Orange County Intelligent Transportation Systems (ITS) Strategic Deployment Plan 2013 UPDATE

FINAL REPORT

Prepared for

OCTA

Prepared by

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Orange County Intelligent Transportation Systems (ITS)

Strategic Deployment Plan

2013 UPDATE

FINAL REPORT

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REVISION HISTORY

Filename	Version	Date	Author/QC	Comment
OC ITS SDP 011513 (draft_final).docx	1.0	01/04/12	DW/MAH	1st draft
OC ITS SDP 030613 (final).docx	1.1	03/0513	DW/MAH	Revised per comments
OC ITS SDP 041013 (final).docx	1.2	04/10/13	DW	Response to final comments
OC ITS SDP 043013 (final).docx	1.3	04/30/13	DW	Final Report
OC ITS SDP 071113 (final).docx	1.4	07/11/13	DW	Final Report – response to final comments
OC ITS SDP 082213 (final).docx	1.5	08/22/13	DW	Revised Inventory

List of Acronyms

Advanced Traffic Management Systems (ATMS)

Automatic Train Stop (ATS)

Automatic Vehicle Location (AVL)

Bus Rapid Transit (BRT)

California Highway Patrol (CHP)

California Toll Operators Committee (CTOC)

Caltrans Performance Measurement System (PeMS)

Closed-Circuit Television (CCTV)

Comprehensive Transportation Funding Programs (CTFP)

Computer Aided Dispatch (CAD)

Congestion Management Program (CMP)

Corridor Synchronization Performance Index (CSPI)

Department of Transportation (USDOT)

Digital Subscriber Lines (DSL)

Electronic Toll Collection (ETC)

Emergency Vehicle Preemption (EVP)

Federal Highway Administration (FHWA)

Federal Transit Administration (FTA)

Freeway Service Patrol (FSP)

General Packet Radio Service (GPRS)

Geographic Information Systems (GIS)

Global Positioning System (GPS)

High-Occupancy Vehicle (HOV)

Intelligent Transit Management System (ITMS)

Internet Protocol (IP)

Long Range Transportation Plan (LRTP)

Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency (LOSSAN)

Memorandum of Understanding (MOU)

National Electrical Manufacturers Association (NEMA)

National Transportation Communications for ITS Protocol (NTCIP)

Orange County Fire Authority (OCFA)

Orange County Transportation Authority (OCTA)

Parking Guidance Systems (PGS)

Positive Train Control (PTC)

Real-Time Passenger Information System (RTPIS)

Regional Transportation Plan (RTP)

Renewed Measure M (M2)

Return on Investment (ROI)

Riverside County Transportation Commission (RCTC)

Service Authority for Freeway Emergencies (SAFE)

Southern California Association of Governments (SCAG)

Southern California Regional Rail Authority (SCRRA)

Strategic Deployment Plan (SDP)

Transmission Control Protocol/Internet Protocol (TCP/IP)

Technical Advisory Committee (TAC)

Technical Steering Committee (TSC)

Traffic Management Center (TMC)

Traffic management center (TMC)

Transit Signal Priority (TSP)

Transportation Corridor Agencies (TCA)

Transportation System Demand/Transportation Demand Management (TSM/TDM)

Vehicle Miles Traveled (VMT)

EXECUTIVE SUMMARY

Intelligent Transportation System (ITS) refers to the use of communication technologies to improve transportation safety, operations, and efficiency. This definition encompasses a broad range of technologies and has created many opportunities for transportation professionals to respond proactively to increasing demand for effective transportation services. Many of these opportunities are predicated upon effective coordination between organizations, at both the institutional and technical level.

Over the past 20 years, agencies in Orange County have embraced ITS applications as a critical component of its regional transportation management system focus and multi-agency operations strategy. In doing so, the agencies have demonstrated benefits in terms of improved customer service and satisfaction, better on-time performance, and reduced capital and operating costs through technology implementation. The benefits of ITS are wide ranging and powerful—creating systems that are fully connected, information-rich, and able to address safety, mobility, and efficiency. Some of the county's deployments have not only enhanced traffic and transit operations within the county, but have also had far reaching impacts by improving the overall regional systems.

Because the Orange County Transportation Authority (OCTA) has supported advances in transportation technology applications and integration over the years, great strides were made in the use of ITS solutions to manage congestion and make for a safer travel experience within the county's multimodal transportation network. With this strong base of ITS commitment, this update of the Orange County ITS Strategic Deployment Plan (SDP) is a next step in the continued advancement of technology deployment in the county. With the current dynamic, fast-paced deployment environment that Renewed Measure M (M2) supports, this important update to the SDP provides a summary of the direction of operations and the role that technology will play in the coming decade in line with the objectives of the Orange County transportation agencies.

Plan Use and Objectives

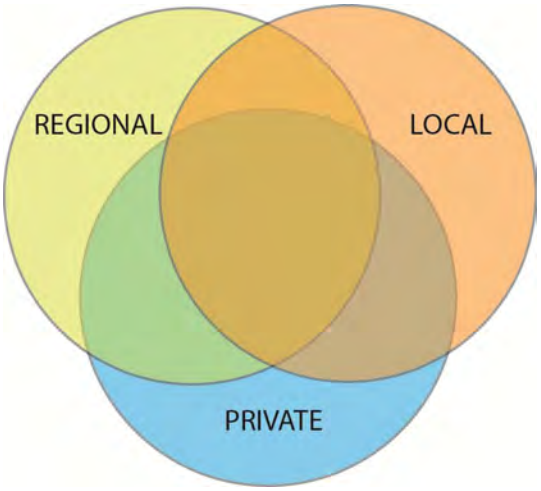
The ITS SDP, last updated in 2007, was drafted to establish, program and communicate strategies for ITS deployment within Orange County. The 2007 Plan was meant to replace the 1998 Orange County ITS Master Plan and provide viable, cost-effective strategies and projects over a 10-year horizon. The Plan defined a vision for Orange County's ITS and included identification of issues and challenges with the existing ITS infrastructure within Orange County.

This 2012 update to the Orange County ITS SDP identifies new and modified needs and objectives and develops a revised, streamlined list of potential ITS strategies to meet these needs over the next ten years. The Plan is intended to provide a framework and guidance to agencies to support the coordinated planning and deployment of these strategies and subsequent projects. It is also intended to bring the region into compliance with federal requirements for keeping the regional ITS architecture (a blueprint for how different ITS systems connect with one another) current while providing an updated basis for compliance for federally-funded projects. This Plan fulfills a critical need for arterial, freeway, transit, and multi-modal ITS projects.

Plan Use and Objectives

The objective of this SDP update is to provide a useful tool for agencies to achieve three primary objectives, as they relate to deployment and use of technologies for the transportation system in Orange County:

1. Continue to build a local foundation for strong future transportation service;
2. Develop regional, multi-modal transportation services, in partnership across the county and into adjacent counties; and
3. Recognize and allow for private sector advancements in appropriate market sectors.



This update has been developed with the intention of providing the stakeholders with the tools to continue to develop the physical and operational foundation to address needs and fill in gaps at a local level. In addition, the update will build on that foundation to further develop regional programs enabling multi-modal and multi-agency system and demand management while enabling private sector innovations where appropriate.

Existing Countywide ITS Programs

OCTA and its partners have deployed technology extensively to improve efficiency and safety across a multi-modal transportation system. Transit, arterial, and freeway management involve the use of ITS applications to support enhanced operations, data sharing, performance monitoring, and traveler information services.

Transit represents a mission-critical function for OCTA, and is a key component of the region's transportation operations and network. OCTA's bus service is supported by several technologies to improve efficiency, service, and security. The bus fleet is outfitted with global positioning system (GPS) based automatic vehicle location (AVL) and fare collection systems to track on-time performance and schedule adherence.

The 34 cities, County of Orange, and the California Department of Transportation (Caltrans) operate a number of traffic signals and advanced traffic management systems (ATMS) within Orange County. A very active and coordinated arterial management programs exists, supported by regular coordination among agencies, OCTA staff support, and a regular funding stream through Project P of M2.

Caltrans District 12 operates their freeway management system from a traffic management center that is collocated with the California Highway Patrol (CHP). The system has the capability to detect and verify incidents, coordinate responses in terms of response and traffic management between CHP and Caltrans.

The 91 Express Lanes is a four-lane, 10-mile-long express toll facility with two toll lanes operating in each direction. The 91 Express Lanes feature all electronic toll collection (ETC) and users of the facility are required to have a FasTrak® transponder. The use and payment on different tolled facilities is seamless to the customer.

OCTA manages the Service Authority for Freeway Emergencies (SAFE) to provide motorists with roadside assistance through the Freeway Service Patrol (FSP). The FSP is a transportation management strategy designed to limit congestion resulting from disabled vehicles in travel lanes.

Advanced traveler information is currently provided within Orange County through numerous outlets. LA SAFE operates both a web based and phone based interactive 511 traveler information service. The 511 system provides traveler information on freeways in Los Angeles, Orange, and Ventura counties primarily, with data also provided for Riverside and San Bernardino counties. The system provides information about traffic drive times and freeway speeds, road construction, incidents, buses and trains, carpool/vanpool, bicycle information, and weather.

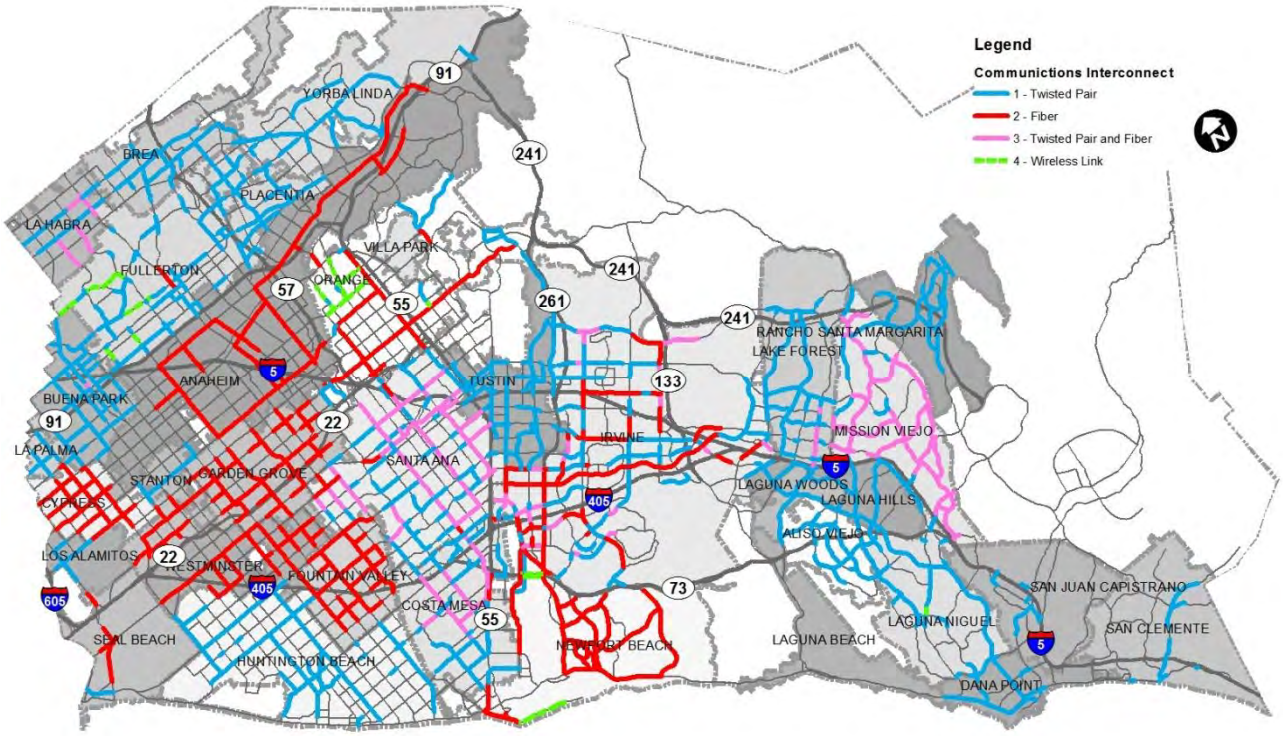
There is a commitment on behalf of OCTA to transparency and accountability, and ITS can help to support the unique data needs to support OCTA's continued focus on performance management. Newly synchronized arterial corridors undergo before and after studies as required by the Regional Traffic Signal Synchronization Program. OCTA also conducts travel time studies of all synchronized corridors every other year. The OCTA geographic information systems (GIS) section manages a data warehouse for the agency's spatial data. The system maintains GIS layers for the county's roadway and transit networks information in a relational database management system. The system archives farebox data collected on buses for service planning and operational analysis. The data tracks ridership activity by route, segment and vehicle.

Regional Communications and Integration

Through OCTA funded programs and local initiatives, traffic system communications are widely deployed across the regional arterial network. Through June 2012, the Master Plan of Arterial Highways (MPAH) has 1,463 center line miles built of which, over 40% was covered by twisted pair or fiber-optic interconnect. The following findings summarize the characteristics and make-up of the communications infrastructure in the county:

- Twisted pair signal interconnect cable remains the most widely used medium for center-to-field communications.
- Agencies that use higher bandwidth single mode fiber-optic (SMFO) cable are concentrated in the north and central areas of the county. In the south, Mission Viejo has the greatest coverage of fiber in its infrastructure.
- Wireless technologies are used for last-mile communications to signals located in the periphery. Wireless technologies are primarily deployed in Fullerton and Orange, due to some topological features that are less favorable for wired interconnect.

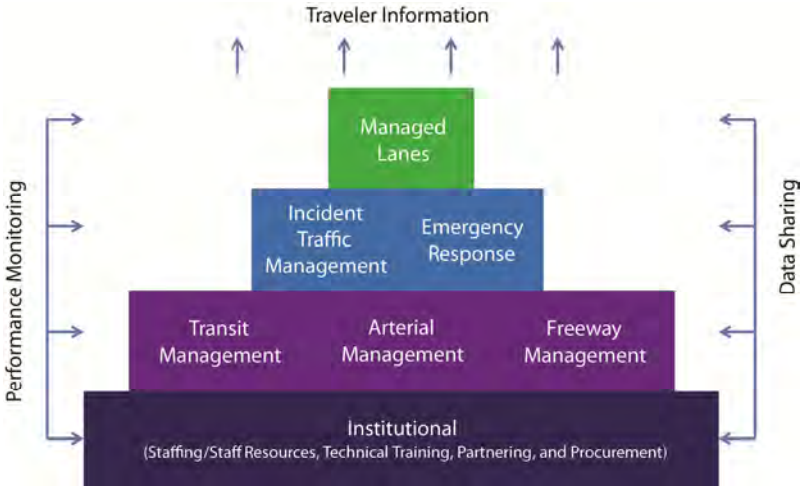
- Most agencies employ distributed networks so that communications is not focused on a centralized location. The communications infrastructure is distributed at key locations throughout the network at hub locations that aggregate connections with field devices. This configuration reduces the impact of losing any single point of communications, resulting in a greater fault tolerance.



The ability to meet future ITS needs starts with a robust communications infrastructure that can expand and evolve with technology. Communication technologies and architecture choices affect a region's ability to keep up with advances in traveler information and active traffic management. As Orange County looks to the next decade of technology deployment in an environment that enables local, regional, and privately-led initiatives, the communications infrastructure choices will become even more critical to operating a cost-effective transportation system for travelers. The ITS SDP identifies strategies for positioning the infrastructure to support greater integration, interoperability and scalability.

ITS Strategies

The collective needs or challenges that exist in the surface transportation environment are the impetus behind ITS planning and architecture development. These needs guide the development of an ITS strategic deployment plan consisting of solutions to those identified challenges, potential integration between new ITS solutions and existing systems, and a framework for implementation of those projects that will ultimately provide the solutions.



Strategies have been identified that will provide the future direction of this ITS SDP. The strategies provide the context for where local agencies, regional agencies, and the private sector are likely to deploy technology now and in the coming ten years. The recommended strategies build upon the current, successful foundation of transit, arterial, and freeway management to provide enhanced operations, data sharing opportunities, performance monitoring, and traveler information. The following table summarizes the breadth of strategies that have been identified for Orange County over the coming decade.

Strategy	Benefits	Integration Opportunities
Transit Management and Multi-Modal		
MM1 – Integrated Transit Management: Roll out the Integrated Transit Management System (ITMS), integrated Transportation Communication System (TCS), Real-Time Passenger Information System (RTPIS), fare collection, and other transit projects to develop a connected, integrated data set for management and planning	▪ Reduced duplication ▪ Better quality data ▪ More robust data for operations and planning	▪ Data sharing within the transit program ▪ Ridership and schedule adherence data for local agencies ▪ Transit usage data for managed lane investment and capital investment planning ▪ Arterial closures and construction activity information can be useful to better managing transit routes
MM2 – Bus Rapid Transit: Roll out BRT service in a two-step implementation process. Technology applications could include TSP (transit signal priority), real-time bus arrival information, and automated fare collection.	▪ Improved customer service and rider experience ▪ Increased ridership ▪ More cost-effective operations on Bravo! routes	▪ Ridership and arrival time data can be shared with other sections at OCTA for planning and project development activities ▪ Data from the ITMS and Integrated TCS can be used to enhance this program ▪ Arterial closures and construction activity information can be useful to better managing transit routes

Strategy	Benefits	Integration Opportunities
MM3 – Rail Operations and Enhancements: Continued rail operations supported by technologies for safety, such as for positive train control, intersection safety, and operations	▪ Increased safety ▪ Improved operations ▪ Increased ridership and multi-modal options for travelers	▪ Construction or traffic conditions (especially during incidents) provided to rail operations ▪ Rail arrival times provided to traffic management agencies, traveler information, and related strategies/programs
MM4 – Integrated Payment: Currently being examined in Orange County in coordination with other Southern California agencies, an integrated payment method that would initially allow for transit payment	▪ Increased ridership and multi-modal options for travelers ▪ Reduced congestion ▪ More cost-effective operations	▪ Integration and streamlining opportunities among transit projects, parking access and revenue control systems, multi-modal centers, FasTrak® operations, and others
MM5 – Support for Pedestrian and Bicycle Travel: local deployments of pedestrian and bicycle safety, bike-sharing and information technologies	▪ Promote non-motorized travel ▪ Increase safety ▪ Reduce congestion	▪ Traveler information services tailored to cyclists and pedestrians
MM6 – Support to Commercial Vehicle Operations (CVO): Primarily privately led, CVO activities will be supported as needed in terms of technology	▪ Improved environment for commercial vehicle operations ▪ Improved safety	▪ Share traffic data with truck dispatch operations to improve trip routing
Traffic Management		
TM1 – Multi-Jurisdictional Arterial Traffic Management: Continue to manage arterials across the county and across jurisdictions; provide a foundation for advanced management and strategies; provide access to more data for operations and planning	▪ Improved mobility ▪ Reduced travel costs ▪ Better data for investment choices	▪ Arterial data can be shared with transit operators, emergency service providers and freeway/managed lanes operators for improved multi-modal operations ▪ Transit routes, ridership, and schedule changes can be useful to arterial management
TM2 – Continued Freeway Traffic Management: Continue to manage freeway traffic through existing and future technology and operational procedures.	▪ Improved mobility ▪ Reduced travel costs	▪ Freeway data is useful to other traffic management strategies and traveler information ▪ Providing access to arterial, transit, and corridor data (including camera images) can add value to freeway management ▪ Physical communications infrastructure has capacity for supporting other strategies
TM3 – Migration to Grid-based Traffic Signal Synchronization: Optimize multiple crossing arterials	▪ Improved progression on arterials ▪ Improved coordination among	▪ Could provide data for transit operations where applicable ▪ Supplement corridor-based MOEs

Strategy	Benefits	Integration Opportunities
through signal synchronization within a grid; upgrade equipment to support grid-based synchronization	crossing arterials ▪ Reduced staff time and cost in accommodating crossing arterials for coordination	with network-based MOEs for performance monitoring
TM4 – Corridor Management: Assess candidate freeway/arterial corridors for enhanced strategies and develop an initial Concept of Operations. Multiple phases would be needed to address feasibility assessment, systems engineering, design, implementation and evaluation.	▪ Improved customer service and traveler experience across modes ▪ Reduced congestion and increased travel time reliability ▪ Improved cross-jurisdictional coordination ▪ Improved capacity balance ▪ More opportunity for demand management	▪ The communications assessment, freeway management system, arterial management systems, and OCTA's intelligent transit management system would collectively provide a strong foundation to build upon for this advanced strategy. ▪ Transit data, construction data, freeway data, arterial data, Freeway Service Patrol (FSP) vehicle locations, etc. can create a more efficient system
TM5 – Regional Coordination of Managed Lanes: Continue 91 Express Lanes operations; extend 91 Express Lanes operational strategies to other corridors and adjacent facilities (where applicable and approved by legislative authority)	▪ Improved customer service and traveler experience ▪ Reduced congestion and increased revenues ▪ Improved cross-jurisdictional coordination	▪ Traffic, revenue, and user experience data can be shared with other agencies for use in planning additional facilities and streamlined operations in other jurisdictions ▪ Operational and project development experiences can be shared with other agencies as facilities are planned and rolled out in other jurisdictions
Incident Management and Emergency Response		
IM1 – Freeway Service Patrol (FSP) Management: Continue FSP management and coordination; continue to improve on efficiencies through enhanced data sets for more efficient research and decision making	▪ More robust research capabilities ▪ Reduced staff time ▪ More effective operational synergies ▪ Reduced program expenditures	▪ Central database and management software/databases used for integrated transit management may be applicable for use by FSP management
IM2 – Emergency Vehicle Preemption (EVP) Migration: Upgrade and enhance emergency vehicle preemption with newer more secure technologies.	▪ Reduce delays for emergency response vehicles ▪ Increase safety for pedestrians, motorists and emergency response vehicles	▪ Global positioning system (GPS) data may be useful outside of the EVP program to local and regional agencies for traffic and safety analyses
IM3 – Arterial-based Incident Traffic Management: Establish a program in Orange County to promote improved arterial incident coordination and response, multi-agency training, and improved freeway-arterial incident	▪ Reduce delays related to incidents on freeways and arterials ▪ Improve traveler information on all modes in the event of incidents and anticipated clearance times ▪ Increase safety for pedestrians,	▪ Data collection on off-ramps and/or arterials used as alternate routes will be critical to optimized incident traffic management; data can also be valuable to local agency operations in terms of investment and staff planning

Strategy	Benefits	Integration Opportunities
management	motorists and emergency response vehicles	▪ Communication infrastructure on highways and arterials can provide a foundation for data sharing within this program (communications master plan can assess this) ▪ Data sharing among agencies, a capability that can be supported through expansion of the performance monitoring program will be highly valuable to building this program
Traveler Information		
TI1 – Continued Expansion of the Southern California 511 Program: Provide enhanced real-time and up-to-date information for Orange County arterials; expand transit trip planner with real-time information, enhance the mobile call box module; integrate private sector sources of data	▪ Encouragement of mode shift to transit ▪ Increased support of transportation program investment ▪ Increased throughput and capacity/demand balance	▪ Data collected through the 511 program can be provided to all transportation agencies for planning, operational analysis and investment decisions. ▪ Local construction data, real-time transit data, and others can be disseminated through these channels ▪ More integration among existing public and private information service providers can provide greater value to travelers and support enhanced traffic and transit management goals ▪ A rich source of crowd-sourced data is available from private sector service providers that can provide predictive area-wide or corridor specific travel times and travel speed information ▪ The private sector Goods Movement industry as a source of truck routing and container tracking data ▪ Connected Vehicles as a real-time travel data gathered from vehicle-to-vehicle or vehicle-to-roadside communications
TI2 – Integrated and Localized Parking Guidance: Seek out additional opportunities for parking guidance systems (PGS) with an emphasis on a regional, integrated parking guidance and information system for park and ride facilities.	▪ Encouragement of mode shift to transit ▪ Increased support of transportation program investment ▪ Increased throughput and capacity/demand balance	▪ Locally deployed PGS can integrate with local arterial management systems ▪ Regional PGS would benefit from real-time and schedules for train and bus arrivals and pricing information on express lanes within southern

Strategy	Benefits	Integration Opportunities
		California
Performance Monitoring		
PM1 – Countywide Performance Monitoring: Collect and analyze data across modes and facilities to track internal performance, investments and needs and report externally to decision makers and the public.	▪ Data for improved operational and investment decisions	▪ Existing and enhanced performance data can support foundational operations and investment planning choices ▪ Integration opportunities among all strategies and modes
Communications and Connectivity		
CC1 – Countywide Communications Master Plan: Physical and logical connectivity to support multi-modal and multi-agency operations and data sharing needs.	▪ Reduced investment duplication and reduced infrastructure costs overall ▪ Redundant infrastructure for emergencies	▪ Communication infrastructure on highways and arterials can provide a foundation for data integration within this program (communications master plan can assess this) ▪ The freeway fiber backbone and existing arterial infrastructure offer potential bandwidth
CC2 – Countywide Connectivity Master Plan: Design a method of data sharing across the county for traffic, transit, non-motorized, operations, and planning data.	▪ Data for improved operational and investment decisions ▪ Communications standards resulting from this study can reduce investment duplication and improve competition in the current environment	▪ Data sharing among agencies can be supported through establishment of the performance monitoring program foundation ▪ The ITMS and integrated TCS being rolled out by the transit group at OCTA offers extensive opportunities for data collection, sharing and integration in concert with this program ▪ Integration opportunities among all strategies and modes
CC3 – Provide a Connected Vehicles Platform: Allow for the future possibility of connected vehicles in order to capitalize on the robust local operational environment and further enhance the existing foundation	▪ Potential for major advancement in integrated traveler information and management ▪ Potential access to additional transportation funding	▪ Significant integration opportunities and needs with all modes and strategies
Safety		
SF1 – Bicycle Detection: Support on-going, local implementation of bicycle detection technologies, with	▪ Increase multi-modal options ▪ Increase safety for non-motorized	▪ Bicycle usage data to improve signal coordination

Strategy	Benefits	Integration Opportunities
implementation focused on bike and transit hubs	travelers ▪ Reduce congestion ▪ Reduce greenhouse gas emissions	▪ Telematics to provide in-vehicle alert to drivers
SF2 – Pedestrian Detection: Support on-going local implementation of pedestrian detection technologies; future technologies might include telematics	▪ Increase multi-modal options ▪ Increase safety for non-motorized travelers ▪ Reduce congestion ▪ Reduce greenhouse gas emissions	▪ Pedestrian usage data to improve signal coordination ▪ Telematics to provide in-vehicle alert to drivers
SF3 – Transit Security: Support data sharing between transit agencies and law enforcement to ensure passenger safety and security	▪ Increase safety for non-motorized travelers ▪ Promote transit adoption	▪ Share video fields and transit vehicle location data using the ITMS infrastructure
Institutional		
IN1 – Continuously Improve Staffing Levels and Skillsets: Establish a countywide training program recognizing the fast paced, dynamic technology environment	▪ Increased skillsets ▪ Reduced training expense ▪ Potential for shared resources (reduced costs)	▪ N/A
IN2 – Formalize Sub-regional Partnerships: Establish northern and southern county partnership groups for sharing information and best practices	▪ Increased skillsets and information sharing ▪ Improved operations ▪ Reduced duplication of effort and investment ▪ Potential for shared resources	▪ N/A

Performance Monitoring and Reporting Plan

Performance measurement helps to ensure that the benefits of ITS investments are quantified and operations are optimized to the greatest extent possible. Agencies that monitor performance can demonstrate to taxpayers that their dollars are being spent wisely. OCTA is interested in implementing a countywide performance monitoring program that establishes a baseline understanding of how well the transportation system performs, from which performance data can drive decisions on how operations and ITS investments can be strategically leveraged to maximize efficiency.

The table below maps OCTA's strategic goals and objectives achievable through investment in ITS and performance measures to evaluate the effectiveness of those investments. The performance measures are targeted at different audiences who process and utilize the information in the following ways:

- **Mobility**: Performance measures that evaluate goals and objectives to improve mobility are targeted at local agencies and staff, who benefit from detailed, technical data to evaluate the operational improvements from signal synchronization and transit priority projects.
- **Public Service**: Performance measures that evaluate goals and objectives to improve public service are focused on translating the detailed, traffic or transit performance data into terms that are readily understood from the perspective of a commuter or transit user as a member of a general public.

  Fiscal Sustainability, Stewardship and Organizational Excellence: Performance measures that evaluate goals and objectives related to fiscal sustainability is the focus of policy makers. These measures compare the dollar investments in project implementation with the quantified benefits from the operations and maintenance of those ITS systems or technologies.

Goal	Objectives	Measures of Effectiveness (MOEs)
Mobility	▪ Travel Time and Speed ▪ Capacity and Level of Service ▪ Operational Performance ▪ Quality and Ease of Use	▪ Arterial/Highway corridor travel time, delay and average speed ▪ Transit route travel time, delay and average speed ▪ Corridor Synchronization Performance Index (CSPI): average speed; greens to red; and number of stops ▪ Vehicle throughput on key corridors ▪ Transit ridership
Public Service	▪ Public Awareness and Perception ▪ Customer Satisfaction ▪ Community Engagement ▪ Collaborative Planning	▪ Travel time reliability ▪ Travel time reduction ▪ Corridor Synchronization Performance Index (CSPI) ▪ Travel time savings (dollar equivalent) ▪ Transit vehicle on-time performance ▪ Transit passenger complaints ▪ 511 traveler information usage ▪ Freeway Service Patrol usage ▪ Freeway Service Patrol vehicle performance
Fiscal Sustainability, Stewardship, and Organizational Excellence	▪ Financial Management ▪ Efficient Operations ▪ External Funding Maximized ▪ Investment Protection	▪ Return on Investment (ROI) ▪ Cost to Benefit Ratio ▪ Fare box recovery ratio ▪ Transit vehicle service calls ▪ Communication up-time ▪ Hardware rate of failure ▪ Reduction in fuel consumption ▪ Reduction in tail pipe emissions

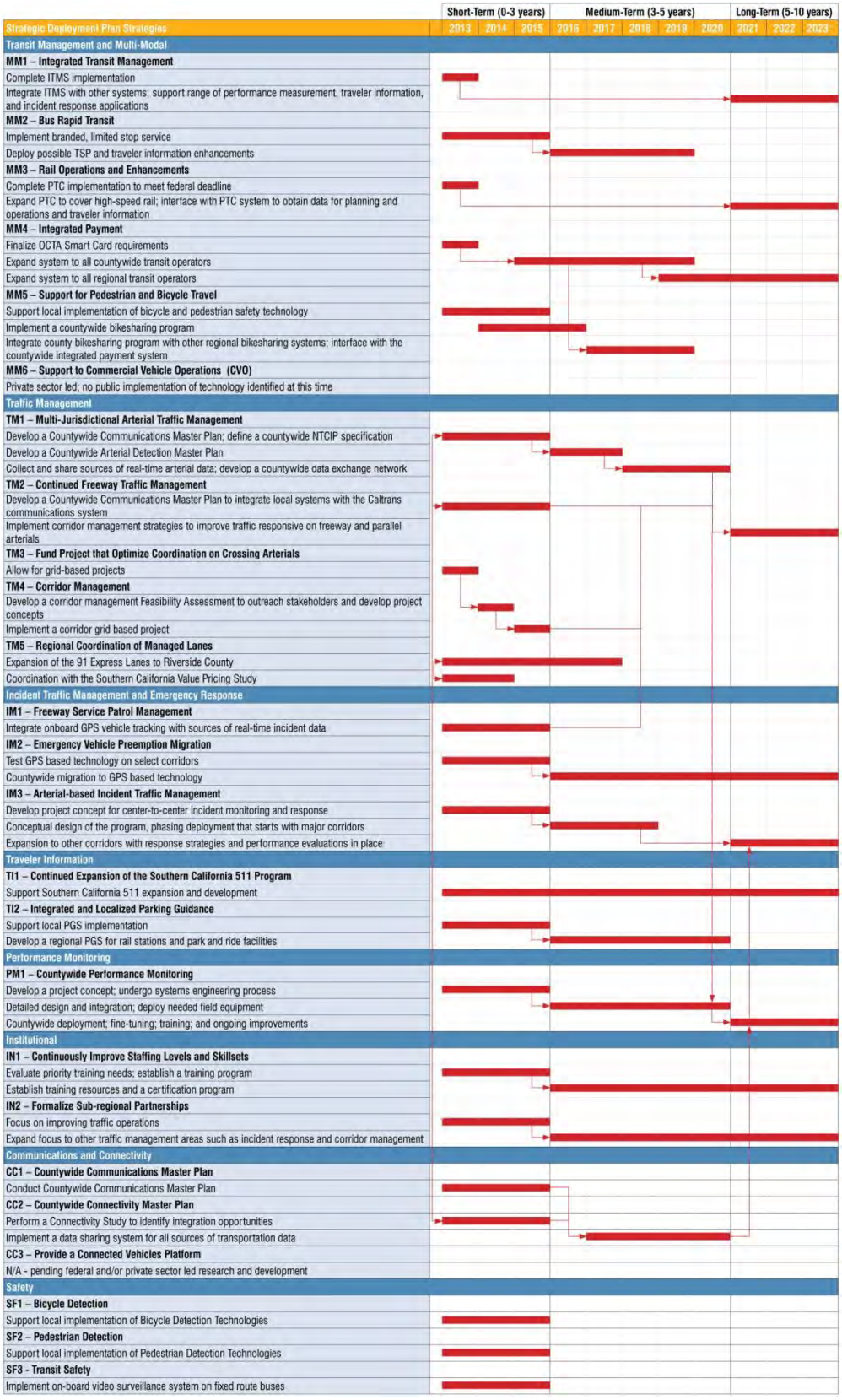
Phased Deployment Plan

OCTA, in partnership with the cities, County of Orange and Caltrans, has embraced ITS in achieving advances in multi-jurisdictional arterial traffic management, development of a robust freeway management infrastructure and effective use of technology in transit operations. These advances have set the foundation for advancing towards integrated transportation management and multi-agency coordination that have a regional focus. This ITS SDP have identified strategies and projects to realize OCTA's vision and position the region for opportunities to deploy emerging technologies that have the potential to improve mobility, safety and efficiency on a multi-modal transportation system.

The ITS strategies constitute critical actions to guide project development and implementation efforts in the next decade to support OCTA's mission in its Long Range Transportation Plan to deliver an effective transportation system. This section outlines a roadmap for implementing the strategies over a ten-year timeline in an approach that phases these actions in logical order by identifying the interconnections between strategies that may take place in sequential order or in parallel. For example, regional arterial traffic management requires communications master planning and arterial detection deployment before integrated systems can provide data sharing capabilities to support coordinated traffic operations and performance monitoring at the regional level.

The figure below illustrates the deployment plan for implementing the strategies proposed in this ITS SDP. The timeline is organizes the deployment of the twenty-two ITS strategies described in Section 5 into three distinct time frames.

- Short-term: these strategies and projects are taking place now or within three years;
- Medium-term: these strategies and projects would take place between 3 to 5 years from now; and
- Long-term: these strategies and projects would take place between 5 to 10 years from now.


Short-Term (0-3 years)
Medium-Term (3-5 years)
Long-Term (5-10 years)
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Strategic Deployment Plan Strategies
Transit Management and Multi-Modal
MM1 – Integrated Transit Management
Complete ITMS implementation
Integrate ITMS with other systems; support range of performance measurement, traveler information, and incident response applications
MM2 – Bus Rapid Transit
Implement branded, limited stop service
Deploy possible TSP and traveler information enhancements
MM3 – Rail Operations and Enhancements
Complete PTC implementation to meet federal deadline
Expand PTC to cover high-speed rail; interface with PTC system to obtain data for planning and operations and traveler information
MM4 – Integrated Payment
Finalize OCTA Smart Card requirements
Expand system to all countywide transit operators
Expand system to all regional transit operators
MM5 – Support for Pedestrian and Bicycle Travel
Support local implementation of bicycle and pedestrian safety technology
Implement a countywide bikesharing program
Integrate county bikesharing program with other regional bikesharing systems; interface with the countywide integrated payment system
MM6 – Support to Commercial Vehicle Operations (CVO)
Private sector led; no public implementation of technology identified at this time
Traffic Management
TM1 – Multi-Jurisdictional Arterial Traffic Management
Develop a Countywide Communications Master Plan; define a countywide NTCIP specification
Develop a Countywide Arterial Detection Master Plan
Collect and share sources of real-time arterial data; develop a countywide data exchange network
TM2 – Continued Freeway Traffic Management
Develop a Countywide Communications Master Plan to integrate local systems with the Caltrans communications system
Implement corridor management strategies to improve traffic responsive on freeway and parallel arterials
TM3 – Fund Project that Optimize Coordination on Crossing Arterials
Allow for grid-based projects
TM4 – Corridor Management
Develop a corridor management Feasibility Assessment to outreach stakeholders and develop project concepts
Implement a corridor grid based project
TM5 – Regional Coordination of Managed Lanes
Expansion of the 91 Express Lanes to Riverside County
Coordination with the Southern California Value Pricing Study
Incident Traffic Management and Emergency Response
IM1 – Freeway Service Patrol Management
Integrate onboard GPS vehicle tracking with sources of real-time incident data
IM2 – Emergency Vehicle Preemption Migration
Test GPS based technology on select corridors
Countywide migration to GPS based technology
IM3 – Arterial-based Incident Traffic Management
Develop project concept for center-to-center incident monitoring and response
Conceptual design of the program, phasing deployment that starts with major corridors
Expansion to other corridors with response strategies and performance evaluations in place
Traveler Information
TI1 – Continued Expansion of the Southern California 511 Program
Support Southern California 511 expansion and development
TI2 – Integrated and Localized Parking Guidance
Support local PGS implementation
Develop a regional PGS for rail stations and park and ride facilities
Performance Monitoring
PM1 – Countywide Performance Monitoring
Develop a project concept; undergo systems engineering process
Detailed design and integration; deploy needed field equipment
Countywide deployment; fine-tuning; training; and ongoing improvements
Institutional
IN1 – Continuously Improve Staffing Levels and Skillsets
Evaluate priority training needs; establish a training program
Establish training resources and a certification program
IN2 – Formalize Sub-regional Partnerships
Focus on improving traffic operations
Expand focus to other traffic management areas such as incident response and corridor management
Communications and Connectivity
CC1 – Countywide Communications Master Plan
Conduct Countywide Communications Master Plan
CC2 – Countywide Connectivity Master Plan
Perform a Connectivity Study to identify integration opportunities
Implement a data sharing system for all sources of transportation data
CC3 – Provide a Connected Vehicles Platform
N/A - pending federal and/or private sector led research and development
Safety
SF1 – Bicycle Detection
Support local implementation of Bicycle Detection Technologies
SF2 – Pedestrian Detection
Support local implementation of Pedestrian Detection Technologies
SF3 - Transit Safety
Implement on-board video surveillance system on fixed route buses

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1. INTRODUCTION

Intelligent Transportation System (ITS) refers to the use of communication technologies to improve transportation safety, operations, and efficiency. This definition encompasses a broad range of technologies and has created many opportunities for transportation professionals to respond proactively to increasing demand for effective transportation services. Many of these opportunities are predicated upon effective coordination between organizations, at both the institutional and technical level.

Over the past 20 years, Orange County agencies have embraced Intelligent Transportation System (ITS) applications as a critical component of its regional transportation management system focus and multi-agency operations strategy. In doing so, they have demonstrated benefits in terms of improved customer service and satisfaction, better on-time performance, and reduced capital and operating costs through technology implementation. The benefits of ITS are wide ranging and powerful—creating systems that are fully connected, information-rich, and able to address safety, mobility, and efficiency. Some of the county's deployments have not only enhanced traffic and transit operations within the county, but have also had far reaching impacts by improving the overall regional systems, including projects such as the 91 Express Lanes (the first express lane facility in the nation); Smart Streets introduced in the 1990s (e.g., Beach Boulevard); decades of highly advanced transit operations; and a robust, well-funded traffic signal synchronization program.

Because OCTA has supported advances in transportation technology applications and integration over the years, great strides were made in the use of ITS solutions to manage congestion and make for a safer travel experience within the county's multimodal transportation network. In the past decade, Orange County has focused heavily on building strong foundations, including:

- The traffic signal synchronization program has resulted in significant improvements in mobility on key arterials;
- OCTA's transit program has continued to advance through technology applications;
- Caltrans District 12 has improved the freeway management infrastructure to over 90% of freeway vehicle detectors reporting;
- Many cities have established traffic management centers and actively monitor arterial traffic conditions; and
- A strong progression of institutional partnership has flourished.

With this strong base of ITS commitment, this update of the Orange County ITS Strategic Deployment Plan (SDP) is a next step in the continued advancement of technology deployment in the county. With the current dynamic, fast-paced deployment environment that Renewed Measure M (M2) supports, this important update to the SDP provides a summary of the direction of operations and the role that technology will play in the coming decade in line with the objectives of the Orange County transportation agencies. By recognizing the system operation advances and the various options to continue to incorporate ITS strategies in the future, the partners will continue to build upon the comprehensive approach that has been a hallmark of their focus on strategic, forward thinking ITS planning efforts that will have positive impacts throughout the region.

1.1 ITS Strategic Deployment Plan Overview

The ITS SDP, last updated in 2007, was drafted to establish, program and communicate strategies for ITS deployment within Orange County. This Plan was meant to replace the 1998 Orange County ITS Master Plan and provide viable, cost-effective strategies and projects over a 10-year horizon. The 2007 Plan defined a vision for Orange County's ITS and included identification of issues and challenges with the existing ITS infrastructure within Orange County.

This 2012 update to the Orange County ITS SDP identifies new and modified needs and objectives and develops a revised, streamlined list of potential ITS strategies to meet these needs over the next ten years. The Plan is intended to provide a framework and guidance to agencies to support the coordinated planning and deployment of these strategies and subsequent projects. It is also intended to bring the region into compliance with federal requirements for keeping the regional ITS architecture (a blueprint for how different ITS systems connect with one another) current while providing an updated basis for compliance for federally-funded projects. This Plan fulfills a critical need for arterial, freeway, transit, and multi-modal ITS projects.

1.2 Alignment with OCTA's Strategic Plan and Goals

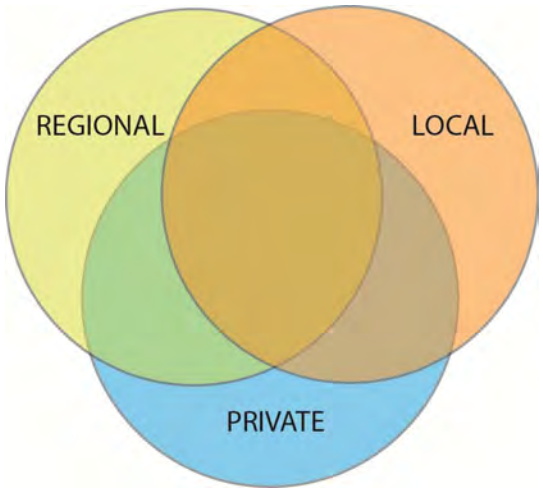
The timing of this update also provides OCTA with an opportunity to align this ITS SDP and hence, Orange County's ITS program, with the 2011 OCTA Strategic Plan. The vision articulated in that plan is: "An integrated and balanced transportation system that supports the diverse travel needs and reflects the character of Orange County". The ITS program, and OCTA's commitment to cost-effective and creative uses of technology to support mobility and safety on the County's transportation network will directly support this countywide vision.

The 2011 OCTA Strategic Plan identified five key goals that will guide priorities and investments for the Authority. The ITS SDP, and the ITS priorities in Orange County directly link to each of these five important goals:

Mobility	Public Service	Fiscal Sustainability	Stewardship	Organizational Excellence
Deliver programs, projects and services to improve the movement of people and goods throughout Orange County and the region. OBJECTIVES: ▪ Travel Time and Speed ▪ Capacity and Level of Service ▪ Operational Performance ▪ Quality and Ease of Use	Enhance customer satisfaction by understanding, connecting with and serving our diverse communities and partners. OBJECTIVES: ▪ Public Awareness and Perception ▪ Customer Satisfaction ▪ Community Engagement ▪ Collaborative Planning	Ensure fiscal health through prudent financial management and by protecting and leveraging available revenue sources. OBJECTIVES: ▪ Financial Management ▪ Efficient Operations ▪ External Funding Maximized ▪ Investment Protection	Embrace responsible policies and practices designed to promote environmental sustainability and enhance the safety and quality of life in Orange County. OBJECTIVES: ▪ Project Delivery ▪ Environmental Sustainability ▪ Safety	Continue the tradition of being a high-performing organization through employee development and efficient business practices. OBJECTIVES: ▪ People Development ▪ Processes Improvements ▪ Systems Efficiencies
ITS SDP Alignment				
▪ Expand corridor and network management focus to improve travel countywide ▪ Promote multi-modal and cross jurisdictional operational integration ▪ Foster transportation system partnerships among state, regional and local operating agencies ▪ Support improved mobility and safety for goods movement	▪ Demonstrate a progressive and cohesive countywide approach to system operations and improvements ▪ Provide enhanced Orange County transportation system data to the Southern California 511 system to benefit many users ▪ Collaborate with partners on planning for high-impact operational strategies	▪ Leverage communications infrastructure to minimize duplicate investments ▪ Maximize available federal and local funds by prioritizing high impact projects that align with strategic objectives ▪ Establish economies of scale for technology investments through collaboration ▪ Promote innovative partnerships for transportation system operations, maintenance and management	▪ Improve safety for all users of the multimodal transportation system ▪ Establishes realistic phasing and implementation scenarios for ITS projects in Orange County Support environmental sustainability objectives by reducing delay and vehicle trips, and using technology	▪ Provide required technical training to staff for operations and management of technology investments ▪ Improve staff and system efficiency through technology and automating processes ▪ Forecast ITS infrastructure and technical requirements to inform future staffing and technical skill needs

1.3 Plan Use and Objectives

The objective of this SDP update is to provide a useful tool for agencies to achieve three primary objectives, as they relate to deployment and use of technologies for the transportation system in Orange County:

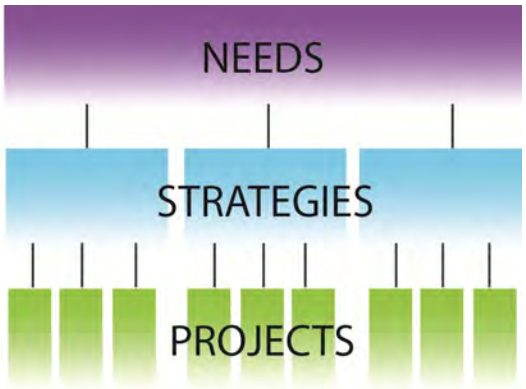


1. Continue to build a local foundation for strong future transportation service;
2. Develop regional, multi-modal transportation services, in partnership across the county and into adjacent counties; and
3. Recognize and allow for private sector advancements in appropriate market sectors.

This update has been developed with the intention of providing the stakeholders with the tools to continue to develop the physical and operational foundation to address needs and fill in gaps at a local level. In addition, the update will build on that foundation to further develop regional programs enabling multi-modal and multi-agency system and demand management while enabling private sector innovations where appropriate. Furthermore, the SDP includes guidance for moving forward with project implementation, and providing technology and communications infrastructure that improves safety and mobility within Orange County.

1.4 Process to Update the ITS Strategic Deployment Plan

This strategic planning process was based on input from a wide range of stakeholders in the county and reflects the results of a six month process to update the Plan previously prepared in 2007. Based on the stakeholder input and a review of existing documentation for long range planning and specific projects and programs, the current state of technology in support of transportation was outlined. Following this existing conditions description as the starting point, a needs assessment was conducted and a resulting list of strategies was defined to reflect the full breadth of ITS potential in the county. The strategies are a combination of current efforts, enhancements to those efforts, and recommendations for additional focus areas.



In addition, the ITS SDP includes the following elements to position the program to pursue integration opportunities, measure performance and adopt future technologies:

1. Each strategy was then described in terms of the current status and future plans, integration opportunities and phasing. The phased deployment anticipated for each strategy in turn defines the "projects" that comprise the deployment plan.

2. Performance measures are based on the initial needs in order that after strategies and projects are deployed, the performance can be measured against the original expectations.

3. A high level communications assessment supports future, more detailed study into a cost effective method of establishing the infrastructure needed to enable the roll-out of the program, especially for those aspects that are regional and wide reaching in nature.

4. The regional ITS architecture was also updated as a part of this effort to encompass the potential technologies that may be deployed in the next ten years. Since technology advances at such a rapid pace, it is realistic to assume that there may be technologies or projects that were not included in this plan (especially in the longer term). These projects can be appended to the architecture at the time of deployment or the architecture can be updated to reflect the project(s). The latter is recommended in cases where the project has significant integration and relationships with other existing technologies.

1.5 Timeframe

According to federal guidelines, the regional ITS architecture (and in the case of Orange County, this related Plan) should look far enough into the future so that the efficient integration of ITS services can be guided over time. The OCTA Long Range Transportation Plan, *Destination 2035*, is intended to guide investments with a long-term planning horizon. The Orange County ITS SDP's planning horizon is **10 years**, which should leverage most of the system integration opportunities as anticipated by the stakeholders, yet represents a reasonable planning horizon for technologies, given the fast-evolving nature of this industry.

1.6 Federal Requirements

Federal regulations require that ITS projects funded with Highway Trust Funds to conform to the National ITS Architecture and approved ITS standards; be guided by a regional architecture for geographic boundaries and defined by stakeholder needs; and utilize a system engineering analysis that considers the total project life-cycle. These requirements are documented in Federal Highway Administration (FHWA) Rule 940 and the associated Federal Transit Administration (FTA) Policy, and apply to all projects using funds made available from the Highway Trust Fund to ensure conformance with the National ITS Architecture and applicable ITS standards. OCTA's ITS SDP (including the component ITS architecture) support these requirements and conformance.

Refer to **Appendix A** to **Appendix E** for components of the regional ITS architecture.

FHWA Final Rule/FTA Policy Requirements	ITS SDP
(1) A description of the region;	Section 2.1
(2) Identification of participating agencies and other stakeholders;	Section 2.2
(3) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;	Appendix A
(4) Any agreements (existing or new) required for operations, including at a minimum those affecting integration of ITS projects; interoperability of different ITS technologies, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture;	Appendix B
(5) System functional requirements;	Appendix C
(6) Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);	Appendix D
(7) Identification of ITS standards supporting regional and national interoperability;	Appendix E
(8) The sequence of projects required for implementation of the regional ITS architecture.	Section 6.0

1.7 Report Organization

This report is organized into the following key sections:

- **Section 1** – Introduction, project overview and objectives, and brief discussion on previous ITS plans in Orange County
- **Section 2** – Background on the Orange County area, key stakeholders participating in the ITS SDP, institutional framework for project planning and implementation, and inventory of existing systems and programs in Orange County, including freeway and arterial networks, transit operations, and current approaches to data sharing and management
- **Section 3** – User needs, including local as well as regional needs, which form the basis for strategies and integration recommendations in later sections of the SDP
- **Section 4** – Existing and planned service packages, which identifies the existing and planned systems in Orange County in the context of the service packages of the National ITS Architecture
- **Section 5** – Summary of recommended strategies to address the county's priority ITS needs
- **Section 6** – Planned and recommended ITS projects
- **Section 7** – Communications and connectivity needs to support the envisioned agency-to-agency data sharing relationships and other regional programs
- **Section 8** – Phased deployment plan outlining the key implementation steps, dependencies and implementation timeline over a 10-year horizon
- **Section 9** – Recommended plan to implement a countywide performance monitoring program to better inform the region's ITS investment strategy

- **Appendix A** – Regional ITS Architecture – Stakeholders
- **Appendix B** – Regional ITS Architecture – Agreements
- **Appendix C** – Regional ITS Architecture – Functional Requirements
- **Appendix D** – Regional ITS Architecture – Service Package Diagrams
- **Appendix E** – Regional ITS Architecture – Standards
- **Appendix F** – Local Communications Inventory Maps

2. Orange County Area and Existing Conditions

This section describes the geographic area covered by this ITS SDP, as well as key stakeholders and agency partners that have been involved in this effort and who will play key roles in advancing the priorities and initiatives identified in this plan. With limited opportunities for physical expansion of the transportation networks within the Orange County area, technology, institutional partnerships and innovative operational strategies are key to successfully managing today's transportation demand, as well as planning for future transportation system operations.

2.1 Geographic Area

Orange County has a total of 789 square miles of land area and the county currently includes 34 incorporated cities. Geographically, the Orange County ITS SDP encompasses the surface transportation network within Orange County. **Figure 1** provides an overview of Orange County. As the third most populated county in California, Orange County is a crucial contributor to the regional economy, home to major employment centers, universities and world-class entertainment venues. Supporting this vital economic engine is an extensive transportation system, featuring over 1,600 lane-miles of freeways, high-occupancy vehicle (HOV) lanes and toll roads. The Master Plan of Arterial Highways (MPAH) is the blueprint for the county's streets and roads with over 1,450 miles of arterials providing local and cross-county access. Air travel and cargo is served by John Wayne Airport, one of the busiest airports in the region serving nearly 9 million passengers in 2011.

Transit users have a wide choice of rail and bus service in Orange County. OCTA is a member of the joint powers authority that operates Metrolink commuter rail service across five counties in Southern California. Metrolink stations in the county are also served by the Amtrak Surfliner, extending inter-city rail to San Luis Obispo and San Diego. OCTA operates nearly 80 bus routes providing local and express bus service, as well as a paratransit shuttle service. OCTA is currently working with local agencies to expand local transit through the Go Local Program that will implement feeder service to Metrolink and community circulators in several cities. Anchoring this expansion of transit service is the future Anaheim Regional Transportation Intermodal Center (ARTIC), which will serve as the principle multi-modal transportation hub in Orange County.

Orange County is an important gateway for Goods Movement, supporting the movement of freight from the Ports of Long Beach and Los Angeles to warehouses and distribution centers further inland. A large volume of freight is transported by train, with about 75 trains passing through the county on a daily basis. A portion of the goods from the ports are transported by trucks on the freeway system and truck routes on arterials.

The Long Range Transportation Plan (LRTP) is the county's long-term vision and strategy for addressing transportation needs and challenges in the county over a 25-year horizon. The LRTP projects the population to increase by 14% in the next 25 years, employment to increase by 10% and vehicle miles traveled (VMT) by 30%. Demographic change and a recovering economy point to increased demands on a transportation system that is already experiencing high-levels of congestion.

To manage growing congestion, the LRTP identifies Transportation System Demand/Transportation Demand Management (TSM/TDM) as a key strategy that employs technology to move people and goods more efficiently. Orange County has a strong history of innovation in implementing advanced arterial and freeway management systems. The local agencies have shown leadership in active traffic management by synchronizing signals on key arterials corridors and investing in traffic communications infrastructure and traffic management centers. This ITS Strategic Plan supports the LRTP objectives, providing a framework for coordinating ITS projects in a manner that greatly enhances the functionality and reach of any one project by promoting data sharing and integration across systems.

Figure 1 – Orange County Map

2.2 Institutional Framework

OCTA, as a multimodal transportation agency, has broad-ranging responsibilities for planning, implementing and overseeing a robust multimodal transportation system in Orange County. It also serves as a key forum for bringing state, local and private partners together to collaborate on high priority transportation needs and issues. The success of the Orange County ITS SDP is directly linked to participation by a diverse set of stakeholders. In the context of this project, stakeholders are defined as the public agencies with transportation-related oversight, responsibility, and/or duties within Orange County. This Plan was developed based on input from these agencies and/or reference to the projects and programs planned by them. The stakeholders include:

- 34 incorporated cities;
- OCTA (including multiple departments to provide input on behalf of various modal programs);
- County of Orange;
- Caltrans District 12;
- Orange County Fire Authority (OCFA);
- Southern California Association of Governments (SCAG);
- Federal Highway Administration (FHWA); and
- Transportation Corridor Agencies (TCA).

This Plan was based on an assessment of the technology-related needs (short-term and long-term) of these stakeholders within Orange County. In order to obtain input from the stakeholders, a series of workshops were held. These workshops provided the primary input for the needs assessment, existing conditions understanding, and the strategy development ideas. The workshops are summarized as follows:

- ITS Roundtable meeting held on June 7, 2012 – attended by local agencies, County of Orange, OCTA, and Caltrans. The purpose of this meeting was to introduce this Plan update and collect preliminary input on the needs and strategic direction of the Plan, primarily from a local perspective.
- Three (3) sub-regional workshops held in July 2012 – attended by small groups of local agencies, OCTA, County of Orange, and Caltrans. The purpose of these meetings was to review a subset of the needs assessment results and discuss potential strategies primarily from a local perspective.
- Individual meetings held in July through September 2012 – the purpose was to reach out to different modal program representatives to ensure that the full breadth of the surface transportation system was being considered and addressed in this Plan.
- ITS Roundtable meeting held on October 17, 2012 – attended by local agencies, County of Orange, OCTA, and Caltrans. The purpose of this meeting was to provide a status update to the local stakeholders and present the draft results of the needs and strategies.
- The Technical Steering Committee (TSC) and Technical Advisory Committee (TAC) advised the consultant team as the details of the Plan were being finalized to assure that the plan would meet the local agency needs.

In addition to the identification of stakeholders, the guidelines for applying the National ITS Architecture to a regional ITS architecture (and SDP) recommends the identification of an ITS champion: one or more key agencies leading the regional ITS architecture development and maintaining it over time. The champion is recommended by federal guidelines to be a stakeholder that is proactive in the field of ITS in the region. The champion must understand the subject at hand, have knowledge of local ITS systems and projects, and have a vision for interconnectivity, partnership, and regional integration. OCTA's role as administrator of the ITS SDP and the ITS Roundtable provides the leadership and forums for OCTA to be the "champion" or steward for the development and monitoring of the regional ITS architecture.

2.3 Existing Conditions and Inventory

The existing ITS programs and projects in the county provide a foundation for the identification of needs and new or continued strategies to meet those needs into the future. This section provides a summary of the existing ITS deployments in Orange County. Information regarding the existing programs that include ITS components was collected based on:

- Input from stakeholder agencies in Orange County;
- Technical reports and documentation describing the design and interconnectivity of existing systems;
- The 2010 Long Range Transportation Plan; and
- The 2007 ITS Strategic Deployment Plan

A geographic representation of the high level communications infrastructure data gathered has been consolidated into a geographic information systems (GIS) database to illustrate the types of communications infrastructure deployed by local agencies and Caltrans. Maps depicting this inventory are provided in **Appendix F**. The following sections provide an overview of the existing and planned countywide ITS programs organized by the following categories:

- Transit Management and Multi-modal
- Traffic Management (both arterial and highways, including managed lanes)
- Incident Management and Emergency Response
- Traveler Information
- Performance Monitoring/Data Management
- Safety
- Connectivity

2.3.1 Transit Management and Multi-modal

Transit represents a mission-critical function for OCTA, and is a key component of the region's transportation operations and network. Effective mobility within Orange County (as well as cross-jurisdictional travel to areas adjacent to Orange County) relies on a robust and connected transit system. OCTA is the primary transit provider in Orange County, operating a fixed route system

with nearly 80 bus routes and the demand based ACCESS paratransit service. OCTA is currently working with cities to implement localized transit service through the Go Local program. Go Local service concepts under development include fixed guideway transit, community circulators and shuttle services to improve connectivity to regional employment and commercial centers.

OCTA's bus service is supported by several technologies to improve efficiency, service, and security. The bus fleet is outfitted with global positioning system (GPS) based automatic vehicle location (AVL) and fare collection systems to track on-time performance and schedule adherence. The information from the fare box collection system is archived in a data warehouse that provides data for service planning. OCTA is currently undergoing an upgrade to the computer aided dispatch (CAD)/AVL system, to integrate separate communications systems for the fixed route bus fleet and ACCESS vehicles. This project, known internally as the Intelligent Transit Management System (ITMS) radio project upgrade, is currently ongoing and will also include the development of two redundant communications centers. The ITMS data will be updated nightly and then queried daily every five minutes to check for updated or changed information. The ITMS will integrate several employee databases (OCTA fixed route, contract operated and ACCESS service) so that vehicle operator, work assignments and schedules are updated three times a year to the CAD/AVL system. There is a need for bus operations to have access to current traffic information as well as detours due to construction and events in order to better adjust schedules and routes on a daily basis. OCTA is currently working on establishing a link to Caltrans to receive live traffic data.

The existing Text-for-Next program allows riders to receive bus arrival information on their phones, based on scheduled service. Given that the on-time performance is very good, the scheduled times are considered to be very close to actual. Real-time arrival information could be provided in the future leveraging the real-time bus location data currently used to support operations.

OCTA is spearheading an effort to examine an integrated account system for fare collection that would move away from the fare card concept to an open account system that allows riders to pay using their own credit or debit cards. While OCTA examines this option for their own service, other transit agencies have expressed an interest and formed a committee to look at the possibility of moving in this direction across Southern California. This type of open accounting system has potential application in other areas of surface transportation for parking and tolls as well. Anticipated benefits include improved customer service, reduced overhead, and improved reconciliation on the processing end.

Meanwhile, ticket vending machines are being deployed in some areas—these may need to be coordinated as OCTA pursues the phased implementation of BRT

improvements in the future: first on a select set of corridors with limited stop service, new buses, and service branding, followed later with the potential to include additional routes, transit signal priority, and/or other enhanced options.

Recently, a demonstration of a web-based dashboard to display customer feedback was rolled out. If successful, this may be extended to include other performance measures for OCTA. On board video surveillance systems are currently used to deter crime and recordings have in some cases been used by law enforcement to later identify activities or persons involved in crimes. If bandwidth were available, the video could be streamed to the operations center for access to live video when situations warrant for even further enhanced safety and security on buses.

Rail transit services are also available to Orange County commuters through Metrolink and Amtrak. OCTA is overseeing the expansion of Metrolink service on the Orange County Line, implementing track improvements and grade separations to increase service frequency. OCTA is a member of the Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency (LOSSAN), a joint powers authority responsible for infrastructure improvements to the rail corridor between San Luis Obispo and San Diego on which the Amtrak Pacific Surfliner operates. OCTA is a member of the Southern California Regional Rail Authority (SCRRA) joint-powers authority that funds and operates Metrolink service. SCRRA is currently developing a federally mandated positive train control (PTC) system expected to be in place by 2013. The PTC system would use GPS tracking to prevent train-on-train collisions and intrusions into work zone areas.

Orange County features an extensive network of bicycle facilities with about 1,000 miles of bikeways and another 700 miles planned in the Commuter Bikeways Strategic Plan. OCTA, local agencies, the County of Orange and Caltrans participate in the Regional Bikeways Planning Initiative to plan and construct bikeway facilities and to improve regional connectivity and bike-to-transit access. To improve last-mile connectivity to Metrolink stations, OCTA is implementing a bike-share pilot project at the Fullerton Transportation Center. While there is movement toward complete streets and interest in promoting and improving safety for bicyclists and pedestrians, the technology applications available in the industry for non-motorized transportation are still evolving. There are trials in Orange County for bicycle detection and there is potential for future technologies and application of technology to further support these goals.

2.3.2 Traffic Management

The 34 cities, County of Orange, and Caltrans operate traffic signals and advanced traffic management systems (ATMS) within Orange County. A very active and coordinated arterial management programs exists, supported by regular coordination among agencies, OCTA staff support, and a regular funding stream through Project P of M2.

Table 1 summarizes the current technologies, both from a central system perspective as well as field equipment. There is a variety of signal controller types deployed in the county, with a majority of agencies using National Electrical Manufacturers Association (NEMA) type controllers

comprised of Econolite ASC/2 or ASC/3 controllers (64% of agencies) and Multisonics 820/820A (25%) controllers. The next most widely deployed controllers are Type 2070 (deployed by 25% of agencies.) A small number of agencies use Type 170 controllers (11%), namely Caltrans, Dana Point, Huntington Beach, Seal Beach, and Brea.

The most commonly deployed signal systems in the county are Econolite Centracs (33% of agencies), Econolite Aries (31%), followed by Siemens ACTRA or I2 systems (19%). McCain QuicNet4 (14%), Siemens TACTICS (3%), and Telvent MIST (3%) comprise the remainder of deployed systems. There are spot deployments of CTNET and ACS-LITE, deployed exclusively by Caltrans and Anaheim, respectively.

In the county, most agencies are using twisted pair signal interconnect cable (81%) for traffic signal communications. Nineteen agencies (53%) have fiber interconnect in addition to twisted pair, and 19% of agencies have wireless communications installed.

Caltrans District 12 operates their freeway management system from a traffic management center that is collocated with the California Highway Patrol (CHP). The system has the capability to detect and verify incidents, coordinate responses in terms of response and traffic management between CHP and Caltrans through verbal/manual communications as well as through some system connectivity. This system also has some capability to monitor traffic within work zones through temporary/portable detection provided by field contractors. Caltrans owns a robust freeway communications network throughout the county. There is potential to share some of this bandwidth for other transportation uses within the county. Traffic signals at Caltrans-owned intersections and ramps are also managed from the District 12 traffic management center (TMC) in Irvine.

There are over 300 lane-miles of high-occupancy vehicle (HOV) lanes in Orange County. There is a countywide minimum occupancy requirement of two passengers per vehicle. The HOV requirements are in effect 24 hours per day. The facilities are operated and maintained by Caltrans while occupancy requirements are enforced by CHP during peak and off peak travel periods. Facilities in the county feature both barrier separated and continuous access.

The 91 Express Lanes is a four-lane, 10-mile-long express toll facility located entirely within the median of SR 91 in Orange County. With two toll lanes operating in each direction, the 91 Express Lanes extend from the Costa Mesa Freeway (State Route 55) interchange in Anaheim to the Riverside County line. The facility is owned by OCTA and operated by a contractor. The 91 Express Lanes TMC is located in the City of Anaheim. The Riverside County Transportation Commission (RCTC)

is currently developing express lane facilities in Riverside County, which will extend the 91 Express Lanes from the Orange County line to I-15. There are also four toll road facilities (SR-73, SR-133, SR-261 and SR-241) that are Caltrans owned, but operated separately by the Transportation Corridor Agencies (TCA).

The 91 Express Lanes feature all electronic toll collection (ETC) and users of the facility are required to have a FasTrak® transponder in the vehicle and a registered customer account. The TCA toll roads are in the process of converting to an entirely ETC system and will phase out cash booths. The FasTrak® transponder meets the current statewide communication standard, known as Title 21. Title 21 defines communication and equipment specifications for toll readers and transponders to identify and validate users on toll or express lane facilities in the state. The specification maintains technical interoperability that allows the use of one transponder and user account versus obtaining separate transponders and accounts with each express lane and/or toll operator. The use and payment on different tolled facilities is seamless to the customer; express lane agencies belong to the California Toll Operators Committee (CTOC) and coordinate back office operations manually to reconcile account transactions. CTOC and Caltrans are considering revisions to Title 21 to allow for a more robust communication standard capable of two-way communications between transponders and roadside readers.

Table 1 – Local Agency Traffic Signal Controller, System and Communications Inventory

Agency	Controller Type					Traffic Signal System									Interconnect		
	170/170E	2070	820/820A	ASC2/3	Other NEMA	McCain QuicNet 4	CTNET	Siemens TACTICS	Siemens ACTRA/I2	Econolite Aries	Econolite Centracs	Telvent MIST	ACS-LITE	Other	WIRELESS	TWP	FIBER
CALTRANS	X	X				X	X									X	X
COUNTY OF ORANGE			X	X						X						X	
ALISO VIEJO				X						X						X	
ANAHEIM		X		X	X			X	X/ X		X		X		X	X	X
BREA	X		X	X							X					X	
BUENA PARK			X		X				X							X	X
COSTA MESA		X	X	X								X	X			X	X
CYPRESS				X						X							X
DANA POINT	X		X	X						X						X	
FOUNTAIN VALLEY		X				X									X		X
FULLERTON					X				X						X	X	X
GARDEN GROVE				X							X						X
HUNTINGTON BEACH	X					X									X	X	X
IRVINE		X							X							X	X
LA HABRA		X							X						X	X	X
LA PALMA				X						X					X	X	
LAGUNA BEACH																	
LAGUNA HILLS				X						X	X					X	
LAGUNA NIGUEL				X						X	X					X	
LAGUNA WOODS				X							X					X	
LAKE FOREST			X	X						X	X					X	X
LOS ALAMITOS				X						X						X	
MISSION VIEJO				X							X					X	X
NEWPORT BEACH		X	X	X							X				X	X	X
ORANGE				X					X						X	X	X
PLACENTIA				X							X			X		X	
RANCHO SANTA MARGARITA				X						X						X	
SAN CLEMENTE			X		X									X		X	
SAN JUAN CAPISTRANO				X						X						X	
SANTA ANA			X										X			X	X
SEAL BEACH		X				X										X	X
STANTON				X						X						X	
TUSTIN				X						X						X	
VILLA PARK			X						X								
WESTMINSTER		X				X											X
YORBA LINDA				X						X						X	

2.3.3 Incident Management and Emergency Response

OCTA manages the Service Authority for Freeway Emergencies (SAFE) to provide motorists with roadside assistance through the Freeway Service Patrol (FSP). The FSP is a transportation management strategy designed to limit congestion resulting from disabled vehicles in travel lanes. Orange County SAFE manages a network of 621 call boxes on most freeways, toll roads and state highways throughout the county. Motorists can request an FSP tow truck using the freeway call box or by calling 511 with their cell phone. Calls to 511 are directed to the appropriate call center in any part of the region based on location of the caller. The calls are handled by the dispatcher at the call center who can dispatch tow trucks or CHP officers to the scene.

FSP beats and contracts are managed by OCTA. Data for evaluation and redistribution of beats is analyzed after manual collection and aggregation of data, roughly on an annual basis. This analysis process can be enhanced if vehicle and response data were automatically collected and provided on a real-time or near real-time basis.

2.3.4 Traveler Information

Advanced traveler information is currently provided within Orange County through numerous outlets. LA SAFE operates both a web based and phone based interactive 511 traveler information service. Private service providers also offer traveler information services primarily through the web – these services are independent of the publically funded programs. Efforts are ongoing to provide integrated transit information to travelers to promote transit use and improve customer service. Currently static schedules are provided with the intent to migrate to real-time arrival information at some point in the future.

The 511 system provides traveler information on freeways in Los Angeles, Orange, and Ventura counties primarily, with data also provided for Riverside and San Bernardino counties. The system provides information about traffic drive times and freeway speeds, road construction, incidents, buses and trains, carpool/vanpool, bicycle information, and weather. Sources for real-time data include the Regional Integration of Intelligent Transportation Systems (District 7 data is collected from this LA Metro operated data exchange service), Caltrans TMCs (District 8 and District 12), Caltrans Lane Closure System portal, California Highway Patrol CAD and NextTrip (transit vehicle status). Transit information includes an integrated trip planner, and NextTrip information also is available for many transit providers. Users can use the phone or website to obtain average freeway speeds, average travel times, and average rail travel times.

Orange County data is provided by Caltrans District 12. OCTA staff represents the county in regular 511 program expansion discussions. Future upgrades to the 511 service also include a multi-lingual module to support Spanish (currently services are offered in English). Arterial information is not currently provided on the publicly offered 511 system.

2.3.5 Performance Monitoring/ Data Management

OCTA is a progressive organization when it comes to implementing and actively reporting on key performance measures and indicators. There is a commitment on behalf of OCTA to transparency and accountability, and ITS can help to support the unique data needs to support OCTA's continued focus on performance management.

Destination 2035 identified several key performance measures that represent a multi-modal and integrated approach to achieving system improvements. These are:

Performance Measure	2035 Baseline	2035 Preferred Plan
Daily vehicle hours traveled	3.4 million	Reduced by 24 percent
Daily hours of delay due to congestion	1.5 million	Reduced by 56 percent
Average peak period freeway speed (AM)	29 miles per hour	Increased by 22 percent
Average peak period high-occupancy vehicle speed (AM)	35 miles per hour	Increased by 24 percent
Average peak period roadway speed (AM)	13 miles per hour	Increased by 82 percent
Daily transit trips	144,000	Increased by 11 percent

Monitoring, measuring and enhancing strategies based on outcomes will require a robust performance management program, underpinned by a multi-agency approach to data management and archiving.

Caltrans District 12 collects traffic data for freeway, HOV lane, and ramp facilities throughout the county primarily using inductive loop detectors. The data is transmitted from the field to the District 12 TMC over Caltrans fiber and historic data is made available through the Caltrans Performance Measurement System (PeMS) website. Users can download raw traffic data from over 2,300 vehicle detection stations covering nearly 1,500 lanes miles of freeway in the county. The website also has reporting tools and performance dashboards that aggregate the traffic data into performance measures that identify bottleneck congestion, travel reliability and delay. Caltrans also manually collects data annually for additional evaluation and cross-checking. Caltrans has made significant progress in recent years in detection maintenance and troubleshooting, bringing the district's detection up to over 90% reporting, which means that enough raw data is available to make the resulting aggregates valuable for use in performance reporting and traveler information.

Newly synchronized arterial corridors undergo before and after studies as a part of the countywide program. Data is collected through various methods and then quantified manually. OCTA also conducts travel time studies of all synchronized corridors every other year. This data can show valuable impacts of corridor synchronization as well as the benefit of ongoing investment in arterial management technologies and strategies.

The OCTA GIS section manages a data warehouse for the agency's spatial data. The system maintains GIS layers for the county's roadway and transit networks information in a relational database management system. The system archives farebox data collected on buses for service planning and operational analysis. The data tracks ridership activity by route, segment and vehicle. The data can also provide a sampling of trip origins and destinations by tracking the anonymous IDs from magnetic fare media.

2.3.6 Safety

A portion of the OCTA bus fleet is currently equipped with cameras to monitor passenger activity and record incidents; new fixed-route buss and paratransit vehicles added to the fleet are equipped with the cameras. The implementation of the ITMS project will extend the video surveillance capability by enabling law enforcement vehicles to access the on-board vehicle feed over wireless communications. In addition, Metrolink trains operating in the Orange County are equipped with inward-facing cameras to monitor train operator activity. SCRRA has also implemented Automatic Train Stop (ATS) technology throughout the Metrolink system. ATS utilizes track sensors that trigger alerts to the cab operator of upcoming curves and speed changes. Breaking is automatically applied if the warning is ignored. SCRRA is currently working on implementing the next generation of train safety technology with PTC, which will implement an interoperable system among the different commuter and freight rail operators in Southern California.

2.3.7 Communications and Connectivity

Communication interties between the local agencies and Caltrans District 12 support center-to-center data sharing and coordinated traffic management. Interties between the local agency TMCs include the City of Laguna Hills, which shares access to its ATMS server with the City of Lake Forest. The intertie allows Lake Forest to utilize some of the unused capacity on the server; the agencies may view each other signals on the server, but are restricted from acquiring operational control. Several of the local agencies TMCs have an intertie with the District 12 TMC utilizing TCP/IP communications over fiber optics to share data feeds from ITS field elements. Along key freeway corridors such I-405 and SR-22, interties between the District 12 TMC and local agencies TMCs allow for the sharing of video feeds to coordinate congestion monitoring and incident verification.

3. User and Regional Needs

The collective needs or challenges that exist in the surface transportation environment are the impetus behind ITS planning and architecture development. These needs guide the development of an ITS strategic deployment plan consisting of solutions to those identified challenges, potential integration between new ITS solutions and existing systems, and a framework for implementation of those projects that will ultimately provide the solutions. Through consultation with stakeholders, the local and regional needs were identified.

The stakeholder needs were compiled from the 2007 Orange County ITS Strategic Deployment Plan and updated based on extensive outreach activities with transportation agencies and staff across a broad spectrum of service areas. Needs correspond to the existing conditions categories presented in **Section 2**, with the addition of categories to capture safety, institutional and connectivity needs of the county's future ITS program.

Transit Management and Multi-Modal

- Fine grained data regarding transit service and operations for regular use in planning and scheduling
- Increased accuracy, availability, and cost-effective collection of transit data: passenger counts/ridership, stop arrival times, payments, and other
- Improved efficiency and reliability of transit systems
- Improved and coordinated parking management and information at rail/transit stations throughout the county
- Improved transit schedule, services, and arrival information
- Improved transit service and trip coordination (between modes and between different providers)
- Improved first and last mile connections to transit with bike-sharing

Traffic Management

- Countywide understanding of the current operations of arterial progression
- Professional skillset development at municipal and County levels for arterial operations and maintenance activities
- Improved detection on arterials
- Improved incident and emergency response times
- Improved signal coordination especially for crossing arterials
- Reduced congestion and improved travel time reliability, including ramp meter coordination with surface streets to avoid additive congestion
- Reduce rail grade crossing delays
- Reduced emissions
- Interoperability of transportation payments: bus, rail, parking, tolls, and other fees
- Coordination of toll systems with surrounding inter-county and intra-county facilities

Incident Management and Emergency Response

- Better and recent data for managing and planning for the freeway service patrol program, including better and more frequent integration of temporary work zone detection
- Improved incident and emergency response times
- Improved transportation system management during disasters and/or evacuations
- Reduced congestion and improved travel time reliability
- Reduced emissions

Traveler Information

- Improved quality and timeliness of information to travelers
- Parking information
- Real-time traffic and transit information, especially in and through construction zones
- Multilingual traffic and transit information (English and Spanish at a minimum)
- Real-time transit information
- Rideshare information
- Reliable road and lane closure information
- Increased promotion of alternate modes of transportation
- Multi-modal traveler information for transit and non-motorized trips

Performance Monitoring/Data Management

- Improved data sharing and archiving for arterial, highway, transit, FSP, and other multi-modal data
- Improved collection of data for transportation planning
- Bike and pedestrian usage data for planning purposes
- Increased accuracy, availability, and cost-effective collection of transit data: passenger counts/ridership, stop arrival times, and payments

Safety

- Improved traveler safety
- Improved bicycle/ pedestrian safety on roadways
- Reduce rail and transit accidents

Communications and Connectivity

- Communications infrastructure to support regional programs
- Improved inter-agency communications
- Open standards to enable countywide center-to-center and center-to-field communications, data sharing and interoperability

Institutional

- Improved staffing levels for arterial and freeway operations

- Improve transportation system operation and maintenance skill sets for local agencies (staff and or contracted services)
- Promotion of open procurement and marketplace competition
- Economies of scale for bulk purchasing within the county (considering the transportation equipment being purchased for multiple agencies and projects around the county)

4. Existing and Planned Service Packages

The services provided by ITS projects, (i.e. traveler information, emergency vehicle preemption or real-time transit arrival information) are organized into *service packages*—a term used by FHWA and the National ITS Architecture to describe a category of ITS projects or services. The table below contains a summary of ITS project categories (service packages) that are existing or planned in Orange County, and as such are addressed in this Plan and its component Regional ITS Architecture. The table shows the entire listing of market packages from the National ITS Architecture and their respective status in the region. These ITS categories (service packages) are classified as: Existing, Planned, or Not Planned. The planned designation includes those strategies that are planned or recommended for future consideration within this document.

Table 2 summarizes the breadth of this Plan and the component Architecture.

Table 2 – Existing and Planned Service Packages

Project Categories (Service Packages)		Existing (E)	Planned (P)/ Future (F)	Private Sector Led (PR)
ARCHIVED DATA MANAGEMENT				
AD1	ITS Data Mart	E		
AD2	ITS Data Warehouse	E		
AD3	ITS Virtual Data Warehouse		F	
PUBLIC TRANSPORTATION SYSTEMS				
APTS01	Transit Vehicle Tracking	E		
APTS02	Transit Fixed-Route Operations	E		
APTS03	Demand Response Transit Operations	E		
APTS04	Transit Fare Collection Management	E		
APTS05	Transit Security	E		
APTS06	Transit Fleet Management	E		
APTS07	Multi-modal Coordination		P	
APTS08	Transit Traveler Information	E		
APTS09	Transit Signal Priority		P	
APTS10	Transit Passenger Counting	E		
APTS11	Multimodal Connection Protection	E		
TRAVELER INFORMATION				
ATIS01	Broadcast Traveler Information	E		
ATIS02	Interactive Traveler Information	E		
ATIS03	Autonomous Route Guidance			PR
ATIS04	Dynamic Route Guidance			PR
ATIS05	ISP Based Trip Planning and Route Guidance	E		
ATIS06	Transportation Operations Data Sharing		F	
ATIS07	Travel Services Information and Reservation	E		
ATIS08	Dynamic Ridesharing		F	
ATIS09	In Vehicle Signing			PR
ATIS10	Short Range Communications Traveler Information		F	
TRAFFIC MANAGEMENT				
ATMS01	Network Surveillance	E		
ATMS02	Traffic Probe Surveillance	E		
ATMS03	Traffic Signal Control	E		

Project Categories (Service Packages)		Existing (E)	Planned (P)/ Future (F)	Private Sector Led (PR)
ATMS04	Traffic Metering	E		
ATMS05	HOV Lane Management	E		
ATMS06	Traffic Information Dissemination	E		
ATMS07	Regional Traffic Management	E		
ATMS08	Traffic Incident Management System	E		
ATMS09	Transportation Decision Support and Demand Management		F	
ATMS10	Electronic Toll Collection	E		
ATMS11	Emissions Monitoring and Management	N/A	N/A	N/A
ATMS12	Roadside Lighting System Control	E		
ATMS13	Standard Railroad Grade Crossing	E		
ATMS14	Advanced Railroad Grade Crossing		P	
ATMS15	Railroad Operations Coordination		P	
ATMS16	Parking Facility Management			PR
ATMS17	Regional Parking Management		F	
ATMS18	Reversible Lane Management		F	
ATMS19	Speed Warning and Enforcement	E		
ATMS20	Drawbridge Management	N/A	N/A	N/A
ATMS21	Roadway Closure Management		F	
ATMS22	Variable Speed Limits		F	
ATMS23	Dynamic Lane Management and Shoulder Use		F	
ATMS24	Dynamic Roadway Warning		F	
ATMS25	VMT Road User Payment		F	
ATMS26	Mixed Use Warning Systems		F	
VEHICLE SAFETY				
AVSS01	Vehicle Safety Monitoring			PR
AVSS02	Driver Safety Monitoring			PR
AVSS03	Longitudinal Safety Warning			PR
AVSS04	Lateral Safety Warning			PR
AVSS05	Intersection Safety Warning			PR
AVSS06	Pre-Crash Restraint Deployment			PR
AVSS07	Driver Visibility Improvement			PR
AVSS08	Advanced Vehicle Longitudinal Control			PR
AVSS09	Advanced Vehicle Lateral Control			PR
AVSS10	Intersection Collision Avoidance			PR
AVSS11	Automated Vehicle Operations			PR
AVSS12	Cooperative Vehicle Safety Systems			PR
COMMERCIAL VEHICLE OPERATIONS				
CVO01	Carrier Operations and Fleet Management			PR
CVO02	Freight Administration			PR
CVO03	Electronic Clearance			PR
CVO04	CV Administrative Processes			PR
CVO05	International Border Electronic Clearance	N/A	N/A	N/A
CVO06	Weigh-In-Motion	E		
CVO07	Roadside CVO Safety		F	
CVO08	On-board CVO Safety			PR
CVO09	CVO Fleet Maintenance			PR

Project Categories (Service Packages)		Existing (E)	Planned (P)/ Future (F)	Private Sector Led (PR)
CVO10	HAZMAT Management		F	
CVO11	Roadside HAZMAT Security Detection and Mitigation		F	
CVO12	CV Driver Security Authentication			PR
CVO13	Freight Assignment Tracking			PR
EMERGENCY MANAGEMENT				
EM01	Emergency Call-Taking and Dispatch	E		
EM02	Emergency Routing		P	
EM03	Mayday and Alarms Support	E		
EM04	Roadway Service Patrols	E		
EM05	Transportation Infrastructure Protection	N/A	N/A	N/A
EM06	Wide-Area Alert	E		
EM07	Early Warning System		P	
EM08	Disaster Response and Recovery	E		
EM09	Evacuation and Reentry Management	E		
EM10	Disaster Traveler Information	E		
MAINTENANCE AND CONSTRUCTION MANAGEMENT				
MC01	Maintenance and Construction Vehicle and Equipment Tracking	E		
MC02	Maintenance and Construction Vehicle Maintenance		F	
MC03	Road Weather Data Collection		F	
MC04	Weather Information Processing and Distribution		F	
MC05	Roadway Automated Treatment		F	
MC06	Winter Maintenance	N/A	N/A	N/A
MC07	Roadway Maintenance and Construction		F	
MC08	Work Zone Management	E		
MC09	Work Zone Safety Monitoring		F	
MC10	Maintenance and Construction Activity Coordination	E		
MC11	Environmental Probe Surveillance		F	
MC12	Infrastructure Monitoring		F	

5. STRATEGIES

Based on the needs identified in Section 3, strategies have been identified that will provide the future direction of this ITS SDP. The strategies provide the context for where local agencies, regional agencies, and the private sector are likely to deploy technology now and in the coming ten years. Section 6 subsequently will break down each strategy into the projects likely to represent how these strategies will be deployed. Each strategy includes a definition, a list of potential integration opportunities—areas where data sharing may be beneficial to support the strategy or an enhancement thereof, and a description of the deployment phasing. The latter will feed into the project definition and the phased strategic deployment plan.

The recommended strategies build upon the current, successful foundation of transit, arterial, and freeway management to provide enhanced operations, data sharing opportunities, performance monitoring, and traveler information. **Figure 2** below depicts the process of building on the current foundation. **Table 3** on the following pages provides a mapping of the strategies to the needs identified in **Section 3**, demonstrating that the strategies are comprehensive in terms of supporting the desired outcomes of the various components of the program.

Figure 2 – Strategy Overview

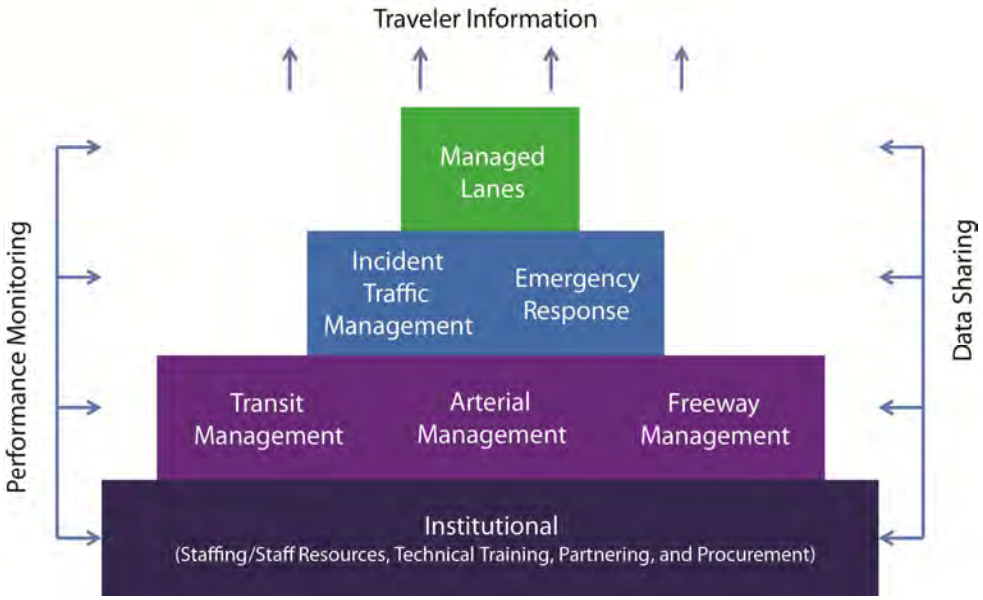


Table 3 – Strategy to Needs Mapping

NEEDS	STRATEGIES																														
	Transit Management and Multi-Modal Strategies	Integrated Transit Management	Bus Rapid Transit	Rail Operations and Enhancements	Integrated Payment	Support for Pedestrian and Bicycle Travel	Support to Commercial Vehicle Operations (CVO)	**Traffic Management**	Multi-Jurisdictional Arterial Traffic Management	Continued Freeway Traffic Management	Migration to Grid-based Traffic Signal Synchronization	Corridor Management	Regional Coordination of Express Lanes	**Incident Management and Emergency Response**	Freeway Service Patrol Management	Emergency Vehicle Preemption Migration	Arterial-based Incident Traffic Management	**Traveler Information**	Continued Expansion of the Southern California 511 Program	Integrated and Localized Parking Guidance	**Performance Monitoring**	Countywide Performance Monitoring	**Communications and Connectivity**	Countywide Communications Master Plan	Countywide Connectivity Master Plan	Provide a Connected Vehicles Platform	**Safety**	Bicycle and Pedestrian Detection	**Institutional**	Continuously Improve Staffing Levels and Skillsets	Formalize Sub-regional Partnerships
Transit Management																															
Fine grained data regarding transit service and operations		X	X																			X		X							
Increased accuracy, availability, and cost-effective collection of transit data		X	X																												
Improved efficiency and reliability of transit systems		X	X			X			X													X		X							
Improved and coordinated parking management and information at rail/transit stations																				X											
Improved transit schedule, services, and arrival information		X	X			X													X											
Improved transit service and trip coordination		X	X																												
Traffic Management																															
Countywide understanding of the current operations of arterial progression			X			X			X	X	X					X	X		X			X		X							X
Professional skillset development at municipal and County levels			X			X			X							X														X	X
Improved detection on arterials			X						X		X	X				X	X					X		X							
Improved incident and emergency response times									X	X		X			X	X	X							X							
Improved signal coordination especially for crossing arterials						X			X		X	X												X							X
Reduced congestion and improved travel time reliability		X	X			X			X	X	X	X			X		X														
Reduce rail grade crossing delays		X		X													X														
Reduced emissions		X	X	X					X	X	X								X	X											

NEEDS	STRATEGIES																														
	Transit Management and Multi-Modal Strategies	Integrated Transit Management	Bus Rapid Transit	Rail Operations and Enhancements	Integrated Payment	Support for Pedestrian and Bicycle Travel	Support to Commercial Vehicle Operations (CVO)	Traffic Management	Multi-Jurisdictional Arterial Traffic Management	Continued Freeway Traffic Management	Migration to Grid-based Traffic Signal Synchronization	Corridor Management	Regional Coordination of Express Lanes	Incident Management and Emergency Response	Freeway Service Patrol Management	Emergency Vehicle Preemption Migration	Arterial-based Incident Traffic Management	Traveler Information	Continued Expansion of the Southern California 511 Program	Integrated and Localized Parking Guidance	Performance Monitoring	Countywide Performance Monitoring	Communications and Connectivity	Countywide Communications Master Plan	Countywide Connectivity Master Plan	Provide a Connected Vehicles Platform	Safety	Bicycle and Pedestrian Detection	Institutional	Continuously Improve Staffing Levels and Skillsets	Formalize Sub-regional Partnerships
Interoperability of transportation payments: bus, rail, parking, tolls, and other fees		X			X								X											X						
Coordination of toll systems with surrounding inter-county and intra-county facilities													X																	
Incident Management and Emergency Response																															
Better and recent data for managing and planning for the freeway service patrol program										X			X									X		X						
Improved incident and emergency response times		X								X		X			X	X	X													
Improved transportation system management during disasters and/or evacuations										X							X					X		X						
Reduced congestion and improved travel time reliability		X	X							X	X		X		X		X		X	X										
Reduced emissions										X							X													
Traveler Information																															
Improved quality and timeliness of information to travelers		X					X		X	X		X							X											
Parking information																			X	X										
Real-time traffic and transit information, especially in and through construction zones		X	X						X	X									X											
Multilingual traffic and transit information (English and Spanish at a minimum)		X																	X											
Real-time transit information		X																	X											
Rideshare information																			X											
Reliable road and lane closure information									X	X									X											
Increased promotion of alternate modes of transportation		X	X	X	X							X																		

NEEDS	STRATEGIES																														
	Transit Management and Multi-Modal Strategies	Integrated Transit Management	Bus Rapid Transit	Rail Operations and Enhancements	Integrated Payment	Support for Pedestrian and Bicycle Travel	Support to Commercial Vehicle Operations (CVO)	Traffic Management	Multi-Jurisdictional Arterial Traffic Management	Continued Freeway Traffic Management	Migration to Grid-based Traffic Signal Synchronization	Corridor Management	Regional Coordination of Express Lanes	Incident Management and Emergency Response	Freeway Service Patrol Management	Emergency Vehicle Preemption Migration	Arterial-based Incident Traffic Management	Traveler Information	Continued Expansion of the Southern California 511 Program	Integrated and Localized Parking Guidance	Performance Monitoring	Countywide Performance Monitoring	Communications and Connectivity	Countywide Communications Master Plan	Countywide Connectivity Master Plan	Provide a Connected Vehicles Platform	Safety	Bicycle and Pedestrian Detection	Institutional	Continuously Improve Staffing Levels and Skillsets	Formalize Sub-regional Partnerships
Performance Monitoring/Archived Data Management																															
Improved data sharing and Archiving for arterial, highway, transit, FSP, and other multi-modal data		X	X						X	X		X	X			X	X			X		X								X
Improved collection of data for transportation planning		X	X						X	X							X		X	X		X		X						
Bike and pedestrian usage data for planning purposes						X			X													X		X						
Increased accuracy, availability, and cost-effective collection of transit data																						X		X						
Safety																															
Improved traveler safety															X	X	X											X			
Improved bicycle/pedestrian safety on roadways						X										X	X											X			
Reduce rail and light rail transit accidents				X																											
Communications and Connectivity																															
Communications infrastructure to support regional programs									X	X		X	X									X		X	X						
Improved inter-agency communications									X		X	X	X			X	X								X						
Open standards									X															X	X	X					
Institutional Needs																															
Improved staffing levels for arterial and freeway operations									X	X	X	X				X	X					X		X					X		
Improve transportation system operation and maintenance skill sets for local agencies (staff and/or contract services)		X	X			X			X	X	X	X				X					X								X		
Promotion of open procurement and marketplace competition									X															X	X						
Economies of scale for bulk purchasing within the county									X															X	X						X

The strategies that comprise the Orange County ITS SDP are summarized in **Table 4** below. The sections that follow describe each in more detail.

Table 4 – ITS Strategies

Strategy	Benefits	Integration Opportunities
Transit Management and Multi-Modal		
MM1 – Integrated Transit Management: Roll out the Integrated Transit Management System (ITMS), integrated Transportation Communication System (TCS), Real-Time Passenger Information System (RTPIS), fare collection, and other transit projects to develop a connected, integrated data set for management and planning	▪ Reduced duplication ▪ Better quality data ▪ More robust data for operations and planning	▪ Data sharing within the transit program ▪ Ridership and schedule adherence data for local agencies ▪ Transit usage data for managed lane investment and capital investment planning ▪ Arterial closures and construction activity information can be useful to better managing transit routes
MM2 – Bus Rapid Transit: Roll out BRT service in a two-step implementation process. Technology applications could include TSP (transit signal priority), real-time bus arrival information, and automated fare collection.	▪ Improved customer service and rider experience ▪ Increased ridership ▪ More cost-effective operations on Bravo! routes	▪ Ridership and arrival time data can be shared with other sections at OCTA for planning and project development activities ▪ Data from the ITMS and Integrated TCS can be used to enhance this program ▪ Arterial closures and construction activity information can be useful to better managing transit routes
MM3 – Rail Operations and Enhancements: Continued rail operations supported by technologies for safety, such as for positive train control, intersection safety, and operations	▪ Increased safety ▪ Improved operations ▪ Increased ridership and multi-modal options for travelers	▪ Construction or traffic conditions (especially during incidents) provided to rail operations ▪ Rail arrival times provided to traffic management agencies, traveler information, and related strategies/programs
MM4 – Integrated Payment: Currently being examined in Orange County in coordination with other Southern California agencies, an integrated payment method that would initially allow for transit payment	▪ Increased ridership and multi-modal options for travelers ▪ Reduced congestion ▪ More cost-effective operations	▪ Integration and streamlining opportunities among transit projects, parking access and revenue control systems, multi-modal centers, FasTrak® operations, and others
MM5 – Support for Pedestrian and Bicycle Travel: local deployments of pedestrian and bicycle safety, bike-sharing and information technologies	▪ Promote non-motorized travel ▪ Increase safety ▪ Reduce congestion	▪ Traveler information services tailored to cyclists and pedestrians

Strategy	Benefits	Integration Opportunities
MM6 – Support to Commercial Vehicle Operations (CVO): Primarily privately led, CVO activities will be supported as needed in terms of technology	▪ Improved environment for commercial vehicle operations ▪ Improved safety	▪ Share traffic data with truck dispatch operations to improve trip routing
Traffic Management		
TM1 – Multi-Jurisdictional Arterial Traffic Management: Continue to manage arterials across the county and across jurisdictions; provide a foundation for advanced management and strategies; provide access to more data for operations and planning	▪ Improved mobility ▪ Reduced travel costs ▪ Better data for investment choices	▪ Arterial data can be shared with transit operators, emergency service providers and freeway/managed lanes operators for improved multi-modal operations ▪ Transit routes, ridership, and schedule changes can be useful to arterial management
TM2 – Continued Freeway Traffic Management: Continue to manage freeway traffic through existing and future technology and operational procedures.	▪ Improved mobility ▪ Reduced travel costs	▪ Freeway data is useful to other traffic management strategies and traveler information ▪ Providing access to arterial, transit, and corridor data (including camera images) can add value to freeway management ▪ Physical communications infrastructure has capacity for supporting other strategies
TM3 – Migration to Grid-based Traffic Signal Synchronization: Optimize multiple crossing arterials through signal synchronization within a grid; upgrade equipment to support grid-based synchronization	▪ Improved progression on arterials ▪ Improved coordination among crossing arterials ▪ Reduced staff time and cost in accommodating crossing arterials for coordination	▪ Could provide data for transit operations where applicable ▪ Supplement corridor-based MOEs with network-based MOEs for performance monitoring
TM4 – Corridor Management: Assess candidate freeway/arterial corridors for enhanced strategies and develop an initial Concept of Operations. Multiple phases would be needed to address feasibility assessment, systems engineering, design, implementation and evaluation.	▪ Improved customer service and traveler experience across modes ▪ Reduced congestion and increased travel time reliability ▪ Improved cross-jurisdictional coordination ▪ Improved capacity balance ▪ More opportunity for demand management	▪ The communications assessment, freeway management system, arterial management systems, and OCTA's intelligent transit management system would collectively provide a strong foundation to build upon for this advanced strategy. ▪ Transit data, construction data, freeway data, arterial data, Freeway Service Patrol (FSP) vehicle locations, etc. can create a more efficient system
TM5 – Regional Coordination of Managed Lanes: Continue 91 Express	▪ Improved customer service and traveler experience	▪ Traffic, revenue, and user experience data can be shared with other

Strategy	Benefits	Integration Opportunities
Lanes operations; extend 91 Express Lanes operational strategies to other corridors and adjacent facilities (where applicable and approved by legislative authority)	▪ Reduced congestion and increased revenues ▪ Improved cross-jurisdictional coordination	agencies for use in planning additional facilities and streamlined operations in other jurisdictions ▪ Operational and project development experiences can be shared with other agencies as facilities are planned and rolled out in other jurisdictions
Incident Management and Emergency Response		
IM1 – Freeway Service Patrol (FSP) Management: Continue FSP management and coordination; continue to improve on efficiencies through enhanced data sets for more efficient research and decision making	▪ More robust research capabilities ▪ Reduced staff time ▪ More effective operational synergies ▪ Reduced program expenditures	▪ Central database and management software/databases used for integrated transit management may be applicable for use by FSP management
IM2 – Emergency Vehicle Preemption (EVP) Migration: Upgrade and enhance emergency vehicle preemption with newer more secure technologies.	▪ Reduce delays for emergency response vehicles ▪ Increase safety for pedestrians, motorists and emergency response vehicles	▪ Global positioning system (GPS) data may be useful outside of the EVP program to local and regional agencies for traffic and safety analyses
IM3 – Arterial-based Incident Traffic Management: Establish a program in Orange County to promote improved arterial incident coordination and response, multi-agency training, and improved freeway-arterial incident management	▪ Reduce delays related to incidents on freeways and arterials ▪ Improve traveler information on all modes in the event of incidents and anticipated clearance times ▪ Increase safety for pedestrians, motorists and emergency response vehicles	▪ Data collection on off-ramps and/or arterials used as alternate routes will be critical to optimized incident traffic management; data can also be valuable to local agency operations in terms of investment and staff planning ▪ Communication infrastructure on highways and arterials can provide a foundation for data sharing within this program (communications master plan can assess this) ▪ Data sharing among agencies, a capability that can be supported through expansion of the performance monitoring program will be highly valuable to building this program
Traveler Information		
TI1 – Continued Expansion of the Southern California 511 Program: Provide enhanced real-time and up-to-date information for Orange County arterials; expand transit trip planner with real-time information, enhance the mobile call box	▪ Encouragement of mode shift to transit ▪ Increased support of transportation program investment ▪ Increased throughput and capacity/demand balance	▪ Data collected through the 511 program can be provided to all transportation agencies for planning, operational analysis and investment decisions. ▪ Local construction data, real-time

Strategy	Benefits	Integration Opportunities
module; integrate private sector sources of data		transit data, and others can be disseminated through these channels ▪ More integration among existing public and private information service providers can provide greater value to travelers and support enhanced traffic and transit management goals ▪ A rich source of crowd-sourced data is available from private sector service providers that can provide predictive area-wide or corridor specific travel times and travel speed information ▪ The private sector Goods Movement industry as a source of truck routing and container tracking data ▪ Connected Vehicles as a real-time travel data gathered from vehicle-to-vehicle or vehicle-to-roadside communications
TI2 – Integrated and Localized Parking Guidance: Seek out additional opportunities for parking guidance systems (PGS) with an emphasis on a regional, integrated parking guidance and information system for park and ride facilities.	▪ Encouragement of mode shift to transit ▪ Increased support of transportation program investment ▪ Increased throughput and capacity/demand balance	▪ Locally deployed PGS can integrate with local arterial management systems ▪ Regional PGS would benefit from real-time and schedules for train and bus arrivals and pricing information on express lanes within southern California
Performance Monitoring		
PM1 – Countywide Performance Monitoring: Collect and analyze data across modes and facilities to track internal performance, investments and needs and report externally to decision makers and the public.	▪ Data for improved operational and investment decisions	▪ Existing and enhanced performance data can support foundational operations and investment planning choices ▪ Integration opportunities among all strategies and modes
Communications and Connectivity		
CC1 – Countywide Communications Master Plan: Physical and logical connectivity to support multi-modal and multi-agency operations and data sharing needs.	▪ Reduced investment duplication and reduced infrastructure costs overall ▪ Redundant infrastructure for emergencies	▪ Communication infrastructure on highways and arterials can provide a foundation for data integration within this program (communications master plan can assess this) ▪ The freeway fiber backbone and

Strategy	Benefits	Integration Opportunities
		existing arterial infrastructure offer potential bandwidth
CC2 – Countywide Connectivity Master Plan: Design a method of data sharing across the county for traffic, transit, non-motorized, operations, and planning data.	▪ Data for improved operational and investment decisions ▪ Communications standards resulting from this study can reduce investment duplication and improve competition in the current environment	▪ Data sharing among agencies can be supported through establishment of the performance monitoring program foundation ▪ The ITMS and integrated TCS being rolled out by the transit group at OCTA offers extensive opportunities for data collection, sharing and integration in concert with this program ▪ Integration opportunities among all strategies and modes
CC3 – Provide a Connected Vehicles Platform: Allow for the future possibility of connected vehicles in order to capitalize on the robust local operational environment and further enhance the existing foundation	▪ Potential for major advancement in integrated traveler information and management ▪ Potential access to additional transportation funding	▪ Significant integration opportunities and needs with all modes and strategies
Safety		
SF1 – Bicycle Detection: Support on-going, local implementation of bicycle detection technologies, with implementation focused on bike and transit hubs	▪ Increase multi-modal options ▪ Increase safety for non-motorized travelers ▪ Reduce congestion ▪ Reduce greenhouse gas emissions	▪ Bicycle usage data to improve signal coordination ▪ Telematics to provide in-vehicle alert to drivers
SF2 – Pedestrian Detection: Support on-going local implementation of pedestrian detection technologies; future technologies might include telematics	▪ Increase multi-modal options ▪ Increase safety for non-motorized travelers ▪ Reduce congestion ▪ Reduce greenhouse gas emissions	▪ Pedestrian usage data to improve signal coordination ▪ Telematics to provide in-vehicle alert to drivers
SF3 – Transit Security: Support data sharing between transit agencies and law enforcement to ensure passenger safety and security	▪ Increase safety for non-motorized travelers ▪ Promote transit adoption	▪ Share video fields and transit vehicle location data using the ITMS infrastructure
Institutional		
IN1 – Continuously Improve Staffing Levels and Skillsets: Establish a countywide training program recognizing the fast paced, dynamic technology	▪ Increased skillsets ▪ Reduced training expense ▪ Potential for shared resources	▪ N/A

Strategy	Benefits	Integration Opportunities
environment	(reduced costs)	
IN2 – Formalize Sub-regional Partnerships: Establish northern and southern county partnership groups for sharing information and best practices	▪ Increased skillsets and information sharing ▪ Improved operations ▪ Reduced duplication of effort and investment ▪ Potential for shared resources	▪ N/A

5.1 Transit Management and Multi-Modal

5.1.1 Integrated Transit Management (MM1)

Description

Integrated transit management represents a number of projects designed to integrate static and real-time sources of transit data for system planning. The system fuses multiple sources of transit related data – transit schedules, geospatial data, fleet vehicle tracking, personnel records, fare collection and ridership. The integrated system could warehouse the data for operational analysis and disseminate to partner agencies and the public using transit data feeds.

OCTA is currently implementing the ITMS project and will integrate two separate AVL/CAD systems – dispatch and scheduling for fixed route bus service and ACCESS paratransit services. The project is moving two separate radio frequencies to 800 MHz digital radio. The back end systems for OCTA and contract operators are being integrated to provide single login access to personnel records and route assignments. With a single login, any operator can access various vehicle subsystems – dispatch, farebox, vehicle message sign and in-vehicle voice annunciation. The ITMS has the potential to support a regional CAD/AVL system for emergency dispatch and data sharing.

Benefits

- Reduced duplication
- Better quality data
- More robust data for operations and planning

Integration Opportunities

- Data sharing within the transit program
- Ridership and schedule adherence data for local agencies
- Transit usage data for managed lane investment and capital investment planning
- Arterial closures and construction activity information can be useful to better managing transit routes

Implementation Schedule

- Short-term (0-3 years): Complete ITMS implementation
- Long-term (5-10 years): Provide real-time bus arrival information to the public; integrate ITMS with OCTA data warehousing system; integrate CAD/AVL systems for Go-Local operators; serve as a regional CAD/AVL system to include local and county fire and police agencies; coordinate regional emergency response and disaster preparedness

5.1.2 Bus Rapid Transit (MM2)

Description

Bus Rapid Transit (BRT) is a tool that can be used to help make transit service more reliable, faster, and more cost effective. BRT can take many forms, ranging from low- or no-technology deployments that alter schedules and headways to provide limited stop and improved customer service to full-deployments that might additionally include better vehicles, transit signal priority, and real-time arrival information. BRT, in its many forms, has great potential to make transit more competitive with the automobile, increasing ridership and mitigating congestion as result of mode shifts.

Transit Signal Priority (TSP), one component strategy under the BRT umbrella, gives transit vehicles extra green time or less red time at traffic signals to assist with keeping on schedule. There are multiple ways of deploying TSP, including allowance of signal timing priority only when vehicles are behind schedule, based on rider occupancy of the bus, or limiting the frequency of priority calls on a per intersection basis. TSP can be a cost-effective method to enhance regional mobility by improving transit travel times and reliability, but it is recognized that there are also concerns by some stakeholders related to the impact to local traffic progression.

The strategy for BRT in Orange County is to roll out the Bravo! Program, previously branded under the trial that was examined in recent years, in two primary phases. The first phase will be a limited stop service on several key routes, that will focus on reducing the number of stops on a route (to approximately ¾ of a mile from ½-mile between stops), provide more frequent service on those routes (reduced headways), and market the service under the Bravo! brand. A future phase, still being analyzed and considered by OCTA staff, might include TSP, real-time arrival information for buses (likely to be provided through an internet-based application rather than installing variable message signs at the stops), and/or off-vehicle fare collection. Additional routes would also be examined. The Bravo! BRT program is currently evaluated by OCTA staff and will be further defined as a result of those analyses and discussions with stakeholders in the short-term.

Benefits

- Improved customer service and rider experience
- Increased ridership
- More cost-effective operations on Bravo! Routes

Integration Opportunities

- Ridership and arrival time data can be shared with other sections at OCTA for planning and project development activities
- Data from the ITMS and Integrated TCS can be used to enhance this program
- Mobile applications to disseminate predictive bus arrival times

Implementation Schedule

- Short-term (0-3 years): Limited stop service on several key routes, reduce number of stops to approximately ¾ of a mile between stops, reduce headways, market the service under the Bravo! brand.
- Medium-term (3-5 years): Still being examined, might include TSP, web-based real-time arrival information for buses, and/or off-vehicle fare collection; additional routes will be examined.

5.1.3 Rail Operations and Enhancements (MM3)

Description

Technologies are being deployed to enhance the safety and performance of rail operations utilizing communications and detection to track train movements in real-time, monitor grade crossings and work zones and provide real-time train departure information to the public. Efforts are underway to implement a PTC system to improve passenger and freight rail safety in Southern California. In a typical PTC system, onboard equipment on the train uses GPS satellites to transmit speed and location data over wireless or hard line communications links to an operations center. A back office system at the operations center analyzes the data using software that determine the likelihood of a collision or derailment. An advance alert is sent by the dispatch center to the locomotive and brakes are automatically engaged if the warnings are not acted on by the train engineer.

Federal regulations do not prescribe the type of technology a PTC system uses as long as it can accomplish the functions of preventing: train-to-train collisions, derailment from over speeding, incursions into designated work zone areas and train movements caused by switches left in the wrong position. The PTC system in Southern California will be interoperable using a common spectrum for radio communications. Back office systems for Southern California Regional Rail Authority (SCRRA), Burlington Northern Santa Fe (BNSF), Union Pacific (UP), Amtrak and the North County Transit District (NCTD) in San Diego are being integrated and standards are being developed for on-board and wayside devices – allowing trains to be monitored seamlessly across various operating territories in the region.

Benefits

- Increased safety
- Improved operations
- Increased ridership and multi-modal options for travelers

Integration Opportunities

- Construction or traffic conditions (especially during incidents) provided to rail operations
- Rail arrival times provided to traffic management agencies, traveler information, and related strategies/programs

Implementation Schedule

- Short-term (0-3 years): Complete PTC implementation ahead of the federal deadline in 2013
- Long-term (5-10 years): Expand PTC system to include the California High Speed Rail; gather data on train movements for operations planning and traveler information

5.1.4 Integrated Payment (MM4)

Description

OCTA is coordinating with twenty other transit operators in a Southern California to implement a regional fare collection system. The fare integration study has been completed and system requirements for a smart card system are being defined to augment OCTA's existing fare box system to accept cashless fares from other transit operators. Working with other agencies in a regional users group, OCTA is looking towards an open, account based system that utilizes innovative payment methods such as contactless credit/debit cards, mobile devices and near-field communications. A pilot project to test the technology would be followed by the full roll out of the program. Future phases may include expansion to other modes and agencies.

Benefits

- Increased ridership and multi-modal options for travelers
- Reduced congestion
- More cost-effective operations

Integration Opportunities

- Integration and streamlining opportunities among transit projects, parking access and revenue control systems, multi-modal centers, FasTrak® operations, and others

Implementation Schedule

- Short-term (0-3 years): Finalize system requirements for the OCTA smart card system; integrate fare collection with other systems within the county such as Go-Local
- Medium-term (3-5 years): Conduct pilot project and/or full implementation
- Long-term (5-10 years): Potential expansion to other modes/agencies across the region

5.1.5 Support for Pedestrian and Bicycle Travel (MM5)

Description

OCTA and local agencies have planned and built a countywide bicycle transportation network. The network consists of off road (Class I) and on road (Class II and Class III) facilities that interface with transit routes and employment and pedestrian activity centers. OCTA is also involved with planning for future bikeways, facility improvements and policies to accommodate the needs of cyclists and pedestrians. Technologies can play a supporting role in these projects to foster pedestrian and/or bicycle travel primarily through safety enhancements. Technologies

may include such applications as bicycle detection, pedestrian detection, bicycle signals, and other safety applications.

As part of the planned expansion of Metrolink service on the Orange County Line, OCTA is including non-motorized improvements to increase bicycle and pedestrian linkages at station areas. A bike-share pilot project is being implemented in Fullerton and could expand to other Metrolink stations, transit hubs, and colleges and universities to improve first and last mile connections to rail. A bike-sharing service provides short-term rentals for short trips between 3-5 miles of the station area, increasing transit accessibility and promoting travel alternatives and public health. Customers will be able to setup a membership account to rent a bike at a docking station, which automatically records usage for billing. The rental bikes are equipped with GPS for tracking and locating.

Benefits

- Promote non-motorized travel
- Increase rail transit ridership
- Increase safety
- Reduce congestion
- Reduce greenhouse gas emissions

Integration Opportunities

- Traveler information services tailored to cyclists and pedestrians
- Integrate the bike-share program with other regional programs for a seamless rental experience
- Provide bike rental status and availability information through the 511 traveler information system
- Accept transit smart cards for bike-sharing account verification and payment

Implementation Schedule

- Short-term (0-3 years): Locally led technology projects to that support pedestrian and bicycle travel will be deployed as needed
- Medium-term (3-5 years): Implement a countywide bike sharing program
- Long-term (5-10 years): Integrate the bike sharing program with other programs in Southern California; integrate bicycle payment into the countywide or regional fare collection system

5.1.6 Support to Commercial Vehicle Operations (MM6)

Description

Significant freight and truck traffic passes through Orange County, bound for distribution centers in the Inland Empire. Truck lanes and grade separation projects are planned or underway in the county to increase system capacity and reduce impacts on communities. Most commercial

vehicle operations technologies will be led by the private sector, though it is important that the environment in the county allows for these private, market-driven programs to emerge and thrive.

Benefits

- Improved environment for commercial vehicle operations
- Improved safety

Integration Opportunities

- Share traffic data with truck dispatch operations to improve trip routing

Implementation Schedule

- No technologies in public sector projects are identified at this time.

5.2 Traffic Management

5.2.1 Multi-Jurisdictional Arterial Traffic Management (TM1)

Description

The county has a well-funded traffic signal synchronization program that has supported the implementation of advanced arterial traffic management systems in local cities. These improvements have laid the foundation to support advanced technologies for arterial traffic management—corridor and grid-based traffic signal synchronization, adaptive traffic control, corridor based management, performance monitoring and interagency operational coordination. Taking arterial traffic management to the countywide level will depend on greater system integration and interoperability to facilitate data sharing among the regional and local agencies. Standards and interfaces will need to be defined for collecting and sharing traffic data and an institutional framework to coordinate performance monitoring and reporting.

Benefits

- Improved mobility
- Reduced travel costs
- Better data for operations and planning
- Reduced greenhouse gas emissions

Integration Opportunities

- Arterial data shared with transit operators, emergency service providers and freeway/managed lanes operators for improved multi-modal operations
- Real-time arterial traffic data accessed through the 511 traveler information services
- Transit routes, ridership, and schedule changes can be useful to arterial management

- Arterial traffic data warehoused for performance monitoring and cross-jurisdictional operations

Implementation Schedule

- Short-term (0-3 years): Develop a Countywide Communications Master Plan; define a countywide National Transportation Communications for ITS Protocol (NTCIP) specification to standardize ITS technologies
- Long-term (5-10 years): Develop a Countywide Arterial Detection System Master Plan; collect and report real-time sources of arterial traffic data; develop a data exchange network to capture and traffic data from local traffic systems

5.2.2 Continued Freeway Traffic Management (TM2)

Description

The existing program that manages freeway traffic incorporates different operating elements and programs to monitor traffic conditions, increase operational efficiencies and reduce non-recurrent congestion. A robust freeway management program is already in place that has Caltrans District 12, CHP and OCTA coordinating closely to clear incidents and respond to emergencies. One of the tools available is an extensive fiber infrastructure throughout the county for collecting real-time traffic data (flow and speed), including a network of closed-circuit television (CCTV) cameras to confirm travel conditions. Technologies can be deployed to future support these vital functions. These projects may include enhancements, infill or replacement of existing technologies, additional communications infrastructure, introduction of new technologies, ongoing operations and maintenance and performance monitoring.

Benefits

- Improved mobility
- Improved travel safety
- Reduced travel costs

Integration Opportunities

- Freeway data is useful to other traffic management strategies and traveler information
- Providing access to arterial, transit, and corridor data can add value to freeway management
- Physical communications infrastructure has capacity for supporting other strategies

Implementation Schedule

- Short-term (0-3 years): Countywide Communications Master Plan to integrate local systems with the Caltrans communications systems
- Long-term (5-10 years)– Integrated corridor management that involves traffic responsive strategies to improve travel progression on the freeway and parallel arterials

5.2.3 Migration to Grid-based Traffic Signal Synchronization(TM3)

Description

Currently, there is an extensive program, funded by M2 that is synchronizing corridors based on a priority based competitive program. This program procures projects for synchronizing individual corridors and updating equipment needed to facilitate the synchronization, across Orange County. Annually, agencies submit applications for corridors to be synchronized and applications are approved by OCTA. Before and after studies are showing significant mobility improvements on a corridor by corridor basis in support of program continuation. However, there is minimal consideration of the effects on crossing corridors.

An additional enhancement to this strong foundation is to begin a migration to a grid-based approach to synchronization, in geographically appropriate and contiguous sectors of the county. Control points are used to determine when particular travel directions should be green, and combined with standard cycle lengths, this strategy can optimize timing for crossing arterials on a grid network. A grid-based approach enables multiple crossing arterials to be synchronized simultaneously, allowing for a more robust optimization within that grid, and creating a more cost-effective approach overall for the county and the program. It is important to note that this migration would be better suited to north Orange County and would be initiated by local agencies through the same planning, coordination, and application process that are currently defined within the program.

Benefits

- Improved progression on all arterials within a geographic sector
- Improved coordination among crossing arterials
- Reduced staff time and cost in accommodating crossing arterials for coordination

Integration Opportunities

- Could provide data for transit operations where applicable
- Supplement corridor-based MOEs with network-based MOEs for performance monitoring

Implementation Schedule

- Short-term (0-3 years): Allow for grid-based projects to be submitted for future funding
- Short-term (0-3 years): Implement corridor pilot project to demonstrate sector control

5.2.4 Corridor Management (TM4)

Description

Corridor management consists of multiple traffic operations systems and strategies, working collectively, to manage traffic congestion along corridors that include highway, arterial, and/or transit services. Depending on the design for a particular program or facility, corridor management can include active monitoring of all modes and facilities within the corridor, management techniques such as ramp metering (traffic responsive, time of day, or adaptive), arterial traffic signal coordination, incident traffic management, coordinated highway, arterial, and transit management, and other advanced technologies and techniques to manage and balance demand throughout the corridor.

In Orange County, corridor management is recommended for further study and stakeholder engagement to assess the feasibility of building on the existing foundation of advanced arterial and freeway management to establish full multi-modal corridor coordination. The feasibility assessment would assess candidate corridors as alternatives for an initial deployment and engage a breadth of stakeholders to conceptually design the first deployment corridor in a cooperative fashion. Such aspects as staffing, operations, and necessary agreements would be assessed and vetted in terms of cost-benefit trade-offs. Similar systems around the country provide a wealth of experience from which to draw lessons learned in developing a program in Orange County.

Benefits

- Improved customer service and traveler experience across modes
- Reduced congestion
- Increased travel time reliability
- Improved cross-jurisdictional coordination

Integration Opportunities

- The communications assessment, freeway management system, arterial management systems, and OCTA's intelligent transit management system would collectively provide a strong foundation to build upon for this advanced strategy.

Implementation Schedule

- Short-term (0-3 years): Feasibility assessment, stakeholder outreach, project concept development
- Mid-term (3-5 years): Select corridor segment to test the concept, including the process of working through the details of the operational concept and memorandum of understanding (MOU) and any related agreements.

5.2.5 Regional Coordination of Managed Lanes (TM5)

Description

The 91 Express Lanes have been operational for over twenty years, providing enhanced service for high occupancy vehicles and for single occupant vehicles for a fee based on congestion (as calculated on a time of day basis). The 91 Express Lanes will continue to operate and will begin to coordinate operations with adjacent and related facilities within southern California. The first such coordination will be with RCTC on the extension of the Express Lanes into Riverside County. Such aspects as pricing methods, technology choices, and account reconciliation are being examined between the two agencies. Additionally, as the Southern California Express Lane Network is being defined in terms of facilities, operations, pricing options, technology, physical characteristics and marketing/outreach, OCTA, as owner of the 91 Express Lanes, will be working with the policy and technical committee(s) to develop the most advantageous coordination methods for all parties involved.

Benefits

- Improved customer service and traveler experience
- Reduced congestion
- Increased revenues
- Improved cross-jurisdictional coordination

Integration Opportunities

- Traffic, revenue, and user experience data can be shared with other agencies for use in planning additional facilities and streamlined operations in other jurisdictions
- Operational and project development experiences can be shared with other agencies as facilities are planned and rolled out in other jurisdictions

Implementation Schedule

- Short-term/mid-term (0-3/3-5 years): Expansion of the 91 Express Lanes into Riverside County; continued operations of the 91 Express Lanes in Orange County
- Short-term (0-3 years): Continued coordination with the Southern California Value Pricing Study and future facility developments on adjacent and related facilities (only as vetted with and approved by the Board)

5.3 Incident Traffic Management and Emergency Response

5.3.1 Freeway Service Patrol Management (IM1)

Description

Continue FSP management and coordination; continue to improve on efficiencies through enhanced data sets for more efficient research and decision making

Benefits

- More robust research capabilities
- Reduced staff time
- More effective operational synergies
- Reduced program expenditures

Integration Opportunities

- Central database and management software/databases used for integrated transit management may be applicable for use by FSP management

Implementation Schedule

- Short-term (0-3 years): Examine expansion opportunities for access to real-time data integration with on-vehicle GPS data

5.3.2 Emergency Vehicle Preemption Migration (IM2)

Description

The countywide emergency vehicle preemption program owned by OCFA in cooperation with many cities around the county has been in place for many years. Emergency vehicle preemption allows for emergency response vehicles (in this case OCFA equipped vehicles) to pass through intersections with little delay during emergency situations. A vehicle equipped with an emitter sends a request to the signal controller for a green movement in the directions that the vehicle is traveling. Newer technologies that are more robust and allow for greater functionality at lower costs have since emerged in the market. This strategy is to provide a cost-effective migration path to allow for those newer technologies (GPS-based) and continue to grow the program geographically.

Benefits

- Reduce delay for emergency response vehicles
- Increase safety for pedestrians, motorists and emergency response vehicles
- Reduce the need for emergency response vehicles to enter the opposite flow of traffic

Integration Opportunities

- GPS data may be useful outside of the emergency vehicle preemption (EVP) program to local and regional agencies for traffic and safety analyses

Implementation Schedule

- Short-term (0-3 years): Begin testing GPS-technology applications in select corridors; continue to expand the program geographically with additional cities and/or corridors throughout the county.

- Long-term (5-10 years): Full migration to GPS-technology as telemetry will require replacement and as future funding opportunities are identified.

5.3.3 Arterial-based Incident Traffic Management (IM3)

Description

Traffic incidents, such as stalled vehicles, crashes, spilled loads, hazardous material incidents, or natural disasters, account for approximately 50 to 60 percent of traffic congestion in large metropolitan areas. Although these are non-recurring, unplanned events, advance planning and coordination can significantly reduce the impact to the system and delays in travel time to the public. National statistics indicate that for every minute of impact to the travel lanes, there are five to six minutes of residual delay to traffic on the facility. Efficient traffic incident management can improve system operations by addressing 50 to 60 percent of traffic congestion and providing a five-fold reduction in delay for every minute saved in response and clearance. With this level of return on operational improvement to the system, preplanning traffic incident response and management is a powerful component of system management.

Effective traffic incident management is based on strong, multidisciplinary cooperation. It includes preplans, or plans developed in advance of an incident, and multi-agency agreements for incident response, traffic management, scene management, and resource management. While incident management is currently conducted on Orange County freeways and express lanes in a robust, coordinated fashion, there is an interest in examining more coordination with local agencies on arterials to address natural diversion due to incidents that occur on freeways as well as arterial-located incidents that affect major multi-agency, cross-county corridors.

Incident management programs compel cooperative action from traffic operations, law enforcement, fire and emergency medical response personnel in compiling information and developing procedures in advance of an incident. Typical areas addressed in the preplanning include: agency roles and responsibilities, alternate routes for major facilities, communication protocols and contact information, scene management guidelines, traffic management procedures, resource inventories and ordering procedures, and traveler information. Preplanning provides input into the needs and application of various ITS technologies to support incident management plans and operations. Incident management programs are built on shared goals for safety, reduced congestion, and enhanced efficiencies. Successful programs include training and exercises, shared control of signal systems, pre-defined traffic flush plans on major corridors, after action reviews of major incidents, and ongoing performance evaluation.

Benefits

- Reduce delays related to incidents on freeways and arterials
- Improve traveler information on all modes in the event of incidents and anticipated clearance times
- Increase safety for pedestrians, motorists and emergency response vehicles

Integration Opportunities

- Data collection on off-ramps and/or arterials used as alternate routes will be critical to optimized incident traffic management; data can also be valuable to local agency operations in terms of investment and staff planning
- Communication infrastructure on highways and arterials can provide a foundation for data sharing within this program (communications master plan can assess this)
- Data sharing among agencies – a capability that can be supported through expansion of the performance monitoring program will be highly valuable to building this program

Implementation Schedule

- Short-term (0-3 years): Further evaluation and discussion of the project concept or approach to implementing this strategy: approaches to be considered include center-to-center based real-time coordinated response by multiple agencies (requires staffed TMCs/systems at each participating agency); pre-agreed-upon strategies that a single agency deploys; or alternate approaches.
- Mid-term (3-5 years): Conceptual design of the program including geographic phasing. It is recommended to begin with a major corridor and later expand to additional corridors. Agreements among all involved parties will be crafted and executed at this stage prior to system start-up.
- Long-term (5-10 years): Deployment on a corridor-by-corridor basis along with further refinement and fine-tuning of response strategies and ongoing performance evaluations.

5.4 Traveler Information

5.4.1 Continued Expansion of the Southern California 511 Program (TI1)

Description

The Southern California 511 program is comprised of three primary components: LA SAFE's deployment of 511 (web and phone based that provides coverage in Orange, LA, and Ventura Counties), Inland Empire 511, and private marketplace offerings for web and smart phone applications. OCTA has been an active participant in the development and ongoing expansion of the LA SAFE program on behalf of the Orange County stakeholders. This strategy is to continue to participate in the expansion of the LA SAFE 511 program encouraging the development and deployment of those modules most needed for Orange County operations and information:

- Construction zone information including real-time traffic and congestion data
- Spanish language option
- Expansion of the transit trip planner to include real-time arrivals/schedules (currently being rolled out based on static schedules) for ATN, iShuttle, Laguna Beach, OCTA, and Go Local programs
- Continued improvement of the mobile call box module that allows for call transfers to provide motorist assistance and/or call transfers to 911 (for example, call transfers to 911 will not

allow 911 dispatch to triangulate vehicle location; this is currently only possible when calls to 911 originate from the vehicle directly)

Benefits

- Encouragement of mode shift to transit
- Increased support of transportation program investment
- Increased throughput and capacity/demand balance

Integration Opportunities

- Data collected through the 511 program can be provided to all transportation agencies for planning, operational analysis and investment decisions.
- Private sector information providers that provides a source of crowd-sourced data for predictive, area-wide or corridor travel times and travel speed information
- Goods Movement industry that provides a source of truck routing and container tracking data
- Connected Vehicles platform that provides real-time travel data gathered from vehicle-to-vehicle or vehicle-to-roadside communications

Implementation Schedule

- Short-term (0-3 years): Continued support of Southern California 511 expansion; Continued progress toward providing real-time transit information through Southern California 511 and other web-based methods; Continued support of improved integration and coordination between Inland Empire 511 and Southern California 511; Continued support of private market traveler information offerings

5.4.2 Integrated and Localized Parking Guidance (TI2)

Description

Parking Guidance Systems (PGS) provide travelers with space availability, location, and/or pricing information related to parking within an individual structure, lot or on-street (whether public, private or a combination of the two) or for a network of parking locations within a CBD or across a region. PGS can be very effective at reducing local arterial congestion due to unnecessary circulation (vehicles looking for available spaces) and have been shown to increase revenue in associated facilities, which in turn can be used for additional transportation improvements in the area. Within Orange County, there are several existing systems and others that are being planned for particular facilities. Additional assessment of opportunities for PGS application is encouraged. Additionally, a region-wide integrated system is recommended for rail and park-and-ride lots.

A regional, integrated parking guidance and information system applied to park and ride facilities around the county can be provided via a web-based application allowing carpools to form with ease as park and ride facility parking is encouraged, which can have direct impacts on reducing regional (highway) congestion and increasing usage of the 91 Express Lanes as well. Likewise,

a similar program applied to the network of parking lots associated with Metrolink and intermodal centers can further encourage transit ridership.

Benefits

- Encouragement of mode shift to transit
- Increased support of transportation program investment
- Increased throughput and capacity/demand balance

Integration Opportunities

- Locally deployed PGS can integrate with local arterial management systems
- Regional PGS would benefit from real-time and schedules for train and bus arrivals and pricing information on express lanes within Southern California

Implementation Schedule

- Short-term (0-3 years): Support of locally-led PGS
- Mid-term (3-5 years): Define and develop a regional PGS for rail and park-and-ride facilities

5.5 Performance Monitoring

5.5.1 Countywide Performance Monitoring (PM1)

Description

Performance monitoring is a powerful tool that will enable agencies to measure the return on investment in technology (equipment), operations, and related strategies. Performance monitoring is currently conducted on freeways (both automatically and manually), on the 91 Express Lanes (through annual traffic and revenue reporting and daily data processing), on arterials through a biannual process, for transit services, and for other programs including 511, FSP, and to some extent, incident management. There is a need across all modes and in many agencies to build upon these existing programs to improve efficiencies, reduce costs, and improve the end data and access to that data to allow for better evaluations on a daily basis. A countywide performance monitoring program is recommended to provide this service and data to all agencies for multiple purposes: for operations fine-tuning, program decision making, investment considerations, for reporting to the public and in some cases even for potential investments and partnerships. The primary challenge in current performance reporting efforts has been the cost of collecting enough data with enough frequency to make analysis effective and cost-effective.

A performance monitoring program is recommended that will collect and analyze data on a continuous basis across multiple modes and facilities. The development of robust performance reporting should be carried out in a series of short-term and long-term actions. Each phase can be described as follows:

Benefits

- Data for improved operational and investment decisions

Integration Opportunities

- Communication infrastructure on highways and arterials can provide a foundation for data integration within this program (communications master plan can assess this)
- Data sharing among agencies can be supported through establishment of the performance monitoring program foundation
- The ITMS and integrated TCS being rolled out by the transit group at OCTA offers extensive opportunities for data collection, sharing and integration in concert with this program

Implementation Schedule

- Short-term (0-3 years): Project concept definition and systems engineering; should be done in parallel with the countywide communications master plan
- Mid-term (3-5 years): Detailed design, development, and integration; construction/deployment of needed field equipment
- Long-term (5-10 years): Deployment, operations fine-tuning, training, and ongoing improvements

5.6 Communications and Connectivity

5.6.1 Countywide Communications Master Plan (CC1)

Description

Many of the programs being pursued in the transportation market sector in Orange County at local and regional levels, including those defined in this Plan require communications as a foundation to the active operations that is needed now and into the future. A detailed communications master plan performed on a countywide basis will provide a cost-effective approach to deploying needed infrastructure and accessing existing infrastructure already in place for additional data uses. The communications master plan should examine in detail the short-term and future needs, gaps, and opportunities for transit, arterials, highways, construction zones, parking, incident and emergency response, motorist services, bike/pedestrian data, and other related data and facilities. Planning ahead based on a countywide master plan can result in significant construction/procurement savings and enhanced functionality over time.

Benefits

- Data for improved operational and investment decisions

Integration Opportunities

- Communication infrastructure on highways and arterials can provide a foundation for data integration within this program (communications master plan can assess this)

- Data sharing among agencies can be supported through establishment of the performance monitoring program foundation
- The ITMS and integrated TCS being rolled out by the transit group at OCTA offers extensive opportunities for data collection, sharing and integration in concert with this program

Implementation Schedule

- Short-term (0-3 years): Conduct a Countywide Communications Master Plan

5.6.2 Countywide Connectivity Master Plan (CC2)

Description

Design a method of data sharing across the county for traffic, transit, non-motorized, operations, and planning data. Methods and technology for data sharing have made significant changes and improvements in recent years. The connectivity study should closely examine the integration opportunities, specific data needs of each stakeholder, and technology options for collecting, and disseminating the data (web data feeds, cloud-based, etc.).

Benefits

- Data for improved operational and investment decisions
- Communications standards resulting from this study can reduce investment duplication and improve competition in the current environment

Integration Opportunities

- Data sharing among agencies can be supported through establishment of the performance monitoring program foundation
- The ITMS and integrated TCS being rolled out by the transit group at OCTA offers extensive opportunities for data collection, sharing and integration in concert with this program
- Integration opportunities among all strategies and modes

Implementation Schedule

- Short-term (0-3 years): Conduct countywide Connectivity Study
- Mid-term (3-5 years): Implement data sharing system

5.6.3 Provide a Connected Vehicles Platform (CC3)

Description

Allow for the future possibility of connected vehicles in order to capitalize on the robust local operational environment and further enhance the existing foundation. Connected vehicles trials may be supported by local public sector agencies alone or in partnership with the Department of Transportation (USDOT) and/or private entities. While no specific plans are currently known in Orange County, allowing for the potential will enable the region to capitalize on additional federal funds in the future and to provide local residents, businesses, and travelers with the most

advanced travel options. It is anticipated that introduction of Connected Vehicles in Orange County will be spearheaded by the private sector.

Benefits

- Potential for major advancement in integrated traveler information and management
- Potential access to additional transportation funding

Integration Opportunities

- Significant integration opportunities and needs with all modes and strategies

Implementation Schedule

- Not applicable – private sector led

5.7 Safety

5.7.1 Bicycle Detection (SF1)

Signalized intersections equipped with inductive loops and video detection systems can detect bicycles and actuate signals. These technologies reduce wait times for bicycles and enhance safety. Standard inductive loop detectors installed in the pavement can detect bicycles, depending on the positioning of the bicycle wheels over the magnetic field of the loop. The Type D loop configuration in Caltrans Standard Plan ES5B is effective for detecting narrow body vehicles such as bicycles and motorcycles. Some cities include a Bicycle Detector Symbol marking (Caltrans, Standard Plan A24C) on the pavement to direct bicycles to the right location to trigger the detector.

Some signalized intersections are equipped with bicycle push buttons that function in a similar manner to pedestrian push buttons that trigger a crossing phase. The push button is located near the sidewalk edge for easier access for bicycles. An intersection could also be equipped with a bicycle signal head that are similar to a standard traffic signal head, except that a bicycle icon is shown to alert bicycles when bicycles are detected or bicycle push buttons activated, providing an exclusive signal phasing for bicycles. Bicycle signal heads have been in use in the City of Davis for several years and approved for use statewide after the California Vehicle Code was amended.

Assembly Bill 1581 requires bicycle detection at all new and replaced signals. This will take affect once Caltrans adopts standards and specifications and guidelines for detection and timing.

Benefits

- Increase multi-modal options for travelers
- Increase safety
- Reduce congestion

- Reduce greenhouse gas emissions

Integration Opportunities

- Bicycle usage data to improve signal coordination

Implementation Schedule

- Ongoing: Local implementation of bicycle detection systems
- Mid-term (3-5 years): Implementation of bicycle detection systems at bike share and transit hubs
- Long-term (10+years): Implementation of telematics on the Connected Vehicles platform that detect could detect pedestrians and bicycles to alert drivers

5.7.2 Pedestrian Detection (SF2)

Passive pedestrian sensors are deployed at select locations throughout the U.S. to evaluate the accuracy and reliability of the technology. The safety effectiveness remains unknown with a limited deployment. The high cost of installing passive pedestrian sensors compared to button activated detection and the lack of a leading technology may hinder the use of this technology in the short-term. Passive pedestrian sensors do not require pedestrians to push a button to activate the crosswalk signal. A number of commercial products are available that use microwave, infrared or weight detecting technology to sense pedestrian activity. Even when pedestrians do not use the call buttons to activate crosswalk signals, the passive sensors ensure that pedestrians are detected at the intersection at all times. Passive pedestrian sensors can also be utilized for data collection applications to measure pedestrian volumes at crosswalks.

A High-Intensity Activated Crosswalk (HAWK) is a traffic signal that stops road traffic and allows pedestrians to cross. A typical HAWK beacon has a signal head consisting of two red lenses mounted above a single yellow lens. A pedestrian crossing would have two of the HAWK beacons mounted on a mast arm that are activated only when a pedestrian push button or passive sensor is activated. The lights on the beacon will first flash yellow, and then become a steady red signal telling vehicles to stop and yield to pedestrians. When all traffic has stopped for the steady red signals, pedestrian signals display a WALK indication until the time to cross is complete.

Benefits

- Increase multi-modal options for travelers
- Increase safety
- Reduce congestion
- Reduce greenhouse gas emissions

Integration Opportunities

- Pedestrian usage data to improve signal coordination

Implementation Schedule

- Ongoing: Local implementation of pedestrian detection systems
- Long-term (10+years): Implementation of telematics on the Connected Vehicles platform that alerts drivers of pedestrians and bicycles

5.7.3 Transit Security (SF3)

The ITMS project promotes passenger safety by extending connectivity to the on-board video surveillance system on OCTA fixed-route buses. Each bus is equipped with GPS and Wi-Fi antennas, which could enable law enforcement vehicles to monitor and view a remote video feed showing activity inside a moving bus vehicle. The ITMS project also has the capability to support a regional CAD/AVL system using the ITMS' integrated, digital radio communications infrastructure. In the event a transit system emergency that affects communications, the ITMS is fully redundant, with two control centers and a mobile trailer to ensure uninterrupted emergency dispatch operations.

Benefits

- Increase safety for transit passengers
- Interagency data sharing and coordination

Integration Opportunities

- Support a regional CAD/AVL system
- Share data feeds and transit vehicle status and location with law enforcement agencies and first responders

Implementation Schedule

- Ongoing/Short-term (0-3 years): ITMS implementation

5.8 Institutional

5.8.1 Continuously Improve Staffing Levels and Skillsets (IN1)

Description

With evolving technologies and systems, increased reliance on system network management and configuration management, and unique maintenance requirements of individual devices, there will need to be an emphasis on providing a mechanism for consistent, timely, enhanced, and advanced training for staff responsible for operations and maintenance (O&M) of ITS investments. Training staff in O&M and cross-training staff on different facets of the ITS program will help to maximize available staff resources, build technical capacity among multiple staff groups, and ensure that key technical competencies are established, achieved, and improved to Best Practice levels. Training can be addressed in a variety of ways, from vendor-provided

training on device operations, troubleshooting and maintenance, to more formal training through customized courses on specific topics. A countywide approach would provide for a level of consistency in the content, curriculum, availability and delivery of specific training, and would provide for an economy of scale that would help to support training needs of the agencies in the county.

Training needs should be evaluated on a periodic basis, given the dynamic technology environment. Upgrading to newer technologies (such as migrating to wireless communications or more advanced surveillance and detection systems) could warrant a review and enhancement to training curricula. Unique network or operating system upgrades or replacements may require specialized technical support to develop or provide training.

Benefits

- Supports cross-training of technical staff to maximize available resources in the county
- Expands technical skill sets of staff resources
- Reduces training expense if coordinated at the county level
- May allow for resource sharing among agencies to support technical needs
- Provides for a sustainable and consistent training approach

Integration Opportunities

- Not applicable

Implementation Schedule

- Short-term (0-3 years): Evaluate priority technical training needs and available mechanisms to develop and deliver. Establish a training plan that outlines potential resources to develop or support training, and work to establish training as a specific project or program that could potentially be eligible for funding.
- Long-term (5-10 years): Continue to build out training resources and strategies, and maintain a resource where training materials can be made available to County partners. Establish a certification program which helps to ensure that staff has achieved certain skill sets and technical competencies.

5.8.2 Formalize Sub-regional Partnerships (IN2)

Description

There is tremendous value in establishing a forum and partnership that promotes sharing of information, best practices, and lessons learned. Orange County, with the number of local agencies active in ITS, could benefit from a sub-regional approach that would build on the current, high degree of partnership and further foster coordination and collaboration in specific geographic areas of the county. This could allow for important discussions on operational strategies for cross-jurisdictional corridors, freeway/arterial coordination on specific freeway

corridors and interchanges, and improved coordination between arterial operations and transit operations for regional routes.

A north Orange County and south Orange County approach could keep discussions focused, while keeping partnership group sizes manageable and focused on those agencies that would need to coordinate on a regular basis. Some agencies such as the county, Caltrans, and local agencies that overlap both regions would participate in both groups. Regularly scheduled meetings (monthly, bi-monthly or quarterly) could serve as an important forum for specific groups, such as technical/communications, TMC operators, incident management, or other focused working groups deemed relevant by stakeholders. Champions would be needed to spearhead coordination and facilitation of these partnerships and forums. OCTA is the appropriate agency to take a leadership role in providing a framework and helping to establish charters and agreements for these partnerships.

Benefits

- Increased skillsets and information sharing through regularly scheduled interactions on specific topics
- Improved operations and consistent approaches to operations on cross-jurisdictional corridors
- Reduced duplication of effort and investment
- Potential for shared resources (reduced costs) through collaboration and common objectives

Integration Opportunities

- Not applicable

Implementation Schedule

- Short-term (0-3 years): Establish partnerships, framework, and priority needs for collaboration. Identify champions that will help to spearhead coordination. A near-term priority should focus on traffic operations/management.
- Long-term (5-10 years): Evaluate effectiveness and benefits of this collaborative partnership, and seek to expand to include additional focus areas (such as incident management).

6. PLANNED AND RECOMMENDED PROJECTS

Currently planned/programmed ITS projects as well as additional projects and strategies to meet the needs identified through the course of this project are listed in this section. Currently planned/programmed projects were identified by reviewing the Regional Transportation Plan (RTP) and LRTP. Additional projects were developed based on the strategies identified above in order to fill gaps to provide a well-rounded program that responds to the full list of needs and to allow for flexibility in project deployment especially in the further out years of the plan where projects may not yet be defined in detail.

6.1 Project Sequencing

Project sequencing in the ITS Architecture is used to maximize the benefits of ITS projects by building on existing infrastructure and projects to enhance and expand systems. Projects are sequenced in terms of increasing information exchange with a foundation of base infrastructure. The sequencing can be divided into tiers, with each tier building upon the next to propagate information exchange throughout the region. The project sequencing tiers are:

- Tier 1 – Base infrastructure (e.g., communications, controllers)
- Tier 2 – Centralized systems (e.g., traffic operations system)
- Tier 3 – Multi-modal, multi-jurisdictional systems (e.g., transit priority systems, Smart Corridors)
- Tier 4 – Center to Center, Regional systems (e.g., 511, center-to-center data exchange)

The tiers build upon each other to form regional systems. For instance, in order to have an advanced signal system (Tier 2) the communications infrastructure must be in place first (Tier 1). Multi-jurisdictional signal coordination (Tier 3) requires both base infrastructure (Tier 1) and individual jurisdiction signal systems (Tier 2). The larger regional programs (Tier 4) compile the information from systems all over the region and disseminate it to a wider audience.

The sequencing of the planned and programmed ITS projects are shown in **Table 5**.

Table 5 – Currently Planned/Programmed Projects

Funding List	Category	Project	Description	Project Sequencing
LRTP 2035 Baseline	Transit Capital	Commuter Rail Monitoring Equipment Upgrade/ Installation	Commuter rail crossing monitors upgrade and/or install monitoring equipment at rail crossings in Orange County to provide notification in the event of damage or malfunction.	Tier 1
LRTP 2035 Baseline	Transit Capital	Video Surveillance System for Irvine Station	Implement a video surveillance system at the Irvine Transportation Center.	Tier 2
LRTP 2035 Baseline	Transit Capital	Video Surveillance System for Base Facilities	Install video surveillance equipment at four OCTA base facilities: Anaheim, Garden Grove, Irvine (Sand Canyon and Construction Circle).	Tier 1
LRTP 2035 Baseline	Transit Capital	On-Board Bus Video Surveillance System	Equip 67 buses with on board video surveillance system equipment, of which 36 are 40-foot buses and 31 are 30- foot mid-size buses.	Tier 1
LRTP 2035 Baseline	Transit Capital	Key Card Access System for Base Facilities	Install key card access system at five OCTA base facilities: Anaheim, Garden Grove, Irvine (Sand Canyon and Construction Circle) and Santa Ana.	Tier 1
LRTP 2035 Baseline	Transit Capital	Implement Positive Train Control (PTC)	Implement PTC, a system of monitoring and controlling train movements to provide increased safety.	Tier 4
LRTP 2035 Baseline	Transit Capital	Orange County Metrolink Fiber Optics Installation Project	Replacement and upgrade of the existing SCRRA communications system with fiber optics.	Tier 1
LRTP 2035 Baseline	Transit Capital	Security-related Equipment for Transit	Security surveillance and monitoring equipment for transit.	Tier 1
LRTP 2035 Baseline	Transit Capital	Radio Communication System Upgrade	Radio Communication System Upgrade.	Tier 2
LRTP 2035 Baseline	Transit Capital	Capital Maintenance on Metrolink System	Rehabilitation of track, signal, communications, structures, facilities, and rolling stock.	Tier 1
LRTP 2035 Baseline	Other	Emergency Response Projects	Emergency response projects in various locations (Countywide).	Tier 3
LRTP 2035 Baseline	Transportation Demand Management	Orange County Signal Improvement Program	This project will target 158 miles and 533 signalized intersections along 10 high-volume regional traffic corridors across the County of Orange for coordinated signal synchronization.	Tier 3

Funding List	Category	Project	Description	Project Sequencing
LRTP 2035 Baseline	Transportation Demand Management	Signal upgrades in Rancho Santa Margarita	Signal upgrades on Avenida De Las Flores, Melinda Road, Avenida De Las Banderas, and Alma Aldea.	Tier 1
LRTP 2035 Baseline	Transportation Demand Management	ITS Master Plan in Anaheim	Develop and implement an ITS Master Plan in Anaheim.	N/A
LRTP 2035 Baseline	Transportation Demand Management	ITS for Harbor Boulevard in Garden Grove	Design and implement Harbor Boulevard ITS in Garden Grove.	Tier 1
LRTP 2035 Baseline	Capacity Improvements	Intelligent Transportation System	Interconnect 21 signals from the west side of Garden Grove to the City's TMC with fiber optics (project closes a 3.5 mile gap).	Tier 1
LRTP 2035 Preferred Plan	Bus Rapid Transit (BRT)	Westminster Avenue/17th Street BRT	22-mile fixed-route BRT between Santa Ana and Long Beach. Includes structures, (23) rolling stock.	Tier 3
LRTP 2035 Preferred Plan	Bus Rapid Transit (BRT)	Harbor Boulevard BRT	19-mile fixed-route BRT between Fullerton and Newport Beach. Includes structures, (23) rolling stock.	Tier 3
LRTP 2035 Preferred Plan	Bus Rapid Transit (BRT)	Bristol Street/State College Boulevard BRT	28-mile fixed-route BRT from Brea Mall to Irvine Transportation Center. Includes structures, (32) rolling stock.	Tier 3
LRTP 2035 Preferred Plan	Transportation System Management Projects	I-405 HOT Project, I-405 Improvements Project from State Route 73 to I-605	Convert existing HOV lane to HOT, add one additional HOT lane each direction from State Route 73 to I-605.	Tier 3
LRTP 2035 Preferred Plan	Transportation System Management Projects	State Route 91/ State Route 241 Interchange	Add HOV/HOT connector at State Route 241/State Route 91 interchange (eastbound on-ramp, westbound off-ramp).	N/A
LRTP 2035 Preferred Plan	Transportation System Management Projects	Freeway Service Patrol & Call Box Program	Continuation of motorist aid services.	Tier 4
LRTP 2035 Preferred Plan	Transportation System Management Projects	Toll Roads Video Detection Demonstration Project	Image-based toll collection system demonstration project.	Tier 2

Funding List	Category	Project	Description	Project Sequencing
LRTP 2035 Preferred Plan	Transportation Demand Management	Signal Synchronization Program	Coordinate traffic signals in key corridors – 750-mile network with 2000 signals (includes local share).	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	Katella Avenue BRT	New BRT service between Long Beach and Orange.	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	Edinger Avenue BRT	New BRT service between Huntington Beach and Tustin.	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	Beach Boulevard BRT	New BRT service between Huntington Beach and La Habra.	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	La Palma Avenue BRT	New BRT service between Buena Park and Anaheim.	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	South County BRT	New BRT service between Central Orange County and South Orange County (via Irvine Center Drive/Moulton Parkway/ Golden Lantern).	Tier 3
LRTP 2035 Unconstrained	Bus Rapid Transit (BRT)	Enhance BRT Routes	Implement by pass lanes at intersections real-time passenger information, transit signal priority, and station improvements.	Tier 3
LRTP 2035 Unconstrained	Transportation System Management Projects	Toll Corridors Improvements	Transportation Corridor Agencies - build-out of toll corridors.	Tier 3
LRTP 2035 Unconstrained	Capacity and Systems	Additional Arterial and Intersection Optimization	Additional turn lanes, advanced traffic management systems, communications, improved lighting and safety treatments on 9 arterials and at 60 intersections identified in Central County MIS.	Tier 3
SCAG 2012 RTP PROJECT LIST	Transit	ORA 110632 and ORA110634	1% transit enhancements – bicycle and pedestrian facilities countywide (Mission Viejo) projects are consistent with 40 CFR part 93.126 exempt Tables 2 and Table 3 categories – bicycle and pedestrian facilities (both motorized and non-motorized).	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA080917	1% transit security projects (Mission Viejo). Transit development credits in FY09/10 for $21 & FY10/11 for $21, FY11/12.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA080907	1% transit security projects (OCTA). Transit development credits in FY10/11 $96,747, in FY11/12 $94,245.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA080909	A project study for the City of Santa Ana – fixed guideway system linking the Santa Ana regional	N/A

Funding List	Category	Project	Description	Project Sequencing
			transportation intermodal center to Harbor Blvd. in the City of Garden Grove. Preliminary engineering and environmental.	
SCAG 2012 RTP PROJECT LIST	Transit	ORA080908	A transit corridor for the City of Anaheim – Anaheim Rapid Connection (ARC) fixed guideway system linking the Anaheim Regional Transportation Intermodal Center (ARTIC) to the platinum triangle to the Anaheim resort. Alternatives analysis, EIR/EIS, LPA and conceptual and advanced engineering, project development activities and preliminary engineering.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	VARIOUS	Various projects - Purchase of buses and related equipment, radios, computers, and/or ITS equipment on or supporting vehicles and related transit programs.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	VARIOUS	Various projects - purchase and upgrade of trains, tracks, platforms, safety equipment, and associated equipment and/or ITS for Metrolink, ARTIC, ARC, and other local and regional rail and commuter rail services.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA020812	Commuter rail crossing monitors upgrade and or install monitoring equipment at rail crossings in Orange County to provide notification in the event of damage or malfunction.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA080903	Environmental clearance and advanced conceptual design of the California High Speed Rail Authority, high speed rail project from San Francisco to Los Angeles.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA020113	Fullerton Train Station – parking structure, phase I and II. Total of 800 spaces (PPNO 2026).	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA081623	Fullerton Transportation Center – initial planning and conceptual engineering of the expansion for the Fullerton transportation center.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA112005	Implement bike stations and bike sharing program in Orange County.	Tier 3
SCAG 2012 RTP PROJECT LIST	Transit	ORA110621	Intermodal park and ride facility at Discovery Science Center in Santa Ana.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA081622	Irvine Transit Station – expansion of the Irvine Transit Center (ITC). Initial planning and conceptual engineering phase.	N/A

Funding List	Category	Project	Description	Project Sequencing
SCAG 2012 RTP PROJECT LIST	Transit	ORA020817	Key card access system for base facilities – install key card access system at five OCTA base facilities in Anaheim, Garden Grove, Irvine (Sand Canyon and construction circle) and Santa Ana.	Tier 2
SCAG 2012 RTP PROJECT LIST	Transit	ORA120537	Laguna Niguel rail station parking expansion – construction of 562 new spaces (281 existing + 562 new = 843 spaces).	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA111229	Orange County ARC – 10 large buses for expansion service. (utilizing $80,290 in toll credit for FY10/11).	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA080906	Orange County ARC – 10 (SE) large buses type III, cameras.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA082605	Orange County Metrolink fiber optics installation project. Replace and upgrade communications system throughout Metrolink) provide a fiber-optic backbone and use microwave hops to transmit data to the MOC in Pomona. CTOS that will fill conduit gaps are being processed. Verizon (formerly MCI) conduit will be used between Ritchey St. and southern terminus. Metrolink rail rehab ora37111 contains the 5309 funds.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA120357	Orange County. Traffic signal synchronization for bus rapid transit corridors.	Tier 3
SCAG 2012 RTP PROJECT LIST	Transit	ORA085001	Orange Transportation Center parking expansion – project will provide approximately 1,100 additional transit parking spaces at the Orange Station parking center.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA080801	Positive train control for Metrolink will help to prevent train-to-train collisions, speeding and over-speed derailments, and movement of a train through a wrong rail segment or into track work zones. The implementation of the project will enhance the safety and security of commuter rail service, while helping to meet 2015 federal mandate enacted in the RSIA of 2008.	Tier 4
SCAG 2012 RTP PROJECT LIST	Transit	ORA080804	Radio communication system upgrade.	Tier 2
SCAG 2012 RTP PROJECT LIST	Transit	ORA65002	Rideshare services Rideguide, database, customer information, and marketing (Orange County portion).	Tier 2

Funding List	Category	Project	Description	Project Sequencing
SCAG 2012 RTP PROJECT LIST	Transit	ORA110613	Security surveillance and monitoring equipment for transit.	Tier 1
SCAG 2012 RTP PROJECT LIST	Transit	ORA110625	Various planning and transportation projects determined by the Orange County Council of Governments (OCCOG) to reduce congestion in OC, including smart growth and increased transit.	N/A
SCAG 2012 RTP PROJECT LIST	Transit	ORA020814	Video surveillance system for base facilities – install video surveillance equipment at four OCTA base facilities in Anaheim, Garden Grove, Irvine (Sand Canyon and construction circle).	Tier 1
SCAG 2012 RTP PROJECT LIST	State Highway	ORA020814	Various state highway projects that may or may not include ITS.	Tier 1
SCAG 2012 RTP PROJECT LIST	State Highway	ORA001102	Grouped projects for safety improvements – SHOPP collision reduction program scope: projects are consistent with 40 CFR part 93.126 exempt Tables 2 and Table 3 categories – railroad/highway crossing, shoulder improvements, traffic control devices, operations assistance intersection signalization projects pavement marking, lighting improvements.	Tier 1
SCAG 2012 RTP PROJECT LIST	State Highway	ORA001108 AND ORA001105	Grouped projects for safety improvements – SHOPP mandates program. Scope: projects are consistent with 40 CFR part 93.126 exempt Tables 2 and Table 3 categories – railroad/highway crossing, safer non-federal-aid system roads, shoulder improvements, traffic control devices and operations assistance other than signalization projects, lighting improvements.	Tier 1
SCAG 2012 RTP PROJECT LIST	State Highway	ORA040607	Orange County – countywide activities: planning, programming and monitoring (PPM).	N/A

Funding List	Category	Project	Description	Project Sequencing
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA110603	Bikeway wayfinding signage – assess existing bikeway wayfinding signage citywide with focus on signage in and around class I bikeways, major institutions, city parks, recreational facilities, schools, and other publicly-owned assets. Produce detailed recommendations on placement and/or replacement of signage to determine the 60 locations for signage installation and/or replacement. May or may not include ITS.	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA02926	BNSF railway line (Kraemer Blvd. to Kellogg Dr.) along SS of Orangethorpe. Install supplemental safety measures at 8 at-grade crossings (4.4 miles).	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA02925	BNSF railway line (Placentia) along SS of Orangethorpe. Grade separation/corridor improvements.	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	VARIOUS	Various local highway and roadway projects that may or may not include ITS.	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA100509	Design and implement Harbor Boulevard ITS in Garden Grove.	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA100508	Develop and implement an ITS Master Plan in Anaheim.	N/A
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA990906	Grouped projects for bicycle and pedestrian facilities funded with TE – scope: projects are consistent with 40 CFR part 93.126 exempt Tables 2 and Table 3 categories – bicycle and pedestrian facilities (both motorized and non-motorized).	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA990907	Grouped projects for transportation enhancement activities – projects are consistent with 40 cfr part 93.126 exempt Tables 2 and Table 3 categories – transportation enhancement activities (except rehabilitation and operation of historic transportation buildings, structures, or facilities).	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA102904	Image based toll collection system – demonstration project (ITS).	Tier 1

Funding List	Category	Project	Description	Project Sequencing
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA112001	Moulton Parkway smart street segment 3 phase II – from approximately 400' north of El Toro Road to 500' north of Santa Maria Avenue (0.7 miles) – improve roadway traffic capacity and smooth traffic flow through traffic signal synchronization, bus turnouts, intersection improvements, additional sidewalk, additional turning lanes and on-road bike lanes within the project limits.	Tier 1
SCAG 2012 RTP PROJECT LIST	Local Highway	ORA020805	Orange County signal improvement program. This project will target 158 miles and 533 signalized intersections along ten high-volume regional traffic corridors across the county of orange for coordinated signal synchronization.	Tier 3

6.2 Strategic ITS Projects

Additional projects representing ITS strategies that fulfill user and regional needs are listed in the sections below. These strategies support the deployment of the ITS SDP.

6.2.1 Transit Management and Multi-Modal

- **Integrated Transit Management (MM1)**: Short-term – continue deployment and integration of ongoing transit management projects; complete ITMS implementation
- **Integrated Transit Management (MM1)**: Long-term – integrate ITMS with other systems
- **Bus Rapid Transit (MM2):** Short-term – Limited stop service on several key routes, reduce number of stops to approximately ¾ of a mile between stops, reduce headways, and branding
- **Bus Rapid Transit (MM2)**: Medium-term – Still being examined, might include TSP, web-based real-time arrival information for buses, and/or off-vehicle fare collection; additional routes will be examined.
- **Rail Operations and Enhancements (MM3):** Short-term – continued rail operations supported by technologies for safety, such as for positive train control, intersection safety, and operations
- **Rail Operations and Enhancements (MM3):** Long-term – establish interface with PTC systems to obtain train movements and schedule data for planning and operations
- **Integrated Payment (MM4):** Short-term – currently being examined in Orange County in coordination with other southern CA agencies, an integrated, open payment method that would initially allow for transit payment
- **Integrated Payment (MM4):** Medium to Long-term – expand contactless payment system to other transit operators in Orange County and to the rest of Southern California
- **Support for Pedestrian and Bicycle Travel (MM5):** Ongoing/Short-term – local deployments of pedestrian and bicycle safety and information technologies; deploy a countywide bike sharing program
- **Support for Pedestrian and Bicycle Travel: (MM5)** Long-term – integrate countywide bike sharing program with other regional bike sharing systems
- **Support to Commercial Vehicle Operations (CVO) (MM6):** Pending – primarily privately led, CVO activities will be supported as needed in terms of technology

6.2.2 Traffic Management

Multi-Jurisdictional Arterial Traffic Management:

- **Continued Arterial Traffic Management (TM1)**: Ongoing/Short-term – continue to manage arterials across the county and across jurisdictions; provide a foundation for advanced management and strategies; provide access to more data for operations and planning
- **Continued Arterial Traffic Management (TM1)**: Short-term/Mid-term – develop a Countywide Communications Master Plan; develop a Countywide Arterial Detection Master Plan; develop the framework for a countywide data exchange network.

- **Continued Freeway Traffic Management (TM2)**: Ongoing/Short-term – continue to manage freeway traffic through existing and future technology and operational procedures.
- **Migration to Grid-based Traffic Signal Synchronization (TM3)**: Short term – fund projects that optimize coordination on crossing arterials
- **Corridor Management Study (TM4)**: Short-term – Feasibility Assessment, stakeholder outreach, project concept development
- **Corridor Management Pilot Project (TM4)**: Medium-term – select corridor segment to test the concept, including the process of working through the details of the operational concept and MOUs and any related agreements
- **Regional Coordination of Managed Lanes (TM5)**: Short-term/Medium-term – expansion of the 91 Express Lanes into Riverside County; continued operations of the 91 Express Lanes in Orange County; continued coordination with the southern California Value Pricing Study and potential future facility developments on adjacent and related facilities (only as vetted with and approved by the Board)

6.2.3 Incident Management and Emergency Response

- **Freeway Service Patrol Management (IM1):** Ongoing/Short-term – continue FSP management and coordination; continue to improve on efficiencies through enhanced data sets for more efficient research and decision making
- **Emergency Vehicle Preemption Migration (IM2):** Short-term – begin testing GPS-technology applications in select corridors; continue to expand the program geographically with additional cities and/or corridors throughout the county.
- **Emergency Vehicle Preemption Migration (IM2):** Long-term – full migration to GPS-technology as transponders require replacement and future funding opportunities are identified.
- **Arterial-based Incident Traffic Management (IM3):** Short-term – further evaluation and discussion of the project concept or approach to implementing this strategy: approaches to be considered include center-to-center based real-time coordinated response by multiple agencies (requires staffed TMCs/systems at each participating agency); pre-agreed-upon strategies that a single agency deploys; or alternate approaches.
- **Arterial-based Incident Traffic Management (IM3)** Medium-term – conceptual design of the program including geographic phasing. It is recommended to begin with a major corridor and later expand to additional corridors. Agreements among all involved parties will be crafted and executed at this stage prior to system start-up.
- **Arterial-based Incident Traffic Management (IM3):** Long-term – deployment on a corridor-by-corridor basis along with further refinement and fine-tuning of response strategies and ongoing performance evaluations.

6.2.4 Traveler Information

- **Continued Expansion of the Southern California 511 Program (TI1)**: Ongoing/Short-term – continued support of Southern California 511 expansion; continued progress toward providing real-time transit information through Southern California 511 and other web-based

methods; continued support of improved integration and coordination between Inland Empire 511 and Southern California 511; continued support of private market traveler information offerings

- **Integrated and Localized Parking Guidance Short-term (TI2)**: Short-term – support of locally-led PGS
- **Integrated and Localized Parking Guidance (TI2)**: Medium-term – define and develop a regional PGS for rail and park-and-ride facilities.

6.2.5 Performance Monitoring

- **Countywide Performance Monitoring Short-term (PM1)**: Short-term – project concept definition and systems engineering; should be done in parallel with the countywide communications master plan
- **Countywide Performance Monitoring (PM2)**: Medium-term – detailed design, development, and integration; construction/deployment of needed field equipment
- **Countywide Performance Monitoring (PM3)**: Long-term – deployment, operations fine-tuning, training, and ongoing improvements

6.2.6 Communications and Connectivity

- **Countywide Communications Master Plan (CC1):** Short-term – identify physical and logical connectivity to support multi-modal and multi-agency operations and data sharing needs.
- **Countywide Connectivity Master Plan (CC2):** Medium-term – design a method of data sharing across the county for traffic, transit, non-motorized, operations, and planning data.
- **Provide a Connected Vehicles Platform (CC3):** Pending – allow for the future possibility of connected vehicles in order to capitalize on the robust local operational environment and further enhance the existing foundation

6.2.7 Safety

- **Bicycle Detection (SF1**): Ongoing/Short-term – support local implementation of bicycle detection technologies at critical intersections and near bicycle and transit hubs
- **Pedestrian Detection (SF2):** Ongoing/Short-term – support local implementation of bicycle detection technologies at critical intersections and near bicycle and transit hubs
- **Transit Safety (SF3):** Ongoing/Short-term – continue ITMS implementation (refer to MM1)
- **Telematics (SF4)**: Pending – provide a Connected Vehicles platform that alerts motorists of bicycles and pedestrians in the surrounding environment (refer to CC3)

6.2.8 Institutional

- **Continuously Improve Staffing Levels and Skillsets (IN1)**: Short-term – evaluate priority technical training needs and available mechanisms to develop and deliver; establish a training plan that outlines potential resources to develop or support training; and work to establish training as a specific project or program that could potentially be eligible for funding

- **Continuously Improve Staffing Levels and Skillsets (IN1):** Medium/Long-term – continue to build out training resources and strategies, and maintain a resource where training materials can be made available to agencies countywide; establish a certification program which helps to ensure that staff has achieved certain skill sets and technical competencies
- **Formalize Sub-Regional Partnerships (IN2)**: Short-term – establish partnerships, framework, and priority needs for collaboration; identify champions that will help to spearhead coordination; a near-term priority should focus on traffic operations/management.
- **Formalize Sub-Regional Partnerships (IN2)**: Medium/Short-term – evaluate effectiveness and benefits of this collaborative partnership, and seek to expand to include additional focus areas (such as incident management and bulk purchasing of equipment).

7. Regional Communications and Integration

The previous sections describe a series of ITS strategies and projects likely to be deployed over the next ten years around the county. Communications infrastructure (wireless, hardwire, fiber, and data exchange) forms the foundation to support these intended programs. This section examines, at a high level, the functional scope and geographic coverage of the ITS communications infrastructure throughout the county. The assessment looks at how multi-agency systems can be leveraged to support a county-wide system that serves future ITS needs and the vision for greater coordination and integration of local and regional operations. Further analysis and the technical details of the future communication network will be analyzed and defined more specifically in a subsequent, in depth communications master plan study (separate from this study) along with preliminary estimates of construction costs and phasing/deployment opportunities.

7.1 Communication Infrastructure Review

Through OCTA funded programs and local initiatives, traffic system communications are widely deployed across the regional arterial network. Through June 2012, the Master Plan of Arterial Highways (MPAH) has 1,463 center line miles built of which, over 40% was covered by twisted pair or fiber-optic interconnect. **Figure 3** provides an overall depiction of the communications coverage on the MPAH network.

The following findings summarize the characteristics and make-up of the communications infrastructure in the county:

- Twisted pair signal interconnect cable remains the most widely used medium for center-to-field communications.
- Agencies that use higher bandwidth single mode fiber-optic (SMFO) cable are concentrated in the north and central areas of the county. In the south, Mission Viejo has the greatest coverage of fiber in its infrastructure.
- Wireless technologies are used for last-mile communications to signals located in the periphery. Wireless technologies are primarily deployed in Fullerton and Orange, due to some topological features that are less favorable for wired interconnect.
- Most agencies employ distributed networks so that communications is not focused on a centralized location. The communications infrastructure is distributed at key locations throughout the network at hub locations that aggregate connections with field devices. This configuration reduces the impact of losing any single point of communications, resulting in a greater fault tolerance.

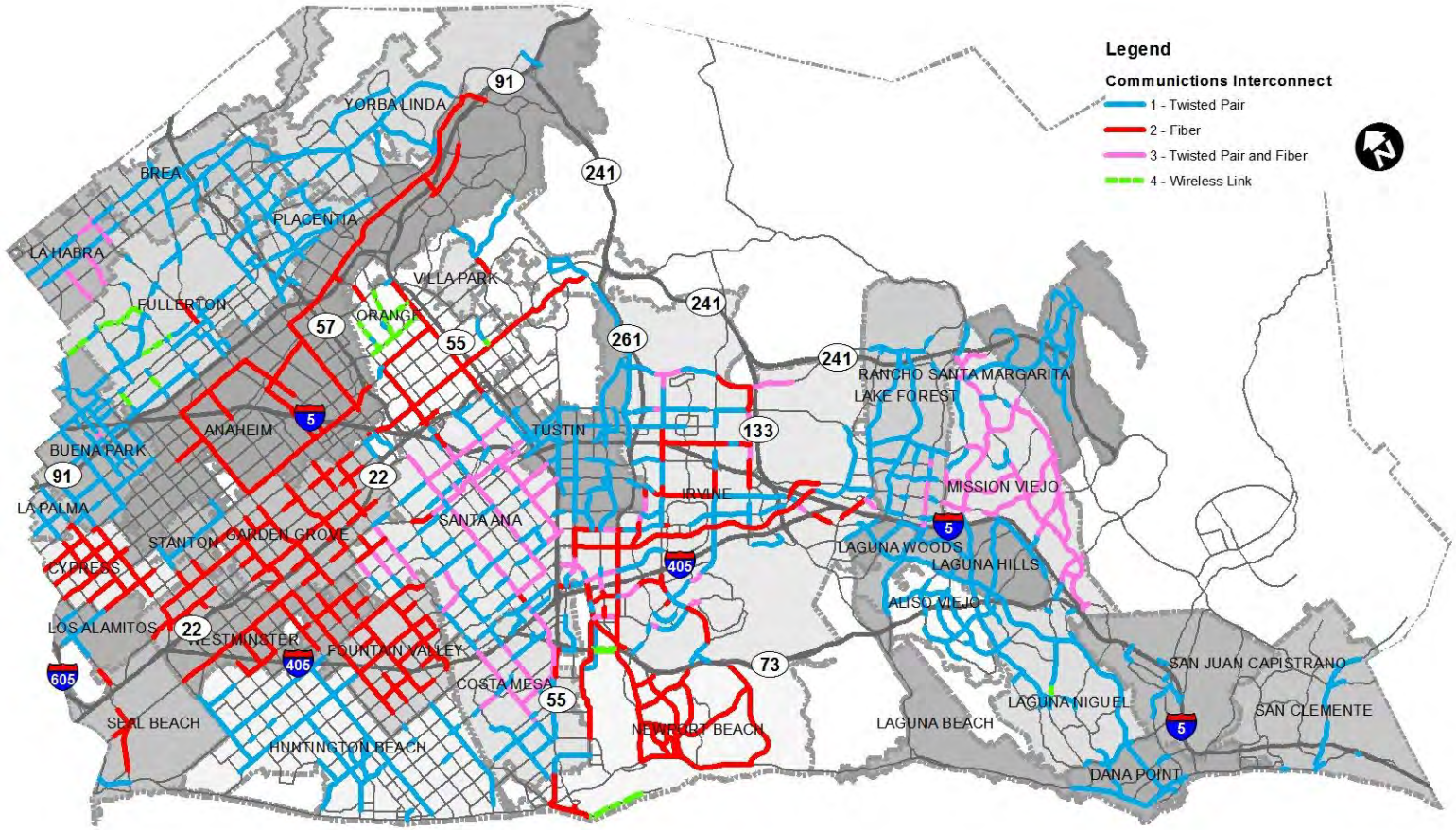


Figure 3 – Signal Communications on the MPAH Network

7.2 Opportunities and Challenges to Countywide Integration

The ability to meet future ITS needs starts with a robust communications infrastructure that can expand and evolve with technology. Communication technologies and architecture choices affect a region's ability to keep up with advances in traveler information and active traffic management. As Orange County looks to the next decade of technology deployment in an environment that enables local, regional, and privately-led initiatives, the communications infrastructure choices will become even more critical to operating a cost-effective transportation system for travelers. This section discusses approaches for positioning the infrastructure to support greater integration, interoperability and scalability.

7.2.1 System Architectures

An *open standard system* is defined as a central system architecture that is specifically designed to interface with equipment provided by multiple suppliers. It is provided by a vendor/firm that does not require the owner to purchase firmware or hardware from a single source. Open systems could encourage agencies to implement projects that use interoperable components and multiple vendors. With an open system, if a field device vendor stops supporting a particular product or it becomes more expensive, it can be replaced by another open standard product without wholesale system replacement. The flexibility of an open standard system preserves initial investments.

The following summarize key benefits of an open system:

- Agencies are able to procure field device from multiple vendors, thereby offering more competitive pricing.
- Different field devices can be supported including those based on emerging technologies.
- Low risk implementation because open systems, by definition, require adherence to published protocol standards for interoperability. Software development follows published standards and protocols including AB3418E and NTCIP. This allows for easier future integration with other systems or modules.
- Enables the agency to have separation of hardware and software at the field device level. Multiple-vendor hardware and different field device firmware can be supported. This is a benefit for large agencies that require different functionality at different locations.
- Permits addition of new agencies and new device classes, granted they adhere to standard, thus promoting expansion and incorporation of new technologies.

The upside to open systems is the compatibility with non-vendor specific components, which means lower integration and replacement costs, especially when aggregated across the County. Open systems allow for devices to be interchanged, supporting software and protocols that make it easier and less costly to integrate field devices from multiple vendors.

7.2.2 Controller Compatibility

Most of the agencies in Orange County have deployed NTCIP compliant central systems that support the range of NEMA standard and 2070 standard controllers as shown in **Table 6**. However, the system architectures are not entirely open as the central system and controllers tend to be tied to proprietary protocols for communications (e.g. ECOM, QuicComm, or ECPIP). Moving toward an open architecture with NTCIP implementation will enable compatibility of 2070 based and NEMA based controllers with different central systems.

Table 6 – Central System Compatibility Comparison

Central System	Protocol Support	Controller Software	Controller Hardware
Siemens TACTICS	NTCIP AB3418E ECOM	SEPAC EPAC ASC/3 NextPhase	NEMA TS1 or TS2, 2070
McCain QuicNet	AB3418 QuicComm	Program 2033 Program 233	Type 170 w/ 233 Type 2070 w/ 2033
Econolite Centracs	NTCIP AB3418E ECPIP	ASC/2 ASC/3 EPAC	NEMA TS1 or TS2, 2070 w/ ASC/3 170 w/ Wapiti W4IKS
Transuite **(set to replace CTNET)**	NTCIP AB3418E	TSCP C8	NEMA TS1 or TS2, 170 w/ C8 2070 w/ TSCP

There are several options for integrating the different controller types if the agencies were to migrate to open systems:

- The vendor releases their protocol and controller memory map information so that controllers can be paired with any open architecture central system;
- The Management Information Base (MIBs) for the controllers is obtained and the firmware is upgraded or modified to run NTCIP; or
- The controller firmware is replaced with an open system firmware compatible with the central system using NTCIP.

There are advantages and challenges associated with each option, as summarized in **Table 7**.

Table 7 – Controller Integration Options

Central System	Advantages	Challenges
Obtain release of proprietary protocols	No need to change controller or firmware	Vendor resistance; may require new policies to require cooperation
Upgrade controllers to NTCIP protocol	Fulfil federal funding requirements for NTCIP compatibility	Cost; NTCIP can be slower for upload/download than vendor protocols; may face resistance from vendors on private MIB sharing; loss of some functionality
Replace controller firmware with an open firmware option	Opportunity to standardize firmware across different controller types	Field tech and engineer training; replacement cost may be higher than the NTCIP upgrade cost

7.2.3 IP/Ethernet Communications

Ethernet is a physical connection standard, as well as a standard for transferring data between devices over a common connection. It is a distinct departure from the RS-232/RS-422 serial world in that an Ethernet network is not a series of point-to point connections, but rather devices sending addressed packets of information over the entire network. Internet Protocol (IP)/Ethernet communications have widespread use in local area and wide area networks that permits the use of a variety of network media (including wireless) and purchased services such as general packet radio service (GPRS), digital subscriber lines (DSL), cable modems, and plain old telephone system (POTS) lines. This communications architecture allows agencies to readily share data with other Ethernet-based networks over center-to-center interfaces.

IP is a set of rules that governs how computers and other network devices communicate over a network. IP works at the device level and in part determines how data packets are passed along a network. IP addressing refers to the device-addressing scheme used by the Internet. It is hierarchical in nature, possessing a format that breaks an address into higher level domain, which may encompass an entire enterprise or organization to sub levels of networks underneath this domain, all the way down to individual device identification. By having a schema allowing for unique addressing that is used universally, devices are not only uniquely identifiable within a single office, organization, or enterprise, but also can be uniquely identified by anyone. This allows for devices to communicate between multiple private and public networks.

As revealed in the inventory, most agencies continue to operate and maintain predominantly serial systems on twisted pair copper media for center-to-field communications. These systems face declining support for legacy components required to maintain a serial-based infrastructure.

Moreover, serial communications lack scalability to integrate new devices/technologies in a reliable and flexible manner. These systems also lack the capacity to support bandwidth intensive applications such as expanded CCTV coverage, adaptive signal operations, future traveler information services and performance measurement. The use of IP-based technologies over twisted pair copper cable is gaining adoption and if used over short distances, provides a viable "last-mile" solution.

The following are key considerations for agencies to migrate their systems to IP/Ethernet communications:

- Local systems will need capacity and scalability to support bandwidth intensive applications such as video surveillance, adaptive signal operations, traveler information services and performance measurement.
- Older systems will face declining support for legacy components required to maintain a serial-based infrastructure. Manufacturers of ITS devices have largely migrated to production of IP-based products.
- An IP/Ethernet enterprise supports interoperability standards that provide flexibility to use ITS devices from different manufacturers. By avoiding proprietary technologies, agencies can procure products and services more competitively from multiple vendors.
- Use of IP/Ethernet networking permits the sharing of ITS networks with other enterprise networks.
- Reliable communications between central and field is mission critical to traffic management and public safety. Network monitoring tools are available that provide an effective and efficient approach to identifying, troubleshooting and correcting/repairing system faults for IP/Ethernet networks. The network can also be configured in a ring or mesh topology for data path redundancy. This provides for greater fault tolerance that reduces the susceptibility to disruptions from a single communication link failure.

7.2.4 National Transportation Communications for ITS Protocol (NTCIP)

Interchangeability has largely been an elusive goal for the traffic signal industry. NEMA controllers have long had proprietary features to set them apart from competitors and have communicated using proprietary protocols. As a result, vendors were able to lock-in customers to their products. This has also been true with ATMS packages used to manage signal systems. With few exceptions, these software packages require controllers by the same vendor to realize their full functionality. The 170 and 2070 standards have separated controller software from the controller hardware, but the central software vendor still needs to be paired with the controller software vendor for full functionality.

The development effort behind NTCIP sought to provide true interchangeability. The goal of NTCIP was to ensure all NEMA controllers were interchangeable, helping agencies to avoid the vendor lock-in that was common in the industry. To ensure a smooth transition from proprietary standards, NTCIP standard objects must first be defined through a protocol requirements list. This process reviews device objects and identifies required and optional objects to maximize

local controller software functionality and interoperability amongst existing and newly deployed controller software with the central system software.

Within the Orange County ITS Roundtable group, agencies are discussing the idea of developing an NTCIP specification for Orange County to standardize center-to-field and center-to-center communications. Agencies would be able to mandate vendors to provide products that are compatible with the NTCIP specification defined for the range of ITS devices in use. With interoperable devices, agencies could benefit from increased market competition and cost savings from ease of integration and replacement. The definition of the regional NTCIP specification requires close coordination to define data elements and data messages for each device type; any agency specific elements would be shared with others and incorporated into the regional specification.

7.2.5 Caltrans Fiber

Caltrans has implemented a fiber communications system with IP/Ethernet-based equipment. At the heart of the communications system is the TMC, where incidents and events are monitored 24 hours a day, seven days a week. Caltrans operations personnel and CHP are collocated at the TMC. All communications and control with the ITS devices on the freeways and toll roads are performed at the TMC. The field devices are connected to the TMC over fiber, including CCTV cameras, changeable message signs, ramp meters, traffic monitoring stations, and controllers.

The communications system features an IP/Ethernet network with the TMC and field communications hubs connected using fiber optics, as shown in **Figure 4**. The system has a network of Ethernet switches including a core switch at the TMC, distribution switches in the hubs, and field switches in the field device cabinets. The system was designed not only for fault tolerance and minimal network latency, but also for significant expansion with the ability to accommodate additional field devices and hubs. Other elements of the system include multiple levels of physical plant and equipment redundancy, use of Layer 2 and Layer 3 routing protocols, an integrated link with Caltrans' statewide ATMS control system, and a connection to a video matrix switch.

A key aspect in the design of this system is the possibility for future system expansion to support an information sharing network that could include various local and regional agency systems in the county. Since the network is IP/Ethernet, the system has the capability for Caltrans to share video and data with other agencies and for agencies to utilize the Caltrans backbone to share data with each other. The dispersion of multiple communication hubs throughout the county provides numerous access points to connect local systems to the Caltrans backbone.

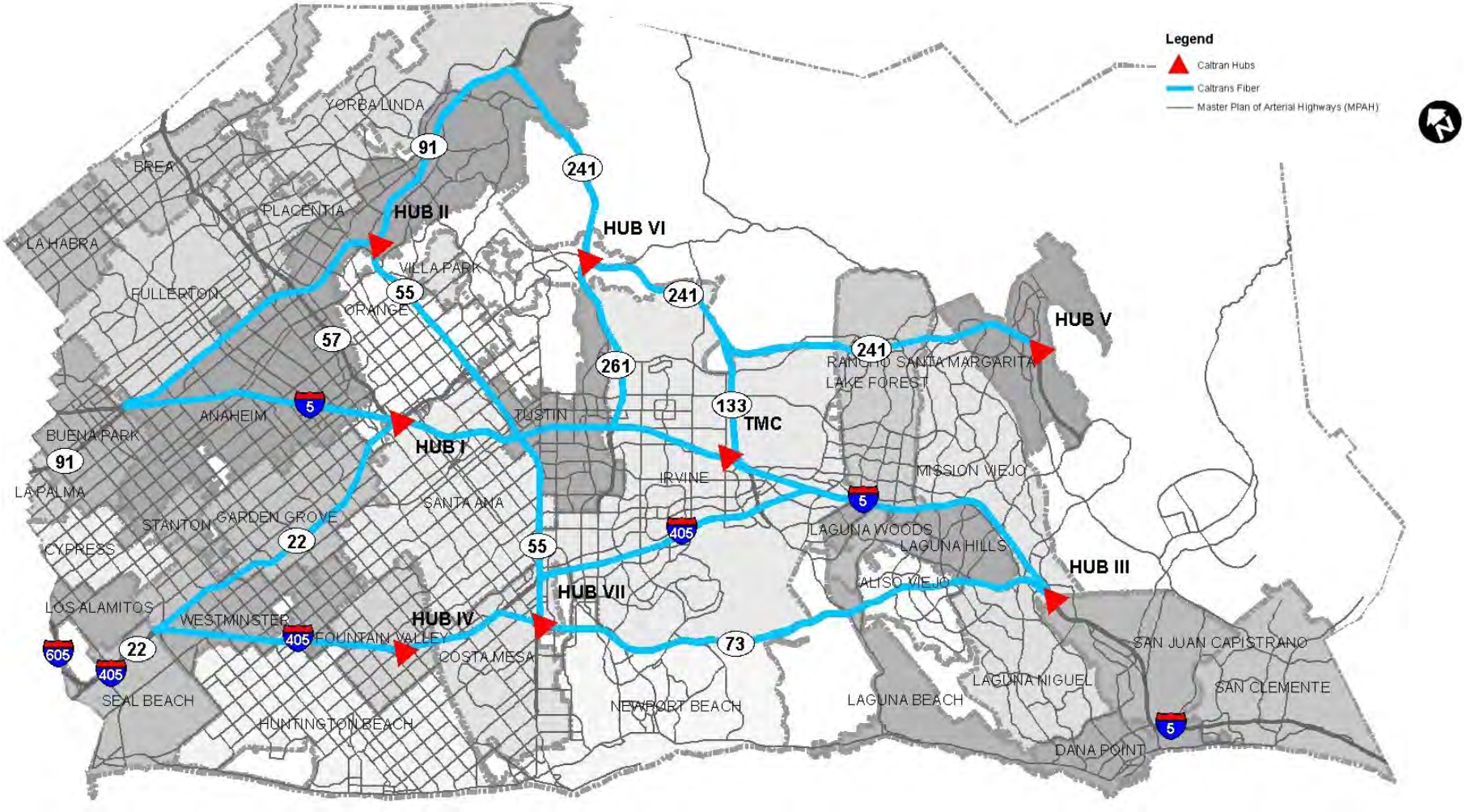


Fig1ure 4 – Caltrans Fiber Network

8. Performance Monitoring and Reporting Plan

Performance measurement helps to ensure that the benefits of ITS investments are quantified and operations are optimized to the greatest extent possible. Agencies that monitor performance can demonstrate to decision-makers and taxpayers that their dollars are being spent wisely. A countywide performance monitoring program will establish a baseline understanding of how well the transportation system performs, from which performance data can drive decisions on how operations and ITS investments can be strategically leveraged to maximize efficiency.

This section describes how the ITS SDP supports the implementation of a regional performance monitoring program to serve performance-based objectives. An approach is outlined for leveraging ITS programs and resources to determine system performance across travel modes and to measure the effectiveness of specific investments in ITS infrastructure improvements and operations.

8.1 State of the Practice

Many Federal, state and local transportation agencies are using performance measures to assess program performance towards goals. State transportation agencies such as Caltrans, Minnesota DOT, Ohio DOT, Missouri DOT, Georgia DOT, and Washington State DOT are well regarded for having robust measures of roadway performance and asset management to support the agency's comprehensive reporting tools. The Washington State DOT, publishes its quarterly "Gray Notebook", to provide in-depth reports on agency and transportation system performance to decision makers and the public. In California, the Freeway Performance Measurement System (PeMS) is a leading edge tool developed jointly by Caltrans and the University of California; traffic data is collected automatically from loop detectors or radar detection devices throughout the freeway system and transmitted to PeMS from the Caltrans district traffic management centers.

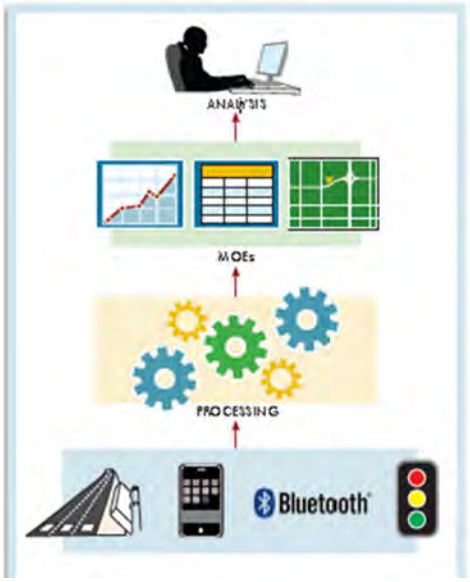
8.2 Applicability to Orange County

Orange County agencies currently monitor system performance through a variety of publications and programs:

- OCTA publishes performance data on regional mobility in the LRTP every four years and the Congestion Management Program (CMP) every two years
- The OCTA website publishes detailed outcomes that track operational performance for the Transit Division on a quarterly basis
- Local agencies evaluate signal timing improvement effectiveness using Before and After studies.

- The Corridor Synchronization Performance Index (CSPI) can be used to evaluate signal timing improvements using average speed, ratio of greens to red and the number of stops.
- OCTA monitors the FSP program on an annual basis in order to redistribute FSP beats
- OCTA collects intersection, pedestrian and bicycle counts, as well as Synchro networks for Project P
- OCTA conducts annual traffic and revenue studies for the 91 Express Lanes
- Caltrans currently monitors freeway performance, HOV lane performance, and equipment reliability (detectors operational, CCTV cameras operational, etc.)
- Caltrans has deployed the Traffic Management Center Performance Evaluation (TMCPE) Module application in District 12 to evaluate the value of TMC operations in reducing traffic delay from freeway incidents.
- LA SAFE uses Google Analytics and other custom tools to monitor usage and reliability of the 511 system for the region (including for the Orange County portion)

A regional performance monitoring program will help establish a baseline understanding of how well the regional transportation system is performing from a multi-modal standpoint. The data can then help OCTA and its partners make strategic decisions on how to optimize operations and leverage ITS investments to maximize system efficiency and demonstrate mobility gains and benefits to the public. The performance monitoring strategy is based on improved, reduced cost data collection and expanded reporting capabilities that transitions away from annual manual reporting (the most common frequency) to a dynamic, real-time system with the resultant data integrated into a single, searchable front end. Data that reflects fluctuations in daily and seasonal traffic are essential for the next steps for more advanced operational strategies that are dependent on granular, real-time data. In addition, crowd-sourced data (data from multiple private traveler sources such as through Bluetooth, GPS, and/or triangulation of cell phones) can provide another valuable, deep source of travel speed and travel time information at relatively low additional costs.



Three keys to developing a robust performance monitoring system for Orange County are: 1. leveraging existing assets, 2. deploying new technologies to fill data gaps, and 3. pursuing integration opportunities to share and distribute information. Most of the infrastructure is already in place on freeways, HOV lanes, and express lanes. Extensive deployment of arterial traffic systems throughout Orange County provides a strong foundation for the arterial portions. Many of these systems have detectors and communications to collect and transmit data. In addition, technologies such as Bluetooth and crowd-sourced data can be used to complete detection gaps and collect end-to-end travel data. A rich array of transit data is already being collected and integrated into a system with more real-time data

and one that integrates data from the on-board fare collection and AVL systems into a single, sophisticated GIS database system end for enhanced analysis and reporting.

Over the long-term, the program is envisioned to support more frequent and timely performance monitoring and reporting by transitioning towards a fully automated system that integrates various data sources – freeway and arterial operations; transit management systems; and 511 traveler information services. The objective is to build upon existing capabilities and infrastructure investments while leveraging new technologies and integration opportunities. The end result is a performance monitoring program that accounts for all aspects of operations, planning and staffing in determining the overall performance of the ITS program.

Table 8 summarizes the performance monitoring strategy described above in a phased approach.

Table 8 – Performance Monitoring Phased Approach

Category	Phased Approach
Data collection infrastructure	**Short-term**: Supplement arterial data collected from manual counts using system detectors and vehicle probe data from transit vehicles or crowd sourcing; **Mid-term**: Mainstream deployment of detection devices and/or an automated central system that can access and utilize multiple data sources to automate data collection, thereby reducing the burden on staff resources and creating a source of continuous data to support operations **Long-term:** Fully integrate work zone, Freeway Service Patrol beats, and other longer term services and modes into the process.
Central system data fusion and processing	**Mid-term**: Integrate multi-modal sources of real-time performance data – local arterials, freeways, bus transit and rail; develop an archived data management system that transform data inputs into analytics; **Long-term**: Develop dashboard capabilities to automate reporting; provide the ability to individualized reports depending on user or function – arterial/highway operations; transit operations; safety; and long-range planning

8.3 Proposed Performance Measures

Table 9 below maps OCTA's strategic goals and objectives achievable through investment in ITS and the performance measures to evaluate the effectiveness of those investments. The performance measures serve agency goals in the following ways:

- **Mobility**: Performance measures that evaluate goals and objectives to improve mobility are targeted at local agencies and staff, who benefit from detailed, technical data to evaluate the operational improvements from signal synchronization and transit priority projects.
- **Public Service**: Performance measures that evaluate goals and objectives to improve public service are focused on translating the detailed, traffic or transit performance data into terms that are readily understood from the perspective of a commuter or transit user as a member of a general public.
- **Fiscal Sustainability, Stewardship and Organizational Excellence**: Performance measures that evaluate goals and objectives related to fiscal sustainability is the focus of policy makers. These measures compare the dollar investments in project implementation with the quantified benefits from the operations and maintenance of those ITS systems or technologies.

Table 9 – Proposed Performance Measures

Goal	Objectives	Measures of Effectiveness (MOEs)
Mobility	▪ Travel Time and Speed ▪ Capacity and Level of Service ▪ Operational Performance ▪ Quality and Ease of Use	▪ Arterial/Highway corridor travel time, delay and average speed ▪ Transit route travel time, delay and average speed ▪ Corridor Synchronization Performance Index (CSPI): average speed; greens to red; and number of stops ▪ Vehicle throughput on key corridors ▪ Transit ridership
Public Service	▪ Public Awareness and Perception ▪ Customer Satisfaction ▪ Community Engagement ▪ Collaborative Planning	▪ Travel time reliability ▪ Travel time reduction ▪ Corridor Synchronization Performance Index (CSPI) ▪ Travel time savings (dollar equivalent) ▪ Transit vehicle on-time performance ▪ Transit passenger complaints ▪ 511 traveler information usage ▪ Freeway Service Patrol usage ▪ Freeway Service Patrol vehicle performance

Goal	Objectives	Measures of Effectiveness (MOEs)
Fiscal Sustainability, Stewardship, and Organizational Excellence	▪ Financial Management ▪ Efficient Operations ▪ External Funding Maximized ▪ Investment Protection	▪ Return on Investment (ROI) ▪ Cost to Benefit Ratio ▪ Fare box recovery ratio ▪ Transit vehicle service calls ▪ Communication up-time ▪ Hardware rate of failure ▪ Reduction in fuel consumption ▪ Reduction in tail pipe emissions

8.4 Data Needs

Performance measurement involves a layered approach that transforms raw data into meaningful information from which the end user can analyze and interpret the results to make determinations as to how the system is performing. Data needs for measures of effectiveness (MOEs) are identified in **Table 10**. The MOEs are organized into two tiers: Tier 1 MOEs relate to mobility indicators such as travel time, delay and reliability can be analyzed directly from the data for systems management operations and analysis while the Tier 2 MOEs equate those outcomes with dollar savings and benefits-to-cost equivalents. The Tier 2 MOEs cross-cut many of the functional areas of the ITS program and are targeted at the public and decision makers.

Table 10 – Data Needs

Functional Area	Data Inputs	Tier 1 (MOEs)	Tier 2 (MOEs)
▪ **Arterial system performance**	▪ Manual vehicle counts ▪ Manual travel time runs ▪ Vehicle re-identification (Bluetooth, magnetometers) ▪ Crowd-sourced data (INRIX, TomTom, Navteq) ▪ Hi-resolution phase timing and detector data	▪ Corridor travel time, delay and average speed ▪ Travel time reliability ▪ Travel time reduction	▪ Vehicle throughput on key corridors ▪ Corridor Synchronization Performance Index (CSPI) ▪ Reduction in fuel consumption ▪ Reduction in tail pipe emissions ▪ Travel time savings (dollar equivalent) ▪ Return on Investment (ROI) ▪ Cost to Benefit Ratio
▪ **Highway system performance**	▪ PeMS loop detector data ▪ Vehicle re-identification technology (Bluetooth, magnetometers) ▪ Crowd-sourced data (INRIX, TomTom, Navteq)	▪ Corridor travel time, delay and average speed ▪ Travel time reliability ▪ Travel time reduction	▪ Vehicle throughput on key corridors ▪ Travel time savings (dollar equivalent) ▪ Return on Investment (ROI) ▪ Cost to Benefit Ratio

Functional Area	Data Inputs	Tier 1 (MOEs)	Tier 2 (MOEs)
▪ **Local bus performance** ▪ **Paratransit service performance** ▪ **Go-Local service performance** ▪ **Rail service performance**	▪ GPS probe data (fixed route services) ▪ GPS probe data (demand responsive services) ▪ Fare box transaction data ▪ Passenger surveys ▪ On-board surveys ▪ Vehicle maintenance logs	▪ Transit vehicle travel time, delay and average speed ▪ Transit ridership ▪ Transit passenger complaints ▪ Transit vehicle on-time performance ▪ Transit vehicle service calls	▪ Fare box recovery ratio ▪ Travel time savings (dollar equivalent) ▪ Return on Investment (ROI) ▪ Cost to Benefit Ratio
▪ **Freeway Service Patrol performance** ▪ **Incident response** ▪ **Transportation demand management**	▪ 511 system phone and website activity logs ▪ Number of 511 advisory messages disseminated ▪ Freeway service patrol requests ▪ GPS probe data (FSP vehicles)	▪ 511 traveler information usage ▪ Freeway Service Patrol (FSP) usage ▪ Freeway Service Patrol (FSP) vehicle performance	▪ Travel time savings (dollar equivalent); ▪ Return on Investment (ROI); ▪ Cost to Benefit Ratio;
▪ **Systems operations and maintenance**	▪ Communication status and metrics ▪ Maintenance logs ▪ Asset management records ▪ Detector diagnostics	▪ Communication up-time ▪ Hardware rate of failure	▪ Return on Investment (ROI); ▪ Cost to Benefit Ratio;

8.5 Program Implementation

A countywide performance monitoring program relies on the implementation of supporting technologies as well as system integration and coordination efforts to collect the source data and share the calculated information among the reporting agencies. Three strategic ITS projects have been identified for implementing the program in the phases shown in **Table 11**.

Table 11 – Performance Monitoring Program Deployment

Strategy	Phase	Objectives
Countywide Performance Monitoring	Short-term	▪ Conduct a systems engineering analysis to determine project risk and subsequent systems engineering effort ▪ Describe how the performance monitoring system works at a high-level concept ▪ Define user needs and requirements ▪ Conduct feasibility assessment ▪ Evaluate system alternatives
Countywide Performance Monitoring	Mid-term	▪ Develop system concept of operations ▪ Develop functional requirements ▪ Develop bid package to procure field equipment that meet functional requirements ▪ Develop bid package to procure a system integrator ▪ Develop acceptance test plans to certify system for deployment
Countywide Performance Monitoring	Long-term	▪ Define MOEs ▪ Define analytics to calculate MOEs from source data ▪ Develop countywide standards to evaluate before and after conditions ▪ Develop countywide standards to evaluate travel conditions on a continual basis ▪ Develop dashboard application tools to summarize MOEs across different modes, geographic extents and facilities ▪ Develop interagency agreements that identify roles and responsibilities for data collection and reporting
Countywide Communications Master Plan	Short-term	▪ Identify system detection gaps ▪ Identify communication gaps ▪ Develop options for completing last-mile communications ▪ Develop options for completing detection coverage ▪ Develop a data exchange network to transmit, fuse and archive various data sources
Countywide Connectivity Master Plan	Mid-term	▪ Address detection technologies in a future regional NTCIP specification to standardize data transmission for field-to-center communications ▪ Address center-to-center data transmission in a future regional NTCIP specification to standardize data distribution and sharing ▪ Define interfaces to obtain data from system detectors and sources of probe data using web connection services or file transfers

9. PHASED DEPLOYMENT PLAN

OCTA, in partnership with the cities, County of Orange and Caltrans, has embraced ITS in achieving advances in multi-jurisdictional arterial traffic management, development of a robust freeway management infrastructure and effective use of technology in transit operations. These projects and programs have set the foundation for advancing towards integrated transportation management and multi-agency coordination that have a regional focus. This ITS SDP have identified strategies and projects to realize OCTA's vision and position the region for opportunities to deploy emerging technologies that have the potential to improve mobility, safety and efficiency on a multi-modal transportation system.

The ITS strategies constitute critical actions to guide project development and implementation efforts in the next decade to support OCTA's mission in its LRTP to deliver an effective transportation system. This section outlines a roadmap for implementing the strategies over a ten-year timeline in an approach that phases these actions in logical order by identifying the interconnections between strategies that may take place in sequential order or in parallel. For example, regional arterial traffic management requires communications master planning and arterial detection deployment before integrated systems can provide data sharing capabilities to support coordinated traffic operations and performance monitoring at the regional level.

Figure 5 illustrates the deployment plan for implementing the strategies proposed in this ITS SDP. The timeline is organizes the deployment of the twenty-two ITS strategies described in Section 5 into three distinct time frames.

- Short-term: these strategies and projects are taking place now or within three years;
- Medium-term: these strategies and projects would take place between 3 to 5 years from now; and
- Long-term: these strategies and projects would take place between 5 to 10 years from now.

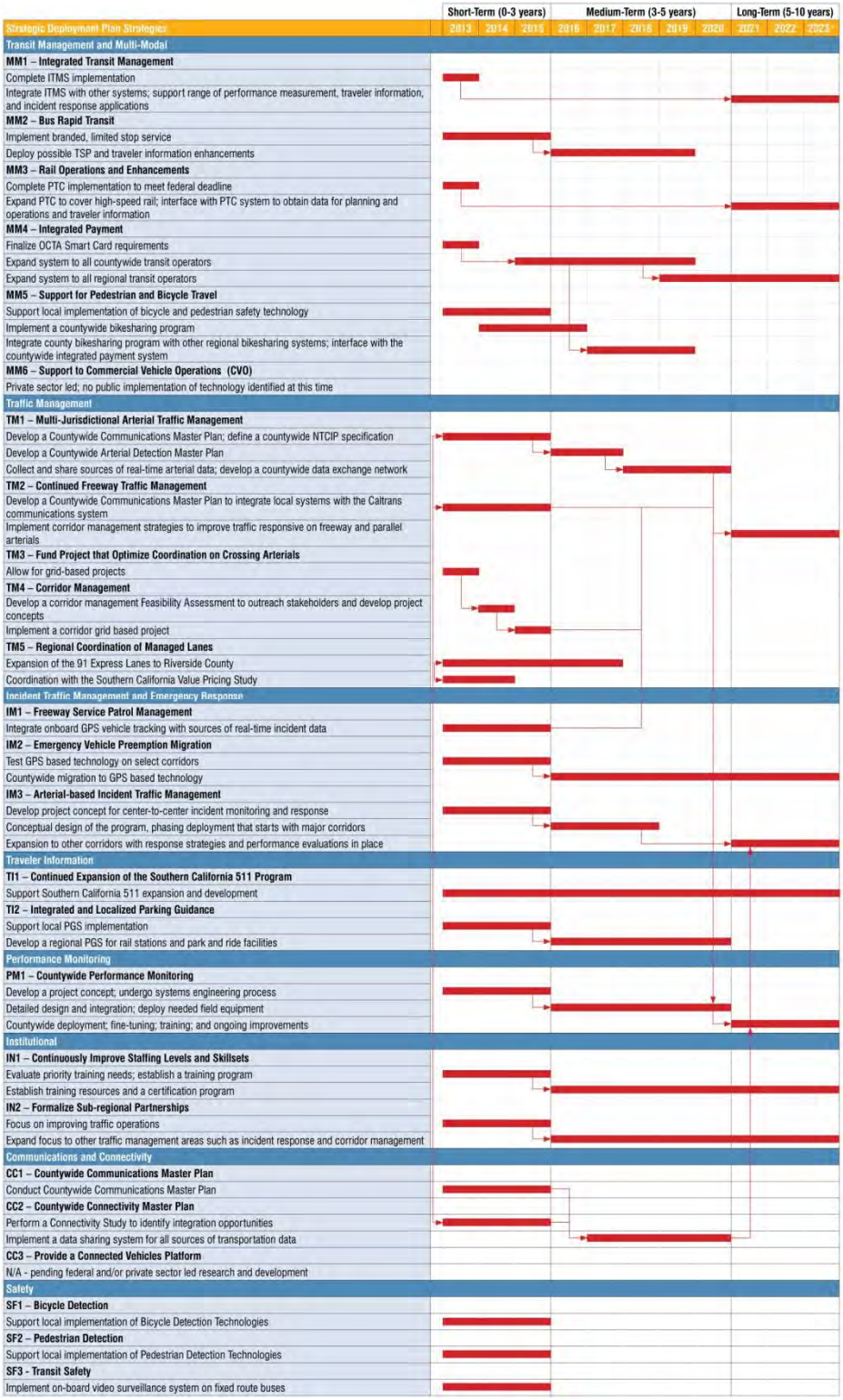


Figure 5 – ITS SDP Deployment Schedule


WAL*MART

Appendix A: Regional ITS Architecture – Stakeholders

Stakeholders Report

12/12/2012 5:38:34PM

Stakeholders for Region Orange County

Stakeholder

California Highway Patrol (CHP)

Description: The CHP is responsible for freeway incident verification, monitoring, and scene management throughout Orange County.

Associated Element: Dispatch Operation Center - CHP
Associated Element: Emergency Vehicles - CHP
Associated Element: Freeway Service Patrol (FSP)

Caltrans District 12

Description: Caltrans District 12 is the state department of transportation for the Orange County. Caltrans covers the county in freeway and state highway operation in traffic monitoring, congestion, and incident management.

Associated Element: Caltrans D12 TMC
Associated Element: Caltrans D12 TMC - Roadside Equipment
Associated Element: TMC Maintenance Dispatch Communications - Caltrans
Associated Element: MCO Vehicles - Caltrans
Associated Element: 91 Express Lanes Traffic Management Center
Associated Element: 91 Express Lanes Customer Administration Center
Associated Element: PeMS
Associated Element: Weigh-in-Motion Sites

Cities

Description: Anaheim, Buena Park, Costa Mesa, Irvine, Orange, Santa Ana, Westminster, Brea, Cypress, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, La Habra, Placentia, Mission Viejo, Newport Beach, Aliso Viejo, Dana Point, La Palma, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Los Alamitos, Rancho santa Margaria, San clemente, San Juan Capistrano, Seal Beach, Stanton, Tustin, Villa Park, Yorba Linda.

Associated Element: TMC - Cities
Associated Element: Roadside - Cities
Associated Element: Emergency Service - Cities
Associated Element: Emergency Vehicle - Cities
Associated Element: Go-Local Transit Vehicles
Associated Element: Parking Guidance Systems

County of Orange

Description:

Associated Element: Security Monitoring Field Equipment - County
Associated Element: John Wayne Airport
Associated Element: RDMD
Associated Element: County Emergency Vehicles
Associated Element: County Emergency Service
Associated Element: Countywide Emergency Vehicle Preemption System

General Public

Description:

Associated Element: Media
Associated Element: Private ISPs
Associated Element: Vehicle

LA County

Description:

Associated Element: IEN

OCTA

Description: The Orange County Transportation Authority is the county's primary transportation agency, focusing on freeways, streets and transit.

Associated Element: OCTA Fixed Route Buses
Associated Element: Transit Vehicle Subsystems - OCTA
Associated Element: Remote Traveler Support - OCTA

Stakeholder

Associated Element: OCTA.net - Trip Planner
Associated Element: 511 MATIS/Go511
Associated Element: OCTA Access Service Vehicles
Associated Element: OCTA Intelligent Transit Management System
Associated Element: OCTA Data Warehouse
Associated Element: Anaheim Regional Transportation Intermodal Center (ARTIC)
Associated Element: Regional Transit Fare Payment System
Associated Element: Bus Rapid Transit Corridor Infrastructure
Associated Element: At-Grade Rail Crossing Equipment
Associated Element: Countywide Communications Network

SCRRA

Description: The purpose of Southern California Regional Rail Authority (SCRRA) was to plan, design, construct and administer the operation of regional passenger rail lines serving the counties of Los Angeles, Orange, Riverside, San Bernardino and Ventura. SCRRA is comprised of MTA, VCTC, OCTA, SANBAG, and RCTC. The regional commuter rail system "Metrolink." has 2 Centers: Operations Center in Pomona and Maintenance Facility in Glendale.
Associated Element: Metrolink
Associated Element: Positive Train Control System

TCA

Description: Transportation Corridor Agency, in charge of all toll roads in Orange County other than SR 91 Express Lanes.
Associated Element: Other Toll Roads

Appendix B: Regional ITS Architecture – Stakeholder Agreements

List of Agreements

3/27/2013 2:00:21PM

Agreements for Region Orange County

Agreement **Status**

Number: 01 Existing
Title: Interjurisdictional Traffic Management
Type: Interagency Agreement
Description: Provides for local agencies to maintain signal timing improvements in exchange for Project P funds and field equipment upgrades.
Lead Stakeholder: Cities
Associated Stakeholders:
Caltrans District 12
Cities
County of Orange
OCTA

Agreement **Status**

Number: 02 Existing
Title: Regional Traffic Management and Emergency Services
Type: Memorandum of Understanding
Description: Provides for signal operations and coordination and local incident management.
Lead Stakeholder: Caltrans District 12
Associated Stakeholders:
California Highway Patrol (CHP)
Caltrans District 12
Cities

Agreement **Status**

Number: 03 Planned
Title: Emergency Vehicle Signal Pre-emption
Type: Interagency Agreement
Description: Documents details on roles, responsibilities, and functions for emergency vehicle pre-emption at signalized intersections within a city for police, fire, ambulance, or other agency.
Lead Stakeholder: County of Orange
Associated Stakeholders:
Cities
County of Orange
OCTA

Agreement **Status**

Number: 04 Future
Title: Transit Signal Priority
Type: Memorandum of Understanding
Description: Documents details on roles, responsibilities, and functions for transit vehicle priority at signalized intersection within a city for a transit agency.
Lead Stakeholder: OCTA
Associated Stakeholders:
Cities
County of Orange
OCTA

Agreement **Status**

Number: 05 Existing
Title: Freeway Service Patrol
Type: Memorandum of Understanding
Description: Documents details on roles, responsibilities, and functions for providing freeway service patrol activities
Lead Stakeholder: OCTA

Associated Stakeholders:
California Highway Patrol (CHP)
Caltrans District 12
OCTA

Agreement	Status
*Number:*06	Future

Title: Transit Fare Management
Type: Memorandum of Understanding
Description: Provides details on the usage of a common regional fare card and the cost allocation formulas.
Lead Stakeholder: OCTA
Associated Stakeholders:
Cities
OCTA

Agreement	Status
*Number:*07	Future

Title: Traveler Information
Type: Memorandum of Understanding
Description: Documents expectations, roles, and responsibilities for the provision of transportation-related data and information to the traveling public. Also, documents the policy or disclaimer for release of traveler information.
Lead Stakeholder: OCTA
Associated Stakeholders:
Caltrans District 12
Cities
County of Orange
OCTA

Agreement	Status
*Number:*08	Future

Title: Shared Use of Communications Infrastructure
Type: Memorandum of Understanding
Description: Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.
Lead Stakeholder: Caltrans District 12
Associated Stakeholders:
Caltrans District 12
Cities
County of Orange
OCTA

Agreement	Status
*Number:*09	Future

Title: Archived Data Management
Type: Memorandum of Understanding
Description: Documents expectations, roles, and responsibilities for the dissemination of transportation-related data and information for archive purposes.
Lead Stakeholder: OCTA
Associated Stakeholders:
Cities
County of Orange
OCTA

Agreement	Status
*Number:*10	Future

Title: Real Time Transit Information
Type: Memorandum of Understanding
Description: Documents provisions for funding with stipulations for data sharing and maintenance
Lead Stakeholder: OCTA

Associated Stakeholders:

Cities
OCTA
SCRRA

Status Value Legend

Name	Description
Existing	
Planned	
Future	
Not Planned	

Appendix C: Regional ITS Architecture – Functional Requirements

Functional Requirements
Orange County (Region)
12/12/2012 5:39:39PM

Architecture		Status
Orange County (Region)		(Region)
Element: **91 Express Lanes Customer Administration Center**		
Entity: **Payment Administration**		
Functional Area: **Center VMT Payment Administration** Management of a VMT payment system. Receives VMT data and computes the total cost to the vehicle owner for payment.		
Requirement:	1 The center shall register vehicles for road use payment, establishing accounts that identify owner billing information and preferences.	Existing
Requirement:	2 The center shall provide secure user account management, providing user access to rules and policies, current billing status, invoices, payments, and mechanisms for review and challenge of the collected data.	Existing
Requirement:	3 This center shall maintain and publish road use prices, as configured by the Payment Administrator.	Existing
Requirement:	4 The center shall receive VMT data (time stamped log of roadways used by the vehicle) and compute the total cost to the vehicle owner.	Existing
Requirement:	5 The center shall calculate road use charges based on the vehicle's mileage, roads traveled, time periods, emissions profile for make/model, fuel economy for make/model, weight, number of axles/tires, or other policies.	Existing
Requirement:	6 The center shall access and use registration and odometer information from the DMV to verify and audit collected VMT data.	Existing
Requirement:	7 The center shall process and clear payments from vehicle owners and operators as well as payments to other Center VMT Payment Administration through clearing houses provided by financial institutions.	Existing
Requirement:	8 The center shall coordinate with other VMT Payment Administration systems to reconcile and apportion payments for vehicles registered in other jurisdictions.	Existing
Requirement:	9 The center shall report payment violations including vehicle information and vehicle image to the designated Enforcement Agency.	Existing
Requirement:	10 The center shall monitor the operational status of VMT field equipment and identify equipment faults.	Existing
Element: **91 Express Lanes Traffic Management Center**		
Entity: **Traffic Management**		
Functional Area: **Collect Traffic Surveillance** Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.		
Requirement:	1 The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **91 Express Lanes Traffic Management Center**		
Entity: **Traffic Management**		
Functional Area: **Collect Traffic Surveillance** Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.		
Requirement:	2 The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing
Requirement:	3 The center shall monitor, analyze, and store multimodal crossing and high occupancy vehicle (HOV) lane sensor data under remote control of the center.	Existing
Requirement:	4 The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Existing
Requirement:	5 The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
Requirement:	6 The center shall maintain a database of surveillance equipment and sensors and associated data (including the roadway on which they are located, the type of data collected, and the ownership of each)	Existing
Requirement:	7 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Existing
Functional Area: **TMC Demand Management Coordination** Provides the capability to gather information on regional toll, parking, and transit usage and request changes to enable dynamic pricing for demand management.		
Requirement:	1 The center shall collect and store toll pricing data from toll administration centers, including the price for each road segment to which a toll applies, with the time and date for when it applies.	Existing
Functional Area: **Traffic Data Collection** Collection and storage of traffic management data. For use by operations personnel or data archives in the region.		
Requirement:	1 The center shall collect traffic management data such as operational data, event logs, etc.	Existing
Requirement:	3 The center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Future
Element: **Anaheim Regional Transportation Intermodal Center (ARTIC)**		
Entity: **Transit Management**		
Functional Area: **Transit Center Connection Protection** Manages the coordination of transit transfers between routes, including routes on different modes. Also supports the capability for travelers to obtain connection protection throughout a trip.		
Requirement:	1 The center shall manage service requests for routing of an individual through the transit system.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Anaheim Regional Transportation Intermodal Center (ARTIC)**		
Entity: **Transit Management**		
Functional Area: **Transit Center Connection Protection** Manages the coordination of transit transfers between routes, including routes on different modes. Also supports the capability for travelers to obtain connection protection throughout a trip.		
Requirement:	2 The center shall provide transit plans for both fixed and demand responsive transit to transit passengers.	Future
Requirement:	3 The center shall be able to coordinate with Other Transit Management systems or Multimodal Transportation Service Providers in order to provide a complete multimodal trip plan.	Future
Requirement:	4 The center shall track the passenger through the transit network, and coordinate with Other TRM and Multimodal Transportation Service Providers so that the passenger makes efficient connections between the transit system and other transit systems or other modes of transportation.	Future
Functional Area: **Transit Center Security** Monitor transit vehicle operator or traveler activated alarms; authenticate transit vehicle operators; remotely disable a transit vehicle; alert operators, travelers, and police to potential incidents identified by these security features.		
Requirement:	5 The center shall receive information pertaining to a wide-area alert such as weather alerts, disaster situations, or child abductions. This information may come from Emergency Management or from other Alerting and Advisory Systems.	Future
Requirement:	6 The center shall send wide-area alert information to travelers (on-board transit vehicles or at stations/stops) and transit vehicle operators.	Future
Requirement:	7 The center shall coordinate the response to security incidents involving transit with other agencies including Emergency Management, other transit agencies, media, traffic management, and traveler information service providers.	Future
Requirement:	8 The center shall receive threat information and status on the integrity of the transit infrastructure.	Future
Functional Area: **Transit Center Information Services** Provide interactive traveler information to travelers (on-board transit vehicles, at stops/stations, using personal devices), traveler information service providers, media, and other transit organizations. Includes routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events.		
Requirement:	1 The center shall provide travelers using public transportation with traffic and advisory information upon request. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.	Future
Requirement:	2 The center shall provide transit information to the media including details of deviations from schedule of regular transit services.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Anaheim Regional Transportation Intermodal Center (ARTIC)**		
Entity: **Transit Management**		
Functional Area: **Transit Center Information Services** Provide interactive traveler information to travelers (on-board transit vehicles, at stops/stations, using personal devices), traveler information service providers, media, and other transit organizations. Includes routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events.		
Requirement:	3 The center shall exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems.	Future
Requirement:	4 The center shall provide transit service information to traveler information service providers including routes, schedules, schedule adherence, and fare information as well as transit service information during evacuation.	Future
Requirement:	5 The center shall enable yellow pages (including non-motorized transportation) information to be output to the traveler.	Future
Requirement:	6 The center shall broadcast transit advisory data, including alerts and advisories pertaining to major emergencies, or man made disasters.	Future
Functional Area: **Transit Center Multi-Modal Coordination** Coordinate schedules with other agencies and modes, including transit transfer cluster and transfer point information.		
Requirement:	1 The center shall coordinate schedules and services between transit agencies, traffic management, maintenance and construction operations, parking management, and other surface or air transportation modes.	Future
Requirement:	2 The center shall share transfer cluster and transfer point information with multimodal transportation service providers, other transit agencies, and traveler information service providers. A transfer cluster is a collection of stop points, stations, or terminals where transfers can be made conveniently.	Future
Requirement:	3 The center shall accept requests from traffic management to change routes and schedules as part of the implementation of demand management strategies.	Future
Requirement:	4 The center shall coordinate transit services for special events, planning services for the event and managing transit services on the day of the event.	Future
Requirement:	5 The center shall provide transit operations personnel with the capability to control and monitor transit service coordination activities.	Future
Functional Area: **Transit Evacuation Support** Support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency. Coordinate regional evacuation plans and resources including transit and school bus fleets.		
Requirement:	1 The center shall manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Anaheim Regional Transportation Intermodal Center (ARTIC)**		
Entity: **Transit Management**		
Functional Area: **Transit Evacuation Support**	Support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency. Coordinate regional evacuation plans and resources including transit and school bus fleets.	
Requirement:	2 The center shall coordinate regional evacuation plans with Emergency Management - identifying the transit role in an evacuation and the transit resources that would be used.	Future
Requirement:	4 The center shall adjust and update transit service and fare schedules and provide that information to other agencies as they coordinate evacuations.	Future
Element: **At-Grade Rail Crossing Equipment**		
Entity: **Roadway**		
Functional Area: **Standard Rail Crossing**	Field elements at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Includes traditional HRI warning systems augmented with other standard traffic management devices.	
Requirement:	2 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Existing
Requirement:	3 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the rail wayside equipment.	Existing
Requirement:	4 The field element shall receive track status from the rail wayside equipment that can be passed on to the traffic management center. This may include the current status of the tracks and whether a train is approaching.	Future
Requirement:	7 The field element shall close the highway-rail intersection (HRI) when a train is approaching using gates, lights/signs, barriers, and traffic control signals.	Existing
Requirement:	8 The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Future
Requirement:	9 The field element shall forward rail traffic advisories received from the Wayside Equipment to the traffic management center.	Planned
Functional Area: **Advanced Rail Crossing**	Field elements at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). Capabilities from the Standard Rail Crossing plus systems which preclude entrance into the intersection when the barriers are activated, additional arriving train information, and detection of blocked intersections.	
Requirement:	1 The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **At-Grade Rail Crossing Equipment**		
Entity: **Roadway**		
Functional Area: **Advanced Rail Crossing** Field elements at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). Capabilities from the Standard Rail Crossing plus systems which preclude entrance into the intersection when the barriers are activated, additional arriving train information, and detection of blocked intersections.		
Requirement:	2 The field element shall determine whether the highway-rail intersection (HRI) is blocked by traffic in the roadway or some other obstruction.	Future
Requirement:	3 The field element shall notify the traffic management center and the rail wayside equipment of any intersection blockages, including trapped vehicles or other obstructions.	Future
Requirement:	4 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Future
Requirement:	5 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the rail wayside equipment.	Future
Requirement:	6 The field element shall receive track status and arriving train information from the rail wayside equipment that can be passed on to the traffic management center. This may include the current status of the tracks and when a train is expected and/or how long the crossing will be closed.	Future
Requirement:	7 The field element shall collect pedestrian images and pedestrian sensor data, and respond to pedestrian crossing requests via display, audio signal, or other manner.	Future
Requirement:	8 The field element shall control the dynamic message signs (DMS) in the vicinity of a highway-rail intersection (HRI) to advise drivers, cyclists, and pedestrians of approaching trains.	Future
Requirement:	9 The field element shall close the highway-rail intersection (HRI) when a train is approaching with enough time for traffic to safely clear the crossing using gates, lights/signs, barriers, and traffic control signals.	Future
Requirement:	10 The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Future
Requirement:	11 The field element shall forward rail traffic advisories received from the Wayside Equipment to the traffic management center.	Future
Requirement:	12 The field element shall provide approaching train advisories using field-vehicle communications to vehicles approaching the grade crossing.	Future
Functional Area: **Field Barrier System Control** Field elements that control barrier systems such as gates and other systems that manage entry to roadways, transportation facilities and infrastructure.		

Architecture		Status
Orange County (Region)		(Region)
Element: **At-Grade Rail Crossing Equipment**		
Entity: **Roadway**		
Functional Area: **Field Barrier System Control**	Field elements that control barrier systems such as gates and other systems that manage entry to roadways, transportation facilities and infrastructure.	
Requirement:	1 The field element shall activate barrier systems for transportation facilities and infrastructure under center control. Barrier systems include automated or remotely controlled gates, barriers and other systems that manage entry to roadways.	Existing
Requirement:	2 The field element shall return barrier system operational status to the controlling center.	Existing
Element: **Bus Rapid Transit Corridor Infrastructure**		
Entity: **Roadway**		
Functional Area: **Roadway Probe Data Communications**	Field elements that collect probe data from vehicles using short range communications.	
Requirement:	1 The field element shall communicate with passing vehicles for traffic data link time calculations and send collected data to the controlling center; identification will be removed to ensure anonymity.	Future
Requirement:	2 The field element shall communicate with on-board equipment on passing vehicles to collect current vehicle position, speed, and heading and a record of previous events (e.g., starts and stops, link travel times) that can be used to determine current traffic conditions.	Future
Requirement:	3 The field element shall communicate with on-board equipment on passing vehicles to collect current status information and a record of previous events (e.g., temperature, wiper status, headlight status, traction control system status) that can be used to determine road and surface weather conditions.	Future
Requirement:	4 The field element shall communicate with on-board equipment on passing vehicles to collect vehicle trip information (e.g., origin and destination information, travel times) that can be used to support transportation planning.	Future
Requirement:	5 The field element shall communicate with on-board equipment on passing vehicles to collect a history of precise positioning information that can be used to derive or verify accurate roadway geometry and lane features for use by map update providers.	Future
Functional Area: **Roadway Signal Priority**	Field elements that provide the capability to receive transit vehicle signal priority requests and control traffic signals accordingly.	
Requirement:	1 The field element shall respond to signal priority requests from transit vehicles.	Future
Element: **Caltrans D12 TMC**		
Entity: **Traffic Management**		
Functional Area: **TMC Roadway Warning**	Remotely monitors and controls field elements used to warn drivers approaching hazards. Detects and warns approaching vehicles of adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.	

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC**		
Entity: **Traffic Management**		
Functional Area: **TMC Roadway Warning** Remotely monitors and controls field elements used to warn drivers approaching hazards. Detects and warns approaching vehicles of adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.		
Requirement:	1 The center shall monitor data on traffic, environmental conditions, and other hazards collected from sensors along the roadway.	Existing
Functional Area: **Collect Traffic Surveillance** Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.		
Requirement:	1 The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing
Requirement:	2 The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing
Requirement:	3 The center shall monitor, analyze, and store multimodal crossing and high occupancy vehicle (HOV) lane sensor data under remote control of the center.	Existing
Requirement:	4 The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Existing
Requirement:	5 The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
Requirement:	7 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Existing
Functional Area: **TMC Signal Control** Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.		
Requirement:	1 The center shall remotely control traffic signal controllers.	Existing
Functional Area: **TMC Traffic Metering** Remotely controls ramp meters, interchange connector meters, and mainline meters, covering all types of metering as well as management of bypass lanes.		
Requirement:	1 The center shall remotely control systems to manage use of the freeways, including ramp, interchange, and mainline metering.	Existing
Requirement:	2 The center shall collect operational status from ramp meters, interchange meters, and mainline meters and compare against the control information sent by the center.	Existing
Requirement:	3 The center shall collect fault data from ramp meters, interchange meters, and mainline meters.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC**		
Entity: **Traffic Management**		
Functional Area: **TMC Traffic Metering** Remotely controls ramp meters, interchange connector meters, and mainline meters, covering all types of metering as well as management of bypass lanes.		
Requirement:	4 The center shall implement control strategies, under control of center personnel, on some or all of the freeway network devices (e.g. ramp meters, interchange meters, and mainline meters), based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the approaches to the meters.	Existing
Functional Area: **TMC HOV Lane Management** Remotely controls HOV lane sensors, HOV lane usage signals, and ramp meters to manage use of HOV or HOT lanes; also detect HOV violators and notifies enforcement agencies.		
Requirement:	1 The center shall remotely control sensors to detect high-occupancy vehicle (HOV) lane usage.	Existing
Requirement:	3 The center shall remotely control freeway control devices, such as ramp signals and mainline metering and other systems associated with freeway operations that control use of HOV lanes.	Existing
Requirement:	4 The center shall collect traffic flow measures and information regarding vehicle occupancy (i.e., lane usage) in HOV lanes.	Existing
Requirement:	6 The center shall collect operational status for the freeway control devices associated with HOV lane control.	Existing
Requirement:	7 The center shall collect fault data for the freeway control devices associated with HOV lane control for repair.	Existing
Functional Area: **TMC Traffic Information Dissemination** Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.		
Requirement:	1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing
Requirement:	2 The center shall remotely control driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.	Existing
Requirement:	3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing
Requirement:	4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing
Requirement:	6 The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	Existing
Requirement:	7 The center shall distribute traffic data to the media; the capability to provide the information in both data stream and graphical display shall be supported.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC**		
Entity: **Traffic Management**		
Functional Area: **TMC Traffic Information Dissemination** Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.		
Requirement:	8 The center shall provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.	Existing
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Existing
Functional Area: **TMC Traffic Management Decision Support** Recommends courses of action to the traffic operator based on current and forecast road and traffic conditions. Recommended actions may include predefined incident response plans, signal timing plan changes, DMS/HAR messages, lane control strategies, metering strategies, etc.		
Requirement:	1 The center shall provide center personnel with 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.	Existing
Requirement:	4 The recommended actions shall include predefined incident response plans, signal timing plan changes, DMS/HAR messages, lane control strategies and freeway control strategies including ramp metering, interchange metering, and mainline metering.	Future
Functional Area: **TMC Incident Detection** Remotely monitors traffic sensor and surveillance systems to detect and verify incidents. Also monitors external advisory and incident reporting systems, intermodal freight depots, and border crossings for additional incident information. Identified incidents are reported to operations personnel and other centers.		
Requirement:	2 The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Existing
Requirement:	4 The center shall exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing
Requirement:	5 The center shall support requests from emergency management centers and border inspection systems to remotely control sensor and surveillance equipment located in the field.	Existing
Requirement:	6 The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Existing
Requirement:	7 The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC**		
Entity: **Traffic Management**		
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.		
Requirement:	1 The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.	Existing
Functional Area: **Traffic Equipment Maintenance** Monitoring and remote diagnostics of field equipment - detect failures, issue problem reports, and track the repair or replacement of the failed equipment.		
Requirement:	3 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Existing
Requirement:	4 The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Existing
Requirement:	7 The center shall exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when the faults are cleared.	Existing
Functional Area: **TMC Transportation Operations Data Collection** Collects real-time information on the state of the regional transportation system for operational use by the center. It establishes communications with a regional repository, requests or subscribes to information relevant to the center, and distributes the received information for use.		
Requirement:	1 The center shall collect real-time information on the state of the regional transportation system including current traffic and road conditions, weather conditions, special event and incident information.	Existing
Element: **Caltrans D12 TMC - Roadside Equipment**		
Entity: **Roadway**		
Functional Area: **Roadway Basic Surveillance** Field elements that monitor traffic conditions using loop detectors and CCTV cameras.		
Requirement:	1 The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	Existing
Requirement:	2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC - Roadside Equipment**		
Entity: **Roadway**		
Functional Area: **Roadway Basic Surveillance** Field elements that monitor traffic conditions using loop detectors and CCTV cameras.		
Requirement:	3 The field element shall collect, digitize, and send multimodal crossing and high occupancy vehicle (HOV) lane sensor data to the center for further analysis and storage.	Existing
Requirement:	4 The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
Requirement:	5 The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing
Functional Area: **Roadway Signal Controls** Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.		
Requirement:	1 The field element shall control traffic signals under center control.	Existing
Requirement:	2 The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing
Requirement:	3 The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.	Existing
Requirement:	4 The field element shall report the current signal control information to the center.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the center.	Existing
Requirement:	7 The field element shall return traffic signal controller fault data to the center.	Existing
Functional Area: **Roadway Traffic Metering** Control equipment including ramp, interchange, and mainline meters and the dynamic message signs that provide information about the meters and any special bypass lanes.		
Requirement:	1 The field element shall regulate the flow of traffic on ramps, interchanges, and the mainline, under center control.	Existing
Requirement:	2 The field element shall monitor operation of ramp, interchange, and mainline meters and report to the center any conflicts between received control plans and current system operation.	Existing
Requirement:	3 The field element shall return ramp, interchange, and mainline meter operational status to the controlling center.	Existing
Functional Area: **Roadway Warning** Field elements used to warn drivers approaching hazards including adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.		
Requirement:	1 The field element shall monitor for hazardous traffic conditions, including queues.	Existing
Requirement:	2 The field element shall monitor for hazardous road surface and local weather conditions.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Caltrans D12 TMC - Roadside Equipment**		
Entity: **Roadway**		
Functional Area: **Roadway Warning** Field elements used to warn drivers approaching hazards including adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.		
Requirement:	4 The field element shall provide collected sensor data to the controlling center.	Existing
Requirement:	6 The field element shall receive commands from the controlling center that activate warning signs to approaching motorists.	Existing
Functional Area: **Roadway Traffic Information Dissemination** Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).		
Requirement:	1 The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
Functional Area: **Roadway Incident Detection** Field elements that monitor traffic conditions to identify incidents. It includes traffic detectors that collect traffic flow information and identify unusual traffic conditions and advanced CCTV cameras with built-in incident detection algorithms.		
Requirement:	1 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
Requirement:	3 The field element's video devices shall be remotely controlled by a traffic management center.	Existing
Functional Area: **Roadway Work Zone Traffic Control** Field elements in maintenance and construction areas including CCTV cameras, driver information systems (such as DMS), and gates/barriers that monitor and control traffic and provide information directly to drivers in affected areas.		
Requirement:	2 Under traffic and maintenance center control, the field element shall include driver information systems (such as dynamic messages signs and highway advisory radios) that advise drivers of activity around the work zone through which they are currently passing.	Existing
Element: **County Emergency Service**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **County Emergency Service**		
Entity: **Emergency Management**		
Functional Area:	**Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.	
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	5 The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
Functional Area:	**Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.	
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	6 The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area:	**Incident Command** Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.	
Requirement:	1 The center shall provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.	Existing
Requirement:	2 The center shall provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.	Existing
Requirement:	3 The center shall track and maintain resource information and action plans pertaining to the incident command.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **County Emergency Service**		
Entity: **Emergency Management**		
Functional Area: **Incident Command** Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.		
Requirement:	4 The center shall share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.	Existing
Requirement:	5 The center shall assess the status of responding emergency vehicles as part of an incident command.	Existing
Functional Area: **Emergency Response Management** Strategic emergency planning and response capabilities and broad inter-agency interfaces to support large-scale incidents and disasters, commonly associated with Emergency Operations Centers.		
Requirement:	1 The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters.	Existing
Requirement:	2 The center shall manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.	Existing
Functional Area: **Emergency Evacuation Support** Evacuation planning and coordination to manage evacuation and reentry of a population in the vicinity of a disaster or other emergency that poses a risk to public safety.		
Requirement:	1 The center shall manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.	Existing
Requirement:	2 The center shall develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.	Existing
Requirement:	4 The center shall coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.	Existing
Requirement:	5 The center shall provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.	Existing
Element: **County Emergency Vehicles**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	1 The emergency vehicle, including roadway service patrols, shall track its current location.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **County Emergency Vehicles**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	2 The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
Requirement:	3 The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Planned
Element: **Countywide Communications Network**		
Entity: **Archived Data Management**		
Functional Area: **ITS Data Repository** Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.		
Requirement:	1 The center shall collect data to be archived from one or more data sources.	Future
Requirement:	2 The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).	Future
Requirement:	3 The center shall store the archived data in a focused repository that is suited to a particular set of ITS data users.	Future
Requirement:	4 The center shall include capabilities for performing quality checks on the incoming archived data.	Future
Requirement:	5 The center shall include capabilities for error notification on the incoming archived data.	Future
Requirement:	6 The center shall include capabilities for archive to archive coordination.	Future
Requirement:	7 The center shall support a broad range of archived data management implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region.	Future
Requirement:	8 The center shall perform quality checks on received data.	Future
Requirement:	9 The center shall provide the capability to execute methods on the incoming data such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	Future
Requirement:	10 The center shall respond to requests from the administrator interface function to maintain the archive data.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Countywide Communications Network**		
Entity: **Archived Data Management**		
Functional Area: **ITS Data Repository** Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.		
Requirement:	11 When data or a catalog of data is received from the archive, the center shall generate the requested data product for the users systems.	Future
Functional Area: **Traffic and Roadside Data Archival** Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.		
Requirement:	1 The center shall manage the collection of archive data directly from collection equipment located at the roadside.	Future
Requirement:	2 The center shall collect traffic sensor information from roadside devices.	Future
Requirement:	4 The center shall respond to requests from the Archive Data Administer to input the parameters that control the collection process.	Future
Functional Area: **Virtual Data Warehouse Services** Provides access to data from geographically dispersed archives and coordinates information exchange with a local data warehouse. Also provides the specialized publishing, directory services, and transaction management functions associated with coordinating remote archives.		
Requirement:	1 The center shall provide capabilities to access "in-place" data from geographically dispersed archives. These capabilities may include analysis, data fusion, or data mining.	Future
Requirement:	2 The center shall coordinate information exchange with a local data warehouse.	Future
Requirement:	3 The center shall provide the specialized publishing, directory services, and transaction management functions associated with coordinating remote archives.	Future
Requirement:	4 The center shall support the collection of archived data from other archives on an as-needed basis. (This minimizes the need to duplicate the comprehensive set of data from the remote archives in the local data warehouse.)	Future
Requirement:	5 The center shall use data collected from different archives to build a set of global schema including the data archive definitions for the local archive plus any archives known to the local archive.	Future
Requirement:	6 The center shall provide the local archived data schema to other archive systems.	Future
Element: **Countywide Emergency Vehicle Preemption System**		
Entity: **Roadway**		
Functional Area: **Roadway Signal Preemption** Field elements that receive signal preemption requests from approaching emergency vehicles and overrides the current operation of the traffic signals		
Requirement:	1 The field element shall respond to signal preemption requests from emergency vehicles.	Planned
Element: **Dispatch Operation Center - CHP**		

Architecture		Status
Orange County (Region)		(Region)
Element: **Dispatch Operation Center - CHP**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	3 The center shall receive emergency call information from motorist call-boxes and present the possible incident information to the emergency system operator.	Existing
Requirement:	5 The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
Requirement:	6 The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	7 The center shall coordinate, correlate, and verify all emergency inputs, including those identified based on external calls and internal analysis of security sensor and surveillance data, and assign each a level of confidence.	Existing
Requirement:	8 The center shall send a request for remote control of CCTV systems from a traffic management center in order to verify the reported incident.	Existing
Requirement:	9 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Dispatch Operation Center - CHP**		
Entity: **Emergency Management**		
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	7 The center shall receive traffic images to support dispatch of emergency vehicles.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area: **Emergency Response Management** Strategic emergency planning and response capabilities and broad inter-agency interfaces to support large-scale incidents and disasters, commonly associated with Emergency Operations Centers.		
Requirement:	1 The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters.	Existing
Requirement:	2 The center shall manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.	Existing
Requirement:	3 The center shall provide the capability to implement response plans and track progress through the incident by exchanging incident information and response status with allied agencies.	Existing
Requirement:	4 The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing
Requirement:	5 The center shall track the availability of resources and coordinate resource sharing with allied agency centers including traffic, maintenance, or other emergency centers.	Existing
Requirement:	6 The center shall allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.	Existing
Requirement:	12 The center shall provide information to the media concerning the status of an emergency response.	Existing
Element: **Emergency Service - Cities**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Emergency Service - Cities**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	7 The center shall coordinate, correlate, and verify all emergency inputs, including those identified based on external calls and internal analysis of security sensor and surveillance data, and assign each a level of confidence.	Existing
Requirement:	10 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		
Requirement:	1 The center shall collect current traffic and road condition information for emergency vehicle route calculation.	Existing
Functional Area: **Emergency Response Management** Strategic emergency planning and response capabilities and broad inter-agency interfaces to support large-scale incidents and disasters, commonly associated with Emergency Operations Centers.		
Requirement:	2 The center shall manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.	Existing
Requirement:	4 The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing
Requirement:	7 The center shall receive event scheduling information from Event Promoters.	Existing
Element: **Emergency Vehicle - Cities**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support**		

Architecture		Status
Orange County (Region)		(Region)
Element: **Emergency Vehicle - Cities**		
Entity: **Emergency Vehicle**		
Functional Area:	**On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.	
Requirement:	1 The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
Requirement:	2 The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
Requirement:	3 The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
Functional Area:	**On-board EV Incident Management Communication** On-board systems provide communications support to first responders. Incident information is provided to dispatched emergency personnel. Emergency personnel transmit information about the incident and response status.	
Requirement:	1 The emergency vehicle shall receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road, and weather conditions, hazardous material information, and the current status of resources that have been allocated to an incident.	Existing
Requirement:	2 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc.	Existing
Requirement:	3 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the current incident response status such as the identification of the resources on site, site management strategies in effect, and current clearance status.	Existing
Element: **Emergency Vehicles - CHP**		
Entity: **Emergency Vehicle**		
Functional Area:	**On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.	
Requirement:	1 The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
Requirement:	2 The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
Requirement:	3 The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Emergency Vehicles - CHP**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	4 The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Existing
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
Requirement:	6 The emergency vehicle shall provide the personnel on-board with dispatch information, including incident type and location, and forward an acknowledgment from personnel to the center that the vehicle is on its way to the incident scene.	Existing
Functional Area: **On-board EV Incident Management Communication** On-board systems provide communications support to first responders. Incident information is provided to dispatched emergency personnel. Emergency personnel transmit information about the incident and response status.		
Requirement:	1 The emergency vehicle shall receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road, and weather conditions, hazardous material information, and the current status of resources that have been allocated to an incident.	Existing
Requirement:	2 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc.	Existing
Requirement:	3 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the current incident response status such as the identification of the resources on site, site management strategies in effect, and current clearance status.	Existing
Element: **Freeway Service Patrol (FSP)**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	1 The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
Requirement:	2 The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
Requirement:	3 The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Freeway Service Patrol (FSP)**		
Entity: **Emergency Vehicle**		
Element: **Go-Local Transit Vehicles**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Transit Trip Monitoring** Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.		
Requirement:	1 The transit vehicle shall track the current location of the transit vehicle.	Future
Requirement:	2 The transit vehicle shall support the computation of the location of a transit vehicle using on-board sensors to augment the location determination function. This may include proximity to the transit stops or other known reference points as well as recording trip length.	Future
Requirement:	3 The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Future
Functional Area: **On-board Transit Fare Management** On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.		
Requirement:	1 The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Future
Functional Area: **On-board Passenger Counting** On-board systems collect transit vehicle loading data and make it available to the center.		
Requirement:	1 The transit vehicle shall count passengers boarding and alighting.	Future
Requirement:	2 The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops.	Future
Requirement:	3 The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	Future
Requirement:	4 The transit vehicle shall send the collected passenger count information to the transit center.	Future
Element: **John Wayne Airport**		
Entity: **Traffic Management**		
Functional Area: **TMC Traffic Information Dissemination** Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.		
Requirement:	5 The center shall retrieve locally stored traffic information, including current and 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.	Future
Functional Area: **TMC Regional Traffic Management**		

Architecture		Status
Orange County (Region)		(Region)
Element: **John Wayne Airport**		
Entity: **Traffic Management**		
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Future
Requirement:	2 The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Future
Element: **MCO Vehicles - Caltrans**		
Entity: **Maintenance and Construction Vehicle**		
Functional Area: **MCV Work Zone Support** On-board systems that provide communications and support for local management of a work zone.		
Requirement:	1 The maintenance and construction vehicle shall monitor, operate, and control work zone devices located at or alongside the roadway. The devices operated on board the vehicle include driver information devices (e.g. dynamic message signs) and work zone intrusion detection and alert devices.	Existing
Requirement:	2 The maintenance and construction vehicle shall provide an interface for field personnel to input status of their work zone activities.	Existing
Element: **Metrolink**		
Entity: **Transit Management**		
Functional Area: **Transit Center Fare Management** Management of fare collection at the center - includes setting and distributing fare information, central processing of fares for transit as well as other ITS services, links to financial institutions and enforcement agencies.		
Requirement:	4 The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Future
Requirement:	7 The center shall process requests for the advanced payment of tolls and parking lot charges as well as other non-transportation services, e.g. yellow-pages services.	Future
Functional Area: **Transit Center Multi-Modal Coordination** Coordinate schedules with other agencies and modes, including transit transfer cluster and transfer point information.		
Requirement:	1 The center shall coordinate schedules and services between transit agencies, traffic management, maintenance and construction operations, parking management, and other surface or air transportation modes.	Future
Element: **OCTA Access Service Vehicles**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Paratransit Operations**		

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA Access Service Vehicles**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Paratransit Operations**	On-board systems to manage paratransit and flexible-route dispatch requests, including multi-stop runs. Passenger data is collected and provided to the center.	
Requirement:	2 The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing
Requirement:	3 The transit vehicle shall provide the transit vehicle operator instructions about the demand responsive or flexible-route transit schedule that has been confirmed from the center.	Existing
Element: **OCTA Data Warehouse**		
Entity: **Archived Data Management**		
Functional Area: **ITS Data Repository**	Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.	
Requirement:	1 The center shall collect data to be archived from one or more data sources.	Existing
Requirement:	2 The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).	Existing
Requirement:	4 The center shall include capabilities for performing quality checks on the incoming archived data.	Existing
Requirement:	7 The center shall support a broad range of archived data management implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region.	Future
Functional Area: **Traffic and Roadside Data Archival**	Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.	
Requirement:	[Not Defined]	
Functional Area: **Virtual Data Warehouse Services**	Provides access to data from geographically dispersed archives and coordinates information exchange with a local data warehouse. Also provides the specialized publishing, directory services, and transaction management functions associated with coordinating remote archives.	
Requirement:	1 The center shall provide capabilities to access "in-place" data from geographically dispersed archives. These capabilities may include analysis, data fusion, or data mining.	Future
Requirement:	2 The center shall coordinate information exchange with a local data warehouse.	Future
Element: **OCTA Fixed Route Buses**		
Entity: **Transit Vehicle**		

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA Fixed Route Buses**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Transit Fare Management** On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.		
Requirement:	1 The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing
Functional Area: **On-board Transit Signal Priority** On-board systems request signal priority through short range communication directly with traffic control equipment at the roadside (intersections, ramps, interchanges, etc.).		
Requirement:	1 The transit vehicle shall determine the schedule deviation and estimated times of arrival (ETA) at transit stops.	Future
Requirement:	2 The transit vehicle shall send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.	Future
Requirement:	3 The transit vehicle shall send the schedule deviation data and status of priority requests to the transit vehicle operator and provide the capability for the transit vehicle operator to control the priority system.	Future
Requirement:	4 The transit vehicle shall prevent a priority request from being sent when the transit vehicle cannot use the priority (e.g., when the transit vehicle makes a passenger stop on the approach to an intersection).	Future
Element: **OCTA Intelligent Transit Management System**		
Entity: **Transit Management**		
Functional Area: **Transit Center Vehicle Tracking** Monitoring transit vehicle locations via interactions with on-board systems. Furnish users with real-time transit schedule information and maintain interface with digital map providers.		
Requirement:	1 The center shall monitor the locations of all transit vehicles within its network.	Existing
Requirement:	2 The center shall determine adherence of transit vehicles to their assigned schedule.	Planned
Requirement:	3 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for transit tracking and dispatch.	Planned
Requirement:	4 The center shall provide transit operational data to traveler information service providers.	Future
Requirement:	5 The center shall provide collected transit probe data to traffic management centers and traveler information service providers for use in measuring current traffic conditions.	Future
Functional Area: **Transit Center Fixed-Route Operations**		

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA Intelligent Transit Management System**		
Entity: **Transit Management**		
Functional Area: **Transit Center Fixed-Route Operations** Management of fixed route transit operations. Planning, scheduling, and dispatch associated with fixed and flexible route transit services. Updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.		
Requirement:	1 The center shall generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, incident information, operational data on current routes and schedules, and digitized map data.	Planned
Requirement:	2 The center shall provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to initiate these processes	Planned
Requirement:	4 The center shall dispatch fixed route or flexible route transit vehicles	Future
Requirement:	5 The center shall collect transit operational data for use in the generation of routes and schedules.	Future
Functional Area: **Transit Vehicle Assignment** Assigns individual transit vehicles to vehicle blocks and downloads this information to the transit vehicle, updating assignments as necessitated by changes. It also provides an inventory management function that stores attributes about each of the transit vehicles.		
Requirement:	2 The center shall download vehicle assignments to the transit vehicle prior to the start of the day's operations.	Planned
Requirement:	3 The center shall provide an exception handling process for the vehicle assignment function. This process shall generate new supplemental vehicle assignments as required due to change events which occur during the operating day.	Planned
Requirement:	5 The center shall generate transit vehicle availability listings, current and forecast, to support transit vehicle assignment planning.	Planned
Functional Area: **Transit Center Information Services** Provide interactive traveler information to travelers (on-board transit vehicles, at stops/stations, using personal devices), traveler information service providers, media, and other transit organizations. Includes routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events.		
Requirement:	1 The center shall provide travelers using public transportation with traffic and advisory information upon request. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.	Future
Requirement:	3 The center shall exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA Intelligent Transit Management System**		
Entity: **Transit Management**		
Functional Area: **Transit Center Information Services** Provide interactive traveler information to travelers (on-board transit vehicles, at stops/stations, using personal devices), traveler information service providers, media, and other transit organizations. Includes routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events.		
Requirement:	4 The center shall provide transit service information to traveler information service providers including routes, schedules, schedule adherence, and fare information as well as transit service information during evacuation.	Future
Functional Area: **Transit Data Collection** Collection and storage of transit management data. For use by operations personnel or data archives in the region.		
Requirement:	1 The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Planned
Requirement:	2 The center shall assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.	Planned
Requirement:	3 The center shall receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.	Future
Element: **OCTA.net - Trip Planner**		
Entity: **Information Service Provider**		
Functional Area: **Interactive Infrastructure Information** Personalized dissemination of traffic, transit, maintenance and construction, multimodal, event, and weather information to traveler interface systems and vehicles, upon request.		
Requirement:	1 The center shall disseminate customized traffic and highway condition information to travelers, including incident information, detours and road closures, recommended routes, and current speeds on specific routes upon request.	Planned
Requirement:	2 The center shall disseminate customized maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities upon request.	Planned
Requirement:	3 The center shall disseminate customized transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers upon request.	Planned
Requirement:	4 The center shall disseminate customized parking information to travelers, including location, availability, and fees upon request.	Planned
Requirement:	5 The center shall disseminate customized toll fee information to travelers upon request.	Planned
Functional Area: **Traveler Telephone Information** Distribution of traveler information and wide-area alerts to traveler telephone information systems such as 511, based on voice-based traveler requests.		

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA.net - Trip Planner**		
Entity: **Information Service Provider**		
Functional Area: **Traveler Telephone Information** Distribution of traveler information and wide-area alerts to traveler telephone information systems such as 511, based on voice-based traveler requests.		
Requirement:	1 The center shall provide the capability to process voice-formatted requests for traveler information from a traveler telephone information system, and return the information in the requested format.	Existing
Requirement:	2 The center shall provide the capability to process dual-tone multifrequency (DTMF)-based requests (touch-tone) for traveler information from a traveler telephone information system.	Existing
Requirement:	3 The center shall provide the capability to process traveler information requests from a traveler telephone information system.	Existing
Requirement:	8 The center shall provide transit service information in the requested voice format and for the requested location.	Existing
Functional Area: **Infrastructure Provided Trip Planning** Generation of pre-trip and enroute trip plans for travelers (and vehicles) based on current traffic conditions, work zones, weather, and travelers constraints and preferences. Includes end-to-end trips using multiple modes, such as bicycle, transit, etc.		
Requirement:	1 The center shall provide the capability to provide specific pre-trip and enroute directions to travelers (and drivers), including costs, arrival times, and transfer points.	Existing
Requirement:	2 The center shall include bicycle routes, walkways, skyways, and multi-use trails in the pre-trip and enroute directions it provides to travelers.	Planned
Requirement:	3 The center shall support on-line route guidance for travelers using personal devices (such as PDAs).	Planned
Functional Area: **ISP Travel Services Information and Reservation** Customized dissemination of yellow pages information to traveler interface systems and vehicles, upon request. Also includes reservation for services to support trip planning.		
Requirement:	1 The center shall disseminate yellow pages information (such as lodging, restaurants, theaters, bicycle facilities, and other tourist activities) to travelers upon request.	Future
Functional Area: **Infrastructure Provided Dynamic Ridesharing** Dynamic rideshare matching, including traveler eligibility, preference information, connections to transit or other multimodal services, confirmation, and payment of rideshare matching services.		
Requirement:	1 The center shall accept requests from traveler interface systems for ridesharing as part of a trip plan request.	Planned
Requirement:	2 The center shall provide a rideshare match based on origin and destination of the traveler's proposed trip, any routing constraints, preferences specified by the traveler, compatibility of this rideshare with rideshares confirmed by other travelers, the requesting traveler's eligibility data, and traffic data.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **OCTA.net - Trip Planner**		
Entity: **Information Service Provider**		
Functional Area: **Infrastructure Provided Dynamic Ridesharing** Dynamic rideshare matching, including traveler eligibility, preference information, connections to transit or other multimodal services, confirmation, and payment of rideshare matching services.		
Requirement:	3 The center shall process rideshare requests by balancing the relative benefits of the rideshare to each rideshare participant.	Future
Requirement:	4 The center shall arrange connections to transit or other multimodal services for portions of a multi-segment trip that includes ridesharing.	Future
Requirement:	5 The center shall provide a confirmation of the traveler's rideshare match and provide the capability to support a payment transaction for the rideshare service.	Future
Requirement:	6 The center shall store all rideshare matches and traveler eligibility data.	Future
Element: **Other Toll Roads**		
Entity: **Payment Administration**		
Functional Area: **Toll Administration** Management of toll collection for private and commercial vehicles, dynamic pricing, payment reconciliation with financial institutions, and violation notification to enforcement agencies.		
Requirement:	1 The center shall manage toll transactions, including maintaining a log of all transactions and toll pricing structure information.	Existing
Requirement:	3 For electronic toll payments requiring financial payment, the center shall process the financial information from toll plazas and manage an interface to a Financial Institution.	Existing
Requirement:	5 The center shall manage the details of toll payment violations based on vehicle information from the toll plaza, registration information from the Department of Motor Vehicles, invalid payment information from a Financial Institution, and previous violation information stored locally, and report such violations to appropriate law enforcement agencies.	Existing
Requirement:	7 The center shall respond to changes in toll prices from the Toll Administrator.	Existing
Requirement:	10 The center shall support wide-area alerts from emergency centers by passing on the information to its toll plazas and the Toll Administrator.	Existing
Functional Area: **Center VMT Payment Administration** Management of a VMT payment system. Receives VMT data and computes the total cost to the vehicle owner for payment.		
Requirement:	1 The center shall register vehicles for road use payment, establishing accounts that identify owner billing information and preferences.	Existing
Requirement:	2 The center shall provide secure user account management, providing user access to rules and policies, current billing status, invoices, payments, and mechanisms for review and challenge of the collected data.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Other Toll Roads**		
Entity: **Payment Administration**		
Functional Area: **Center VMT Payment Administration** Management of a VMT payment system. Receives VMT data and computes the total cost to the vehicle owner for payment.		
Requirement:	3 This center shall maintain and publish road use prices, as configured by the Payment Administrator.	Existing
Requirement:	4 The center shall receive VMT data (time stamped log of roadways used by the vehicle) and compute the total cost to the vehicle owner.	Existing
Requirement:	5 The center shall calculate road use charges based on the vehicle's mileage, roads traveled, time periods, emissions profile for make/model, fuel economy for make/model, weight, number of axles/tires, or other policies.	Existing
Requirement:	6 The center shall access and use registration and odometer information from the DMV to verify and audit collected VMT data.	Existing
Requirement:	7 The center shall process and clear payments from vehicle owners and operators as well as payments to other Center VMT Payment Administration through clearing houses provided by financial institutions.	Existing
Requirement:	8 The center shall coordinate with other VMT Payment Administration systems to reconcile and apportion payments for vehicles registered in other jurisdictions.	Existing
Requirement:	9 The center shall report payment violations including vehicle information and vehicle image to the designated Enforcement Agency.	Existing
Requirement:	10 The center shall monitor the operational status of VMT field equipment and identify equipment faults.	Existing
Element: **Parking Guidance Systems**		
Entity: **Parking Management**		
Functional Area: **Parking Coordination** Coordination between parking facilities and between parking facilities and traffic, transit, and traveler information systems. Includes sharing of hours of operation, charging strategies, lot sizes, current parking availability, and parking reservations.		
Requirement:	1 The parking element shall exchange parking management data with other parking facilities including location, hours, availability, status, lot usage, operating strategies, and charging information.	Future
Requirement:	2 The parking element shall provide parking management data to traffic management centers upon request as part of the implementation of demand management programs in the region. This could include changes to hours of operation or pricing.	Future
Requirement:	3 The parking element shall distribute parking lot information to traffic management centers upon request to support integrated regional traffic control and parking management. This could include information on facility hours of operation and current parking availability.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Parking Guidance Systems**		
Entity: **Parking Management**		
Functional Area: **Parking Coordination** Coordination between parking facilities and between parking facilities and traffic, transit, and traveler information systems. Includes sharing of hours of operation, charging strategies, lot sizes, current parking availability, and parking reservations.		
Requirement:	4 The parking element shall distribute parking lot information upon request to transit management centers for park and ride facilities, parking shuttle services, and other applications that integrate transit and parking services.	Future
Requirement:	5 The parking element shall distribute parking lot information upon request to traveler information providers to support travel planning.	Future
Requirement:	6 The parking element shall support requests for parking reservations.	Future
Element: **RDMD**		
Entity: **Traffic Management**		
Functional Area: **Traffic Equipment Maintenance** Monitoring and remote diagnostics of field equipment - detect failures, issue problem reports, and track the repair or replacement of the failed equipment.		
Requirement:	1 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.	Existing
Requirement:	2 The center shall collect and store CCTV surveillance system (traffic, pedestrian) operational status.	Existing
Requirement:	3 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Existing
Element: **Remote Traveler Support - OCTA**		
Entity: **Remote Traveler Support**		
Functional Area: **Remote Interactive Information Reception** Public traveler interface, such as a kiosk, that provides traffic, transit, yellow pages, special event, and other personalized traveler information services upon request.		
Requirement:	1 The public interface for travelers shall receive traffic information from a center and present it to the traveler upon request.	Planned
Requirement:	2 The public interface for travelers shall receive transit information from a center and present it to the traveler upon request.	Existing
Requirement:	3 The public interface for travelers shall receive yellow pages information (such as lodging, restaurants, theaters, bicycle facilities, and other tourist activities) from a center and present it to the traveler upon request.	Planned
Requirement:	4 The public interface for travelers shall receive event information from a center and present it to the traveler upon request.	Existing
Requirement:	5 The public interface for travelers shall receive evacuation information from a center and present it to the traveler.	Planned
Requirement:	6 The public interface for travelers shall receive wide-area alerts and present it to the traveler.	Planned

Architecture		Status
Orange County (Region)		(Region)
Element: **Remote Traveler Support - OCTA**		
Entity: **Remote Traveler Support**		
Functional Area: **Remote Interactive Information Reception** Public traveler interface, such as a kiosk, that provides traffic, transit, yellow pages, special event, and other personalized traveler information services upon request.		
Requirement:	7 The public interface for travelers shall accept reservations for confirmed trip plans.	Future
Requirement:	8 The public interface for travelers shall support payment for services, such as confirmed trip plans, confirmed traveler services, tolls, transit fares, parking lot charges, and advanced payment for tolls.	Future
Requirement:	9 The public interface for travelers shall provide an interface through which credit identities and stored credit values may be collected from tags, traveler cards, or payment instruments used by travelers.	Future
Requirement:	10 The public interface for travelers shall base requests from the traveler on the traveler's current location or a specific location identified by the traveler, and filter the provided information accordingly.	Future
Requirement:	11 The public interface for travelers shall provide digitized map data to act as the background to the information presented to the traveler.	Future
Requirement:	12 The public interface for travelers shall support traveler input in audio or manual form.	Future
Requirement:	13 The public interface for travelers shall present information to the traveler in audible or visual forms consistent with a kiosk, including those that are suitable for travelers with hearing or vision physical disabilities.	Future
Requirement:	14 The public interface for travelers shall be able to store frequently requested data.	Future
Requirement:	15 The public interface for travelers shall provide an interface to establish and manage user VMT accounts, process VMT payments, and access VMT reports under user control.	Future
Functional Area: **Remote Traveler Security** Public traveler interface that provides the capability for travelers to report an emergency or activate a panic button to summon assistance in areas such as transit stops, park-and-ride areas, etc.		
Requirement:	1 The public interface for travelers shall provide the capability for a traveler to report an emergency and summon assistance from secure areas such as transit stops, transit stations, modal transfer facilities, rest stops, park-and-ride areas, travel information areas, and emergency pull off areas.	Future
Requirement:	2 When initiated by a traveler, the public interface for travelers shall forward a request for assistance to an emergency management function and acknowledge the request.	Future
Requirement:	3 The public interface for travelers shall provide the capability to broadcast a message to advise or warn a traveler.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Remote Traveler Support - OCTA**		
Entity: **Remote Traveler Support**		
Functional Area:	**Remote Traveler Security** Public traveler interface that provides the capability for travelers to report an emergency or activate a panic button to summon assistance in areas such as transit stops, park-and-ride areas, etc.	
Requirement:	4 The public interface for travelers shall accept input and provide information to the traveler in a form suitable for travelers with physical disabilities.	Future
Functional Area:	**Remote Transit Information Services** Public traveler interface that provides real-time travel-related information at transit stops and multi-modal transfer points, including general annunciation, display of imminent arrival information, the latest available information on transit routes, schedules, transfer options, available services, fares, and real-time schedule adherence.	
Requirement:	1 The public interface for travelers shall collect and provide real-time travel-related information at transit stops, multi-modal transfer points, and other public transportation areas.	Future
Requirement:	2 The public interface for travelers shall collect and present to the transit traveler information on transit routes, schedules, and real-time schedule adherence.	Future
Requirement:	3 The public interface for travelers shall provide support for general annunciation and/or display of imminent arrival information and other information of general interest to transit users.	Future
Requirement:	4 The public interface for travelers shall present information to the traveler in a form suitable for travelers with physical disabilities.	Future
Element: **Roadside - Cities**		
Entity: **Roadway**		
Functional Area:	**Roadway Basic Surveillance** Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	
Requirement:	1 The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	Existing
Requirement:	2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
Requirement:	4 The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
Requirement:	5 The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing
Functional Area:	**Roadway Signal Controls** Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.	
Requirement:	1 The field element shall control traffic signals under center control.	Existing
Requirement:	2 The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Roadside - Cities**		
Entity: **Roadway**		
Functional Area: **Roadway Signal Controls** Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.		
Requirement:	3 The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.	Existing
Requirement:	4 The field element shall report the current signal control information to the center.	Existing
Requirement:	5 The field element shall report current preemption status to the center.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the center.	Existing
Requirement:	7 The field element shall return traffic signal controller fault data to the center.	Existing
Requirement:	8 The field element shall report current transit priority status to the center.	Existing
Functional Area: **Field Management Stations Operation** Supports direct communications between field management stations and the local field equipment under their control.		
Requirement:	[Not Defined]	
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive transit vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to signal priority requests from transit vehicles.	Planned
Functional Area: **Roadway Signal Preemption** Field elements that receive signal preemption requests from approaching emergency vehicles and overrides the current operation of the traffic signals		
Requirement:	1 The field element shall respond to signal preemption requests from emergency vehicles.	Planned
Functional Area: **Roadway Warning** Field elements used to warn drivers approaching hazards including adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.		
Requirement:	1 The field element shall monitor for hazardous traffic conditions, including queues.	Planned
Requirement:	2 The field element shall monitor for hazardous road surface and local weather conditions.	Planned
Requirement:	3 The field element shall monitor for debris, animals, or other objects in the travel lanes.	Planned
Requirement:	4 The field element shall provide collected sensor data to the controlling center.	Planned
Requirement:	5 The field element shall autonomously identify potentially hazardous conditions and activate warning signs to approaching motorists.	Planned

Architecture		Status
Orange County (Region)		(Region)
Element: **Roadside - Cities**		
Entity: **Roadway**		
Functional Area:	**Roadway Warning** Field elements used to warn drivers approaching hazards including adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.	
Requirement:	6 The field element shall receive commands from the controlling center that activate warning signs to approaching motorists.	Planned
Requirement:	7 The field element shall collect operational status of the warning system field equipment and report the operational status to the controlling center.	Planned
Requirement:	8 The field element shall monitor and report faults to the controlling center.	Planned
Functional Area:	**Roadway Traffic Information Dissemination** Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).	
Requirement:	1 The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
Requirement:	2 The field element shall include driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers, under center control.	Existing
Requirement:	3 The field element shall include pedestrian information systems under center control (e.g. warning pedestrians of a potential hazard, or providing mandatory instructions as to the availability of pedestrian access).	Planned
Requirement:	4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing
Functional Area:	**Roadway Incident Detection** Field elements that monitor traffic conditions to identify incidents. It includes traffic detectors that collect traffic flow information and identify unusual traffic conditions and advanced CCTV cameras with built-in incident detection algorithms.	
Requirement:	1 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
Requirement:	2 The field element shall remotely process video data and provide an indication of potential incidents to the traffic management center.	Existing
Requirement:	3 The field element's video devices shall be remotely controlled by a traffic management center.	Existing
Functional Area:	**Roadway Equipment Coordination** Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	

Architecture		Status
Orange County (Region)		(Region)
Element: **Roadside - Cities**		
Entity: **Roadway**		
Functional Area:	**Roadway Equipment Coordination** Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
Requirement:	1 The field element shall include sensors that provide data and status information to other field element devices, without center control.	Future
Requirement:	2 The field element shall include sensors that receive configuration data from other field element devices, without center control.	Future
Requirement:	3 The field element shall include devices that provide data and status information to other field element devices without center control.	Future
Requirement:	4 The field element shall include devices that receive configuration data from other field element devices, without center control.	Future
Functional Area:	**Roadway Speed Monitoring and Warning** Vehicle speed sensors that detect excessive vehicle speeds, optionally based on conditions and vehicle type, informing drivers, centers and/or enforcement agencies of speed violations.	
Requirement:	1 The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	Existing
Requirement:	3 If the speed detected by vehicle speed sensors is determined to be excessive, the field element shall provide a safe speed advisory to passing drivers via a driver information system (such as portable messages signs, field to vehicle communications to in-vehicle signing systems, etc.).	Existing
Functional Area:	**Roadway Work Zone Traffic Control** Field elements in maintenance and construction areas including CCTV cameras, driver information systems (such as DMS), and gates/barriers that monitor and control traffic and provide information directly to drivers in affected areas.	
Requirement:	1 The field element shall collect, process, and send work zone images to the center for further analysis and distribution, under center control.	Future
Requirement:	2 Under traffic and maintenance center control, the field element shall include driver information systems (such as dynamic messages signs and highway advisory radios) that advise drivers of activity around the work zone through which they are currently passing.	Existing
Functional Area:	**Roadway Short Range Traveler Information Communications** Field elements that distribute information to in-vehicle equipment. The information provided may be determined locally or under the control of a center.	
Requirement:	1 The field element shall distribute traveler information including traffic and road conditions to passing vehicles using short range communications, under center control.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **Roadside - Cities**		
Entity: **Roadway**		
Functional Area: **Roadway Short Range Traveler Information Communications** Field elements that distribute information to in-vehicle equipment. The information provided may be determined locally or under the control of a center.		
Requirement:	2 The field element shall distribute advisory information, such as evacuation information, wide-area alerts, incident information, work zone intrusion information, and other special information to passing vehicles using short range communications, under center control.	Future
Requirement:	3 The field element shall distribute indicator and fixed sign information, including static sign information (e.g., stop, curve warning, guide signs, service signs, and directional signs) and dynamic information (e.g., current signal states and local conditions warnings identified by local environmental sensors) to equipment on-board vehicles under center control.	Future
Requirement:	4 The field element shall return system operational status to the controlling center.	Future
Requirement:	5 The field element shall return system fault data to the maintenance center for repair.	Future
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.		
Requirement:	1 The field element shall collect traffic, road, and environmental conditions information.	Existing
Requirement:	2 The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Existing
Requirement:	3 The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Existing
Element: **Security Monitoring Field Equipment - County**		
Entity: **Remote Traveler Support**		
Functional Area: **Traveler Secure Area Surveillance** Security surveillance devices that monitor traveler-frequented areas such as transit stops and rest stops.		
Requirement:	1 The field element shall include video and/or audio surveillance of traveler secure areas including transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and traveler information centers).	Existing
Requirement:	2 The field element shall be remotely controlled by a center.	Existing
Requirement:	3 The field element shall provide equipment status and fault indication of surveillance equipment to a center.	Existing
Requirement:	4 The field element shall provide raw video or audio data.	Existing
Functional Area: **Traveler Secure Area Sensor Monitoring**		

Architecture		Status
Orange County (Region)		(Region)
Element: **Security Monitoring Field Equipment - County**		
Entity: **Remote Traveler Support**		
Functional Area: **Traveler Secure Area Sensor Monitoring** Security sensors monitoring traveler-frequented areas such as transit stops, park-and-ride lots, and rest areas for environmental threats, intrusion and motion, and object detection.		
Requirement:	1 The field element shall include security sensors that monitor conditions in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers).	Planned
Requirement:	2 The field element shall be remotely controlled by a center.	Planned
Requirement:	3 The field element shall provide equipment status and fault indication of security sensor equipment to a center.	Planned
Requirement:	4 The field element shall include environmental threat sensors (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological).	Planned
Requirement:	5 The field element shall include motion and intrusion detection sensors.	Planned
Requirement:	6 The field element shall include object detection sensors (such as metal detectors).	Planned
Requirement:	7 The field element shall provide raw security sensor data.	Planned
Requirement:	8 The field element shall remotely process security sensor data and provide an indication of potential incidents or threats to a center.	Planned
Functional Area: **Remote Traveler Security** Public traveler interface that provides the capability for travelers to report an emergency or activate a panic button to summon assistance in areas such as transit stops, park-and-ride areas, etc.		
Requirement:	1 The public interface for travelers shall provide the capability for a traveler to report an emergency and summon assistance from secure areas such as transit stops, transit stations, modal transfer facilities, rest stops, park-and-ride areas, travel information areas, and emergency pull off areas.	Existing
Requirement:	2 When initiated by a traveler, the public interface for travelers shall forward a request for assistance to an emergency management function and acknowledge the request.	Future
Requirement:	3 The public interface for travelers shall provide the capability to broadcast a message to advise or warn a traveler.	Existing
Entity: **Security Monitoring**		
Functional Area: **Field Secure Area Sensor Monitoring** Security sensors monitoring facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, and transit railways or guideways) for environmental threats, intrusion and motion, object detection, and infrastructure integrity.		
Requirement:	1 The field element shall include security sensors that monitor conditions of secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways).	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **Security Monitoring Field Equipment - County**		
Entity: **Security Monitoring**		
Functional Area: **Field Secure Area Sensor Monitoring** Security sensors monitoring facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, and transit railways or guideways) for environmental threats, intrusion and motion, object detection, and infrastructure integrity.		
Requirement:	2 The field element shall be remotely controlled by a center.	Existing
Functional Area: **Field Secure Area Surveillance** Security surveillance devices (audio/video) that monitor facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, and transit railways or guideways).		
Requirement:	1 The field element shall include video and/or audio surveillance of secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways).	Existing
Requirement:	2 The field element shall be remotely controlled by a center.	Existing
Requirement:	4 The field element shall provide raw video or audio data.	Existing
Element: **TMC - Cities**		
Entity: **Information Service Provider**		
Functional Area: **ISP Traveler Data Collection** Collects traveler information from other centers, consolidates and refines the collected data, and makes this data available to traveler information applications.		
Requirement:	1 The center shall collect, process, and store traffic and highway condition information, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.	Future
Requirement:	2 The center shall collect, process, and store maintenance and construction information, including scheduled maintenance and construction work activities and work zone activities.	Future
Requirement:	4 The center shall collect, process, and store parking information, including location, availability, and fees.	Future
Requirement:	6 The center shall collect, process, and store current and forecast road conditions and surface weather conditions.	Future
Requirement:	7 The center shall collect, process, and store event information.	Future
Functional Area: **ISP Emergency Traveler Information** Distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.		
Requirement:	1 The center shall disseminate emergency evacuation information to the traveler interface systems, including evacuation zones, shelter information, available transportation modes, road closures and detours, changes to transit services, and traffic and road conditions at the origin, destination, and along the evacuation routes.	Future
Requirement:	2 The center shall provide evacuation information to shelter providers.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Information Service Provider**		
Functional Area: **ISP Emergency Traveler Information** Distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.		
Requirement:	3 The center shall disseminate wide-area alert information to the traveler interface systems, including major emergencies such as a natural or man-made disaster, civil emergency, child abductions, severe weather watches and warnings, military activities, and law enforcement warnings.	Future
Requirement:	4 The center shall provide the capability for a system operator to control the type and update frequency of emergency and wide-area alert information distributed to travelers.	Future
Entity: **Traffic Management**		
Functional Area: **TMC Roadway Warning** Remotely monitors and controls field elements used to warn drivers approaching hazards. Detects and warns approaching vehicles of adverse road weather conditions, traffic conditions including queues, and obstacles or animals in the road.		
Requirement:	1 The center shall monitor data on traffic, environmental conditions, and other hazards collected from sensors along the roadway.	Existing
Requirement:	2 The center shall identify hazardous road weather and surface conditions.	Existing
Requirement:	3 The center shall identify hazardous traffic conditions including queues.	Existing
Functional Area: **Collect Traffic Surveillance** Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.		
Requirement:	1 The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing
Requirement:	2 The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing
Requirement:	4 The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Existing
Requirement:	5 The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
Requirement:	6 The center shall maintain a database of surveillance equipment and sensors and associated data (including the roadway on which they are located, the type of data collected, and the ownership of each)	Existing
Requirement:	7 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area: **TMC Signal Control** Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.		
Requirement:	1 The center shall remotely control traffic signal controllers.	Existing
Requirement:	2 The center shall accept notifications of pedestrian calls.	Existing
Requirement:	3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing
Requirement:	4 The center shall collect traffic signal controller fault data from the field.	Existing
Requirement:	5 The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Existing
Requirement:	6 The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Existing
Requirement:	7 The center shall manage boundaries of the control sections used within the signal system.	Existing
Requirement:	8 The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing
Functional Area: **TMC Traffic Information Dissemination** Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.		
Requirement:	1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing
Requirement:	3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing
Requirement:	4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing
Requirement:	5 The center shall retrieve locally stored traffic information, including current and 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.	Existing
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area:	**TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.	
Requirement:	2 The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Existing
Functional Area:	**TMC Traffic Management Decision Support** Recommends courses of action to the traffic operator based on current and forecast road and traffic conditions. Recommended actions may include predefined incident response plans, signal timing plan changes, DMS/HAR messages, lane control strategies, metering strategies, etc.	
Requirement:	1 The center shall provide center personnel with 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.	Existing
Requirement:	2 The center shall identify network imbalances and potential courses of action.	Planned
Requirement:	3 The center shall compare the impact of potential courses of action and make recommendations to the operator.	Planned
Requirement:	4 The recommended actions shall include predefined incident response plans, signal timing plan changes, DMS/HAR messages, lane control strategies and freeway control strategies including ramp metering, interchange metering, and mainline metering.	Planned
Requirement:	5 The recommended actions shall include multimodal strategies that include suggested transit strategies and suggested route and mode choices for travelers.	Planned
Requirement:	6 The center shall provide an interface to center personnel to input control parameters for the decision support process and receive recommended actions and supporting information presentation.	Planned
Functional Area:	**TMC Incident Detection** Remotely monitors traffic sensor and surveillance systems to detect and verify incidents. Also monitors external advisory and incident reporting systems, intermodal freight depots, and border crossings for additional incident information. Identified incidents are reported to operations personnel and other centers.	
Requirement:	2 The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Existing
Requirement:	3 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters and traveler information service providers.	Existing
Requirement:	4 The center shall exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area:	**TMC Incident Detection** Remotely monitors traffic sensor and surveillance systems to detect and verify incidents. Also monitors external advisory and incident reporting systems, intermodal freight depots, and border crossings for additional incident information. Identified incidents are reported to operations personnel and other centers.	
Requirement:	6 The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Existing
Functional Area:	**TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.	
Requirement:	1 The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.	Existing
Requirement:	2 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
Requirement:	3 The center shall support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.	Future
Requirement:	4 The center shall exchange incident information with emergency management centers, maintenance and construction centers, transit centers, information service providers, and the media including description, location, traffic impact, status, expected duration, and response information.	Future
Requirement:	5 The center shall share resources with allied agency centers to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	Future
Requirement:	6 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, border crossings, and rail operations centers.	Future
Requirement:	7 The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.		
Requirement:	8 The center shall monitor incident response performance and calculate incident response and clearance times.	Future
Requirement:	9 The center shall exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Future
Requirement:	10 The center shall coordinate information and controls with other traffic management centers.	Future
Requirement:	11 The center shall receive inputs from emergency management and transit management centers to develop an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.	Future
Requirement:	12 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic incident management.	Future
Functional Area: **TMC Evacuation Support** Development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. Interfaces with emergency management and other traffic management centers.		
Requirement:	1 The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.	Existing
Requirement:	2 The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.	Planned
Requirement:	3 The center shall coordinate information and controls with other traffic management centers.	Existing
Requirement:	4 The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.	Planned
Functional Area: **TMC Traffic Network Performance Evaluation** Measures performance and predicts travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.		

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area: **TMC Traffic Network Performance Evaluation** Measures performance and predicts travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.		
Requirement:	1 The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.	Existing
Requirement:	2 The center shall collect wide-area pollution data from emissions management centers to support overall network performance evaluations.	Planned
Requirement:	3 The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	Planned
Requirement:	4 The center shall collect and store anticipated route information from information service providers to support overall network performance evaluations and predictions.	Planned
Requirement:	5 The center shall exchange information with transit management centers including details 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.	Planned
Requirement:	6 The center shall exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	Planned
Requirement:	7 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for network performance evaluations.	Planned
Requirement:	8 The center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning to predict future traffic patterns and conditions.	Planned
Requirement:	9 This center shall use the collected information to measure overall current and forecast network performance and predict travel demand patterns.	Planned
Functional Area: **TMC Speed Monitoring and Warning** Remotely monitors vehicle speeds, and informs an enforcement agency if excessive speeds are detected. Also configures and controls speed warning systems that provide safe speed advisories to the motorist.		
Requirement:	1 The center shall remotely control vehicle speed sensors typically placed in work zones; control parameters may include environmental and traffic conditions.	Planned
Requirement:	2 The center shall collect operational status for the vehicle speed sensors; the status shall include logged information including measured speeds, warning messages displayed, and violation records.	Planned

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area: **TMC Speed Monitoring and Warning** Remotely monitors vehicle speeds, and informs an enforcement agency if excessive speeds are detected. Also configures and controls speed warning systems that provide safe speed advisories to the motorist.		
Requirement:	3 The center shall provide the capability to notify an enforcement agency when vehicle speeds in the work zone are in excess of the posted speed limit or are creating an unsafe condition based upon the current environmental or traffic conditions.	Planned
Requirement:	4 The center shall collect fault data for the vehicle speed sensors for repair.	Planned
Functional Area: **Traffic Equipment Maintenance** Monitoring and remote diagnostics of field equipment - detect failures, issue problem reports, and track the repair or replacement of the failed equipment.		
Requirement:	1 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.	Planned
Requirement:	2 The center shall collect and store CCTV surveillance system (traffic, pedestrian) operational status.	Planned
Requirement:	3 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Planned
Requirement:	4 The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Planned
Requirement:	5 The center shall collect environmental sensor operational status.	Planned
Requirement:	6 The center shall collect environmental sensor equipment fault data and send to the maintenance center for repair.	Planned
Requirement:	7 The center shall exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when the faults are cleared.	Planned
Requirement:	8 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic maintenance data.	Planned
Functional Area: **TMC Work Zone Traffic Management** Coordination with maintenance systems using work zone images and traveler information systems (such as DMS), and distribution of work plans so that work zones are established that have minimum traffic impact.		
Requirement:	3 The center shall remotely control driver information systems (such as dynamic messages signs, highway advisory radios) to advise drivers of activity around a work zone.	Existing
Requirement:	4 The center shall collect operational status for the driver information systems equipment in work zones.	Future
Requirement:	5 The center shall collect fault data for the driver information systems equipment in work zones for repair.	Future

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC - Cities**		
Entity: **Traffic Management**		
Functional Area: **TMC Work Zone Traffic Management**	Coordination with maintenance systems using work zone images and traveler information systems (such as DMS), and distribution of work plans so that work zones are established that have minimum traffic impact.	
Requirement:	6 The center shall receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback to the sending center.	Future
Functional Area: **TMC Multimodal Coordination**	Provides traffic signal priority for transit vehicles based on center-to-center communications with the transit management center; also exchange traffic and transit information.	
Requirement:	1 The center shall respond to requests from transit management centers for signal priority at one or more intersections along a particular transit route.	Future
Requirement:	2 The center shall exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes.	Future
Functional Area: **TMC Transportation Operations Data Collection**	Collects real-time information on the state of the regional transportation system for operational use by the center. It establishes communications with a regional repository, requests or subscribes to information relevant to the center, and distributes the received information for use.	
Requirement:	1 The center shall collect real-time information on the state of the regional transportation system including current traffic and road conditions, weather conditions, special event and incident information.	Existing
Requirement:	2 The center shall support the capability for the system operator to monitor and control the information collection service.	Existing
Element: **TMC Maintenance Dispatch Communications - Caltrans**		
Entity: **Maintenance and Construction Management**		
Functional Area: **MCM Vehicle Tracking**	Remotely tracks the location of maintenance and construction vehicles and other equipment; presented to the center personnel.	
Requirement:	1 The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
Functional Area: **MCM Incident Management**	Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
Requirement:	1 The center shall receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC Maintenance Dispatch Communications - Caltrans**		
Entity: **Maintenance and Construction Management**		
Functional Area: **MCM Incident Management** Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.		
Requirement:	2 The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, etc.	Existing
Requirement:	3 The center shall exchange incident and threat information with emergency management centers as well as traffic management centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing
Requirement:	4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
Requirement:	5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	Existing
Requirement:	6 The center shall exchange road network status assessment information with emergency management and traffic managemen centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Existing
Requirement:	7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	Existing
Requirement:	8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.	Existing
Functional Area: **MCM Work Zone Management** Remotely monitors and supports work zone activities, controlling traffic through dynamic message signs (DMS), highway advisory radio, gates and barriers, and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).		
Requirement:	1 The center shall generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC Maintenance Dispatch Communications - Caltrans**		
Entity: **Maintenance and Construction Management**		
Functional Area: **MCM Work Zone Management** Remotely monitors and supports work zone activities, controlling traffic through dynamic message signs (DMS), highway advisory radio, gates and barriers, and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).		
Requirement:	2 The center shall control the collection of work zone status information including video images from cameras located in or near the work zone.	Existing
Requirement:	3 The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.	Existing
Requirement:	4 The center shall control traffic in work zones by providing remote control of dynamic message signs, highway advisory radio systems, gates, and barriers located in or near the work zone.	Existing
Requirement:	5 The center shall exchange information with administrative systems to support the planning and scheduling of work zone activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	Existing
Functional Area: **MCM Work Zone Safety Management** Remotely monitors work zone safety systems that detect vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone.		
Requirement:	1 The center shall provide remote monitoring and control of work zone safety devices - including intrusion detection devices that have been installed in work zones or maintenance areas.	Existing
Requirement:	2 The center shall provide remote monitoring and control of intrusion alert devices that have been installed in work zones or maintenance areas.	Existing
Functional Area: **MCM Work Activity Coordination** Disseminates work activity schedules and current asset restrictions to other agencies. Work schedules are coordinated, factoring in the needs and activities of other agencies and adjacent jurisdictions.		
Requirement:	1 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	Existing

Architecture		Status
Orange County (Region)		(Region)
Element: **TMC Maintenance Dispatch Communications - Caltrans**		
Entity: **Maintenance and Construction Management**		
Functional Area: **MCM Work Activity Coordination** Disseminates work activity schedules and current asset restrictions to other agencies. Work schedules are coordinated, factoring in the needs and activities of other agencies and adjacent jurisdictions.		
Requirement:	2 The center shall provide status information about scheduled maintenance and construction activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, multimodal transportation providers, rail operations, and the media.	Existing
Requirement:	3 The center shall collect and respond to feedback concerning scheduled maintenance and construction activities with other management centers such as traffic, emergency, transit, and rail operations.	Existing
Requirement:	5 The center shall exchange information with administrative systems to support the planning and scheduling of maintenance and construction activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	Existing
Functional Area: **MCM Infrastructure Monitoring** Remotely monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure (e.g., culverts) using vehicle-based and roadway-based infrastructure monitoring sensors.		
Requirement:	2 The center shall monitor maintenance vehicle-based mobile sensors and data logging devices that collect information on current infrastructure condition.	Existing
Requirement:	4 The center shall process the collected information and use it to monitor the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure.	Existing
Element: **Transit Vehicle Subsystems - OCTA**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Transit Trip Monitoring** Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.		
Requirement:	1 The transit vehicle shall track the current location of the transit vehicle.	Existing
Requirement:	2 The transit vehicle shall support the computation of the location of a transit vehicle using on-board sensors to augment the location determination function. This may include proximity to the transit stops or other known reference points as well as recording trip length.	Existing
Requirement:	3 The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Planned

Architecture		Status
Orange County (Region)		(Region)
Element: **Transit Vehicle Subsystems - OCTA**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Transit Trip Monitoring** Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.		
Requirement:	4 The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, running times, etc.	Planned
Requirement:	5 The transit vehicle shall send the transit vehicle trip monitoring data to center-based trip monitoring functions.	Planned
Functional Area: **On-board Schedule Management** Collecting of data for schedule generation and adjustment on-board a transit vehicle. Supports communication between the vehicle, operator, and center.		
Requirement:	1 The transit vehicle shall receive a vehicle assignment including transit route information, transit service instructions, traffic information, road conditions, and other information for the operator.	Existing
Requirement:	2 The transit vehicle shall use the route information and its current location to determine the deviation from the predetermined schedule.	Planned
Requirement:	3 The transit vehicle shall calculate the estimated times of arrival (ETA) at transit stops.	Existing
Requirement:	4 The transit vehicle shall determine scenarios to correct the schedule deviation.	Existing
Requirement:	5 The transit vehicle shall provide the schedule deviations and instructions for schedule corrections to the transit vehicle operator if the deviation is small, or the transit vehicle is operating in an urban area.	Planned
Requirement:	6 The transit vehicle shall send the schedule deviation and estimated arrival time information to the center.	Planned
Requirement:	7 The transit vehicle shall support the operations of a flexible route service. This may include requests for route deviations that would then lead to schedule corrective actions.	Planned
Functional Area: **On-board Paratransit Operations** On-board systems to manage paratransit and flexible-route dispatch requests, including multi-stop runs. Passenger data is collected and provided to the center.		
Requirement:	1 The transit vehicle shall manage data input to sensor(s) on-board a transit vehicle to determine the vehicle's availability for use in demand responsive and flexible-route transit services based on identity, type, and passenger capacity.	Planned
Requirement:	2 The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Planned
Requirement:	3 The transit vehicle shall provide the transit vehicle operator instructions about the demand responsive or flexible-route transit schedule that has been confirmed from the center.	Planned

Architecture		Status
Orange County (Region)		(Region)
Element: **Transit Vehicle Subsystems - OCTA**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Paratransit Operations** On-board systems to manage paratransit and flexible-route dispatch requests, including multi-stop runs. Passenger data is collected and provided to the center.		
Requirement:	4 The transit vehicle shall provide the capability to log passenger boardings and alightings and make passenger use data available to the transit center.	Planned
Functional Area: **On-board Transit Fare Management** On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.		
Requirement:	1 The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing
Requirement:	4 The transit vehicle shall calculate the traveler's fare based on the origin and destination provided by the traveler as well as factors such as the transit routing, transit fare category, traveler history, and route-specific information.	Existing
Requirement:	5 The transit vehicle shall have access to the complete range of transit services (routes and schedules) that are available to the traveler.	Planned
Requirement:	6 The transit vehicle shall provide a transit fare payment interface that is suitable for travelers with physical disabilities.	Existing
Requirement:	7 The transit vehicle shall include a database on-board the transit vehicle for use in fare processing from which the fares for all possible trips within the transit operational network can be determined.	Planned
Requirement:	8 The transit vehicle shall support an emergency fare structure overriding all other fares that can be activated during disasters, states of emergency or evacuations.	Planned
Requirement:	9 The transit vehicle shall support the support advanced payments for tolls, and/or parking lot charges, and/or transit fares via the traveler card / payment instrument.	Planned
Requirement:	10 The transit vehicle shall provide fare statistics data to the center.	Existing
Functional Area: **On-board Passenger Counting** On-board systems collect transit vehicle loading data and make it available to the center.		
Requirement:	1 The transit vehicle shall count passengers boarding and alighting.	Existing
Requirement:	2 The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops.	Planned
Requirement:	3 The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	Planned
Requirement:	4 The transit vehicle shall send the collected passenger count information to the transit center.	Future
Functional Area: **On-board Transit Security**		

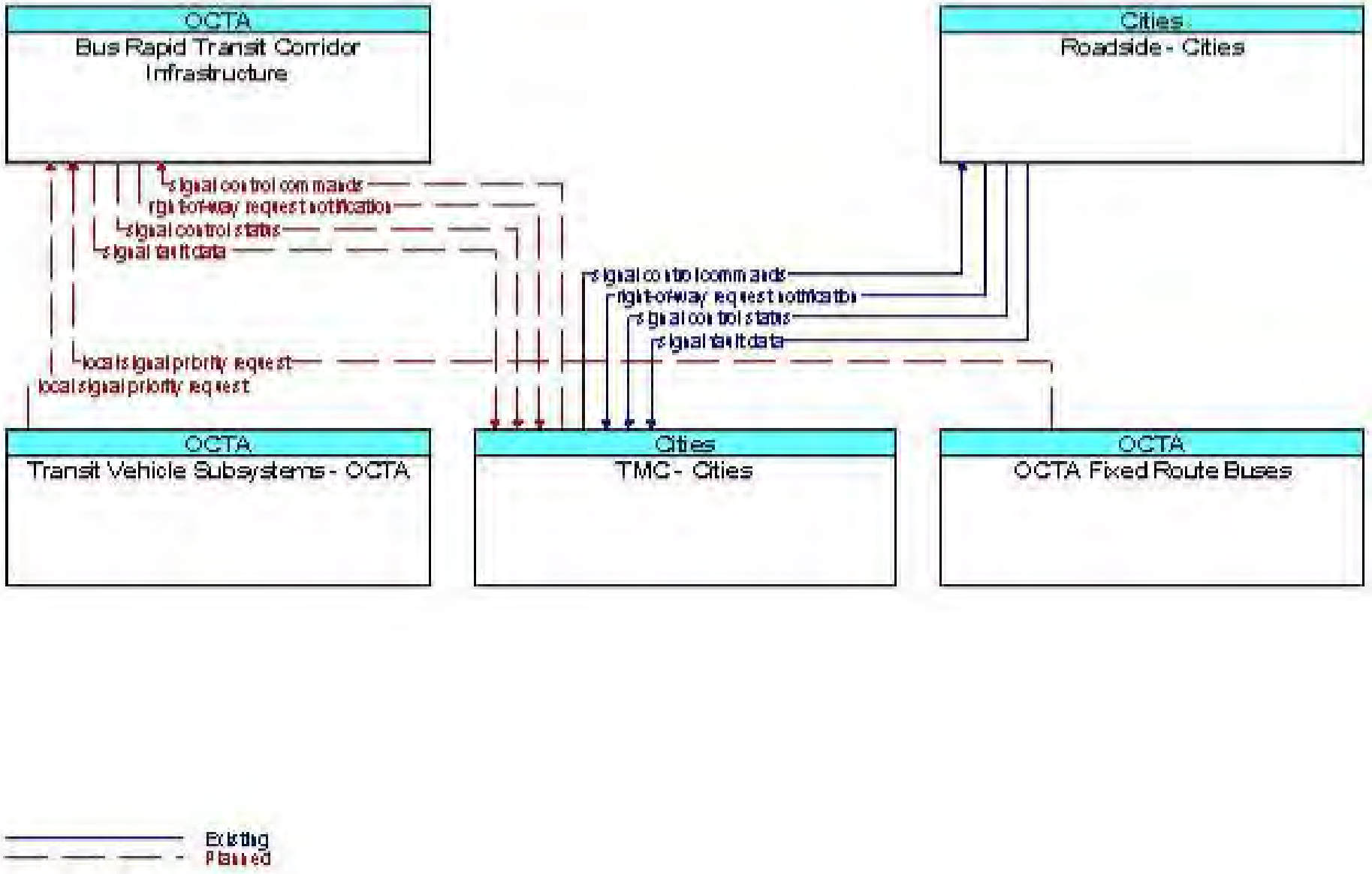
Architecture		Status
Orange County (Region)		(Region)
Element: **Transit Vehicle Subsystems - OCTA**		
Entity: **Transit Vehicle**		
Functional Area: **On-board Transit Security** On-board video/audio surveillance systems, threat sensors, and object detection sensors to enhance security and safety on-board a transit vehicles. Also includes silent alarms activated by transit user or vehicle operator, operator authentication, and remote vehicle disabling.		
Requirement:	1 The transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).	Planned
Requirement:	2 The transit vehicle shall perform local monitoring of video or audio surveillance data collected inside of transit vehicles, and identify potential incidents or threats based on received processing parameters.	Planned
Requirement:	3 The transit vehicle shall output an indication of potential incidents or threats and the processed video or audio information to the center along with the vehicle's current location.	Planned
Functional Area: **On-board Maintenance** On-board systems to collect and process transit vehicle maintenance data including mileage and vehicle operating conditions for use in scheduling future vehicle maintenance.		
Requirement:	[Not Defined]	
Functional Area: **On-board Transit Signal Priority** On-board systems request signal priority through short range communication directly with traffic control equipment at the roadside (intersections, ramps, interchanges, etc.).		
Requirement:	1 The transit vehicle shall determine the schedule deviation and estimated times of arrival (ETA) at transit stops.	Future
Requirement:	2 The transit vehicle shall send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.	Future
Requirement:	3 The transit vehicle shall send the schedule deviation data and status of priority requests to the transit vehicle operator and provide the capability for the transit vehicle operator to control the priority system.	Future
Requirement:	4 The transit vehicle shall prevent a priority request from being sent when the transit vehicle cannot use the priority (e.g., when the transit vehicle makes a passenger stop on the approach to an intersection).	Future
Element: **Weigh-in-Motion Sites**		
Entity: **Commercial Vehicle Check**		
Functional Area: **Roadside WIM** Roadside check facility equipment to detect and measure the weight commercial vehicles at high speed. Can include an interface to the credential checking or it can be a stand alone package with display.		

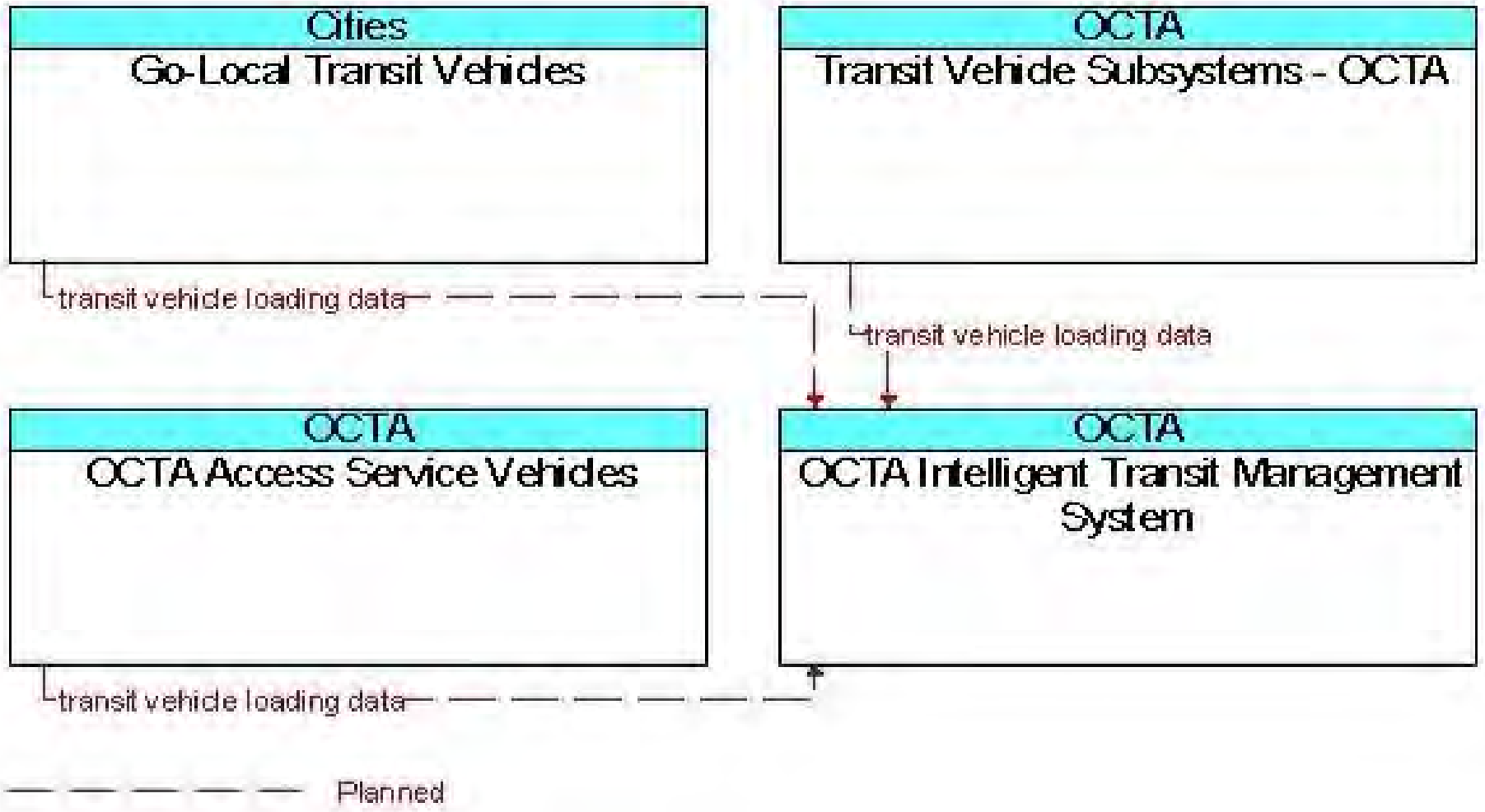
Architecture		Status
Orange County (Region)		(Region)
Element: **Weigh-in-Motion Sites**		
Entity: **Commercial Vehicle Check**		
Functional Area:	**Roadside WIM** Roadside check facility equipment to detect and measure the weight commercial vehicles at high speed. Can include an interface to the credential checking or it can be a stand alone package with display.	
Requirement:	1 The roadside check facility equipment shall detect the presence of commercial vehicles and freight equipment approaching a facility. Sensors can differentiate between different types of vehicles and determine the number of axles, gross vehicle weight, weight per axle, and the identification of the vehicle and its cargo.	Existing
Requirement:	2 The roadside check facility equipment shall request and input electronic screening data from the commercial vehicle's electronic tag data.	Existing
Requirement:	3 The roadside check facility equipment shall send a pass/pull-in notification to the commercial vehicle and its driver based on the information received from the vehicle and the measurements taken. The message may be sent to the on-board equipment in the commercial vehicle or transmitted to the driver using equipment such as dynamic message signs, red-green lights, flashing signs, etc.	Existing

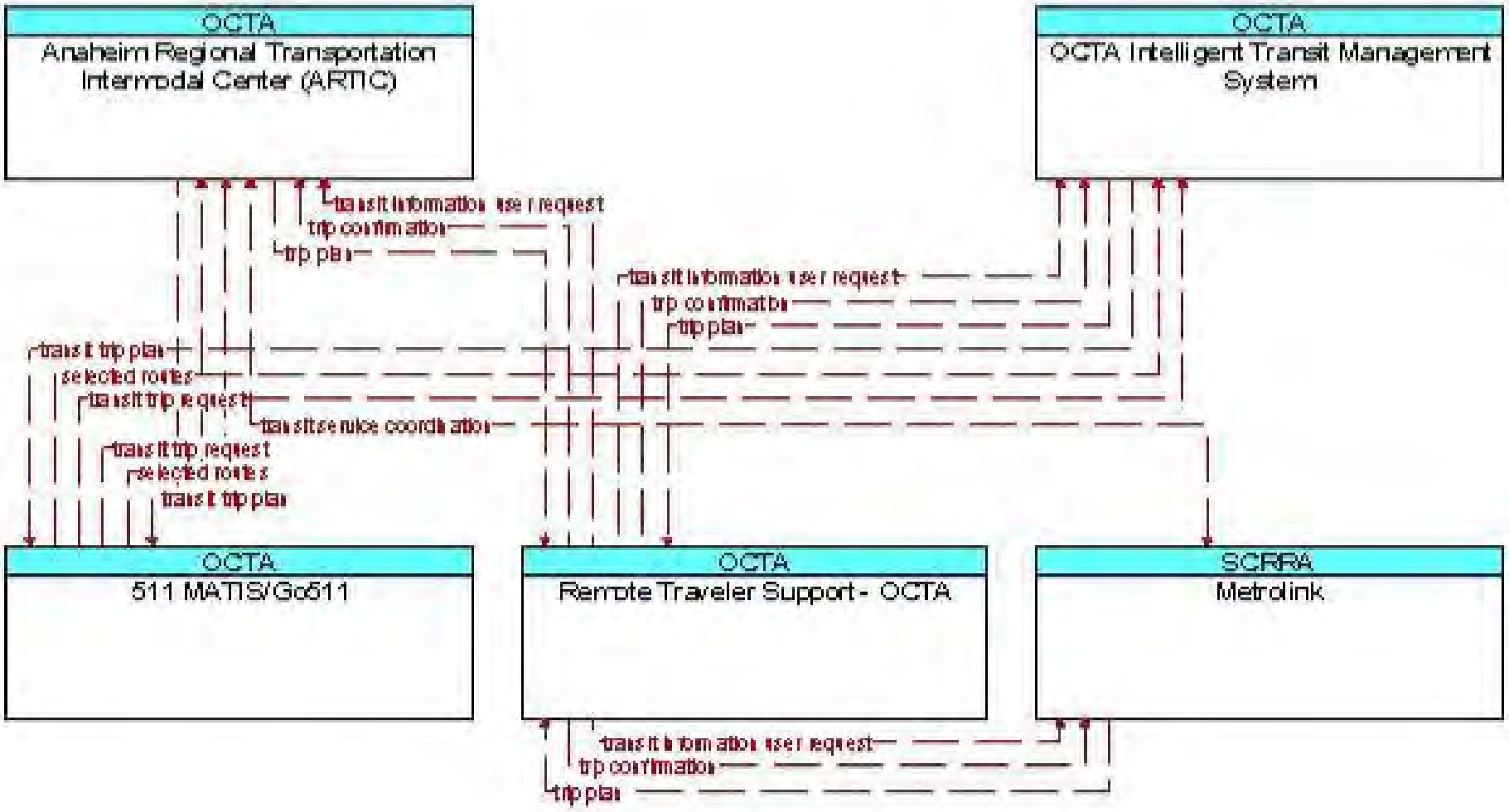
Status Value Legend

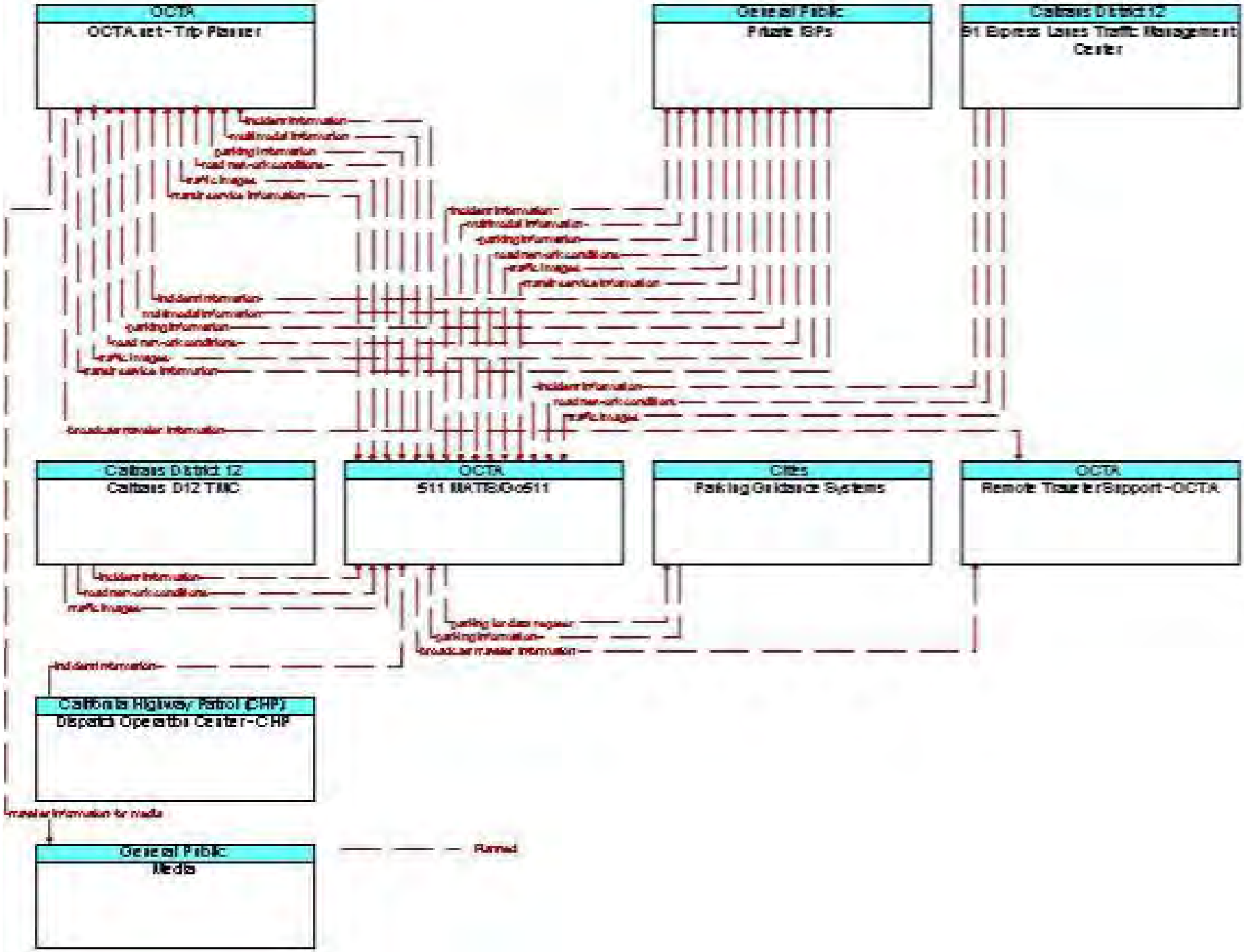
Name	Description
Existing	
Planned	
Future	
Not Planned	

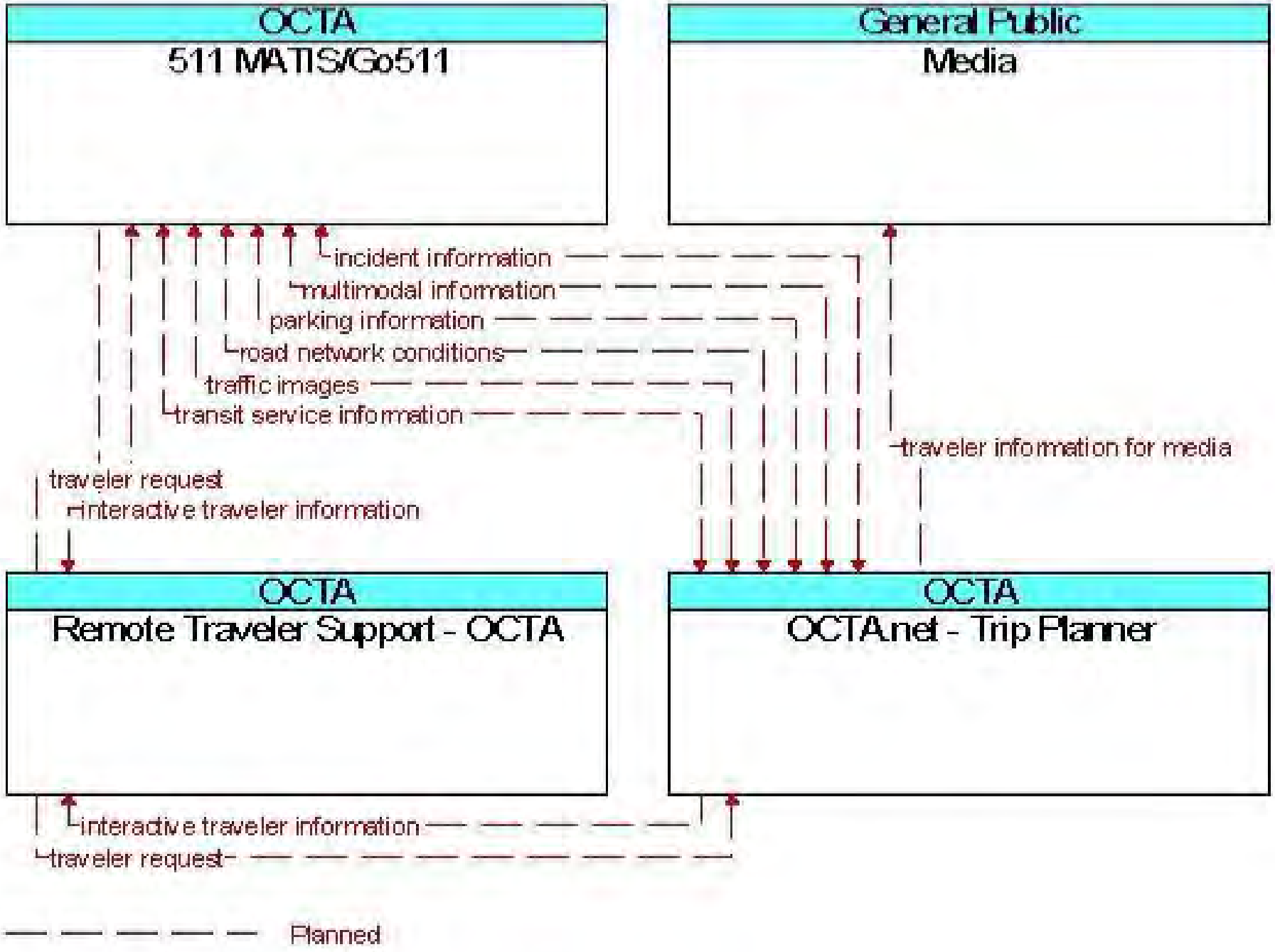
Appendix D: Regional ITS Architecture – Service Package Diagrams

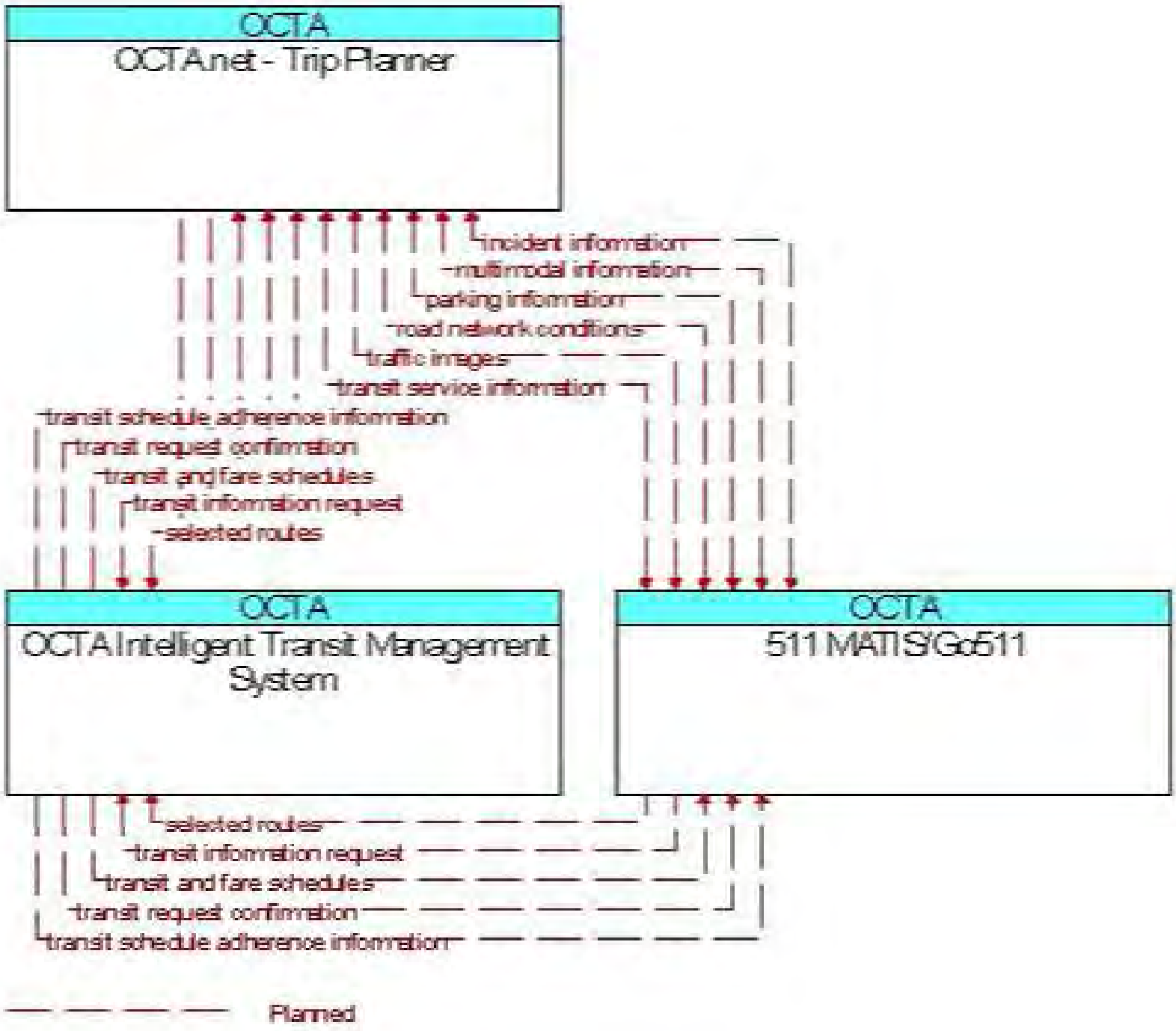

OCTA
Bus Rapid Transit Corridor Infrastructure
Cities
Roadside - Cities
signal control commands
right-of-way request notification
signal control status
signal fault data
signal control commands
right-of-way request notification
signal control status
signal fault data
local signal priority request
local signal priority request
OCTA
Transit Vehicle Subsystems - OCTA
Cities
TMC - Cities
OCTA
OCTA Fixed Route Buses
Existing
Planned

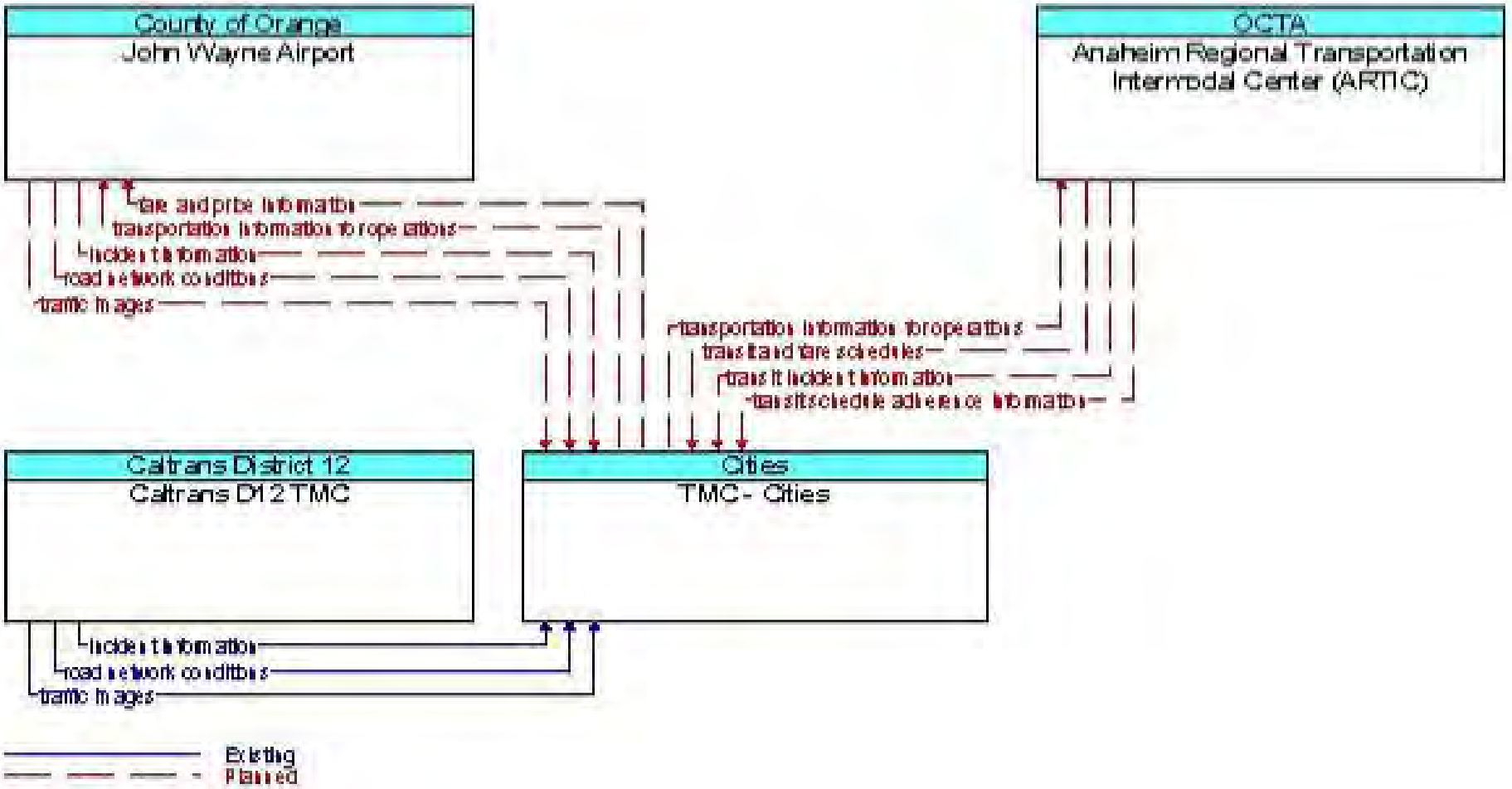

Cities
Go-Local Transit Vehicles
OCTA
Transit Vehicle Subsystems - OCTA
transit vehicle loading data
transit vehicle loading data
OCTA
OCTA Access Service Vehicles
OCTA
OCTA Intelligent Transit Management System
transit vehicle loading data
Planned

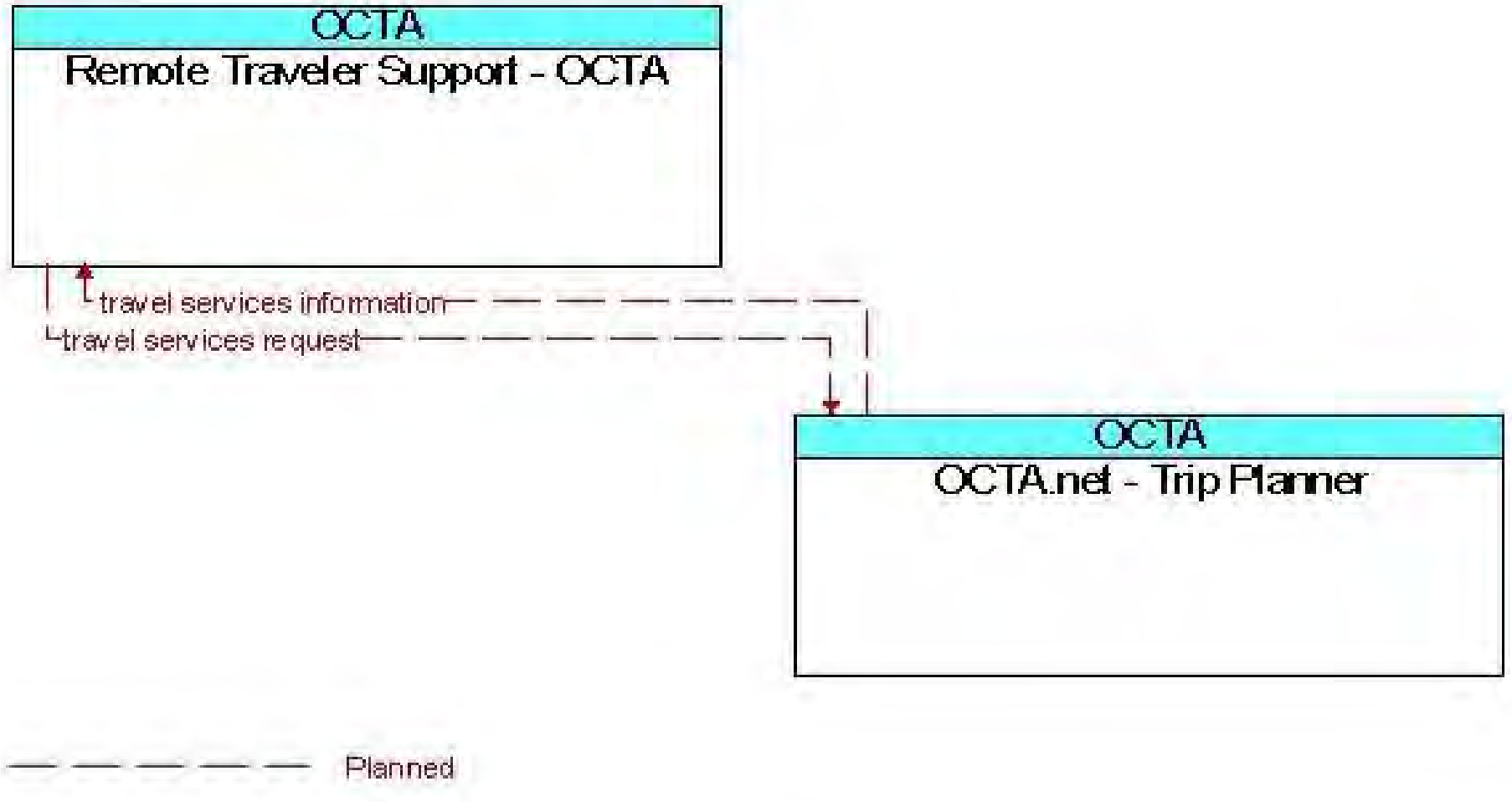

OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
OCTA
OCTA Intelligent Transit Management System
transit information user request
trip confirmation
trip plan
transit information user request
trip confirmation
trip plan
transit trip plan
selected routes
transit trip request
transit service coordination
transit trip request
selected routes
transit trip plan
OCTA
511 MATIS/Go511
OCTA
Remote Traveler Support - OCTA
SCRRA
Metrolink
transit information user request
trip confirmation
trip plan
Planned


OCTA
OCTA iet-Trip Planner
General Public
Private ISPs
Caltrans District 12
91 Express Lanes Traffic Management Center
Caltrans District 12
Caltrans D12 TMC
OCTA
511 IMTIS/Go511
Cities
Parking Guidance Systems
OCTA
Remote TravelerSupport-OCTA
California Highway Patrol (CHP)
Dispatch Operation Center-CHP
General Public
Media
Planned


OCTA
511 MATIS/Go511
General Public
Media
incident information
multimodal information
parking information
road network conditions
traffic images
transit service information
traveler information for media
traveler request
interactive traveler information
OCTA
Remote Traveler Support - OCTA
OCTA
OCTAnet - Trip Planner
interactive traveler information
traveler request
Planned


OCTA
OCTAnet - Trip Planner
incident information
multimodal information
parking information
road network conditions
traffic images
transit service information
transit schedule adherence information
transit request confirmation
transit and fare schedules
transit information request
selected routes
OCTA
OCTA Intelligent Transit Management System
OCTA
511 MATISGo511
selected routes
transit information request
transit and fare schedules
transit request confirmation
transit schedule adherence information
Planned


County of Orange
John Wayne Airport
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
fare and price information
transportation information to operations
incident information
road network conditions
traffic images
transportation information to operations
transit and fare schedules
transit incident information
transit schedule adherence information
Caltrans District 12
Caltrans D12 TMC
Cities
TMC - Cities
incident information
road network conditions
traffic images
Existing
Planned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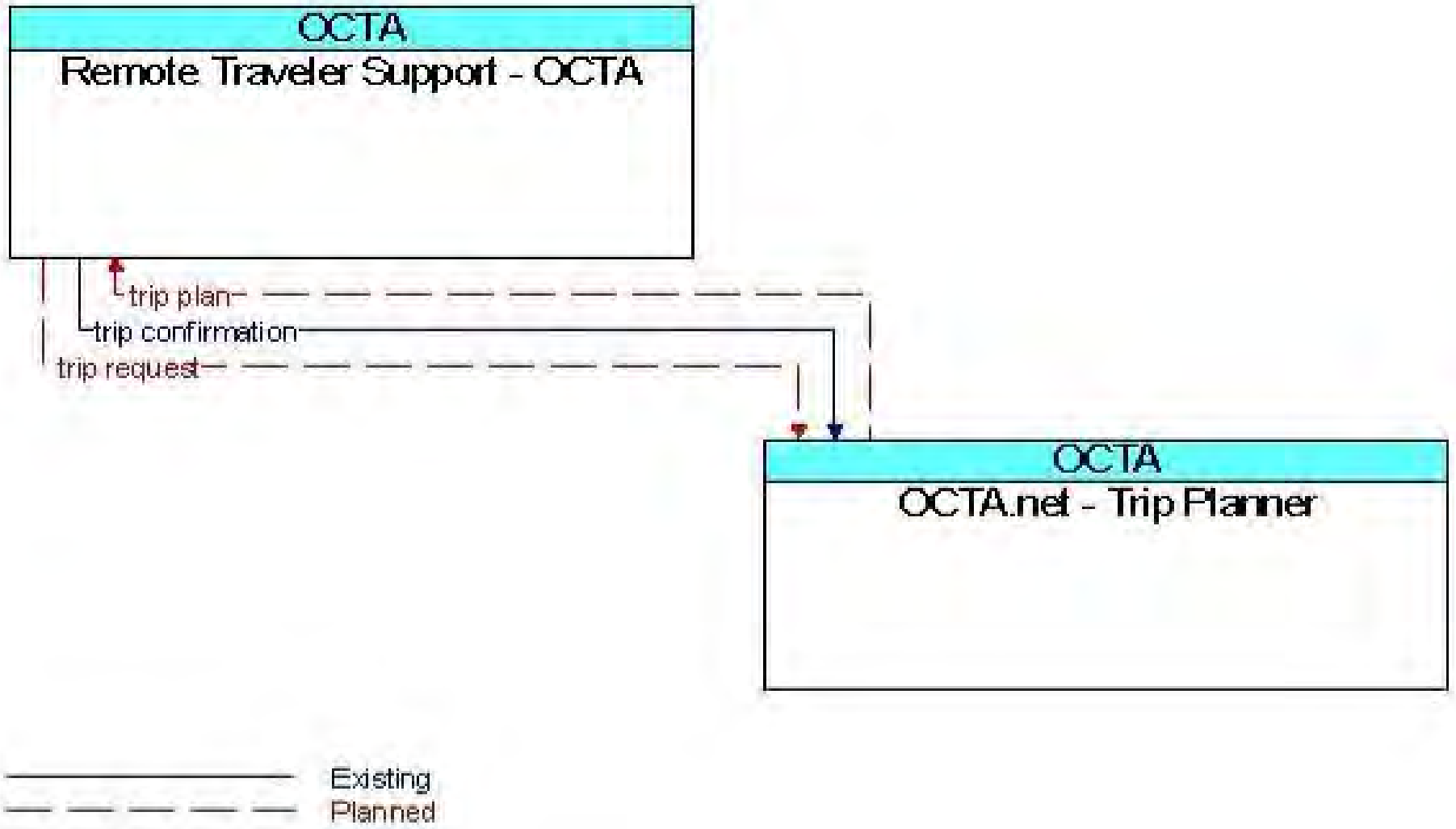
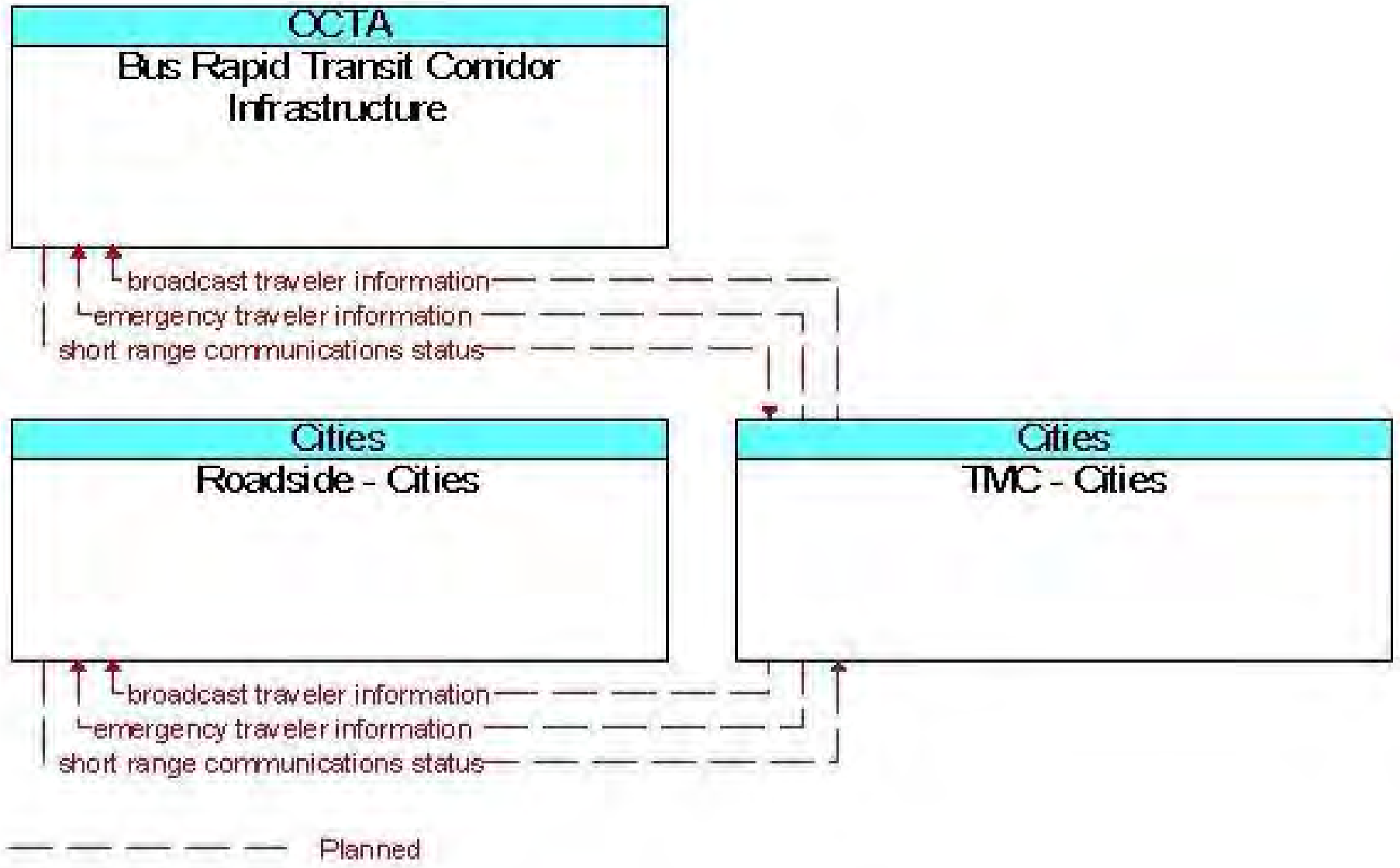
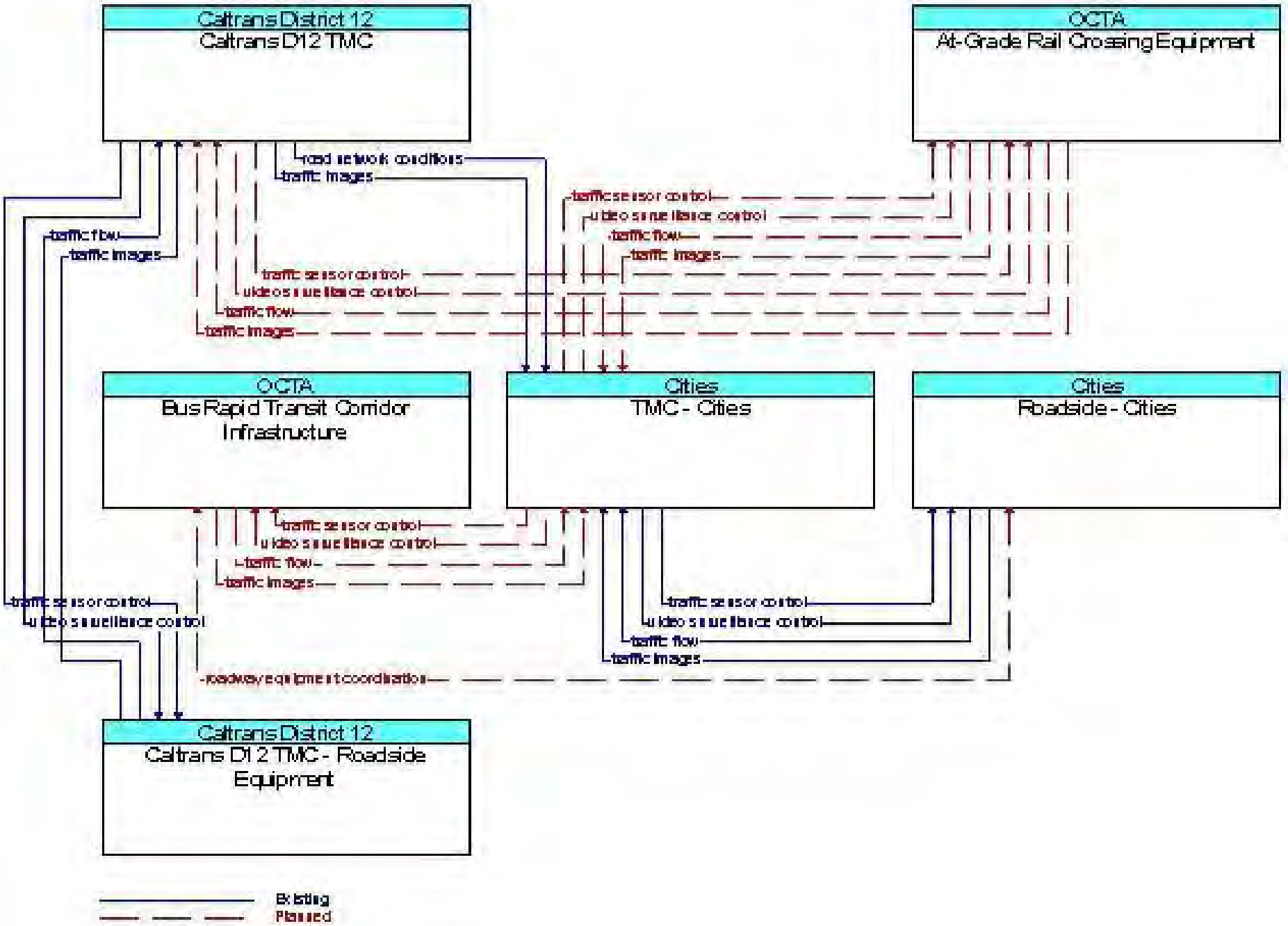
travel services information
travel services request
OCTA
OCTA.net - Trip Planner
Planned


OCTA
Remote Traveler Support - OCTA
trip plan
trip confirmation
trip request
OCTA
OCTA.net - Trip Planner
Existing
Planned


OCTA
Bus Rapid Transit Corridor Infrastructure
broadcast traveler information
emergency traveler information
short range communications status
Cities
Roadside - Cities
Cities
TMC - Cities
broadcast traveler information
emergency traveler information
short range communications status
Planned


Caltrans District 12
Caltrans D12 TMC
OCTA
At-Grade Rail Crossing Equipment
road network conditions
traffic images
traffic sensor control
video surveillance control
traffic flow
traffic images
traffic sensor control
video surveillance control
traffic flow
traffic images
traffic flow
traffic images
OCTA
Bus Rapid Transit Corridor Infrastructure
Cities
TMC - Cities
Cities
Roadside - Cities
traffic sensor control
video surveillance control
traffic flow
traffic images
traffic sensor control
video surveillance control
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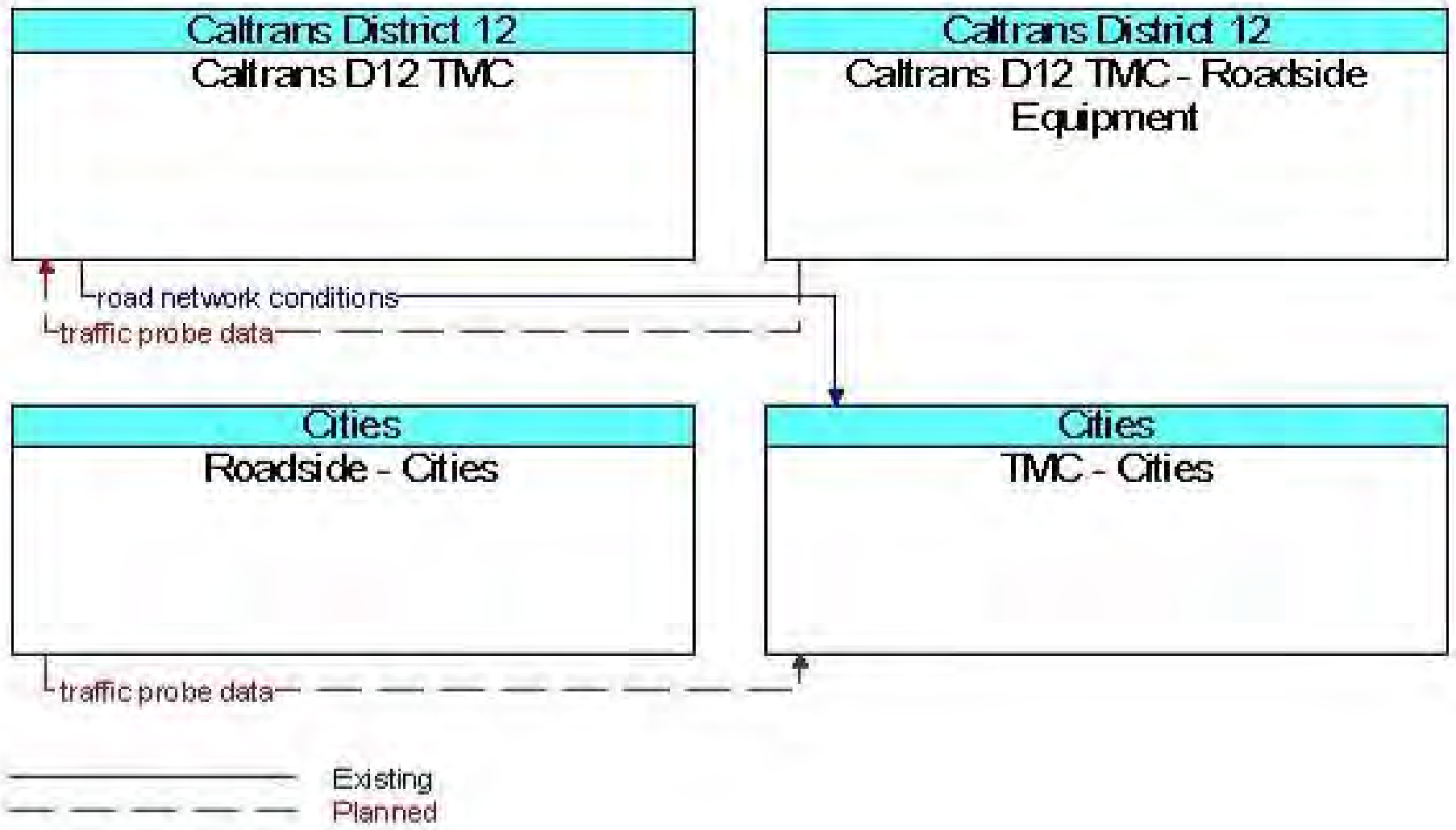
video surveillance control
traffic flow
traffic images
roadway equipment coordination
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing
Planned


Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
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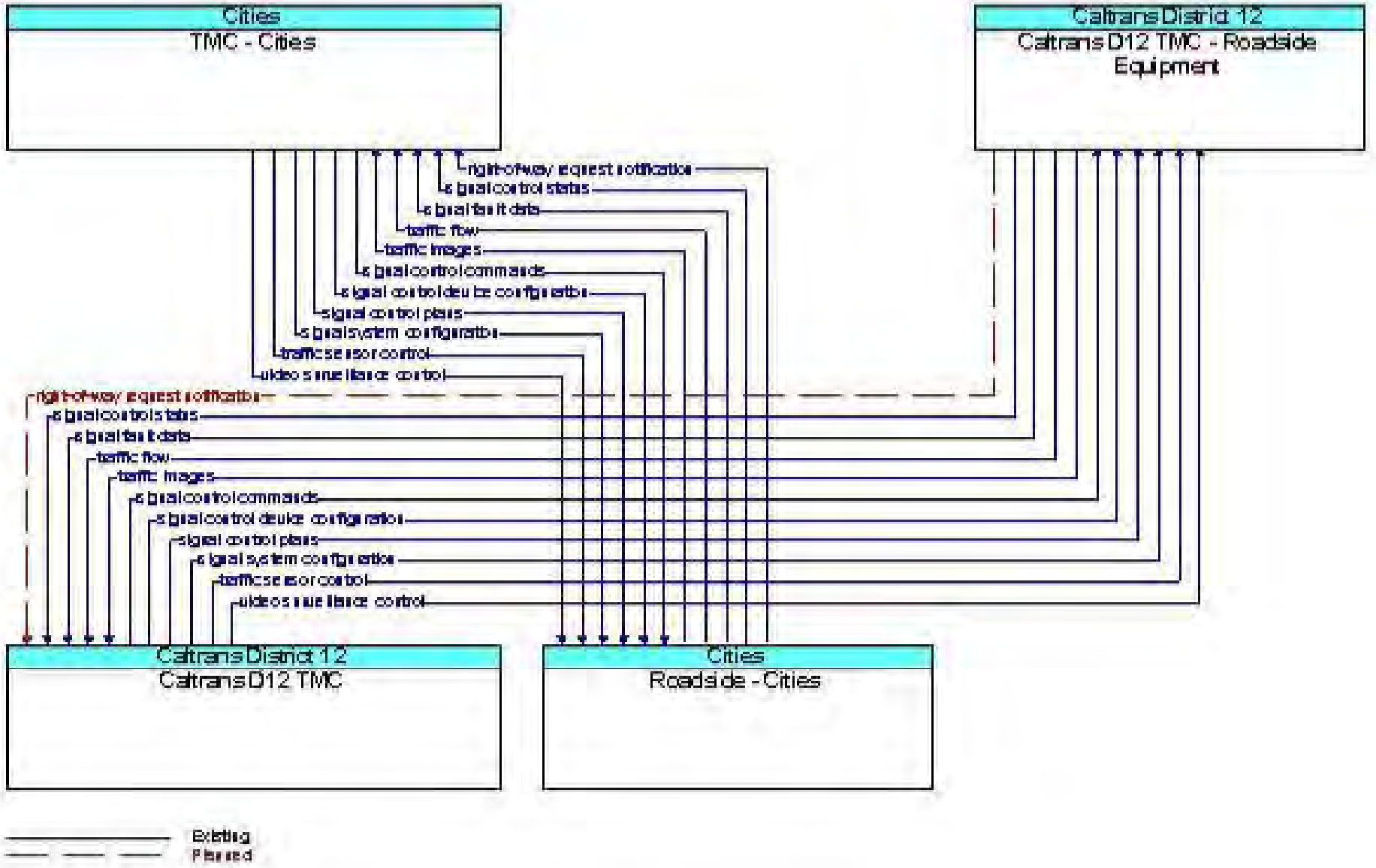
Roadside - Cities
Cities
TMC - Cities
traffic probe data
Existing
Planned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TMC - Cities
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
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signal control status
signal fault data
traffic flow
traffic images
signal control commands
signal control device configuration
signal control plans
signal system configuration
traffic sensor control
video surveillance control
right-of-way request notification
signal control status
signal fault data
traffic flow
traffic images
signal control commands
signal control device configuration
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signal system configuration
traffic sensor control
video surveillance control
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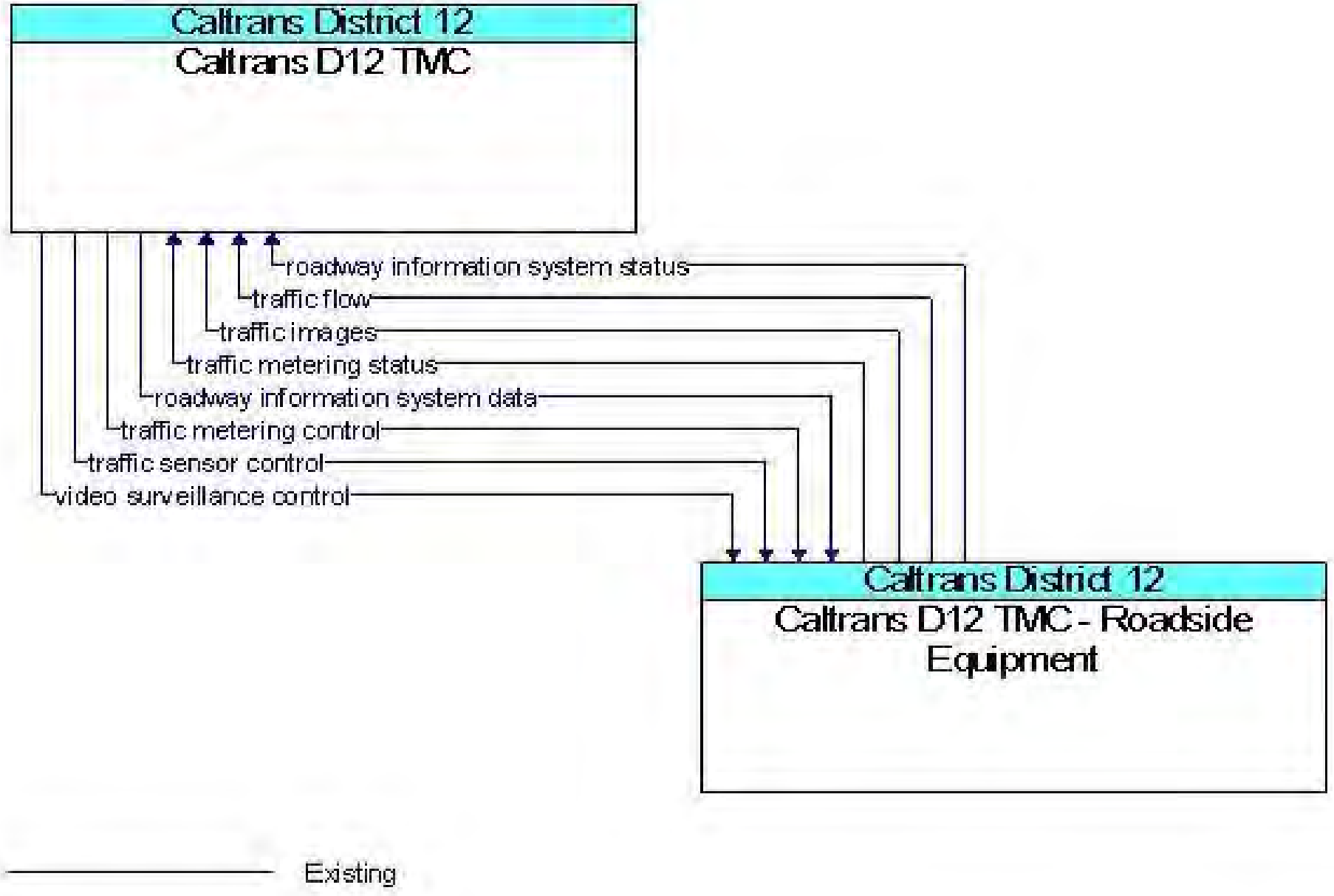
Cities
Roadside - Cities
Existing
Planned


Caltrans District 12
Caltrans D12 TMC
roadway information system status
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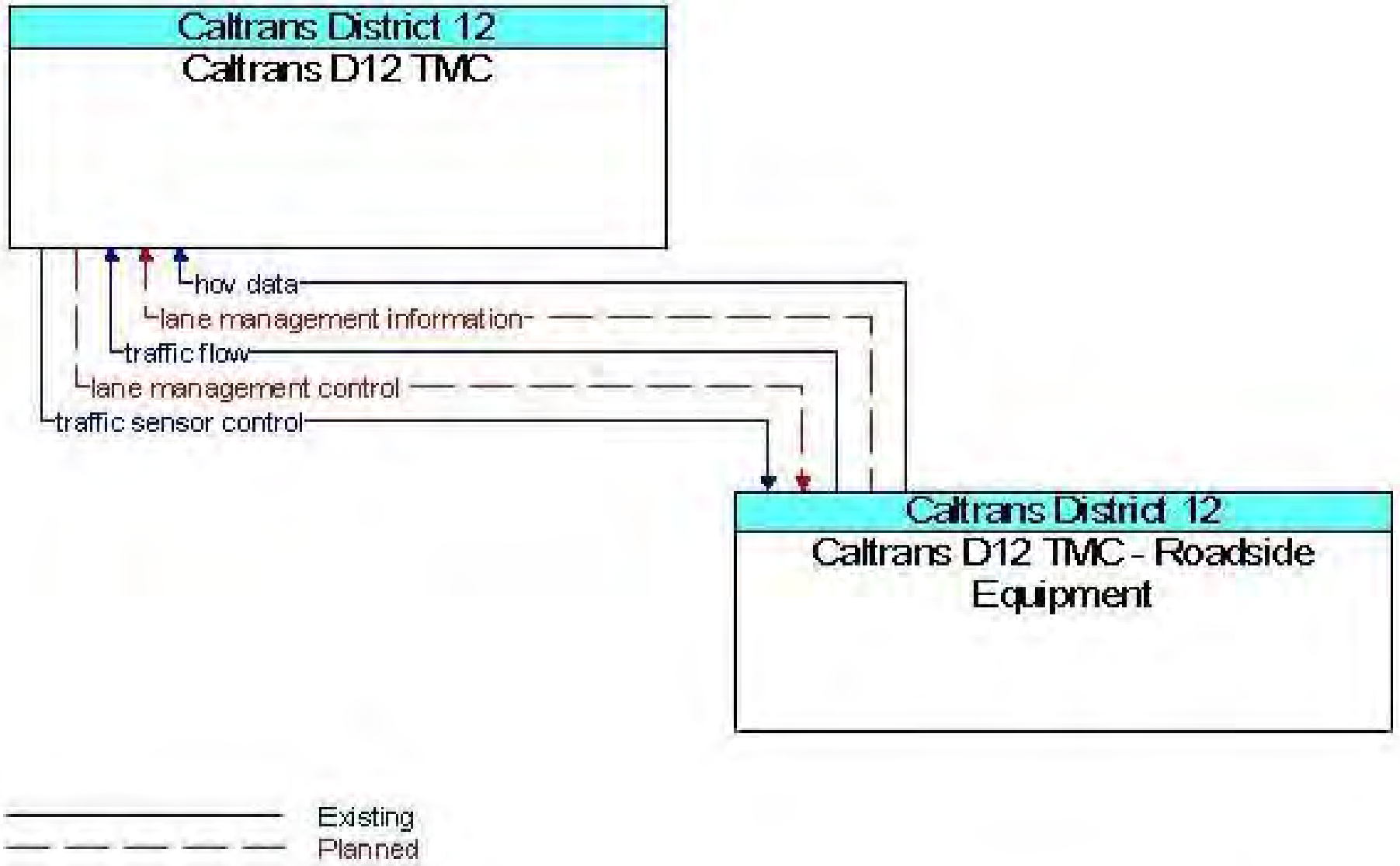
traffic images
traffic metering status
roadway information system data
traffic metering control
traffic sensor control
video surveillance control
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing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traffic flow
lane management control
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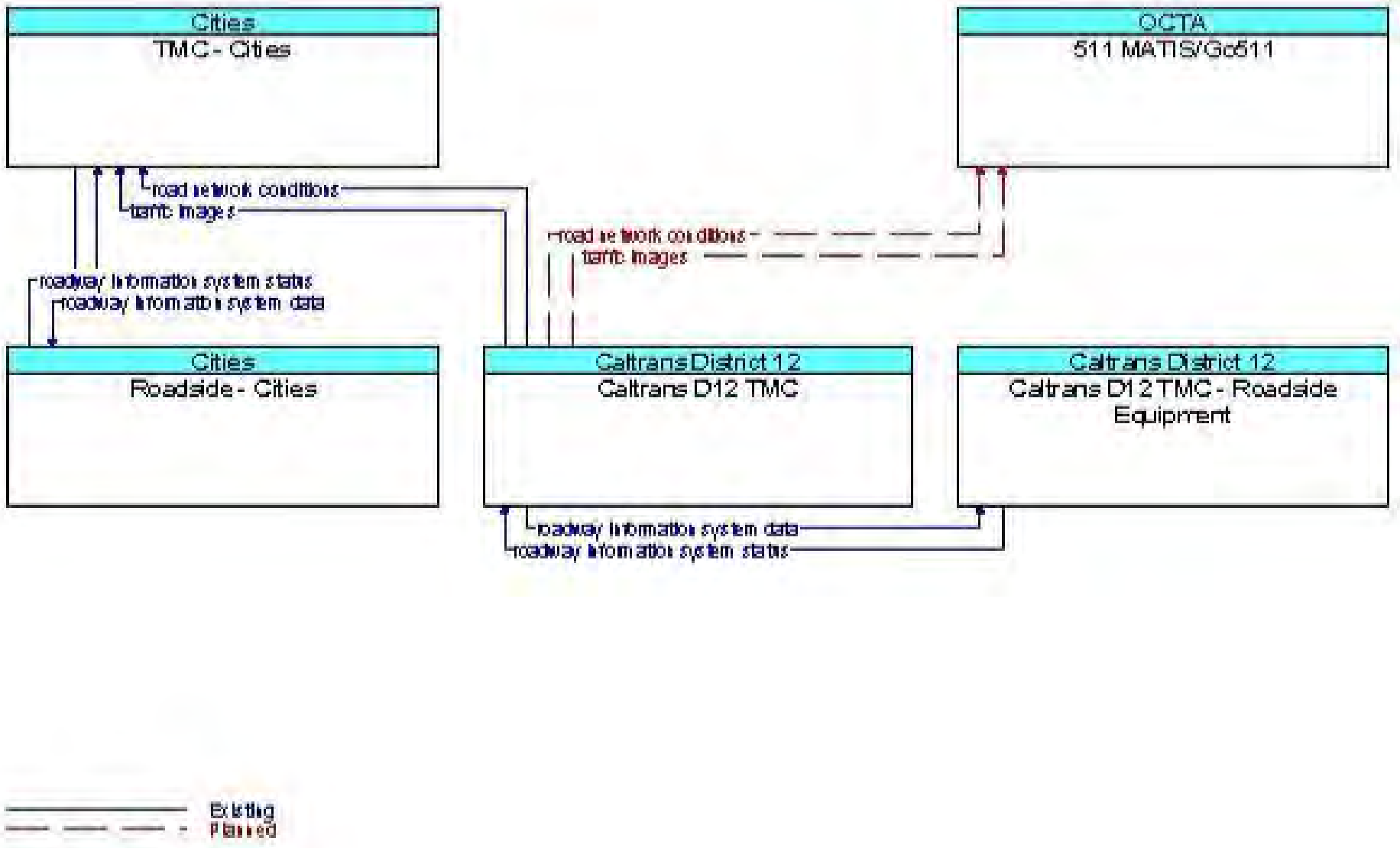
Existing
Planned


Cities
TMC - Cities
OCTA
511 MATIS/Go511
road network conditions
traffic images
road network conditions
traffic images
roadway information system status
roadway information system data
Cities
Roadside - Cities
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Caltrans D12 TMC
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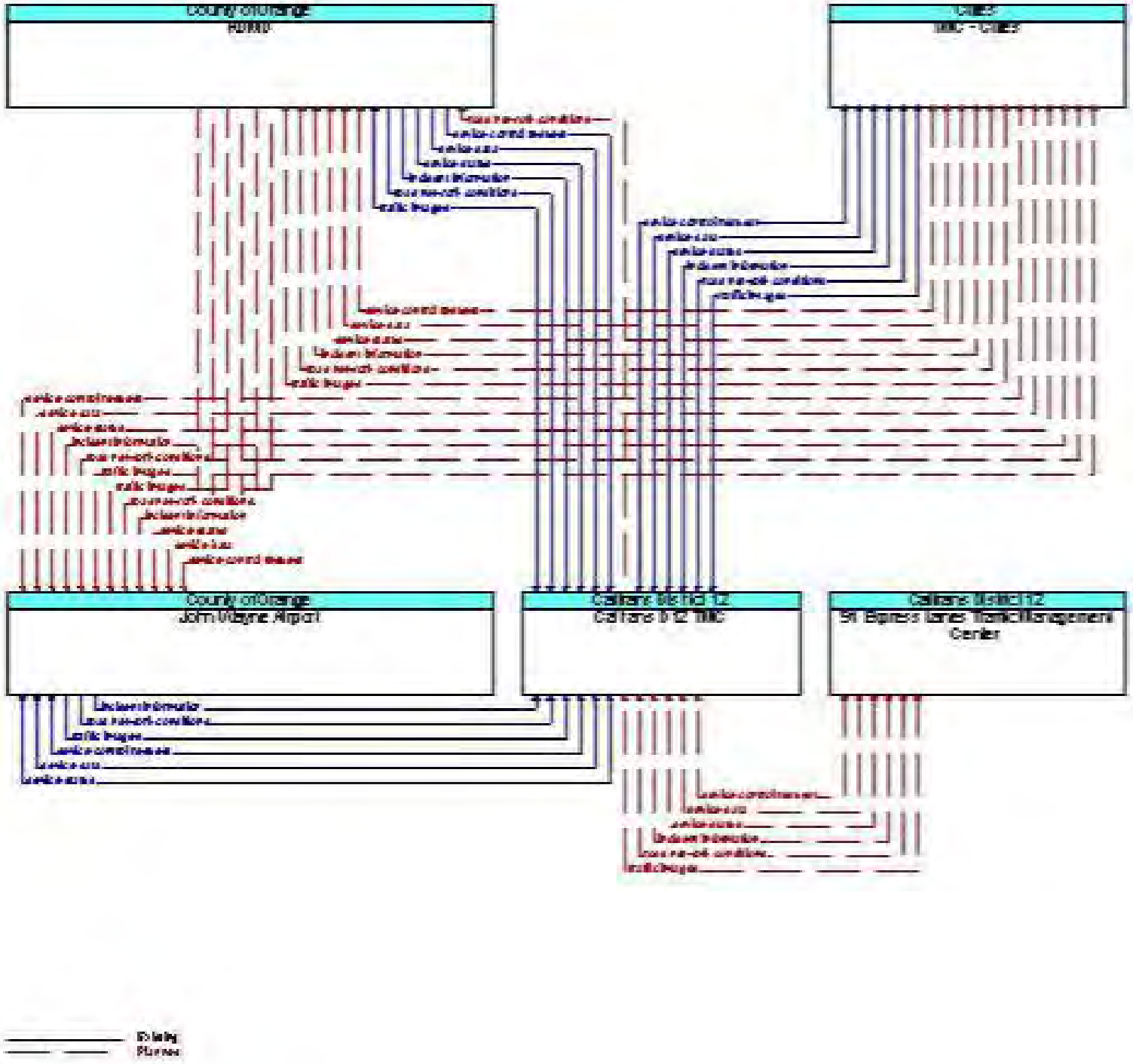
roadway information system data
roadway information system status
Existing
Planned


County of Orange
RCMS
Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
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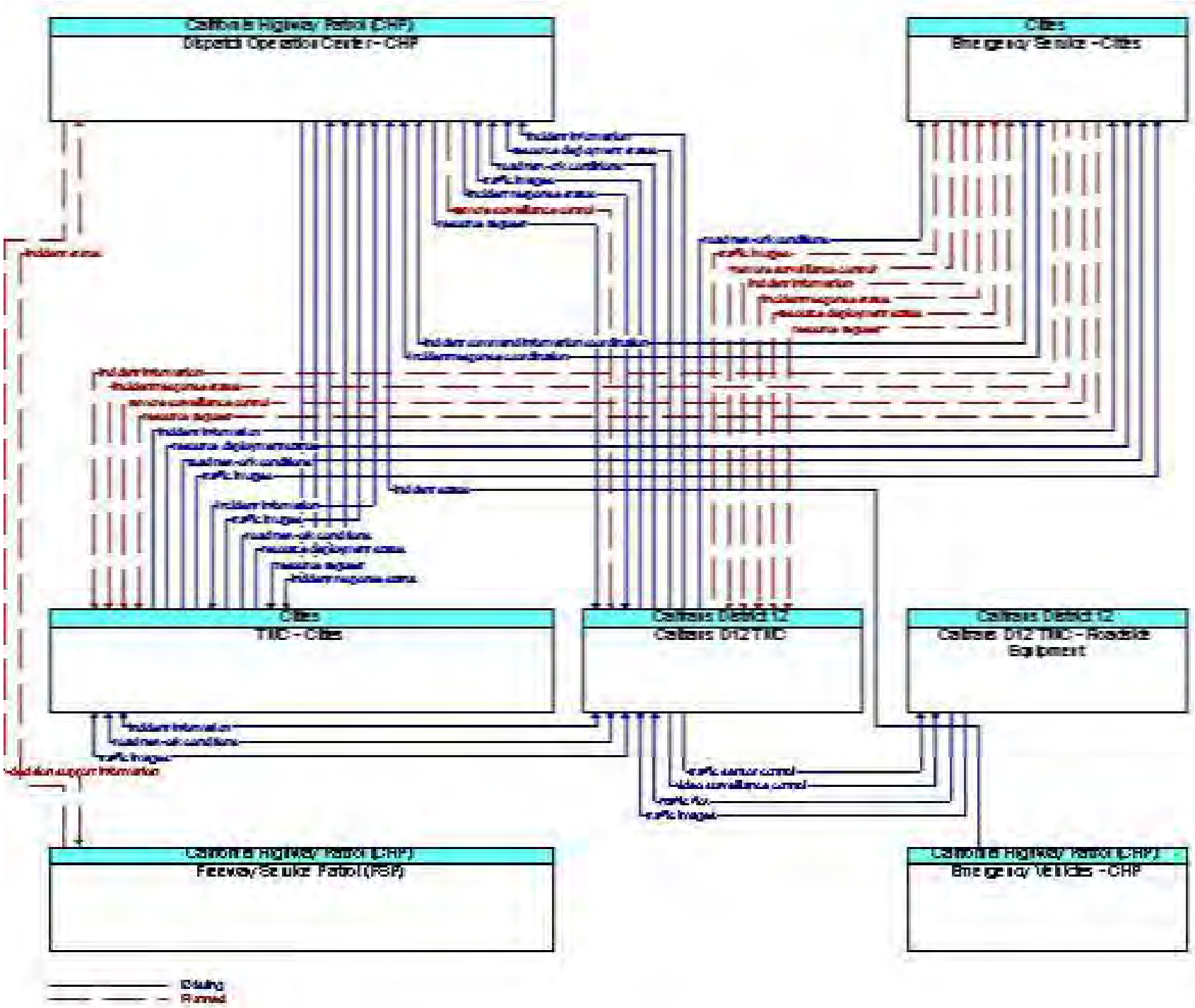
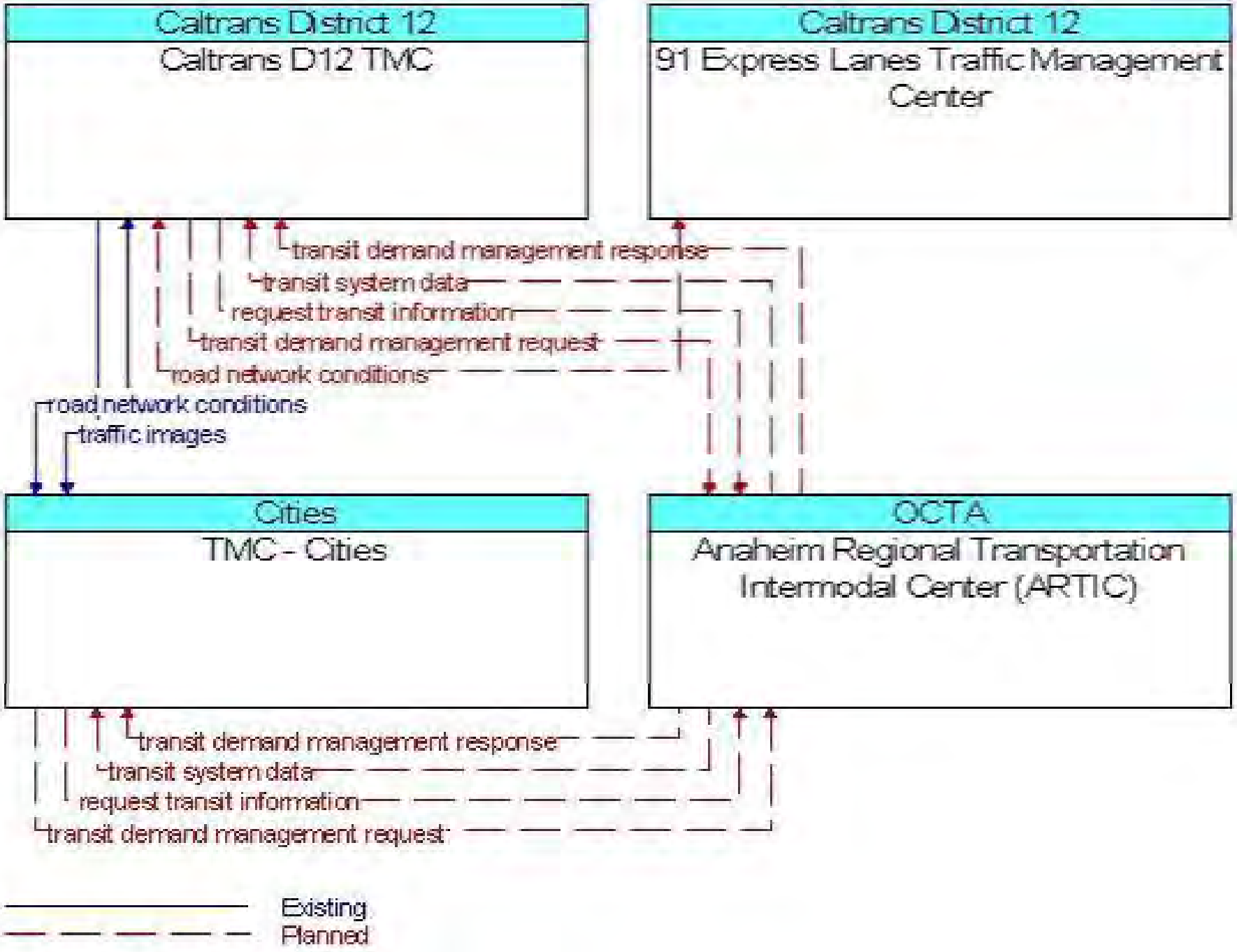
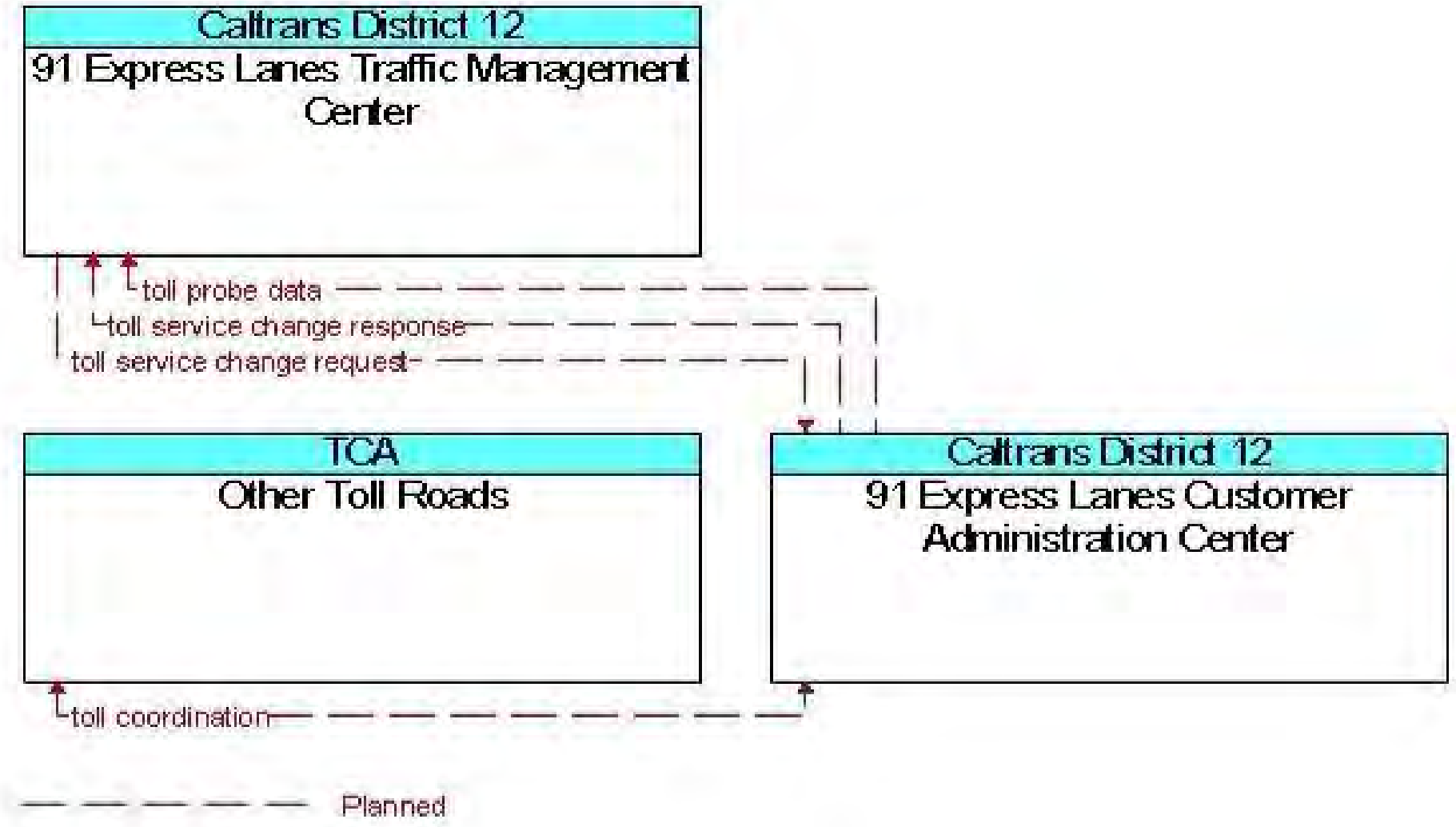
Existing
Planned


California Highway Patrol (CHP)
Dispatch Operations Center - CHP
Cities
Emergency Services - Cities
Cities
TOC - Cities
Caltrans District 12
Caltrans D12 TOC
Caltrans District 12
Caltrans D12 TOC - Roadside Equipment
California Highway Patrol (CHP)
Freeway Service Patrol (FSP)
California Highway Patrol (CHP)
Emergency Vehicles - CHP
Existing
Planned


Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
91 Express Lanes Traffic Management Center
transit demand management response
transit system data
request transit information
transit demand management request
road network conditions
road network conditions
traffic images
Cities
TMC - Cities
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
transit demand management response
transit system data
request transit information
transit demand management request
Existing
Planned


Caltrans District 12
91 Express Lanes Traffic Management Center
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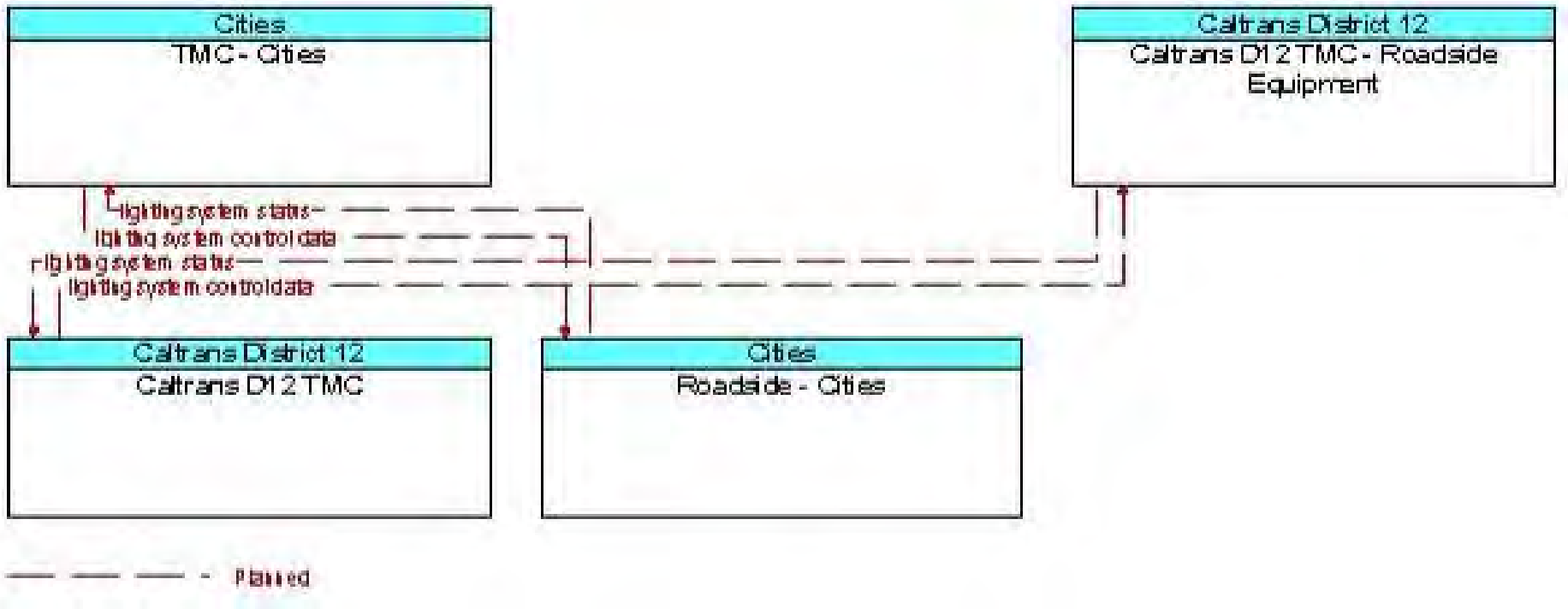
toll service change response
toll service change request
TCA
Other Toll Roads
Caltrans District 12
91 Express Lanes Customer Administration Center
toll coordination
Planned


Cities
TMC - Cities
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
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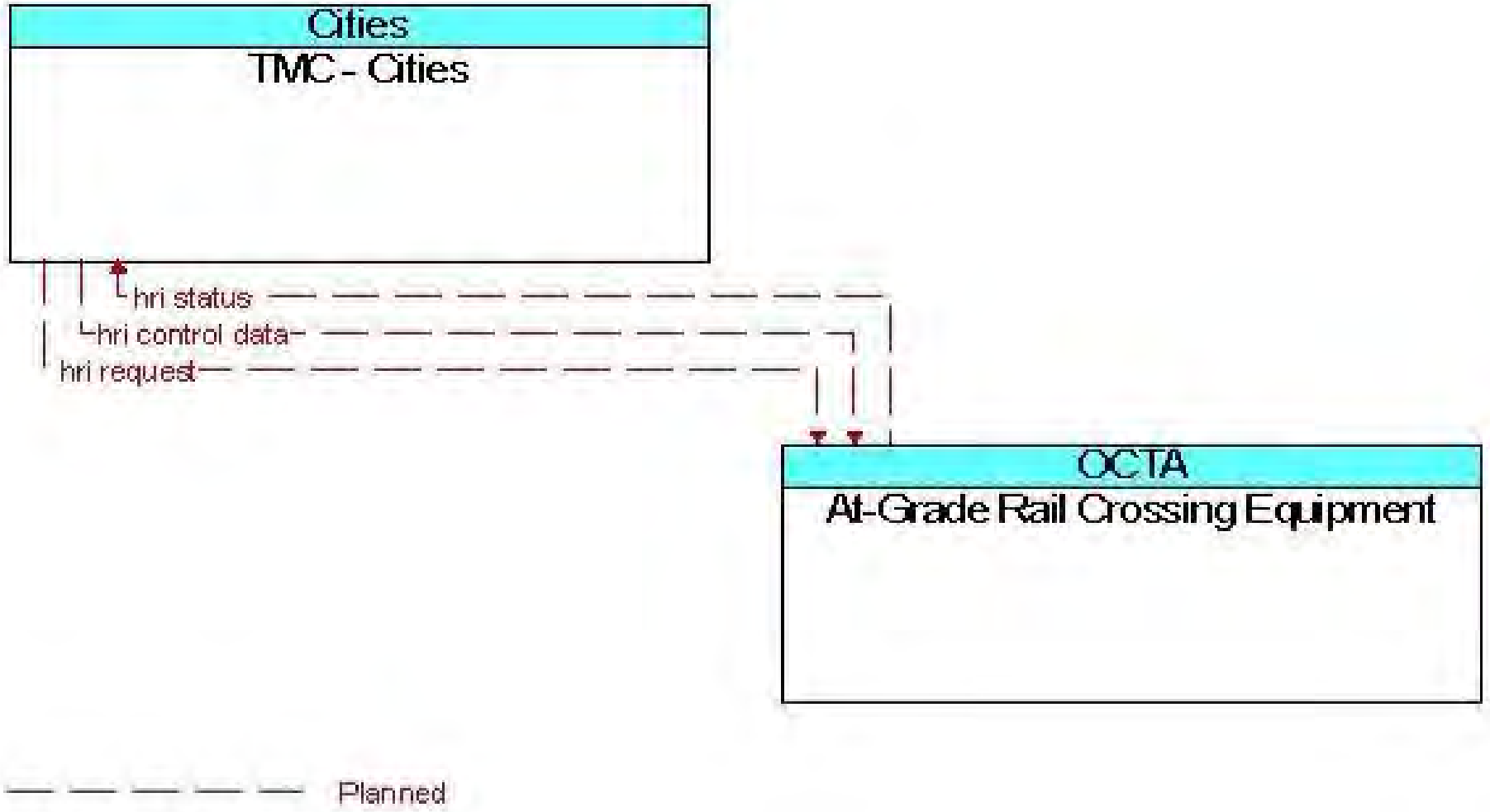
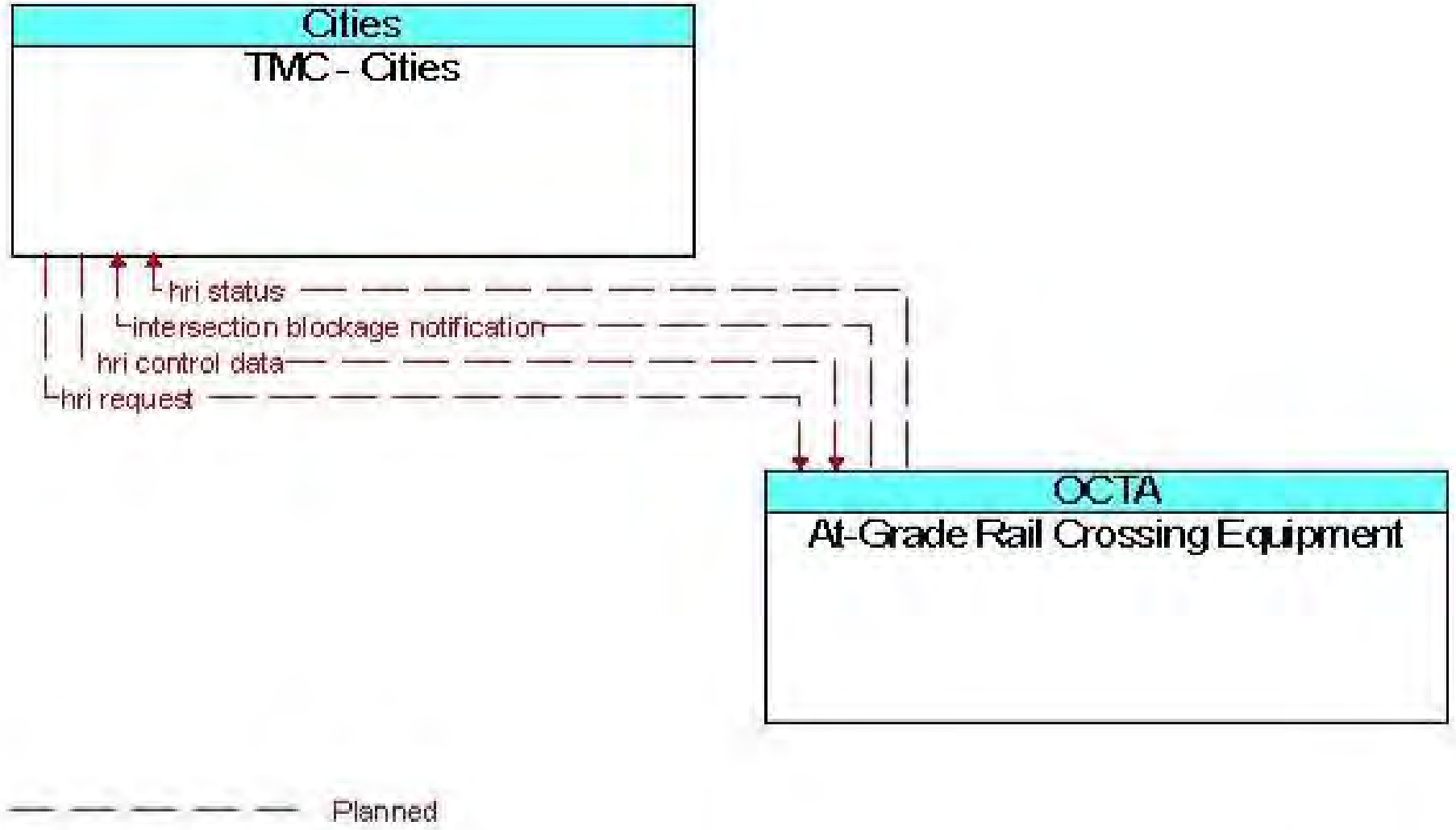
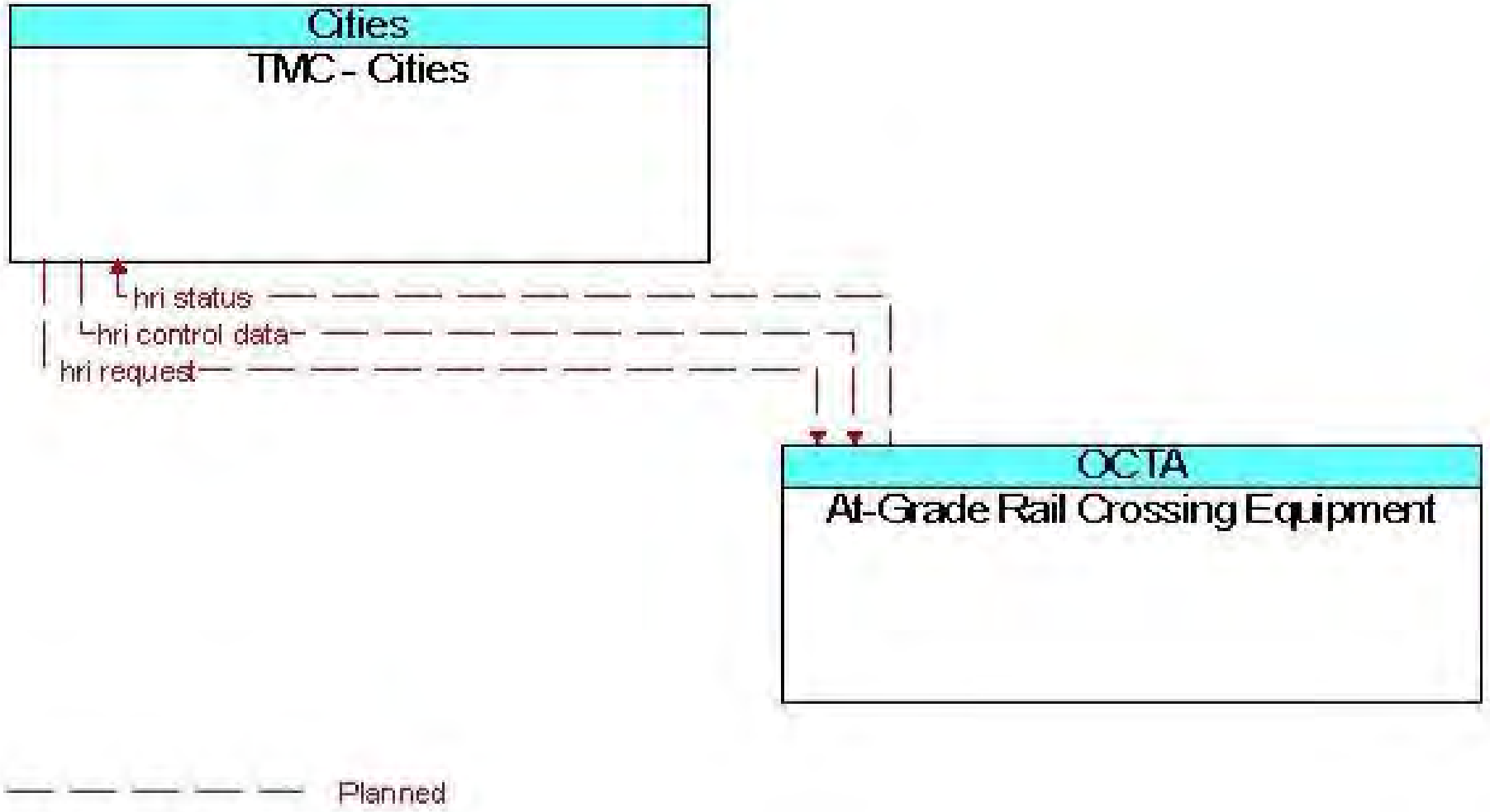
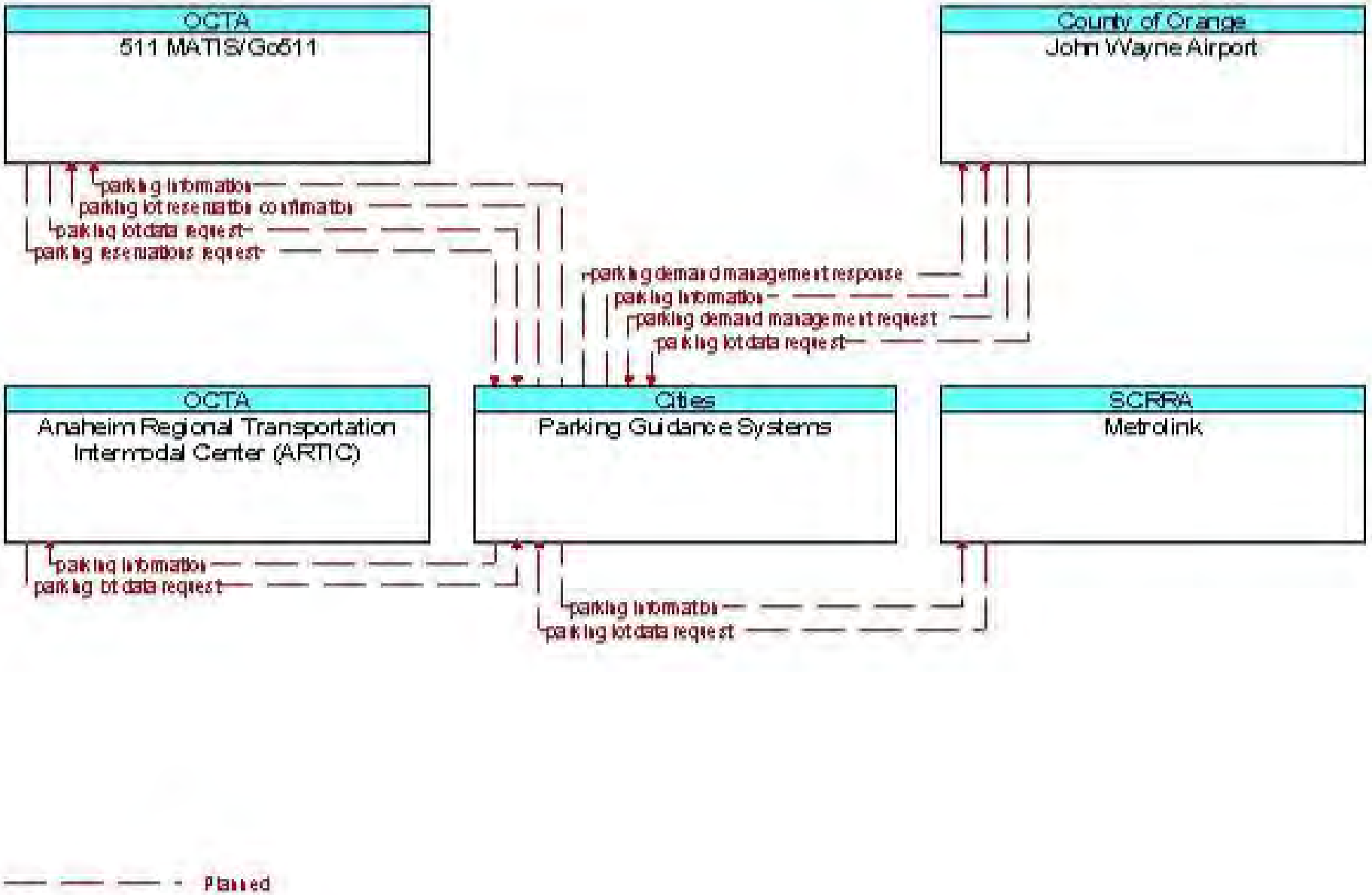
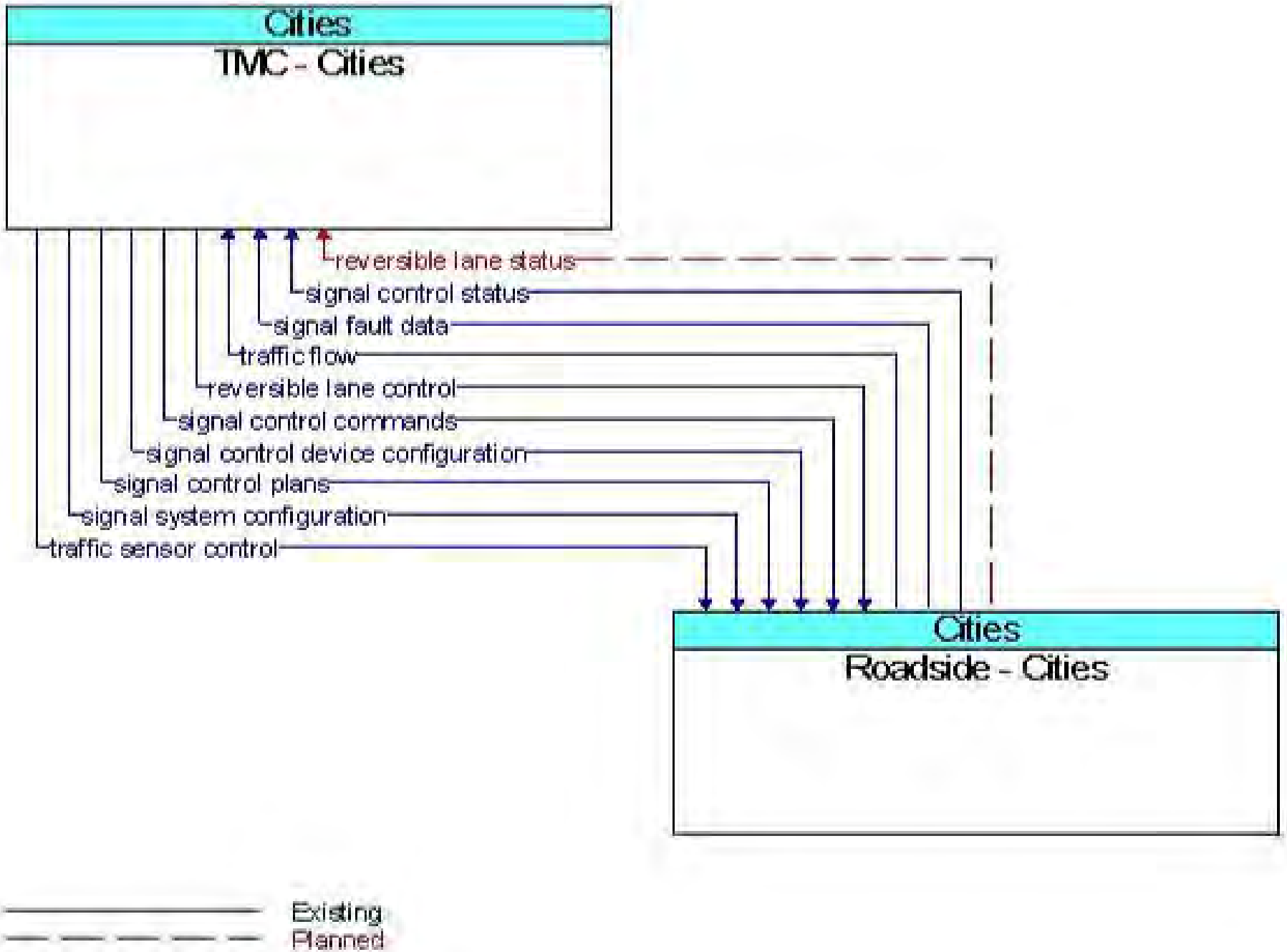
lighting system control data
lighting system status
lighting system control data
Caltrans District 12
Caltrans D12 TMC
Cities
Roadside - Cities
Planned

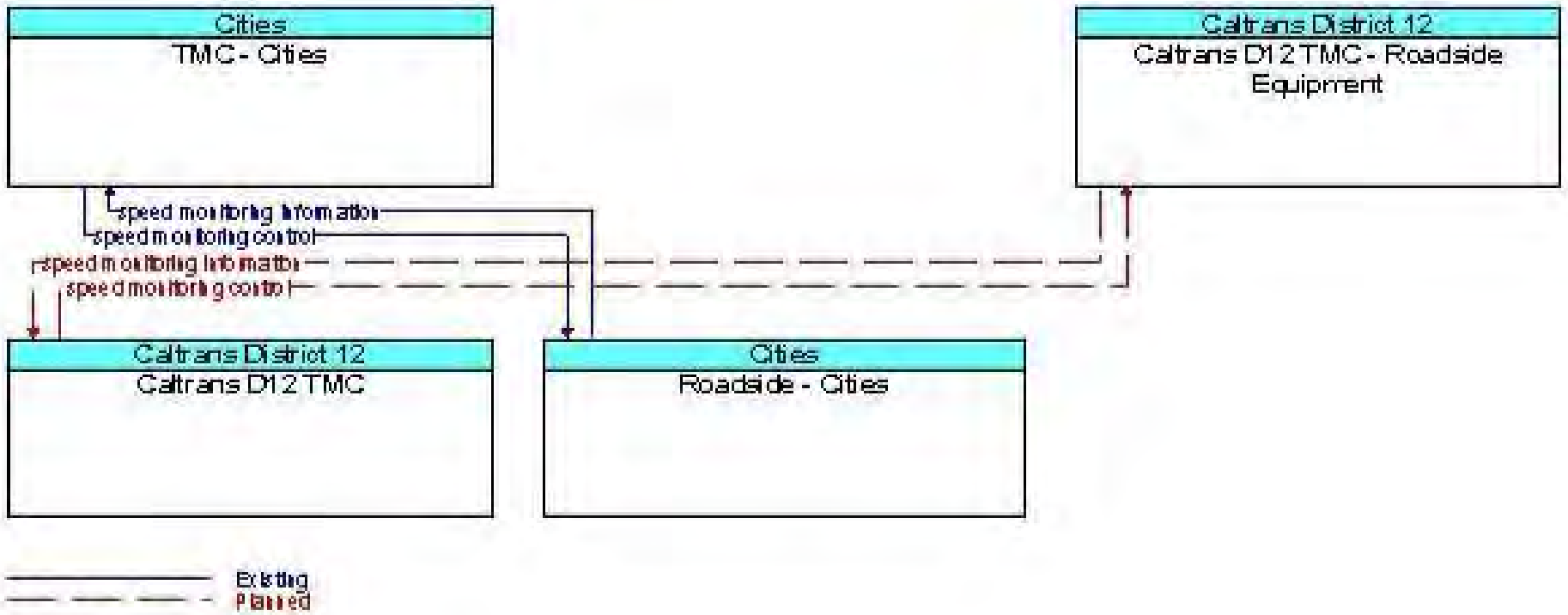

Cities
TMC - Cities
hri status
hri control data
hri request
OCTA
At-Grade Rail Crossing Equipment
Planned

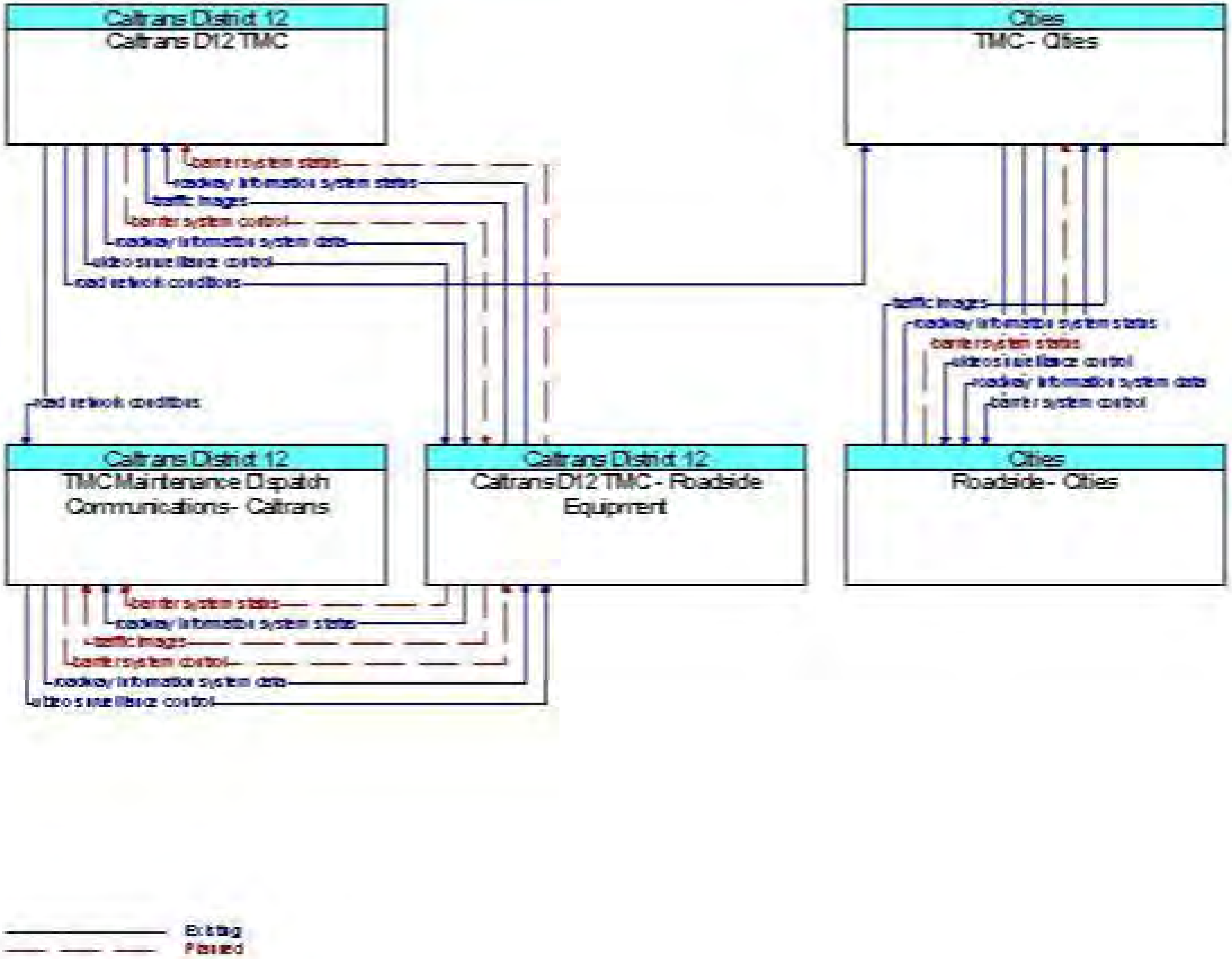

Cities
TMC - Cities
hri status
intersection blockage notification
hri control data
hri request
OCTA
At-Grade Rail Crossing Equipment
Planned

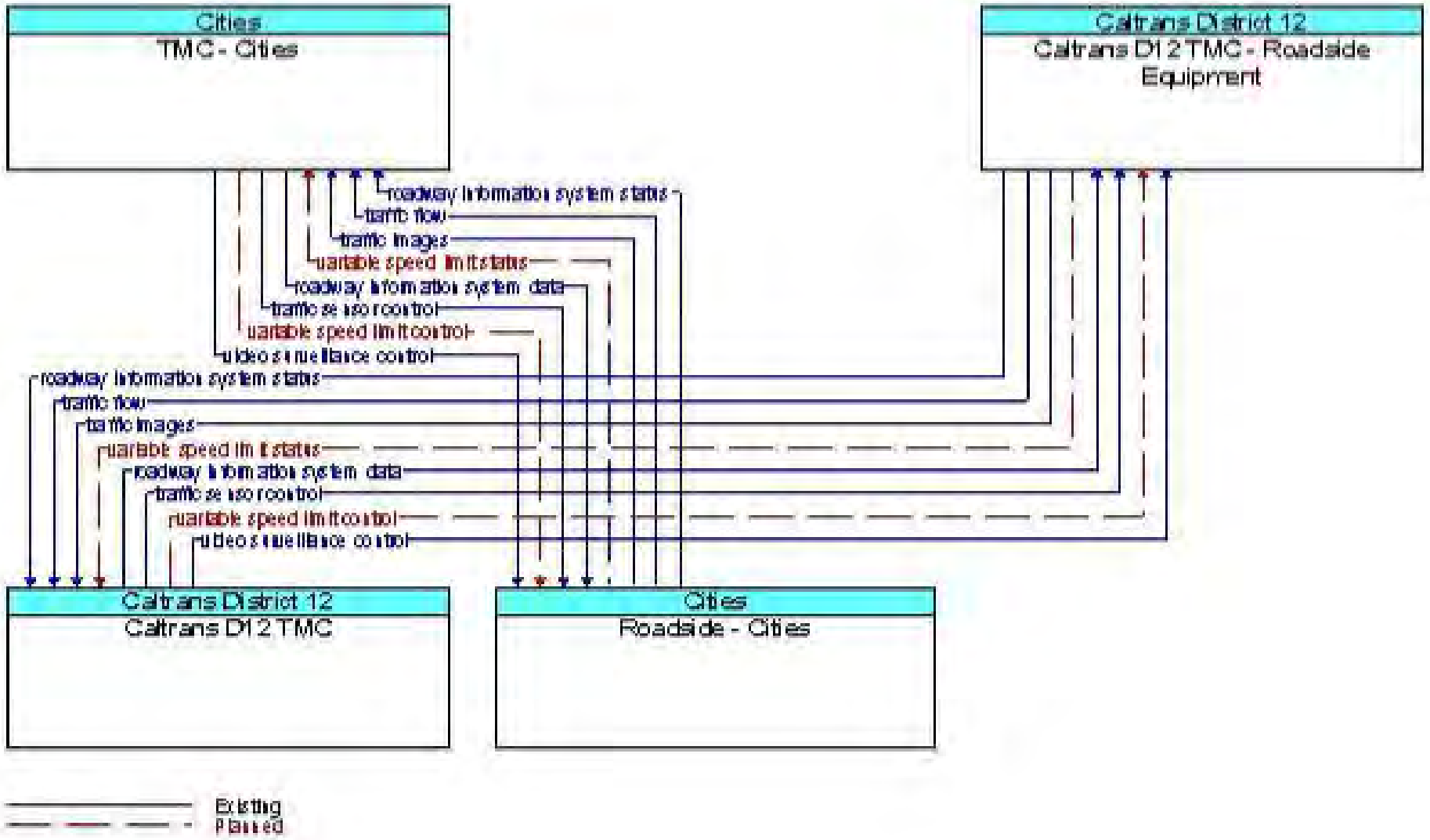

Cities
TMC - Cities
hri status
hri control data
hri request
OCTA
At-Grade Rail Crossing Equipment
Planned

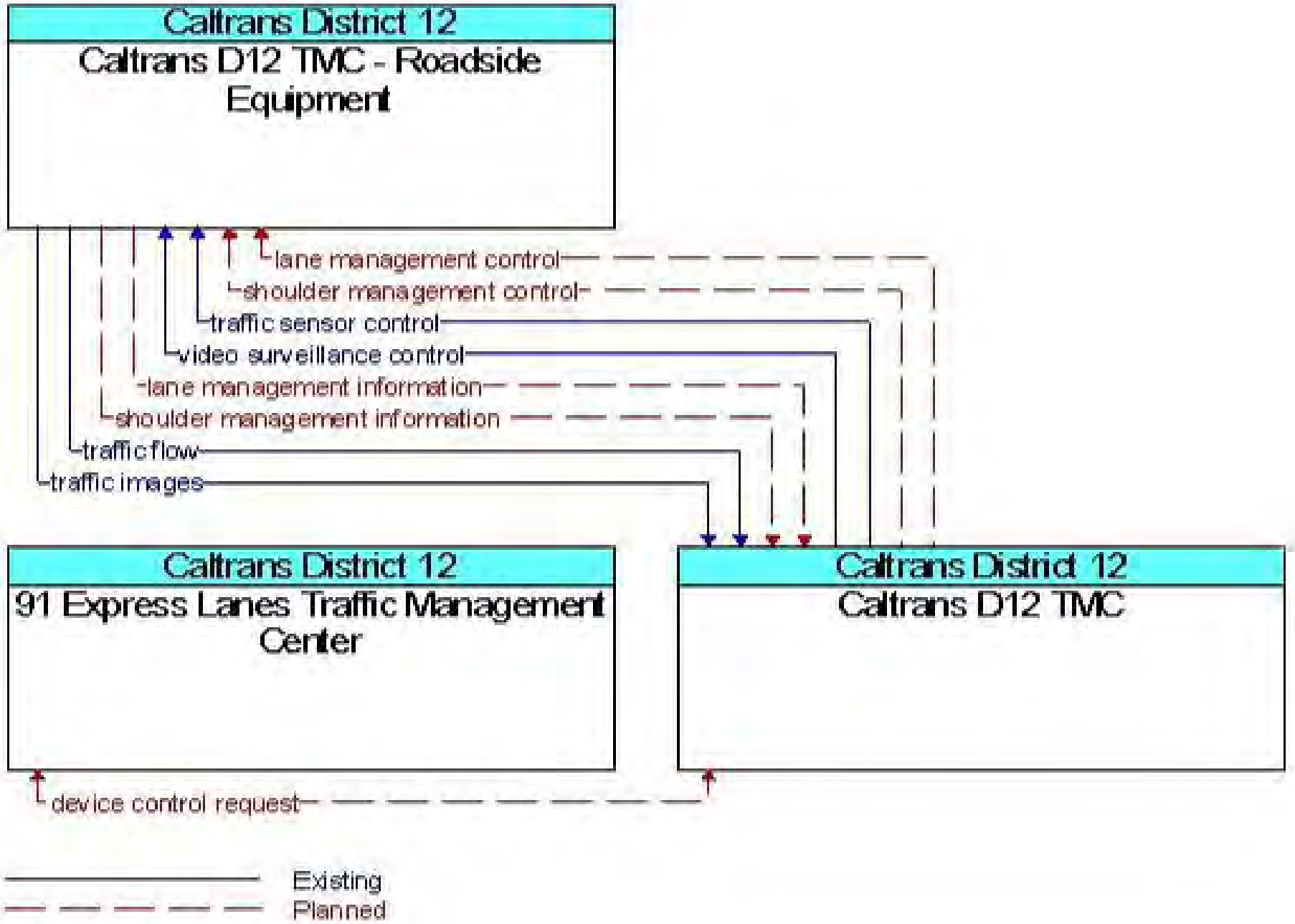

OCTA
511 MATIS/Go511
County of Orange
John Wayne Airport
parking information
parking lot reservation confirmation
parking lot data request
parking reservation request
parking demand management response
parking information
parking demand management request
parking lot data request
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
Cities
Parking Guidance Systems
SCRRA
Metrolink
parking information
parking lot data request
parking information
parking lot data request
Planned

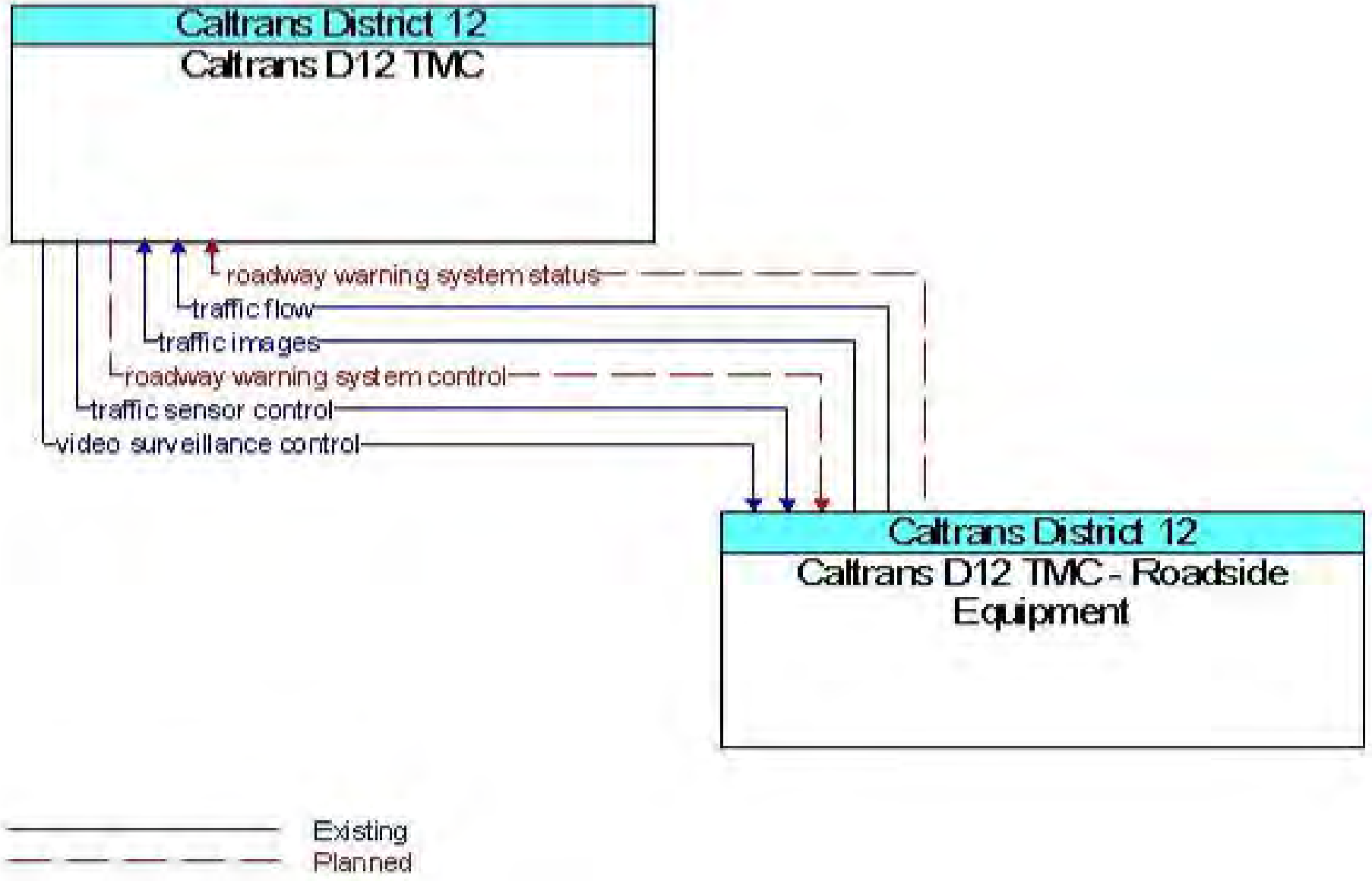

Cities
TMC - Cities
reversible lane status
signal control status
signal fault data
traffic flow
reversible lane control
signal control commands
signal control device configuration
signal control plans
signal system configuration
traffic sensor control
Cities
Roadside - Cities
Existing
Planned

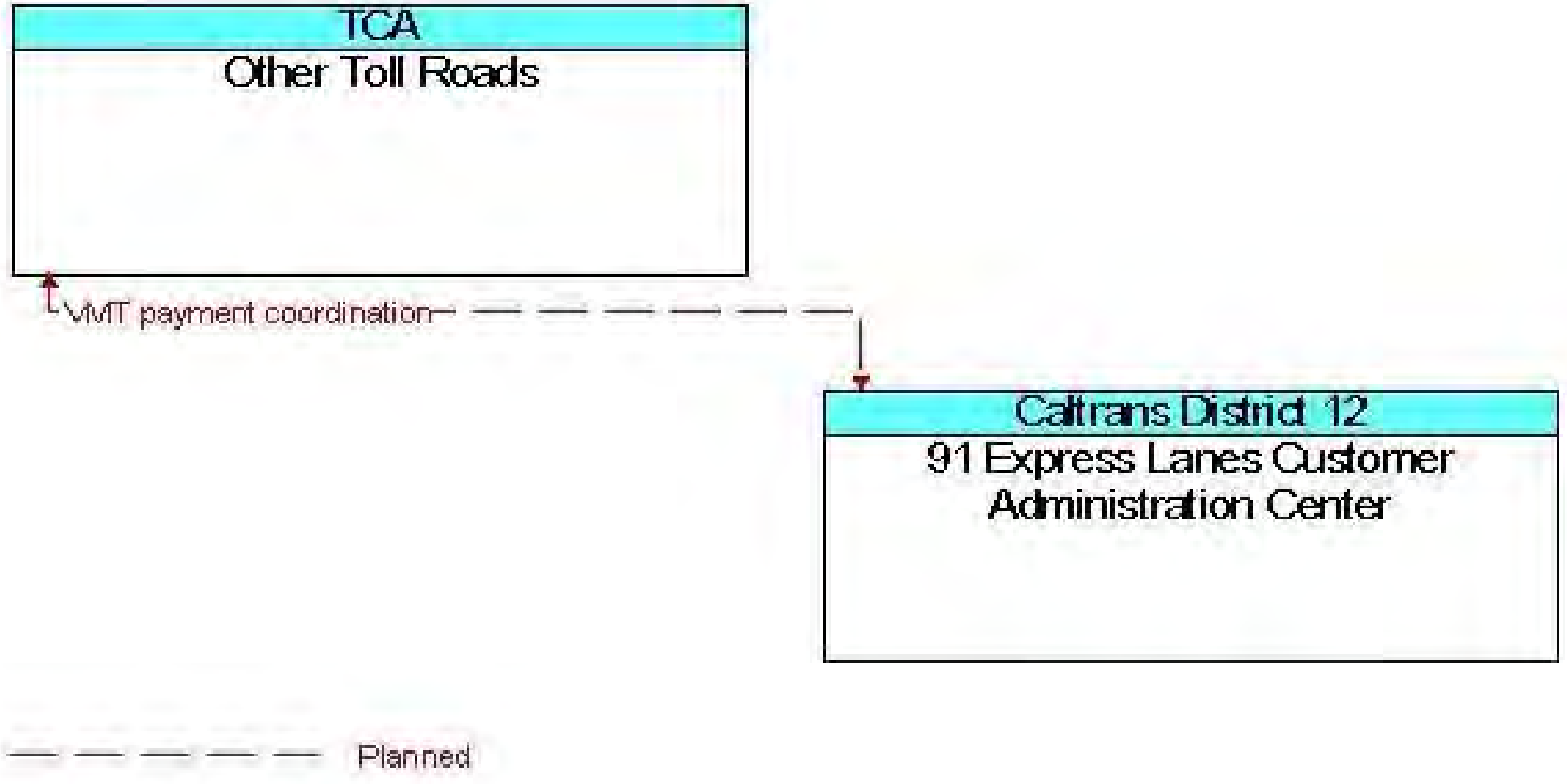

Cities
TMC - Cities
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
speed monitoring information
speed monitoring control
speed monitoring information
speed monitoring control
Caltrans District 12
Caltrans D12 TMC
Cities
Roadside - Cities
Existing
Planned

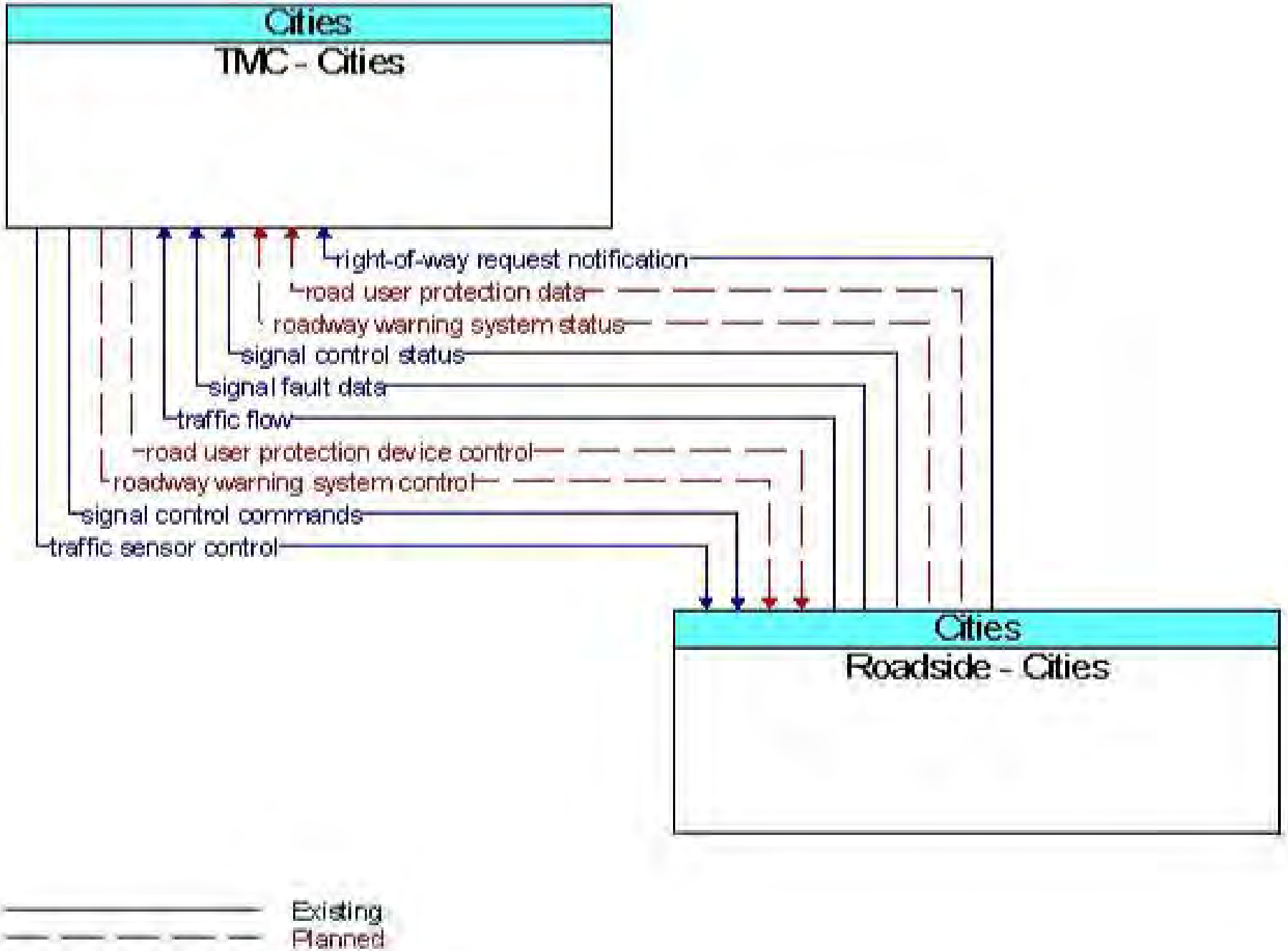

Caltrans District 12
Caltrans D12 TMC
Cities
TMC - Cities
Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Cities
Roadside - Cities
Existing
Planned

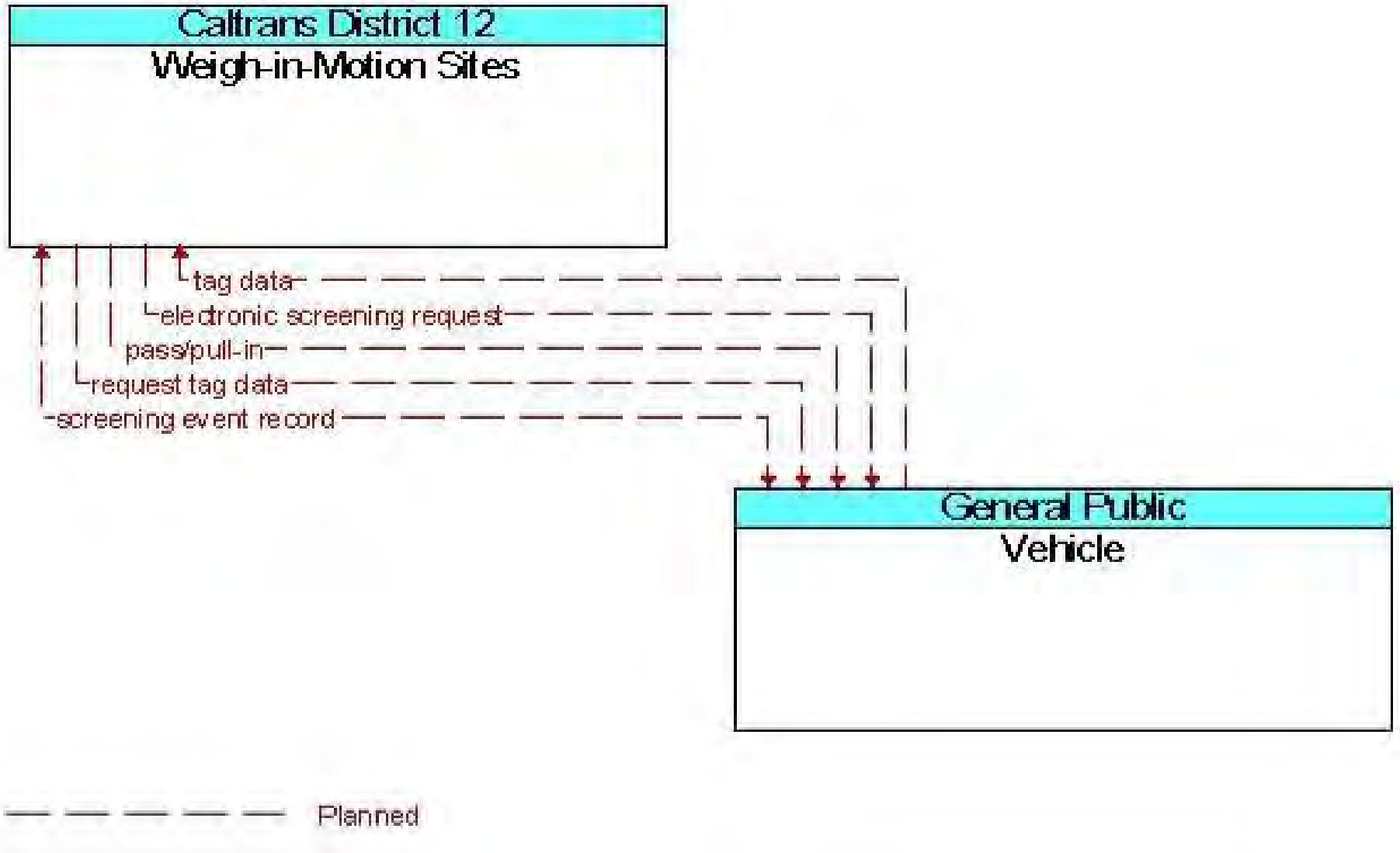

Cities
TMC - Cities
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
roadway information system status
traffic flow
traffic images
variable speed limit status
roadway information system data
traffic sensor control
variable speed limit control
video surveillance control
roadway information system status
traffic flow
traffic images
variable speed limit status
roadway information system data
traffic sensor control
variable speed limit control
video surveillance control
Caltrans District 12
Caltrans D12 TMC
Cities
Roadside - Cities
Existing
Planned

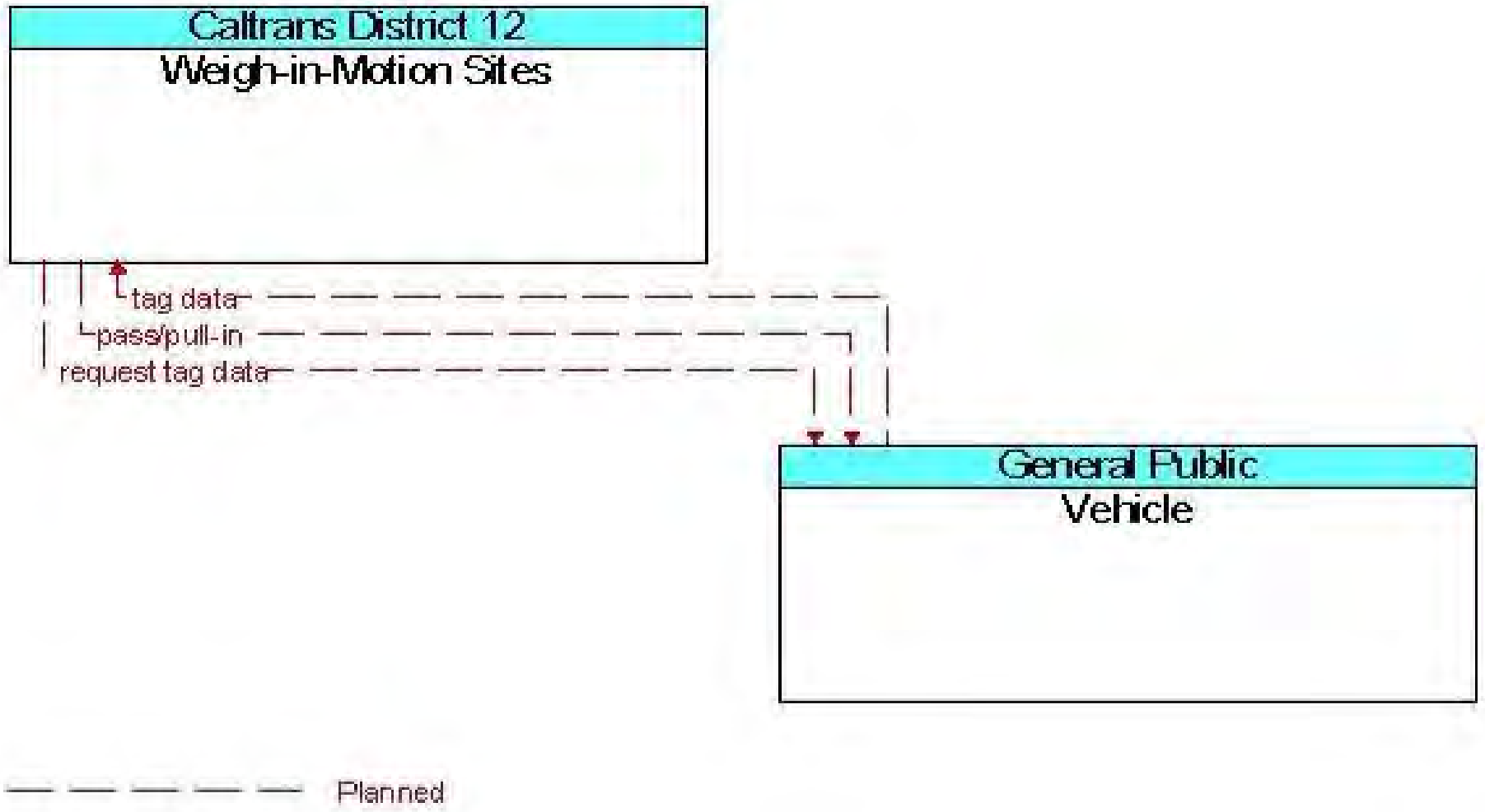

Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
lane management control
shoulder management control
traffic sensor control
video surveillance control
lane management information
shoulder management information
traffic flow
traffic images
Caltrans District 12
91 Express Lanes Traffic Management Center
Caltrans District 12
Caltrans D12 TMC
device control request
Existing
Planned

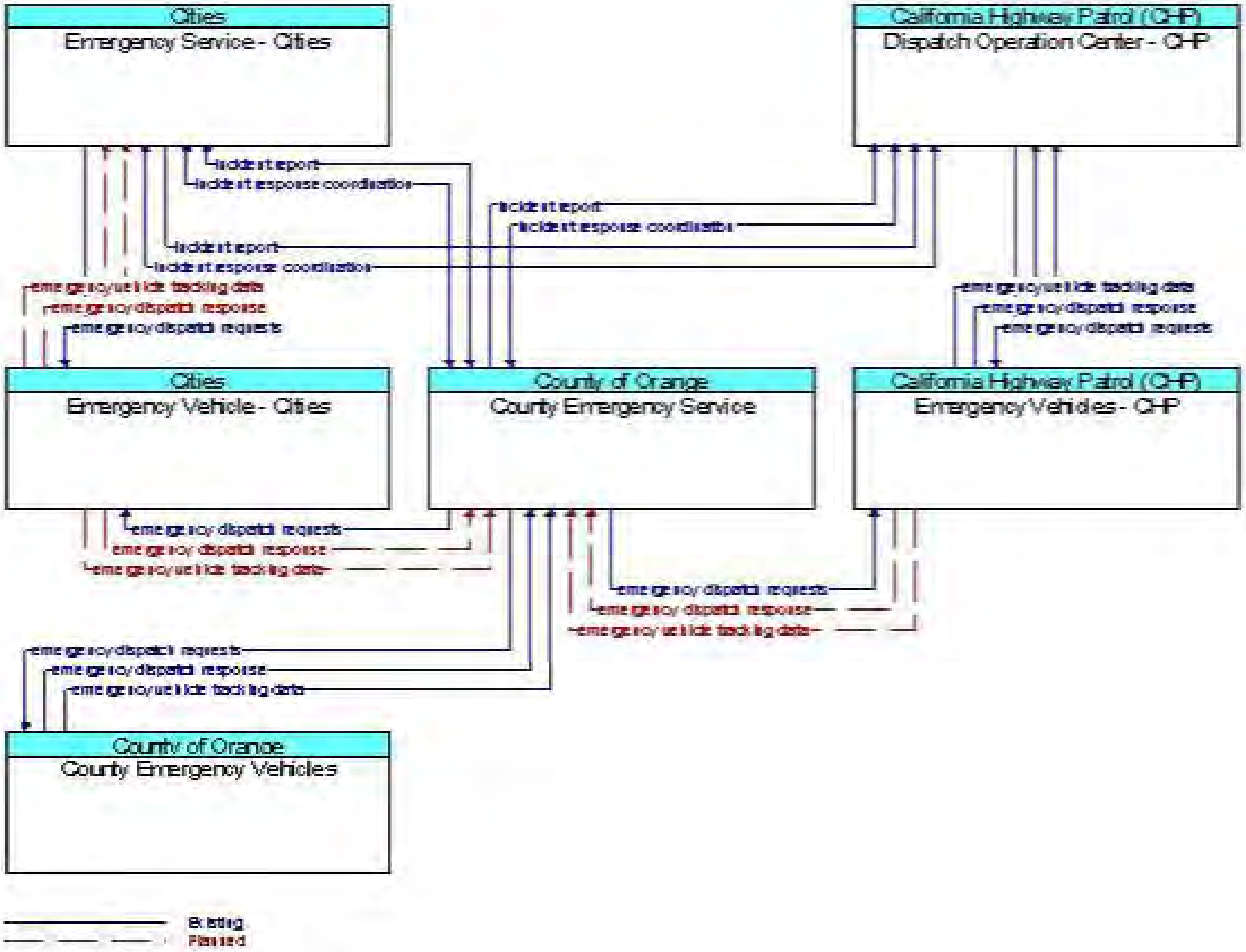

Caltrans District 12
Caltrans D12 TMC
roadway warning system status
traffic flow
traffic images
roadway warning system control
traffic sensor control
video surveillance control
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing
Planned

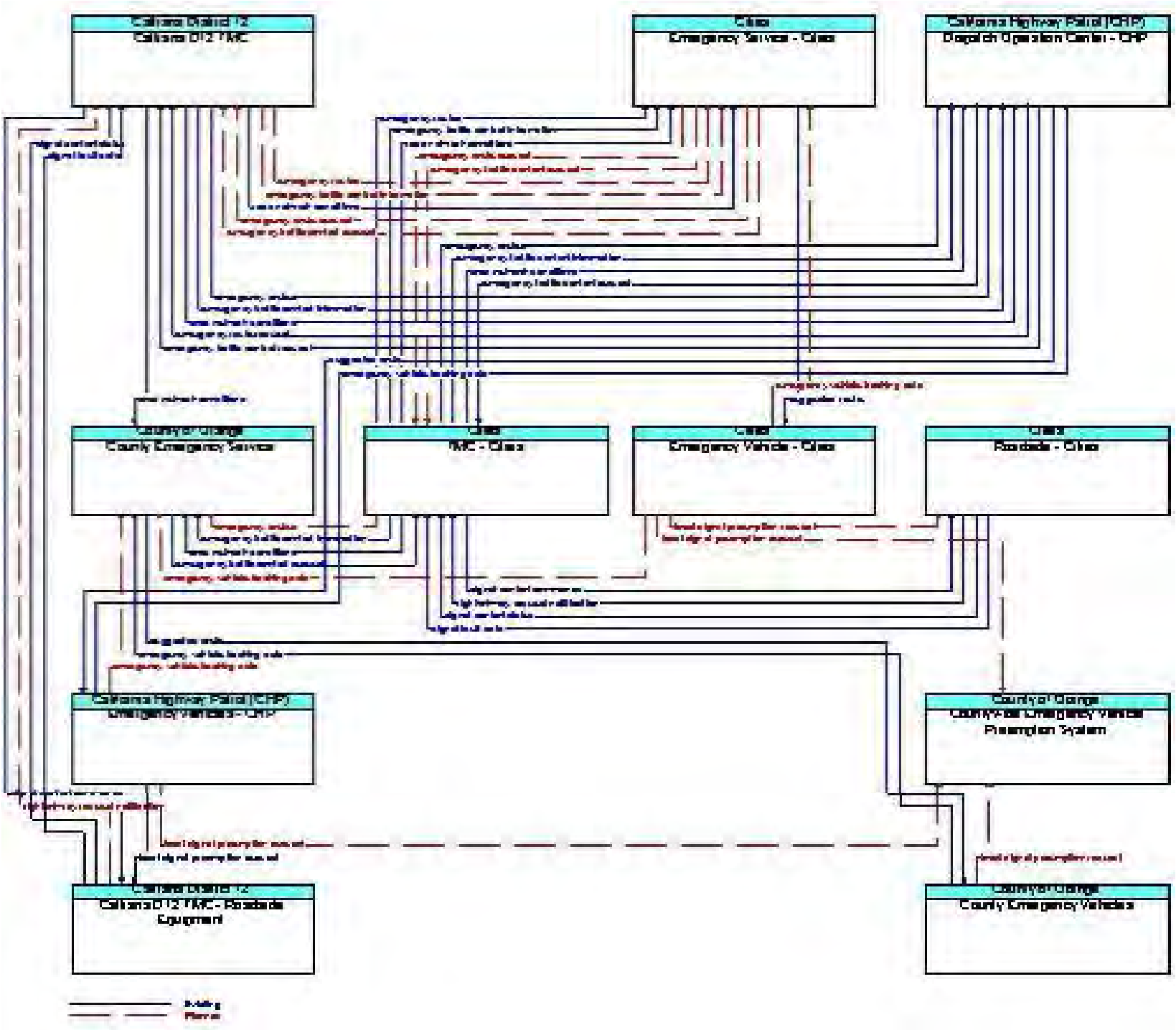

TCA
Other Toll Roads
VMT payment coordination
Caltrans District 12
91 Express Lanes Customer Administration Center
Planned

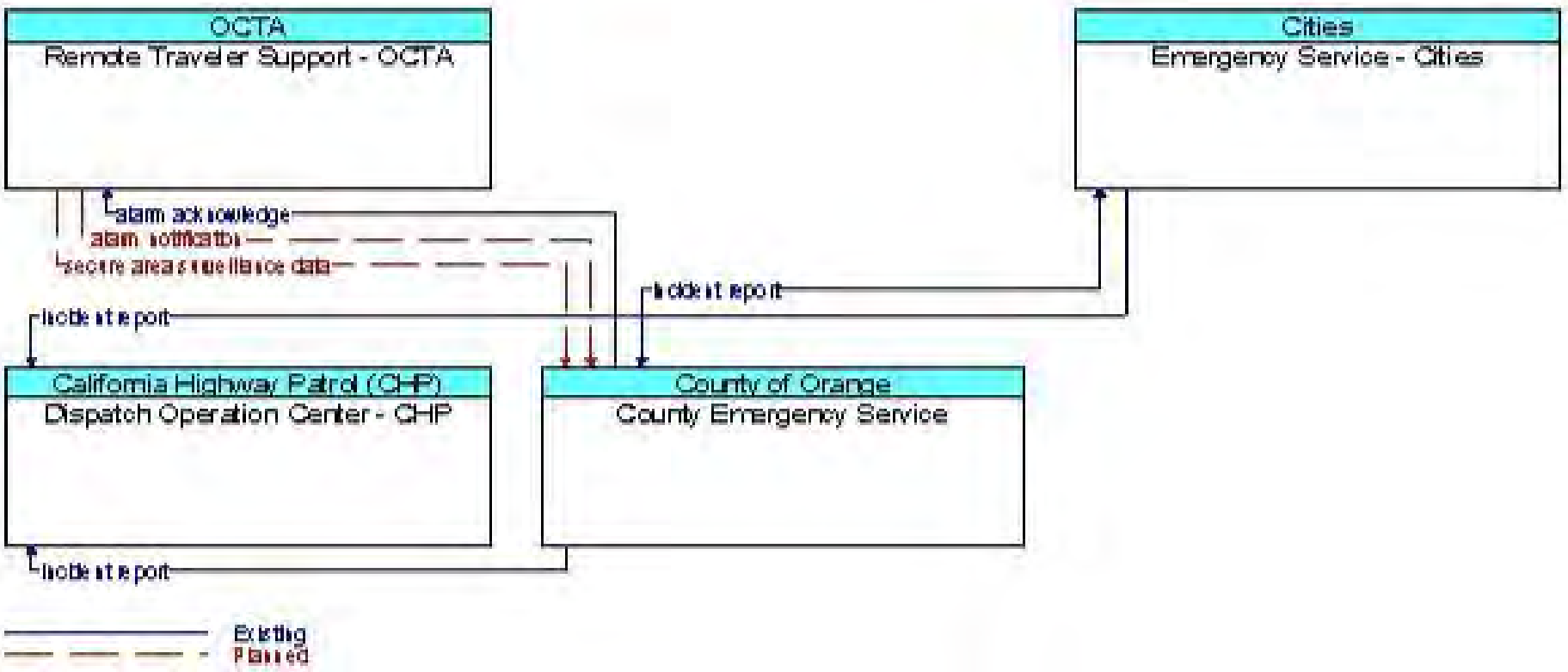

Cities
TMC - Cities
right-of-way request notification
road user protection data
roadway warning system status
signal control status
signal fault data
traffic flow
road user protection device control
roadway warning system control
signal control commands
traffic sensor control
Cities
Roadside - Cities
Existing
Planned

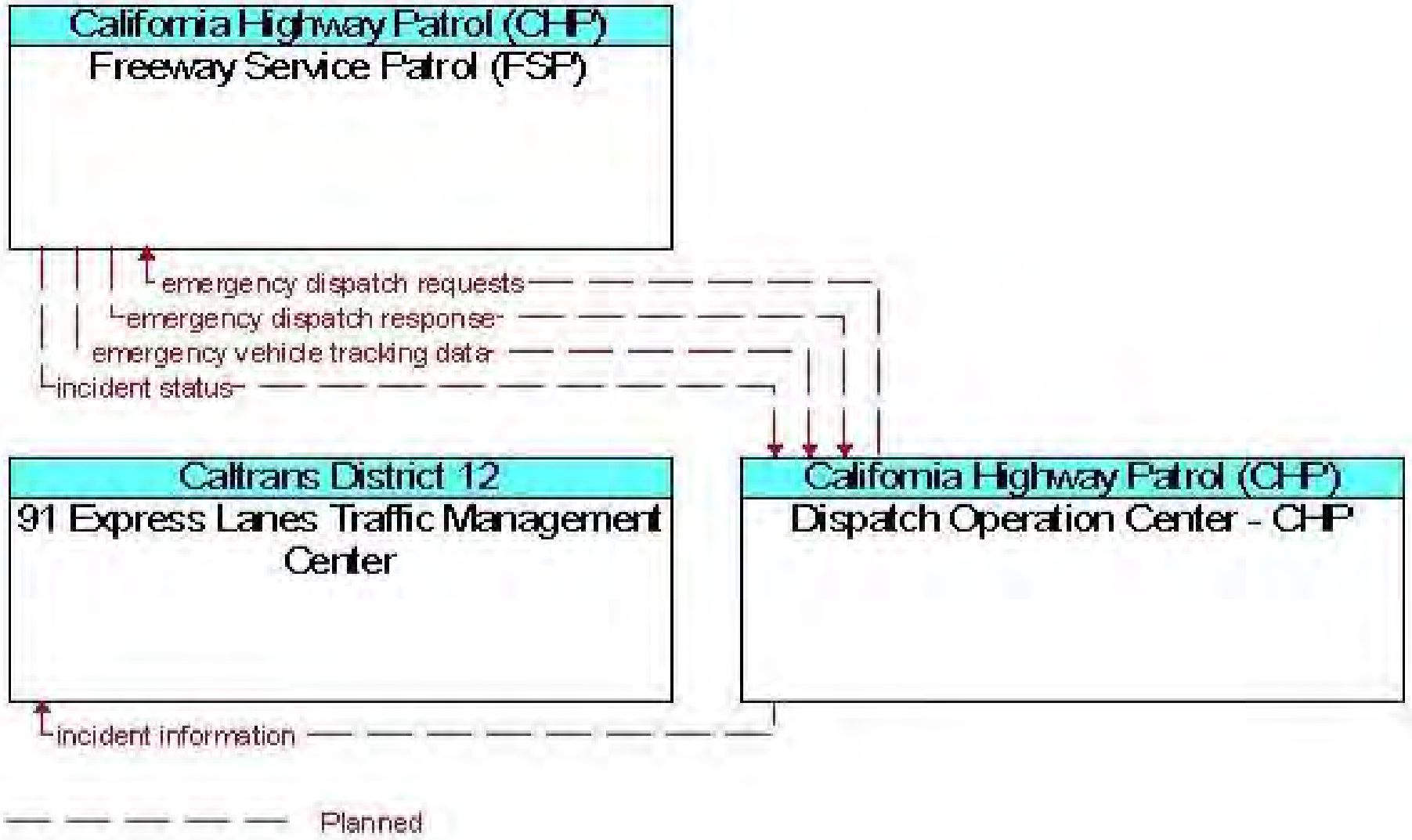

Caltrans District 12
Weigh-in-Motion Sites
tag data
electronic screening request
pass/pull-in
request tag data
screening event record
General Public
Vehicle
Planned

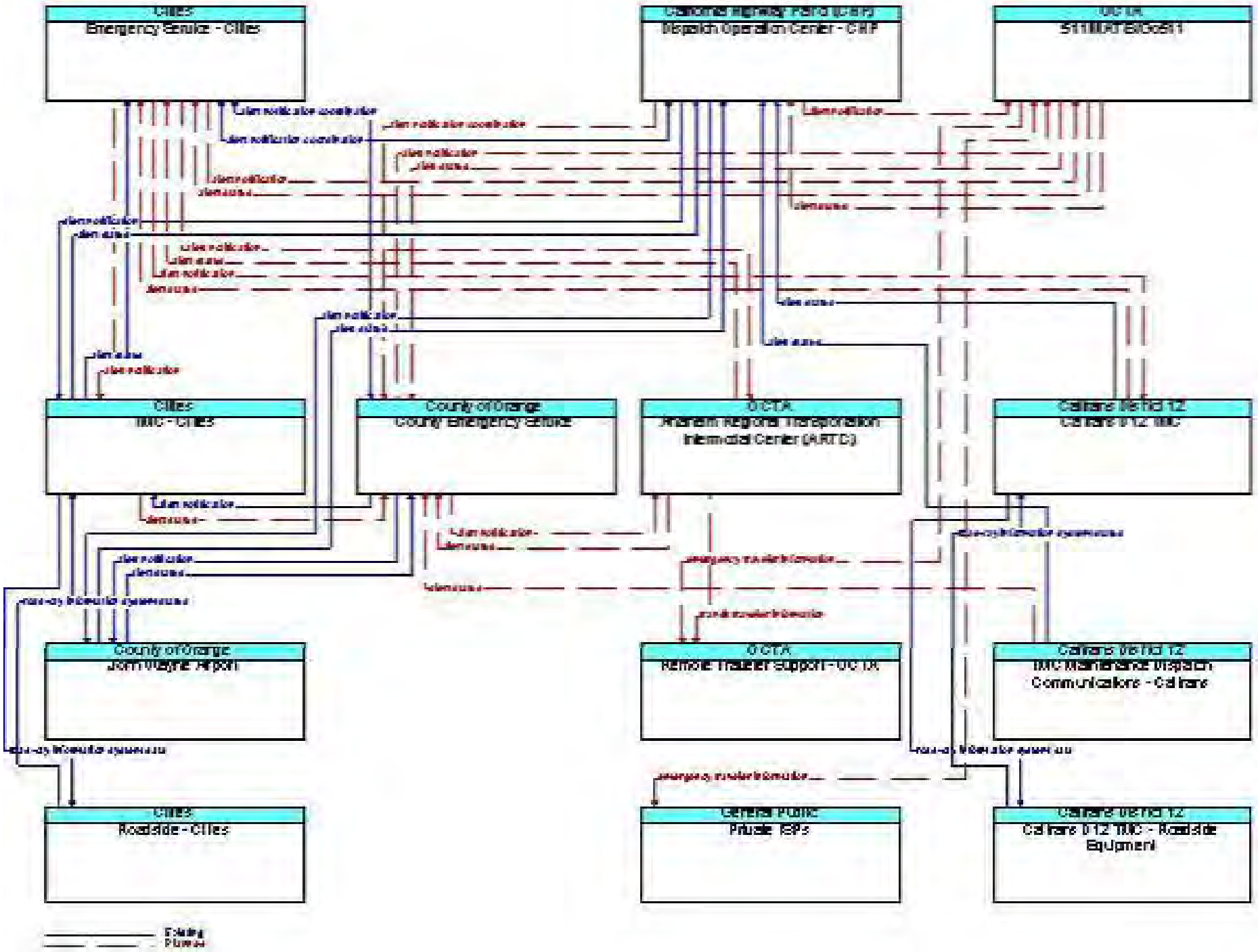

Caltrans District 12
Weigh-in-Motion Sites
tag data
pass/pull-in
request tag data
General Public
Vehicle
Planned

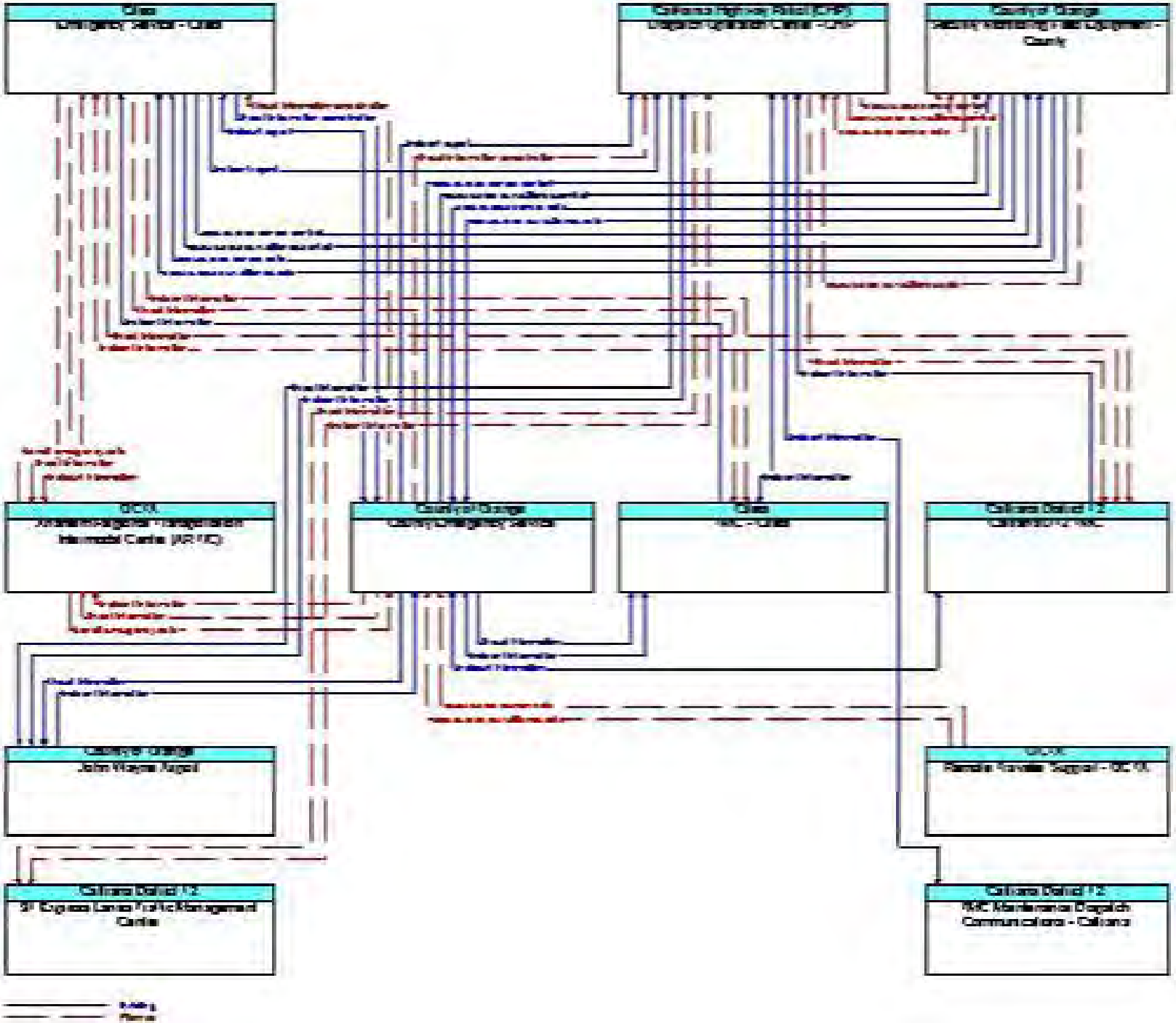

Cities
Emergency Service - Cities
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
Cities
Emergency Vehicle - Cities
County of Orange
County Emergency Service
California Highway Patrol (CHP)
Emergency Vehicles - CHP
County of Orange
County Emergency Vehicles
Existing
Planned

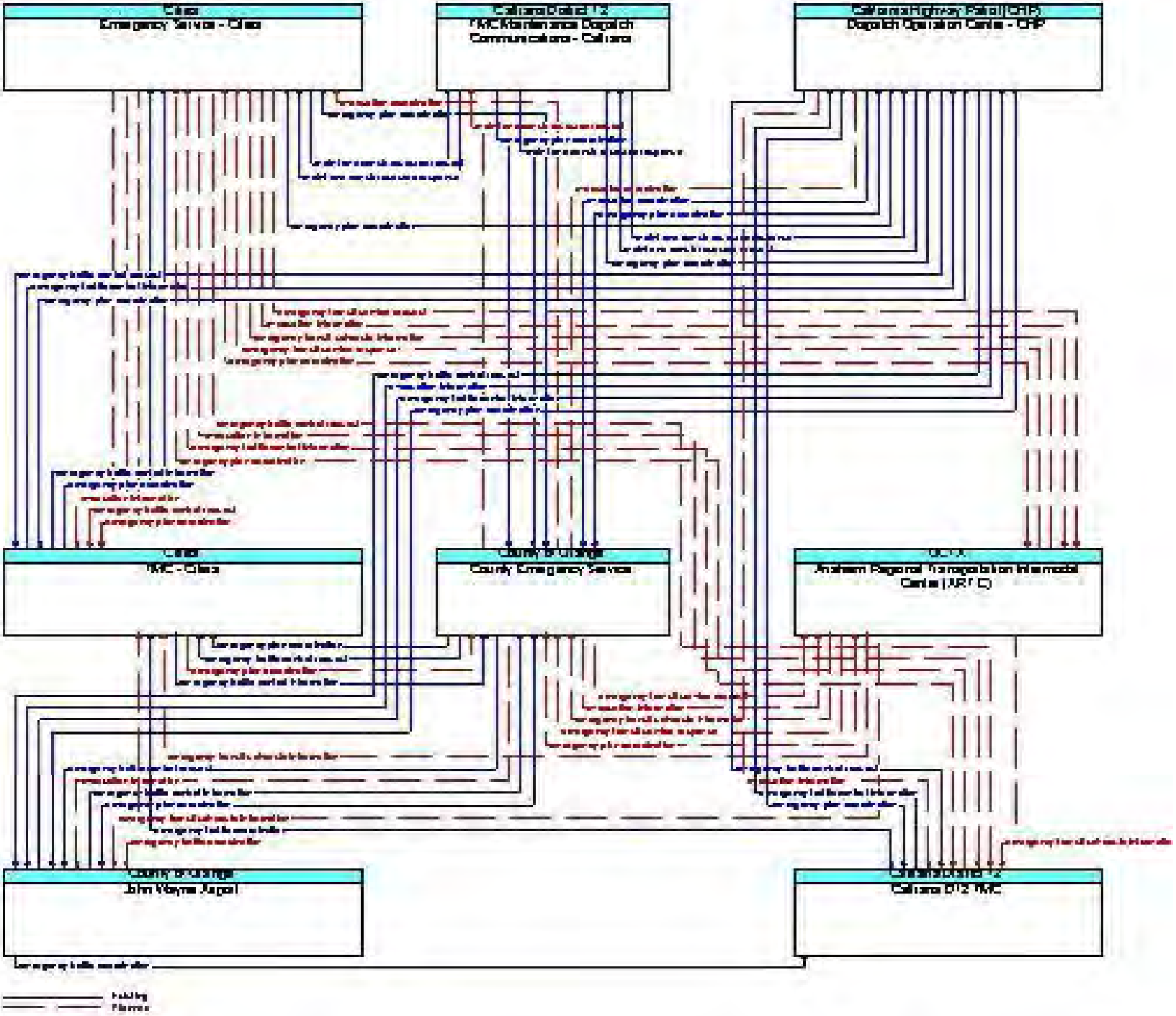

Caltrans District 12
Caltrans D12 TMC
Cities
Emergency Services - Cities
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
County of Orange
County Emergency Service
Cities
TMC - Cities
Cities
Emergency Vehicle - Cities
Cities
Roadside - Cities
California Highway Patrol (CHP)
Emergency Vehicles - CHP
County of Orange
County-wide Emergency Vehicle
Preemption System
Caltrans District 12
Caltrans D12 TMC - Roadside
Equipment
County of Orange
County Emergency Vehicles
Existing
Planned

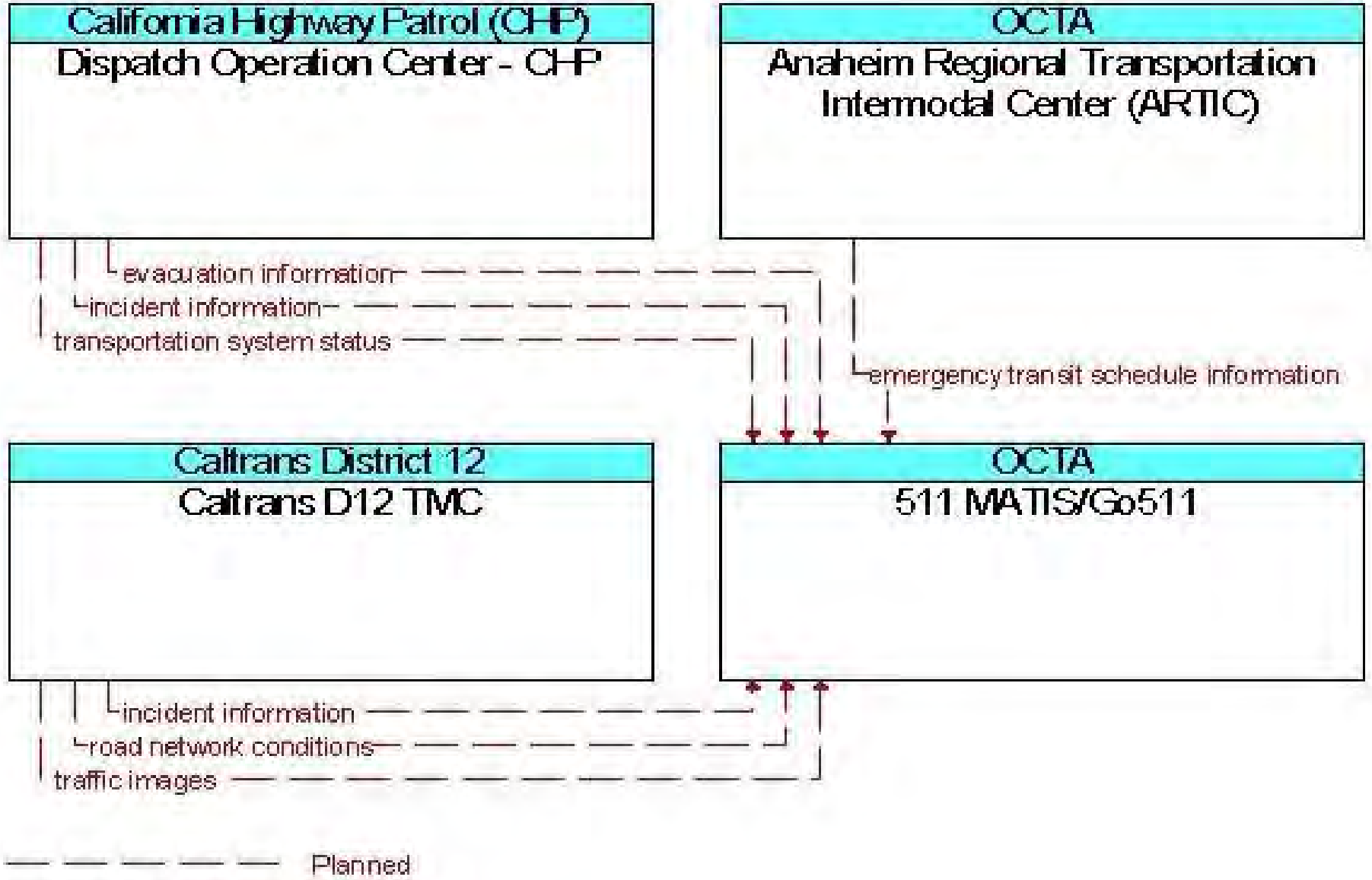

OCTA
Remote Traveler Support - OCTA
Cities
Emergency Service - Cities
alarm acknowledge
alarm notification
secure area surveillance data
incident report
incident report
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
County of Orange
County Emergency Service
incident report
Existing
Planned

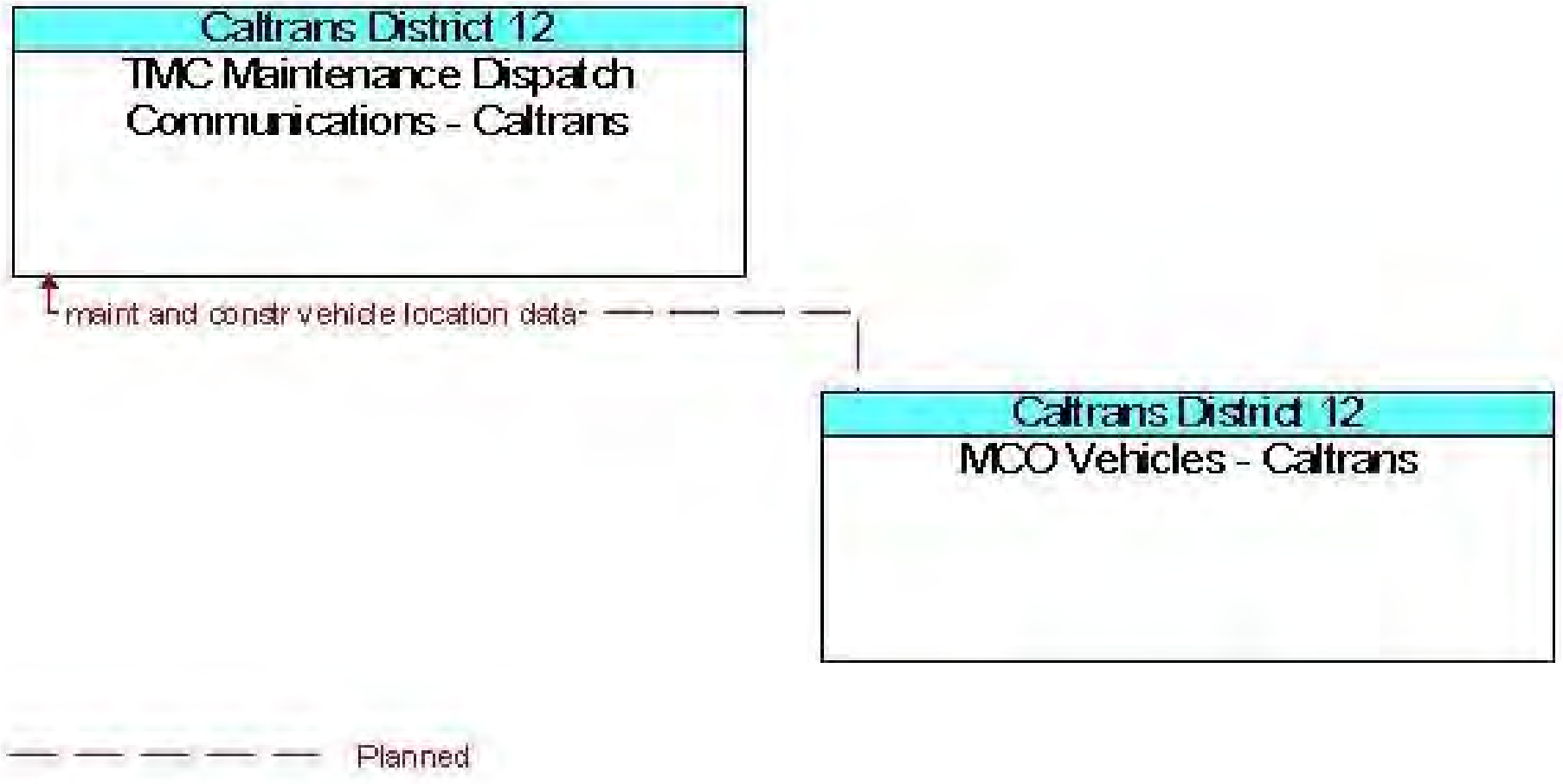

California Highway Patrol (CHP)
Freeway Service Patrol (FSP)
emergency dispatch requests
emergency dispatch response
emergency vehicle tracking data
incident status
Caltrans District 12
91 Express Lanes Traffic Management Center
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
incident information
Planned

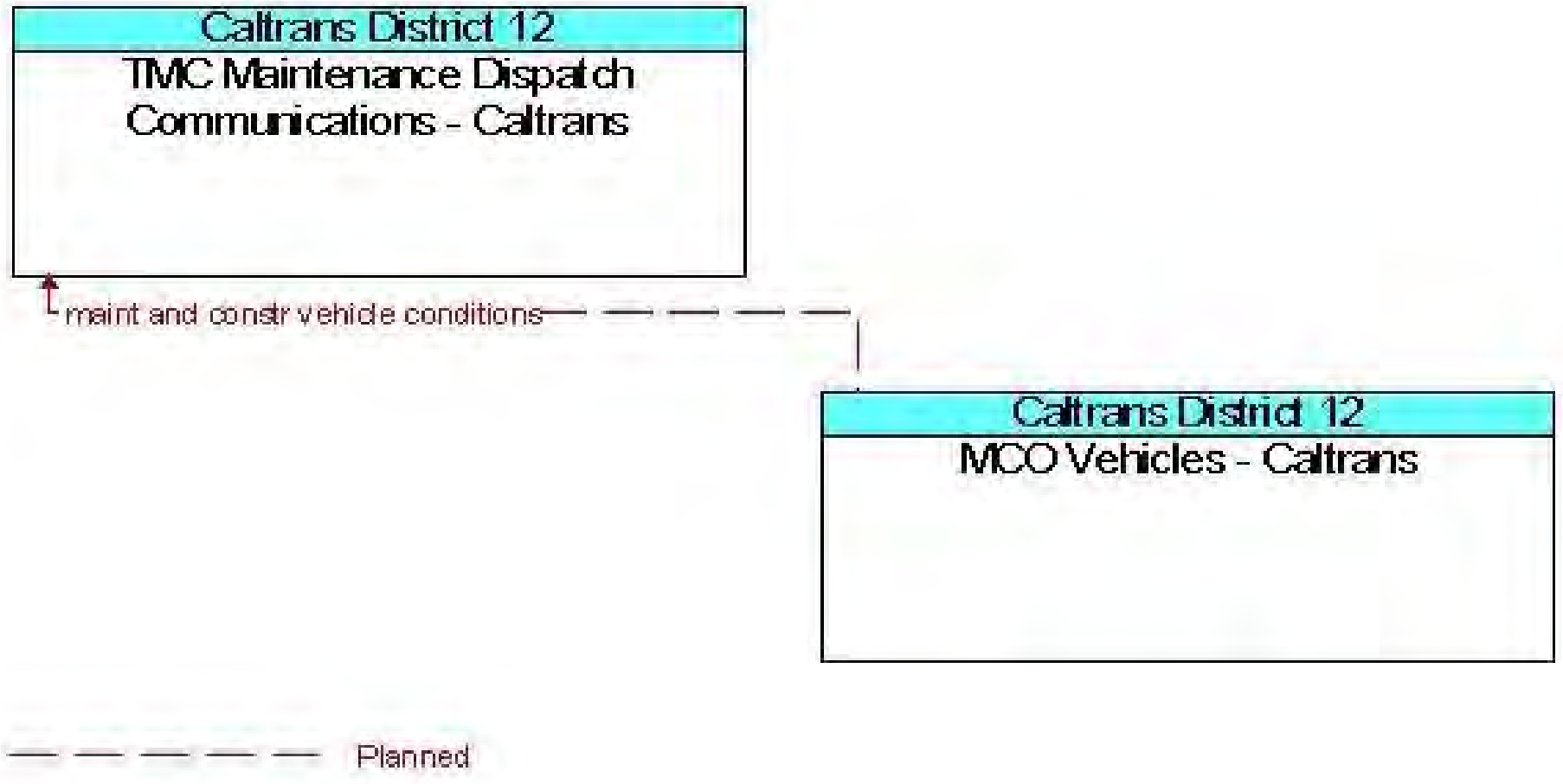

Cities
Emergency Service - Cities
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
OC IX
Existing
Planned

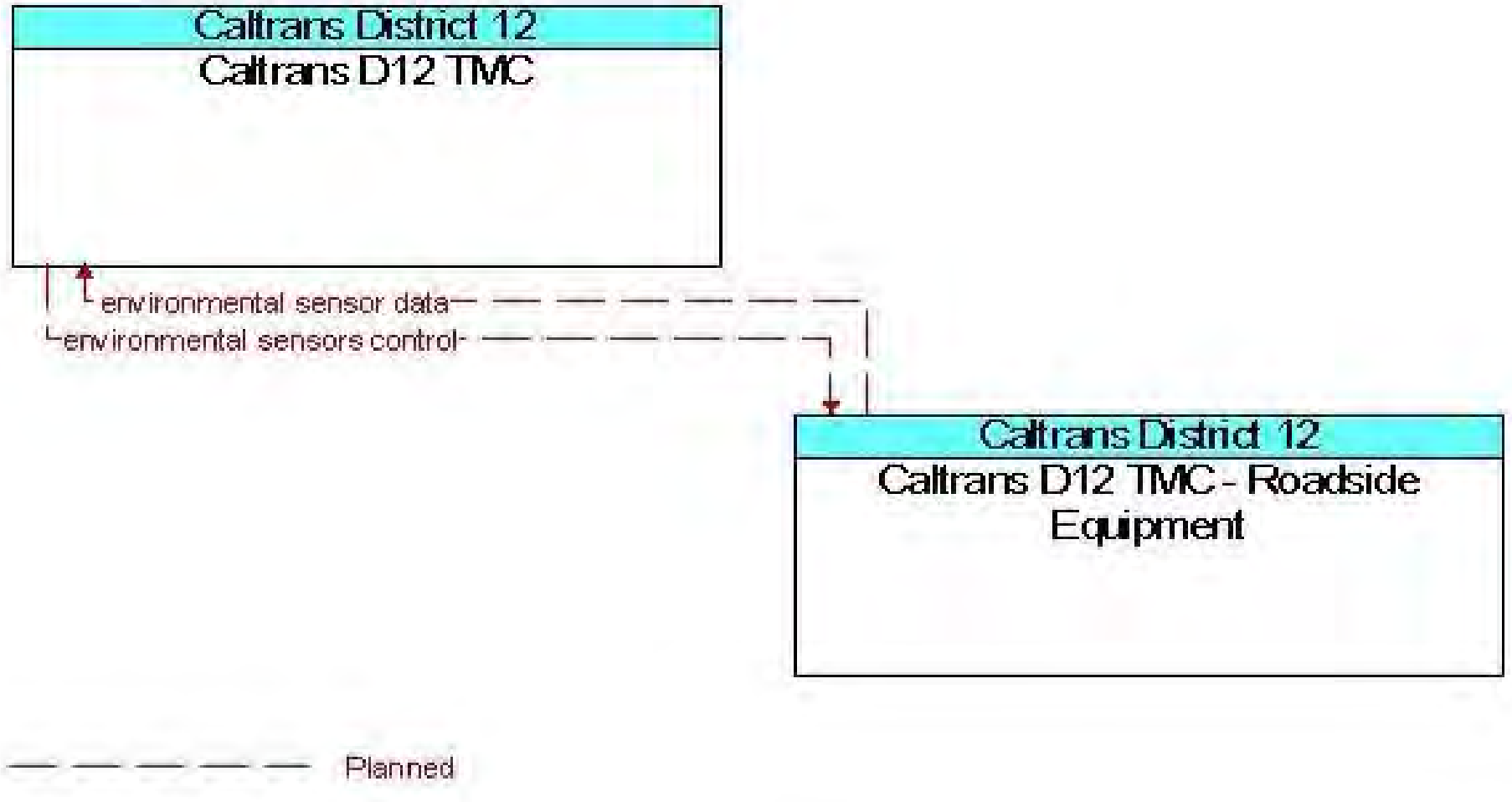


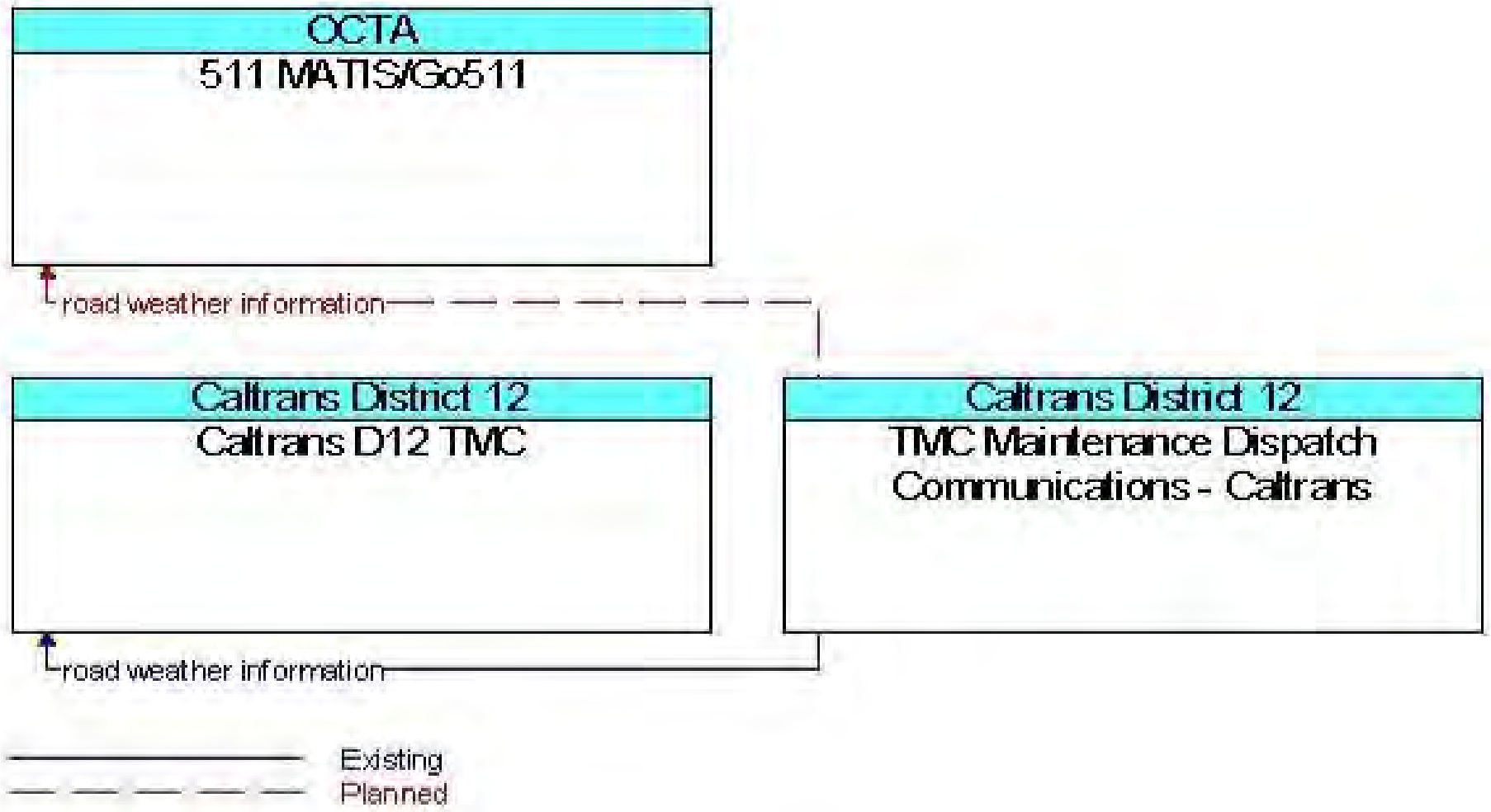

Orange
Emergency Services - Orange
Caltrans District 12
TMC Maintenance Dispatch
Communications - Caltrans
California Highway Patrol (CHP)
Dispatch Operation Center - CHP
Orange
TMC - Orange
County of Orange
County Emergency Services
OCTA
Anaheim Regional Transportation Intermodal
Center (ARTIC)
County of Orange
John Wayne Airport
Caltrans District 12
Caltrans D12 TMC

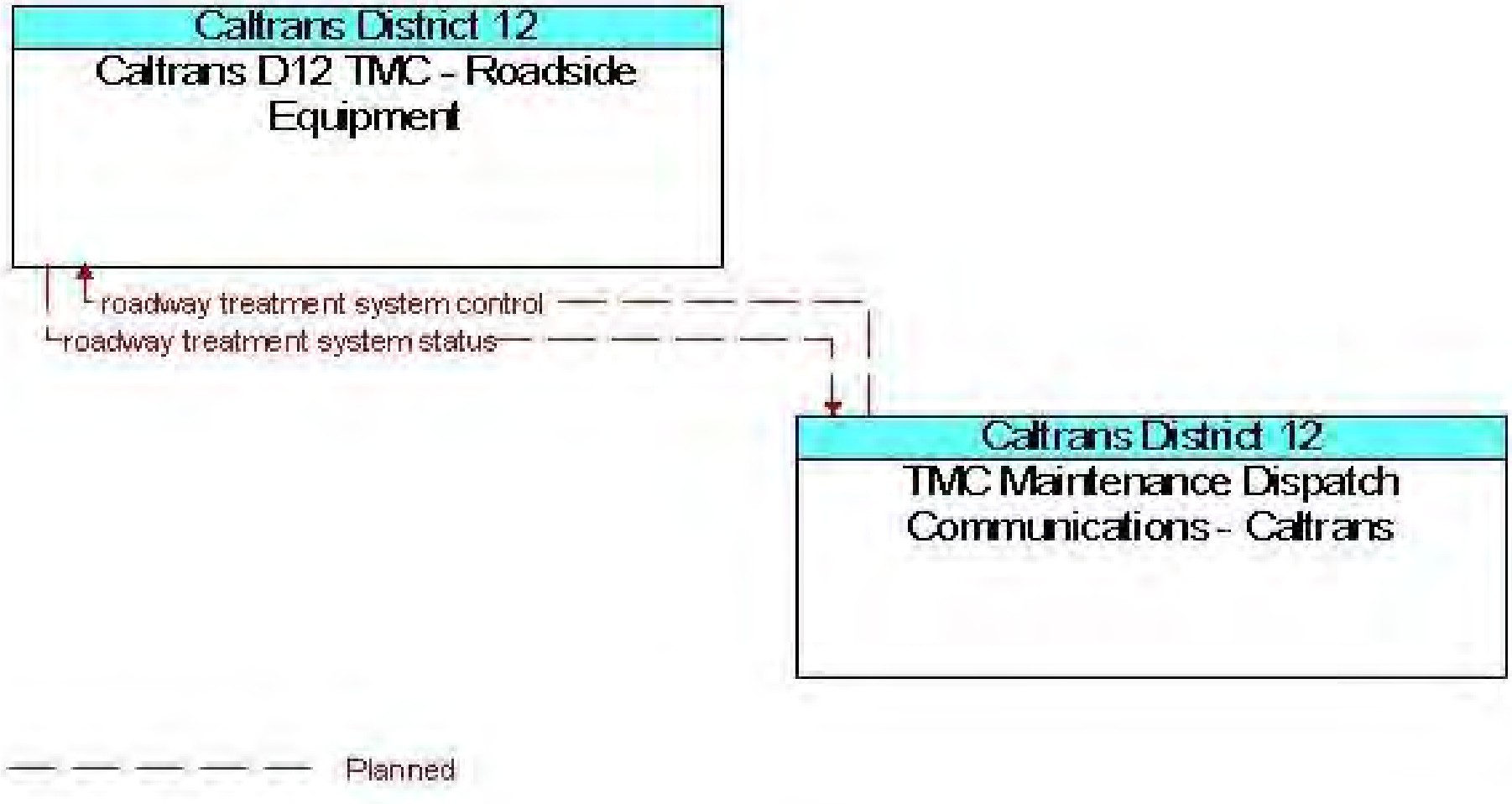

California Highway Patrol (CHP)
Dispatch Operation Center - CHP
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
evacuation information
incident information
transportation system status
emergency transit schedule information
Caltrans District 12
Caltrans D12 TMC
OCTA
511 MATIS/Go511
incident information
road network conditions
traffic images
Planned

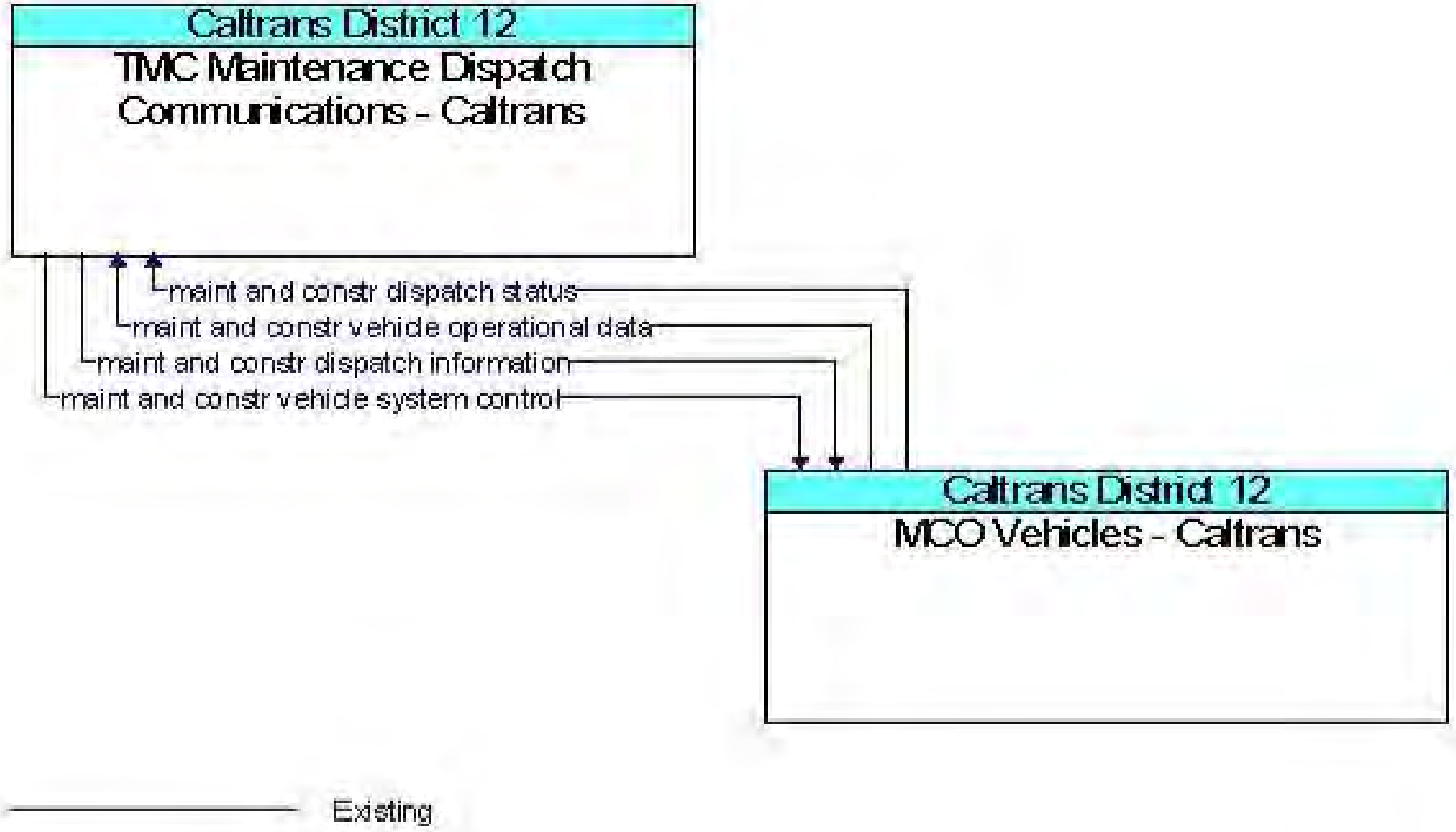

Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
maint and constr vehicle location data
Caltrans District 12
MCO Vehicles - Caltrans
Planned

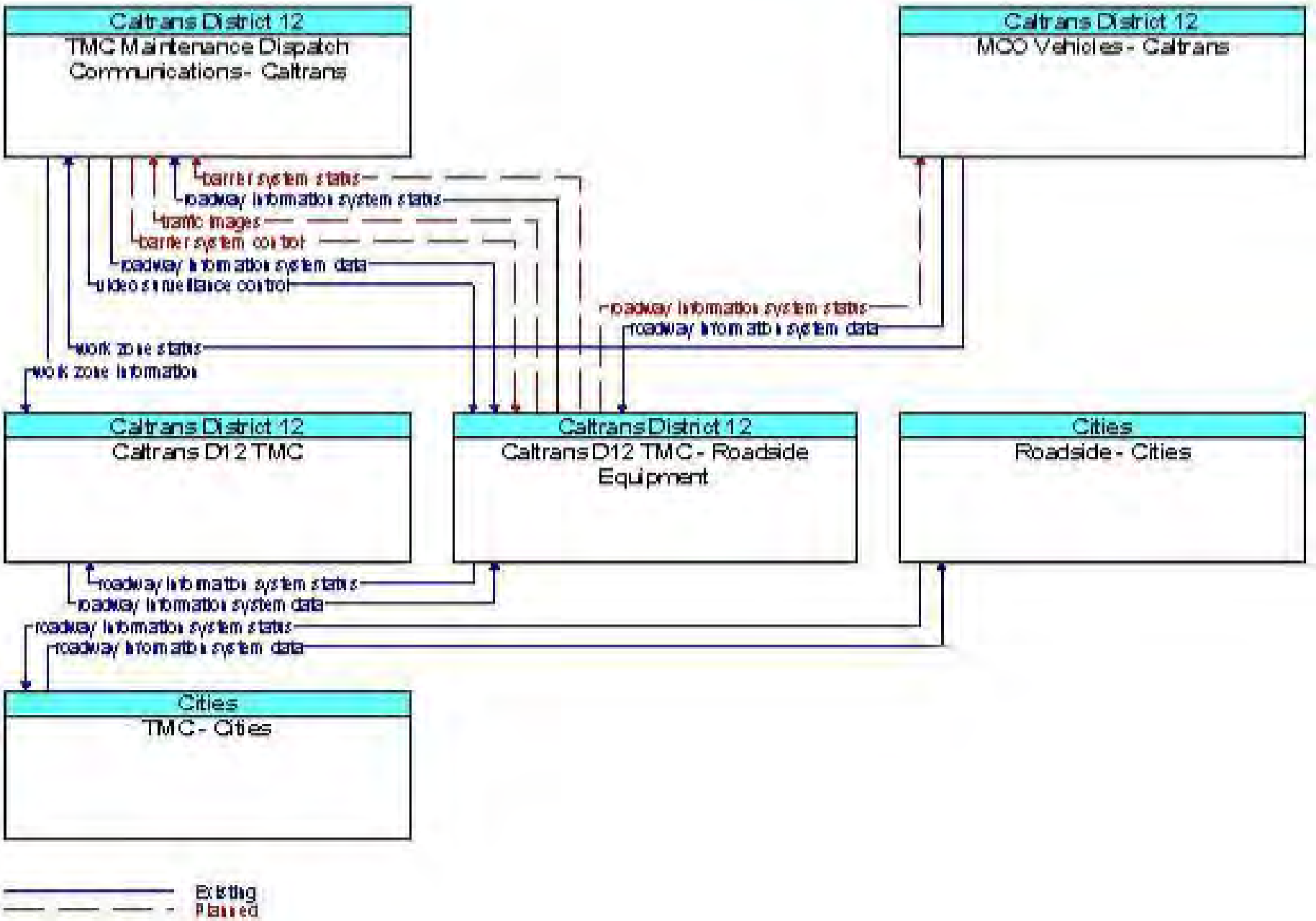

Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
maint and constr vehicle conditions
Caltrans District 12
MCO Vehicles - Caltrans
Planned

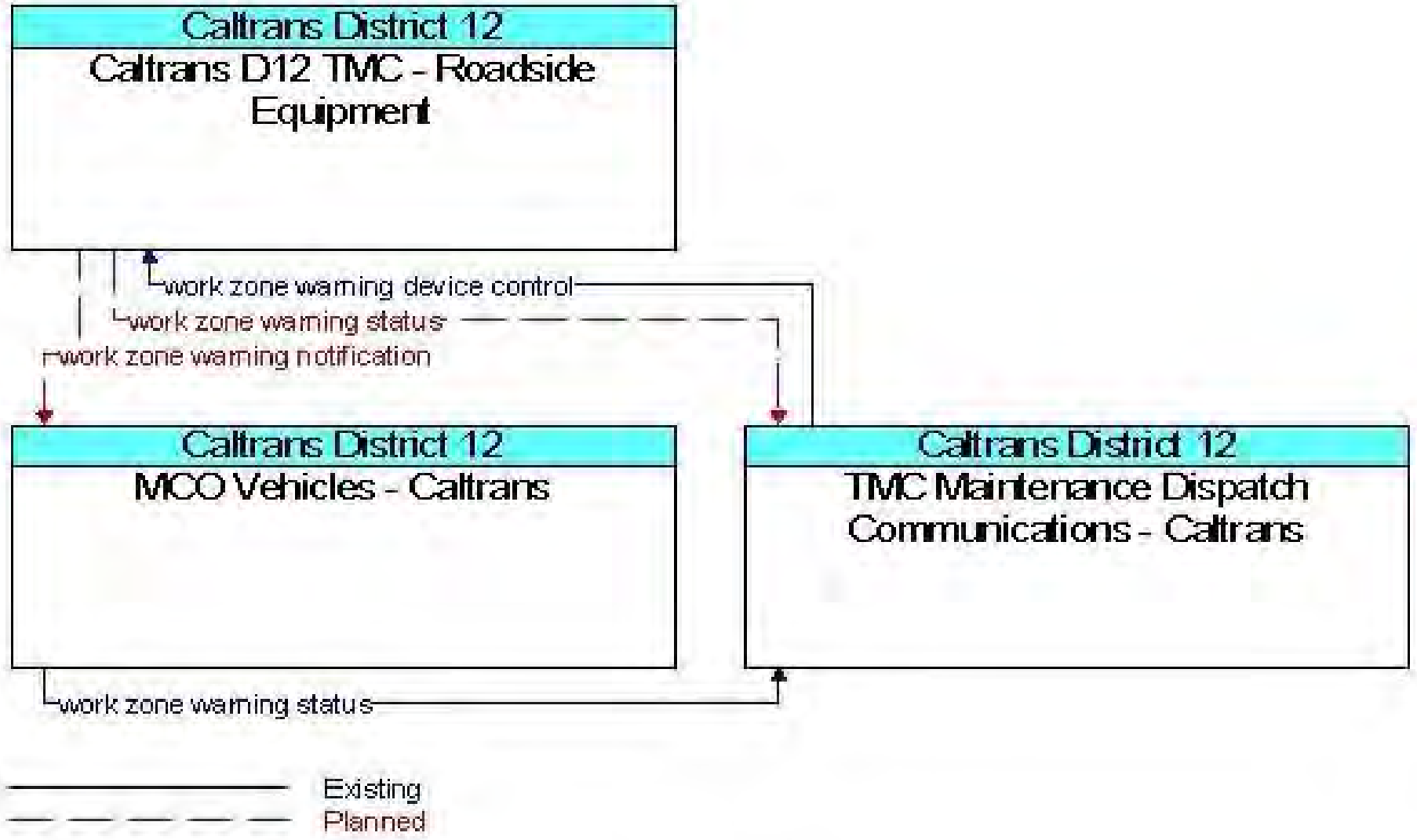

Caltrans District 12
Caltrans D12 TMC
environmental sensor data
environmental sensors control
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Planned

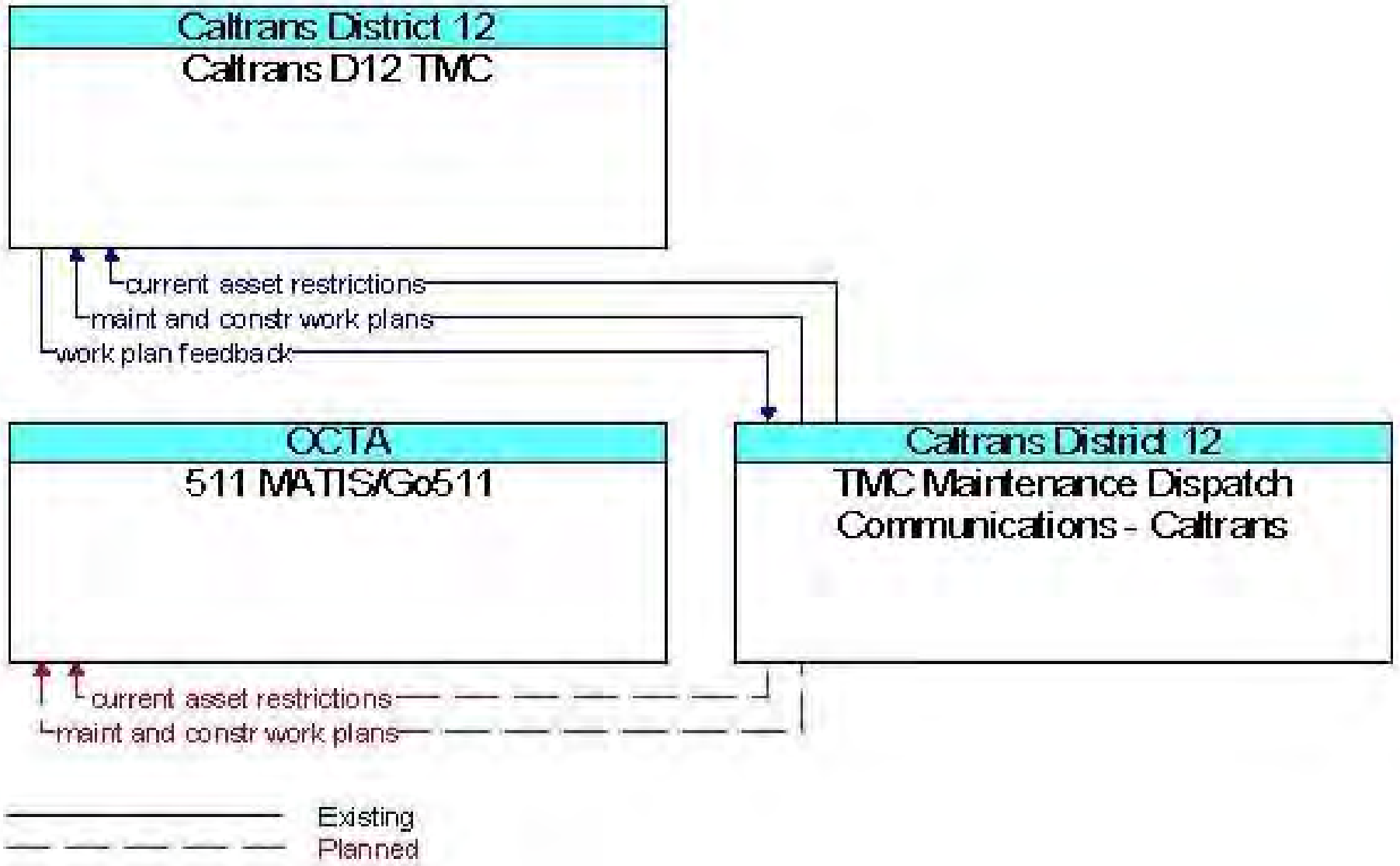

OCTA
511 MATIS/Go511
road weather information
Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
TMC Maintenance Dispatch
Communications - Caltrans
road weather information
Existing
Planned

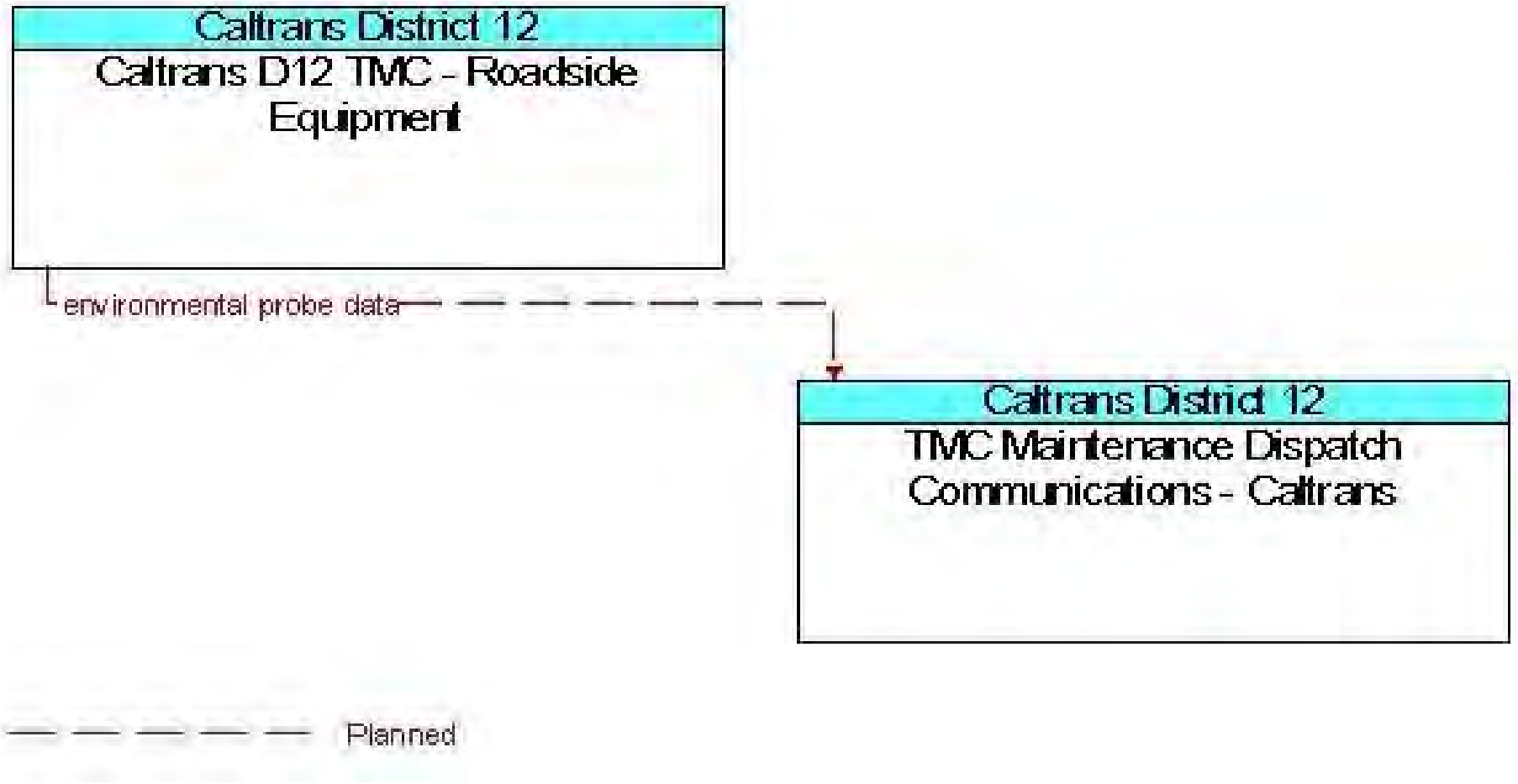

Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
roadway treatment system control
roadway treatment system status
Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
Planned

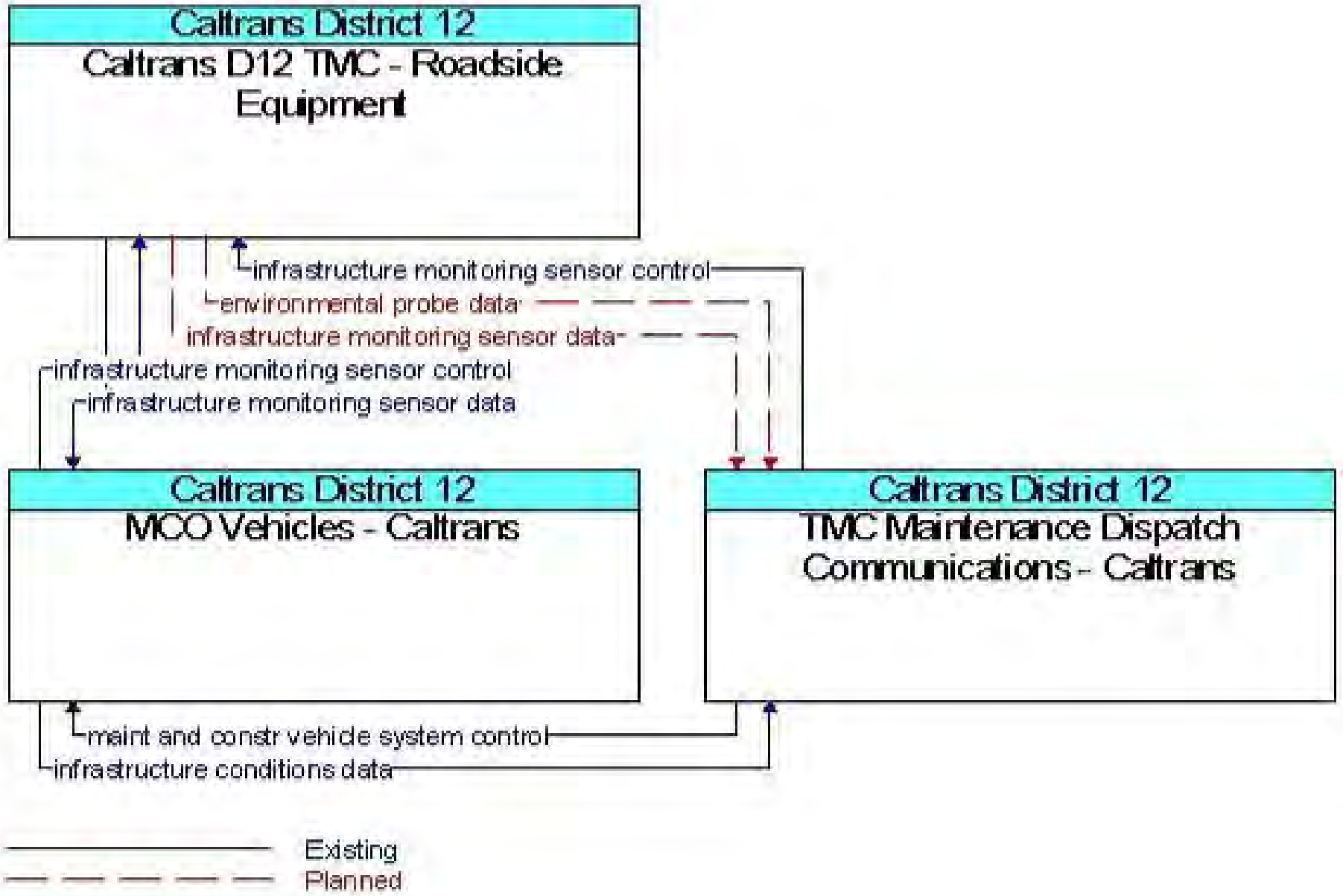

Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
maint and constr dispatch status
maint and constr vehicle operational data
maint and constr dispatch information
maint and constr vehicle system control
Caltrans District 12
MCO Vehicles - Caltrans
Existing

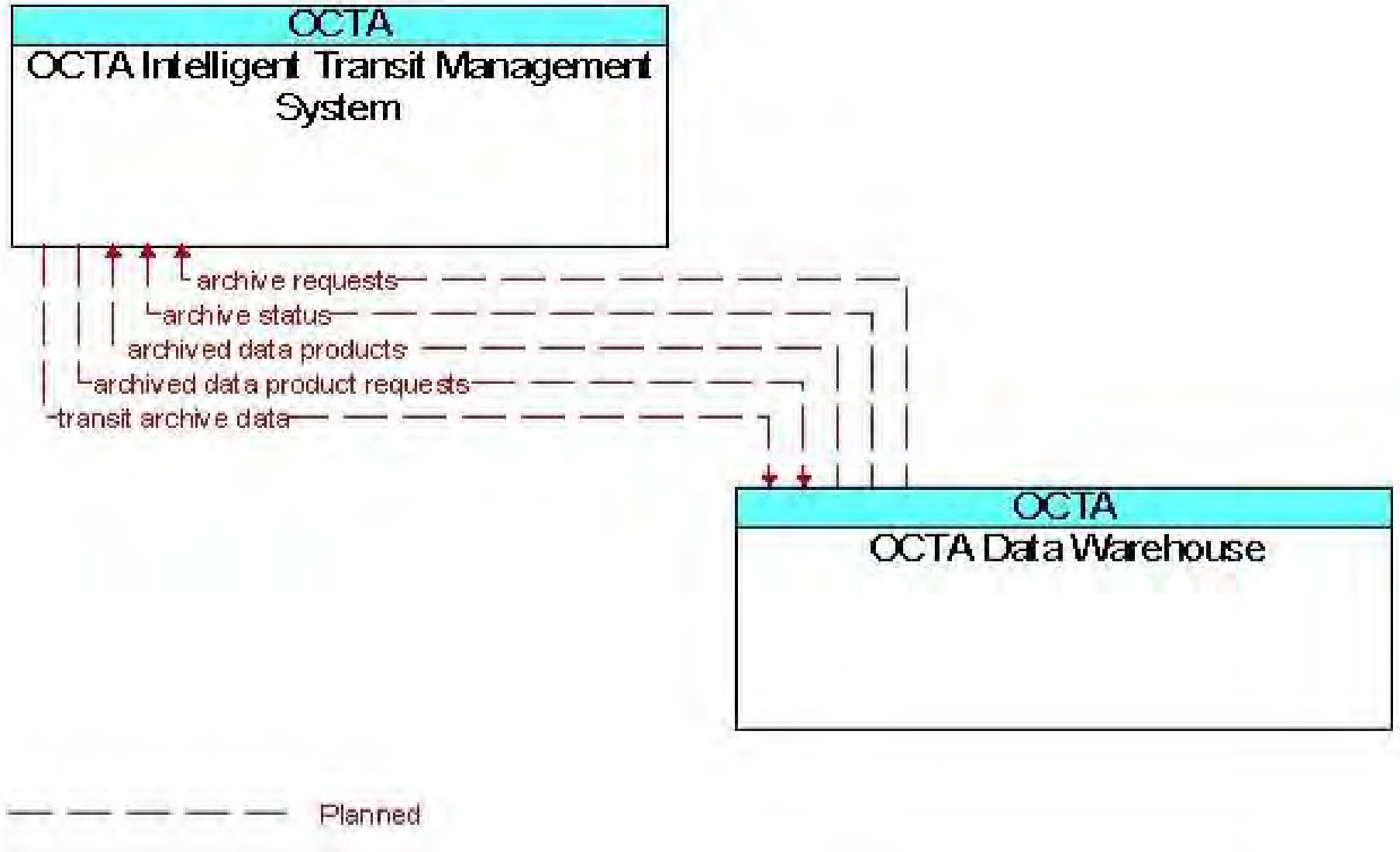

Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
Caltrans District 12
MCO Vehicles - Caltrans
barrier system status
roadway information system status
traffic images
barrier system control
roadway information system data
video surveillance control
roadway information system status
roadway information system data
work zone status
work zone information
Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Cities
Roadside - Cities
roadway information system status
roadway information system data
roadway information system status
roadway information system data
Cities
TMC - Cities
Existing
Planned

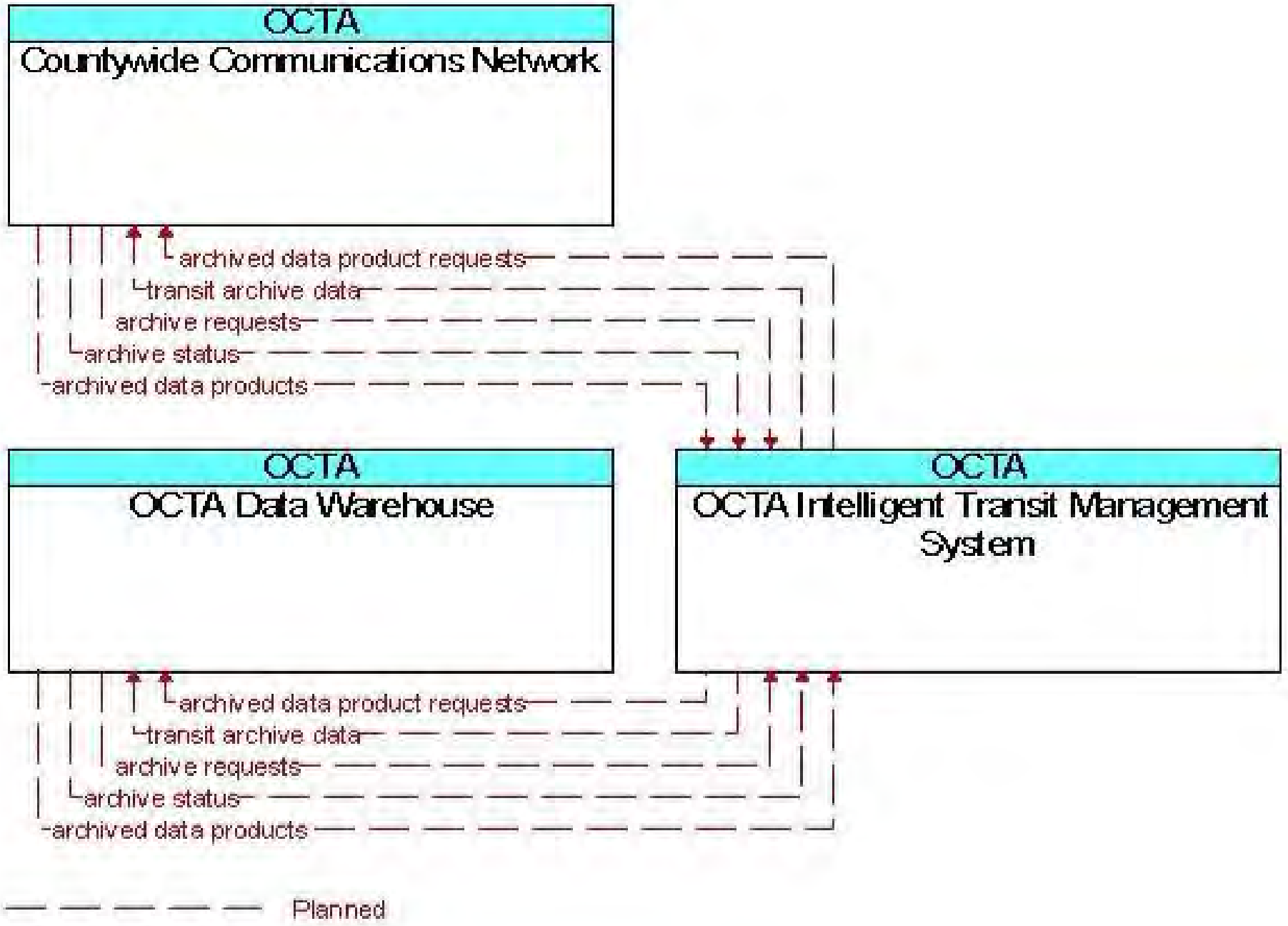

Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
work zone warning device control
work zone warning status
work zone warning notification
Caltrans District 12
MCO Vehicles - Caltrans
Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
work zone warning status
Existing
Planned

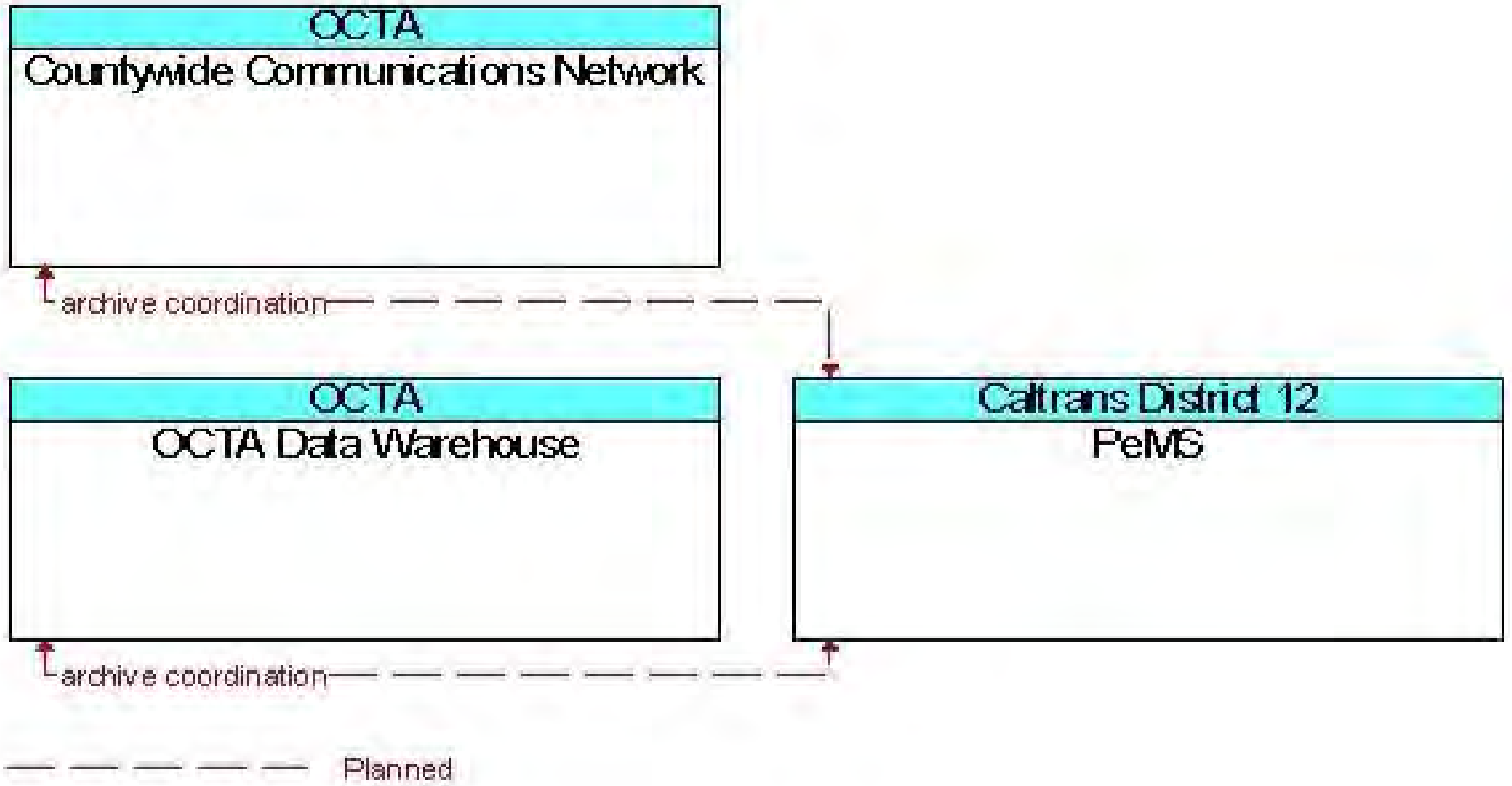

Caltrans District 12
Caltrans D12 TMC
current asset restrictions
maint and constr work plans
work plan feedback
OCTA
511 MATIS/Go511
Caltrans District 12
TMC Maintenance Dispatch
Communications - Caltrans
current asset restrictions
maint and constr work plans
Existing
Planned

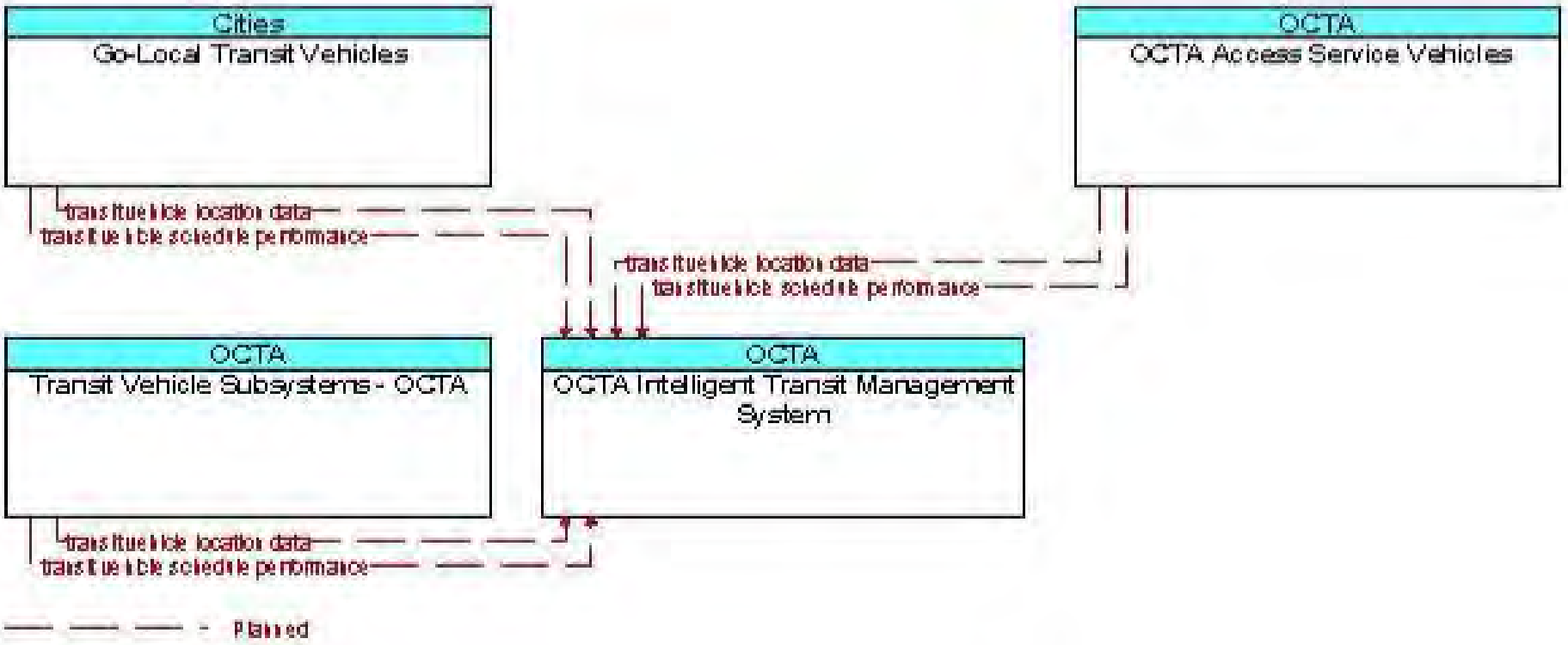

Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
environmental probe data
Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
Planned

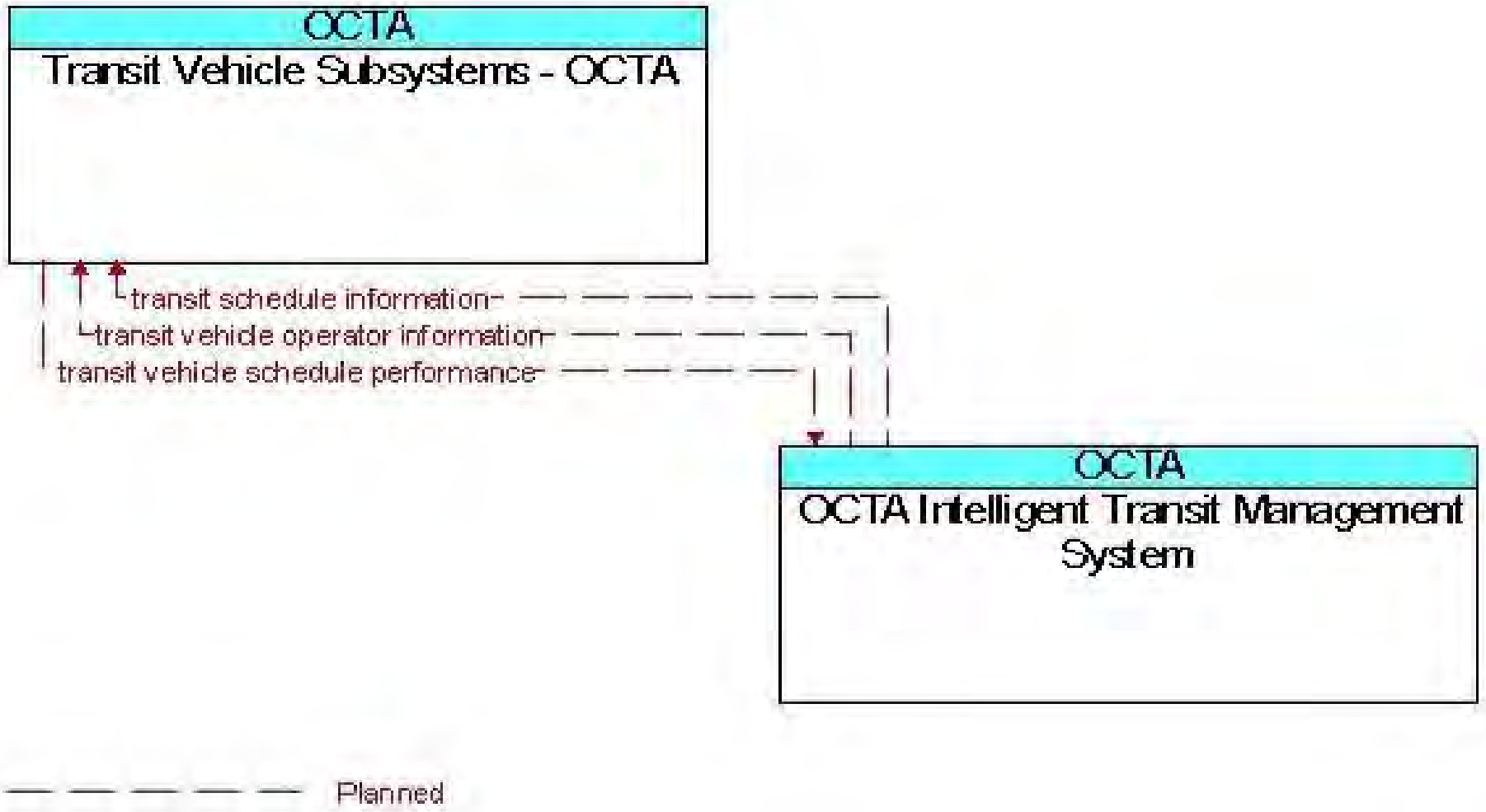

Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
infrastructure monitoring sensor control
environmental probe data
infrastructure monitoring sensor data
infrastructure monitoring sensor control
infrastructure monitoring sensor data
Caltrans District 12
MCO Vehicles - Caltrans
Caltrans District 12
TMC Maintenance Dispatch Communications - Caltrans
maint and constr vehicle system control
infrastructure conditions data
Existing
Planned

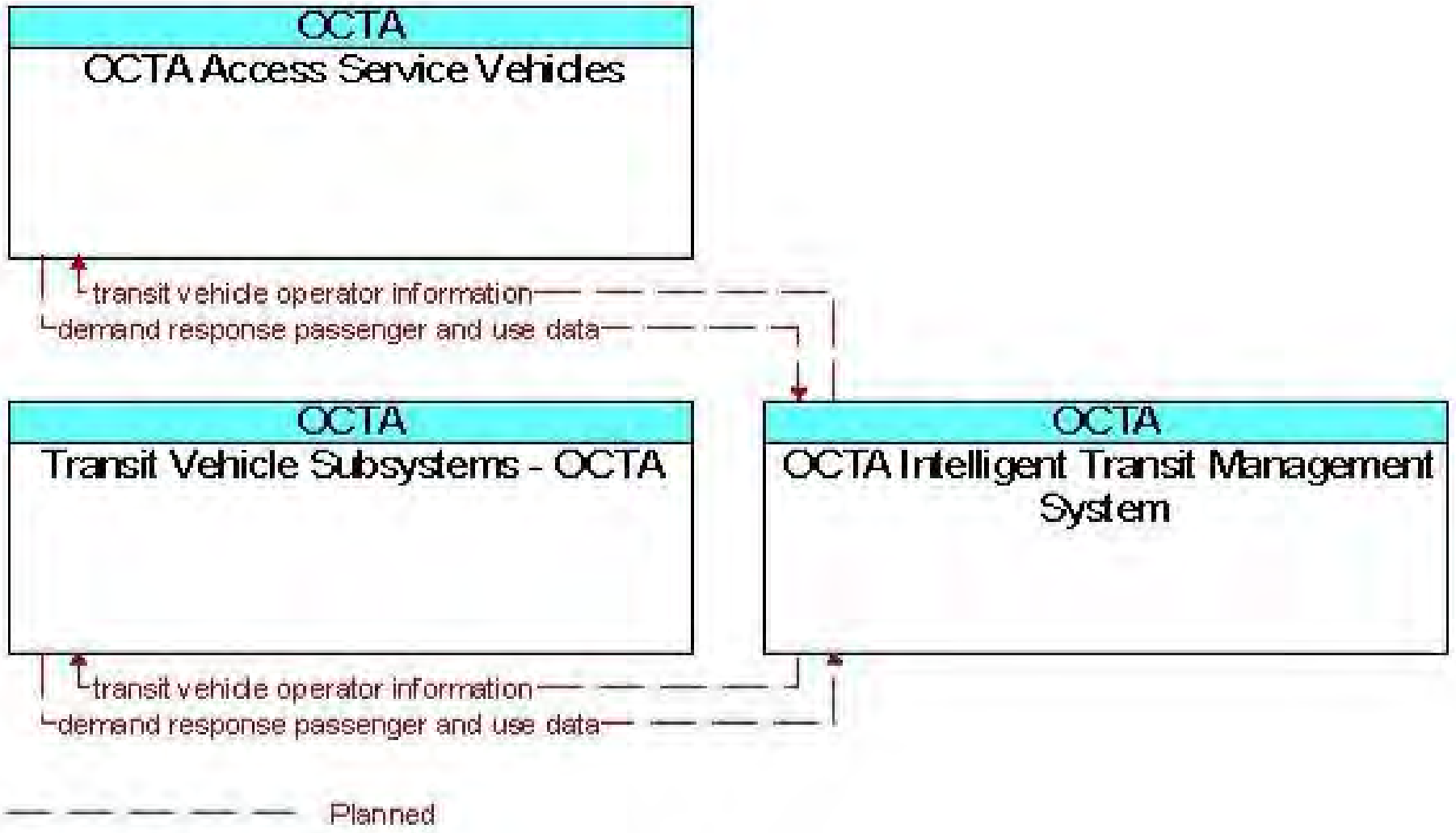

OCTA
OCTA Intelligent Transit Management System
archive requests
archive status
archived data products
archived data product requests
transit archive data
OCTA
OCTA Data Warehouse
Planned

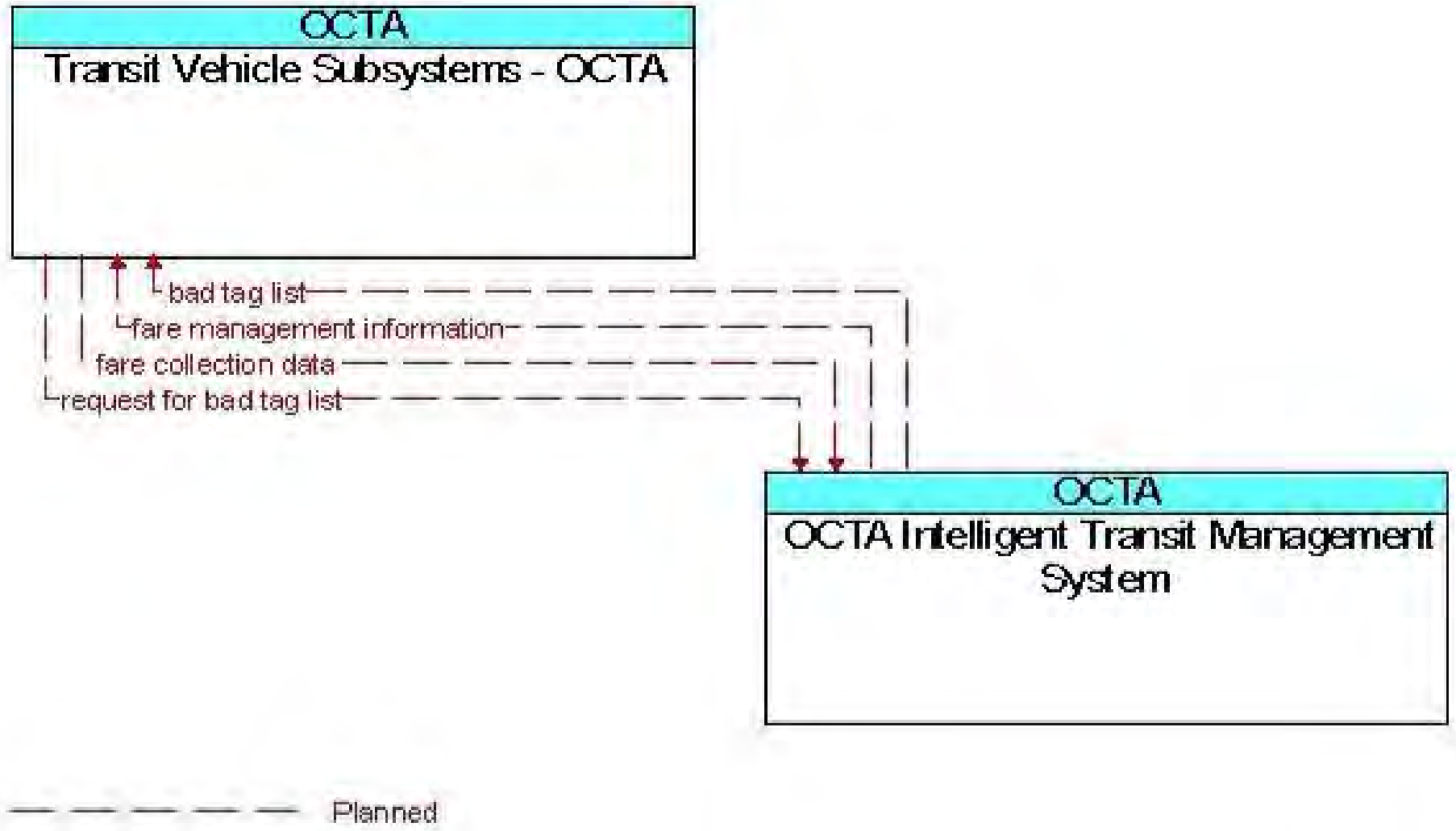

OCTA
Countywide Communications Network
archived data product requests
transit archive data
archive requests
archive status
archived data products
OCTA
OCTA Data Warehouse
OCTA
OCTA Intelligent Transit Management System
archived data product requests
transit archive data
archive requests
archive status
archived data products
Planned


OCTA
Countywide Communications Network
archive coordination
OCTA
OCTA Data Warehouse
Caltrans District 12
PeMS
archive coordination
Planned


Cities
Go-Local Transit Vehicles
OCTA
OCTA Access Service Vehicles
transit vehicle location data
transit vehicle schedule performance
transit vehicle location data
transit vehicle schedule performance
OCTA
Transit Vehicle Subsystems - OCTA
OCTA
OCTA Intelligent Transit Management System
transit vehicle location data
transit vehicle schedule performance
Planned


OCTA
Transit Vehicle Subsystems - OCTA
transit schedule information
transit vehicle operator information
transit vehicle schedule performance
OCTA
OCTA Intelligent Transit Management System
Planned


OCTA
OCTA Access Service Vehicles
transit vehicle operator information
demand response passenger and use data
OCTA
Transit Vehicle Subsystems - OCTA
OCTA
OCTA Intelligent Transit Management System
transit vehicle operator information
demand response passenger and use data
Planned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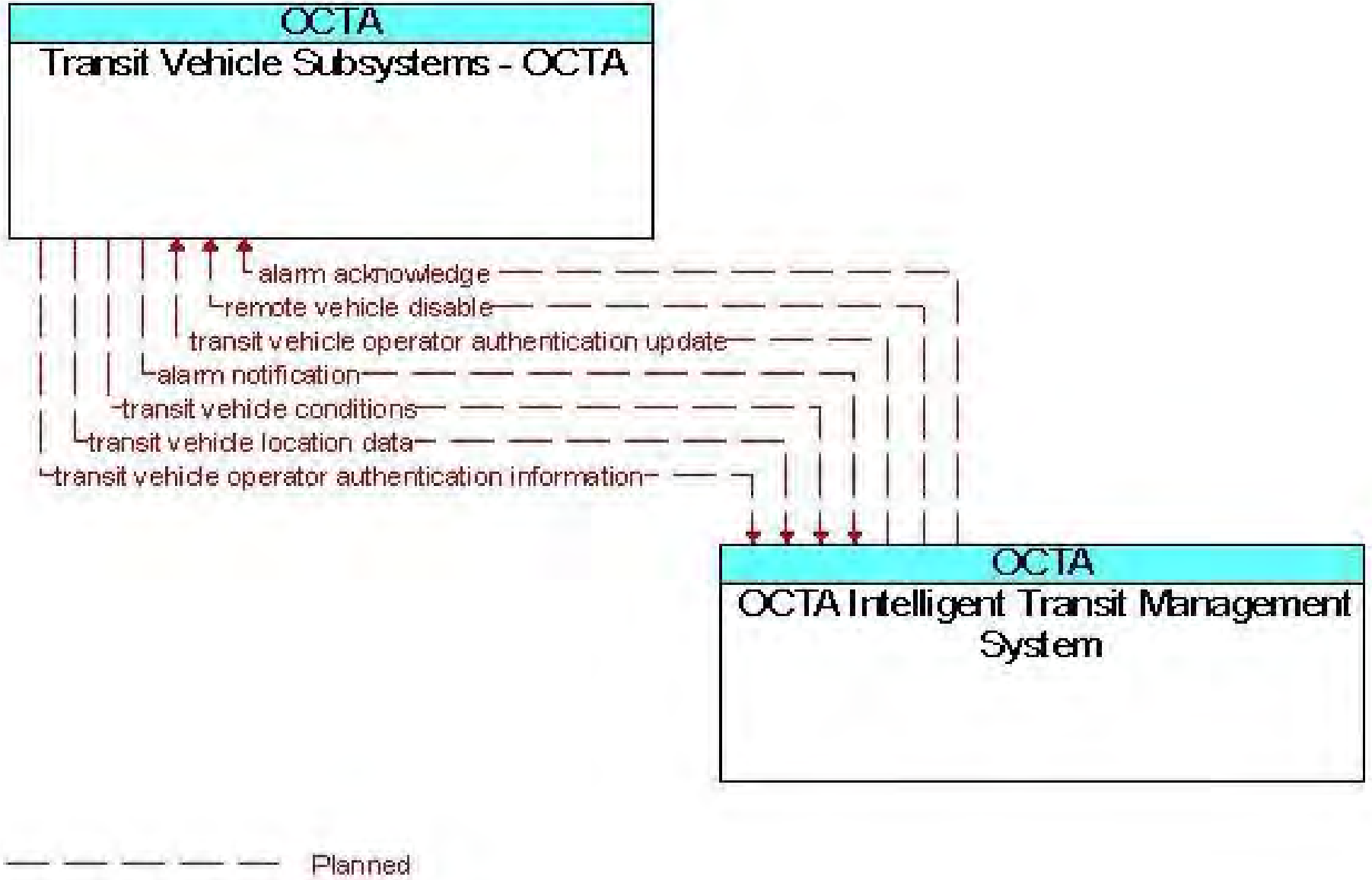
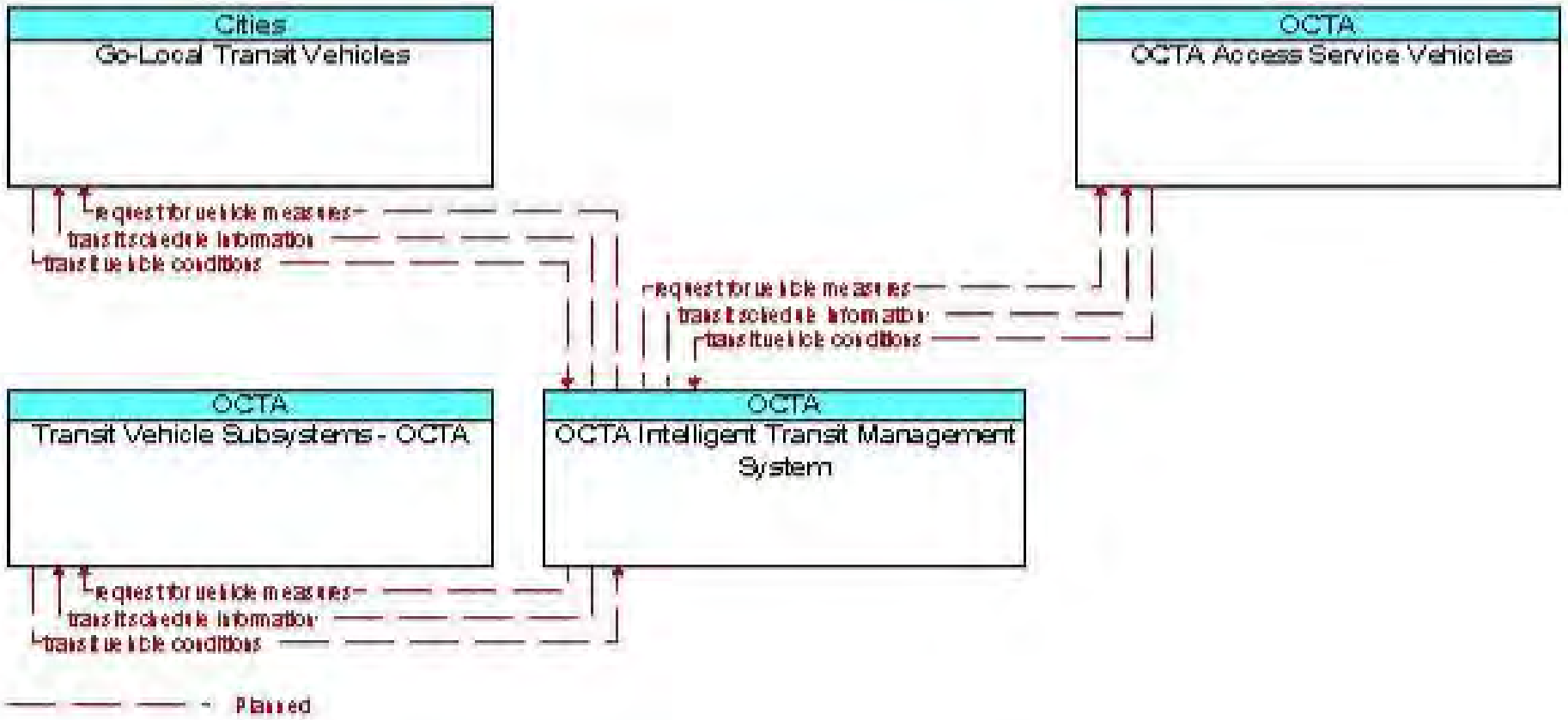
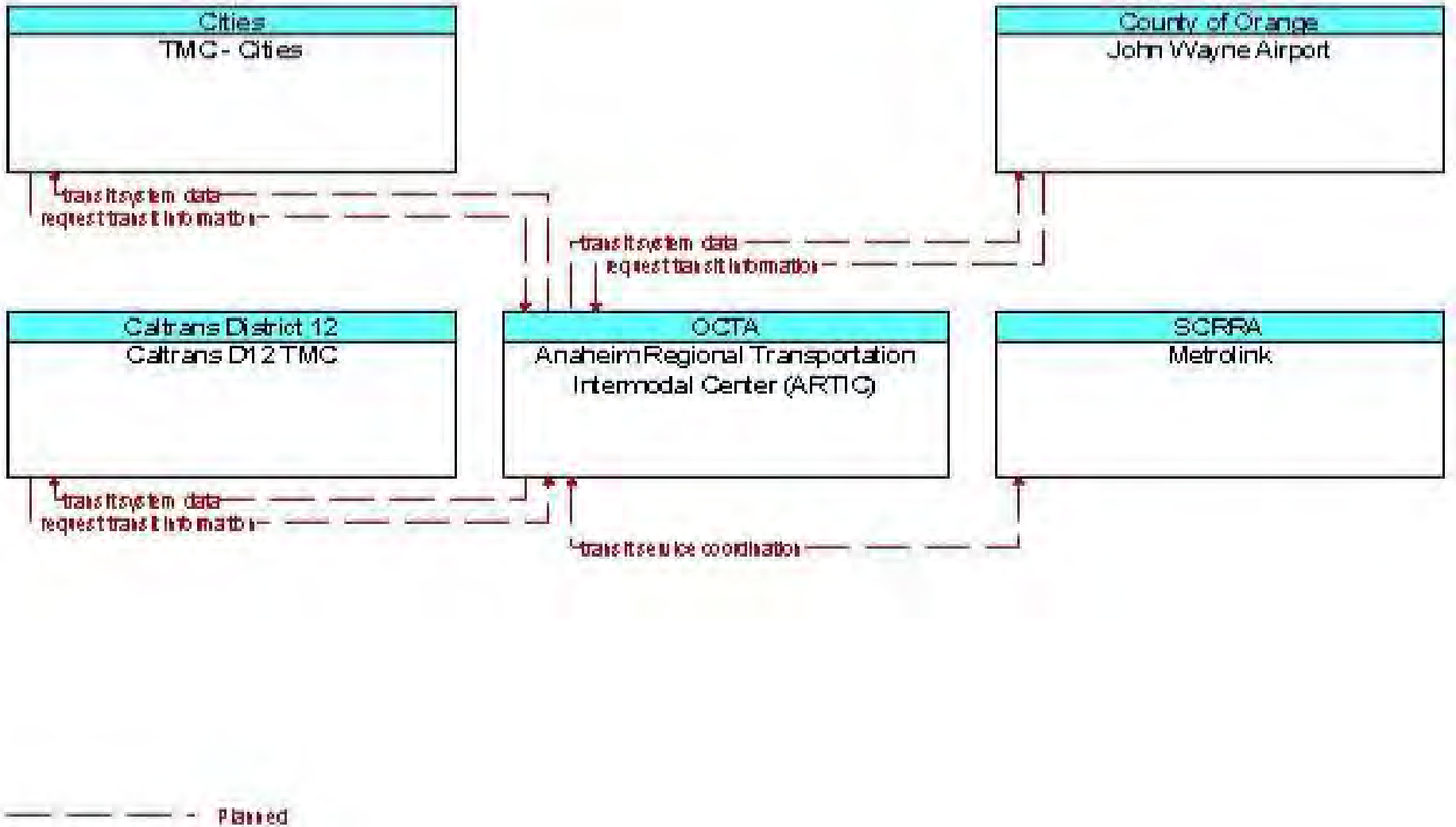
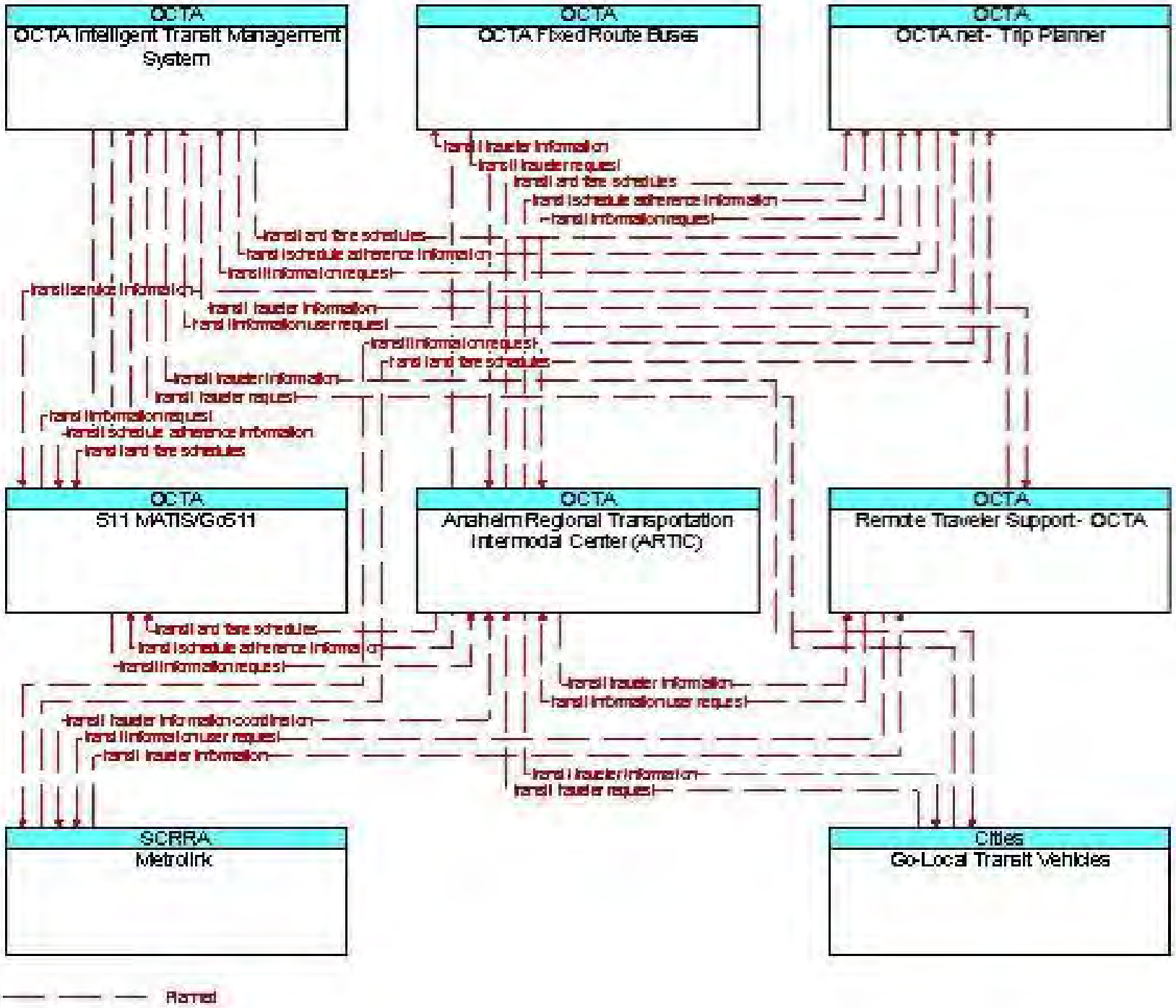
Transit Vehicle Subsystems - OCTA
bad tag list
fare management information
fare collection data
request for bad tag list
OCTA
OCTA Intelligent Transit Management System
Planned


OCTA
Transit Vehicle Subsystems - OCTA
alarm acknowledge
remote vehicle disable
transit vehicle operator authentication update
alarm notification
transit vehicle conditions
transit vehicle location data
transit vehicle operator authentication information
OCTA
OCTA Intelligent Transit Management System
Planned


Cities
Go-Local Transit Vehicles
OCTA
OCTA Access Service Vehicles
request for vehicle measures
transit schedule information
transit vehicle conditions
request for vehicle measures
transit schedule information
transit vehicle conditions
OCTA
Transit Vehicle Subsystems - OCTA
OCTA
OCTA Intelligent Transit Management System
request for vehicle measures
transit schedule information
transit vehicle conditions
Planned


Cities
TMC - Cities
County of Orange
John Wayne Airport
transit system data
request transit information
transit system data
request transit information
Caltrans District 12
Caltrans D12 TMC
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
SCRRA
Metrolink
transit system data
request transit information
transit service coordination
- Planned


OCTA
OCTA Intelligent Transit Management System
OCTA
OCTA Fixed Route Buses
OCTA
OCTA.net- Trip Planner
transit traveler information
transit traveler request
transit and fare schedules
transit schedule adherence information
transit information request
transit and fare schedules
transit schedule adherence information
transit information request
transit service information
transit traveler information
transit information user request
transit information request
transit and fare schedules
transit traveler information
transit traveler request
transit information request
transit schedule adherence information
transit and fare schedules
OCTA
511 MATIS/Go511
OCTA
Anaheim Regional Transportation Intermodal Center (ARTIC)
OCTA
Remote Traveler Support- OCTA
transit and fare schedules
transit schedule adherence information
transit information request
transit traveler information
transit information user request
transit traveler information coordination
transit information user request
transit traveler information
transit traveler information
transit traveler request
SCRRA
Metrolink
Cities
Go-Local Transit Vehicles
Planned

Appendix E: Regional ITS Architecture – Standards

Relevant Standards Activities

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Standards for Orange County

NOTE: The ITS standards presented in this report may represent a superset of options, and in some cases, provide redundant capabilities. In addition, these ITS standards are at different maturity levels. Care should be taken to select the standards that best meet the needs of the region or project.

Lead SDO	Standard Name	Version	Document ID
AASHTO/ITE	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)		ITE TMDD
AASHTO/ITE/NEMA	NTCIP Center-to-Center Standards Group		(See Footnote)
AASHTO/ITE/NEMA	NTCIP Center-to-Field Standards Group		(See Footnote)
AASHTO/ITE/NEMA	Global Object Definitions		NTCIP 1201
AASHTO/ITE/NEMA	Object Definitions for Actuated Traffic Signal Controller (ASC) Units		NTCIP 1202
AASHTO/ITE/NEMA	Object Definitions for Dynamic Message Signs (DMS)		NTCIP 1203
AASHTO/ITE/NEMA	Object Definitions for Environmental Sensor Stations (ESS)		NTCIP 1204
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Camera Control		NTCIP 1205
AASHTO/ITE/NEMA	Object Definitions for Data Collection and Monitoring (DCM) Devices		NTCIP 1206
AASHTO/ITE/NEMA	Object Definitions for Ramp Meter Control (RMC) Units		NTCIP 1207
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Switching		NTCIP 1208
AASHTO/ITE/NEMA	Data Element Definitions for Transportation Sensor Systems (TSS)		NTCIP 1209
AASHTO/ITE/NEMA	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters		NTCIP 1210
AASHTO/ITE/NEMA	Object Definitions for Signal Control and Prioritization (SCP)		NTCIP 1211
AASHTO/ITE/NEMA	Object Definitions for Electrical and Lighting Management Systems (ELMS)		NTCIP 1213
AASHTO/ITE/NEMA	Object Definitions for Conflict Monitor Units (CMU)		NTCIP 1214

Standards for Orange County

Lead SDO	Standard Name	Version	Document ID
APTA	Standard for Transit Communications Interface Profiles		APTA TCIP-S-001 3.0.4
ASTM	Dedicated Short Range Communication at 915 MHz Standards Group		(See Footnote)
ASTM	Standard Practice for Metadata to Support Archived Data Management Systems		ASTM E2468-05
ASTM	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data		ASTM E2665-08
ASTM/IEEE/SAE	Dedicated Short Range Communication at 5.9 GHz Standards Group		(See Footnote)
IEEE	Incident Management Standards Group		(See Footnote)
IEEE	Standard for Message Sets for Vehicle/Roadside Communications		IEEE 1455-1999
SAE	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group		(See Footnote)
SAE	Advanced Traveler Information Systems (ATIS) General Use Standards Group		(See Footnote)

Lead SDO	Standard Name	Version	Document ID

Footnotes:

Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group

SDO	Standard Name	Document ID
SAE	Location Referencing Message Specification (LRMS)	SAE J2266
SAE	Message Set for Advanced Traveler Information System (ATIS)	SAE J2354
SAE	Standard for ATIS Message Sets Delivered Over Reduced Bandwidth Media	SAE J2369
SAE	Messages for Handling Strings and Look-Up Tables in ATIS Standards	SAE J2540
SAE	RDS (Radio Data System) Phrase Lists	SAE J2540/1
SAE	ITIS (International Traveler Information Systems) Phrase Lists	SAE J2540/2
SAE	National Names Phrase List	SAE J2540/3

Advanced Traveler Information Systems (ATIS) General Use Standards Group

SDO	Standard Name	Document ID
SAE	Location Referencing Message Specification (LRMS)	SAE J2266
SAE	Message Set for Advanced Traveler Information System (ATIS)	SAE J2354
SAE	Messages for Handling Strings and Look-Up Tables in ATIS Standards	SAE J2540
SAE	RDS (Radio Data System) Phrase Lists	SAE J2540/1
SAE	ITIS (International Traveler Information Systems) Phrase Lists	SAE J2540/2
SAE	National Names Phrase List	SAE J2540/3

Dedicated Short Range Communication at 5.9 GHz Standards Group

SDO	Standard Name	Document ID
ASTM	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications	ASTM E2213-03
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager	IEEE 1609.1-2006
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages	IEEE 1609.2-2006
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services	IEEE 1609.3
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation	IEEE 1609.4-2006
IEEE	Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification	IEEE 802.11p

Lead SDO	Standard Name	Version	Document ID

Dedicated Short Range Communication at 5.9 GHz Standards Group

SDO	Standard Name	Document ID
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Architecture	IEEE P1609.0

Dedicated Short Range Communication at 915 MHz Standards Group

SDO	Standard Name	Document ID
ASTM	Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band	ASTM E2158-01

Incident Management Standards Group

SDO	Standard Name	Document ID
IEEE	Standard for Common Incident Management Message Sets for use by Emergency Management Centers	IEEE 1512 -2006
IEEE	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.1-2006
IEEE	Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.2-2004
IEEE	Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.3-2006
IEEE	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers	IEEE P1512.4

NTCIP Center-to-Center Standards Group

SDO	Standard Name	Document ID
AASHTO/ITE/NEMA	Octet Encoding Rules (OER) Base Protocol	NTCIP 1102
AASHTO/ITE/NEMA	Center-to-Center Naming Convention Specification	NTCIP 1104
AASHTO/ITE/NEMA	Ethernet Subnetwork Profile	NTCIP 2104
AASHTO/ITE/NEMA	Internet (TCP/IP and UDP/IP) Transport Profile	NTCIP 2202
AASHTO/ITE/NEMA	File Transfer Protocol (FTP) Application Profile	NTCIP 2303
AASHTO/ITE/NEMA	Application Profile for DATEX-ASN (AP-DATEX)	NTCIP 2304
AASHTO/ITE/NEMA	Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML)	NTCIP 2306

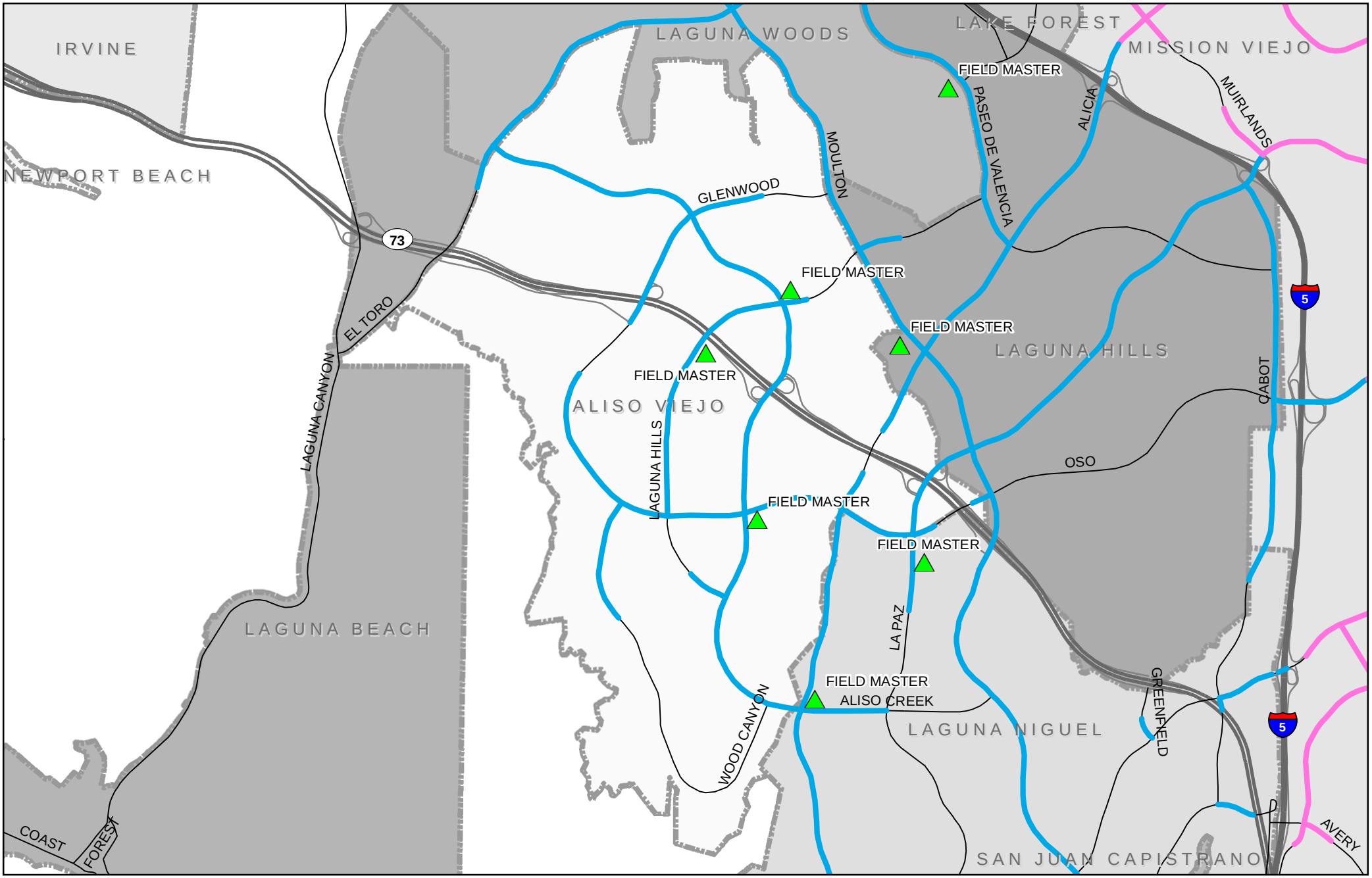
NTCIP Center-to-Field Standards Group

SDO	Standard Name	Document ID
AASHTO/ITE/NEMA	Octet Encoding Rules (OER) Base Protocol	NTCIP 1102
AASHTO/ITE/NEMA	Transportation Management Protocols (TMP)	NTCIP 1103
AASHTO/ITE/NEMA	Point to Multi-Point Protocol Using RS-232 Subnetwork Profile	NTCIP 2101
AASHTO/ITE/NEMA	Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile	NTCIP 2102
AASHTO/ITE/NEMA	Point-to-Point Protocol Over RS-232 Subnetwork Profile	NTCIP 2103
AASHTO/ITE/NEMA	Ethernet Subnetwork Profile	NTCIP 2104
AASHTO/ITE/NEMA	Transportation Transport Profile	NTCIP 2201
AASHTO/ITE/NEMA	Internet (TCP/IP and UDP/IP) Transport Profile	NTCIP 2202
AASHTO/ITE/NEMA	Simple Transportation Management Framework (STMF) Application Profile	NTCIP 2301
AASHTO/ITE/NEMA	Trivial File Transfer Protocol (TFTP) Application Profile	NTCIP 2302
AASHTO/ITE/NEMA	File Transfer Protocol (FTP) Application Profile	NTCIP 2303

Standards for Orange County

Lead SDO	Standard Name	Version	Document ID

Appendix F: Local Communications Inventory Maps



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF ALISO VIEJO

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

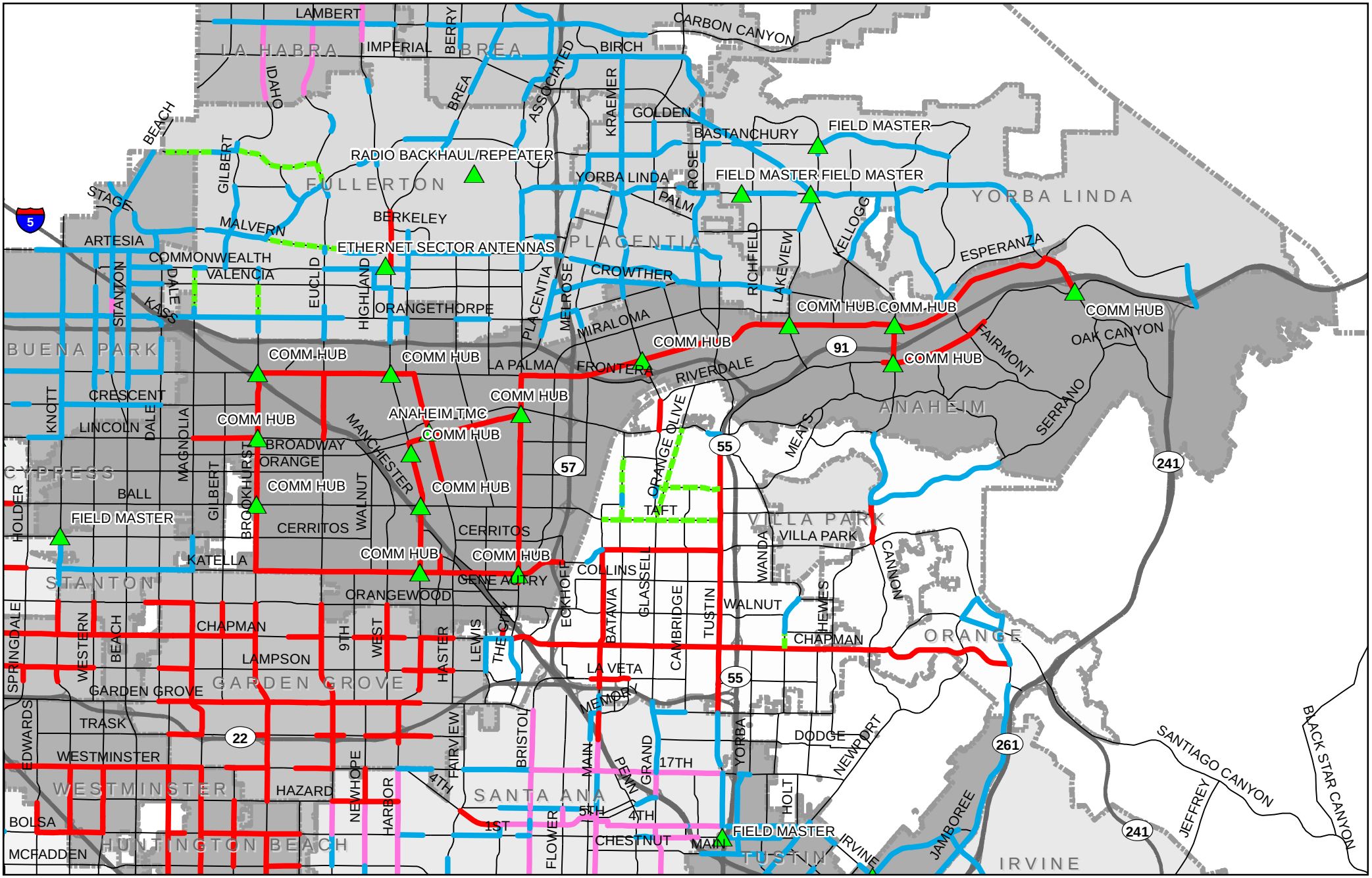
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF ANAHEIM

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

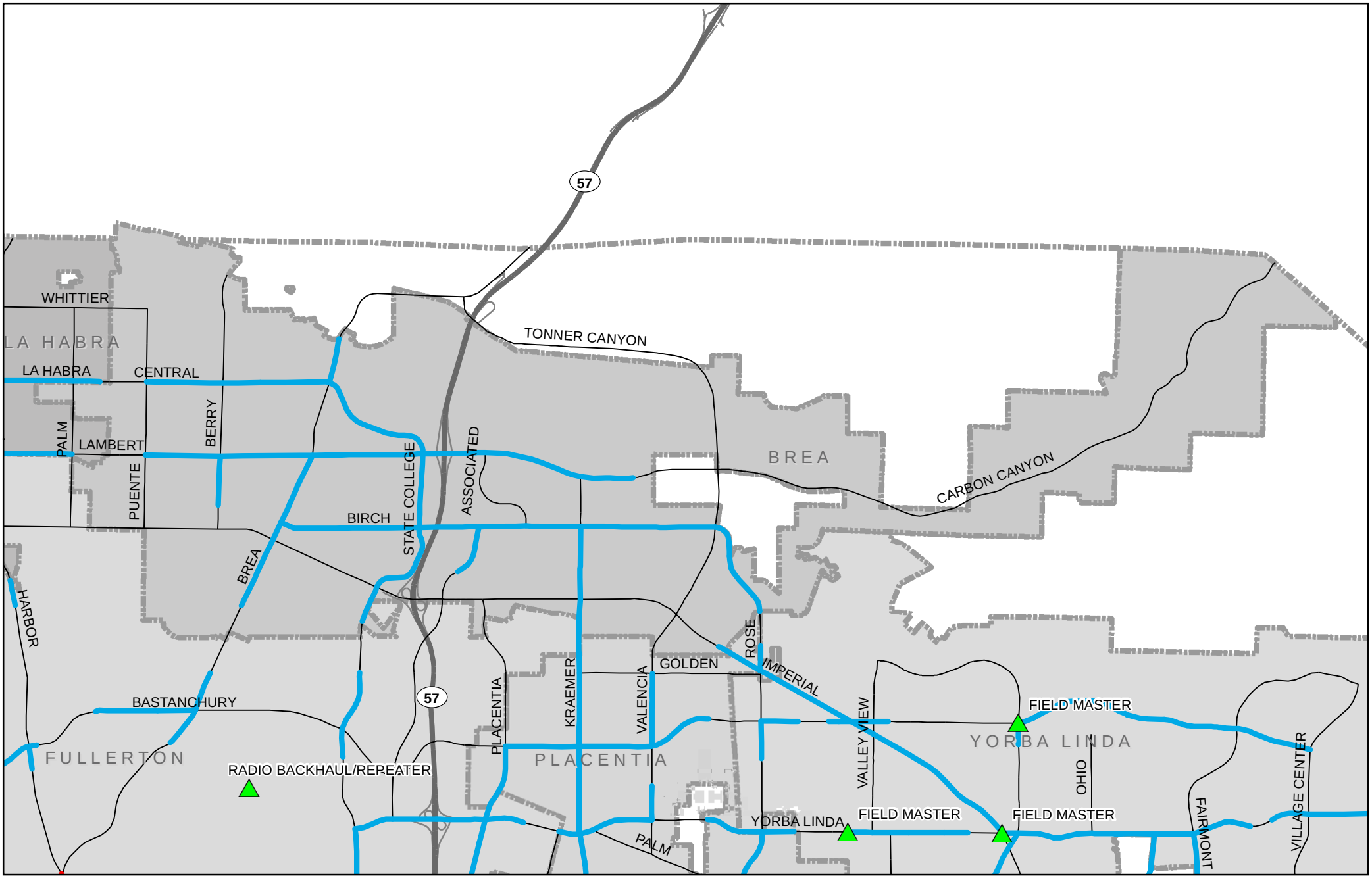
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF BREA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

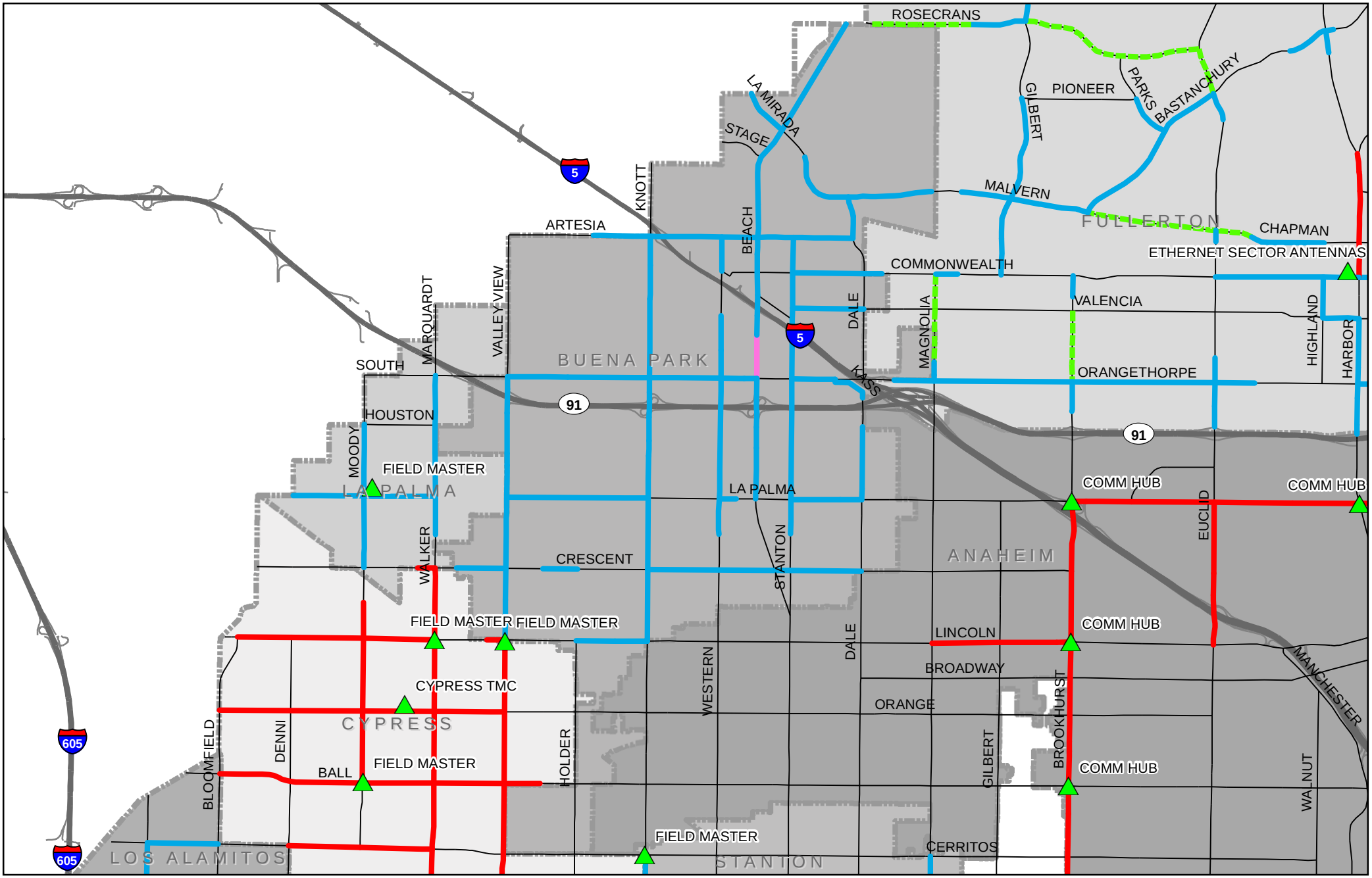
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS)
Strategic Deployment Plan Update

CITY OF BUENA PARK

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

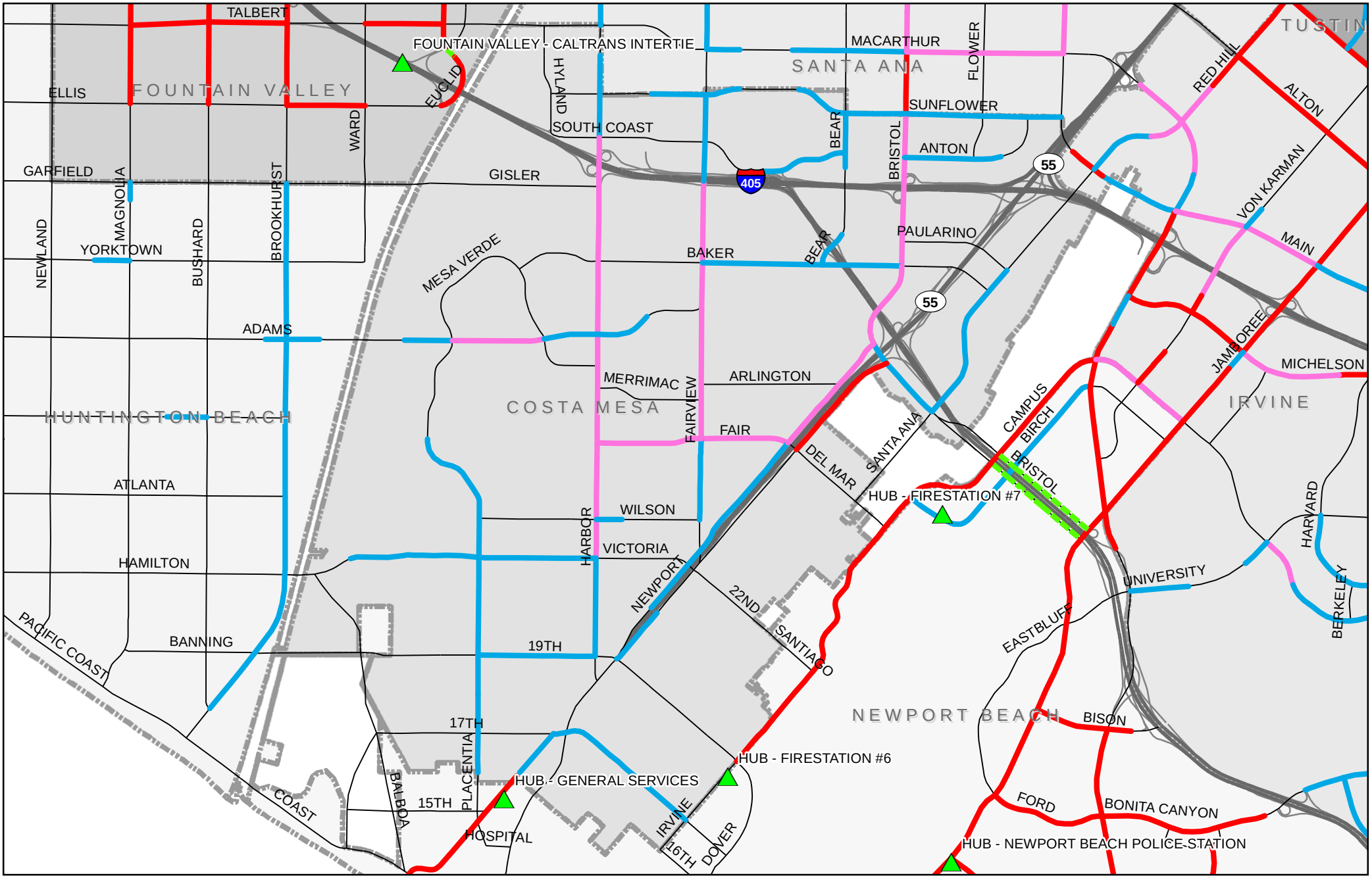
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF COSTA MESA

Legend

Communictions Interconnect

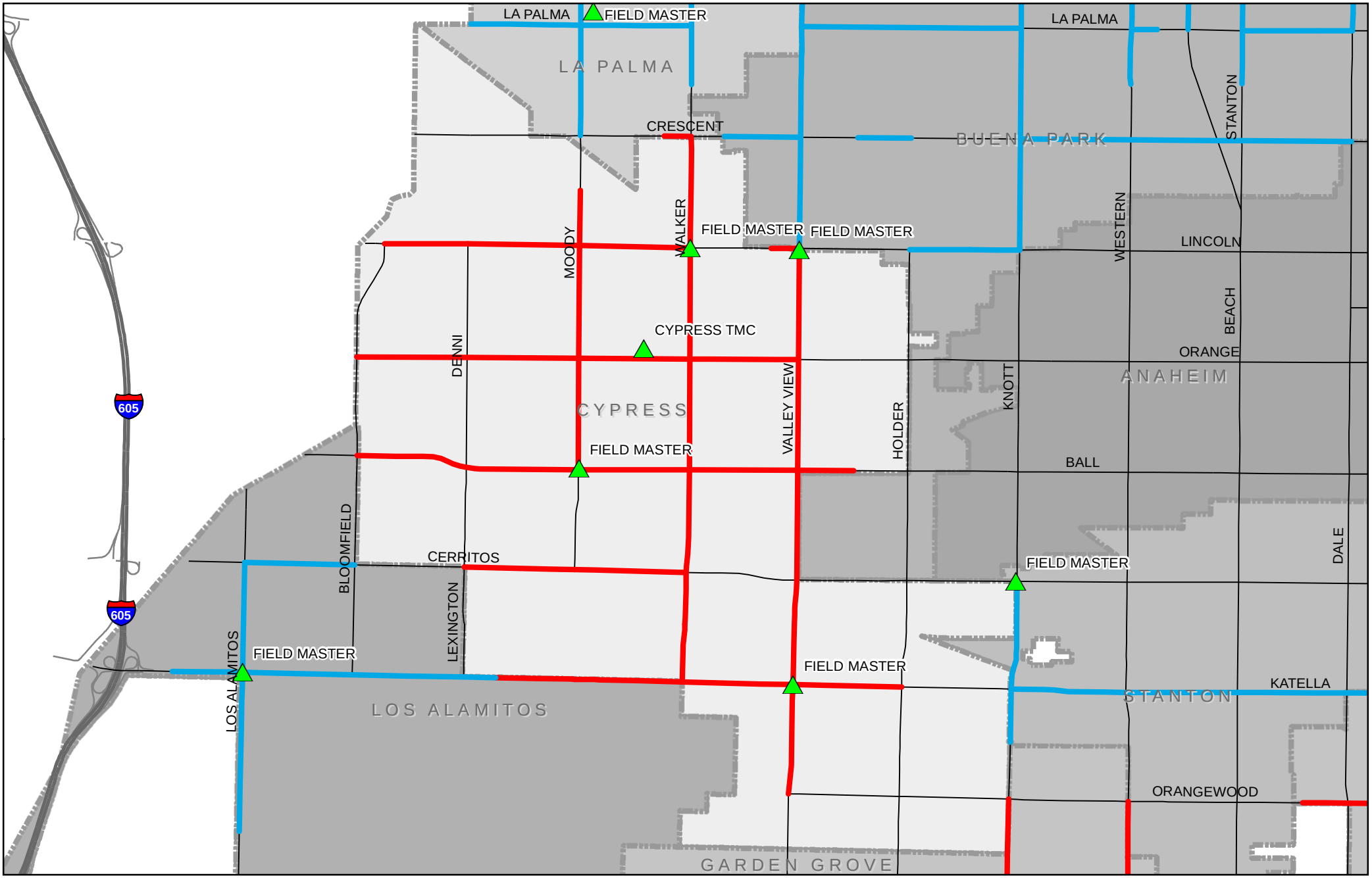
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF CYPRESS

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

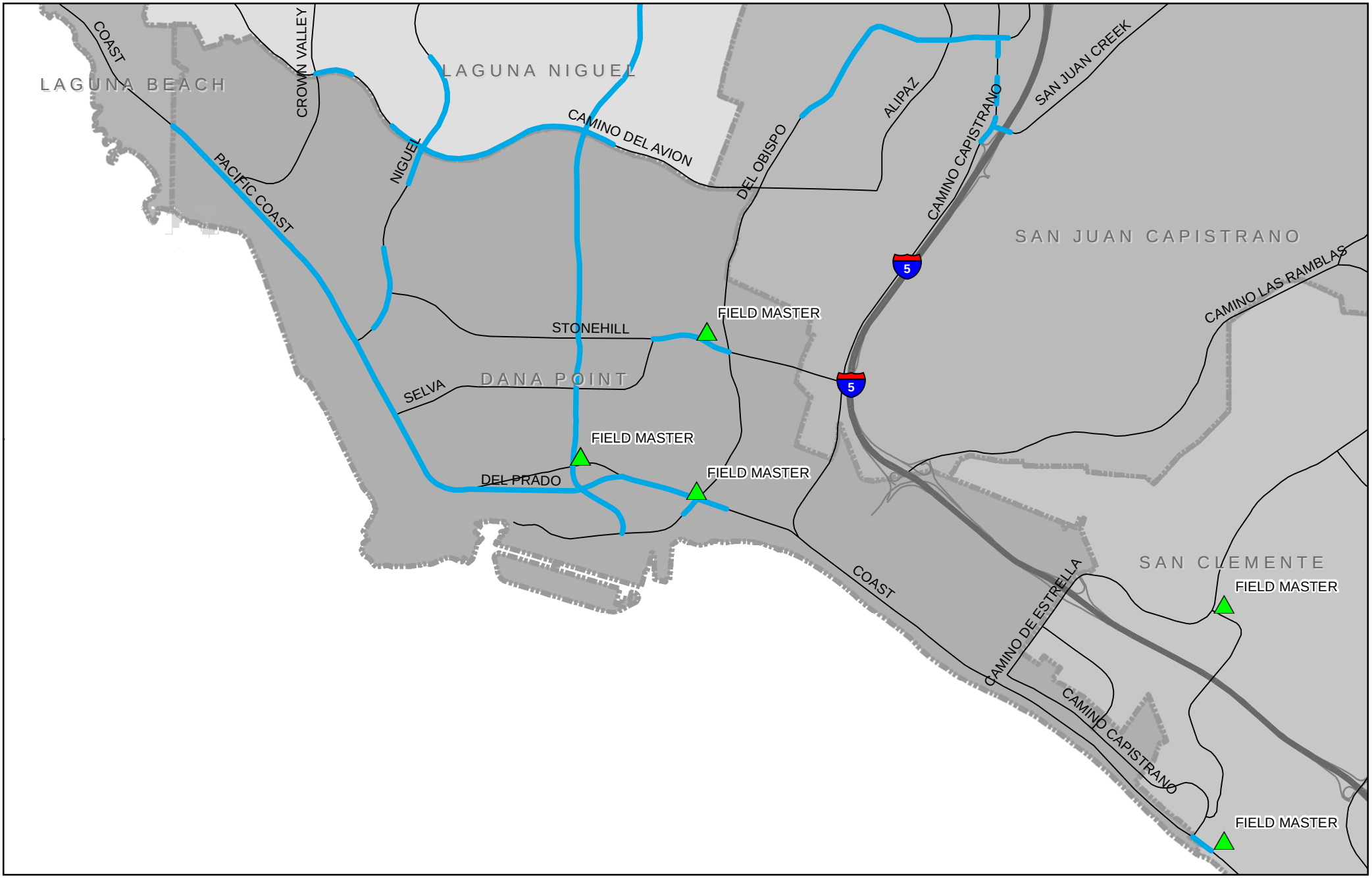
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF DANA POINT

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

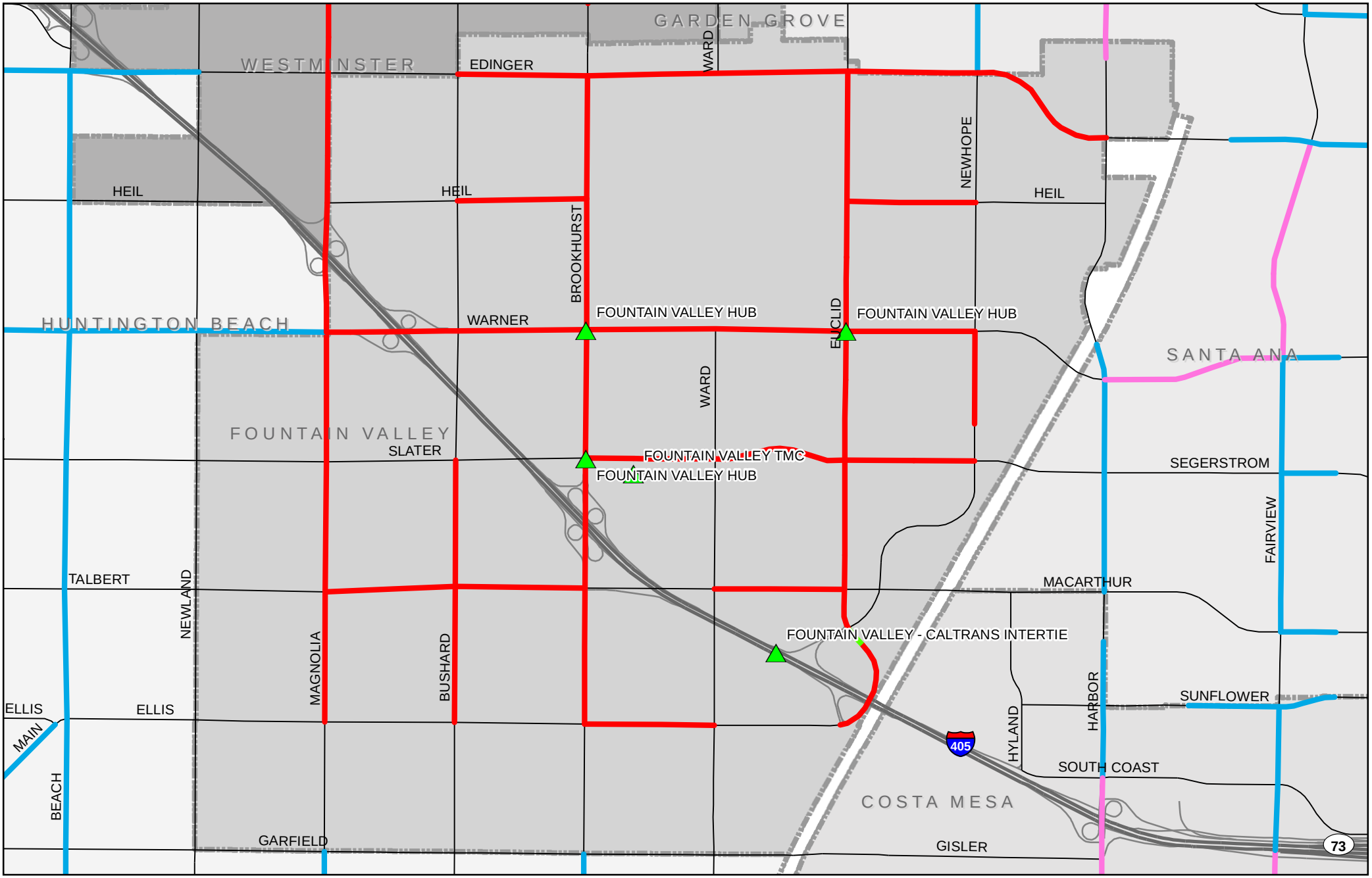
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF FOUNTAIN VALLEY

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

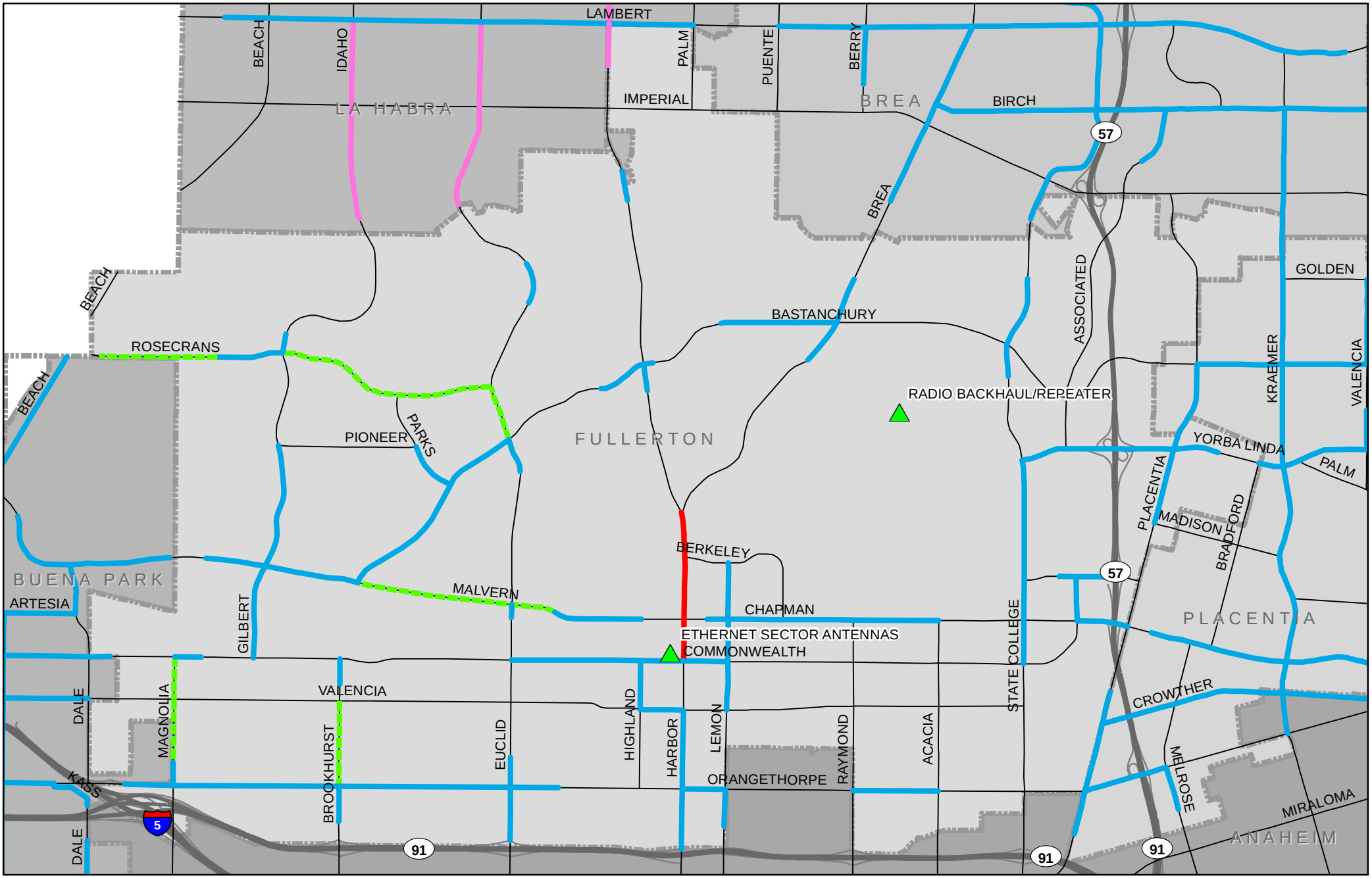
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF FULLERTON

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

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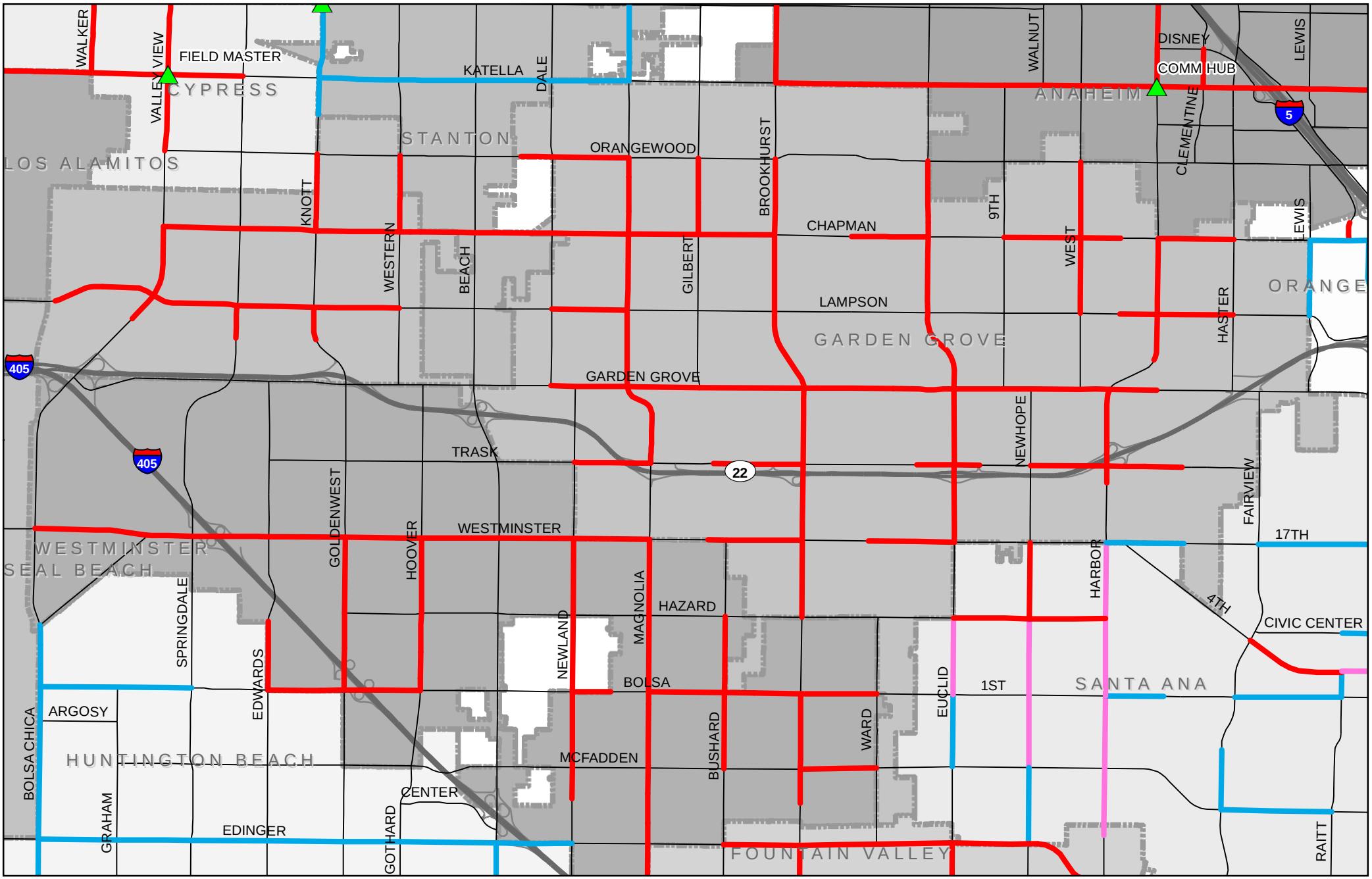


2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF GARDEN GROVE

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

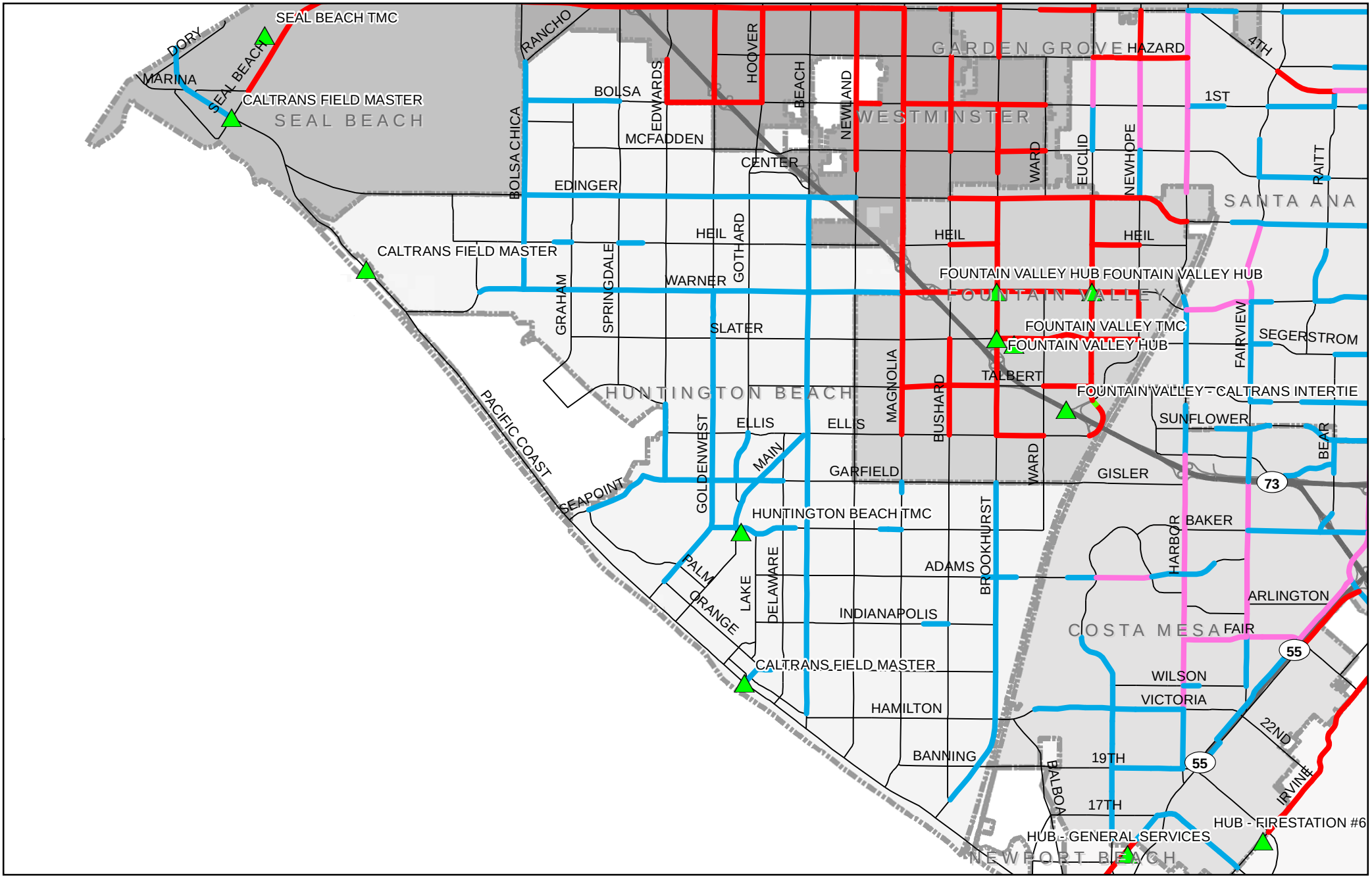
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF HUNTINGTON BEACH

Legend

Communictions Interconnect

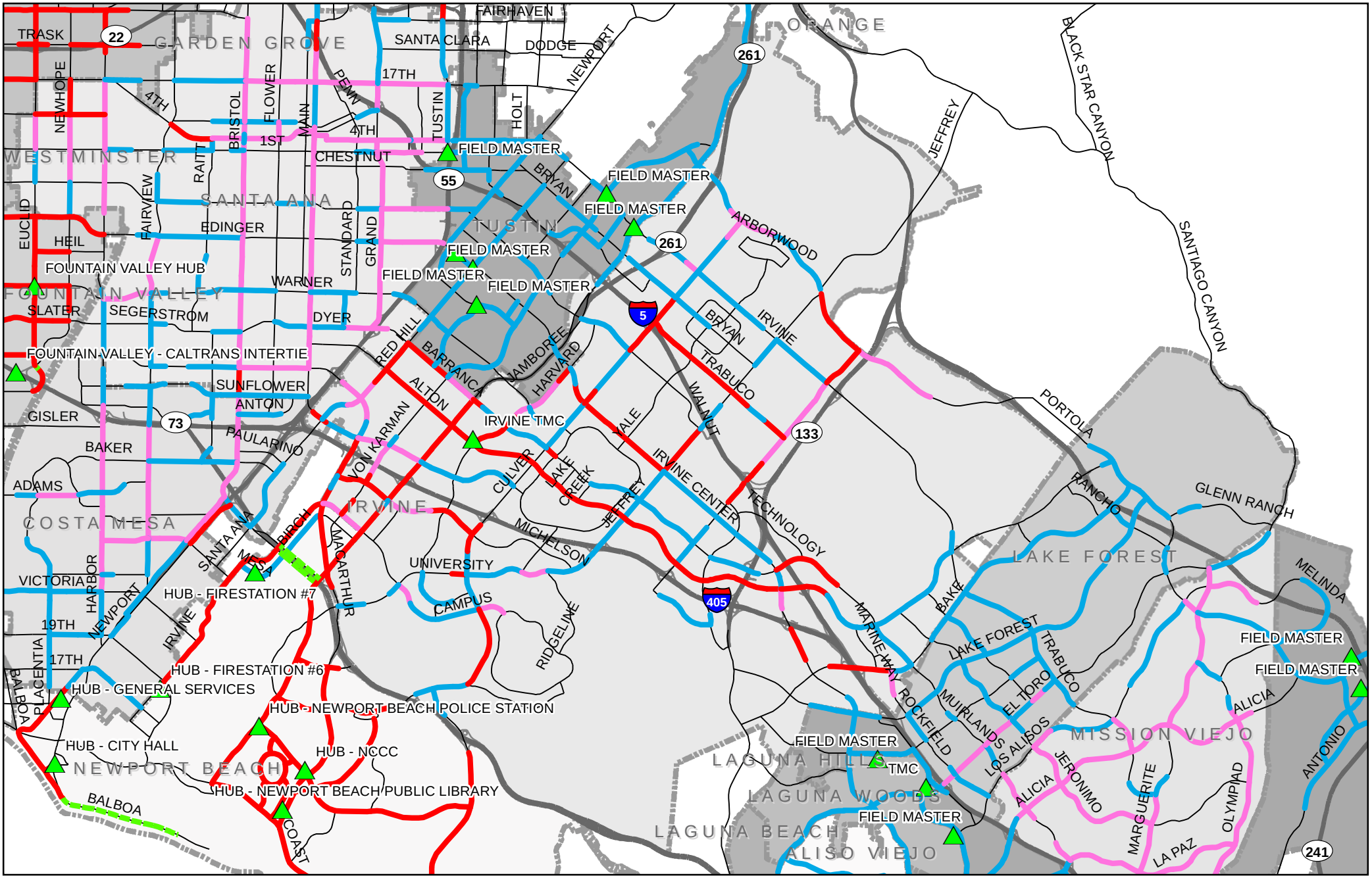
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF IRVINE

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

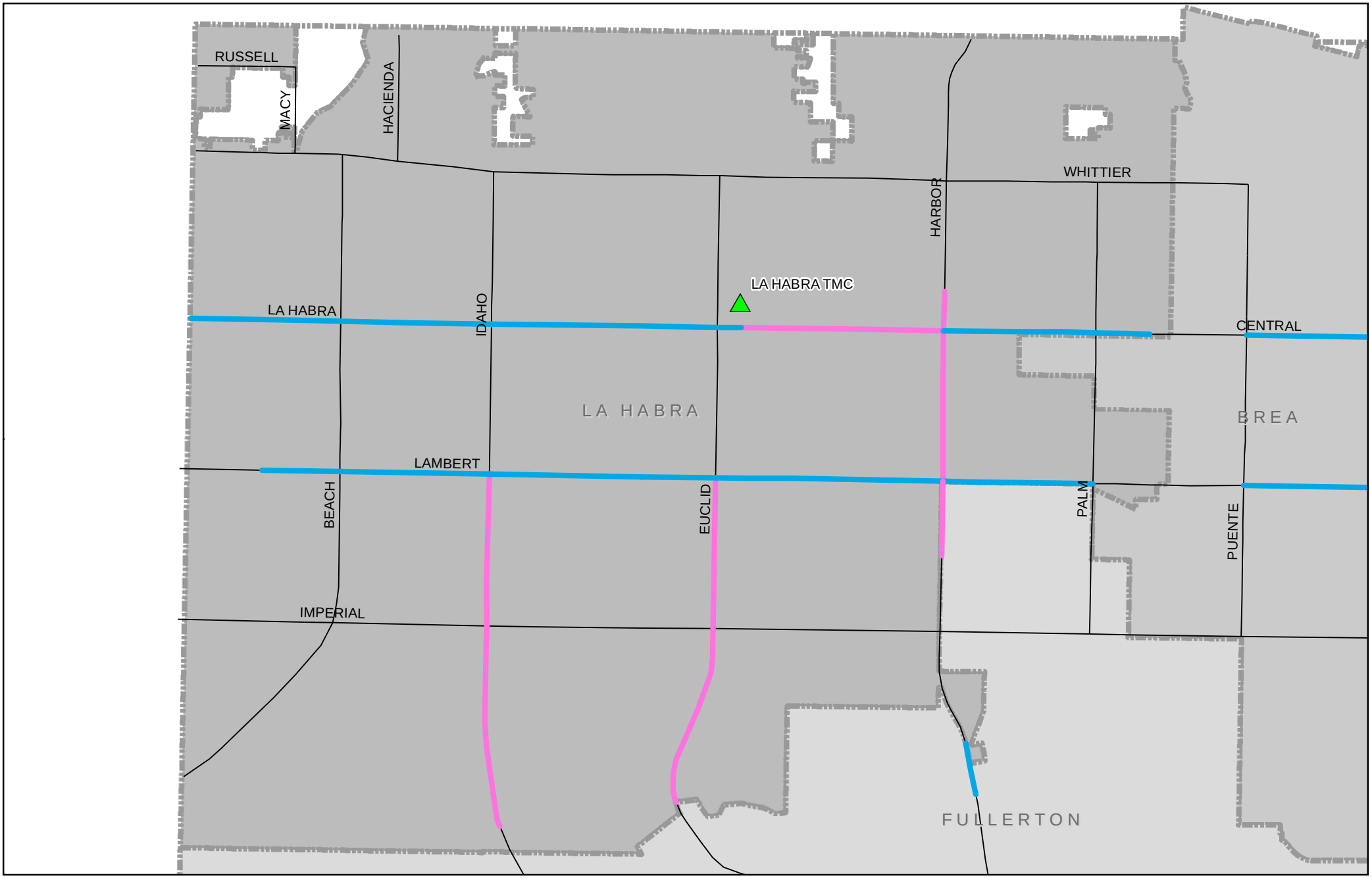
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LA HABRA

Legend

Communictions Interconnect

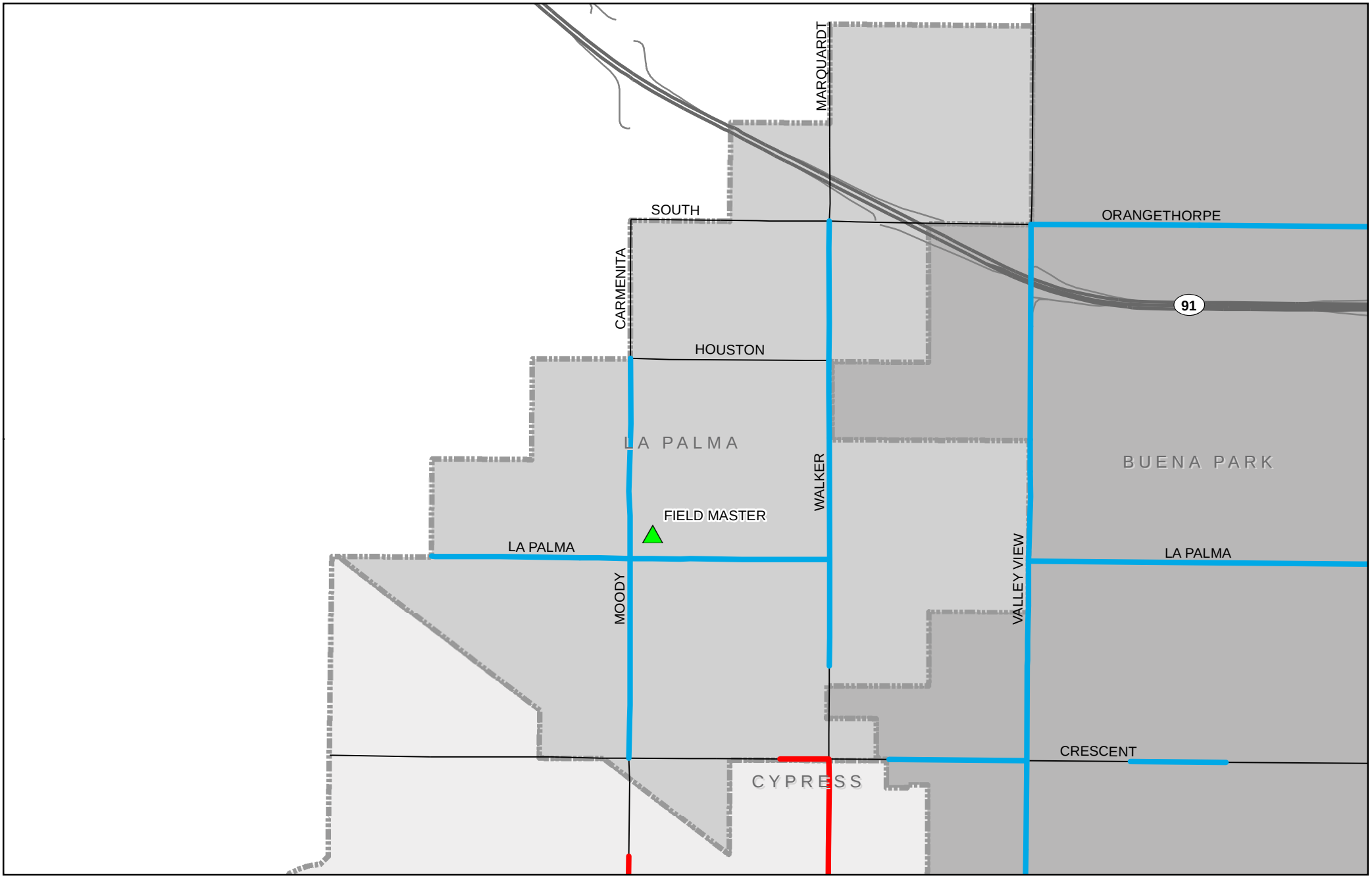
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LA PALMA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

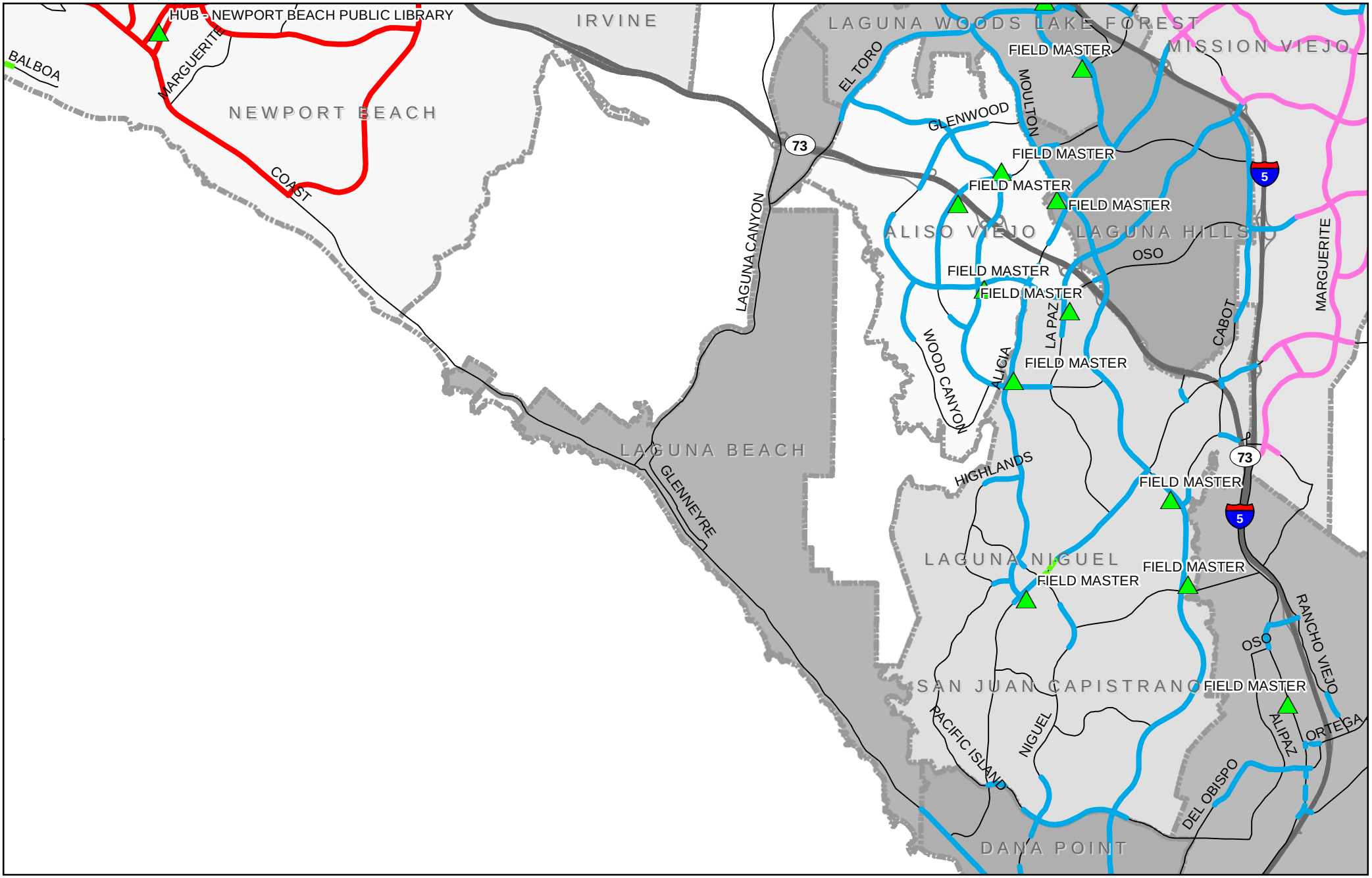
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LAGUNA BEACH

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

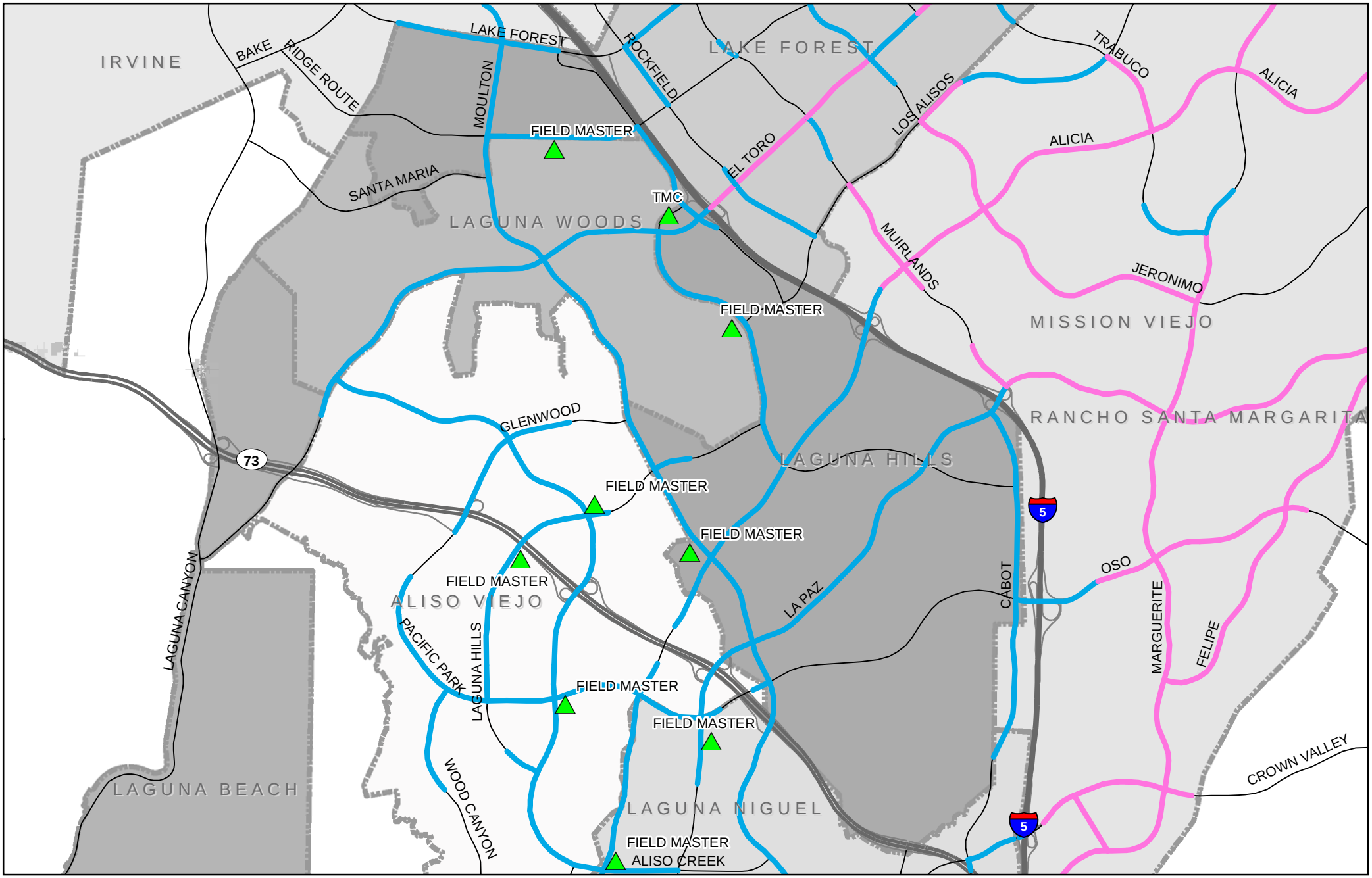
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS)
Strategic Deployment Plan Update

CITY OF LAGUNA HILLS

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

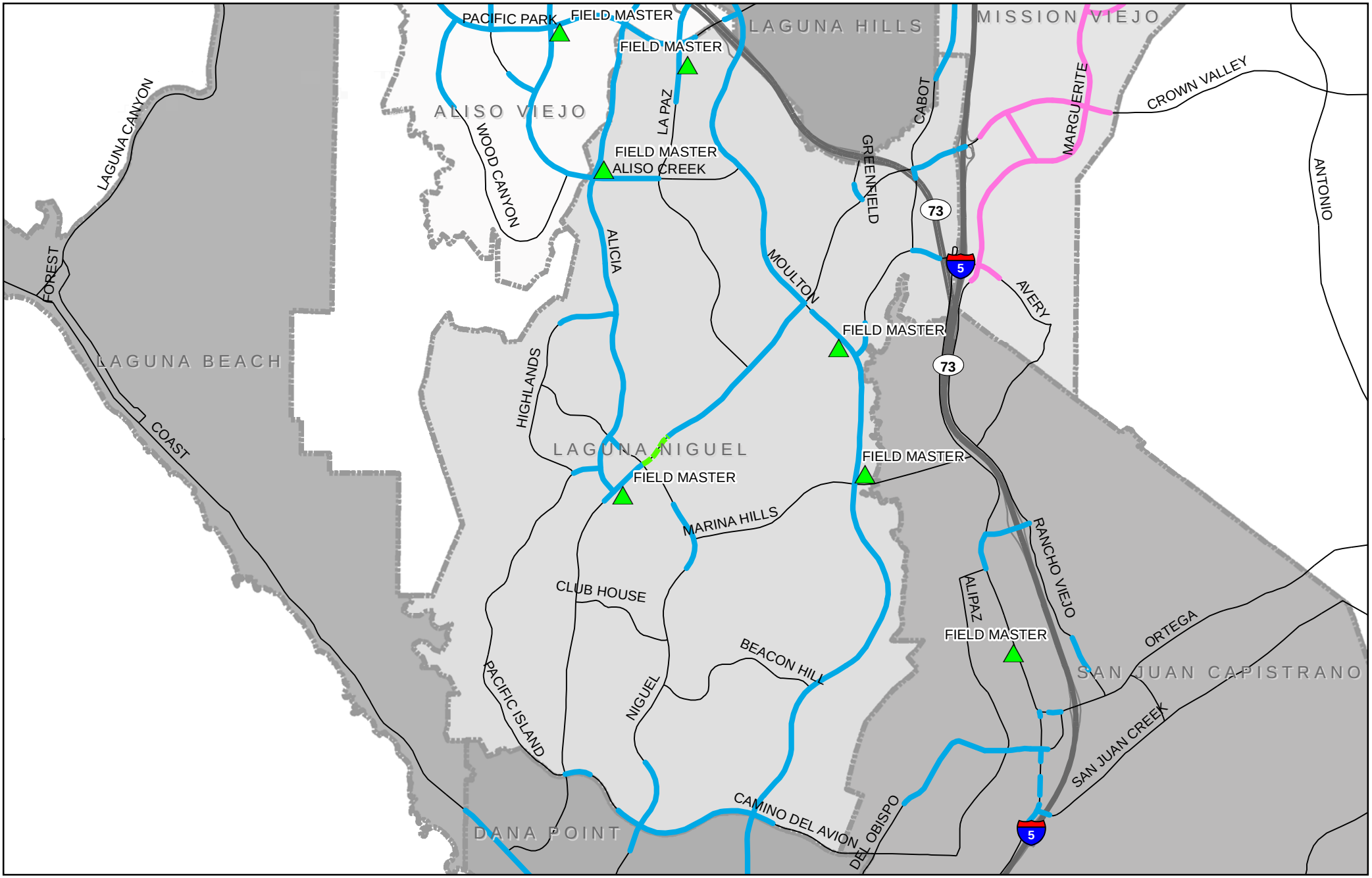
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS)
Strategic Deployment Plan Update

CITY OF LAGUNA NIGUEL

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

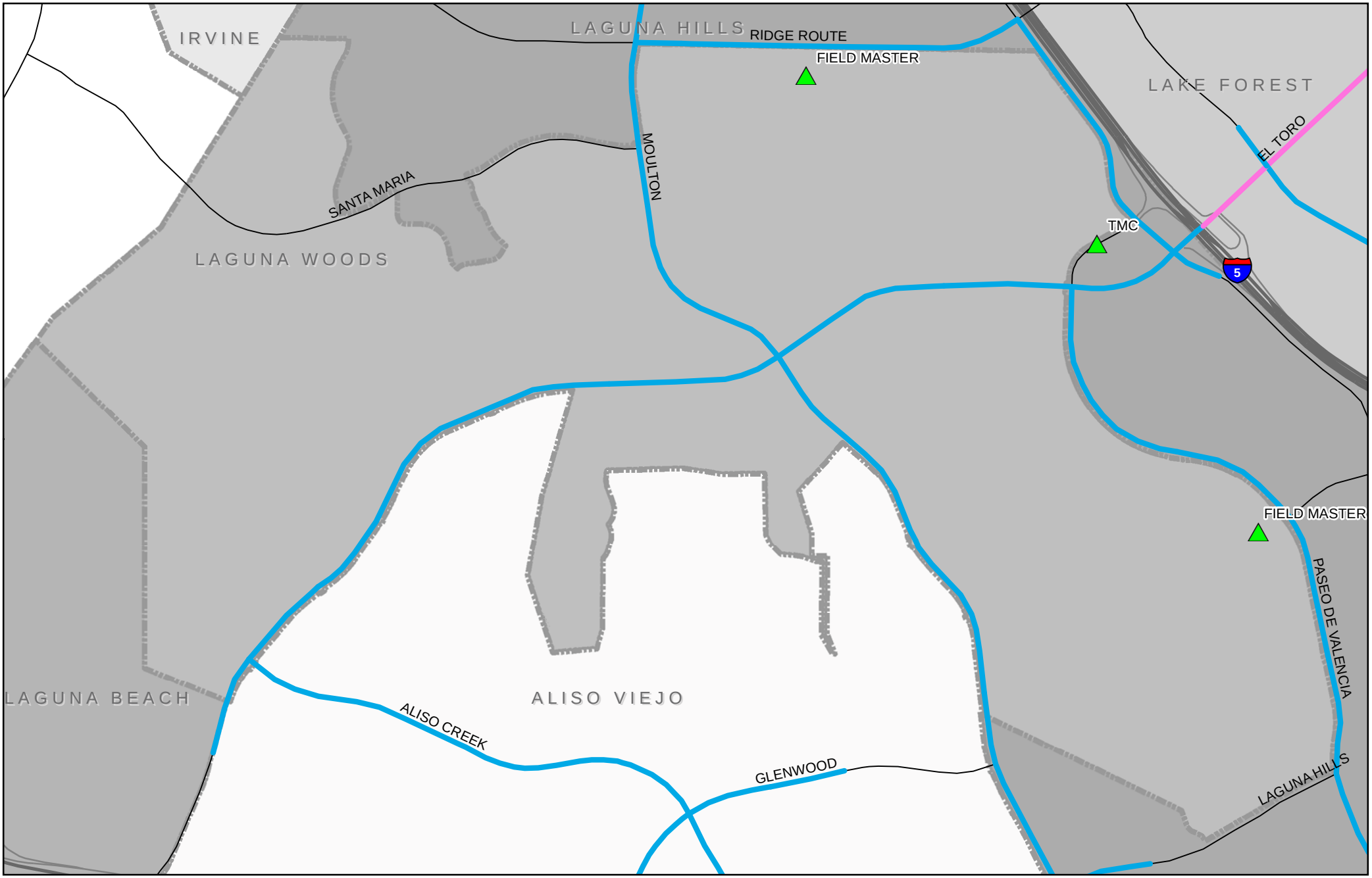
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LAGUNA WOODS

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

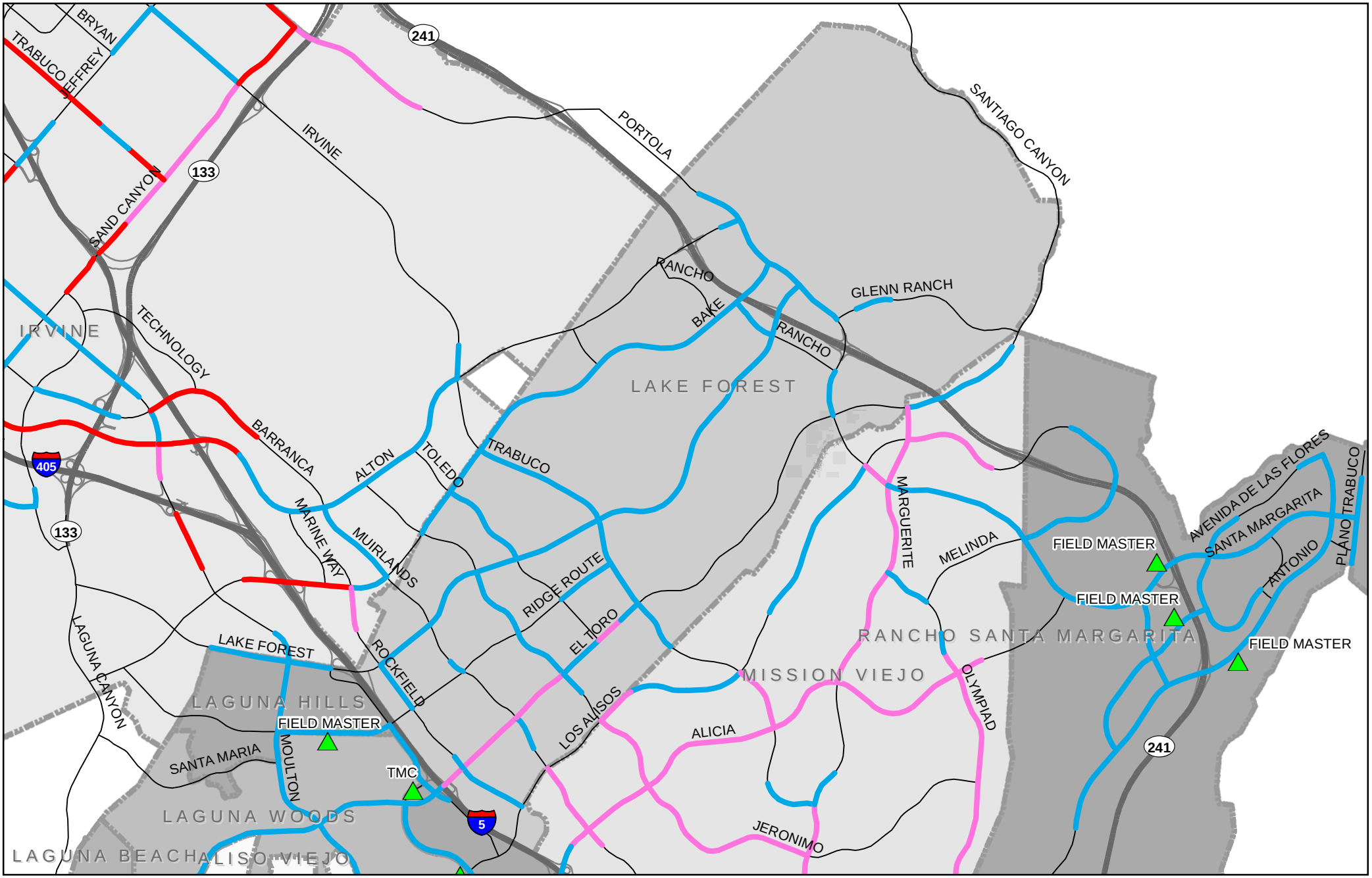
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LAKE FOREST

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF LOS ALAMITOS

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

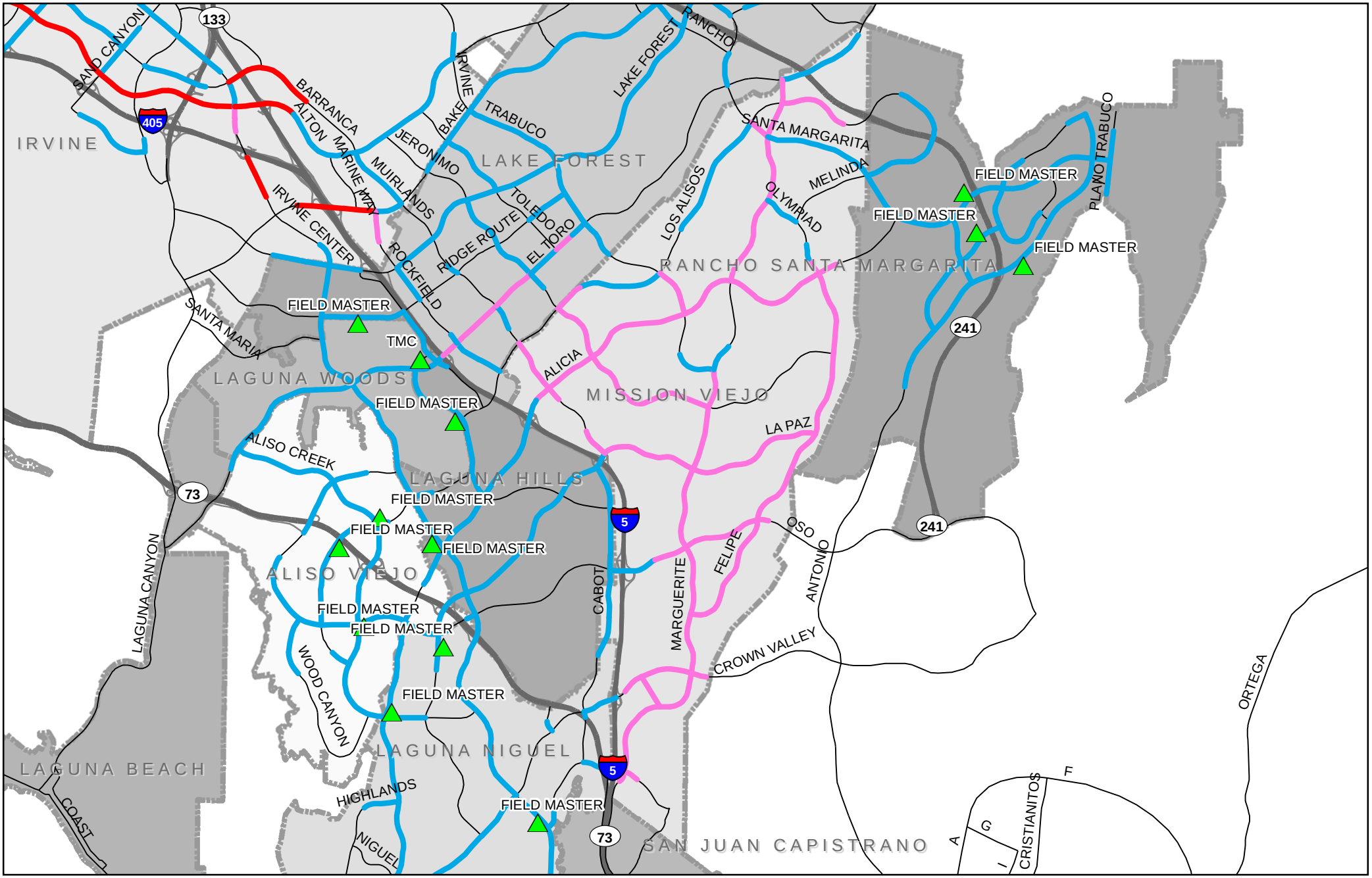
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF MISSION VIEJO

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

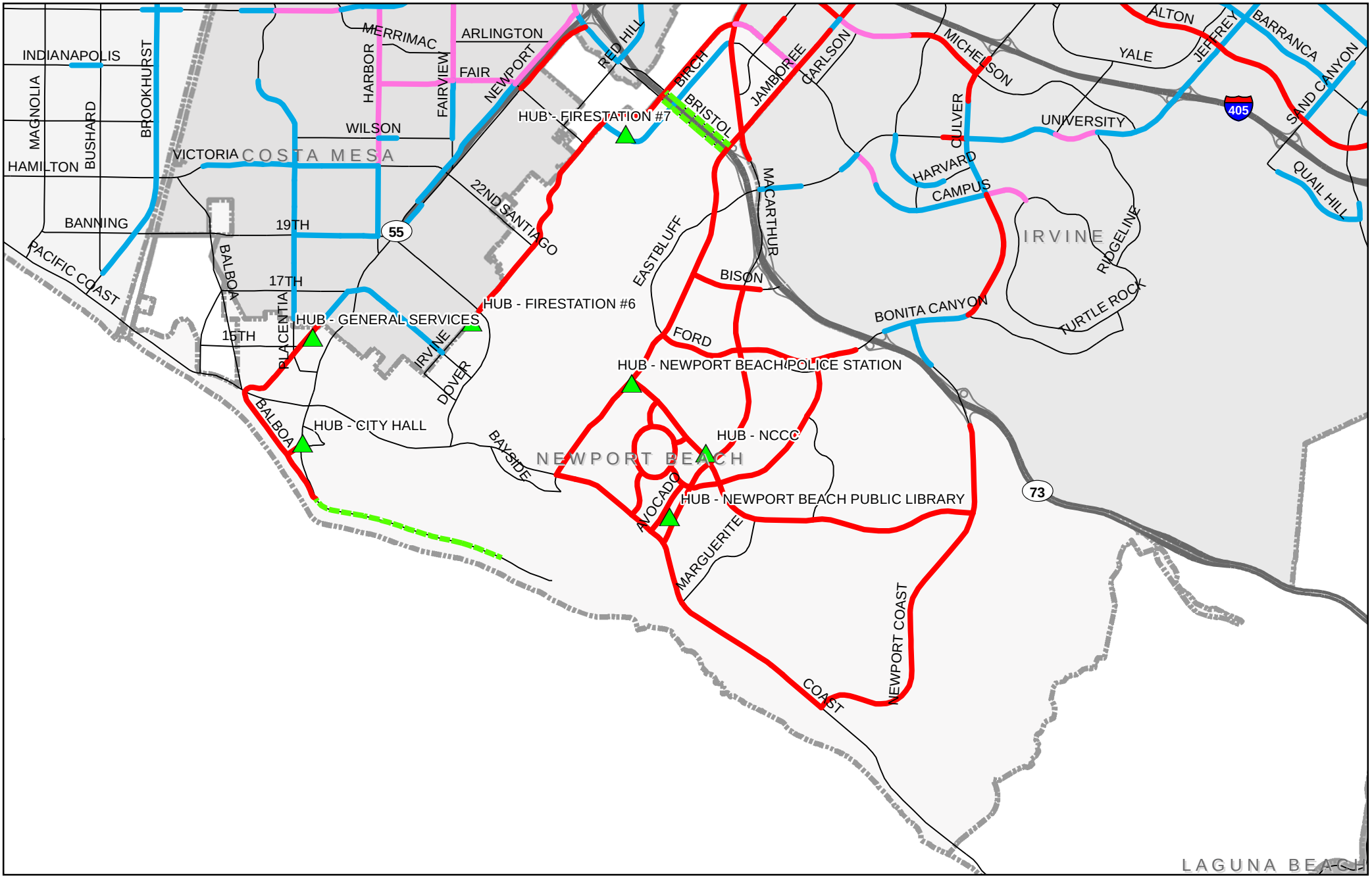
ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

Kimley-Horn and Associates, Inc.

8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF NEWPORT BEACH

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

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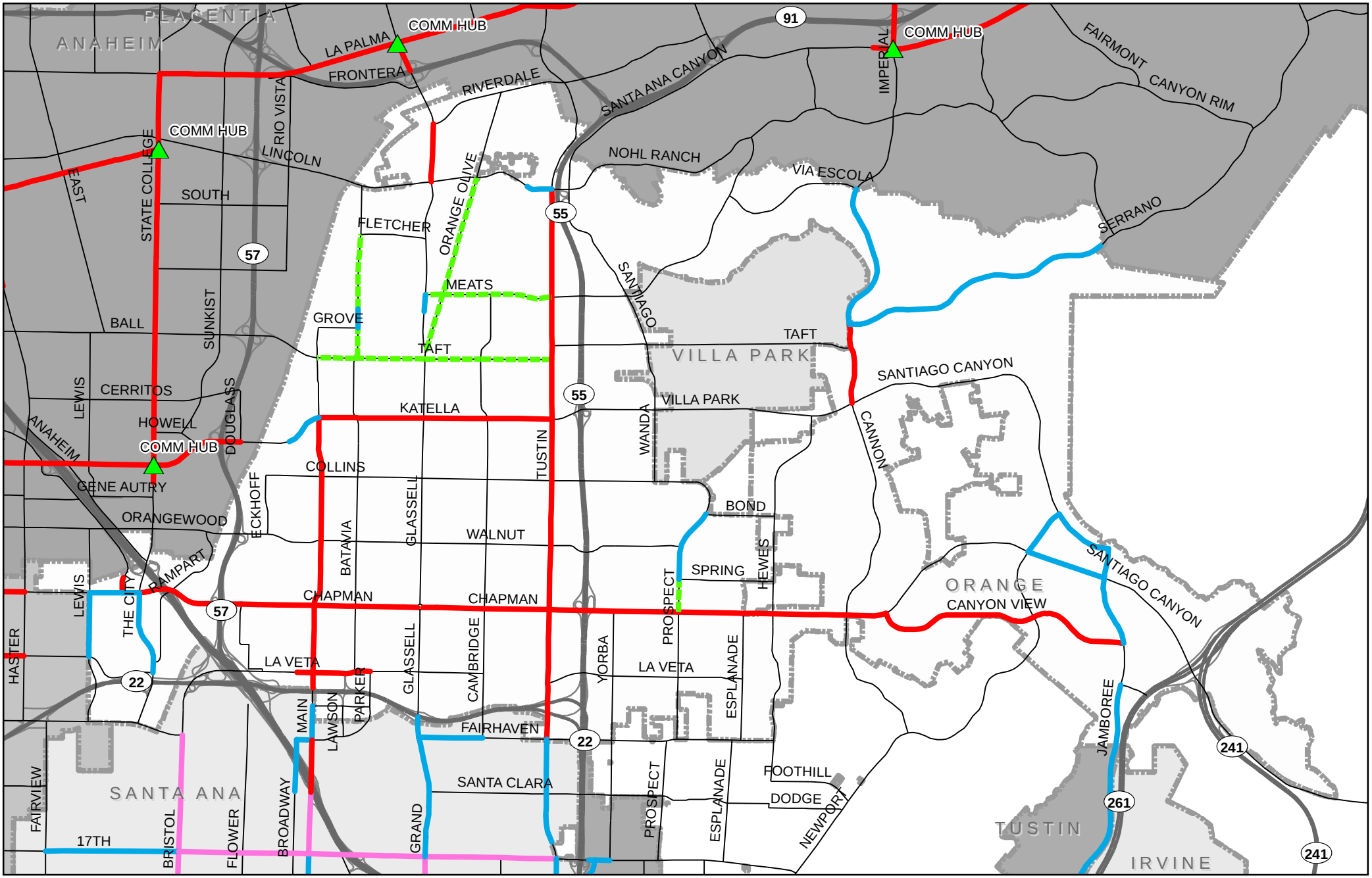
8/22/2013



2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF ORANGE

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

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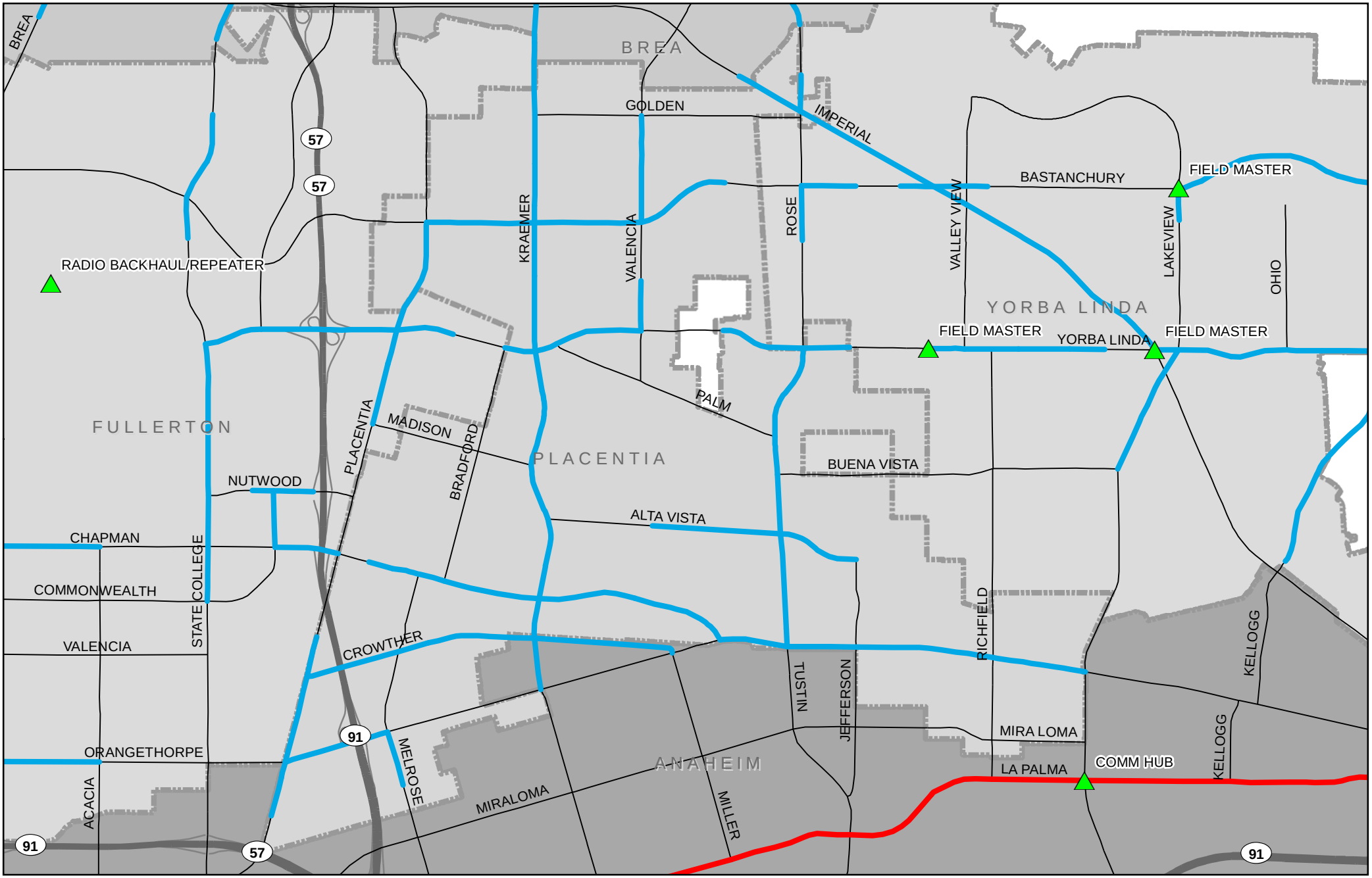

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF PLACENTIA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

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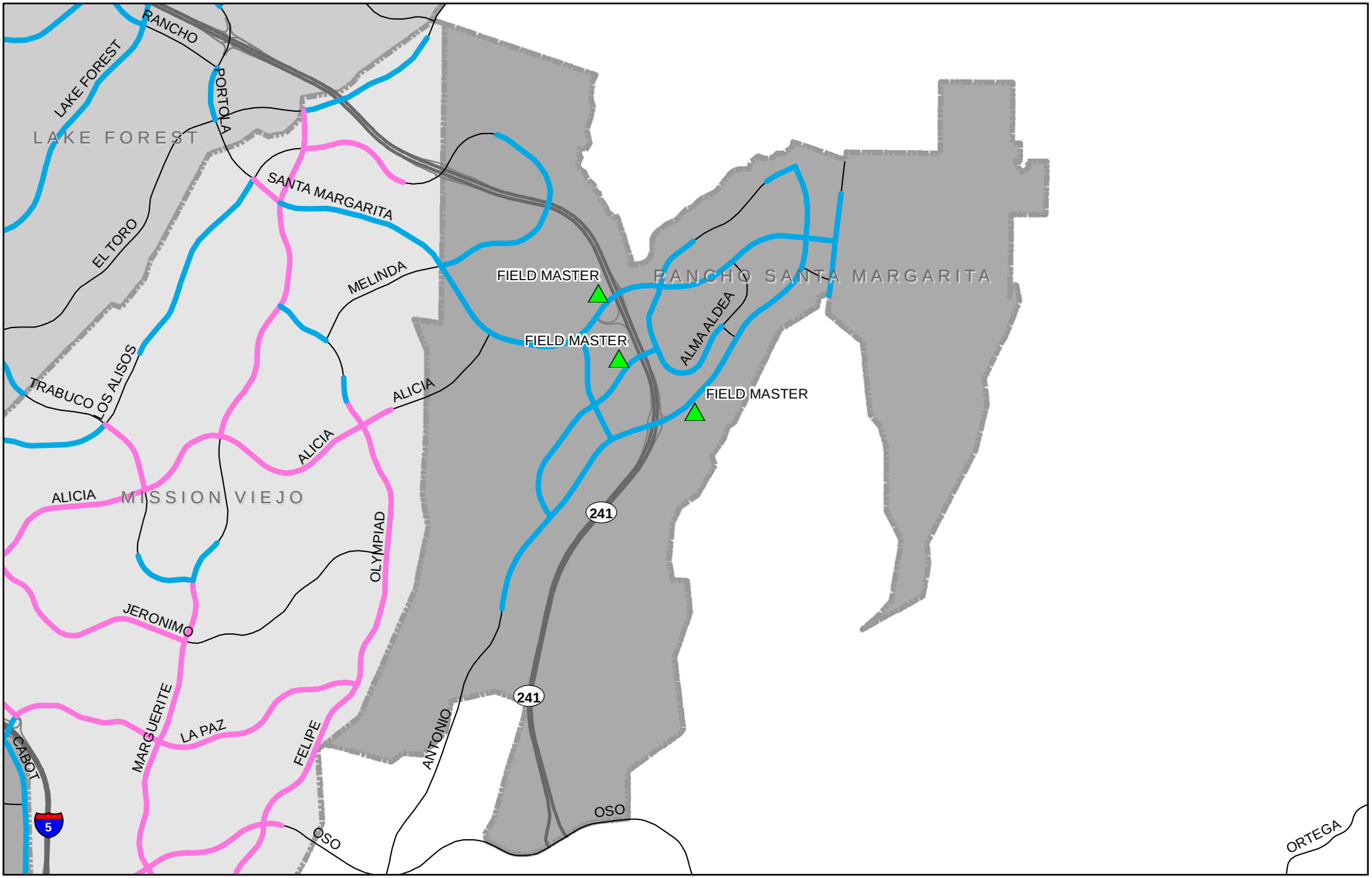

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF RANCHO SANTA MARGARITA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

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2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF SAN CLEMENTE

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

OCTA

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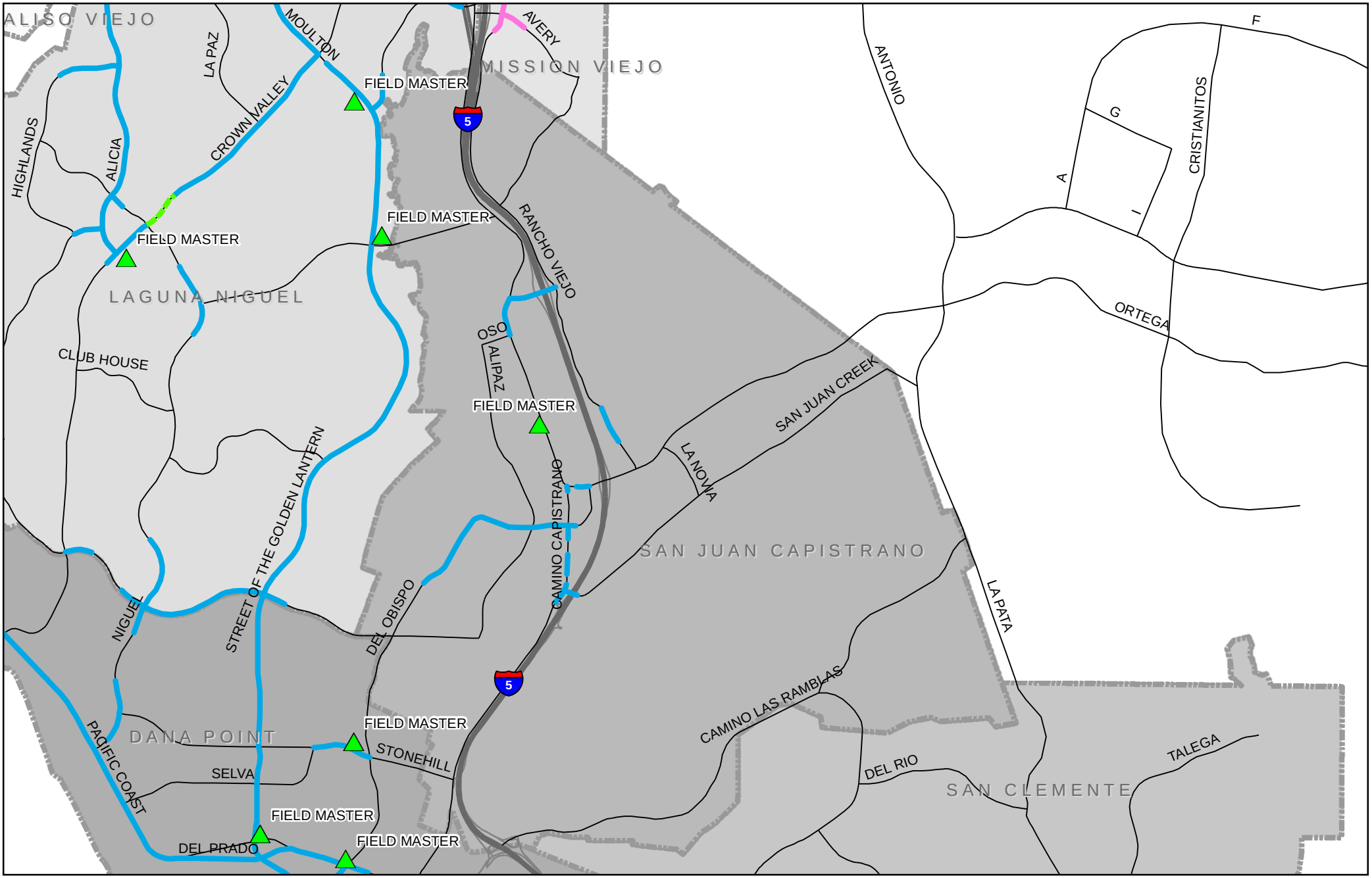

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF SAN JUAN CAPISTRANO

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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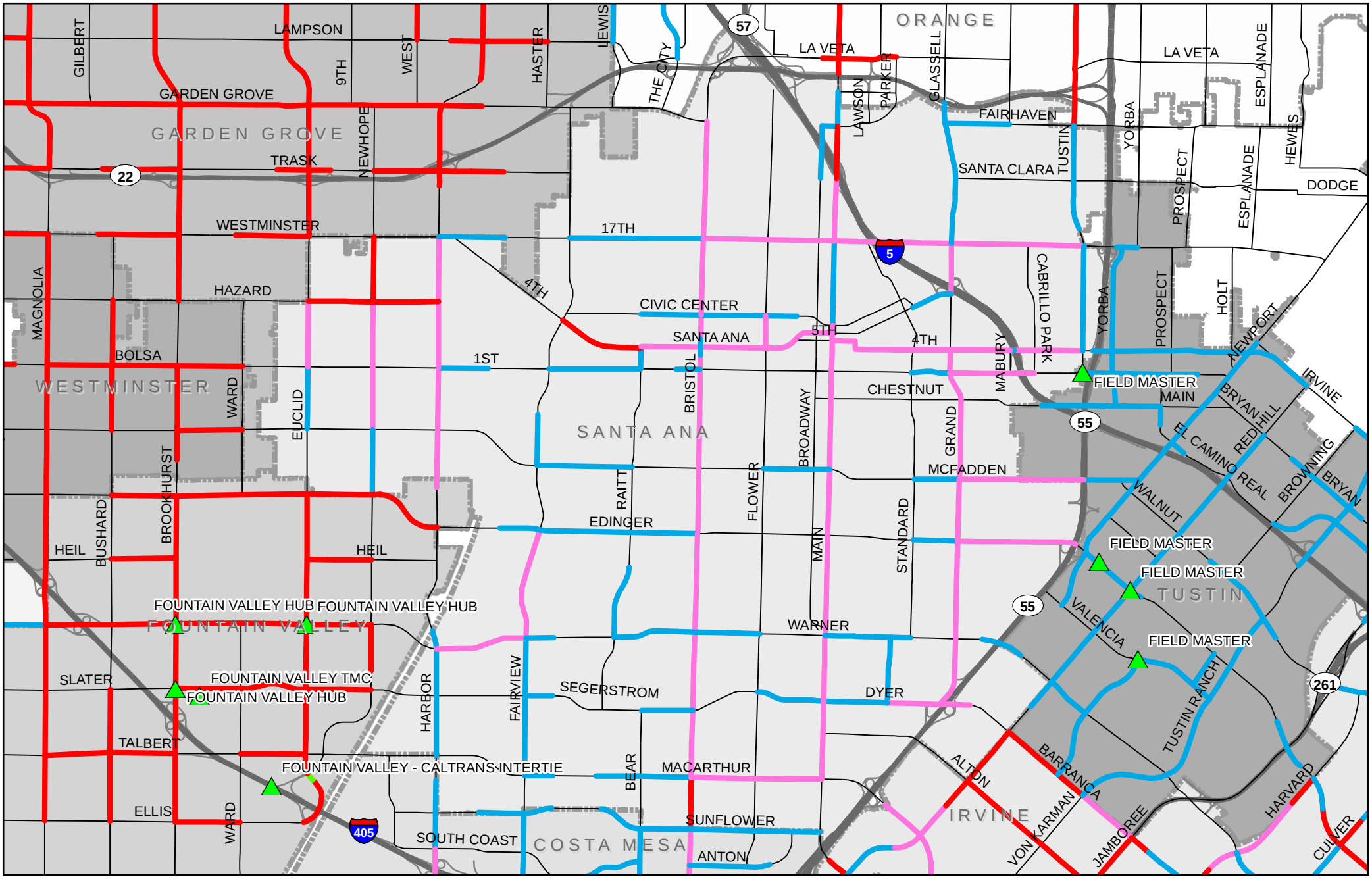

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF SANTA ANA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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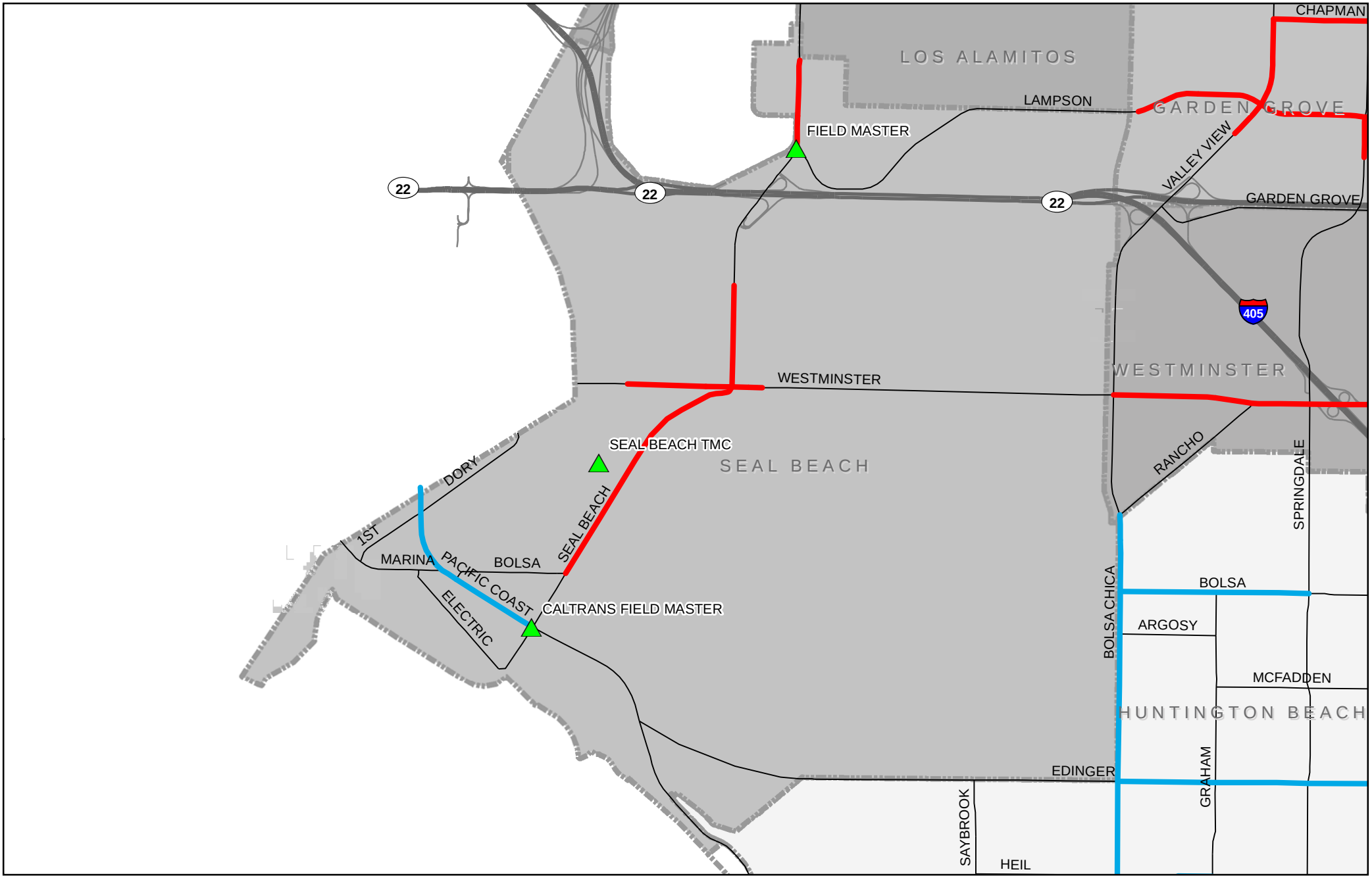

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF SEAL BEACH

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

OCTA

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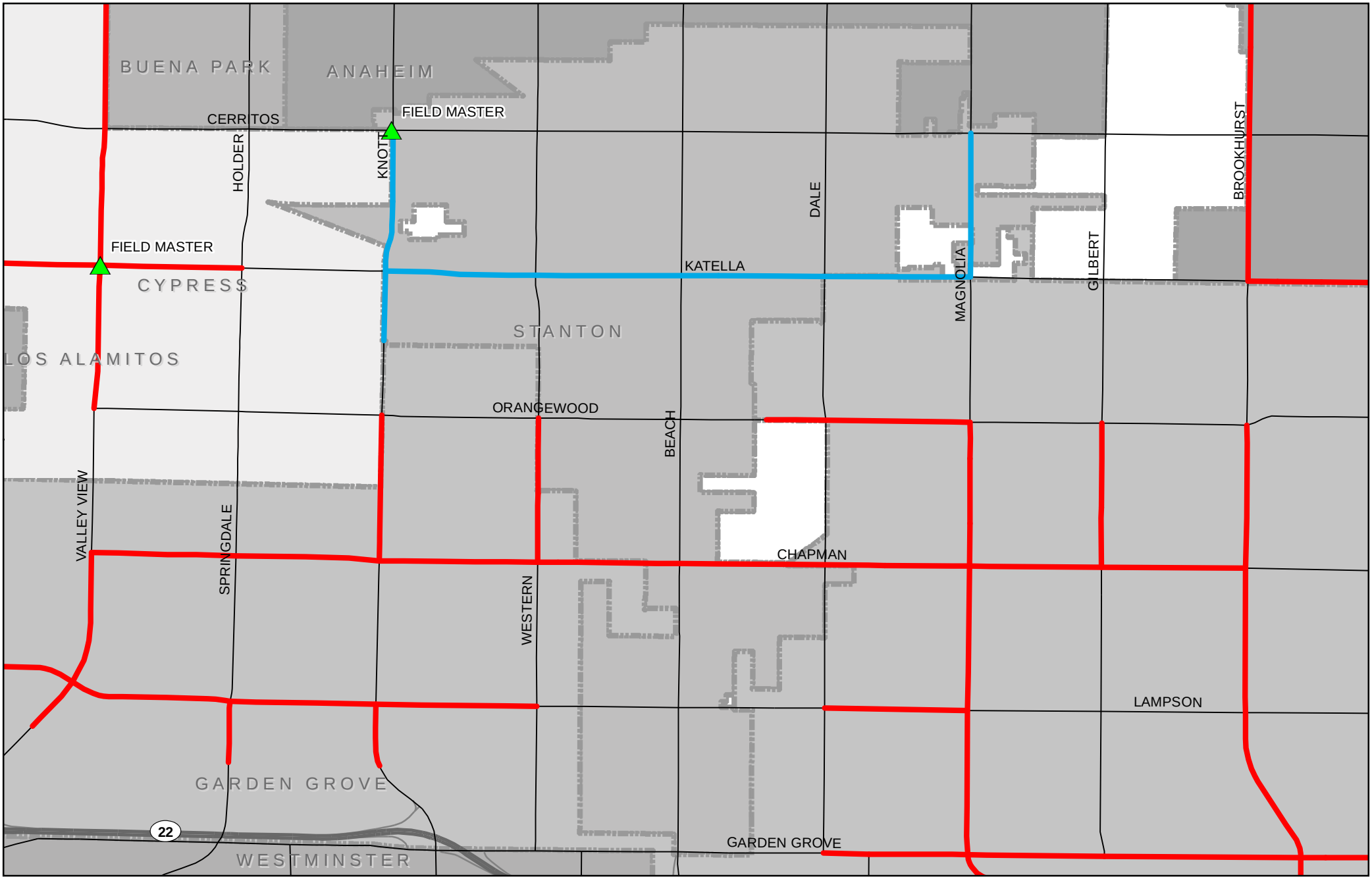

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF STANTON

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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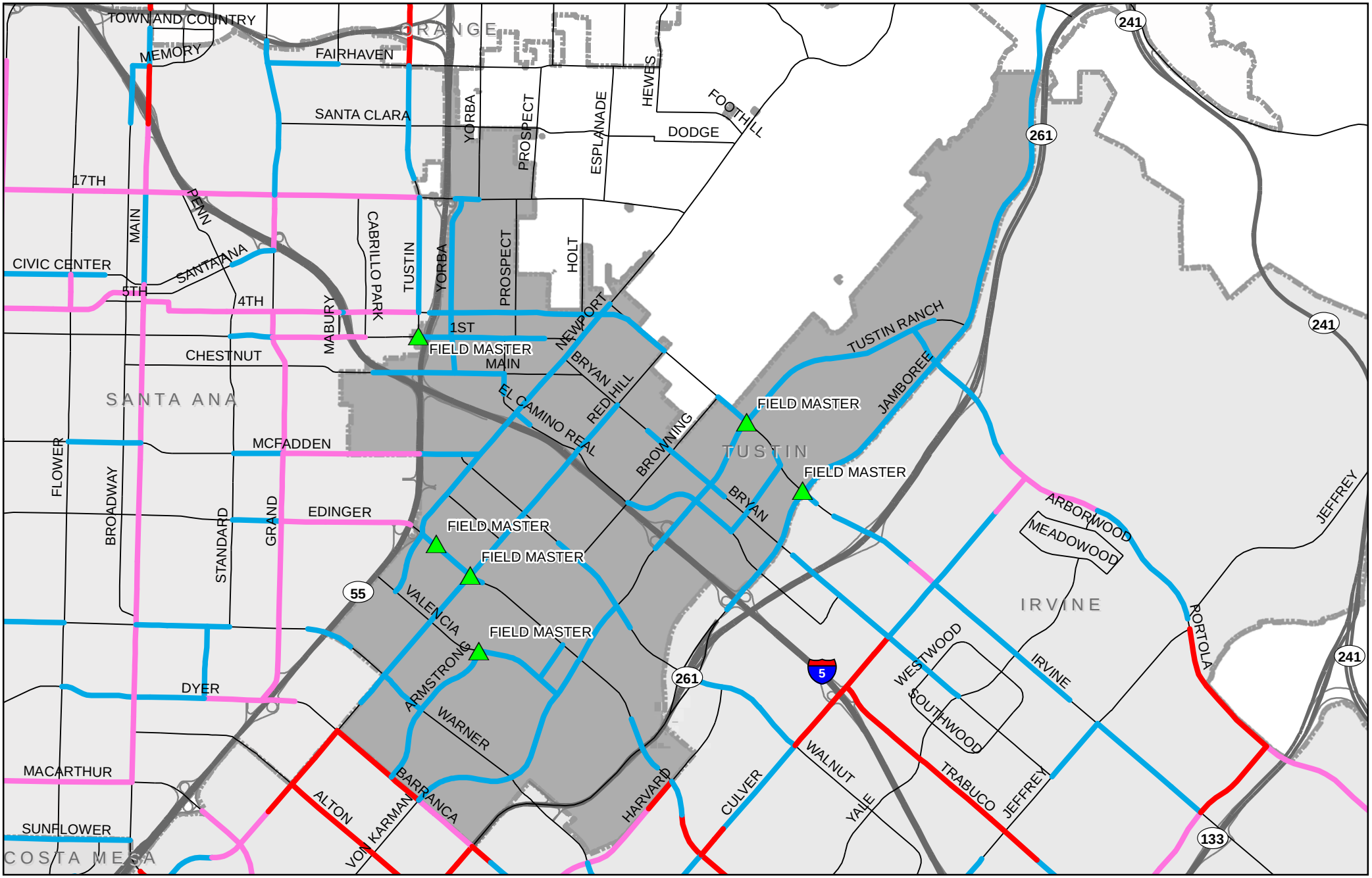

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF TUSTIN

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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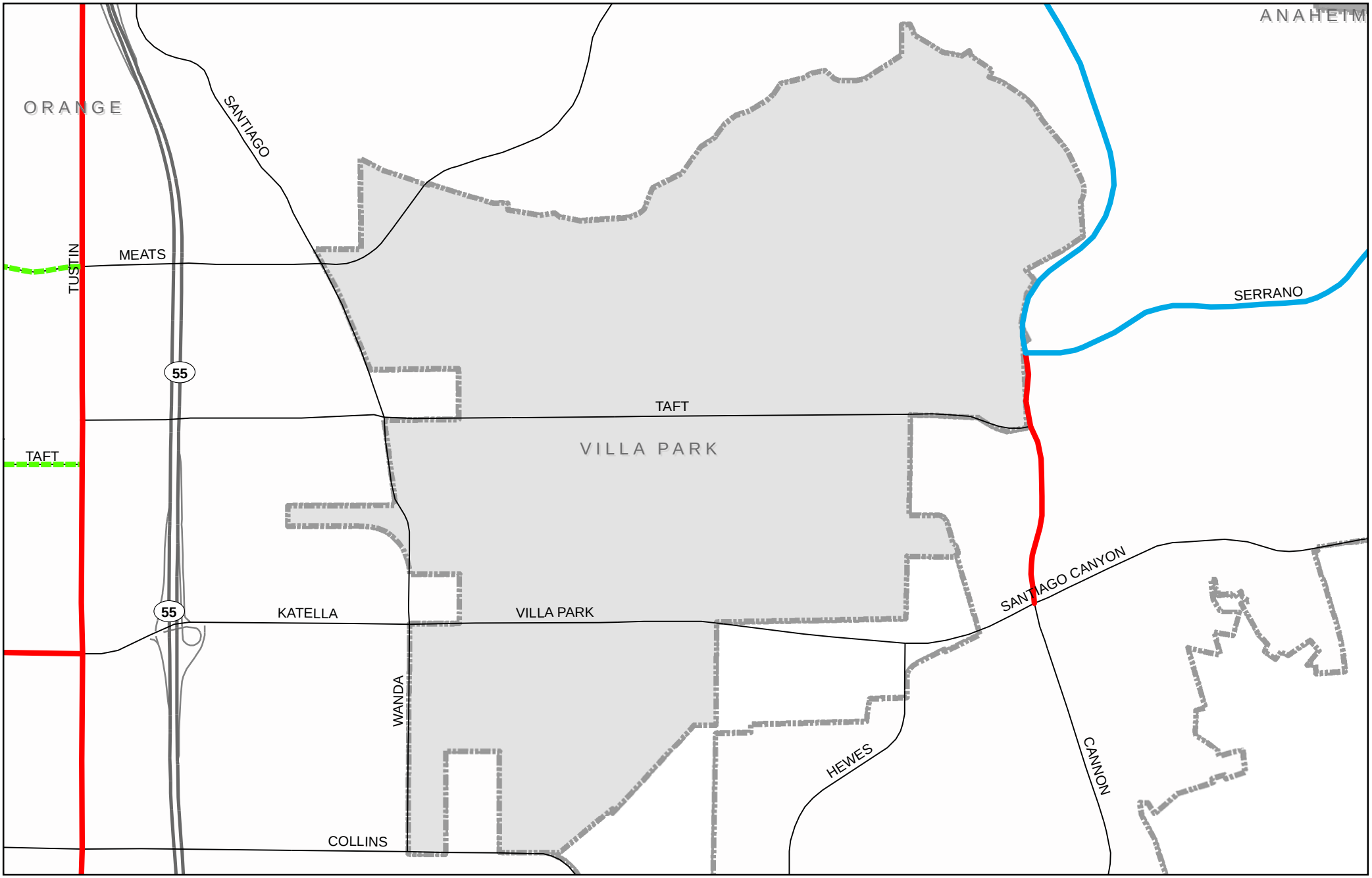

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF VILLA PARK

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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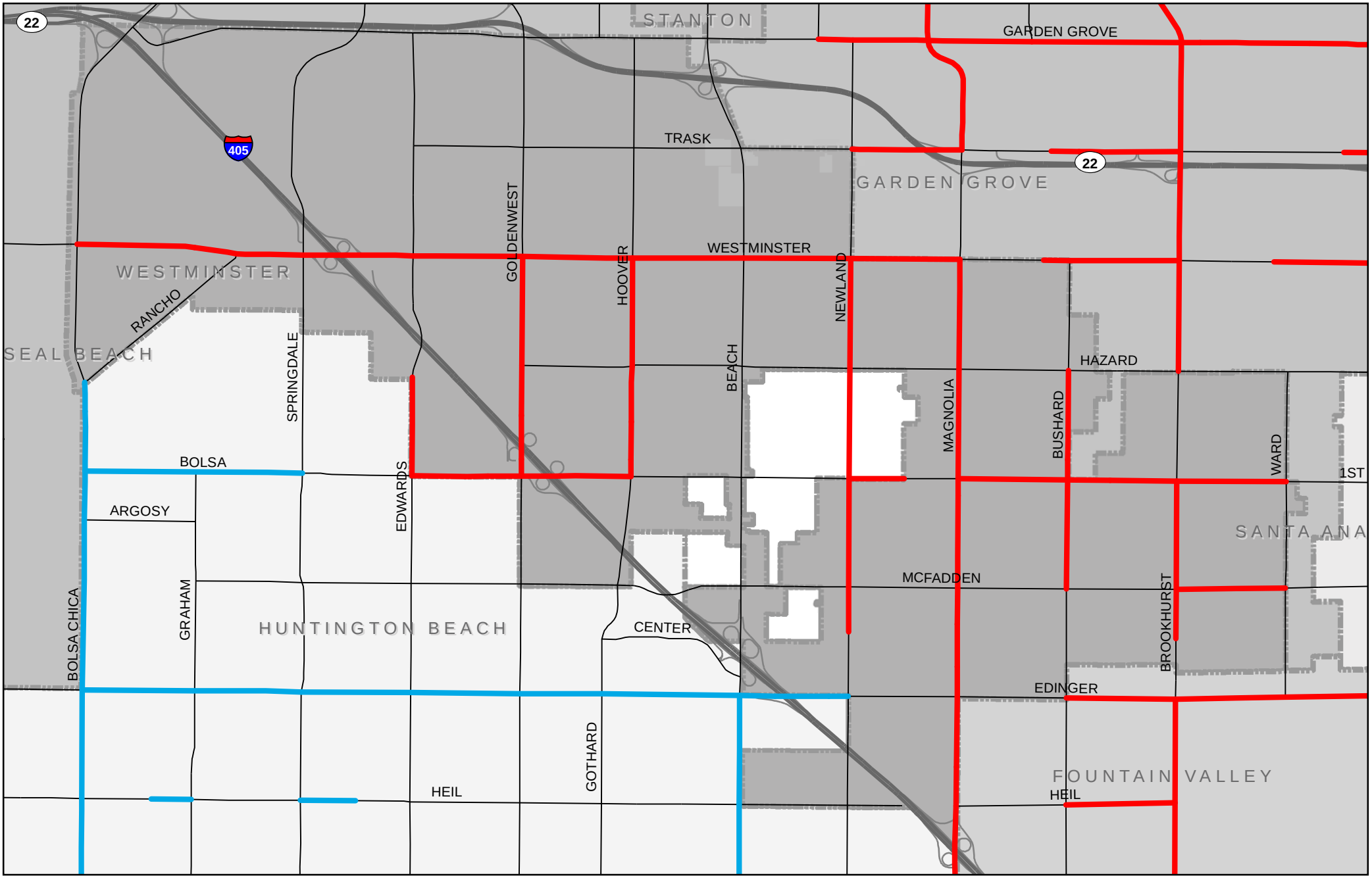

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF WESTMINSTER

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

- ITS Field Elements
- Master Plan of Arterial Highways (MPAH)

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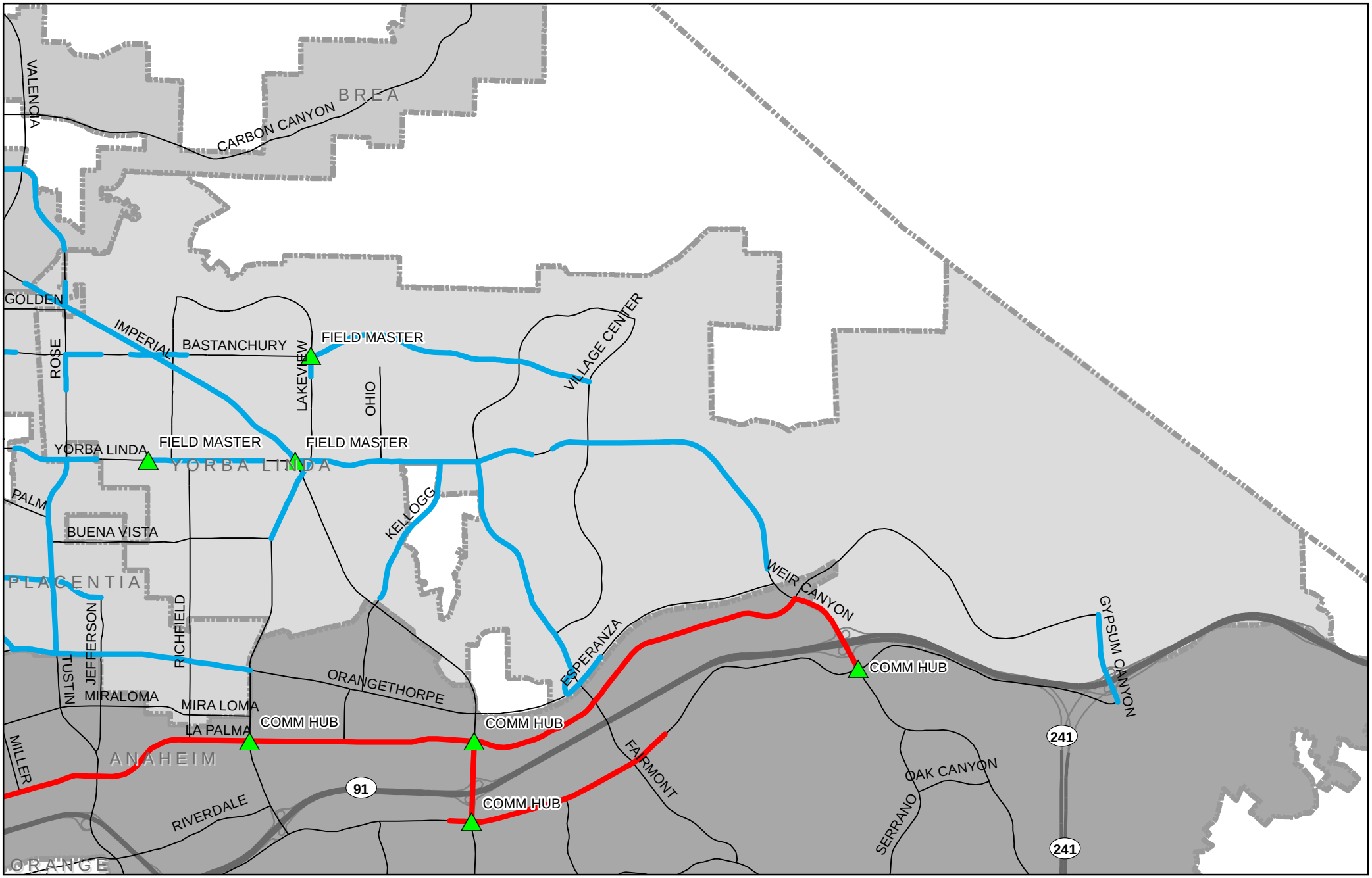

2012 Intelligent Transportation Systems (ITS) Strategic Deployment Plan Update

CITY OF YORBA LINDA

Legend

Communictions Interconnect

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link

ITS Field Elements

Master Plan of Arterial Highways (MPAH)

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