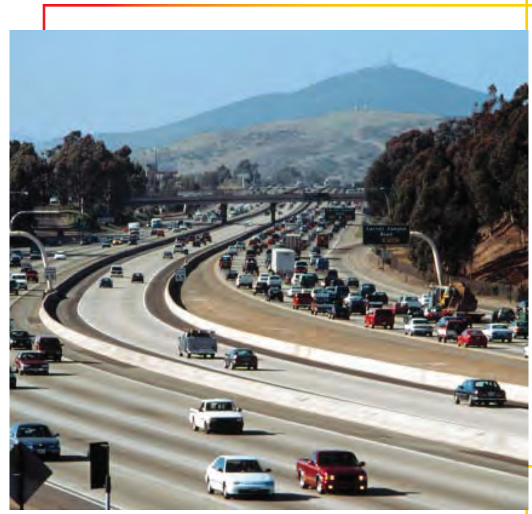
San Diego I-15 Integrated Corridor Management (ICM) System

May 2009



FINAL

I-15 ICM Concept of Operations

SANDAG

Partnerships. Technology. Mobility.

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1. SCOPE AND SUMMARY: I-15 ICMS CORRIDOR IN SAN DIEGO

Guidance The Scope and Summary chapter serves as an introduction to the Concept of Operations (ConOps) document and San Diego region's Interstate 15 (I-15) Integrated Corridor Management System (ICMS). It is a high-level understanding of the multi-modal approach of the I-15 corridor, with details provided in subsequent chapters.

1.1 Introduction and Document Contents

The I-15 corridor in San Diego is a model for the multi-modal deployment of the latest and evolving technologies in the region. The region continues to seek the benefits of Intelligent Transportation Systems (ITS) through capital investments in transit, highway, and arterial systems, while focusing on data sharing through early adoption of the Regional ITS Architecture. The San Diego region has a rich history of partnership among the San Diego Association of Governments (SANDAG), its member agencies, and diverse stakeholders, who are all committed to the ICM vision and implementation of the ICMS to support ICM programs.

ICM consists of the operational coordination of multiple transportation networks and cross-network connections comprising a corridor and the coordination of institutions responsible for corridor mobility. ICM programs provide better information, coordination of network junctions, proactive management of capacity and demand, advanced technologies and systems, and improved institutional arrangements. ICMS is a "system of systems," i.e., an transportation management system (TMS) that connects the individual network-based TMS, provides decision support, and enables joint operations according to a set of operational procedures agreed to by the network owners. ICMS facilitates ICM programs to meet corridor needs and realize the ICM vision.

This ConOps for an ICMS to be deployed along the I-15 corridor includes the cities of San Diego, Poway, and Escondido. The corridor connects major regional employment centers and interregional goods movement locations. The 21-mile I-15 corridor, including a Managed Lanes section, is already a model for the multi-modal deployment of the latest and evolving technologies for data collection, demand management, and pricing strategies. The region is dedicated to providing additional value from comprehensive approaches to transportation management. The newly implemented 511 advanced traveler information system (511 ATIS) provides corridor users with real-time information and efficient travel alternatives.

This document provides an overview of the San Diego region's ICMS concept, describes current operations in the corridor, how they will function in the near term once the ICMS concept is operational, and identifies current and future responsibilities of San Diego regional stakeholders. By highlighting the flexible and innovative approaches to management along this corridor, the user will understand how improvements currently underway along the corridor serve as a foundation for even further integration in the future. For example, there will be a Bus Rapid Transit (BRT) system along the corridor with BRT stations (called centers) having direct access ramps (DARs) to the Managed Lanes facility and fostered through transit-oriented developments. The centers will include an array of ITS elements such as real-time arrival information, trip planning kiosks, smart card electronic payment devices for pre-boarding payment, and smart parking technologies to allow for posting of space availability and reservations.

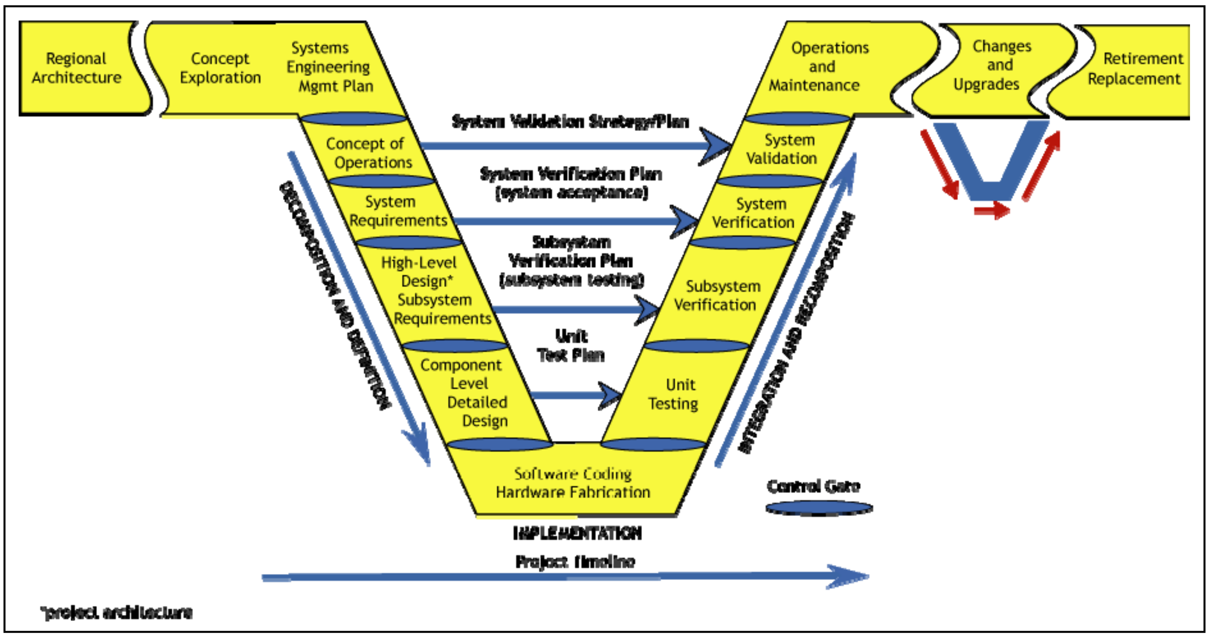
The successful implementation of the ICMS and concepts requires a proactive, strategic, and collaborative approach to public and private-sector stakeholder partnerships, along with a history of successful joint operation initiatives, both of which have been achieved under the institutional umbrella of SANDAG. The Virtual Corridor Transportation Management Center (VCTMC) outlined in this document will allow for the coordination among multiple agencies on multiple levels for data collection and processing, data sharing, and decision support based on workflow and on an expansion of available information.

By providing a user-oriented view of the potential for integrated management along the I-15 corridor, the ConOps focuses on the corridor's needs and problems, goals and objectives, proposed operational approaches, and strategies for attaining these goals, the institutional framework in which the ICMS will operate, and the associated operational, technical, and institutional issues that must be addressed in the future. SANDAG's partnerships can fully capitalize on existing technologies to design and implement model deployment and technology transfer initiatives to dramatically improve corridor mobility and productivity along the I-15 corridor.

1.2 Development of the ConOps

The development of the ConOps for the San Diego I-15 ICMS is an important step in the overall process to plan and implement integrated corridor management for the corridor. The development and implementation of the I-15 ICMS follows the principles of "systems engineering," which is a formal process to help develop a system of higher integrity, reduce the risk of schedule delays and cost overruns, ensure better system documentation, and promote a higher level of stakeholder participation. The systems engineering process is shown as a "V" diagram below in Figure 1-1 as a way of relating the different stages in the system life cycle to one another. As shown in the diagram, the ConOps is a relatively early activity in the overall systems engineering process.

Figure 1-1. "V" Diagram



The I-15 ICMS ConOps is essentially a user-oriented perspective of integrated corridor management for the corridor, and thus, corridor stakeholders play the primary and invaluable role in its development and mark the initial milestone along the road to I-15 ICMS implementation for the corridor's stakeholders. The development of the ConOps has, in essence, been the first test of institutional coordination and integration for the I-15 corridor stakeholders and because of the history and strong foundation that these stakeholders have in successfully working together under the leadership of SANDAG, the stakeholder team moved efficiently through the ConOps development task.

The ConOps document lays out the I-15 ICMS concept, explains how things are expected to work once it is in operation, and identifies the roles and responsibilities of the various stakeholders to make this happen. The ConOps answers the following set of core questions:

- Why: Justification for the system, identifying what the corridor currently lacks, and what the system will provide
- What: Currently known elements and the high-level capabilities of the system

- Where: Geographical and physical extents of the system
- Who: Stakeholders involved with the system and their respective responsibilities
- When: Time sequence of activities that will be performed
- How: Resources needed to design, build, operate, and maintain the system

The ConOps does not delve into technology or detailed requirements of the ICMS, but it does address the operational scenarios and objectives, information needs, and overall functionality. The ConOps must also address the "institutional" environment in which integrated corridor management must be deployed, operated, and maintained.

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1.3 Corridor Boundaries, Networks, and Stakeholders

The I-15 ICMS corridor is a 21-mile segment of I-15 in San Diego County that currently includes an 8-mile Managed Lanes facility. This corridor is a regionally significant segment of I-15 from State Route (SR) 52 in the City of San Diego to SR 78 in the City of Escondido. It also includes the portion of SR 163 from SR 52 to I-15 in the City of San Diego. This Managed Lanes corridor is a critical component of I-15 as one of the two primary north-south transportation corridors in San Diego County. I-15 is the primary north-south highway in inland San Diego County, serving local, regional, and interregional travel. The corridor is a heavily utilized regional commuter route, connecting communities in northern San Diego County with major regional employment centers. It encompasses three cities (San Diego, Poway, and Escondido). The I-15 corridor is situated within a major interregional goods movement corridor connecting Mexico with Riverside and San Bernardino counties, as well as Las Vegas, Nevada.

The I-15 Managed Lanes corridor is currently an eight- to ten-lane freeway within the corridor boundaries, with additional auxiliary lanes throughout the corridor. Within the median of I-15 from SR 163 to SR 56 is a two-lane reversible, high occupancy toll (HOT) facility. Known locally as the I-15 Express Lanes, this eight-mile, barrier-separated facility operates in the southbound direction during the a.m. peak period, northbound during the p.m. peak period, and all day (northbound) during the weekend.

The corridor is in the jurisdiction of SANDAG, the California Department of Transportation (Caltrans) District 11, and the cities of San Diego, Poway, and Escondido. Partnerships also exist with the transit agencies: Metropolitan Transit System (MTS) and North County Transit District (NCTD) to operate services along the corridor. The corridor includes the following networks:

- I-15 Freeway Network operated by Caltrans with agreements with the California Highway Patrol (CHP) for incidents and SANDAG for the value pricing program. It includes four to five lanes in each direction, including a two-lane reversible HOT facility operating during peak periods (and all traffic during non-peak hours) and a more extensive Managed Lanes facility currently under construction.
- Arterial Network that encompasses the cities of San Diego, Poway, and Escondido. Each city's public works/transportation department operates the three arterial links identified as candidates to carry excess capacity in their jurisdiction: Kearny Villa Road/Black Mountain Road (7 miles), Pomerado Road (13 miles); and Centre City Parkway (6 miles). Additionally, there are secondary parallel routes that can be used in the case of emergencies.
- Transit Network that includes express bus service into San Diego operated by MTS and local service operated by NCTD and San Diego Transit. BRT service will be operational with the Managed Lanes system and will include service from three stations along the corridor functioning as a rail system.

The I-15 corridor stakeholders are instrumental in the development of the ConOps and associated projects along the corridor. Additional stakeholders will be involved along each arterial, as appropriate.

I-15 Corridor Stakeholders

- San Diego Association of Governments (SANDAG) (including the San Diego Traffic Engineers' Council (SANTEC), and Intelligent Transportation Systems Chief Executive Officer (ITS CEO) Group)
- California Department of Transportation (Caltrans)
- California Highway Patrol (CHP)
- Metropolitan Transit System (MTS)
- North County Transit District (NCTD)
- San Diego County Service Authority for Freeway Emergencies (SD SAFE)
- City of San Diego
- City of Poway
- City of Escondido
- County of San Diego Office of Emergency Services (OES)
- Department of Homeland Security (DHS)
- Federal Highway Administration (FHWA)
- Federal Transportation Administration (FTA)

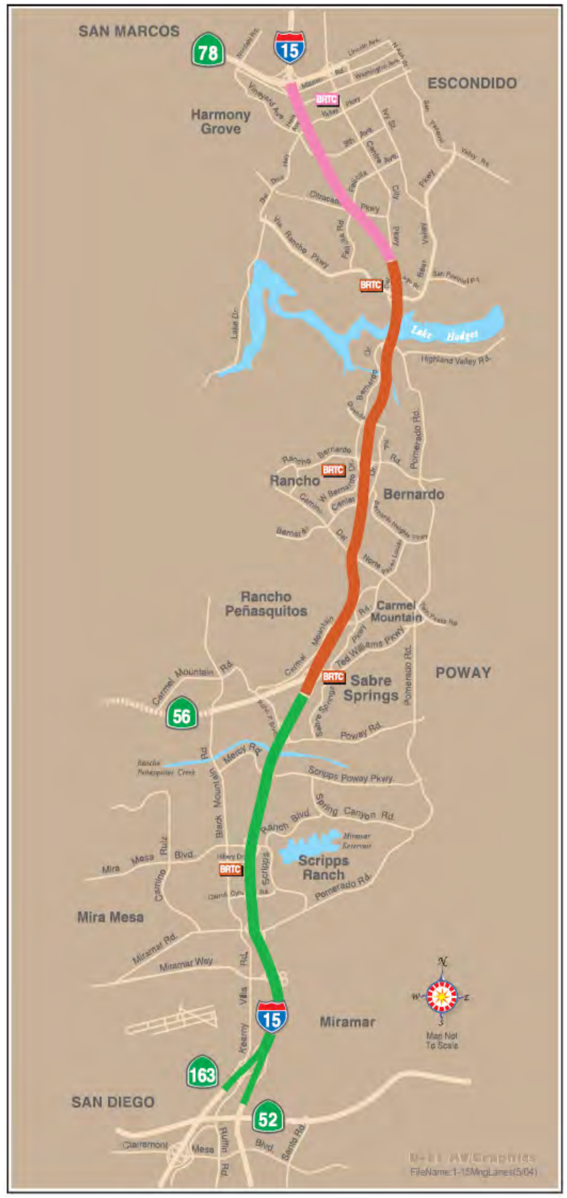
1.4 Corridor Operating and Institutional Conditions

The I-15 corridor serves as the primary artery for the movement of commuters, goods, and services from inland northern San Diego County to downtown San Diego and two burgeoning employment centers located at the midpoint of the corridor. The corridor also serves a growing number of interregional trips, composed increasingly of employees who work in the greater San Diego region, but who are finding affordable housing outside of the region in neighboring Riverside County to the north. The I-15 general purpose lanes and I-15 express lanes are experiencing increasing levels of congestion during ever-lengthening peak travel periods, while travelers are incurring commensurate increases in trip delays. For example, the following characteristics are currently observable on the corridor.

- Corridor bottlenecks include the SR 163 junction, the SR 56 interchange, the SR 78 interchange, and the Lake Hodges Bridge
- Travel times for northbound travelers increase by 50 percent during the p.m. peak travel. Travel times in the southbound direction have increased by 400 percent.
- The express bus service operates currently in the HOT lanes on the corridor. Average weekday speed is 26 mph. The addition of the Managed Lanes/BRT system will increase the capacity and performance.
- The I-15 Reversible Lanes have noticeably reduced congestion in the South Segment of the corridor for both a.m. and p.m. peak periods.

When incidents or heavy congestion occur on the I-15 within the corridor, historical data show that travelers will use alternate arterial routes. These decisions are based on traveler experience and knowledge of typical arterial travel times or incident-bypass capability.

Figure 1-2. I-15 Integrated Corridor



In terms of the institutional context, the following lists improvements that are categorized by network and responsible agency:

- SANDAG – 511; inter-agency coordination between freeway and transit systems.
- Caltrans, District 11 – Implementation of Managed Lanes along the I-15 corridor with reconfigurable lanes and multiple exit/entry points; new fiber optic network; upgrades to the freeway management system surveillance capabilities that include more detectors and full-coverage, closed-circuit television (CCTV); revised and upgraded incident management procedures for automated detection and response (including expanded freeway service patrols); changeable message signs (CMS) at additional locations along the freeway; upgrading of the I-15 Reversible Lane Control System (RLCS) on the south segment.

- Cities of San Diego, Poway, and Escondido ─ Implementation of QuicNet 4+ traffic signal control system for inter-jurisdictional signal coordination along major arterials; implementation of Intermodal Transportation Management System (IMTMS) regional integrated workstations in city traffic engineering departments.
- NCTD (rail) and MTS (bus) ─ New BRT service along the I-15 corridor as part of the Managed Lanes project; smart card system on the buses and at the train stations for transit fares; new SPRINTER light rail system; in-terminal/wayside system (e.g., next train arrival) at all SPRINTER stations and platforms; improved public address (PA) systems for in-vehicle annunciation and in-terminal announcements.

The agency-specific strategies, systems, and networks benefit individual networks. While there is a history of cooperation in the San Diego region, many decisions are still made by individual agencies. The following are examples where independent systems exist and can be improved with integrated management.

- Continuous count and occupancy data is not provided for each arterial.
- Traveler information (511 and http://www.511sd.com/) is new and has not included all pre-trip information yet.
- Real-time information for route and modal shifts is not available yet.
- Access to high occupancy vehicle (HOV)/HOT lanes is limited.
- Advanced travel information is minimal.
- Park and Ride facilities are at or near capacity.
- Express bus service is not fully developed.

The agency-specific systems, strategies, and technologies provide benefits primarily in their individual networks. Since the corridor encompasses multiple agencies, jurisdictions, and travel modes in areas where there are cooperative agreements and systems in place, the region offers expanded opportunities. The Transportation Committee at SANDAG functions in a coordinating capacity and serves as a model for institutional partnerships. In addition, special task forces and coordination mechanisms have been established for special events.

The I-15 corridor is also part of the development of the San Diego regional ITS architecture in which the I-15 corridor stakeholders fully participated. The existing and proposed functionality of the regional architecture includes the following:

- An Intermodal Transportation Management System that integrates freeway data from the Caltrans Advanced Traffic Management System (ATMS) 2005 and the Regional Transit Management System. Arterial data is due to be added in 2009.
- Real-time information sharing between all agencies and providing a clearinghouse of real-time information covering all critical routes and modes and implementation of center-to-center linkages and storage capabilities. Inclusion of ITS standards as developed by U.S. Department of Transportation.
- Coordination and support between transportation and public safety agencies, including integration on the corridor for major incidents, construction, special events, and daily operations.
- A regional 511 system became operational in February 2007. SANDAG has contracted the 511 Information Service Provider (ISP) as the portal operator. Data for the 511 system comes from the IMTMS system, which acts as a clearinghouse for freeway and transit data now and in the future will include arterial congestion and incident data.
- A regional payment/financial clearinghouse, by which the same fare payment smart card can be used to pay transit fares in the region.
- Inclusion of emergency management agencies for the purpose of inputting arterial incidents and informing them of real-time freeway and transit conditions.
- Inter-agency operations are not included.

1.5 Issues, Needs, and Potential for Integrated Corridor Management

The I-15 corridor stakeholders discussed the ICMS through the various networks and associated systems that comprise the current corridor. Using available technologies, they can be integrated further. The issues of congestion and capacity can be addressed through the planned Managed Lanes facility and associated BRT stations and routes and coordination with arterial networks.

The stakeholders in the San Diego region are focusing on the operation, institutional, and technical coordination of transportation networks and cross-network connections throughout the corridor. The ICMS concept will address the issues and needs identified by the stakeholders.

Table 1-2. San Diego I-15 Corridor Issues and Needs

Issues and Needs
Congestion and Capacity— ▪ Issue: Increasingly congested conditions on I-15 ▪ Issue: Increasingly congested conditions on corridor's arterial network ▪ Issue: Park and Ride facilities are not sufficient
Transit— ▪ Need: Improved transit reliability ▪ Need: Real-time, comprehensive, accurate information to travelers ▪ Need: Frequent service ▪ Need: Competitive service
Transportation System Management— ▪ Issue: Managing traffic flow between I-15 freeway ramps and adjacent arterials with ramp metering ▪ Issue: Managing traffic flow on I-15 (general purpose/managed lanes) ▪ Issue: Limited access to HOV/HOT facilities ▪ Issue: Coordination across multiple functional systems
Traveler Information Services— ▪ Issue: Minimal ATIS coverage of the corridor
Inter-organizational Coordination— ▪ Need: Inter-jurisdictional and inter-organizational coordination and integration among corridor stakeholders ▪ Need: Exchange and sharing of real-time data ▪ Need: Improved response times to non-recurring incidents

1.6 Vision, Goals, and Objectives

The vision statement for the I-15 corridor was developed with the San Diego region stakeholders. This statement reflects current practices, planned improvements, and future scenarios.

Vision

The San Diego I-15 ICMS transportation corridor will be managed collaboratively and cooperatively through ongoing partnerships among SANDAG, Caltrans, MTS, NCTD, CHP, and the Cities of San Diego, Poway, and Escondido.

Within approximately the next five years, the corridor will give travelers the opportunity to make seamless and convenient shifts among modes and among the corridor's networks to complete their trips. Enhanced mobility for people, goods, services, and information will be achieved by further enhancing current levels of existing interoperability between field elements and through continued collaboration and cooperation among the corridor's institutional partners and their native functional environments or systems.

The ICMS is therefore focused on improving person- and vehicle-throughput, productivity, connectivity, safety, environmental compatibility, and enhancing accessibility to reach destination points in a reliable and timely manner.

Using this vision as a starting point and taking into account the I-15 corridor specifics, the stakeholders developed a list of goals and objectives detailed in the following table. The stakeholders produced five goals and associated objectives covering the following primary topics. These take into account the traveler's experience on the corridor.

Table 1-3. I-15 ICMS Corridor Goals and Objectives

Goals	Objectives
The corridor's multi-modal and smart-growth approach shall improve accessibility to travel options and attain an enhanced level of mobility for corridor travelers.	▪ Reduce travel time for commuters within the corridor ▪ Increase transit ridership within the corridor ▪ Increase the use of HOVs (carpools and vanpools) for commuters ▪ Increase person and vehicle throughput within the corridor on general purpose and managed lanes ▪ Increase person and vehicle throughput on arterials ▪ Reduce delay time for corridor travel on the corridor's networks (e.g., I-15 and arterials) ▪ Increase percentage share of telecommuters from corridor commuter market ▪ Increase the use of established and effective TDM programs ▪ Promote development to encourage the use of transit (especially BRT)
The corridor's safety record shall be enhanced through an integrated multi-modal approach.	▪ Reduce incident rate ▪ Reduce injury rate ▪ Reduce fatality rate ▪ Reduce roadway hazards

Table 1-3. I-15 ICMS Corridor Goals and Objectives (cont'd)

Goals	Objectives
The corridor's travelers shall have the informational tools to make smart travel choices within the corridor.	▪ Improve collection and dissemination of arterial network information ▪ Collect and process data on the operational condition/status of all corridor networks, including ‣ Comparative travel times between major origins and destinations ‣ Construction, detours, and other planned road work ‣ Occurrence and location of incidents ‣ Expected delays ‣ Number of parking spaces available at Park an Ride lots/structures ▪ Disseminate, in a multi-lingual fashion, comprehensive, real-time, and accurate information to travelers within the corridor by means of multiple media (e.g., phone, computer, PDA/Blackberry, TV, CMSs, 'Next Bus' informational signs) ▪ Make available archived historical data to travelers ▪ Achieve a high level of 511 call volume and Web use ▪ Achieve high overall satisfaction with 511 system
The corridor's institutional partners shall employ an integrated approach through a corridorwide perspective to resolve problems.	▪ Improve level of institutional coordination among stakeholders by leveraging off of and modifying existing agreements among the partners to accommodate the needs of the I-15 corridor ▪ Strengthen existing communication linkages among all Corridor institutional stakeholders and establish new communication linkages where appropriate (e.g., business/industrial parks along the corridor) ▪ Enhance the regional/joint operations concept throughout the corridor ▪ Balance the needs of through traffic and local communities by coordinating construction and overall mitigation management on I-15 and arterials
The corridor's networks shall be managed holistically under both normal operating and incident/event conditions in a collaborative and coordinated way.	▪ Establish/enhance joint agency action plans to respond to congestion especially at I-15/arterial network interfaces and at the Lake Hodges chokepoint ▪ Develop/improve methods for incident and event management (e.g., data sharing) ▪ Reduce overall incident clearance time ▪ Identify means of enhancing corridor management across all networks (e.g., implement transit signal priority on selected components of arterial network)

These goals and objectives form the basis for developing the ConOps scenarios. They enable the current and future corridor characteristics to be evaluated based on the needs identified by the stakeholders in the region.

1.7 ICM Operational Concept Description: Approaches and Strategies

In the future, the I-15 ICM will provide, to the greatest extent possible, efficient and reliable travel throughout the corridor and the constituent networks, resulting in benefits to corridor travelers in terms of, for example, improved and consistent trip travel times and real-time traveler information. Using cross-network strategies, the corridor will capitalize on integrated network operations to manage the total capacity and demand of the system in relation to the changing corridor conditions. The stakeholders identified several ICM strategies based on the I-15 corridor goals and objectives. They are categorized as follows.

- Share/Distribute Information: manual information sharing, information clearinghouse/information exchange network between corridor networks and agencies; 511 (pre-trip traveler information); en-route traveler information (smart signage and smart parking); access to corridor information by ISPs and other value-added entities; automated information sharing (real-time data); and common incident reporting system and asset management system.
- Improve Junctions/Interfaces: signal pre-emption – identifying “best route” for emergency vehicles; multi-modal electronic payment; signal priority for transit, bus priority on arterials; transit hub connection protection; multi-agency/multi-network incident response teams/service patrols; and training exercise.
- Accommodate/Promote Network Shifts: modify ramp metering rates to accommodate traffic (including buses) shifting from arterials; promote route shifts between roadway and transit via en-route traveler information devices; promote shifts between transit facilities via en-route traveler information devices; congestion pricing for managed lanes; and modify arterial signal timing to accommodate traffic diverted from the freeway.
- Capacity/Demand Management (short-term): land use control; modify HOV restrictions; increase roadway capacity by opening HOV/HOT lanes/shoulders; scheduled closures for construction; coordinate schedule maintenance and construction activities among corridor networks; planned temporary addition of transit capacity; and modify parking fees (smart parking).
- Capacity/Demand Management (long-term): peak spreading; ridesharing programs; expand transit capacity; and land use around BRT stations.

Some of these strategies appear to be mode-focused because actions are to be taken by an individual agency on one network; however, such actions under ICM also consider conditions on other networks. Moreover, corridor agencies will rely on ICMS to provide decision support for such actions.

By implementing the corridorwide ICM strategies, the I-15 corridor has the potential to enhance current and near-term operations. By working together on such strategies, the stakeholders in the San Diego region can succeed in realizing these enhancements along the corridor**.**

The daily operation of the corridor will be similar to the transportation and public safety command center model (i.e., Mission Valley East pilot) that has been used for major special events (e.g., Super Bowl XXXVII in 2003 in San Diego), but will now be applied on a permanent basis for day-to-day transportation operations. This will be accomplished via a Virtual Corridor Traffic Management Center (VCTMC) operating among the corridor agencies. This VCTMC will operate the ICMS as a “sub-regional” system, managing the various networks and influencing trips that use the corridor. The VCTMC is run by a coordinator jointly appointed by collaborating agencies. While the City of San Diego, MTS, and Caltrans may provide dedicated support staff and co-locate them, other agencies may provide remote or virtual support with existing staff on a non-dedicated basis.

All operations among corridor networks and agencies (e.g., activation of specific ICMS strategies) will be coordinated by the VCTMC. The VCTMC will investigate and prepare corridor response plans for various scenarios that can be expected to occur within the corridor.

The VCTMC operates over the infrastructure of the IMTMS. Voice, data, video, information, and control will be provided to all agencies based on the adopted protocols and standards for the sharing of information and the distribution of responsibilities. The VCTMC will monitor corridor travel conditions 24 hours a day/7 days (24/7) a week and use the response plans, real-time information, and the implemented corridor strategies to address any conditions that present themselves. All supporting staff will know their respective roles and responsibilities and will be aided, when available, by response plans and ICMS decision support software. Moreover, the coordinator will be able and authorized to improvise as situations may dictate.

Corridor-based traveler information will be made available on 511, Web sites, CMSs, and through the media and ISPs, presenting corridor trip alternatives complete with current and predicted conditions. Travelers will access or be given real-time corridor information so they can plan or alter aspects their trips such as mode, route choice, or departure time in response to current or predicted corridor conditions.

Each traveler will be able to easily make route and modal shifts between networks due to integrated corridor information, integrated fare/parking payment system, and coordinated operations between networks. Travelers will be able to educate themselves about the corridor so they can identify their optimal travel alternatives and obtain the necessary assets (e.g., smart card, available parking) to facilitate their use of corridor alternatives when conditions warrant.

1.8 Required Assets, User Needs, and ICMS Implementation Issues

The various stakeholders within the I-15 corridor have developed a number of assets to improve performance along the I-15 corridor. They have implemented a variety of policies, strategies, and ITS technologies and have identified where assets can be added in the near term.

The following assets, which are currently implemented or are under development/construction, are critical for the San Diego I-15 corridor:

- 511 ATIS, launched in February 2007
- IMTMS, implemented in June 2006
- Performance Measurement System (PeMS)
  - Freeway PeMS is already operational
  - Arterial PeMS, is scheduled for a March 2010 implementation
  - Transit PeMS is scheduled for a December 2010 initial implementation, yet its functionality will be fully developed by June 2010
- Regionwide adoption of QuicNet 4 (and its upgrade to QuicNet 4+) traffic signal control platform
  - Pilot Implementation Phase (regionalization of QuicNet 4+ with Caltrans, San Diego, and Chula Vista): July 2008
  - Integration of QuicNet 4+ into the IMTMS environment: August 2009
  - Full Implementation Phase (regionalization of QuicNet 4+): November 2009
- Managed Lanes, together with Value Pricing, is currently under phased construction according to the following schedule
  - Middle Segment (July 2008 – January 2009 in a phased implementation)
  - North Segment (January 2012)
  - South Segment (January 2013)
- BRT with DARs is currently under phased construction in accordance with the Managed Lane construction schedule

The three most important additions to ICMS assets with current expected completion dates are the following:

- VCTMC/Decision Support System, completion date of March 2011 (start of operations of I-15 ICMS)
- Transit signal priority on NCTD Bus Route 350, a bus feeder for BRT system, August 2009
- Improved data collection, incident reporting, and data archiving for arterials
  - Pilot Phase, December 2009
  - Full implementation (ICM Phase III Demonstration), March 2010

The stakeholders suggested that a VCTMC be established to take a lead role in corridor management. This center would enable further integration of ICMS functions. In order to establish this center, current operational agreements could be amended. For example, operational agreements have recently been established between institutional partners for the Mission Valley Event Management project. Similar agreements can be established for the I-15 corridor management and provide a platform for the VCTMC operation. VCTMC would take advantage of the information sharing infrastructure provided by the IMTMS.

Transit signal priority reduces transit vehicle travel time and improves reliability. Although the regionwide adoption of QuicNet 4 traffic signal control platform makes it less complicated for cross-jurisdictional coordination, transit signal priority has yet to be deployed on arterials in the corridor.

Improved data collection and traffic monitoring are needed on the I-15 corridor arterials. Traffic count stations need to be installed at several locations on key parallel arterials in the cities of San Diego, Poway, and Escondido. Assuming these stations are constructed as part of the I-15 ICMS project, the cities' current staff will be able to operate these stations as part of their daily tasks. The traffic data (volume and speed) will be linked directly to the main Transportation Management Center ((TMC) Caltrans) and the cities' TMCs. The traffic data from the local arterial, combined with the data from the freeway, can be used to trigger specific timing plans. The data transfer from the count stations to the nearest traffic signal will be either hard-wired or wireless. From the traffic signal the data will transferred via fiber signal communication cable to cities' TMC where the QuicNet 4 is located. The Regional Arterial Management System connects Caltrans TMC to the cities' QuicNet 4.

Based on the development of our ICMS concept and its operational description, the following implementation issues have been identified by the I-15 corridor stakeholders. These issues comprise technical, operational, and institutional components of the I-15 ICMS concept.

Technical Issues

- Data archiving and accessibility for future analyses
- Modifying/updating San Diego regional ITS architecture to bring it into alignment with the I-15 ICMS concept
- Use of regional transit fare system (*Compass Card*) across multiple transit service providers
- Expansion of functionality for 511
- Ensuring quality, frequency, and accuracy of information

Operational Issues

- Enhancing transit capacity in response to accidents
- Implementing bus signal priority for transit on arterials
- Coordinating different operating systems across agencies to work together (e.g., I-15 freeway on-ramp metering signals with adjacent arterial traffic signals)
- Fully integrating commercial vehicle operations into I-15 the ICMS concept

Institutional Issues

- Establishing policies and arrangements with private entities (parking, information service providers, and major employment centers along the I-15 corridor)
- Compatibility of VCTMC responsibilities for I-15 ICMS corridor stakeholders with their conventional responsibilities
- Expansion of set of organizational stakeholders as part of the I-15 ICMS team beyond those that are only transportation-focused
- Enhanced level of inter-organizational coordination and integration among stakeholders

The stakeholder agencies have already implemented various polices, strategies, and ITS technologies to improve performance along the I-15 corridor. These assets can be enhanced to implement and meet the corridor goals and objectives. The table on the following page outlines some of these assets.

Based on the development of our ICMS concept and its operational description, the following set of User Needs (Table 1-4) has been developed by the I-15 corridor stakeholders. This set of User Needs is complete and appropriate for the I-15 ICM operational concept and that the planned I-15 ICM system must satisfy. The User Needs describe the operational functions of the proposed I-15 ICMS based on our vision, goals, and objectives for the system. Subsequent to development of the ConOps is the development of specific requirements for the I-15 ICM system, and these requirements will be explicitly derived from this set of User Needs.

Table 1-4. I-15 ICMS User Needs

ID Number	Title	Description/Rationale
1	Access/Store ICMS Configuration Data	This User Need provides for the creation and management of a configuration database instance that maintains static information on various parameters within the I-15 corridor.
2	Collect and Process Data	This User Need is the core service of ICMS that supports most of the system functionality. Data is collected from a variety of existing and planned systems according to Interface Control Documents, some of which need to be developed as new systems come on line. Once data is collected, certain processing algorithms are invoked that provide a higher level of information aggregation (e.g. volumes, occupancies and speeds at multiple locations are converted to travel times). Process Data function also includes conversion of host system data formats to standard XML schema for publishing information across the ICMS system.
3	Access/Store ICMS Historical Information	This User Need provides the capability to create and populate a historical database instance. This database contains real- time information on corridor performance as derived from data collected in the Collect and Process Data User Need. Accessing existing historical databases in ATMS 2005, RTMS and RAMS is an important function of this User Need. Having consistent export formats for data from these historical databases would simplify corridor-wide analysis. Ad hoc reporting based on this historical data allows the system users to create a variety of reports that characterize corridor operations and performance. These reports can then be stored in the ICMS historical database.

Table 1-4. I-15 ICMS User Needs (cont'd)

ID Number	Title	Description/Rationale
4	Publish Information to System Managers	This User Need disseminates ICMS data from all sources to agencies that manage one or more modes in the integrated corridor network: freeway, arterial, transit, public safety, commercial vehicles. This information is differentiated from the information published to system users (see User Need 11).
5	Interactively Conference with Multiple Agencies	This User Need allows system managers to directly collaborate in real-time prior to, during or after a major event in the I-15 Corridor. A variety of voice, video and data formats will be supported for multi-site collaboration.
6	Display Information	This User Need covers the ability to take information produced by ICMS and its subsystems and display a variety of data formats in a form that agency decision-makers can use to visualize corridor operations, make decisions and take actions to implement the various decision components.
7	Coordinate Transportation and Public Safety Operations	This is another core User Need for the I-15 ICMS because it addresses major institutional issues in getting the transportation and public safety communities to work closer together. This is accomplished by providing public safety users the multi-dimensional data inherent in transportation management systems while at the same time seeking technical solutions to extracting useful incident information from public safety Computer Aided Dispatch systems.
8	Share Control of Devices	This User Need allows agencies to remotely control selected functions of field devices regardless of location or agency ownership. For this User Need to become real there must be interagency agreements to allow such sharing under carefully defined conditions.
9	Manage Video Imagery	The San Diego region has a variety of video sources that provide a critical view of emerging and on-going events. These video sources can produce aerial, snapshot, archived clips and real-time imagery to a wide variety of system users via high-bandwidth links.
10	Respond to Corridor Planned and Unplanned Events	The Response Plan User Need allows ICMS users and Corridor Managers to use some form of decision tool (Expert System or table- driven) that fuses real-time data and manually-entered data derived from field communications at the event site (e.g. CHP Traffic Officers talking to dispatchers using the CHP radio system). The response plan is then either manually or automatically generated based on the fused data input. Once a response plan is generated, the system operator can review the plan's components and make changes as deemed necessary before transmitting plan components to the affected systems. The status of affected systems is then returned to the ICMS operator and logged in the historical database.
11	Assess Impact of Corridor Management Strategies	This User Need allows corridor managers to model various traffic and service management strategies for the corridor to gauge the impact of these strategies on corridor performance. The intent of this User Need is to model strategies and to return results within a time frame suitable to affect decision-making during a major event in the corridor. The impact results will be displayed to corridor managers in both 2D and 3D formats. This User Need will also be invoked for longer- term assessments.

Table 1-4. I-15 ICMS User Needs (cont'd)

ID Number	Title	Description/Rationale
12	Publish Information to System Users	This is the information dissemination User Need that parallels the Publish Information for System Managers. The intent of this User Need is to provide corridor information to the regional 511 system where it will be further disseminated to various classes of system users across a variety of media. This User Need will also make available a standard XML data stream and video imagery to other entities for dissemination to system users as SANDAG policy determines (e.g. direct feeds to the media).
13	Measure Corridor Performance	This User Need looks at multi-modal corridor data from both a short-term and long-term perspective. Existing historical databases for ATMS 2005, RTMS, RAMS, CAD systems, CPS and Smart Parking provide mode-specific data. Likewise PeMS provides a traffic and transit operations view of data. Based on these data sources, corridor demand will be analyzed using actual data or by demand modeling techniques. Using stored corridor configuration data, excess corridor capacity can be measured for any desired time period. This User Need will be most valuable for long-term corridor management.
14	Manage Corridor Demand and Capacity to Optimize Long-Term Performance	This User Need provides the ability for corridor managers to collaboratively develop longer-term corridor management strategies. These strategies include both capacity and demand management strategies. For example, a classic demand management strategy is ramp metering. A classic capacity management strategy is managed lanes. The goal of this User Need is to increase total corridor performance in the long-term by optimal balancing of capacity and demand.
15	Measure System Performance	This User Need provides for constant monitoring of field devices, server systems and communications networks needed to support the various integrated corridor management functions. Based on monitored data, metrics for system components such as reliability and availability will be measured and stored in the ICMS historical database.
16	Manage ICMS System	This User Need is the administrative function of ICMS. Data management for ICMS configuration data, user account management incorporating system-wide security functions and IT- centric functions such as data backup and archival are included within this User Need.
17	Document System and Train System Users and Maintainers	This User Need provides logistical support to the ICMS system through documentation and training.

1.9 Concept Institutional Framework

The management and operation of the I-15 corridor and the ICMS will be a joint effort of all of the stakeholders. In San Diego, a structure already exists that can be utilized for this operation.

SANDAG's Transportation Committee is a standing committee responsible for policy direction and review. It comprises the current stakeholders, as well as community representatives.

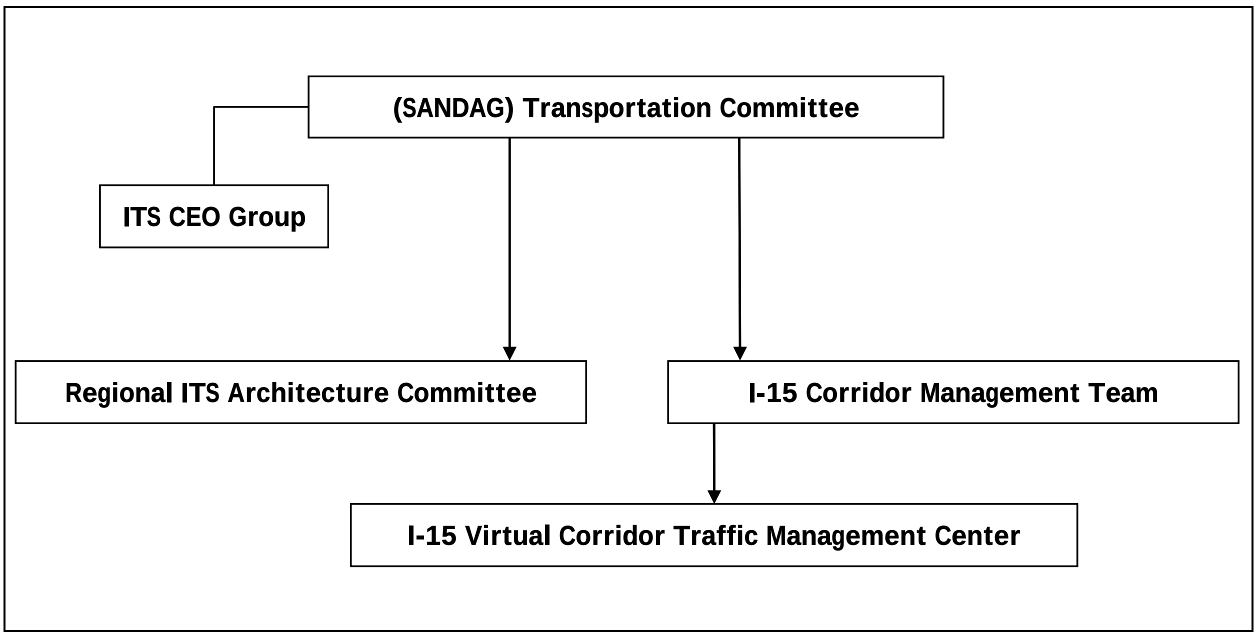
The **ITS Chief Executive Officer (CEO) Group** will be established as a subset of the Transportation Committee in order to manage specific functions on the I-15 corridor. This group will build on current inter-agency agreements, operational policies and procedures, and overall administration.

The **ITS CEO Group** provides executive oversight and policy for the region's ITS program. Participants include the chief executive officers from SANDAG, Caltrans, MTS, NCTD, and the Mayor's representative from the City of San Diego. This working group provides a forum for the executives to discuss strategy, address problem resolution, receive status reports, and provide direction to ITS project managers. New projects and potential grant proposals also are proposed to key executives at this meeting for partnership discussion and commitment.

To support the ITS CEO Group, the **Regional Architecture Committee** will work closely with the **I-15 Corridor Management Team** to promote corridor-based coordination throughout the San Diego region.

Current members will participate in the **VCTMC**. They will be responsible for the daily operations of the I-15 ICMS corridor. This center will start by coordinating activities of the I-15 corridor, but will be tasked with future coordinated operations opportunities, such as corridor management systems in other corridors. The VCTMC will ensure consistency with the Regional ITS Architecture and operating procedures and policies, as well as coordinate operational functions.

Figure 1-3. Institutional Framework for the I-15 ICMS



SANDAG's committee structure provides the backdrop for the I-15 ICMS institutional framework. Overall, these committees provide opportunities for involvement in regional programs by citizens, elected officials, agency staff, and representatives of civic and community groups. The I-15 Corridor Management Team will be the primary decision-making body for the I-15 ICMS corridor and will consist of leadership-level representatives from each of the stakeholders in the I-15 ICMS corridor. Members of the team will manage the distribution of responsibilities, the sharing of control, and related functions among the corridor partners. The I-15 Corridor Management Team will be responsible for establishing the necessary inter-agency and service agreements, budget development, project selection and initiation, corridor operational policies and procedures, and overall administration.

The Regional ITS Architecture Committee, which maintains the San Diego regional ITS architecture, will ensure that this concept is consistent with the regional architecture. Its responsibilities will expand to promote coordinated operations within the various corridors that make up the region, as well as addressing any “inter-corridor” operational issues (i.e., be the coordinator of multiple corridor operation panels and ICMS).

Each of the I-15 ICMS corridor partners will have specific responsibilities they will perform as part of ICMS operations. The VCTMC will leverage staff off of existing positions held at I-15 stakeholder agencies. This virtual center will enable primary stakeholders, as well as other organizations (i.e., local law enforcement and emergency personnel) to participate.

The VCTMC will enable the I-15 corridor to be managed as an integrated transportation system. The goals and objectives of the corridor stakeholders, including the users, will be realized through the coordinated efforts of the team. Travelers will realize maximum benefits through the central operation and collective management of VCTMC and experience a seamless transportation system offering choice and real-time information about corridor travel.

2. REFERENCES

Guidance

This Concept of Operations (ConOps) chapter serves as a guide to resources utilized in the development of the I-15 Integrated Corridor Management System (ICMS) ConOps document. Moreover, this chapter serves as source for additional information regarding the various agencies and their network-specific systems for the I-15 corridor to be integrated into the ICMS, related guides and standards, and the ICM initiative itself.

The following references were used in developing the ConOps for the I-15 ICM corridor:

References Specific to the I-15 Corridor

- Proposal submitted to Federal Highway Administration (FHWA) by the San Diego Association of Governments (SANDAG) in response to request for applications to participate in the ICM Initiative
- Charter for San Diego Regional Traffic Engineer's Council (SANTEC), SANDAG Committee, 2006
- Fact sheet for new light-rail SPRINTER service and related documentation available at:
  - http://www.gonctd.com/oerail/oerailc.html
- 511 Advanced Traveler Information Service (511) for San Diego County available at:
  - http://www.511sd.com
- San Diego Service Authority for Freeway Emergencies Program available at:
  - http://www.sdcallbox.org/program.html
- SANDAG's Regional Transit Fare Policies and related documentation available at:
  - http://www.sandag.org/index.asp?projectid=311&fuseaction=projects.detail
- SANDAG's Compass Card and related documentation available at:
  - http://www.sandag.org/index.asp?projectid=290&fuseaction=projects.detail
- I-15 Managed Lanes and related documentation available at:
  - http://www.sandag.org/?projectid=34&fuseaction=projects.detail
- Background material on San Diego's *TransNet* Program's applications to the I-15 corridor and related documentation available at:
  - http://www.keepsandiegomoving.com/i-15.html
- SANDAG, NCTD, City of Escondido, Escondido Rapid Bus Transit Priority Concept Study Final Report, June 30, 2006

References Specific to San Diego County

- SANDAG Intermodal Transportation Management System (IMTMS) Task 6.3 Communications Existing Conditions Document (Draft), June 2007
- SANDAG Intermodal Transportation Management System (IMTMS) Task 6.4 Regional Communications Network Plan (Draft), June 2007
- SANDAG I-15 Bus Rapid Transit Operations Plan Executive Summary, August 18, 2006

General References for Integrated Corridor Management

- ICM initiative documentation (e.g., Task 2.3 – ICMS ConOps for a Generic Corridor Final Draft FHWA – JPO – 06 – 32) available at:
  - http://www.itsa.org/icm.html

Systems Engineering

- "Systems Engineering Guidebook for ITS," California Department of Transportation, Division of Research and Innovation, Version 1.1, February 14, 2005

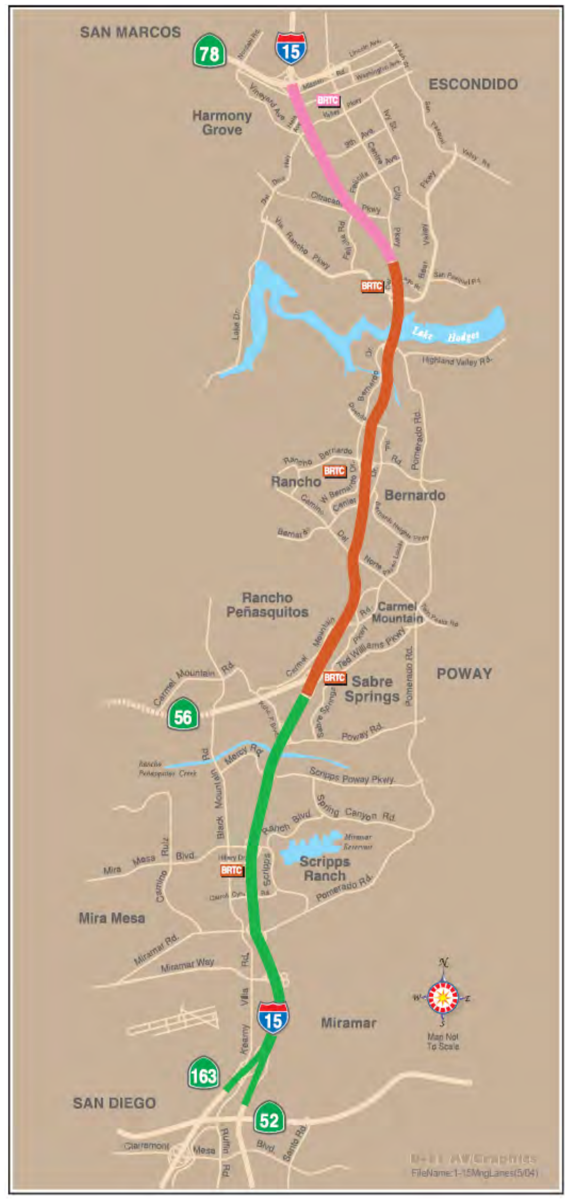
3. EXISTING INTERSTATE 15 (I-15) CORRIDOR SCOPE AND OPERATIONAL CHARACTERISTICS

3.1 Corridor Boundaries and Networks

Guidance The concept exploration and the system conception activities (within the systems engineering process) include two levels of boundaries delineation analyses for the I-15 corridor. The initial corridor identification and boundary delineation identified during concept exploration is primarily conceptual and qualitative in nature, relying on local knowledge and a high-level review of available data on travel patterns and markets.

It is combined with engineering judgment to ferret out the rough impact area of the I-15 corridor. This is followed by a more quantitative analysis conducted during system conception that takes into account, current and forecasted travel patterns, the travel market(s) that are served by the I-15 corridor (and their respective needs and issues), operational characteristics and typical scenarios/events within the I-15 corridor, availability of cross-network connections and spare capacity, and other conditions and deficiencies. The results of the system conception-level corridor boundaries analysis is documented in the Concept of Operations (ConOps).

Figure 3-1. I-15 Integrated Corridor



The I-15 corridor (Figure 3-1) is a 21-mile freeway segment in San Diego County. This corridor is a regionally significant segment of I-15 from State Route (SR) 52 in the City of San Diego to SR 78 in the City of Escondido. The corridor also includes the portion of SR 163 from SR 52 to I-15 in the City of San Diego.

The I-15 corridor is presently an eight- to ten-lane freeway within the corridor boundaries, with additional auxiliary lanes throughout the corridor. Near the southern section and within the median of I-15 from SR 56 is a two-lane reversible, high occupancy toll (HOT) facility. Known locally as the I-15 Express Lanes, this eight-mile, barrier-separated facility operates in the southbound direction during the a.m. peak period, northbound during the p.m. peak period, and all day (northbound) during the weekend.

As one of two primary north-south transportation corridors in San Diego County, the I-15 is the primary north-south highway in inland San Diego County, serving local, regional, and interregional travel. The corridor is a heavily utilized regional commuter route, connecting communities in northern San Diego County with major regional employment centers. The corridor is situated within a major interregional goods movement corridor, connecting Mexico with Riverside and San Bernardino counties, as well as Las Vegas, Nevada.

Recent population and housing growth in southwestern Riverside County has resulted in significant interregional commuter travel into San Diego County on I-15. Due to geographic/land use constraints and a lack of contiguous parallel roadways, the segments of I-15 in the corridor also serve as the local north-south roadway, providing communities local access and connectivity. Current weekday traffic volumes range from 170,000 to 290,000 vehicles on the general purpose lanes of I-15. Approximately 20,000 vehicles use the I-15 Express Lanes during weekdays. During weekdays peak-hour travel has traditionally been southbound during a.m. peak periods and northbound during p.m. peak periods. However, recent growth in manufacturing and industrial parks in the Rancho Bernardo and Carmel Mountain areas are resulting in increased peak-period travel opposite to traditional patterns (i.e., a.m. peak period northbound and p.m. peak period southbound). Peak-period demand exceeds capacity in the traditional and newly emerging p.m. southbound peak directions, resulting in recurrent congestion which can cause corridor delays averaging 30 to 45 minutes.

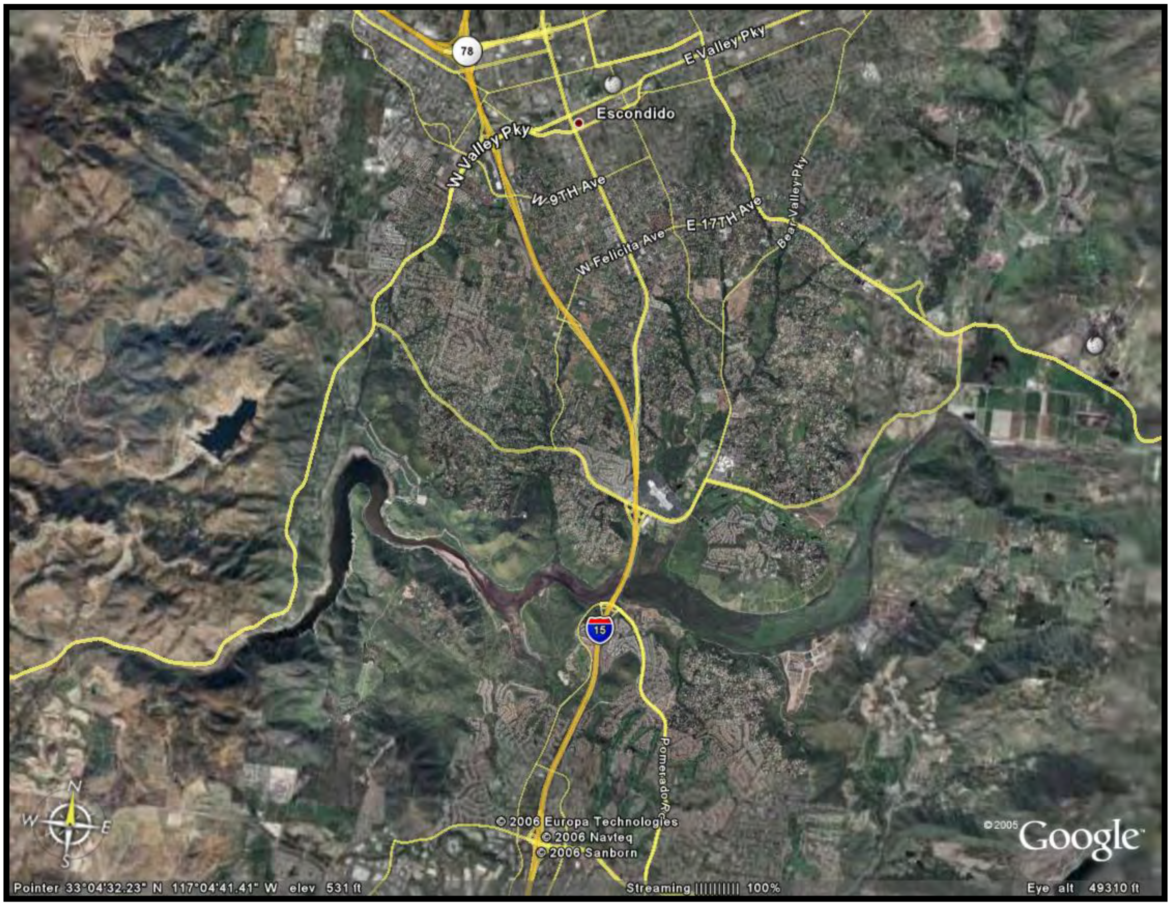
Corridor bottlenecks include the SR 163 junction, the SR 56 interchange, the SR 78 interchange, and the Lake Hodges Bridge. Recurrent congestion occurs on various segments of the corridor during the weekends. Given the limited number of alternative routes, peak-period delays will be further exacerbated by incidents, special events, and/or inclement weather. Future (year 2020) forecasts for the I-15 corridor indicate a 30 percent increase in weekday traffic, which will result in even longer corridor delays and travel times. Corridor travel is anticipated to increase significantly in what are now non-peak travel directions.

The existing I-15 corridor can be split into three distinct segments: north, middle and south as shown in Figures 3-2 through 3-4.

North Segment

As shown in Figure 3-2 below, the north segment of I-15 encompasses an eight-mile stretch of freeway with eight to ten travel lanes, including various auxiliary lanes. This segment includes links to interregional destinations, including Riverside County, North County suburban communities and employment centers, and inland recreation areas. For this segment the major activity generators include commuters from Riverside County, the Escondido Transit Center, suburban commuters from North County cities, Westfield shopping center, and Cal State San Marcos.

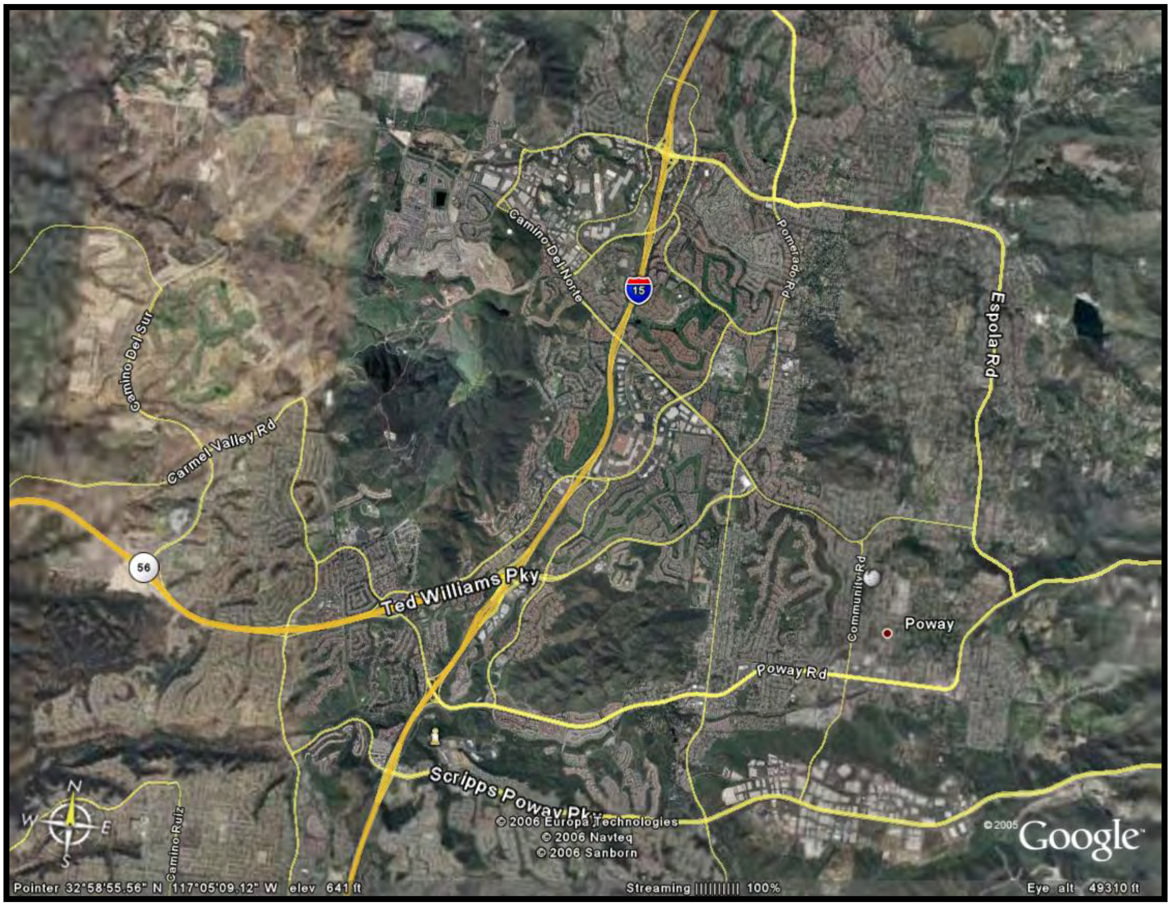
Figure 3-2. North Segment – I-15 Corridor



Middle Segment

Figure 3-3 depicts the middle segment of the I-15 corridor. The middle segment links the north and south segments of the corridor, providing passage to destinations for commuters, commercial vehicle operators, and transit operators. The middle segment's major activity generators include the Wild Animal Park, a Rancho Bernardo industrial center, Carmel Mountain industrial-retail centers, and the SR 56 interchange.

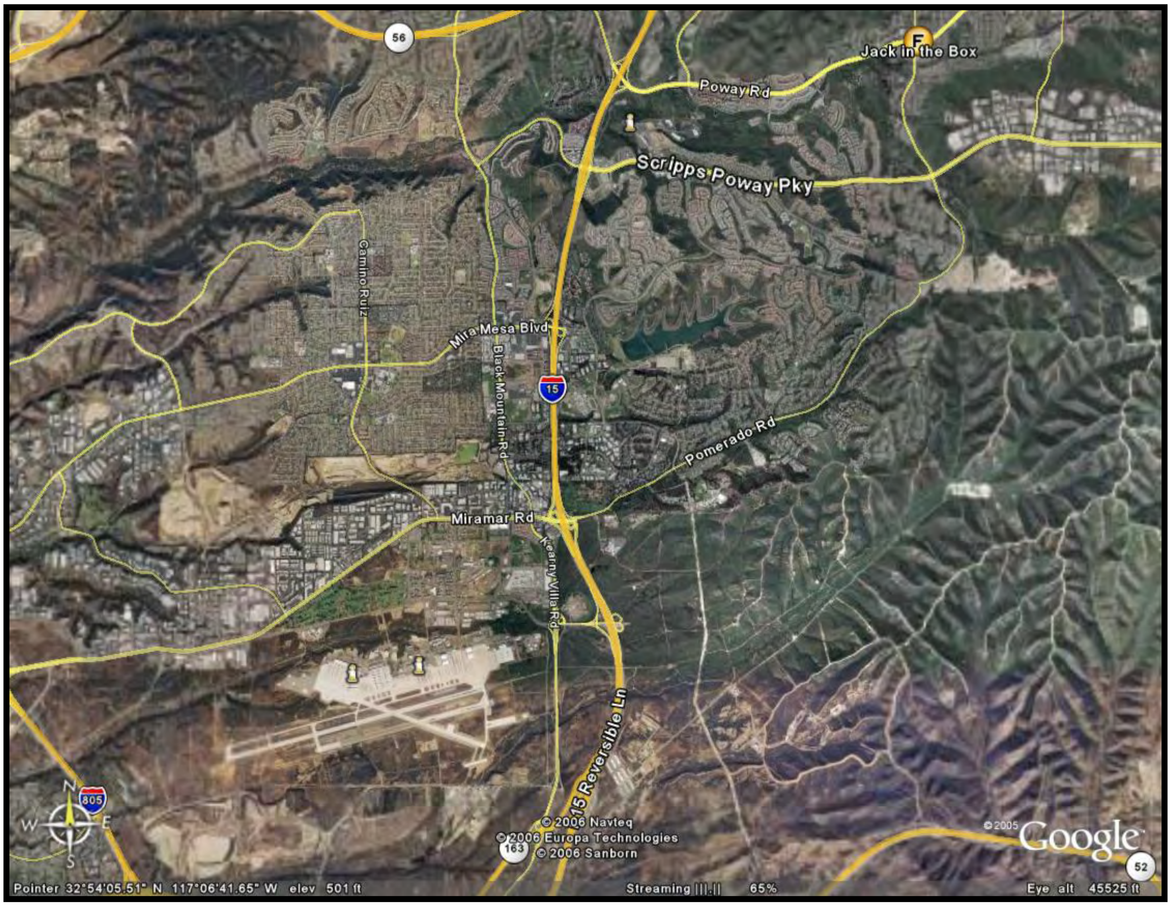
Figure 3-3. Middle Segment – I-15 Corridor



South Segment

The south segment, which is depicted in Figure 3-4, provides major traveler distribution exchange network links, including the I-15 Express Lanes, SR 52, and SR 163. The major activity generators in this segment include the Marine Corps Air Station Miramar, a Mira Mesa industrial-retail center, and commuters from the Cities of San Diego and Poway. Most of the activity in this segment is generated by pass-through commuters in the a.m. and p.m. peak periods.

Figure 3-4. South Segment – I-15 Corridor



3.2 San Diego ICMS Corridor Stakeholders and Institutional Partners

Guidance A "stakeholder" is any person or group with a direct interest (a "stake" as it were) in the integrated operation of the I-15 corridor and its associated networks and cross-network linkages. The number and types of corridor stakeholders will be dependent on the transportation networks included in the I-15 corridor and its proposed ICMS concepts. All appropriate I-15 corridor stakeholders were brought into the picture early on to make sure their needs are considered and to determine how they will be involved in the process to plan and develop an ICMS. The list of stakeholders will be reviewed at key points throughout the ICMS development process to determine if any needed stakeholders are missing. In completing this section of the ConOps, all potential stakeholders – even ones not involved in the development of the document – are identified. If there are stakeholders identified that are not part of the concept development, plans will be made to contact those stakeholders to enlist their review of the document and participation in subsequent activities.

SANDAG

The San Diego Association of Governments (SANDAG) will serve as the lead ICMS agency, providing project management and oversight for the successful completion of the effort. SANDAG is the metropolitan planning organization for the region and the primary recipient of state and federal funding. SANDAG is responsible for transportation planning in the region and works with its member agencies to deliver transit, highway, and arterial infrastructure improvements, including deployment of ITS technologies and their integration.

SANDAG would continue its regional role in delivering ICMS integration and facilitating discussions for coordinated operations among system managers. Although SANDAG is not a system operator, it has responsibility for modal system integration, as well as delivery and management of the region's newly deployed 511 advanced traveler information system (511 ATIS). There are a number of committees and working groups under SANDAG's jurisdiction, and these will also be incorporated into the process.

California Department of Transportation (Caltrans)

Caltrans is the system operator for the I-15 mainline, reversible lanes and arterial intersections for freeway on- and off-ramps. Caltrans builds, operates and maintains freeway management systems, fiber and leased communications networks, and field devices in the corridor and in partnership with the California Highway Patrol (CHP), operates the Transportation Management Center in Kearny Mesa. Caltrans operates and maintains the Ramp Meter Information System to inventory and control all on-ramps along the corridor and will operate the I-15 Managed Lanes system from the Transportation Management Center (TMC). Caltrans is also responsible for selected arterial signals, principally at freeway interchanges.

California Highway Patrol (CHP)

The CHP is the mobile 911 public safety answering point and responds to all reported incidents on freeways and state highways, and in some areas, County "S" roads. The CHP has responsibility for safe and lawful operation of the state's freeway and state highway system and, as such, is the primary resource for incident management procedures and policies in San Diego. The CHP also operates and maintains the Freeway Service Patrol (FSP) that is provided by contracted towing companies.

Metropolitan Transit System (MTS)

MTS operates the San Diego metropolitan bus system and the San Diego Trolley, which provide bus and light rail service throughout the San Diego metropolitan area. MTS also operates several commuter express services, as well as various transit services under contract. MTS operates the Regional Transit Management System, including the regional Transit Call Center. For ICMS corridor operations, MTS will operate the bus rapid transit (BRT) system that is being built along the I-15 Managed Lanes. MTS also provides a fiber optic network that will become a part of the Intermodal Transportation Management System (IMTMS) network.

North County Transit District (NCTD)

NCTD operates the suburban transit service throughout North San Diego County, including the Marine Corps Base at Camp Pendleton. NCTD operates and schedules the COASTER (Oceanside to Downtown San Diego), and the recently opened SPRINTER commuter rail service between Oceanside and Escondido. NCTD owns and operates a fiber optic network that will become another piece of the IMTMS network.

Cities of San Diego, Poway, and Escondido

The cities of San Diego, Poway, and Escondido operate traffic control systems on the major arterials that are a part of the I-15 integrated corridor. Each city performs traffic signal re-timing for routine arterial operations, as well as for special events. The respective police and fire departments in these cities will participate in corridor operations by reporting arterial incidents in their jurisdictions that have a major impact on either local arterial or adjacent freeway operations. Optimization and synchronization of traffic signal timings for each of these three corridor cities is an important transportation management function. The last time traffic signals in Escondido that lie in the I-15 corridor were re-timed were in 2001 and are listed in Table 3-1. For Poway traffic signals that lie in the I-15 corridor all were last optimized between August and December 2006 (Table 3-2). For the City of San Diego, there is a wide distribution for when the 159 corridor traffic signals were last re-timed (Table 3-3), ranging between 1982 and 2006; however, approximately one-third of the corridor traffic signals were re-timed within the past five years and more than three-quarters of the corridor traffic signals were retimed within the past ten years.

Additional Stakeholders

Additional stakeholders include: County of San Diego Office of Emergency Services (OES), San Diego County Service Authority for Freeway Emergencies (SD SAFE), the Department of Homeland Security, Federal Highway Administration (FHWA), Federal Transportation Administration (FTA), and local constituencies affected by future corridor enhancements.

Table 3-1. Signalized Intersections in Escondido within the I-15 Corridor

Street Name(s)	Cross Street(s)
13th	Escondido
2nd	Escondido
2nd	Juniper
5th	Centre City
5th	Escondido
9th	Auto Park Way
9th	Centre City
9th	Escondido
9th	Quince
9th	Tulip
Andreason	Auto Park Way
Andreason	Enterprise
Auto Park Way	Citracado
Auto Park Way - South	Howard
Bear Valley	Canyon
Bear Valley	Las Palmas
Bear Valley	MARY
Bear Valley	North County/Fair
Bear Valley	Sunset/Vermont
Broadway	2nd
Broadway	Mission
Broadway	Washington
Centre City	2nd
Centre City	13th
Centre City	Country Club
Centre City	Decatur
Centre City	Felicita
Centre City	Felicita Town Center
Centre City	Grand
Centre City	Iris
Centre City	Mission
Centre City	Valley
Citracado	Centre City
Citracado	Valley
Country Club	Citracado
El Norte	Centre City
El Norte	Iris
El Norte	Morning View
El Norte	Nutmeg/Nordahl
Escondido	Felicita
Escondido	Mission
Escondido	Sunset/Vermont

Street Name(s)	Cross Street(s)
Escondido	Washington
Felicita	Gamble/Citracado
Grand	Broadway
Grand	Escondido
Grand	Juniper
Hale	Auto Park Way
Hale	Tulip
Juniper	5th
Juniper	Felicita
La Terraza	9th
Lincoln	Lincoln
Mission	Andreason
Mission	Enterprise
Mission	Metcalf
Mission	Nordahl/Citracado
Mission	Rock Springs
Quince	2nd
Quince	Mission
Quince	Valley
Quince	Washington
San Pasqual	Bear Valley
San Pasqual	Ryan/Sierra Linda
Seven Oakes	El Norte Parkway
Tulip	Valley
Valley	9th
Valley	Auto Park Way
Valley	Broadway
Valley	Del Dios
Valley	Escondido
Valley	Hickory
Valley	Home Depot
Valley	Juniper
Valley	La Terraza
Valley	11th
Valley	Grand
Valley/Del Dios	Via Rancho
Via Rancho	Bear Valley
Via Rancho	Caminito del Postigo
Via Rancho	Sunset
Washington	Centre City
Washington	Rock Springs

Table 3-2. Signalized Intersections in Poway within the I-15 Corridor

Street Name(s)	Cross Street(s)	Synchronized/Optimized Date
Pomerado	Pomerado Hospital	Optimized, Coordinated 08/06
Pomerado	Twin Peaks/Cam Norte	Optimized 12/06
Pomerado	Colony	Optimized, Coordinated 08/06
Pomerado	Glenoak	Optimized, Coordinated 08/06
Pomerado	Meadowbrook	Optimized, Coordinated 08/06
Pomerado	Oak Knoll	Optimized, Coordinated 08/06
Pomerado	Metate	Optimized, Coordinated 08/06
Poway	Pomerado	Optimized 08/06
Poway	Oak Knoll	Optimized, Coordinated 08/06
Poway	IOLA	Optimized, Coordinated 08/06
Robison	Pomerado	Optimized, Coordinated 08/06
Scripps Poway	Pomerado	Optimized, Coordinated 08/06
Stowe	Pomerado	Optimized, Coordinated 08/06
Summerfield	Espola/Rancho Bernardo	Optimized 08/06
Ted Williams	Pomerado	Optimized, Coordinated 08/06
Twin Peaks	Ted Williams	Optimized, Coordinated 08/06

Table 3-3. Signalized Intersections in San Diego within the I-15 Corridor

Street Name(s)	Cross Street(s)	Last Retimed
Acena Drive	Rancho Bernardo Road	06/07/2000
Adolphia Street/Park Village Road	Black Mountain Road	04/04/2005
Alemania Road	Mercy Road	11/07/2001
Angelique Street/Springbrook Drive	Scripps Poway Parkway	12/01/1997
Avenida Abeja	Bernardo Center Drive	10/31/1989
Avenida la Valencia/Higa Place	Pomerado Road	07/29/2005
Avenida Magnifica	Pomerado Road	11/16/2006
Avenida Venusto	Bernardo Heights Parkway	07/10/1985
Avenida Venusto	Paseo Lucido	03/09/2004
Avenue of Science	Rancho Carmel Drive	04/12/1989
Bernardo Center Drive	Bernardo Heights Parkway/Iberia Place	05/02/2000
Bernardo Center Drive	Bernardo Plaza Court/Bernardo Plaza Drive	05/02/2000
Bernardo Center Drive	Camino del Norte	03/25/2004
Bernardo Center Drive	Cloudcrest Drive	12/07/2001
Bernardo Center Drive	Escala Drive	04/18/2002
Bernardo Center Drive	Lomica Drive	05/02/2000
Bernardo Center Drive	Maturin Drive	03/25/2004
Bernardo Center Drive	Rancho Bernardo Road	04/18/2000
Bernardo Center Drive	Rancho Bernardo Town Center Drive	05/02/2000
Bernardo Center Drive	Regalo Lane	10/29/1992
Bernardo Center Drive/Duenda Road	West Bernardo Drive	12/07/2001
Bernardo Heights Parkway	Paseo Lucido	10/19/1982
Bernardo Oaks Drive	Rancho Bernardo Road	06/07/2000

Table 3-3. Signalized Intersections in San Diego within the I-15 Corridor (cont'd)

Street Name(s)	Cross Street(s)	Last Retimed
Black Mountain Road	Capricorn Way	02/24/1999
Black Mountain Road	Carmel Mountain Road	06/22/1988
Black Mountain Road	Carmel Valley Road	09/07/2005
Black Mountain Road	Carroll Canyon Road	03/29/2005
Black Mountain Road	Carroll Centre Road/Kearny Villa Road	05/13/2003
Black Mountain Road	Galvin Avenue	02/24/1999
Black Mountain Road	Gemini Avenue	02/24/1999
Black Mountain Road	Gold Coast Drive	03/11/1996
Black Mountain Road	Hillery Drive	02/24/1999
Black Mountain Road	Maler Road	04/24/2001
Black Mountain Road	Maya Linda Drive	03/16/2005
Black Mountain Road	Mercy Road	04/04/2005
Black Mountain Road	Mira Mesa Boulevard	02/05/1999
Black Mountain Road	Miramar College Entrance	02/24/1999
Black Mountain Road	Miramar Road	07/04/2001
Black Mountain Road	Oviedo Street	09/04/2002
Black Mountain Road	Paseo Montalban	10/09/2001
Black Mountain Road	Stargaze Avenue	01/20/2004
Black Mountain Road	Twin Trails Drive	09/15/2005
Black Mountain Road	Westview Parkway	01/23/2002
Blue Cypress Drive	Spring Canyon Road	04/07/1999
Businesspark Avenue	Carroll Canyon Road	11/13/2002
Calle de las Rosas	Rancho Penasquitos Boulevard	08/26/2004
Calle Saucillo	Paseo Lucido	03/12/2005
Camino del Norte	Carmel Mountain Road/Paseo Lucido	06/07/2004
Camino del Norte	Paseo Montanoso	08/30/2002
Camino del Norte	World Trade Drive	07/25/1996
Camino del Sur	Carmel Valley Road	10/18/2000
Camino del Sur	Highland Village Place	01/14/2004
Camino del Sur	Torrey Meadows Drive	01/14/2004
Camino del Sur	Watson Ranch Road	08/20/2002
Camino del Sur	Wolverine Way	01/14/2004
Capricorn Way	Westview Parkway	02/05/1998
Carmel Mountain Road	Conference Way	11/29/2000
Carmel Mountain Road	Cuca Street/Caminata Deluz	12/08/1992
Carmel Mountain Road	Freeport Road	12/08/1992
Carmel Mountain Road	Highland Ranch Road	11/29/2000
Carmel Mountain Road	Paseo Cardiel	12/08/1992
Carmel Mountain Road	Paseo Montalban	12/08/1992
Carmel Mountain Road	Penasquitos Drive	12/08/1992
Carmel Mountain Road	Rancho Carmel Drive (North)	11/29/2000
Carmel Mountain Road	Rancho Carmel Drive (South)	11/29/2000
Carmel Mountain Road	Stoney Creek Road	12/08/1992
Carmel Mountain Road	Stoney Peak Drive	11/29/2000
Carmel Mountain Road	Sundevil Way	03/09/1998
Carmel Ridge Road	Highland Ranch Road	11/03/2003
Carroll Canyon Road	Scripps Ranch Boulevard	04/04/2002

Table 3-3. Signalized Intersections in San Diego within the I-15 Corridor (cont'd)

Street Name(s)	Cross Street(s)	Last Retimed
Chesapeake Drive	Ruffin Road	04/30/1990
Clairemont Mesa Boulevard	Complex Drive	11/15/2004
Clairemont Mesa Boulevard	Kearny Villa Road	11/15/2004
Clairemont Mesa Boulevard	Murphy Canyon Road	11/15/2004
Clairemont Mesa Boulevard	Overland Avenue	11/15/2004
Clairemont Mesa Boulevard	Ruffin Road	11/15/2004
Clayton Drive/Mitscher Way	Miramar Road	07/24/2001
Compass Point Drive N	Westview Parkway	08/30/2006
Compass Point Drive S	Westview Parkway	08/30/2006
Conference Way	World Trade Drive	12/22/1999
Creekview Drive	Poway Road	06/16/1993
Cypress Canyon Park Drive/Pomerado Road	Pomerado Road/Spring Canyon Road	10/30/1990
Cypress Canyon Road/Ivy Hill Drive	Scripps Poway Parkway	12/01/1997
Eastbourne Road	Highland Ranch Road	04/14/1997
Erma Road	Scripps Ranch Boulevard	12/19/2002
Escala Drive	Pomerado Road	07/29/2005
Esprit Avenue/Highland Ranch Road	Ted Williams Parkway	10/09/1992
Evening Creek Drive E/Evening Creek Drive N	Sabre Springs Parkway	03/03/2001
Evening Creek Drive S	Sabre Springs Parkway	07/05/2002
Fairbrook Road	Pomerado Road	07/11/1985
Farmingdale Street/Spencerport Way	Scripps Ranch Boulevard	11/13/2002
Galvin Avenue	Westview Parkway	01/29/1991
Greenford Drive	Mira Mesa Boulevard	02/05/1999
Greens East Road/Paseo del Verano	Pomerado Road	07/29/2005
Hibert Street	Scripps Ranch Boulevard	11/18/2002
Highland Ranch Road	World Trade Drive	12/17/1991
Highland Valley Road/Paseo Monte Batalla	Pomerado Road	07/25/1991
Hillery Drive	Westview Parkway	06/06/2000
Innovation Drive	Rancho Carmel Drive	06/01/1992
Ivy Hill Drive/Spring Canyon Road	Scripps Poway Parkway	12/01/1997
Kearny Mesa Road	Miramar Road	07/24/2001
Kearny Villa Road	Miramar Road	07/24/2001
Kearny Villa Road	Ruffin Road/Waxie Way	04/12/1996
Kearny Villa Road	Topaz Way	06/14/2000
Kika Court	Mercy Road	02/25/1997
Legacy Road	Pomerado Road	03/29/2005
Lightwave Avenue	Overland Avenue	07/11/2000
Lightwave Avenue	Ruffin Road	09/07/2000
Marbury Avenue/Westmore Road	Mira Mesa Boulevard	02/24/1999
Matinal Road	Rancho Bernardo Road	07/19/2001
Matinal Road/Caminito Siega	West Bernardo Drive	05/24/1989
Meanley Drive	Scripps Ranch Boulevard	11/15/2001
Mira Mesa Boulevard	Scripps Ranch Boulevard	07/25/2000
Mira Mesa Boulevard	Westonhill Drive	02/24/1999
Mira Mesa Boulevard	Westview Parkway	02/24/1999
Mirasol Drive/Vezelay Lane	Pomerado Road	07/29/2005
Morning Creek Drive North	Sabre Springs Parkway	05/08/2001

Table 3-3. Signalized Intersections in San Diego within the I-15 Corridor (cont'd)

Street Name(s)	Cross Street(s)	Last Retimed
Morning Creek Drive S	Sabre Springs Parkway	03/12/1992
North Brookville Drive	Spring Canyon Road	01/12/1998
Oaks North Drive	Pomerado Road	07/29/2005
Paseo del Verano Norte	Pomerado Road	07/29/2005
Paseo Montalban	Salmon River Road	10/09/2001
Paseo Montalban	Twin Trails Drive	10/08/2001
Paseo Montril	Rancho Penasquitos Boulevard	08/26/2004
Poblado Road	West Bernardo Drive	05/13/1998
Pomerado Road	Rancho Bernardo Road	04/25/2000
Pomerado Road	Rios Road	07/29/2005
Pomerado Road	Scripps Ranch Boulevard	08/05/1998
Pomerado Road	Semillon Boulevard	07/11/1985
Pomerado Road	Stone Canyon Road	07/29/2005
Pomerado Road	Stonebridge Parkway	04/28/2004
Pomerado Road	Willow Creek Road/Alliant Int'l. University Driveway	08/05/1998
Poway Road	Sabre Springs Parkway	04/27/1994
Poway Road	Springbrook Drive	07/05/1995
Poway Road	Springhurst Drive	05/21/1996
Provencal Place	Rancho Carmel Drive	03/26/2001
Rancho Bernardo Road	Via del Campo	06/13/1997
Rancho Bernardo Road	West Bernardo Drive	11/19/2003
Rancho Carmel Drive	Sellers Post Office Driveway	01/12/1999
Rancho Carmel Drive	Shoal Creek Drive	03/26/2001
Rancho Carmel Drive	Windcrest Lane	03/26/2001
Rancho Carmel Drive/Sabre Springs Parkway	Ted Williams Parkway Westbound Off/On Ramps	03/26/2001
Rancho Penasquitos Boulevard	Via del Sud	08/26/2004
Red Cedar Drive	Scripps Lake Drive	07/13/1994
Sabre Springs Parkway	Ted Williams Parkway Eastbound Off/On Ramps	03/26/2001
Scripps Creek Drive	Spring Canyon Road	01/16/2003
Scripps Creek Drive/Village Ridge Road	Scripps Poway Parkway	12/01/1997
Scripps Highlands Drive	Scripps Poway Parkway	05/02/2001
Scripps Lake Drive	Scripps Ranch Boulevard	04/18/1989
Scripps Poway Parkway	Scripps Summit Drive	12/01/1997
Scripps Poway Parkway	Sunshine Peak Court	12/01/1997
Scripps Ranch Boulevard	Spring Canyon Road	06/11/1998
Shoal Creek Drive	Ted Williams Parkway	04/11/2002
Twin Trails Drive	Post Office Driveway	11/25/1997
Via del Campo	West Bernardo Drive	01/27/1994
Via Frontera	West Bernardo Drive	11/06/1986
West Bernardo Court	West Bernardo Drive	04/20/2005
West Bernardo Drive	Casa de las Companas Driveway/ Rancho Bernardo Park Driveway	03/22/1996
Westview Parkway	Market Center Drive	06/06/2000

3.3 Operational Conditions of the San Diego ICMS Corridor and Associated Networks

Guidance This section focuses on the operational characteristics of the I-15 corridor and its associated arterial and transit networks. Attributes for the I-15 corridor addressed in this section include the description of areas with recurring congestion and the source(s) of this congestion, multi-modal corridor demand and usage, and the types and frequency of events that impact corridor and network operations. Freeway, arterial, transit, and routine corridor operations will be discussed in the following sections.

I-15 Corridor Freeway Characteristics

The operational characteristics on the I-15 general purpose lanes and the I-15 reversible express lanes are impacted by the travel generators and markets described in Section 3.1. Southwest Riverside County is one of the fastest growing areas in California and will continue to impact traffic within the I-15 integrated corridor. Likewise, increasing commercial traffic moving to and from the Otay Mesa and Inland Empire commercial vehicle operations (CVO) gateways will have an increasing impact on the corridor.

The I-15 integrated corridor is instrumented with a total of 51 vehicle detection stations (VDS), each VDS consisting of a connected set of magnetic induction loops in each lane of a single freeway direction (northbound or southbound) (Figure 3-5). Opposite-side VDSs are not necessarily located across the median from each other, but are located to optimize mainline measurements just upstream of a metered on-ramp. The location and numerical identification of the 26 northbound and 25 southbound VDS sites are shown in Figure 3-5. Real-time data from these VDS stations are sent in its raw form (individual loop data polled every 30 seconds) to the California Performance Measurement System (PeMS) at the University of California Berkeley (UC Berkeley). The web-based PeMS application aggregates the data in several different ways to provide on-line performance metrics of every instrumented freeway in California. Incident statistics in the corridor are provided by PeMS via the California Highway Patrol's (CHP) Computer Aided Dispatch system. In the case of the I-15 corridor, this data comes from CHP's Border Communications Center in San Diego.

For purposes of this ConOps, I-15 VDS tabular data from PeMS was combined with local geographic information system (GIS) data layers from San Diego's regional GIS agency, SANGIS, and SANDAG GIS layers to provide a capsule view of freeway performance. GIS data was analyzed using the ESRI ArcView 9.2 application. Some data is aggregated by segments or bins, while other data is aggregated by VDS station. Incident bins are typically three miles in length, and travel time data is segmented roughly along the same boundaries as the North, Middle, and South Corridor segments described earlier. VDS-specific data includes metrics such as bottleneck analyses (delay in vehicle-hours, duration in minutes and extent in miles to be described in more detail below), the proportion of CVO vehicles, vehicle miles traveled (VMT), vehicle hours traveled (VHT) and the "Q" coefficient (VMT/VHT), among others. VDS-based data can be geo-located on a GIS layer while segment data can be depicted with polyline features on a GIS layer.

Figures 3-6 through 3-11 show I-15 Corridor performance through the use of bottleneck analyses. A bottleneck is defined as a location on the freeway where the occupancy downstream of the bottleneck is substantially lower than the occupancy upstream. Typical causes of bottlenecks are loss of lanes, beginning of construction zones, excessive weaving at on- and off-ramps, and similar geometric or traffic flow issues. Inspection of Figures 3-6 through 3-8 shows that bottleneck locations are the most severe at Center City Parkway, Via Rancho Parkway, and Pomerado/West Bernardo Road during the peak a.m. hours for southbound traffic. The duration of these bottlenecks can be from one to three hours depending on conditions further downstream, and the extent (queue due to the bottleneck) can be up to seven miles upstream of Rancho Bernardo Road. This data is in agreement with observed traffic backups sometimes extending to north of the SR 78 interchange in Escondido during the southbound a.m. peak.

Figures 3-9 through 3-11 show that the most severe bottleneck for p.m. peak northbound traffic is at Rancho Bernardo Road, with smaller bottlenecks south of Rancho Bernardo to SR-56 and at Felicita Road in Escondido. The Rancho Bernardo bottleneck can have durations from a little less than 1.5 hours to a little over 2 hours, with extents ranging up to six miles. Again, this data is in agreement with observed northbound peak p.m. traffic backups to Poway Road. The general patterns found in this analysis generally followed pre-Managed Lane construction patterns, but have been exacerbated by the Managed Lane construction zone from SR-56 north to Center City Parkway. The impact of this construction zone will be evident in the following discussion of incidents along the corridor. With a predicted 30 percent increase in traffic volumes by 2020, these bottleneck areas will continue to be problematic until the Managed Lanes are fully operational in 2012. The results presented here are weekday averages and can be significantly worse on days when accidents occur downstream of normal bottlenecks. Major accidents occurring at or near peak-hour traffic on I-15 have tied up traffic for up to several hours.

For Figures 3-8 and 3-11, we used GIS map depictions and the bottleneck icons do not depict radii in miles but indicate the queue length of vehicles upstream where congestion exists from the point depicted. For example, in Figure 3-11, which depicts the extent of northbound bottlenecks, looking at the large icon just north of Rancho Bernardo Road – what that icon means is that the northbound bottleneck congestion (queue length) is from 3.2 to 6.1 miles long measured south from that point. The icons themselves do not directly measure congestion distance but only indicate the point from which congestion is measured in the appropriate direction. In this usage, GIS icons only indicate relative values and are used to depict comparative values. Similarly, Figure 3-8 depicts the extent of southbound bottlenecks and icons indicate southbound queue lengths measured north from each icon for a distance range indicated by the icon legend.

Figure 3-12 shows the northbound and southbound incident totals for July 1 2006 to June 30 2007. The largest number of incidents, as would be expected, is in the construction zone from SR 56 to Lake Hodges. The data shown does not include breakdowns and road hazards as these events are generally not roadway-dependent, but more a function of vehicle mechanical condition or poorly loaded cargo. The two most significant weaving hazard zones along the I-15 corridor are northbound at the approach to the SR 78 westbound ramp and southbound at the on-ramp from Via Rancho Parkway. The northbound hazard has had remarkably few accidents, while the Via Rancho hazard is a known problem area as shown by the data. The northbound weaving zone is likely the cause of the secondary bottleneck at Felicita Road during the p.m. peak.

In summary, bottleneck and incident analysis indicates that the most problematic areas of the I-15 corridor are Escondido during the southbound a.m. commute and the SR 56 to Rancho Bernardo construction zone during the northbound p.m. commute. What the data provided does not show is the increasing reverse commute congestion, particularly in the southbound p.m. commute, as the number of employment centers grow in the Rancho Bernardo/Carmel Mountain area. This reverse congestion extends roughly from Bernardo Center Road to south to Miramar Road at its peak. Based on the data provided above, corridor modeling and management strategies should emphasize planning for the impact of severe non-recurring events in the most congested areas of the I-15 corridor.

Appendix A depicts additional PeMS output possibilities for displaying freeway performance. These graphs are more difficult to envision in the geographic context, but contain a richer data content as they combine metric values, time of day, and post-mile location in a three-dimensional format.

I-15's capacity deficiencies may also be viewed from a more macroscopic perspective. In Figures 3-13 and 3-14 the level of service (LOS) is displayed for I-15 freeway corridor for the a.m. and p.m. peak periods, respectively between SR 52 and SR 78. Each map is color coded to represent different LOS values. In Figure 3-13, there are substantial southbound segments of I-15 with LOS F, which is understandable since this is the peak direction for commuters heading toward San Diego from northern San Diego County. Moreover, most of the southbound freeway lanes vary between LOS D and F. Conversely, in the p.m. peak period, during which northbound lanes of the freeway comprise the peak direction, a substantial portion of the northbound lanes also are at LOS D through F.

Figure 3-5. I-15 Integrated Corridor Vehicle Detection Stations

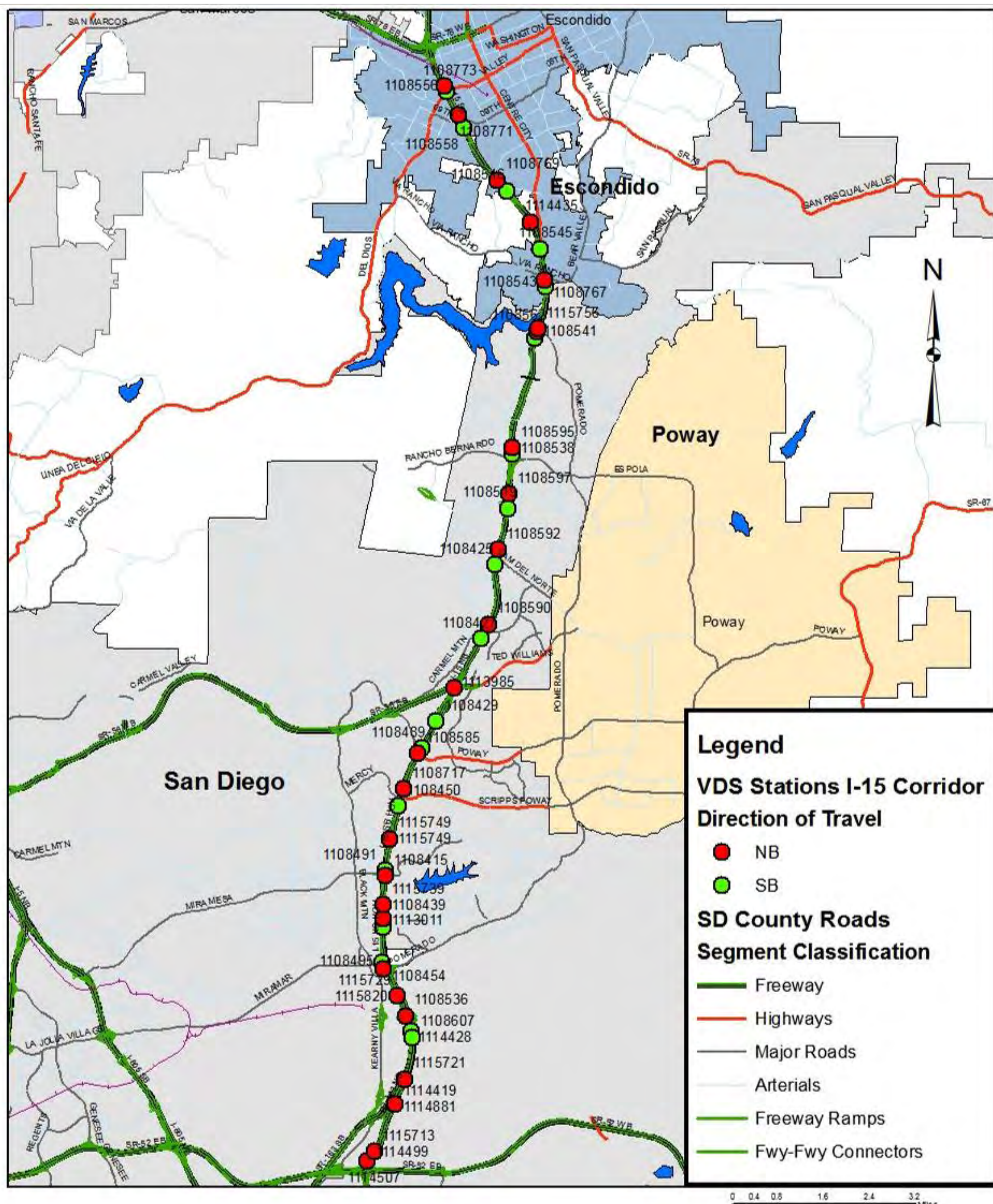


Figure 3-6. I-15 Southbound Bottleneck Delay for the A.M. Peak

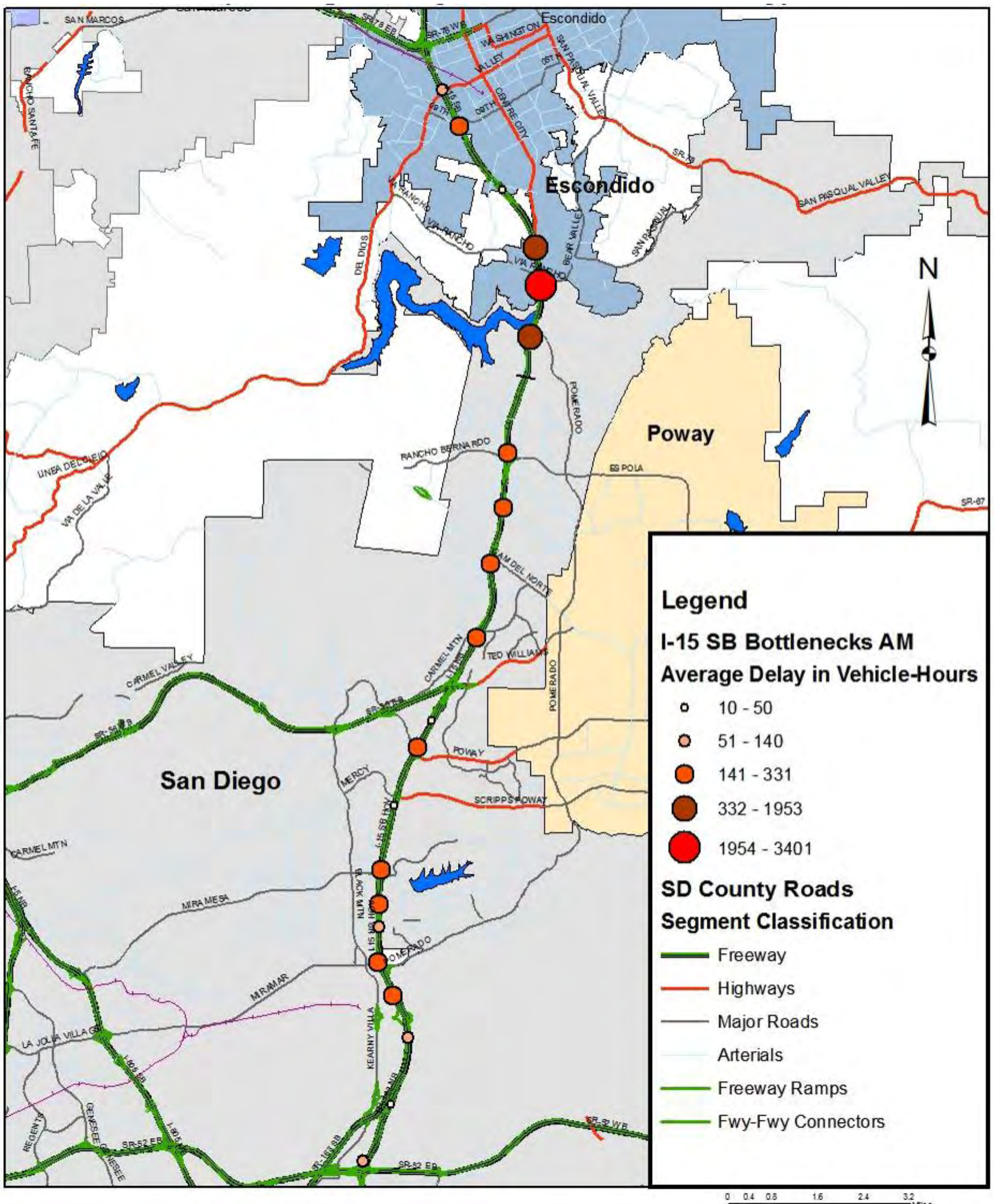


Figure 3-7. I-15 Southbound Bottleneck Duration for the A.M. Peak

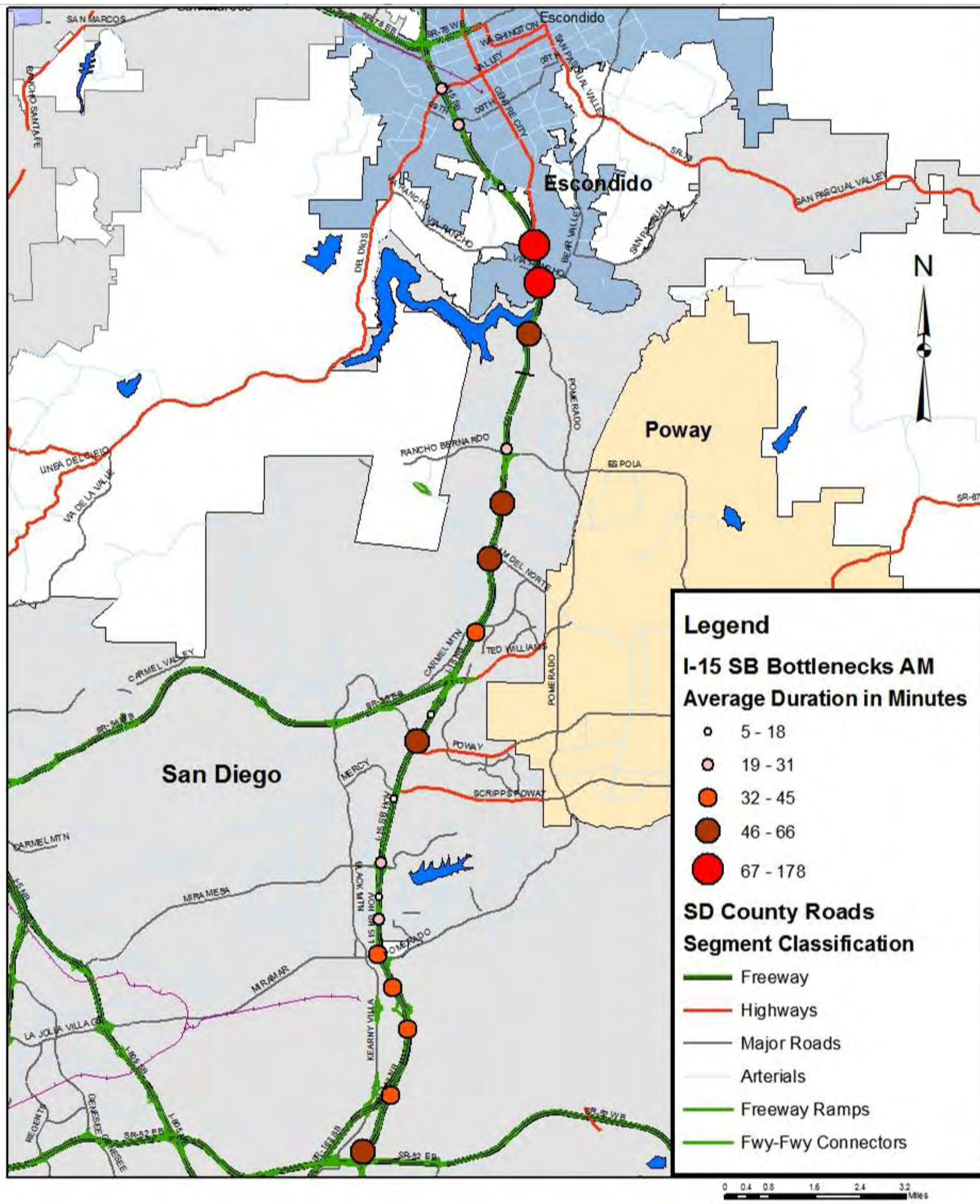


Figure 3-8. I-15 Southbound Bottleneck Extent for the A.M. Peak

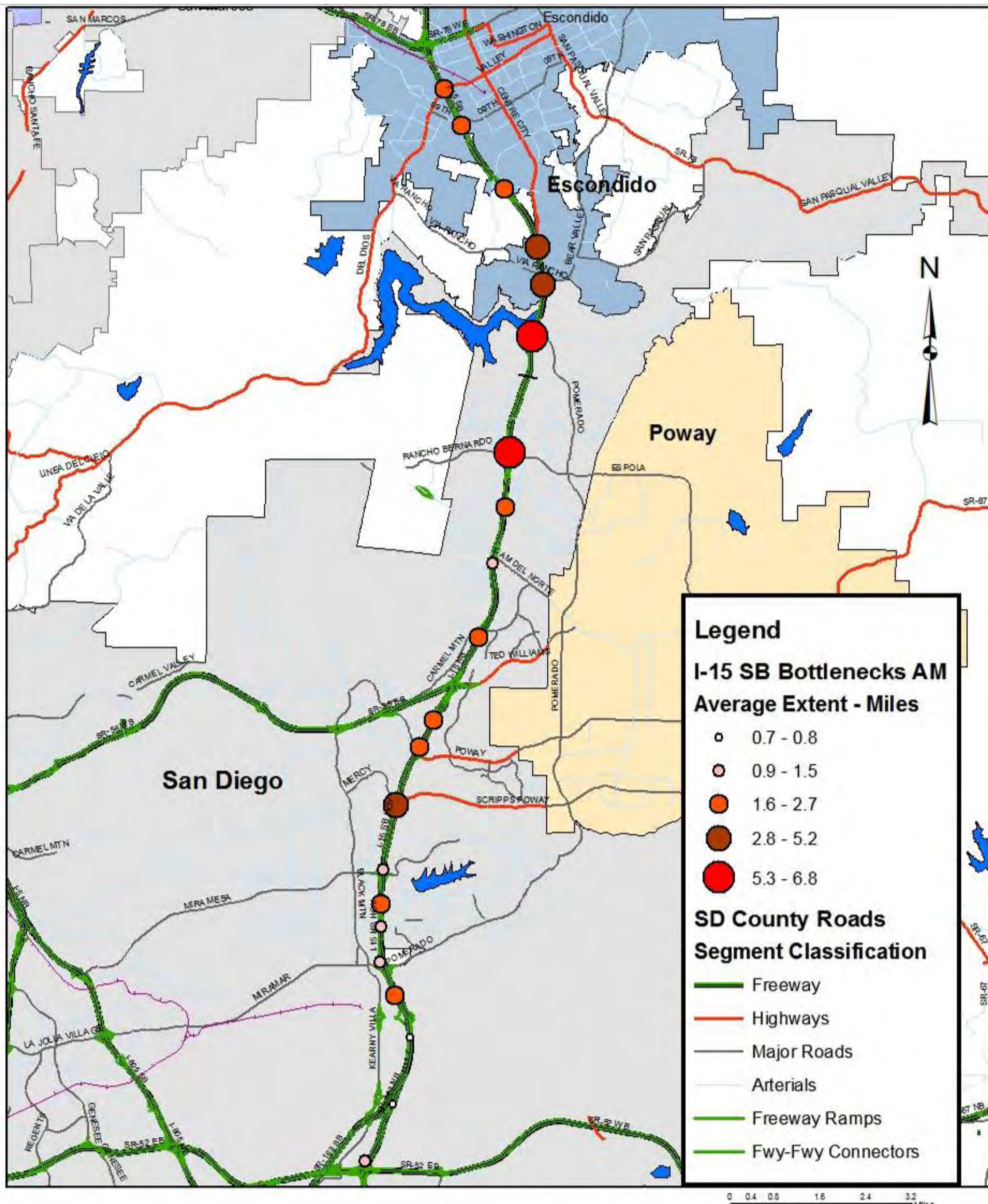


Figure 3-9. I-15 Northbound Bottleneck Delay for the P.M. Peak

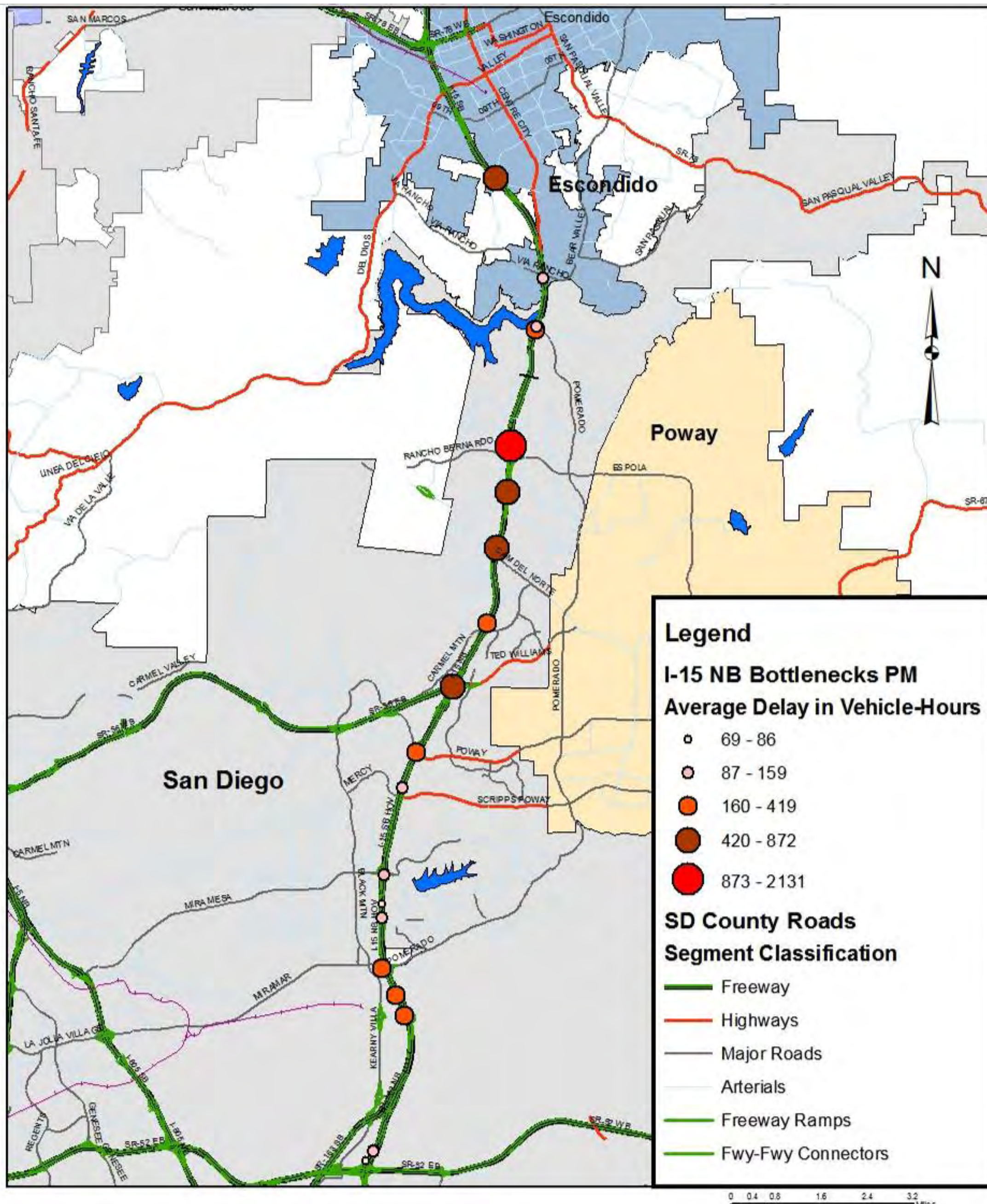


Figure 3-10. I-15 Northbound Bottleneck Duration for the P.M. Peak

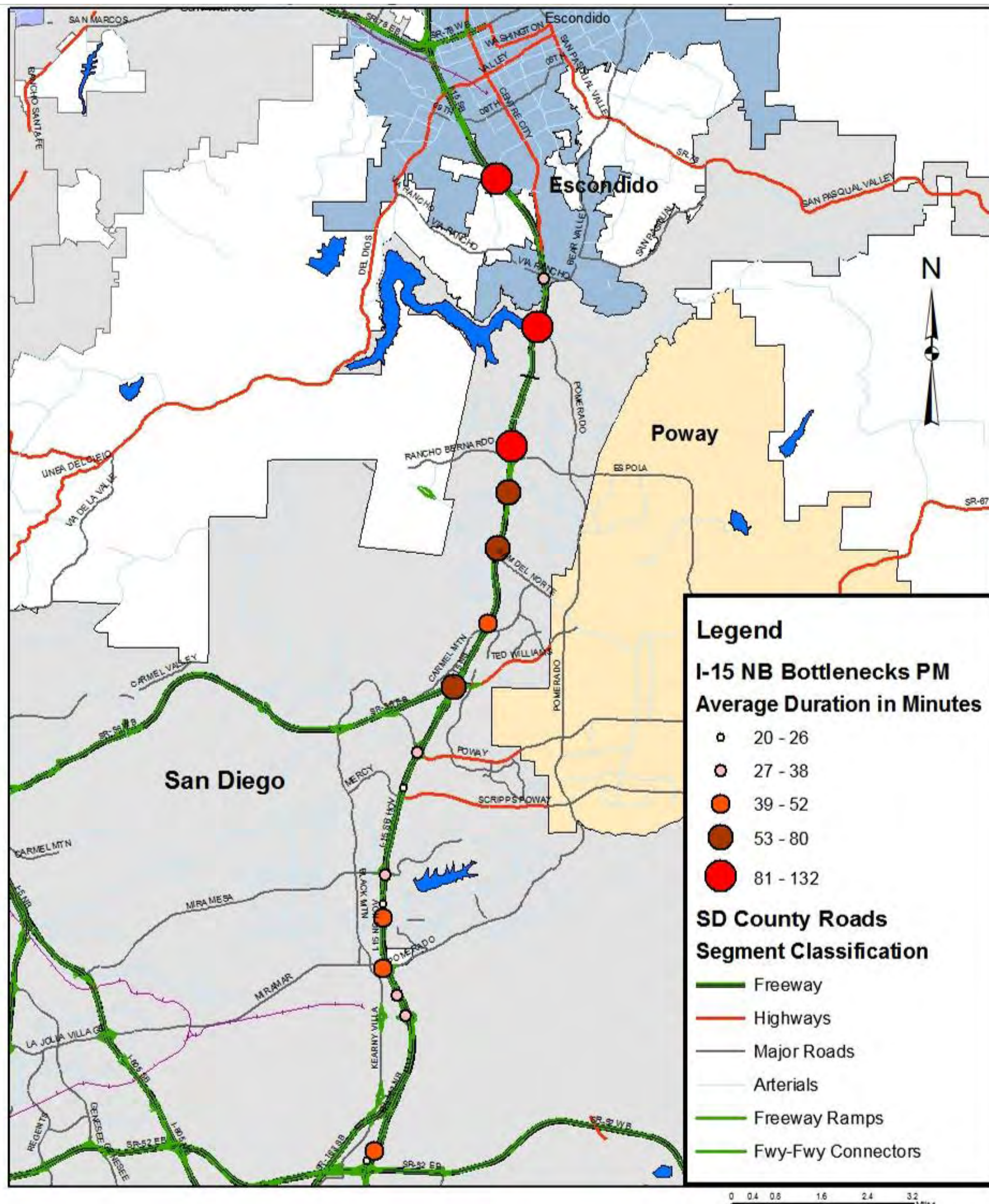


Figure 3-11. I-15 Northbound Bottleneck Extent for the P.M. Peak

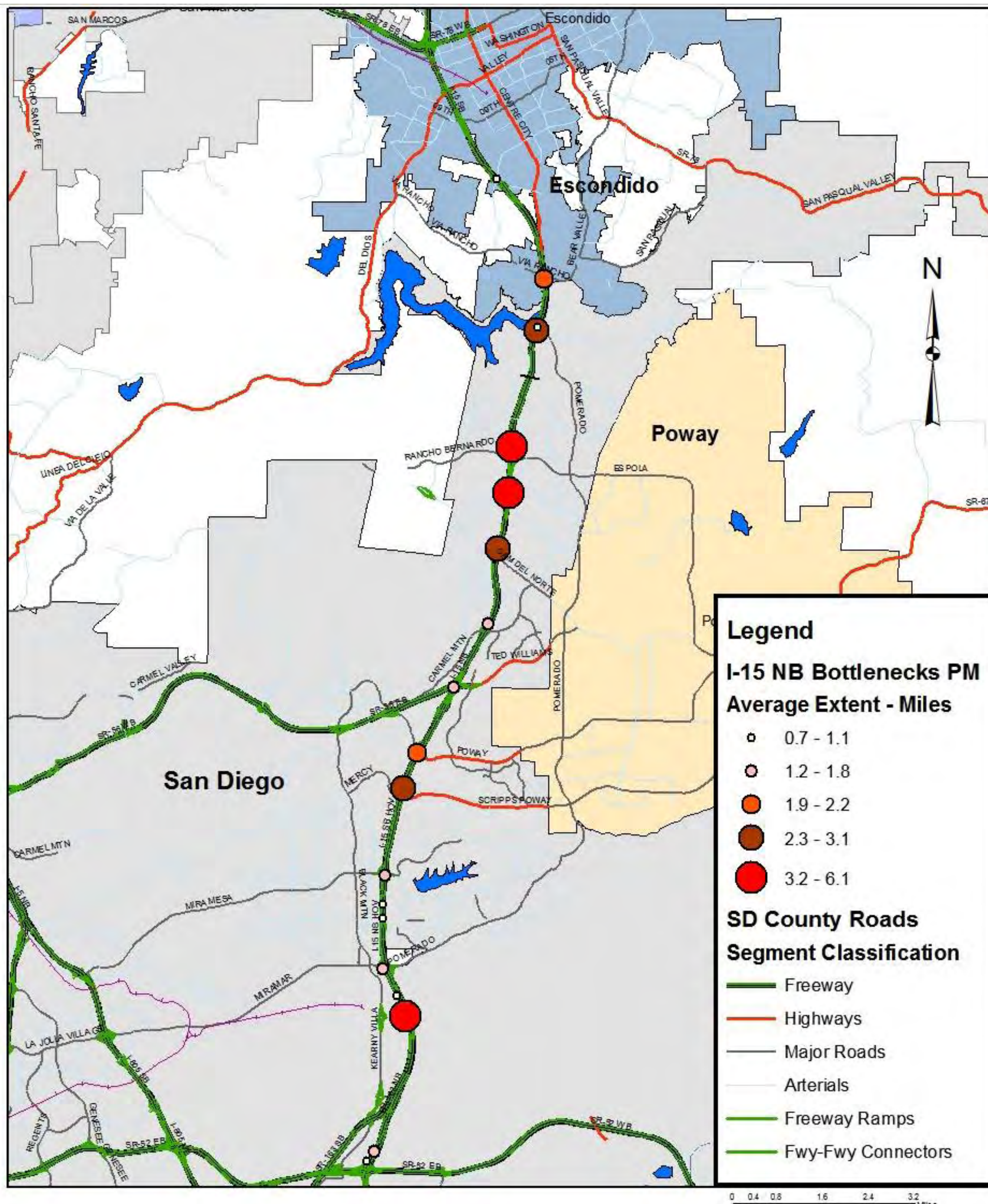


Figure 3-12. I-15 Corridor Incident Locations (3-Mile Bins)

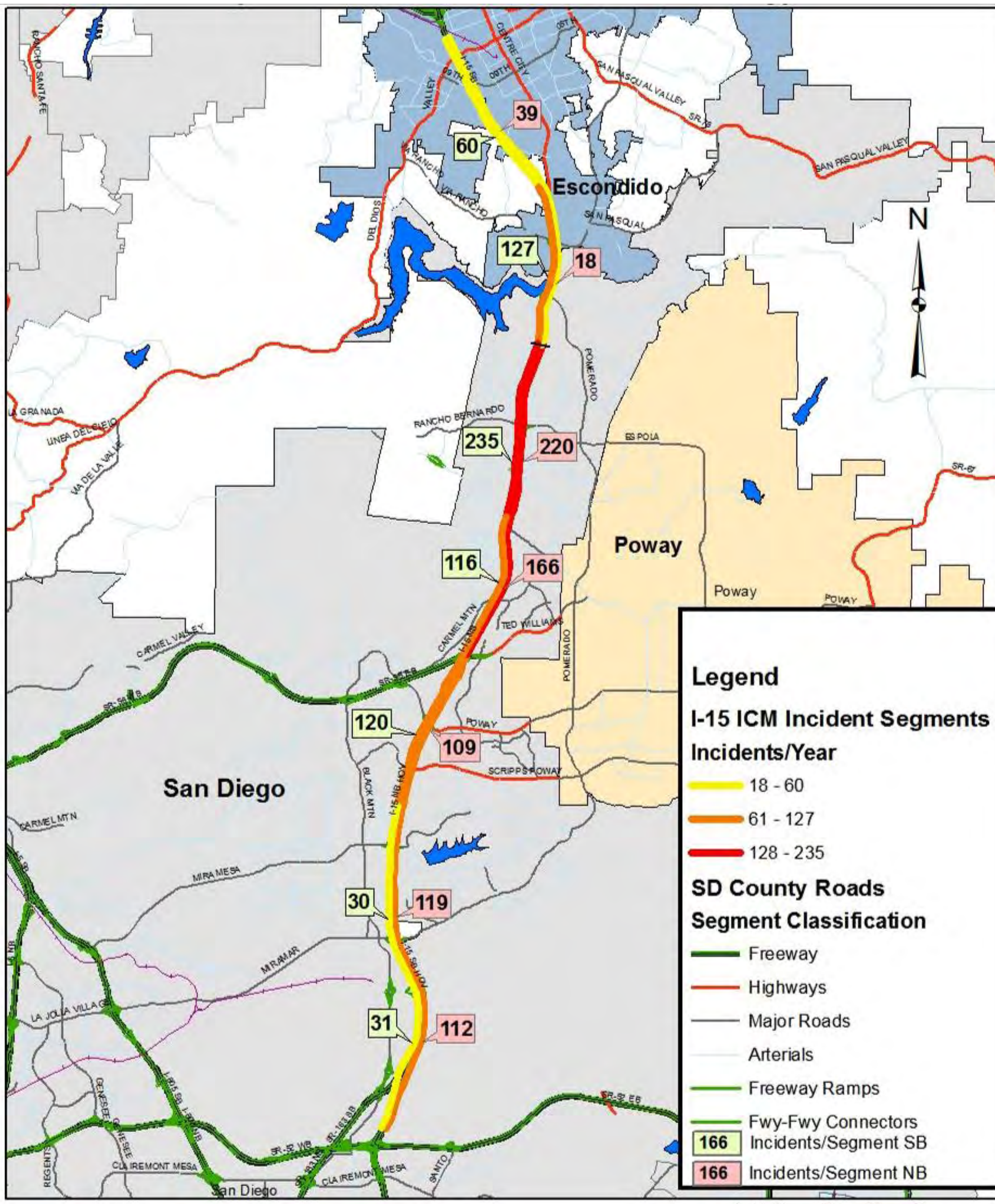


Figure 3-13. LOS for I-15 During A.M. Peak Period

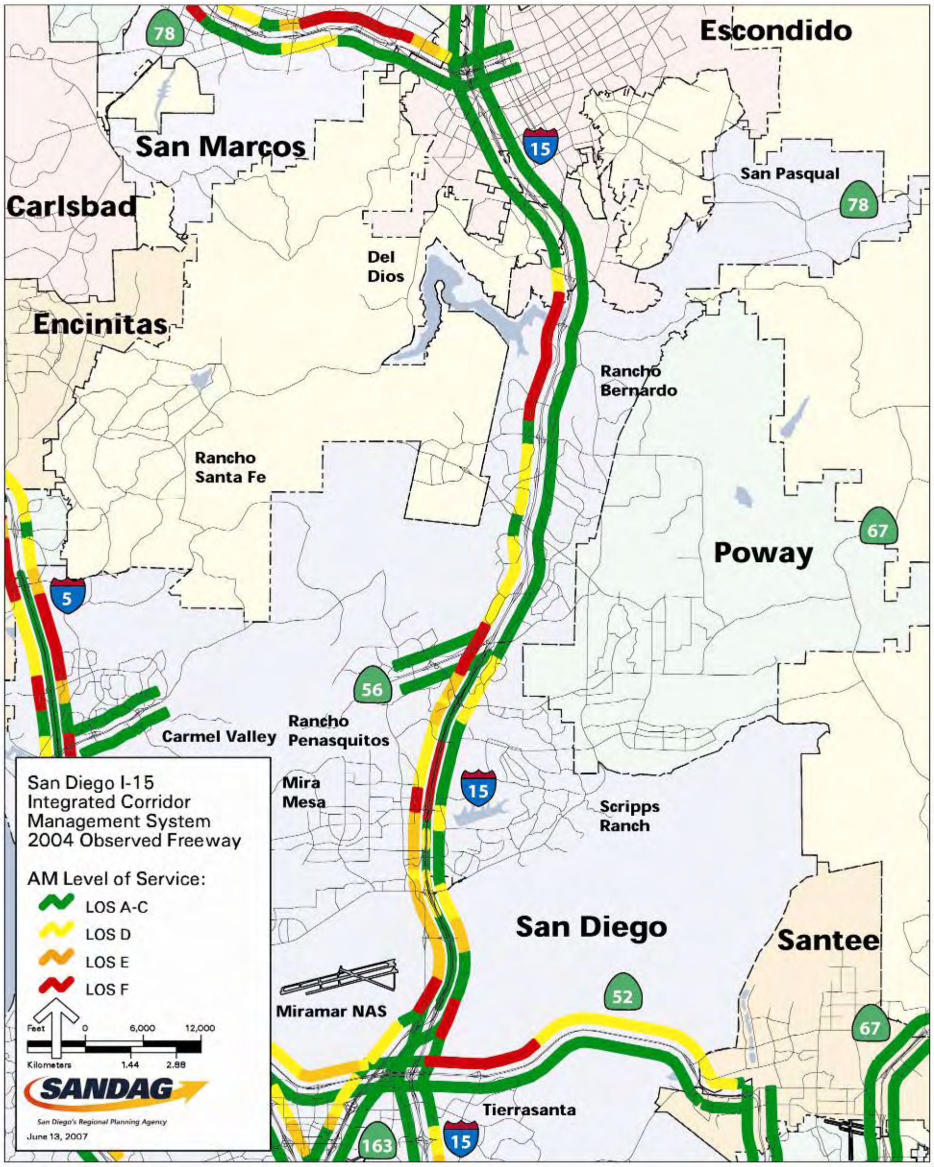
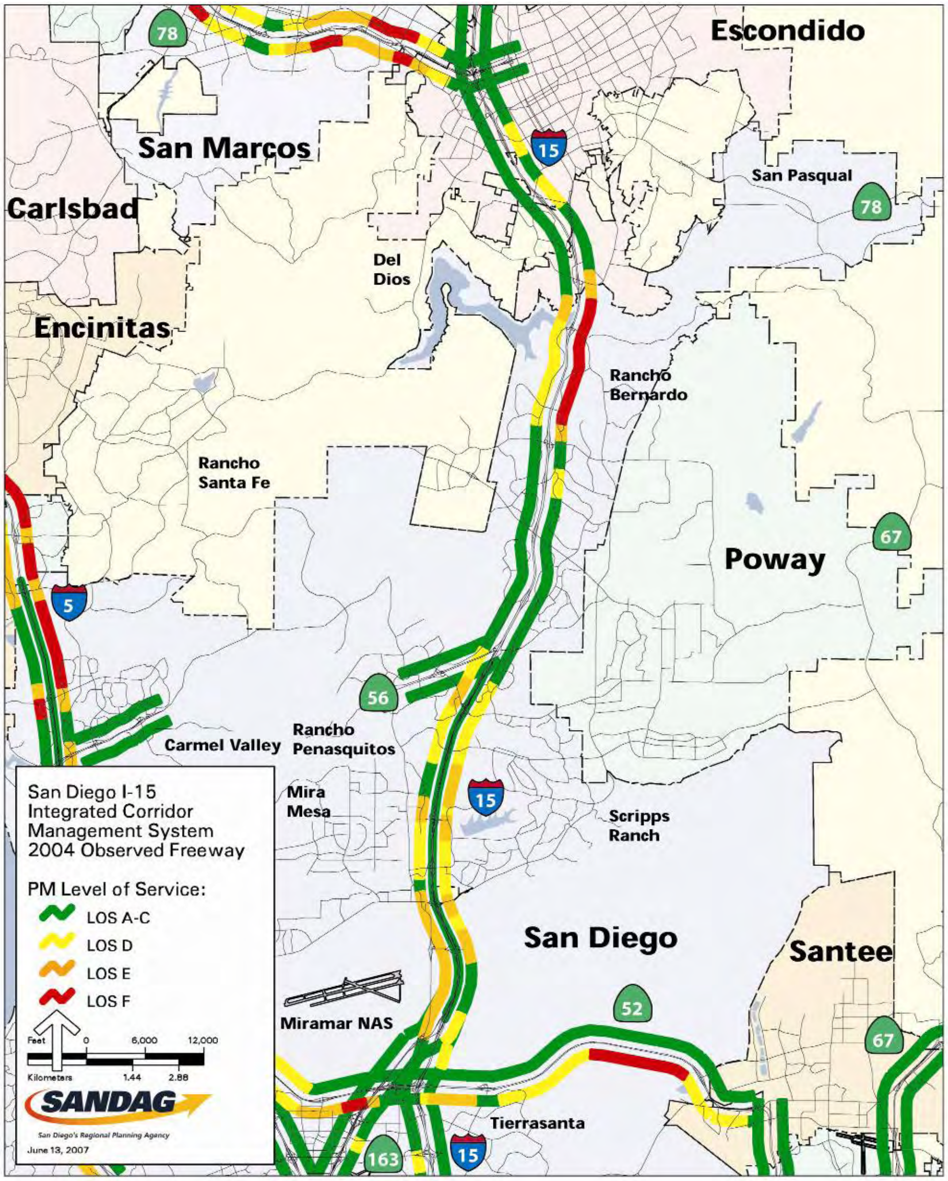


Figure 3-14. LOS for I-15 During P.M. Peak Period



Corridor Arterial Characteristics

The arterial network in the corridor encompasses three major cities in the San Diego region: the cities of San Diego, Poway, and Escondido. These cities help to provide at least 15 arterial links to accommodate transfers from the I-15 freeway within the corridor. Of the 15 available arterial links, three links have been identified as candidates for providing additional corridor capacity during non-recurring incidents: Kearny Villa Road/Black Mountain Road, Pomerado Road, and Centre City Parkway. Additionally, there are secondary parallel routes in the Middle and North Segments of the corridor that have less capacity, but can be used in an emergency. Lake Hodges effectively blocks any north-south arterial traffic; therefore, Escondido diversions will be independently operated from the Cities of San Diego and Poway.

The Kearny Villa Road/Black Mountain Road arterial corridor is composed of two regional arterials located west of I-15 in the corridor. This segment currently carries between 5,000 and 45,000 vehicles per day. This eight-mile arterial starts on SR 52 and ends at SR 56. Kearny Villa Road serves various communities within the City of San Diego, including Kearny Mesa, the Marine Corps Air Station Miramar, Mira Mesa, and Rancho Peñasquitos.

Pomerado Road is a regionally significant arterial located east of I-15, running from Miramar Road in the south and connecting to West Bernardo Road at I-15 just south of Lake Hodges. This arterial is approximately 14 miles long and carries between 10,000 and 31,000 vehicles per day. Pomerado Road serves Scripps Ranch and Rancho Bernardo in the Cities of San Diego and Poway. Pomerado Road is accessible from I-15 from Scripps-Poway Parkway, Poway Road, Ted Williams Parkway (extension of SR 56 east of I-15), Camino del Norte, and Rancho Bernardo Road.

Centre City Parkway is a regional arterial located east of I-15. This six-mile arterial starts from just north of Via Rancho Parkway on I-15 and accesses I-15 again north of El Norte Parkway in Escondido. This segment currently carries between 5,000 and 53,000 vehicles per day. The road continues to Riverside County parallel to I-15 as Champagne Boulevard and Old Highway 395 in the County of San Diego.

For these primary arterials capacity deficiencies may be viewed from a macroscopic perspective as shown in Figures 3-15 and 3-16 for the a.m. and p.m. peak periods, respectively, using level of service (LOS) as the measure of performance. Each map is color coded to represent different LOS values. In Figure 3-15, while traffic conditions on each of these three primary arterials indicates a LOS A through C, there are segments on each of them at LOS D through F in the southbound direction. In Figure 3-16 similar conditions exist, except in the northbound direction.

When incidents or heavy congestion occur on I-15 within the corridor, historical data show that travelers will use alternate arterial routes. These decisions are based on traveler experience and knowledge of typical arterial travel times or incident-bypass capability. On rare occasions when the I-15 freeway is completely closed, as happened during the Cedar Fire in October 2003, freeway traffic will be diverted onto local arterials.

None of the arterial segments identified have equipment capable of providing continuous count or occupancy data as well as incident reporting and data archiving, without hardware and/or software modifications. This type of equipment has been identified as a priority in the region to support effective corridor operations. While these types of capabilities are not expected to be fully implemented before Phase III of the ICM program (demonstration) currently scheduled to be operational in March 2011, a pilot phase implementation is scheduled for December 2009. Currently no surveillance cameras or changeable message signs (CMS) are installed on these arterials, although the City of Poway has video detection systems.

Figure 3-15. LOS for Major Arterials During A.M. Peak Period

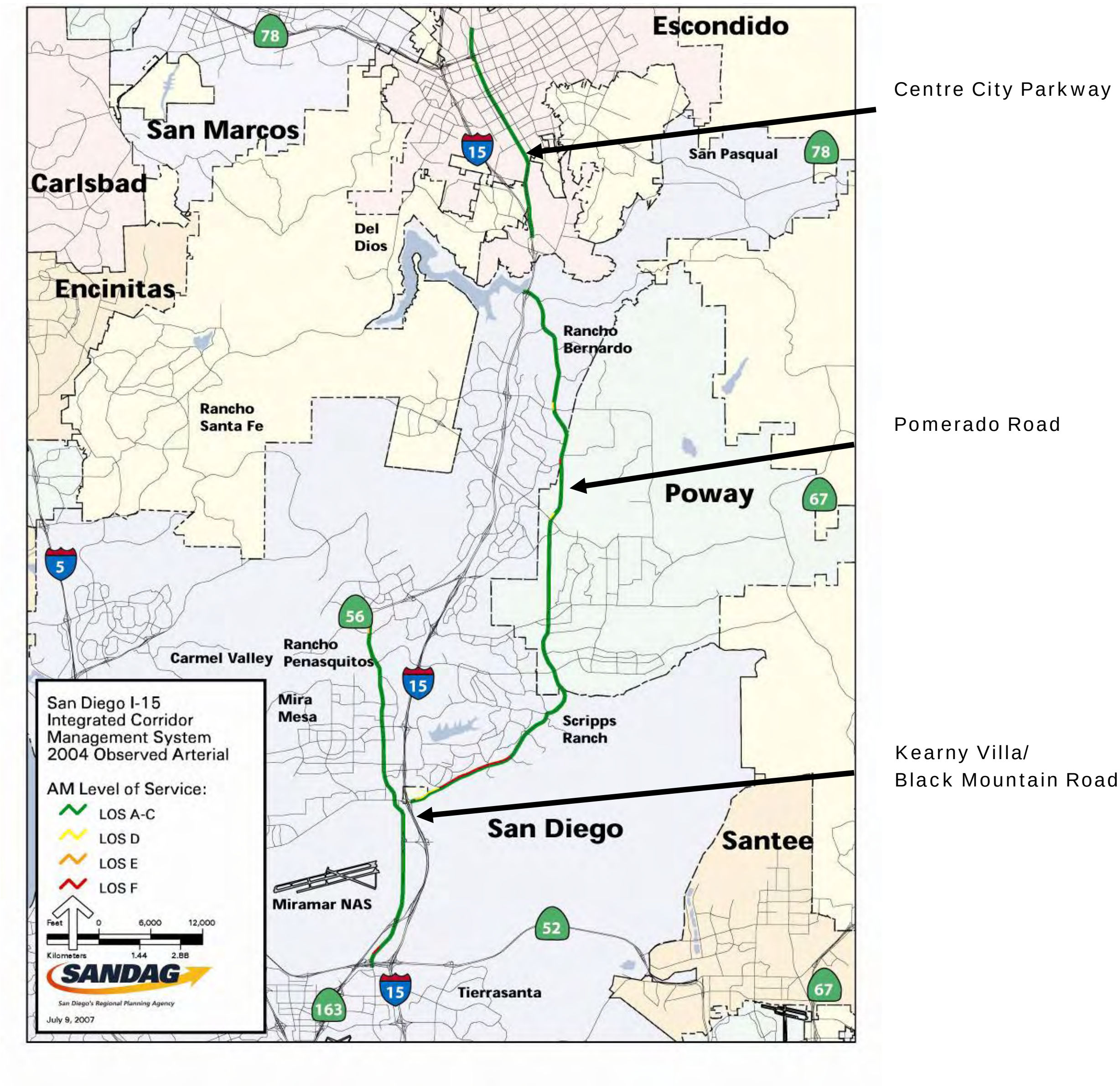
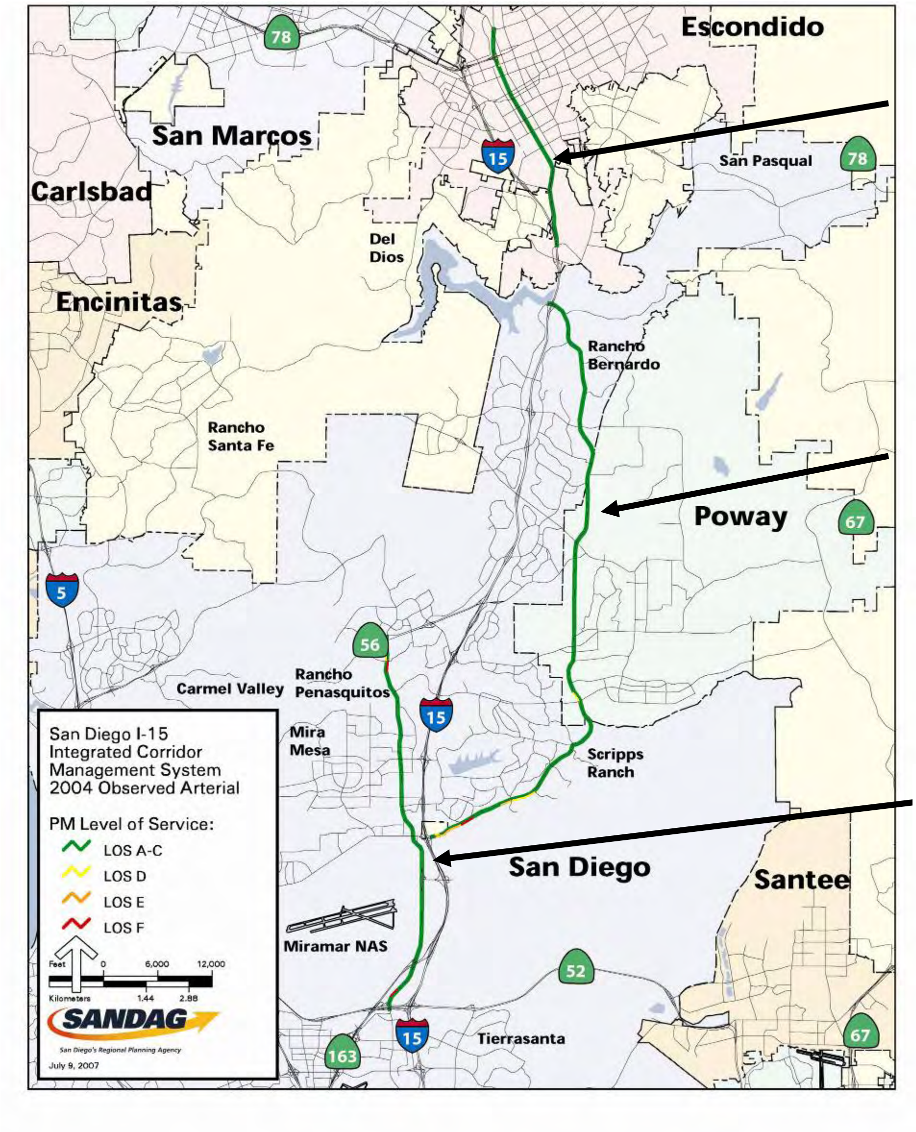


Figure 3-16. LOS for Major Arterials During P.M. Peak Period



Corridor Transit Characteristics

The I-15 corridor is served by several express and local transit routes. MTS operates express service between various points along the corridor and downtown San Diego (Routes 810, 820, 850, and 860 under contract). San Diego Transit (G) operates one primary local service along the corridor between North County Fair in Escondido and downtown San Diego (Routes 20 and 20B). NCTD operates one local service route paralleling the I-15 corridor from Westfield Shoppingtown North County to the Escondido Transit Center (Route 350). NCTD will be opening a new light rail service from the Escondido Transit Center to the Oceanside Transit Center in December 2007. This route will have a service loop for the California State University San Marcos campus, one of the primary trip generators for the I-15 corridor. Future plans in conjunction with the I-15 Managed Lanes project include the use of BRT service from three stations along the corridor – this service will use dedicated access ramps and lanes to provide an equivalent to light rail service in the corridor.

Table 3-4 provides the most recent data (2005) for the I-15 transit corridor routes as provided in the SANDAG Congestion Management Plan. Tables 3-5, 3-6, and 3-7 show average speeds for both Route 20 and Express Routes for MTS for both morning and afternoon peak periods, together with the posted speed limits on the roadway segments covered by each of these routes. This enables the reader to see a more complete picture of the performance of these bus lines relative to the posted speed limits and better understand the level of congestion experienced by public transit. Table 3-8 provides on-time performance data for these routes, where available, from December 2005 to November 2006.

Maps showing the selected corridor routes are shown in Appendix B, Figures B-1 through B-6. Figure B-7 shows the new SPRINTER route.

Table 3-4. I-15 Transit Corridor Existing Conditions (2005)

Route No.	Route Name	Operator	One-way Mileage	Number of Trips				Ridership				Average Weekday Bus Speed
				AM		PM		AM		PM		
				NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
20, 20B	Downtown San Diego/ North County Fair	MTS	32.1	15	15	17	17	595	458	375	495	19.9
810	Escondido/San Diego Express	MTS	32.1	N/A	8	8	N/A	N/A	128	193	N/A	23.9
820	Poway/San Diego Express	MTS	25.8	N/A	4	4	N/A	N/A	89	85	N/A	25.7
850	Rancho Peñasquitos/ San Diego Express	MTS	24.0	N/A	4	4	N/A	N/A	87	92	N/A	26.1
860	Rancho Bernardo/ Carmel Mountain Ranch/ San Diego Express	MTS	28.6	N/A	4	4	N/A	N/A	79	51	N/A	26.5
350	Escondido/ North County Fair	NCTD	5.5	13	13	12	12	143	332	334	222	18.0

Table 3-5. I-15 MTS Express Routes: Average Speeds by Peak Period (2005)

Express Route No.	Roadway Segment	One-way Mileage		Minutes		MPH AM	MPH PM	Speed Limits
		SB	NB	SB	NB			
810	Escondido Local	1.8	1.8	9	7	12.1	15.5	Approximately one-third is 20 mph; two-thirds is 35 mph
810	F'wy (Felicita Park and Ride to Downtown)	28.5	28.7	50	60	34.4	28.5	60 mph
820	Poway Local	4.9	4.9	12	10	24.4	29.3	Approximately three-quarters is 35 mph; one-quarter is 45 mph
820	F'wy (Sabre Springs/ Evening Creek to Downtown)	19.3	19.0	26	25	44.6	46.4	60 mph
850	Rancho Peñasquitos Local	1.9	1.9	7	7	16.2	16.2	35 mph
850	F'wy (Carmel Mtn./Paseo Cardiel to Downtown)	20.2	20.2	27	26	44.8	46.5	60 mph
860	Rancho Bernardo Local	7.5	7.5	22	24	20.5	18.8	Most is 35 mph; approximately one-fifth is 45 mph; one-tenth is 20 mph
860	F'wy (Rancho Carmel/Ted Williams to Downtown)	19.2	19.0	27	26	42.7	44.3	60 mph

Table 3-6. I-15 MTS Route 20 North Bound: Average Speeds by Time of Day (2005)

Roadway Segment	MINUTES				MPH				Speed Limits
	AM	MID	PM	EVE	AM	MID	PM	EVE	
3rd/B to 3rd/Bw'y	4	4	7	4	11.4	11.4	6.5	11.4	20 mph
3rd/Bw'y to 11th/Bw'y	7	8	8	7	3.9	3.4	3.4	3.9	20 mph
11th/Bw'y to Fashion Valley	11	12	13	11	26.9	24.7	22.8	26.9	Mostly 45 mph; approximately 10 percent at 60 mph; 10 percent at 40 mph
Fashion Valley to Kearny Mesa TC	14	13	14	12	25.8	27.8	25.8	30.1	Mostly (freeway) 60 mph; approximately 1.75 miles at 35 mph
Kearny Mesa TC to Mira Mesa/Black Mountain	23	22	25	18	17.6	18.4	16.2	22.5	35 mph
Mira Mesa/Black Mountain to Paseo Montril/Rancho Peñasquitos	8	8	10	7	24.5	24.5	19.6	28.1	Mostly (freeway) 60 mph; Approximately 50 percent at 35 mph
Paseo Montril/Rancho Peñasquitos to Carmel Mountain/Peñasquitos	9	10	10	8	18.6	16.7	16.7	20.9	35 mph
Carmel Mountain/ Peñasquitos to W. Bernardo/Rancho Bernardo	14	16	17	12	21.5	18.8	17.7	25.0	Mostly 35 mph; two-thirdsof a mile along Camino del Norte at 45 mph
W. Bernardo/Rancho Bernardo to North County Fair	12	12	13	10	21.6	21.6	19.9	25.9	Mostly 35 mph; approximately one-half of a mile on freeway at 60 mph; one-mile loop through North County Fair is approximately 15 mph

Table 3-7. I-15 MTS Route 20 South Bound: Average Speeds by Time of Day (2005)

Roadway Segment	MINUTES				MPH				Speed Limits
	AM	MID	PM	EVE	AM	MID	PM	EVE	
North County Fair to W. Bernardo/Rancho Bernardo	20	11	11	11	13.6	24.7	24.7	24.7	Mostly 35 mph; approximately one-half of a mile on freeway at 60 mph; one mile loop through North County Fair is approximately 15 mph
W. Bernardo/Rancho Bernardo Carmel Mountain/ Peñasquitos	18	18	19	17	16.5	16.5	15.7	17.5	Mostly 35 mph; two-thirds of a mile along Camino del Norte at 45 mph
Carmel Mountain/ Peñas-quitos to Paseo Montril/ Rancho Peñasquitos	12	10	9	9	14.0	16.8	18.6	18.6	35 mph
Paseo Montril/Rancho Peñasquitos to Mira Mesa/Black Mountain	11	8	9	8	15.9	21.9	19.5	21.9	Mostly (freeway) 60 mph; approximately 50 percent at 35 mph
Mira Mesa/Black Mountain to Kearny Mesa TC	23	25	25	20	18.0	16.5	16.5	20.6	35 mph
Kearny Mesa TC to Fashion Valley	12	13	15	12	31.9	29.4	25.5	31.9	Mostly (freeway) 60 mph; approximately 1.75 miles at 35 mph
Fashion Valley to 11th/Bw'y	10	9	11	9	28.2	31.3	25.6	31.3	Mostly 45 mph; approximately 10 percent at 60 mph; 10 percent at 40 mph
11th/Bw'y to 3rd/Bw'y	3	3	3	3	7.8	7.8	7.8	7.8	20 mph
3rd /Bw'y to 3rd /B	2	2	3	2	5.9	5.9	3.9	5.9	20 mph

Table 3-8. I-15 Transit Corridor On-Time Performance (Monthly Average in %) – December 2005 - November 2006

Route	12/05	1/06	2/06	3/06	4/06	5/06	6/06	7/06	8/06	9/06	10/06	11/06
20	N/A											
810	86.67		75.00	86.67		75.00	95.83		100.00	71.43		95.83
820	81.82		66.67	91.67		50.00	76.92		100.00	90.91		66.67
850	75.00		100.00	100.00		75.00	100.00		100.00	100.00		87.50
860	75.00		100.00	100.00		100.00	100.00		100.00	92.31		91.67
350												

Routine Corridor Operations

Incident Management. Incident management is handled by the CHP for all freeways and state highways in San Diego. For the I-15 corridor, this includes I-15, SR 163, SR 52, SR 56 and SR 78. 911 calls go to the CHP Border Communications Center (BCC) co-located with Caltrans District 11 at the regional TMC in Kearny Mesa. When an accident or hazard is reported to a CHP call taker, an incident record is created in the CHP computer-aided dispatch (CAD) system and passed to a dispatcher who is in radio contact with CHP traffic officers (TOs) and field supervisors. Depending on the nature of the reported incident, the dispatcher will use a “hot line” to contact other first responders including fire/rescue and paramedics. A standard medical response to the scene of an injury accident is one paramedic-capable fire apparatus and one ambulance for transport. If the accident is severe enough to cause a major traffic backup, traffic management team (TMT) vehicles with sign boards are dispatched to the end of the queue to prevent secondary accidents and to provide motorists advance notice before major freeway interchanges. Only rarely is traffic diverted by explicit action. Incident data in the Advanced Traffic Management System (ATMS) 2005 is passed to the regional IMTMS system, which, in turn, is the portal for the 511 Internet Service Provider (ISP).

SAFE Call Boxes. The San Diego Service Authority for Freeway Emergencies (SAFE) operates call boxes at 1/2-mile intervals along the full extent of the I-15 corridor. The call boxes are equipped with high-power cellular radios and optimized antennas to provide a higher level of coverage than might be possible with portable cell phones at any given location. When a motorist pushes the call button, the call box automatically dials the privately operated SAFE answering center. Although motorists are more likely to use cell phones to report incidents than a call box, the call boxes still get substantial usage for variety of reasons. The call boxes are self-powered by solar panels and automatically report their position to the answering center. If a caller needs to report an emergency situation, the SAFE answering center forwards the call to the CHP where it is then handled like a cellular 911 call.

Freeway Service Patrol. The Freeway Service Patrol (FSP) helps get stranded motorists back on the highway during morning and afternoon rush hours. FSP drivers help stranded motorists with a gallon of gas, a “jump-start,” water for the radiator, and will even change a flat tire.

Since many traffic tie-ups are caused by vehicle breakdowns, FSP patrols assist motorists or remove vehicles from the region’s most congested freeways as rapidly as possible. Getting these stranded motorists and disabled vehicles on their way helps to improve traffic flow. In addition, FSP drivers are frequently the first on the scene to assist with accidents. If the FSP driver can’t get the vehicle running in a few minutes, they tow the vehicle to a safe, pre-determined drop location.

Using a fleet of 25 tow trucks and 7 light-duty pickup trucks, FSP drivers have assisted more than 50,000 motorists during the past year. The FSP trucks patrol approximately 225 miles of San Diego freeways, including sections of Interstates 5, 8, 15, and 805, and State Routes 52, 54, 56, 78, 94, 125, 163, and 905. The FSP operates during weekday rush hours from 5:30 to 9:30 a.m. and from 3 to 7 p.m., excluding holidays. I-15 corridor beats include 5, 6, 12, and 13 as shown in Figure C-1 in Appendix C.

This free service is provided by SANDAG, Caltrans, and the CHP. A portion of the region’s motor vehicle registration fees that support operation of the San Diego SAFE helps fund the FSP in San Diego County. FSP vehicles are dispatched by CHP from the regional TMC in Kearny Mesa. Specially designated CHP traffic officers act as FSP field supervisors.

Freeway Operations. Caltrans controls freeway operations with TMC operators, operations dispatchers, and maintenance dispatchers. These personnel operate three major systems within the TMC: the ATMS 2005 automated freeway management system; the Ramp Meter Information System (RMIS); and the Reversible-Lane Control System (RLCS). ATMS 2005 allows operators to: see traffic congestion in real time; operate and monitor cameras and CMSs; create freeway events including incidents, special events, and emergency closures; and activate event response plans according to pre-stored severity logic. The ATMS 2005 Expert System provides operators with suggested CMS messages and locations where to display messages and a list of operator actions according to the incident severity.

Operators can accept the recommended signing strategy or manually override the recommendation as appropriate. The RMIS system operates similarly to a traffic signal control system by allowing traffic engineers to monitor ramp operation, build timing plans, and upload timing plans to individual or grouped controllers. Real-time ramp data is collected and stored in real-time and, in parallel, sent to the PeMS data archival system. The RLCS operates safety equipment on both ends of the I-15 corridor 8-mile, segregated, reversible-lane facility. This safety equipment is monitored by stations on either end of the facility and includes barrier gates, pop-up barriers, and CMSs. The local control stations are connected via fiber communications to the TMC in Kearny Mesa for monitoring and remote activation. Caltrans' personnel reverse the lanes according to set schedules during weekdays and set the lanes for northbound operation on weekends. Radio dispatchers control TMT vehicles and other operations and maintenance equipment that may be needed for incident recovery operations.

Arterial Operations. Arterial operations are conducted by the cities, the County, and Caltrans to operate their installed traffic signal control systems (TSCS). San Diego County enjoys the unique advantage of having all jurisdictions in the region operating their signals using the QuicNet 4 TSCS. Caltrans operates traffic signals at all on- and off-ramps in coordination with local jurisdiction signals located near freeway interchanges. These are operated separately from the ramp meter system. QuicNet 4 gives traffic engineers the capability to create and upload timing plans and to monitor specific intersections in detail, including signal phasing, controller status, timing plans loaded, and timing plan in use. The Regional Arterial Management System (RAMS) is a regional ITS project that is currently upgrading controller software to allow inter-jurisdictional coordination of timing plans and the ability of jurisdictions to observe timing plans of adjacent jurisdictions and the enhanced system has been named QuicNet 4+ to indicate that it is based on the QuicNet 4 system with added features and capabilities. This project will also allow joint control of timing plans subject to pre-arranged bi-lateral and/or regional agreements. RAMS is being implemented in three phases, as follows:

- Jul 2008: Pilot Implementation Phase (regionalization of QuicNET 4+ with Caltrans, San Diego, and Chula Vista)
- Aug 2009: Integration of QuicNET 4+ into the IMTMS environment
- Nov 2009: Full Implementation Phase (regionalization of QuicNET 4+)

The RAMS project is also creating a regional database server that will feed real-time data to the IMTMS network and provides the platform from which to build and disseminate regional timing plans that can be used during major events.

Transit Operations. Transit bus systems are controlled from three separate facilities using the newly deployed Regional Transit Management System (RTMS). These facilities are located in downtown San Diego for San Diego Transit bus routes and in Escondido (East Dispatch) and Oceanside (West Dispatch) for North County transit buses. The light rail system operated by the San Diego Trolley Corporation does not operate within the I-15 corridor, but will interconnect with the future BRT systems operated in the corridor. RTMS allows dispatchers to monitor bus routes in real-time, including current bus position and schedule adherence. Data is sent from buses to dispatch to monitor key bus events, passenger counts, and real-time global positioning system (GPS). If a driver encounters an emergency situation, a panic button can be activated as a silent alarm. This activation provides dispatchers an "open mike" on the radio system to monitor events on the bus and more frequent updating of bus positions on the RTMS displays. The IMTMS system provides freeway incident data to RTMS in real-time and collects key bus information for dissemination to other regional agencies and the 511 system.

Traveler Information. SANDAG formally activated the regional 511 system in February 2007. This system allows landline and cellular callers to receive tailored travel information by route and time of day. The 511 system has a "mobile callbox" feature that allows the caller to directly connect to the San Diego SAFE call answering center that was described previously in this section under "SAFE Call Boxes." There is also a public Web page for the 511 ATIS at: http://www.511sd.com and, in particular, for the mobile call box feature at http://www.sdcallbox.org/. By calling 511 on his/her cellular phone and saying "Roadside Assistance," a motorist can directly access the Call Box Answer Center, which handles such calls as call box calls were handled before this feature became available, including any necessary transfers to the California Highway Patrol, American Automobile Association, Manufacturer Help Line, or other sources of assistance.

In its first two days of operation, the 511 system received 64,000 Web page hits and 10,000 calls. The 511 program also provides information on the regional RideLink program, regional transit systems and has a trip planning feature.

3.4 Existing Network-Based Transportation Management and ITS Assets

Guidance This section inventories the I-15 corridor existing network-specific transportation management and ITS-based assets. The section identifies each asset and provides a brief description that explains the attributes of each asset.

The San Diego region has invested in a significant ITS infrastructure made up of communications and field devices that support a number of relatively new management systems for freeway, arterial, and transit operations. This infrastructure is being expanded and improved to provide data along the numerous “gaps” where the required supporting infrastructure is currently missing. The existing and planned supporting infrastructure is briefly summarized in Table 3-9 below. For each system, the table summarizes some of the basic functional services and major types of data from the system and the types of agencies likely to share these functions and data.

Table 3-9. Brief Summary of ITS Systems

Systems	Description	Basic Functional Services/Data Types	Agency Types
IMTMS Network	Regional communications network, including leased and agency-owned communications resources that form the backbone for the exchange of information between ITS systems in the region.	Services– System integration, security, communications, regional network management, etc. Data– All types of data, including both data exclusive to a particular project and data shared between multiple ITS projects.	All agencies
Freeway Management System	ATMS 2005 deployed by Caltrans District 11; it is the core of freeway management, including the control of cameras, CMSs, and vehicle detection sensors. RMIS controls ramp metering signals.	Services– Field device (cameras, CMSs, vehicle detection stations) control/management, incident/event management, incident response, resource management, etc. Data– Freeway speeds, incidents, video, sign messages, etc.	Caltrans, CHP, cities, transit, and emergency services

Table 3-9. Brief Summary of ITS Systems (cont'd)

Systems	Description	Basic Functional Services/Data Types	Agency Types
Managed Lanes Control System	Provides control and status displays for reversible lanes from SR 163/ I-15 merge north to Ted Williams Parkway and for Managed Lanes from Ted Williams Parkway north to SR 78 in Escondido. There are two reversible lanes with a single northbound and southbound entry point protected by barrier gates, pop-ups and CMSs. There will be four managed lanes with multiple entry/exit points and reconfigurable lane controls.	Control reversible lanes and associated safety devices. Display status of safety devices. Display status of managed lanes.	Caltrans
Regional Arterial Management System	Comprised of two basic tiers: 1. Inter-jurisdictional signal coordination 2. Freeway and arterial operational coordination Tier 1 is in evaluation phase with three agencies and will be expanded with software enhancements to the region's QuicNet 4 signal control system. There will be a regional server to provide systemwide real-time data for IMTMS. Tier 2 provides a browser-based integrated workstation.	Services– Signal timing/control, interjurisdictional signal timing, regional timing plan implementation, field device (cameras, CMSs, vehicle detection stations) control/ management, incident/event management, incident response, resource management, etc. Data– Signal status, timing, local incidents/ events, arterial cameras, vehicle sensors, and message signs.	Cities, Caltrans, local law enforcement, and transit agencies
Transit Management Systems	Comprised of the Regional Transit Management System (RTMS) deployed by Metropolitan Transit System and North County Transit District for purposes of fleet management, enhanced schedule performance, improved fare payment, and improved interagency coordination.	Services– Fleet management, vehicle tracking, emergency alerts, transit schedule and arrival information, transit traveler information, automated fare payment, etc. Data– Transit vehicle locations, vehicle status, schedule adherence, real-time information displays at stops, dispatch/ vehicle text messages, transit incidents, etc.	Transit agencies, some local cities, and emergency services during safety related incidents

Table 3-9. Brief Summary of ITS Systems (cont'd)

Systems	Description	Basic Functional Services/Data Types	Agency Types
Traveler Information Management System	SANDAG has contracted for a regional 511 system provided by a single information service provider	Services– Portal for public sector transportation information on IMTMS network to private sector information providers, data translation, data filtering, etc. Data– Freeway/roadway speeds, incidents, travel times, announcements, transit schedule information, and next stop arrival, etc.	Private sector traveler information providers

Transportation Management Center (TMC)

The San Diego regional TMC is jointly operated by Caltrans and the CHP and is located near the southern boundary of the I-15 corridor. The TMC is the hub for freeway and state highway arterial operations and acts as the BCC for the CHP. The region's FSP is operated from this facility by CHP dispatchers. CHP call takers answer emergency and service calls, and dispatchers send appropriate first responders to the scene of an incident and maintain radio communications with personnel on scene. Caltrans' traffic operations and maintenance radio operators control their assigned mobile resources for incident management and recovery. The TMC is the primary hub for the Caltrans' Traffic Operations System Network (TOSNET) that links traffic control and display devices from the field to the TMC.

Regional Communications

The IMTMS network is comprised of public (leased) and private (agency) communications resources. Early on, the majority of the communications infrastructure between the major modal systems will be leased, and this will be replaced by agency communications as they continue to link together. Field devices are linked to their appropriate management systems most often through agency-owned communications, e.g., agency-owned fiber networks, but some field communications are leased from telephone common carriers (Telcos). Major elements of the communications resources in the region will ultimately include agency fiber networks owned by Caltrans, the City of San Diego, SANDAG, MTS, and NCTD. The communications plan, which will identify gaps in the current communication networks and the most cost-effective strategies to fill these gaps, will be complete in April 2008. Approximately 90 percent of the regional communication networks for the I-15 corridor will be completed by 2012.

Freeway

The I-15 freeway network has significant physical and systems management infrastructure. The freeway network includes communications and systems to support management functionality. The Caltrans' District 11 TMC is the central management location for all monitoring and data collection on the freeway.

The I-15 Reversible Lane facility has remotely controlled pop-ups and safety gates on each entry/exit point (northbound and southbound), 12 CMSs, and a CCTV surveillance system utilizing 15 cameras that are shared with the mainline facility. The facility is controlled by a Reversible Lane Control System (RCLS), which resides at the TMC.

The I-15 mainline facility is equipped with:

- 30 vehicle loop detector stations;
- 15 cameras;
- 62 metered ramps;
- CMSs; and
- Several radar detectors used to supplement loop data.

The Caltrans' ATMS 2005 is the core system for managing the San Diego freeway system and is being enhanced with intermodal capabilities to display arterial and transit data. The functional capabilities of ATMS 2005 include:

- Congestion Management. The front end processor (FEP) manages the Caltrans' District 11 TOSNET multi-drop serial communications to traffic monitoring stations (TMS). The FEP collects real-time traffic data from embedded loop detectors, allows central control of the TMS elements, and passes data to the San Diego ramp metering information system (SD RMIS), ATMS 2005, and PeMS through a device called the FEP repeater.

  Volume, occupancy, and speed are collected every 30 seconds and are output from the data acquisition process to other ATMS processes for the graphical user interface (GUI), incident detection, and data storage. The data storage process is responsible for putting real-time data into Oracle database tables for historical traffic analysis and system event logging. The incident detection process continuously scans real-time surveillance data and compares it to pre-stored, location-specific parameters as an input to the all-purpose incident detection (APID) algorithm. APID will detect potential incidents and notify the operator through an alert on the GUI. The operator verifies the incident through CCTV or other means and enters incident details through a dialogue window on the GUI.

  Congestion management also supports a relatively new capability to compute estimated travel times for posting to CMSs in the San Diego region. These travel times are continuously updated for travel segments from the CMS location to selected points along the freeway route.

- Event Management. Incidents are detected as described above or by 911 calls to the CHP and responded to by the event management process. An expert system is connected to Oracle databases that are used to derive automatic response plans for TMC operators. The expert system "knows" about the highway network configuration by reading the Oracle highway configuration table and creating its own "node-link" representation of the actual roadway network. Likewise, the expert system is connected to the operator GUI. This allows the operator to view certain outputs of the expert system or the system engineer to reconfigure the expert system as necessary. The primary purpose of the expert system is to generate a CMS signing strategy in response to an incident in the system. The expert system also will generate a set of recommended operator actions for the type of incident input.

- CMSs and CCTV Device Management. Once the system determines the need to activate a sign, the ATMS CMS sign manager becomes responsible for communicating with CMSs in the field. An operator can also manually activate one or more signs. ATMS 2005 also allows the operator to place a broadcast message on every CMS in the region simultaneously for events such as AMBER Alerts. CCTV video imagery is received from the Caltrans TOSNET, where it can be switched to various display destinations, including NTSC analog monitors, display windows on the operator workstation, or to the TMC graphics walls. The operator directly controls camera functions through data commands sent to the selected camera control receiver in the field.

Arterial

The Regional Arterial Management System (RAMS) was designed to leverage the fact that every arterial control system in San Diego County uses a common traffic signal control architecture, known as QuicNet 4. This system currently is being enhanced to allow for coordinated multi-jurisdictional operations by implementing regional intersection databases and improved security for multi-agency access by pre-agreed privileges. Thirteen cities in the region, including all those in the proposed corridor, will use QuicNet 5, the enhanced system. A regional server will reside in the Caltrans' TMC, which simplifies integration between freeway and arterial management systems. In effect, the regional RAMS network is a subset of the IMTMS network, allowing only selected data to pass outside for regional dissemination.

Transit

San Diego's RTMS system is a multi-agency transit management system with a centralized implementation for voice/data communications, automatic vehicle location, and traveler information functions. The system provides for the capture of performance data on scheduled arrivals and departures and includes ridership data collected through automatic passenger counters. The RTMS system architecture allows NCTD and MTS to share dispatch information across multiple dispatch sites and to serve transit riders from a single customer service site. The RTMS allows both NCTD and MTS to share repeater sites, system servers, and traveler information functions, while providing for a number of external interfaces to regional non-transit agencies and the SANDAG 511 program. Data is currently collected in the system through two- to three-minute polling cycles for vehicle status; however, the average cycle is lower due to the system design, which includes transmittal of data at specified stops and as part of other message sets. Transit information from the RTMS is provided in real-time to the regional IMTMS system, while IMTMS events are directly imported into the RTMS CAD system. The seamlessness of NCTD and MTS transit management is important to the proposed I-15 corridor since the two service providers share transit centers at the North County Fair mall in Escondido.

Intermodal Transportation Management System (IMTMS)

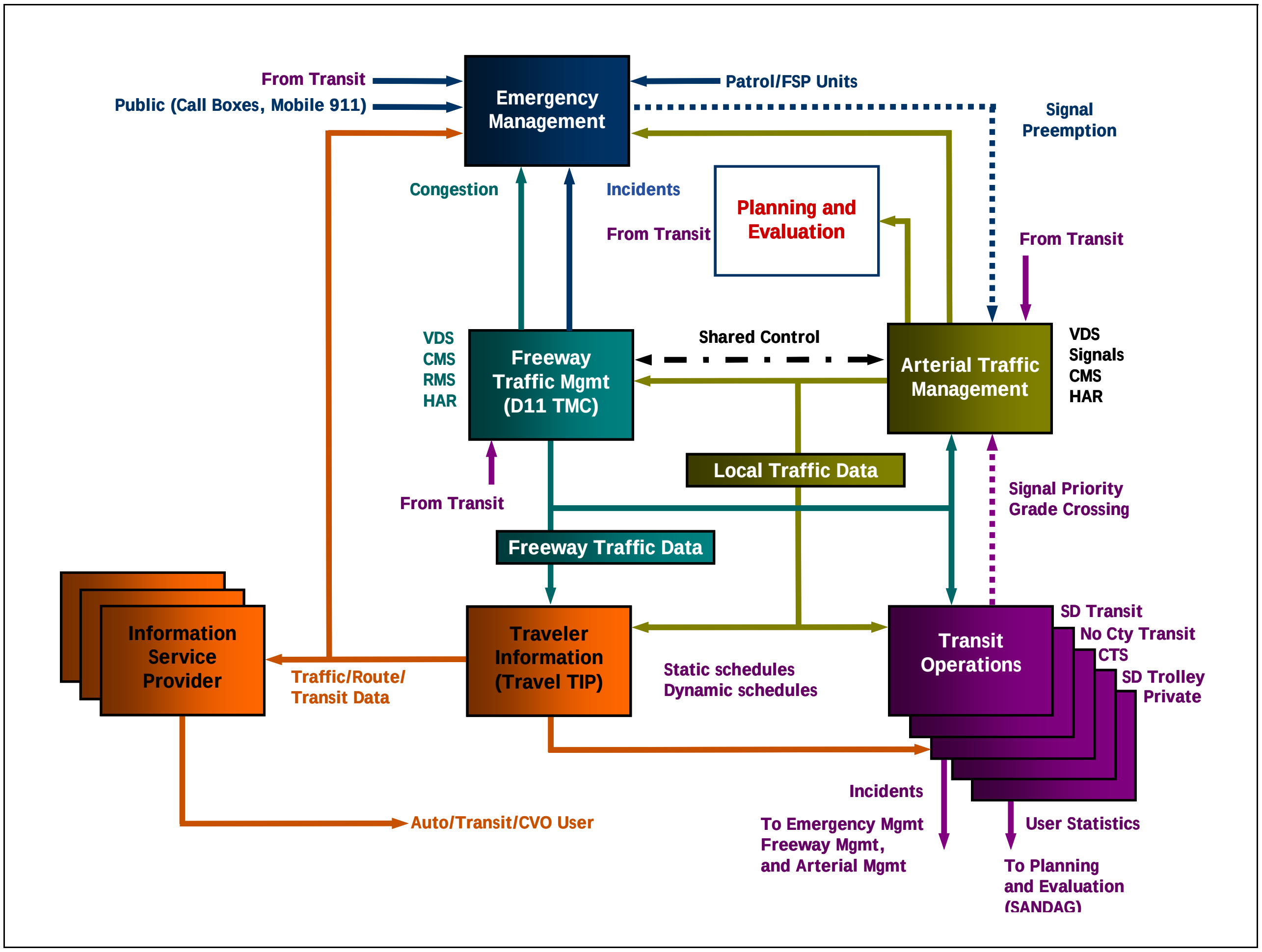
IMTMS refers to the San Diego region's "system of systems." In layman's terms, IMTMS is the "glue" that ties together the management systems of the individual modes and allows for the intermodal sharing of data and functional capabilities. For example, IMTMS is what allows a transit agency to receive information on traffic conditions, and IMTMS is the system that allows cities to share event management information, as well as traffic video and camera control, with other cities and Caltrans. IMTMS is the critical system concept in the San Diego regional ITS architecture.

The IMTMS network refers both to the communications network across which each of the individual management systems communicates to share information and functional services, as well as the interfaces, equipment, and software that allow this communication to occur. Figure 3-17 displays a high-level logical architecture of the IMTMS system.

Communications across the IMTMS network occurs at two basic levels:

- Communications between agencies within a system – The IMTMS network is utilized to link together various agencies utilizing a single system. For example, several cities will utilize the IMTMS network for communicating information internal to the RAMS. A specific example is when one agency is sharing signal timing coordination data with another agency. This coordination data travels between the agencies in a format specific to RAMS and is not available to the broader users of the IMTMS network. At this level, the IMTMS network lets agencies throughout the region make use of a common integrated management system.
- Communications between different modal management systems – The IMTMS network is utilized to communicate information and share functionality between modal management systems. For example, information may travel from the TMS to the Freeway Management System or vice versa. Data at this level uses the regionally adopted XML data standards consistent with those used elsewhere in Southern California. This means that systems in the region can share information and functionality with other management systems in Southern California. The IMTMS network also provides data to a SANDAG-operated information "portal" known as the Advanced Traveler Information Management System (ATIMS) server. ATIMS is a data server dedicated for SANDAG's 511 private sector provider for information such as freeway speeds, lane closures, transit schedules, bus arrival times, and regional traffic and transit incidents.

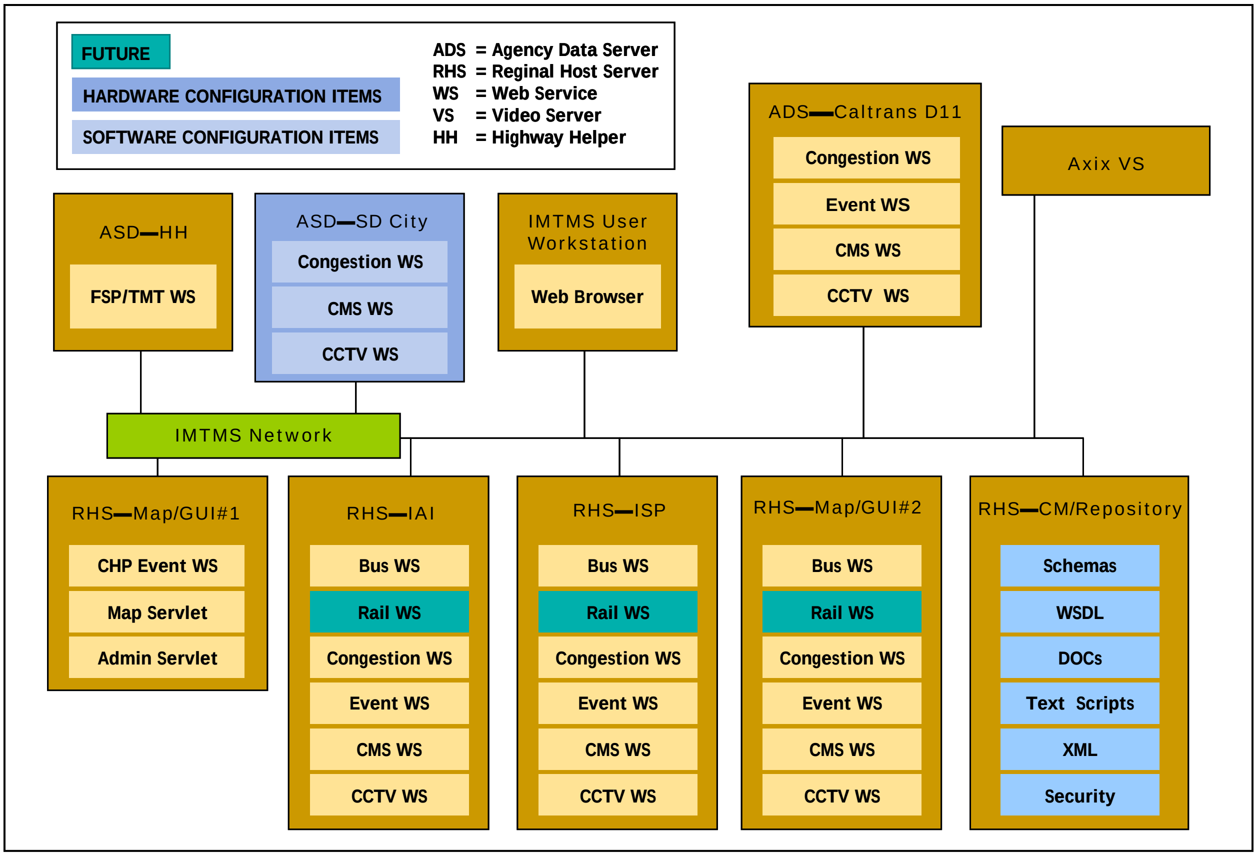
Figure 3-17. San Diego IMTMS Logical Architecture



The IMTMS has interfaces to ATMS, RTMS, and the CHP and will soon have an interface to RAMS. IMTMS is the primary means of sharing data with regional agencies in the corridor. Each participating data provider in IMTMS (for this corridor: Caltrans ATMS, Caltrans Signal Branch, the CHP, the cities of San Diego, Poway, and Escondido, NCTD, and MTS) will have either a direct or indirect connection to the IMTMS network via an agency data server (ADS) as shown in Figure 3-18. The ADS takes legacy server data and converts it to a standardized XML format before passing it on to a set of Web servers. Collectively, these Web servers (shown in Figure 3-18) provide an XML-based Web services platform to disseminate intermodal data via either HTML map pages for browser display or as a direct XML data stream for third-party applications.

One (or more) map servers provide HTML-based, interactive maps to browser-based Regional Integrated Workstations (RIWS). One (or more) regional Web servers provide real-time field element data to populate the map. An Intermodal Agency Integration (IAI) server provides an XML data stream for third-party applications. One (or more) ISP servers provide IMTMS data to SANDAG's contracted 511 provider for ATIS applications. Browser-based workstations needing no special software or installation effort are used as RIWS to provide real-time, intermodal data to any number of potential client users from 911 dispatch centers to city traffic engineers and transit managers. Thus, the entire region will have a common operating picture on the state of the all-mode, all-road transportation network.

Figure 3-18. Physical Deployment of IMTMS Elements



The IMTMS network is comprised of:

- Physical Communications– Overall, fiber optic and other high-capacity communications networks are being deployed by Caltrans, cities, and transit agencies, and leased communications are used to reach locations where agency-owned communications are not practical or available. Caltrans District 11, including its TOSNET, uses a combination of fiber, leased-lines, DSL, twisted pair copper, wireless, and others in establishing communications with field elements to provide data and video. Caltrans' goal is to have a fiber network backbone system that supports all communications; however, due to the high cost of fiber installation within the existing freeway roadbed, the process is timely and Caltrans expects to continue to use all forms of communication links; the City of San Diego uses its own fiber and copper twisted pair communications networks for most of its traffic signal communications; and the City uses telephone lines to communicate with particular field masters. There are no immediate plans to convert everything to the city-owned fiber network due, again, to the high cost of fiber installation. Nonetheless, there is ongoing discussion with the City's Communications Division to collaborate on using their wireless networks to communicate with the field masters in order to eliminate the telephone lines. MTS uses its own fiber optic network together with a private wireless LAN, T-1, and frame relay for different components of its communications network. NCTD uses its own fiber optic network, as well as a wireless mesh network. Over time, it is anticipated that the balance of connections that comprise the IMTMS network will shift from largely leased communications to more agency-owned communications.

- Integration/Management Software and Systems– Based on a standard XML-based data architecture and industry-standard Web services, IMTMS delivers a suite of regional services that can be easily expanded to new clients and extended with new functionality. Because IMTMS is browser-based, the only equipment needed for deployment is a standard PC running either Internet Explorer or commonly used alternative internet browsers, as well as a local connection to the Internet.

Advanced Traveler Information System/511

SANDAG has deployed a regional 511 system using the nationally recognized three-digit (511) telephone number. 511 also includes an Internet site (http://www.sd511.com) providing real-time traffic conditions and travel times for freeway users. The 511 system will include real-time transit information, such as next transit arrival times for the entire fleet of publicly owned and operated transit services, including buses, light rail (San Diego Trolley and the new SPRINTER service in North County), and the COASTER commuter rail. The system will receive its data from the IMTMS network, which provides for the modal integration of data. SANDAG 511 will also include the dissemination of real-time congestion changes on the I-15 Reversible Lane and Managed Lane facilities, as well as travel-time estimates for both main line and managed lane facilities.

3.5 Proposed Near-Term Network Improvements

Guidance This section captures any transportation management and ITS improvements that are likely to be implemented on networks within the I-15 corridor within the next five years. These improvements may factor into the development of an ICMS for the I-15 corridor. Each improvement is identified, and any significant assets are also included.

The current Transportation Improvement Plan (TIP) identifies an array of improvements for the region. Those improvements located within the I-15 corridor are listed below and need to be accounted for in any subsequent requirements analysis and I-15 ICMS design. The improvements are categorized by network and responsible agency. Dates in parentheses indicate current projected completion dates.

Freeway – Caltrans

- New fiber optic network installed along the I-15 corridor in conjunction with Managed Lanes construction project, which is now operational.
- Upgrades to the freeway management system surveillance capabilities that include more detectors and full-coverage CCTV. This is being implemented in two phases with Phase 1 just completed in late 2008 and Phase 2 scheduled for completion in 2012.
- Revised and upgraded incident management procedures for automated detection and response (including expanded freeway service patrols). This is being implemented in two phases with Phase 1 just completed in late 2008 and Phase 2 scheduled for completion in 2012.
- Dynamic Message Signs (DMS) at additional locations along the freeway. This is being implemented in two phases with the following projected completion dates: 2010 and 2012.
- Upgrading of the I-15 Reversible Lane Control System (RLCS) on the south segment of the I-15 corridor. This freeway network improvement was completed in May 2007.
- Implementation of Managed Lanes along the I-15 corridor with reconfigurable lanes and multiple exit/entry points as depicted in Figures 3-19 through 3-22. The Managed Lanes are being implemented in three phases corresponding to plans for construction along three roadway segments:
  - Middle Segment (July 2008 – January 2009 in a phased implementation)
  - North Segment (January 2012)
  - South Segment (January 2013)

Arterials – Cities of San Diego, Poway, and Escondido

- Implementation of QuicNet 4+ traffic signal control system for inter-jurisdictional signal coordination along major arterials in the corridor. Completion dates for the implementation of QuicNet 4+ corresponds to the implementation dates of RAMS, which is provided in Section 3.3.
- Implementation of IMTMS Regional Integrated Work Station (RIWS) in city traffic engineering centers and public safety dispatch centers is currently anticipated to be deployed in 2009 (See Section 3.9).
- New count stations along major arterials in the I-15 corridor as shown in Table 3-10. This has been discussed previously in Section 3.3 under Corridor Arterial Characteristics, which stated that implementation for this equipment is not expected to be implemented before Phase III of the ICM Program Demonstration currently scheduled for 2009.

Table 3-10. Proposed New Count Stations in the I-15 Corridor

Arterial	Location or Cross Street	Controller	Coordinated Signal System
Poway			
Pomerado	Scripps-Poway Parkway	170	Yes
Pomerado	Between Scripps-Poway Parkway and Poway Road	170	Yes
Pomerado	Between Poway Road and Ted Williams Parkway	170	Yes
Pomerado	Between Ted Williams Parkway and Camino del Norte	170	Yes
Pomerado	Camino del Norte	170	Yes
Scripps-Poway Parkway	Pomerado Road	170	Yes
Poway Road	JEO Pomerado	170	Yes
Twin Peaks Road	JEO Pomerado	170	Yes
San Diego			
Pomerado Road	@ Pas Del Morano Norte	170	Yes
Pomerado Road	@ Bernardo Heights Parkway	170	Yes
Pomerado Road	@ Springs Canyon Road	170	No
Pomerado Road	@ Avenida Magnifica	170	No
Black Mountain Road	@ Park Village Road	170	Yes
Black Mountain Road	@ Mercy Road	170	Yes
Black Mountain Road	@ Capricorn Way	170	Yes
Black Mountain Road	@ Gold Coast Drive	170	Yes
Black Mountain Road	@ Westview Parkway	170	Yes
Kearny Villa Road	JNO Miramar Way*	None	No

Table 3-10. Proposed New Count Stations in the I-15 Corridor (cont'd)

Arterial	Location or Cross Street	Controller	Coordinated Signal System
San Diego (cont'd)			
Kearny Villa Road	JSO Miramar Way*	None	No
Rancho Bernardo Road	@ Acena Drive	170	No
Camino del Norte	@ Paseo Lucido	170	No
Carmel Mountain Road	@ Highland Ranch Road	170	Yes
Rancho Carmel Drive	@ Windcrest Lane	170	Yes
Rancho Peñasquitos Boulevard	@ Via del Sud	170	Yes
Ted Williams Parkway	@ Shoal Creek Road	170	No
Poway Road	@ Creek View Drive	170	Yes
Scripps-Poway Parkway	@ Spring Canyon Road	170	Yes
Bernardo Center Drive	@ Cloudcrest Drive	170	Yes
Bernardo Center Drive	@ Lomica Drive	170	Yes

**Separate count station needed at this location*

Bus – MTS and NCTD

- New BRT service along the I-15 corridor as part of the Managed Lanes project (see Figures 3-19 to 3-22 and the schedule for the Managed Lanes implementation on Page 3-43.)
- In-terminal/wayside system (e.g., next bus arrival/route number) at each bus stop: Scheduled for implementation in 2012
- Improved public address systems for in-vehicle annunciation and in-terminal announcements: Currently under negotiation regarding implementation; no timeframe has been defined yet
- Smart card system on the buses and at the train stations for transit fares (joint bus/rail transit improvement that will eventually cover the entire region); This is the Compass Card system, which will be deployed in a phased implementation between 2007 and 2009 (Specific phased implementation dates are provided in Section 3.9 Potential for an Integrated Corridor Management System in sub-section *Integration of Transit, Road Pricing, and Parking Payment Systems* on Page 3-63.)

Figure 3-19. Managed Lanes Configuration – Junction SR 163 to Mira Mesa Boulevard

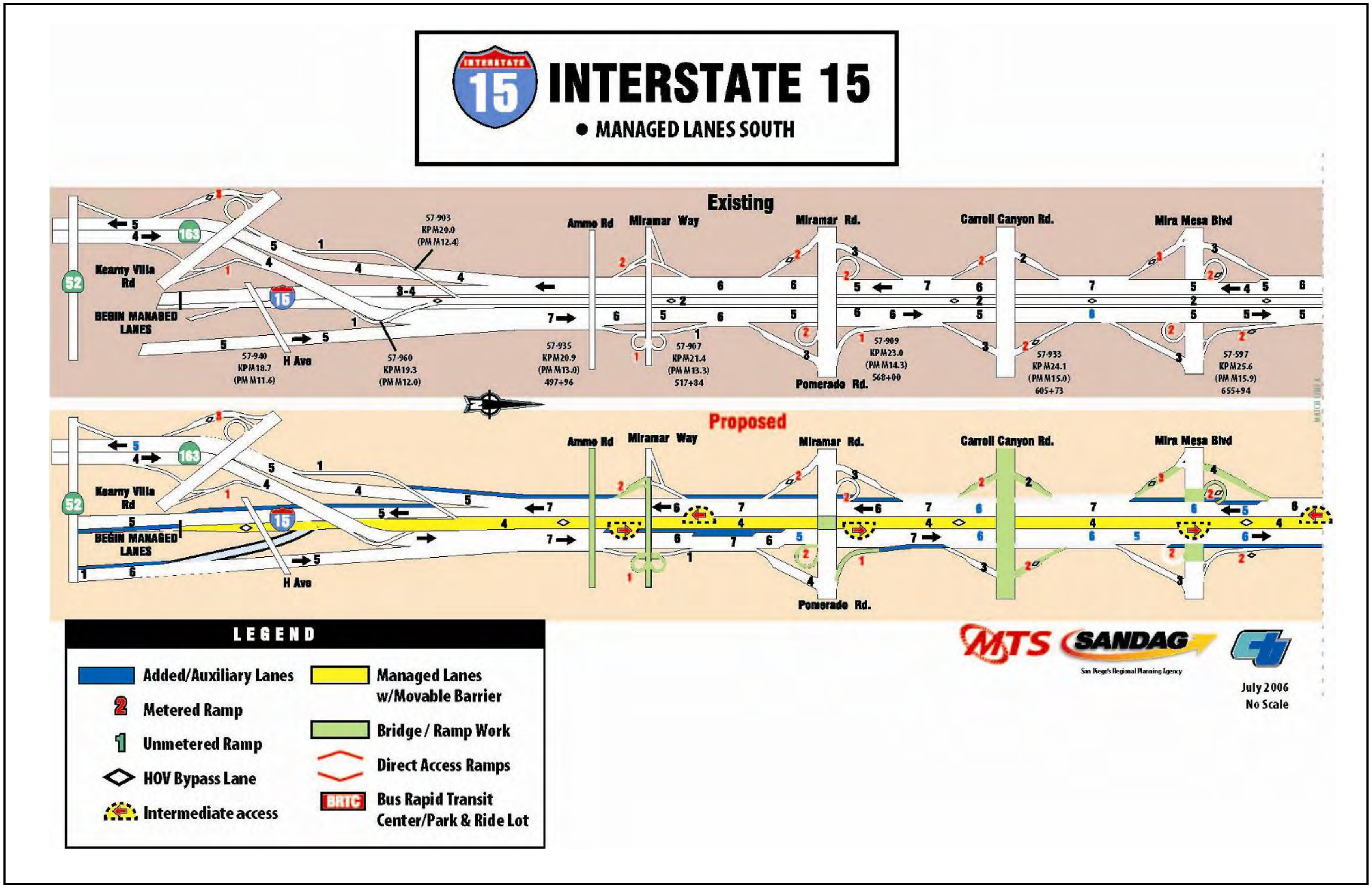


Figure 3-20. Managed Lanes Configuration – Scripps Poway Parkway to Camino del Norte

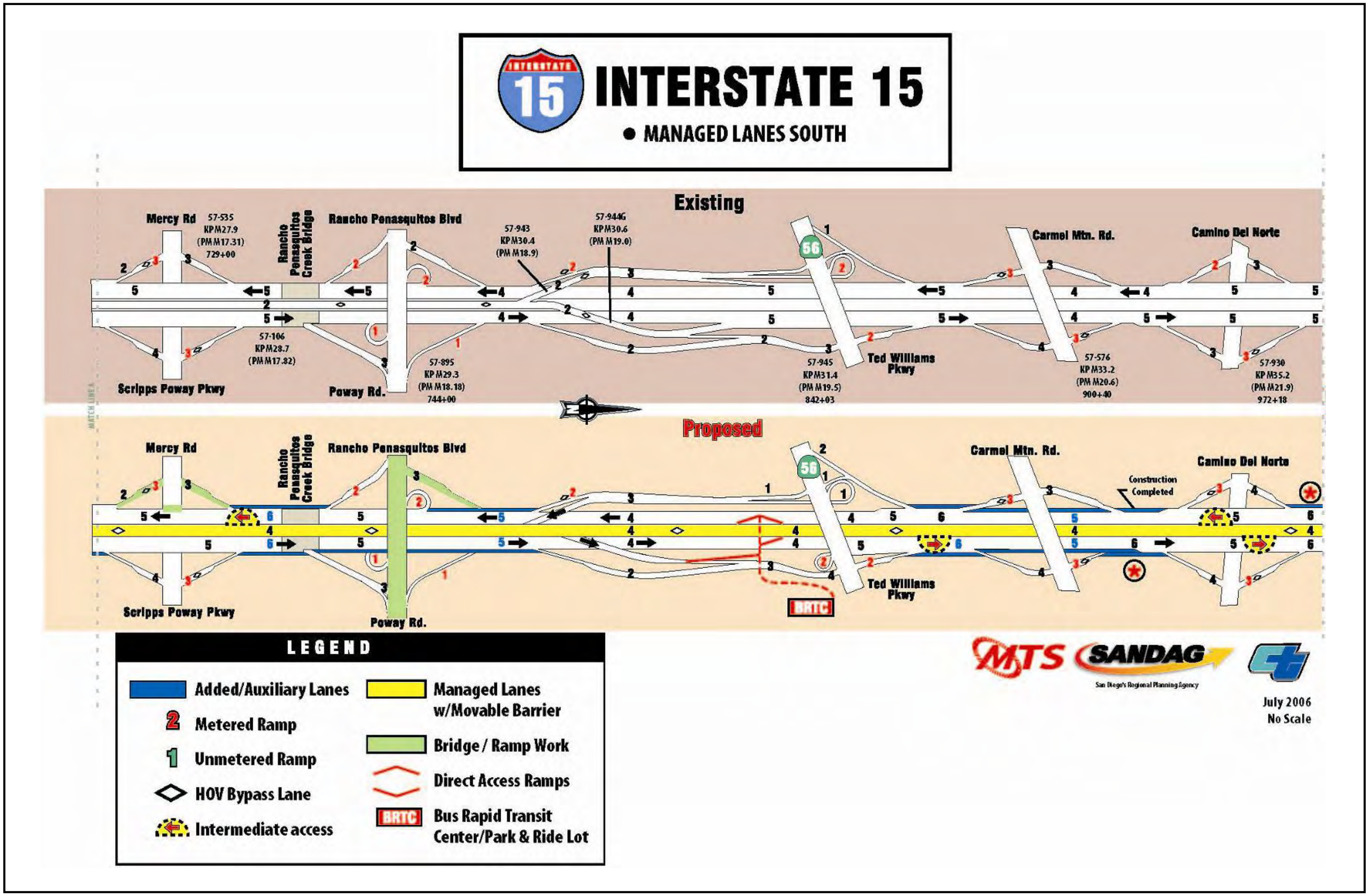


Figure 3-21. Managed Lanes Configuration – Bernardo Center Drive to Via Rancho Parkway

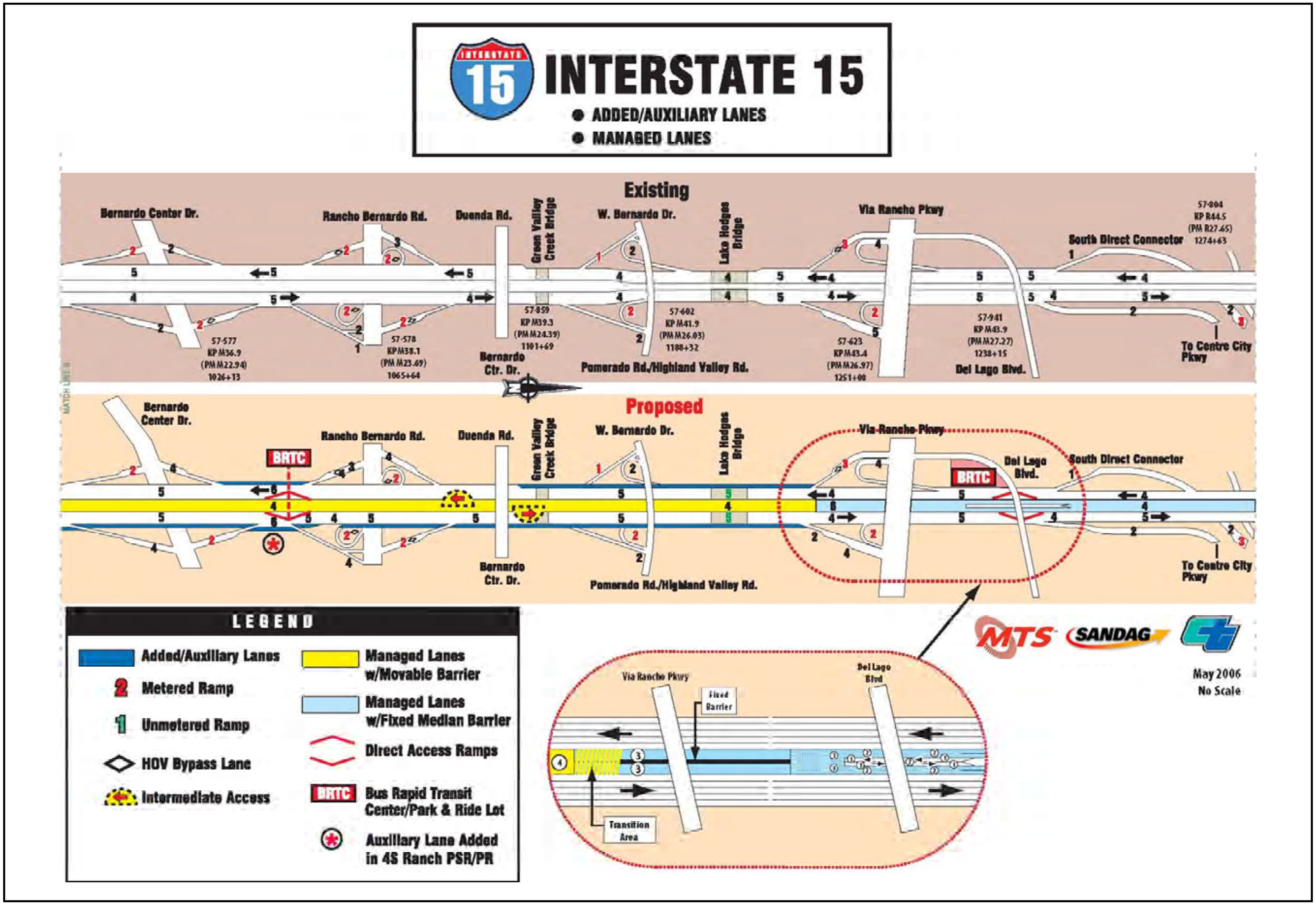
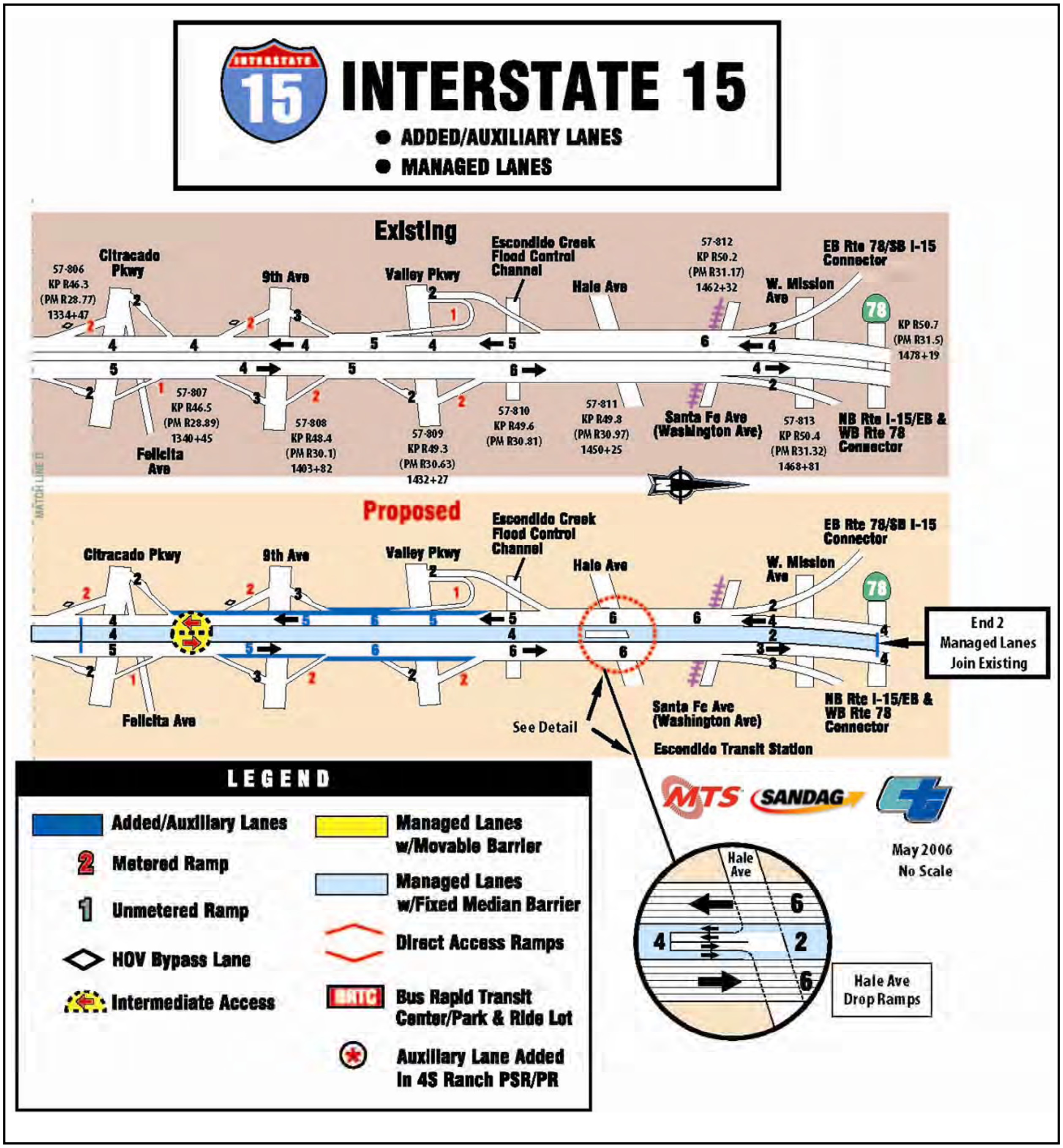


Figure 3-22. Managed Lanes Configuration – Citracado Parkway to Junction SR 78



3.6 Current Network-Based Institutional Characteristics

Guidance This section describes the current institutional environment of the I-15 corridor, taking into account each network, the entire San Diego region, and any other institutions that will affect the integration of the corridor. Any mechanisms that were established to enhance coordination, including inter-agency relationships and agreements, information sharing, and joint operational procedurals, whether they are at the regional or corridor levels, are addressed. The section also identifies institutional constraints that affect integrated corridor management on the I-15 corridor.

In Section 3.3 the San Diego ICMS corridor stakeholders and institutional partners were identified. The initial ICMS I-15 Working Group includes SANDAG, Caltrans District 11, MTS, NCTD, and the cities of San Diego, Poway, and Escondido, representing a diverse group of organizations with different missions, cultures, and sometimes, priorities. Yet this group has a rich history of partnering together, coordinating their efforts, and working cooperatively that is comprehensive in both its depth and breadth. In the remainder of this section the current institutional environment of the corridor is described. Included are relationships among the stakeholders, in which network-, regional-, and corridor-focused inter-agency agreements for enhancing coordination are established and used. These include those resulting in information sharing, joint operational procedures, special event/emergency response coordination, and coordinated public information dissemination activities. The remainder of this section is organized on a network basis; however, there are numerous instances of cross-network institutional coordination as well.

I-15 Freeway Network

Caltrans and the CHP have existing joint operational policy agreements to enhance cooperation and understanding between the two agencies to better manage the state's transportation systems. These agreements define roles and responsibilities of each agency that contributes to reducing communication failures and unnecessary delays and have been in place for more than 15 years and are renewed on a bi-annual basis. The agreements focus on traffic management and control, bomb searches for explosive devices, hazardous material spill clean-up, roadside rest area security, special events, FSP, visibility-related restrictions and closures, and ITS. The agreements also focus on multi-disciplinary accident investigation teams, pedestrian safety, planned freeway/highway closures, and the TMC.

Benefits of the agreements are typically highlighted during times of crisis (i.e., traffic- and weather-related incidents, malfunctioning equipment, or special events) on the transportation system. When traffic incidents occur, information immediately is gathered via traffic monitoring stations embedded within the roadway and 911 calls into the TMC from the traveling public. CHP patrol units immediately are dispatched to the incident scene, while Caltrans' support is simultaneously requested for traffic and roadway assistance. Each agency responder proceeds while continuously gathering information from the TMC on factors such as vehicle type, incident type, vehicles involved, injuries or fatalities, number of lanes blocked, and associated traffic impacts. En-route responders can request specific assistance from the FSP. Signal alerts are issued via CMSs to inform the public at large of expected traffic delays. TMC staff continually monitors incident scenes via CCTV, traffic speed sensors, and by other means.

SANDAG, Caltrans, and the CHP have had existing agreements in place since 1992 for the creation and operation of the FSP on I-15 and other freeways in San Diego County. The FSP program, which initially began in 1992 as a demonstration program in Los Angeles, was made a statewide program supported as part of the California budget in 2000 as a result of statewide legislation. In San Diego County, the FSP operates as a free public service with funding from SANDAG, Caltrans, and the CHP. Additionally, a portion of the region's motor vehicle registration fees that support operation of the San Diego Service Authority for Freeway Emergencies (SAFE) also helps to fund this valuable motorist assistance/congestion relief program in San Diego County. FSP mitigation projects were outlined in a 2005 memorandum of understanding and revenue agreement between SANDAG and Caltrans.

I-15 HOV/HOT and Managed Lanes Freeway Network

SANDAG and Caltrans are currently developing an agreement to define roles and responsibilities for the value pricing program and other elements in the development of HOV lanes and their use as HOT lanes for the I-15 Managed Lanes corridor project currently under construction. This agreement also calls for the implementation of an upgraded and improved Advanced Traffic Management System for better, real-time traffic management activities, automated CMS travel-time information, and support for the region's 511 system. This agreement will also lead to improved transportation system management strategies and efficiencies. Caltrans and SANDAG have a long-standing relationship in jointly developing regional transportation plans and policies, priorities, funding sources, and managing the transportation system.

An existing agreement between SANDAG and the CHP, together with follow-up agreements and amendments, has been in place since 1996. It identifies enforcement responsibilities and resources for police services to patrol the I-15 HOV/HOT Express Lanes to enforce vehicle occupancy and toll violations.

Arterial Network

SANDAG, Caltrans, and the City of San Diego have an existing cooperative agreement that was signed in 1998 between Caltrans and SANDAG to develop the RAMS as part of the Southern California Intermodal Transportation and Information System known as the "Showcase" project. The goal was to enhance inter-jurisdictional coordination of traffic signals along arterial corridors in the San Diego region. The benefits would be reduction of traffic congestion through inter-jurisdictional signal connectivity and capabilities, safety improvements, possible cost efficiencies, and enhanced event/emergency management.

Transit Network

SANDAG is responsible for developing and overseeing regional transit fare policies, including different types of fare payment integration that governs all MTS and NCTD services. Regional passes are available and valid on all MTS and NCTD buses, moreover, there are inter-agency transfer agreements between MTS and NCTD that may or may not require upgrades depending on the level of service. The next stage of fare payment integration is the region's new Compass Card scheduled for a phased debut between 2007 and 2008 and will enable travelers to use a single-fare media to receive both MTS and NCTD transit services.

MTS and NCTD have different service areas; however, they do have routes that overlap in the northern part of the I-15 corridor. MTS' Route 20 meets NCTD's Route 350 at Westfield Shoppingtown North County, just north of Lake Hodges in Escondido, while MTS' Route 810 (the commuter express route that runs from Escondido to San Diego on I-15) has its northern terminus at the Escondido Transit Center, where it provides connections to numerous NCTD routes. To the extent warranted these two transit service providers engage in schedule integration (coordination and synchronization of arrival and departure times) at such points of overlap. At Westfield Shoppingtown North County where NCTD's Route 350 has frequent service with ten-minute headways, there is less of a need for such schedule coordination and synchronization.

At the Escondido Transit Center, Route 350 meets over a dozen other NCTD routes, MTS' Route 810, and Greyhound buses. Timed transfers between Routes 350 and 810 at this location are also not conducted; however, approximately 20 miles west of the I-15 corridor at the I-5 corridor, NCTD's COASTER (commuter rail line) runs from Oceanside in the north to downtown San Diego in the south, and MTS runs a free shuttle service, called the COASTER Connection, for COASTER patrons between COASTER's Sorrento Valley Station and nearby major employment centers. Thus, while this schedule coordination is located on the I-5 and not the I-15 corridor, it exemplifies the partnership that MTS and NCTD have established for the benefit of the traveling public.

The Escondido Transit Center also provides an example of infrastructure integration (establishment of passenger facilities for transfers between transit providers or transit modes) between NCTD and MTS. Currently, two transit services are being implemented: NCTD's new light rail transit service, called SPRINTER, will run parallel to SR 78 between Oceanside in the west and Escondido in the east, while the new BRT system will be operated by MTS (see discussion immediately below on the BRT service along the I-15 corridor). Thus, the SPRINTER's eastern terminus and the BRT's northern terminus intersect at the Escondido Transit Center. To make available a convenient transfer process between the SPRINTER and the BRT service for passengers, current planning allows for a less-than-five-minute walk between the two services. Moreover, enhancements to this transit connectivity are under study by NCTD as part of an ongoing station development and land use study of the Escondido Transit Center.

SANDAG, MTS, and NCTD are working together on development and implementation of a BRT system along the I-15 corridor in parallel to construction of the Managed Lanes facility. MTS' current Route 810 – its express bus service between Escondido and San Diego – is the pre-cursor to the new BRT service along the I-15 corridor. Its northern terminus will be in Escondido at the Escondido Transit Center and will have five stations along I-15 with Park and Ride lots accessible from I-15 via direct access ramps (DARs). The BRT system will operate between Escondido to both downtown San Diego (via I-15) and Sorrento Valley (via I-15 and Mira Mesa Boulevard). SANDAG has recommended that MTS be identified as the preferred BRT service operator, and NCTD has agreed to this. Moreover, SANDAG, MTS, NCTD, and Caltrans are developing memorandums of understanding that will address operating and capital funding, service levels, fare structure, revenue sharing, service coordination, station and vehicle maintenance, joint development in the vicinity of the BRT stations, and marketing aspects of the new service.

Cross-Network Institutional Coordination and Partnerships

There currently exists a master fund transfer agreement (MFTA), which has established both agreements and program funding through Caltrans, that is effective through December 2014. Long-standing institutional agreements stemming from the MFTA direct continuing cooperation among SANDAG, Caltrans, the CHP, MTS, NCTD, federal funding agencies, and local area governments and private sector partners in support of collective efforts to improve transportation infrastructures, jointly manage ongoing planning and construction initiatives, and address growing traffic congestion challenges. Several institutional agreements guide planning and development of the I-15 Managed Lanes corridor and all relate to the continuing use of the region's TMC as the communications hub.

SANDAG and Caltrans have also had a cooperative agreement since 2002 that initiated the Automatic Vehicle Classification (AVC) project to enhance the collection, distribution, and processing of vehicle classification data along 20 traffic monitoring sites throughout the San Diego region. The goal is to successfully deploy an AVC system that would operate 24/7 with the ability to collect, process, archive, export, and integrate classification data with other data collection and reporting management applications. The data and information that are gathered and analyzed will establish the foundation for determining how well the transportation system is operating and for identifying possible transportation deficiencies. The AVC system would automate and expand the type of data collected and processed, utilizing existing loop detection systems throughout the San Diego region. The primary use of the vehicle detection data collected throughout the AVC system is to supplement detection data that is used for transportation modeling, performance monitoring, and traveler information activities.

Caltrans and local government entities have mutual informal agreements on the use, integration, and emergency modification of traffic signals at freeway ramp and arterial intersections. These existing agreements allow for ease of signal coordination and synchronization in an effort to improve traffic control between intersecting roadways.

Park and Ride operations along I-15 have been created through existing agreements, such as those between Caltrans and the City of San Diego and Caltrans and the San Diego Community College District.

Another existing cooperative agreement initiated in 1997 among Caltrans District 11, MTS, NCTD, and the City of San Diego was for the purpose of developing the IMTMS. The goal was to implement an automated exchange of data and complete multi-modal data integration from the following regional systems: ATMS, RTMS, the 511 system, RAMS, the CHP's CAD system, and the FSP.

SANDAG, Caltrans, the CHP, and the City of San Diego have formed their partnership as part of the deployment of the first phase of the San Diego region's IMTMS surveillance and control network in San Diego's Mission Valley corridor during Super Bowl XXXVII in January 2003. The primary objective was to reduce non-recurring congestion delays for special events through the application of advanced traffic management and traveler information strategies. To achieve this goal SANDAG created the first iteration of RIWS that successfully integrated data and video from San Diego's Transportation Operations Center (TOC), the Caltrans Traffic Management Center, and Qualcomm Stadium's Event Management Center. The multi-agency, consensus event management approach, known as the Mission Valley Event Traffic and Operations Plan, brought together the technologies and institutional processes necessary to successfully manage multi-modal transportation services in support of major events. The Mission Valley project initiated the San Diego region's tradition of transportation innovation in multi-agency device control, cooperative intermodal operations management, regional data networking architectures, and state-of-the-art Web services integration.

SANDAG, Caltrans, MTS, NCTD, SD SAFE, and the CHP have partnered together for San Diego County's new 511 service (http://www.511sd.com) that was successfully launched on February 21, 2007. This new service is a prime example of information integration, that is, a single source of multi-provider information for the traveler about traffic conditions, transit (including schedules, routes, trip itineraries, and fares), trip itinerary planning, regional commuter and employer transportation assistance program, bicycling, and FasTrak®, California's electronic toll collection system. The 511 system is led by SANDAG together with the San Diego area transportation partners: Caltrans, MTS, NCTD, SD SAFE, and the CHP.

SANDAG has a committee structure that provides opportunities for involvement in regional programs by citizens, elected officials, agency staff, and representatives of civic and community groups. Some are standing committees responsible for policy direction and review, while others are established on an ad hoc basis to assist with specific projects. For transportation issues, there are two committees of particular noteworthiness in the context of the I-15 ICMS corridor:

- the I-15 Project Management Team; and
- the San Diego Regional Traffic Engineers' Council (SANTEC)

The I-15 Project Management Team assists in the cooperative planning, implementation, monitoring, and evaluation of the I-15 Value Pricing Project, as well as the I-15 Managed Lanes project. The committee is composed of our I-15 ICMS project partners and other interested agencies, including FHWA, FTA, and the American Automobile Association of Southern California.

SANTEC is an example of a multi- and inter-organizational entity that has been designated by SANDAG as its technical advisory body with the specific objective of addressing traffic and transportation engineering aspects of the planning, design, construction, operation, and maintenance of the region's roadway network including pedestrian, vehicular, transit, and bicycle traffic. Membership consists of a traffic engineering representative from each of the region's cities, in particular San Diego, Poway, and Escondido, the County of San Diego, Caltrans, MTS, NCTD, and SANDAG. SANTEC may discuss, review, recommend, and/or approve items associated with regional transportation goals and policies.

3.7 Regional Architecture Review

Guidance Integrated corridor management builds upon regional management. The I-15 ICMS is considered a "sub-regional architecture" in this regard. The development of ICMS operations (and the associated ICM architecture) will, therefore, be compatible and consistent with San Diego's regional ITS architecture; this requires an understanding of the various attributes that comprise the regional architecture and the associated management functions. This section presents a review of the San Diego regional ITS architecture in which the I-15 ICMS will function, including the current state of the architecture and how changes to the architecture are currently handled.

The current San Diego regional ITS architecture was approved in April 2005 as required by the FHWA Final Rule and FTA Policy Part 940.9(b) released on January 8, 2001. This rule and policy was established to implement Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21) enacted on June 9, 1998, pertaining to conformance with the National Intelligent Transportation Systems Architecture and Standards. The scope of the FHWA Final Rule and FTA Policy covers any and all ITS projects funded from the Federal Highway Trust Fund. The approved San Diego regional ITS architecture consists of the following sections, which follow the outline established in the Final Rule, Part 940.9(d):

Introduction

This section is an overview of the architecture, including definition of basic terms and how the architecture will be used in the region.

Regional Description

This section contains a description of the transportation characteristics of the San Diego region, including existing ITS systems and transportation network data taken from the Regional Transportation Plan (RTP). Each ITS modal system is covered in detail using customized market package diagrams representing physical elements of the architecture (nodes, systems, and links). This section should be updated with transportation network planning data from the latest version of the RTP.

Stakeholders

This section contains a description of the agencies that have planning, deployment, operations, or maintenance responsibilities for the region's ITS systems. The agencies are described in the context of regional working groups and other collaborative bodies that collectively make policy for ITS deployments, perform project development, and operate and maintain ITS systems. Of all the sections in the current architecture, this section is most in need of revision as virtually all of the working groups described herein have served their purpose or dissolved from lack of activity. In addition, there are new stakeholders as a result of the ICMS concept and evolving emergency management functions in the region.

Operational Concept

This section is a market package-oriented description of scenarios with information flows, roles and responsibilities and scenario timelines. The architecture operational concept section focuses on interactions between modal systems in the region, such as freeway management, arterial management, transit management, and emergency management. The six scenarios described in this section include:

- Transit emergency incident (interaction with emergency management);
- Freeway fatal accident (interaction with emergency management);
- Freeway incident affecting transit operations (interaction with transit management);
- Freeway incident affecting arterial operations (interaction with arterial management);

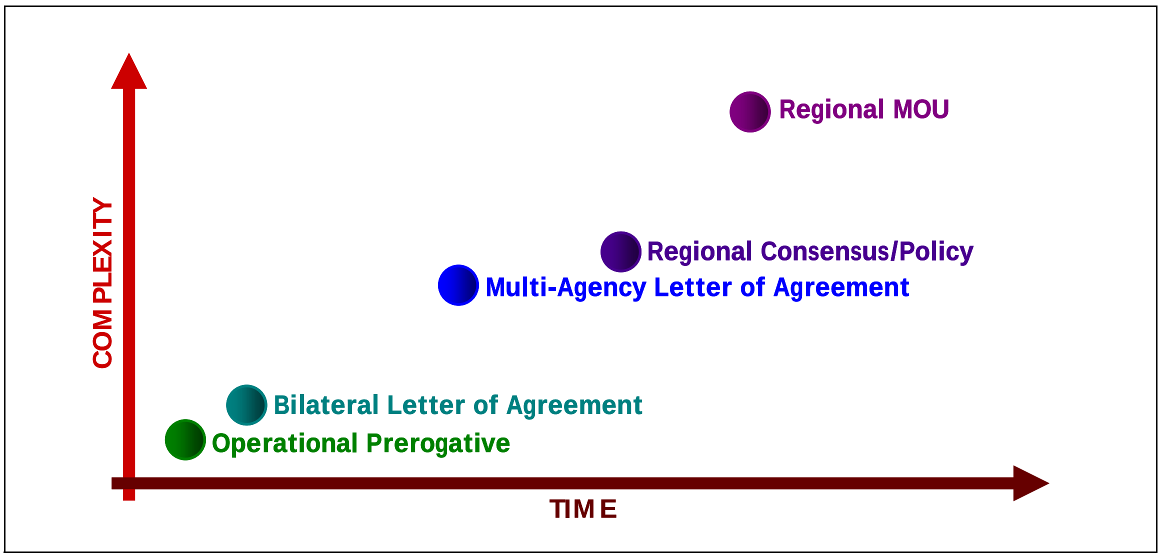
- High-speed pursuit (emergency management internal coordination); and
- Brush fire incident (collaboration among all modes).

These scenarios track very closely with the scenarios proposed in this ConOps. This section also addresses roles and responsibilities as they apply to operations and maintenance of the regional IMTMS network. Roles and responsibilities need to be updated to incorporate corridor management considerations.

Operational Agreements

This section includes a description of existing operational agreements in the region and basic principles to guide future development of new agreements. Figure 3-23 shows the scope of different types of interagency agreements, while Figure 3-24 shows the concept of regional responsibility compared to local responsibility for operations and maintenance of ITS elements being deployed in the San Diego region.

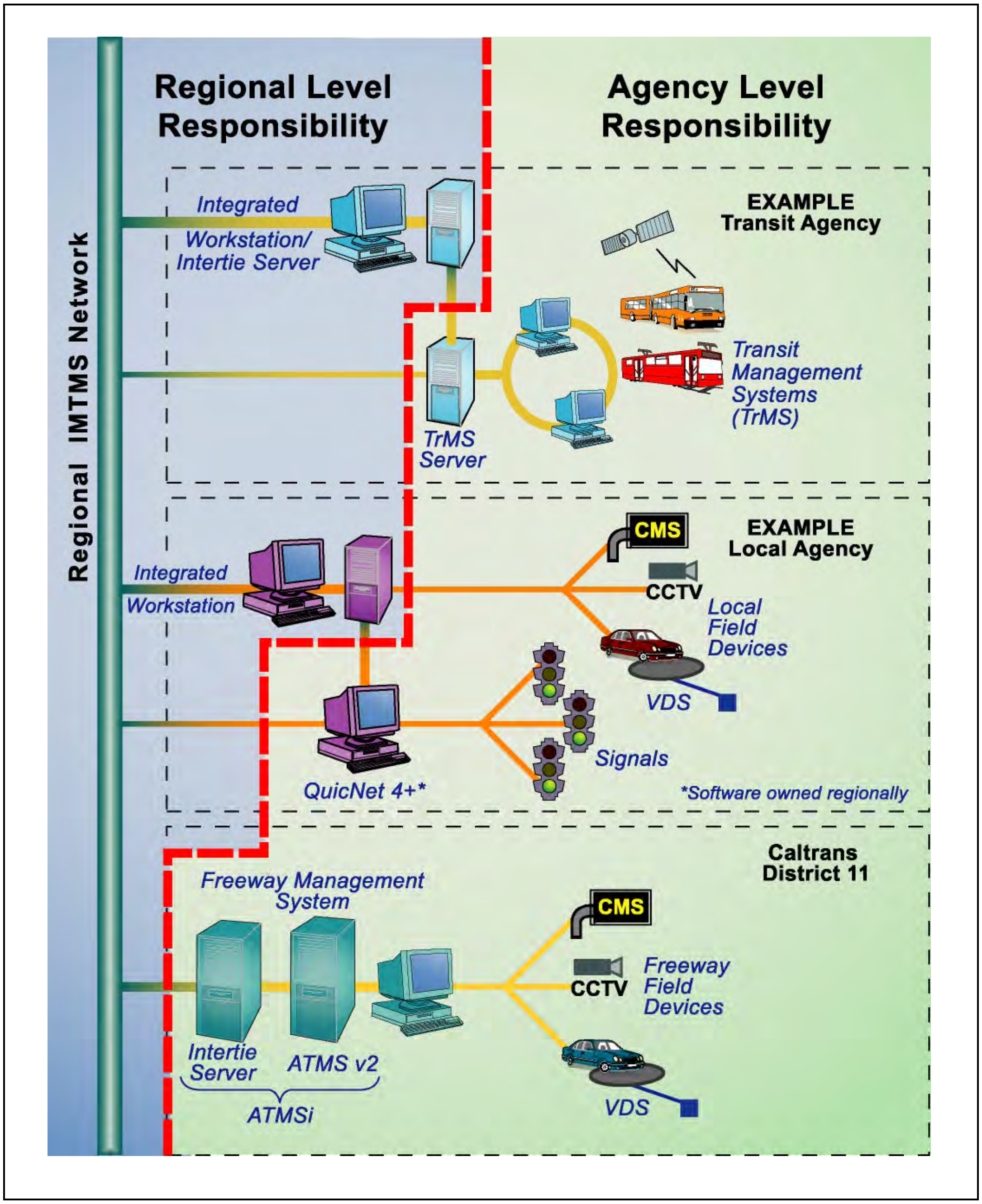
Figure 3-23. Complexity Versus Implementation Time
for Various Types of Regional Agreements



Functional Requirements

For purposes of the San Diego region's architecture development, equipment packages were considered equivalent to high-level functions. Equipment packages group like processes (or functions) of a particular subsystem together into an "implementable" package of hardware and/or software. Since equipment packages represent the functionality needed to implement market packages (and are shown in market packages), they provide a link between the interface-oriented physical architecture definition and the deployment-oriented market packages. This notation will be carried through in this ICMS ConOps.

Figure 3-24. Regional Versus Local IMTMS O&M Responsibility



Information Flows and Interface Requirements

In the context of the San Diego regional ITS architecture, information flows were interpreted as “architecture flows” as defined in the national ITS architecture. These flows are high-level data exchange requirements between physical elements of the architecture (i.e., the architecture subsystems). As shown in the previous section, these subsystems include the major functional areas of management centers, roadway devices, vehicles, and personal access. The data in these flows is carried by the architecture interconnects or communications networks supporting ITS. These have been established as:

- Wireline Networks – networks supporting fixed elements of the architecture (centers and roadway devices). These networks include the Internet, public agency-owned fiber optic networks, signal interconnect networks, and the like. In San Diego these include the Caltrans TOSNET, SANDAG, MTS, and NCTD fiber networks, and the City of San Diego’s fiber network, as well as those in other cities and various leased services.
- Wide Area Wireless Networks – public and private networks that support both fixed and mobile elements of the architecture. These networks can support mobile access to the Internet. Wide-area wireless networks also include “private” radio systems (as seen by the Federal Communications Commission), such as law enforcement-trunked radio systems, transit fleet radio systems, etc. In San Diego this includes the Regional Communications System (RCS), a new transit radio service and other smaller dedicated networks.
- Dedicated Short-Range Communications (DSRC) Networks – networks primarily serving communications between roadway devices and vehicles. These networks include, for example, emergency vehicle preemption and transit vehicle signal priority treatments through direct vehicle to signal controller communications. DSRC will be an underlying standard for the planned vehicle infrastructure initiative (VII). San Diego also has, or plans to have, variable pricing roadways, as well as toll facilities.
- Vehicle-to-Vehicle Networks – networks that support advanced vehicle control applications, such as the Automated Highway System (AHS). San Diego has demonstrated the AHS test bed for both light (passenger) and heavy (CVO and buses) vehicles on the I-15 Reversible Lane facility; however, this capability is not in the current architecture.

Other communications systems that support ITS applications include local area networks (LANs) that are typically used within modal management centers, such as the freeway management system running in the Caltrans District 11/the CHP Border Division TMC. These internal networks typically support single systems like ATMS that include components such as applications servers, database servers, and operator workstations.

This section also discusses the methodology by which ITS systems in the region will communicate and exchange information. At the time of writing, the region was transitioning from the CORBA center-to-center (C2C) standard to the evolving service-oriented architecture using a Web services model for service delivery. Current deployments are following SOA industry standards, and the CORBA standards have been phased out due to deployment cost, schedule, and O&M cost considerations; however, the basic design philosophy of the regional architecture that provides for shared control has remained unchanged.

Identification of Required Standards

This section contains a listing of existing and planned ITS standards being developed on a national level, as well as regional choices for standards adoption.

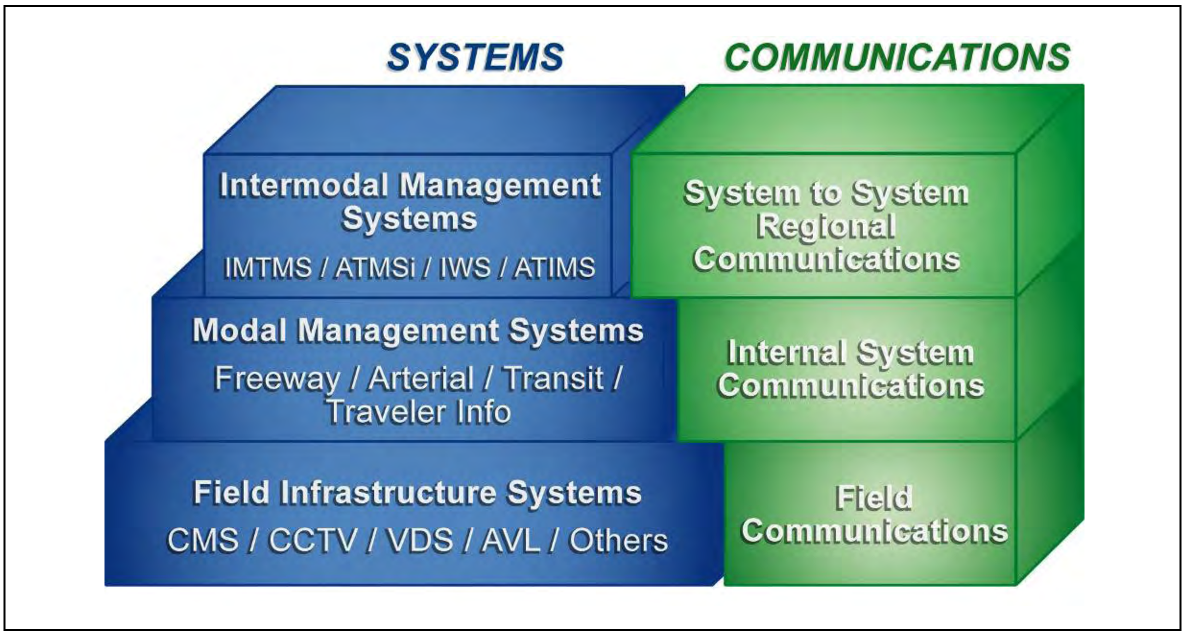
Project Deployment Sequencing

This section contains a general discussion of project phasing considerations in the San Diego region, including project sequencing and dependency charts, current as of December 2004. This section is in need of updating as timelines and sequencing have changed for many of the ITS projects in San Diego. Figure 3-25 from this section shows the logical project building blocks leading to intermodal applications across the region.

Maintaining the Regional Architecture

This section contains policies and procedures for ensuring that the regional ITS architecture remains current and relevant to ongoing ITS deployment efforts. The ICMS project will require a review of the San Diego regional architecture and updating using these procedures.

Figure 3-25. San Diego's Overall ITS Deployment Sequencing Strategy



3.8 Problems, Issues, and Needs for the San Diego I-15 Integrated Corridor and Associated Networks

Guidance — This section summarizes the problems, issues, and needs of the individual networks and the I-15 corridor as a whole. Using the inventory information and other gathered data, coupled with stakeholder discussions, this section addresses operational, technical, and institutional deficiencies and constraints, thereby providing insight as to the types of problems being faced in the corridor.

I-15 corridor stakeholders identified a set of problems to be resolved and needs to be satisfied along the corridor and its associated networks. These are listed in Table 3-11 and while they provide as thorough a set of such problems and needs as possible, there are overlaps among these problems and needs, which indicate their interdependencies. After the stakeholders completed the process of identifying these problems and needs, they were organized into specific groupings.

Table 3-11. San Diego I-15 Corridor Problems and Needs

Problems and Needs
Congestion and Capacity— ▪ Issue: Increasingly congested conditions on I-15 ▪ Issue: Increasingly congested conditions on corridor's arterial network ▪ Issue: Park and Ride facilities are not sufficient
Transit— ▪ Need: Improved transit reliability ▪ Need: Real-time, comprehensive, accurate information to travelers ▪ Need: Frequent service ▪ Need: Competitive service
Transportation System Management— ▪ Issue: Managing traffic flow between I-15 freeway ramps and adjacent arterials with ramp metering ▪ Issue: Managing traffic flow on I-15 (general purpose/managed lanes) ▪ Issue: Limited access to HOV/HOT facilities ▪ Issue: Coordination across multiple functional systems
Traveler Information Services— ▪ Issue: Minimal ATIS coverage of the corridor
Inter-organizational Coordination— ▪ Need: Inter-jurisdictional and inter-organizational coordination and integration among corridor stakeholders ▪ Need: Exchange and sharing of real-time data ▪ Need: Improved response times to non-recurring incidents

Previous sections identified that congestion ─ along the freeway and arterials for public transit and commercial vehicle operations ─ is a major and growing problem. For the freeway, traffic congestion problems affect commuters and businesses along the corridor, as well as commercial vehicle operators. The average daily traffic (ADT) on the freeway corridor currently ranges between 170,000 and 290,000 vehicles, with daily commute delays ranging from 30 to 45 minutes. If no transportation improvements are implemented, then by the year 2020, ADT is projected to increase to approximately 380,000 vehicles per day with delays approaching 90 minutes. The three cities within the I-15 ICMS corridor (San Diego, Poway, and Escondido) manage traffic along their arterials. Arterial congestion of major concern occurs in two areas: (1) at the interface between the freeway's on-ramps and adjacent arterials in these cities; and (2) arterials used by buses to travel between transit transfer stations, such as the Westfield Shoppingtown Transfer Station in Escondido and on-ramps to I-15.

Lake Hodges is another major traffic diversion choke point along the corridor. It is approximately five miles south of SR 78 at the northern boundary of the I-15 corridor and has only a single bridge crossing, with no arterial frontage roads to which to divert traffic if necessary. I-15 ICMS strategies will also be engaged to address this issue.

Demand for transit services along the corridor has increased. For example, there has been nearly a doubling of the number of passenger trips serviced by MTS between 1980 and 2005. Approximately 75 percent of MTS riders in 2002 did not have a car available to them to use and consequently were transit-dependent. This very high percentage of transit-dependent riders contributes to the issue of transit service availability at specific locations and at specific times for this group of transit riders.

In Section 3.6, we discussed near-term improvements on the corridor's networks that are planned to be implemented within the next five years. One of these is the implementation of a Managed Lanes facility on I-15, the 21-mile long freeway within the freeway that will help manage freeway traffic. The Managed Lanes facility is the next stage in the development and operation of the 8-mile long HOV/HOT facility along I-15. However, the Managed Lanes facility, when completed, will be more than twice the length of the current HOV/HOT facility together with access and egress points along the corridor at interim points instead of only at the facility's termini, as in the case of the HOV/HOT facility. Moreover, at these interim points along the corridor there are DARs to bus rapid transit stations. On the Managed Lanes facility, traffic will be managed to maintain free-flow conditions by means of moveable barriers and dynamic pricing strategies to determine the appropriate toll to charge.

The issue of arterial congestion at the interface between freeway on-ramps along I-15 and adjacent arterials was pinpointed as a congestion-related problem. It is also be viewed as an issue of transportation system management that deals with the ramp-metering system on the freeway on-ramp and the traffic signaling system on adjacent arterials, where the former is under the control of Caltrans, while the latter is under the control of the individual city's traffic department. This is an example of transportation systems management where inter-organizational coordination also plays an important role. Other examples of such coordination that are needed include the exchange and sharing of data among corridor stakeholders and improved response times to non-recurring incidents.

Another problem that exists along the corridor that affects travelers using any one or more of the corridor's networks is the availability of only minimal advanced traveler information services. There is a substantive need for the I-15 corridor to provide, in an integrated and comprehensive way, real-time and accurate information to travelers within the corridor by means of multiple media. To satisfy this need will require the coordinated involvement of multiple corridor stakeholders in inter-organizational partnerships. The 511 service launched in February 2007 will be used as a tool to communicate accurate information to the traveling public.

3.9 Potential for an Integrated Corridor Management System

Guidance This section discusses how the corridor deficiencies and needs can be addressed from a corridor perspective by applying corridor management and cross-network operational strategies. The result of this section includes an assessment of which I-15 ICMS strategies can address the operational deficiencies that are limiting corridor performance.

In this section, we discuss how the problems and needs previously identified in Section 3.8 are addressed based on integrated corridor management strategies and techniques as described as follows.

The concept of integrated corridor management is defined as follows:

consisting of the operational coordination of specific transportation networks and cross-network connections comprising a corridor and the coordination of institutions responsible for corridor mobility.

(Integrated Corridor Management Initiative – Program Plan Update, 2006, http://www.its.dot.gov/icms/icms_workplan.htm

The San Diego region has numerous enterprises at various stages of deployment that will contribute significantly toward addressing the identified problems and needs for the I-15 corridor. They are discussed in the remainder of this section.

Managed Lanes Facility and BRT System

The Managed Lanes facility that is currently under construction is scheduled to be completed by 2012. This 21-mile-long, 4-lane-wide facility will have movable barriers to permit configuring the number of lanes per direction to adapt to peak-demand levels. This facility will also utilize dynamic variable pricing to determine tolls for I-15 FasTrak® customers, which, together with HOVs that will use the facility for free, will help to ensure that traffic on the Managed Lanes will consistently travel under free-flow conditions and, thus, make public transit a more attractive option on this travel corridor. A BRT system will operate in the Managed Lanes. Stations and Park and Ride lots will be adjacent to I-15 and connected to the Managed Lanes via five DARs along the 21-mile Managed Lanes facility. These DARs will permit access and egress to and from these stations for BRT buses, vanpools, carpools, and I-15 FasTrak® customers and enable these users to bypass freeway on-ramps. The management of traffic flow between the Managed Lanes and general purpose lanes will be achieved by means of a coordinated approach among several of I-15 corridor's institutional stakeholders, including SANDAG, Caltrans, and the CHP.

Enhancing Connectivity Across Networks

The SPRINTER is a new light rail transit service that will operate approximately between I-5 in Oceanside on the west to I-15 in Escondido on the east. The SPRINTER route parallels SR 78. This has the potential to make transit a more attractive option by expanding the service area and population coverage of rail services in the northern parts of San Diego County. Of particular note is that the eastern terminus of the SPRINTER light rail line is co-located with the northern terminus of the I-15 BRT system at the Escondido Transit Center Station. This situation can help promote increased use of transit and the connectivity of the SR 78 corridor to the I-15 corridor.

511 Regional Advanced Traveler Information System (511)

In February 2007 SANDAG launched its regional 511 system, that is, its 511 regional real-time information service for travelers that is accessible by telephone, Internet (http://www.511sd.com), or public access television, as well as strategically placed CMSs to allow travelers to make informed travel choices. This new traveler information service provides the following information:

- Traffic information with respect to both recurring and non-recurring incidents and associated delay information and driving times between major origins and destinations;
- Transit route and fare information;
- Carpool and vanpool information;
- Bicycle route maps and commuting information;
- FasTrak® toll information; and
- Roadside assistance on freeways throughout San Diego County.

The ICMS project presents a significant opportunity to leverage and expand the features already planned for the 511 system by additionally enabling travel time comparisons among various modes along the I-15 corridor. Using integrated real-time information, the various I-15 networks, working together as a corridor, could more effectively influence traveler network shifts, especially in promoting appropriate shifts to express bus, bus rapid transit, and Managed Lanes networks with unused capacity. In terms of institutional partnerships, SANDAG is joined by Caltrans, MTS, NCTD, and SD SAFE on the 511 enterprise.

Integrating Traveler Information for Improved Systems Management

An important element of ICMS involves enhanced mobility opportunities, including shifts to alternate routes and modes. Due to the limited number of parallel arterials, the choices for travelers appear restricted. Making system users aware of viable alternates is a key driver for the effectiveness of ICMS. Using integrated real-time information, the various networks, working together as a corridor, could more effectively influence traveler network shifts, especially in promoting appropriate shifts to express bus, bus rapid transit, and Managed Lanes networks with unused capacity.

This information will be disseminated through various mechanisms, including CMSs and the newly launched 511 traveler information system. While CMSs have the potential for en-route decision-making, accessing the system for information has the potential to enhance both en-route, as well as pre-trip decision-making. The 511 system is accessible via the phone and the Internet from the home or office, as well as while on the road for travelers with cell phones and PDAs.

CMS deployment among the networks will be operationally integrated through the region’s modal integration project, the IMTMS. Messages can be used to provide information on conditions in all corridor networks so that each traveler can take appropriate action if one or more of the corridor’s network’s performance is compromised. Also in the case of special events or unplanned incidents, the signs and other dissemination tools could be used to direct travelers to specific corridor transportation services as part of an operations strategy or for disaster scenarios.

Integration of Local Arterial Traffic Signals and Freeway Ramp Meters

Managing the flow of traffic (especially at the interface between freeways and arterials at freeway on-ramps) and improving transit reliability are significant challenges that can be addressed by ICMS strategies. Because the cities of San Diego, Poway, and Escondido all use QuicNet 4, the traffic signal control system software, a few corridor strategies could be readily introduced in conjunction with the proposed I-15 ICMS corridor project. To address freeway/arterial congestion at the ramps and adjacent intersections, integrated operations of adjacent ramp meters and signalized intersections could be implemented. There is also potential to provide signal priority to arterial buses and express buses that are delayed by ramp and arterial congestion. Signal priority on the arterials would increase the schedule adherence of buses.

Real-Time Data and Device Sharing – Regional Integrated Work Stations (RIWS)

With real-time data and device sharing among the network operators, each network could monitor the conditions of adjacent networks to anticipate, and possibly influence when travelers may shift to their network and then take appropriate actions. SANDAG is well under way with development of a regional IMTMS, which integrates regional modal management systems for freeways, arterials, transit, and traveler information, and which is focused on the real-time data and device sharing needed for ICMS. The work already completed as part of the development of the IMTMS has included significant outreach to key stakeholders and the development of user needs assessments. The result of this effort was the development of the RIWS concept. The RIWS allows corridor partner agencies to share in the command and control of various operations in a coordinated manner and is currently operational. The RIWS will prove to be an effective platform to enable ICMS for the I-15 corridor and become a valuable tool for the region's public safety and homeland security community.

Integration of Transit, Road Pricing, and Parking Payment Systems

In promoting either the network and/or modal shifts that are needed to optimize corridor throughput, an effective ICMS strategy must address the convenience of travelers. A key component of this aspect is pricing and payment for transportation services. The San Diego region is addressing this need through development of a regional payment/ financial clearinghouse system called the Compass Card program. This financial system is scheduled for staged deployment between 2007 and 2009 beginning with a pre-test phase in spring 2007, followed by a pilot test for employees of SANDAG, MTS, and NCTD between October 2007 and July 2008; there will be a mini-customer controlled pilot test in May 2009 and finally the official full system launch of the Compass Card Program in July 2009. The program is being deployed as part of SANDAG's regional automated fare collection system, which will deploy a smart card-based fare collection network throughout San Diego County and initially used for transit. Moreover, SANDAG is working to define a combined universal transportation account concept, whereby the same electronic toll collection tag/smart card can be used to pay transit fares, tolls, and parking for added convenience.

Smart Parking – Integrating Parking and Parking Pricing

One challenge to influencing a shift to express bus use is the region's severe parking shortage. Smart parking systems provide real-time parking availability, notification, and reservation systems to direct travelers to available parking. In some situations, temporary parking can be instituted to handle the new demand. To address this challenge, a further leveraging of the 511 system could occur under the proposed ICMS project.

SANDAG is deploying a pilot program of a smart parking system with incentive-based pricing for transit facilities. The focus of the pilot deployment is to demonstrate the effectiveness of providing advance traveler information regarding the availability and cost of parking and to encourage the use of transit services by offering credit-based pricing discounts to motorists utilizing transit. The next phase of the smart parking program is planned for I-15. By providing real-time parking information on I-15, SANDAG expects increased intermodal trips from the freeway to express bus services operating at the future BRT stations. The pricing schemes that will be implemented for these transit parking lots will be designed to encourage the use of alternative modes.

3.10 Vision for San Diego I-15 Integrated Corridor Management

Guidance This vision statement portrays the state of the I-15 corridor and its operation via ICMS in the next five years, providing a platform for establishing goals and objectives. The vision statement is simple, easy to read, and accessible to a wide audience.

This chapter has focused on the current state of the I-15 transportation corridor, in particular, its operational characteristics, institutional stakeholders, and their ongoing relationships, problems, and needs of the corridor and its associated networks. This section begins the transition to the future of the I-15 corridor with a presentation of the vision statement developed and embraced by the corridor's stakeholders. This vision is a significant component of the ConOps because it lays the foundation for the future state of the I-15 corridor that will address the identified problems and needs as we move from phase to successive phase toward full implementation of an ICMS for the I-15 corridor.

Vision The San Diego I-15 ICMS transportation corridor will be managed collaboratively and cooperatively through ongoing partnerships among SANDAG, Caltrans, MTS, NCTD, the CHP, and the cities of San Diego, Poway, and Escondido.

Within approximately the next five years, the corridor will give travelers the ability to make seamless and convenient shifts among modes and among the corridor's networks to complete their trips, including shifts between the arterial and freeway networks and between the freeway's general purpose lanes and its managed lanes. Enhanced mobility for people, goods, services, and information will be achieved by integrating intelligent transportation system elements and through continued collaboration among the corridor's institutional partners to improve people and vehicle throughput, productivity, connectivity, safety, environmental compatibility, and enhancing accessibility to reach destination points in a reliable and timely manner.

To facilitate HOV use, travelers will be able to use Park and Ride facilities equipped with smart parking technologies at BRT stations along the corridor, and buses will have efficient access from the BRT stations to the Managed Lanes through DARs. The Managed Lanes, while also promoting HOV use, will serve multiple modes of transportation and operate as limited-access lanes in which carpools, vanpools, and buses have first priority and travel free of charge. Single occupancy vehicles will be able to legally use these lanes by paying a fee and physically gain access to them from general purpose lanes through ingress-egress points. The Managed Lanes will maintain free-flow conditions, and the volume of traffic will be controlled by regulating the toll fee through dynamic variable pricing.

All users in the corridor will be able to readily access traveler information from the regional 511 system via telephone, Internet, or public access television focused on the I-15 market, as well as strategically placed CMSs to allow travelers to make informed travel choice decisions. The 511 system will provide comprehensive, real-time, historical, accurate, and practical information and will allow travelers to connect to roadside assistance, if necessary, allowing them to travel more safely and with assurance of reaching their destinations in a reasonable and predictable period of time.

There will also be improved capacity on essential arterial segments to support shorter commute trips, as well as optimized arterial signal timing to increase people and vehicle throughput. Moreover, there will be real-time monitoring of operations via transportation management computer systems from the regional TMC and integrated transit service operations monitoring and dispatching.

4. SAN DIEGO I-15 ICMS OPERATIONAL CONCEPT

Guidance This chapter of the San Diego I-15 Integrated Corridor Management System (ICMS) corridor Concept of Operations (ConOps) describes the ICMS operational concept for the I-15 corridor based on stakeholder input. The proposed ICMS concept explains how things are expected to work once the ICMS program and system are in operation and identifies the responsibilities of the various stakeholders for making this happen. Information included in this chapter include the I-15 ICMS goals and objectives; the operational approaches and strategies to be implemented in response to the corridor problems and needs; gaps in the I-15 ICMS asset requirements when compared with current and planned for corridor assets; and proposed changes to the current technical, operational, and institutional situation within the corridor — providing a sense of the overall scope for the I-15 ICMS concept, alignment of the I-15 ICMS with the San Diego regional Intelligent Transportation System (ITS) architecture, the proposed institutional framework for the I-15 ICMS, and I-15 corridor performance measures and metrics. The I-15 ICMS concept also addresses the key system implementation issues, including how they may be resolved. An initial mapping of each selected I-15 ICMS strategy to the goal(s) and the corresponding need(s) it addresses is also developed.

4.1 Goals and Objectives

Guidance This section defines the I-15 corridor goals and objectives, which are formulated to address the current corridor conditions, deficiencies, and needs and to help achieve the long-term vision.

In the previous section we presented the stakeholders' ICMS vision of the future for the I-15 corridor and its associated networks. This vision is presented in general terms without a great deal of specificity. In this section, with the vision statement as our foundation, we proceed to the next step by transforming the vision statement into a set of specifically worded goals and objectives for the I-15 ICMS corridor based on stakeholders' input as shown in Table 4-1. The stakeholders developed the goals and objectives based on the Vision Statement and, in particular, in the context of addressing the I-15 corridor's existing problems and needs. Table 4-2 shows the relationships between ICM corridor goals with existing corridor problems and needs.

Table 4-1. I-15 ICMS Corridor Goals and Objectives

Goals	Objectives
The corridor's multi-modal and smart-growth approach shall improve accessibility for corridor travelers to travel options and attain an enhanced level of mobility	▪ Reduce travel time for commuters within the corridor ▪ Increase transit ridership within the corridor ▪ Increase the use of HOVs (carpools and vanpools) for commuters ▪ Increase person and vehicle throughput within the corridor on general purpose and managed lanes ▪ Increase person and vehicle throughput on arterials ▪ Reduce delay time for corridor travel on the corridor's networks (e.g., I-15 and arterials) ▪ Increase percentage share of telecommuters from corridor commuter market ▪ Increase the use of established and effective TDM programs ▪ Promote development to encourage the use of transit (especially BRT)

Table 4-1. I-15 ICMS Corridor Goals and Objectives (cont'd)

Goals	Objectives
The corridor's safety record shall be enhanced through an integrated multi-modal approach	▪ Reduce incident rate ▪ Reduce injury rate ▪ Reduce fatality rate ▪ Reduce roadway hazards

The corridor's travelers shall have the informational tools to make smart travel choices within the corridor	▪ Improve collection and dissemination of arterial network information
	▪ Collect and process data on the operational condition/status of all corridor networks, including
	  ▸ Comparative travel times between major origins and destinations
	  ▸ Construction, detours, and other planned road work
	  ▸ Occurrence and location of incidents
	  ▸ Expected delays
	  ▸ Number of parking spaces available at Park and Ride lots/structures
	▪ Disseminate, in a multilingual fashion, comprehensive, real-time, and accurate information to travelers within the corridor by means of multiple media (e.g., phone, computer, PDA/Blackberry, TV, CMSs, 'Next Bus' informational signs)
	▪ Make available archived historical data to travelers
	▪ Achieve a high level of 511 call volume and Web use
	▪ Achieve high overall satisfaction with 511 system

The corridor's institutional partners shall employ an integrated approach through a corridorwide perspective to resolve problems	▪ Improve level of institutional coordination among stakeholders by developing and executing a memorandum of understanding (MOU) among ICMS corridor partners by adapting the SANTEC organizational model and mission to the I-15 ICMS corridor ▪ Strengthen existing communication linkages among all corridor institutional stakeholders and establish new communication linkages where appropriate (e.g., business/industrial parks along the corridor) ▪ Enhance the regional/joint operations concept throughout the corridor ▪ Balance the needs of through traffic and local communities by coordinating construction and overall mitigation management on I-15 and arterials

Table 4-1. I-15 ICMS Corridor Goals and Objectives (cont'd)

Goals	Objectives
The corridor's networks shall be managed holistically under both normal operating and incident/event conditions in a collaborative and coordinated way	▪ Establish/enhance joint agency action plans to respond to congestion especially at I-15/arterial network interfaces and at the Lake Hodges choke point ▪ Develop/improve methods for incident and event management (e.g., data sharing) ▪ Reduce overall incident clearance time ▪ Identify means of enhancing corridor management across all networks (e.g., implement transit signal priority on selected components of arterial network)

The stakeholders produced five goals and associated objectives covering the following primary topics:

- Accessibility and mobility;
- Safety;
- Information for travelers;
- Coordination among institutional partners; and
- Network management.

San Diego County recently launched its regional 511 advanced traveler information system (511 ATIS) (http://www.511sd.com), which constitutes the primary (though not only) way in which the "Information for Travelers" goal and its associated objectives will be achieved.

In Table 4-2 the goals are mapped to the various corridor deficiencies and needs. Each listed deficiency/need must maps to at least one ICMS goal, and each ICMS goal corresponds to at least one deficiency/need. If the former was not satisfied, then at least one additional goal was developed; if the latter was not satisfied, then that goal was removed from further consideration. There are only two problems/needs mapped to a single goal, and the safety goal is mapped to the smallest number of problems/needs of all goals. In fact, the two congestion-focused problems are mapped to each of the five goals.

Table 4-2. Relationship Between Corridor Goals and Problems/Needs

Problems and Needs	Accessibility and Mobility	Safety	Traveler Information	Institutional Partners	Network Management
CONGESTION AND CAPACITY					
Increasingly congested conditions on I-15	■	■	■	■	■
Increasingly congested conditions on corridor's arterial network	■	■	■	■	■
Park and Ride facilities are not sufficient	■		■		■
TRANSIT					
Improve transit reliability	■		■	■	■
Provide real-time, comprehensive, and accurate information	■		■		
Provide frequent service	■		■		
Provide competitive service	■		■		
TRANSPORTATION SYSTEM MANAGEMENT					
Managing traffic flow between I-15 freeway ramps and adjacent arterials with ramp metering	■		■	■	■
Managing traffic flow on I-15 (General Purpose/Managed Lanes)	■		■		■
Limited access to HOV/HOT facilities	■				
TRAVELER INFORMATION SERVICES					
Minimal advanced traveler information services cover the corridor			■	■	
INTER-ORGANIZATIONAL COORDINATION					
Inter-jurisdictional/inter-organizational coordination and integration among corridor stakeholders				■	
Exchange and sharing of real-time data				■	■
Improved response times to non-recurring incidents		■		■	■

4.2 ICMS Approaches and Strategies for the San Diego I-15 Corridor

Guidance This section identifies the proposed ICMS approaches and strategies, how they satisfy the I-15 ICMS corridor's goals and objectives, how large the gaps are between the current and desired state-of-practice, and how likely they will be successfully implemented. A list of those approaches and strategies that likely will be part of the I-15 ICMS are included in this section.

To determine possible ICMS approaches and strategies for the San Diego I-15 corridor, a "corridor type" analysis was initially conducted based on the guidance provided by the U.S. Department of Transportation (DOT). It was found that:

- The corridor's type is: Roadway with Managed/Tolling Lanes and Transit Utilizing Roadway Right-of-Way (ROW). Other notable network characteristics are: arterials in parallel of freeway, bicycle paths along roadway, and Lake Hodges Bridge as a critical link on the corridor.
- Various types and events requiring ICMS, including recurring congestion, freeway incident, arterial incident, transit incident, special planned event, and disaster response. Some types of incidents/events encompass a wide range of potential durations (both short and long term) and severities.
- Regionwide ITS deployment provides solid infrastructure for corridor management for collaboration between transportation management agencies. At the current time support for coordinating with emergency response and public safety agencies beyond event notifications is limited.
- Available spare capacity does exist in the corridor. Cross-network shift between Managed Lanes and general purpose lanes is smooth. Cross-network shift between freeway and arterials faces physical and institutional challenges. Cross-network junctions between transit and roadway are being built rapidly.

The ICMS implementation guidance provided by the U.S. DOT defined the following five ICMS approaches:

1. Information sharing and distribution.
2. Improve operational efficiency of network junctions and interfaces.
3. Accommodate and promote cross-network route and modal shifts.
4. Manage capacity, or the demand relationship within corridor, in "real-time" for the short term.
5. Manage capacity, or the demand relationship within corridor, for the long term.

The ICMS Working Group identified specific ICMS approaches and strategies. First, these stakeholders identified potential ICMS strategies under each approach. Then, they reached consensus on the ranking of strategies according to three criteria: importance, gap, and likelihood of success. Importance reflects perceived potential benefit from implementing a strategy. Gap reflects perceived difference between current and desired state-of-practice. Likelihood of success reflects perceived likelihood of reaching the desired state-of-practice within the project time frame.

Most identified strategies were considered important to the I-15 corridor, and most of the important strategies fall into the following categories according to the combination of the gap rating and the success rating:

1. High likelihood of success and small to medium gap: those currently deployed, or in the pipeline.
2. High likelihood of success and large gap: recent technological advancement or institutional agreement is likely to lead to a leap forward.
3. Low to medium likelihood of success and large gap: there are significant barriers to bridging the gap. Significant investment can bring in large reward.
4. Low to medium likelihood of success and small to medium gap: there are significant barriers to bring partial implementation to the next level. Return on additional investment may be low.

The measures we used for the three criteria are highly qualitative rather than quantitative. Even a ten-point ranking scheme proved to be too controversial for consensus to be reached. Nevertheless, the qualitative categorization will assist in the prioritization of the strategies for staged deployment. Given that the San Diego I-15 corridor has already been a model for multi-modal deployment of the latest and evolving technologies, it is no surprise that many strategies fall into category 1. The likelihood of success often depends on the level of difficulty in getting agencies to work together or the amount of investment needed. Thus, people typically expect low likelihood of success goes together with large gap. However, in many occasions technological breakthroughs happened already, so the likelihood of success is high, but the gap is large either because the breakthroughs (e.g., information technology that facilitates the approach of sharing and distributing information) happened too recently, or the agencies are slow to adopt them for various reasons, one of which being transportation investment is often long term.

In Tables 4-3 through 4-7, ICMS strategies under each approach are mapped to the five corridor goals. "■" indicates a direct link between a strategy and a goal.

Table 4-3. Mapping of Strategies Under Approach 1

Share/Distribute Information	Relevance to Goals					Gap	Success	Category
	Access & Mobility	Safety	Traveler Info	Inst. Partners	Network Mgmt			
Manual information sharing				■	■	Small	High	1
Information clearing-house/ Information Exchange Network between corridor networks/agencies				■	■	Small	High	1
Pre-trip traveler information (511)	■	■	■	■	■	Small	High	1
En-route traveler information	■	■	■	■	■	Small	High	1
Access to corridor information by Information Service Providers (ISPs) and other value-added entities	■	■	■	■	■	Medium	High	1
Automated information sharing (real-time data)				■	■	Large	High	2
A common incident reporting system and asset management system		■		■	■	Large[1]	High	2
Archive historical data			■	■	■	Large[2]	Medium	3

[1] The gap is large only for arterials. For freeway, the gap is low.
[2] The gap is large only for arterials. For freeway, the gap is low.

Information sharing between corridor networks/agencies is traditionally conducted through established agreements and operation procedures. More recently, the IMTMS is deployed as a platform for automated information sharing. Field elements such as CMSs are used to inform en-route travelers. The regional 511 system was launched in February 2007.

Table 4-4. Mapping of Strategies Under Approach 2

Junctions/Interfaces Improvement	Relevance to Goals					Gap	Success	Category
	Access & Mobility	Safety	Traveler Info	Inst. Partners	Network Mgmt			
Signal pre-emption/“best route” for emergency vehicles		■		■		Small	High	1
Multi-modal electronic payment	■			■		Medium	High	1
Signal priority for transit				■		Large	Medium	3
Coordinated operation between ramp meters and arterial traffic signals in close proximity	■			■		Large	Low to Medium	3
Bus priority on arterial				■		Large	Medium	3
Transit hub connection protection (holding one service while waiting for another service to arrive)	■				■	Small	Medium	4
Multi-agency/multi-network incident response teams/service patrols and training exercises		■		■		Medium	Medium	4

The vision for I-15 ICMS stated that “Within approximately the next five years, the corridor will give travelers the ability to make seamless and convenient shifts among modes and among the corridor’s networks to complete their trips.” Improving operational efficiency at network junctions and modal interfaces builds a foundation for a larger corridor perspective.

A trip can be either unimodal (e.g. via personal car) or multi-modal. Individual modes that the ICMS focuses on includes personal car, carpool, and transit (vans, buses, and bus rapid transit (BRT)). During a trip, a traveler may change vehicle either because of modal change (e.g., car to bus) or because of transferring from one transit line to another, and a vehicle may stay on one road network or move from one to another. The corridor’s road networks include the freeway network, the Managed Lanes (a network within the freeway network), and the arterial network.

Accordingly, the corridor has the following junctions:

- Junctions that connect links within a network; for example, intersections in the arterial network.
- Junctions that connect links from different networks; for example, freeway on/off ramps and managed lane entry/exit points.
- Junctions that connect transit lines; for example, transit hubs.
- Junctions that connects different mode; for example, Park and Ride facilities.

In addition, at many junctions travelers and vehicles may need to be identified by the network through interfaces, such as electronic payment systems. As avoidable delays often occur at network junctions, the operational efficiency of network junctions and interfaces directly affects the travel time. Efficient operation at network junctions and interfaces is also the prerequisite for improving short-term network/modal shifts. Travel demand fluctuations and incidents may be better managed this way if the transition cost for such shifts is kept low.

Last but not least important, efficient operation at network junctions and interfaces can promote a long-term modal shift toward more transit use. Transit, if sufficiently utilized, provides a more efficient mode of travel than cars; however, a transit trip is often multi-modal, and may involve transfer between vehicles. Thus, network junctions and interfaces have a stronger impact on travel time and convenience for transit than for cars.

Because of the urgent need to accommodate emergency vehicles, signal preemption has been a standard practice for a long time. The Universal Transportation Account and multi-modal electronic payment make it convenient for travelers to make inter-modal trips. The likelihood of success for other strategies under this approach is mostly medium. Some of these strategies require the trade-off between different groups of users, and it is more difficult to find a win-win solution in these cases.

Table 4-5. Mapping of Strategies Under Approach 3

Accommodate/ Promote Network Shifts	Relevance to Goals					Gap	Success	Category
	Access & Mobility	Safety	Traveler Info	Inst. Partners	Network Mgmt			
Modify ramp metering rates to accommodate traffic, including buses, shifting from arterial	■			■	■	Medium	High	1
Promote route shifts between roadways and transit via en-route traveler information devices	■		■	■	■	Small	High	1
Congestion pricing for managed lanes	■				■	Small	High	1
Promote shifts between transit facilities via en-route traveler information devices (e.g., by comparing travel times)	■		■		■	Large	High	2
Modify arterial signal timing to accommodate traffic shifting from freeway	■			■	■	Large	High	2

The need to accommodate traffic and promote route shifts arises from temporary fluctuations of travel demand, or when an event interrupts the normal operation of a network and redistribution of traffic over networks is beneficial. With efficient operations at network junctions and interfaces and when there is spare capacity in some part of the integrated corridor, network/modal shifts are often cost-effective.

The I-15 corridor is characterized by configurable Managed Lanes. The managed lanes accommodate high occupancy vehicles (HOVs) and toll-paying, single-occupant vehicles. Congestion pricing is implemented to ensure efficient allocation of road capacity in real-time. In addition, travelers can be informed of all their transportation alternatives and the conditions on each route or be instructed to shift among modes and corridor networks.

It is notable that all strategies under the approach of improving modal/network shifts and enhancing event response recovery practices are highly likely to succeed. The technologies are mostly mature, and the agencies are willing to collaborate. When events happen on one network, users will try to use other networks, so it is either to accommodate and facilitate the shifts or to suffer the consequence of chaos brought about by a surge of unexpected visitors.

Table 4-6. Mapping of Strategies Under Approach 4

Capacity/Demand Management (Short-Term)	Relevance to Goals					Gap	Success	Category
	Access & Mobility	Safety	Traveler Info	Inst. Partners	Network Mgmt			
Lane use control (configur-able lanes/contra-flow)	■				■	Small	High	1
Modify HOV restrictions (increase minimum number, make bus only)	■				■	Small	High	1
Increase roadway capacity by opening HOV/HOT lanes/shoulders	■				■	Small	High	1
Scheduled closures for construction	■				■	Small	High	1
Coordinate scheduled maintenance and construction activities among corridor networks	■				■	Medium	High	1
Planned temporary addition of transit capacity	■				■	Medium	High	1
Modify parking fees	■				■	Large	High	2

When network shifts alone cannot fully absorb the impact of an event, short-term management of the relationship between capacity and demand is necessary. Applicable strategies either increase capacity or reduce demand temporarily. As such, they will be deployed only during major incident, events, and emergencies.

The first three strategies appear mode-focused because actions are to be taken by one agency (Caltrans) on one network (freeway). However, it should be kept in mind that the Managed Lanes are a “network within a network,” and the three strategies are relocating capacities among networks.

In addition, under ICMS, while the authority of taking certain measures still rests with individual agencies which are responsible for individual networks or jurisdictions, the agencies will take conditions on other networks into consideration. In these cases, corridor agencies rely on ICMS to provide decision support for such actions.

Table 4-7. Mapping of Strategies Under Approach 5

Capacity/Demand Management (Long-Term)	Relevance to Goals					Gap	Success	Category
	Access & Mobility	Safety	Traveler Info	Inst. Partners	Network Mgmt			
Peak spreading	■					Small	High	1
Ride-sharing programs	■					Small	High	1
Expand Transit Capacity	■					Large	Medium	3
Land-use around BRT stations	■					Large	Medium	3
High-Bandwidth Development	■					Small	Low	4

Long-term management of the relationship between demand and supply reduces temporal demand fluctuations and increases spare capacity. It enhances the effectiveness of operational strategies under Approaches 2, 3 and 4.

4.3 ICMS Asset Requirements and User Needs

Guidance — This section examines what is needed to implement the list of strategies that make up the I-15 ICMS corridor concept and are expressed as User Needs. Asset-based "requirements" are listed under categories of network systems, network subsystems and technologies, information, communications subsystems, and others.

For the successful corridor wide integration and implementation of ICMS strategies to occur, certain assets are required and particular needs should be satisfied. The individual agencies within the corridor already are actively managing their respective network via ITS. The asset requirements are generated with the ICMS strategy selection database tool provided by the U.S. Department of Transportation. For these individual systems, the asset requirements can be categorized as the following:

- Network Systems: required network-based systems – they are identified by the national ITS architecture nomenclature of "market package" for ease of reference to functionality.
- Network Subsystems and Technologies: the minimum network ITS-based requirements (e.g., specific field devices, hardware, and system functionality).
- Information: data and other information to be gathered by the network systems and subsequently shared among the stakeholders and corridor travelers.
- Communication: communications-related, including the types of communications (e.g., center-to-center) as identified in the national ITS architecture, interfaces to systems, and associated ITS standards.

Asset Requirements

Network Systems[3]	Network Subsystems and Technologies	Information	Communication	Multi-system
▪ HOV Lane Management ▪ Electronic Toll Collection ▪ Freeway Control ▪ Maintenance/Construction Vehicle & Equipment Tracking ▪ Maintenance and Construction Activity Coordination ▪ Network/Probe Surveillance ▪ Reversible Lane Management ▪ Roadway Closure Management ▪ Roadway Maintenance and Construction ▪ Roadway Service Patrols ▪ Surface Street control ▪ Traffic Incident Management ▪ Traffic Information Dissemination ▪ Work Zone Management ▪ Transit Fixed Route Operations ▪ Transit Passenger and Fare Management ▪ Transit Traveler Information ▪ Transit Vehicle Tracking ▪ Emergency Call Taking and Dispatch ▪ Emergency Routing ▪ Dynamic Ridesharing	▪ CMS-Roadway ▪ Electronic Toll Collection Equipment ▪ Emergency Vehicle Priority/ Preemption Equipment ▪ HOV Bypass ▪ Lane Control Signals ▪ Maintenance Vehicle AVL ▪ Ramp Metering ▪ Real-Time Conditions Database/Common Displays ▪ Roadway/Ramp Gates and Control ▪ Service Patrol Vehicles ▪ Traffic Detectors/Surveillance/ Probes ▪ Traffic Signal Control/ Monitoring ▪ CMS-Transit/Transit Public Address System ▪ Electronic Fare Payment ▪ Spare Transit Vehicles/Operators ▪ Transit Priority Equipment (intersection /vehicles) ▪ Transit Schedule Performance Monitoring	▪ CCTV cameras location and status ▪ Electronic toll/fare/parking equipment location and status ▪ HOT fares ▪ Intersection approach volumes ▪ Link information (volumes, occupancies, speeds, travel times, congestion levels) ▪ Link travel times - transit ▪ Maintenance/construction events/location/status ▪ Maintenance/service vehicle location ▪ Ramp meters location and status ▪ Ramp queues ▪ Surveillance/detectors/in-vehicle device location and status ▪ Traffic signals location and status ▪ Tolls ▪ Video images ▪ Available spare transit vehicles/location ▪ Schedules and headways; status/adherence	▪ Center-to-center ▪ Center-to-field ▪ Roadside-to-vehicle, vehicle-to-vehicle, & other device-to-device ▪ Communications subsystem capacity (data transmissions) ▪ Communications subsystem capacity (video transmissions) ▪ Communications subsystem capacity (voice, including interoperability) ▪ ITS Standards for data formats and data transfer functions ▪ Video transport standards ▪ Voice communications standards ▪ Interfaces to emergency service systems (CAD) ▪ Interfaces to financial transaction networks ▪ Interfaces to Internet ▪ Interfaces to ISPs ▪ Interfaces to legacy/proprietary systems ▪ Interfaces to network systems ▪ Security firewalls	▪ Regional ITS Architecture ▪ Regional Traffic Control ▪ Regional Parking Management ▪ Multi-Modal Coordination ▪ Corridor Models (simulation) ▪ Network/Common Displays for Data Entry/Display ▪ Data Aggregation/Storage of Processed Data for Subsequent Analysis ▪ Information Exchange ▪ System Back-up/Disaster Recovery ▪ Definitions of Responsibilities of Agencies ▪ Common Policies for Incident Reporting and Response ▪ Response Plans ▪ Special Event Plans ▪ Online Decision Support (for selecting response plans) ▪ Common Fare Collection Technology ▪ Integrated Back Office Systems

[3] See http://www.iteris.com/itsarch/html/mp/mpindex.htm for definitions of market packages

Asset Requirements (cont'd)

Network Systems	Network Subsystems and Technologies	Information	Communication	Multi-system
▪ ITS Data Mart/Warehouse ▪ Parking Facility Management ▪ Traffic Forecast/Demand Management	▪ Transit Vehicle Location/GPS ▪ Incident Detection (manual/automated) ▪ Incident Reporting System (GIS) ▪ Incident Response Plans/Guidelines ▪ Public Safety CAD ▪ Electronic Parking Payment ▪ Internet Traveler Information ▪ Parking Surveillance/ Occupancy	▪ Signal priority requests ▪ Transit fares ▪ Vehicle locations/next vehicle arrival/departure ▪ Vehicle occupancy ▪ Contact lists ▪ Emergency vehicle location ▪ HAZMAT information/tracking ▪ Incident location ▪ Incident status/details ▪ CMS device location and status ▪ Electronic payment account status ▪ Other traveler information device location and status ▪ Parking fees ▪ Parking space availability ▪ Special Event schedule/status		

In addition, the ICMS also requires:

- Regional/multi-system market packages, institutional assets (responsibilities and policies), and support tools.

Network systems, subsystems, internal communications, and information gathered separately are indispensable parts of ICM. However, it is the ICMS that leverages institutional agreements and facilitates the sharing of information through communications between network systems, prepares multi-system response, provides decision support.

Based on the development of our ICMS concept and its operational description, the following set of User Needs (Table 4-8) has been developed by the I-15 corridor stakeholders. This set of User Needs is complete and appropriate for the I-15 ICMS operational concept and that the planned I-15 ICMS must satisfy. The User Needs describe the operational functions of the proposed I-15 ICMS based on our vision, goals, and objectives for the system. Subsequent to development of the ConOps is the development of specific system requirements for the I-15 ICMS and these requirements will be explicitly derived from this set of User Needs.

Table 4-8. I-15 ICMS User Needs

ID Number	Title	Description/Rationale
1	Access/Store ICMS Configuration Data	This User Need provides for the creation and management of a configuration database instance that maintains static information on various parameters within the I-15 corridor.
2	Collect and Process Data	This User Need is the core service of ICMS that supports most of the system functionality. Data is collected from a variety of existing and planned systems according to Interface Control Documents, some of which need to be developed as new systems come on line. Once data is collected, certain processing algorithms are invoked that provide a higher level of information aggregation (e.g. volumes, occupancies and speeds at multiple locations are converted to travel times). Process Data function also includes conversion of host system data formats to standard XML schema for publishing information across the ICMS system.
3	Access/Store ICMS Historical Information	This User Need provides the capability to create and populate a historical database instance. This database contains real- time information on corridor performance as derived from data collected in the Collect and Process Data User Need. Accessing existing historical databases in ATMS 2005, RTMS and RAMS is an important function of this User Need. Having consistent export formats for data from these historical databases would simplify corridor-wide analysis. Ad hoc reporting based on this historical data allows the system users to create a variety of reports that characterize corridor operations and performance. These reports can then be stored in the ICMS historical database.
4	Publish Information to System Managers	This User Need disseminates ICMS data from all sources to agencies that manage one or more modes in the integrated corridor network: freeway, arterial, transit, public safety, commercial vehicles. This information is differentiated from the information published to system users (see User Need 11).
5	Interactively Conference with Multiple Agencies	This User Need allows system managers to directly collaborate in real-time prior to, during or after a major event in the I-15 Corridor. A variety of voice, video and data formats will be supported for multi-site collaboration.

Table 4-8. I-15 ICMS User Needs (cont'd)

ID Number	Title	Description/Rationale
6	Display Information	This User Need covers the ability to take information produced by ICMS and its subsystems and display a variety of data formats in a form that agency decision-makers can use to visualize corridor operations, make decisions and take actions to implement the various decision components.
7	Coordinate Transportation and Public Safety Operations	This is another core User Need for the I-15 ICMS because it addresses major institutional issues in getting the transportation and public safety communities to work closer together. This is accomplished by providing public safety users the multi-dimensional data inherent in transportation management systems while at the same time seeking technical solutions to extracting useful incident information from public safety Computer Aided Dispatch systems.
8	Share Control of Devices	This User Need allows agencies to remotely control selected functions of field devices regardless of location or agency ownership. For this User Need to become real there must be interagency agreements to allow such sharing under carefully defined conditions.
9	Manage Video Imagery	The San Diego region has a variety of video sources that provide a critical view of emerging and on-going events. These video sources can produce aerial, snapshot, archived clips and real-time imagery to a wide variety of system users via high-bandwidth links.
10	Respond to Corridor Planned and Unplanned Events	The Response Plan User Need allows ICMS users and Corridor Managers to use some form of decision tool (Expert System or table- driven) that fuses real-time data and manually-entered data derived from field communications at the event site (e.g. CHP Traffic Officers talking to dispatchers using the CHP radio system). The response plan is then either manually or automatically generated based on the fused data input. Once a response plan is generated, the system operator can review the plan's components and make changes as deemed necessary before transmitting plan components to the affected systems. The status of affected systems is then returned to the ICMS operator and logged in the historical database.
11	Assess Impact of Corridor Management Strategies	This User Need allows corridor managers to model various traffic and service management strategies for the corridor to gauge the impact of these strategies on corridor performance. The intent of this User Need is to model strategies and to return results within a time frame suitable to affect decision-making during a major event in the corridor. The impact results will be displayed to corridor managers in both 2D and 3D formats. This User Need will also be invoked for longer- term assessments.
12	Publish Information to System Users	This is the information dissemination User Need that parallels the Publish Information for System Managers. The intent of this User Need is to provide corridor information to the regional 511 system where it will be further disseminated to various classes of system users across a variety of media. This User Need will also make available a standard XML data stream and video imagery to other entities for dissemination to system users as SANDAG policy determines (e.g. direct feeds to the media).

Table 4-8. I-15 ICMS User Needs (cont'd)

ID Number	Title	Description/Rationale
13	Measure Corridor Performance	This User Need looks at multi-modal corridor data from both a short-term and long-term perspective. Existing historical databases for ATMS 2005, RTMS, RAMS, CAD systems, CPS and Smart Parking provide mode-specific data. Likewise PeMS provides a traffic and transit operations view of data. Based on these data sources, corridor demand will be analyzed using actual data or by demand modeling techniques. Using stored corridor configuration data, excess corridor capacity can be measured for any desired time period. This User Need will be most valuable for long-term corridor management.
14	Manage Corridor Demand and Capacity to Optimize Long-Term Performance	This User Need provides the ability for corridor managers to collaboratively develop longer-term corridor management strategies. These strategies include both capacity and demand management strategies. For example, a classic demand management strategy is ramp metering. A classic capacity management strategy is managed lanes. The goal of this User Need is to increase total corridor performance in the long-term by optimal balancing of capacity and demand.
15	Measure System Performance	This User Need provides for constant monitoring of field devices, server systems and communications networks needed to support the various integrated corridor management functions. Based on monitored data, metrics for system components such as reliability and availability will be measured and stored in the ICMS historical database.
16	Manage ICMS System	This User Need is the administrative function of ICMS. Data management for ICMS configuration data, user account management incorporating system-wide security functions and IT- centric functions such as data backup and archival are included within this User Need.
17	Document System and Train System Users and Maintainers	This User Need provides logistical support to the ICMS system through documentation and training.

4.4 Comparison of ICMS Asset Requirements with Current and Planned Assets

Guidance This section compares those assets that already exist, or will exist in the near-term, within the I-15 corridor with the needed ICMS assets. This analysis will guide proposed changes and subsequent development of detailed ICMS requirements.

In order to identify needed changes and additions to the corridor systems and operations, a comparison is made between the assets that already exist within the corridor or soon will exist and the needed ICMS assets. The result of the comparison is verified with the stakeholder consensus on gaps between current and desired practices. Subsequently, a designation is assigned to each asset according to the following classification scheme:

- A = Asset is extensively deployed throughout the corridor.
- B = Asset is moderately deployed within the corridor.
- C = Asset is minimally deployed within the corridor.

Tables 4-9 through 4-13 list the assets and their designations.

Table 4-9. Status of Network Systems Required Assets

Freeway	A	HOV lane management
	A	Electronic toll collection
	A	Freeway control
	A	Maintenance/construction vehicle and equipment tracking
	A	Maintenance and construction activity coordination
	A	Network/probe surveillance
	A	Reversible lane management
	A	Roadway closure management
	A	Roadway maintenance and construction
	A	Roadway service patrols
	A	Traffic incident management
	A	Traffic information dissemination
	A	Work zone management
Arterials	A	Maintenance/construction vehicle and equipment tracking
	B	Maintenance and construction activity coordination
	B	Network/probe surveillance
	A	Roadway closure management
	A	Roadway maintenance and construction
	B	Surface street control
	C	Traffic incident management
	C	Traffic information dissemination
	A	Work zone management
Transit	A	Transit fixed-route operations
	A	Transit passenger and fare management
	B	Transit traveler information
	A	Transit vehicle tracking
Emergency Response	A	Emergency call taking and dispatch
	A	Emergency routing
Others	A	Dynamic ridesharing
	A	ITS data mart/warehouse
	A	Parking facility management
	A	Traffic forecast/demand management

Among the network systems assets listed in Table 4-9, the mainline freeway facility, I-15, is equipped with 30 inductive loop detectors at approximately half-mile intervals across all lanes, 62 centrally-controlled metered ramps, CMSs prior to major interchanges, a digital CCTV surveillance system consisting of 15 cameras, and highway advisory radio. Radar detectors capable of scanning up to eight lanes also are installed at selected locations to supplement inductive loops. Currently in the reversible lane HOV/HOT environment, there is one electronic toll collection in each direction using the FasTrak® system, which charges a toll on a per-trip basis. Beginning in 2008 with the scheduled opening of the Middle Segment of the Managed Lane facility, there will be multiple intermediate access and egress points to the Managed Lanes. Tolls – referred to as value pricing – will be charged on a per-distance basis at this time.

For the transit network, MTS and NCTD already operate numerous bus stops and garage facilities along the I-15 corridor, and a new passenger rail system – SPRINTER – will include the Escondido station at I-15 as one of 15 transit stations along its path. Both operators have or are implementing sophisticated tracking and management systems that provide real-time status information used by staff in their respective operation centers.

Table 4-10. Status of Network Subsystems and Technologies Required Assets

Freeway	A	CMS-roadway
	A	Electronic toll collection equipment
	A	HOV bypass
	A	Lane control signals
	A	Maintenance Vehicle AVL
	A	Ramp metering
	B	Real-time conditions database/common displays
	A	Roadway/ramp gates and control
	A	Service patrol vehicles
	A	Traffic detectors/surveillance/probes
	A	Traffic signal control/monitoring
Arterials	C	CMS-roadway
	A	Emergency vehicle priority/preemption equipment
	A	Lane control signals
	C	Maintenance Vehicle AVL
	B	Real-time conditions database/common displays
	B	Traffic detectors/surveillance/probes
	B	Traffic signal control/monitoring
Transit	B	CMS-transit/transit public address system
	A	Electronic fare payment
	A	Spare transit vehicles/operators
	C	Transit priority equipment (intersection/vehicles)
	A	Transit schedule performance monitoring
	A	Transit vehicle location/GPS
Emergency Response	A	Incident detection (manual/automated)
	A	Incident reporting system (GIS)
	A	Incident response plans/guidelines
	A	Public safety CAD
Others	B	Electronic parking payment
	A	Internet traveler information
	B	Parking surveillance/occupancy

Table 4-11. Status of Information Required Assets

Freeway	A CCTV cameras location and status A CMS device location and status A Electronic toll/fare/parking equipment location and status A HOT fares B Link information (volumes, occupancies, speeds, travel times, congestion levels) B Link travel times - transit A Maintenance/construction events/location/status A Maintenance/service vehicle location A Ramp meters location and status B Ramp queues A Surveillance/detectors/in-vehicle device location and status A Traffic signals location and status A Tolls A Video images
Arterials	A CCTV cameras location and status A CMS device location and status B Intersection approach volumes B Link information (volumes, occupancies, speeds, travel times, congestion levels) B Link travel times - transit A Maintenance/construction events/location/status A Maintenance/service vehicle location A Surveillance/detectors/in-vehicle device location and status A Traffic signals location and status A Video images
Transit	A Available spare transit vehicles/location A Schedules/headways and status/adherence C Signal priority requests A Transit fares B Vehicle locations/next vehicle arrival/departure B Vehicle occupancy
Emergency Response	A Contact lists A Emergency vehicle location A HAZMAT information/tracking A Incident location A Incident status/details
Others	A Electronic payment account status B Other traveler information device location and status A Parking fees B Parking space availability A Special Event schedule/status

Table 4-12. Status of Communications Subsystems Required Assets

Operational Components	A Center-to-center A Center-to-field B Roadside-to-vehicle, vehicle-to-vehicle, and other device-to-device
Capabilities and Standards	A Communications subsystem capacity (data transmissions) A Communications subsystem capacity (video transmissions) A Communications subsystem capacity (voice, including interoperability) A ITS Standards for data formats and data transfer functions A Video transport standards A Voice communications standards
Interfaces	B Interfaces to emergency service systems (CAD) B Interfaces to financial transaction networks B Interfaces to Internet B Interfaces to ISPs A Interfaces to legacy/proprietary systems A Interfaces to network systems
Security	A Security Firewalls

Table 4-13. Status of Multi-System Required Assets

Regional Management	A Regional ITS Architecture B Regional Traffic Control B Regional Parking Management B Multi-Modal Coordination B Corridor Models (simulation)
Information Systems	A Network/Common displays for data entry/display A Data aggregation/storage of processed data for subsequent analysis A Information Exchange System back up/disaster recovery
Institutional Agreements and Plans	A Definitions of responsibilities of agencies A Common policies for incident reporting and response A Response plans A Special Event Plans C Online decision support (for selecting response plans)
Technology Integration and Support	A Common fare collection technology C Integrated back office systems

The San Diego I-15 corridor has and/or will have in the near term, the following critical assets that distinguish the corridor from others:

- 511 ATIS, launched in February 2007
- IMTMS, implemented in June 2006
- Freeway, arterial, and transit performance monitoring system (PeMS): freeway PeMS, usually referred to as simply PeMS is already operational; arterial PeMS (A-PeMS) and transit PeMS (T-PeMS) are currently scheduled for implementation in the San Diego region in December 2009 – March 2010 and June 2010 – December 2010, respectively.
- Regionwide adoption of QuicNet 4 (and its upgrade to QuicNet 4+) traffic signal control platform
  - Pilot Implementation Phase (regionalization of QuicNet 4+ with Caltrans, San Diego, and Chula Vista): July 2008
  - Integration of QuicNet 4+ into the IMTMS environment: August 2009
  - Full Implementation Phase (regionalization of QuicNet 4+): November 2009
- Managed Lanes, together with Value Pricing, is currently under phased construction according to the following schedule:
  - Middle Segment (July 2008 – January 2009 in a phased implementation)
  - North Segment (January 2012)
  - South Segment (January 2013)
- BRT with direct access ramps (DARs) is currently under phased construction consistent with the schedule above for the three segments of Managed Lanes construction. As construction of each Managed Lane segment is completed and opens for service, the BRT Stations within that segment are also scheduled to become operational. New high-capacity buses operating with more frequent service than previously, together with bus arrival information, are currently scheduled to be available when all three Managed Lanes segments are complete.

As the I-15 Managed Lanes are currently under construction within the corridor, every effort is being made to minimize delay to travelers using the freeway. A transportation management plan (TMP) was developed in coordination with construction contract plans to implement a number of strategies to reduce project related traffic impacts, delay, and accidents. The primary goals of the TMP are:

- Reduce traffic demand and delay time to less than 15 minutes above normal recurring traffic delay;
- Manage/maintain traffic flow throughout the corridor and surrounding areas; and
- Provide a safe environment for the work force and motoring public.

The TMP strategies used are:

- Dissemination of information to the public
- Dissemination of information to motorists
- Incident management
- Construction
- Demand management:
- Alternate routes/detours

The I-15 construction work zone activities will utilize an ICMS strategy similar to that for handling special events as construction activities are planned in advance (See Section 5.5). The work zone timeline would be as follows:

1. Caltrans plans, develops and refines the TMP and traffic control plan (TCP) for specific work zones and submits it to corridor partner agencies for their input.

2. Caltrans uses the lane closure system (LCS) to transmit work zone information to IMTMS, which in-turn disseminates the information to partner and public safety agencies and local jurisdiction traffic control systems.
3. IMTMS receives input on planned work zones from local, partner, and public safety agencies, including needed improvements or additional services, and Caltrans makes adjustments as appropriate.
4. Caltrans, local, and other partner agencies confirm approvals in IMTMS and implements the approved TMP and TCP.

The three most important additions to ICMS assets with current expected completion dates are the following:

- VCTMC/decision support system, with completion date of March 2011 (start of operations of I-15 ICMS)
- Transit signal priority on NCTD Bus Route 350, a bus feeder for BRT system, August 2009
- Improved data collection, incident reporting, and data archiving for arterials
  - Pilot Phase, December 2009
  - Full implementation (ICMS Phase III demonstration), March 2010

The stakeholders suggested that a VCTMC be established to take a lead role in corridor management. This center would enable further integration of ICMS functions. In order to establish this center, current operational agreements could be amended. For example, operational agreements have recently been established between institutional partners for the Mission Valley Event Management project. Similar agreements can be established for the I-15 corridor management and provide a platform for the VCTMC operation. VCTMC would take advantage of the information sharing infrastructure provided by the IMTMS.

In January 2006, Congress appropriated $4.35 million for establishing the San Diego Joint Transportation Operation Center (JTOC). $1.67 million was included in Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) for FY 2006 through FY 2009 under the category of Bus and Bus Facilities. The eventual goal of the JTOC project is to integrate the transportation, transit, and public safety and security functions into a single regional operation, incident, and event management facility. The goal of the first stage is to integrate transportation operations. The estimated total cost is $16.8 million. The ICM Working Group suggested that the VCTMC be supported by the JTOC funding and serve as a corridorwide pilot for the regional JTOC. Further details on the VCTMC are provided in Section 4.5.

Transit signal priority reduces transit vehicle travel time and improves reliability. Although the regionwide adoption of QuicNet 4 traffic signal control platform makes it less complicated for cross-jurisdictional coordination, transit signal priority is yet to be deployed on arterials in the corridor.

Improved data collection and traffic monitoring are needed on the I-15 corridor arterials. Table 3-4 outlines suggested additional count stations in the cities of Poway and San Diego. In addition, several count stations may be needed in the city of Escondido. Centre City Parkway (including connections to I-15 at both the north and south ends), Mission Avenue, Valley Parkway, Ninth Avenue, Via Rancho Parkway, and Escondido Boulevard are impacted by I-15 traffic attempting to go south. Most of these roadway connections to I-15 have nearby signalized and unsignalized intersections, which compound the congestion impacts for both roadways. The occasional backup of traffic on I-15 also periodically impacts eastbound to southbound traffic on SR 78 in Escondido. Traffic overflows onto city streets at Centre City Parkway, Broadway, and at Nordahl Road, where traffic continues on Citracado Parkway/Vineyard Avenue/Auto Park Way or Mission Road. Either traffic traveling on I-15 diverts to Escondido surface streets to bypass freeway stoppages, or drivers from Escondido and other north county cities use city streets to attempt getting ahead of other traffic headed for southbound I-15 and other destinations. Most of the time this effect also impacts Felicita Road to reach the Citracado Parkway southbound I-15 on-ramp.

Assuming these stations are constructed as part of the I-15 ICMS project, the cities' current staff will be able to operate these stations as part of their daily tasks. The traffic data (volume and speed) will be linked directly to the main TMC (Caltrans) and the cities' TMC. The traffic data from the local arterial, combined with the data from the freeway, can be used to trigger specific timing plans.

The data transfer from the count stations to the nearest traffic signal will be either hard-wired or wireless. From the traffic signal the data will transferred via fiber signal communication cable to cities' TMC where the QuicNet 4 is located. The Regional Arterial Management System (RAMS) connects Caltrans' TMC to the cities' QuicNet 4.

Summarized in Figure 4-1 (pages 4-22 and 4-23) is the timeline/schedule for the operational deployment of assets discussed in this section and previously.

4.5 Operational Description of ICMS Concept (High-Level/General)

Guidance — This section provides a general description of the I-15 corridor under ICMS. This description provides all stakeholders with a consistent picture of what is envisioned for the corridor and provides a basis to identify roles, responsibilities, and needs.

In the future the I-15 corridor ICMS will provide, to the greatest extent possible, efficient and reliable travel throughout the corridor and the constituent networks, resulting in improved and consistent trip travel times. Using cross-network strategies, the corridor will capitalize on integrated network operations to manage the total capacity and demand of the system in relation to the changing corridor conditions.

The daily operation of the corridor will be similar to the transportation command center model (i.e., Mission Valley East pilot) that has been used for major special events (i.e., Super Bowl XXXVII in 2003 in San Diego), but will now be applied on a permanent basis for day-to-day operations. This will be accomplished via a VCTMC operating among the corridor agencies. This VCTMC will operate the ICMS as a "sub-regional" system, managing the various networks and influencing trips that use the corridor. The VCTMC is run by a coordinator jointly appointed by collaborating agencies, and the coordinator is supported by existing staff within respective agencies. While the city of San Diego, MTS, and Caltrans may provide dedicate support staff and co-locate them, other stakeholder agencies may provide remote though non-dedicated support with existing staff.

The responsibilities of the VCTMC include:

- investigate and prepare corridor response plans for various scenarios that can be expected to occur within the corridor
- develop and deploy a decision support system (DSS) to be used by the coordinator and support staff from corridor agencies
- organize multi-agency incident response exercises regularly to update response plan, improve the DSS, and ensure response readiness
- monitor corridor travel conditions 24/7, activate response plans and inform corridor agencies

Desirable features of the DSS are:

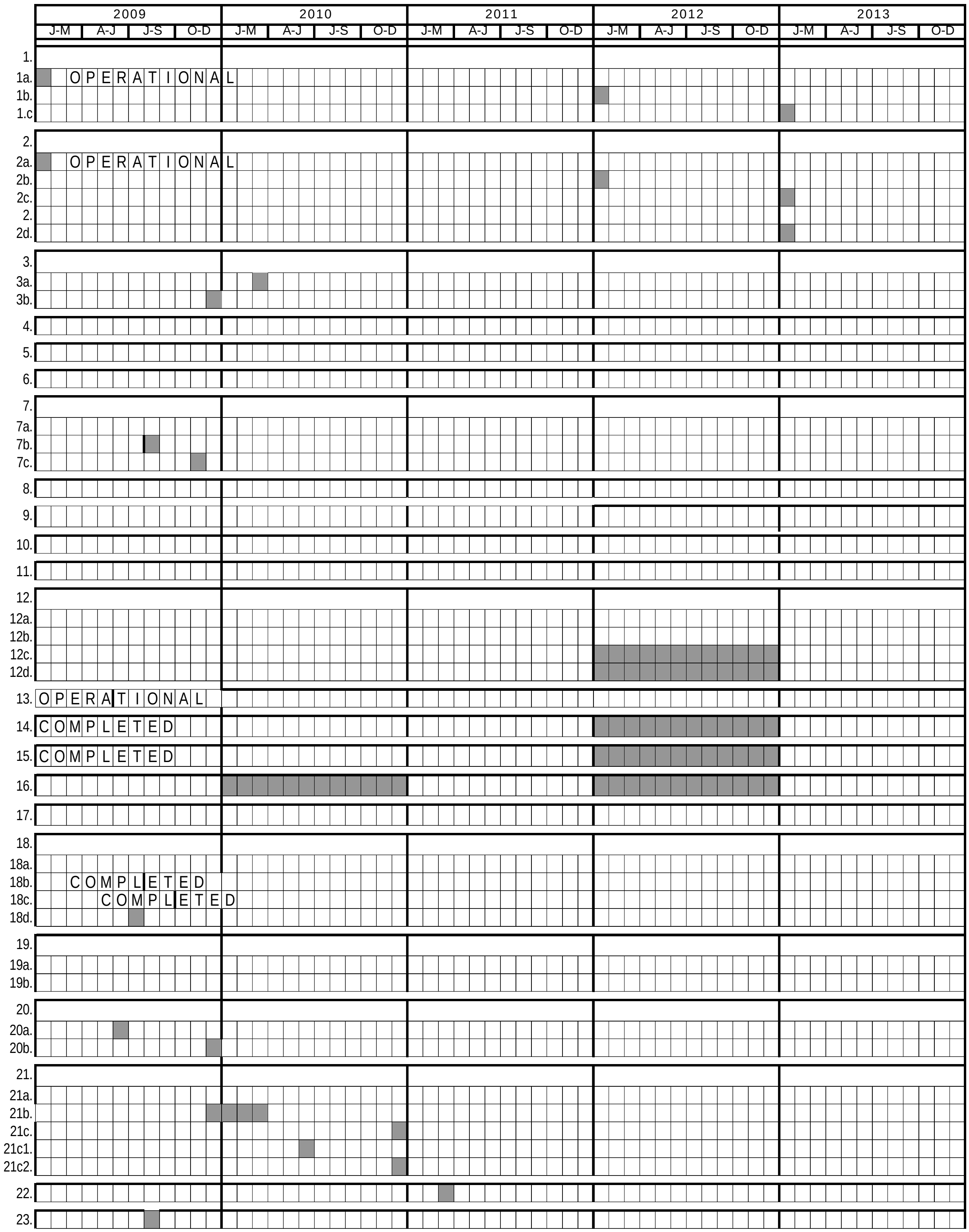
- help the coordinator identify scenarios and activate response plans
- help agency staff implement response plans to minimize the overall impact of incidents

The VCTMC will deploy the DSS over the infrastructure of the Inter-Modal Transportation Management System (IMTMS). Voice, data, video, information, and control will be provided to all agencies based on the adopted protocols and standards for the sharing of information and the distribution of responsibilities.

Figure 4-1. Timeline – Schedule For Operational Deployment Of Assets

	2007			2008			
	J	J-S	O-D	J-M	A-J	J-S	O-D
1. Managed Lanes Control System (MLCS) (together w/Congestion Pricing System)							
a. Middle Segment (phased deployment)						■	■
b. North Segment							
c. South Segment							
2. Bus Rapid Transit Stations and Direct Access Ramps							
a. Middle Segment (phased deployment)						■	■
b. North Segment							
c. South Segment							
2. Bus Rapid Transit							
d. New vehicles, more frequent service, Next Stop arrival signage							
3. Arterial Data Collection Capabilities							
a. A-PeMS initial deployment phase along primary I-15 arterials*							
b. Initial Pilot implementation beyond I-15 arterials							
4. Advanced Transportation Management System (ATMS 2005)	■	OPERATIONAL					
5. Intermodal Transportation Management System ((IMTMS) less RIWS and RAMS)	■	OPERATIONAL					
6. Lane Closure System (LCS)	■	OPERATIONAL					
7. Regional Arterial Management System (RAMS)							
a. Initial deployment phase						■	
b. Integration of QuicNET 4+ into the IMTMS environment							
c. Full Implementation Phase (regionalization of QuicNET 4+)							
8. Regional Event Management System ((REMS) currently is CHP CAD)	■	OPERATIONAL					
9. Regional Integrated Work Stations (RIWS)	■	OPERATIONAL					
10. Regional Transit Management System (RTMS)	■	OPERATIONAL					
11. CHP Media Incident Feed and Integration into IMTMS Environment	■	OPERATIONAL					
12. Regional Communications Networks							
a. Communication plan with gaps identified and most cost-effective strategies identified; 90% complete by 2012					COMPLETED		
b. South Segment of Managed Lanes					COMPLETED		
c. Middle Segment of Managed Lanes							
d. North Segment of Managed Lanes							
13. Caltrans Fiber Optic Network Installed in Two Phases on I-15 Corridor							■
14. Upgrades in Freeway Management System Monitoring Capabilities (more detectors & full coverage CCTV) in Two Phases							
15. Revised/Upgraded Incident Management Procedures for Automated Detection and Response in Two Phases							
16. Expanded Implementation of Changeable Message Signs (Dynamic Along I-15 Managed Lanes in Two Phases)							
17. Upgrading of I-15 Reversible Lane Control System (RLCS) on South Segment of I-15 Managed Lanes System		COMPLETED					
18. Compass Card Financial Clearinghouse System							
a. Pre-test phase		COMPLETED					
b. Employee initial test phase (SANDAG, MTS, NCTD)		|					
c. Mini-customer pilot test				|			
d. Full system launch							
19. 511 Advanced Traveler Information System							
a. Initial system launch for phone and web		COMPLETED					
b. Launch for public access TV channel				COMPLETED			
20. Smart Parking System (SPS)							
a. Initial deployment phase (Coaster commuter rail stations along I-5)							
b. Framework for regional extensibility							
21. Performance Monitoring System (PeMS) for San Diego Area Data							
a. Freeway	■	OPERATIONAL					
b. Arterial (see #3 above)							
c. Transit							
c1. Framework of functionality						■	
c2. Initial deployment							
22. VCTMC/Decision Support System							
23. Transit Signal Priority on NCTD Bus Route 350 in Escondido (BRT Feeder)							

*Centre City Parkway, Pomerado Road, Kearny Villa/Black Mountain Road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While all the ICMS operational strategies will be available, it is envisioned that only a subset of these strategies will be activated at any one time, depending on the operational conditions and events within the corridor. The VCTMC will conduct desktop scenario sessions to prepare, train, and refine response plans for incidents, special events, weather, and evacuations. All supporting staff will know their respective roles and responsibilities and will be aided, when available, by response plans and ICMS decision-support software. Moreover, the coordinators will be able and authorized to improvise as situations may dictate.

Corridor-based traveler information will be made available on 511, Web sites, CMSs, and through the media and ISPs, presenting corridor trip alternatives complete with current and predicted conditions. Travelers will access or be given real-time corridor information so they can plan or alter their trips in response to current or predicted corridor conditions.

Each traveler will easily be able to make route and modal shifts between networks due to integrated corridor information, integrated fare/parking payment system, and coordinated operations between networks.

Travelers will be able to educate themselves about the corridor so they can identify their optimal travel alternatives and obtain the necessary assets (e.g., smart card and available parking) to facilitate their use of corridor alternatives when conditions warrant.

4.6 Alignment with Regional Architecture

Guidance — This section compares the ICMS concept to the regional ITS architecture to identify any possible issues and needs that may arise during the ICMS design and deployment. Any potential revisions and/or enhancements to the regional ITS architecture are identified.

As discussed in Section 3.7, the San Diego regional ITS architecture has been approved by the FHWA and the SANDAG Board and has an associated architecture maintenance plan. The ICMS Working Group, with representatives of the SANDAG's Regional ITS Architecture Committee, have conducted a high-level comparison of the regional ITS architecture and the I-15 corridor ICMS concept. Their findings are as follows:

- Major focus areas of the regional ITS architecture include real-time information sharing (data and video) between all agencies and providing a clearinghouse of real-time information covering all critical routes and modes within the region. The I-15 ICMS includes these same functions (focusing on the "sub-region" as defined by the I-15 corridor's boundaries). In fact, the I-15 ICMS will represent the initial implementation of freeway/transit/arterial coordinated operations and the information sharing/storage capabilities in support of this functionality.
- The regional ITS architecture provides a comprehensive review of ITS standards and how they apply to San Diego's ITS projects. For the I-15 corridor project, specific standards must be selected and applied as part of the corridor system's engineering process. The currently deployed IMTMS project already uses existing XML data-definition standards that will form the backbone of further standards implementation along the I-15 corridor.
- Another function of the regional ITS architecture is regional coordination support between transportation agencies and public safety agencies during "major" incidents, construction activities and special events, (i.e., those for which the impacts cross most of the agency boundaries). The ICM concept includes such inter-agency coordination, but goes much further to address the integrated operations of the corridor networks on a daily basis, including recurring congestion and minor incidents.
- The regional ITS architecture provides the technical basis for inter-agency operations and control of system components; however, each organization in the region and the corridor currently operate independently, maintaining control of all aspects of their respective systems. The I-15 ICM concept changes this mode of operations, providing for proactive management of cross-network operations within the I-15 corridor, particularly during major incidents and events.

The I-15 ICMS concept is consistent with the regional ITS architecture. There are no conflicts, per se; but the ICMS concept does include significantly more information sharing (including command and control functions) and integrated operational capabilities than provided by the San Diego regional ITS architecture. Moreover, the ICMS concept includes a Virtual Joint Traffic Operations Center (VJTOC), which is not addressed in the regional architecture.

The I-15 ICMS Working Group will propose to the Regional ITS Architecture Committee that the current regional architecture be modified to include the sub-regional ICMS concept and integrated operation of I-15 corridor networks and systems. This will include the depiction of new centers such as the VJTOC. Moreover, the I-15 ICMS Working Group will coordinate with the Regional ITS Architecture Committee to ensure that the specific ITS standards identified for the I-15 corridor are consistent with regional use.

4.7 Implementation Issues

Guidance This section reviews and discusses I-15 ICMS corridor concept issues, including any related strategy and system implementation issues. By identifying these issues, the stakeholders developed a joint understanding of their impact on the successful development and implementation of the ICMS concept. Many of these issues will involve choices that cannot be fully addressed and subsequently resolved until later stages of the systems engineering process (e.g., design, procurement, and implementation).

Based on the discussion in Section 4.2 (ICMS Approaches and Strategies for the San Diego I-15 Corridor), the following issues have been identified by the I-15 corridor stakeholders. These issues comprise technical, operational, and institutional components of the I-15 ICMS concept.

Technical Issues

- Data archiving and accessibility for future analyses
- Modifying/updating San Diego regional ITS architecture to bring it into alignment with I-15 ICMS concept
- Use of regional transit fare system (Compass Card) across multiple transit service providers
- Expansion of functionality for 511 advanced traveler information system

Operational Issues

- Enhancing transit capacity in response to planned events and major incidents
- Implementing bus signal priority for transit on arterials
- Coordinating different operating systems across agencies to work together (e.g., I-15 freeway on-ramp metering signals with adjacent arterial traffic signals)
- Fully integrating commercial vehicle operations into I-15 ICMS concept

Institutional Issues

- Establishing policies and arrangements with private entities (parking, information service providers, and major employment centers along the I-15 corridor)
- Compatibility of VCTMC responsibilities for I-15 ICMS corridor stakeholders with their conventional responsibilities
- Expansion of set of organizational stakeholders as part of the I-15 Corridor Management Team beyond those that are only transportation-focused (e.g., public health agencies)
- Enhanced level of inter-organizational coordination and integration among corridor stakeholders

4.8 Institutional Framework

Guidance This section describes the proposed institutional framework for the I-15 ICMS corridor by which the ICMS concept will be implemented, operated, managed, and maintained. The section explains how the institutional framework will be established, the responsibilities of the various units that comprise the framework, the composition of leadership and staff, the distribution of decision-making authority, and how the framework will facilitate necessary external corridor interactions. The institutional framework proposed for the I-15 ICMS corridor is an approach that is supported by all I-15 corridor stakeholders that will be implemented.

This section identifies the performance measures and targets that will be used to evaluate ICMS operations in San Diego. It reviews how the selected performance measures are related to the San Diego corridor goals and objectives (Table 4-2 in Section 4.1), what level of each measure will indicate operational success, and methods for data collection and processing to obtain performance measures estimates.

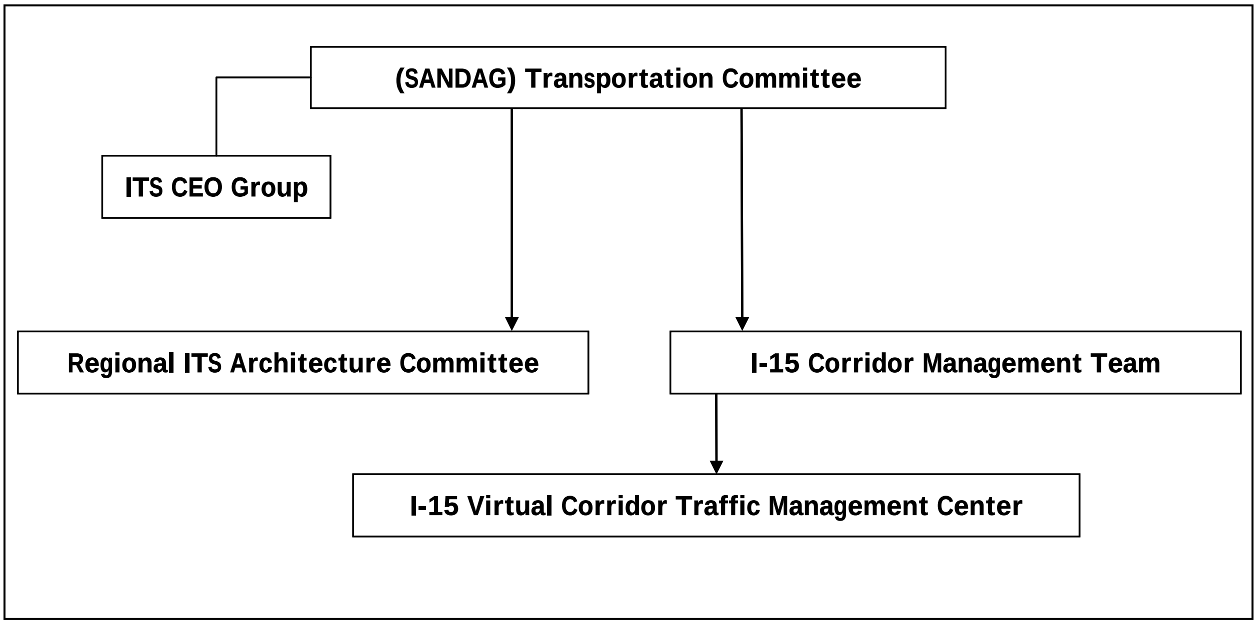
SANDAG's committee structure provides the backdrop for the I-15 ICMS institutional framework. Overall, these committees provide opportunities for involvement in regional programs by citizens, elected officials, agency staff, and representatives of civic and community groups. Some, such as the Transportation Committee, are standing committees responsible for policy direction and review, while others are established on an ad hoc basis to assist with specific projects. The Transportation Committee advises the SANDAG Board of Directors on major policy-level matters related to transportation. The committee assists in the preparation of the Regional Transportation Plan and other regional transportation planning and programming efforts. It provides oversight for the major highway, transit, regional arterial, and regional bikeway projects funded under the Regional Transportation Improvement Program, including the *TransNet* Early Action Program. Areas of interest include project schedules, costs, and scope.

Because of the significance of intelligent transportation, the ITS Chief Executive Officer (CEO) Working Group will report to the Transportation Committee. The ITS CEO provides executive oversight and policy for the region's ITS program. Participants include the CEOs from SANDAG, Caltrans, MTS, NCTD, and the Mayor's representative from the city of San Diego. This Working Group provides a forum for the executives to discuss strategy, address problem resolution, receive status reports, and provide direction to ITS project managers. New projects and potential grant proposals are also proposed to key executives at this meeting for partnership discussion and commitment. There will be two additional groups – the Regional ITS Architecture Committee and the I-15 Corridor Management Team. The I-15 Corridor Management Team will be the primary decision-making body for the I-15 ICMS corridor and will consist of leadership-level representatives from each of the stakeholders in the I-15 ICMS corridor. Members of the team will manage the distribution of responsibilities, the sharing of control, and related functions among the corridor partners. The I-15 Corridor Management Team will be responsible for establishing the necessary inter-agency and service agreements, budget development, project selection and initiation, corridor operational policies and procedures, and overall administration.

The Regional ITS Architecture Committee, which will continue to support the I-15 Corridor Management Team, as well as continue to maintain San Diego County's regional ITS architecture, will expand its responsibilities to promote coordinated operations within the various corridors that make up the region, as well as addressing any "inter-corridor" operational issues (i.e., be the coordinator of multiple corridor operation panels and ICMSs).

As previously discussed in section 4.5 (Operational Description of ICMS Concept), the VCTMC will handle the daily operations of the I-15 ICMS corridor. The VCTMC will, by its very name, be a virtual center operating across and linking together each of the I-15 corridor partner agencies. Its position in the institutional framework is shown in Figure 4-2.

Figure 4-2. Institutional Framework for I-15 ICMS



Each of the I-15 ICMS corridor partners will have specific responsibilities they will perform as part of ICMS operations. Each participating agency, its responsibilities, and its representatives who staff the VCTMC are depicted in Table 4-14. Of particular significance is the fact that the positions listed under the "VCTMC Aligned Staff" are ones that are leveraged off of existing positions across I-15 corridor stakeholder agencies. In addition to the primary stakeholder partners, we also list additional organizations whose participation is crucial to the proper operation of the VCTMC, including local law enforcement agencies, emergency response service providers (such as fire and paramedic), and the County Office of Emergency Services.

4.9 Performance Measures for Evaluation of San Diego ICMS Operations

Guidance — This section identifies the performance measures and targets that will be used to evaluate ICMS operations on the San Diego I-15 corridor. The information herein should address how the performance measures are related to the I-15 corridor goals and objectives, what level of each measure will indicate operational success, data collection methods and performance measure processing techniques, and the relationships between the corridor performance measures and network-specific measures.

This section identifies the performance measures and targets that will be used to evaluate ICMS operations in San Diego. We describe how the selected performance measures are related to the San Diego corridor goals and objectives (Table 4-15 with reference to Table 4-2 in Section 4.1), what level of each measure will indicate operational success (Table 4-16), and methods for data collection and processing to obtain performance measures estimates.

Table 4-14. Virtual Corridor Traffic Management Center Staff

Agency/Service	Responsibilities	VCTMC Aligned Staff
Virtual Corridor TMC*	▪ Corridor coordination of operations ▪ Corridor administration ▪ Corridor performance monitoring ▪ Corridor technical management and development	▪ TMC Manager ▪ Technical support staff
SANDAG	▪ Corridor operations ▪ 511 operations and maintenance ▪ Freeway Service Patrol ▪ Toll operations (contractor) ▪ Enact response plans	▪ Senior Transportation Planner ▪ Technical support staff
Caltrans (District 11)	▪ Corridor operations ▪ Monitor freeway traffic flow ▪ Operate field devices ▪ Freeway monitoring ▪ Travel times on freeway ▪ Maintenance ▪ Enact response plans	▪ TMC Manager ▪ Technical support staff
City of San Diego	▪ Corridor operations ▪ Signal systems ▪ CMSs on arterials ▪ Arterial monitoring ▪ Enact response plans ▪ Maintenance	▪ City Traffic Engineer ▪ Technical support staff
City of Escondido	▪ Corridor operations ▪ Signal systems ▪ CMSs on arterials ▪ Arterial monitoring ▪ Enact response plans ▪ Maintenance	▪ City Traffic Engineer ▪ Technical support staff
City of Poway	▪ Corridor operations ▪ Signal systems ▪ CMSs on arterials ▪ Arterial monitoring ▪ Enact response plans ▪ Maintenance	▪ City Traffic Engineer ▪ Technical support staff
MTS	▪ Corridor operations ▪ Monitor bus operations ▪ Enact response plans	▪ Senior Planner ▪ Technical support staff
NCTD	▪ Corridor operations ▪ Monitor bus operations ▪ Enact response plans	▪ Senior Planner ▪ Technical support staff
CHP and Local Law Enforcement	▪ Coordination of law enforcement activities and incident response	▪ CHP/local law enforcement staff ▪ Technical support staff
Fire-Rescue Departments	▪ Emergency response	▪ City emergency staff ▪ Technical support staff
County Office of Emergency Services (OES)	▪ Coordination of emergency services activities and response ▪ Service Authority for Freeway Emergencies (SAFE)	▪ County OES staff ▪ Technical support staff

Located at SANDAG

Table 4-15. San Diego ICMS Goals and Selected Performance Measures

Goal	Performance Measure
Accessibility and Mobility	▪ Average travel time per trip for the corridor and each network ▪ Average delay per trip (for the corridor and each network) ▪ Travel time reliability measures – Travel time index (ratio of peak period travel times to free-flow travel time – Buffer index: extra time needed to be on-time 95% of the time ▪ Person and vehicle throughput – Freeways (general purpose & managed lanes) ▪ Vehicle hours traveled ▪ Mode shift to other modes – Carpool and vanpools – Transit – Telecommute
Safety	▪ Incident rate ▪ Accident rate – Injury, fatality
Information for Travelers	▪ Accurate travel time information – Per origin-destination pair – Incidents – Per mode – Work zones – Special events ▪ 511 system usage
Coordination Among Institutional Partners	▪ Number of instances of inter-organizational coordination among corridor stakeholders ▪ Level of satisfaction with inter-organizational coordination measures based on institutional feedback
Network Management	▪ Incident response and clearance times ▪ Multi-jurisdictional signal coordination and signal priority ▪ Coordinated freeway arterial/operations

4.9.1 Performance Measures Targets

Performance measures targets to identify success include quantitative measurements to assess if the goals of the corridor have been achieved. Examples include average travel times for long trips or travel time reliability measures (buffer time). Other measures can only be assessed in qualitative terms. Examples include seamless integration of data archival systems and coordinated operation of the stakeholder agencies in responding to major incidents or special events.

Table 4-16 lists thresholds (or targets) for selected performance measures for the San Diego ICMS corridor. The values represent long-term targets, and the specific values are preliminary and subject to revision.

The various targets for travel time index represent our synthesis of existing academic literature and industry practices. So are the targets for incident response and clearance time. The buffer index comes from the fact that according to PeMS data for the corridor, the amount of extra "buffer" time needed to be on time 95 percent of the time is 30 percent of the free-flow travel time.

The travel time targets are set on the following basis: freeway HOV is assumed to be kept at free-flow condition, and the average travel time of 20 minutes over 21 miles is taken from PeMS data. The freeway travel time target (22 minutes) is the product of free-flow travel time and the target travel time index of 1.1. In Appendix A in Figure A-8 the highest average travel time is 21 minutes; this 1 minute difference is due to the fact that the graph represents the 8-mile long North Segment of the corridor and, hence, only a portion of the corridor while the 22 minute travel time is for traversing the entire corridor length. The transit travel time assumes that the BRT vehicles utilize freeway HOV, but need to make stops during the trip. Arterial travel time is based on the assumption that with arterial signal coordination, vehicles travel at the speed of 35 miles/hour. The corridor travel time is the weighted average of freeway, transit, and arterial travel times.

Table 4-16. Potential Performance Measure Targets

Performance Measure	Performance Measure Success Threshold	
Travel Time Index	Corridor daily vs. off peak	1.2
	Corridor Incident vs. peak	1.3
	Freeway daily vs. off peak	1.1
	Freeway incident vs. peak	1.4
	Arterials daily vs. off-peak	1.3
	Arterials incident vs. peak	1.4
	Transit daily vs. off peak	1.0
	Bus daily vs. off peak	1.2
Incident Response and Clearance Time	Incident Response within 10 minutes	
	Incident clearance: 90 minutes for all incidents (including major incidents)	
Buffer Index	Corridorwide buffer index of 30 percent	
Average Travel Time Per Trip for the corridor and each network (includes long and short trips)	Freeway HOV	20 minutes / 21miles
	Freeway	22 minutes / 21 miles
	Transit (BRT)	30 minutes / 21 miles
	Arterials	36 minutes / 21 miles
	Corridor	25 minutes / 21 miles

Some of the performance measures, particularly related to travel time and incident, will be used to provide real-time information to travelers via CMSs, 511, Web, or other means. Examples include:

- Network corridor link travel time per network travel unit, car/truck, bus, train, car HOV, and bus HOV; and
- Locations of capacity-reducing incidents and their expected duration and impact on the travel times.

4.9.2 Methods for Data Collection and Processing of Performance Measures

The San Diego ICMS corridor will be able to demonstrate performance characteristics based on individual network measurements and on common measurements across corridor networks. The specific corridor network-based components will include the following:

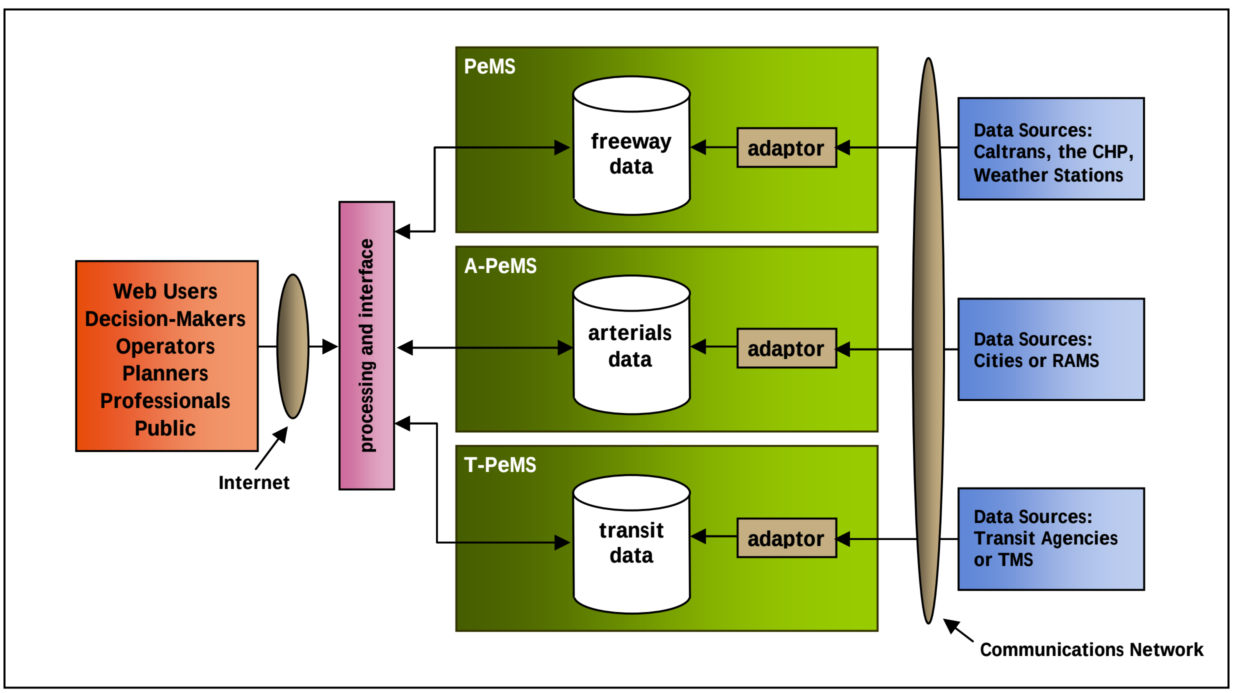
Freeway performance measures will be based on the processing of surveillance data that already are archived and processed in U.C. Berkeley Freeway PeMS. This system has been tracking, monitoring, and logging freeway congestion-type data for several years on most of California freeways. Historical congestion-type data will be compared against real-time data after the ICMS operational improvements have been implemented in San Diego. PeMS algorithms provide most of the commonly used performance measures including:

- Trip-Based:
  - Travel time
  - Travel rate
  - Buffer index
- Freeway-Based:
  - Vehicle miles traveled
  - Vehicle hours traveled
  - Vehicle delays
  - Freeway level of service
  - Congestion causes (recurrent and incident related)
  - Congestion impacts (spatial and temporal)
- Bottleneck-Based:
  - Bottleneck analysis (location and duration)
  - Maximum discharge flow

Arterials and Transit

Currently, the PeMS system is being extended to archive and process data from arterial and transit surveillance and monitoring systems in the San Diego region. This enhanced capability for PeMS for arterials and transit is expected to be completed by March 2010 and December 2010, respectively. Figure 4-3 shows the logical architecture of the multi-modal PeMS system.

Figure 4-3. Multi-Modal PeMS Logical Architecture



System Metrics, Inc. and BTS, Inc., SANDAG Design Document for PeMS, October 2005
The proposed multi-modal PeMS will provide a wealth of performance measures for arterials and transit as described below:

Arterial

The San Diego ICMS has compiled level of service data on various arterials in the cities of San Diego, Poway, and Escondido. Also the arterial detector data and signal status data from the QuicNet 4 system will be processed using application modules into the PeMS system to provide the following performance measures:

- Level of service;
- Average speed;
- Travel time; and
- Delay time.

Transit

In the San Diego ICMS there are currently five existing bus routes. The implementation of BRT facilities will dramatically change the infrastructure of the San Diego ICMS. Nonetheless, the performance measures will include the following:

- Ridership levels;
- Real-time transit arrivals; and
- Vehicle capacity utilization.

5. OPERATIONAL SCENARIOS

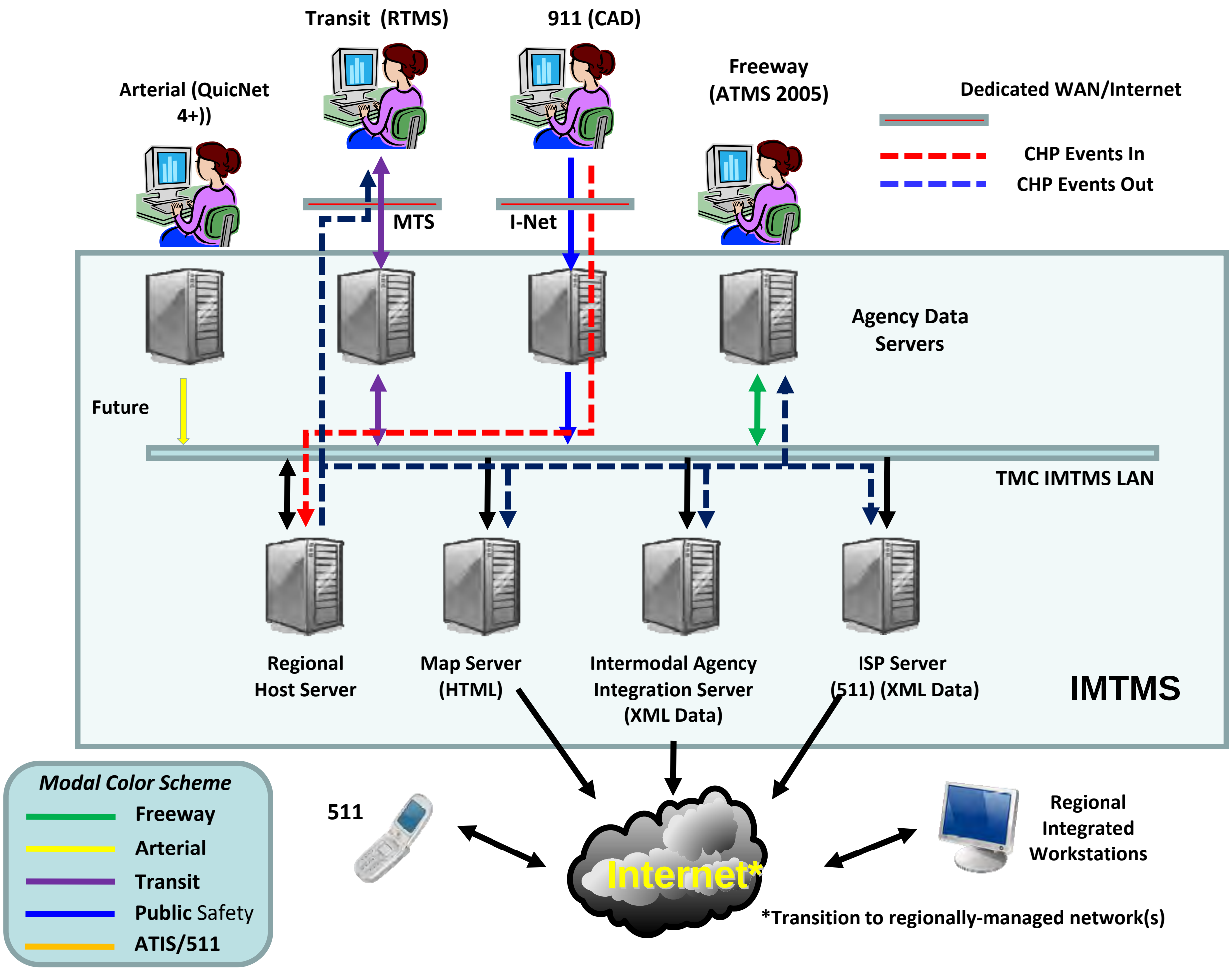
Guidance This chapter presents representative scenarios for the I-15 ICMS corridor and details how various networks and corridor stakeholders are expected to operate under each scenario.

This chapter provides examples of representative scenarios for the I-15 corridor, identifying how the connected corridor networks and the Virtual Corridor Traffic Management Center (VCTMC) will respond to the scenario conditions. The examples are not all-inclusive, but provide understanding of ICMS processes under a variety of conditions.

Since all the following scenarios show a box titled “IMTMS,” we will provide a brief summary of the Intermodal Transportation Management System (IMTMS) operation because of its central role in regional data sharing. Figure 5-1 depicts the primary subsystems and data flows involved in this operation for the case where the California Highway Patrol (CHP) initiates a freeway event (incident). The CHP data goes to a regional host server through its agency data server that converts CHP Computer-Aided Dispatch (CAD) data into a standard XML format. The regional host server then distributes the event data to Regional Transit Management System (RTMS) (for input to the Transit Management System), to Advanced Traffic Management Systems (ATMS) 2005 (to automatically populate an ATMS event summary screen), to the regional map server (to provide an HTML map page to subscribed Internet clients) and to the intermodal agency integration and ISP servers (to provide XML data feeds to third-party applications including the Regional 511 information service provider). Once the Caltrans TMC operator confirms the event as an ATMS event, the CHP updates terminate and future event information updates are provided through the ATMS 2005 agency data server. Regional Integrated Workstations (RIWS) (standard Windows or Linux PCs with compatible browsers) can display real-time HTML maps and manually enter data for local incidents, special events and roadway construction, etc.

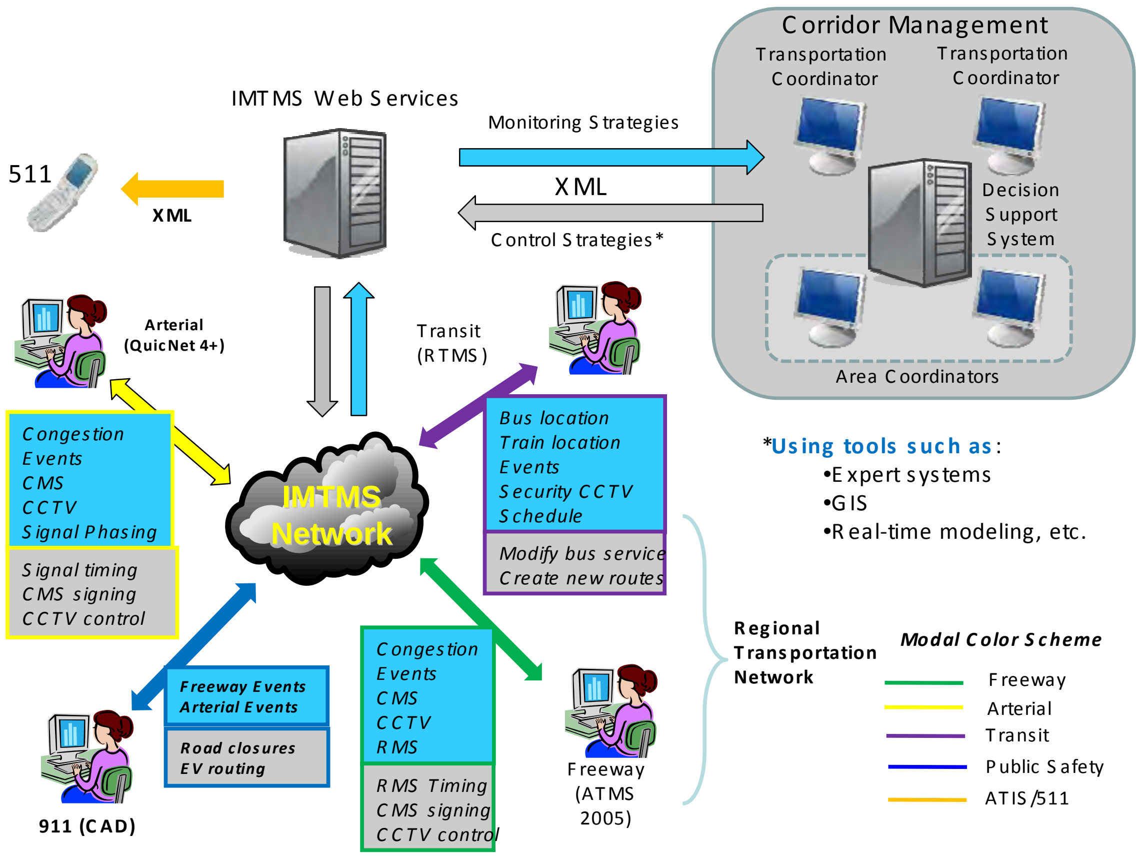
The design of IMTMS lends itself to scalability and flexibility. The servers shown are largely located in the Caltrans District 11 TMC but can be located anywhere, subject to available communications bandwidth in the region. This feature supports redundant command centers for disaster recovery. More servers can be added to distribute the processing load should the operational tempo dictate that necessity. New agencies can be added by adding a new agency data server which contains either a one-way or two-way bridge depending on the agency’s needs. Figure 5-1 shows both one-way and two-way agency data servers in the currently deployed configuration.

Figure 5-1. Intermodal Transportation Management System Operation (CHP Event)



For the ensuing scenarios and for future corridor operations, the San Diego ICM team envisions the need to extend the existing Intermodal Transportation Management System. IMTMS became operational in May 2007 and has a modular, standards-based, Web service architecture upon which to build. The corridor management blocks in Figures 5-3 through 5-8 depict IMTMS and a conceptual "decision support system" (DSS). This DSS extends the functionality of IMTMS because it provides improved data fusion and decision-making based on the increased sharing of data among corridor agencies. IMTMS was designed to be a data sharing architecture, not necessarily to provide decision support tools. The User Needs articulated in this Concept of Operations (ConOps) envision a generic higher level of decision-making than occurs in today's "stovepipe" modal operations in the corridor. IMTMS facilitates better decision-making by providing higher-quality information to modal operators, but does not offer the applications needed to integrate this information into actionable control strategies. Figure 5-2 depicts the conceptual monitoring and control strategies along with the data elements needed to support these strategies. This concept leverages the existing IMTMS and its ability to collect data from a variety of modal management systems.

Figure 5-2. Future Decision Support System (conceptual)



We emphasize that DSS is only conceptual at this point in the ICMS definition phase and may be any combination of human operators, hardware, and/or software applications. Its specific implementation will be progressively described in later systems engineering phases of the I-15 ICMS. It is provided here as a conceptual response to the stated User Needs (Table 4-8, Section 4.3) for managing corridorwide control strategies.

The underlying assumptions for all scenarios are that: (1) the required network improvements have been completed; (2) response plans have been developed and approved by network operators; (3) institutional agreements have been established so that the ICMS coordinator and supporting staff are properly authorized to respond according to the agreed response plans and improvise as situations may dictate; and (4) sufficient training and exercises have been conducted.

The ICMS Working Group identified the following representative scenarios for ICMS:

1. Daily operations;
2. Freeway incident;
3. Arterial incident;
4. Transit incident;
5. Special event; and
6. Disaster response.

The first scenario represents the condition of recurring congestion, while the remaining scenarios address different types of incidents and planned events that lead to non-recurring congestion. Incidents and other events can be differentiated by their location, duration, time-of-day, impact type (traffic and safety), and impact area. Specific response plans can be developed using the representative scenarios as starting points.

For each scenario the interaction of system networks and stakeholders are shown on a diagram, followed by description of the timeline of actions and information flows. Applicable ICMS strategies are listed, and the roles and responsibilities of each agency involved are identified.

5.1 Daily Operations

Guidance This scenario addresses corridor management activities and strategies in response to day-to-day transportation flows in a typical environment.

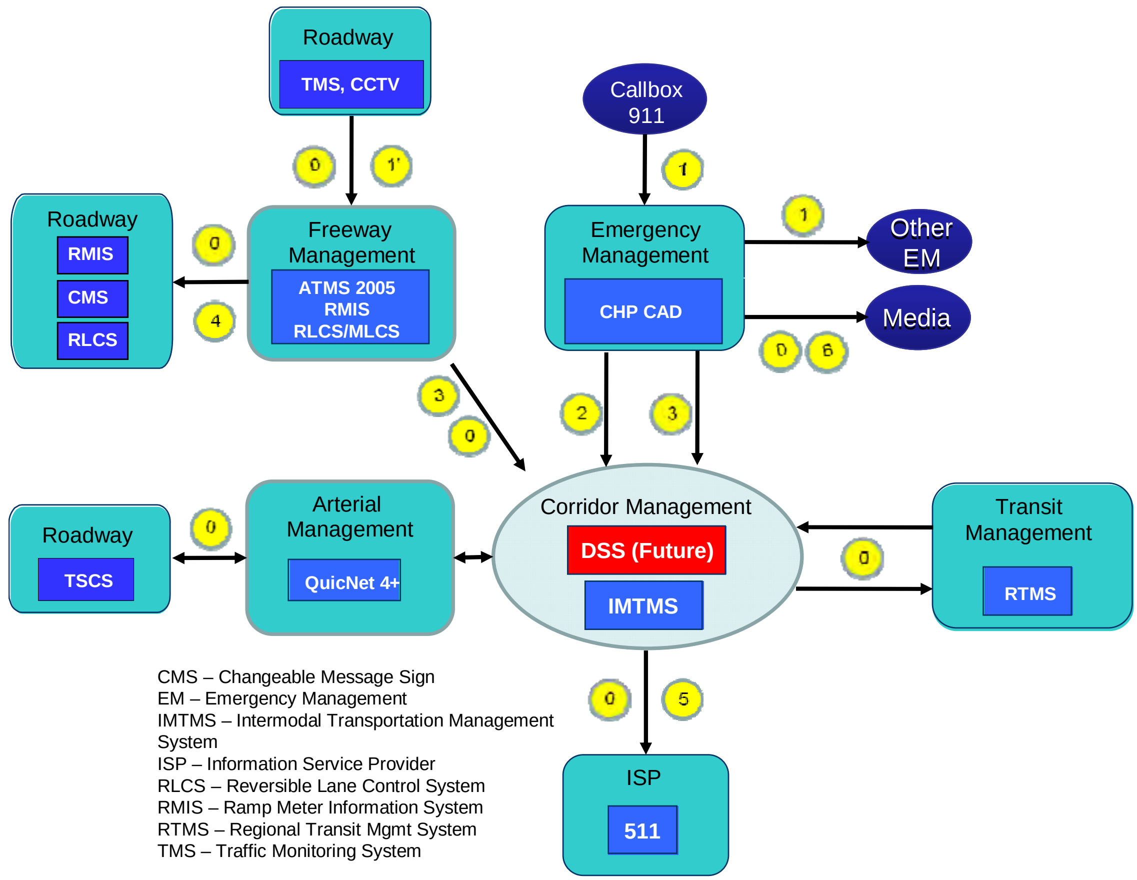
Daily operations are primarily concerned with recurrent congestion caused by traffic demand exceeding the roadway capacity and temporal variations of traffic volumes. It is assumed that there are no accidents (roadway, transit, or arterial), road or track maintenance, weather events, or other random events that impact the networks and require an active response. The daily operations scenario forms the baseline for daily freeway, arterial, and transit operations in the I-15 corridor. Interactions of system networks are illustrated in Figure 5-3. Broken lines in Figure 5-3 indicate optional paths of information flow.

Each stakeholder monitors and operates their respective systems in accordance with their network-specific operational procedures and implements collaboration agreements (ramp metering, signal timing plans, etc.) that address routine traffic variations. No “lead” agency is required for this scenario.

Caltrans collects real-time freeway data from the surveillance system (loop detectors, radar, and other sensors) every 30 seconds and uses data for monitoring, ramp metering, incident detection, reporting, and travel time calculations. Caltrans operates the I-15 Reversible Lanes on a daily schedule. Caltrans operates a traffic responsive ramp metering system to minimize recurring freeway congestion during the a.m. and p.m. peak periods. Travel times are posted on CMSs every five minutes. Traffic on arterials is managed by the cities, whose monitoring and control networks are interconnected by the Regional Arterial Management System (RAMS).

The IMTMS collects data from the Caltrans ATMS 2005 agency data server, converts this to XML format, and disseminates to RIWSs and to the Advanced Traveler Information Management System (ATIMS) server for 511 use. IMTMS also collects real-time arterial data from RAMS, and real-time transit data from Metropolitan Transit System (MTS) and North County Transit District (NCTD) RTMS servers and after conversion to XML, disseminates in the same manner as freeway data. The IMTMS interfaces with emergency management agencies through the CHP CAD system.

Figure 5-3. I-15 Corridor Baseline Operations



5.1.1 ICMS Strategies and Agency Roles/Responsibilities

The ICMS focus during daily operations is on automated information sharing/distribution and the operational efficiency at network junctions and interfaces. These strategies are "baseline" strategies that will also be applicable in other scenarios.

In addition, accommodating or promoting modal and network shifts may become necessary under heavy congestion. The long-term strategies to manage the demand-capacity relationship are an ongoing activity.

Baseline ICMS strategies, as well as roles and responsibilities of each agency, are shown in Table 5-1.

Table 5-1. Baseline Operations Scenario

ICM Strategies	Agency/Entity	Roles and Responsibilities
▪ Automated information sharing through IMTMS ▪ Advanced traveler information system (511) ▪ En-route traveler information (511 and field devices) ▪ Access to corridor information by information service providers (ISPs) ▪ Value pricing for managed lanes ▪ Multi-modal electronic payment ▪ Smart parking ▪ Dynamic ramp metering ▪ Coordinated operation of ramp meters/arterial traffic signals ▪ Direct access ramps for transit ▪ Signal priority for transit ▪ Accommodate cross-network shifts for unusually heavy congestion	VCTMC	Coordinate corridor operations
		Monitor corridor performance
		Conduct corridor technical management and development
	SANDAG	Freeway Service Patrol
		Conduct toll operations (contractor)
		IMTMS
		RAMS
		RIWS
		511
	Caltrans	ATMS
		RLCS
		Monitor freeway traffic flow
		Operate freeway field devices
	City Traffic Divisions (San Diego, Poway, Escondido)	Monitor arterial traffic flow monitoring
		Operate arterial field devices
	Transit Agencies (MTS and NCTD)	Bus service provision
		RTMS
	CHP	Receive incident notification calls and respond to incident
		Notify other agency responders
	Local First Responders and Law Enforcement	Respond to incident ▪ fire suppression ▪ medical assistance ▪ scene clearance
	County Emergency Services	Coordinate emergency services activities and response
		SD SAFE operates call boxes

5.2 Freeway Incident

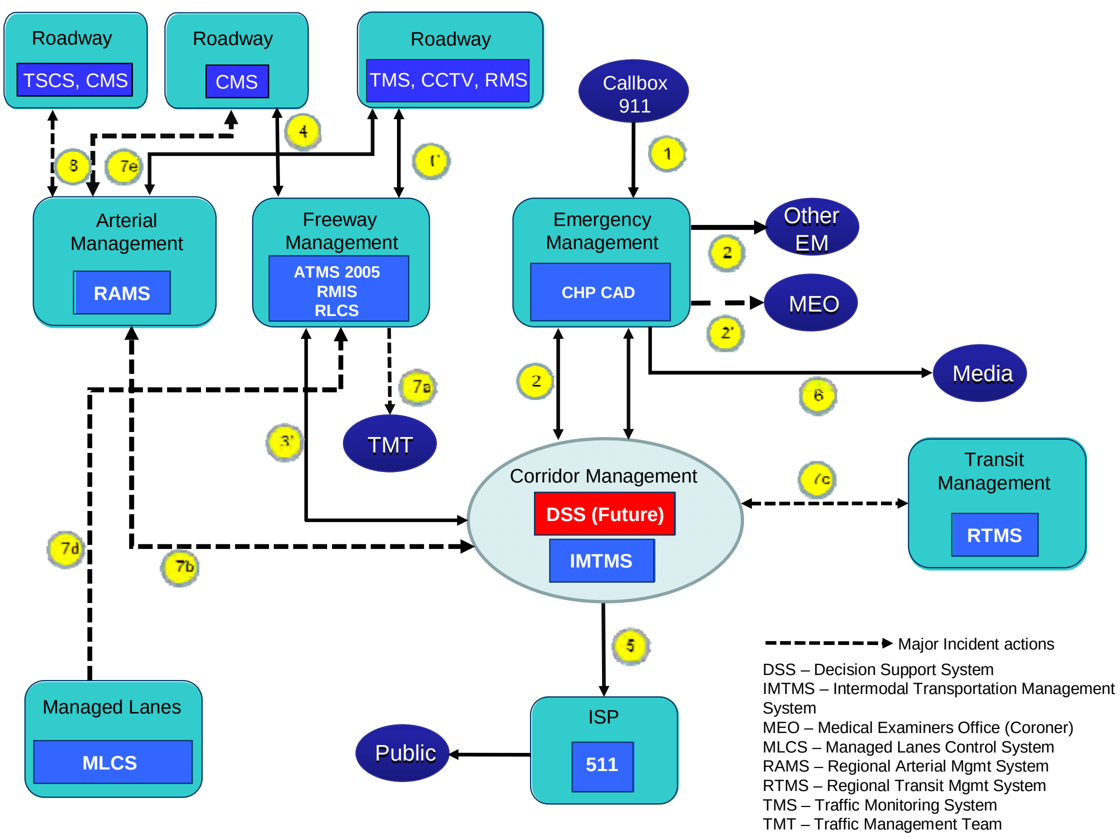
Guidance This scenario addresses corridor management activities and strategies in response to a freeway incident.

This scenario, shown in Figure 5-4, is based upon an incident occurring on the freeway. The scenario figure covers both minor and major incidents, with dotted lines indicating additional communications and data exchanges required for major incidents. A major incident is defined as an event with one or more of the following characteristics:

- One or more fatalities;
- Freeway closure;
- Hazardous material (HAZMAT) incident (incident involving hazardous materials); and
- Law enforcement action.

All other freeway incidents are categorized as “routine.” Although responses are detailed by individual modal centers, the higher-level decision support system can make decisions and recommend control actions across multiple modes as necessary. Ultimately, each recommended control action must resolve to an individual system even though the “decision” may involve coordinated actions of several agencies. For example, a major freeway incident may resolve to an arterial signal timing change in multiple jurisdictions, road closures by local law enforcement, and transit emergency service changes. Each of these actions occurs on a single system, but the recommendations come from a regional DSS that integrates multiple sources of data.

Figure 5-4. Freeway Incident (Minor and Major) Scenario



The incident timeline is the following:

1. From the San Diego callbox answering service and/or a 911 cell phone call, the CHP is alerted to a possible incident. The CHP call taker creates a new incident and transfers the incident to a dispatcher for CHP response. In the event of injuries or possible injuries, paramedic units are notified via telephone.
   - 1’ An incident can also be initiated by roadway sensors using the Caltrans ATMS 2005 incident detection algorithms. Such incidents are classified as “unconfirmed” until some verification activity occurs.
2. The regional IMTMS system acquires the incident data from the CHP CAD system. The Caltrans ATMS initiates an automatic incident event based on CHP event data received from IMTMS.
   - 2’ If the accident involves one or more fatalities, the County Medical Examiner’s Office (MEO) (see Figure 5-3) is notified.
3. The CHP dispatcher confirms the existence of the incident, exact incident location, and associated supplementary information as received from investigating officers. The CAD system is updated by the dispatcher with response status. IMTMS receives CAD updates until the incident is confirmed by ATMS 2005. A future system update will allow continuous CHP updates to IMTMS regardless of ATMS incident status. Tow and recovery resources are called based on traffic officer radio reports.
4. Caltrans initiates CMS messages as needed. Incident messages have priority over any existing travel time messages.
5. Filtered information concerning the freeway incident and the response actions is disseminated to the 511 ISP operator through the IMTMS network.
6. Filtered incident information is disseminated directly to the media agencies by the CHP media officer.
7. The following additional actions are taken for major freeway incidents – the specific need for and order of action depends on the specific incident situation.
   a. The Caltrans maintenance dispatcher contacts required traffic management team (TMT) vehicles for location instructions to prevent secondary accidents at the end of the queue and/or to reroute traffic as required.
   b. For extended freeway blockages or closures (major incident), a pre-agreed regional timing plan request is sent to the RAMS for implementation by individual cities along the corridor (San Diego, Poway, and Escondido, proceeding south to north). Each city has override authority on the regional timing plan’s action on their particular signalized intersections.
   c. The RTMS for MTS and NCTD receive real-time incident data via IMTMS. These agencies will take appropriate service adjustments depending on incident location, severity, and duration.
   d. The Managed Lanes Control System (MLCS) can take specific actions to mitigate non-recurring congestion by reconfiguring lanes. MLCS status is provided to ATMS 2005 and to IMTMS for situation display. The MLCS is represented by the existing Reversible Lane Control System in the South Segment of the Corridor until the Managed Lanes become operational.
8. Based on real-time data from IMTMS, local jurisdictions may independently take traffic signal and/or CMS actions (as available), the status of which will be automatically reported to IMTMS.

5.2.1 ICMS Strategies and Agency Roles/Responsibilities

The major feature of freeway incident response is the CHP's coordination of emergency response. To relieve traffic congestion caused by the incident, the ICMS focuses on information dissemination, accommodating network shifts, and conduct short-term, capacity-demand management. For minor incidents, Caltrans takes the lead in ICMS. For major incidents that require elevated coordination between corridor networks, the VCTMC coordinator takes the lead.

Applicable strategies, as well as roles and responsibilities of each agency, are shown in Table 5-2.

Table 5-2. Freeway Incident Scenario

ICM Strategies	Agency/Entity	Roles and Responsibilities
▪ Information sharing and distribution (as in baseline scenario) ▪ Operational efficiency at network junctions (as in baseline scenario) ▪ Common incident reporting system and asset management system ▪ Promote route/network/mode shifts via traveler information, (e.g., providing travel times on different networks) ▪ Lane use control on freeway (configurable lanes, contra-flow operations) ▪ Modify HOV restrictions ▪ Opening freeway shoulders to traffic at certain locations ▪ Restrict/reroute/delay commercial traffic ▪ Modify arterial signal timing to accommodate traffic shifting from freeway	VCTMC	Monitor corridor conditions
		Coordinate information dissemination
		Suggest capacity-demand management measures
	SANDAG	Operate IMTMS and other information systems
	Caltrans	Respond to and assist with incident clearance
		Monitor freeway conditions
		Operate filed elements
		Reconfigure managed lanes
	City Traffic Divisions (San Diego, Poway, Escondido)	Monitor arterial conditions
		Adjust arterial signal timing
	Transit Agencies (MTS and NCTD)	Monitor transit service
		Reroute if necessary
	CHP	Receive incident notification calls, enter into CAD, and respond to incident
		Notify other agency responders
	Local First Responders and Law Enforcement	Respond to accident for victim extraction, fire suppression, medical assistance
	County Emergency Services	MEO responds to accidents with fatalities

5.3 Arterial Incident

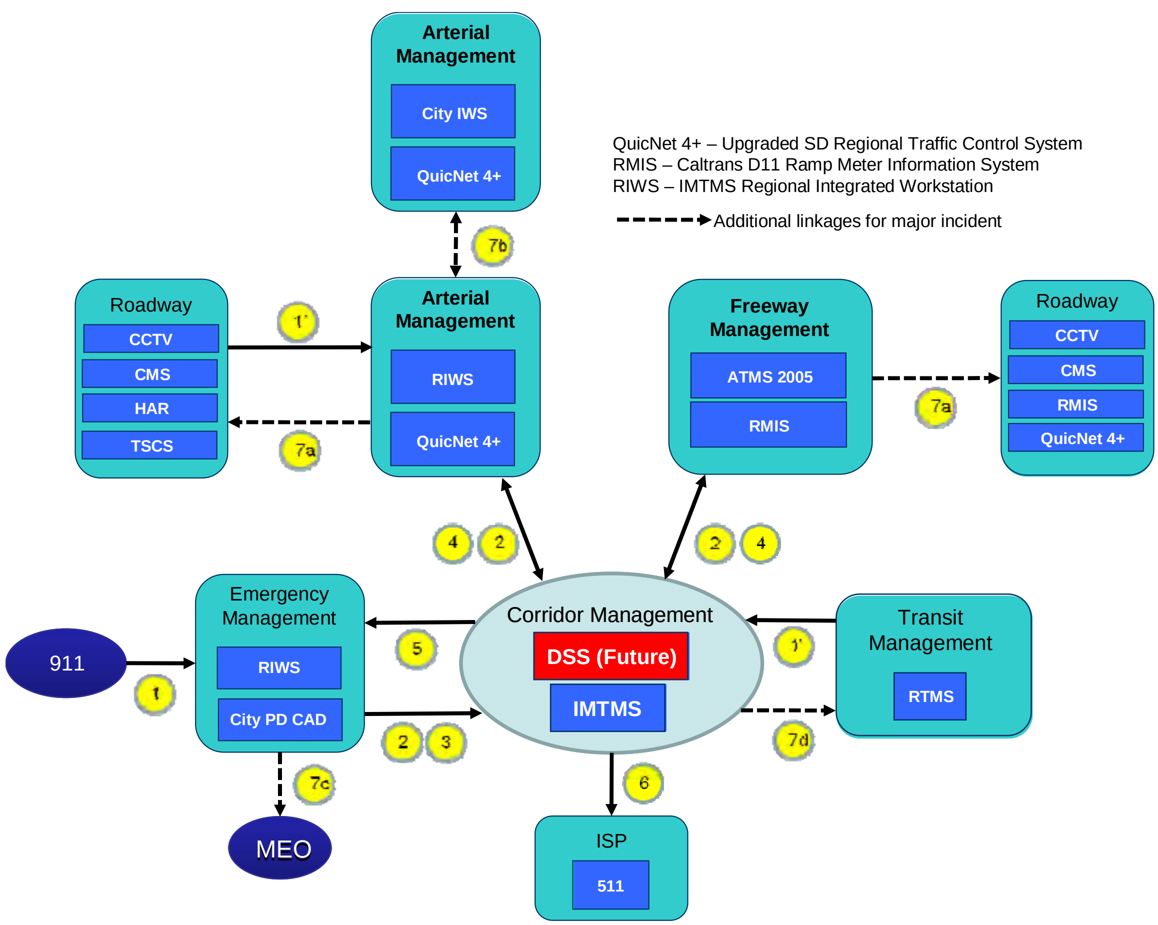
Guidance This scenario addresses corridor management activities and strategies in response to an arterial incident.

The arterial incident scenario is illustrated in Figure 5-5. This figure covers both minor and major incidents, with dotted lines indicating additional communications and data exchanges required for major incidents. A major incident is defined as an event with one or more of the following characteristics:

- One or more fatalities or major injuries (e.g., requiring victim extraction and/or Life Flight missions);
- Arterial closure;
- HAZMAT incident; and
- Law enforcement action.

All other arterial incidents are categorized as minor.

Figure 5-5. Arterial Incident (Minor and Major) Scenario



The incident timeline is the following:

1. From cellular or landline 911 reports, the local police department (PD) is alerted to a possible incident on an arterial within their jurisdiction. The PD call taker creates a new incident and transfers the incident to a dispatcher for PD response. In the event of injuries or possible injuries, paramedic units (typical response is one paramedic truck and a transport ambulance) are notified via telephone.
   - 1’ An alternate incident reporting source may be an arterial closed-circuit television (CCTV).
   - 1’ Another alternate incident reporting source may be MTS or NCTD transit dispatchers receiving reports from bus drivers on routes. These reports become transit “incidents” in the RTMS system and are passed to IMTMS for further dissemination via 511 and regional Web servers as discussed earlier in this section.
2. The regional IMTMS system acquires the incident data from the PD or RTMS CAD system. The local jurisdiction TMC operator (if present) receives an automatic incident notification from IMTMS. IMTMS disseminates law enforcement CAD data (traffic-related only) to all subscribed RIWSs and to Caltrans ATMS as an “external” event for information only (until notified otherwise).
3. The PD dispatcher confirms the existence of the incident, exact incident location, and associated supplementary information as received from investigating officers. IMTMS receives periodic CAD updates as they occur. Tow and recovery resources are called based on police officer radio reports.
4. Caltrans and the local jurisdiction exchange congestion and field device status information throughout incident (via IMTMS), including any nearby freeway incidents that might exacerbate the arterial incident.
5. IMTMS updates PD or San Diego Sheriff’s Department (SDSD) with current congestion information from surrounding freeways and any freeway device activation and associated messages.
6. Filtered information concerning the arterial incident and the response actions is disseminated to the 511 ISP operator through the IMTMS network.
7. The following additional actions are taken for major arterial incidents – the specific need for and order of action depends on the specific incident situation.
   a. The PD may activate emergency road closures to isolate the incident. This may include freeway on-ramps and off-ramps. This, in turn, requires coordination with the CHP and Caltrans.
   b. For extended arterial blockages or closures (major incident) pre-computed Signal Timing Plans may be activated on diversion routes by individual affected cities along the corridor (San Diego, Poway, San Diego, and Escondido, proceeding south to north).
   c. If the accident involves one or more fatalities, the County MEO (in Figure 5-5) is notified.
   d. The RTMS for MTS and NCTD (as appropriate for incident location) receive real-time incident data via IMTMS. These agencies will take appropriate service actions depending on incident location, severity, and duration.

5.3.1 ICMS Strategies and Agency Roles/Responsibilities

Emergency management for arterial incidents is handled through local police and other emergency service. When the incident is minor, the ICMS focuses on information dissemination. When there is a major incident, the ICMS focuses on information dissemination, cross-jurisdictional coordination, and freeway/arterial operation coordination. The VCTMC coordinator takes the lead in this scenario.

Applicable strategies, as well as roles and responsibilities of each agency, are shown in Table 5-3.

Table 5-3. Arterial Incident Scenario

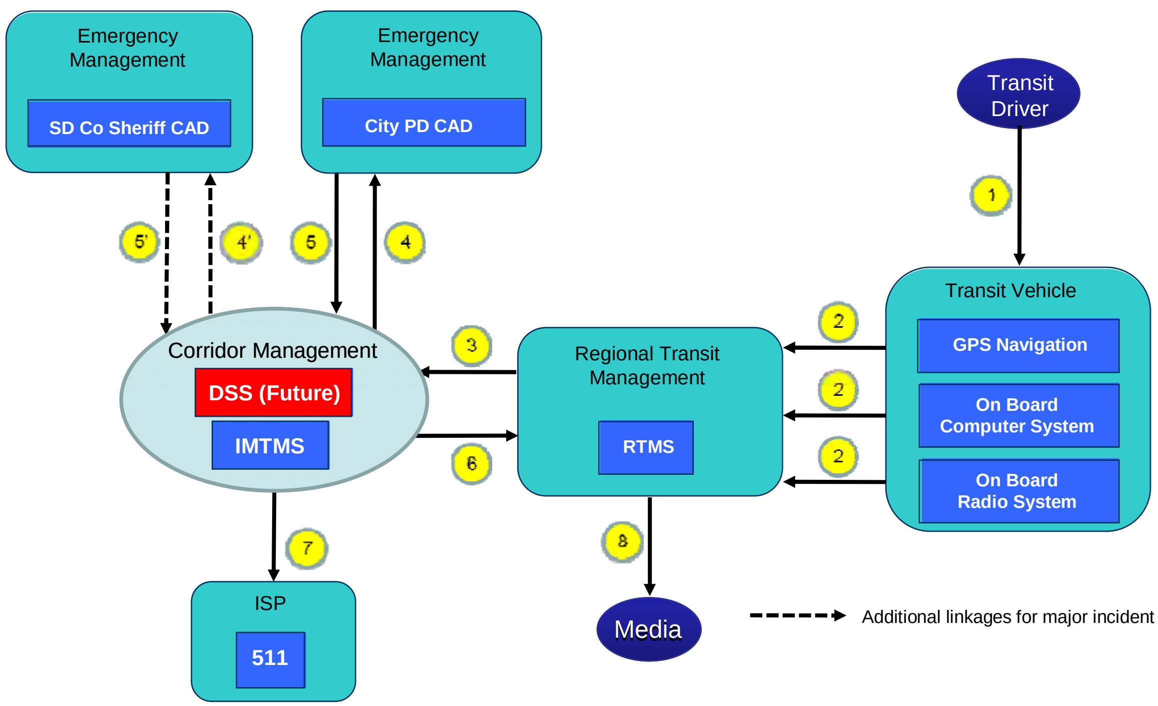
ICM Strategies	Agency/Entity	Roles and Responsibilities
▪ Information sharing and distribution (as in baseline scenario) ▪ Operational efficiency at network junctions (as in baseline scenario) ▪ A common incident reporting system and asset management system ▪ Emergency road closure (including freeway off ramps) ▪ Modify ramp metering rates to accommodate traffic shifting from arterial ▪ Modify signal timing plans to restrict/divert traffic from the incident location ▪ Reroute transit vehicles	VCTMC	Monitor corridor conditions
		Coordinate information dissemination
		Suggest capacity-demand management measures
	SANDAG	Operate IMTMS and other information systems
	Caltrans	Modify ramp metering rates
		Respond to off-ramp closure request
		Monitor freeway conditions
		Operate filed elements
	City Traffic Divisions (San Diego, Poway, Escondido)	Monitor arterial conditions
		Adjust arterial signal timing
		Inform travelers via field elements
	Transit Agencies (MTS and NCTD)	Monitor transit service
		Reroute if necessary
	Local First Responders and Law Enforcement	Respond to accident for victim extraction, fire suppression, medical assistance
	County Emergency Services	MEO responds to accidents with fatalities

5.4 Transit Incident

Guidance This scenario addresses corridor management activities and strategies in response to a transit incident.

The transit incident scenario is illustrated in Figure 5-6. This scenario assumes a crime in progress on a regional bus (MTS or NCTD). The scenario makes use of the driver's "panic button" to initiate the scenario sequence. Although San Diego transit agencies have their own security forces (private security), we make the assumption that local law enforcement (the city PD or the San Diego County Sheriff, as appropriate) will be notified to respond to a crime in progress.

Figure 5-6. Transit Incident Scenario



The incident timeline is the following:

1. A transit incident would normally be reported by the bus driver, either by voice communications with the transit dispatcher, or, if necessary, by panic button activation. This scenario assumes the latter, as would be the case for a hijacking or terrorist attack, for example.

2. The bus continually updates its position with installed global positioning system (GPS) equipment and reports the position at selected intervals to the RTMS. When the transit driver activates the panic button, the bus is centered on the RTMS display and the position is updated more frequently. The radio system goes to an "open mike" mode so dispatchers can discretely monitor what is being said on the bus without the assailant's knowledge.

3. The transit incident and bus location are reported to the IMTMS system.

4. and 4’. The IMTMS network reports the bus position and incident status to all network users, including selected law enforcement communications centers via the browser-based RIWS.

5. Law enforcement dispatchers report response status to the IMTMS network.

6. The IMTMS network disseminates law enforcement status to the transit management system.

7. The IMTMS network disseminates releasable incident information to the SANDAG 511 Information Service Provider.

8. Direct media inquiries are handled by the transit agencies.

5.4.1 ICMS Strategies and Agency Roles/Responsibilities

Transit incident information is relayed via IMTMS to emergency responders. Certain ICMS strategies facilitate emergency responses, such as emergency vehicle signal preemption. Since emergency responses may lead to disruption of traffic flow on an arterial, ICMS strategies for arterial incidents also apply. The VCTMC takes the lead in identifying arterials that may be affected by emergency response and notifies local jurisdictions accordingly.

Applicable strategies, as well as roles and responsibilities of each agency, are shown in Table 5-4.

Table 5-4. Transit Incident Scenario

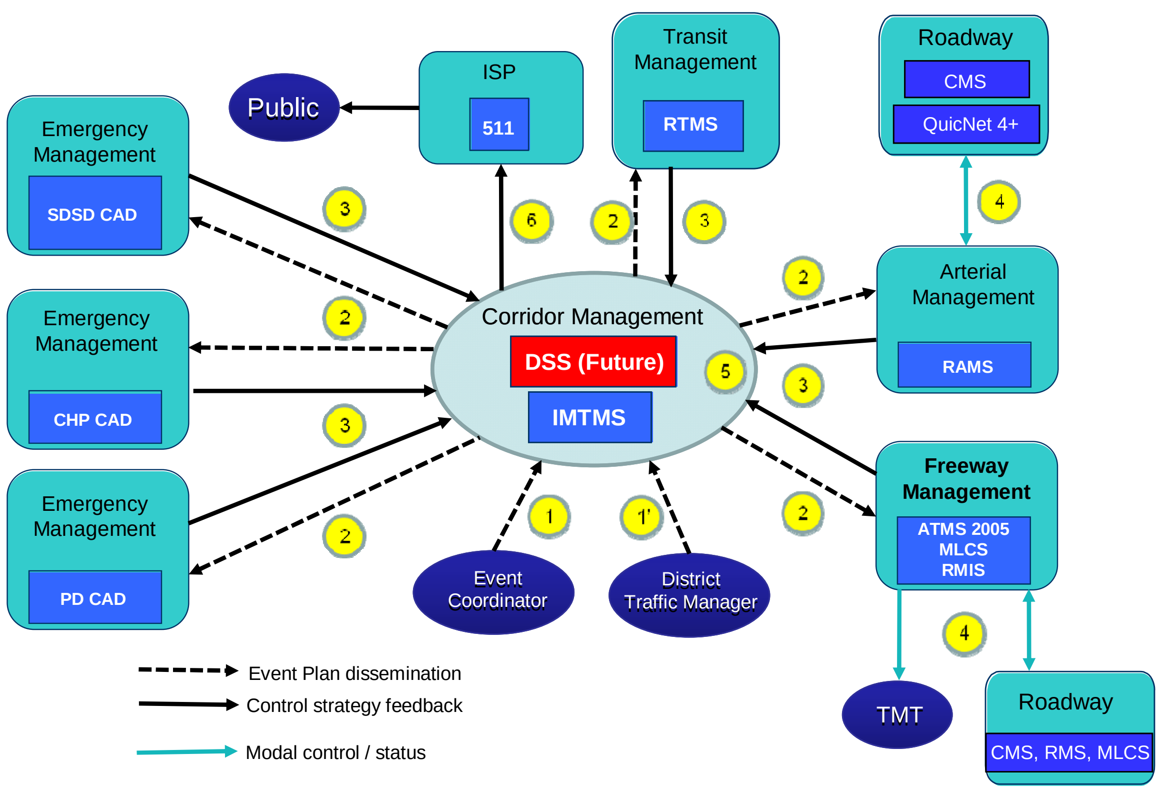
ICM Strategies	Agency/Entity	Roles and Responsibilities
▪ Information sharing and distribution (as in baseline scenario) ▪ A common incident reporting system and asset management system ▪ Emergency vehicle signal preemption ▪ Transit connection protection ▪ Emergency road closure (including freeway off ramps)	VCTMC	Monitor corridor conditions
		Coordinate information dissemination
		Identify arterials that may be affected by emergency response vehicles
	SANDAG	Operate IMTMS and other information systems
	Caltrans	Respond to off-ramp closure request
		Monitor freeway conditions
		Operate filed elements
	City Traffic Divisions (San Diego, Poway, Escondido)	Monitor arterial conditions
		Adjust arterial signal timing
		Inform travelers via field elements
	Transit Agencies (MTS and NCTD)	Monitor transit service
		Relay information
		Accommodate passengers affected by incident
	Local First Responders and Law Enforcement	Respond to accident for victim extraction, fire suppression, medical assistance

5.5 Special Event

Guidance This scenario addresses corridor management activities and strategies in response to a planned special event.

The distinguishing characteristic of a special-event scenario is the elevated need for coordination between corridor networks. A Joint Traffic Operations Center (JTOC) may be formed well in advance for centralized coordination of transportation and public safety operations during the special event. Typical special events affecting the I-15 corridor would include the Marine Corps Air Station (MCAS) Miramar Air Show in October of each year and home games for the San Diego Chargers football team (September through January), especially National Football League playoff games. Figure 5-7 shows center relationships and information flows for major special events.

Figure 5-7. Major Special Event Scenario



The special event timeline is the following:

1. The event coordinator and other affected agencies develop a special event plan outlining traffic control strategies, security needs, etc. Special events are entered into the IMTMS from multiple sources depending on event needs.

2. The IMTMS disseminates planned special event data to affected public safety agencies, transit agencies, Caltrans, and local jurisdiction traffic control systems.

3. IMTMS receives special event inputs from affected agencies (public safety, transit, and traffic).
4. Caltrans, transit, and local traffic agencies implement event services and traffic control strategies including field device activation, TMT, and portable sign deployment, etc.
5. Caltrans and local jurisdictions use IMTMS to exchange device control and real time congestion and incident data as agreed by the plan.
6. IMTMS provides special event data and traffic plans to the regional 511 operator. The regional 511 operator disseminates real-time traffic conditions to the motoring public and other subscribers.

5.5.1 ICMS Strategies and Agency Roles/Responsibilities

Special events require well-coordinated plans for managing expected traffic, as well as emergency response plans. Desktop scenario sessions should be conducted to refine the plans and train involved personnel. During the event, short-term, demand-capacity management, especially addition of transit capacity and priority for transit vehicles, are often needed. Information dissemination in advance, as well as during the event is important. The JTOC is the lead for the ICMS in this scenario.

Applicable strategies, as well as roles and responsibilities of each agency, are shown in Table 5-5.

Table 5-5. Special Event Scenario

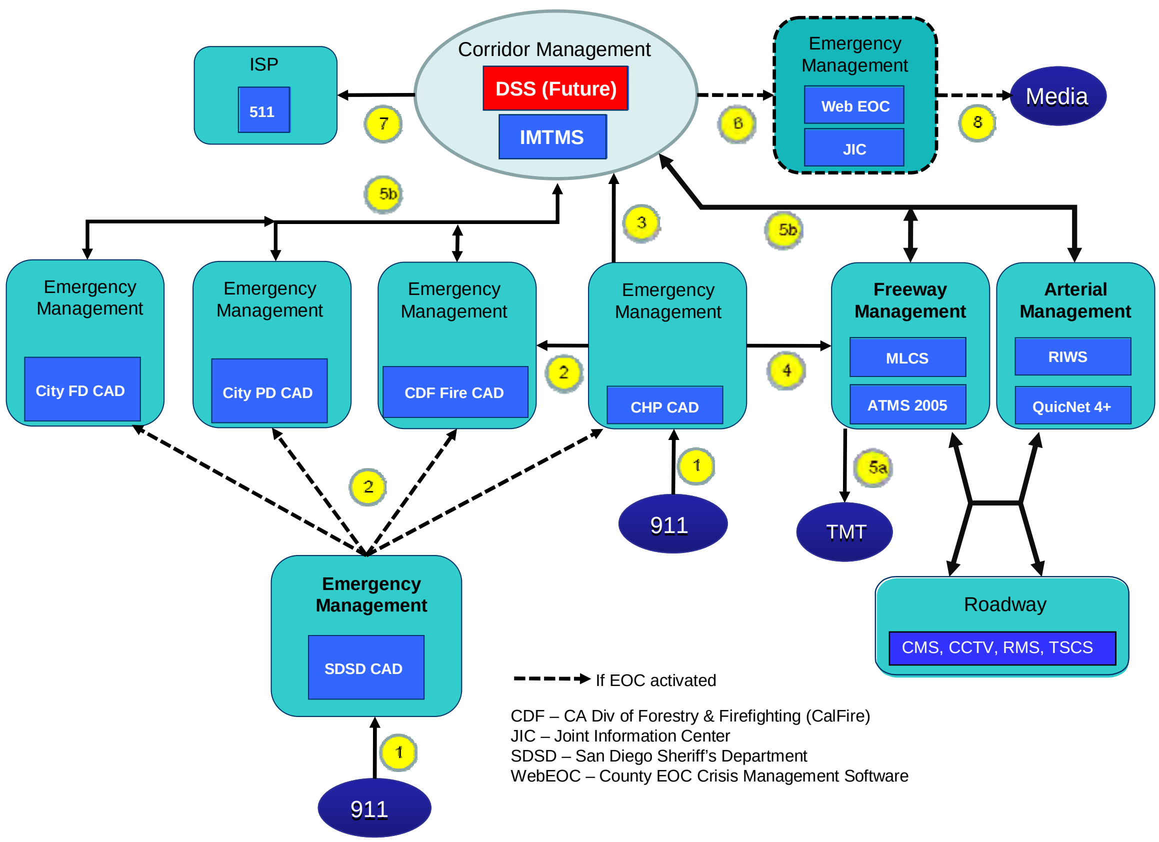
ICM Strategies	Agency/Entity	Roles and Responsibilities
▪ Distribution of event management plan to the public in advance ▪ Information sharing and distribution (as in baseline scenario) ▪ Operational efficiency at network junctions (as in baseline scenario) ▪ Coordinated scheduled maintenance activities on corridor networks to ensure available capacity at event ▪ Joint Transportation Operations Center ▪ Desktop sessions for enacting event plans ▪ Add transit capacity ▪ Reroute transit vehicles ▪ Provide transit priority (exclusive lanes, transit priority at traffic signals) ▪ Planned road closure and restrictions ▪ Modify ramp metering rates to accommodate traffic ▪ Implement special traffic signal timing plans ▪ Parking management ▪ Police assistance in directing traffic	JTOC	Lead role in coordination
		Develop operational agreements between agencies and prepare event plan and incident response plan
		Conduct desktop training sessions
		Parking management
	VCTMC	Monitor corridor conditions
		Coordinate information dissemination
	SANDAG	Operate IMTMS and other information systems
	Caltrans	Modify ramp metering rates
		Close ramps if necessary
		Monitor freeway conditions
		Operate filed elements
		Plans deployment of TMT vehicles, portable CMSs, and appropriate CMS signing
	City Traffic Divisions (San Diego, Poway, Escondido)	Monitor arterial conditions
		Implement road closure/restrictions
		Prepare temporary signage
		Adjust arterial signal timing
		Inform travelers via field elements
		Plan parking access
	Transit Agencies (MTS and NCTD)	Add temporary transit capacity and services
		Monitor transit service
		Reroute, if necessary
		Coordinate schedules among service providers
	Local First Responders	Respond to accident for victim extraction, fire suppression, medical assistance
	Local Police	Street patrol
		Assisting in directing traffic

5.6 Disaster Response Scenario

Guidance This scenario addresses corridor management activities and strategies in response to a disaster.

The San Diego region is subject to a number of natural disasters and manmade incidents, such as aircraft accidents, terrorist attacks, HAZMAT events, etc. The most prevalent natural disaster affecting San Diego is wildland-urban interface fires, such as the Cedar Fire of October 2003. This fire burned from Ramona westward, all the way to I-15 in less than 8 hours, eventually jumping 14 lanes of I-15 and causing the abandonment of the Southern California Terminal Radar Approach Control (TRACON) facility at MCAS Miramar. This fire caused the closure of I-15, State Routes 52 and 163, and portions of I-805 before changing directions and burning east San Diego County. On the same day, another wildfire just east of Escondido (the Paradise Fire) affected parts of the northern I-15 corridor. Evacuations and road closures caused chaotic conditions for several hours along the I-15 corridor throughout October 26, 2003. The following scenario is based on this 2003 event, which has a reasonable likelihood of reoccurring in the future. Figure 5-8 shows information flows and involved centers during this event.

Figure 5-8. Major Disaster (Wildland – Urban Interface Fire)



The disaster response timeline is the following:

1. The public (home-based or motorists) calls 911 to report a brush fire. The 911 dispatch call center then notifies Calfire dispatch. CalFire is the county's de-facto County Fire Department and handles the coordination of all wildfires on non-federal property. For federal property wildfires, either the U.S. Forest Service or Bureau of Land Management coordinates the response.

2. The California Department of Forestry (CDF) responds and after initial evaluation, activates automatic mutual aid from surrounding fire departments and requests traffic control from the San Diego County Sheriff, local PD, and the CHP, as required. The San Diego County Sheriff, local PD, and the CHP generate appropriate responses and transmit that information to the CDF Fire Emergency Management system.

3. IMTMS receives CAD incident data from the CHP Border Communications Center.

4. ATMS 2005 receives preliminary data from the CHP CAD system (via IMTMS as described earlier in this Section) on the fire event.

5. The Caltrans ATMS 2005 system activates appropriate CMSs and deploys TMT vehicles for traffic control and to assist in evacuation.

5' Real-time freeway information is transmitted from the ATMS 2005 system to the IMTMS network. Assuming various public safety systems are connected to IMTMS, this information also goes to regional dispatch centers. The IMTMS network fuses incoming data and transmits to IMTMS users.

6. If the fire is extensive, the County Emergency Operation Center (EOC) is activated (as happened in October 2003 for fires in San Diego County). The EOC receives transportation information from IMTMS, including road closures, traffic congestion, Managed Lanes activation, CCTV images, CMS activation, etc.

7. The regional 511 system disseminates information concerning the fire-related traffic impacts.

8. Press releases are disseminated directly to media agencies by CalFire.

8'. If a regional Joint Information Center (JIC) is activated, the JIC handles all media requests for information and schedules periodic press conferences.

5.6.1 ICMS Strategies and Agency Roles/Responsibilities

The wildfire disaster is likely to cause major prolonged interruption of freeway service and possibly closure of significant freeway segments. Evacuations from the fire zone may exacerbate chaotic conditions on the roadways. Under this scenario, Caltrans and the CHP will jointly take the lead in coordinating transportation-related disaster response, under the overall incident command of the CDF. The IMTMS facilitates information flow and coordination with local law enforcement and local traffic control.

Applicable strategies, as well as roles and responsibilities of each agency, are shown in Table 5-6.

Table 5-6. Disaster Response Scenario

<table>
<tr><th>ICM Strategies</th><th>Agency/Entity</th><th>Roles and Responsibilities</th></tr>
<tr><td rowspan="24">▪ Information sharing and distribution (as in baseline scenario)
▪ Operational efficiency at network junctions (as in baseline scenario)
▪ Desktop sessions for enacting evacuation plans
▪ Signal preemption for emergency vehicles
▪ Add temporary transit capacity
▪ Reroute transit vehicles
▪ Emergency road closure and restrictions
▪ Modify ramp metering rates to accommodate diverted traffic
▪ Police assistance in directing traffic
▪ Promote route/network/mode shifts via traveler information
▪ Lane use control on freeway (configurable lanes/contra-flow operations)
▪ Modify HOV restrictions
▪ Opening freeway shoulders to traffic
▪ Restrict/reroute/delay commercial traffic
▪ Modify arterial signal timing to accommodate diverted traffic</td><td rowspan="7">Caltrans</td><td>Deploy TMT vehicles, portable CMSs, and appropriate CMS signing</td></tr>
<tr><td>Modify ramp metering rates</td></tr>
<tr><td>Reconfigure managed lanes</td></tr>
<tr><td>Modify lane restrictions</td></tr>
<tr><td>Close roadways/ramps if necessary</td></tr>
<tr><td>Monitor freeway conditions</td></tr>
<tr><td>Operate filed elements</td></tr>
<tr><td>CHP</td><td>Freeway and state highway traffic control as requested by CDF</td></tr>
<tr><td>CDF</td><td>Overall incident command of fire operations</td></tr>
<tr><td>SANDAG</td><td>Operate IMTMS and other information systems</td></tr>
<tr><td rowspan="2">VCTMC</td><td>Monitor corridor conditions</td></tr>
<tr><td>Coordinate information dissemination</td></tr>
<tr><td rowspan="5">City Traffic Divisions (San Diego, Poway, Escondido)</td><td>Monitor arterial conditions</td></tr>
<tr><td>Implement road closure/restrictions</td></tr>
<tr><td>Deploy temporary signage</td></tr>
<tr><td>Adjust arterial signal timing</td></tr>
<tr><td>Inform travelers via field elements</td></tr>
<tr><td rowspan="3">Transit Agencies (MTS and NCTD)</td><td>Add temporary transit capacity and services</td></tr>
<tr><td>Monitor transit service</td></tr>
<tr><td>Reroute if necessary</td></tr>
<tr><td>Local First Responders</td><td>Respond to accident for victim extraction, fire suppression, medical assistance</td></tr>
<tr><td rowspan="3">Local Police</td><td>Street traffic patrol</td></tr>
<tr><td>Assisting in directing traffic</td></tr>
<tr><td>Evacuation support services</td></tr>
</table>

Appendix A

Sample PeMS Output – Freeway Metrics

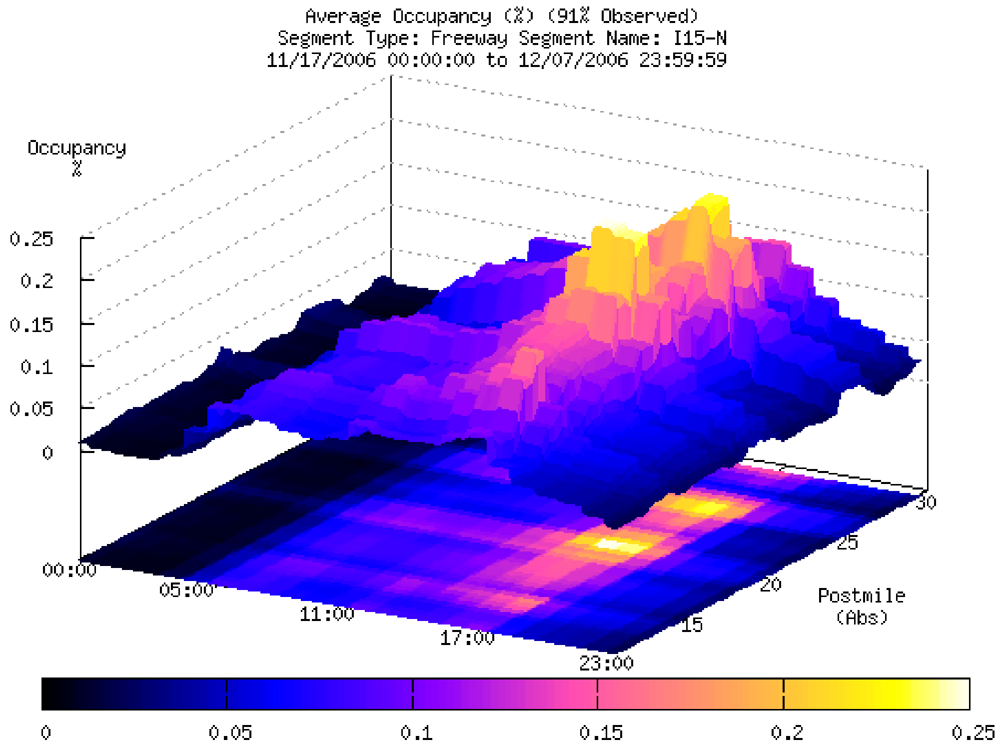


Figure A-1. Average Occupancy, I-15 Northbound

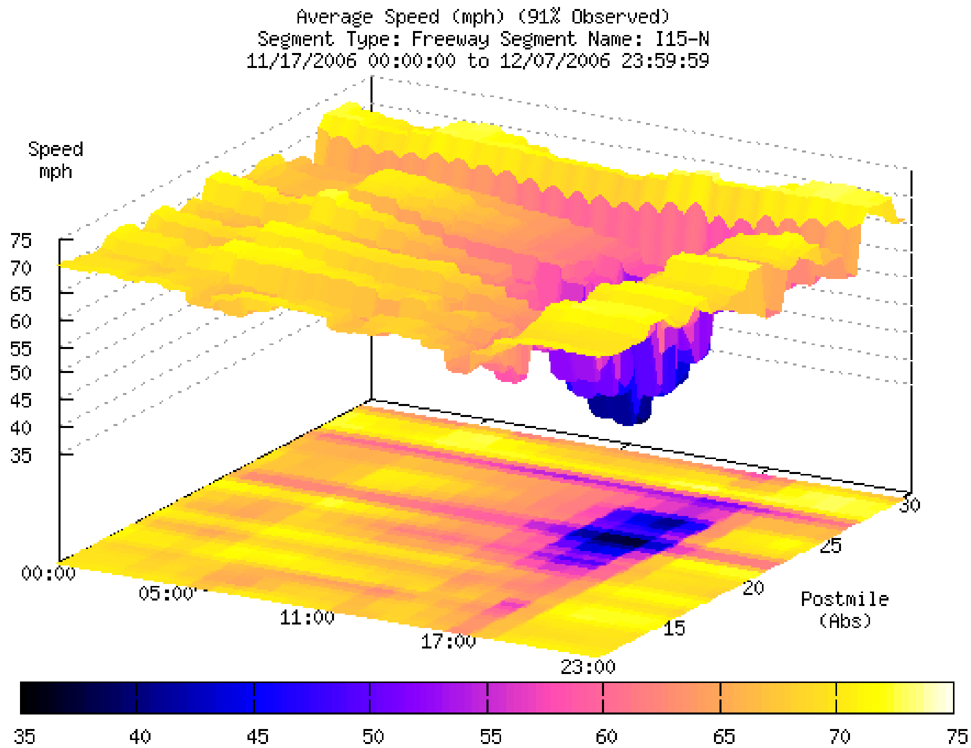


Figure A-2. Average Speeds, I-15 Northbound

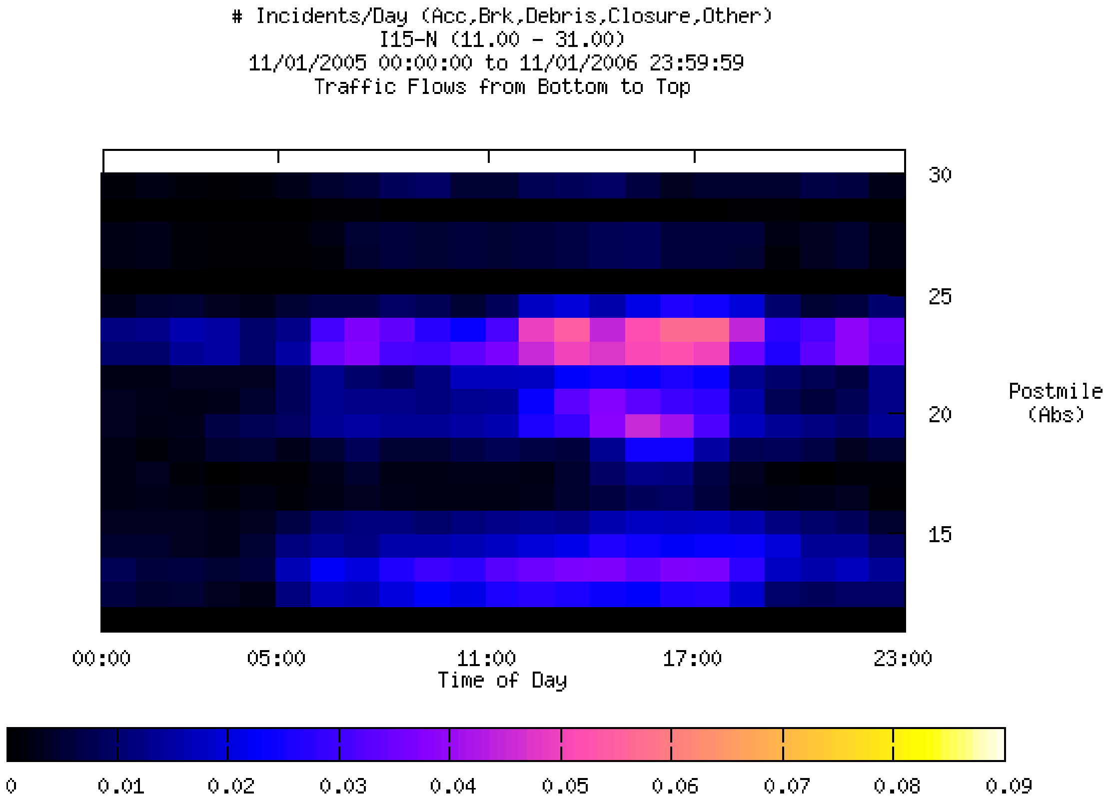


Figure A-3 Incidents, I-15 Northbound

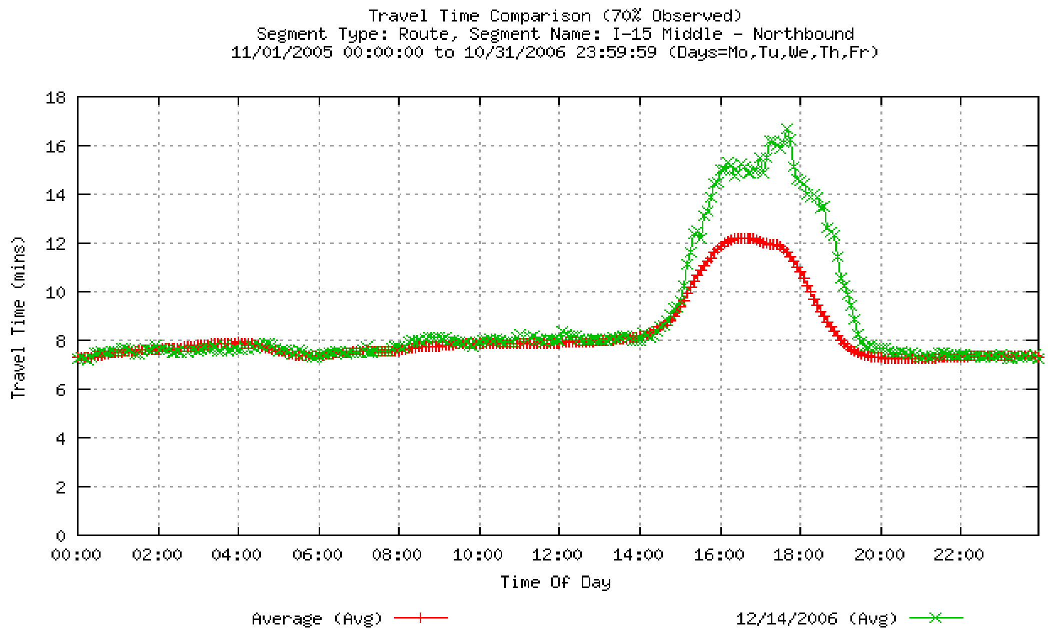


Figure A-4. Travel Times, I-15 Northbound

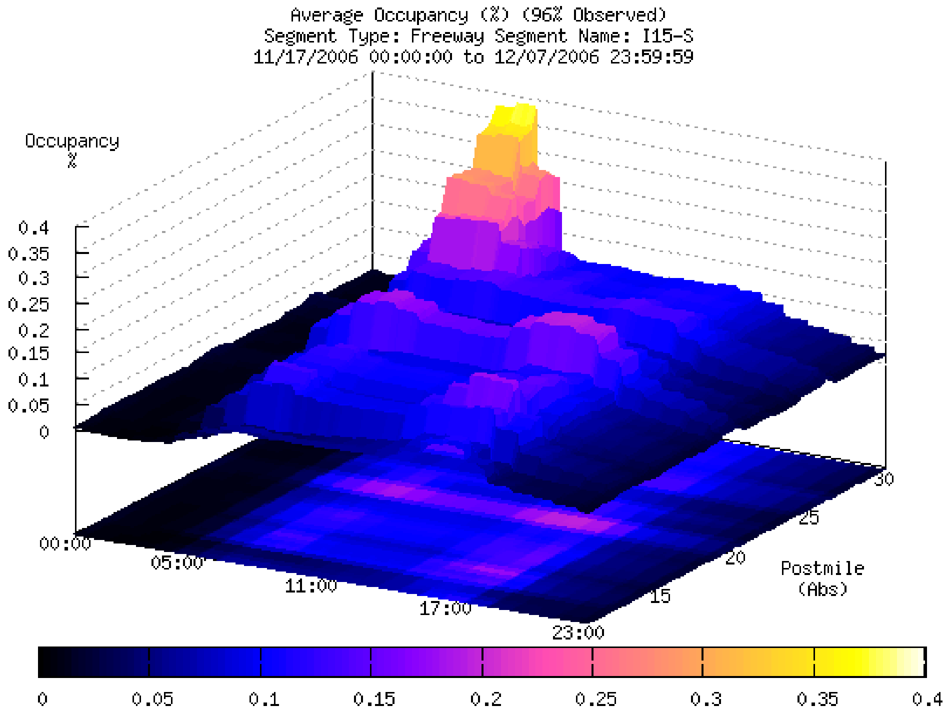


Figure A-5. Average Occupancy, I-15 Southbound

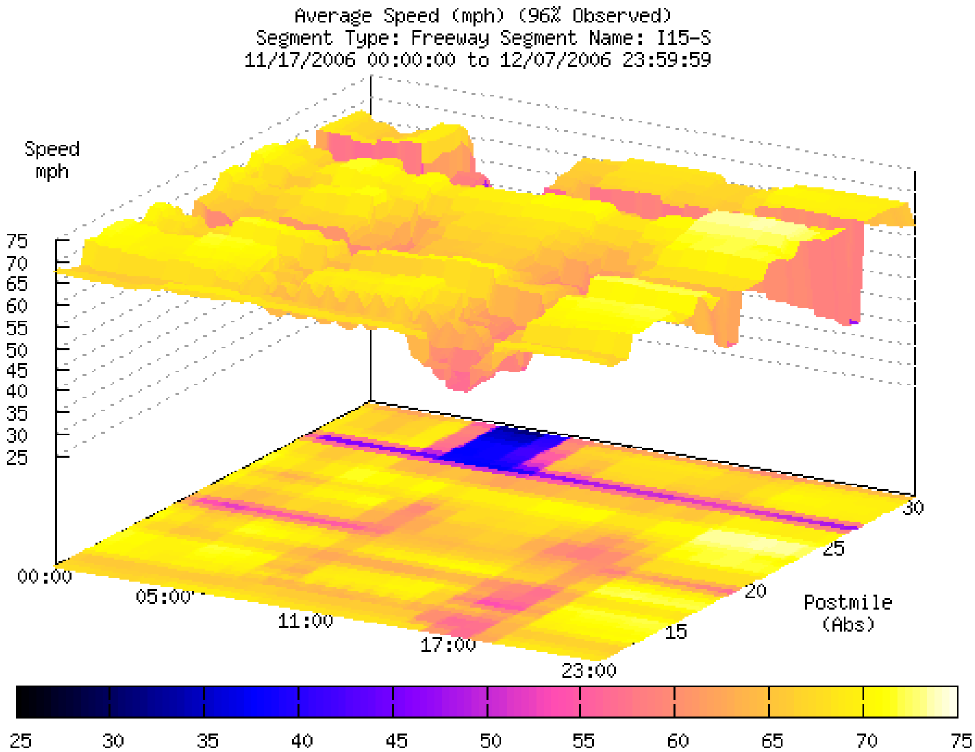


Figure A-6. Average Speed, I-15 Southbound

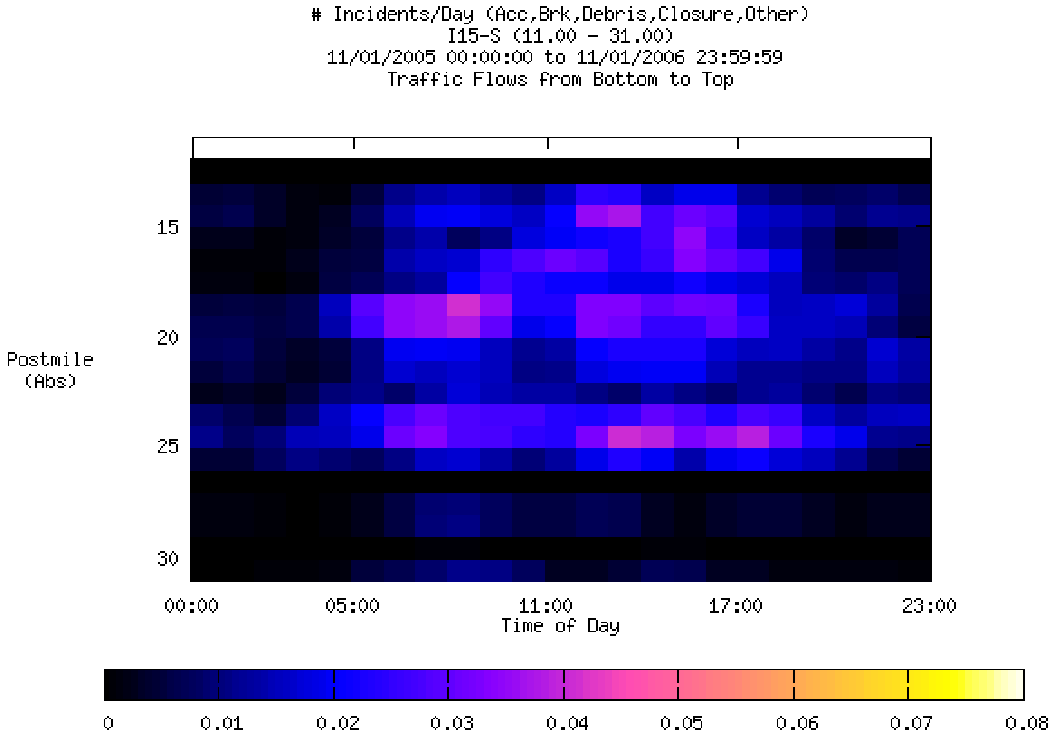


Figure A-7. Incidents, I-15 Southbound

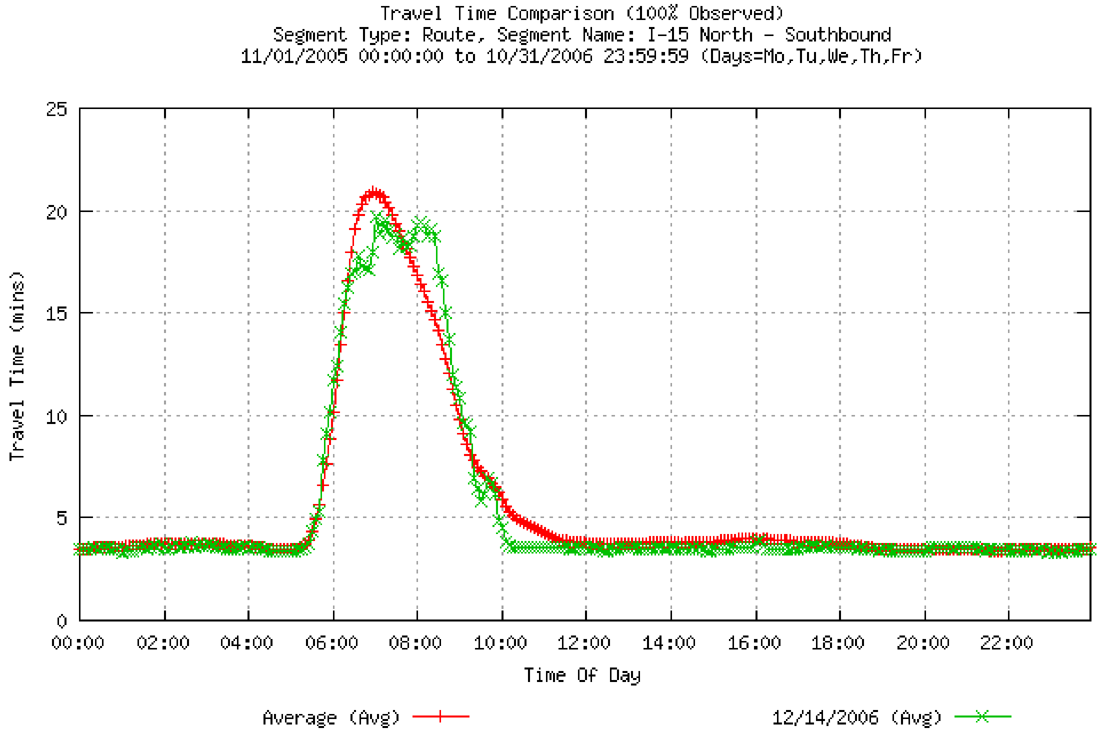


Figure A-8. Travel Times, I-15 Southbound

Appendix B

I-15 Corridor Transit Route Maps

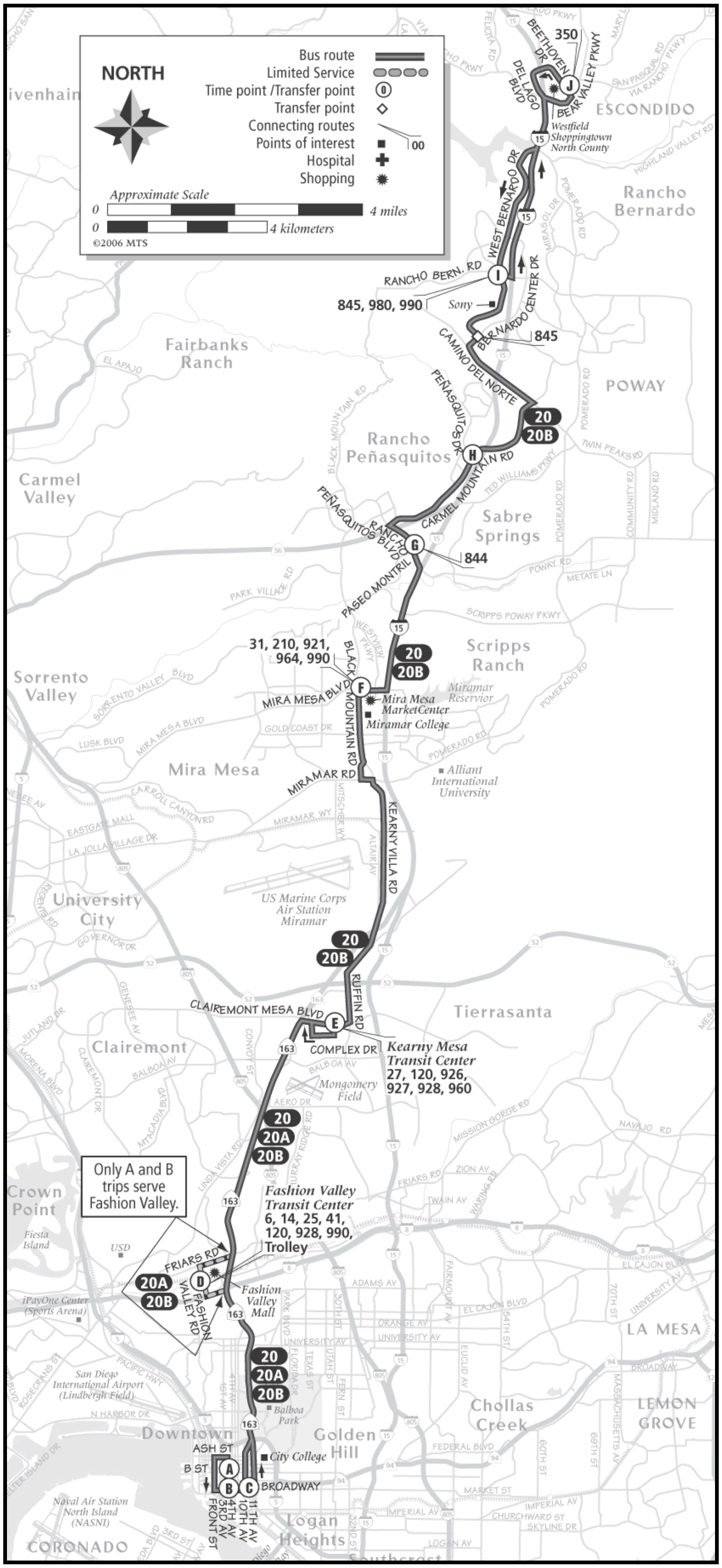


Figure B-1. MTS Route 20

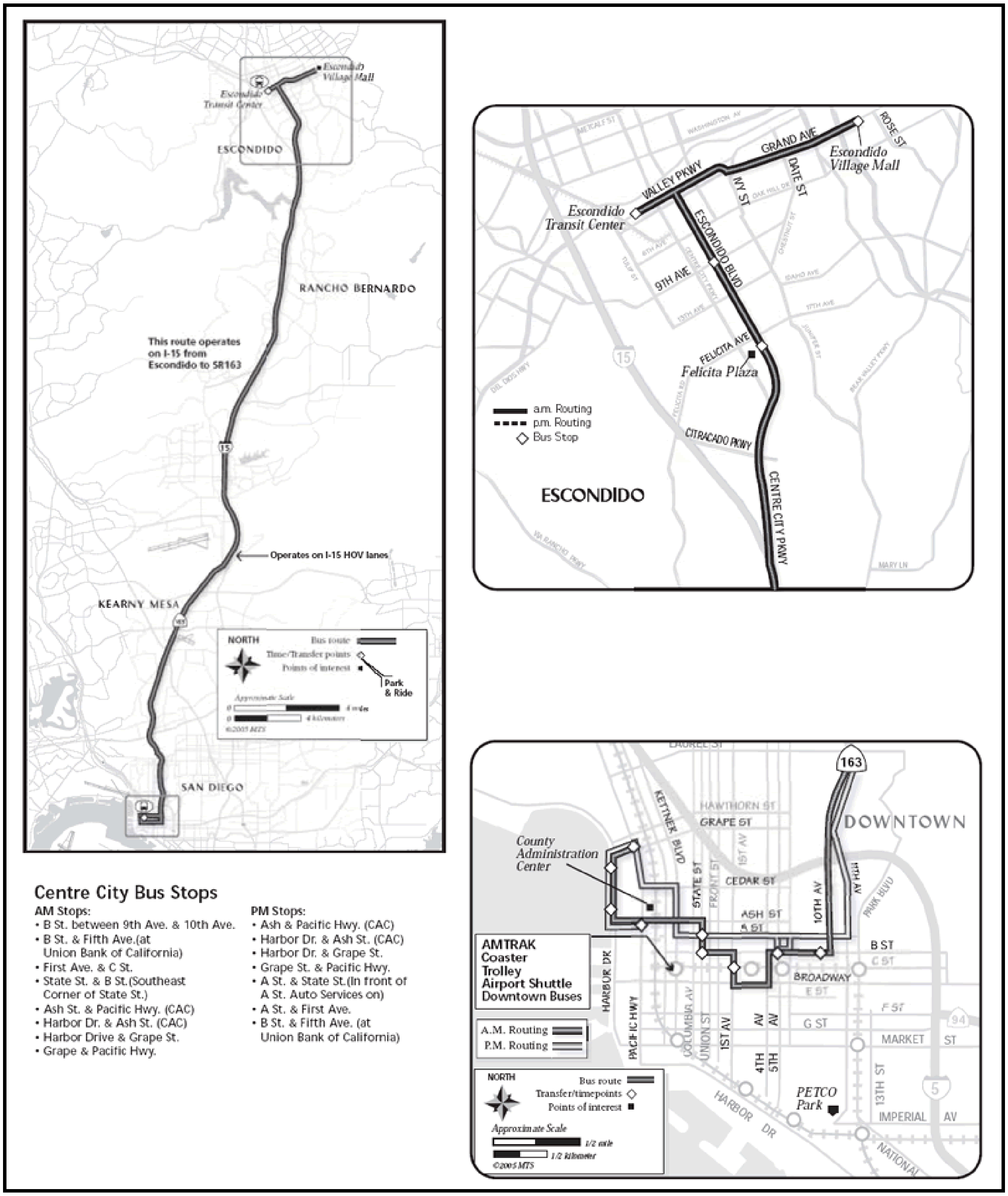


Figure B-2. MTS Route 810

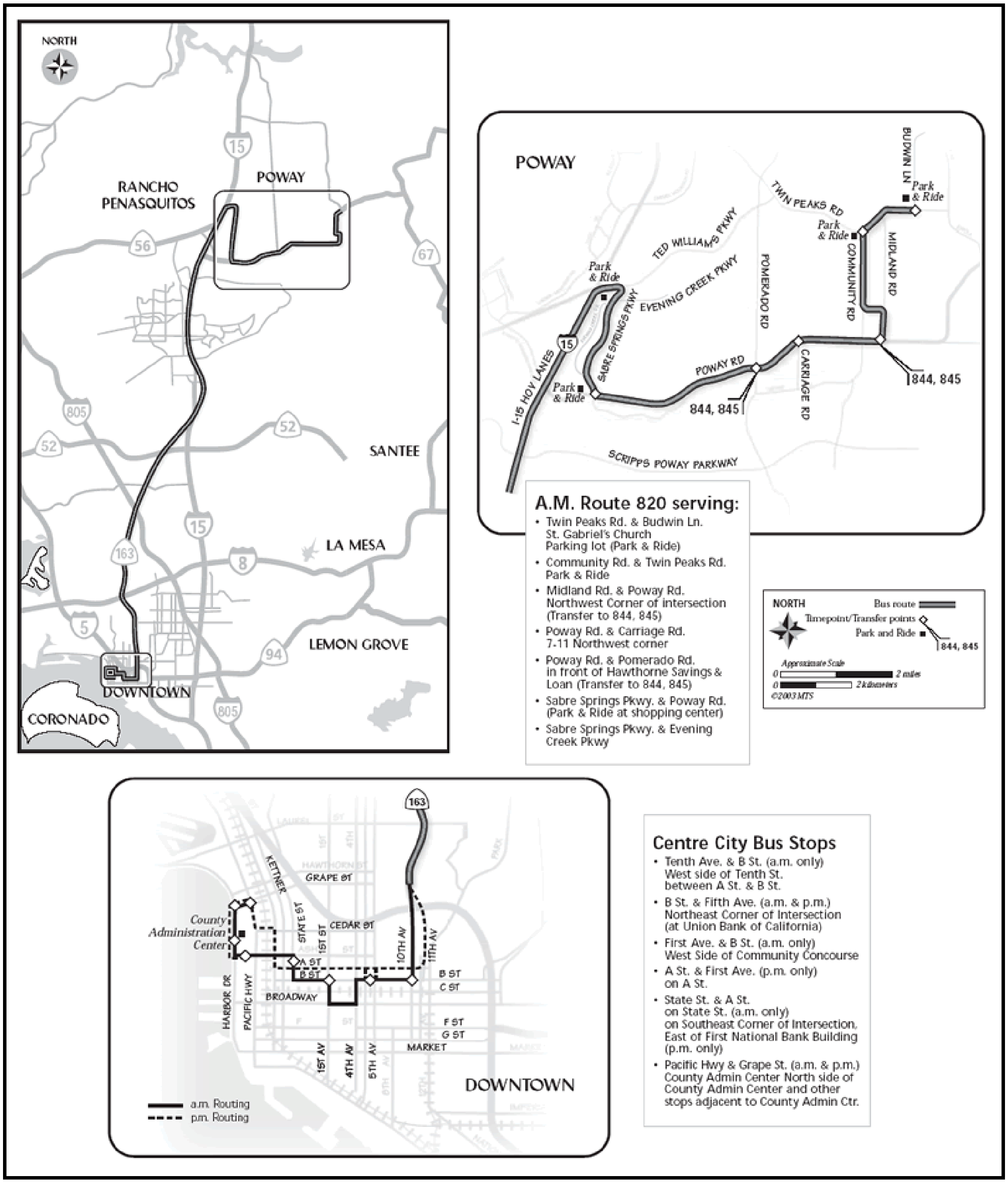


Figure B-3. MTS Route 820

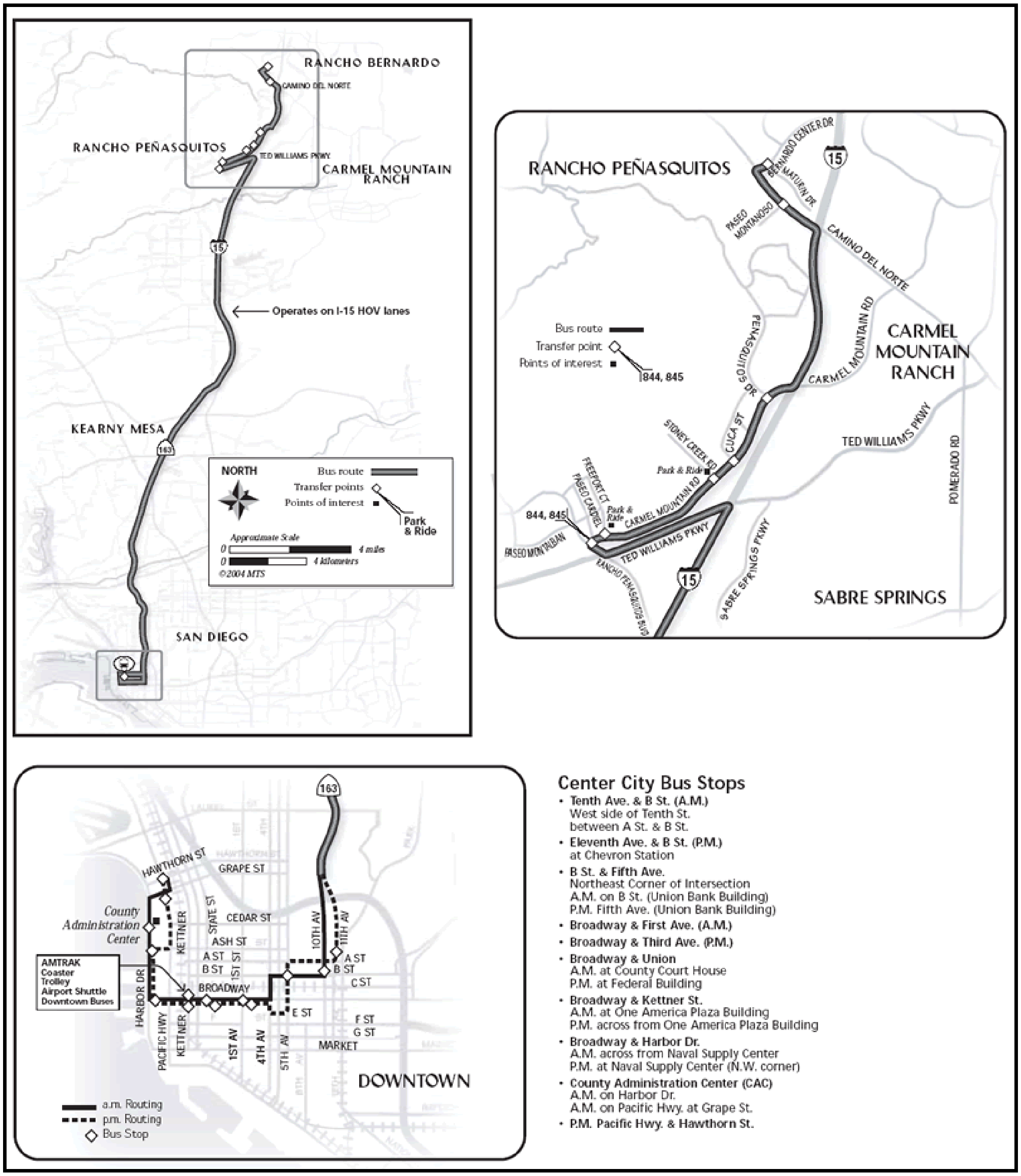
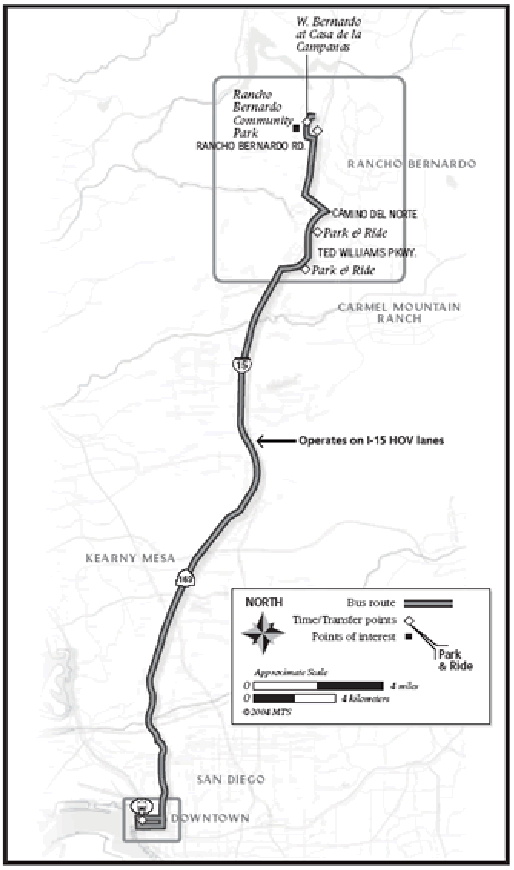
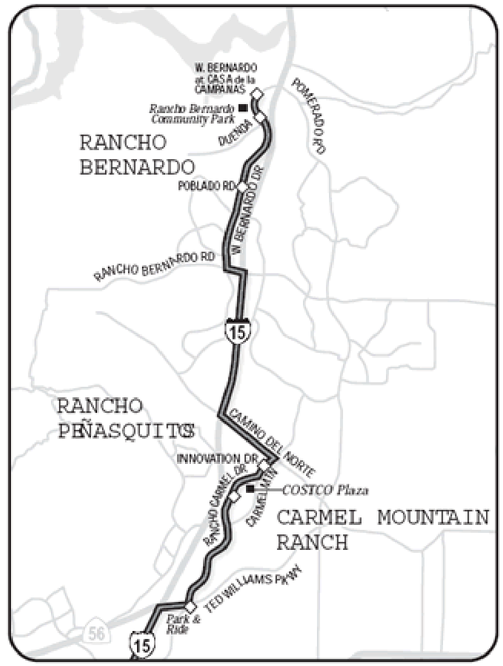
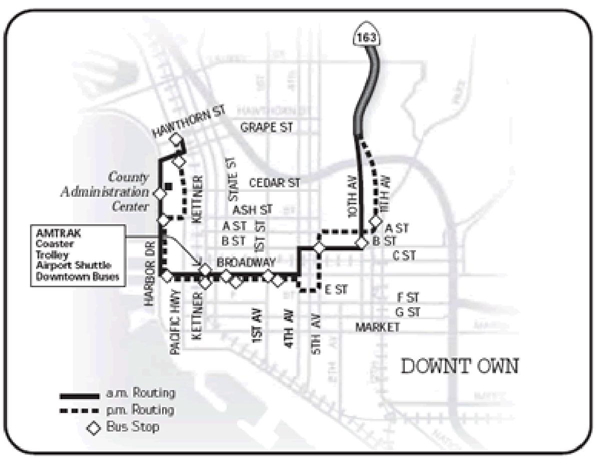


Figure B-4. MTS Route 850







Center City Bus Stops:

- **Tenth Ave. & B St. (A.M.)** West side of Tenth St. between A St. & B St.
- **Eleventh Ave. & B St. (P.M.)** at Chevron Station
- **B St. & Fifth Ave.** Northeast Corner of Intersection A.M. on B St. (Union Bank Building) P.M. on Fifth Ave. (Union Bank Building)
- **Broadway & First Ave. (A.M.)**
- **Broadway & Third Ave. (P.M.)**
- **Broadway & Union St.** A.M. at County Court House P.M. at Federal Building
- **Broadway & Kettner St.** A.M. at One America Plaza Building P.M. across from One America Plaza Building
- **Broadway & Harbor Dr.** A.M. across from Naval Supply Center P.M. at Naval Supply Center (N.W. corner)
- **County Administration Center (CAC)** A.M. on Harbor Dr.
- **County Administration Center (CAC)** A.M. on Harbor Dr. A.M. on Pacific Hwy. at Grape St.
- **A.M. & P.M. Pacific Hwy. & Hawthorn St.**

Figure B-5. MTS Route 860

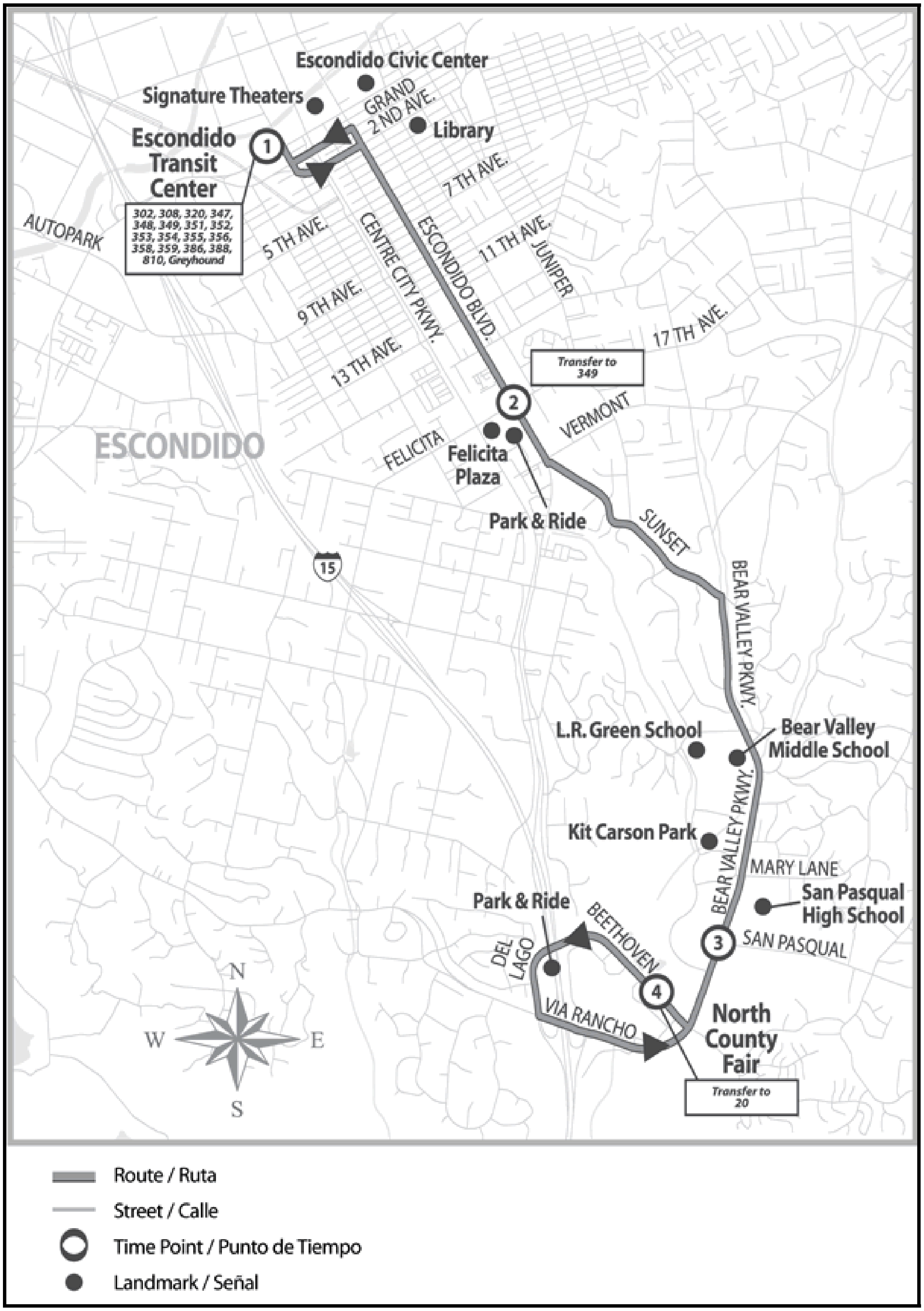


Figure B-6. NCTD Route 350

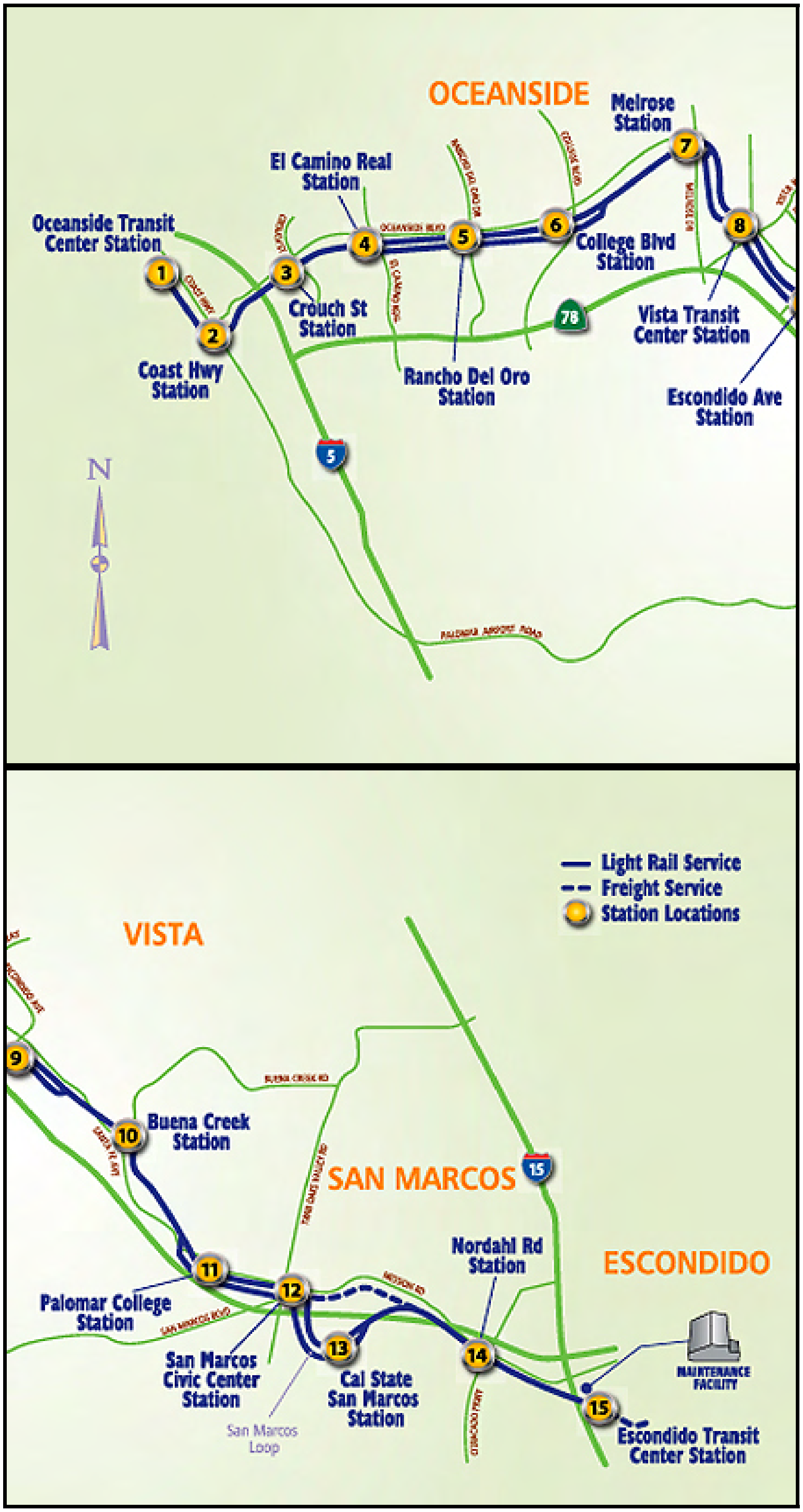


Figure B-7. NCTD SPRINTER Route (December 2007)

Appendix C

San Diego Freeway Service Patrol Beat Maps

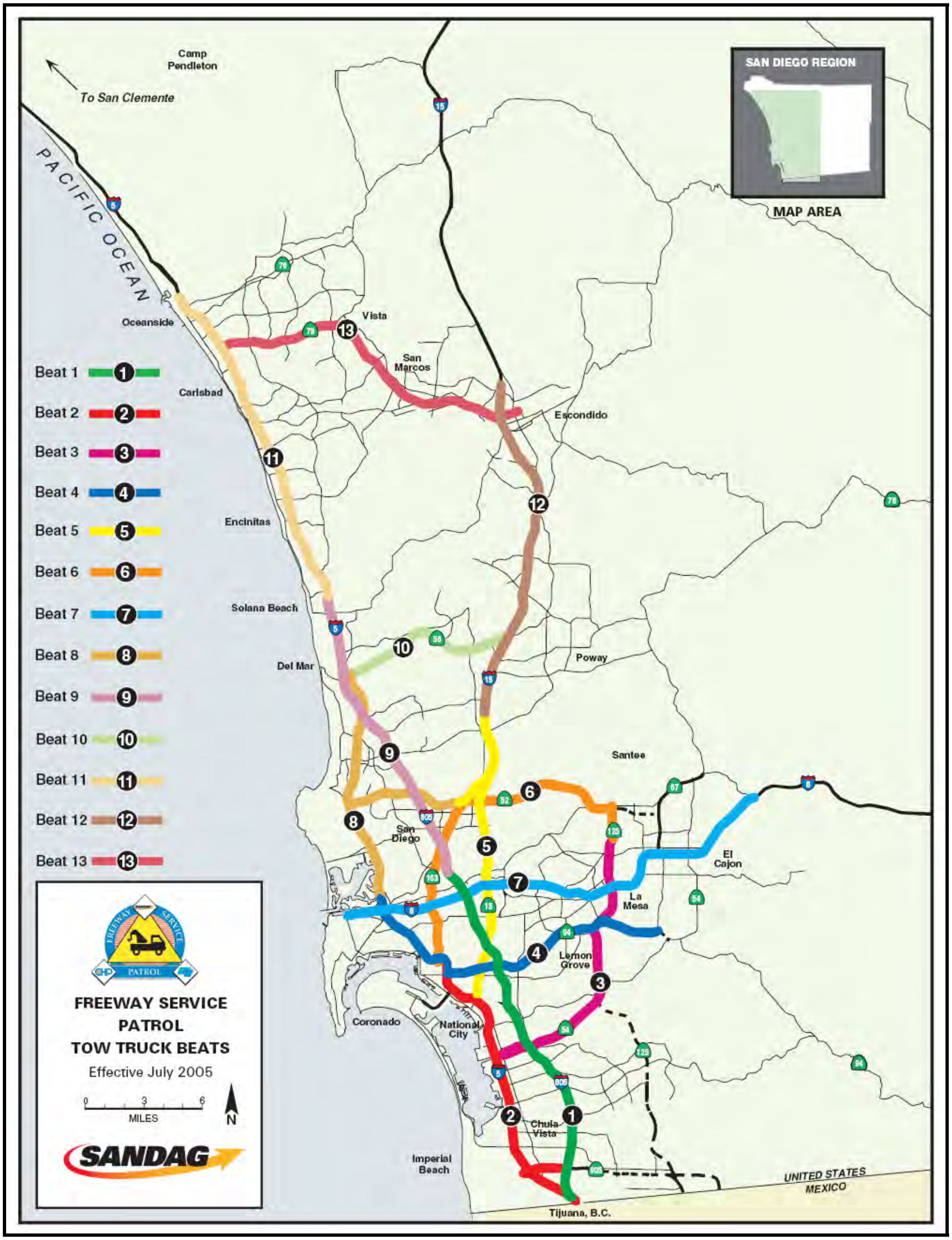


Figure C-1. San Diego Freeway Service Patrol Beat Map

Appendix D

San Diego County Emergency Command Structure

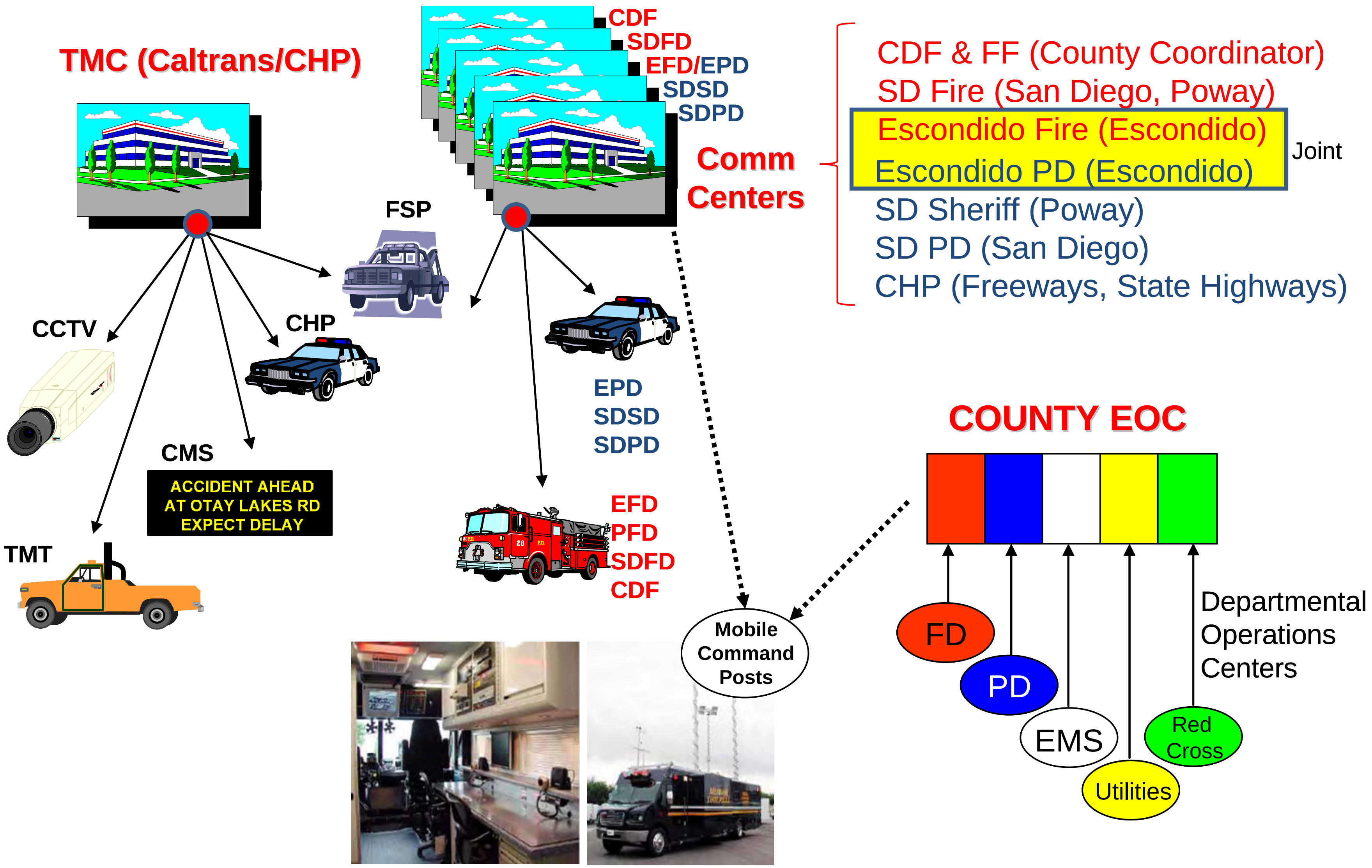


Figure D-1. San Diego County Emergency Command Structure

Appendix E

I-15 Corridor Schematic

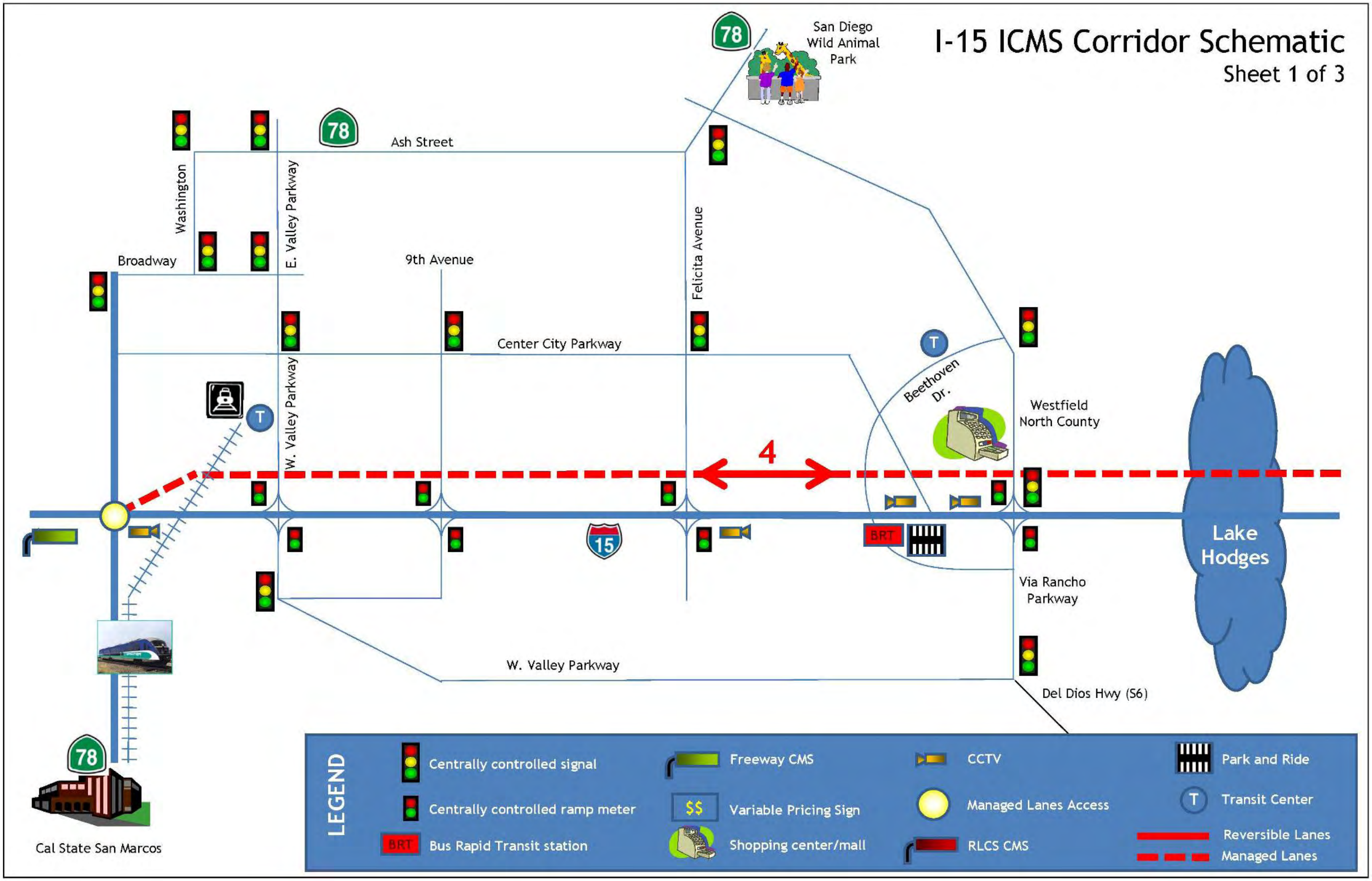


Figure E-1. I-15 Corridor Schematic

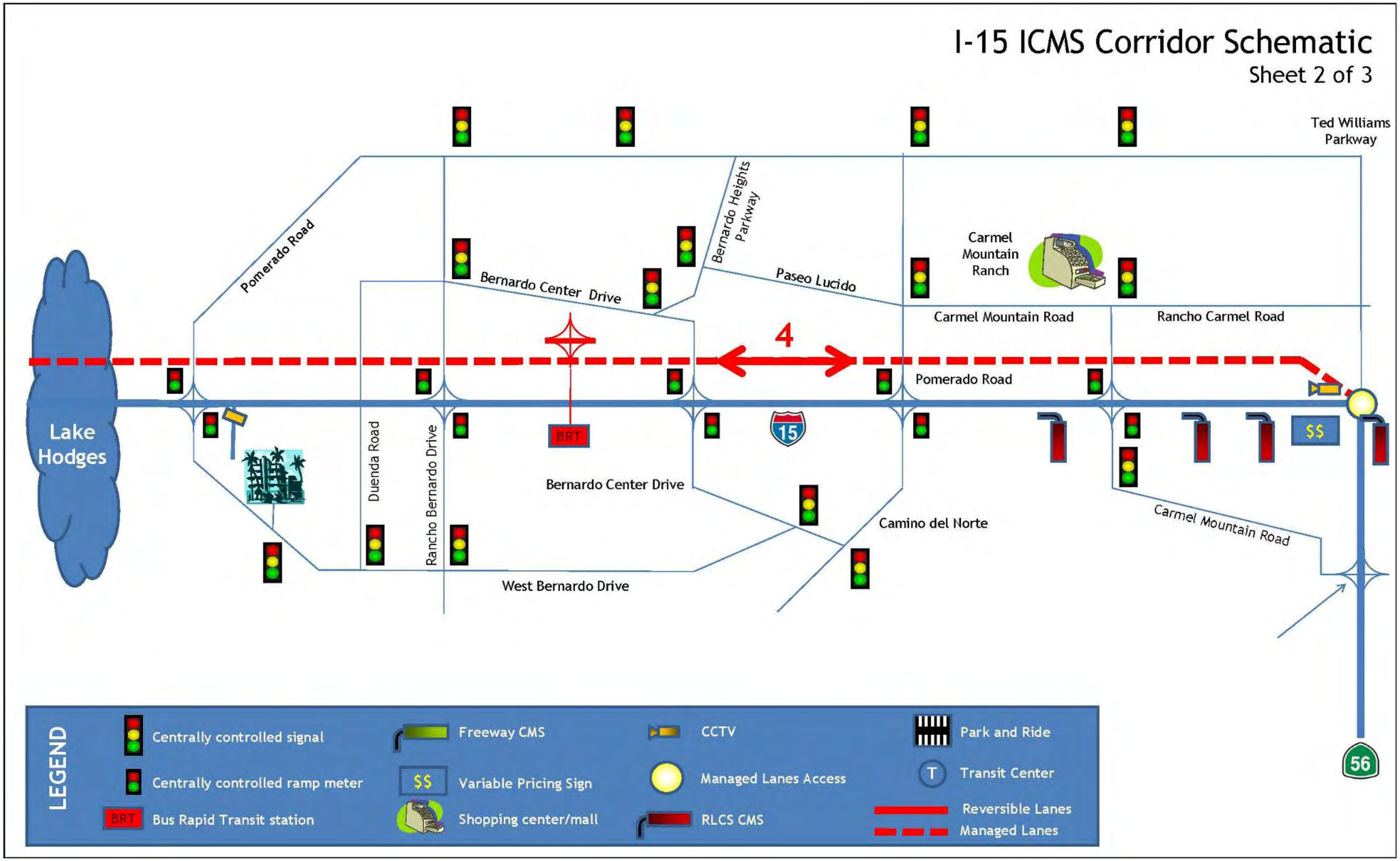


Figure E-1. I-15 Corridor Schematic (cont'd)

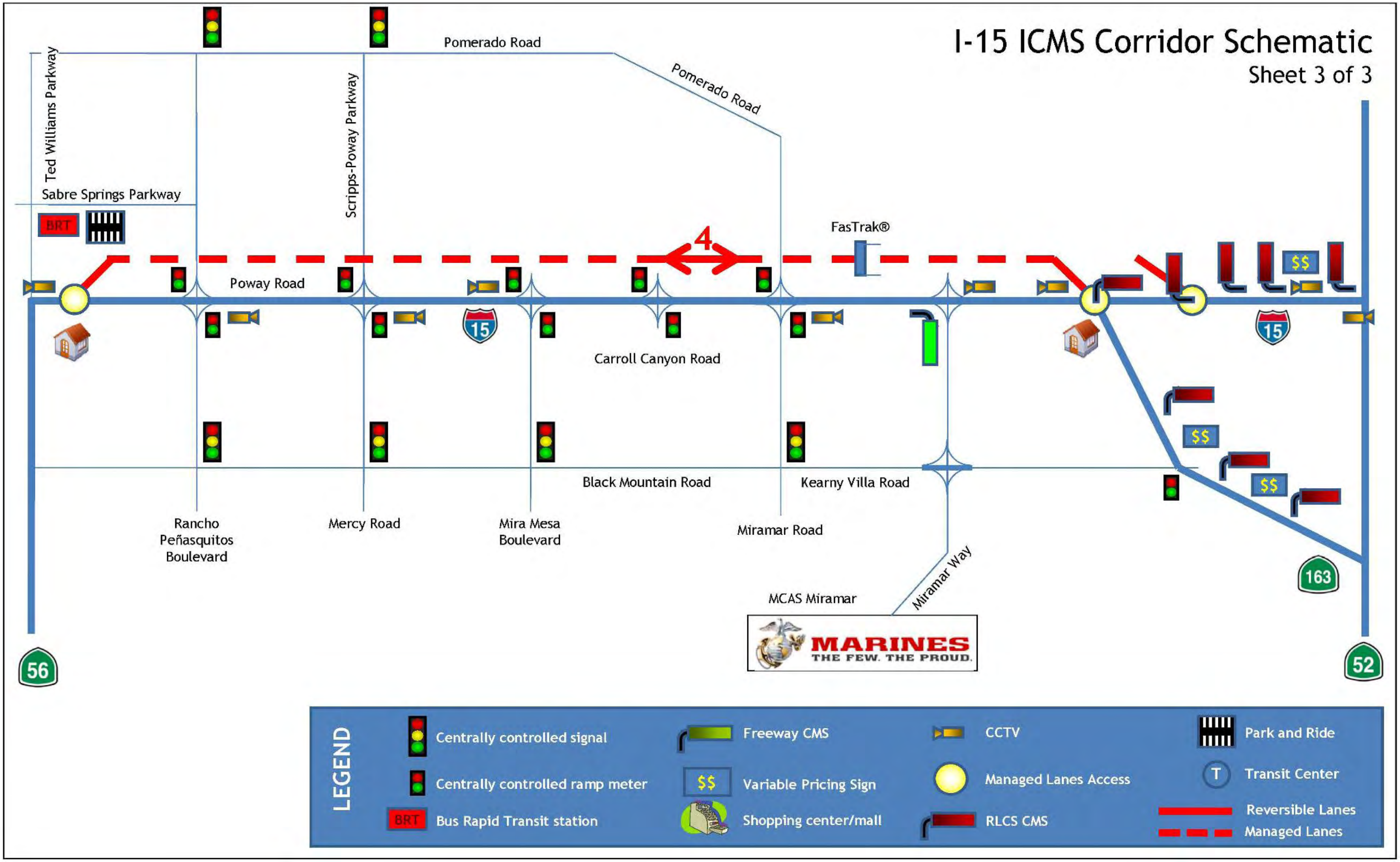


Figure E-1. I-15 Corridor Schematic (cont'd)

Appendix F

Glossary of ICMS Concept of Operations Acronyms

Glossary of Acronyms

ADS	Agency Data Server
ADT	Average Daily Traffic
A-PeMS	Arterial Performance Measurement System
APID	All-Purpose Incident Detection
ATIMS	Advanced Traveler Information Management System
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVC	Automatic Vehicle Classification
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
Caltrans	California Department of Transportation
CCTV	Closed-Circuit Television
CDF	California Department of Forestry
CHP	California Highway Patrol
CMS	Changeable Message Sign
COASTER	Express Rail Service Between San Diego and Oceanside
ConOps	Concept of Operations
CORBA	Common Object Request Broker Architecture
CVO	Commercial Vehicle Operations
DAR	Direct Access Ramp
DHS	Department of Homeland Security
DOT	Department of Transportation
DSRC	Dedicated Short-Range Communications
EOC	Emergency Operation Center
FasTrak®	Fee-Based Transportation Program Allowing Single Drivers Use of I-15 Fast Lanes
FEP	Front End Processor
FSP	Freeway Service Patrol
FTA	Federal Transit Administration
FWHA	Federal Highway Administration
GPS	Global Positioning System
HAZMAT	Hazardous Material
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
IAI	Intermodal Agency Integration
ICM	Integrated Corridor Management

ICMS	Integrated Corridor Management System
IMTMS	Intermodal Transportation Management System
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
JIC	Joint Information Center
JTOC	Joint Transportation Operation Center
MCAS	Marine Corps Air Station
MEO	Medical Examiner's Office
MFTA	Master Fund Transfer Agreement
MLCS	Managed Lanes Control System
MOU	Memorandum Of Understanding
MTS	Metropolitan Transit System
NTCD	North County Transit District
NTSC	National Television Systems Committee
O&M	Operations and Maintenance
O-D	Origin-Destination
OES	Office of Emergency Services
PD	Police Department
PDA	Personal Digital Assistant
PeMS	Performance Management System
QuicNet 4	Traffic Signal Control Platform
QuicNet 4+	Upgraded Version of QuicNet 4 for RAMS
RCS	Regional Communications System
RideLink	Region Commuter and Employer Transportation Assistance Programs
RIWS	Regional Integrated Workstation
RLCS	Reversible Lane Control System
RMIS	Ramp Meter Information System
ROW	Right-of-Way
RTMS	Regional Transit Management System
RTP	Regional Transportation Plan
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SANDAG	San Diego Association of Governments
SANTEC	San Diego Traffic Engineers' Council
SAFE	Service Authority for Freeway Emergencies
SDFD	San Diego Fire Department
SOA	Service-Oriented Architecture
SPRINTER	Commuter Light Rail Service Between Oceanside and Escondido
TDM	Transportation Demand Management
Telco	telephone carrier

TMC	Transportation Management Center
TMT	Traffic Management Team
TO	Traffic Officer
TOC	Transportation Operations Center
TOSNET	Traffic Operations System Network
T-PeMS	Transit Performance Measurement System
TRACON	Terminal Radar Approach Control
TSCS	Traffic Signal Control System
VCTMC	Virtual Corridor Transportation Management Center
VJTOC	Virtual Joint Transportation Operation Center
XML	Extensible Markup Language

Appendix G

San Diego ICM ConOps Detailed Review

San Diego ICM ConOps Detailed Review

1/7/2008

General Comments

The *General Comments* encompass both *Strengths* and *Requested Clarifications* of items in the ConOps.

Strengths

a) There is a good discussion on managed lanes expansion and new transit access.

Requested Clarifications

b) Please consider providing additional information on the figures located in Section 3 on existing conditions on I-15. While the figures show there are variations in corridor or segment occupancies, speed, incidents and travel times throughout the day and at certain mileposts, it's difficult to derive quantitative information. For example what is the average number of incidents that take place on I-15 Southbound between postmile 24 and 30 on a weekly basis between the hours of 6:00am and 10:00am for the Year 2006?

USDOT Update 1/7/2008	Addressed—new maps in Section 3.3 with bottlenecks, incidents, and LOS; previous "Sample PeMS Output – Freeway Metrics" moved to Appendix A.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

c) The document provides a good vision for ICM, but there needs to be a focused discussion on the ICMS and how corridor agencies plan to use the system.

USDOT Update 1/7/2008	Addressed—User Needs are contained in the updated ConOps in Section 4.3, Table 4-8, on pages 4-13 to 4-14; also IMTMS described in Section 5.
San Diego ICM Pioneer Site Response 2/29/2008	*Even though the original USDOT comment was addressed, the set of User Needs were significantly revised based on guidance from the Federal Technical Assistance Team during a site visit in October 2007. The revised set of User Needs are shown in Table 1-4 in Section 1.8 and in Table 4-8 in Section 4.3 and are completely consistent with the set of System Requirement functional areas as shown in our System Requirements document.*

d) Please clarify between current and proposed infrastructure and subsystems. A better correlation between the maps and narrative might help. There is discussion about proposed infrastructure and subsystems, but there is no comprehensive detailed schedule for implementation of proposed infrastructure and subsystems.

USDOT Update 1/7/2008	Addressed—see Figure 4-1, page 4-22.

San Diego ICM Pioneer Site Response 2/29/2008	*Updated noted; no response necessary.*

e) Sections in the document discuss problems and needs. However, the descriptions of user needs should be re-rewritten. As currently written, the discussion on user needs for the future system focuses on solutions. Please provide a set of uniquely identified user needs. This will be critical for developing system requirements and establishing traceability.

USDOT Update 1/7/2008	Addressed—User Needs are contained in the updated ConOps in Section 4.3, Table 4-8, on pages 4-13 to 4-14.
San Diego ICM Pioneer Site Response 2/29/2008	*Please see response written in c) above.*

f) Many of the approaches and strategies are mode focused. Please provide an explanation for how modes will be used as an integrated system (e.g., p. 1-11).

USDOT Update 1/7/2008	Addressed—see page 1-10.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

g) The authors may want to reconsider the evaluation of potential success for the different strategies because so many of them are rated as "high".

USDOT Update 1/7/2008	N/A.
San Diego ICM Pioneer Site Response 2/29/2008	*No response necessary.*

h) Please explain how the numbers for the performance measure success threshold were derived or from where they come (Table 4-15).

USDOT Update 1/7/2008	Addressed—see sections 4.9.1 and 4.9.2 beginning on page 4-29.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

i) Please expand on the section addressing work zones resulting from managed lanes construction and how this is to be addressed as part of ICM.

USDOT Update 1/7/2008	Addressed—see page 4-19.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

j) Bi-directional flow between the VCTMC and some of the subsystems appears to be missing in some of the scenarios. Is that the case? Please clarify.

USDOT Update 1/7/2008	Addressed—see Section 5.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

k) Recommend section 4.2 be improved by providing focused discussions on the need to improve modal/network shifts and to enhance event response recovery practices.

USDOT Update 1/7/2008	Addressed—see Section 4.2.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

l) Please explain what type of features the DSS will have and when it will become operational.

USDOT Update 1/7/2008	Addressed—see pages 4-21 and 4-22.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

m) A clear distinction needs to be made between Integrated Corridor Management (ICM) and an Integrated Corridor Management System (ICMS). An ICMS facilitates ICM.

USDOT Update 1/7/2008	Addressed—see text (e.g.: "…system of systems…") on page 1-1.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

n) Please identify and discuss where the network capacity deficiencies are.

USDOT Update 1/7/2008	Addressed—see text on page 3-14.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

o) The document talks about connecting 511 to freeway call boxes. Please clarify how this will be used.

USDOT Update 1/7/2008	Addressed—see text on page 3-35.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

p) Please discuss how agency coordination and system integration will occur for incident management.

USDOT Update 1/7/2008	Addressed—see pages 3-34 and 3-39.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

Specific Comments

Specific Problem Statement Comments

This section provides specific comments on the problem statement contained in the ConOps—i.e., the ConOps must clearly identify the problem you are trying to solve. The specific comments below request clarification of some items.

Item	1.
Page	3-10, 3-12 and 4-26
Section	Figure 3-8 Travel Times – I-15 Northbound, and Figure 3-12 Travel Times – I-15 Southbound Table 4-15, Potential Performance Measure Targets
USDOT Comment 5/10/2007	Based on review of Figure 3-12 and associated text, it appears that the length of the segment identified in Figure 12 is approximately 11 miles. Based on a rough calculation, it appears that vehicles traveling through the segment at 4:00AM are traveling at 160+ miles per hour. Obviously, we must have made an error in our calculations or assumptions, can you please shed some light on this issue. In addition, Table 4-15, Potential Performance Measure Targets on page 4-26 states that the Performance Measure Success Threshold for the Freeway is to traverse the corridor, on average, in 22 minutes. Based on a review of Figure 3-12, Travel Times – I-15 Southbound, it appears that the highest average travel time through the corridor currently is 21 minutes. Can you please verify if our interpretation is correct or incorrect? This information is needed to ascertain the type and extent of the problem(s) identified in the corridor.
USDOT Update 1/7/2008	Section 3 comments addressed—new maps in Section 3.3 with bottlenecks, incidents, and LOS; however please note that in figures 3-8 and 3-11 the bottleneck icons do not correlate with the scale provided beneath the legend. In Section 4 the response to the comment cannot be found.

San Diego ICM Pioneer Site Response 2/29/2008	*Figures 3-8 and 3-11 bottleneck icons: In these figures, we utilized GIS map depictions and the icons do <u>not</u> depict radii in miles but indicate the queue length of vehicles upstream where congestion exists from the point depicted. For example, in Figure 3-11, which depicts the extent of <u>northbound</u> bottlenecks, looking at the large icon just north of Rancho Bernardo Road – what that icon means is that the northbound bottleneck congestion (queue length) is from 3.2 to 6.1 miles measured <u>south</u> from that point. Likewise the large icon at Bernardo Center Road (not identified on this map, but just south of Rancho Bernardo Road) indicates that northbound congestion exists from 3.2 to 6.1 miles south of that icon. The icons themselves do not directly measure congestion distance but only indicate the point from which congestion is measured in the appropriate direction. In this usage, GIS icons only indicate relative values and are usually the preferred way to depict comparative values. When layouts of ArcGIS maps are developed, all scaling is automatic, including the bottom distance scale. Icon sizes are fixed but can indicate different value ranges depending on the data being shown. Similarly for Figure 3-8, which depicts the extent of <u>southbound</u> bottlenecks, the large icon at Rancho Bernardo Road indicates southbound bottleneck congestion that is 5.3 to 6.8 miles measured <u>north</u> from that point. The text of the ConOps will explain this more precisely.* *Prior to addressing USDOT's second comment regarding travel times and performance measure targets, we first point out that USDOT's original comment and update referenced "Table 4-15" & "Figure 12"; however, this specific table and figure refer to the March 2007 version of the ConOps (appropriate at the time the comment was given). For the August 2007 version, it is "Table 4-16" and "Figure A-8" (in Appendix A) and remains so in the Final version of the ConOps.* *The 22 minute average travel time shown in Table 4-16 is for traversing the entire length of the 21-mile corridor. In Figure A-8, the highest average travel time is 21 minutes; however, this graph represents just the 8-mile long North Segment of the I-15 corridor (Section 3.1 and Figure 3-2 of the ConOps) and only a sample of the corridor. Thus Figure A-8 and Table 4-16 are not comparable.*

Item	2.
Page	3-9 and 3-11
Section	Figure 3-7 Incidents I-15 Northbound, Figure 3-11 Incidents – I-15 Southbound
USDOT Comment 5/10/2007	The extent of the incident related problems can't be ascertained based on Figure 3-11. For example, if Figure 3-11 is interpreted correctly there is only one accident every 20 days near postmile 18 at approximately 2:00PM. It is difficult to interpret the total number and frequency of incidents from these figures. Please provide a listing of the number of incidents per month or per year for a range of times and postmiles. This suggested representation might be easier to comprehend. This information is needed to ascertain the type and extent of the problem(s) identified in the corridor.
USDOT Update 1/7/2008	Addressed—new maps in Section 3.3 with bottlenecks, incidents, and LOS.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*
Item	3.
Page	3-12
Section	Arterial Operations
USDOT Comment 5/10/2007	Please provide detailed information about congestion levels on major arterials in the corridor. For example, Level of Service for the AM and PM peak periods by direction, e.g. northbound. This information is needed to ascertain the type and extent of the problem(s) identified in the corridor.
USDOT Update 1/7/2008	Addressed—see Figures 3-13 and 3-14 on pages 3-23 and 3-24.
San Diego ICM Pioneer Site Response 2/29/2008	*Update is noted; however, it is Figures 3-15 and 3-16 (August 2007 version of the ConOps) and not Figures 3-13 and 3-14 that show congestion levels on the corridor's three major arterials (Centre City Parkway, Pomerado Road, and Kearny Villa/Black Mountain Road).*

Item	4.
Page	3-14
Section	Table 3-1. I-15 Transit Corridor Existing Conditions (2005)
USDOT Comment 5/10/2007	Would it be possible to provide the Average Weekday Bus Speed by time of day period? Also, could you please provide the posted speed limits for the routes? This information is needed to ascertain the type and extent of the problem(s) identified in the corridor.
USDOT Update 1/7/2008	Addressed—see Tables 3-5, 3-6, and 3-7 on pages 3-30 through 3-32.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

Specific Inventory Comments

This section provides specific comments on the inventory contained in the ConOps—i.e., the ConOps must clearly describe the coverage, location, availability, capabilities of the corridor inventory. The specific comments below request clarification of some items.

Item	5.
Page	3-7
Section	Cities of Escondido, San Diego and Poway
USDOT Comment 5/10/2007	Optimization of traffic signal timings is an important transportation management function. Can you please provide the dates when traffic signal timings were last optimize for traffic signals located in the corridor?
USDOT Update 1/7/2008	Addressed—see page 3-7.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

Item	6.
Page	3-13
Section	Arterial Operations ¶3
USDOT Comment 5/10/2007	Please provide a projected date when this capability will be operational. If these improvements are needed realize the ICM Operational Concept, it's important to identify when the improvements will become operational
USDOT Update 1/7/2008	Addressed—see page 3-35.
San Diego ICM Pioneer Site Response 2/29/2008	*The update is noted and our only response is that the original comment was addressed in the August 2007 version of the ConOps on Page 3-25, not 3-35.*
Item	7.
Page	3-16, 3-20
Section	Page 3-16. Arterial Operations Page 3-20. Arterial
USDOT Comment 5/10/2007	Please provide a projected completion date for the RAMS project. Will this project cover all corridor traffic signals? If this improvement is needed to realize the ICM Operational Concept, it's important to identify when the improvement will become operational
USDOT Update 1/7/2008	Addressed—see page 3-35.
San Diego ICM Pioneer Site Response 2/29/2008	*Since the last version of the ConOps (August 2007), we have updated both Section 3.3 Arterial Operations and the Timeline- Schedule for the operational deployment dates for RAMS. So, the Final ConOps shows these current deployment dates.*
Item	8.
Page	3-19
Section	Regional Communications
USDOT Comment 5/10/2007	Please provide a projected date for completion of the telecommunications infrastructure. If this capability is necessary to implement the ICM operational concept, it's important to know when this infrastructure will be operational.
USDOT Update 1/7/2008	Addressed—see page 3-38.

San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*
Item	9.
Page	3-23
Section	Physical Communications
USDOT Comment 5/10/2007	Please describe the current telecom infrastructure and type of service, e.g. ATM and Dial-up, for each network, e.g. Transit and Freeway. This information is needed to ascertain the adequacy of the current telecommunications infrastructure.
USDOT Update 1/7/2008	Addressed—see page 3-42.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*
Item	10.
Page	3-24
Section	3.5 Proposed Near-Term Network Improvements
USDOT Comment 5/10/2007	Please provide projected completion dates for the improvements listed in this section. If these improvements are needed to realize the ICM Operational Concept, it's important to identify when the improvements will become operational.
USDOT Update 1/7/2008	Partially addressed—included dates for Freeway and Arterial projects, but not for all Transit projects—see pages 3-43 to 3-45.
San Diego ICM Pioneer Site Response 2/29/2008	*This comment has now been completely addressed in the Final Version of the ConOps.*

Item	11.
Page	3-43
Section	Real-Time Data and Device Sharing – Regional Integrated Work Stations (RIWS)
USDOT Comment 5/10/2007	Please provide a projected completion date for the RIWS. If this system is needed to realize the ICM Operational Concept, it's important to identify when the system will become operational.
USDOT Update 1/7/2008	Addressed—see page 3-44.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*
Item	12.
Page	3-43
Section	Integration of Transit, Road Pricing, and Parking Payment Systems
USDOT Comment 5/10/2007	Please provide a projected completion date for the system identified in the text. If this system is needed to realize the ICM Operational Concept, it's important to identify when the system will become operational.
USDOT Update 1/7/2008	Addressed—see page 3-63.
San Diego ICM Pioneer Site Response 2/29/2008	*Since the last version of the ConOps (August 2007), we have updated both Section 3.9 Integration of Transit, Road Pricing, and Parking Payment Systems and the Timeline- Schedule for the operational deployment dates for the Compass Card Program. Thus, the Final ConOps shows these current deployment dates.*
Item	13.
Page	4-14
Section	Table 4-8. Status of Network Systems Required Assets
USDOT Comment 5/10/2007	Thank you for the extensive amount of information contained in the table. However, the A, B, C notation is not quantifiable. Please clearly identify the location and number (if applicable) of existing and proposed assets if not provided previously. Also, if the assets are needed to realize the ICM Operational Concept, please identify when the improvements will become operational.

USDOT Update 1/7/2008	Addressed—see page 4-14.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*
Item	14.
Page	4-18
Section	4.4 Comparison of ICMS Asset Requirements with Current and Planned Assets.
USDOT Comment 5/10/2007	At the top of page 4-18, there is a list of assets identified by ten (10) bullets in the first two (2) paragraphs. If the assets are needed to realize the ICM Operational Concept, please identify when the improvements will become operational.
USDOT Update 1/7/2008	Addressed—see page 4-19.
San Diego ICM Pioneer Site Response 2/29/2008	*Since the last version of the ConOps (August 2007), we have updated both Section 4.4 Comparison of ICMS Asset Requirements with Current and Planned Assets and the Timeline- Schedule for the operational deployment dates of assets. So, the Final ConOps shows these current deployment dates.*
Item	15.
Page	4-26
Section	Arterials and Transit Figure 4-2. Multi-Modal PeMS Logical Architecture
USDOT Comment 5/10/2007	Please provide a projected completion date for the system identified in the text and Figure 4-2. If this system is needed to realize the ICM Operational Concept, it's important to identify when the system will become operational.
USDOT Update 1/7/2008	Addressed—now Figure 4-3 page 4-31.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

Specific ICM Operational Concept Comments

This section provides specific comments on the ICM operational concept contained in the ConOps—i.e., the ConOps must have a clearly defined operational concept for ICM, for example the ability to assess performance on a corridor level. The specific comments below request clarification of some items.

Item	16.
Page	1-8, 1-10 through 1-11, and 3-43 through 3-44
Section	1.6 Vision, goals, and Objectives, 1.7 Concept Operational Description: Approaches and Strategies, 3.10 Vision for San Diego I-15 Integrated Corridor Management System
USDOT Comment 5/10/2007	A high level description of the ICM vision was found in sections 1.6 and 1.7. However, without a clear description of the corridor problems (see item 3 above) it is difficult to evaluate the vision against the problem. Please note that the same vision is provided in section 3-10. No new information on the vision was provided.
USDOT Update 1/7/2008	Addressed—see Section 3.3 starting on page 3-13.
San Diego ICM Pioneer Site Response 2/29/2008	*Update noted; no response necessary.*

Specific ICMS Comments

This section provides specific comments on the description of the ICM System contained in the ConOps—i.e., the ConOps must have a clearly defined ICMS that addresses all elements of their ICM operational concept, including ICMS user needs that are complete and correct for the ICM operational concept. The specific comments below request clarification of some items.

Item	17.
Page	3-21 through 3-24, 3-41 through 3-43, 4-1 through 4-10
Section	3.4 Existing Network-Based Transportation management and ITS Assets 3.9 Potential for an Integrated Corridor Management System, 4.1 Goals and Objectives, 4.2 ICMS Approaches and Strategies for the San Diego I-15 corridor, 5.0 Operational Scenarios

USDOT Comment 5/10/2007	The next activity in the ICM process is to develop ICMS requirements. ICMS requirements should be derived from a set of user (i.e., operational) needs. The above sections have provided a high level explanation of the ICMS for I-15. The description of the IMTMS (Section 3.4) and the Operational Scenarios (Section 5.0) provided indications of the ICMS operational activities and multiple proposed system architectures by scenario. However, user needs were not available and would be helpful to describe the ICMS. Please provide user needs to describe the operational functions of the proposed ICMS (see Appendix 1 and Appendix 2 for examples of user needs developed to explain the operational concepts for an ICMS).
USDOT Update 1/7/2008	Addressed—User Needs are contained in the updated ConOps in Section 4.3, Table 4-8, on pages 4-13 to 4-14.
San Diego ICM Pioneer Site Response 2/29/2008	*Please see response written in c) of Section 1.2 above.*

Comments on User Needs

1) USDOT Comments Dated 7/11/2007
   The original USDOT comments on the Pioneer Site User Needs were previously sent as a separate document.

2) Pioneer Site ConOps Update 8/8/2007
   The Pioneer Site User Needs are contained in the updated ConOps in Section 4.3, Table 4-8, on pages 4-13 to 4-14 (PDF pages 103-104) [also in the updated ConOps in Section 1.8, Table 1-4, on pages 1-13 to 1-14 (PDF pages 21-22)].

3) USDOT Update 1/7/2008
   The revised user needs satisfy the criteria of a well written need:
   1. Uniquely Identifiable
   2. Major Desired Capability
   3. Solution Free
   4. Capture Rationale

San Diego ICM Pioneer Site Response 2/29/2008: *Please see response written in c) of Section 1.2 above.*

Made possible in conjunction with the following partners:

Caltrans

Freeway Service Patrol

MTS

NCTD

CHP

City of Poway

Escondido City of Choice

The City of San Diego

SANDAG