I-15 Integrated Corridor Management System Requirements

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16. Abstract

This document is intended as a listing and discussion of the Requirements for the I-15 Integrated Corridor Management System (ICMS) Demonstration Project in San Diego. This document describes what the system is to do (the functional requirements), how well it is to perform (the performance requirements), and under what conditions (non-functional and performance requirements). This document does not define how the system is to be built; that is the providence of the design document. This document pulls together requirements from a number of sources including but not limited to the Concept of Operations, the initial Systems Requirements Document and constraints identified by the agencies. This document sets the technical scope of the system to be built for the Demonstration Project.

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Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1.1 Integrated Corridor Management System (ICMS) Purpose

The ICMS will provide stakeholder agencies with an integrated, multi-modal system and the accompanying institutional agreements to implement the agreed upon ICM operational concept as described in the Interstate 15 (I-15) Integrated Corridor Management System Concept of Operations Document dated March 31, 2008.

The ICMS is currently under development by a team of San Diego area transportation agencies led by the San Diego Association of Governments (SANDAG). Team members include the following agencies:

- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)
- U.S. Department of Homeland Security (DHS)
- San Diego Association of Governments (SANDAG)
- California Department of Transportation (Caltrans) District 11
- California Highway Patrol (CHP)
- City of Escondido (Traffic, Police, Fire)
- City of Poway (Traffic, Fire)
- City of San Diego (Traffic, Police, Fire)
- Metropolitan Transportation System (MTS)
- North County Transit District (NCTD)
- San Diego Sheriff's Department (SDSD - City of Poway contract PD, unincorporated areas in the corridor)
- San Diego County Office of Emergency Services (OES)

1.2 ICMS Scope

1.2.1 Needs and Issues

I-15 corridor stakeholders visualize current corridor operations through the individual networks and associated systems that comprise the I-15 corridor today. Using available technologies, these "stovepipes" can be effectively integrated to support a multi-modal management approach. The issues of congestion and capacity can be addressed through the planned Managed Lanes facility and associated bus rapid transit (BRT) stations and routes and coordination with arterial networks.

I-15 stakeholders in the San Diego region are focusing on the operational, 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 in Table 1-1.

Table 1-1. Issues and Needs Identified by I-15 Corridor Stakeholders

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 at, or near capacity
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 high occupancy vehicle/high occupancy toll (HOV/HOT) facilities
Issue: Coordination across multiple functional systems
Traveler Information Services—
Issue: Minimal Advanced Traveler Information System (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 and ability to scale up for major disasters

1.2.2 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 Table 1-2. 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 1-2. I-15 ICMS Corridor Goals and Objectives

Goals	Objectives
1. 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 Transportation Demand Management (TDM) progArterial Management System • Promote development to encourage the use of transit (especially BRT)
2. 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

3. 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

Table 1-2. I-15 ICMS Corridor Goals and Objectives (cont'd)

Goals	Objectives
3. The corridor's travelers shall have the informational tools to make smart travel choices within the corridor. (cont'd)	• 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, personal digital assistant ((PDA)/Blackberry, TV, changeable message signs (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
4. The corridor's institutional partners shall employ an integrated approach through a corridor-wide 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
5. 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)

1.3 Definitions, Acronyms, and Abbreviations

See Appendix A.

1.4 References

The following documents were used in developing the System Requirements Document for the I-15 Integrated Corridor Management project and are listed in alphabetical order.

- 2030 San Diego Regional Transportation Plan Final, November 2007
- Advanced Transportation Management System 2005 (Freeway Management System): Architecture Document, Delcan Corporation, Version 4.1 June 27, 2006
- Common Alerting Protocol v1.1 (OASIS Standard CAP-V1.1, October 2005)
- I-15 Managed Lanes Operations and Traffic Incident Management Plans, HNTB, July 2006
- I-15 Managed Lanes Task 3.1 Electronic Toll Collection System (ETC) – Concept of Operations, HNTB, September 2006.
- I-15 Managed Lanes Traffic Incident Management (TIM) Plan, HNTB, January 2007
- I-15 Managed Lanes Toll System – Draft System Requirements, Wilbur Smith Associates, October 2002
- I-15 Managed Lanes Value Pricing Project Planning Study – Volume 1 Traffic, Revenue, and Toll Operations Concept Plan, Wilbur Smith Associates, February 2002
- Software Life Cycle Processes, IEEE Standard IEEE/EIA 12207.0-1996
- Software Life-Cycle Practices – Life Cycle Data, IEEE Guide IEEE/EIA 12207.1-1997
- IEEE Guide for Developing System Requirements Specifications, IEEE Std. 1233, The Institute of Electrical and Electronics Engineers, Inc., 1998 Edition
- Intermodal Transportation Management Systems (IMTMS) Integration Guidebook, Delcan Corporation, Version 1.0, April 2007
- San Diego I-15 Integrated Corridor Management System - Final Concept of Operations, San Diego Association of Governments, August 2007
- San Diego Interstate 15 Managed Lanes Value Pricing Project Final Traffic Operations Plan, June 2002
- San Diego Region Intermodal Transportation Management System – San Diego 511 System Requirements Document (Final Version 3.0), National Engineering Technology Corporation, July 2006
- IEEE Recommended Practice for Software Requirements Specifications, IEEE Std. 830, The Institute of Electrical and Electronics Engineers, Inc., 1998 Edition
- Integrated Corridor Management: The Transition from a Concept of Operations to Requirements, Mixon-Hill, Version 1.6 August 2007
- San Diego Regional Transit Management System Radio Communications/CAD/AVL Conformed Technical Specification, May 2003
- Software Detailed Design Document: San Diego Intermodal Transportation Management System, Delcan Corporation, March 2006
- Systems Engineering for Intelligent Transportation Systems: An Introduction for Transportation Professionals, U.S. Department of Transportation, January 2007
- Systems Engineering Guidebook for ITS, California Department of Transportation, Division of Research and Innovation, Version 1.1, February 14, 2005

1.5 Document Overview

The remainder of this document is divided into the following sections:

- Section 2 – Overview description of the I-15 ICMS, which includes the ICMS Context, ICMS Description, ICMS User Characteristics, System Constraints and Assumptions, and Dependencies.
- Section 3 – Requirements framework, definitions of the I-15 ICMS components and key terms, action verb description, user needs developed in the I-15 Concept of Operations, an overview "mind map" of the IMCS requirements, and an indexed listing of the system requirements organized according to the ICMS' 17 functional areas
- Appendix A – Definitions, Acronyms, and Abbreviations
- Appendix B – Requirements Management Metadata (for future requirements management activity)
- Appendix C – U.S. Department of Transportation Comments on the Draft System Requirements Specification for the San Diego ICM Pioneer Site with SANDAG Responses

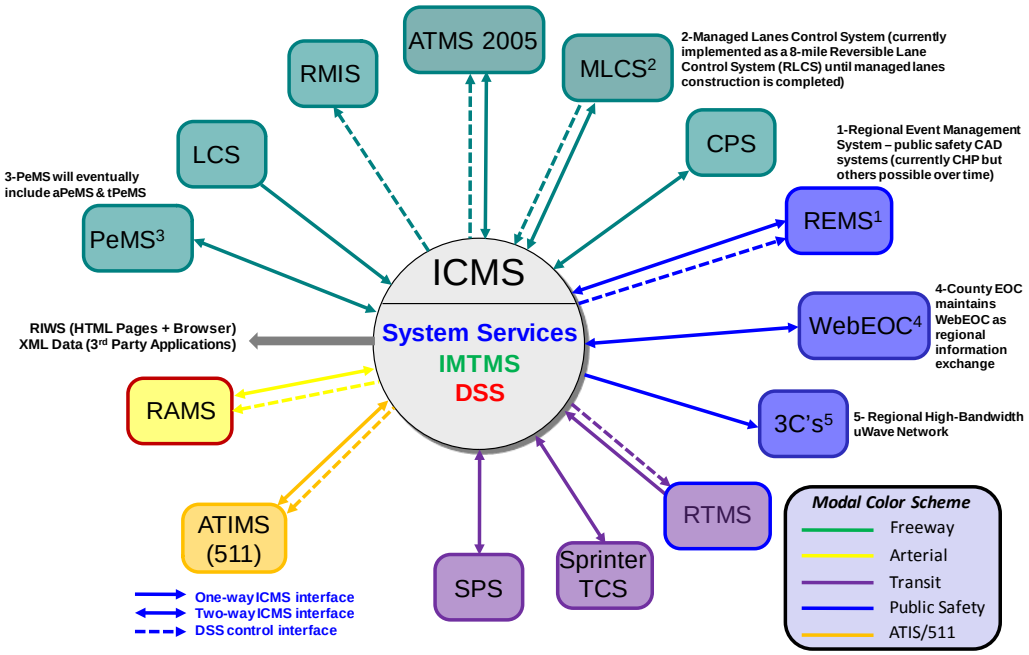
Chapter 2 Integrated Corridor Management System (ICMS) – Overall Description

2.1 ICMS Context

The ICMS will consist of two major subsystems: the existing Intermodal Transportation Management Subsystem and a new, as-yet-undeveloped subsystem to be known as the Decision Support Subsystem. In addition, the ICMS will include organic functions such as Collect and Process Data, Access/Store Historical Data, System Management, and Lifecycle Support. Several existing and planned regional systems will be connected with the ICMS – some of these will be upgrades to Intermodal Transportation Management System (IMTMS), some will be new systems.

Figure 2-1 shows the ICMS, its subsystems, and the systems to which it will be connected. These systems are listed in Table 2-1 with the owning agency and in Table 2-2 with the major data elements being exchanged. Table 2-2 shows the high-level data flows in and out of ICMS – no entry in the table signifies that no data is assumed to flow in that direction.

Figure 2-1. ICMS Context Diagram



[Source: SANDAG I-15 ICM Site Team.]

Table 2-1. ICMS Interfacing Systems and Owner Agencies

Existing or Planned System	Owning Agency
Advanced Transportation Management System (Freeway Management System)	Caltrans District 11
Reversible [Managed] Lanes Control System (R[M]LCS)	Caltrans District 11 (RLCS becomes Express Lanes Management System)
Ramp Meter Information System (RMIS)	Caltrans District 11
Lane Closure System (LCS)	Caltrans District 11
Regional Transit Management System (Transit Management System)	SANDAG (MTS and NCTD are system operators)
Modeling System (TransModeler)	SANDAG
Regional Arterial Management System (Arterial Management System)	SANDAG (local agencies are system operators)
Regional Event Management System (REMS)	California Highway Patrol ((CHP) in future, other public safety agencies will be included)
Multi-Agency Collaboratno (3Cs - Command, Control, and Communications Network)	Regional Technology Partnership
Advanced Transportation Information Management System (ATIMS or 511)	SANDAG
Parking Management System (SPS)	SANDAG (Planned)
Congestion Pricing System (Congestion Pricing System)	SANDAG (FasTrak®)

2.2 ICMS Description

The ICMS will be a system that consists of three major subsystems:

- System Services, consisting of systemwide functions of Data Management, System Management, and Life Cycle Support;
- IMTMS, an existing data acquisition and dissemination network within the San Diego region; and
- Decision Support System (DSS), a new capability that provides the integration of event management, multi-agency collaboration tools, multi-modal response plans, and impact assessment (modeling) to the existing IMTMS network.

Table 2-2. Context Diagram High-Level Data Flows

ICMS Subsystem	Data FROM the System TO ICMS	Data FROM ICMS TO the System (Control Interface)
Freeway Management System	Freeway congestion, freeway incidents, travel times, planned events, CMS status and current messages, and CCTV imagery	CMS plans
RMIS	Current metering plan and stored metering plans	Ramp meter plans
LCS	Construction and maintenance status	N/A
Express Lanes Management System	ML traffic, ML status, and mainline traffic	ML configuration request
Congestion Pricing System	Current dynamic pricing	General Purpose Lane congestion
Model	Model outputs in 2D and 3D	Input data sets
Arterial Management System	Arterial congestion, intersection status, system alarms, local traffic advisories, CMS status, and CCTV imagery	Signal timing plans, EV preemption, transit priority; and CMS plans
ATIMS (511)	Future	Filtered IMTMS data (e.g., Transit Management System data and toll road data do not go to 511)
Transit Management System	Transit incidents, bus automatic vehicle location, schedule adherence, selected stop/route data, panic alarms, and security video	Service change request
SPS	Facility identification and free spaces	N/A
REMS	Incident detection, incident details, and response status	N/A
Conferencing	N/A	Conference request, participating agencies, and call-in data

The IMTMS subsystem is, in turn, connected to a number of existing and planned external systems in the region (shown in Figure 2-1) that provide static and dynamic data on the condition of the region's transportation networks. The IMTMS system also provides a degree of shared changeable message

signs (CMSs) and closed circuit television (CCTV) control, data processing, and information display capabilities that will be enhanced by the ICMS development process.

I-15 ICMS functions will be developed for extensibility and adaptability to other corridors in the San Diego region.

As shown in Figure 2-1, the ICMS will interface to a number of existing and planned *modal management systems* in the San Diego region. A *modal management system* is a legacy (i.e., existing) system that is designed to manage the operations of a single transportation mode – freeway, transit, arterial, etc. Freeway, reversible lane, transit and limited public safety systems currently exist. Arterial, additional public safety, lane closure and Parking Management System management systems are planned. The I-15 Managed Lanes will have a control system when the first (middle) phase is completed in 2008.

2.2.1 ICMS Services Description

The ICMS will encompass three basic subsystems that apply to both IMTMS and DSS. These are the System Management Subsystem, the Data Management Subsystem, and the Life Cycle Support Subsystem.

2.2.1.1 DSS – "System Management Subsystem"

The System Management Subsystem encompasses system security, backup, and archival functions.

2.2.1.2 DSS – "Road Asset Configuration & Conditions Data Store" Subsystem

The Data Stores Subsystem encompasses the creation, management, and reporting of configuration and historical data stores needed for ICMS functions. This function also incorporates the functions needed to access existing modal databases in Freeway Management System, Transit Management System, and Arterial Management System. The data in these databases will not be replicated in ICMS.

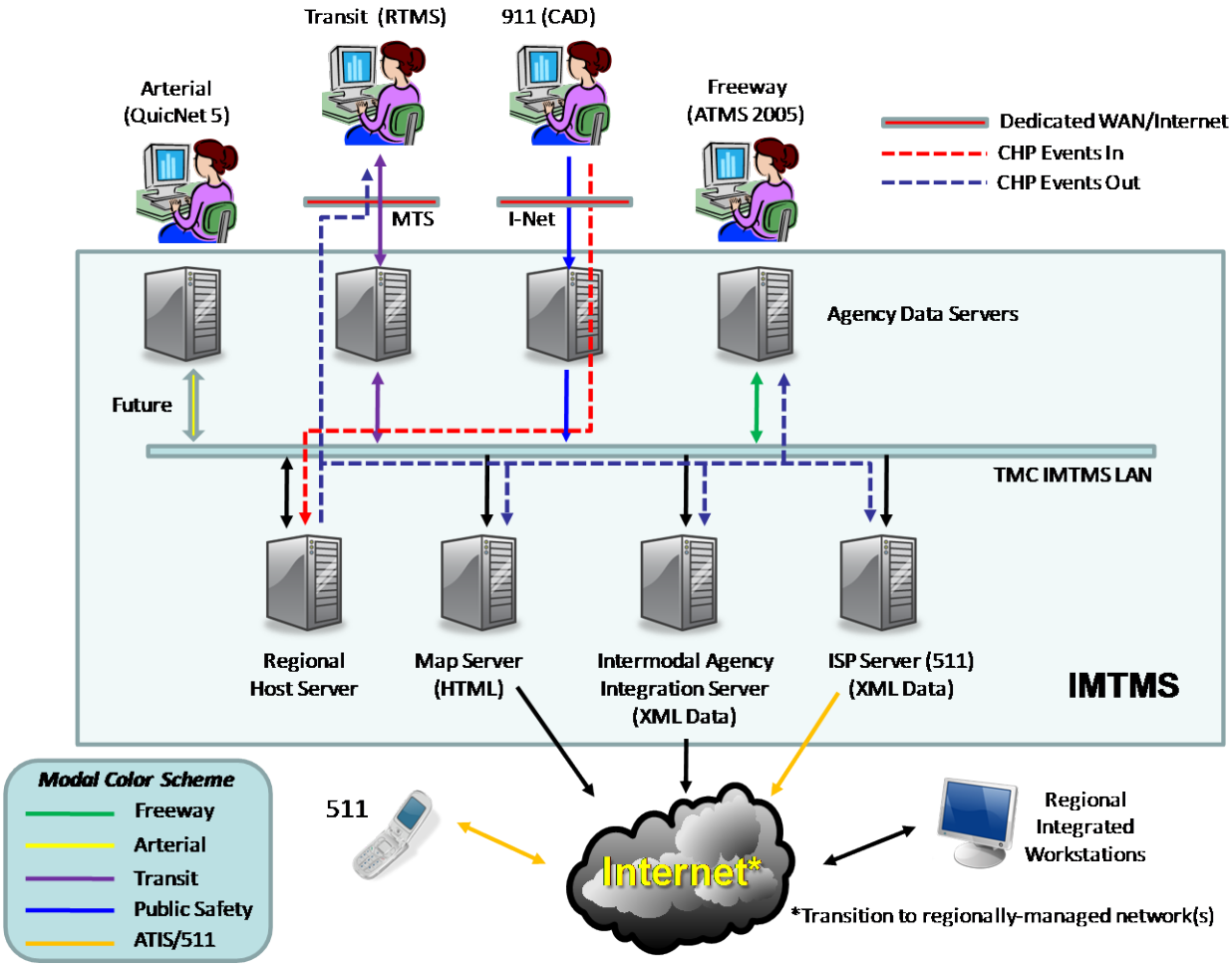
2.2.1.3 Lifecycle Support Subsystem

The Lifecycle Support Subsystem encompasses training, documentation, and maintenance for the ICMS, including online help, online training, and system maintenance functions.

2.2.2 DSS – Data Hub

The DSS – Data Hub architecture is shown in Figure 2-2. The Data Hub is implemented as a distributed Service-Oriented Architecture (SOA) using off-the-shelf Web service development technologies. Most DSS - DATA HUB servers shown in the figure are located in the Caltrans/CHP Transportation Management Center (TMC), but that location is a convenience, not a necessity. The DSS - DATA HUB architecture facilitates scalability and redundancy to handle a variety of anticipated operational environments. New data suppliers can be added by adding a new Agency Data Server (ADS) to the DSS - DATA HUB network and defining new eXtensible Markup Language (XML) schemas as needed for new data elements.

Figure 2-2. Intermodal Transportation Management Subsystem Architecture



[Source: SANDAG I-15 ICM Site Team.]

For example, adding the county's Emergency Communications Center (ECC - San Diego Sheriff Dispatch) or a new Parking Management System (SPS) would be handled in this manner. Using a variety of distribution servers, DSS - DATA HUB takes data received from participating agencies and provides fused data to participating agencies as either Hypertext Transfer Protocol (HTTP) Web pages or XML data feeds and to the general public through the regional 511 system. Subject to regional agreements, DSS - DATA HUB allows the shared control of agency CCTV cameras and CMSs. DSS - DATA HUB provides a dynamic, Web-based Graphical User Interface (GUI) to selected agencies for the monitoring and control of regional field devices.

Figure 2-2 also shows a typical DSS - DATA HUB interaction for CHP events (freeway incidents). The [CHP Computer-Aided Dispatch (CAD)] system initiates a new incident record in response to a Mobile 911 call. The initial data is extracted by the DSS - DATA HUB via the CHP Agency Data Server (ADS). The ADS converts the CHP data format into XML and sends the XML data to the Regional Host Server (RHS). The RHS acts as a "traffic cop" for DSS - DATA HUB data and sends the CHP incident information to the Map Server (for Hypertext Markup Language (HTML) formatting and HTTP distribution)

to the Intermodal Agency Integration (IAI) server for XML data distribution for third-party applications and to the Internet Service Provider (ISP) server for the regional 511 program. The incident data also is sent to the Freeway Management System subsystem to automatically create an UNCONFIRMED incident in the FMS system. Updates from the CHP dispatcher are distributed as free text in the same manner until the TMC FMS operator changes the incident to a CONFIRMED status. At this time, the automatic updates from CHP cease. Data from transit, arterial, and other subsystems are (or will be for planned systems) distributed in a similar manner.

2.2.2.1 Advanced Traffic Management System (FMS) 2005

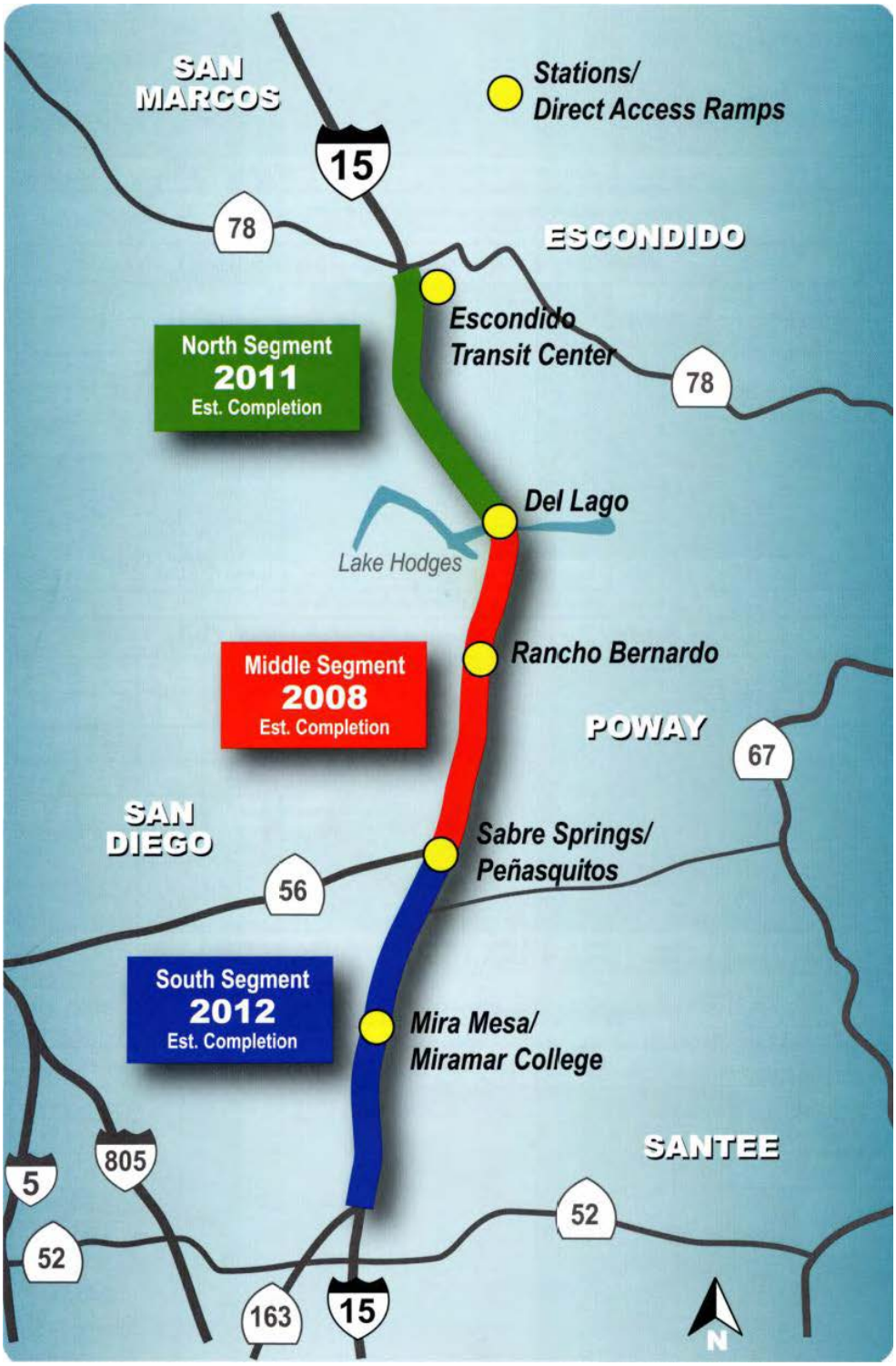
Freeway Management System is the latest generation of Caltrans freeway management systems, deployed in Districts 11 in San Diego and 7 in Los Angeles. Freeway Management System uses an SOA, PC hardware components, and a browser-based user interface to reduce acquisition and operating costs. Freeway Management System functions are nearly identical to those of the previous generation, UNIX-based FMS 2.0, but with enhanced device control features. Freeway Management System provides the following major functions:

- Real-time vehicle occupancy and count data collection every 30 seconds from embedded inductor loops and non-intrusive radar detectors on freeway mainlines and on-ramps
- Processing of the real-time data to provide the most accurate incident detection algorithms and reporting functions
- Automatic Incident Detection (AID)
- Automatic response plan generation using an expert system
- Event management for incidents, special events and emergency closures
- Device status monitoring and control for loops, CMSs, and CCTV cameras
- Display of real-time data for freeway mainlines, (HOV lanes, on-ramps, and off-ramps)
- Display of device locations and status
- Display of streaming video imagery from CCTV sites
- Report generation
- FMS configuration database editing

2.2.2.2 Managed Lanes Control System (Express Lanes Management System)

The ML facility is currently under construction from SR 52 to SR 78 and is divided into three segments as noted in Figure 2-3. Two types of access will be provided for ingress and egress to and from the ML facility: Intermediate Access Points (IAP) and Direct Access Ramps (DAR). The fully-operational ML facility will have seven northbound and six southbound IAPs. IAPs are at-grade transitions to allow vehicular traffic to safely enter and exit the ML facility. DARs are grade-separated interchanges leading from a Bus Rapid Transit (BRT) station to the ML facility as depicted in Figure 2-4.

Figure 2-3. Managed Lanes Segments



[Source: SANDAG I-15 ICM Site Team.]

Figure 2-4. DAR Depiction for Rancho Bernardo

[Source: SANDAG and Caltrans District 11.]

DARs will be located at the following points along the fully constructed ML facility:

- Mira Mesa/Miramar College
- Sabre Springs/Peñasquitos
- Rancho Bernardo
- Del Lago
- Escondido Transit Center

The Managed Lanes will be partitioned from the main lanes by fixed barriers. Within the fixed barriers, lane reconfiguration will be accomplished using movable barriers and a Barrier Transfer Machine (BTM). Except in the northern segment through Escondido, managed lanes can be configured as 3N/1S, 2N/2S, or 3S/1N. The northern segment will be fixed at 2N/2S.

The southern segment is currently a reversible lane facility with two segregated lanes that are fixed at 2N or 2S. This facility is controlled by a recently upgraded Reversible Lane Control System (RLCS) for an eight-mile segment of I-15. The RLCS consists of gates, pop-up barriers, CMSs and CCTV cameras to control the flow of traffic in one direction during scheduled peak hours. The Express Lanes Management System will differ in that it will control the two-way flow of traffic using a variable number of lanes in each direction with multiple ingress and egress points. Freeway Management System will be modified to show

the lane configuration status of the Managed Lanes. Sensors in the managed lanes will be incorporated as part of the Freeway Management System configuration database schema. As part of the DSS - DATA HUB architecture, the Express Lanes Management System will have an Agency Data Server to provide data on status to DSS - DATA HUB.

2.2.2.3 Congestion Pricing System (CPS)

The Congestion Pricing System is the system through which appropriate tolls are charged to single occupancy vehicle (SOV) users of the Managed Lanes facility who are enrolled with FasTrak®[1]. The Congestion Pricing System is a form of electronic toll collection that is based on radio frequency identification (RFID) technology and uses transponders and antennas mounted over traveled lanes to communicate and process high-speed, open road toll transactions in real-time.

A legacy Congestion Pricing System installed in 1997 is being replaced in 2008. The new Congestion Pricing System is under development now in parallel with the construction of the Managed Lanes facility on I-15. Tolls rates will be computed using a dynamic variable pricing algorithm, and transactions will be based on the rate per mile at the time of travel multiplied by the distance of travel (i.e., a distance-based fare). The toll rate algorithm will have two primary formulas: the first will base the price on the value of travel time (VOTT) saved for a user of the Managed Lanes in relation to the adjacent free lanes; the second calculation will operate in the background and is set to maintain a minimum level of service (LOS) rating of “C” at all times in conformance with the congestion pricing enabling legislation.

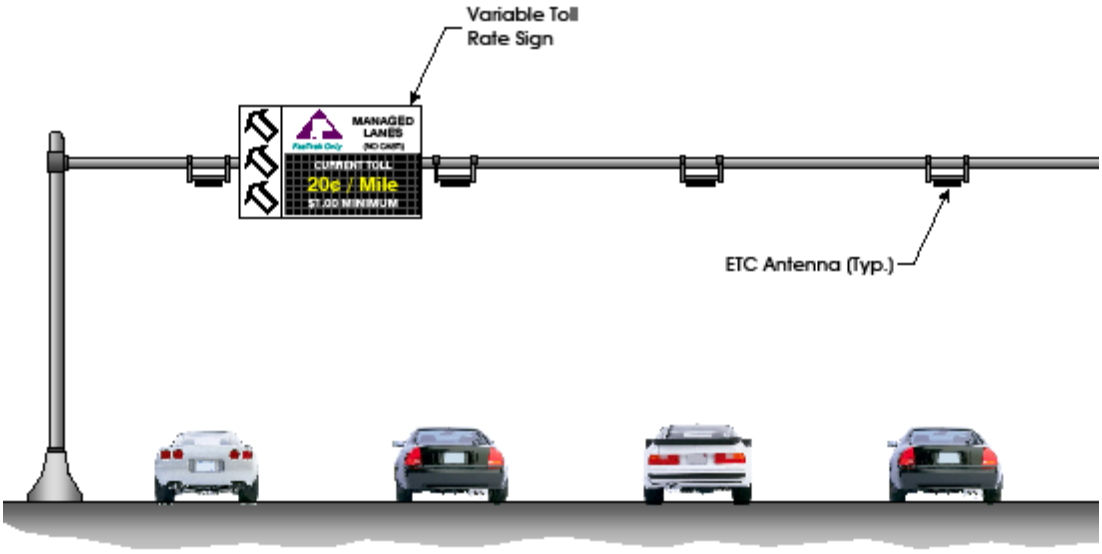
Just like HOVs, including buses, authorized FasTrak® users will physically gain access to or leave the managed lanes through two means: (1) a series of IAPs spaced roughly every two miles, which include a combination of General Purpose-Managed Lanes weave zones, essentially a break in the barrier that separates those lanes; and (2) from a number of DARs that connect the Managed Lanes to BRT centers near the freeway’s edge. It is also noted that to help maintain free-flow conditions on the Managed Lanes, traffic also will be managed by re-configurable barriers in the Managed Lanes that separate northbound from southbound traffic. This movable barrier will allow for two lanes to operate in both directions, or for three lanes to operate in the peak direction with a single lane in the off-peak direction. Thus, both strategies will help to ensure an efficient allocation of scarce resources (i.e., road capacity). Each time the toll rate is recomputed, the Congestion Pricing System will compose and disseminate a message to the appropriate sign controller(s) instructing the sign controller(s) to update the toll rate and travel time information on the variable toll message signs (VTMS) that will be installed at each entry location. A typical VTMS is shown in Figure 2-5.

Further, for the I-15 Managed Lanes, a series of overhead lasers will be installed as part of the Congestion Pricing System in order to associate transponder reads to vehicles. The lasers will be a new source of traffic vehicle detection stations (VDS) that can provide detailed traffic speed, occupancy, and possibly vehicle classification data to the regional DSS - DATA HUB network. Additionally, historic average toll rate data or “current” toll rate data will be available from the Congestion Pricing System in a configurable (e.g., six-minute) interval for all Managed Lane entrance locations. This data also will be made available to THE DSS - DATA HUB for broadcast via 511. Additionally, based on the average vehicle speeds as determined by the lasers, as well as supplemental travel time data derived from the sampled transponders themselves, the I-15 Managed Lane FasTrak® system will broadcast estimated

[1] FasTrak® is California’s electronic toll collection system used on tollways in the state that allow drivers to drive through designated "FasTrak® Only" lanes without stopping. The toll is automatically deducted from a prepaid account.

travel times within the Managed Lane facility at the same configurable interval (e.g., six-minute), and this data will be made available to IMTMS for broadcast via 511.

Figure 2-5. Typical Installation of a VTMS



[Source: SANDAG and Caltrans District 11.]

To support the dynamic pricing algorithm, the Congestion Pricing System data management system will obtain real-time traffic sensor data from the regional sensor network for the I-15 corridor. This includes all general purpose and Managed Lane sensors in the default network, but excludes the internal FasTrak® lasers. This data will be used by the dynamic pricing algorithm to determine the VOTT factor for each segment. The algorithm support need will be met by a new data feed based on National Transportation Communications ITS Protocol (NTCIP) protocols (2304 for message encoding and Traffic Management Data Dictionary (TMDD) v2.1 for data structure) specified in the I-15 Managed Lanes Toll Collection System request for proposal.

Finally, the Congestion Pricing System has its own maintenance online management system (MOMS) that will monitor all Congestion Pricing System field element health (e.g., power, data connectivity, heartbeats, etc.). The Congestion Pricing System also has a violation enforcement subsystem that includes enforcement cameras, automatic license plate recognition (ALPR) technology, and a full violation noticing system. The Congestion Pricing System also has an account management system for direct customer Web account management and customer service representative account-handling features. A variety of other subsystems and interfaces exist within the Congestion Pricing System framework. Access will be granted to the FasTrak® maintenance contractor to obtain real-time CCTV feeds from the Caltrans' CCTV network via the Regional Integrated Workstation (RIWS) with appropriate login/password credentials. This would allow the FasTrak® operator to monitor field element status beyond what is provided by the MOMS in addition to monitoring overall traffic flow and providing superior customer service on traffic conditions.

2.2.2.4 Lane Closure System (LCS)

The LCS collects and manages information that is related to construction projects that deal with the time, location, and impact associated with a specific construction or maintenance project. Construction staff sends closure requests to the district traffic manager who reviews these and approves or disapproves based on potential conflicts, such as with special events, etc. Approved planned closures are entered into the LCS Web application and Freeway Management System. When closures actually occur, construction staff notifies the TMC with start and end times and locations and the number of lanes being closed (impact).

2.2.2.5 Ramp Meter Information System (RMS)

The RMIS is an existing system that performs congestion management by limiting access to freeways at over 300 controlled on-ramps in the region. RMIS collects data from a Front End Processor (FEP) that, in turn, manages communications between leased line and fiber optic modems and loop controllers in the field. Each loop controller manages one or more Vehicle Detection Stations (VDS) which are connected sets of individual loops in freeway main lanes, on-ramps, and off-ramps. RMIS manages individual controllers or defined sets of controllers (e.g., I-15 NB PM peak ramps) including the uploading of new ramp meter timing plans.

2.2.2.6 Regional Arterial Management System (AMS)

The Arterial Management System is a two-tier subsystem that both allows multi-jurisdictional control of traffic signals and the display of regional data to local traffic agencies. Tier 1 is a re-architecture of the existing McCain product “QuicNet4” arterial traffic control system to allow multi-agency security features for viewing and ultimately controlling external signal systems. The San Diego region is fortunate to have a unified QuicNet4 traffic signal control system throughout its 20 state and local arterial management jurisdictions (18 cities, the County of San Diego, and Caltrans). There are some differences in roadside controller firmware from agency to agency, but all use the same QuicNet4 Traffic Signal Control System (TSCS). This will facilitate the integration of multiple jurisdictions using a regional communications architecture. Tier 2 is the distribution of network access to all QuicNet4 users so that a common browser-based display is available for the dissemination of regional data collected from all network users. This display is referred to as the RIWS, although there is not a separate hardware component required for local agencies. RIWS can be integrated with existing QuicNet4 PC displays using the personal computer’s (PC’s) browser. The RIWS dynamic map display can be routed to large screen displays located in local agency TMCs.

2.2.2.7 Regional Transit Management System (TMS)

The Transit Management System is an existing system that supports all fixed-route transit operations for the San Diego Metropolitan Transit System (MTS) and the North County Transit District (NCTD). Transit Management System will be capable of supporting other regional transit operators in the future, such as regional rail systems (COASTER, SPRINTER, Amtrak), Chula Vista Transit, National City Transit, and San Diego County Transit System. The Transit Management System provides the following primary functions:

- Computer-Aided Dispatch (CAD) functions for the control of all data and voice communications between revenue and non-revenue buses and their respective dispatch offices for both SDMTS and NCTD, as well as regional transit operators to be added in the future.

- Global Positioning System (GPS)-based Automatic Vehicle Location (AVL) functions that are integrated with the supplied CAD functions.
- Traveler information functions to capture performance data on scheduled arrivals and departures and ridership data collected by means of the Automatic Passenger Counting System .
- Integration of the supplied CAD/AVL functions with the scheduling system and trip planning system

The operations of MTS and NCTD supported by Transit Management System are independent of each other, and accessibility of privileged data associated with each operator by other transit operators is controlled. Nonetheless, Transit Management System allows data-sharing and information exchange as needed to promote more efficient regional transit operations and coordination of transit services between operators, such as to coordinate passenger transfers between transit systems (e.g., at the North County Fair Mall in Escondido).

2.2.2.8 SPRINTER Train Control System

The SPRINTER train control system operates from the SPRINTER operations facility in Escondido and is independent of the Transit Management System used for bus operations. The SPRINTER currently has limited ability to share train position information, but this limitation is likely only temporary. The SPRINTER does not implement a continuous train GPS capability, but does have fixed GPS points that can be detected by on-board train equipment and used to estimate time of arrival at each station along the route. Arrival times are then transmitted to station visual and aural annunciators. The feasibility of trapping this data for ICMS display and dissemination is being investigated. Two SPRINTER stations are in the corridor: the Escondido Transit Center on West Valley Parkway and the Nordahl Road station at the Escondido/San Marcos city boundary.

2.2.2.9 Regional Event Management System (REMS)

The REMS currently consists of an XML-based, Web services interface to the CHP's CAD Media Server. When the CHP initiates an incident in the CAD as a result of a mobile 911 or call box call, the following sequence of events occurs:

- CHP call taker initiates an incident record in the CAD
- Call taker passes the record to a CHP radio dispatcher
- Radio dispatcher assigns one or more responding traffic officers via the CHP radio system
- Radio dispatcher updates incident details in the CAD as radio reports are received from officers in the field
- Initial incident details and updates are passed to the DSS - DATA HUB system via a one-way interface
- THE DSS - DATA HUB passes incident information to Freeway Management System via two-way interface to the 511 server and to regional data servers for external agency use
- When FMS operator confirms the incident in the FMS system, the CHP updates are no longer provided to THE DSS - DATA HUB – all further updates to 511 and agencies are provided by Freeway Management System

In the future, similar interfaces are planned for other public safety CAD systems in the San Diego region. For the I-15 corridor these include San Diego County Sheriff (Poway law enforcement), San Diego Police

Department, San Diego Fire (also dispatches for Poway Fire), NorthCom Fire Dispatch (Escondido Fire dispatch), and Escondido Police Department.

2.2.2.10 County Operational Area Emergency Operations Center (EOC)

The San Diego County EOC is located in Kearny Mesa at the southern end of the I-15 corridor. The EOC has been fully activated twice in the past four years, both for destructive wildfires in the I-15 corridor. The EOC uses a countywide Web services application called WebEOC, which is rapidly becoming the standard system for sharing information among a wide variety of agencies during major emergencies. WebEOC is a distributed information-sharing application that can accept data from virtually any source in the county. WebEOC is linked to a Geographic Information System (GIS) display system that the ICMS can leverage to share critical transportation data during emergencies. Since virtually all of the I-15 corridor data is, or will be geo-referenced, it is feasible to supply this data as a continuous stream onto a GIS 'transportation" layer in WebEOC. Additionally, a WebEOC application will be included in the TMC to allow data to be entered on National Incident Management System (NIMS-)compliant forms and directly passed to the planning and intelligence section of the EOC.

2.2.2.11 Regional Traveler Information Management System (Regional 511)

The regional advanced traveler information system – 511 – was formally launched by SANDAG in San Diego County in February 2007. This system allows landline and cellular callers to receive tailored information via the Web, phone, and public access television about traffic conditions and driving times between selected origin and destination pairs to: use the transit trip planner; use the mobile callbox feature that allows the caller to directly connect to the San Diego County Service Authority for Freeway Emergencies (SAFE) call answering center; acquire carpool and vanpool information; get bicycle route maps and commuting information; and get FasTrak® program price announcement signs and registration information. The 511 system will in the future also include the dissemination of real-time congestion changes on the I-15 Reversible Lane and Managed Lanes facility, as well as travel-time estimates for both general purpose lanes and managed lanes. Data for the 511 system comes from the DSS - DATA HUB, which acts as a clearinghouse for freeway conditions, incident data, and transit data. In the future this data storehouse will include arterial-related data.

2.2.2.12 Parking Management System (SPS)

The SPS will be a future system that uses a variety of technologies to collect real-time parking data and provide this real-time parking information to transit users. This system is currently being deployed along the Coaster commuter rail corridor as a pilot project. The primary objective of this pilot project is to demonstrate and evaluate how Parking Management System technologies can be used to:

- Improve parking management capabilities through the delivery of actual parking utilization data;
- Enhance transit services by delivering real-time information to customers as a means of increasing access, convenience, and reliability to parking availability;
- Measure user acceptance of paid and preferential-based parking strategies; and
- Develop and evaluate the application of parking pricing management strategies and business models as a means to generate alternative funding sources for increasing parking supply, maintenance, and enhanced parking facilities.

The project involves the installation of small stationary parking censors and wireless communications at the selected COASTER stations and transmission of data to a central system. These devices will transmit and provide real-time information about parking utilization and availability. Such a system will provide the ability to monitor parking supply by collecting and tabulating count data from entrance and exit points within the parking stations and occupancy at selected parking spaces. The Parking Management System concept introduces a powerful management system and customer information tool, which will support COASTER parking users via the Internet, cell phone, or other traveler information systems like our 511 program.

The SPS technology encompasses Web-related systems, wireless communications, dynamic databases, pricing algorithms, user and parking company partner interfaces, and parking sensor networks that will deliver new services to system users. The network sensors and interfaces capture parking information, and application programming interfaces deliver it to the dynamic databases. Users, local organizations, and media services can access the database using a variety of interfaces. The information contained in the dynamic databases is processed and consolidated based upon the intersection of user, parking facility, and local organization and media services requests.

It is anticipated that this project will provide the basis for a regional Parking Management System in the San Diego area, including the I-15 corridor as part of its ICMS. Accordingly, this implementation would warrant further coordination within the proposed I-15 ICMS and Intelligent Transportation System (ITS) architecture. By providing real-time parking availability information along the I-15 corridor, SANDAG expects increased intermodal trips from the freeway to express bus services operating at future BRT stations currently under construction where, it is estimated, there are 500 parking spots will be available for possible consideration of an SPS implementation. The pricing strategies that will be implemented at these transit parking lots will be designed to encourage the use of alternative modes, increase parking management efficiency, and provide system enhancements to BRT system users (i.e., convenient access, improve reliability to parking spaces).

2.2.3 Decision Support Subsystem (DSS)

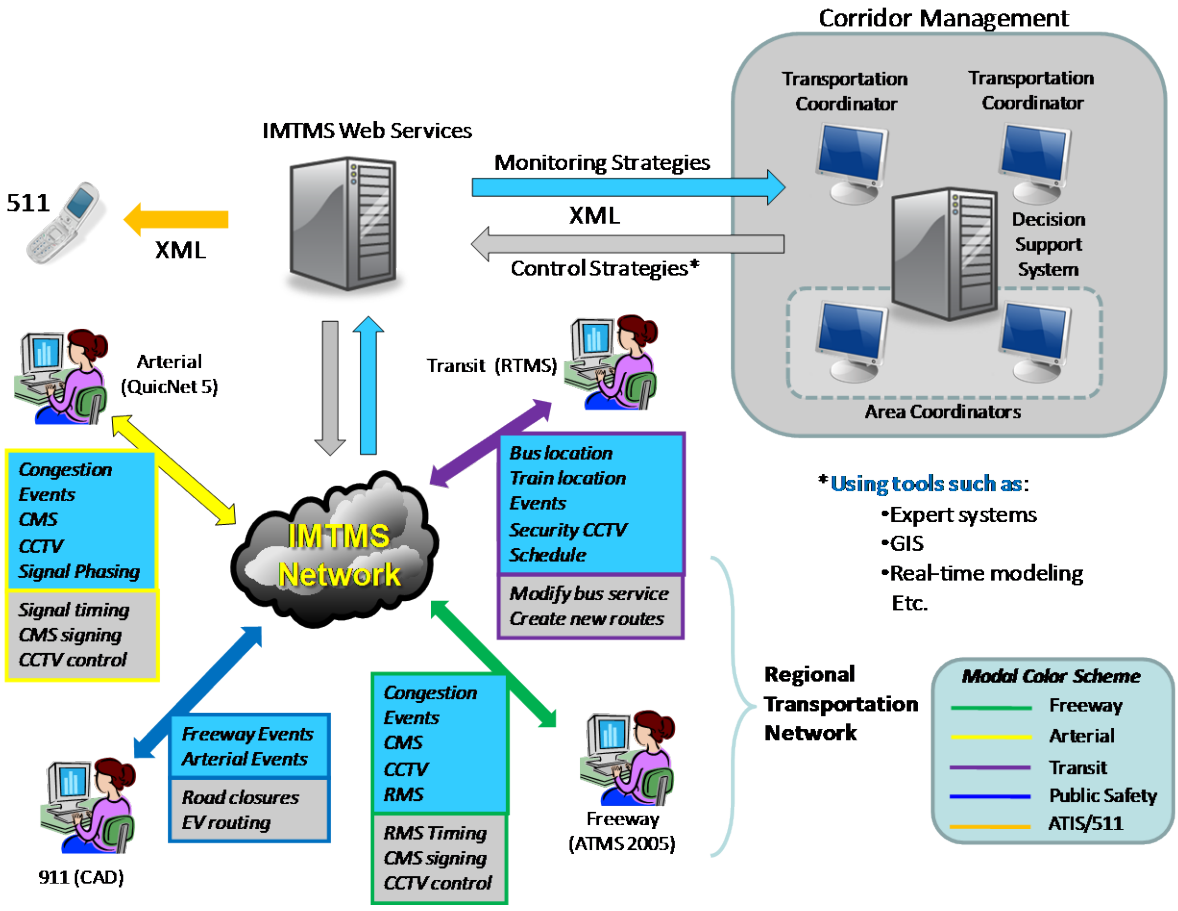
A new subsystem to support multi-modal, integrated corridor management will be added as part of the ICMS. This system will be given the generic name “Decision Support System (DSS).” Functionally, DSS will support the ability to automatically, semi-automatically, or manually generate suggested plans for modal actions in response to regional events. The significance and importance of the DSS lies in the fact that modal actions in response to short-term or long-term impacts on the corridor will be coordinated and not carried out in isolation as is usually the case. The events may be recurring, non-recurring, or scheduled. Generally DSS plans will be short-term plans, covering a range of up to several hours, or possibly days or weeks in the case of major disasters such as the recent October 2007 wildfires in San Diego County. DSS is conceptually an outgrowth of the Freeway Management System Event Management process, where field data is added to initial incident reports to provide inputs to an Expert System.

The Expert System combines a *rule base* using incident response parameters with *knowledge base* information on roadway geometry and field device locations to automatically generate response plans consisting of CMS signing strategies and incident checklists. The Expert System *rule base* is created with operator inputs on the impact of certain types of incidents on the freeway system. For example, for the I-15 corridor, several decision trees exist for selected scenarios in the corridor that apply to Managed Lanes operations. These decision trees can be coded as part of the rule base for the Response Plan subsystem in DSS. The Expert System *knowledge base* is provided by selected FMS configuration

database tables that are read when the Expert System module starts up. As long as the configuration database is properly maintained, the Expert System will always have the latest field configuration information. Alternative methods to generate response plans include establishing *action tables* that are keyed to projected incident locations on the freeway network.

For any method chosen, the ability to generate automatic or semi-automatic response plans requires a substantial analysis effort during the set-up phase. Figure 2-6 illustrates how the DSS concept combines existing modal management data sources with data fusion tools to aid in the complex decision-making inherent in corridor operations.

Figure 2-6. ICMS Concept



[Source: SANDAG and Caltrans District 11.]

2.2.3.1 Conferencing Subsystem

There are many available tools that can facilitate multiple agency conferencing. Some tools provide shared video conferencing, others provide a group “whiteboard” capability. and still others a Web-based meeting application. Some of these tools are off-the-shelf applications that can be integrated into ICMS.

Two other tools specific to the San Diego region are the WebEOC emergency management application and the 3Cs network. The WebEOC application is hosted at the County's EOC and provides a virtual information-sharing extension to many agencies that cannot be physically present at the EOC. Thus, an agency need only have a WebEOC license to run the application and be connected to the EOC for the exchange of critical event status information.

The regional 3Cs project strives to connect dispatch/emergency operations centers across the far southwest region. Spanning San Diego County (CA) and reaching into Imperial (CA), Orange (CA), Riverside (CA), and Yuma (AZ) counties, the project links public safety agencies via a high-speed, secure hybrid microwave/fiber optic network. Bridging communications between agencies, the network will provide two-way communication via video teleconferencing, publish/subscribe technology on a public safety intranet, and distribute video feeds outside the network through secure Web streaming and cable broadcasts. Currently funded through the pilot phase, unfunded future phases are planned to improve geographic coverage and add additional agencies and/or regions. As microwave access is improved, the 3Cs project plans to incorporate all local public safety dispatch and emergency centers within the coverage area at a pace of 15 to 20 agencies a year. Additional functionality in the 3Cs network includes the ability to incorporate specialized video feeds (aerial downlink, CCTV), and bridge disparate radio systems via radio/voice over IP. By incorporating 3Cs technology, responding agencies will have a fast, reliable means to contact any agency in the area, improving the ability to successfully manage any incident.

Given the diverse nature of agencies involved in I-15 corridor operations and the difficulty of setting up face-to-face meetings during a crisis, the conferencing function will be important for corridor operations under stress.

2.2.3.2 Event Management Subsystem

The Event Management Subsystem extends the existing Regional Event Management System (REMS) under THE DSS - DATA HUB. As REMS is currently structured, it provides event collection from only the CHP CAD system. As THE DSS - DATA HUB expands and incorporates additional arterial event data from other CAD systems for
I-15 corridor agencies, an event bookkeeping function will be required. This function will maintain an integrated regional event list including freeway, arterial, and transit events from all reporting sources (Freeway Management System, REMS, and Transit Management System). As different agencies add their arterial incident data to the corridor event picture, it becomes more critical to maintain a "common operating picture." What this really means is that the Event Management Subsystem will maintain a harmonized picture of all the events in the corridor. This includes merging multiple incident records that refer to the same event, splitting records when a secondary event occurs from the original incident, transferring control of incidents when the jurisdiction changes, and maintaining an integrated list of active incidents (filtered for traffic related events) in ICMS.

2.2.3.3 Response Plan Subsystem

The Response Plan Subsystem is key to the entire concept of integrated corridor management in the I-15 corridor. The response plan function within Freeway Management System provides a "template" by which the San Diego region can develop a design concept. This function uses an Expert System called G2, which combines a *rule base* of decision trees related to the severity and estimated impact of freeway incidents with a *knowledge base* of roadway geometry and field device locations and characteristics.

The *rule base* is developed by analyzing parameters of time of day, incident location, and severity of an incident and then using a decision tree of "If-Then" statements to develop recommended CMS signing and operator notification responses. The TMC operator can review these recommended actions and modify them as needed before implementation. Analysts must develop the *rule base* by using functions within the G2 application provided for that purpose.

The *knowledge base* uses the existing FMS configuration database to "learn" about roadway geometry and field devices. Roadway geometry includes knowing where the number of lanes changes and the location of ramp intersections for arterials and connecting freeways. Field device data in the *knowledge base* includes CMS locations and type. The appropriate database tables are connected to G2 via an application program interface.

The advantage of the Expert System approach is that any changes in roadway geometry or field device locations are automatically included in future response plan recommendations. Because the G2 application in FMS only uses a fraction of the application's capability, it is well within the bounds of feasibility to consider this application for the IMCS, using the same architecture, but expanding both the *rule base* and *knowledge base* extents. As long as the incident and its response can be captured in a reasonable number of decision paths and there is a well-formed database design to incorporate new records for arterial roadways, transit routes, arterial notification devices, etc., the G2 application or another semi-automated approach will be feasible. This would allow the introduction of new action plans (see Section 2.2.4.4 below) that, for example, would handle arterial timing plan changes, Managed Lane reconfiguration, and ramp metering plans.

2.2.3.4 Modeling Subsystem

SANDAG has recently acquired the TransModeler application from Caliper that is capable of both micro- and meso-level simulations. TransModeler can simulate ITS systems such as ramp metering, HOT lanes, driver response to ATIS information. and transit operations. With careful setup and input of data, TransModeler can be run as a mesoscopic model in a real-time or near real-time mode to affect decision-making during major incidents. Run in the micro-simulation mode in conjunction with TransCAD, TransModeler is an excellent tool for longer-range corridor management and can investigate detailed ramp meter, HOT lane, and signal timing scenarios. As an impact analysis tool, TransModeler will be used to evaluate recommended action plans coming from the response plan function and to support longer-range corridor management.

2.2.4 ICMS Concept

2.2.4.1 Overview

The I-15 corridor ICMS will uniquely exploit existing and planned ITS deployments in the San Diego region. The recently deployed THE DSS - DATA HUB is a robust data management and routing system that has an extensible and scalable architecture for connecting a variety of data providers to a regional network; however, THE DSS - DATA HUB does not have decision support nor impact analysis functions, therefore the IMCS requires a new DSS. DSS will take THE DSS - DATA HUB data from existing and new modal management systems, analyze this data in response to corridor incidents of varying magnitude, and develop semi-automated and automated response plans.

Response Plan processing will be based on existing Expert System technology currently in use by the Caltrans Freeway Management System or an equivalent table-driven application. The response plans will recommend active control measures to be implemented by *modal management systems*, such as Freeway Management System, Arterial Management System 4, and Transit Management System. The response plan is based on integrated corridor data analysis from multiple data sources, but uses action plans for individual modal management systems. The actual implementation of recommended action plans is the responsibility of the target management system.

An example may help to understand this concept. A major incident occurs on northbound I-15 between Mira Mesa Boulevard and Mercy Road/Scripps-Poway Parkway just after the end of the afternoon peak period. The general time frame is after the current reversible lanes have been converted to Managed Lanes. A limited number of CMSs are located on Black Mountain Road and Pomerado Road. Pomerado Road has some deployed CCTV sites. The San Diego County Sheriff, San Diego Police Department, and Escondido Police Department are integrated into the DSS - DATA HUB network.

A multi-modal, operations-trained corridor manager is monitoring corridor operations. When the incident is first reported to CHP, Freeway Management System automatically opens an unconfirmed incident. When CHP officers arrive on scene, the incident is confirmed, and FMS provides freeway CMS and operator action recommendations as part of its Event Management and Response Plan functions. As the incident progresses, the corridor manager determines that additional actions are needed. Based on impact assessments from FMS, existing traffic congestion on parallel arterials, and a growing queue on northbound I-15, the manager activates the ICMS Response Plan function. The Response Plan function recommends 5 action plans:

- Recommend timing plan changes along both Black Mountain and Pomerado Roads. These changes will be sent to the cities of San Diego and Poway as timing plan numbers for plans that have been predetermined to alleviate increasing congestion on these arterials due to motorist self-selection of alternate routes. The corridor manager reviews these plans and after approval and/or modification, they are transmitted to Arterial Management System for system implementation using Arterial Management System internal functions. At the city level these plans can be reviewed and modified or overridden by city traffic engineers or allowed to execute automatically.
- On-ramps to northbound I-15 are activated with adaptable timing plans based on mainline traffic flow at that point on the freeway. The ICMS sends a timing plan identification to RMIS for execution after operator review and modification as necessary.
- A Managed Lane reconfiguration is recommended to open two additional northbound lanes. This recommendation is passed to the TMC operator for implementation by the Managed Lane control system, again after review and modification as necessary.
- The freeway is closed and anticipated to be so for an extended period so alternative routing is no longer “self-select” but advisory in nature. Traffic must be routed off the freeway upstream of the incident. An action plan is generated to deploy appropriate CMS messaging, portable signs, and Traffic Management Team (TMT) vehicles to specific locations. The action plan is sent to FMS and to THE DSS - DATA HUB for implementation on their respective signs. This situation actually occurred during the recent October 2007 wildfires in San Diego county, during which the Witch Creek Fire event had a direct impact within the I-15 corridor boundaries in all three corridor cities. The same issue occurred in 2003 during the Cedar Fire event.

- The regional 511 system is updated with periodic alert messages and road closures as the situation changes.

Throughout this process, the corridor manager continually monitors all modal systems for disruptions in service or situations that require additional corrective action. Much of the data fusion from multiple management systems is done through the corridor manager's experience and training, but some fusion is done automatically. If the situation requires a corrective action, a set of action plans are input into the Impact Assessment function to model the anticipated response. The model outputs become another data source to be combined with real-time data to modify action plans.

2.2.4.2 Database Management

A number of databases currently exist for San Diego modal management systems and are planned for new ITS systems in the horizon of ICMS implementation. It is not the intent of the ICMS development plan to recreate existing databases, but to reuse these through remote access to the modal management systems. Currently these include Freeway Management System (Caltrans District 11 freeway data), Transit Management System (transit data for MTS and NCTD) and the Regional Event Management System (REMS – CHP incident data).

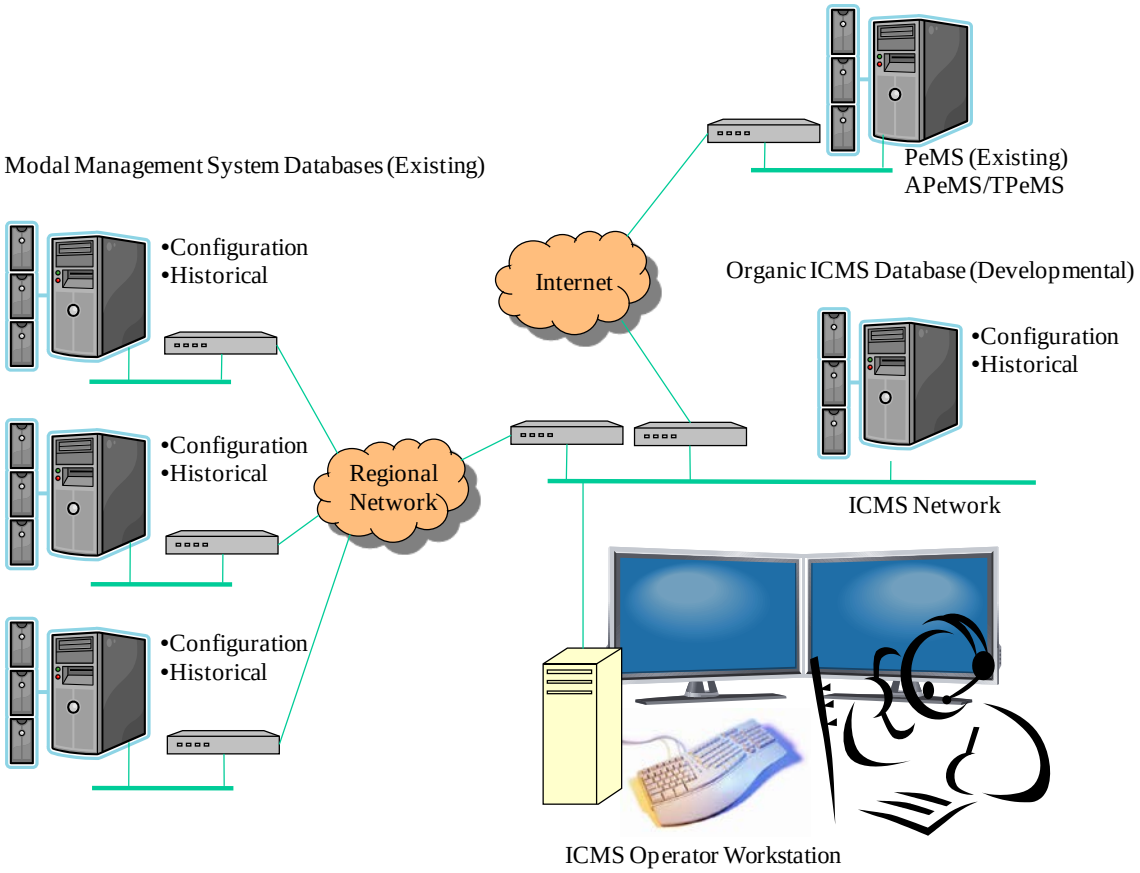
Planned systems (Arterial Management System, Congestion Pricing upgrades to FasTrak®, and an SPS also will develop their internal databases that the ICMS will remotely access. The ICMS will develop an organic configuration database (static data) and historical database (real-time and aggregated data) for those elements not already included in existing external systems. The ICMS organic database instances will be combined with remotely accessible databases to give the ICMS operator access to the widest possible data sources for the support of corridor operations. Figure 2-7 shows this concept.

In addition, remote access to the California Performance Measurement System (PeMS) is a big part of the ICMS data acquisition concept. Although in some cases, accessing PeMS data is duplicative of what will be received from Freeway Management System (primarily in the areas of congestion and events), PeMS provides a readily accessible level of analysis that does not exist in Freeway Management System. PeMS data can be extracted and placed into comma-separated values format, thus facilitating its display in a GIS platform such as ArcView. Selected tables of this nature will be stored locally in the ICMS data environment for GIS analysis of corridor performance measures.

2.2.4.3 Event Management

When incident records are initiated by multiple agencies related to a single specific event, event management becomes more complex than if just one agency is managing the event. Likewise, multiple events may exist, but only one incident record is active in a modal management system. Other similar scenarios pose challenges for regional event management. Much of this arises from the nature of public reporting via mobile 911 as the motoring public are not experienced traffic observers or may not have a good grasp of their exact location at the time of reporting. The current situation is relatively straightforward since CHP initiates most events from motorist reports and automatically transfers these to the Freeway Management System application. As more agencies become involved in generating events, event management will become commensurately more complex and the ICMS will need an event management protocol. This is particularly true as more public safety communications centers link into the regional THE DSS - DATA HUB network.

Figure 2-7. ICMS Shared Database Concept



[Source: SANDAG I-15 ICM Site Team.]

Each event initiated by an ICMS agency has its own life cycle from initiation to termination. However each agency must independently manage its own events. One agency terminating an event does not automatically clear the event from all other agencies involved in that event since each agency has a particular timeline of responsibility regarding that event.

2.2.4.4 Response Plan Processing

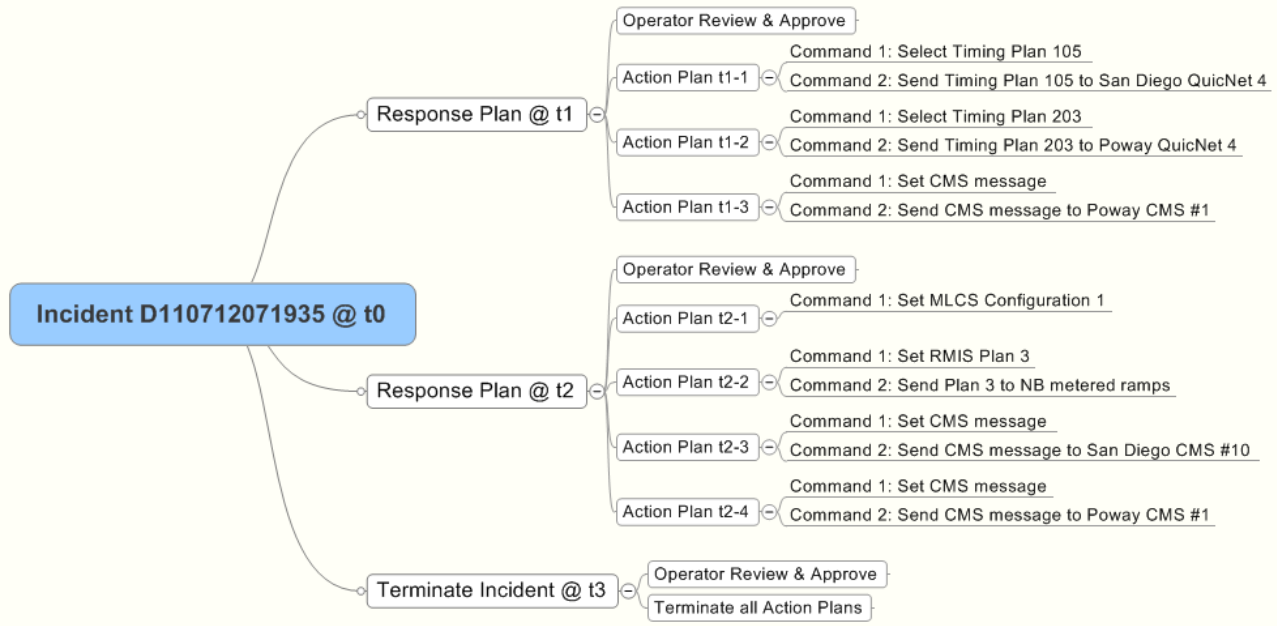
Figure 2-8 illustrates the conceptual processing flow for response plan generation and execution. The response plan function activation generates a Response Plan for a specific incident location, type, severity and impact, based on the time of day and other operational parameters. Each response plan consists of one or more action plans. An action plan consists of one or more commands. A single command is designed to recommend a specified single action for a single modal system in a single jurisdiction. This processing scheme is designed to improve accountability and auditing for actions taken is response to corridor events. [*Example: As shown in the figure for CMS activation, one command selects a message (e.g., from a library of pre-constructed messages) and the next series of commands sends that message to one or more CMSs in a single city*.] The response plan generator is an Expert System or equivalent table-driven application that reads a *knowledge base* of the roadway configuration in the corridor (by accessing highway and field device tables in the corridor configuration database) and

then applies a *rule base* of predetermined "If-Then" statements that describe the business rules for corridor operations under specified conditions.

It is important to note that the ICMS does not actually *control* corridor modal management systems – that function is left to the modal management systems themselves. What the ICMS does is send the action plan in a manner that can be reviewed by the modal management system operator (if desired) and/or input as a message that initiates action within the modal management system without operator interaction. This, in turn, requires that the modal management system (e.g., the Regional Arterial Management System) have an input function that triggers for example, a timing plan change at selected intersections.

Note that in Figure 2-8, response plans may vary during the life cycle of an event, or other events may impact the original event in a way that impacts the selection of a response plan. CMS messages need to be modified or terminated, Managed Lanes configuration may change, and/or traffic signal timing plans in adjacent jurisdictions may change. Logging response plans, their component parts, and times that decisions are made is an important piece of reconstructing a major event, therefore these key data elements will be stored into the corridor's historical event database.

Figure 2-8. ICMS Response Plan Processing



[Source: SANDAG I-15 ICM Site Team.]

2.2.4.5 Modeling

This project will require development of two micro-simulation applications. A traffic engineer or modeler and a dedicated PC with the traffic modeling software will be in place at the virtual traffic management center. Both traffic simulation applications will be in operation at the management center and will ultimately be tied together.

2.2.4.5.1 Analysis, Modeling, and Simulation (AMS)

The San Diego ICMS team and Cambridge Systematics will create a 2003 traffic simulation model. This simulation model will be extracted from SANDAG's base year 2003 travel demand model. The extraction will be from the demand model software TransCAD into the simulation model software TransModeler. The extraction will include two scenarios: the AM peak period (6 a.m. to 9 a.m.) and the PM peak period (3 p.m. to 6 p.m.). The extracted base year 2003 simulation model will be calibrated and validated with PeMS data.

The same extraction process will be used to create two year 2012 scenarios: the AM peak period (6 a.m. to 9 a.m.) and the PM peak period (3 p.m. to 6 p.m.). The 2012 scenario will be used because it will include completion of the three phases of the I-15 Managed Lanes construction. These two base 2012 traffic simulation scenarios will be used to create a multiple simulation alternatives that will be used to compile a comprehensive response plan database. The database will simply include the time period, link identification, a description of the incident, and the appropriate response plan for either time period. Table 2-3 is an example of how this database might look.

Table 2-3. Notional Response Database Containing Incident-Response Pairs

No	TOD	Direction/Fwy	Incident Description	Recommended Response
1	AM	SB I-15	Lane 1 is blocked between Poway Road and SR 56	a) Take no action
2	AM	SB I-15	Lanes 1 and 2 are blocked between SR 56 and Poway Road	a) Turn on upstream CMS with warning b) Lengthen meter cycle at closest 3 upstream ramp meters
3	AM	SB I-15	All lanes are blocked between SR 56 and Poway Road	a) Turn on upstream CMS with diversion to WB SR 56 to Rancho Peñasquitos Road b) Lengthen meter cycle at all upstream ramp meters c) Change signal timing on Rancho Peñasquitos Rd to accommodate traffic rerouting
4	PM	Pomerado Road & Ted Williams Parkway	Intersection closed due to a crash	a) Turn on freeway and arterial CMS with diversion b) Loosen ramp meter rates at Pomerado Road and Ted Williams Parkway c) Change signal timing on Poway Road, Scripps Poway Parkway and Carmel Mountain Road
5	PM	NB & SB I-15	All lanes blocked in both directions on the bridge over Lake Hodges	a) Turn on all CMS with diversion using SR 78 to I-5 b) Turn on all CMS with diversion using SR 56 to I-5

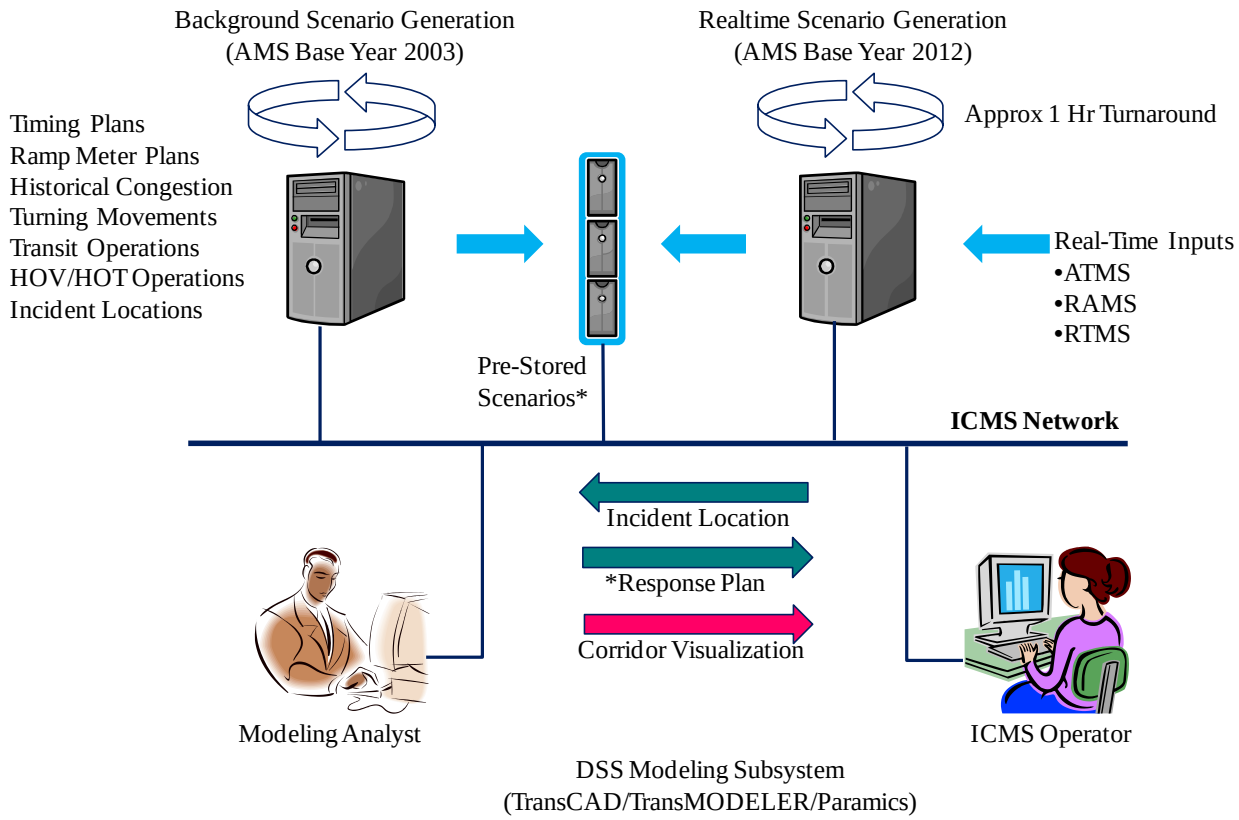
2.2.4.5.2 Live Feed Traffic Simulation

The second traffic simulation application will continuously monitor traffic in the corridor at the mesoscopic level. The continuous feed of volume and speed data will come from PeMS and arterial PeMS (A-PeMS). Using the mesoscopic level of traffic simulation will allow the simulation software to keep up with the large volume of input data.

2.2.4.5.3 Integration of the Two Applications

As shown in Figure 2-9, when a real world incident that has already been modeled with an appropriate response plan occurs, it is anticipated that the response plan can be set into action within five minutes from the reporting of the incident. When a real world incident that has not been modeled occurs, the incident will be modeled on the fly using the appropriate 2012 time-period simulation model created in the AMS application. The new simulation alternative will include the incident, and the simulation output will be used by the engineer/modeler to define a new response plan. It is anticipated that a new simulation model, and thus, response plan can be defined and set into place in about one hour from the reporting of the incident. All newly defined incidents and appropriate response plans will be added to the database for continuous improvement.

Figure 2-9. DSS Modeling Subsystem



[Source: SANDAG I-15 ICM Site Team.]

2.3 ICMS Operational Modes

The ICMS will operate in two basic modes:

- **Normal Mode** – day-to-day operations, including minor incidents.
- **Failure Mode** – The Failure Mode will be detected by continuous monitoring of the health of ICMS subsystems and external system communications links. The IMCS will enter the Failure Mode when any of the following conditions occur:
  - Complete system failure
  - Partial failure (one or more data feeds from external systems, one or more subsystems, etc.)
  - Planned maintenance to one or more

2.3.1 ICMS States

During ICMS operation, transitions to and from various operational states will occur in the Normal Mode. These transitions will closely track changes in state of the corridor itself (i.e., if an incident occurs in the corridor, the ICMS transitions to an event management and response plan state).

- **Event State** – when a major event (planned or unplanned) occurs, the ICMS will transition to the Event Mode in which decisions are made relative to the need to activate one or more Response Plans and/or to execute short-term modeling to test response strategies in real-time (within a reasonable run time to impact corridor operational decisions)
- **Modeling State** – the Modeling Mode of ICMS is a "parallel processing" mode, with integration of input data and model visualization through ICMS. Parallel processing means that modeling is running while other ICMS functions continue to execute. The Modeling Mode can be entered from the Event Mode (in response to planned and unplanned events) or in the Steady State Mode to test longer-term corridor management strategies to balance capacity and demand.
- **Long-Term Operations State** – Over time, the Steady-State Mode becomes Long-Term Operations as the corridor incorporates increasing amounts of operational experience and system historical data.

2.4 ICMS Life Cycle Management

The Institute of Electrical and Electronics Engineers/Electronics Industries Association (IEEE/EIA) 12207.0:1996 Standard groups the activities that may be performed during the life cycle of software into five *primary processes*, eight *supporting processes*, and four *organizational processes*. The IMCS will incorporate many, but not necessarily all of the processes described below. Tailoring of this standard is to be expected in any software development effort, and ICMS will be no exception. Complete implementation of the standard can be very costly, yet there must be some structure imposed on the ICMS development process. The following paragraphs are meant to provide a quick overview of the standard and are by no means complete. Much more guidance for application is provided in the standard, its appendices, and in a non-IEEE guidebook by Michael E.C. Schmidt.[2]

[2] Michael E.C. Schmidt. 2000. *Implementing the IEEE Software Engineering Standards*. Sams Publishing, Indianapolis, IN

2.4.1 Primary Processes

The primary processes consist of five processes that serve primary parties during the life cycle of software. A primary party is one that initiates or performs the development, operation, or maintenance of software products. These primary parties are the acquirer, the supplier, the developer, the operator, and the maintainer of software products. For ICMS sustainability, the operation and maintenance processes will be important. The primary processes are:

1. *Acquisition process* – Defines the activities of the acquirer, the organization that acquires a system, software product, or software service.
2. *Supply process* – Defines the activities of the supplier, the organization that provides the system, software product, or software service to the acquirer.
3. *Development process* – Defines the activities of the developer, the organization that defines and develops the software product.
4. *Operation process* – Defines the activities of the operator, the organization that provides the service of operating a computer system in its live environment for its users.
5. *Maintenance process* – Defines the activities of the maintainer, the organization that provides the service of maintaining the software product; that is, managing modifications to the software product to keep it current and in operational fitness. This process includes the migration and retirement of the software product.

2.4.2 Supporting Life Cycle Processes

The supporting life cycle processes consist of eight processes. A supporting process supports another process as an integral part with a distinct purpose and contributes to the success and quality of the software project. A supporting process is employed and executed, as needed, by another process. These processes are likely to be the most germane to the ICMS development effort. The supporting processes are:

1. *Documentation process* – *Defines* the activities for recording the information produced by a life cycle process.
2. *Configuration management process* – Defines the configuration management activities.
3. *Quality assurance process* – Defines the activities for objectively assuring that the software products and processes are in conformance with their specified requirements and adhere to their established plans. Joint reviews, audits, verification, and validation may be used as techniques of quality assurance.
4. *Verification process* – Defines the activities (for the acquirer, the supplier, or an independent party) for verifying the software products and services in varying depth depending on the software project.
5. *Validation process* – Defines the activities (for the acquirer, the supplier, or an independent party) for validating the software products of the software project.
6. *Joint review process* – Defines the activities for evaluating the status and products of an activity. This process may be employed by any two parties, where one party (reviewing party) reviews another party (reviewed party) in a joint forum.
7. *Audit process* – Defines the activities for determining compliance with the requirements, plans, and contract. This process may be employed by any two parties, where one party (auditing party) audits the software products or activities of another party (audited party).
8. *Problem resolution process* – Defines a process for analyzing and removing the problems (including non-conformances), whatever their nature or source, that are discovered during the execution of development, operation, maintenance, or other processes.

2.4.3 Organizational Life Cycle Processes

The organizational life cycle processes consist of four processes. They are employed by an organization to establish and implement an underlying structure made up of associated life cycle processes and personnel and continuously improve the structure and processes. They are typically employed outside the realm of specific projects and contracts; however, lessons from such projects and contracts contribute to the improvement of the organization. Organizational life cycle processes will most likely not be formalized in the ICMS development effort. The organizational processes are:

1. *Management process* – Defines the basic activities of the management, including project management, related to the execution of a life cycle process.
2. *Infrastructure process* – Defines the basic activities for establishing the underlying structure of a life cycle process.
3. *Improvement process* – Defines the basic activities that an organization (that is, acquirer, supplier, developer, operator, maintainer, or the manager of another process) performs for establishing, measuring, controlling, and improving its life cycle process.
4. *Training process* – Defines the activities for providing adequately trained personnel.

2.5 ICMS User Characteristics

Projected ICMS users represent a diverse set of unique operations and maintenance skills and include the categories, roles and system modes when primary duties are performed listed in Table 2-4.

2.6 ICMS Constraints

The ICMS will function within an existing regional ITS architecture and a comprehensive set of existing applications that exist under the DSS - DATA HUB umbrella and its constituent data feeds. Each legacy application has varying degrees of flexibility in how it may be modified to support ICMS functional requirements. Detailed constraint requirements for ICMS functions will be described in Section 3.6 of this document.

2.7 Assumptions and Dependencies

2.7.1 Regional Architecture

The currently deployed THE DSS - DATA HUB will be a core subsystem of the ICMS. THE DSS - DATA HUB will retain its current architecture, but will be expanded to collect and distribute data from new regional ITS systems. The current THE DSS - DATA HUB architecture does not include decision support functions; therefore, a new DSS is required for the ICMS.

2.7.2 Partners

The EOC will become a new partner in the ICMS.

Table 2-4. ICMS User Categories

Position	Position Roles
Barrier transfer machine (BTM) operators	Operate BTM equipment to reconfigure Managed Lanes
BTM maintenance staff	Maintain BTM equipment
Broadcast media	Gather information on planned and unplanned corridor events and inform the public via radio, TV, and satellite
Caltrans maintenance dispatchers	Dispatch Caltrans maintenance vehicles and personnel
CHP traffic officers	Incident response and freeway/highway enforcement
Corridor managers	Multi-modal corridor operations management, with a working knowledge of freeway, arterial, transit, and public safety operations
District traffic manager(s)	Maintenance of lane closure system
EOC watch officer EOC planning and intelligence staff	When the EOC is activated, Intelligence and Planning Section staff collect data from many sources in the county and use this data to develop plans for the next “operational period” (usually 24 hours) during a major emergency
FasTrak customer service center operators	Operate and maintain Congestion Pricing System
Freeway Service Patrol drivers	Perform motorist aid duties on assigned freeway beats
IT managers	Develop IT hardware and software standards and deploy IT equipment and applications
IT maintenance staff	Operate and maintain ICMS IT equipment
Parking facility staff	Operate and maintain SPS and facilities
Public safety call takers	Receive calls for assistance from the motoring public via mobile or landline phones and initiate incident records within a CAD system
Public safety dispatchers	Dispatch and track public safety units using CAD systems and update incident records based on officer field reports
Roadway equipment maintenance staff	Monitor, troubleshoot, and maintain roadway ITS devices
TMC operators	Operate Freeway Management System and Arterial Management System systems and dispatch Caltrans operations staff
Traffic engineers	Maintain traffic signal and ramp metering systems, develop signal and ramp meter timing plans, and tune system traffic algorithms
Transit dispatchers	Maintain communications with transit drivers and monitor transit vehicle schedule adherence
Transit drivers	Operate regional bus vehicles and monitor roadway conditions on their assigned routes
Transportation planners	Analyze all modes of transportation operations, run modeling software, and develop long-term corridor operations strategies

2.7.3 Regional ITS Deployments

The functioning of ICMS assumes the following general capabilities are present in addition to existing ITS applications in the San Diego region:

- Arterial data collection, capable of providing intersection controller data and traffic volume, occupancy, speed, and travel times on key arterials in the corridor
- Connections to public safety CAD systems for the cities of San Diego, Poway, and Escondido, capable of sharing selected traffic-related incident data with external agencies
- Accessibility of PeMS data via an external interface
- Accessibility to existing modal management system database tables and reporting functions via external interfaces
- Additional field elements (CCTV, CMSs, detectors) deployed along the Pomerado Road, Black Mountain Road, and Centre City Parkway arterial corridors

2.7.4 Data Management

Each modal management system (Freeway Management System, Express Lanes Management System, Congestion Pricing System, Transit Management System, Arterial Management System) will maintain its organic configuration and historical database instances – the ICMS will maintain non-redundant configuration and historical databases. The ICMS will maintain corridor event history database tables.

2.7.5 ICM Project Dates

The I-15 ICMS assumes that the following dates will apply to the overall ICM initiative at the U.S. Department of Transportation:

- AMS modeling phase – summer 2008 to summer 2009
- Begin ICMS deployment – fall 2009
- Complete ICMS deployment and start ICMS operations/evaluation – fall 2010
- Complete ICMS pioneer site project – fall 2011

2.7.6 THE DSS - DATA HUB New Data Feeds – Planned Dates

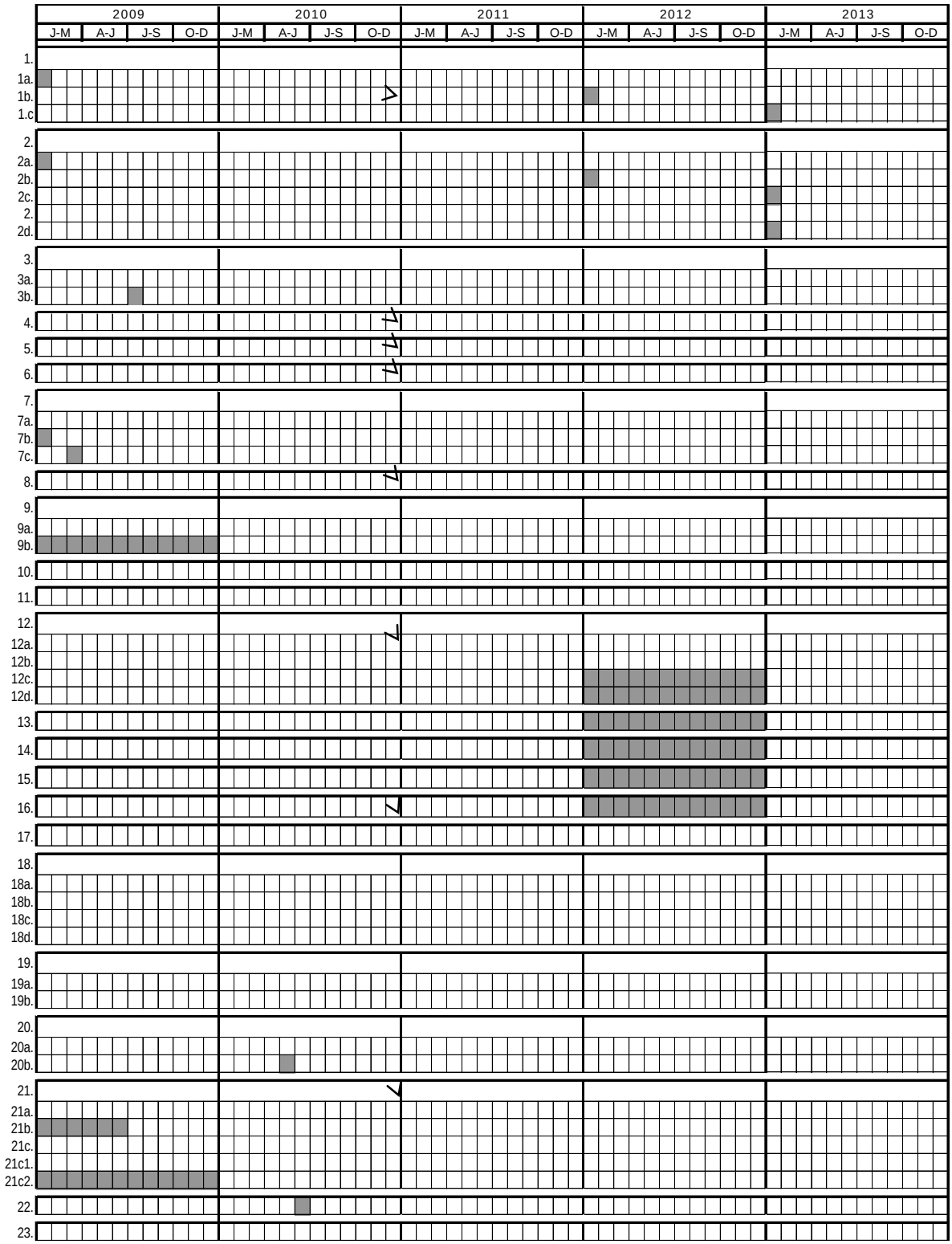
Table 2-5 lists the planned implementation dates for new data feeds and external systems that impact ICMS deployments.

Table 2-5. Planned Deployment Schedule for External Systems Associated With ICMS

	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. Extended 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)							
a. Acceptance testing		COMPLETED					
b. Phased implementation subject to regional agreements							
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							
b. South Segment of Managed Lanes							
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							
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

Table2-5. Planned Deployment Schedule for External Systems Associated With ICMS (cont'd)



Chapter 3 Integrated Corridor Management System (ICMS) Requirements

3.1 Requirements Framework

In formulating the system requirements for the Interstate 15 (I-15) ICMS the project team has never lost sight of the larger picture, that is, on the ICMS itself. The team's objective is to produce a top-quality system that truly stands out as a market leader and that is able to serve as a template for other regions interested in deploying ICMSs to use as a model. To help satisfy this objective, the team developed a set of proposed requirements – in both content and quantity – for the ICMS that is based on a two-part development strategy. The first part rests on the recommended guidance and practice from Institute of Electrical and Electronics Engineers' (IEEE's) specifications[3] documents and the second part focuses specifically on the San Diego region's vision for their ICMS.

The project team has as a result, a set of system requirements that is best suited for the San Diego region's unique combination of operating characteristics, transportation assets, and mobility management strategies. Upon reviewing this system requirements document, the reader will have a complete appreciation of San Diego's ICMS, including its description, context, subsystems, users and their roles, and constraints.

Additionally, readers will grasp the system requirements from static, dynamic, and institutional perspectives. The static perspective provides system context. The dynamic perspective provides the reader with an understanding of how the ICMS will operate under its Normal (short-term and long-term) Mode and Failure Mode (degraded operations, complete system failure, and maintenance operations). In addition, we have defined states through which the system transitions during Normal Mode operations. The institutional perspective provides an understanding of who the corridor stakeholders are and how they work as a management team.

The San Diego local area stakeholder working group provided the technical and operational foundation for the document. The group conducted a series of workshops with both a "core" working group and an expanded team that included regional public safety personnel. This iterative process resulted in a set of detailed requirements reflecting the specific needs and systems of the San Diego region. The Federal Technical Assistance Team[4] visited the site and provided further guidance on the development of both user needs and system requirements themselves. Through this process, the project team significantly

[3] *IEEE Guide for Developing System Requirements Specifications*, IEEE Std. 1233, The Institute of Electrical and Electronics Engineers, Inc., 1998 Edition; *IEEE Recommended Practice for Software Requirements Specifications*, IEEE Std. 830, The Institute of Electrical and Electronics Engineers, Inc., 1998 Edition.

[4] *Integrated Corridor Management – The Transition from a Concept of Operations to Requirements*, Mixon/Hill, Inc., Version 1.6, August 2007; Requirements Checklist for FMS/ICMS Systems, Mixon/Hill, Inc., November 2007.

and comprehensively updated our original set of user needs[5] to reflect the current and proposed ICMS and listed in an ordered way that reflects the flow of corridor activities during the life cycle of the ICMS.

In the second part of the requirements development strategy, the project team created a high-level functional decomposition modeled on our updated set of 17 user needs (See Sections 3.4 (Table 3-3) and 3.5 (Figure 3-1)), which provides the benefit of maintaining a one-to-one correspondence between the requirements within each functional area and its corresponding user need. The team then partitioned the 17 functional areas two additional times according to: (1) the current implementation state of the ICMS subsystems (operational or awaiting development and implementation); and (2) the context of the ICMS subsystems (internal or external to the ICMS). This partitioning was based on the Concept of Operations and Figure 2-1 of this document.
This approach has afforded the team an opportunity to take full advantage of the nature of the San Diego region's current and successful transportation management strategies. Moreover, the team has developed system requirements for the ICMS in a systematic fashion that is detailed and complete. The project team is confident that this will also allow the San Diego region to move toward the system design phase in an efficient manner. This methodology provides SANDAG with the added benefit that the I-15 ICMS should be readily transportable to other corridors within the San Diego region without major modifications. SANDAG fully intends to expand the Integrated Corridor Management (ICM) corridors beyond I-15.

Guided by this two-part strategy, the project team followed a detailed and iterative process that resulted in an extensive set of requirements in both depth and breadth. The process consisted of: (1) repeated questioning as to whether each requirement describes a capability that the I-15 ICMS must have to meet its objectives, whether it is well formed, and whether it refrains from designing the system; (2) revising requirements where necessary; and (3) adding to the requirements list.

The project team views the development of system requirements as a dynamic and not a static process. While the team is confident that the current set of requirements covers all aspects of the proposed ICMS for the I-15 corridor, there will certainly be additional opportunities to again employ the described iterative requirements development process for further enhancements. Nonetheless, at this time, SANDAG and the region are fully prepared to move forward into the system design stage.

3.2 Definitions

The ICMS requirements listed in Section 3.6 use existing Intermodal Transportation Management System (THE DSS - DATA HUB) system components and other key terms that are defined in Table 3-1.

[5] The set of seven User Needs that appear in the August 2007 version of the Concept of Operations.

Table 3-1. Definitions Referred to in Requirements Specifications

Term	Definition
Action Plan	An action plan is a set of one or more commands, with each command implementing a control function on one modal system in one jurisdiction.
Active Incident	An incident being managed locally with an open incident record.
Agency Data Server	An agency data server transforms legacy data formats (as defined by appropriate ICDs) into a standard XML schema based on NTCIP 2306 and TMDD v3.0. Each legacy (or newly developed external) system has its own agency data server and rules for converting legacy data into standard XML schema.
Block	In transit operations, a single bus ID and driver ID assigned to a scheduled time period on a specific route.
Bottleneck	A location on the freeway where the occupancy downstream of the bottleneck is substantially lower than the occupancy upstream.
Buffer Index	Additional time travelers must add to their average travel time when planning trips to ensure on-time arrival (on-time arrival assumes the 95th percentile of the travel time distribution).
Command	A recommended action for one modal management system in a single jurisdiction. An action plan consists of one or more commands.
Display Panel	A discretely assignable area of a large screen display.
Intermodal Agency Integration (IAI) Server	An IAI server provides XML data streams in response to Web service client requests. IAI servers are scalable as needed.
Inventory	Static configuration and system data maintained by I-15 partner agencies
Internet Service Provider (ISP) Server	An ISP server feeds XML data to SANDAG's ISP to support the regional 511 service.
Knowledge Base	In the response plan context, a knowledge base is a database of information regarding roadway geometries and geographic information and information about the location and characteristics of roadway field devices. The database is external and must be linked to an Expert System or table-driven application via an application programming interface.
Level I Agency	A Level I agency is one that has a "legacy" management system through which their operations are semi- or wholly-automated and who shares this data with IMTMS. Level I agencies are connected to the region's IMTMS network via an agency data server, which can be either a one-way or a two-way bridge. A "bridge" is IMTMS nomenclature for a data interface. A one-way bridge passes data from the legacy host system to IMTMS or from IMTMS to a dissemination partner; a two-way bridge also allows data to pass from IMTMS back into the host system for information and/or control. The California Highway Patrol (CHP) (data into IMTMS), and 511 (data from IMTMS) bridges are currently one-way. Caltrans and Transit Management System bridges are two-way, primarily for event data exchange. The planned Arterial Management System bridge will be a two-way bridge. The Regional Event Management System (REMS) and 511 bridges are planned as future two-way bridges.

Table3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
Level II Agency	A Level II agency is one that does not have a legacy data interface to IMTMS. Level II agencies can transition to a Level I agency when they acquire a management system and when a formal interface control document is created for IMTMS connection to this system. For example the city of San Diego is currently a Level II agency, but when an interface is created for their FMS system, they will become a Level I agency. Most local agencies in the region operate the Arterial Management System 4 traffic signal control system, but will not directly interface to IMTMS. The Arterial Management System project is creating a regional server that will act as the single IMTMS interface point for arterial traffic information. Thus the Arterial Management System regional server becomes a Level I "agency," while individual Arterial Management System 4 users remain as Level II agencies.
Lost Productivity	Reduction in facility throughput
Map Server	A map server responds to HTTP requests and provides dynamic Java and HTML map pages to client browser applications. The map pages contain both static and dynamic elements. Map servers are scalable as needed.
Non-Redundant Data Store	A database that does not duplicate data already collected by modal database management systems (e.g., Advanced Traffic Management System (FMS) 2005, Regional Transit Management System (Transit Management System), Regional Arterial Management System (Arterial Management System), Congestion Pricing System (Congestion Pricing System), Express Lanes Control System (ELCS), Parking Management System (PMS)).
Peak Period	AM – defined period of morning commute traffic. PM – defined period of afternoon commute traffic.
Portal	The application shall not duplicate functionality found in existing performance measurement systems, rather, it should provide the user access to that system's web delivered interface as if it were an integrated component of the existing system.
Productivity	Percent utilization of the freeway network under peak conditions.
Real-Time	Received within the most recent update cycle of continuous data streams from a modal management system (e.g., 30 seconds for Freeway Management System, 2 minutes for Transit Management System). Does not include periodic updates of static data.
Regional Host Server	A regional host server collects data from all Level I sources and creates Web services for data distribution. Regional host servers are scalable as needed.
active response plan	Assets associated with an active response plan are those that are either participating currently or are queued to participate once the correct triggers have been satisfied.
advisory data	A request to a data source for information on available data (i.e., "catalog") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.

Table3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
Alerts	Notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified.
archival data	Raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information.
archive coordination data	Catalog data, meta data, published data, and other information exchanged between archives to support data synchronization and satisfy user data requests.
archive request	A request to a data source for information on available data (i.e., "catalog") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.
archive status	Notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified.
archived data product	Raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information.
authentication information	Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large-scale natural or human-caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.
configuration data	synonymous with the data returned from those "inventory" elements within the TMDD (version 3.0) standard. See "device standard" above.
configuration data [2]	In the context of the DSS - Response Strategy Data Store, "configuration data" would refer to the gross selections able to be made by operators under incident or event conditions. This would include, the local definition and or selection of plans / messages / rates / enable of / disable of / and timing of control commands being sent to field devices. "Configuration data" would also capture the escalation levels and the messages needing to be distributed (i.e., public broadcasts / operator (Public) notifications / operator (Private) requests, and the expected responses and timeframes. This data would be associated with a specific "Response Plan" and a set of sequenced "Actions Plans" and it's definition will drive the Business Rules and Process Management Engine "live" management of an incident.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
confirmed action	In the context of the orchestration of an individual "Action Plan", the confirmed action is the process of verifying and validating that an action request has been satisfied by being implemented in the field. This may include a specific system "confirmation" response that an action request has been accepted and implemented, which would then be verified by correlating the "action request" with a device poll for "current status". Alternately, the ICMS may be required to validate that a "confirmed action" status exists through the latter process (correlation), if the former (specific system "confirmation") response does not exist in the ICD.
contact details	A contact is a concept that fits either an individual person or a specific named role at an organization or center. Examples of named roles would be the key operator at a TMC or a police dispatcher for a city. Must be conformant to requirements TMDD 3.3.3.(1-5)
corridor network (1)	This term refers to the definition of the roadway itself. This includes all routes, sections, links, and nodes that work as a functioning modal network that has been processed and tagged by the DSS - Road Asset Configuration and Conditions Data Store as forming part of the "I-15 Integrated Corridor Management Project".
corridor network (2)	This term also refers to the definition of the individual modal networks collectively functioning as a "corridor".
data catalog	see definition of inventory under the Traffic Management Data Dictionary.
decision support information	Information provided to support effective and safe incident response, including local traffic, road, and weather conditions, hazardous material information, and the current status of resources that have been allocated to an incident.
device control response [1]	A specific "response" from the field device control system that has been sent a "control request" to make a change.
device control response [2]	A field device control system is sent a "control request" as above, but the ICD does not specify that a specific response from the control system is required. In such cases, the sending system must be capable of determining if the correct change has been made by tracking the "current" status of the field device, and then using a "timeout threshold" monitor that specific device for "change" to the requested control state (i.e., the displayed "Message" on a sign; a traffic signal's "Signal Timing Plan" change; a ramp meter's "Metering Rate" change, etc). Only at the point in time that this can be confirmed or deduced should the implementation plan be marked as successfully implemented.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
device inventory	For the purposes of this standard only, data elements whose values are not expected to change more than once in a 24-hour period are classified as an inventory data element. Otherwise, the data element is classified as a status data element. This definition relates to all mandatory and optional elements "able" to be populated from External Systems and Internal Systems where the referenced conformance standard relates to: TMDD 3.3.5.2.1; 3.3.5.3.1; 3.3.5.4.1; 3.3.6.1.2; 3.3.6.2.1; 3.3.6.3.1; 3.3.6.4.1; 3.3.6.5.1; 3.3.6.7.1; 3.3.6.8.1; 3.3.6.9; 3.3.6.10.1; 3.3.6.11.1; 3.3.7.1.1; and for Transit related ICD's.
driver information systems	General advisory and traffic control information provided to the driver while en route.
error log message	Centers need to report errors encountered during the exchange of information. The center sending a message should be made aware of why a receiving center is unable to process or understand the message. Types of errors may include incomplete messages, incorrect syntax, or unsupported messages. Must conform to the TMDD (Version 3.0) requirement 3.3.1.4.
events / event information	An Event is defined as a situation that may impede movement across the transportation network. This may also include a "forecasted event" which is a predicted event, such as weather forecasts or roadway conditions, based on an estimation or calculation of conditions. Event information includes data entered manually by the operations staff as well as data automatically collected. Event based data will need to conform to the TMDD 3.3.4 requirement for presentation between internal subsystems and to external systems alike. An Event may also relate to the timing of "data availability", and as such should be used as the "trigger" for making this data available in support of TMDD requirements 3.3.1.2, 3.3.1.3, and 3.3.1.4
fare and price information	Current transit, parking, and toll fee schedule information.
fault data	This will be referred to in different ways, depending on device / context / and status. However, it is synonymous with "error", "error condition", "fault", "alert", "alarm", etc.
final response plan	This is the Response Plan configuration that was actually simulated. The need for a "Final" is due to the Operator being able to agree to allow the ICMS to automatically control the implementation of a Response Plan recommendation, but only "with modifications" made by the operator at the time requested. This may include an adjusted "metering rate", or "timing plan" or "library message" text.
freeway control status	Control commands and operating parameters for ramp meters, mainline metering/lane controls and other systems associated with freeway operations.
freeway control status	Current operational status and operating parameters for ramp meters, mainline metering/lane controls (e.g., barrier separation systems), and off ramp signalized intersections associated with freeway operations.
implementation request	This request is sent either to a stakeholder's identified contact, or to the stakeholder's field device control system.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
implementation verification flag	This flag is set when the requested action plan has been verified as having been implemented through field equipment status checks. For example, if the ICMS system has checked that Agency A's signal at Intersection A is running in Plan B, the ICMS system will send a request for that system to change Intersection A's current timing plan to Plan A. The verification flag is set when a check of the "status" information received by the DSS - Business Rules and Process Management Engine has verified that Plan A is the currently running timing plan.
incident information	Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large-scale natural or human-caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.
maintenance and construction information	Presentation of maintenance and construction operations information to center personnel. This information includes maintenance resource status (vehicles, equipment, and personnel), work schedule information, work status, road and weather conditions, traffic information, incident information and associated resource requests, security alerts, emergency response plans and a range of other information that supports efficient maintenance and construction operations and planning.
maintenance and construction work	Future construction and maintenance work schedules and activities including anticipated closures with anticipated impact to the roadway, alternate routes, anticipated delays, closure times, and durations.
meta data	Shall satisfy the following user needs, defined by the TMDD (Version 3.0) standard; 1) 2.3.6.1.4; (2) 2.3.6.5.5; (3) 2.3.6.5.6; (4) 2.3.7.1.4; (5) 2.3.7.1.5;
no bounce time out	This threshold is set when an operator is unable to respond to a "Response Plan" implementation request due to unforeseen circumstances. This may be if the specific contact were unable to get to a terminal to access the field control external system. This threshold would avoid the operator receiving constant requests for a block of time (i.e., 10 minutes, 30 minutes, 1 hour, 2 hours)
parking archive data	Data used to analyze and monitor trends in parking demand, pricing, and operational actions. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.
parking information	General parking information (facility ID, facility name, capacity, operating hours, operating days, location, access points) and current parking availability
parking lot data request	Request for parking lot occupancy, fares, and availability. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
parking lot inputs	Instructions for operation of local parking facilities to support regional traffic management objectives (e.g., which parking lot exits to use). Also, includes inputs from traffic sensors to support calculation of parking lot occupancy and support more effective management of parking entrances and exits.
probe archive data	Probe data that allows calculation of travel times, volumes, and other measures that support transportation planning. Optionally, this flow also includes origin and destination information for vehicles that opt to provide this information.
processed data	This data is the result of the post-processing by the ICMS Subsystems. It may include the adding a designation of "corridor" to routes, assets and events, OR it is the aggregation of specific field assets along with timing and location information into response plans and the associated action plans.
qualified environmental conditions data	Environmental Sensor Stations (ESS) data are used by centers to assess environmental conditions using atmospheric, surface and subsurface observations, pavement conditions, visibility and air/water quality. ESSs are generally located near a roadway but may be located in an area that the environmental conditions affect the roadway such as avalanche control. ESS data may be used independently or combined with modeling algorithms for enhancements such as predicting future conditions for fog or roadway icing. ESS data can be used by centers to: Monitor weather conditions; Direct maintenance activities; Provide weather information to travelers and third-party weather service providers; Provide pavement conditions, such as icing and flooding that may reduce roadway capacity; Direct traffic operations; and Predict future weather conditions. To follow the TMDD standard identified in 3.3.6.6
raw data	This data is taken directly from the source system, with none of the post-processing implemented by the ICMS subsystems to aggregate and organize this data into corridor information.
recommended response plan set	An output of the DSS - Business Rules and Process Management Engine, this is an array of unique identifiers pointing to specific Response Plans | Action Plan configurations stored within the DSS - Response Strategy Data Store. (See DSS - Business Rules and Process Management Engine requirements for how this set is determined)
regional transportation operator	This generic term describes the staff members of the Region who are responsible for operations as a single entity. This includes, Arterial Management System Operators in Engineering and Street Divisions; Congestion Pricing System Operators in the Maintenance Division; CALTRANS staff in the "Traffic Operations, Traffic Control Systems, and Signal Control Systems"; the Regional Corridor Manager; Transit "Dispatch" Operators, and Regional Support staff.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
road network conditions	Current and forecasted traffic information, road and weather conditions, traffic incident information, and other road network status. Either raw data, processed data, or some combination of both may be provided by this architecture flow. Information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect is also included.
roadway configuration data	This term refers to the definition of the roadway itself. This includes all routes, sections, links, and nodes that work as a functioning modal network an operator is responsible for. It also includes the calculated or documented capacity of the route, section, and link.
roadway information system data	Information used to initialize, configure, and control roadside systems that provide driver information (e.g., dynamic message signs, highway advisory radio, beacon systems). This flow can provide message content and delivery attributes, local message store maintenance requests, control mode commands, status queries, and all other commands and associated parameters that support remote management of these systems.
route available information	A contiguous set of links, or sections, that may be formed from a combination of Freeway, Arterial, and Transit assets. "Route Available" forms a status over the road infrastructure itself as an "end-to-end corridor" as differentiated from the modal definition of the route.
secure connection	Connections between systems (Internal:Internal; Internal:External) must adhere to industry best practice for Authenticating and Securing connections.
signal control status	Status of surface street signal controls including operating condition and current operational state.
special event	This type of event may refer to data received from an external entity through the Regional Event Management System, or captured from the Lane Closure System as a predicted event.
status data	Information used to configure and control traffic signal systems.
status information	For the purposes of this standard only, data elements whose values are expected to change more than once in a 24-hour period are classified as an status data elements. This definition relates to all mandatory and optional elements "able" to be populated from External Systems and Internal Systems where it relates to: TMDD (version 3.0) 3.3.5.2.2; 3.3.5.3.2; 3.3.5.4.2; 3.3.6.2.2; 3.3.6.3.2; 3.3.6.4.2; 3.3.6.5.2; 3.3.6.7.2; 3.3.6.8.2; 3.3.6.9.2; 3.3.6.10.2; 3.3.6.11.2; 3.3.6.11.8; and for Transit related ICD's elements not related to the "published" schedule.
toll archive data	Data indicating toll facility usage and pricing schedules. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

Table 3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
toll coordination	This flow supports reciprocity between toll agencies/service centers by exchanging information that supports reconciliation of toll charges by customers that are enrolled with other toll service centers. In addition to toll charge reconciliation, exchanged information may include toll schedule information, customer information and other toll service information that is coordinated between toll agencies or centers.
toll probe data	Aggregate probe data derived from electronic toll collection operations. Data collected could include vehicle speeds and travel times for a given link or collection of links.
traffic archive data	Information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.
traffic control coordination	Information transfers that enable remote monitoring and control of traffic management devices (traffic signals, ramp meters) . This flow is intended to allow cooperative access to, and control of, field equipment during incidents and special events and during day-to-day operations. This flow also allows 24-hour centers to monitor and control assets of other centers during off-hours, and otherwise enables integrated traffic control strategies in a region.
traffic flow	Raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic detectors.
traffic information coordination	Traffic information exchanged between TMC's. Normally would include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.
traffic operator data	Presentation of traffic operations data to the operator including traffic conditions, current operating status of field equipment, maintenance activity status, incident status, video images, incident alerts, response plan updates, graphical representations of networks within a 2 mile radius of an incident or congestion bottleneck. This data keeps the operator appraised of current road network status, provides feedback to the operator as traffic control actions are implemented, provides transportation security inputs, and supports review of historical data and preparation for future traffic operations activities.
traffic operator inputs	User input from traffic operations personnel including requests for information, configuration changes to response plan execution timing, commands to adjust current traffic control strategies (e.g., adjust signal timing plans, change DMS messages), an operator selected "priority" to be associated with the "Action Plan", and either a flag to indicate whether a response plan "event" or "control request" has been accepted (automatically accepted, accepted with change, or accepted as is) or declined.

Table3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
transit archive data	Information describing the use and vehicle composition on transportation facilities (i.e., routes, schedules, fares, passenger loading counts at a stop, transfer points, etc) and the transit control strategies employed. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.
transit fare and schedule	Transit service information including routes, schedules, schedule adherence, and fare information. Includes transit service information during evacuation.
transit fares OR transit fare information	Information provided by transit management that supports fare payment transactions and passenger data collection.
transit incident information	Information on transit incidents that impact transit services for public dissemination.
transit information	This includes "transit fare and schedule" data, "transit incident information", "transit system data", and "automated passenger count" data.
transit system data	Current transit system operations information indicating current transit routes, the level of service on each route, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance.
transportation information for operations	Information and graphical representations of the state of transportation system operations including "traffic operator data", "road network conditions", "regional event advisories", "incidents", "transit service information", "weather information", "parking information", "toll information", "maintenance and construction information", and current "roadway configuration" (i.e., Barrier position).
traveler archive data	Data associated with traveler information services including service requests, facility usage, rideshare, routing, and traveler payment transaction data. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.
validated external system {type} data	The data flow from the external system to the DSS - Road Asset Configuration and Conditions Data Store is one with multiple levels of security and validation to ensure that a data set does not contain corruption or invalid root and attribute entries.
video surveillance control	Information used to configure and control video surveillance systems.
weather information	Accumulated forecasted and current weather data (e.g., temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.).

Table3-1. Definitions Referred to in Requirements Specifications (cont'd)

Term	Definition
workflow information	In the context of the DSS, a workflow refers to the management of achieving an outcome through a systems oriented approach to multi-organizational coordination. "A workflow management system is a computer system that manages and defines a series of tasks within an organization to produce a final outcome or outcomes. Workflow Management Systems allow you to define different workflows for different types of jobs or processes. At each stage in the workflow, one individual or group is responsible for a specific task. Once the task is complete, the workflow software ensures that the individuals responsible for the next task are notified and receive the data they need to execute their stage of the process. Workflow management systems also automate redundant tasks and ensure uncompleted tasks are followed up. Workflow management systems may control automated processes in addition to replacing paper work order transfers. This is the concept of dependencies. A workflow management system reflects the dependencies required for the completion of each task (source Wikipedia)
workflow information "triggers"	These are the thresholds - set by an agency operator - that control the execution pathway of a Response Plan.

3.3 Action Verbs

Table 3-2 lists action verbs used in I-15 ICMS requirements and their meanings. This table will help reduce ambiguity in the interpretation of the I-15 ICMS requirements.

Table 3-2. Action Verbs Used in Requirements Specifications

Term	Definition
Access (database)	Retrieve information stored in local database tables.
Acquire	Receive data from an external system through a defined interface.
Classify	Identify as a unique category of data.
Compute	To determine by means of calculating parameters.
Configurable	A parameter changeable by operator input to a configuration dialog or database table.
Disseminate	Send data to an external system through a defined interface (synonym for "publish" - see below).
Determine	To ascertain the meaning or value.
Display	Place an image, map, dialog box, table, or system alert on a device that an operator can view (workstation or large screen display).
Forecast	To calculate and predict the future value of, generally through modeling.

Term	Definition
Incorporate	Include as a system function satisfied by hardware, software, human action (such as non-automated personnel notification, pager call-out, or e-mail transmission, etc.), or a combination of these.
Maintain	To update with current information.
Manage	Create, modify, delete, transfer (events), merge (events), and split (events)
Process	Convert data from one form to another, e.g., from Transit Management System OrbCAD format to TMDD XML data format.
Provide	Include as a system function satisfied by hardware, software, human action (such as non-automated personnel notification, pager call-out, or e-mail transmission, etc.), or a combination of these.
Publish	Send data to an external system through a defined interface.
Remotely access	View information stored in external systems through a defined interface. For receiving data, use the term “acquire” (see above definition).
Store	Place data into a persistent data store.
Transfer	To provide a handover of control to another agency (in the incident context).
Use	To incorporate an existing capability.

3.4 User Needs

The ICMS Concept of Operations documents 17 user needs as listed in Table 3-3.

Table 3-3. ICMS Concept of Operations User Needs

ID Number	Title	Description/Rationale
1	Access/Store ICMS Configuration Data	Store Configuration Data 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	Collect and Process Data 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.

Table 3-3. ICMS Concept of Operations User Needs (cont'd)

ID Number	Title	Description/Rationale
3	Access/Store ICMS Historical Information	Access/Store Historical Data 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 Freeway Management System, Transit Management System, and Arterial Management System is an important function of this user need. Having consistent export formats for data from these historical databases would simplify corridorwide 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	Publish Information to System Managers 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, and commercial vehicles. This information is differentiated from the information published to system users (see User Need 11).
5	Interactively Conference with Multiple Agencies	Interactive Multi-Agency Conferencing 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	The Information Display 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	Transportation and Public Safety Coordination User Need 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 CAD systems.
8	Share Control of Devices	Shared Device Control 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 inter-agency agreements to allow such sharing under carefully defined conditions.

Table 3-3. ICMS Concept of Operations User Needs (cont'd)

ID Number	Title	Description/Rationale
9	Manage Video Imagery	The San Diego region has a variety of video sources that provide a critical view of emerging and ongoing 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	Impact Assessment 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 also will be invoked for longer-term assessments.
12	Publish Information to System Users	Publish Information to System Users User Need is the information dissemination user need that parallels the Publish Information to 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 also will 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	Measure Corridor Performance User Need looks at multi-modal corridor data from both a short-term and long-term perspective. Existing historical databases for Freeway Management System, Transit Management System, Arterial Management System, CAD systems, Congestion Pricing System, and Parking Management System provide mode-specific data. Likewise, Performance Measurement System (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.

Table 3-3. ICMS Concept of Operations User Needs (cont'd)

ID Number	Title	Description/Rationale
14	Manage Corridor Demand and Capacity to Optimize Long-Term Performance	Capacity/Demand Management 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	Measure System Performance 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	System Management User Need is the administrative function of ICMS. Data management for ICMS configuration data, user account management incorporating systemwide security functions and IT-centric functions, such as data backup and archival, are included within this user need.
17	Maintain the ICMS System Throughout its Full Life Cycle	Life Cycle Maintenance User Need provides logistical support to the ICMS through its full life cycle through definition, development, testing, documentation, training, and maintenance phases.

3.5 ICMS Standards Implementation

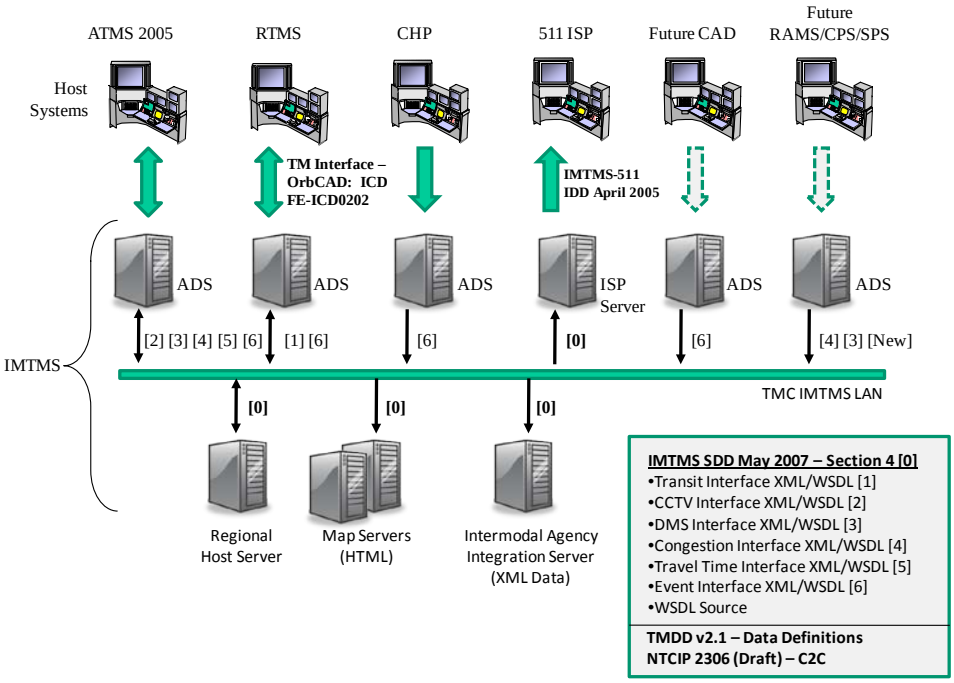
Table 3-4 lists the standards in use or planned for use in developing ICMS subsystem interfaces.

Table 3-4. Standards Used or Planned for ICMS

Interface	Standard	Version
IMTMS Distribution	TMDD	3.0
	NTCIP 2306	Draft
	IMTMS Systems Design Document (SDD) – Section 4	1.0
511 Dissemination	TMDD	3.0
	NTCIP 2306	Draft
	IMTMS-511 Interface Design Document (IDD)	1.0
OrbCAD (Transit Management System)	Interface Control Document (ICD) FE-ICD202	1.0

Figure 3-1 shows the relationship of documentation and standards for each interface currently in use for IMTMS. New systems such as the Congestion Pricing System, Parking Management System and Arterial Management System Regional Server will use TMDD v3.0 for data definitions and NTCIP 2306 for Center-to-Center message interfaces. IDDs and/or ICDs are not available for these systems as of March 2008. All references to interface documentation and standards in Section 3.8 are taken to mean the below illustrated interfaces.

Figure 3-1. Standards and Interface Documentation in Use and Planned for ICMS



[Source: SANDAG I-15 ICM Site Team.]

3.6 ICMS Data Sources

IMTMS employs a number of data sources that are referenced in the requirements in Section 3.8. Table 3-5 lists the data sources for the various categories of data being used currently in IMTMS and planned for use in ICMS.

Table 3-5. ICMS Data Sources

Data Type	Source
Events	
•Incidents	
•Freeway	ATMS*, REMS (CHP)*
•Arterial	REMS* (planned)
•Transit	RTMS*
•Special Events	ATMS*, RIWS
•Lane Closures	LCS, RIWS
•Emergency Closures	ATMS*, RIWS
Congestion	ATMS*, RAMS*, CPS*
Intersection Phasing/Alarms	RAMS*
CCTV Imagery	IMTMS Video Servers
CMS Messages/Status	ATMS*
Bus Locations, Schedule Adherence	RTMS*
Parking Availability	SPS*
Dynamic Pricing – Managed Lanes	CPS*
* Via Agency Data Servers	

3.7 ICMS Requirements Overview

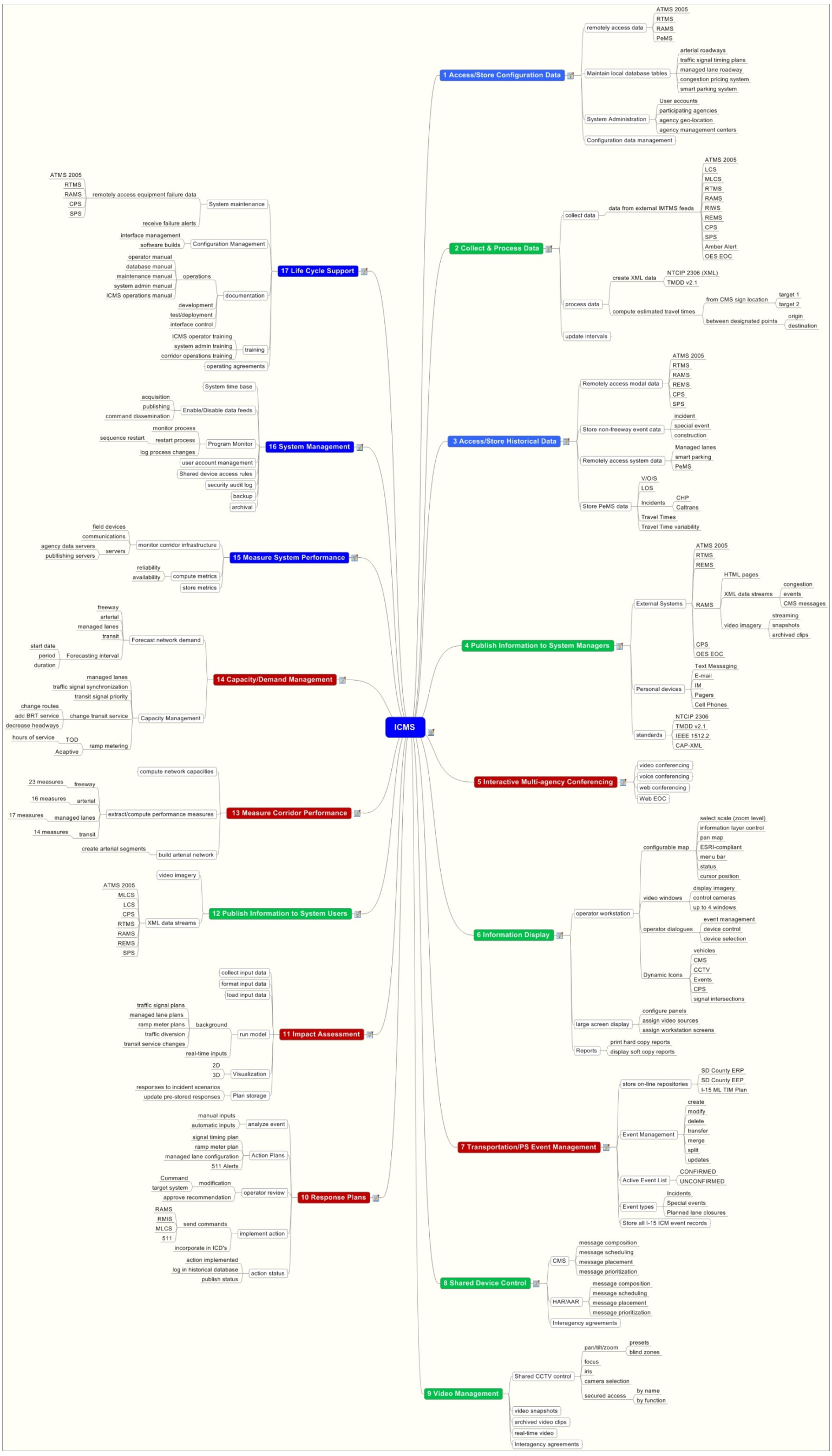
Figure 3-2 provides an overview of the ICMS requirements and their interrelationship at a high level.

3.8 ICMS Requirements

The following sections provide the high-level requirements for the currently defined 17 ICMS system functions based on the Concept of Operations, various guidance documents provided by U.S. Department of Transportation (U.S. DOT) during the requirements development stage of Integrated Corridor Management and existing ICMS subsystem definition documents (Software Design Descriptions, System Requirements, System Architecture Descriptions, Interface Control Documents, etc.). Each of the below functions of the ICMS and its subsystems was derived from an expanded set of user needs presented to U.S. DOT on November 8, 2007, during the ICM Requirements Workshop. Each major function will contain all its associated requirement types, including constraints, data, functional, interface, hardware and performance. The I-15 project team feels that this approach will simplify the transition to the design phase of ICM by grouping all requirements related to a single function. For example, the designer for the *Data Collection and Processing* function will need to know what systems to interface to, what data elements are involved, what computer hardware is needed to store collected data, and what functions are needed to collect and process the data.

Each requirement is coded with the following general schema: X-Y-N_1.N_2.N_3.N_4. . . . , where “X” can be is the short code for the internal DSS subsystem, including DH (Data Hub), RAC (Road Asset Configuration & Conditions Data Store), RSDS (Response Strategy Data Store), RTSS (Real-Time Simulation Subsystem), BPRMS (Business Rules and Process Management Engine), GUI (Graphical User Interface Subsystem), SMS (Systems Management Subsystem), NPS (Network Prediction Subsystem), CCTV (Legacy CCTV Control Subsystem). This is then followed by “Y” the type of requirement DF (Data Flow), FR (Functional Requirement). Subsequent classification levels indicated by decimal points and following numbers (.N_1, .N_2, .N_3, .N_4, etc.) indicate parent-child relationships among requirements.

Figure 3-2. ICMS Requirements Overview



[Source: SANDAG I-15 ICM Site Team.]

3.8.1 ICMS Configuration and Historical Data Storage

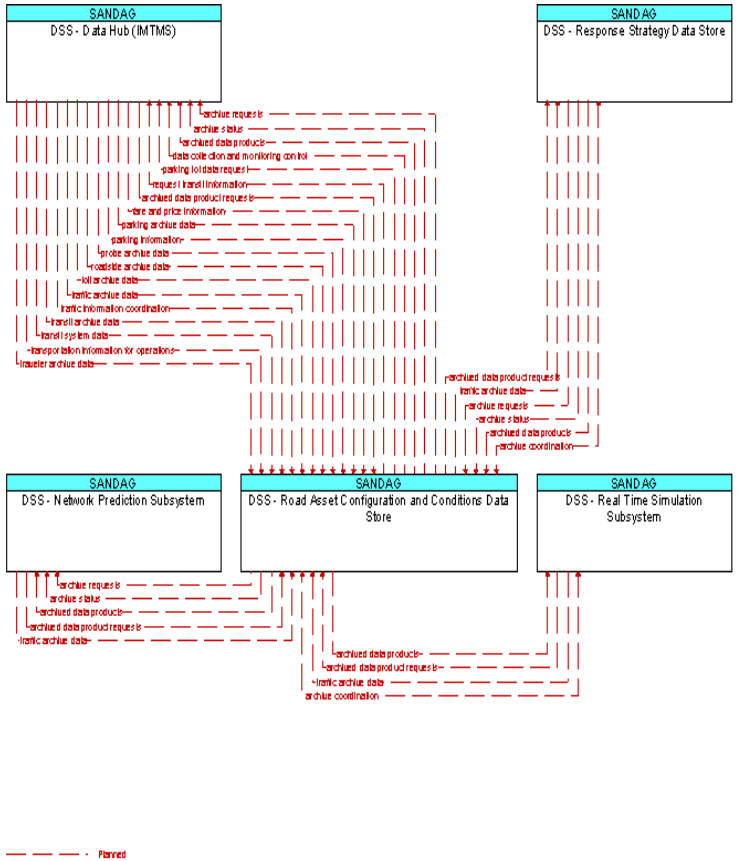
As shown in Figure 3-3 and Table 3-6, ICMS configuration data will be provided by a combination of existing modal databases and new configuration database tables containing I-15 corridor-specific information. Modal databases exist for Freeway Management System (freeway), Transit Management System (Metropolitan Transit System (MTS) and North County Transit District (NCTD) transit), and Arterial Management System. Configuration data is needed, for example, for response plan processing, for data processing algorithms, to initialize certain ICMS functions and to track various static corridor metrics such as highway capacities and transit capacities. The data will be stored in a relational database instance and managed (created, modified, deleted) through data entry screens that conform to current industry best practice for design and ease of use measures.

A reports function uses the historical data, information and procedures to display traffic congestion, operational events, and system failures across user-selectable time periods. The California Performance Measurement System (PeMS) currently collects real-time data from all freeway and arterial systems within the region and makes a variety of configurable reports available by district and by highway.

For I-15 corridor purposes, this data must uniquely identified as participating in the I-15 corridor boundaries. The ICMS shall not limit the data captured from External subsystems, but instead will identify road networks, transit networks, toll networks and nodes that participate within the corridor boundaries.

The ICMS will have the capability to access long term trend and performance analysis data from the CALTRANS PeMS system. The *ICMS will not maintain a separate historical database for existing corridor modal data*; however, the ICMS will maintain a historical database for corridorwide data or for modal data specific to corridor operations.

Figure 3-3. ICMS Configuration and Historical Data Storage Interface Diagram



[Source: SANDAG.]

Table 3-6. ICMS Configuration and Historical Data Storage Requirements

Requirement ID	Description	User Need ID
RAC-DF-IN-1	The DSS - Road Asset Configuration and Conditions Data Store shall collect data from the DSS - Data Hub to support internal subsystem access to current "qualified" or "processed" data inventory and status data.	1,3
RAC-DF-IN-1.1.1	The DSS - Road Asset Configuration and Conditions Data Store shall collect "transportation control coordination" data from the DSS - Data Hub based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6 (control elements only), 3.3.7	1,3
RAC-DF-IN-1.1.1.1	The DSS - Road Asset Configuration and Conditions Data Store shall collect "transportation control coordination" from the DSS - Data Hub after every 30 seconds, but before every 2 minutes.	1,3
RAC-DF-IN-1.1.2	The he DSS - Road Asset Configuration and Conditions Data Store shall collect "transportation information coordination" from the DSS - Data Hub based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	1,3
RAC-DF-IN-1.1.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall collect "transportation information coordination" from the DSS - Data Hub no less than every second, and no more than every 2 minutes.	1,3
RAC-DF-IN-1.1.3	The DSS - Road Asset Configuration and Conditions Data Store shall collect "archived data product" requests from the DSS - Data Hub for the time period specified. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3

Requirement ID	Description	User Need ID
RAC-DF-IN-1.2	The DSS - Data Hub shall collect "archived data product" requests to the DSS - Road Asset Configuration and Conditions Data Store which is a user-specified request for "archived data product" (i.e., data, meta data, or data catalogs). This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3
RAC-DF-IN-1.2.1	The DSS - Data Hub shall collect all "transportation control coordination" data to the DSS - Road Asset Configuration and Conditions Data Store based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	1,3
RAC-DF-IN-1.2.2	The DSS - Data Hub shall collect all "transportation information coordination" data to the DSS - Road Asset Configuration and Conditions Data Store based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	1,3
RAC-DF-IN-1.3	The DSS - Road Asset Configuration and Conditions Data Store shall collect "data collection and monitoring control" from the DSS - Systems Management Subsystem which will include information used to configure and control data collection and monitoring systems, based on a user or organizations security profile.	1,3
RAC-DF-IN-1.4	The DSS - Road Asset Configuration and Conditions Data Store shall collect data from a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	1,3
RAC-FR-2	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub for storage, comprising sensor data (both smoothed and unsmoothed): processed sensor surveillance data, data sent to control indicators (output devices e.g., intersection controllers, pedestrian controllers, ramp metering equipment), parking lot management data and other street equipment, the status data received from the indicators, plus current traffic conditions, planned events, current incidents, calculated incident response and clearance times, parking lot states, freeway ramp states, link travel times, traffic conditions provided by vehicle probes and from other centers, and selected traffic control strategy.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.1	The DSS - Road Asset Configuration and Conditions Data Store shall process data and information received from the DSS - Data Hub into a locally "qualified" repository which maintains the most current data available from both External systems and Internal Subsystems.	1,3
RAC-FR-2.1.1	The DSS - Road Asset Configuration and Conditions Data Store shall analyze incoming data from the DSS - Data Hub for deltas between existing (stored) configuration data and data in the current device inventory and provide version control over their "inventory" configuration.	1,3
RAC-FR-2.1.2	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub, for additions and deletions to the ICM networks (arterial, freeway, transit, parking, toll).	1,3
RAC-FR-2.1.3	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub and uniquely identify assets unable to participate in corridor operations due to being unavailable (e.g., out for maintenance, off line, etc). The "availability" status or "error" condition will be determined by the source system.	1,3
RAC-FR-2.1.4.1	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub, and evaluate it against the "route unavailable" condition previously captured, which was set manually through the DSS - Graphical User Interface by the Regional Transportation Operator.	1,3
RAC-FR-2.1.4.2	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub, and evaluate it's "availability status" based on the capacity threshold previously set by each jurisdiction's Regional Transportation Operator in the DSS - Business Rules and Process Management.	1,3
RAC-FR-2.1.4.3	The DSS - Road Asset Configuration and Conditions Data Store shall process data received from the DSS - Data Hub. If capacity data drops below the "availability status" threshold set by the Regional Transportation Operator, the link, route, or node, shall be marked as "unavailable for use (corridor)" OR "unavailable for use (incident)".	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.11	The DSS - Road Asset Configuration and Conditions Data Store shall store data from the DSS - Data Hub for no less than 90 days and no more than 390 days before removal from the system.	1,3
RAC-FR-2.11.1	The DSS - Road Asset Configuration and Conditions Data Store shall store data from the DSS - Data Hub, the upper and lower bounds of this data storage is to be set through the DSS - Systems Management Subsystem	1,3
RAC-FR-2.12	The DSS - Road Asset Configuration and Conditions Data Store shall store configuration data from the Express Lanes Control System containing entrance points, exit points, direct access ramp points, lane type (fixed, configurable), speed limit	1,3
RAC-FR-2.12.1	The DSS - Road Asset Configuration and Conditions Data Store shall analyze and respond to requests for data within 1 to 5 seconds for "current" conditions data.	1,3
RAC-FR-2.13	The DSS - Road Asset Configuration and Conditions Data Store shall store configuration data from the Parking Management System containing facility ID, facility name, capacity, operating hours, operating days, location, access points	1,3
RAC-FR-2.13.1	The DSS - Road Asset Configuration and Conditions Data Store shall store configuration data received from Parking Management System for characteristics containing facility ID, facility name, capacity, operating hours, operating days, location, access points	1,3
RAC-FR-2.13.2	The DSS - Road Asset Configuration and Conditions Data Store shall analyze and respond to requests for data within 30 seconds to 5 minutes for "archive" data requests.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.14	The DSS - Road Asset Configuration and Conditions Data Store shall store configuration data from Transit Management System for containing route, run, vehicle, performance, apc data	1,3
RAC-FR-2.14.1	The DSS - Road Asset Configuration and Conditions Data Store shall write an error message to the DSS - Systems Management Subsystem as a "Network Additions Violation" with a codified description of the exception.	11
RAC-FR-2.15	The DSS - Graphical User Interface shall display to the Regional Transportation Operator a locally retained copy of the regional emergency and incident management plans including the; a) SD County Emergency Response Plan (ERP); (b) SD County Emergency Evacuation Plan (EEP) and, (c) I-15 Managed Lanes Traffic Incident Management (ML TIM) Plan	1,3
RAC-FR-2.2	The DSS - Road Asset Configuration and Conditions Data Store shall store "transportation information coordination" data from the DSS - Data Hub into the current data stores.	1,3
RAC-FR-2.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall store event information and, associated configuration data from the DSS - Data Hub.	1,3
RAC-FR-2.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall maintain the "transportation information for operations" received from the DSS - Data Hub, and look for any changes of static data used in the processing of field data. This field data is used to provide traffic surveillance information for use by other processes within the ICMS environment.	1,3
RAC-FR-2.2.1.1	The DSS - Road Asset Configuration and Conditions Data Store shall store "transit events" including; project-references, full-report-texts, event-comments, event-element-details, event-headline, event-headline, event-reference, message-header, restrictions, other-references, event-indicators and, transit-location-text, transit-stop-detail, transit-route-id, transit-direction from the DSS - Data Hub to support internal subsystem access to Transit Management status data.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.2.1.2	The DSS - Road Asset Configuration and Conditions Data Store shall store "events" including -project-references, full-report-texts, event-comments, event-element-details, event-headline, event-headline, event-reference, message-header, restrictions, other-references, event-indicators and, event-locations, confidence-level, event, event-lanes, event-name, access-level, event-descriptions, event-source, event-category, schedule-element-id, element-id, event-times, event-locations from the DSS - Data Hub to support internal subsystem access to the External System "Congestion Pricing System" historical data.	1,3
RAC-FR-2.2.1.3	The DSS - Road Asset Configuration and Conditions Data Store shall store FullEventUpdate including, but not limited to; project-references, full-report-texts, event-comments, event-element-details, event-headline, event-headline, event-reference, message-header, restrictions, other-references, event-indicators from the DSS - Data Hub to support internal subsystem access to Arterial 'Construction' Incident historical data.	1,3
RAC-FR-2.2.1.4	The DSS - Road Asset Configuration and Conditions Data Store shall store FullEventUpdate including, but not limited to; project-references, full-report-texts, event-comments, event-element-details, event-headline, event-headline, event-reference, message-header, restrictions, other-references, event-indicators from the DSS - Data Hub to support internal subsystem access to Arterial Incident historical data.	1,3
RAC-FR-2.2.1.5	The DSS - Road Asset Configuration and Conditions Data Store shall store FullEventUpdate including, but not limited to; project-references, full-report-texts, event-comments, event-element-details, event-headline, event-headline, event-reference, message-header, restrictions, other-references, event-indicators from the DSS - Data Hub to support internal subsystem access to Freeway Incident historical data.	1,3
RAC-FR-2.2.1.6	The DSS - Road Asset Configuration and Conditions Data Store shall store "events" including, but not limited to; project-references, full-report-texts, event-comments, event-element-details, event-headline, event-reference, message-header, restrictions, other-references, event-indicators, agency, person, date-time, justification of incident closure, from the DSS - Data Hub for each incident report received	1,3
RAC-FR-2.2.1.7	The DSS - Road Asset Configuration and Conditions Data Store shall store a terminated incident's historical data, including who was responsible for closing the incident, the date-time, and a reason.	1,3
RAC-FR-2.2.10	The DSS - Road Asset Configuration and Conditions Data Store shall store NodeStatus and, NodeStatusList including ;restrictions, organization-information, organization-information, node-list and, network-id, last-update-time, node-status, node-name, network-name, node-id from the DSS - Data Hub to support internal access to Field Status data from the regional Transportation Management System (i.e., Freeway	1,3

Requirement ID	Description	User Need ID
	Management System, Arterial Management System, Ramp Management System, Congestion Pricing System).	
RAC-FR-2.2.11	The DSS - Road Asset Configuration and Conditions Data Store shall store road definition data including owning-organization-information, link-list, restrictions, network-id, network-name, link-route-designator, link-id, link-speed-limit, last-update-time, lane-separator, right-shoulder-width, left-shoulder-width, link-owner, link-jurisdiction, link-name, link-speed-limit-truck, alternate-link-name, link-capacity, and, section-id, section-link-count, link-id and, network-id, route-url, route-node-id-list, route-length, alternate-route-name-list, route-name, route-type, route-link-id-list, network-name, last-update-time, route-id and, linear-reference, geo-location, signed-destination, link-name, point-name, cross-street-designator, cross-street-name, upward-area-reference, landmark-type, location-rank and, secondary-location, alternate-designations, link-direction, primary-location, link-alignment, linear-reference-version, link-designator, second-link-designator, link-id, link-name, link-ownership and, node-type, network-id, network-name, node-id, node-name, node-description, node-route-designator, node-direction, node-location, node-links-number, last-update-time, linear-reference-version, linear-reference and, landmark-name, upward-area-reference, geo-location, location-rank, landmark-point-name, landmark-type received from the DSS - Data Hub to describe a Freeway Network, Arterial Network, Congestion Pricing Facility roadway characteristics.	1,3
RAC-FR-2.2.12	The DSS - Road Asset Configuration and Conditions Data Store shall store RouteInventory and, RouteInventoryList including, but not limited to; restrictions, organization-information, organization-information, route-list and, network-id, route-url, route-node-id-list, route-length, alternate-route-name-list, route-name, route-type, route-link-id-list, network-name, last-update-time, route-id from the DSS - Data Hub to support internal subsystem access to the Regional Transportation System locally understood definitions of Route configuration data.	1,3
RAC-FR-2.2.13	The DSS - Road Asset Configuration and Conditions Data Store shall store RouteStatus and, RouteStatusList including, but not limited to; organization-information, organization-information, route-list, restrictions and, travel-time-increase, last-update-time, event-description-time, current-speed-advisory, occupancy, density, volume, travel-time, headway, alternate-route-delay, delay, route-traffic-data-algorithm, route-status, speed-average, route-data-stored-type, rout from the DSS - Data Hub to support internal subsystem access to the current status of regional Routes.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.2.14	The DSS - Road Asset Configuration and Conditions Data Store shall store transit schedule adherence, incidents, passenger counts and, route ID, stop ID, schedule deviation (minutes), time and, incident type, incident location, time, date, #vehicles, #injuries, #fatalities, incident text, route ID, block ID and, emergency alarm, driver involved traffic accident, driver observed traffic accident, crime in progress and, route ID, block ID, stop ID, passenger count, time, date from the DSS - Data Hub to support internal subsystem access to Transit Management status data.	1,3
RAC-FR-2.2.15	The DSS - Road Asset Configuration and Conditions Data Store shall store SectionLinkList and, SectionNodeList including, but not limited to; section-id, section-link-count, link-id and, node-id, section-id, section-node-count from the DSS - Data Hub to support internal subsystem access to Section Field data.	1,3
RAC-FR-2.2.2	The DSS - Road Asset Configuration and Conditions Data Store shall maintain information received from the DSS - Data Hub with respect to the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network. This will be used by processes involved in exchanging surveillance information (and optionally control) with other functions.	1,3
RAC-FR-2.2.5	The DSS - Road Asset Configuration and Conditions Data Store shall store LCSInventory including, but not limited to; controlled-lane-number, link-id, device-inventory-header, restrictions, link-lane-count from the DSS - Data Hub to support internal subsystem access to Express Lanes Closure Field data.	1,3
RAC-FR-2.2.6	The DSS - Road Asset Configuration and Conditions Data Store shall store LinkInventory and, LinkInventoryList including, but not limited to; organization-information, organization-information, link-list, restrictions and, network-id, network-name, link-route-designator, link-id, link-speed-limit, last-update-time, lane-separator, right-shoulder-width, left-shoulder-width, link-owner, link-jurisdiction, link-name, link-speed-limit-truck, alternate-link-name, link-capacity, from the DSS - Data Hub to support internal subsystem access to Link configuration data.	1,3
RAC-FR-2.2.7	The DSS - Road Asset Configuration and Conditions Data Store shall store LinkStatus and, LinkStatusList including ;link-list, restrictions, organization-information, organization-information and, density, delay, volume, link-id, network-id, oversaturated-threshold, lane-numbers, detection-method, link-traffic-data-algorithm, surface-condition, stops, restriction-units, alternate-route-delay, headway, travel-time, capacity-existing, travel-time-inc from the DSS - Data Hub to support internal subsystem access to Link state data.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.2.8	The DSS - Road Asset Configuration and Conditions Data Store shall store NodeInventory and, NodeInventoryList including, but not limited to; organization-information, restrictions, node-list, organization-information and, node-type, network-id, network-name, node-id, node-name, node-description, node-route-designator, node-direction, node-location, node-links-number, last-update-time, linear-reference-version, linear-reference from the DSS - Data Hub to support internal subsystem access to Node configuration data.	1,3
RAC-FR-2.2.9	The DSS - Road Asset Configuration and Conditions Data Store shall store NodeInventory including, but not limited to; organization-information, restrictions, node-list, organization-information and, node-type, network-id, network-name, node-id, node-name, node-description, node-route-designator, node-direction, node-location, node-links-number, last-update-time, linear-reference-version, linear-reference from the DSS - Data Hub to support internal subsystem access to Field Inventory data from the Regional Transportation Management System (i.e., Freeway Management System, Arterial Management System, Ramp Management System, Congestion Pricing System).	1,3
RAC-FR-2.3	The DSS - Road Asset Configuration and Conditions Data Store shall store "transportation control coordination" data from the DSS - Data Hub into the current data stores.	1,3
RAC-FR-2.3.1	The DSS - Road Asset Configuration and Conditions Data Store shall store HARInventory including, but not limited to; har-call-sign, restrictions, device-inventory-header, device-beacon, har-characteristics, har-frequency-description from the DSS - Data Hub to support internal subsystem access to HAR Field Inventory data.	1,3
RAC-FR-2.3.10	The DSS - Road Asset Configuration and Conditions Data Store shall store "Congestion Pricing System" configuration data from the DSS - Data Hub containing tolling zone locations, toll transaction controller locations, variable toll message sign locations, variable message sign locations	1,3
RAC-FR-2.3.2	The DSS - Road Asset Configuration and Conditions Data Store shall store a region wide Signal "inventory configuration" from the Arterial Management System signals including; turning-movement-list, time-reference-code, special-functions-list, interval-list, phase-list, link-list, link-list, device-inventory-header, interval-list, restrictions, controller-master-id, node-id, node-name, intersection-name, controller-model, firmw and, link-direction, link-id and, last-update-time, timing-pattern-name, plan-mode, offset-time, cycle-time, timing-pattern-id, device-id, organization-information, organization-information, restrictions and, timing-pattern-id, device-id, authentication, organization-information and, phase-identifier and, turning-movement-identifier,	1,3

Requirement ID	Description	User Need ID
	turning-movement-text, turning-movement-lane-count, turning-movement-lanes, turning-movement-code, turning-movement-angle, approach-link-id from the DSS - Data Hub. This data shall support calls for traffic data for operations both inside the ICM boundary and out.	
RAC-FR-2.3.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall store the Intersection Signal "inventory configuration" data, received from the from the DSS - Data Hub including; turning-movement-list, time-reference-code, special-functions-list, interval-list, phase-list, link-list, link-id, device-inventory-header, interval-list, restrictions, controller-master-id, node-id, node-name, intersection-name, controller-model, and firmwen to enable the operator to configure the device (both spatially, temporally, and with device specific parameters).	1,3
RAC-FR-2.3.2.2	The DSS - Road Asset Configuration and Conditions Data Store shall store IntersectionSignalInventory and, IntersectionSignalInventoryLinkList including turning-movement-list, time-reference-code, special-functions-list, interval-list, phase-list, link-list, link-list, device-inventory-header, interval-list, restrictions, controller-master-id, node-id, node-name, intersection-name, controller-model, firmw and, link-direction, link-id from the DSS - Data Hub to support internal subsystem access to Intersection Signal Controller Field Inventory data.	1,3
RAC-FR-2.3.2.3	The DSS - Road Asset Configuration and Conditions Data Store shall store IntersectionSignalStatus including, but not limited to; signal-control-source, cycle-counter-master, interval-duration-percent, interval-duration-seconds, active-interval, active-phase-list, active-special-functions-list, preempt-description, master-sync-time, controller-time, controller-sync-time, offset-time from the DSS - Data Hub for all regional signals available.	1,3
RAC-FR-2.3.2.4	The DSS - Road Asset Configuration and Conditions Data Store shall store IntersectionSignalTimingPatternInventory including, but not limited to; last-update-time, timing-pattern-name, plan-mode, offset-time, cycle-time, timing-pattern-id, device-id, organization-information, organization-information, restrictions from the DSS - Data Hub to support internal subsystem access to Intersection Signal Controller Timing Plan Inventory data.	1,3
RAC-FR-2.3.2.5	The DSS - Road Asset Configuration and Conditions Data Store shall store data turning-movement-list, time-reference-code, special-functions-list, interval-list, phase-list, link-list, link-list, device-inventory-header, interval-list, restrictions, controller-master-id, node-id, node-name, intersection-name, controller-model, firmw and, timing-pattern-id, restrictions, device-control-response-header, section-id, request-control-mode and, restrictions, request-control-mode, timing-pattern-id, device-control-schedule-header and, last-update-time, timing-pattern-name, plan-mode, offset-time, cycle-time, timing-pattern-id, device-id, organization-information, organization-	1,3

Requirement ID	Description	User Need ID
	information, restrictions and, timing-pattern-id, device-id, authentication, organization-information from the DSS - Data Hub for pre-determined traffic signal timing plans	
RAC-FR-2.3.3	The DSS - Road Asset Configuration and Conditions Data Store shall store CCTVInventory including, but not limited to; cctv-camera-tilt-down-limit, cctv-requests-supported, cctv-image-list, cctv-titling-text, node-id, cctv-camera-type, cctv-camera-pan-left-limit, cctv-camera-tilt-up-limit, device-inventory-header, cctv-camera-zoom-limit, cctv-camera-focus-limit, cctv-came from the DSS - Data Hub to support internal subsystem access to CCTV Field Inventory data.	1,3
RAC-FR-2.3.4	The DSS - Road Asset Configuration and Conditions Data Store shall store cctv-position-tilt, cctv-position-iris-lens, cctv-position-pan, device-status-header, cctv-position-preset, restrictions, cctv-position-zoom-lens, cctv-image-list, cctv-position-focus-lens, cctv-error from the DSS - Data Hub	1,3
RAC-FR-2.3.5	The DSS - Road Asset Configuration and Conditions Data Store shall store all surveillance and sensors from the freeways, surface street and rural roadways, e.g., where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network from the DSS - Data Hub.	1,3
RAC-FR-2.3.5.1	The DSS - Road Asset Configuration and Conditions Data Store shall store DetectorData and, DetectorDataDetail including, but not limited to; restrictions, organization-information, detector-list and, vehicle-speed, vehicle-count-bin2, station-id, detector-id, detection-time-stamp, vehicle-count, vehicle-occupancy, start-time, end-time, detector-data-type, vehicle-stops, vehicle-count-bin1, vehicle-count-bin3, vehicle-count-bin4, vehicle-count-bin5, qu from the DSS - Data Hub to support internal subsystem access to the External System "Congestion Pricing System" historical data.	1,3
RAC-FR-2.3.5.2	The DSS - Road Asset Configuration and Conditions Data Store shall store DetectorInventory and, DetectorInventoryDetails including, but not limited to; detector-list, restrictions, detector-station-inventory-header and, detection-lanes, vehicle-classification-bin2, link-direction, vehicle-classification-bin3, vehicle-classification-bin1, is-detector-speed-trap-flag, node-id, link-name, detector-type, detector-inventory-header, vehicle-classification-bin4 from the DSS - Data Hub to support internal subsystem access to Detector Field Inventory data.	1,3

Requirement ID	Description	User Need ID
RAC-FR-2.3.5.3	The DSS - Road Asset Configuration and Conditions Data Store shall store DMSDeviceStatus including, but not limited to; message-source-mode, restrictions, device-status-header, current-message, message-number, message-time-remaining from the DSS - Data Hub.	1,3
RAC-FR-2.3.5.4	The DSS - Road Asset Configuration and Conditions Data Store shall store DMSInventory including; dms-color-scheme, charWidthPixels, dms-multi-tag-support, charHeightPixels, restrictions, device-inventory-header, dms-sign-type, link-direction, signTechnology, signHeightPixels, signWidthPixels, dms-vertical-border, signWidth, dms-max-message-length, dm and, message-status, message-run-time-priority, enable-beacon-flag, message-owner-organization-information, message, message-number, message-memory-type, device-id, organization-information, organization-information, restrictions, last-update-time from the DSS - Data Hub to support internal subsystem access to DMS/CMS Field Inventory historical data.	1,3
RAC-FR-2.3.5.5	The DSS - Road Asset Configuration and Conditions Data Store shall store DMSMessageInventory including -message-status, message-run-time-priority, enable-beacon-flag, message-owner-organization-information, message, message-number, message-memory-type, device-id, organization-information, organization-information, restrictions, last-update-time from the DSS - Data Hub to support internal subsystem access to the External System "Congestion Pricing System" historical data.	1,3
RAC-FR-2.3.6	The DSS - Road Asset Configuration and Conditions Data Store shall store RampMeterInventoryDetails including, but not limited to; device-inventory-header, ramp-meter-number-list, firmware, firmware-version, restrictions and, ramp-meter-inventory-header, node-id, lane-number, node-name, lane-type, associated-detectors, absolute-minimum-metering-rate, absolute-maximum-metering-rate, system-minimum-metering-rate, system-maximum-metering-rate, ramp-exit-roadway-name, link-directi from the DSS - Data Hub to support internal subsystem access to Ramp Meter Controller Field data.	1,3
RAC-FR-2.3.6.1	The DSS - Road Asset Configuration and Conditions Data Store shall store RampMeterPlanInventory including, but not limited to; restrictions, device-id, meter-plan-id, occupancy-threshold, organization-information, speed-threshold, last-update-time, organization-information, meter-rate, flow-rate-threshold from the DSS - Data Hub to support internal subsystem access to Ramp Meter Controller Plan Inventory data.	1,3
RAC-FR-2.3.6.2	The DSS - Road Asset Configuration and Conditions Data Store shall store RampMeterStatus and, RampMeterLaneStatusDetails including, but not limited to; restrictions, ramp-meter-lane-list, mainline-flow-rate, mainline-vehicle-occupancy, mainline-vehicle-speed, device-status-header and, requested-vehicles-per-green, meter-operational-mode, violation-count, request-meter-command-source, implemented-meter-command-source, implemented-plan-id, implemented-rate, implemented-vehicles-per-green, requested-	1,3

Requirement ID	Description	User Need ID
	action, device-status-header, requested from the DSS - Data Hub to support internal subsystem access to Ramp Meter Status information	
RAC-FR-2.3.7	The DSS - Road Asset Configuration and Conditions Data Store shall store Section Status including, but not limited to; timing-pattern-name, section-name, last-comm-time, node-id-list, section-id, section-control-mode, timing-pattern-id, cycle-time, operator-id, organization-information, restrictions, response-plan-id, event-id, organization-information from the DSS - Data Hub received from the Arterial Management System	1,3
RAC-FR-2.3.8	The DSS - Road Asset Configuration and Conditions Data Store shall store HARStatus including, but not limited to; restrictions, device-status-header, har-current-message, message-beacon, message-number from the DSS - Data Hub where available from the External Systems (Freeway Management System).	1,3
RAC-FR-2.3.9	The DSS - Road Asset Configuration and Conditions Data Store shall store future "maintenance and construction" data from the DSS - Data Hub from the Lane Closure System including construction and maintenance work schedules and activities including anticipated closures with anticipated impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	1,3
RAC-FR-2.4	The DSS - Road Asset Configuration and Conditions Data Store shall process data collected from the DSS - Data Hub into "corridor" relationships that may exist within the local data store. These may not be apparent to modal operators, as agency owned sensors on the freeways, surface street and rural roadways, may derive a corridor relationship based on for example the transit routes that are now working upon it. This process must look at where they are located, to which part(s) of the network their data applies, the type of data available, in a many to many relationship.	1,3
RAC-DF-OUT-3	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate data to the DSS - Data Hub. The dissemination will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	1,3
RAC-DF-OUT-3.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "transportation information coordination" requests to the DSS - Data Hub for the latest data available from External Systems.	1,3

Requirement ID	Description	User Need ID
RAC-DF-OUT-3.1.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate multiple requests for "transportation information for operations" to the DSS - Data Hub. These requests will return static data (inventory) for incidents, special events, roadway characteristics, sensors, parking lot information, traffic control, weather sensors, and transit data [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	1,3
RAC-DF-OUT-3.1.2	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "transportation control coordination" requests to the DSS - Data Hub for the latest data available from External Systems.	1,3
RAC-DF-OUT-3.1.3	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "transportation information coordination" requests to the DSS - Data Hub for the latest data available from Internal Sub-Systems.	1,3
RAC-DF-OUT-3.1.4	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archived data products" to the DSS - Data Hub which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	1,3
RAC-DF-OUT-3.1.5	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive status" to the DSS - Data Hub which consists of a notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3
RAC-DF-OUT-3.2	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive requests" to the DSS - Network Prediction Subsystem which is a request for information on available prediction data (i.e., "catalog") either for a specified time period. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3
RAC-DF-OUT-3.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive status" to the DSS - Network Prediction Subsystem. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3

Requirement ID	Description	User Need ID
RAC-DF-OUT-3.2.2	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archived data product" to the DSS - Network Prediction Subsystem which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information for the requested period. This data flow uses the following standards; i) [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	1,3
RAC-DF-OUT-3.2.2.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive data products" to the DSS - Network Prediction Subsystem, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	1,3
RAC-DF-OUT-3.3	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archived data product" requests to the DSS - Response Strategy Data Store for a specified time period. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	1,3
RAC-DF-OUT-3.3.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "traffic archive data" to the DSS - Response Strategy Data Store which consists of the information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. This data flow uses the following standards; [Inside System Boundary]:TMDD Requirements: 3.3.5, 3.3.6.	1,3
RAC-DF-OUT-3.3.2	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive data products" to the DSS - Response Strategy Data Store, including traffic archive data, parking archive data, transit archive data, toll archive data, traveler archive data to support development of response strategies.	1,3
RAC-DF-OUT-3.3.3	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archive coordination" to the DSS - Response Strategy Data Store which consists of catalog data, meta data, published data, and other information exchanged between archives to support data synchronization and satisfy user data requests. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	1,3
RAC-DF-OUT-3.4	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate data to the DSS - Real-Time Simulation Subsystem, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information, parking information, weather information, events and special events, and transit information to support microsimulated selection of a response strategy.	1,3

Requirement ID	Description	User Need ID
RAC-DF-OUT-3.4.1	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archived data product" to the DSS - Real Time Simulation Subsystem which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards; i) [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	1,3
RAC-DF-OUT-3.5	The DSS - Road Asset Configuration and Conditions Data Store shall disseminate "archived data product" to the External Systems which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards; i) [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	1,3

3.8.2 Data Collection and Processing

As shown in Figure 3-4 and Table 3-7, data will be collected continuously from deployed modal management systems, including those listed below. Relative to the operational start date for the ICM demonstration, which is currently scheduled for the fall of 2010, the following dates apply (see Section 2.7.6, Table 2-5 for the complete list of scheduled deployment dates).

- Freeway Management System (currently operational)
- Managed Lanes Control System (Middle Segment of I-15 Managed Lanes will be operational by January 2009)
- Lane Closure System (currently operational)
- Regional Transit Management System (currently operational)
- Regional Arterial Management System (fully operational by March 2009)
- Regional Event Management System (currently existing as California Highway Patrol)
- Congestion Pricing System (on Middle Segment of I-15 Managed Lanes will be operational by January 2009)
- Parking Management System (initial deployment on I-5 scheduled for summer 2008; framework for system regional extensibility completed by spring 2010)
- Manual data from Regional Integrated Workstation (currently has completed acceptance testing; scheduled deployment in 2009)

Data processing is currently accomplished by IMTMS or the region's modal management systems. For example, IMTMS converts proprietary host data formats to standard XML schema using agency data servers, and Freeway Management System computes travel times from designated CMS locations for up to two target destinations per sign. This data will be available to the ICMS through the data collection function. However the ICMS will require additional data processing to calculate metrics such as corridor capacity and excess corridor capacity in the aggregate and by mode, non-freeway travel times, etc. and to filter data according to a variety of parameters such as type and source.

Figure 3-4. Data Collection and Processing Interface Diagram [Source: SANDAG.]

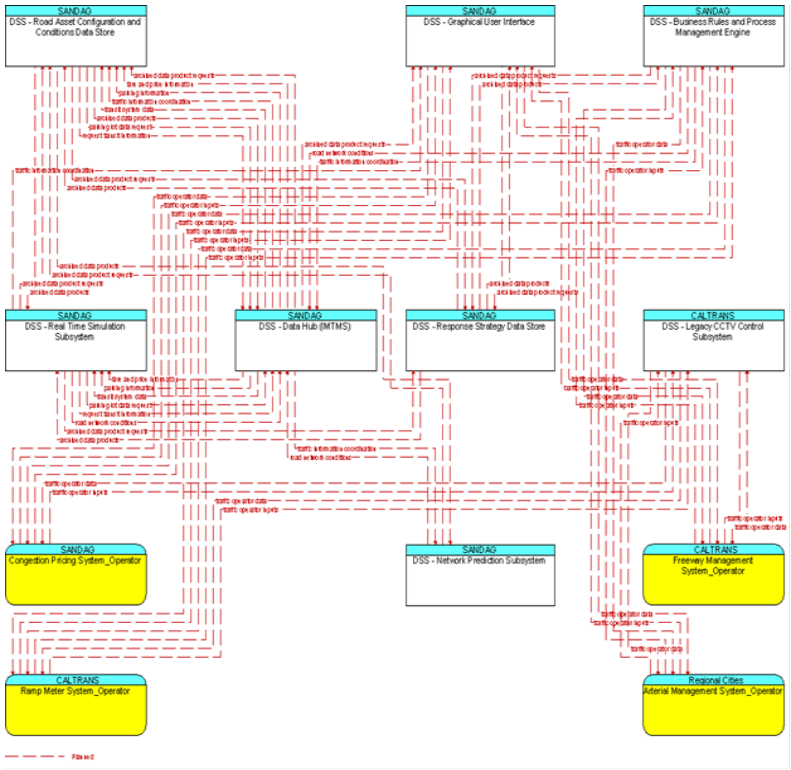


Table 3-7. ICMS Data Collection and Processing Requirements

Requirement ID	Description	User Need ID
DH-DF-IN-1	The DSS - Data Hub shall collect raw "transportation information for operations" data from external systems according to interface control documents, including the; 1) Congestion Pricing System; 2) Ramp Management System; 3) Arterial Management System; 4) Freeway Management System; 5) Lane Closure System; 6) Parking Management System; 7) Regional Event Management System; 8) Express Lanes Management System; 9) Weather Data Provider; 10) Arterial Travel Time System; 11) Transit Management System; 12) 511;	2
DH-DF-IN-1.1	The DSS - Data Hub shall collect "toll data" from the external systems, including the Congestion Pricing System (CPS)	2
DH-DF-IN-1.1.1	The DSS - Data Hub shall collect "traffic information coordination" from the Congestion Pricing System data listed in ICD Appendix 1: “CPS – ATIS Interface”.	2
DH-DF-IN-1.1.1.1	The DSS - Data Hub shall collect "traffic congestion" status data from the "Congestion Pricing System", including the traffic flow for each road network (route & link) to which a toll applies with the time and date for when it applies, the current status of messages displayed within the laneway on CMS signs,	2
DH-DF-IN-1.1.1.2	The DSS - Data Hub shall collect "device inventory" data from the "Congestion Pricing System", including the dynamic message signs, vehicle detection stations, toll plaza locations, network (route & link) configuration to support regional access to the data and capabilities of this external system	2
DH-DF-IN-1.1.1.3	The DSS - Data Hub shall collect "toll network inventory" data from the "Congestion Pricing System", including the road link and segment network to which a toll applies.	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.1.1.4	The DSS - Data Hub shall collect "toll pricing" status data from the "Congestion Pricing System", including the current price for each road segment to which a toll applies, with the time and date for when it applies, and the toll schedule inventory which is a list of toll schedules and defined activation datas.	2
DH-DF-IN-1.1.1.5	The DSS - Data Hub shall collect "toll schedule inventory" data from the "Congestion Pricing System" which is a list of toll schedules and defined activation datas.	2
DH-DF-IN-1.2	The DSS - Data Hub shall collect data from the external systems, including the Ramp Management System (RMS)	2
DH-DF-IN-1.2.1	The DSS - Data Hub shall collect all data from the Ramp Management System listed in ICD Appendix 1: “Ramp Meter Center to Center ICD”.	2
DH-DF-IN-1.2.1.1	The DSS - Data Hub shall collect all data from the Ramp Management System and be supported by a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-IN-1.2.1.2	The DSS - Data Hub shall collect all data from the Ramp Management System and be supported by a general publishing event intended to initiate a continuous or regular data stream.	2
DH-DF-IN-1.2.2	The DSS - Data Hub shall collect "traffic control coordination" from the Ramp Management System which consists of the information transfers that enable remote monitoring and control of traffic management devices. This data flow uses the following standards;:	2
DH-DF-IN-1.2.3	The DSS - Data Hub shall collect "traffic information coordination" from the DSS - Ramp Management System which consists of the traffic information exchanged between TMC’s. This shall include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.3	The DSS - Data Hub shall collect data from the external systems, including the Arterial Management System (AMS)	2
DH-DF-IN-1.3.1	The DSS - Data Hub shall collect all data from the Arterial Management System listed in ICD Appendix 1: “SDDD - San Diego Regional Intermodal Transportation Management System”. (Version 5.0 or later).	2
DH-DF-IN-1.3.1.1	The DSS - Data Hub shall collect "traffic control coordination" from the Arterial Management System which consists of the information transfers that enable remote monitoring and control of traffic management devices. This data flow uses the following standards;: [Outside System Boundary]:TMDD Requirements: 3.3.6 (the control related requirement for each device):	2
DH-DF-IN-1.3.1.2	The DSS - Data Hub shall collect "traffic information coordination" from the "Arterial Management System" which consists of the traffic information exchanged between TMC’s. This shall include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information. This data flow uses the following standards;: [Outside System Boundary]: ICD: Appendix 1 - "Regional Arterial Management System, Phase 4, Detailed Center to Center Interface Design Document, RAMST 1.6.1"	2
DH-DF-IN-1.4	The DSS - Data Hub shall collect data from the external systems, including the; * Freeway Management System (FMS)	2
DH-DF-IN-1.4.1	The DSS - Data Hub shall collect all data from the Freeway Management System listed in ICD Appendix 1: “SDDD - San Diego Regional Intermodal Transportation Management System”. (Version 5.0 or later).	2
DH-DF-IN-1.4.1.1	The DSS - Data Hub shall collect "traffic control coordination" from the Freeway Management System, which consists of the information transfers that enable remote monitoring and control of traffic management devices. This data flow uses the following standards;:	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.4.1.2	The DSS - Data Hub shall collect "traffic and highway condition information", including incident information, detours and road closures, event information, and current speeds on specific routes from the Freeway Management System.	2
DH-DF-IN-1.4.1.2	The DSS - Data Hub shall collect "maintenance and construction information", including scheduled maintenance and construction work activities and work zone activities from the Lane Closure Management System. The collection will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-IN-1.5	The DSS - Data Hub shall collect data from the external systems, including the Lane Closure System (LCS)	2
DH-DF-IN-1.5.1	The DSS - Data Hub shall collect "maintenance and construction work plans" data, which consists of notification of future construction and maintenance work schedules and activities including anticipated closures with anticipated impact to the roadway, alternate routes, anticipated delays, closure times, durations, location (begin and end points), activity description and title, start and end times, and current status from the Lane Closure System. This data will be used as an input to the current understanding of corridor conditions, both present and forecast for DSS tools.	2
DH-DF-IN-1.6	The DSS - Data Hub shall collect data from the external systems, including the Parking Management System (PMS)	2
DH-DF-IN-1.6.1	The DSS - Data Hub shall collect "parking information" from the Parking Management System which consists of general "parking information" and status, including current parking availability. This data flow uses the following standards;: [Outside System Boundary]: ICD: Appendix 1: Parking Management System SOAP API Version 2:	2
DH-DF-IN-1.6.1	The DSS - Data Hub shall collect "parking management data" with other parking facilities including location, hours, availability, status, lot usage, operating strategies, and charging information.	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.6.1.1	The DSS - Data Hub shall collect all data from the Parking Management System listed in ICD Appendix 1: "Parking Management System SOAP API Version 2". The collection will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-IN-1.7	The DSS - Data Hub shall collect data from the external systems, including the Regional Event Management System (REMS)	2
DH-DF-IN-1.7.1	The DSS - Data Hub shall collect "event information" from the Regional Event Management System, which aggregates all events from the Freeway Management System, the Transit Management System, and the CHP - CAD system. The collection will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-IN-1.7.1.1	The DSS - Data Hub shall collect all data from the Regional Event Management System listed in ICD Appendix 1: "SDDD - San Diego Regional Intermodal Transportation Management System". (Version 5.0 or later).	2
DH-DF-IN-1.8	The DSS - Data Hub shall collect data from the external systems, including the Express Lanes Management System	2
DH-DF-IN-1.8.1	The DSS - Data Hub shall collect "traffic information coordination" from the Express Lanes System data listed in Appendix 1: [ICD not yet developed].	2
DH-DF-IN-1.9	The DSS - Data Hub shall collect data from the external systems, including the Weather Data Provider	2
DH-DF-IN-1.9.1	The DSS - Data Hub shall collect "qualified environmental conditions data" from the Weather Provider System which consists of surface weather information (e.g., air temperature, wind speed, precipitation, visibility) that has had quality checks performed on it and has been formatted and consolidated by an	2

Requirement ID	Description	User Need ID
	External Data Provider system. Meta data relating to the data collection (and aggregation) should also be included. This data flow uses the following standards;: [Outside System Boundary]: Unknown. Must be decided during HLD.:	
DH-DF-IN-1.9.1	The DSS - Data Hub shall collect current and forecast weather data from a weather data provider.	2
DH-DF-IN-1.9.1.1	The DSS - Data Hub shall collect weather information from a Weather Provider System which consists of the accumulated forecasted and current weather data (e.g., temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.).	2
DH-DF-IN-1.9.1.1.1	The DSS - Data Hub shall collect "qualified "environmental conditions" from a Weather Provider System which consists of surface weather information (e.g., air temperature, wind speed, precipitation, visibility) that has had quality checks performed on it and has been formatted and consolidated by an External Data Provider system. Attributes relating to the data collection (and aggregation) should also be included. This data flow uses the following standards;: [Outside System Boundary]: Unknown.	2
DH-DF-IN-1.10	The DSS - Data Hub shall collect data from the external systems, including the Arterial Travel Time System (ATTS)	2
DH-DF-IN-1.10.1	The DSS - Data Hub shall collect all data from the Arterial Travel Time System listed in ICD Appendix 1: “SensysTravelTimeServerProtocol” [Outside System Boundary].	2
DH-DF-IN-1.10.1.1	The DSS - Data Hub shall collect "traffic information coordination" from the "Arterial Travel Time System" which consists of the traffic information exchanged between TMC’s. This shall include roadway network, congestion data, traffic data. This data flow uses the following standards;: [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6.2, 3.3.6.6, 3.3.6.11	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.11	The DSS - Data Hub shall collect data from the external systems, including the Transit Management System	2
DH-DF-IN-1.11.1	The DSS - Data Hub shall collect all "Transit Management System" data using the ICD in Appendix 1: “SDDD - San Diego Regional Intermodal Transportation Management System”.	2
DH-DF-IN-1.11.1.1	The DSS - Data Hub shall collect "transit fare and schedule information" from the Transit Management System, including routes, schedules, and fare information.	2
DH-DF-IN-1.11.1.2	The DSS - Data Hub shall collect "transit routes and schedules","transit transfer options", "transit fares", "real-time schedule adherence information", and "passenger count" information from the Transit Management System	2
DH-DF-IN-1.11.1.3	The DSS - Data Hub shall collect "transit incident information" from the Transit Management System, including bus and rail events.	2
DH-DF-IN-1.12	The DSS - Data Hub shall collect data from the external systems, including the 511	2
DH-DF-IN-1.12.1	The DSS - Data Hub shall collect data from the 511. The collection can be via a general subscription intended to the DSS - Data Hub to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-IN-1.12.1.1	The DSS - Data Hub shall collect all data from the 511 listed in ICD Appendix 1: [ICD to be created].	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.12.1.1	The DSS - Data Hub shall collect number of total # calls where the roadway requested (beginning or end point) was within the boundaries of the corridor	2
DH-DF-IN-1.12.1.2	The DSS - Data Hub shall collect "ISP coordination" from the 511, which consists of the coordination and exchange of transportation information between centers. Data collected from 511 will support the development of IVR and Web usage metrics.	2
DH-DF-IN-1.12.1.2.1	The DSS - Data Hub shall collect "archive requests" from the 511 for Advanced Traveler system usage metrics. This flow shall be a request to a data source for information on available data (i.e., "catalog") or a request that defines the data to be archived. Specifically, catalog refers to the metrics captured by the 511 system related to web and phone usage (aggregate), number of web requests for traveler information on a particular route, number of phone requests for traveler information on a particular route, and number of registered users requiring recurring congestion information on a particular route. This data flow uses the following standards; (i) [Outside System Boundary]: TMDD Requirements: 3.3.7, returning data from 3.3.4, 3.3.5.	2
DH-DF-IN-1.12.1.2.2	The DSS - Data Hub shall collect number of total calls where the city (Poway, Escondido, San Diego) were used as both the beginning and end point. (This could be Poway-Escondido; Poway-San Diego; etc)	2
DH-DF-IN-1.13.1.1	The DSS - Data Hub shall collect "archive status" responses from the Performance Measurement System which consists of a notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards; (i) [Outside System Boundary]: TMDD Requirements: 3.3.7	2
DH-DF-IN-1.13.1.2	The DSS - Data Hub shall collect "archive requests" from the Performance Measurement System which is a request for information on available data (i.e., "catalog") or a request that defines the data to be archived. This data flow uses the following standards; (i) [Outside System Boundary]: TMDD Requirements: 3.3.7	2

Requirement ID	Description	User Need ID
DH-DF-IN-1.13.1.3	The DSS - Data Hub shall collect "archive status" from the Performance Measurement System which consists of a notification that data contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards; (i) [Outside System Boundary]: TMDD Requirements: 3.3.7	2
DH-DF-IN-1.13.1.4	The Performance Measurement System shall disseminate "archived data product" to the DSS - Data Hub which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information. This data flow uses the following standards; (i) [Outside System Boundary]: TMDD Requirements: 3.3.7	2
DH-DF-IN-1.14	The DSS - Data Hub shall collect a graphical representation "traffic information coordination" from the DSS - Road Asset Configuration and Conditions Data Store, including current traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), and the definition of the road network itself.	2
DH-DF-IN-1.14.1	The DSS - Data Hub shall collect a graphical representation of the "traffic information coordination" from the DSS - Road Asset Configuration and Conditions Data Store, including forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), and the definition of the road network itself. This shall include "graphical depictions" of the data.	2
DH-DF-IN-1.14.2	The DSS - Data Hub shall collect data from the DSS - Road Asset Configuration and Conditions Data Store to support higher functioning DSS Subsystems (i.e., DSS - Business Rules and Process Management Engine, DSS Real Time Simulation Subsystem, DSS - Network Prediction Subsystem). [Inside System Boundary] This data flow will use TMDD specifications: 3.3.4; 3.3.5; 3.3.6	2
DH-DF-IN-1.14.3	The DSS - Data Hub shall collect information on the state of the regional transportation system including; "current traffic and road conditions", "weather conditions", "transit information", "parking information", "special event" and "incident information" from the DSS - Road Asset Configuration and Conditions Data Store, to satisfy a request for "archival data" at a point in time.	2
DH-FR-2	The DSS - Data Hub shall process data from the external systems, including the; 1) Congestion Pricing System; 2) Ramp Management System; 3) Arterial Management System; 4) Freeway Management System; 5) Lane Closure System; 6) Parking Management System; 7) Regional Event Management System; 8) Express Lanes Management System; 9) Weather Data Provider; 10) Arterial Travel Time System; 11) Transit Management System; 12) 511	2

Requirement ID	Description	User Need ID
DH-FR-2.1	The DSS - Data Hub process data received from the external systems, including the Congestion Pricing System	2
DH-FR-2.1.1	The DSS - Data Hub shall process data received from the "Congestion Pricing System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.1.2	The DSS - Data Hub shall process data received from the "Congestion Pricing System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.1.3	The DSS - Data Hub shall transform data received from the "Congestion Pricing System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.1.4	The DSS - Data Hub shall process data received from the "Congestion Pricing System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.10	The DSS - Data Hub process data from the external systems, including the "Arterial Travel Time System"	2
DH-FR-2.10.1	The DSS - Data Hub shall transform data received from the "Arterial Travel Time System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.10.1.1	The DSS - Data Hub shall process data received from the "Arterial Travel Time System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2

Requirement ID	Description	User Need ID
DH-FR-2.10.1.2	The DSS - Data Hub shall process data received from the "Arterial Travel Time System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.10.2	The DSS - Data Hub shall process data received from the "Arterial Travel Time System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.10.3	The DSS - Data Hub shall process data received from the "Arterial Travel Time System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.11	The DSS - Data Hub process data from the external systems, including the Transit Management System	2
DH-FR-2.11.1	The DSS - Data Hub shall transform data received from the "Transit Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.11.1.1	The DSS - Data Hub shall process data received from the "Transit Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.11.1.2	The DSS - Data Hub shall process data received from the "Transit Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.11.2	The DSS - Data Hub shall process data received from the "Transit Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2

Requirement ID	Description	User Need ID
DH-FR-2.12	The DSS - Data Hub process data from the external systems, including the 511	2
DH-FR-2.12	The DSS - Data Hub shall process data received from the "511", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.12.1	The DSS - Data Hub shall process data received from the "511" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.12.2	The DSS - Data Hub shall process data received from the "511" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.12.3	The DSS - Data Hub shall transform data received from the "511" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.13	The DSS - Data Hub shall process all data from "internal subsystems" and generate a log of the results of that processing (positive or negative results inclusive) for capture at the DSS - Systems Management Subsystem. The process will evaluate the quality of the message received from the internal system and report it in the TMDD standard 3.3.1.4 message format.	2
DH-FR-2.2	The DSS - Data Hub process data received from the external systems, including the Ramp Management System	2
DH-FR-2.2.1	The DSS - Data Hub shall process data received from the "Ramp Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2

Requirement ID	Description	User Need ID
DH-FR-2.2.2	The DSS - Data Hub shall process data received from the "Ramp Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.2.3	The DSS - Data Hub shall transform data received from the "Ramp Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.2.4	The DSS - Data Hub shall process data received from the "Ramp Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.3	The DSS - Data Hub process data from the external systems, including the Arterial Management System.	2
DH-FR-2.3.1	The DSS - Data Hub shall process data received from the "Arterial Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.3.2	The DSS - Data Hub shall process data received from the "Arterial Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.3.3	The DSS - Data Hub shall transform data received from the "Arterial Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.3.4	The DSS - Data Hub shall process data received from the "Arterial Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2

Requirement ID	Description	User Need ID
DH-FR-2.4	The DSS - Data Hub process data from the external systems, including the Freeway Management System.	2
DH-FR-2.4.1	The DSS - Data Hub shall process data received from the "Freeway Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.4.2	The DSS - Data Hub shall process data received from the "Freeway Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.4.3	The DSS - Data Hub shall transform data received from the "Freeway Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.4.4	The DSS - Data Hub shall process data received from the "Freeway Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.5	The DSS - Data Hub process data from the external systems, including the Lane Closure System.	2
DH-FR-2.5.1	The DSS - Data Hub shall process data received from the "Lane Closure System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.5.2	The DSS - Data Hub shall process data received from the "Lane Closure System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2

Requirement ID	Description	User Need ID
DH-FR-2.5.3	The DSS - Data Hub shall transform data received from the "Lane Closure System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.5.4	The DSS - Data Hub shall process data received from the "Lane Closure System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.6	The DSS - Data Hub process data from the external systems, including the Parking Management System.	2
DH-FR-2.6.1	The DSS - Data Hub shall process data received from the "Parking Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.6.2	The DSS - Data Hub shall process data received from the "Parking Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.6.3	The DSS - Data Hub shall transform data received from the "Parking Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.6.4	The DSS - Data Hub shall process data received from the "Parking Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.7	The DSS - Data Hub process data from the external systems, including the Regional Event Management System.	2

Requirement ID	Description	User Need ID
DH-FR-2.7.1	The DSS - Data Hub shall process data received from the "Regional Event Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.7.2	The DSS - Data Hub shall process data received from the "Regional Event Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.7.3	The DSS - Data Hub shall transform data received from the "Regional Event Management System" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.7.4	The DSS - Data Hub shall process data received from the "Regional Event Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.8	The DSS - Data Hub process data from the external systems, including the Express Lanes Management System.	2
DH-FR-2.8.1	The DSS - Data Hub shall process data received from the "Express Lanes Management System" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.8.2	The DSS - Data Hub shall process data received from the "Express Lanes Management System" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.8.3	The DSS - Data Hub shall transform data received from the "Express Lanes Management System" into TMDD (ver 3.0) compliant messages - if required.	2

Requirement ID	Description	User Need ID
DH-FR-2.8.4	The DSS - Data Hub shall process data received from the "Express Lanes Management System", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-FR-2.9	The DSS - Data Hub process data from the external systems, including the Weather Data Provider.	2
DH-FR-2.9.1	The DSS - Data Hub shall process data received from the "Weather Data Provider" for the quality of the entire message structure and contents, and its conformance to the mandatory TMDD (ver 3.0) standards applicable to that interface. This process checks conformance against 3.3.4, 3.3.5, 3.3.6, and 3.3.7.	2
DH-FR-2.9.2	The DSS - Data Hub shall process data received from the "Weather Data Provider" for the quality of the entire message structure and contents, and its conformance to the "optional" elements defined as required during the System Detailed Design phase of the project.	2
DH-FR-2.9.3	The DSS - Data Hub shall transform data received from the "Weather Data Provider" into TMDD (ver 3.0) compliant messages - if required.	2
DH-FR-2.9.4	The DSS - Data Hub shall process data received from the "Weather Data Provider", logging the outcome of the error checking routines into a TMDD (Version 3.0) 3.3.1.4 compliant "Error Log Message" .	2
DH-DF-OUT-3	The DSS - Data Hub shall disseminate data to the external systems, including the; 1) Congestion Pricing System: [traffic information coordination], 2) Ramp Management System: [traffic control coordination], 3) Arterial Management System: [control data], 4) Freeway Management System: [traffic control coordination, traffic information coordination], 5) Regional Event Management System: [traffic control coordination, traffic information coordination], 6) Transit Management System: [traffic information coordination], 7) Performance Management System: [traffic information coordination, traffic control coordination, archive data coordination, archived data products], 8) 511: [traffic information coordination], 9) Other ISP: [traffic information coordination];	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.1	The DSS - Data Hub shall disseminate "traffic information coordination" and "traffic control coordination" to the external systems	2
DH-DF-OUT-3.2	The DSS - Data Hub shall disseminate "traffic control coordination" related requests to the External System External Systems which consists of a request made to obtain system information. The request is a subscription that initiates as-needed information updates as well as a one-time request for information.	2
DH-DF-OUT-3.2.1	The DSS - Data Hub shall disseminate "traffic control coordination" to the External Systems which consists of the information transfers that enable remote monitoring and control of traffic management devices. This flow is intended to allow cooperative access to, and enables integrated traffic control strategies in a region. This data flow uses the following standards;: [Outside System Boundary]: Refer to Appendix 1	2
DH-DF-OUT-3.3	The DSS - Data Hub shall disseminate "traffic information coordination" data to the External Systems	2
DH-DF-OUT-3.3.1	The DSS - Data Hub shall disseminate "traffic information coordination" related requests to the External System External Systems which consists of a request made to obtain toll system information. The request is a subscription that initiates as-needed information updates as well as a one-time request for information.	2
DH-DF-OUT-3.3.2	The DSS - Data Hub shall disseminate "traffic information coordination" to the External Systems which includes incidents, congestion data (current / forecast), traffic data, transit data, parking data, congestion pricing system data, weather data, ramp metering rates, and arterial signal cycle times. This data flow uses the following standards;: [Outside System Boundary]: Refer to multiple ICD's in Appendix 1.	2
DH-DF-OUT-3.4.1	The DSS - Data Hub shall disseminate data to the "internal subsystems" where the source data comes from any of the following; External Systems: 1) Congestion Pricing System; 2) Ramp Management System; 3) Arterial Management System; 4) Freeway Management System; 5) Lane Closure System; 6) Parking Management System; 7) Regional Event Management System; 8) Express Lanes Management System; 9) Weather Data Provider; 10) Arterial Travel Time System; 11) Transit Management System; 12) 511; 13) Performance Measurement System	2

Requirement ID	Description	User Need ID
	Other Internal Systems: 1) DSS - Business Process and Rules Management Engine, 2) DSS - Graphical User Interface Subsystem, 3) DSS - CCTV Legacy Control Subsystem, 4) DSS - Real Time Simulation Subsystem, 5) DSS - Real-Time Simulation Subsystem, 6) DSS - Road Asset Configuration and Conditions Data Store, 7) DSS - Response Strategy Data Store, 8) DSS - Systems Management Subsystem, 9) DSS - Network Prediction Subsystem	
DH-DF-OUT-3.4.1.1	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Business Rules and Process Management Engine based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.1.2	The DSS - Data Hub shall disseminate all "transportation information for operations" data to the DSS - Business Rules and Process Management Engine based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.2	The DSS - Data Hub shall disseminate data to the DSS - Graphical User Interface Subsystem. The dissemination will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-OUT-3.4.2.1	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Graphical User Interface based on a user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.2.2	The DSS - Data Hub shall disseminate all "transportation information for operations" data to the DSS - Graphical User Interface based on a user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.3	The DSS - Data Hub shall disseminate data to the DSS - Legacy CCTV Control Subsystem.	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.3.1	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Legacy CCTV Control Subsystem based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.3.2	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Legacy CCTV Control Subsystem based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.3.4.1	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Network Prediction Subsystem based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.3.4.2	The DSS - Data Hub shall disseminate all "traffic information coordination" data to the DSS - Network Prediction Subsystem based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.4	The DSS - Data Hub shall disseminate data to the DSS - Network Prediction Subsystem.	2
DH-DF-OUT-3.4.5	The DSS - Data Hub shall disseminate data to the DSS - Real Time Simulation Subsystem. This data will be available both on event based and a filtered one-time request	2
DH-DF-OUT-3.4.5	The DSS - Data Hub shall disseminate data to the DSS - Real-Time Simulation Subsystem.	2
DH-DF-OUT-3.4.5.1	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Real-Time Simulation Subsystem based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.5.2	The DSS - Data Hub shall disseminate all "transportation information for operations" data to the DSS - Real-Time Simulation Subsystem based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.6	The DSS - Data Hub shall disseminate data to the DSS - Road Asset Configuration and Conditions Data Store.	2
DH-DF-OUT-3.4.6.1	The DSS - Data Hub shall disseminate "archived data product" requests to the DSS - Road Asset Configuration and Conditions Data Store which is a user-specified request for "archived data product" (i.e., data, meta data, or data catalogs). This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.7	2
DH-DF-OUT-3.4.6.2	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Road Asset Configuration and Conditions Data Store based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.6.3	The DSS - Data Hub shall disseminate all "transportation information for operations" data to the DSS - Road Asset Configuration and Conditions Data Store based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.7	The DSS - Data Hub shall disseminate data to the DSS - Response Strategy Data Store.	2
DH-DF-OUT-3.4.7	The DSS - Data Hub shall disseminate a log of processed messages to the DSS - Systems Management Subsystem. Logs contain data from either internal or external systems, whether the processed results are valid or invalid in readiness for further evaluation at a later time by the Performance Monitoring System. The dissemination can be via a general subscription intended to the DSS - Data Hub to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.7.1	The DSS - Data Hub shall disseminate all "transportation information for operations" data to the DSS - Response Strategy Data Store based on a system or user-specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.7.2	The DSS - Data Hub shall disseminate all "traffic control coordination" data to the DSS - Response Strategy Data Store based on a system or user specified request. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.6, 3.3.7	2
DH-DF-OUT-3.4.8	The DSS - Data Hub shall disseminate data to the DSS - Systems Management Subsystem.	2
DH-DF-OUT-3.4.8.1	The DSS - Data Hub shall disseminate all "error handling" reports to the DSS - Systems Management Subsystem based on a system or user-specified event. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.1.4	2
DH-DF-OUT-3.4.9	The DSS - Data Hub shall disseminate data to all Internal ICMS Subsystems. The dissemination will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient.	2
DH-DF-OUT-3.4.9.1	The DSS - Data Hub shall disseminate "transportation information for operations" to the Internal DSS Subsystems which consists of the information on the state of transportation system operations including traffic and road conditions, advisories, incidents, transit service information, weather information, parking information, toll road information, and other related congestion data. This data flow uses the following standards;: [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	2
DH-DF-OUT-3.4.9.11	The DSS - Data Hub shall disseminate "fare and price information" to the Internal ICMS Subsystems which consists of current transit, parking, and toll fee schedule information.	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.9.12	The DSS - Data Hub shall disseminate "traveler archive" data to the Internal DSS Subsystems which consists of the data associated with traveler information services including service requests, facility usage, rideshare, routing, and traveler payment transaction data. Content will include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information. This data flow uses the following standards;: [Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.7	2
DH-DF-OUT-3.4.9.13	The DSS - Data Hub shall disseminate "parking information" to the Internal Subsystems which consists of general "parking information" and status, including current parking availability. This data flow uses the following standards;: [Inside System Boundary] TMDD ver 3.0 – Req: 3.3.4;	2
DH-DF-OUT-3.4.9.14	The DSS - Data Hub shall disseminate "parking archive data" to the Internal DSS Subsystems which consists of data used to analyze and monitor trends in parking demand, pricing, and operational actions. Content will include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information. This data flow uses the following standards;: [Inside System Boundary]:TMDD ver 3.0 – Req: 3.3.7	2
DH-DF-OUT-3.4.9.15	The DSS - Data Hub shall disseminate "roadway information system" status to the Internal ICMS Subsystems which consists of the current operating status of dynamic message signs, highway advisory radios, beacon systems, or other configurable field equipment that provides dynamic information to the driver. This data flow uses the following standards;:[Inside System Boundary]:ICD: Appendix 1 - "Software Detailed Design Document: San Diego Regional Intermodal Transportation Management System (IMTMS)"	2
DH-DF-OUT-3.4.9.16	The DSS - Data Hub shall disseminate "signal control status" to the Internal ICMS Subsystems which consists of a status of surface street signal controls including operating condition and current operational state. This data flow uses the following standards;: [Inside System Boundary]:TMDD Requirements: 3.3.6 (control elements only)	2
DH-DF-OUT-3.4.9.17	The DSS - Data Hub shall disseminate "traffic flow" to the Internal ICMS Subsystems which consists of the raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic detectors. This data flow uses the following standards;:[Inside System Boundary]: TMDD Requirements: 3.3.6	2

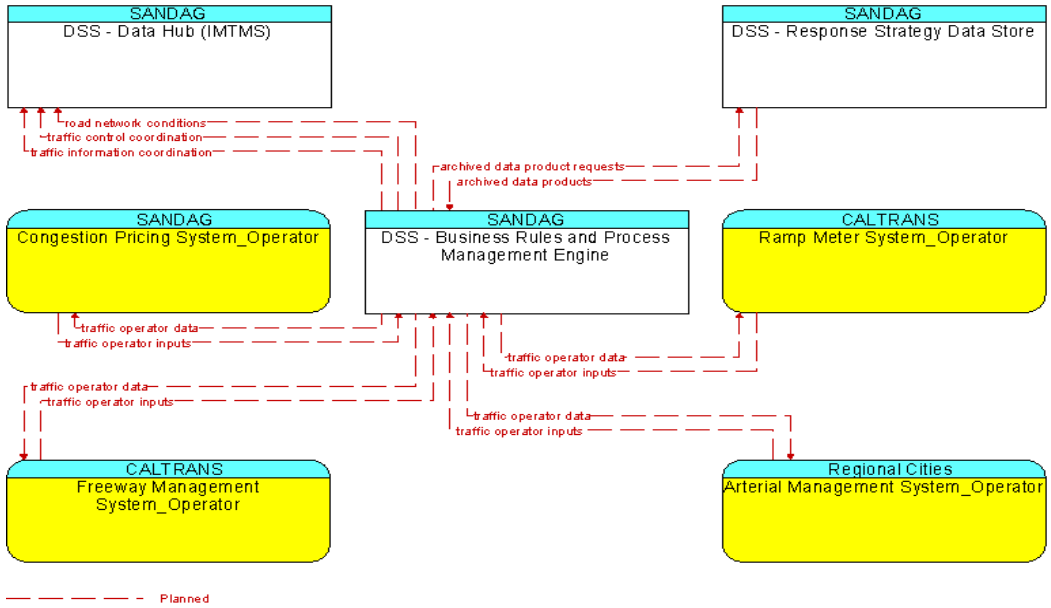
Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.9.18	The DSS - Data Hub shall disseminate "transportation information for operations" to the Internal ICMS Subsystems which consists of the information on the state of transportation system operations including traffic and road conditions, advisories, incidents, transit service information, weather information, parking information, and other related data. This data flow uses the following standards;: [Inside System Boundary]: Partial satisfied by ICD: Appendix 1 - "Software Detailed Design Document: San Diego Regional Intermodal Transportation Management System (IMTMS)". Elements for parking, weather required.	2
DH-DF-OUT-3.4.9.19	The DSS - Data Hub shall disseminate "freeway control status" to the Internal ICMS Subsystems which consists of current operational status and operating parameters for ramp meters, mainline metering/lane controls and other control equipment associated with freeway operations. This data flow uses the following standards;[Inside System Boundary]:(i)Ramp Meters: : TMDD ver 3.0 – Req: 3.3.6.10;(i)Dynamic Message Signs: : TMDD ver 3.0 – Req: 3.3.6.5(i)Highway Advisory Radio: : TMDD ver 3.0 – Req: 3.3.6.8;	2
DH-DF-OUT-3.4.9.2	The DSS - Data Hub shall disseminate "transit system data" to the Internal DSS Subsystems which consists of the current transit system operations information indicating current transit routes, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance. This data flow uses the following standards;: [Inside System Boundary]: ICD: IMTMS with extensions for APC and Fare data.	2
DH-DF-OUT-3.4.9.3	The DSS - Data Hub shall disseminate "probe archive data" to the Internal DSS Subsystems which consists of flow data that allows calculation of travel times, volumes, and other measures that support transportation planning. Optionally, this flow also includes origin and destination information for vehicles that opt to provide this information. This data flow uses the following standards;:[Inside System Boundary]: TMDD ver 3.0 – Req: 3.3.5, 3.3.6	2
DH-DF-OUT-3.4.9.4	The DSS - Data Hub shall disseminate "transit archive data" to the Internal DSS Subsystems which consists of data used to describe and monitor transit demand, fares, operations, and system performance. Content will include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information. This data flow uses the following standards;: [Inside System Boundary]: TMDD: 3.3.4,3.3.7	2
DH-DF-OUT-3.4.9.5	The DSS - Data Hub shall disseminate "traffic archive data" to the Internal DSS Subsystems which consists of the information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. Content will include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information. This data flow uses the following standards;:[Inside System Boundary]:TMDD Requirements: 3.3.7	2

Requirement ID	Description	User Need ID
DH-DF-OUT-3.4.9.6	The DSS - Data Hub shall disseminate "parking information" to the Internal DSS Subsystems which consists of general "parking information" and status, including current parking availability. This data flow uses the following standards;: [Outside System Boundary]: ICD: Appendix 1: Parking Management System SOAP API Version 2: [Inside System Boundary]: TMDD ver 3.0 – Req: 3.3.4;	2
DH-DF-OUT-3.4.9.7	The DSS - Data Hub shall disseminate a request for "traffic information coordination" to the Internal DSS Subsystems. The returned data consists of the traffic information exchanged between TMC's and includes incidents, congestion data, traffic data, signal timing plans, and real-time signal control information. This data flow uses all of the mandatory and some optional elements of the following standard: [Inside System Boundary]: TMDD Requirements (version 2.1, version 3.0, version 3.1): 3.3.4, 3.3.6	2
DH-DF-OUT-3.4.9.8	The DSS - Data Hub shall disseminate "fare and price information" to the Internal DSS Subsystems which consists of current transit, parking, and toll fee schedule information. This data flow uses the following standards; [Inside System Boundary];: TMDD Requirements: 3.3.4, 3.3.5	2
DH-DF-OUT-3.4.9.9	The DSS - Data Hub shall disseminate "toll archive data" to the Internal DSS Subsystems which consists of data indicating toll facility usage and pricing schedules. Content will include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information. This data flow uses the following standards;: [Inside System Boundary]:Transform ICD Appendix 1: "CPS – ATIS Interface" to TMDD 3.3.7	2

3.8.3 Information Publishing (Corridor Managers)

As shown in Figure 3-5 and Table 3-8, processed data will be available to all participating agencies through a regional data distribution mechanism. Participating agencies will include traffic, transit, public safety, and emergency management. Data will be shared using HTML and XML data formats. HTML data will be viewable through standard PC-based browsers, such as Internet Explorer and Mozilla Firefox. XML data will be provided for third-party applications. An XML data schema will be maintained along with XML data integration guidelines for potential application developers. In addition, information publishing will support agency personnel notification systems such as pagers, e-mail, Fax, text messaging, and instant messaging. In this manner information publishing to corridor managers differs from information publishing to corridor users, where personalized alerts and travel information are provided as revenue services by the regional 511 ISP.

Figure 3-5. Information Publishing Interface Diagram



[Source: SANDAG.]

Table 3-8. ICMS Information Publishing Requirements

Requirement ID	Description	User Need ID
BRPMS-DF-OUT-3	The ICMS shall publish traffic and transit operator information to system managers (freeway, arterial, transit, public safety, and commercial vehicles).	4
BRPMS-DF-OUT-3.1	The DSS - Business Rules and Process Management Engine shall disseminate "decision support information" to the Regional Transportation Operator (Freeway Management System, Arterial Management System, Congestion Pricing System, Ramp Management System, and Transit Management System).	4
BRPMS-DF-OUT-3.1.1	The DSS - Business Rules and Process Management Engine shall disseminate data using the following; a) Email, b) Text Message, c) Multi-Media Message (phone) d) Modal Management System Console (ATMS, RIWS, RTMS, and RIMS), e) Instant Messenger Service, f) Text-to-Speech Voice Message.	4
BRPMS-DF-OUT-3.1.1.1	The DSS - Business Rules and Process Management Engine shall disseminate an "error log message" to the operator, if the system fails the "implementation verification flag" processing.	4
BRPMS-DF-OUT-3.1.1.2	The DSS - Business Rules and Process Management Engine shall disseminate an action plan's "configuration data" [2] to the operator.	4
BRPMS-DF-OUT-3.1.1.3	The DSS - Business Rules and Process Management Engine shall disseminate "decision support information" directly to the Regional Transportation Operator to assist the operator make decisions based on the current environment.	4

Requirement ID	Description	User Need ID
BRPMS-DF-OUT-3.1.1.2.1	The DSS - Business Rules and Process Management Engine shall disseminate the graphical depictions of the "Top 3" "response plans" to the operator, with a recommendation of which is best for the corridor.	4
BRPMS-DF-OUT-3.1.1.3	The DSS - Business Rules and Process Management Engine shall disseminate an action plan to the Regional Transportation Operator, with a graphical representation of the local traffic "prediction".	4
BRPMS-DF-OUT-3.1.1.3	The DSS - Business Rules and Process Management Engine shall disseminate an "implementation request" directly to the operator.	4
BRPMS-DF-OUT-3.1.1.3.1	The DSS - Business Rules and Process Management Engine shall disseminate a request to implement an Action Plan(s) that identifies which field elements are to be controlled.	4
BRPMS-DF-OUT-3.1.1.3.2	The DSS - Business Rules and Process Management Engine shall disseminate a request to implement an Action Plan(s) that identifies which field elements are to respond to the request "automatically".	4
BRPMS-DF-OUT-3.1.1.3.3	The DSS - Business Rules and Process Management Engine shall disseminate a request to implement an Action Plan(s) that enables an operator to make "high level" changes to a group of field devices (e.g., Metering Rate, Traffic Signal Plan, and Message).	4
BRPMS-DF-OUT-3.1.1.3.4	The DSS - Business Rules and Process Management Engine shall disseminate a request that enables an operator to "save" changes for; a) this incident only, or b) all future requests for this device group.	4

Requirement ID	Description	User Need ID
BRPMS-DF-OUT-3.1.1.4	The DSS - Business Rules and Process Management Engine shall disseminate an action plan to the Regional Transportation Operator, with a graphical representation of the local traffic "forecast" of the response plan effect on congestion.	4
BRPMS-DF-OUT-3.1.1.4	The DSS - Business Rules and Process Management Engine shall disseminate "transportation information for operations" (related to event orchestration) to the DSS - Graphical User Interface.	4
BRPMS-DF-OUT-3.1.1.5	The DSS - Business Rules and Process Management Engine shall disseminate Response Plan driven "event" information to the DSS - Graphical User Interface including; a) information on diversions and alternate routes, b) closures, c) special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect.	4
BRPMS-DF-OUT-3.1.1.5.1	The DSS - Business Rules and Process Management Engine shall disseminate "event" information which shall guide Transit Operators. This information includes; a) affected routes due to incident; b) affected routes due to episodic congestion; c) downstream events and expected clearance time.	4
BRPMS-DF-OUT-3.1.1.5.2	The DSS - Business Rules and Process Management Engine shall disseminate "traffic information coordination" to the DSS - Data Hub. This includes a notification of the event, which field elements are participating in the event and highlights the event as active, and any management orchestration information (action|timing pairs).	4
BRPMS-DF-OUT-3.1.1.5.2.1	The DSS - Business Rules and Process Management Engine shall disseminate "traffic information coordination" to the DSS - Data Hub no less than every 30 seconds, and no more than every 5 minutes.	4
BRPMS-DF-OUT-3.2	The DSS - Business Rules and Process Management Engine shall disseminate "traffic control coordination" data to the DSS - Data Hub.	4

Requirement ID	Description	User Need ID
BRPMS-DF-OUT-3.2.2	The DSS – Business Rules and Process Management Engine shall disseminate "traffic control coordination" data to the Freeway Management System, Arterial Management System, and Ramp Management System.	4
BRPMS-DF-OUT-3.2.2.1	The DSS - Business Rules and Process Management Engine shall disseminate requests to the Ramp Management System to change the metering rate.	4
BRPMS-DF-OUT-3.2.2.2	The DSS - Business Rules and Process Management Engine shall disseminate requests to the Arterial Management System to change traffic signal timing plans.	4
BRPMS-DF-OUT-3.2.2.3	The DSS - Business Rules and Process Management Engine shall disseminate requests to the Freeway Management System to control the messages published to CMS signs and Highway Advisory Radio's.	4
BRPMS-DF-OUT-3.2.2.4	The DSS - Business Rules and Process Management Engine shall disseminate requests to the modal management system not less than 1 second and not more than 30 seconds after a "workflow" or "threshold" trigger has been activated.	4
BRPMS-DF-OUT-3.2.3	The DSS - Business Rules and Process Management Engine shall disseminate "traffic operator inputs" to the DSS - Response Strategy Data Store to store for later analysis.	4
BRPMS-DF-OUT-3.2.3.1	The DSS - Business Rules and Process Management Engine shall disseminate "Response Plan" implementation data (agency, response_plan_id, action_plan_id, system or operator "direct response" to an "implementation request", implementation_verification_flag, time_date sent, time_date acknowledged, time_date implemented) to the DSS - Data Hub.	4

Requirement ID	Description	User Need ID
BRPMS-DF-OUT-3.2.4	The DSS - Business Rules and Process Management Engine shall disseminate "traffic operator inputs" to the DSS - Data Hub not less than 10 seconds and not more than 30 seconds after it is received.	4
BRPMS-DF-OUT-3.2.5	The DSS - Business Rules and Process Management Engine shall disseminate a summary of how the Response Plan changed during the course of the event. This could be a reference to the series of Action Plans and a timestamp.	4
BRPMS-DF-OUT-3.3	The DSS – Business Rules and Process Management Engine, shall disseminate "archival data" related to the orchestration of a Response Plan implementation to the DSS - Response Strategy Data Store.	4
BRPMS-DF-OUT-3.3.1	The DSS - Business Rules and Process Management Engine shall disseminate all messages (System-to-User or System-to-System) used during the execution of the event without further editing.	4
BRPMS-DF-OUT-3.3.2	The DSS - Business Rules and Process Management Engine shall disseminate all messages sent, including those sent to an Operator; the time/date stamp of any control messages sent; the destination subsystem or external system; the cleartext descriptive title of the message purpose; the execution timing and reference to all workflow events; the execution timing and unique reference to all thresholds met. This data is to be used for "incident fingerprinting" at a later time.	4

3.8.4 Multi-Agency Collaboration

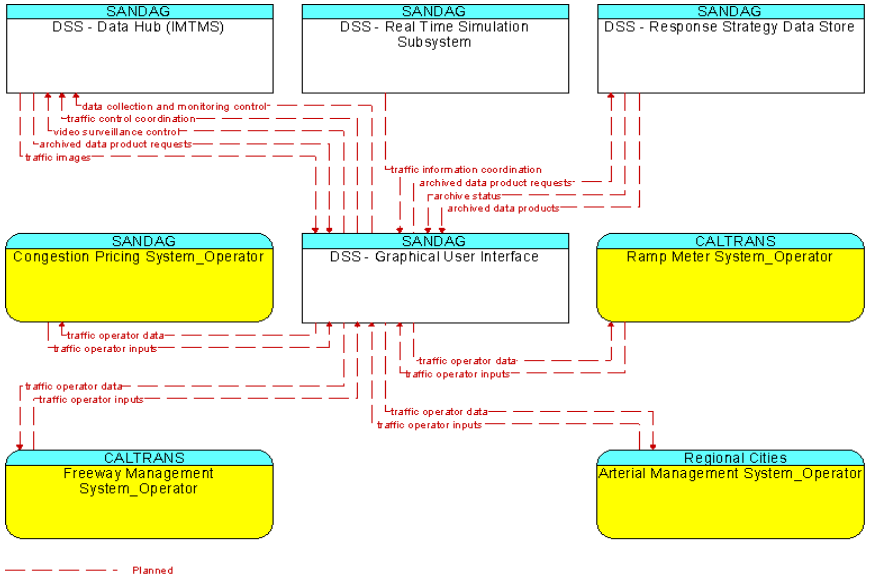
Multi-agency collaboration will provide corridor agencies with the means to share voice, video, imagery, and data collaboratively, both for routine management and for the management of major events (planned or unplanned). Multi-agency conferencing will support the concept of a virtual corridor TMC by allowing decision-makers to share data and pool their knowledge from different physical sites. This function can be supported by systems such as the San Diego region's 3Cs high-bandwidth microwave network and commercial off-the shelf collaborative communications tools.

[removed from Phase I]

3.8.5 Information Display

Information produced by ICMS and its subsystems will be displayable on workstations, large screen displays, and handheld devices. As shown in Figure 3-6 and Table 3-9, corridor information is displayed and managed through user dialogues on a browser-based workstation, an upgrade to the existing RIWS. A regional map will be manipulated by the operator for scale, management of display layers, panning, assignment of information to a large screen display, and selection of dynamic icons for viewing of field device data.

Figure 3-6. Information Display Interface Diagram



[Source: SANDAG.]

Table 3-9. ICMS Information Display Requirements

Requirement ID	Description	User Need ID
GUI-DF-IN-1	The ICMS shall, provide agency decision-makers a graphical view of corridor status.	6.2
GUI-DF-IN-1.1	The DSS - Graphical User Interface shall collect data from the DSS - Data Hub.	6.2
GUI-DF-IN-1.1.1	The DSS - Graphical User Interface shall collect data from the DSS - Data Hub both through a general subscription intended to initiate a continuous or regular data stream, and a specific request intended to initiate a one-time response from the recipient.	6.2
GUI-DF-IN-1.1.2.1	The DSS - Graphical User Interface shall collect data stored in the DSS - Road Asset Configuration and Conditions Data Store for display and modification.	6.2
GUI-DF-IN-1.1.2.1.1	The DSS - Graphical User Interface shall collect "road configuration data" for the; 1) Freeway Management System; 2) Arterial Management System; 3) Congestion Pricing System; 4) Transit Routes; 5) Express Lanes Control System;	6.2
GUI-DF-IN-1.1.2.1.2	The DSS - Graphical User Interface shall collect additional "corridor networks (1)" from the DSS - Road Asset Configuration and Conditions Data Store.	6.2

Requirement ID	Description	User Need ID
GUI-DF-IN-1.1.2.1.3	The DSS - Graphical User Interface shall collect the "traffic control coordination" data, stored in the DSS - Road Asset Configuration and Conditions Data Store.	6.2
GUI-DF-IN-1.1.2.1.4	The DSS - Graphical User Interface shall collect the "transportation information for operations" stored in the DSS - Road Asset Configuration and Conditions Data Store.	6.2
GUI-DF-IN-1.1.2.1.6	The DSS - Graphical User Interface shall collect data stored in the DSS - Road Asset Configuration and Conditions Data Store after 1 second, but before 30 seconds.	6.2
GUI-DF-IN-1.1.3.4	The DSS - Graphical User Interface shall collect data stored in the DSS - Network Prediction Subsystem after 1second, but before 30 seconds of a new prediction being available.	6.2
GUI-DF-IN-1.1.3.1	The DSS - Graphical User Interface shall collect the most current "graphical representations" and "traffic flow" data output by the DSS - Network Prediction Subsystem from the DSS - Data Hub	6.2
GUI-DF-IN-1.1.3.2	The DSS - Graphical User Interface shall collect the predicted "traffic archive data" that has been stored in the DSS - Network Prediction Subsystem, from the DSS - Data Hub. These predictions are packaged into 15 minute time slices for 60 minutes from the "beginning" period requested.	6.2
GUI-DF-IN-1.1.3.3	The DSS - Graphical User Interface shall collection data from the DSS - Network Prediction Subsystem through the DSS - Data Hub. This will support a general subscription intended to initiate a continuous or regular data stream and a specific request intended to initiate a one-time response from the recipient	6.2

Requirement ID	Description	User Need ID
GUI-DF-IN-1.1.4	The DSS - Graphical User Interface shall collect the current "personal preferences profile" and "agency profile" data stored in the DSS - Systems Management Subsystem from the DSS - Data Hub.	6.2
GUI-DF-IN-1.1.5.1	The DSS - Graphical User Interface shall collect data stored in the DSS - Response Strategy Data Store updates after 1 second, but before 30 seconds of a new strategy being made available.	6.2
GUI-DF-IN-1.1.5	The DSS - Graphical User Interface shall collect "archive data products" including "response plan" data, its associated "action plan" data, and "traffic operator inputs" where these have been stored in the DSS - Response Strategy Data Store.	6.2
GUI-DF-IN-1.1.2.1.5	The DSS - Graphical User Interface shall collect "transportation information for operations" data, "traffic control coordination" data, "toll archive information", "parking archive data", toll road "traffic archive data", "traffic archive data", "traveler archive data", and "road configuration data" from the "processed" data stored in the DSS - Road Asset Configuration and Conditions Data Store.	6.2
GUI-DF-IN-1.1.6	The DSS - Graphical User Interface shall collect "response plan" execution data from the data stored in the DSS - Business Rules and Process Management Engine updates within 1 second, but before 30 seconds of it being updated.	6.2
GUI-DF-IN-1.1.6.1	The DSS - Graphical User Interface shall collect "Response Plan Implementation Matrix" and "Action Log" data to populate a graphical representation of field assets to be included in a Response Plan's associated Action Plans from the DSS - Business Rules and Process Management Engine.	6.2
GUI-DF-IN-1.1.7	The DSS - Graphical User Interface shall collect the output of the DSS - Real-Time Simulation Subsystem updates within 1 second, but before 30 seconds a new forecast being made available.	6.2

Requirement ID	Description	User Need ID
GUI-DF-IN-1.1.7.1	The DSS - Graphical User Interface shall collect a graphical representation of the most recent forecast of "traffic archive data", "transit archive data", "toll archive data", and "parking archive data".	6.2
GUI-DF-IN-1.1.7.2	The DSS - Graphical User Interface shall collect "graphical representations" of the latest simulated "road network conditions" generated by the DSS - Real Time Simulation Subsystem.	6.2
GUI-DF-OUT-3.1	The DSS - Graphical User Interface shall disseminate control commands to select agency owned CCTV "video surveillance control".	9
GUI-DF-OUT-3.1.1	The DSS - Graphical User Interface shall disseminate "video surveillance control" commands to the DSS - Legacy CCTV Control Subsystem, which consists of the information used to configure and control video surveillance systems. This data flow uses the following standards; [Inside System Boundary]: IMTMS ICD.	9
GUI-DF-OUT-3.1.1.1	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" (i.e., Requesting Agency, Requesting User, Owning Agency, Camera ID, Streaming Request, and Snapshot Request) to the DSS - Legacy CCTV Control Subsystem.	9
GUI-DF-OUT-3.1.2	The DSS - Graphical User Interface shall disseminate "personal profile" data captured to the DSS - Systems Management Subsystem	16
GUI-DF-OUT-3.1.3	The DSS - Graphical User Interface shall disseminate "agency profile" data captured to the DSS - Systems Management Subsystem	16

Requirement ID	Description	User Need ID
GUI-DF-OUT-3.2	The ICMS shall, provide agency decision-makers selection capabilities that reflect their decisions.	6.1
GUI-DF-OUT-3.2.1	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" to the DSS - Data Hub that captures an operator's decision on a requested "Action Plan" implementation request in the "action log" stored in the DSS - Systems Management Subsystem.	10.1
GUI-DF-OUT-3.2.2	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" to the DSS - Data Hub that captures an operator's change to a "response plan" for storage in the DSS - Response Strategy Data Store.	10.1
GUI-DF-OUT-3.2.3	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" that captures an operators changes to a "process flows" for storage in the DSS - Business Rules and Process Management Engine.	10.1
GUI-DF-OUT-3.2.4	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" that captures an operator's change to an "escalation rules" for storage in the DSS - Business Rules and Process Management Engine.	10.1
GUI-DF-OUT-3.2.5	The DSS - Graphical User Interface shall disseminate "traffic operator inputs" that captures an operator's change to a "thresholds" for storage in the DSS - Business Rules and Process Management Engine.	10.1
GUI-DF-OUT-3.3	The ICMS shall, provide agency decision-makers a graphical view of corridor status.	6.2

Requirement ID	Description	User Need ID
GUI-DF-OUT-3.3.1	The DSS - Graphical User Interface shall disseminate the additions or deletions to the multimodal "network configuration" link data to the DSS - Data Hub. This data is to be stored in the DSS - Road Asset Configuration and Conditions Data Store. This data flow uses the following standards;: [Inside System Boundary]: TMDD Requirements: 3.3.5	1
GUI-DF-OUT-3.3.1.1	The DSS - Graphical User Interface shall disseminate additions on "corridor networks", "road network configuration", "toll networks", and "transit networks" data to the DSS - Data Hub, for storage in the DSS - Road Asset Configuration and Conditions Data Store.	1
GUI-DF-OUT-3.3.1.2	The DSS - Graphical User Interface shall disseminate operator additions or deletions to network link, segment or section to of Freeway, Arterial, or Congestion Pricing network to the DSS - Data Hub. This data flow shall use the following standard: [Inside System Boundary] TMDD Requirements: 3.3.5.	1
GUI-DF-OUT-3.4	The ICMS shall provide the following administrative functions; a. system wide security functions, b. data backup, c. user account management, and d. ICMS configuration data.	16
GUI-DF-OUT-3.4.1	The DSS - Graphical User Interface shall disseminate "personal preferences profile" updates to the DSS - Data Hub, for processing at the DSS - Systems Management Subsystem.	16
GUI-DF-OUT-3.4.2	The DSS - Graphical User Interface shall disseminate "system control" commands, (i.e., DSS - Data Hub externals system collection "on/off"; DSS - Data Hub external system dissemination "on/off"; DSS - Systems Management Subsystem "user access management"; DSS - Systems Management Subsystem "device access privileges") to create, update and delete subsystem functions.	16
GUI-DF-OUT-3.4.3	The DSS - Graphical User Interface shall disseminate "administrator data input" to the DSS - Data Hub, including User account information (username, password, first name, middle initial, last name, organization ID, location ID, office telephone number, mobile telephone number, e-mail address, fax number, pager number) for storage in the DSS - Systems Management Subsystem.	16

Requirement ID	Description	User Need ID
GUI-FR-2	The ICMS shall allow users and corridor managers to modify response plans.	10.1
GUI-FR-2	The ICMS shall provide users and corridor managers' response plans and allow users to modify and activate said plans. Response plans are based on current or predicted corridor status and context (i.e., temporally and spatially)	10.1
GUI-FR-2	The ICMS shall allow corridor managers to perform simulation of various traffic and service management strategies for the corridor in 'real-time'.	11.1
GUI-FR-2	The ICMS shall gauge and report the impact of these strategies on corridor performance to System Managers.	11.2
GUI-FR-2	The ICMS shall, provide agency decision-makers selection capabilities that reflect their decisions.	6.1
GUI-FR-2	The ICMS shall, provide agency decision-makers a graphical view of corridor status.	6.2
GUI-FR-2.1	The DSS - Graphical User Interface shall provide an input screen to configure how data is displayed by the DSS - Graphical User Interface.	6.1

Requirement ID	Description	User Need ID
GUI-FR-2.1.1	The DSS - Graphical User Interface shall provide an input screen for the Regional Transportation Operator to create, update, and delete data within the configuration tables.	6.1
GUI-FR-2.1.1.1	The DSS - Graphical User Interface shall provide an input screen to modify a transit vehicle icon	6.1
GUI-FR-2.1.1.1.1	The DSS - Graphical User Interface shall display on a map of the San Diego region the selection of up to a configurable number of transit fixed routes (route ID, route shape file) to be displayed on the map	6.2
GUI-FR-2.1.1.1.2	The DSS - Graphical User Interface shall provide an input screen to modify a transit vehicle icons in appearance and color based on an "on-time" status threshold (i.e., Time ahead, Time behind, On-Time)	6.1
GUI-FR-2.1.1.1.3	The DSS - Graphical User Interface shall display on a map of the San Diego region a screen to modify how a transit vehicle icon's appearance will indicate that the vehicle is behind schedule by a configurable period of time	6.2
GUI-FR-2.1.1.2	The DSS - Graphical User Interface shall display an integrated regional view of "current" and "forecast" road and traffic conditions including traffic incidents, special events, maintenance activities and other events or conditions that impact capacity or demand.	6.1
GUI-FR-2.1.1.2	The DSS - Graphical User Interface shall display on a map of the San Diego region the option of selecting the "roadway link status" parameter (volume, occupancy, speed) to be displayed	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.1.1.2.1	The DSS - Graphical User Interface shall display on a map of the San Diego region the option to display lane-by-lane "roadway link status"	6.2
GUI-FR-2.1.1.2.2	The DSS - Graphical User Interface shall display on a map of the San Diego region the option to select which "roadway link status" parameter (volume, occupancy, and speed) to be displayed globally. This parameter shall be saved in the users "personal preferences profile" in the DSS - Systems Management Subsystem.	6.2
GUI-FR-2.1.1.2.2.1	The DSS - Graphical User Interface shall provide an input screen to set a unique color and threshold configuration for multiple icons to be presented on the display and store a user's "personal preferences profile".	6.1
GUI-FR-2.1.1.2.2.2	The DSS - Graphical User Interface shall display a screen to configure the color and threshold (i.e., unavailable for 10 minutes) to use when displaying roadside equipment (i.e., CMS, VTMS, VMS, RMS, HAR, and Intersection) on the map. The color and threshold shall be configurable by the Regional Transportation Operator, and saved in the user's "personal preferences profile" in the DSS - Systems Management Subsystem.	6.1
GUI-FR-2.1.1.3	The DSS - Graphical User Interface shall display "response plan" implementation data on a map of the San Diego region	6.2
GUI-FR-2.1.1.3	The DSS - Graphical User Interface shall display on a map of the San Diego region a way to recenter the map on a user-selectable location. The user selectable location is based on a selection of either freeway intersection (freeway name / arterial off-on ramp), absolute post-mile, post mile, transit station name, transit station id, parking facility name, arterial intersection (main/cross street), toll entry/exit/plaza, or city center.	6.2
GUI-FR-2.1.1.3.1	The DSS - Graphical User Interface shall display an option to manually terminate a response plan from the DSS - Graphical User Interface by selecting it's icon on the map display.	10.1

Requirement ID	Description	User Need ID
GUI-FR-2.1.1.3.10	The DSS - Graphical User Interface shall display to the Regional Transportation Operator, the 2 dimensional graphic showing those assets affected by the "active response plan" when requested.	6.2
GUI-FR-2.1.1.3.11	The DSS - Graphical User Interface shall display to the Regional Transportation Operator, the 2 dimensional graphic showing potential "rerouting" opportunities for broadcast.	6.2
GUI-FR-2.1.1.3.2	The DSS - Graphical User Interface shall display an interface that graphically summarizes the "status" data collected from the DSS - Business Rules and Process Management Engine. It displays the field elements that are part of a Response Plan.	6.2
GUI-FR-2.1.1.3.4	The DSS - Graphical User Interface shall display on a map of the San Diego region, those field assets that are participating in an active response plan.	6.2
GUI-FR-2.1.1.3.5	The DSS - Graphical User Interface shall display distinct icons for those field assets currently queued and ready to participate in an active response plan, and enable the operator to distinguish whether the asset is waiting for approval or threshold conditions to be met.	6.2
GUI-FR-2.1.1.3.6	The DSS - Graphical User Interface shall display distinct icons for those field assets participating in an active response plan, and enable the operator to distinguish whether an asset is currently under coordinated control.	6.2
GUI-FR-2.1.1.3.7	The DSS - Graphical User Interface shall display the set of recommended control requests, or action plans - tailored to a single modal management system (e.g., Ramp Meter Information System, 511) and jurisdictions - received from the DSS - Real Time Simulation Subsystem at the completion of the latest simulation run.	10.1

Requirement ID	Description	User Need ID
GUI-FR-2.1.1.3.7	The DSS - Graphical User Interface shall display on a map of the San Diego region a way to zoom in and out. This must be able to be controlled through the wheel of a standard desktop mouse, and by using specific keyboard "shortcut" keys.	6.2
GUI-FR-2.1.1.3.7.1	The DSS - Graphical User Interface shall display the current modal recommended "Action Plan" based on the evaluation of "Response Plans" modeling by the DSS - Real Time Simulation Subsystem.	6.1
GUI-FR-2.1.1.3.7.2	The DSS - Graphical User Interface shall display on a map of the San Diego region, a distinctive icon that conveys whether a field device is participating in a single action plan or multiple action plans.	6.2
GUI-FR-2.1.1.3.8	The DSS - Graphical User Interface shall display the details of the action plans that a field device is participating in (i.e., a single action plan or multiple action plans).	6.2
GUI-FR-2.1.1.3.8.1	The DSS - Graphical User Interface shall display on a map of the San Diego region all active Planned Events, and all active Action Plans that are part of a distinct Response Strategy.	10.1
GUI-FR-2.1.1.3.8.2	The DSS - Graphical User Interface shall display an interface that graphically summarizes what field elements have "been requested" to join a Response Plan from the DSS - Business Rules and Process Management Engine	6.2
GUI-FR-2.1.1.3.8.3	The DSS - Graphical User Interface shall display an interface that graphically summarizes what field elements have "successfully" joined a Response Plan from the DSS - Business Rules and Process Management Engine	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.1.1.3.8.4	The DSS - Graphical User Interface shall display an interface that graphically summarizes what field elements have “not successfully" joined a Response Plan from the DSS - Business Rules and Process Management Engine.	6.2
GUI-FR-2.1.1.3.8.5	The DSS - Graphical User Interface shall provide a method that allows the operator to manually initiate a DSS - Real Time Simulation System recommendation for a Response Plan to support events where the DSS - Network Prediction Subsystem has not identified a network imbalance from the DSS - Graphical User Interface.	10.1
GUI-FR-2.1.1.3.9	The DSS - Graphical User Interface shall display to the Regional Transportation Operator, the 2 dimensional graphic for each of the "response plans" simulated when requested.	6.2
GUI-FR-2.1.1.4	The DSS - Graphical User Interface shall display on a map of the San Diego region an operator-configurable menu bar. The operator must be able to select specific map layers to be displayed The DSS - Graphical User Interface shall display on a map of the San Diego region the following selectable layers; (1) Roadways & Freeways; (2) Transit; (3) CMS; (4) Arterial Signalized Intersections; (5) CCTV; (6) Toll Plazas; (7) BRT Stations; (8) Park and Ride Lots; (9) Ramp Meters, and (10) Transit Routes and Stops. These layers must be capable of being displayed alone and in conjunction with all other layers. (including "all")	6.2
GUI-FR-2.1.2.2	The DSS - Graphical User Interface shall provide an input screen to configure data stored in the DSS - Road Asset Configuration and Conditions Data Store.	6.1
GUI-FR-2.1.2.2.11	The DSS - Graphical User Interface shall provide an input screen to add a network link, segment and section to the Freeway, Arterial, or Congestion Pricing network manually and have it stored in the DSS - Road Asset Configuration and Conditions Data Store.	6.1

Requirement ID	Description	User Need ID
GUI-FR-2.1.2.2.12	The DSS - Graphical User Interface shall provide an input screen to delete a network link, segment and section to the Freeway, Arterial, or Congestion Pricing network manually.	6.1
GUI-FR-2.1.2.3	The DSS - Graphical User Interface shall provide an input screen to configure data that is stored in the DSS - Response Strategy Data Store.	10.1
GUI-FR-2.1.2.3.1	The DSS - Graphical User Interface shall provide a screen that compares DSS - Response Strategy Data Store captured configuration data for a field asset against the current operation parameters (status, plan/message/rate) of the device received from the DSS - Data Hub, and highlights the differences.	10.1
GUI-FR-2.1.2.4	The DSS - Graphical User Interface shall provide an input screen to configure data that is stored in the DSS - Systems Management Subsystem.	6.1
GUI-FR-2.1.2.4.1	The DSS - Graphical User Interface shall provide an input screen that sets "global" display parameters.	6.1
GUI-FR-2.1.2.5.1	The DSS - Graphical User Interface shall provide an input screen for the System Administrator to control the enabling and disabling of data acquisition and data publishing from and to external systems.	16
GUI-FR-2.1.2.7	The DSS - Graphical User Interface shall provide an input screen to configure "administrator input" data stored in the DSS - Legacy CCTV Subsystem.	9

Requirement ID	Description	User Need ID
GUI-FR-2.1.2.8	The DSS - Graphical User Interface shall provide an input screen to configure "administrator input" data that is stored in the DSS - Legacy CCTV Subsystem.	9
GUI-FR-2.1.2.9	The DSS - Graphical User Interface shall provide an input screen that sets security parameters for all users and systems.	6.1
GUI-FR-2.2.1.2	The DSS - Graphical User Interface shall provide an input screen to modify the rules and process flows as part of response plan and stored in the DSS - Business Rules and Process Management Engine.	10.1
GUI-FR-2.2.1.2	The DSS - Graphical User Interface shall display user interfaces to create/update or modify the content of the internal systems including the DSS - Business Rules and Process Management Engine, the DSS - Response Strategy Data Store, the DSS - Real Time Simulation Subsystem, the DSS - Systems Management Subsystem, the DSS - Network Prediction Subsystem, and the DSS – Data Hub;	10.1
GUI-FR-2.2.1.2.1	The DSS - Graphical User Interface shall provide an input screen to configure the DSS - Business Rules and Process Management Engine rules for which "contacts" an Action Plan should be approved by; which "contacts" it should notify during execution.	10.1
GUI-FR-2.2.1.2.1.1	The DSS - Graphical User Interface shall provide an input screen for capturing the operator selected "maximum" number of multiple transit vehicles (icon, bus ID, block ID) to be displayed on the visible map at the same time. This parameter shall be saved in the user's "personal preferences profile" in the DSS - Systems Management Subsystem.	6.1
GUI-FR-2.2.1.2.1.2	The DSS - Graphical User Interface shall provide an input screen to configure a workflow that defines multiple contacts (i.e., person or position). The contact information captured will conform to the TMDD mandatory & optional fields for Requirement: 3.3.3	10.1

Requirement ID	Description	User Need ID
GUI-FR-2.2.1.2.1.3	The DSS - Graphical User Interface shall provide an input screen to configure the DSS - Business Rules and Process Management Engine's definition of a "successful Action Plan implementation".	10.1
GUI-FR-2.2.1.2.2	The DSS - Graphical User Interface shall provide an input screen to capture "traffic operator inputs" in the form of a work flow for a set of agency owned devices.	10.1
GUI-FR-2.2.1.2.2.1	The DSS - Graphical User Interface shall provide an input screen to configure a workflow that includes; location and time based parameters related to when a specific "class" of field assets, or specific assets themselves are added to a workflow	10.1
GUI-FR-2.2.1.2.2.2	The DSS - Graphical User Interface shall provide an input screen to configure a workflow that defines a multiple-contact (i.e., person or position) hierarchy to be used as entry point's into an organization during the coordination of an incident.	10.1
GUI-FR-2.2.1.2.2.2.1	The DSS - Graphical User Interface shall provide an input screen to configure a workflow that defines a time based thresholds needing to be satisfied before an escalation pathway is followed.	10.1
GUI-FR-2.2.1.2.2.4	The DSS - Graphical User Interface shall provide an input screen to capture the following time based thresholds associated with escalating a request within a workflow; 1) Respond to notification; 2) "Confirm" action request - implement request; 3) "Confirm" action request - no response; 4) "Confirm" action request - decline; 6) "Request No-Bounce" time out;	10.1
GUI-FR-2.2.1.2.2.5	The DSS - Graphical User Interface shall provide Action Plan data entry screen should present the operator with device configuration (e.g., CMS Message Library, Signal Timing Plan, Ramp Metering Rate) and a field to attach a specific "textual" tag (Action Plan-3, Response Plan-1) notes to the specific configuration. This is to aid an operator in identifying specific device configurations usage, such that an operator's ability to recall the specific reasoning for configuration is retained within the system.	10.1

Requirement ID	Description	User Need ID
GUI-FR-2.2.1.2.2.6	The DSS - Graphical User Interface shall provide an input screen to configure a device or class of devices for a specific Action Plan.	10.1
GUI-FR-2.2.1.2.2.6.1	The DSS - Graphical User Interface shall provide an input screen to display the existing CCTV "inventory configuration", including, but not limited to; cctv-camera-tilt-down-limit, cctv-requests-supported, cctv-image-list, cctv-titling-text, node-id, cctv-camera-type, cctv-camera-pan-left-limit, cctv-camera-tilt-up-limit, device-inventory-header, cctv-camera-zoom-limit, cctv-camera-focus-limit, cctv-came from the DSS - Data Hub.	10.1
GUI-FR-2.2.1.2.2.6.2	The DSS - Graphical User Interface shall display Detector "inventory configuration", including, but not limited to; detection-lanes, vehicle-classification-bin2, link-direction, vehicle-classification-bin3, vehicle-classification-bin1, is-detector-speed-trap-flag, node-id, link-name, detector-type, detector-inventory-header, vehicle-classification-bin4 from the DSS - Data Hub and enable the operator to configure the device (both spatially, temporally, and with specific parameters) to participate in a specified RESPONSE PLAN.	10.1
GUI-FR-2.2.1.2.2.6.3	The DSS - Graphical User Interface shall display Digital Message Sign "inventory configuration", including, but not limited to; dms-color-scheme, charWidthPixels, dms-multi-tag-support, charHeightPixels, restrictions, device-inventory-header, dms-sign-type, link-direction, signTechnology, signHeightPixels, signWidthPixels, dms-vertical-border, signWidth, dms-max-message-length, dm from the DSS - Data Hub and enable the operator to configure the device (both spatially, temporally, and with device specific parameters) to participate in a specified RESPONSE PLAN.	10.1
GUI-FR-2.2.1.2.2.6.4	The DSS - Graphical User Interface shall display Express Lanes Control System "inventory configuration" data to the Congestion Pricing System Operator, including, but not limited to; controlled-lane-number, link-id, device-inventory-header, restrictions, link-lane-count enabling the operator to configure the device (both spatially, temporally, and with specific parameters) to participate in a specified RESPONSE PLAN.	10.1
GUI-FR-2.2.1.2.2.6.5	The DSS - Graphical User Interface shall display Highway Advisory Radio "inventory configuration", including, but not limited to; har-call-sign, restrictions, device-inventory-header, device-beacon, har-characteristics, har-frequency-description from the DSS - Data Hub and enable the operator to configure the device (both spatially, temporally, and with device specific	10.1

Requirement ID	Description	User Need ID
	parameters) to participate in a specified RESPONSE PLAN.	
GUI-FR-2.2.1.2.2.6.7	The DSS - Graphical User Interface shall display Intersection Signal Timing Pattern "inventory configuration" data to the Arterial Management System Operator, including, but not limited to; last-update-time, timing-pattern-name, plan-mode, offset-time, cycle-time, timing-pattern-id, device-id, organization-information, organization-information, restrictions enabling the operator to configure the device (both spatially, temporally, and with specific parameters) to participate in a specified RESPONSE PLAN.	10.1
GUI-FR-2.2.1.2.2.6.8	The DSS - Graphical User Interface shall display Ramp Meter Inventory and, Ramp Meter Plan "inventory configuration" data to the Ramp Management System Operator, including, but not limited to; device-inventory-header, ramp-meter-number-list, firmware, firmware-version, restrictions and, restrictions, device-id, meter-plan-id, occupancy-threshold, organization-information, speed-threshold, last-update-time, organization-information, meter-rate, flow-rate-threshold enabling the operator to configure the device (both spatially, temporally, and with specific parameters) to participate in a specified RESPONSE PLAN.	10.1
GUI-FR-2.2.1.2.2.6.9	The DSS - Graphical User Interface shall display Route "inventory configuration" data , including, but not limited to; network-id, route-url, route-node-id-list, route-length, alternate-route-name-list, route-name, route-type, route-link-id-list, network-name, last-update-time, route-id thereby enabling a Regional Transportation Operator to add and configure a section of roadway to participate in a specific RESPONSE PLAN, with that Route's inclusion having both spatial, temporal, significance in congestion mitigation strategies.	10.1
GUI-FR-2.2.1.2.2.7	The DSS - Graphical User Interface shall provide an input screen to configure the sequence in which commands to adjust current traffic control strategies (e.g., adjust signal timing plans, change DMS messages) should be issued to field control systems.	10.1
GUI-FR-2.2.1.2.3	The DSS - Graphical User Interface shall provide an input screen to select a "contact" for use during implementation of a Response Plan. This detail would include a participating agency location information (organization, location, street address, city, county, state, zip9, primary phone #, fax #, latitude and longitude)	6.1

Requirement ID	Description	User Need ID
GUI-FR-2.2.1.2.3	The DSS - Graphical User Interface shall provide an input screen to configure Response Plans that are made up of multiple, escalating "Action Plans".	10.1
GUI-FR-2.2.1.2.3.1	The DSS - Graphical User Interface shall provide screen that enables an Operator to make requests for information on "Historical Response Plan / Action Plan" configuration details (e.g., inventory, schedules, patterns, library)	10.1
GUI-FR-2.2.3	The DSS - Graphical User Interface shall display a portal interface to the Performance Measurement System for a Regional Transportation Operator to view "Historical Performance" data.	11.2
GUI-FR-2.2.3.1	The DSS - Graphical User Interface shall display a view of the Performance Measurement System (PEMS). This will enable the operator to track the "long-term" operating data for use in the long-term cyclically analysis of corridor and stakeholder performance...	11.2
GUI-FR-2.2.3.2	The DSS - Graphical User Interface shall display in a user screen that is hosted (or perhaps portal based), a view of the Performance Measurement System (PEMS). This will enable the operator to track performance metrics on the corridor in "near real-time".	11.2
GUI-FR-2.3.1	The DSS - Graphical User Interface shall display a screen to a system administration to control the functions provided by the DSS - Systems Management Subsystem.	16
GUI-FR-2.3.1.1	The DSS - Graphical User Interface shall provide an provide an input screen to allow an operator to edit "traffic control coordination" device access rules in the DSS - Systems Management Subsystem	16

Requirement ID	Description	User Need ID
GUI-FR-2.3.1.1.1	The DSS - Graphical User Interface shall provide and provide an input screen to enable an operator to configure rules controlling device access at either the Agency, Class (of device), or Device specific levels and associated with either a specific operator, group, or agency.	16
GUI-FR-2.3.1.1.2	The DSS - Graphical User Interface shall provide an input screen to allow an operator to edit ITS device access rules for use of "motorist information devices" (CMS, HAR) captured in the DSS - Systems Management Subsystem	16
GUI-FR-2.3.1.2	The DSS - Graphical User Interface shall verify validate that an operator is able to access the DSS - Legacy CCTV Control Subsystem, and which cameras are currently accessible.	16
GUI-FR-2.3.1.3	The DSS - Graphical User Interface shall provide an input screen of cctv "access rights" for a user to create/update/delete records consisting of; camera id, owning agency, access level (i.e., (1) view snapshot; (2) view live stream; (3) view archive footage; (4) no access).	9
GUI-FR-2.3.1.3	The DSS - Graphical User Interface shall display a screen that supports the capability for the system administrator to "monitor and control" the information collection (i.e., DSS - Data Hub) service specified within the DSS - Systems Management Subsystem	16
GUI-FR-2.3.1.3.1	The DSS - Graphical User Interface shall display a screen that provides access to the "audit log" in the DSS - Systems Management Subsystem.	16
GUI-FR-2.3.1.3.2	The DSS - Graphical User Interface shall display a screen to the Systems Administrator to view system user logons and logoffs	16

Requirement ID	Description	User Need ID
GUI-FR-2.3.1.4	The DSS - Graphical User Interface shall display a screen to the user that makes all documentation stored within the DSS - Systems Management Subsystem accessible on-line including the; 1) Configuration Management Records (CM Plan, records, CCB minutes); 2) System Development Documentation (ConOps, SysReqs, System Architecture, Software Development Plan, System Release Notes); 3) Interface Control Documents (FMS, AMS, ELCS, RMIS, LCS, CPS, TMS, AMTTS, REMS, Weather); 4) Deployment Documentation (Test Plans, Test Procedures, Test Report, Installation Plans, Cutover Plan); 5) System Operator Manuals (modal specific); 6) Training Presentations; 7) External User Operations Manual;	16
GUI-FR-2.4	The DSS - Graphical User Interface shall display a modal dialog to enter event supplementary details (lane blockage, number of vehicles, injuries, fatalities, property damage, estimated clearance time, estimated queue length, ID of responding units) where an agency considers CORRIDOR information missing.	6.1
GUI-FR-2.4.1	The DSS - Graphical User Interface shall display data on a map of the San Diego region.	6.2
GUI-FR-2.4.1.1	The DSS - Graphical User Interface shall display on a map of the San Diego region the following selectable layers; (1) Roadways & Freeways; (2) Transit; (3) CMS; (4) Arterial Signalized Intersections; (5) CCTV; (6) Toll Plazas; (7) BRT Stations; (8) Park and Ride Lots; (9) Ramp Meters, and (10) Transit Routes and Stops. These layers must be capable of being displayed alone and in conjunction with all other layers.	6.2
GUI-FR-2.4.1.10	The DSS - Graphical User Interface shall display "traffic operator data" including traffic conditions, current operating status of field equipment, maintenance activity status, incident status, video images, security alerts, and response plan updates. This data keeps the operator apprised of current road network status, provides feedback to the operator as traffic control actions are implemented, provides transportation security inputs, and supports review of historical data and preparation for future traffic operations activities.	6.2
GUI-FR-2.4.1.11	The DSS - Graphical User Interface shall display future planned events as a distinctive icon set	6.1

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.11.1	The DSS - Graphical User Interface shall display event information records for special events received from external agencies	6.1
GUI-FR-2.4.1.11.5	The DSS - Graphical User Interface shall display the complete set of details of an event information record for planned lane closures.	6.1
GUI-FR-2.4.1.11.6	The DSS - Graphical User Interface shall display - on the map - an alert for each new external incident report received from DSS - Data Hub as an icon	6.1
GUI-FR-2.4.1.11.6.1	The DSS - Graphical User Interface shall display - on the map - an alert for each new external incident report received from DSS - Data Hub as a "rolling" text description	6.1
GUI-FR-2.4.1.2	This DSS - Graphical User Interface shall display "advisory data" from the Freeway Management System, the Transit Management System, and the Regional Event Management System	6.2
GUI-FR-2.4.1.2.1	The DSS - Graphical User Interface shall display " all event classes (incidents, planned events, emergency closures, lane closures) using distinctive icons	6.2
GUI-FR-2.4.1.2.1.1	The DSS - Graphical User Interface shall display UNCONFIRMED events on the map display as a distinctive icon	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.2.1.2	The DSS - Graphical User Interface shall display CONFIRMED events on the map display as a distinctive icons	6.2
GUI-FR-2.4.1.2.1.3	The DSS - Graphical User Interface shall display active planned events on the map as a distinctive icon set	6.2
GUI-FR-2.4.1.2.1.4	The DSS - Graphical User Interface shall display future planned events as a distinctive icon set	6.2
GUI-FR-2.4.1.2.1.5	The DSS - Graphical User Interface shall display on a map of the San Diego region the details of an event from the DSS - Data Hub in a mouse-over window when the operator hovers over an Incident icon.	6.2
GUI-FR-2.4.1.2.2	The DSS - Graphical User Interface shall display on a map of the San Diego region current system data (sensor data, event data, field device data) in response to operator selection of a dynamic icon	6.2
GUI-FR-2.4.1.2.2.1	The DSS - Graphical User Interface shall display on a map of the San Diego region system summary data (field devices, events) in user dialog windows	6.2
GUI-FR-2.4.1.4	The DSS - Graphical User Interface shall display "parking information" from the DSS - Data Hub	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.5	The DSS - Graphical User Interface shall display "transit data" on a map of the San Diego region.	6.2
GUI-FR-2.4.1.5.1	The DSS - Graphical User Interface shall display on a map of the San Diego region a transit vehicle icon that indicates the vehicle has an active emergency alarm condition	6.2
GUI-FR-2.4.1.5.2	The DSS - Graphical User Interface shall display on a map of the San Diego region a transit vehicle icon's appearance to indicate that the vehicle is off-route by a configurable distance	6.2
GUI-FR-2.4.1.5.3	The DSS - Graphical User Interface shall display on a map of the San Diego region the last known position of selected transit vehicles.	6.2
GUI-FR-2.4.1.5.4	The DSS - Graphical User Interface shall display on a map of the San Diego region the last known position of selected transit vehicles.	6.2
GUI-FR-2.4.1.5.5	The DSS - Graphical User Interface shall display on a map of the San Diego region transit data (routes, route ID, bus locations, bus ID, schedule adherence, off route, emergency alarm) to enable the operator to identify transit vehicles in the corridor	6.2
GUI-FR-2.4.1.5.6	The DSS - Graphical User Interface shall display on a map of the San Diego region transit data (routes, route ID, bus locations, bus ID, schedule adherence, off route, emergency alarm)	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.5.7	The DSS - Graphical User Interface shall display on a map of the San Diego region a transit vehicle icon's appearance that changes to indicate that the vehicle is "on-time" status with respect to the schedule.	6.2
GUI-FR-2.4.1.5.8	The DSS - Graphical User Interface shall display on a map of the San Diego region the current positions of multiple transit vehicles (icon, bus ID, block ID, schedule adherence) on the map at a single point in time	10.1
GUI-FR-2.4.1.6	The DSS - Graphical User Interface shall display "freeway data" on a map of the San Diego region.	6.2
GUI-FR-2.4.1.7	The DSS - Graphical User Interface shall display roadside equipment (CMS, variable toll message sign (VTMS), video management subsystem (VMS), Ramp Management System (RMS), highway advisory radio (HAR), signalized intersection) status on the map.	6.2
GUI-FR-2.4.1.7.1	The DSS - Graphical User Interface shall display on a map of the San Diego region roadside equipment's (CMS, variable toll message sign (VTMS), video management subsystem (VMS), Ramp Management System (RMS), highway advisory radio (HAR), signalized intersection) current status on the map	6.2
GUI-FR-2.4.1.7.1.1	The DSS - Graphical User Interface shall display on a map of the San Diego region the current CMS message when the operator selects the icon for that device	6.2
GUI-FR-2.4.1.7.1.2	The DSS - Graphical User Interface shall display on a map of the San Diego region the current managed lanes DMS message when the operator points to the icon for that device	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.7.1.3	The DSS - Graphical User Interface shall display on a map of the San Diego region the current ramp meter data (status, metering rate, queue length) when the operator points to the icon for that device	6.2
GUI-FR-2.4.1.7.1.4	The DSS - Graphical User Interface shall display on a map of the San Diego region the current signal system information (alarms, phasing, coordinated operations status) when the operator points to a signal icon	6.2
GUI-FR-2.4.1.7.1.5	The DSS - Graphical User Interface shall display on a map of the San Diego region the current VTMS toll rate message when the operator selects the icon for that device	6.2
GUI-FR-2.4.1.7.1.6	The DSS - Graphical User Interface shall display on a map of the San Diego region the current HAR message when the operator selects the icon for that device	6.2
GUI-FR-2.4.1.8	The DSS - Graphical User Interface shall display CCTV video (streaming, archived clips, snapshots)	6.2
GUI-FR-2.4.1.8.1	The DSS - Graphical User Interface shall display on a map of the San Diego region a maximum of four simultaneous camera views at any point in time.	6.2
GUI-FR-2.4.1.8.2	The DSS - Graphical User Interface shall display video snapshots in a mouse-over window when the operator hovers over a CCTV icon.	6.2

Requirement ID	Description	User Need ID
GUI-FR-2.4.1.9	The DSS - Graphical User Interface shall display a base map of the County of San Diego, centered on the I-15 corridor and adjacent areas.	6.2
GUI-FR-2.4.1.9.1	The DSS - Graphical User Interface shall display on a map of the San Diego region a way for the operator to be able to "slip" the map on a 2 dimensional plane.	6.2
GUI-FR-2.4.1.9.10	The DSS - Graphical User Interface shall display on a map of the San Diego region dynamic icons overlaid on the base map.	6.2
GUI-FR-2.4.1.9.14	The DSS - Graphical User Interface shall display on a map of the San Diego region dialog windows for configuring the selections monitoring and control functions in response to selection of dynamic icons. (e.g., Pop-up menus)	6.2
GUI-FR-2.4.1.9.2	The DSS - Graphical User Interface shall display on a map of the San Diego region an ability to continuously pan the map by using the mouse.	6.2
GUI-FR-2.4.1.9.3	The DSS - Graphical User Interface shall display on a map of the San Diego region an interface built based on Google Maps, including the ability to "import" and "export" current map view in a Google standard format for portability to other systems.	6.2
GUI-FR-2.4.3.1	The DSS - Graphical User Interface shall display "parking facility availability" as an icon with three colors that correspond to the amount of remaining capacity. The color and threshold is configurable by the Regional Transportation Operator.	6.1

Requirement ID	Description	User Need ID
GUI-FR-2.5.1	The DSS - Graphical User Interface shall display a record for each new incident received.	6.1
GUI-FR-2.5.1.1	The DSS - Graphical User Interface shall display an area on the main screen where a rolling list of regionally initiated events is displayed in near-real-time.	6.1
GUI-FR-2.5.1.2	The DSS - Graphical User Interface shall display a notification that an incident has been removed from active incident list	6.1
GUI-FR-2.5.1.3	The DSS - Graphical User Interface shall provide an input screen to enable them to select a filter for display of future planned events. The filter includes options to display events by location, time, or type of event.	6.1
GUI-FR-2.6.1	The DSS - Graphical User Interface shall provide a user interface that allows access directly to the graphical user interface of another internet delivered external system.	13
GUI-FR-2.7.1	The DSS - Graphical User Interface shall display on a map of the San Diego region, the current output of the DSS - Network Prediction Subsystem prediction. The Operator should be able to alter the timescale on the presented prediction by 15 minute lots, up to 60 minutes from the last prediction execution run. The Operator must be able to "pin" the current prediction data by opening it in a new static screen.	6.1
GUI-FR-2.9.2	The DSS - Graphical User Interface shall display an Action Log from the DSS - Business Rules and Process Management Engine to enable an operator to review all response plan-generated action plans. The Action Log is grouped by Response Plan, Action Plan, Modal Operator, and Field Asset. The Action Log uses highlighting to display real-time action plan requests that have been sent to a Regional Transportation Operator for "manual" approval where that approval is	6.1

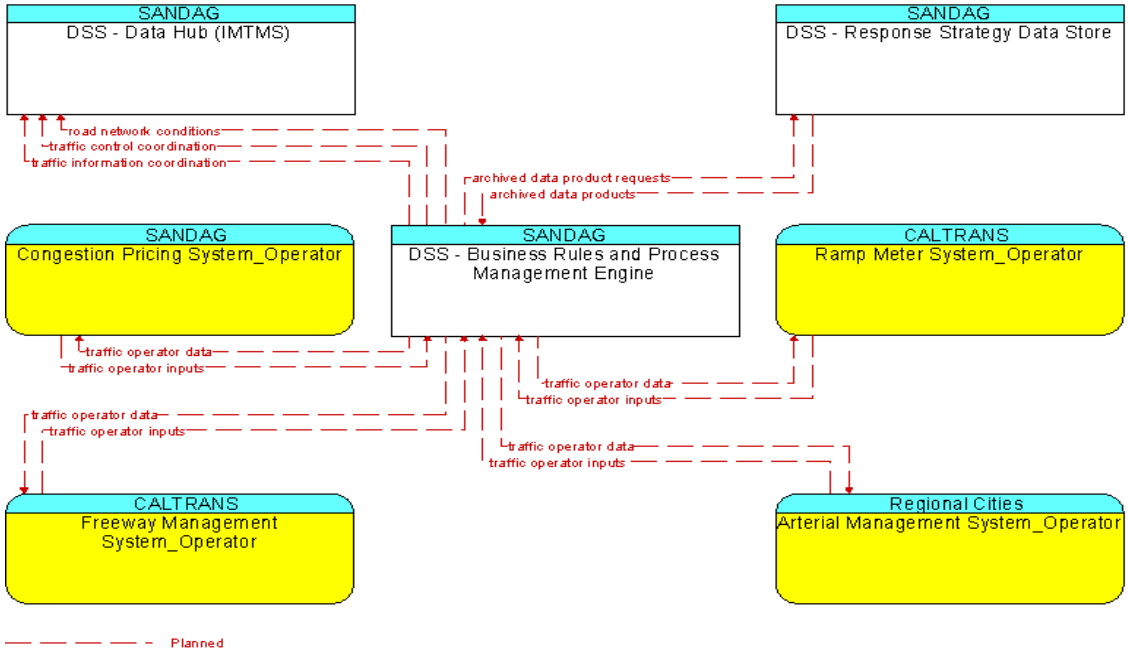
Requirement ID	Description	User Need ID
	received, denied, received with a change, or where a response has not be received within the agreed threshold.	
GUI-FR-2.9.2.1	The DSS - Graphical User Interface shall display an Action Log grouped by Response Plan, Action Plan, Modal Operator, and Field Asset.	6.1
GUI-FR-2.9.2.2	The DSS - Graphical User Interface shall display an Action Log to highlight and display real-time action plan requests that have been sent to a Regional Transportation Operator for approval.	6.1
GUI-FR-2.9.2.2.1	The DSS - Graphical User Interface shall display an Action Log where approval has been received, denied, received with a change, or where a response has not been received within the agreed threshold.	6.1
GUI-FR-2.9.3	The DSS - Graphical User Interface shall display an Action Log including, but not limited to; restrictions, action-type, action-description, action-time, event-id, action-log-element-id from the DSS - Business Rules and Process Management Subsystem to review all response plan-generated action plans	6.1
GUI-DF-IN-1.1.7.3	The DSS - Graphical User Interface shall collect a "graphical representation" of the latest simulated "transit" rerouting forecast to avoid an incident.	6.2
GUI-DF-IN-1.1.7.4	The DSS - Graphical User Interface shall collect the "performance measures" (mobility, reliability, emissions) output from the DSS - Real Time Simulation Subsystem	6.2

Requirement ID	Description	User Need ID
GUI-DF-IN-1.1.8	The DSS - Graphical User Interface shall collect from the Regional Transportation Operator a configurable parameter for "saturation threshold" for use by the DSS - Network Prediction Subsystem; This parameter is customizable by owning agency to modify how detection of imbalances is calculated in the corridor network.	6.2
GUI-DF-IN-1.1.9	The DSS - Graphical User Interface shall collect "archive data products" from the DSS - Data Hub including "transportation information for operations" data, "traffic control coordination" data, current and forecasted "road network conditions", "weather information", "transportation information for operations", "toll archive information", "parking archive data", toll road "probe archive data", "traffic archive data", "traveler archive data", "road configuration data", "response plan" execution data, and "traffic operator inputs".	6.2

3.8.6 Transportation Incident Management

Based on the receipt of non-recurring incident information from all sources (Mobile 911, callbox, CCTV, road crews, Traffic Officers, etc.), the ICMS will provide the capability to manage the complete life cycle of an event across multiple agencies. As shown in Figure 3-7 and Table 3-10, this includes the ability to: create and terminate events by agency; split one event into multiple events; merge multiple events into one event; and transfer an event from one agency to another. “Transfer” in this context means to transfer responsibility for event management. Event Management differs from the REMS subsystem of IMTMS in that the REMS subsystem collects the data via defined interfaces while Event Management provides functionality to manage event life cycles.

Figure 3-7. Transportation Incident Management Interface Diagram



[Source: SANDAG.]

Table 3-10. ICMS Transportation Incident Management Requirements

Requirement ID	Description	User Need ID
BRPMS-DF-IN-1	The DSS - Business Rules and Process Management Engine shall collect the data required to orchestrate the implementation of a Response Plan.	10.1
BRPMS-DF-IN-1.1	The DSS - Business Rules and Process Management Engine shall collect "agency profile" and "personal preferences profile" data from the DSS - Systems Management Subsystem.	16
BRPMS-DF-IN-1.1.1	The DSS - Business Rules and Process Management Engine shall collect permissions data for an agency and or operator. These permissions control what an agency operator is able to manage with respect to manually implementing Response Plans across multiple modes, jurisdictions and agencies.	16
BRPMS-DF-IN-1.1.2	The DSS – Business Rules and Process Management Engine shall collect "personal preferences profile" data from the DSS - System Management Subsystem. The profile information related to the operator's selected level of "control automation" desired will be used to control a Response Plan implementation	16
BRPMS-DF-IN-1.2	The DSS – Business Rules and Process Management Engine shall collect the predefined Response Plans stored in the DSS - Response Strategy Data Store.	10.1
BRPMS-DF-IN-1.2.1	The DSS - Business Rules and Process Management Engine shall collect "traffic control coordination" data from the DSS - Data Hub to support remote monitoring and control of traffic management devices (e.g., signs, sensors, signals, cameras, ramps, etc.).	10.1

Requirement ID	Description	User Need ID
BRPMS-DF-IN-1.2.1.1	The DSS - Business Rules and Process Management Engine shall collect the "Device Control Response" acknowledgement from the DSS - Data Hub.	10.1
BRPMS-DF-IN-1.2.2	The DSS - Business Rules and Process Management Engine shall collect "traffic operator inputs" from the Freeway Management System Operator, which consists of commands to adjust current traffic control strategies (e.g., CMS Message Sign text, distance from Incident location to include assets).	10.1
BRPMS-DF-IN-1.2.2.1	The DSS - Business Rules and Process Management Engine he shall collect "traffic operator inputs" from the Arterial Management System Operator, which commands to adjust current traffic control strategies (e.g., adjust signal timing plans, distance from the incident location to include assets).	10.1
BRPMS-DF-IN-1.2.2.2	The DSS - Business Rules and Process Management Engine he shall collect "traffic operator inputs" from the Congestion Pricing System Operator, which consists of confirmation of a Tolling "Change" Event (e.g., "Close Lanes", "Reopen Lanes")	10.1
BRPMS-DF-IN-1.2.2.3	The DSS - Business Rules and Process Management Engine he shall collect "traffic operator inputs" from the Ramp Management System Operator, which consists of commands to adjust current traffic control strategies (e.g., Metering Rates).	10.1
BRPMS-DF-IN-1.3	The DSS - Business Rules and Process Management Engine shall collect and store from the DSS - Graphical User Interface, the business rules and workflows for evaluating Response Plans when they are recommended by the DSS - Real Time Simulation Subsystem.	10.1
BRPMS-DF-IN-1.3.1	The DSS - Business Rules and Process Management Engine shall collect rules that result in; (1) Assets being disregarded from the workflow; (2) Escalating the Notification Request to Operations Management teams within each organization; (3) Cancel ICM Event with Notification's sent of "Failure to Enact".	10.1

Requirement ID	Description	User Need ID
BRPMS-DF-IN-1.3.1.1	The DSS - Business Rules and Process Management Engine shall collect a list of contact:system:time pairs (i.e., Who to contact in order to control what system at what time) to be used to orchestrate management of an incident or event.	10.1
BRPMS-DF-IN-1.3.1.2	The DSS - Business Rules and Process Management Engine shall collect all Response Plan | Action Plan implementation workflows from the DSS - Graphical User Interface.	10.1
BRPMS-DF-IN-1.3.1.2.1	The DSS - Business Rules and Process Management Engine shall collect the sequential phasing of Action Plans. This phasing is intended to enable the operator to derive a cumulative benefit in controlling congestion, while maintaining a reserve of assets to support secondary incidents...	10.1
BRPMS-DF-IN-1.3.1.2.1.1	The DSS - Business Rules and Process Management Engine shall collect Action Plans triggers through a configurable set of performance based thresholds ("Mobility", "Reliability", and “Emissions").	10.1
BRPMS-DF-IN-1.3.1.2.1.2	The DSS - Business Rules and Process Management Engine shall collect Action Plan triggers that relate to time based thresholds; (a) From the beginning of an event (b) After the initiation of a response plan; (c) Triggers based on "Level of Service" within the managed environment; (d) Type and Distance of Asset from Incident Location;	10.1
BRPMS-DF-IN-1.3.1.2.2	The DSS - Business Rules and Process Management Engine shall collect the hierarchical priorities for implementing Action Plans across multiple modes and jurisdictions.	10.1
BRPMS-DF-IN-1.3.2	The DSS - Business Rules and Process Management Engine shall collect "traffic operator inputs" directly from the Regional Transportation Operator when they are not working at a console.	10.1

Requirement ID	Description	User Need ID
BRPMS-DF-IN-1.3.2.1	The DSS - Business Rules and Process Management Engine shall collect "traffic operator inputs" sent via a secure medium.	10.1
BRPMS-DF-IN-1.3.2.1.1	The DSS - Business Rules and Process Management Engine shall collect "traffic operator inputs" including time received and the actual response ("approved", "denied", "approved with change").	10.1
BRPMS-DF-IN-1.3.2.1.2	The DSS - Business Rules and Process Management Engine shall collect "traffic operator inputs" that contain a change to the recommended modal Action Plan, including a Ramp Metering Rate, Signal Timing Plan, and Message. This change will not require re-simulation before being implemented.	10.1
BRPMS-DF-IN-1.3.2.2	The DSS - Business Rules and Process Management Engine shall collect an operator selected adjustment to a recommended traffic control strategy (e.g., adjust signal timing plans, change DMS messages).	10.1
BRPMS-DF-IN-1.3.3	The DSS - Business Rules and Process Management Engine shall collect configuration data from the DSS - Graphical User Interface to enable an operator to classify whether the Action Plan "implementation request" message should be classified as; (1) Low Impact Incident - Freeway; (2) Low Impact Incident - Arterial; (3) Low Impact Incident - Transit; (4) Medium Impact Incident - Freeway; (5) Medium Impact Incident - Arterial; (6) Medium Impact Incident - Transit; (7) High Impact Incident - Freeway; (8) High Impact Incident - Arterial; (9) High Impact Incident - Transit; (10) Low Impact Incident - Multimodal; (11) Medium Impact Incident - Multimodal; (12) High Impact Incident - Multimodal; (13) Low Impact Incident - CPS; (14) Medium Impact Incident - CPS; (15) High Impact Incident - CPS.	10.1
BRPMS-DF-IN-1.4	The DSS - Business Rules and Process Management Engine shall collect the forecast "road network conditions" from the DSS - Network Prediction Subsystem as a series of graphical depictions of congestion in the corridor in 15 minute time intervals.	7

Requirement ID	Description	User Need ID
BRPMS-DF-IN-1.5	The DSS - Business Rules and Process Management Engine shall collect the "availability status" from the DSS - Road Asset Configuration and Conditions Subsystem on all assets within the Response Plan geographical boundary.	7
BRPMS-DF-IN-1.6	The DSS - Business Rules and Process Management Engine shall collect the "Response Plan(s)" from the DSS - Data Hub that have been recommended by the DSS - Real-Time Simulation Subsystem.	7
BRPMS-FR-2	The ICMS shall provide users and corridor managers' response plans and allow users to modify and activate plans. Response plan recommendations are based on current or predicted corridor status and context (i.e., temporally and spatially)	10.1
BRPMS-FR-2.1.1	The DSS - Business Rules and Process Management Engine shall store data required to construct a Response Plan Implementation Matrix. This matrix is used to sequence the multi-jurisdictional multi-agency response plan, and to track management performance.	10.1
BRPMS-FR-2.1.1.1	The DSS - Business Rules and Process Management Engine shall store process flow information captured from the DSS - Graphical User Interface.	10.1
BRPMS-FR-2.1.1.1.1	The DSS - Business Rules and Process Management Engine shall store the sequence in which Regional Transportation Operators are notified for a specific Action Plan.	10.1
BRPMS-FR-2.1.1.1.2	The DSS - Business Rules and Process Management Engine shall store the agency "response required" (time-out) threshold for the contact to respond to an "implementation request".	10.1

Requirement ID	Description	User Need ID
BRPMS-FR-2.1.1.1.3	The DSS - Business Rules and Process Management Engine shall store rules that govern how devices are to be associated with the implementation of an Action Plan, including a) device "type", b) device proximity to incident or congestion, c) device by time of day, d) device by day of week, e) device by month of year, f) multi-jurisdictional hierarchy rules (e.g., City then State, OR State then City, OR City|State at same time, OR City(a) then City(b) etc.)	10.1
BRPMS-FR-2.1.1.1.4	The DSS - Business Rules and Process Management Engine shall store "performance" related rules captured from the DSS - Graphical User Interface. This includes; a) Mobility b) Reliability c) Emissions.	10.1
BRPMS-FR-2.1.1.1.5	The DSS - Business Rules and Process Management Engine shall store rules to define "priority actions" within rapidly adjusting conditions that have been received from the DSS - Graphical User Interface Subsystem.	10.1
BRPMS-FR-2.1.1.1.6	The DSS - Business Rules and Process Management Engine shall store the upper and lower bound of those thresholds.	10.1
BRPMS-FR-2.1.1.2	The DSS - Business Rules and Process Management Engine shall store "traffic operator inputs" received directly from the Regional Transportation Operator.	10.1
BRPMS-FR-2.1.1.3	The DSS - Business Rules and Process Management Engine shall store a version controlled copy of the response plan implementation matrix.	10.1
BRPMS-FR-2.1.2	The DSS - Business Rules and Process Management Engine shall build a "response plan implementation matrix" to monitor and report the progression of implementation on each Action Plan.	10.1

Requirement ID	Description	User Need ID
BRPMS-FR-2.1.2.1	The DSS – Business Rules and Process Management Engine shall process the "Response Plan(s) Recommendation" made by the DSS - Real-Time Simulation Subsystem.	10.1
BRPMS-FR-2.1.2.2	The DSS - Business Rules and Process Management Engine shall process the "Action Plans" stored in the DSS - Response Strategy Data Store that make up the particular Response Plan.	10.1
BRPMS-FR-2.1.2.3	The DSS - Business Rules and Process Management Engine shall process the "availability status" of assets stored in the DSS - Road Asset Configuration and Conditions Data Store.	10.1
BRPMS-FR-2.1.2.4	The DSS – Business Rules and Process Management Engine shall process the process flows, rules and thresholds stored locally before building the Response Plan Implementation Matrix.	10.1
BRPMS-FR-2.1.2.4.1	The DSS - Business Rules and Process Management Engine shall process the process flows, rules and thresholds and build both positive and negative pathways into the Response Plan Implementation Matrix.	10.1
BRPMS-FR-2.1.2.4.2	The DSS - Business Rules and Process Management Engine shall process negative pathways by including a "back out" strategy for a failed "device implementation request" once all process flows and escalation thresholds have been violated.	10.1
BRPMS-FR-2.1.2.5	The DSS - Business Rules and Process Management Engine shall process the "agency profile" and "personal preferences profile" stored in the DSS - Systems Management Subsystem	10.1

Requirement ID	Description	User Need ID
BRPMS-FR-2.1.2.5.1	The DSS - Business Rules and Process Management Engine shall process the "personal preferences file" for the priority an operator has given to the multiple methods of communication.	10.1
BRPMS-FR-2.1.2.5.2	The DSS - Business Rules and Process Management Engine shall process the "personal preferences file" and queue "implementation requests" to the two methods of communication given highest priority.	10.1
BRPMS-FR-2.1.2.5.3	The DSS - Business Rules and Process Management Engine shall process the "agency profile" for the "response time-out" threshold before escalating an "implementation request".	10.1
BRPMS-FR-2.1.3	The DSS - Business Rules and Process Management Engine shall rebuild the response plan implementation matrix when one or more thresholds or escalation process flows change.	10.1
BRPMS-FR-2.1.3.1	The DSS - Business Rules and Process Management Engine shall evaluate "Device Control Response" data received from the DSS - Data Hub	10.1
BRPMS-FR-2.1.3.1.1	The DSS - Business Rules and Process Management Engine shall evaluate "response plan implementation performance" based on the responses received from field devices.	10.1
BRPMS-FR-2.1.3.1.1.1	The DSS - Business Rules and Process Management Engine shall evaluate whether a "mobility" based trigger has been met or violated based on DSS - Real-Time Simulation Subsystem input. This is used when selecting the execution pathway through the response plan implementation matrix.	10.1

Requirement ID	Description	User Need ID
BRPMS-FR-2.1.3.1.1.2	The DSS - Business Rules and Process Management Engine shall evaluate whether a "reliability" based trigger has been met or violated based on DSS - Real-Time Simulation Subsystem input. This is used when selecting the execution pathway through the response plan implementation matrix.	10.1
BRPMS-FR-2.1.3.1.1.3	The DSS - Business Rules and Process Management Engine shall evaluate whether an "emissions" based trigger has been met or violated based on DSS - Real-Time Simulation Subsystem input. This is used when selecting the execution pathway through the response plan implementation matrix.	10.1
BRPMS-FR-2.1.3.1.1.4	The DSS - Business Rules and Process Management Engine shall evaluate whether thresholds (upper | lower) have been met or violated based on DSS - Real-Time Simulation Subsystem input. This is used when selecting the execution pathway through the response plan implementation matrix.	10.1
BRPMS-FR-2.1.3.1.1.5	The DSS - Business Rules and Process Management Engine shall evaluate whether escalation "time-outs" have been met or violated based on responses received from the Regional Transportation Operators. This is used when selecting the execution pathway through the response plan implementation matrix.	10.1
BRPMS-FR-2.1.3.1.1.6	The DSS - Business Rules and Process Management Engine shall evaluate whether thresholds (upper | lower) have been associated with a time based criteria when deciding to follow an execution pathway through the response plan implementation matrix. These criteria are; a) by time of day, b) by day of week, c) by month of year.	10.1
BRPMS-FR-2.1.3.1.1.7	The DSS - Business Rules and Process Management Engine shall evaluate whether thresholds (upper | lower) have been associated with a spatial based criteria when deciding to follow an execution pathway through the response plan implementation matrix. These criteria are a) by direction of travel; b) by link; c) by node.	10.1
BRPMS-FR-2.1.3.1.1.8	The DSS - Business Rules and Process Management Engine shall evaluate whether the "response time-out" threshold has been met or violated to correctly select the execution pathway through the response plan implementation matrix.	10.1

Requirement ID	Description	User Need ID
BRPMS-FR-2.1.3.2	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" for changes made to the incident process flow. This evaluation will be used to determine if a "new" response plan implementation matrix is to be dynamically created.	10.1
BRPMS-FR-2.1.3.2.1	The DSS - Business Rules and Process Management Engine shall evaluate the content of the "traffic operator inputs" (from the DSS - Graphical User Interface OR directly from the Regional Transportation Operator) for changes to the current "traffic control coordination" data within an Action Plan.	10.1
BRPMS-FR-2.1.3.2.2	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" where changes made to "traffic control coordination" commands affect a single field device based on a Device_ID.	10.1
BRPMS-FR-2.1.3.2.1.3	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" where changes made to "traffic control coordination" commands affect a group of field devices based on Asset Class (e.g., CMS, HAR, Metering Rate, Timing Plan).	10.1
BRPMS-FR-2.1.3.2.4	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" where changes made to "traffic control coordination" commands affect a group of field devices based on a geographic distance from an event.	10.1
BRPMS-FR-2.1.3.2.5	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" where changes were made to the level of "automation" for a single field device based on Device_ID.	10.1
BRPMS-FR-2.1.3.2.6	The DSS - Business Rules and Process Management Engine shall evaluate “traffic operator inputs" where changes were made to the level of "automation" for a group of field devices based on Asset Class.	10.1

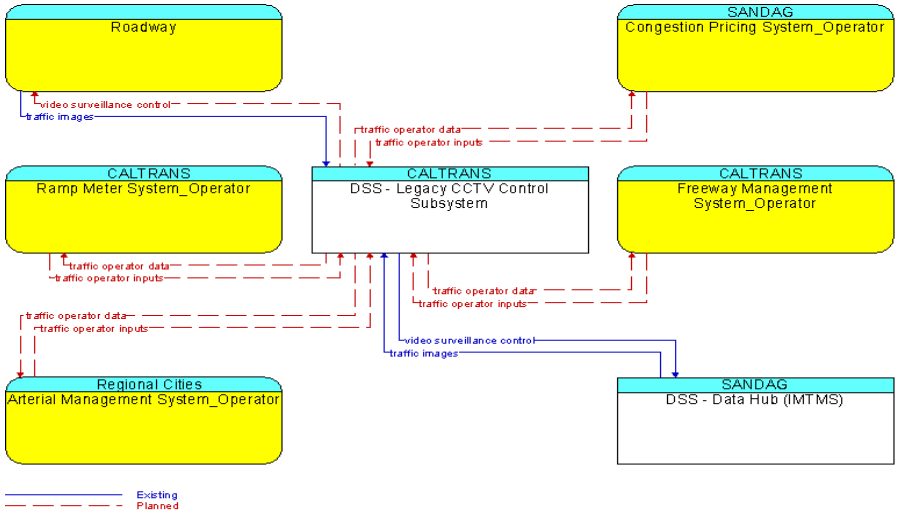
Requirement ID	Description	User Need ID
BRPMS-FR-2.1.3.2.7	The DSS - Business Rules and Process Management Engine shall evaluate "traffic operator inputs" where changes were made to be saved for "all future plans".	10.1
BRPMS-FR-2.2	The ICMS shall provide the following administrative functions; a. system wide security functions, b. data backup, c. user account management, and d. ICMS configuration data.	16
BRPMS-FR-2.2.1	The DSS - Business Rules and Process Management Engine shall process a Response Plan's need for "contacts" from the DSS - Systems Management Subsystem.	16
BRPMS-FR-2.2.1.1	The DSS - Business Rules and Process Management Engine shall process the information available on the designated person(s) including, Name, Position, staff ID, organization ID, location ID, street address, city, county, state, zip9, primary phone #, cell #, fax #, email address, "personal preferences profile".	16
BRPMS-FR-2.2.1.2	The DSS - Business Rules and Process Management Engine shall process the information available on participating contact(s) agency including, organization ID, location ID, street address, city, county, state, zip9, primary phone #, fax #, latitude and longitude, Manager-Contact-ID.	16
BRPMS-FR-2.2.1.3	The DSS - Business Rules and Process Management Engine shall process multiple contacts across a single organization in a "primary" / "backup" / "second backup" hierarchy.	16
BRPMS-FR-2.2.1.4	The DSS - Business Rules and Process Management Engine shall process the organization "contact list" and build an escalation tree for use in orchestrating the implementation of a Response Plan	16

Requirement ID	Description	User Need ID
BRPMS-FR-2.2.1.4.1	The DSS - Business Rules and Process Management Engine shall process a Response Plan's multiple contacts across multiple organizations, and build a dynamic "matrix" based on the Response Plan workflow, and time-of-day.	16
BRPMS-FR-2.2.2	The DSS – Business Rules and Process Management Engine, shall process the "contact matrix" at the time of implementing an Action Plan and select the correct "contact" to request Action Plan "approval" from.	16
BRPMS-FR-2.2.2.1	The DSS – Business Rules and Process Management Engine, shall process an "agency profile" to identify the approach to field device control ; (1) "Operator Approval Required"; (2) "Change to Plan Recommendation Allowed"; (3) "Automatic Implementation of Simulated Response Plan Recommendations is Default"; (4) "Automated Implementation of Recommended Modal Response Plan after user selected Time to Respond".	16
BRPMS-FR-2.2.2.2	The DSS - Business Rules and Process Management Engine shall validate the 'Virtual Corridor Transportation Management Center (VCTMC)' use of information complies with operating agreements defined by Regional Transportation Operators. Validation should consider interconnect and field element sharing, priority, asset and operator sequencing, time-of-day, and operator required approval dependencies listed into agreements.	16
BRPMS-FR-2.3	The DSS – Business Rules Process Management Engine shall store the current "configuration data" from the DSS - Road Asset Configuration and Conditions Data Store.	10.1
BRPMS-FR-2.4	The DSS – Business Rules and Process Management Engine shall process "traffic operator inputs" in evaluating how it may change an Action Plan's implementation (priority, timing, content).	7

3.8.7 Video Management

Arguably, the most complex and yet useful sensor system in the region is the multi-agency collection of video surveillance systems. The largest systems are owned by Caltrans for freeway monitoring and event confirmation and by MTS/NCTD for station and parking security. As shown in Figure 3-8 and Table 3-11, the ICMS will provide the capability for users to select cameras from a graphical user interface and subject to regional agreements, to control selected operations of these cameras, such as pan, tilt, zoom, focus, iris control, etc. The ICMS will support a video wall management capability for future dedicated facilities. Video display formats will include live streaming video, archived video clips, and video snapshots.

Figure 3-8. Video Management Interface Diagram



[Source: SANDAG.]

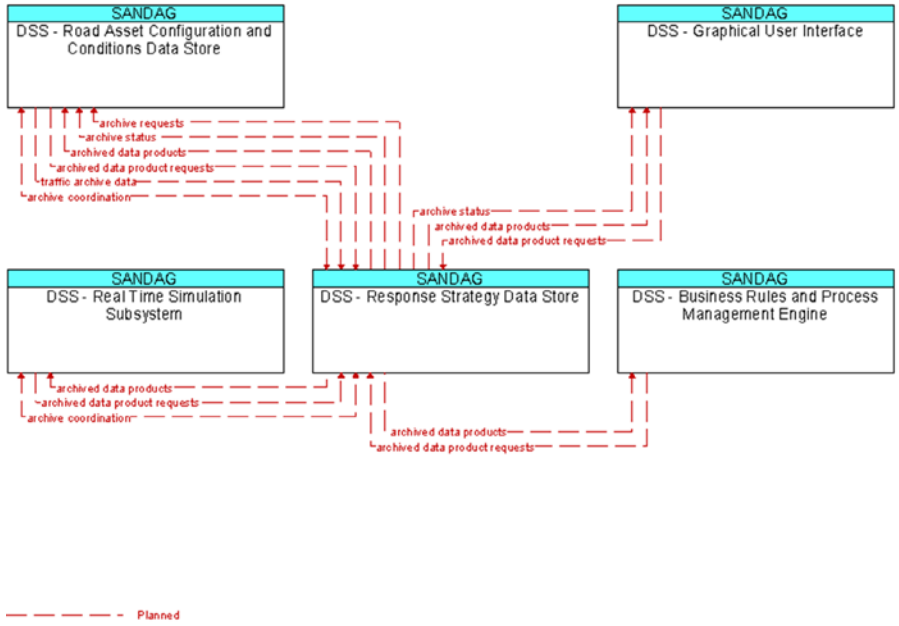
Table 3-11. ICMS Video Management Requirements

Requirement ID	Description	User Need ID
CCTV-DF-IN-1	The DSS - Legacy CCTV Control Subsystem shall collect "traffic operator inputs" from the DSS - Graphical User Interface. These include commands to display different CCTV camera images, and live video. This data flow uses the following standards;: [Outside System Boundary]: ICD: Appendix 1 - "Software Detailed Design Document: San Diego Regional Intermodal Transportation Management System (IMTMS)":	9
CCTV-DF-OUT-3.1	The DSS - Legacy CCTV Control Subsystem shall disseminate "traffic operator data" to the DSS - Graphical User Interface which consists of video images, and status. This data flow uses the following standards;: [Inside System Boundary only]: TMDD Requirements: 3.3.6.1, 3.3.6.3	9
CCTV-DF-OUT-3.2	The DSS - Legacy CCTV Control Subsystem shall monitor, analyze, and distribute traffic images from Regional Transportation Operator owned CCTV systems under remote control of the center.	9
CCTV-FR-2	The DSS - Legacy CCTV Control Subsystem shall disseminate all "video surveillance control" commands input by the Regional Transportation Operator to the DSS - Systems Management Subsystem. These commands consist of the information used to configure and control video surveillance systems, and the detail of which command was issued by whom and when. This data flow uses the following standards;: [Inside System Boundary]: TMDD Requirements: 3.3.6.3	9

3.8.8 Response Plan

The ICMS will determine the appropriate response for managing traffic in response to major perturbations in "normal" traffic due to traffic incidents, special events, emergency closures, construction, and/or major disasters. As shown in Figure 3-9 and Table 3-12, the heart of the DSS subsystem within the ICMS is the ability to analyze collected data, ascertain abnormal or scheduled events, determine appropriate responses, and suggest a set of actions that collectively form a "Response Plan." The Response Plan may be manually or automatically generated, but if automatically generated, will include the capability for human operator review and modification. This is particularly critical for field device (i.e., CMS and camera) control actions.

Figure 3-9. Response Plan Interface Diagram



[Source: SANDAG.]

Table 3-12. ICMS Response Plan Requirements

Requirement ID	Description	User Need ID
RSDS-DF-IN-1	The DSS - Response Strategy Data Store shall collect inventory data, status data, existing business rules and workflows, and internally derived performance triggers from the ICMS subsystems.	10
RSDS-DF-IN-1.2	The DSS - Response Strategy Data Store shall collect "business rules" and "process workflows" associated with a Response Plan from the DSS - Graphical User Interface.	10
RSDS-DF-IN-1.3	The DSS - Response Strategy Data Store shall collect the data required to configure "Response Plans" and modal "Action Plans" from the DSS - Graphical User Interface.	10
RSDS-DF-IN-1.4	The DSS - Response Strategy Data Store shall collect the DSS - Business Rules and Process Management Engine's request to retrieve the most current "Response Plan" data stored in the local archive	10
RSDS-DF-IN-1.5	The DSS - Response Strategy Data Store shall collect "transportation information coordination" from the DSS - Road Asset Configuration and Conditions Data Store. This data shall provide the subsystem with the latest "status" information on available assets able to be utilized within a modal "action plan"	10
RSDS-FR.2	The DSS - Response Strategy Data Store shall process inventory data, status data, existing business rules and workflows, and internally derived performance triggers from the ICMS subsystems.	10

Requirement ID	Description	User Need ID
RSDS-FR.2.1	The DSS - Response Strategy Data Store shall process "transportation information coordination" and "transportation control coordination" data from the DSS - Data Hub.	10
RSDS-FR.2.1.1	The DSS - Response Strategy Data Store shall provide the capability to execute methods on the incoming data "transportation information coordination" data from the DSS - Data Hub, such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	10
RSDS-FR.2.1.2	The DSS - Response Strategy Data Store shall provide the capability to execute methods on the incoming data "transportation control coordination" data from the DSS - Data Hub, such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	10
RSDS-FR.2.1.3	The DSS - Response Strategy Data Store shall analyze incoming data from the DSS - Data Hub for deltas between existing (stored) configuration data and data in the current device inventory. This function will identify any field assets that would not be able to participate in a specific response plans due to being unavailable (e.g., out for maintenance, off line, etc)	10
RSDS-FR.2.1.4	The DSS - Response Strategy Data Store shall perform quality checks on the incoming archived data from the DSS - Data Hub. This will aim to remove redundant, spurious or erroneous data from the local archive, such that Response Plan selection, simulation and agency orchestrated recommendation (by the DSS – Business Rules and Process Management engine) is not impacted.	10
RSDS-FR.2.1.5	The DSS – Response Strategy Data Store shall synchronize its locally held configuration data for CMS Inventory, CMS Message Library, Vehicle Detection Inventory, Ramp Meters Inventory, Arterial Traffic Signals Inventory, Arterial Traffic Signal Timing Patterns, Transit Routes, Transit Schedules, Toll Road Inventory, Toll Fee Schedules, with the DSS – Road Asset Configuration and Conditions Data Store between every 15 to 20 minutes from the latest information published to the DSS - Data Hub..	10
RSDS-FR.2.2	The DSS - Response Strategy Data Store shall store data from the Arterial Management System for pre-determined traffic signal timing plans (jurisdiction, intersection ID, timing plan ID, incident segment start position, incident segment end position, time of day)	10

Requirement ID	Description	User Need ID
RSDS-FR.2.3	The DSS - Response Strategy Data Store shall process "requests" to return a list of Response Plans to a "Corridor Manager" in the DSS - Graphical User Interface	10
RSDS-FR.2.3.1	The DSS - Response Strategy Data Store shall respond to requests from the DSS - Graphical User Interface administrator function to maintain the archive data.	10
RSDS-FR.2.4	The DSS - Response Strategy Data Store shall store "Response Plan" configuration data in the DSS - Graphical User Interface	10
RSDS-FR.2.4.1	The DSS - Response Strategy Data Store shall store all of the associated broadcast messages, "system control requests" configuration settings, and "approval sequencing" information captured from the DSS - Graphical User Interface.	10
RSDS-FR.2.4.2	The DSS - Response Strategy Data Store shall process the data received from the DSS - Graphical User Interface, and develop the request to retrieve the most current set of response and action plans that equate to the "nearest neighbors" based on the existing "real-time" conditions stored in the local archive.	10
RSDS-FR.2.5	The DSS - Response Strategy Data Store shall store data from the DSS - Business Rules and Process Management Engine	10
RSDS-FR.2.5.1	The DSS - Response Strategy Data Store shall store the "Response Plan" implementation data (agency, response_plan_id, action_plan_id, system or operator "direct response" to an "implementation request", implementation_verification_flag, time_date sent, time_date acknowledged, time_date implemented) received from the DSS - Business Rules and Process Management Engine.	10

Requirement ID	Description	User Need ID
RSDS-FR.2.5.2	The DSS - Response Strategy Data Store shall store quality check data received from the DSS - Business Rules and Process Management Engine. Quality checks shall differ based on the asset type and be defined in the DSS - Business Rules and Process Management Engine, with asset data and quality controlled measures "failed" being stored along with response plan|action plan data implementation logs.	10
RSDS-FR.2.6	The DSS - Response Strategy Data Store shall store data from the DSS - Network Prediction System	10
RSDS-FR.2.6.1	The DSS - Response Strategy Data Store shall store a reference to the "archive data product" from the DSS - Network Prediction System, which contained the congestion prediction data used to evoke or trigger a "corridor event"	10
RSDS-FR.2.7	The DSS - Response Strategy Data Store shall store data from the DSS - Real Time Simulation Subsystem.	10
RSDS-FR.2.7.1	The DSS - Response Strategy Data Store shall store the "recommended" set of response plans from the DSS - Real Time Simulation Subsystem.	10
RSDS-FR.2.7.2	The DSS - Response Strategy Data Store shall store the "response plan"|"action plans" paired sets that were simulated from the DSS - Real Time Simulation Subsystem and the resulting "congestion relief" metric that resulted.	10
RSDS-FR.2.8	The DSS - Response Strategy Data Store shall process profile data received from the DSS - Systems Management Subsystem before enabling a user to make modifications to a response plan | action plan paired set, and changes are applied.	10

Requirement ID	Description	User Need ID
RSDS-DF-OUT-3	The DSS - Response Strategy Data Store shall disseminate "Response Plan" data consisting of a number of "Action Plans" that have been guided by existing operational documentation, configured through the DSS - Graphical User Interface, and have been agreed to operationally by the stakeholders.	10
RSDS-DF-OUT-3.1	The DSS - Response Strategy Data Store shall disseminate requested "Response Plan" data to the DSS - Data Hub, DSS - Graphical User Interface, and DSS - Business Rules and Process Management Engine not before 1 second and not after 15 seconds of receiving a user or system request.	10
RSDS-DF-OUT-3.2	The DSS - Response Strategy Data Store shall disseminate "archive status" to the DSS - Data Hub.	10
RSDS-DF-OUT-3.2.1	The DSS - Response Strategy Data Store shall disseminate any inventory changes that result from the analyze function to the DSS - Data Hub for consumption internal subsystems to synchronize against. This data flow conforms to the TMDD (ver 3.0) requirement 3.3.6 with an associated message conformant to 3.3.4 describing the change event.	10
RSDS-DF-OUT-3.3	The DSS - Response Strategy Data Store shall disseminate "error reports" to the DSS - System Management Subsystem for regional assets that have failed to pass quality checks.	10
RSDS-DF-OUT-3.3.1	The DSS - Response Strategy Data Store shall disseminate "archive status" to the DSS - Graphical User Interface which consists of a notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6	10
RSDS-DF-OUT-3.3.2	The DSS - Response Strategy Data Store shall disseminate "archived data product" to the DSS - Graphical User Interface which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;(i)[Inside System	10

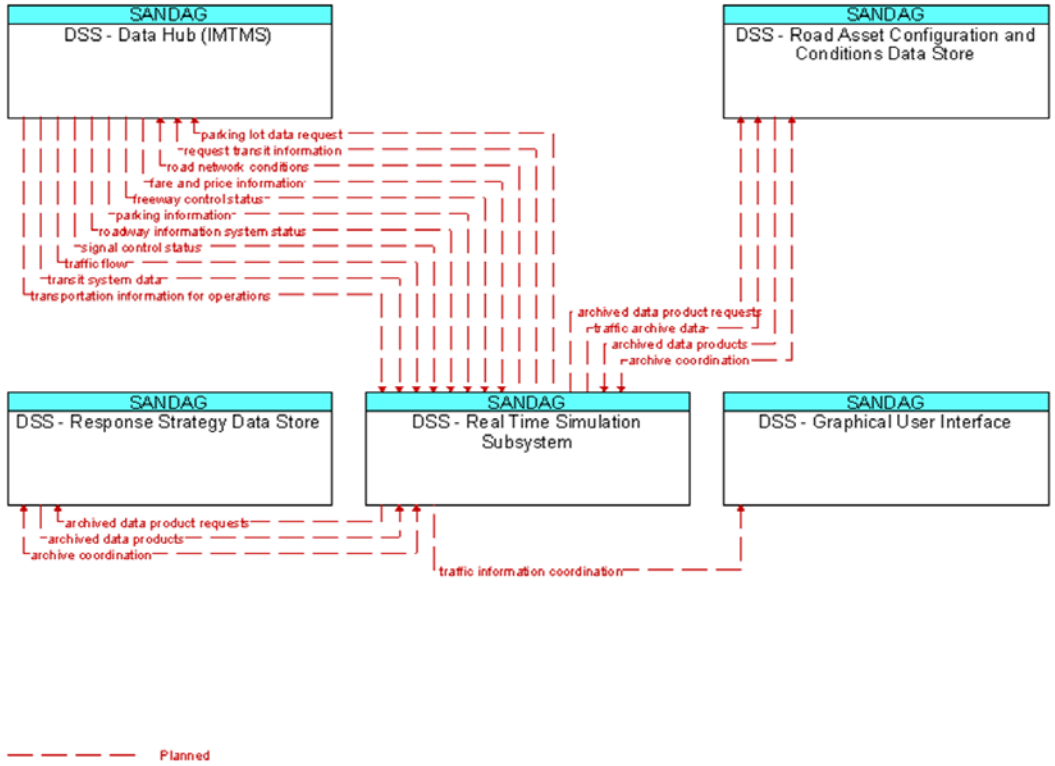
Requirement ID	Description	User Need ID
	Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	
RSDS-DF-OUT-3.4	The DSS - Response Strategy Data Store shall disseminate "archived data product" to the DSS - Business Rules and Process Management Engine which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	10
RSDS-DF-OUT-3.5.1	The DSS - Response Strategy Data Store shall disseminate "archive coordination" to the DSS - Road Asset Configuration and Conditions Data Store which consists of catalog data, meta data, published data, and other information exchanged between archives to support data synchronization and satisfy user data requests. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6	10
RSDS-DF-OUT-3.5.2	The DSS - Response Strategy Data Store shall disseminate "archive requests" to the DSS - Road Asset Configuration and Conditions Data Store which is a request to a data source for information on available data (i.e., "catalog") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6	10
RSDS-DF-OUT-3.5.3	The DSS - Response Strategy Data Store shall disseminate "archive status" to the DSS - Road Asset Configuration and Conditions Data Store which consists of a notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6	10

Requirement ID	Description	User Need ID
RSDS-DF-OUT-3.5.4	The DSS - Response Strategy Data Store shall disseminate "archived data product" to the DSS - Road Asset Configuration and Conditions Data Store which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	10
RSDS-DF-OUT-3.6.1	The DSS - Response Strategy Data Store shall disseminate "archive coordination" to the DSS - Real Time Simulation Subsystem which consists of catalog data, meta data, published data, and other information exchanged between archives to support data synchronization and satisfy user data requests. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.6	10
RSDS-DF-OUT-3.6.2	The DSS - Response Strategy Data Store shall disseminate "archived data product" to the DSS - Real Time Simulation Subsystem which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	10

3.8.9 Impact Assessment (RTSS)

As shown in Figure 3-10 and Table 3-13, the ICMS will use a micro/meso scale modeling tool to assess the impact of both short-term responses to planned and unplanned events in the corridor (such as the recent wildfires in San Diego) and long-term strategies to optimize corridor performance based on cumulative measures of corridor performance.

Figure 3-10. Impact Assessment (RTSS) Interface Diagram



[Source: SANDAG.]

Table 3-13. ICMS Impact Assessment (RTSS) Requirements

Requirement ID	Description	User Need ID
RTSS-DF-IN-1	The DSS - Real-Time Simulation Subsystem shall collect forecast "road network conditions" and "weather conditions" from the DSS - Network Prediction Subsystem.	11.1
RTSS-DF-IN-1.1	The DSS - Real-Time Simulation Subsystem shall collect "archive data products" from the DSS - Road Asset Configuration and Conditions Data Store to be used in configuration of the microsimulation environment for the next response plan evaluation simulation.	11.1
RTSS-DF-IN-1.1.1	The DSS - Real Time Simulation Subsystem shall collect "archived data product" from the DSS - Road Asset Configuration and Conditions Data Store which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request.	11.1
RTSS-DF-IN-1.1.1.1	The DSS - Real-Time Simulation Subsystem shall collect data from the DSS - Road Asset Configuration and Conditions Data Store, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information, parking information, weather information, events and special events, and transit information to support microsimulated selection of a response strategy.	11.1
RTSS-DF-IN-1.1.2	The DSS - Real Tim Simulation Subsystem shall collect "route unavailable" information from the DSS - Road Asset Configuration and Conditions Data Store. This includes a list of links or routes that are currently unavailable for traffic and transit vehicles to traverse, or are at reduced capacity due to an incident that meets an Regional Transportation Operator's threshold for "exclusion".	11.1
RTSS-DF-IN-1.1.3	The DSS - Real-Time Simulation Subsystem shall collect data from the DSS - Road Asset Configuration and Conditions Data Store no later than 2 minutes before the execution of a monte-carlo simulation run, and no more than once every 5 minutes for all field devices.	11.1

Requirement ID	Description	User Need ID
RTSS-DF-IN-1.2	The DSS - Real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Graphical User Interface, where a Regional Transportation Operator has requested an alternate Action Plan data be included in the Response Plan.	11.1
RTSS-DF-IN-1.2.1	The DSS - real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Graphical User Interface, where a Regional Transportation Operator has requested an alternate ramp "metering rate" be implemented.	11.1
RTSS-DF-IN-1.2.2	The DSS - real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Graphical User Interface, where a Regional Transportation Operator has requested an alternate "signal timing plan" be implemented.	11.1
RTSS-DF-IN-1.2.3	The DSS - real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Graphical User Interface, where a Regional Transportation Operator has requested an alternate "dms message".	11.1
RTSS-DF-IN-1.3	The DSS - Real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Business Rules and Process Management Engine, where a Regional Transportation Operator has requested an alternate Action Plan data be included in the Response Plan.	11.1
RTSS-DF-IN-1.3.1	The DSS - Real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Business Rules and Process Management Engine, where a Regional Transportation Operator has requested an alternate ramp "metering rate" be implemented.	11.1
RTSS-DF-IN-1.3.2	The DSS - Real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Business Rules and Process Management Engine, where a Regional Transportation Operator has requested an alternate "signal timing plan" be implemented.	11.1

Requirement ID	Description	User Need ID
RTSS-DF-IN-1.3.3	The DSS - Real Time Simulation Subsystem shall collect Action Plan "change data" from the DSS - Business Rules and Process Management Engine, where a Regional Transportation Operator has requested an alternate "dms message".	11.1
RTSS-DF-IN-1.4	The DSS - Real Time Simulation Subsystem shall collect "archived data products" from the DSS - Response Strategy Data Store which consists of raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response will also include any associated transaction information. This data flow uses the following standards;(i)[Outside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6(i)[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	11.1
RTSS-DF-OUT-3.1	The DSS - Real Time Simulation Subsystem shall disseminate a graphical representation of the "road network conditions" at the completion of each simulation run to the DSS - Data Hub.	11.1
RTSS-DF-OUT-3.1.1	The DSS - Real Time Simulation Subsystem shall disseminate to the DSS - Data Hub a graphical representation of the location of field assets to be modified during the implementation of a Response Plan's associated modal Action Plans.	11.1
RTSS-DF-OUT-3.1.2	The DSS - Real Time Simulation Subsystem shall disseminate a 2 dimensional graphical representation, using a four color schema (based on the saturation thresholds captured in the DSS - Business Rules and Process Management Engine) to visually represent the level of congestion on each of the network links.	11.1
RTSS-DF-OUT-3.1.3	The DSS - Real Time Simulation Subsystem shall disseminate a 2 dimensional graphical representation of the level of congestion on each of the Freeway, Arterial, Express Lanes, and Transit network links.	11.1
RTSS-DF-OUT-3.2	The DSS - Real Time Simulation Subsystem shall disseminate to the DSS - Data Hub the reference to the "final" response plan configuration that was simulated.	11.1

Requirement ID	Description	User Need ID
RTSS-DF-OUT-3.2.1	The DSS - Real Time Simulation Subsystem shall disseminate to the DSS - Data Hub, the set of uniquely identifiable "final" response plan sets that were executed. These unique references will correlate to those stored in the DSS - Response Strategy Data Store including the configuration of all "final" Actions Plans (i.e., after an operator has made their decision to implement unchanged, or "with modification").	11.1
RTSS-DF-OUT-3.2.2	The DSS - Real Time Simulation Subsystem shall disseminate "traffic information coordination" to the DSS - Data Hub, which consists of the traffic information exchanged between TMC's including an evaluation of the impact of incidents, congestion data, traffic data, signal timing plans, and real-time signal control information on each link on the simulated network. This data flow uses the following standards;:	11.1
RTSS-DF-OUT-3.2.3	The DSS - Real Time Simulation Subsystem shall disseminate "traffic archive data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:TMDD Requirements: 3.3.5, 3.3.6.	11.1
RTSS-DF-OUT-3.2.4	The DSS - Real Time Simulation Subsystem shall disseminate "parking archive data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:TMDD Requirements: 3.3.4	11.1
RTSS-DF-OUT-3.2.5	The DSS - Real Time Simulation Subsystem shall disseminate "toll archive data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:TMDD Requirements: 3.3.4	11.1
RTSS-DF-OUT-3.2.6	The DSS - Real Time Simulation Subsystem shall disseminate "traffic flow data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:TMDD Requirements: 3.3.6	11.1
RTSS-DF-OUT-3.2.7	The DSS - Real Time Simulation Subsystem shall disseminate "transit archive data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:IMTMS ICD.	11.1

Requirement ID	Description	User Need ID
RTSS-DF-OUT-3.2.8	The DSS - Real Time Simulation Subsystem shall disseminate "traveler archive data" to the DSS - Data Hub This data flow uses the follow standards; [Inside System Boundary]:IMTMS ICD.	11.1
RTSS-DF-OUT-3.3	The DSS - Real Time Simulation Subsystem shall disseminate "archived data product" requests to the DSS - Response Strategy Data Store for "archived data product" (i.e., data, meta data, or data catalogs) related to the "Response Strategy" to be included in a simulation run.	11.1
RTSS-FR.2	The ICMS shall gauge and report the impact of "Response Plan" strategies on corridor performance to System Managers.	11.1
RTSS-FR.2.2	The DSS - Real Time Simulation Subsystem shall compute a "Response Plan Congestion Relief" metric by running at least 5 distinct response plans through a monte carlo simulation analysis of response strategies saved in the DSS - Response Strategy Data Store.	11.1
RTSS-FR.2.2.1	The DSS - Real Time Simulation Subsystem computation of monte-carlo analysis shall request the latest four DSS - Network Prediction Subsystem identified network imbalances (in 15 minute time slices) from the DSS - Data Hub. The DSS - Real Time Simulation Subsystem should use the predicted volume and occupancy calculations from the DSS - Network Prediction Subsystem as the baseline for real-time input for the monte-carlo simulation computation runs.	11.1
RTSS-FR.2.2.2	The DSS - Real Time Simulation Subsystem will compute Response Plan recommendations, based on predicted data from the DSS - Network Prediction Subsystem. To ensure that the DSS - Real Time Simulation Subsystem is able to correctly present network conditions, it shall roll forward the arterial signal timing plan schedule in effect on an intersection to the next identified prediction interval from the data stored in the DSS - Road Asset Configuration and Conditions Data Store.	11.1
RTSS-FR.2.2.3	The DSS - Real Time Simulation Subsystem shall compute microsimulation based monte-carlo simulation analysis of at least 5 varying response plans from the DSS - Response Strategy Data Store as nearest neighbor "Response Plan". [The formulation of how a Nearest Neighbor evaluation is conducted will be determined during the Detailed Design phase of the project and this requirement updated.] The output from	11.1

Requirement ID	Description	User Need ID
	these simulation runs is used by the DSS - Business Rules and Process Workflow Engine to implement the Response Strategy.	
RTSS-FR.2.2.3.1	The "archived data product" requests shall be driven by the content of the "recommended response plan set" requested by the DSS - Business Rules and Process Management Engine. The request also includes information that is used to identify and authenticate the user . This data flow uses the following standards;[Inside System Boundary]: TMDD Requirements: 3.3.4, 3.3.5, 3.3.6	11.1
RTSS-FR.2.2.4	The DSS - Real Time Simulation Subsystem shall request a Response Plan from the DSS - Response Strategy Data Store, and include predefined incident response plans, signal timing plan changes, DMS/HAR messages, and freeway control strategies including ramp metering, interchange control, and lane controls.	11.1
RTSS-FR.2.2.5	The recommended actions from the DSS - Real Time Simulation Subsystem shall include multimodal strategies that include suggested transit strategies and suggested route and mode choices for travelers.	11.1
RTSS-FR.2.2.6	The DSS - Real Time Simulation Subsystem shall be capable of uniquely identify the configuration of any Response Plan (including individual Action Plans) that has been "recommended" in the last 90 days.	11.1

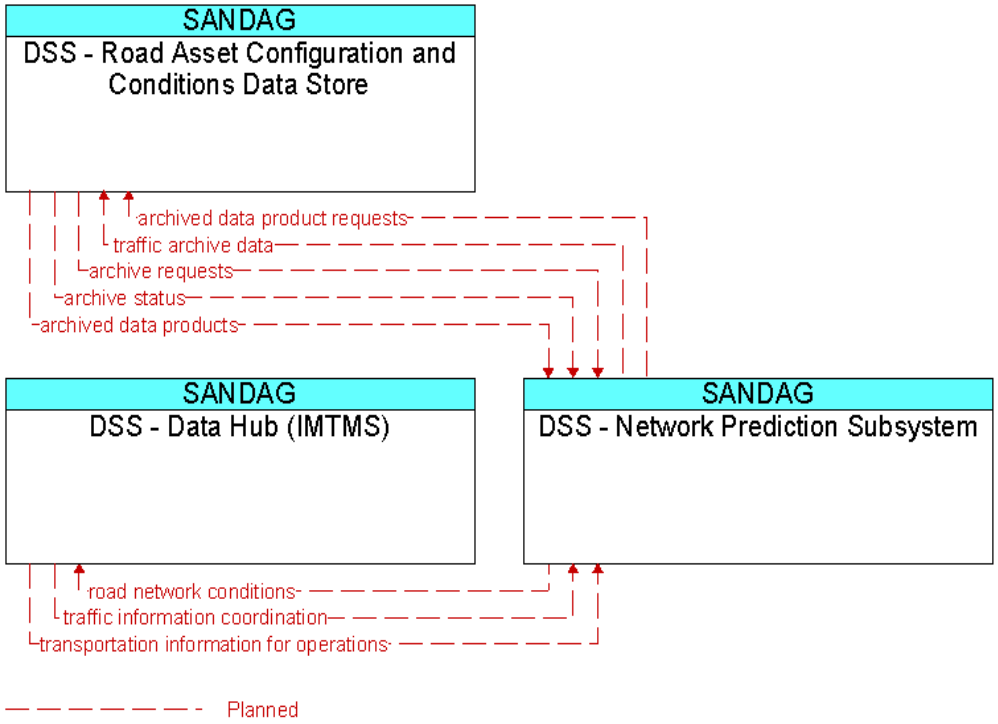
3.8.10 Information Publishing (Corridor Users)

Processed data will be made continuously available to the regional 511 program for public dissemination. This includes freeway, arterial and transit incidents, congestion data, travel times, ramp meter status, and any future data types such as parking availability, congestion pricing, etc. The 511 system will be responsible for selecting and activating all appropriate means of delivery, including the worldwide Web, e-mail, pagers, wireless devices, and landline telephones.

3.8.11 Capacity and Demand Management (NPS)

Long-term corridor management is needed to optimize traveler throughput and other metrics established by regional policy. This entails measuring highway, transit, parking, and congestion pricing performance over an extended period (see Section 3.8.13) and applying this data to various demand and capacity management strategies. As shown in Figure 3-11 and Table 3-14, demand management in the corridor includes van pooling, mode shift with Parking Management System, ramp metering, and congestion pricing. Capacity management includes managed lanes, traffic signal synchronization, transit service changes, and transit signal priority. The testing and deployment recommendation of these strategies will be done using long-term impact assessment tools such as macro-, meso- and micro-level simulations (and combinations of these). Simulation outputs then guide the application of appropriate measures to optimize corridor performance.

Figure 3-11. Capacity and Demand Management (NPS) Interface Diagram



[Source: SANDAG.]

Table 3-14. ICMS Capacity and Demand Management (NPS) Requirements

Requirement ID	Description	User Need ID
NPS-DF-IN-1.1	The DSS - Network Prediction Subsystem shall collect "archive data products" from the DSS - Road Asset Configuration and Conditions Data Store to be used in configuration of physical environment.	11
`	The DSS - Business Rules and Process Management Subsystem system shall collect "corridor capacities" (freeway, arterial, HOV/HOT/ML) from the DSS - Road Asset Configuration and Conditions Data Store	11
NPS-DF-IN-1.1.2	The DSS - Real-Time Simulation Subsystem shall collect the current "route unavailable" information from the DSS - Road Asset Configuration and Conditions Data Store.	11
NPS-DF-IN-1.2	The DSS - Network Prediction Subsystem shall collect "traffic information for operations" from the DSS - Data Hub. This data flow provides input to the "real-time" data required to predict multimodal corridor capacity.	11
NPS-DF-IN-1.3	The DSS - Network Prediction Subsystem shall collect "global" display thresholds from the DSS - Data Hub, to generate a graphical depiction of the prediction. "Global" display thresholds are stored in the agency profile in DSS - Business Rules and Process Management Engine.	11
NPS-DF-IN-1.4	The DSS - Network Prediction Subsystem shall collect regional asset “location and configuration” data from the DSS – Road Asset Configuration and Conditions Data Store prior to running network imbalance prediction.	11

Requirement ID	Description	User Need ID
NPS-DF-IN-1.5	This DSS - Network Prediction Subsystem shall collect "road network conditions" data from the DSS - Data Hub, and use this to algorithmically measure overall current demand. This will be used to trigger the generation of a forecast on network capacity and performance in the DSS - Real-Time Simulation Subsystem.	11
NPS-DF-IN-1.6	The DSS - Network Prediction Subsystem shall collect from the DSS - Data Hub current "alerts, events, and maintenance schedules" that will possibly impact traffic to support overall network performance evaluations.	11
NPS-FR-2.1	The DSS - Network Prediction Subsystem shall analyze "traffic sensor" data (speed, volume, occupancy) collected from the DSS - Data Hub and published by the external systems (e.g., FMS, RMS, AMS, TMS, CPS), to support overall network performance evaluations.	11
NPS-FR-2.1.1	The DSS - Network Prediction Subsystem system shall compute "excess capacity" by comparing current real-time demand against stored capacity (freeway, arterial, HOV/HOT/ML)	11
NPS-FR-2.1.10	The DSS - Network Prediction Subsystem shall compute network capacities for the arterial network for the next 1 hour in 15 minute time slices.	11
NPS-FR-2.1.11	The DSS - Network Prediction Subsystem shall compute real-time excess capacities (freeway, arterial, HOV/HOT/ML) and store these in the DSS - Road Asset Configuration and Conditions Data Store.	11
NPS-FR-2.1.12	The DSS - Network Prediction Subsystem shall compute a prediction of arterial network demand for the next 1 hour in 15 minute time slices.	11

Requirement ID	Description	User Need ID
NPS-FR-2.1.13	The DSS - Network Prediction Subsystem shall compute "travel times" where they are not collected from the Arterial Management System, Freeway Management System, Congestion Pricing System, or Arterial Travel Time System within the boundary of project network.	11
NPS-FR-2.1.14	The DSS - Network Prediction Subsystem shall compute congestion (volume, occupancy, speed) at an intersection no less than every 2 minutes, and no more than every 5 minutes.	11
NPS-FR-2.1.15	The DSS - Network Prediction Subsystem shall compute congestion (volume, occupancy, speed) on an arterial no less than every 2 minutes, and no more than every 5 minutes.	11
NPS-FR-2.1.16	The DSS - Network Prediction Subsystem shall compute congestion (volume, occupancy, speed) on a bus route (within the next three links of a buses scheduled route) no less than every 2 minutes, and no more than every 5 minutes.	11
NPS-FR-2.1.2	The DSS - Network Prediction Subsystem shall compute excess capacity by comparing current real-time demand against stored capacity for the freeway network for the next 1 hour, in 15 minute time slices	11
NPS-FR-2.1.3	The DSS - Network Prediction Subsystem shall compute excess capacity by comparing current real-time demand against stored capacity for the next 1 hour, in 15 minute time slices.	11
NPS-FR-2.1.4	The DSS - Network Prediction Subsystem shall compute network capacities for the freeway network for the next 1 hour, in 15 minute time slices	11

Requirement ID	Description	User Need ID
NPS-FR-2.1.5	The DSS - Network Prediction Subsystem shall compute network capacities for the HOV/HOT/ML network for the next 1 hour, in 15 minute time slices.	11
NPS-FR-2.1.6	The DSS - Network Prediction Subsystem shall compute a forecast network (freeway, arterial, HOV/HOT/ML) demand for the next 1 hours, in 15 minute time slices	11
NPS-FR-2.1.7	The DSS - Network Prediction Subsystem shall compute a prediction of freeway network demand for the next 1 hour in 15 minute time slices	11
NPS-FR-2.1.8	The DSS - Network Prediction Subsystem shall compute a prediction of HOV/HOT/ML network demand for the next 1 hour, in 15 minute time slices.	11
NPS-FR-2.1.9	The DSS - Network Prediction Subsystem shall compute excess capacity by comparing current real-time demand against stored capacity for the arterial network for the next 1 hour in 15 minute time slices.	11
NPS-FR-2.2	The ICMS shall gauge and report the impact of these strategies on corridor performance to System Managers.	11
NPS-FR-2.3	The DSS - Network Prediction Subsystem shall compute network (freeway, arterial, HOV/HOT/ML) capacities based on inventory information requested from the DSS - Road Asset Configuration and Conditions Data Store.	11

Requirement ID	Description	User Need ID
NPS-FR-2.3.1	The DSS - Network Prediction Subsystem shall compute predicted travel demand patterns for every freeway and arterial network link returned from the DSS - Road Asset Configuration and Conditions Data store via the DSS - Data Hub, and identified as within the ICM boundary with a frequency of every 2 to 5 minutes.	11
NPS-FR-2.4	DSS - Network Prediction Subsystem shall validate a "new" network link added through the DSS - Graphical User Interface for network connectivity and geometric configuration at the time of inclusion, and before being stored in the DSS - Road Asset Configuration and Conditions Data Store.	11
NPS-FR-2.5	The DSS - Network Prediction Subsystem shall maintain secure connections to all other subsystems at all times.	11
NPS-DF-OUT-3.1	The DSS - Network Prediction Subsystem shall disseminate multiple 2D "road network conditions" graphics to the DSS - Data Hub, consisting of forecasted traffic information in 15 minute time slices for 60 minutes into the future.	11
NPS-DF-OUT-3.2	The DSS - Network Prediction Subsystem shall disseminate the predicted "road network conditions" data to the DSS - Data Hub, including the direction, a saturation flag, the oversaturated-threshold that was used during the computation run, the link-traffic-data-algorithm that was used, the predicted delay time, the speed-average, and the predicted level-of-service broken down by lane.	11
NPS-DF-OUT-3.2.1	The DSS - Network Prediction Subsystem shall disseminate "road network conditions" to the DSS - Data Hub which consists of predicted traffic information for the current computational cycle.	11
NPS-DF-OUT-3.2.1.1	The DSS - Network Prediction Subsystem shall disseminate predicted traffic information including a definition of the links, nodes, and routes that make up the road network, and the road conditions for 15 minute intervals.	11

Requirement ID	Description	User Need ID
NPS-DF-OUT-3.2.1.2	The DSS - Network Prediction Subsystem shall disseminate predicted traffic information including the direction, a saturation flag, the oversaturated-threshold that was used during the computation run, the link-traffic-data-algorithm that was used, the predicted delay time, the speed-average, and the predicted level-of-service broken down by lane.	11
NPS-DF-OUT-3.2.1.3	The DSS - Network Prediction Subsystem shall disseminate predicted traffic information including a notification of the prediction's identification of impending "events" within the same 15 minute interval.	11
NPS-DF-OUT-3.2.1.4	The DSS - Network Prediction Subsystem shall disseminate predicted traffic information using the following standards;: [Inside System Boundary]:TMDD ver 3.0 – Req: 3.3.4, 3.3.5, 3.3.6	11
NPS-DF-OUT-3.3	The DSS - Network Prediction Subsystem shall disseminate a Network Prediction "archived data product" to the DSS - Road Asset Configuration and Conditions Data Store, inclusive of all data, meta data, and data catalogs required for other systems to gain access to all of the predicted configuration data, including freeways, arterials, and toll network. This data flow uses the following standards;[Inside System Boundary]: TMDD Requirement: 3.3.7.	11

3.8.12 System Performance Measurement

As shown in Table 3-15, system performance measurement encompasses the collection of data related to system failures, bandwidth allocation, server reliability and availability, communication link performance, and other metrics related to the management of ICMS subsystems.

Table 3-15. ICMS System Performance Management Requirements

Requirement ID	Description	User Need ID
SMS-FR-2.8	**The DSS - Systems Management Subsystem shall monitor the internal systems performance.**	**15.1**
SMS-FR-2.8.1	The DSS - Systems Management Subsystem shall incorporate a network management system capable of 24/7 monitoring of ICMS networks and connected IT equipment (servers, routers, firewalls)	15.1
SMS-FR-2.8.2	The DSS - Systems Management Subsystem (servers, routers, firewalls) shall monitor and report on all subsystem uptime through a continuous 24/7 schedule	15.1
SMS-FR-2.8.3	The DSS - Systems Management Subsystem shall monitor and report on all external system interfaces that fail an "availability test" of 716 out of every 720 consecutive hours	15.1
SMS-FR-2.8.4	The DSS - Systems Management Subsystem shall monitor and report on all internal system interfaces that fail an "availability test" of 716 out of every 720 consecutive hours	15.1

Requirement ID	Description	User Need ID
SMS-FR-2.8	**The DSS - Systems Management Subsystem shall monitor the internal systems performance.**	**15.1**
SMS-FR-2.8.5	The DSS - Systems Management Subsystem shall monitor and report all communication links that fail an "availability test" of 716 out of every 720 consecutive hours	15.1
SMS-FR-2.9.1	The DSS - Systems Management Subsystem shall use a standard time source to synchronize all connected systems to a common time reference	15.1
SMS-FR-2.9.2	The DSS - Systems Management Subsystem shall automatically adjust the standard time source for daylight savings time	15.1
SMS-FR-2.9.3	The DSS - Systems Management Subsystem shall use a network firewall to isolate the ICMS local area network	15.1

3.8.13 System (User Need 16) & Life Cycle (User Need 17) Management

The ICMS will implement a security system that allows the shared viewing of regional resources and the shared control of selected field devices. Shared viewing and control will be subject to regional agreements to be determined. System security will as a minimum implement user privilege levels and a password system linked to user levels. As shown in Table 3-16, the ICMS will provide the capability to add new users, delete users, and modify user privileges. System management also will include the ability to backup critical files on an automatic schedule and to archive data to offline storage for retention purposes.

Software will form an integral part of the ICMS. There is a proliferation of standards, procedures, methods, tools, and environments for developing and managing software. This proliferation has created difficulties in software management and engineering, especially in integrating products and services. The ICMS will use an industry-standard framework that can be used by ICMS developers, managers, operators, maintainers, and trainers to "speak the same language" to create and manage the software component of the ICMS. The IEEE/Electronics Industries Association (EIA) 12207.0-1996 Standard for Life Cycle processes will provide such a framework for the ICMS and guide its use throughout the ICMS life cycle.

The framework covers the life cycle of software from conceptualization of ideas through retirement and consists of processes for acquiring and supplying software products and services. In addition, the framework provides for controlling and improving these processes.

The processes in this IEEE Standard form a comprehensive set. The standard is, therefore, designed to be tailored for an individual project, in this case the ICMS. It is designed to be used when software is an embedded or integral part of the total system, such as is the case with the ICMS.

Table 3-16. ICMS User Need 16 and Life Cycle Management Requirements

Requirement ID	Description	User Need ID
SMS-DF-IN-1	The ICMS shall provide the following administrative functions; a. system wide security functions, b. data backup, c. user account management, d. ICMS configuration data.	16
SMS-DF-IN-1.1	The system shall collect an "agency profile" from the DSS - Graphical User Interface that sets global thresholds, permissions, contacts and process flows.	16
SMS-DF-IN-1.1.1	The DSS - Systems Management Subsystem shall collect rules into the "agency profile" that prevent unauthorized disclosure of information deemed "sensitive" from being disseminated to the 511	16
SMS-DF-IN-1.1.2	The DSS - Systems Management Subsystem shall collect the selections made by a Regional Transportation Operator in the DSS - Graphical User Interface into a "personal preferences profile, including; a) the selection of threshold level configuration for all parameters related to that modal operator's functional system.	16
SMS-DF-IN-1.2	The DSS - Systems Management Subsystem shall collect an Internet-based standard time source	16
SMS-DF-IN-1.3	The DSS - Systems Management Subsystem shall collect all systems based "event" data and log it locally.	16

Requirement ID	Description	User Need ID
SMS-DF-IN-1.3.1	The DSS - Systems Management Subsystem shall collect systems based "event" data sent or generated by the following; a) DSS - Business Rules and Process Management Engine; b) DSS - Data Hub; c) DSS - Graphical User Interface; d) DSS - Legacy CCTV Control Subsystem; e) DSS - Network Prediction Subsystem; f) DSS - Real Time Simulation Subsystem; g) DSS - Response Strategy Data Store; and h) the DSS - Road Asset Configuration and Conditions Data Store	16
SMS-DF-IN-1.4	The DSS - Systems Management Subsystem shall collect subsystem and individual user actions and activities into an Audit Log	16
SMS-DF-IN-1.4.1	The DSS - Systems Management Subsystem shall collect the identity of a user and/or other system prior to granting access to a requested resource. The identify is to be based on a two factor authentication for all "users" at all entry points to the environment.	16
SMS-FR-1	The ICMS shall provide the following administrative functions; a. system wide security functions, b. data backup, c. user account management, d. ICMS configuration data.	16
SMS-FR-2.1	The DSS - Systems Management Subsystem shall store "on-line" documentation, to be available from the DSS - Graphical User Interface.	16
SMS-FR-2.1.1	The DSS - Systems Management Subsystem shall store online configuration management records (CM plan, configuration records, configuration change board minutes).	16
SMS-FR-2.1.10	The DSS - Systems Management Subsystem shall store an online system operator user manual	16

Requirement ID	Description	User Need ID
SMS-FR-2.1.11	The DSS - Systems Management Subsystem shall store online training presentations for operations staff	16
SMS-FR-2.1.12	The DSS - Systems Management Subsystem shall store an online system maintenance manual	16
SMS-FR-2.1.14	The DSS - Systems Management Subsystem shall store online training presentations for maintenance staff	16
SMS-FR-2.1.15	The DSS - Systems Management Subsystem shall store an online system administrator's manual	16
SMS-FR-2.1.2	The DSS - Systems Management Subsystem shall store online training presentations for system administrators	16
SMS-FR-2.1.3	The DSS - Systems Management Subsystem shall store an online database manual	16
SMS-FR-2.1.4	The DSS - Systems Management Subsystem shall store online training presentations for database administrators	16

Requirement ID	Description	User Need ID
SMS-FR-2.1.5	The DSS - Systems Management Subsystem shall store an online external user operations manual	16
SMS-FR-2.1.6	The DSS - Systems Management Subsystem shall store online training presentations for external users	16
SMS-FR-2.1.7	The DSS - Systems Management Subsystem shall store online system development documentation (concept of operations, system requirements specification, system architecture description, system design description, system release notes)	16
SMS-FR-2.1.8	The DSS - Systems Management Subsystem shall store online system test and deployment documentation (system test plan, system test procedures, system test report, system installation plans, system cutover plan)	16
SMS-FR-2.1.9	The DSS - Systems Management Subsystem shall store online interface control documents for all external subsystems (Freeway Management System, Express Lanes Management System, RMIS, LCS, Congestion Pricing System, Transit Management System, Arterial Management System, SPS, CHP CAD, Weather)	16
SMS-FR-2.2	The DSS - Systems Management Subsystem shall protect the environment from unauthorized intentional or unintentional modifications.	16
SMS-FR-2.2.1	The DSS - Systems Management Subsystem shall monitor that secure connections are maintained for all connections between External Systems and the DSS - Data Hub, and between the DSS - Data Hub and all internal DSS - systems.	16

Requirement ID	Description	User Need ID
SMS-FR-2.2.2	The DSS - Systems Management Subsystem shall validate that an operator is able to access the subsystem functionality.	16
SMS-FR-2.2.3	The DSS - Systems Management Subsystem shall collect security information on all data flows within the system boundary and between the system boundary and external transportation information providers. This security information will use industry best practice as defined by the W3C, CIS, and SANS.	16
SMS-FR-2.3	The DSS - Systems Management Subsystem shall incorporate a system backup function using an off-the-shelf application	16
SMS-FR-2.3.1	The DSS - Systems Management Subsystem backup function shall incorporate an automatic scheduling feature	16
SMS-FR-2.3.2	The DSS - Systems Management Subsystem backup process shall include system software applications	16
SMS-FR-2.3.3	The DSS - Systems Management Subsystem backup process shall include all ICMS database files	16
SMS-FR-2.3.4	The DSS - Systems Management Subsystem backup function shall allow the designation of directories and files for backup	16

Requirement ID	Description	User Need ID
SMS-FR-2.3.5	The DSS - Systems Management Subsystem shall incorporate an archival function for historical inventory data using an off-the-shelf application	16
SMS-FR-2.3.6	The DSS - Systems Management Subsystem archival tool shall include a process to create removable media archives	16
SMS-FR-2.4	The DSS - Systems Management Subsystem shall provide controls to enable and disable data publishing feeds from DSS - Systems Management Subsystem to external systems	16
SMS-FR-2.4.1	The DSS - Systems Management Subsystem shall provide controls to enable and disable response plan recommendations to external systems.	16
SMS-FR-2.5	The DSS - Systems Management Subsystem shall provide a program monitor process	16
SMS-FR-2.5.1	The DSS - Systems Management Subsystem program monitor shall automatically initialize and start all processes on the Internal Systems in the required order	16
SMS-FR-2.5.2	The DSS - Systems Management Subsystem program monitor shall continuously monitor all DSS - Systems Management Subsystem processes	16

Requirement ID	Description	User Need ID
SMS-FR-2.5.3	The DSS - Systems Management Subsystem program monitor shall automatically restart processes that terminate abnormally	16
SMS-FR-2.5.4	The DSS - Systems Management Subsystem program monitor shall automatically sequence a process restart to include the correct order of associated process restarts	16
SMS-FR-2.5.5	The DSS - Systems Management Subsystem program monitor shall log all system process restarts with process ID, failure time, restart time and associated process restarts	16
SMS-FR-2.6	The DSS - Systems Management Subsystem shall provide a system administration (administrator, user) user interface	16
SMS-FR-2.6.1	The DSS - Systems Management Subsystem shall provide a user interface to log on and off the system with a username and password	16
SMS-FR-2.6.10	The DSS - Systems Management Subsystem shall provide an interface to edit ITS device access rules for motorist information devices (CMS, HAR)	16
SMS-FR-2.6.2	The DSS - Systems Management Subsystem shall provide an interface to edit ITS device access rules for CMS (organization ID, user ID, time period, allowed functions)	16

Requirement ID	Description	User Need ID
SMS-FR-2.6.3	The DSS - Systems Management Subsystem shall provide a system administrator function to manage (create, modify, delete) user accounts	16
SMS-FR-2.6.4	The DSS - Systems Management Subsystem shall provide an interface to create operator/administrator accounts	16
SMS-FR-2.6.5	The DSS - Systems Management Subsystem shall provide an interface to modify operator/administrator accounts	16
SMS-FR-2.6.6	The DSS - Systems Management Subsystem shall provide an interface to delete operator/administrator accounts	16
SMS-FR-2.6.7	The DSS - Systems Management Subsystem shall ensure there is always at least one active administrator account per server	16
SMS-FR-2.6.8	The DSS - Systems Management Subsystem shall provide an interface to manage (create, modify, delete) user groups	16
SMS-FR-2.6.9	The DSS - Systems Management Subsystem shall incorporate a function to assign system privileges (ITS device access) by user group	16

Requirement ID	Description	User Need ID
SMS-FR-2.7	The DSS - Systems Management Subsystem shall support the capability for the system operator to monitor and control the information collection service from the DSS - Graphical User Interface	16
SMS-FR-2.7.1	The DSS - System Management Subsystem shall manage a "personal preferences profile" for each user logging on to the system.	16
SMS-FR-2.7.1.1	The DSS - Systems Management Subsystem shall store account information (username, password, first name, middle initial, last name, organization ID, location ID, office telephone number, mobile telephone number, e-mail address, fax number, pager number) to be used for establishing a user history with the VCTMC.	16
SMS-FR-2.7.1.2	The DSS - Systems Management Subsystem shall store Contact Details input through the DSS - Graphical User Interface for system administration data (user accounts, participating agency, participating agency location, participating agency source system, facility) for contact in the case of an IT related event	16
SMS-DF-OUT-3.1	The DSS - Systems Management Subsystem shall generate a Response Plan Implementation Summary report, to display the operator based actions issued during an Response Plan Implementation event.	16
SMS-DF-OUT-3.2	The DSS - Systems Management Subsystem shall generate an Action Log (Raw) report, to display in the DSS - Graphical User Interface which consists of the raw system and operator based actions issued during an Response Plan Implementation event. All subsystem (user or machine based) actions are reported in time sequential listing.	16
SMS-DF-OUT-3.3	The DSS - Systems Management Subsystem shall disseminate a Regional Transportation Operator "Profile", that records an operator's selections of map icons, colors, and thresholds to use when displaying a map. These preferences should be customized to an individual operators logon, and loaded into the DSS - Graphical User Interface each time the operator returns to the application.	16

Requirement ID	Description	User Need ID
SMS-DF-OUT-3.4	The DSS - Systems Management Subsystem shall disseminate "contacts" for a participating agency (organization ID, location ID, street address, city, county, state, zip9, primary phone #, fax #, latitude and longitude) for use in orchestrating response plans.	16

APPENDIX A. Acronyms and Abbreviations

511	Regional Traveler Information Phone Number
911	Regional Emergency Phone Number
ADS	Agency Data Server
AID	Automatic Incident Detection
ALPR	Automatic License Plate Recognition
AMS	Analysis, Modeling, and Simulation
A-PeMS	Arterial Performance Management System
Arterial Management System	Regional Arterial Management System
Arterial Management System 4	Traffic Signal Control Platform
Arterial Management System 4+	(Arterial Management System 5) - Upgraded Version of Arterial Management System 4 for Arterial Management System
ATIMS	Advanced Traveler Information Management System
ATIS	Advanced Traveler Information System
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
BTM	Barrier Transfer Machine
3Cs	Command, Control, and Communications Network
CAD	Computer-Aided Dispatch
Caltrans	California Department of Transportation
CCTV	Closed-Circuit Television
CHP	California Highway Patrol
CMS	Changeable Message Sign
COASTER	Express Rail Service between San Diego and Oceanside
Congestion Pricing System	Congestion Pricing System
ConOps	Concept of Operations

DAR	Direct Access Ramp
DHS	Department of Homeland Security
DOT	Department of Transportation
DSS	Decision Support Subsystem (ICMS)
ECC	Emergency Communications Center (San Diego Sheriff Dispatch)
EEP	Emergency Evacuation Plan
EFD	Escondido Fire Department
EIA	Electronics Industries Association
EOC	Emergency Operation Center
EPD	Escondido Police Department
ERP	Emergency Response Plan
ESRI	Environmental Sciences Research Institute
Express Lanes Management System	Managed Lanes Control System
FasTrak®	Fee-Based Transportation Program Allowing Single Drivers Use of I-15 Fast Lanes
FEP	Front End Processor
FMS	Advanced Traffic Management System
FTA	Federal Transit Administration
FWHA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HAZMAT	Hazardous Material
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
I-15	Interstate 15

IAI	Intermodal Agency Integration
IAP	Intermediate Access Point (managed lanes)
ICD	Interface Control Document
ICM	Integrated Corridor Management
ICMS	Integrated Corridor Management System
IDD	Interface Design Document
IEEE	Institute of Electrical and Electronic Engineers
IMTMS	Intermodal Transportation Management System
ISP	Internet Service Provider
ITS	Intelligent Transportation Systems
LCS	Lane Closure System
LOS	Level of Service
ML	Managed Lanes
ML TIM	Managed Lanes Traffic Incident Management
MOMS	Maintenance Online Management System
MTS	Metropolitan Transit System
NCTD	North County Transit District
NIMS	National Incident Management System
NorthCom	North County Fire Communications Joint Powers Authority
NTCIP	National Transportation Communications ITS Protocol
OES	Office of Emergency Services
PDA	Personal Digital Assistant
PeMS	Performance Management System
RCS	Regional Communications System
REMS	Regional Event Management System
RFID	Radio Frequency Identification
RHS	Regional Host Server
RideLink	Region Commuter and Employer Transportation Assistance ProgArterial Management System

RIWS	Regional Integrated Workstation
RLCS	Reversible Lane Control System
RMIS	Ramp Meter Information System
R[M]LCS	Reversible [Managed] Lane Control System
RMS	Ramp Metering System
SAFE	Service Authority for Freeway Emergencies
SANDAG	San Diego Association of Governments
SDD	Systems Design Document
SDFD	San Diego Fire Department
SDPD	San Diego Police Department
SDSD	San Diego Sheriff's Department
SOA	Service-Oriented Architecture
SOV	Single Occupancy Vehicle
SPRINTER	Commuter Light Rail Service between Oceanside and Escondido
SPS	Parking Management System
TDM	Transportation Demand Management
TMC	Transportation Management Center
TMDD	Traffic Management Data Dictionary
TMT	Traffic Management Team
T-PeMS	Transit Performance Measurement System
Transit Management System	Regional Transit Management System
TSCS	Traffic Signal Control System
U.S. DOT	United States Department of Transportation
VDS	Vehicle Detection Stations
VJTOC	Virtual Joint Transportation Operation Center
VMS	Video Management Subsystem (IMTMS)
VOS	Volume, Occupancy, and Speed
VOTT	Value of Travel Time

VTMS	Variable Toll Message Sign
WebEOC	Countywide Web services application currently used for sharing information among a variety of agencies during major emergencies
XML	eXtensible Markup Language

APPENDIX B. Requirements Management Metadata

Requirements Management Metadata

The following requirement attribute data dictionary provides a consistent definition of terms and values that will be used to manage the requirements database. These attributes are associated with each tagged (numbered) requirement in the project requirements database and will be assigned by the Project Team or specific user representation as indicated.

Attribute: Status

Condition of Use
Set after negotiation and review by the project management team. Tracks progress during definition of the project baseline.

Values

Proposed	Used to describe requirements that are under discussion but have not yet been reviewed and accepted by the project stakeholders.
Approved	Capabilities that are deemed useful and feasible and have been approved for implementation by project stakeholders.
Incorporated	Requirements incorporated into the system baseline at a specific point in time.

Applicability
Status attribute applies to system requirements and user interface requirements.

Attribute: Priority

Condition of Use
Set by modal stakeholders. All requirements are not created equal. Ranking requirements by their relative benefit to the end user opens a dialogue with customers, analysts and members of the development team. Used in managing scope and determining development priority.

Values

Critical	Essential requirements. Failure to implement means the system will not meet stakeholder needs. All critical features must be implemented in the release or the schedule will slip.
Important	Features important to the effectiveness and efficiency of the IMTMS for most applications. The functionality cannot be easily provided in some other way. Lack of inclusion of an important requirement may affect customer or user satisfaction, but release will not be delayed due to lack of any important feature.

Useful	Requirements that are useful in less typical applications, will be used less frequently, or for which reasonably efficient workarounds can be achieved. No significant stakeholder satisfaction impact can be expected if such a requirement is not implemented in a release.

Applicability
Priority attribute applies to system requirements and user interface requirements.

Attribute: Level of Effort

Condition of Use
Set by the development team. Because some features require more time and resources than others, estimating the number of team or person-weeks, lines of code required or function points, for example, is the best way to gauge complexity and set expectations of what can and cannot be accomplished in a given time frame. Used in managing scope and determining development priority.

Values
Effort will be quantified in person-weeks.

Applicability
Level of Effort attribute applies to system requirements and user interface requirements.

Attribute: Risk

Condition of Use
Set by development team based on the probability that implementation of this requirement will result in undesirable events, such as cost overruns, schedule delays, or technical hurdles.

Values

Critical	A 75% or greater probability that this requirement implementation will result in an adverse schedule, cost or technical impact to the project
Significant	A 50-74% probability that this requirement implementation will result in an adverse schedule, cost or technical impact to the project
Moderate	A 25-49% probability that this requirement implementation will result in an adverse schedule, cost or technical impact to the project
Minimal	Less than a 25% probability that this requirement implementation will result in an adverse schedule, cost or technical impact to the project

Applicability
Risk attribute applies to System Requirements and User Interface Requirements.

Attribute: Stability

Condition of Use

Set by the project management team based on the probability the requirement will change or the team's understanding of the requirement will change. Used to help establish development priorities and determine those items for which additional elicitation is the appropriate next action.

Values

5	Unanimous consensus among stakeholders on requirement
4	Majority of stakeholders agree with requirement
3	Stakeholders split evenly on requirement
2	Majority of stakeholders disagree with requirement
1	Unanimous consensus against requirement

Applicability

Stability attribute applies to System Requirements and User Interface Requirements.

Attribute: Target Release

Condition of Use

Records the intended system version in which the requirement will first appear. This field can be used to allocate requirements into a particular baseline release. When combined with the status field, the project team can propose, record and discuss various features of the release without committing them to development. Only features whose Status is set to Incorporated and whose Target Release is defined will be implemented. When scope management occurs, the Target Release Version Number can be increased so the item will remain in the requirements document but will be scheduled for a later release.

Values

Target Release attribute will be expressed as a decimal number, e.g., 1.0, 2.1, 3.2, etc.

Applicability

Target Release attribute applies to system requirements and user interface requirements.

Attribute: Assigned To

Condition of Use

Personnel responsible for further elicitation, development of software requirements and implementation. This simple pull down list will help everyone on the project team better understand responsibilities.

Values

This attribute will consist of individual or group names.

Applicability

This attribute applies to system requirements and user interface requirements.

Attribute: Source

Condition of Use

This text field is used to track the source of the requested requirement. Requirements exist for specific reasons. This field records an explanation or a reference to an explanation. For example, the reference might be to a page and line number of a system requirement specification, or to a counter setting on a tape recording of an important user interview.

Values

This attribute value is a free text field that can be used to describe a variety of source types, such as previous documentation, meeting agenda items, etc.

Applicability

This attribute applies to system requirements and user interface requirements.

APPENDIX C. Interface Control Specifications

Included: [6]

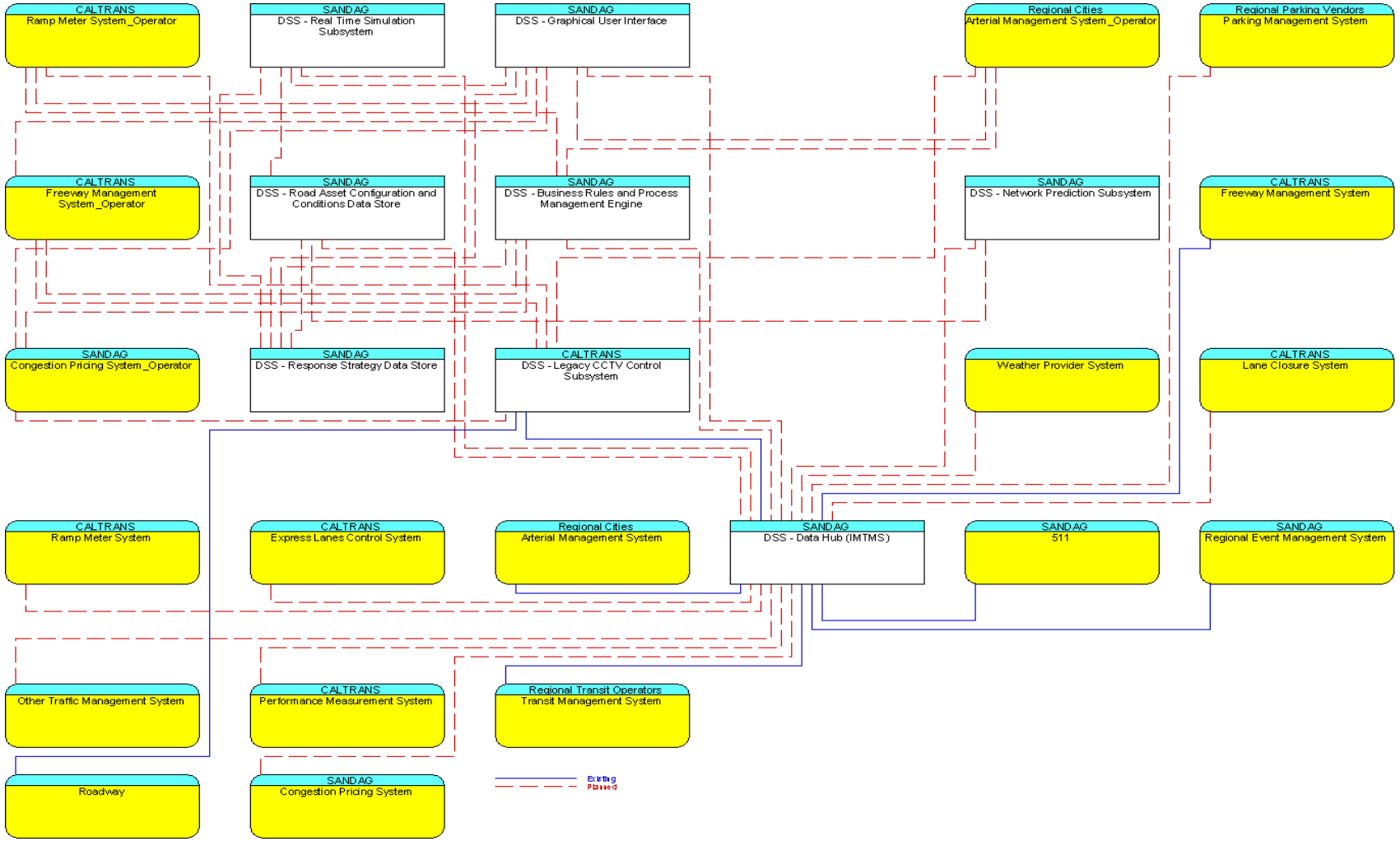
- IMTMS (FMS, REMS, TRANSIT, CHP)
- Congestion Pricing System
- Arterial Management System
- Ramp Metering System
- Parking Management System

[6] Attachments included separately

APPENDIX D. Regional Architecture Diagrams

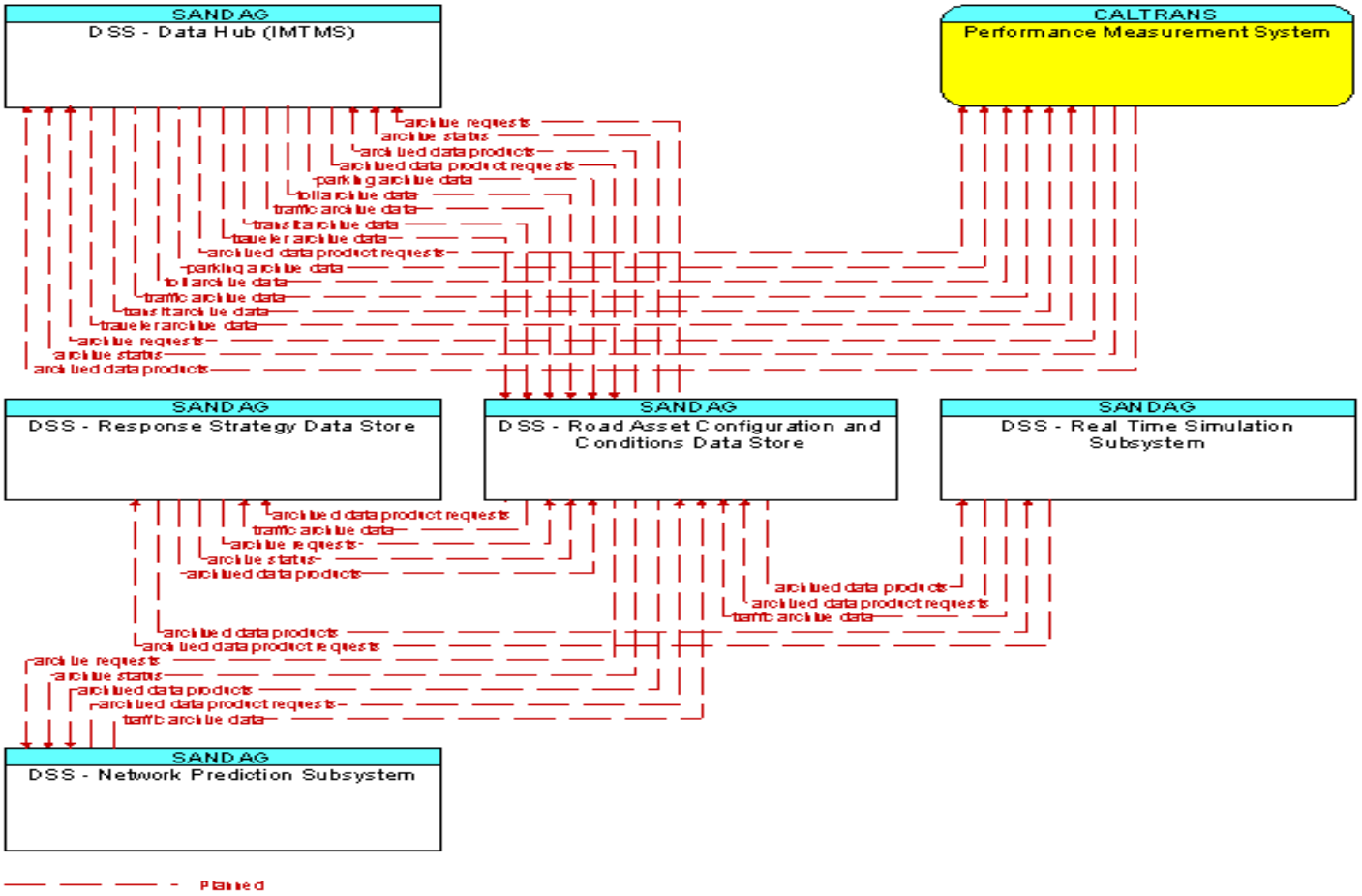
The following set of Market Package and Context diagrams (Figures D-1 to D-6) is provided to aid the review and system design.

Figure D-1. InterConnect



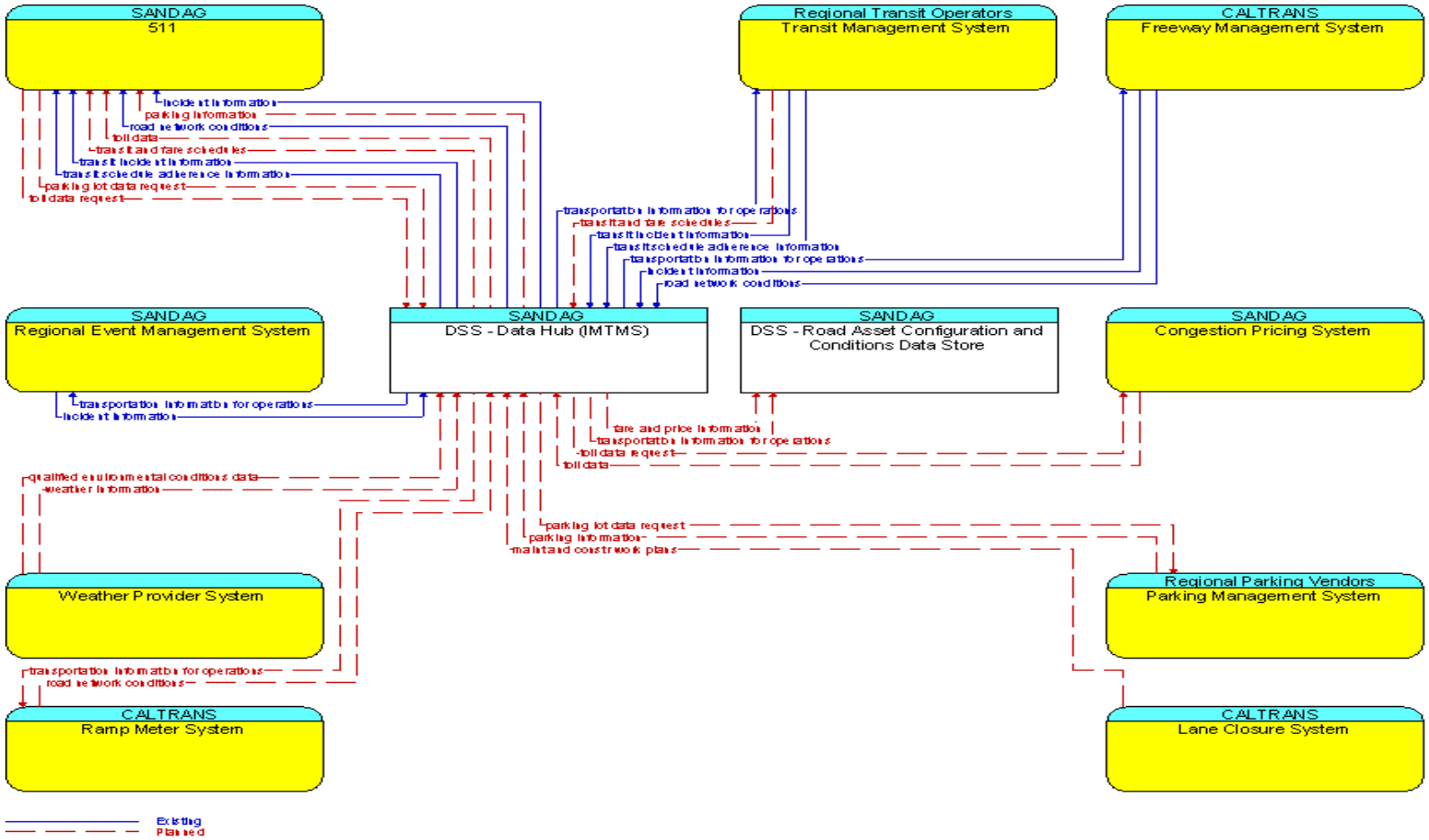
[Source: SANDAG.]

Figure D-2. Market Package: AD2



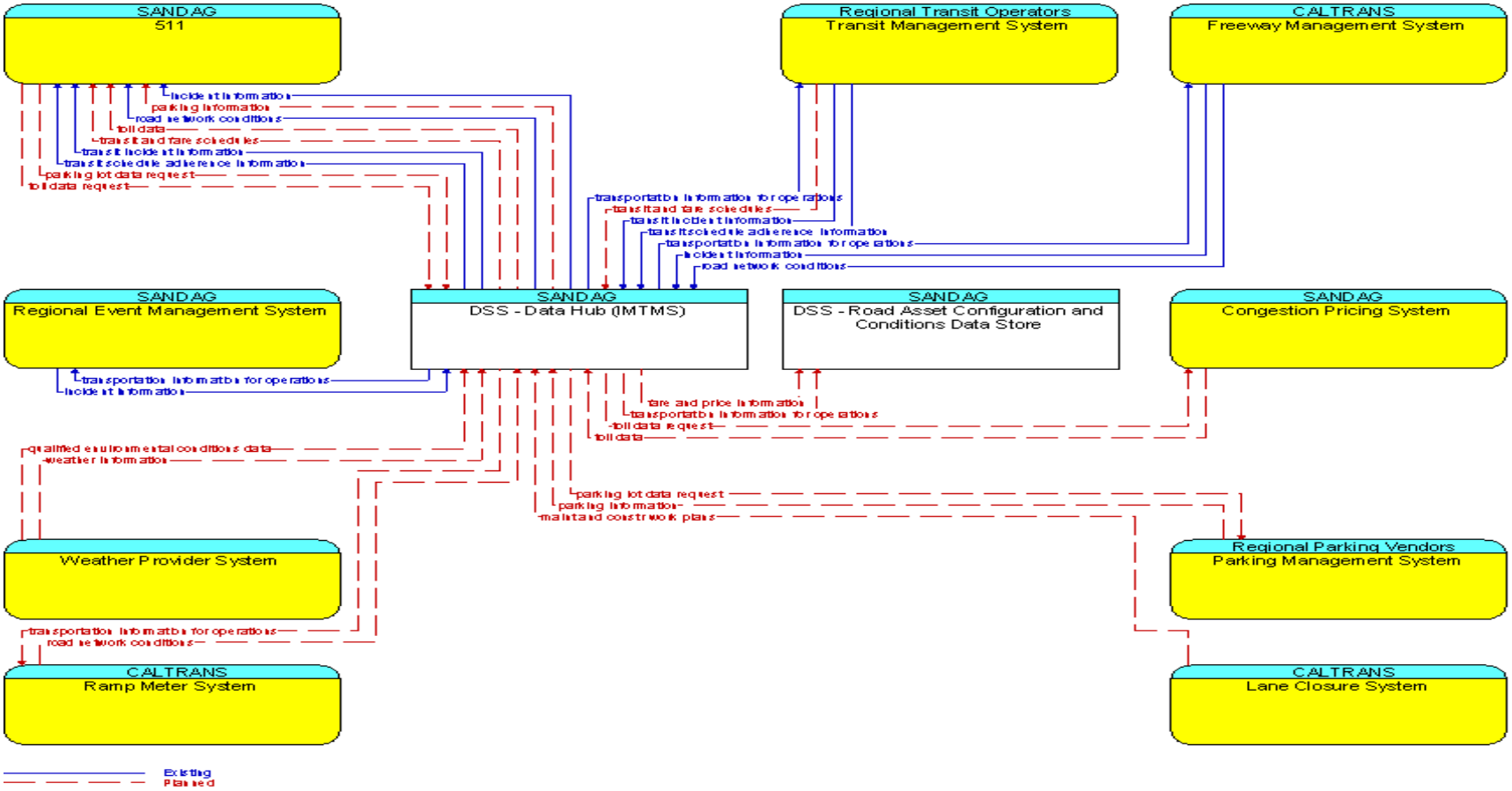
[Source: SANDAG.]

Figure D-3. Market Package: ATIS06



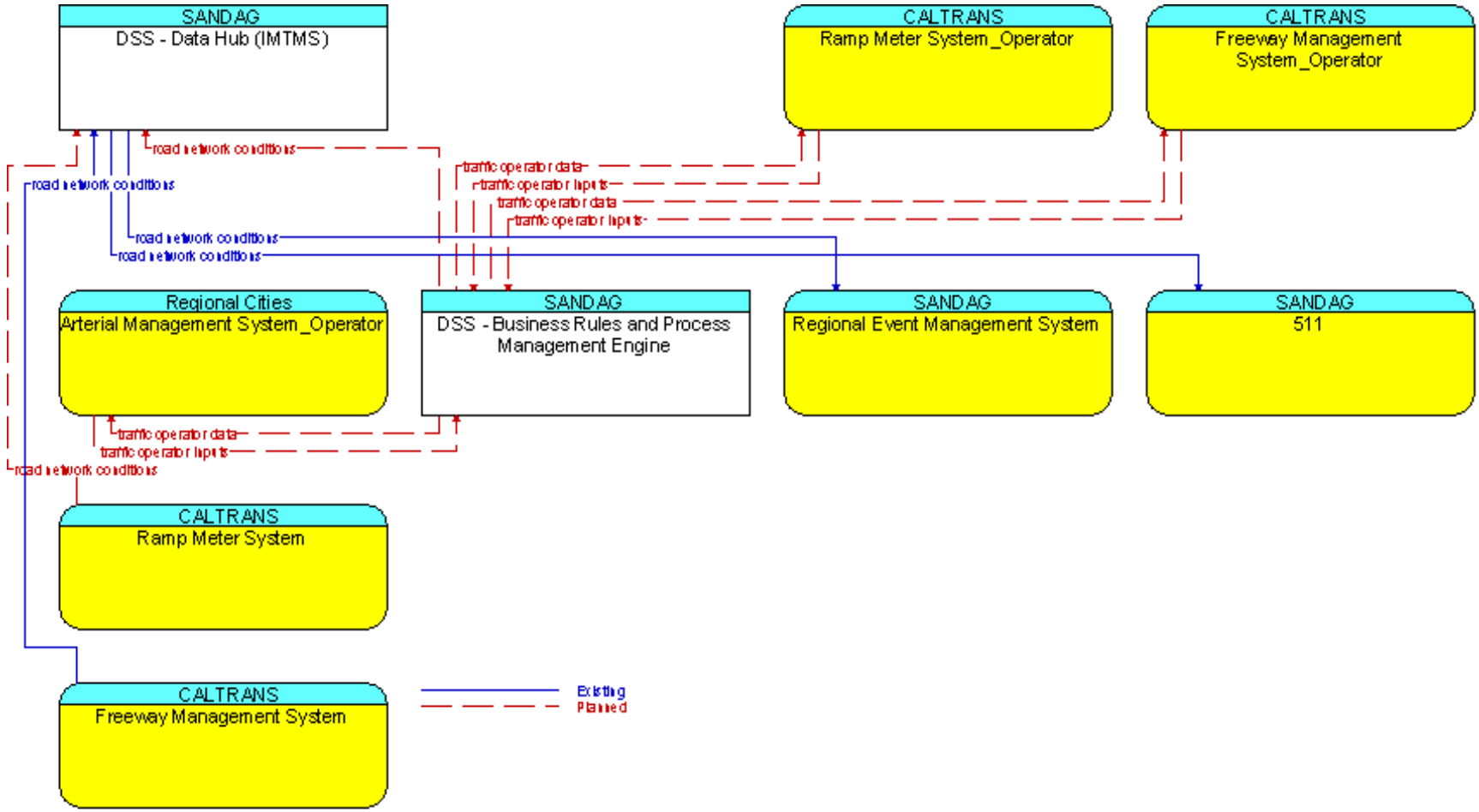
[Source: SANDAG.]

Figure D-4. Market Package: ATMS06



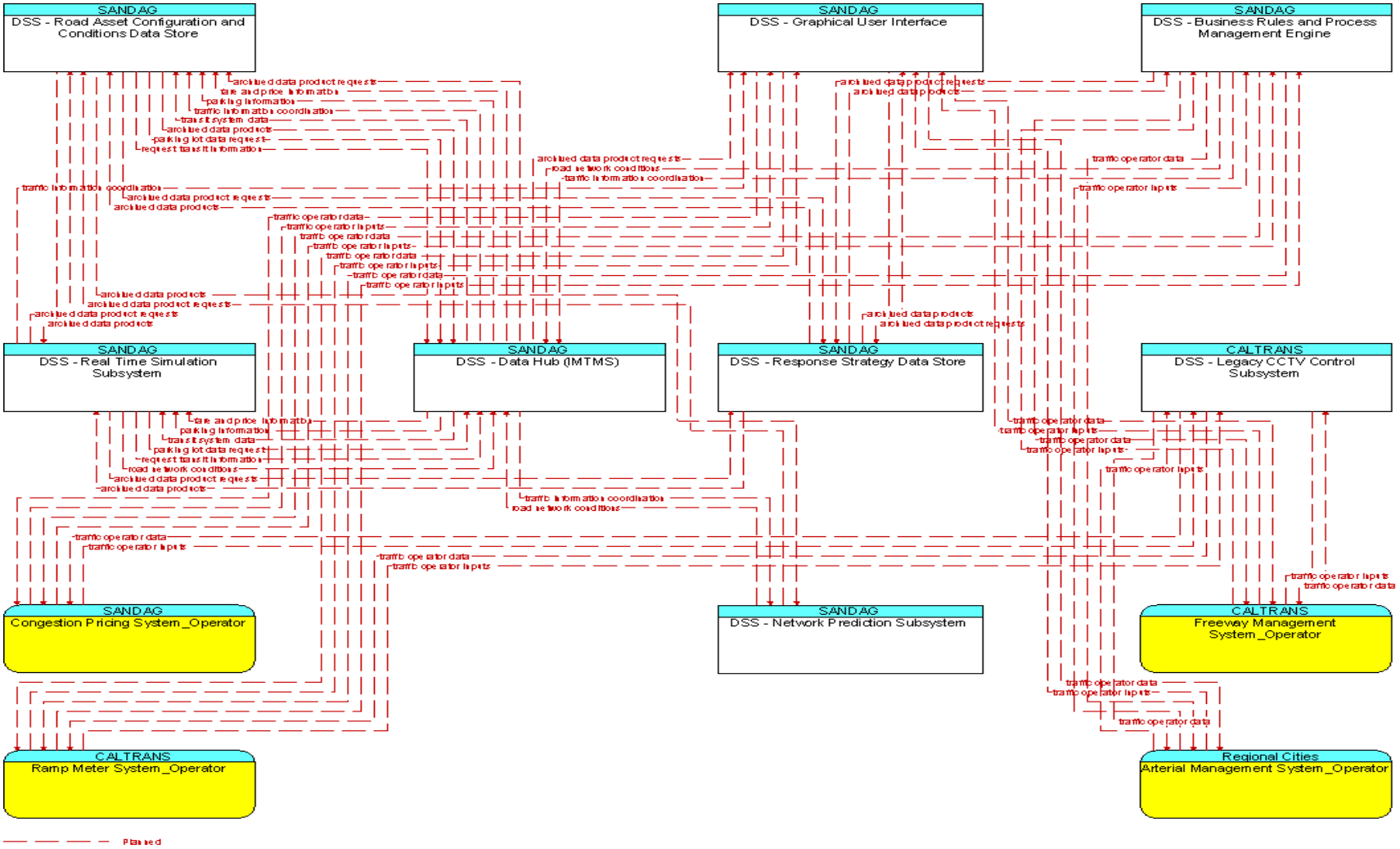
[Source: SANDAG.]

Figure D-5. Market Package ATMS07



[Source: SANDAG.]

Figure D-6. ATMSS09



[Source: SANDAG.]

U.S. Department of Transportation
ITS Joint Program Office-HOIT
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

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