

- Has the ITS standard been adopted by multiple vendors?
- Has the ITS standard been approved or published by the SDOs?
- 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?
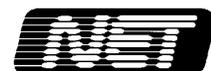
10.5 ITS Standards for Imperial County

ITS standards address interfaces and information flows between systems. Imperial County is at such an immature level of ITS development that there is little need for concern about the immediate adoption of consensus on regional ITS standard. However, ITS standard will be of importance as multi agency projects are developed. When this occurs, the many National ITS Architecture resources on standards should be consulted. FHWA also has educational opportunities that can help support understanding of ITS standard, their importance and application.
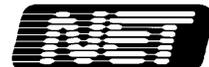
11 ARCHITECTURE MAINTENANCE

An ITS architecture is a blueprint for the deployment of ITS in a region. Since ITS deployment is not a static process, regional ITS architectures are also living documents. As mentioned earlier, the horizon for this document is twenty years. During this period, much can occur including the deployment of some ITS projects, definition of new ITS projects and a maturing view of the need for ITS in Imperial County. The goal of maintaining the Imperial County Regional ITS Architecture is to keep an up to date architecture that is accessible and easily used for deploying ITS projects in Imperial County.

11.1 Responsibility of Architecture Maintenance

The Imperial County Regional ITS Architecture belongs to its stakeholders. IVAG will take responsibility for the documentation and will make any of the agreed changes. Caltrans District 11 will be looked to for technical advice and FHWA will help coordinate educational support with stakeholders. SCAG will need updates in the future for the potential projects for Imperial County.

A group of active stakeholders agrees to take responsibility for meeting at some regular interval and to jointly agree to any changes to the document on an as needed basis. Responsibility for organizing meetings has yet to be decided but might best be arranged on a rotating basis between the major stakeholder agencies. Meetings can be made more efficient by using established processes and meeting venues to discuss the Imperial County Regional ITS Architecture maintenance. For Imperial County, these frequent group meetings include the League of Cities, Public Work Directors monthly meetings, IVAG Regional Council monthly meetings, Institute of Transportation Engineers (ITE) meetings two to three times per year, etc. These Imperial County meetings could have an alternate meeting sponsor, such as a city host. The most important thing to maintain is a dialogue even at relatively infrequent intervals.

11.2 Identification of Maintenance Items

There are several different parts that make up the Imperial County Regional ITS 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 the Imperial County Regional ITS Architecture will be established as the baseline architecture. Maintenance time frames can be developed. For the most part, it is anticipated that the baseline document will require little major review for the first five years. As indicated earlier, SCAG will request updates to the list of projects for inclusion in the tri-annual Regional Transportation Improvement Program (RTIP). As need arises, changes to the documentation can be forwarded to SCAG for recording and filing.
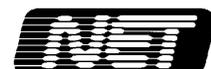
11.3 Architecture Modification Process

The process for amending the architecture is based on agreement between stakeholders as to what needs to be changed or updated. Minor changes can simply be made to the Word document. The only requirement is that changes are noted and copied to SCAG. More significant changes, which will occur much less frequently, can be performed by agency staff and or with support from consultants.

## 11.4 Frequency of Architecture Maintenance

The operational concept, system functional requirements and the list of agency agreements represent high level views of the Imperial County Regional ITS 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. This is unlikely to take place in the first five years given the current level of ITS immaturity in Imperial County. Every three years, stakeholders will need to review the project list to see whether new project categories and definitions need to be added. Added projects will need to be forwarded to SCAG as well.

11.5 Change Process Management

The change management process is the procedure for modifying the Imperial County Regional ITS Architecture. It specifies how changes are identified, how often they will be made and how the changes will be defined, reviewed, implemented and released. Because Imperial County needs are so simple at this stage, there is no need for a formal configuration management process. This may be reviewed after five or ten years according to the ITS development in Imperial County. Change must continue to be a stakeholder consensus process.

11.6 How Changes are Identified

The Imperial County Regional ITS Architecture was created as a consensus view of what limited ITS systems the stakeholders in the region have currently implemented and what systems they plan to implement in the future. The Imperial County Regional ITS Architecture will need to be updated to reflect changes resulting from project implementation or resulting from the planning process itself.
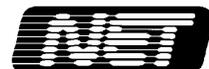
12 INTERAGENCY AGREEMENTS

Agreements among the different stakeholder agencies and organizations are required to implement the integration described in the Southern California Regional ITS Architecture. According to the FHWA's ITS Architecture Guidance, any agreements (existing or new) required for operations, including those affecting ITS projects interoperability, utilization of ITS related standards and the operation of the projects identified in the Imperial County Regional ITS Architecture are required by the Rule/Policy. The requirement is only to provide a list of agreements and not the agreements themselves. It takes an actual project deployment to drive the agreements process along.

12.1 Agreement Process

The typical process of agreements development starts from existing agreements that support sharing of information, funding, or specific ITS projects. These agreements are reviewed and assessed to determine if they can be extended and used to support the cooperative implementation and operation of ITS. The list of the required Imperial County agreements was developed based on the regional operational concepts, knowledge of the types of ITS existing or planned for implementation in Imperial County and the information that needs to be exchanged in order to operate those systems. The detailed agreement work, including the preparation and execution of the identified agreements, will be performed to support ITS projects as they are implemented in the future.

12.2 Types of Agreements

There is considerable variation between ITS projects and among stakeholders regarding the types of agreements that are created to support ITS integration. Some common types of agreements provided by the Regional ITS Architecture Guidance are shown in Table 12-1. The agreement should describe the high level information that each agency needs to exchange in order to meet the goals and expectations of each other rather than defining how the delivery of that information will occur. The agreements should avoid being excessively technology prescriptive since technology changes rapidly.

The process may begin with something as simple as a handshake agreement. Once interconnections and integration of systems begin, agencies may want to have something more substantial in place. A documented agreement will aid agencies in planning their operational costs, understanding their respective roles and responsibilities and build trust for future projects. Formal agreements are necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required.
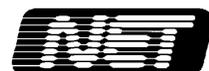
Table 12-1: Agreement Types

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
Handshake Agreement	• Early agreement between one or more partners • Not recommended for long term operations
Interagency Agreement	• Between public agencies (i.e., transit authorities, cities, counties, etc.) for operations, services or funding • Documents responsibility, functions and liability
Intergovernmental Agreement	• Between governmental agencies (i.e., agreements between universities and State DOT, MPOs and State DOT, etc.)
Master Agreements	• Allows states, cities, transit agencies and other public agencies that do business with the same agencies over and over (i.e., cities and counties) to have one Master Agreement that uses smaller agreements (i.e., 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. • Standard contract and/or legal verbiage for a specific agency and serving as a Master Agreement by which all business is done. These agreements can be found in the legal department of many public agencies.
Memorandum of Understanding (MOU)	• Initial agreement used to provide minimal detail and usually demonstrating a general consensus • 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 • Used to expand a more detailed agreement like an Interagency Agreement that may be broad in scope but contains all of the standard contract clauses required by a specific agency
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
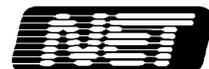
Catalysts for agreement development are usually projects involving any of the following:

- Any aspects of shared control/interoperability
- Configuration management of jointly owned and operated systems
- Data sharing
- Liability issues
- Ownership and maintenance of equipment
- Ownership of data
- Shared communications (i.e. fiber, operations, twenty four hours a day or peak period only)
- Third party agreements

12.3 Sample Agreements for Imperial County

Table 12-2 presents the list of sample agreements for Imperial County. A simple handshake agreement may be enough for some Imperial County activities. However, interagency projects bring much greater demands for clarity of ownership, roles with regard to operations and maintenance and questions of liability. Examples of agency agreements are included in Appendix L. Other agreements can only ever be treated as examples as each project and set of stakeholders are unique.
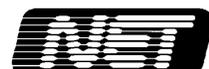
Table 12-2: Imperial County Potential List of Agreements

ITS Service	Stakeholder	Type of Agreement	Status	Agreement Description
Emergency Call Answering and Freeway Service Patrol	Caltrans District 11 & CHP	Interagency Agreement	Mid Term	Specifies the roles, responsibilities and functions for providing a call answering service and freeway service patrol activities
Emergency Vehicles Signal Preemption	All Cities, Imperial County, Caltrans District 11, EMS Providers	Interagency Agreement or MOU	Long Term	Specifies the roles, responsibilities and functions for emergency vehicle preemption at signalized intersections for police, fire, ambulance and other agencies
Inter Jurisdictional Traffic Management	All Cities, Imperial County, Caltrans District 11, CHP	Interagency Agreement	Long Term	Provides for data exchange, device control, detailed jurisdiction to jurisdiction operations and regional incident management
Rail/Highway Crossing Management	All Cities, Imperial County, Caltrans District 11, Union Pacific Railroad	Interagency Agreement	Long Term	Specifies roles, responsibilities and functions for rail grade crossing coordination and optimization at signaled intersections
Regional Traffic Management and Emergency Services	All Cities, Imperial County, Caltrans District 11, EMS Providers	MOU	Long Term	Provides for signal operations and coordination and local incident management
Traveler Information	All Transportation Agencies in Imperial County and Information Service Providers	MOU/ Service Agreements with ISPs	Long Term	Specifies expectations, roles and responsibilities for the provision of transportation related data and information to the raveling public. Also documents the policy or disclaimer for release of traveler information.