Prepared for:

OCTA

Orange County Intelligent Transportation Systems (ITS) Strategic Deployment Plan 2019 Update – Final Report (8-1488)

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iteris®

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FIGURES

APPENDICES

ACRONYMS

APC	Automated Passenger Counter
APM	Arterial Pavement Management
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ARTIC	Anaheim Regional Transportation Intermodal Center
ATC	Advanced Transportation Controller
ATMS	Advanced Traffic (or Transportation) Management Systems
AVL	Automated (or Automatic) Vehicle Location
BCIP	Bicycle Corridor Improvement Program
BRT	Bus Rapid Transit
C2C	Center to Center
CAD	Computer Aided Dispatch
CAV	Connected and Autonomous Vehicles
CC	Communications and Connectivity
CCTV	Closed-Circuit Television
CHP	California Highway Patrol
CMP	Congestion Management Program
CSMP	Corridor System Management Plan
CSPI	Corridor Synchronization Performance Index
CTFP	Comprehensive Transportation Funding Programs
CTOC	California Toll Operators Committee
CV	Connected Vehicle
CVO	Commercial Vehicle Operations
DOT	Department of Transportation
DMPM	Data Management and Performance Monitoring
DSRC	Dedicated Short Range Communications
ETC	Electronic Toll Collection
EVP	Emergency Vehicle Preemption
FHWA	Federal Highway Administration
FP2FP	Fixed-Point to Fixed-Point
FSP	Freeway Service Patrol
FTA	Federal Transit Administration
FTIP	Federal Transportation Improvement Program
GIS	Geographic Information Systems
GPS	Global Positioning System
HOT	High Occupancy Toll
HOV	High-Occupancy Vehicle
HSIP	Highway Safety Improvement Program
ICM	Integrated Corridor Management
IP	Internet Protocol
ITMS	Intelligent Transit Management System

ITS	Intelligent Transportation Systems
JPO	Joint Program Office
LOSSAN	Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency
LRTP	Long Range Transportation Plan
M2	Renewed Measure M
MAP-21	Moving Ahead for Progress in the 21st Century Act
MCO	Maintenance and Construction Operations
MDT	Mobile Display (or Data) Terminal
MIS	Major Investment Study
MM	Multimodal
MOE	Measures Of Effectiveness
MOU	Memorandum of Understanding
MPAH	Master Plan of Arterial Highways
NEMA	National Electrical Manufacturers Association
NHTSA	National Highway Traffic Safety Administration
NTCIP	National Transportation Communications for ITS Protocol
NVR	Network Video Recorder
OC	Orange County
OCFA	Orange County Fire Authority
OCPW	OC Public Works
OCSD	Orange County Sheriff's Department
OCTA	Orange County Transportation Authority
OCTAM	Orange County Travel Demand Model
PA	Public Address
PeMS	Caltrans Performance Measurement System
PEROW	Pacific Electric right-of-way
PGS	Parking Guidance Systems
PM	Parking Management
PS	Public Safety
PT	Public Transportation
PTC	Positive Train Control
RCTC	Riverside County Transportation Commission
ROI	Return on Investment
RSE	Roadside Equipment
RSU	Roadside Unit
RSWZ	Reduced Speed/Work Zone Warning
RTP	Regional Transportation Plan
RTSSP	Regional Traffic Signal Synchronization Program
SAFE	Service Authority for Freeway Emergencies
SARTC	Santa Ana Regional Transportation Center
SB	Senate Bill

SCAG	Southern California Association of Governments
SCRRA	Southern California Regional Rail Authority
SCS	Sustainable Communities Strategy
SDP	Strategic Deployment Plan
SHOPP	State Highway Operations and Protection Program
SMS	Short Message Service
SPaT	Signal Phase and Timing
SPM	Signal Performance Measures
SR	State Route
ST	Sustainable Travel
TAC	Technical Advisory Committee
TCA	Transportation Corridor Agencies
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	Transportation Demand Management
TI	Traveler Information
TM	Traffic Management
TMC	Transportation Management Center
TOC	Traffic Operations Center
TSC	Technical Steering Committee
TSCP	Traffic Signal Control Program
TSM	Transportation System Management
TSOC	Transit Security and Operations Center
TSP	Transit Signal Priority
TSS	Traffic Signal System
TWP	Twisted Wire Pair
U.S.C.	United States Code
USDOT	United States Department of Transportation
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Multiple Other Objects / Devices
VCTC	Ventura County Transportation Commission
VDC	Volts Direct Current
VMT	Vehicle Miles Traveled
VS	Vehicle Safety
WLAN	Wireless Local Area Network
WX	Weather

EXECUTIVE SUMMARY

Intelligent Transportation Systems (ITS) refers to the use of communications and technologies to improve transportation safety, operations, and efficiency. This definition encompasses a broad range of transportation modes and technologies. Some of the demonstrated benefits of ITS include improved transportation operations, reduced travel time delays, 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.

Equal in importance to the technological issues of ITS deployment are the organizational and institutional relationships that are required to fully realize the potential of ITS. Over the past 25 years, Orange County agencies have embraced ITS applications as a critical component of local and regional transportation management. In addition to several multijurisdictional traffic signal synchronization efforts, some very preliminary discussion about multi-agency operations have begun, and are sparking interest in more cooperative, unified daily operations and strategies.

Some deployments in Orange County have not only enhanced traffic and transit operations, but have also had far reaching impacts by improving overall regional surface transportation 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 management and operations; and a robust, well-funded traffic signal synchronization program.

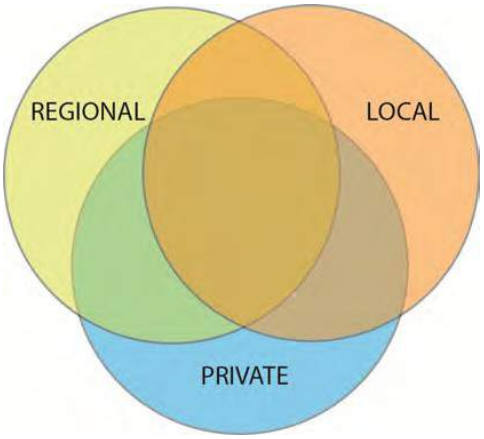
Because the Orange County Transportation Authority (OCTA) has supported advances in transportation technology applications and integration over the years, great strides have been made in the use of ITS solutions to manage congestion and make for a safer travel experience within the county's multimodal surface transportation network. Over the past 15-20 years, Orange County has focused heavily on building strong foundations, including:

- The ongoing traffic signal synchronization program, providing significant improvements in mobility on key multijurisdictional arterials throughout the county;
- OCTA's transit program has continued on the forefront of technology applications to better manage operations, inform transit patrons, and enhance system security;
- Caltrans District 12 continues operation, expansion, and upgrades to a mature freeway management system, and its current emphasis on Integrated Corridor management (ICM) techniques;
- Establishment of several local traffic management centers around the county, actively monitoring arterial traffic conditions; and
- An emerging atmosphere of institutional partnership that has begun to flourish.

Plan Use and Objectives

The objective of this ITS Strategic Deployment Plan (SDP) update is to provide a useful tool for Orange County 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 Orange County ITS 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 systems, while enabling private sector innovations where appropriate. Furthermore, the SDP includes high-level guidance for moving forward with project implementation, and providing technology and communications infrastructure that improves safety and mobility within Orange County.

Alignment with other OCTA and Regional Plans and Goals

This ITS Strategic Deployment Plan Update aligns with other OCTA and Regional Plans and Goals. The latest version of the Long Range Transportation Plan (LRTP) developed by OCTA, *Designing Tomorrow, 2018 Long-Range Transportation Plan* was completed in 2018. The LRTP represents OCTA's vision for mobility over the next 20+ years. ITS Traffic Management strategies most closely align with one LRTP goal of, "*Improve System Performance,"* and, the objectives to, *"Improve efficiency of highways (freeways and toll facilities) and roadways" and "Leverage emerging technologies and services."* Transit and Multi-Modal Management ITS strategies also align closely with the LRTP goals and objectives. A significant investment has been made in deploying technologies on OCTA transit vehicles – fixed route and paratransit buses – as well as in complementary central management systems and enterprise office systems.

Augmenting the LRTP Goals and Objectives, which are relatively high-level, OCTA staff has indicated in more detail that, to keep ITS efforts moving forward, and in order to prepare Orange County for Connected and Autonomous Vehicles (CAV) in the future, OCTA's funding programs and the local agencies should focus on, and support the following:

- Advanced Transportation Controller (ATC) upgrades
- Communications gap closures, supplemented with alternative communications technologies (cellular, other wireless, "cloud"), as appropriate, and as needed
- Improve vehicle detection in general and expand functionality to include vehicle counting
- Continue installing roadside intelligent cameras with transportation analytics functionality
- Create a Countywide Signal Performance Measures (SPM) Dashboard
- Continue Advanced Transportation Management Systems (ATMS) improvements

This can be broadly referred to as an "all of the above approach." In addition, OCTA supports both Dedicated Short Range Communications (DSRC) and cellular 5G technologies as complementary technologies that will tie in to future CAV efforts. Longer term (5 – 10 years), OCTA would support an effort to define Orange County specific standards for transportation data exchange and management.

The State of California and the federal government require that the Southern California Association of Governments (SCAG) and other regional planning agencies update their respective Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) every four years. ITS in general, and the Orange County ITS SDP specifically supports several goals contained in the most current RTP/SCS, including the maximization of mobility and accessibility for all people and goods, travel safety and reliability, preservation of a sustainable regional transportation system, and maximizing the productivity of the transportation system. In addition, the Orange County ITS SDP generally supports the guiding policies contained in the RTP that relate to supporting investments and strategies to reduce non-recurrent congestion and demand for single occupancy vehicle use, by leveraging advanced technologies; and encouraging transportation investments that result in cleaner air, a better environment, a more efficient transportation system and sustainable outcomes in the long run.

Existing Countywide ITS Programs

A large majority of cities in Orange County currently operate or plan to operate Advanced Traffic Management Systems, Closed-Circuit Television (CCTV) cameras and systems for roadway surveillance, vehicle detection, traffic signal systems for coordination, control, monitoring, and reporting, and Emergency Vehicle Preemption (EVP) systems. Several of those agencies that currently operate these systems are actively planning, or at minimum, discussing upgrades to those systems. About one-third of the agencies currently operate or plan to deploy Changeable/Dynamic Message Signs, both stationary and portable.

Connected vehicle roadside equipment is currently deployed in one agency in Orange County, with one other agency actively deploying similar equipment. Approximately seven of the larger Orange County cities indicate that they are planning to also deploy connected vehicle roadside equipment. This is a burgeoning segment of ITS, which is envisioned to both improve traffic safety and traffic operations.

OCTA is the primary (and largest) transit operator in Orange County. OCTA provides fixed route and paratransit services, and will shortly inaugurate the first fixed rail electrified street car system in Orange County since the demise of the Pacific Electric System in the middle of the 20th century. With the introduction of more local agency (city) operated transit services, about one-third of local agencies indicated that they are currently operating or planning to operate transit management systems and/or transit traveler information systems in the future. OCTA operates a Public Transportation Management (Dispatch) Center that manages the OCTA fixed route transit fleet. The contractor that operates the Paratransit services on behalf of OCTA operates the Paratransit dispatch center.

OCTA's fixed route buses are equipped with Automated Vehicle Location (AVL) system equipment, video surveillance security systems, and other integrated on-board monitoring systems. Transit traveler information is disseminated to the public through Internet web pages, smart phone applications, a mobile phone text messaging system, and via on-board electronic displays/audio announcements. OCTA also provides transit trip planning through interactive web pages. Transit route and schedule data is shared with a regional 511-telephone traveler information system known Southern California 511 (511). The 511 system and associated public facing computer applications is a free traveler information service that provides live traffic reports, transit planning, commuter service information, motorist aid, and FasTrak information in the Southern California area. 511 is operated and funded by a coalition of Southern California transportation agencies, including OCTA.

Phased Deployment Plan

OCTA, in partnership with Orange County cities, the 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 local and regional benefits. This ITS SDP has identified strategies and projects to realize OCTA's vision, and positions Orange County for opportunities to deploy emerging technologies that have the potential to improve mobility, safety, and efficiency on a multi-modal transportation system.

The recommended ITS strategies and projects 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. Project sequencing in the Strategic Deployment Plan is used to maximize the benefits of ITS projects by building on existing infrastructure and projects to enhance and expand systems, in a building block approach. Projects are sequenced in terms of increasing system functionality and information exchange with a foundation of base infrastructure. These strategies and

projects, which were largely derived based on input from local agency staff and OCTA staff, support the development of the ITS Strategic Deployment Plan (SDP).

Table E-1 illustrates the strategic deployment plan for implementing the projects proposed in this ITS SDP. The timeline organizes the deployment of the sixty-seven ITS strategies and projects described in Section 6 of the Strategic Deployment Plan into three distinct time frames.

- Short-term: these strategies and projects are taking place now or within three years from now (0-3 years);
- Medium-term: these strategies and projects would take place between 3 to 6 years from now (4-6 years); and
- Long-term: these strategies and projects would take place between 6 to 10 years from now (7-10 years).

Table E-1 – Recommended ITS SDP Implementation Timeline

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Data Management and Performance Monitoring											
DPM 1	Implement Signal System Performance Monitoring System at the Local Agencies										
DPM 2	Upgrade/Expand Signal System Performance Monitoring System at the Local Agencies										
DMP 3	Multiagency (countywide) Signal System Performance Monitoring (Dashboard)										
Public Safety											
PS1	Expand/Upgrade Emergency Vehicle Preemption (EVP) System(s)										
PS2	Implement Incident Detection System(s)										
PS3	Expand Technologies to Support Freeway Service Patrol (FSP) Operations										
Vehicle Safety											
VS1	Implement/Expand Connected and Autonomous Vehicle (CAV) Supporting Infrastructure										
VS2	Implement/Upgrade/Expand Pedestrian/Bicycle Safety Devices										
VS3	Implement basic Connected Vehicle applications (local agency/OCTA)										
VS4	Upgrade rail grade crossing technologies										
VS5	Implement Technology for Pedestrian/Bicycle Counting Program										
VS6	Implement work zone safety oriented Connected Vehicle applications (local agency)										
VS7	Support Implementation of Commercial Vehicle Operations (CVO) Systems										
VS8	Implement Work Zone Intrusion detection and alerts to workers (Local Agencies and Caltrans)										
Traffic Management											
TM1	Upgrade Local Agency Advanced Traffic Management Systems										
TM2	Upgrade/Expand Vehicle Detection Systems										
TM3	Complete a Phased Implementation/Upgrade of all Traffic Signal Controllers Countywide to ATC Standards										
TM4	Fund, administer, and implement multi-agency Traffic Signal Synchronization Projects throughout the county										
TM5	Conduct feasibility study on sector-based traffic signal timing versus corridor-based traffic signal timing										
TM6	Upgrade/Expand Local Agency Closed Circuit Television (CCTV) Surveillance Systems										
TM7	Procure and Deploy Portable Traffic Control (with remote monitoring and management capabilities)										
TM8	Local Agency participation in, and support for Freeway/Arterial Integrated Corridor Management (ICM) Activities										
TM9	Implement Freeway Components of Integrated Corridor Operations (Integrated Corridor Management (ICM))										
TM10	Develop the Triangle Integrated Corridor Management (ICM) Program.										
TM11	Upgrade/Expand Deployment of Probe Readers for Travel Times on Arterials										
TM12	Implement Local Agency Parking Management Systems										

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
TM13	Implement Local Agency Electronic Payment Systems for Parking										
TM14	Implement a Maintenance/Construction Vehicle Management System for Local Agency Fleet(s)										
TM15	Implement Local Agency Changeable Message Sign (CMS) Systems										
Traveler Information											
TI1	Provide road construction information and notification on local roads										
TI2	Implement Advanced Traveler Information System Element(s)										
TI3	Upgrade Advanced Traveler Information System Element(s) (Regional 511 system)										
TI4	Deploy Traveler Information Kiosks as part of OC Streetcar System										
TI5	Work with state and regional partners to provide travel information for commercial vehicle operators										
Transit and Multimodal Management											
MM1	Upgrade/Expand/Migrate OCTA Transit Traveler Information System(s)										
MM2	Disseminate/display bus arrival times at bus stops										
MM3	Implement Transit Signal Priority (TSP) for OC Street Car										
MM4	Upgrade/Expand OCTA Transit AVL System (CAD/AVL component of ITMS)										
MM5	Implement Transit Signal Priority on Bravo! Limited Stop Routes										
MM6	Implement Transit AVL, and other management systems on local agency transit systems										
MM7	Implement Transit Traveler Information Systems on local agency transit systems										
MM8	Implement Paratransit Transit Management System for local agency paratransit operations										
MM9	Implement Transit Vehicle Security System(s) for Local Agency transit operations										
MM10	Local Agency implementation of Bike Share Systems										
MM11	Support implementation of a countywide, or regional Ridesharing System										
MM12	Upgrade/Expand OCTA Transit Vehicle Security System(s)										
MM13	Upgrade Transit Vehicle Security System(s) (on-board and central systems)										
MM14	Upgrade/Expand OCTA Transit Management Systems (non-CAD/AVL components)										
MM15	Upgrade OCTA Electronic Fare Payment System(s) (on-board and central systems)										
MM16	Expand OCTA Electronic Fare Payment System(s) to other Local Agency Transit Operators										
MM17	Implement TSP for local agency transit operations										
MM18	Upgrade/Expand OCTA Paratransit Transit Management System(s)										
Communications and Connectivity											
CC1	Expand deployment of ATCs										
CC2	Implement more traffic signal interconnect (high bandwidth/low latency)										

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
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CC3	Study Feasibility of Installing Fiber Optic Communications Infrastructure in the Pacific Electric right-of-way and the LOSSAN corridor right-of-way for Countywide Inter-agency Communications										
CC4	Develop Policy Language that Recommends Additional Fiber Optic Capacity (dark fiber) be Included in all OCTA Funded Traffic Signal Synchronization and ITS Projects (where appropriate)										
CC5	Update the Orange County Countywide Communications Study for ITS										
CC6	Perform the Connectivity Study, as Recommended in the 2015 Countywide Communications Study										
CC7	Develop the capability to share data with Private Sector (Waze, etc.)										
CC8	Develop data sharing capabilities among Caltrans and Local Agencies to support Integrated Corridor Management (ICM) operations										
CC9	Plan and Design a Communications Link Among County Agencies (OCTA, OCSD, OCFA, OC Public Works, etc.)										
CC10	Implement a Transportation Data Archive System - AND/OR - Participate in a Multi-agency Transportation Data Archive System										
Institutional											
IN1	Work with Triangle ICM Local Agencies to Develop Integrated Corridor Management (ICM) Operations for the Triangle ICM area.										
IN2	Investigate the feasibility of pooling of staff, or staff augmentation to perform remote monitoring and operations for Local Agency traffic signal operations										
IN3	Work with Local Agencies to Develop Integrated Corridor Management (ICM) Operations										
IN4	Conduct a Study to Re-examine the Interest of the Local Agencies, and the Feasibility, of Implementing Multi-agency (or Sub-regional) Traffic Signal Control										
IN5	Work cooperatively to identify additional corridors in Orange County in which to plan and develop ICM systems, techniques, and institutional relationships										

1 INTRODUCTION

Intelligent Transportation Systems (ITS) refers to the use of communications and technologies to improve transportation safety, operations, and efficiency. This definition encompasses a broad range of transportation modes and technologies. Some of the demonstrated benefits of ITS include 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.

Equal in importance to the technological issues of ITS deployment are the organizational and institutional relationships that are required to fully realize the potential of ITS. Over the past 25 years, Orange County agencies have embraced ITS applications as a critical component of local and regional transportation management. In addition to several multijurisdictional traffic signal synchronization efforts, some very preliminary discussion about multi-agency operations have begun, to gauge interest in more cooperative, unified daily operations strategies. Some deployments in Orange County have not only enhanced traffic and transit operations, but have also had far reaching impacts by improving overall regional surface transportation 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 management and 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 have been made in the use of ITS solutions to manage congestion and make for a safer travel experience within the county's multimodal surface transportation network. Over the past 15-20 years, Orange County has focused heavily on building strong foundations, including:

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- Establishment of several local traffic management centers around the county, actively monitoring arterial traffic conditions; and
- An emerging atmosphere of institutional partnership that has begun to flourish.

1.1 Updated ITS Strategic Deployment Plan Overview

The overarching objective of the ITS Strategic Deployment Plan (ITS-SDP or Plan) Update is to develop, program, and communicate strategies for the deployment of a broad-based ITS program within Orange County. Ultimately, the Plan should encompass, and enhance any and all transportation system modes, efficiencies, and mobility, with support from appropriate stakeholders, countywide. The Plan was last updated in 2012/2013, and this effort builds upon that Plan update.

The primary purpose of this document is to unite and summarize interim study deliverables into a comprehensive ITS strategy and plan for Orange County. Interim deliverables included development of a comprehensive menu of ITS strategies from which potential applications can be chosen for implementation in Orange County, as well as an existing and planned system inventory and evaluation of existing ITS in Orange County.

1.2 Alignment with other OCTA and Regional Plans and Goals

1.2.1 OCTA Long Range Transportation Plan (LRTP) Goals and Objectives

The latest version of the LRTP developed by OCTA, *Designing Tomorrow, 2018 Long-Range Transportation Plan* was completed in 2018. This version is OCTA's vision for mobility over the next 20+ years. The LRTP is updated approximately every four years to reflect changing demographics, economic trends, and mobility needs. It also serves as Orange County's input into regional planning efforts for all of Southern California, primarily for SCAG planning efforts. **Table 1-1** shows the stated Goals and Objectives contained in OCTA's 2018 LRTP.

Table 1-1: Designing Tomorrow, 2018 Long-Range Transportation Plan Goals and Objectives

GOALS	OBJECTIVES
Deliver on Commitments	• Prioritize OC Go (Measure M) Investments • Maintain consistency with the Next 10 Plan • Maximize external funds to support OC Go and complementary investments
Improve System Performance	• Deploy transit resources in a cost-effective manner • Improve efficiency of highways (freeways and toll facilities) and roadways • Leverage emerging technologies and services
Expand System Choices	• Deploy on-demand transit service and rideshare options • Support improved connectivity for active transportation • Explore public/private partnerships for new transportation capacity
Support Sustainability	• Deliver a financially constrained long-range transportation plan and identify opportunities to reduce funding uncertainty • Explore environmental and emission reduction strategies • System maintenance

Source: *Designing Tomorrow, 2018 Long-Range Transportation Plan Goals and Objectives*; OCTA; 2018

ITS Traffic Management strategies most closely align with one LRTP goal of, "*Improve System Performance,"* and, the objectives to, *"Improve efficiency of highways (freeways and toll facilities) and roadways" and "Leverage emerging technologies and services."* The LRTP specifically cites *"synchronizing signals along a corridor to reduce congestion and increase the flow of traffic through intersections"* as an example of maximizing an existing roadway's performance. The extensive and mature arterial and freeway management systems in Orange County contribute heavily toward this Goal and its associated Objectives. A universal challenge over time will be to provide funding and resources to continually maintain existing systems properly, as well as to modernize or replace these systems to keep abreast/pace with the ever advancing and emerging ITS technologies dedicated to leverage arterial and freeway management and operations over all transportation modalities.

Transit and Multi-Modal Management ITS strategies also align closely with the LRTP goals and objectives listed above. A significant investment has been made in deploying technologies on OCTA transit vehicles – fixed route and paratransit buses – as well as in complementary central management systems and enterprise office systems. A similar suite of technologies will be deployed for the OC Streetcar systems and vehicles, and integrated with the existing central systems and enterprise office systems. These technologies, both on-board vehicles and central management, can be further leveraged to implement traveler information services, mobile and universal payment systems, and Transit Signal Priority (TSP). As previously stated, maintenance of these systems will be key. And, the systems must keep pace with advancement of Connected and Autonomous Vehicle (CAV) and transit management systems technologies and strategies.

As currently envisioned, the introduction of CAV Applications to the Orange County setting has the potential to support the LRTP Goal, "Improve System Performance." One of the primary focus areas of CAV applications is safety improvements in the form of collision avoidance and pedestrian safety. This focus area improves system performance by reducing non-recurring congestion due to vehicle to vehicle crashes, and vehicle to pedestrian crashes. Only small investments have been made thus far in Orange County in this emerging field of ITS. But there appears to be growing interest in CAV applications by OCTA and a handful of local agencies.

Another focus area of CAV applications is air quality and the environmental concerns. Several of the CAV applications fall into an "Environmental" category, with such applications as, Eco-Approach and Eco-Departure at Signalized Intersections, Eco-Traffic Signal Timing, Eco-Transit Signal Priority, Connected Eco-Driving, and Eco-Lanes Management. These CAV applications and strategies support the LRTP Goal, *"Support Sustainability"* and the Objective, *"Explore environmental and emission reduction strategies."* It appears that many of these Environment CAV applications require a significant market penetration of Connected Vehicles and Connected/Autonomous Vehicles, and a significant deployment of CAV roadside infrastructure, for them to have an impact and to succeed. Therefore, these applications should be considered medium to long term CAV application deployments, rather than short term deployments. In other words, deployment of the Environmental Connected Vehicle applications would follow the deployment of the base Connected Vehicle Applications in the Safety and Mobility categories.

1.2.2 Additional OCTA Emphasis Areas

Augmenting the LRTP Goals and Objectives, which are relatively high-level, OCTA staff has indicated in more detail that, to keep ITS efforts moving forward, and in order to prepare Orange County for CAV in the future, OCTA's funding programs and the local agencies should focus on, and support the following:

- ATC upgrades
- Communications gap closures, supplemented with alternative communications technologies (cellular, other wireless, "cloud"), as appropriate, and as needed
- Improve vehicle detection in general and expand functionality to include vehicle counting
- Continue installing roadside intelligent cameras with transportation analytics functionality
- Create a Countywide SPM Dashboard
- Continue ATMS improvements

This can be broadly referred to as an "all of the above approach." In addition, OCTA supports both DSRC and cellular 5G technologies as complementary technologies that will tie in to future CAV efforts. Longer term (5 – 10 years), OCTA would support an effort to define Orange County specific standards for transportation data exchange and management.

1.3 Other Pertinent ITS Goals and Objectives

Regional Traffic Signal Synchronization Master Plan
The Regional Traffic Signal Synchronization Master Plan provides the basis for implementing regional signal synchronization in Orange County through multiple components. The 750-mile regional signal synchronization network is identified as the basis for coordinated operation across the County. Key priority corridors are identified for a targeted signal synchronization effort. The Master Plan defines traffic forums consisting of local agencies, OCTA, and Caltrans. Model agreements are defined outlining the roles and responsibilities for local agencies and OCTA. Finally, an assessment is outlined to evaluate the performance of regional signal synchronization.

Local Signal Synchronization Plans
Local jurisdictions must adopt and maintain a local signal synchronization plan according to M2 Ordinance No. 3. Each agency's local signal synchronization plan shall identify traffic signal synchronization streets and traffic signals, include information on how the street routes and traffic signals may be synchronized, and include a three-year plan showing costs, available funding and phasing of capital, and operations and maintenance of the street routes and traffic signals. The local signal synchronization plan must be consistent with the Regional Traffic Signal Synchronization Master Plan.

Traffic Forum
The Traffic Forum is a technical working group with transportation staff from all Orange County cities, Caltrans, and OCTA. It is a venue to allow stakeholders to coordinate and discuss technical details related to ITS and signal system efforts. It facilitates a focus exchange of technical information to help Implementation of multi-agency signal synchronization and promote a cooperative approach to traffic management in Orange County. It meets a minimum of twice yearly. In addition, the Traffic Forum holds workshops and training regularly to update transportation staff on new trends and technologies.

Comprehensive Transportation Funding Program
OCTA Board of Directors (Board) authorizes staff to issue calls for projects for the Comprehensive Transportation Funding Program's (CTFP) Regional Traffic Signal Synchronization Program (RTSSP). The CTFP Guidelines Document identifies procedures necessary for Orange County agencies to apply for funding of RTSSP projects through a simplified and consistent process. The RTSSP objectives, competitive selection criteria, and eligible activities are contained within these CTFP Guidelines.

The combination of the Regional Traffic Signal Synchronization Master Plan, the Local Signal Synchronization Plans, the Traffic Forum, and the Comprehensive Transportation Funding Program (CTFP) work to establish and maintain a vision of ITS and signal synchronization projects in Orange County. Additionally, these documents and programs ensure coordination between and among local agencies on key systems and work towards standardized deployments.

1.3.1 Orange County Countywide Communications Study for ITS

In 2015 OCTA completed a study that looked at existing and planned communications infrastructure used for traffic management purposes around Orange County. The final report is titled, *Orange County Countywide Communications Study for Intelligent Transportation Systems* (OCTA; 2015). The overarching intent of the study was to determine the feasibility of utilizing existing and planned communications infrastructure to create a countywide center-to-center communications network. The network would create a regional communications backbone that can facilitate sharing of resources and data and provide a secured intranet for emergencies and incident management among agencies in Orange County. Data sharing would also enable system performance monitoring on arterial roadways in which Regional Traffic Signal Synchronization Program funds have been invested. As part of the Countywide Communications Study, a Vision Statement was developed, as well as a set of Goals and Objectives. The Vision for the Countywide Communications Study is as follows:

"A collaborative intelligent transportation systems communications network that securely connects partner agencies to provide multimodal information sharing necessary to support improved safety, mobility, and the traveler experience[1]."

Table 1-2 shows the stated Goals and Objectives contained in the Countywide Communications Study.

Table 1-2: Countywide Communications Study for ITS Goals and Objectives

GOALS	OBJECTIVES
Collect data for key transportation modes.	• Provide better information for real-time operations and planning decisions. • Improve management of incidents and events that cross-jurisdictional boundaries. • Enhance multimodal traveler information. • Support performance requirements for MAP-21. • Be ready for future applications including connected vehicles.
Connect local, county, state, and other stakeholders into a secure data-sharing network.	• Complete gaps in the network. • Provide the opportunity to leverage investments and share resources.
Expand System Choices	• Deploy on-demand transit service and rideshare options • Support improved connectivity for active transportation • Explore public/private partnerships for new transportation capacity
Support the ability to share data and resources between multiple systems.	• Use national standards as basis for countywide ITS protocol and data formats. • Retrieve, compile, and distribute data from multiple systems. • Use aggregated data for reporting. • Provide a means to access data.

Orange County Countywide Communications Study for Intelligent Transportation Systems (OCTA; 2015)

The concepts contained in the Countywide Communications Study most closely align with the LRTP Goal, *"Improve System Performance,"* and the Objectives, *"Improve efficiency of highways (freeways and toll facilities) and roadways"* and *"Leverage emerging technologies and services."* OCTA intends to encourage

[1] *Orange County Countywide Communications Study for Intelligent Transportation Systems* (OCTA; 2015)

Orange County municipal, County, and state transportation and public service agencies toward the implementation of a countywide ITS communications network, as reflected in this Plan update.

1.3.2 The 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (2016-2040 RTP/SCS)

The State of California and the federal government require that the SCAG and other regional planning agencies update their respective Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) every four years. Key laws and requirements that mandates or drives SCAG's work include these two laws:

- Federal law (23 U.S.C.) §134 et seq) to prepare and update a long-range RTP, with a minimum 20 year planning horizon. Because most areas within the SCAG region have been designated as nonattainment or maintenance areas for one or more transportation-related criteria pollutants, the federal Clean Air Act requires that SCAG's RTP/SCS meet all federal transportation conformity requirements.
- California Senate Bill 375 (SB 375) requires that the RTP also include an SCS, which outlines growth strategies that better integrate land use and transportation planning and help reduce the state's greenhouse gas emissions from cars and light trucks (California Government Code §65080 (b)(2)(B).

In the process of developing the 2016 RTP/SCS, SCAG developed a set of goals and guiding policies, and a vision, through extensive outreach to the general public and the numerous stakeholders across the six-county SCAG region. **Table 1-3** provides the list of Goals contained in the 2016-2040 RTP/SCS; and **Table 1-4** provides the list of Guiding Policies contained in the 2016-2040 RTP/SCS.

Table 1-3: Goals Contained in the 2016-2040 RTP/SCS

GOALS
1. Align the plan investments and policies with improving regional economic development and competitiveness.
2. Maximize mobility and accessibility for all people and goods in the region.
3. Ensure travel safety and reliability for all people and goods in the region.
4. Preserve and ensure a sustainable regional transportation system.
5. Maximize the productivity of our transportation system.
6. Protect the environment and health of our residents by improving air quality and encouraging active transportation (e.g., bicycling and walking).
7. Actively encourage and create incentives for energy efficiency, where possible.
8. Encourage land use and growth patterns that facilitate transit and active transportation.
9. Maximize the security of the regional transportation system through improved system monitoring, rapid recovery planning, and coordination with other security agencies.

ITS generally support Goals 2, 3, 4, 5, and 9 from the 2016-2040 RTP/SCS. It is anticipated that the outcomes of this ITS Plan Update will support those specific goals contained in the 2016-2040 RTP/SCS.

Table 1-4: Guiding Policies Contained in the 2016-2040 RTP/SCS

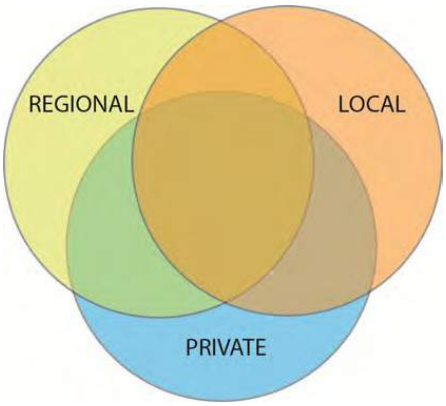
GUIDING POLICIES
1. Transportation investments shall be based on SCAG's adopted regional Performance Indicators.
2. Ensuring safety, adequate maintenance and efficiency of operations on the existing multimodal transportation system should be the highest RTP/ SCS priorities for any incremental funding in the region.
3. RTP/SCS land use and growth strategies in the RTP/SCS will respect local input and advance smart growth initiatives.
4. Transportation demand management (TDM) and active transportation will be focus areas, subject to Policy 1.
5. HOV gap closures that significantly increase transit and rideshare usage will be supported and encouraged, subject to Policy 1.
6. The RTP/SCS will support investments and strategies to reduce non-recurrent congestion and demand for single occupancy vehicle use, by leveraging advanced technologies.
7. The RTP/SCS will encourage transportation investments that result in cleaner air, a better environment, a more efficient transportation system and sustainable outcomes in the long run.
8. Monitoring progress on all aspects of the Plan, including the timely implementation of projects, programs, and strategies, will be an important and integral component of the Plan.

ITS generally supports Guiding Policies 6 and 7 from the 2016-2040 RTP/SCS. It is anticipated that the outcomes of this ITS Plan Update will support those specific Guiding Policies contained in the 2016-2040 RTP/SCS.

1.4 Plan Use and Objectives

The objective of this ITS Strategic Deployment Plan (SDP) update is to provide a useful tool for Orange County 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 Orange County 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 systems, 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.

1.5 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 an approximately one year process to update the Plan previously prepared in

2013. Based on stakeholder input, as well as 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. The first step in the Plan update process was to identify a wide range of potential ITS strategies to be considered in the Plan update. The strategies were described, with examples provided, a statement on the maturity of the technologies included in the strategy, and, where available, cost and benefit information. Additional emphasis was placed on Vehicle to Infrastructure (V2I) infrastructure and emerging Connected Vehicle applications.

Following the overview of potential strategies, an inventory of existing and planned ITS was documented, with assistance from ITS stakeholders from around Orange County. Supplementing the inventory is an ITS User Needs assessment, that also includes a summation of the relative priorities for each of the ITS User Needs. The Inventory was then compared to the ITS User Needs to determine if any gaps existed.

A high-level program of projects was assembled that reflects the planned ITS inventory, any identified gaps between Needs and the existing and planned ITS inventory, and any other projects or programs identified by ITS stakeholders as a desired future strategy.

In addition, the ITS SDP includes the following information that should allow OCTA and local stakeholders to position the program to pursue integration opportunities, measure performance and adopt future technologies:

1. Performance measures that are based on the initial needs in order that after strategies and projects are deployed, the performance can be measured against the original expectations.
2. A high level communications assessment that supports a potential future countywide Center to Center (C2C) ITS and Traffic Signal Communications network.

1.6 Timeframe

There are no federal or state guidelines that require any specific planning time horizon for an ITS Plan. This ITS 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 (LRTP), *Designing Tomorrow* (2018), has a planning time horizon of just over 20 years. *Designing Tomorrow* is intended to guide investments with a long-term planning horizon. The Orange County ITS SDP planning time 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. Routine updates to the ITS SDP also allow it to keep pace with technology, and keep it ahead of the LRTP.

1.7 Federal Requirements

There are no specific federal requirements for the development of an ITS Plan. However, OCTA has committed to updating the countywide ITS SDP on a routine basis. Related to this, federal regulations do require that ITS projects funded with Highway Trust Funds 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 systems 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 ITS architecture component) support these requirements and conformance. This ITS SDP and the ITS architecture elements have been coordinated with a recently completed update to the Cross-County Services component of the Southern California Regional Association of Governments (SCAG) Southern California Regional ITS Architecture.

Table 1-5 provides a guide to the location of the Orange County ITS architecture documentation that shows Orange County's conformance with the National ITS Architecture Rule and Policy.

Table 1-5: Orange County ITS Architecture Documentation

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 9

2 ORANGE COUNTY AREA AND EXISTING CONDITIONS

This section describes the geographic area covered by this ITS SDP Update, 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. Therefore, cooperative, multijurisdictional ITS efforts are highly desirable, and are most likely to provide maximum return on investment.

2.1 Geographic Area

The project area covers the entirety of Orange County, which encompasses approximately 798 square miles and has a population of just under 3.19 million[2]. It is the 3rd largest County by population in California[3]. **Figure 2-1** is a map of the study area – Orange County – and includes major roadways, freeways and toll roads. The County is bordered by Los Angeles County to the west and north; San Bernardino County to the northeast; Riverside County to the east and San Diego County to the south and east. There are 34 cities within the County, with the cities of Anaheim, Santa Ana, and Irvine being the most populous. There are also several unincorporated communities located throughout the County.

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.

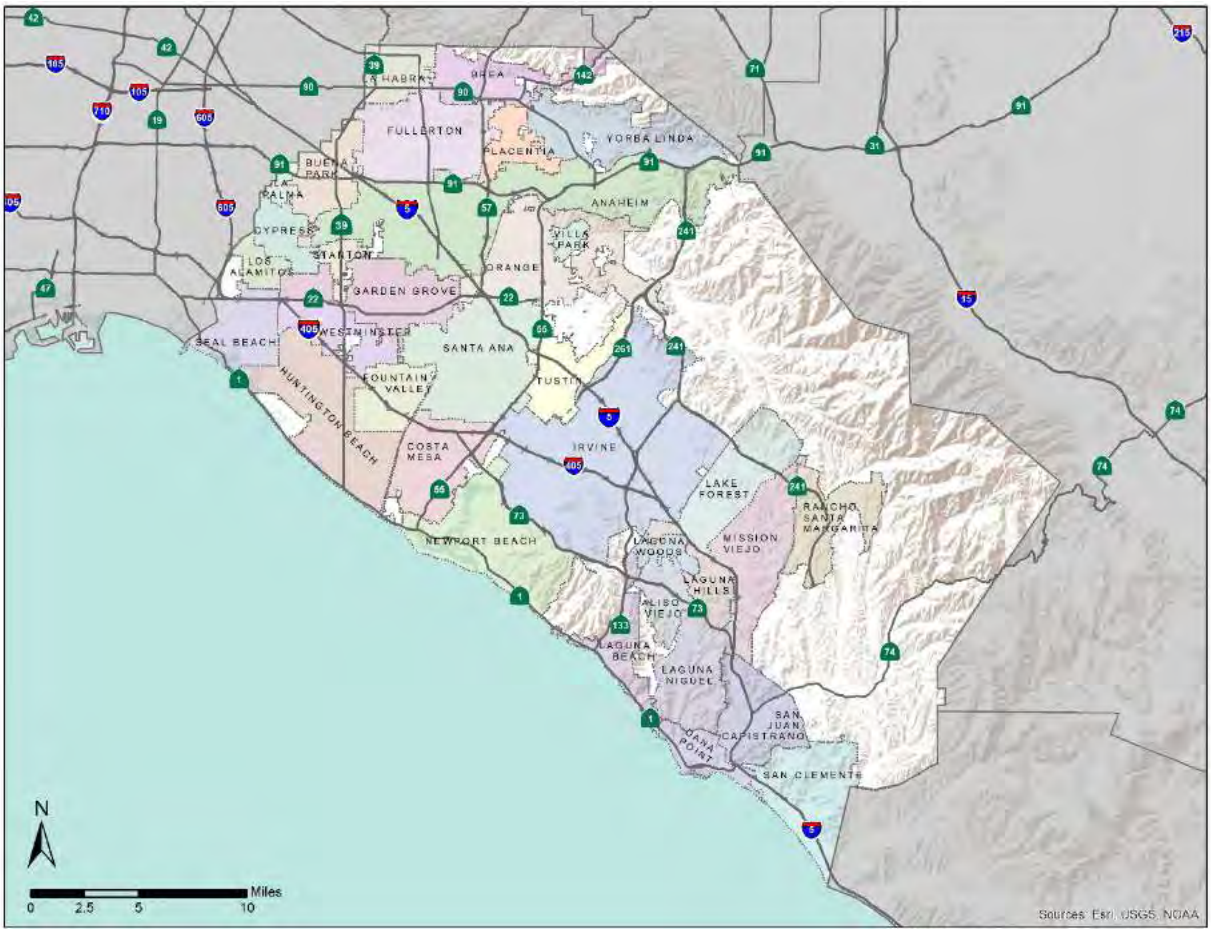
Major freeways and tollways that traverse the County include:

- I-5 – the Santa Ana Freeway,
- SR-22 – the Garden Grove Freeway,
- SR-55 – the Costa Mesa Freeway,
- SR-57 – the Orange Freeway,
- SR-91 – the Riverside Freeway,
- I-405 – the San Diego Freeway,
- SR-73 – the San Joaquin Hills Toll Road,
- SR-133/SR-241/SR 261 – the Foothill/Eastern Toll Road

[2] United States Census Bureau 2018 Estimate

[3] State of California, Department of Finance; E-1 Population Estimates for Cities, Counties, and the State — January 1, 2018 and 2019; http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

Figure 2-1: Project Study Area



Major Highways that traverse Orange County include:

- SR-1 – Pacific Coast Highway
- SR-39 – Beach Boulevard
- SR-72 – Whittier Boulevard
- SR-74 – Ortega Highway
- SR-90 – Imperial Highway
- SR-133 – Laguna Canyon Road
- SR-142 – Carbon Canyon Road

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.

Since 2003, OCTA has operated the 91 Express Lanes; a 10 mile long toll lane facility, located in the median of SR-91, between SR-55 and the Orange/Riverside County line. In 2017, the Riverside County Transportation Commission (RCTC) opened an eight-mile eastward extension of the 91 Express Lanes

facility into Riverside County, extending the Express Lanes from the Orange/Riverside County Line to the SR-91/I-15 interchange. The four lane cross section of the Express Lanes facility in Riverside County matches the four lane cross section of the Express Lanes in Orange County. The opening of that eastward extension of the Express Lanes to the SR-91/I-15 interchange also includes a direct connector from the 91 Express Lanes to Express Lanes currently being constructed on I-15; expanding the system of Express Lanes in the region. In addition, OCTA is currently overseeing construction of an approximately 16 mile long Express Lanes facility on I-405, between SR-73 in Costa Mesa and I-605 in northwest Orange County. The project is scheduled to be complete and open to traffic in 2023.

Commercial air passenger service and air cargo services are provided at John Wayne Airport, one of the busiest airports in the region. In 2018, John Wayne Airport served just over 10.5 million passengers, a 2.3% increase over 2017. Similarly, the airport served just over 19,500 tons of cargo, a 3.5% increase over 2017. John Wayne Airport is one of only two airports in Orange County that accommodates general aviation activities, and is home to approximately 450 general aviation aircraft.

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. Some Metrolink commuter rail stations in the county are also served by the Amtrak Surfliner service, which extends intercity passenger rail from Orange County to San Luis Obispo in the north and San Diego in the south. OCTA operates approximately 60 bus routes providing local and express bus service, as well as a paratransit shuttle service. OCTA is currently constructing the OC Streetcar system, a 4.1 mile long fixed guideway streetcar system, which will connect the Santa Ana Regional Transportation Center (SARTC) with a new multimodal hub at the intersection of Harbor Boulevard and Westminster Avenue in the city of Garden Grove.

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, north and east of Orange County. A large volume of freight is transported by train, including more than 75 trains a day passing through northern Orange County. Additional rail freight moves along the Los Angeles – San Diego – San Luis Obispo (LOSSAN) rail corridor. A portion of the goods from the ports are transported by trucks on the freeway system and truck routes on arterials.

2.2 Institutional Framework

OCTA, as a multimodal transportation planning and operating agency, has broad-ranging responsibilities for planning, funding, implementing, operating, 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 Plan development, stakeholders are defined as the public agencies with transportation-management and operations related oversight, responsibility, and/or duties within Orange County. **Table 2-1** lists the stakeholder agencies engaged in the Plan update process. 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;
- County of Orange (primarily representing unincorporated areas of the county);
- OCTA (including multiple departments to provide input on behalf of various modal programs);
- Caltrans District 12;
- Orange County Fire Authority (OCFA);
- SCAG;
- Federal Highway Administration (FHWA); and

Table 2-1: Project Stakeholder Agencies

Project Stakeholder Agencies	
City of Aliso Viejo	City of Laguna Woods
City of Anaheim	City of Lake Forest
City of Brea	City of Los Alamitos
City of Buena Park	City of Mission Viejo
City of Costa Mesa	City of Newport Beach
City of Cypress	City of Orange
City of Dana Point	City of Placentia
City of Fountain Valley	City of Rancho Santa Margarita
City of Fullerton	City of San Clemente
City of Garden Grove	City of San Juan Capistrano
City of Huntington Beach	City of Santa Ana
City of Irvine	City of Seal Beach
City of La Habra	City of Stanton
City of La Palma	City of Tustin
City of Laguna Beach	City of Villa Park
City of Laguna Hills	City of Westminster
City of Laguna Niguel	City of Yorba Linda
OCTA	County of Orange – OC Public Works (OCPW)
Transportation Corridor Agencies (TCA)	Caltrans, District 12
Orange County Fire Authority (OCFA)	Orange County Sheriff's Department (OCSD)
California Highway Patrol (CHP)	

This Plan was developed based on an assessment of the ITS User Needs (short-term and long-term) of these stakeholders within Orange County, as well as their own existing and planned ITS. In order to obtain input from the stakeholders, a series of workshops were held. These workshops provided important input for the needs assessment, existing conditions understanding, discussion of Connected Vehicle Applications, and the potential for a countywide ITS communications network. In addition to the workshops, the Plan Update was presented at multiple Traffic Forum meetings. The workshops and Traffic Forum presentations are summarized as follows:

- Traffic Forum meeting held on September 25, 2018 – attended by local agencies, County of Orange, OCTA, and Caltrans. The ITS SDP Update was one presentation provided, among many. The purpose of this presentation was to introduce this Plan update, provide an update of the update process, and to gather strategic direction for the Plan, primarily from a local perspective.

- Three (3) sub-regional workshops held in July and August 2018 – attended by small groups of local agencies, OCTA, County of Orange, and Caltrans. The purpose of these meetings was to perform and review the needs assessment results and discuss potential strategies primarily from a local perspective.
- Traffic Forum meeting held on February 5, 2019 – attended by local agencies, County of Orange, OCTA, and Caltrans. The ITS SDP Update was one presentation provided, among many. The purpose of this presentation was to provide a status update to the local stakeholders and present the draft results of the needs and strategies.

2.3 Existing Conditions and Inventory

Existing ITS programs and projects in Orange County provide a foundation for the identification of needs and new or continued ITS strategies to meet those needs into the future. This section provides a summary of 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 2013 ITS Strategic Deployment Plan

A geographic representation of the primary traffic signal and ITS communications infrastructure has been gathered into a geographic information systems (GIS) database to illustrate the location and types of communications infrastructure deployed by local agencies. This communications infrastructure inventory is discussed in more detail in Section 7 of this document.

The following subsections provide an overview of existing and planned ITS projects and programs organized by the following categories:

- Data Management and Performance Monitoring
- Public Safety
- Vehicle Safety
- Traffic Management
- Traveler Information
- Transit and Multi-Modal Management
- Communication and Connectivity

2.3.1 Data Management and Performance Monitoring

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 transportation systems performance monitoring.

Designing Tomorrow, 2018 Long-Range Transportation Plan (OCTA's Long Range Transportation Plan) identified several key performance measures that represent a multi-modal and integrated approach to achieving system improvements. Some of these performance measures, which are shown in **Table 2-2**, include the following comparison of the baseline (year 2015) conditions, forecast conditions (year 2040) under a "no project" scenario, and forecast conditions (year 2040) under a financially constrained "preferred build alternative" scenario called Trend 2040:

Table 2-2: OCTA LRTP Performance Measures

METRICS (DAILY)	2015 BASE YEAR	2040 NO BUILD	TREND 2040
Delay as a percent of travel time	15.2%	21.4%	15.4%
Transit Trips	149,000	165,000	174,000
Freeways – AM Peak average speed (mph)	38.3	36.2	39.7
Arterials– AM Peak average speed (mph)	25.7	24.3	25.9

Note: Trend 2040 assumes managed lanes are operated as carpool/tolled express lanes by 2040

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 facilities, High Occupancy Vehicle (HOV) lane usage and performance, and ramp facilities throughout the county, primarily using inductive loop detectors. In general, the data is transmitted from the field to the District 12 Transportation Management Center (TMC) over Caltrans' extensive fiber optic communications infrastructure. The data is used in real time for traffic operations purposes.

Historic data and other information is also collected and made available through the Caltrans Performance Measurement System (PeMS) website. Users can download raw traffic data from PeMS from over 2,300 vehicle detection stations covering nearly 1,500 lanes miles of freeway in the county. The PeMS website also has reporting tools and performance dashboards that aggregate the traffic data into performance measures that identify bottleneck locations, travel reliability, delay, and some other measures. Caltrans also manually collects data annually for additional evaluation and cross-checking.

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.

Related to the synchronized arterial corridors, OCTA staff envisions development of a countywide traffic SPM system that would allow OCTA staff and other authorized stakeholders to view and monitor traffic signal performance from a common dashboard. Several steps will need to be taken to achieve this vision, including wider deployment of Advanced Traffic Controllers (ATCs), more robust communications to allow data from many traffic signal systems to flow to the SPM system, and interagency agreements that govern access, roles, and responsibilities. The countywide SPM dashboard is a project concept that is in the proposed project list later in this document.

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. The data can also provide a sampling of trip origins and destinations by tracking the anonymous IDs from magnetic fare media. The GIS section also manages arterial traffic volume data from around the county, managing and maintaining the Annual Traffic Flow Map; as well as forecast data contained in the countywide travel demand model, known as the Orange County Travel Demand Model (OCTAM).

2.3.2 Public Safety

OCTA manages the Service Authority for Freeway Emergencies (SAFE) to provide motorists with roadside assistance through the Freeway Service Patrol (FSP). FSP is a motorist aid service in the form of tow trucks that drive on area freeways primarily in peak commute hours. The tow trucks are positioned to remove disabled vehicles from travel lanes in a quick and efficient manner to return the freeway to its full capacity as quickly as possible. FSP personnel can provide a jump start, or a gallon of gas, or to change a flat tire, or potentially even towing vehicles to a safe location off the freeway without charge. The FSP is a transportation management strategy designed to limit congestion resulting from disabled vehicles in travel lanes.

FSP contracts are managed by OCTA. Day to day operations of FSP personnel are managed by California Highway patrol (CHP). FSP vehicles contain a basic vehicle location system that allows some real time monitoring, as well as logging of vehicle locations. In addition, FSP personnel carry tablets (mobile personal computing devices) that integrate with the vehicle location system, which allows FSP personnel to log their activities. Location and service data from these systems are evaluated to assist with asset deployment decisions. Caltrans also obtains the service data and information for evaluation of SAFE FSP programs on a statewide basis.

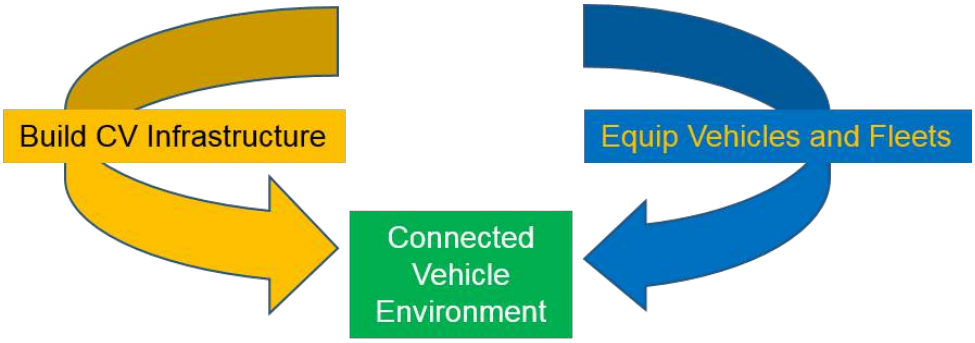
Orange County SAFE manages a shrinking network of motorist aid call boxes on most freeways, toll roads and state highways throughout the county. Motorists can request assistance using the freeway call box or by calling 511 with their cell phone. Calls to 511 are directed to the appropriate call center in any part of the region based on the location of the caller. The calls are handled by the dispatcher at the call center who can dispatch motorist assistance or CHP officers to the location of the caller. Orange County SAFE is currently planning to upgrade older cellular technologies on the callboxes to the next generation cellular technology.

Orange County SAFE also manages OCTA's participation in the Southern California 511 system. Southern California 511 is a free traveler information service that provides live traffic information, transit planning services, commuter service information, access to motorist aid, and FasTrak information in the Southern California area, through a toll-free phone number, a website, and a mobile application. Southern California 511 is operated by Los Angeles SAFE, on behalf of Los Angeles County Metropolitan Transportation Authority (Metro), OCTA, and Ventura County Transportation Commission (VCTC). More information on this system is provided below, under Traveler Information.

2.3.3 Vehicle Safety

The Connected Vehicle (CV) initiative led by United States Department of Transportation (USDOT) is a set of research and development activities centered on enabling vehicles to communicate with one another and as well as with surrounding infrastructure in support of applications that enhance safety and mobility, improve operational performance, and reduce environmental impacts. The USDOT's Intelligent Transportation Systems Joint Program Office (ITS-JPO) is the primary sponsor of the CV research program. This program has also garnered support from most major automakers and many state departments of transportation including the California Department of Transportation (Caltrans).

The "Connected Vehicle Environment" goes beyond ITS infrastructure to address communications to and from, and between, vehicles. The National Highway Traffic Safety Administration (NHTSA) states that connected vehicle technology could potentially address 80% of all unimpaired crash scenarios. To enable this, the standardization of these communications, as well as their utilization on a national and statewide basis, are essential, and will be a tacit assumption in their incorporation into this ITS Strategic Deployment Plan. In particular, this environment will require the increased engagement of the private sector as well as further standardization of data sharing capabilities between agencies as outlined in California's Connected Corridor initiatives.



Currently, USDOT has identified approximately 56 CV applications that are in various stages of development, testing and deployment. These applications are categorized into seven (7) categories including Vehicle-to-Vehicle (V2V) Safety, Vehicle-to-Infrastructure (V2I) Safety, Agency Data, Environment, Road Weather, Mobility and Smart Roadside. The *Vehicle-to-Infrastructure State of the Practice Review* (OCTA, 2017) summarized the current state of the practice of CV Applications, and their applicability in Orange County. The study identified 36 CV applications which appear to be relevant to the Orange County setting.

In the course of this ITS SDP Update, the local agencies were polled on their priorities and level of interest in the shortlisted CV 36 applications. The top 10 CV applications as rated by the 25 cities and countywide agencies that participated in the poll are listed as follows:

1. V2I Safety: Reduced Speed/Work Zone Warning
2. V2I Safety: Pedestrian in Signalized Crosswalk Warning (Transit)
3. V2I Safety: Red Light Violation Warning

4. Mobility: Emergency Vehicle Preemption (PREEMPT)
5. Mobility: Intelligent Traffic Signal System (I-SIG)
6. Mobility: Mobile Accessible Pedestrian Signal System (PED-SIG)
7. Mobility: Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
8. Mobility: Queue Warning (Q-WARN)
9. Mobility: Advanced Traveler Information System
10. Agency Data: Probe-enabled Traffic Monitoring

It is anticipated that any future efforts by OCTA to support, and encourage CV applications development and deployment, would use this information as a starting point.

There is currently very little CV infrastructure present in Orange County. The city of Anaheim has deployed 15 DSRC radios as a pilot. One part of the pilot deployment was to determine the level of effort required to install and configure a DSRC roadside unit. Another part of the pilot was to deploy DSRC roadside units from different vendors to see how the in-vehicle (on-board) DSRC units interacted with roadside units from different vendors. The City has short term plans to beta test CV communications hardware and CV safety applications in testbed areas prior to citywide permanent deployments.

The city of Brea has also deployed ten hybrid radios in the vicinity of the Brea Mall that are both Bluetooth readers and DSRC roadside units. The Bluetooth readers are used to develop and report travel time profiles. The DSRC functionality is not yet operating but the units are installed and are ready to be activated and configured to broadcast Signal Phase and Timing (SPaT) message data from the intersection. It is likely that the DSRC broadcast function will be operational by the end of 2020. There are no other short term plans to implement Connected Vehicle applications in the City of Brea.

2.3.4 Traffic Management

The vast majority of the 34 cities, the 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 measure M2 (now known as OC Go).

In review of the Summary of Traffic Signal Control Systems in Orange County shown in **Table 2-3**, several jurisdictions in Orange County utilize multiple traffic signal controller types and traffic signal central systems within their respective jurisdictions. In most cases, the agencies are migrating from an older controller type or central system, to the newest, ATC and newest compatible across manufacturer ATMS in a phased approach.

Table 2-3: Summary of Traffic Signal Control Systems in Orange County

(F) = Indicates future migration path

Agency	Controller Type						Traffic Signal System									Interconnect			
	170/170E	2070	820/820A	ASC2/3	Cobalt	Other NEMA	McCain QuicNet	TransSuite	Siemens TACTICS	Siemens ACTRA/12	Econolite Aries	Econolite Centracs	Maxview	ACS-LITE	Other	WIRELESS	TWP	FIBER	CELLULAR
CALTRANS		X						X							X[4]		X	X	
COUNTY OF ORANGE				X	X(F)							X				X	X	X	
ALISO VIEJO				X	X						X	X(F)					X		
ANAHEIM		X				X[1]			X	X		X	X	X		X	X	X	
BREA			X	X	X(F)							X					X		
BUENA PARK		X	X			X[2]			X							X	X	X	X
COSTA MESA			X	X	X(F)							X					X	X	
CYPRESS				X							X							X	
DANA POINT	X			X	X						X						X		
FOUNTAIN VALLEY		X					X									X		X	
FULLERTON						X[2]				X						X	X	X	
GARDEN GROVE				X	X(F)							X						X	
HUNTINGTON BEACH	X	X					X								X(F)[5]	X	X	X	
IRVINE		X								X		X	X(F)		X[6]	X	X	X	
LA HABRA		X								X			X(F)			X	X	X	
LA PALMA				X	X(F)						X	X(F)					X		
LAGUNA BEACH																			
LAGUNA HILLS				X	X(F)							X					X		
LAGUNA NIGUEL				X	X(F)							X					X		
LAGUNA WOODS				X								X				X	X		
LAKE FOREST				X	X(F)							X					X	X	
LOS ALAMITOS				X	X(F)							X(F)					X	X	
MISSION VIEJO				X	X(F)							X					X	X	
NEWPORT BEACH				X	X(F)							X				X	X	X	
ORANGE				X	X(F)							X				X	X	X	
PLACENTIA				X	X(F)							X					X	X	
RNCHO SNTA MARGARITA				X	X(F)						X						X	X	
SAN CLEMENTE			X			X[3, 1]							X			X	X		
SAN JUAN CAPISTRANO				X	X(F)						X	X(F)					X		
SANTA ANA		X										X(F)			X[7]	X	X	X	
SEAL BEACH		X					X										X	X	
STANTON				X	X(F)						X	X(F)					X		
TUSTIN				X	X(F)						X	X(F)				X	X	X	
VILLA PARK			X	X	X(F)														
WESTMINSTER		X					X											X	
YORBA LINDA				X	X(F)						X	X					X	X	

Footnotes: 1 = Intelight X3; 2 = Siemens; 3 = Peek; 4 = Traffic Management and Surveillance System (TSMSS); 5 = Transparity; 6 = Adaptive; 7 = MIST; (F) = Future migration path for agencies utilizing multiple controllers and/or central systems

The Econolite Cobalt controller is in use in 20 jurisdictions (19 cities plus the County) in Orange County. Most of those jurisdictions have indicated that they are migrating all (or most) intersections to use of the Cobalt controller for the foreseeable future. All of the jurisdictions utilizing Cobalt controllers also employ legacy ASC/2 and/or ASC/3 controllers from the same manufacturer. Eleven jurisdictions utilize Type 2070 controllers but utilize the same firmware or program from the ASC/3. Caltrans uses Type 2070 controllers with an agency developed firmware known as TSCP. Seven jurisdictions still employ older Multisonics model 820/820A legacy controllers left over from the late 1980's and early 1990's. The ASC and 820 controllers are no longer supported by their respective manufacturers. Only two jurisdictions reported using Type 170 controllers. In one case, the city is still using the Type 170 controllers on a road that was once owned and operated by Caltrans, who, at the time of the relinquishment of the state road to the local agency, utilized Type 170 controllers. Note: At the time of this writing, these two jurisdictions have made the conscious decision and action to upgrade to the 2070 controller form factor and are determining the direction of their respective ATMS.

Twenty-two agencies in Orange County are using Econolite Centracs as their central system for traffic signal control, monitoring, and management. About one-third of those of those jurisdictions have indicated that they are migrating to use of Centracs for the foreseeable future. Most of the jurisdictions using Centracs are using Cobalt controllers. Econolite Aries closed loop system is being used in eight agencies in Orange County, with four of those jurisdictions indicating that they are migrating to use of Centracs for the foreseeable future. Nine agencies are using multiple central systems for traffic signal control, monitoring, and management, with one agency using up to five different central systems. Most of the agencies using multiple central systems are migrating over to a newer central system over time, in a phased manner. Some are using one or more of the central systems for some unique purpose, such as adaptive operations, in a specific area of their jurisdiction. Note: at the time of this writing, several agencies are considering or have begun migration from the Econolite Centracs to another manufacturer's similar ATMS that is compatible with all of their respective ITS field elements.

Thirty of the thirty-six agencies operating traffic signals in Orange County use some form of copper wire for some portion of the traffic signal communications infrastructure. It is used to interconnect traffic signals for coordination purposes, and to provide data to and between the central system and the controllers in the field. **Table 2-3** refers to this form of communications media as Twisted Wire Pair (TWP). Twenty two agencies are using fiber optic cable for some portion of their traffic signal communications infrastructure; as well as communications with other ITS elements such as CCTV cameras. Eighteen agencies are utilizing a combination of TWP and fiber optic cable. Fifteen agencies are using some form of wireless communications media for traffic signal communications. In most cases, those agencies are also using TWP and/or fiber optics, and the wireless is likely supplementing the wired media at isolated intersections or corridors.

Caltrans District 12 operates a mature, full feature Freeway Management System from a stand-alone Transportation Management Center (TMC) located in the city of Irvine. California Highway Patrol (CHP) personnel are collocated in the TMC with Caltrans personnel, which provides close coordination and cooperation between the two agencies in monitoring and managing freeway operations. The Freeway management System has the capability to detect incidents, and assist with coordinated responses

between CHP and Caltrans. The Freeway Management System also has some capability to monitor traffic within work zones through temporary/portable detection provided by field contractors.

Caltrans owns a robust fiber optic communications network along the majority of the freeways throughout the county. The potential to share some of this bandwidth for other transportation uses within the county has been explored in the past, and may be attempted again in the future. Traffic signals at Caltrans-owned intersections on state conventional highways, and at freeway ramp termini are also managed from the District 12 TMC in Irvine.

There are approximately 267 lane-miles of high-occupancy vehicle (HOV) lanes in Orange County. There is currently a countywide minimum vehicle occupancy requirement of two passengers per vehicle to drive in an HOV lane. The HOV requirements are in effect 24 hours per day. The HOV facilities are operated and maintained by Caltrans while vehicle occupancy is enforced by CHP on the road. Due to high demand to use the HOV lanes in Orange County, and a corresponding deterioration of the level of service in the HOV lanes, some consideration is being given to changing the minimum vehicle occupancy requirement from two passengers per vehicle, to three passengers per vehicle. Excluding alternative fuel vehicles from the HOV lanes has also been discussed. A timetable for either or both of these actions is not in place.

Since 2003, OCTA has operated the 91 Express Lanes; a 10 mile long toll lane facility, located in the median of SR-91, between SR-55 and the Orange/Riverside County line. In 2017, the Riverside County Transportation Commission opened an eight mile eastward extension of the 91 Express Lanes facility into Riverside County, extending the Express Lanes from the Orange/Riverside County Line to the SR-91/I-15 interchange. The four lane cross section of the Express Lanes facility in Riverside County matches the four lane cross section of the Express Lanes in Orange County. The opening of that eastward extension of the Express Lanes to the SR-91/I-15 interchange also includes a direct connector from the 91 Express Lanes to Express Lanes currently being constructed on I-15; expanding the system of Express Lanes in the region. 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. In addition, OCTA is currently overseeing construction of an approximately 16 mile long Express Lanes facility on I-405, between SR-73 in Costa Mesa and I-605 in northwest Orange County. The project is scheduled to be complete and open to traffic in 2023.

There are also four toll road facilities (SR-73, SR-133, SR-261 and SR-241) that are owned and maintained by Caltrans. The toll roads are operated cooperatively by the Transportation Corridor Agencies (TCA) and Caltrans. TCA's principal role in toll road operations is the collection of tolls, and operations and maintenance of the electronic toll collection equipment and facilities. For several years the TCA toll roads operated some cash toll collection sites. However, they have now converted to all electronic toll collection.

In June 2019, TCA began distributing new "sticker transponders" to TCA FasTrak account holders. The sticker transponder is a small and unobtrusive transponder that is mounted to the inside of a vehicle's windshield using an adhesive backing. It has an internal antennae that passively communicates with the roadside equipment. The TCA toll roads do not offer toll discounts based on vehicle occupancy. The

sticker transponder will work on all public toll facilities throughout California. On some of California's express lanes, qualifying carpools and other select vehicles are eligible for free or discounted toll rates. Drivers with a sticker transponder will always pay the full toll, regardless of the number of occupants in the vehicle. The older style, hardcase transponder can still be used on the TCA toll roads, as well as any other tolled bridge, lane, or road throughout California. To be eligible for free or discounted toll rates, drivers need a switchable hardcase FasTrak transponders (also called FasTrak Flex ®) that has a small black switch that can be set to indicate the number of occupants in the vehicle.

2.3.5 Traveler Information

Advanced traveler information is currently provided within Orange County through numerous outlets. The Los Angeles Service Authority for Freeway Emergencies (LA SAFE) operates both a web based and phone based interactive 511 traveler information service, known as Southern California 511 that covers the greater Los Angeles metropolitan area. LA SAFE operates Southern California 511on behalf of a coalition of counties in the region, one of which is Orange County. Other private entities also offer other traveler information services primarily through Internet websites and smart phone applications. These services are, generally speaking, independent of the publicly funded programs.

The 511 system provides traveler information on freeways in Los Angeles, Orange, Ventura, 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 (Districts 8 and 12), the Caltrans Lane Closure System portal, the California Highway Patrol Computer Aided Dispatch (CAD) system, and data/information from automated vehicle location (AVL) systems on several Los Angeles County bus transit systems. Transit information includes an integrated trip planner, and Real-time Arrivals information. 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 Orange County in the on-going 511 program operations discussions.

The Southern California 511 system provides real time bus location and arrival information on the website and over the phone for several Los Angeles County based transit operators. A text message (Short Message Service – SMS) service is also available. OCTA's website provides similar real time bus location and arrival information for OCTA fixed route bus service. It is referred to as, "Next Ride." A text message (SMS) service called, "Text4Next" is also available for OCTA's fixed route service. The Text4Next user sends a text message from their cell phone to the Text4Next service number, with a specific bus stop number. The service then responds with the next three arrival times via text message for that specific stop. The arrival time predictions are based on real time locations for buses that serve that specific stop, based on the time of day that the original text message was sent.

2.3.6 Transit and Multi-Modal Management

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's bus service is supported by several technologies to improve efficiency, service, and security. The primary on-board ITS equipment/system is known as the Integrated Transportation Management System (ITMS). ITMS is a Computer Aided Dispatch (CAD)/Automated Vehicle Location (AVL) system, coupled with a Harris OpenSky2I radio system. The ITMS on-board system replaced many of the components of a legacy system that had some, but not all, of the same functionality. The overall ITMS project and equipment installation was completed in 2015. Other on-board ITS systems include a video security system and fare collection system. The on-board components of the ITMS system include the following:

- Mobile Display Terminal (MDT) – the operator's interface with ITMS, upon which an operator is able to perform a variety of functions, including: operator logon, viewing of messages from dispatch, sending canned messages to dispatch, and critical mechanical alarms, and initiating audio announcements on the on-board public address (PA) system.
- On-board Processor – performs multiple functions within the on-board suite of equipment, as follows:
    - Interfaces with the MDT for operator interactions;
    - Interfaces with the radio for voice and data radio communications;
    - Sends and receives data with the ITMS fixed end when the bus is in range of the wireless local area network (WLAN) at the OCTA bus bases;
    - Receives global positioning system (GPS) inputs from the GPS antenna;
    - Stores the route and schedule database;
    - Calculates route and schedule adherence;
    - Periodically sends data messages to the ITMS fixed end with vehicle location information;
    - Receives and stores passenger count data from Automated Passenger Counting (APC) sensors;
    - Interfaces with other on-board components, including: the Network Video Recorder (NVR), the GFI farebox, the headsign, the PA system, the internal LED sign, door switches, the vehicle odometer, the engine controller, the transmission controller, the silent alarm switch, and 12 and 24 Volts Direct Current (VDC) bus battery power.
- The voice and data radio interfaces with the ITMS radio system for voice and data communications.
- Automatic Passenger Counters (APCs) are infrared sensors mounted over each door that automatically count passenger boardings and alightings.

OCTA is currently constructing a modern streetcar system known as OC Streetcar. It is intended to complement Orange County's Metrolink service, as a way for Metrolink passengers to get to their final destination after getting off a Metrolink train. Upon completion, OC Streetcar will be a 4.15-mile route (in each direction) that connects the Santa Ana Regional Transportation Center (SARTC) with a new multimodal transit hub to be developed as part of the OC Streetcar system at the intersection of Harbor Boulevard and Westminster Avenue in the city of Garden grove. The OC Streetcar route will travel along Santa Ana Boulevard, 4th Street, and the Pacific Electric right-of-way. OC Streetcar will connect directly

with 18 OCTA bus routes. OC Streetcar is expected to begin operations in 2022. OC Streetcar rail vehicles will be equipped with transit management systems and equipment similar to that present on OCTA transit buses. Transit Signal Priority (TSP) will be a standard feature at all signalized intersections through which the OC Streetcar vehicles pass.

OCTA has deployed a smart phone mobile application called OC Bus Mobile. The OC Bus Mobile app allows OC Bus riders to use their smartphone for trip planning and convenient mobile ticketing. All pass fares are available and can be used on all fixed route buses. OC Bus Mobile enables purchase of a single ride ticket, or multiple tickets for future use. Account management and review of purchase history is possible by logging into an account online. App users purchase ride tickets on the app and activate the tickets right before boarding the bus. When boarding the bus, the rider holds his or her phone under a validator that scans a QR code on the smart phone screen. The app then provides feedback to the user that indicates what type of ticket or fare is being used, and whether or not it is currently valid.

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 trains operate. OCTA is a member of the Southern California Regional Rail Authority (SCRRA) joint-powers authority that funds and operates Metrolink commuter rail service. SCRRA has deployed a federally mandated positive train control (PTC) system that uses 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 400 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. Interest in complete streets and promoting and improving safety for bicyclists and pedestrians as gained great traction over the last several years. Technology applications available for non-motorized transportation are still evolving, with intersection bicycle detection maturing at a more rapid rate than other non-motorized technology applications.

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 Transmission Control Protocol/Internet Protocol (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.

In 2015 OCTA completed a study that looked at existing and planned communications infrastructure used for traffic management purposes around Orange County. The final report is titled, *Orange County Countywide Communications Study for Intelligent Transportation Systems* (OCTA; 2015). The overarching intent of the study was to determine the feasibility of utilizing existing and planned communications infrastructure to create a countywide center-to-center communications network. The network would create a regional communications backbone that can facilitate sharing of resources and data and provide a secured intranet for emergencies and incident management among agencies in Orange County.

Sharing traffic signal system performance monitoring on arterial roadways in which Regional Traffic Signal Synchronization Program funds have been invested would likely be an early effort toward establishing a countywide network. A small scale communications network for integrated corridor management may be a logical, and focused step in developing a larger network. A more robust, and full featured countywide data sharing system would be a longer term goal for center-to-center communications in Orange County.

2.3.8 Institutional

OCTA has a broad-ranging responsibilities and works in partnership with federal, state, regional, and local agencies to fund, implement, and maintain transportation programs and service throughout Orange County. One of the principal institutional mechanisms through which OCTA exercises these responsibilities is through calls for projects. Through various calls for projects, OCTA makes state, federal and local funding available to the 34 incorporated cities and the County of Orange. Depending on eligibility, local agencies and organizations are also welcomed to apply, but must go through one of the 34 incorporated cities or county. OCTA's Call for Projects allocates available funds through a competitive process to improve all modes of surface transportation.

The Comprehensive Transportation Funding Programs (CTFP) is the primary funding program for local agencies that OCTA administers. In 2019 makes funds available through a competitive call for projects in four project categories, which are:

- Regional Capacity Program (Project O of the OC Go Program)
- Regional Traffic Signal Synchronization Program (Project P)
- Environmental Cleanup Program (Project X)
- Safe Transit Stops (Project W)

OCTA also administers the following funding programs, making funds available through competitive calls for projects:

- Bicycle Corridor Improvement Program (BCIP)
- Arterial Pavement Management (APM) Program
- Highway Safety Improvement Program (HSIP)

OCTA also exercises countywide planning, funding, and programming planning responsibilities through comprehensive and coordinated countywide planning efforts in the form of the Long Range Transportation Plan (LRTP), the Congestion Management Program (CMP), the Human Services

Transportation Coordination Plan, transit master plans, transit corridor studies, sub-area studies, corridor studies, the ITS Strategic Deployment Plan (SDP), the Countywide Communications Study, and an assortment of other general and special purpose studies.

More specific to the in Orange County, OCTA administers the Regional Traffic Signal Synchronization Program (Project P), which funds improvements to traffic signal systems and equipment, as well as other affiliated ITS enhancements. As a condition of Measure M (M2) eligibility reviews and determinations, each jurisdiction must attend at least one Traffic Forum on an annual basis. Traffic Forum topics include items such as: general traffic and transportation issues; traffic circulation between participating jurisdictions; coordination of specific projects; and the Regional Traffic Signal Synchronization Program (RTSSP). General and specific ITS planning and deployment issues are discussed at Traffic Forum meetings, making the Traffic Forum a good ITS coordination institution.

The RTSSP (Project P) includes competitive funding for the coordination of traffic signals across jurisdictional boundaries. OCTA will provide funding priority to programs and projects that are multijurisdictional in nature. The goal of the RTSSP is to provide regional signal synchronization that cross jurisdictional, geographical, or physical boundaries. The multijurisdictional nature of these projects promote institutional coordination throughout the county.

3 ITS USER NEEDS ASSESSMENT

An important step in the process of developing the ITS Strategic Deployment Plan is determining the ITS needs of the stakeholders in the County. The needs are compared to the Inventory of Existing and Planned ITS to determine which needs are currently being met with Existing ITS, will be met in the near future with Planned ITS, or are not being met at all.

ITS Needs were determined with the help of a stakeholder survey that contained a comprehensive, preformed list of ITS Needs. The preformed list was used as a common starting point to elicit input from the stakeholder group. At the project workshops, each respective stakeholder group was asked to provide input on the relative priorities for responding to the ITS Needs shown in the preformed list. The bullet lists in the following subsections represent the High and Medium priority ITS Needs as determined by the results of the aforementioned surveys. The bullet lists in the following subsections do not necessarily identify or represent projects, per se, but they do influence the Strategic ITS Projects outlined in section 6 and the Phased Deployment Plan shown in section 9.

3.1 Data Management and Performance Monitoring

- Signal Performance Monitoring
    - About 20% of the respondents indicated that they are planning to implement a SPM in the future.
    - OCTA staff has indicated interest in developing a countywide SPM system, in a dashboard-type configuration.
        - It is envisioned that the dashboard would provide some immediate, pre-configured performance indicators for traffic signal system performance countywide, and would likely provide the capability to generate ad-hoc reports by geography and time period.
- Improve inter-agency coordination
- Improve incident response coordination between agencies
- Improve coordination on construction notification and information distribution
- Improve quality and timeliness of communications
- Continue planning for implementation of a Center-to-Center communications network (e.g. the Orange County Traffic Signal Systems (TSS) and ITS Communications Network)

3.2 Public Safety

- Improve incident response coordination between agencies
- Improve incident response times
- Improve response to hazardous materials spills/incidents (better manage resulting traffic congestion, improve clean-up time)
- Improve incident detection
- Reduce response delays at signals
- Implement and/or upgrade Emergency Vehicle Management Systems

- Upgrade emergency vehicle (traffic signal) preemption (EVP) systems (include the latest features that aid interagency coordination
- Implement and/or upgrade Freeway Service Patrol (FSP) vehicle technologies, such as vehicle location systems and service logging systems
- Deploy incident detection systems on arterial roadways
- Implement Integrated Corridor Management (ICM) techniques, strategies, and institutions to improve incident response coordination between agencies

3.3 Vehicle Safety

- Improve traffic flow and vehicle safety via Connected Vehicle applications
- Improve network traffic flow optimization via Connected Vehicle applications
- Improve work zone safety via Connected Vehicle applications
- Improve non-motorized travel safety via Connected Vehicle applications
- Deploy Connected Vehicle Roadside Units (RSUs)
- Deploy Other Connected Vehicle Roadside Equipment (RSE)
    - Properly equipped signal controllers and other ITS field equipment
    - Consider appropriate cellular technology(ies) for Connected Vehicle functionality, providing "dual-mode" V2I communications (DSRC and cellular), where appropriate
- Implement the Intelligent Traffic Signal System (I-SIG) Connected Vehicle Application
  Using high-fidelity data collected from though CV technologies, facilitates accurate measurements and predictions of lane-specific platoon flow, platoon size, and other driving characteristics. Uses V2V and V2I data via wireless communications to control signals and maximize flows in real-time.
- Implement the Reduced Speed/Work Zone Warning Connected Vehicle Application
  Roadside equipment at a work zone sends out alert information pertaining to its location and the recommended speed(s) and directions for vehicles.

3.4 Traffic Management

Arterial Traffic Management

- Implement or improve signal coordination
- Improve system operation monitoring
- Improve arterial roadway traffic surveillance
- Reduce detector failures
- Improve traffic flow monitoring
- Upgrade signal hardware
- Deploy and upgrade existing Advanced Traffic Management Systems (ATMS)
- Deploy and upgrade existing Vehicle Detection Systems
- Remote monitoring of signal system status/operations by traffic operations staff
- Expansion of staff, or pooling of staff, or staff augmentation to perform remote monitoring and operations
- Improve/enhance work zone traffic handling plans

- Systems that provide travelers with advanced notification of work zones, and that also automate traffic monitoring in work zones (consistent with Needs in the Vehicle Safety category)
- Devices and systems that provide Work Zone Intrusion detection and alerts to workers in the work zone (consistent with Needs in the Vehicle Safety category)
- Evaluate network-based (or grid-based) signal coordination (as opposed to corridor-based signal coordination)
- Evaluate joint operations and/or maintenance among groups of local agencies

Freeway Traffic Management

- Improve incident response and clearance times
- Improve inter-agency coordination
- Improve incident detection
- Improve incident management
- More timely incident information dissemination (traveler information)
- Implementation of Integrated Corridor Management (ICM) techniques and institutions (improving inter-agency coordination and more timely dissemination of incident information
    - ICM is currently being planned and designed in an area bounded by I-5, SR-57, and SR-91; and is referred to as the Triangle ICM.
- Identify additional corridors in which to plan and implement ICM in Orange County
- More timely incident information dissemination
- Improve/enhance work zone traffic handling plans
- Systems that provide travelers with advanced notification of work zones, and that also automate

3.5 Traveler Information

- Provide better road construction information and notification
- Improve quality and timeliness of communications
- Improve road construction information and notification on local roads
- Provide more travel information that is specifically geared toward commercial vehicle operators
- Leverage Integrated Corridor Management (ICM) techniques and institutions to provide improved traveler information

3.6 Transit and Multi-Modal Management

- Improve regional and interregional trip planning
- Improve patron safety (in-vehicle and at stations/waypoints)
- Enable dissemination/display of bus arrival times
- Receive and provide quality real time congestion related information
- Improve service coordination and information exchange between/among transit operators
- Better dissemination of emergency information from public safety agencies to transit operators
- Deployment of a universal fare payment system for transit fare payment
- Improved electronic toll collection systems

3.7 Communication and Connectivity

- Expansion of high capacity/bandwidth signal interconnect/ITS communications network(s)
- Reduce dependency on proprietary systems
- Implement/utilize ITS communications standards
- Improve information sharing among agencies
- Acquire IT support for participation in expanded information sharing network
- Acquire elected board/council support for participation in expanded information sharing network
- Improve existing Center to Center communications
- High bandwidth and low latency communications infrastructure that will accommodate more data intensive applications such as video, and potentially Connected Vehicle applications
- Acquire management support for participation in expanded information sharing network
- Update the *Orange County Countywide Communications Study for Intelligent Transportation Systems* (OCTA; 2015)
- Greater deployment of ATCs that are more fully capable of exchanging data through standardized interfaces, using utilizing national standards for communications and interoperability

3.8 Institutional

- Evaluate joint operations and/or maintenance among groups of local agencies
- Implement Integrated Corridor Management (ICM) techniques, strategies, and institutions to improve incident response coordination between agencies
- 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

Service Packages are a concept from the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), formerly known as the national ITS Architecture. Service Packages provide an accessible, service-oriented perspective to ARC-IT. They are tailored to fit, separately or in combination, real world transportation problems and needs. Service Packages collect together one or more functional objects that must work together to deliver a given ITS service and the information flows that connect them and other important external systems. Service packages are implemented through projects (or groups of projects, aka programs) and in transportation planning, are directly related to ITS strategies used to meet regional goals and objectives.

ARC-IT contains 141 Service Packages, divided into 12 service areas. **Table 4-1** is a listing of all 141 Service Packages, subdivided by service areas. The columns to the right indicate whether or not the Service Package exists and is in use in Orange County, or is Planned, or a longer-term Future initiative. In some cases, primarily with Autonomous Vehicle initiatives, the Service package may be led by the Private Sector, perhaps with some level of support from the Public Sector.

Table 4-1: Existing and Planned Service Packages

SERVICE PACKAGE NAMES		EXISTING (E)	PLANNED (P) / FUTURE (F)	PRIVATE SECTOR LED (PS)
Commercial Vehicle Operations				
CVO01	Carrier Operations and Fleet Management			PS
CVO02	Freight Administration			PS
CVO03	Electronic Clearance	E		
CVO04	CV Administrative Processes			
CVO05	International Border Electronic Clearance	N/A	N/A	N/A
CVO06	Freight Signal Priority		F	
CVO07	Roadside CVO Safety	E		
CVO08	Smart Roadside and Virtual WIM		F	
CVO09	Freight-Specific Dynamic Travel Planning		F	
CVO10	Road Weather Information for Freight Carriers		F	
CVO11	Freight Drayage Optimization			PS
CVO12	HAZMAT Management		F	
CVO13	Roadside HAZMAT Security Detection and Mitigation		F	
CVO14	CV Driver Security Authentication			PS
CVO15	Fleet and Freight Security			PS
CVO16	Electronic Work Diaries			PS
CVO17	Intelligent Access Program			PS
CVO18	Intelligent Access Program - Weight Monitoring			PS
CVO19	Intelligent Speed Compliance		N/A	
Data Management				
DM01	ITS Data Warehouse	E		
DM02	Performance Monitoring	E		
Maintenance and Construction				
MC01	Maintenance and Construction Vehicle and Equipment Tracking	E		
MC02	Maintenance and Construction Vehicle Maintenance		F	
MC03	Roadway Automated Treatment	N/A	N/A	N/A

SERVICE PACKAGE NAMES		EXISTING (E)	PLANNED (P) / FUTURE (F)	PRIVATE SECTOR LED (PS)
MC04	Winter Maintenance	N/A	N/A	N/A
MC05	Roadway Maintenance and Construction		F	
MC06	Work Zone Management		E	
MC07	Work Zone Safety Monitoring		F	
MC08	Maintenance and Construction Activity Coordination	E		
MC09	Infrastructure Monitoring		F	
Parking Management				
PM01	Parking Space Management			PS
PM02	Smart Park and Ride System			PS
PM03	Parking Electronic Payment			PS
PM04	Regional Parking Management		F	
PM05	Parking Reservations			PS
PM06	Loading Zone Management		N/A	
Public Safety				
PS01	Emergency Call-Taking and Dispatch	E		
PS02	Emergency Response	E		
PS03	Emergency Vehicle Preemption	E		
PS04	Mayday Notification	E		
PS05	Vehicle Emergency Response		F	
PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders		F	
PS07	Incident Scene Safety Monitoring		F	
PS08	Roadway Service Patrols	E		
PS09	Transportation Infrastructure Protection		F	
PS10	Wide-Area Alert	E		
PS11	Early Warning System	E		
PS12	Disaster Response and Recovery	E		
PS13	Evacuation and Reentry Management	E		
PS14	Disaster Traveler Information	E		
Public Transportation				
PT01	Transit Vehicle Tracking	E		
PT02	Transit Fixed-Route Operations	E		
PT03	Dynamic Transit Operations	E		
PT04	Transit Fare Collection Management	E		
PT05	Transit Security	E		
PT06	Transit Fleet Management	E		
PT07	Transit Passenger Counting	E		
PT08	Transit Traveler Information	E		
PT09	Transit Signal Priority		P	
PT10	Intermittent Bus Lanes	N/A	N/A	N/A
PT11	Transit Pedestrian Indication		F	
PT12	Transit Vehicle at Station/Stop Warnings		F	
PT13	Vehicle Turning Right in Front of a Transit Vehicle		F	
PT14	Multi-modal Coordination		P	
PT15	Transit Stop Request	E		
PT16	Route ID for the Visually Impaired		F	
PT17	Transit Connection Protection	E		
PT18	Integrated Multi-Modal Electronic Payment		F	
Support				
SU01	Connected Vehicle System Monitoring and Management		F	

SERVICE PACKAGE NAMES		EXISTING (E)	PLANNED (P) / FUTURE (F)	PRIVATE SECTOR LED (PS)
SU02	Core Authorization		F	
SU03	Data Distribution		F	
SU04	Map Management		F	
SU05	Location and Time		F	
SU06	Object Registration and Discovery		F	
SU07	ITS Communications		F	
SU08	Security and Credentials Management		F	
SU09	Device Certification and Enrollment		F	
SU10	Center Maintenance		F	
SU11	Field Equipment Maintenance		F	
SU12	Vehicle Maintenance		F	
SU13	Personal Device Maintenance		F	
Sustainable Travel				
ST01	Emissions Monitoring	N/A	N/A	N/A
ST02	Eco-Traffic Signal Timing		F	
ST03	Eco-Traffic Metering		F	
ST04	Roadside Lighting		F	
ST05	Electric Charging Stations Management		F	
ST06	HOV/HOT Lane Management	E		
ST07	Eco-Lanes Management		F	
ST08	Eco-Approach and Departure at Signalized Intersections		F	
ST09	Connected Eco-Driving		F	
ST10	Low Emissions Zone Management		F	
Traffic Management				
TM01	Infrastructure-Based Traffic Surveillance	E		
TM02	Vehicle-Based Traffic Surveillance	E		
TM03	Traffic Signal Control	E		
TM04	Connected Vehicle Traffic Signal System		F	
TM05	Traffic Metering	E		
TM06	Traffic Information Dissemination	E		
TM07	Regional Traffic Management	E		
TM08	Traffic Incident Management System	E		
TM09	Integrated Decision Support and Demand Management		F	
TM10	Electronic Toll Collection	E		
TM11	Road Use Charging	N/A	N/A	N/A
TM12	Dynamic Roadway Warning		F	
TM13	Standard Railroad Grade Crossing	E		
TM14	Advanced Railroad Grade Crossing		P	
TM15	Railroad Operations Coordination		F	
TM16	Reversible Lane Management		F	
TM17	Speed Warning and Enforcement	E		
TM18	Drawbridge Management	N/A	N/A	N/A
TM19	Roadway Closure Management		F	
TM20	Variable Speed Limits		F	
TM21	Speed Harmonization		F	
TM22	Dynamic Lane Management and Shoulder Use		F	
TM23	Border Management Systems	N/A	N/A	N/A
Traveler Information				
TI01	Broadcast Traveler Information	E		
TI02	Personalized Traveler Information	E		

SERVICE PACKAGE NAMES		EXISTING (E)	PLANNED (P) / FUTURE (F)	PRIVATE SECTOR LED (PS)
TI03	Dynamic Route Guidance		F	
TI04	Infrastructure-Provided Trip Planning and Route Guidance		F	
TI05	Travel Services Information and Reservation	E		
TI06	Dynamic Ridesharing and Shared Use Transportation		F	
TI07	In-Vehicle Signage		F	
Vehicle Safety				
VS01	Autonomous Vehicle Safety Systems			PS
VS02	V2V Basic Safety			PS
VS03	Situational Awareness		F	
VS04	V2V Special Vehicle Alert			PS
VS05	Curve Speed Warning	N/A	N/A	N/A
VS06	Stop Sign Gap Assist	N/A	N/A	N/A
VS07	Road Weather Motorist Alert and Warning	N/A	N/A	N/A
VS08	Queue Warning		P	
VS09	Reduced Speed Zone Warning/Lane Closure		P	
VS10	Restricted Lane Warnings		P	
VS11	Oversize Vehicle Warning	N/A	N/A	N/A
VS12	Pedestrian and Cyclist Safety		F	
VS13	Intersection Safety Warning and Collision Avoidance		P	
VS14	Cooperative Adaptive Cruise Control			PS
VS15	Infrastructure Enhanced Cooperative Adaptive Cruise Control			PS
VS16	Automated Vehicle Operations			PS
VS17	Traffic Code Dissemination			PS
Weather				
WX01	Weather Data Collection		F	
WX02	Weather Information Processing and Distribution		F	
WX03	Spot Weather Impact Warning		F	

5 STRATEGIES

Strategies have been selected from the Plan Component Identification document that address the ITS User Needs identified in Section 3 of this document. The strategies provide the context for how 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.

Table 5-1 shows the mapping of identified Strategies to the ITS User Needs. This mapping of strategies to user needs demonstrates that the strategies are comprehensive in terms of supporting the desired outcomes of the various components of the program, and that they meet the needs of ITS stakeholders in Orange County.

Following Table 5-1, each strategy is described briefly in terms of functionality and potential integration opportunities—areas where data sharing may be beneficial to support the strategy or an enhancement thereof. The latter will feed into the project definition and the phased strategic deployment plan.

Table 5-1: Mapping of Strategies to ITS User Needs

	STRATEGIES																																								
NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Data Mgmt/Performance Monitoring																																								
Signal Performance Monitoring			●												●																								●	
Improve inter-agency coordination		●					●										●	●	●				●							●			●				●	●	●
Improve coordination on construction notification and information distribution		●					●										●	●					●										●	●			●	●	●
Center-to-Center communications																	●	●	●				●							●			●				●	●	●
Public Safety																																								
Improve incident response coordination between agencies		●													●		●	●	●				●										●				●	●	●
Improve incident response times					●	●													●														●	●					●
Improve response to hazardous materials spills/incidents (better manage resulting traffic congestion, improve clean-up time)		●			●	●									●		●		●				●										●	●					●
Improve incident detection		●	●												●	●	●		●														●	●				●	●
Reduce response delays at signals/Emergency Vehicle (traffic signal) Preemption (EVP) systems					●										●	●			●				●											●					
Implement and/or upgrade Freeway Service Patrol (FSP) vehicle technologies						●							●						●															●					
Deploy incident detection systems on arterial roadways		●	●												●	●	●		●														●	●					
Implement Integrated Corridor Management (ICM) techniques, strategies, and institutions		●	●			●	●								●	●	●	●	●				●				●			●			●	●					

	STRATEGIES (cont.)																																								
NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Vehicle Safety																																								
Improve traffic flow and vehicle safety via Connected Vehicle applications							●		●	●		●	●			●				●														●						
Improve work zone safety via Connected Vehicle applications							●			●		●	●			●					●														●					●
Deploy Connected Vehicle Roadside Units (RSUs)		●	●						●	●		●	●			●	●						●						●					●	●			●	●
Deploy Other Connected Vehicle Roadside Equipment (RSE)		●	●		●		●		●	●		●	●		●	●	●			●	●		●						●					●	●			●	●
Implement the Intelligent Traffic Signal System (I-SIG) Connected Vehicle Application		●	●						●			●			●	●	●																		●			●	●
Implement the Reduced Speed/Work Zone Warning Connected Vehicle Application		●	●				●			●			●		●	●	●				●														●			●	●
Traffic Management																																								
Arterial Traffic Management																																								
Implement or improve signal coordination			●												●			●																	●				●	●	●
Improve system operation monitoring		●	●												●																				●					●	
Improve arterial roadway traffic surveillance		●	●												●			●																	●				●	●	
Reduce detector failures			●												●																				●				●	●	●
Deploy new and upgrade existing Advanced Traffic Management Systems (ATMS)		●	●												●			●																	●				●	●	
Deploy new and upgrade existing Vehicle Detection Systems			●												●			●																	●				●	●	●

	STRATEGIES (cont.)																																									
NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Remote monitoring of signal system status/operations by traffic operations staff		●	●												●			●															●			●	●	●
Improve/enhance work zone traffic handling plans		●	●				●						●		●		●	●			●		●										●	●		●	●	●
Evaluate network-based (or grid-based) signal coordination (as opposed to corridor-based signal coordination)		●	●												●			●																		●	●	●
Evaluate joint operations and/or maintenance among groups of local agencies																																				●	●	●	●
Freeway Traffic Management																																									
Improve incident response and clearance times					●	●	●			●			●				●	●	●		●		●										●	●			●	●	●
Improve inter-agency coordination		●					●						●				●	●	●				●							●			●	●			●	●	●
Improve incident detection		●	●												●	●	●		●														●	●				●	●
Implementation of Integrated Corridor Management (ICM) techniques and institutions		●	●			●	●								●	●	●	●	●				●				●			●			●	●			●	●	●
More timely incident information dissemination		●	●												●	●	●		●				●										●	●			●	●	●
Improve/enhance work zone traffic handling plans		●	●				●						●		●		●	●			●		●										●	●			●	●	●
Systems that provide travelers with advanced notification of work zones		●					●			●			●		●	●	●	●			●		●										●	●			●	●	●
Traveler Information																																									
Provide better road construction information and notification		●					●			●			●										●										●	●			●	●	●
Improve quality and timeliness of communications		●	●				●																●										●	●			●	●	●

	STRATEGIES (cont.)																																								
NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Improve road construction information and notification on local roads		●	●				●						●										●										●	●			●	●	●
Provide more travel information that is specifically geared toward commercial vehicle operators		●																					●		●								●	●				●	
Leverage Integrated Corridor Management (ICM) techniques and institutions to provide improved traveler information		●	●			●	●																●				●			●			●	●			●	●	●
Transit and Multimodal																																								
Improve regional and interregional trip planning		●															●						●	●			●	●		●			●	●				●	
Improve patron safety (in-vehicle and at stations/waypoints)																											●						●	●				●	
Enable dissemination/display of bus arrival times		●																					●				●			●			●	●				●	
Improve service coordination and information exchange between/among transit operators		●				●									●	●	●						●	●			●	●	●	●			●	●				●	
Better dissemination of emergency information from public safety agencies to transit operators		●													●	●	●		●				●				●	●		●			●	●				●	●
Deployment of a universal fare payment system for transit fare payment		●																									●			●	●		●	●			●	●	
Improved electronic toll collection systems		●													●					●													●	●					

STRATEGIES (cont.)																																										
NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Communications and Connectivity																																									
Expansion of high capacity/bandwidth signal interconnect/ITS communications network(s)		●	●																														●				●	●		
Reduce dependency on proprietary systems		●													●																						●	●		
Implement/utilize ITS communications standards		●																															●	●		●	●	●	
Improve information sharing among agencies		●													●	●	●	●	●	●			●							●			●	●			●	●	●
Acquire IT support for participation in expanded information sharing network		●																															●	●		●	●	●	
Acquire elected board/council support for participation in expanded information sharing network		●																															●	●		●	●	●	
Improve existing Center to Center communications		●																	●				●							●			●	●			●	●	●
High bandwidth and low latency communications infrastructure that will accommodate more data intensive applications such as video, and potentially Connected Vehicle applications		●	●																														●				●	●	
Acquire management support for participation in expanded information sharing network		●	●																●				●							●			●	●			●	●	●
Update the Orange County Countywide Communications Study for ITS (OCTA; 2015)		●	●																																			●		
STRATEGIES (cont.)																																									

NEEDS	**Data Mgmt/Performance Monitoring**	ITS Data Warehouse	Performance Monitoring	**Public Safety**	Emergency Vehicle Preemption	Roadway Service Patrols	Work Zone Management	**Vehicle Safety**	Intersection Safety Warning and Collision Avoidance	Reduced Speed Zone Warning/Lane Closure	Autonomous/Automated Vehicle Safety Systems	Automated Vehicle Operations	Work Zone Safety Monitoring	**Traffic Management**	Infrastructure-Based Traffic Surveillance	Vehicle-Based Traffic Surveillance	Traffic Information Dissemination	Regional Traffic Management	Traffic Incident Management	Electronic Toll Collection	Speed Warning and Enforcement	**Traveler Information**	Traveler Information Systems/Trip Planning	Dynamic Ridesharing and Shared Use Transportation	Parking Management	**Transit and Multimodal**	Transit Vehicle Tracking/Fleet Management	Dynamic Transit Operations	Transit Signal Priority	Multi-Modal Coordination	Integrated Multi-Modal Electronic Payment	**Communications and Connectivity**	Fixed-Point to Fixed-Point (FP2FP) Communications	Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	**Institutional**	Pooled Purchasing Agreements	Subregional Partnerships	Enhanced Data Sharing	Integrated Corridor Management
Greater deployment of ATCs that are more fully capable of exchanging data through standardized interfaces, using utilizing national standards for communications and interoperability		●	●												●	●		●																●			●	●		
Institutional																																									
Evaluate joint operations and/or maintenance among groups of local agencies																																							●	●	
Implement Integrated Corridor Management (ICM) techniques, strategies, and institutions to improve incident response coordination between agencies		●	●			●	●								●	●	●	●	●			●				●			●				●	●			●	●	●
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)																																					●	●		

The strategies itemized in Table 5-1 above are summarized in **Table 5-2**, along with a summary listing of their benefits and integration opportunities. The sections that follow Table 5-2 provide more detail, and examples on the strategies.

Table 5-2: Strategic Plan Strategies, Benefits, and Integration Opportunities

STRATEGY	BENEFITS	INTEGRATION OPPORTUNITIES
Data Management and Performance Monitoring		
DMPM1 – Data Warehouse	• Cost effective in producing reports in-house from archived data • Accessibility of historical data for agency staff to conduct traffic analysis	• Advanced Traffic Management Systems (ATMS) • Traffic SPM systems • Regional Traffic Control • ICM • Transit performance measurement reporting systems • Connected Vehicle Applications
DMPM2 – Performance Monitoring	• Improved traffic operations data • Improves transportation planning, supports long-range planning analyses, and transportation performance analyses • Improves policy and investment decision making • Provides rapid access to data	• ICM • Regional Traffic Control
Public Safety		
PS1 – Emergency Vehicle Preemption	• Reduction in emergency vehicle response times with minimal disruption to overall traffic flow • Safer negotiation of signalized intersections by emergency response vehicles	• Regional Traffic Control • Coordinated multi-agency emergency response • TSP system(s) • Connected Vehicle Applications
PS2 – Roadway Service Patrols	• Improved operational efficiency of highways • Reduced number of secondary incidents • Improved average incident clearance time • Decreased average incident duration	• ICM • Regional Traffic Control • Traveler Information systems • Public Safety Emergency Management Systems
PS3 – Work Zone Management	• Reduced average clearance times for incidents • Improved worker safety • Improved emergency response personnel safety	• ICM • Regional Traffic Control • Traveler Information systems • Public Safety Emergency Management Systems
Vehicle Safety		
VS1 – Intersection Safety Warning and Collision Avoidance	• Enhanced intersection safety • Reduction in crashes • Lowered intersection approach speeds	• Connected Vehicle Applications • Roadway-based data collection systems • Vehicle-based data collection systems

STRATEGY	BENEFITS	INTEGRATION OPPORTUNITIES
VS2 – Reduced Speed Zone Warning/Lane Closure/Work Zone Safety Monitoring	• Reduced speeds approaching, and within, work zones, and other areas of special interest • Reduction in over the speed limit driving	• Connected Vehicle applications • Roadway-based data collection systems • Vehicle-based data collection systems
VS3 – Automated Vehicle Operations	• Enhanced vehicle safety • Reduction in vehicle crashes • Potential for improved transportation data from Connected Vehicles	• Connected Vehicle applications • Roadway-based data collection systems • Vehicle-based data collection systems
Traffic Management		
TM1 – Infrastructure-Based Traffic Surveillance	• Supports incident detection systems • Improved performance of traffic signal systems • Supports remote system monitoring, improving staff efficiency • Foundation element of traveler information systems	• Performance monitoring systems • Arterial traffic management systems • Freeway traffic management systems • Connected Vehicle applications • Regional traffic control • Improved data collection and sharing
TM2 – Vehicle-Based Traffic Surveillance	• Minimize disruption to traffic during installation and maintenance • Reduction in service needs for infrastructure-based detection • Foundation element of traveler information systems	• Connected Vehicle applications • Arterial traffic management systems • Regional traffic control • Improved data collection and sharing
TM3 – Traffic Information Dissemination	• Provides en-route traveler information • Improved mobility • Emission reductions • Cost savings in construction traffic control • Improved travel time reliability	• Traveler information systems, including 511 • Local construction information coordination systems • Transit traveler information systems • Private information service providers systems • Integration with crowd-sourced data • Goods movement (truck and container) routing and tracking systems
TM4 – Regional Traffic Management	• Improved interagency coordination • Improved mobility • Emission reductions • Improved travel time reliability	• Local traffic management systems • Regional traffic management systems • Traveler information systems • Incident detection and management systems
TM5 – Traffic Incident Management	• Improved incident clearance times • Reduction in secondary incidents • Reduced delay • Improved mobility	• Public safety incident management systems • Regional traffic management systems • Traveler information systems • Incident detection and management systems
TM6 – Electronic Toll Collection	• Decreased mainline toll plaza travel time • Increased travel speed on express lanes	• Traveler information systems

STRATEGY	BENEFITS	INTEGRATION OPPORTUNITIES
	• Increased safety	• Incident detection and management systems
TM7 – Speed Warning and Enforcement	• Reduced speeds approaching, and within, work zones, and other areas of special interest • Reduction in over the speed limit driving • Enhanced vehicle safety • Reduction in vehicle crashes	• Public safety incident management systems • Regional traffic management systems • Incident detection and management systems • Connected Vehicle applications
Traveler Information		
TI1 – Traveler Information Systems/Trip Planning	• Improved mobility • Emission reductions • Improved travel time reliability • Improved traffic safety	• Traveler information systems, including 511 • Private sector, crowd sourcing systems • Connected Vehicle applications
TI2 – Dynamic Ridesharing and Shared Use Transportation	• Peak-period congestion reduction • Reduced peak-period automobile travel • Consumer Savings • Increases travel choices • Reduction in vehicle miles traveled • Emission reductions	• Transit management systems • Traveler information systems • Mobility as a Service (MaaS) systems
TI3 – Parking Management	• Reduction in downtown traffic volumes related to the search for parking • Potential to generate revenue • Improved mobility Provides Reduction in vehicle miles traveled • Emission reductions	• Traveler information systems, including 511 • Private sector, crowd sourcing systems • Universal payment systems
Transit and Multimodal		
MM1 – Transit Vehicle Tracking/Fleet Management	• Supports improved transit on-time performance • Supports improved transit vehicle operations and maintenance • Improved transit security • Improved transit connections • Supports transit traveler information • Improves transit performance monitoring data reporting	• Traveler information systems, including 511 • Transit security systems • Transit fare collection systems • Transit passenger counting systems • Transit performance measurement reporting systems • Transit vehicle maintenance management systems
MM2 – Transit Signal Priority	• Improved transit travel time reliability • Increased throughput • Reduced fuel usage • Smoother and more comfortable ride for transit patrons	• Arterial traffic management systems • Emergency vehicle preemption systems • Transit management systems
MM3 – Multi-Modal Coordination	• Improved transit connections • Improved transit travel time reliability • Improved service quality	• Transit management systems • Traveler information systems, including 511

STRATEGY	BENEFITS	INTEGRATION OPPORTUNITIES
MM4 – Integrated Multimodal Electronic Payment	• Supports more flexible fare structures • Improved coordination across multiple modes • Improved security of transit revenues • Expands base for transit revenue • Reduces fare collection and processing costs • Improved customer satisfaction	• Transit management systems • Traveler information systems, including 511
Communications and Connectivity		
CC1 – Fixed-Point to Fixed-Point (FP2FP) Communications	• Improved interagency coordination • Improved connection to field devices • Supports enhanced data collection and sharing	• Local traffic management systems • Regional traffic management systems • Traveler information systems • Incident detection and management systems • Transportation data archive systems
CC2 – Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications	• Enables Connected Vehicle applications • Potential to support automated vehicle operations • Improved vehicle safety	• Connected Vehicle applications • Incident detection and response systems • Local traffic management systems
Institutional		
IN1 – Pooled Purchasing Agreements	• Improved purchasing power for public agencies • Improved economies of scale • Improved interagency coordination • Improved interagency cooperation	N/A
IN2 – Subregional Partnerships	• Improved interagency coordination • Improved interagency cooperation	N/A
IN3 – Enhanced Data Sharing	• Improved interagency coordination • Improved incident response and clearance times • Reduction in secondary incidents • Reduced delay • Improved travel time reliability	• Local traffic management systems • Regional traffic management systems • Traveler information systems • Incident detection and management systems • Transportation data archive systems
IN3 – Integrated Corridor Management	• Improved mobility • Improved interagency coordination • Improved incident response and clearance times • Emission reductions • Improved travel time reliability • Reduction in secondary incidents • Reduced delay	• Local traffic management systems • Regional traffic management systems • Traveler information systems • Incident detection and management systems • Transportation data archive systems

5.1 Data Management and Performance Monitoring

5.1.1 DMPM1 – Data Warehouse

The ITS Data Warehouse strategy would provide access to a wide range of transportation data for a variety of purposes including: transportation planning, condition and performance monitoring, traveler information, safety analysis, and research. Configurations range from focused repositories that house data collected and owned by a single agency, district, private sector provider, or research institution to broad repositories that contain multimodal, multidimensional data from varied data sources covering a broader region. The ITS Data Warehouse could be a central repository, or geographically distributed ITS data repositories. The ITS Data Warehouse could also include a platform for access to real time data and information, such as roadway link speeds and travel times, and video images.

Implementation Schedule

- Medium Term (4-6 years): Conduct Feasibility Study and User Needs Assessment, including a gauge of desire to participate in such a system by stakeholders from around the county.
- Long Term (7-10 years): Begin concept plans and systems engineering activities in advance of system development.

5.1.2 DMPM2 – Performance Monitoring

The Performance Monitoring strategy uses information collected from detectors and sensors, connected vehicles, and operational data feeds from traffic and transit management centers to support performance monitoring and other uses of historical data, including transportation planning, condition monitoring, safety analyses, and research. More complex performance measures may be derived from the collected data. Several local agencies have indicated that they are currently operating signal performance monitoring systems, or plan to do so in the short term. OCTA has indicated the desire to develop a countywide signal performance monitoring dashboard.

Implementation Schedule

- Short-Term (0-3 years): Continue local deployments of signal performance monitoring systems.
- Medium Term (4-6 years): Develop a countywide signal performance monitoring capability.

5.2 Public Safety

5.2.1 PS1 – Emergency Vehicle Preemption

Emergency Vehicle Preemption (EVP) systems detect oncoming emergency vehicles through a variety of communications technologies (radio, acoustic, infrared) and can be used to bring up a pre-planned timing response that is programmed into the controller. EVP typically focuses on giving priority to larger firefighting emergency response vehicles, rather than typical police emergency response vehicles, which have different deceleration and acceleration characteristics.

Most local agencies in Orange County have EVP systems in place. Many have already migrated away from an infrared light bases system to a more modern Global Positioning System (GPS) and radio based system.

The newer systems offer essentially the same functionality but provide a more secure system that is less prone to unauthorized use. Because it uses a radio technology for communications between the emergency vehicle and the intersection, it does not depend on line of sight for that communications link.

Implementation Schedule

- Short-Term (0-3 years): Continue local agency upgrades from older technologies to newer technologies.

5.2.2 PS2 – Roadway Service Patrols

More typically known in Orange County (and California), as Freeway Service Patrol (FSP). FSP is a joint program provided by OCTA, Caltrans, and the California Highway Patrol (CHP). The FSP program is a free service of privately owned tow trucks that patrol designated routes on congested freeways. Typically, FSP operates Monday through Friday during peak commute hours, and all day in pre-designated freeway construction zones. In heavily congested freeway corridors it is becoming more commonplace for FSP to operate during the midday and on weekends/holidays in addition to the weekday peak period service.

OCTA sponsored FSP vehicles utilize Automated Vehicle Locations (AVL) technologies, as well as other hand held electronic devices for reporting and administrative functions. OCTA will continue to implement these technologies to ensure efficient and safe service delivery.

Implementation Schedule

- Short-Term (0-3 years): Continue local agency upgrades from older technologies to newer technologies.

5.2.3 PS3 – Work Zone Management

This system manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Work zone speeds and delays are provided to the motorist prior to the work zones. Work zone information is coordinated with other groups (e.g., traveler information, traffic management, and other maintenance and construction centers). This system may provide control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

Much of this functionality is performed to varying degrees in freeway work zone locations by Caltrans, from the District 12 TMC. It is not a single system that performs all of this functionality, but it is a suite of systems and subsystems. There has been some interest in developing a more unified system that provides more localized control for each work zone location.

Also, two of the “Top Ten” Connected Vehicle applications identified by local agency stakeholders during the ITS Plan update are related to work zone safety. They are #1 – Reduced Speed/Work Zone Warning and #7 – Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE). OCTA and the local agency ITS stakeholders should consider deploying this functionality as a Connected Vehicle application, perhaps as a pilot project that could be replicated in additional jurisdictions.

Implementation Schedule

- Short Term (0-3 years): Deploy basic Connected Vehicle infrastructure that would support implementation of work zone safety Connected Vehicle applications.
- Medium Term (4-6 years): Initiate systems engineering and concept design activities for a work zone safety Connected Vehicle application pilot project.

5.3 Vehicle Safety

5.3.1 VS1 – Intersection Safety Warning and Collision Avoidance

Installation of devices at high crash locations to warn drivers of changing conditions such as "tee" intersections or sharp horizontal curves. Red Light Violation Warning (RLVW) is a Connected Vehicle application that broadcasts Signal Phase and Timing (SPaT) information and other data to the in-vehicle device, allowing warnings for impending red light violations, and in more advanced applications can provide intersection collision warnings to approaching vehicles. Depends largely on deployment of DSRC between the roadway infrastructure and the vehicle. This technology is not mature, and would require investment in the roadside infrastructure by the public sector, as well as the presence of appropriate in-vehicle equipment provided by automobile manufacturers and/or aftermarket suppliers.

Implementation Schedule

- Medium Term (4-6 years): Deploy roadside infrastructure and implement the RLVW Connected Vehicle application.

5.3.2 VS2 – Reduced Speed Zone Warning/Lane Closure/ Work Zone Safety Monitoring

Reduced Speed/Work Zone Warning (RSWZ) is a Connected Vehicle application that utilizes roadside equipment to broadcast alerts to drivers warning them to reduce speed, change lanes, or come to a stop within work zones. The RSZW safety application is intended to alert or warn drivers of equipped and non-equipped vehicles who are approaching a reduced speed zone if they are operating at a speed higher than the zone's posted speed limit and/or if the configuration of the roadway is altered (e.g., lane closures, lane shifts). This will be achieved through the integration of both vehicle-based and infrastructure-based technologies, including onboard and roadside signage warning systems, to make drivers approaching a reduced speed zone aware of the potential for a crash due to changes in speed and roadway configuration. In this way, the RSZW application will help reduce the number of vehicles speeding in reduced speed zones and those vehicles unfamiliar with changed roadway configurations.

The functionality provided by this system was rated as a high priority need in the User Needs assessment performed in support of this ITS Strategic Deployment Plan update. However, it is highly dependent on specialized infrastructure that is not widely deployed. Therefore, in the short term, it will likely be deployed as a pilot project to exercise the technology and learn lessons for additional deployments.

Implementation Schedule

- Short Term (0-3 years): Deploy basic Connected Vehicle infrastructure that would support implementation of work zone safety Connected Vehicle applications.

- Medium Term (4-6 years): Initiate systems engineering and concept design activities for a work zone safety Connected Vehicle application pilot project.

5.3.3 VS2 – Automated Vehicle Operations

Autonomous/Automated Vehicle operations is largely considered to be a private sector deployment, largely based on in-vehicle technologies, and functionality. However, many in the public sector also believe that Autonomous/Automated Vehicle operations will be more successful if they also utilize Connected Vehicle infrastructure to communicate with other vehicles on roadway, as well as the roadside infrastructure.

Implementation Schedule

- Short Term (0-3 years): Deploy basic Connected Vehicle infrastructure that would support implementation of Connected Vehicle applications, as well as autonomous vehicle cooperation.
- Long Term (6-10 years): Private sector deployment of in-vehicle technologies and functionality.

5.4 Traffic Management

5.4.1 TM1 – Infrastructure-Based Traffic Surveillance

This strategy includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit field data back to a central system, or a Traffic Management Center. This infrastructure is already widely deployed throughout Orange County and used for arterial traffic signal operations and freeway traffic operations. The primary challenge at this point in time is field equipment maintenance and reliability. Many traffic management systems could also perform at a higher level with more wide deployment of field surveillance equipment.

Implementation Schedule

- Short-Term (0-3 years): Enhance maintenance of existing field equipment to promote greater reliability. Deploy additional field surveillance equipment to enhance central systems functionality and effectiveness.

5.4.2 TM2 – Vehicle-Based Traffic Surveillance

This strategy uses probe data information obtained from vehicles on the roadway network to support traffic operations, including incident detection and the implementation of localized operational strategies. This strategy includes the capability to collect data from Connected Vehicles so that "probe" data can be collected from all equipped vehicles, providing access to a large vehicle population as market penetration of Connected Vehicle on-board equipment increases. A few local agencies in Orange County currently operate Bluetooth-based traffic surveillance systems, on a limited scale, that provide roadway speeds, travel times, and delay data. A handful of Connected Vehicle applications perform or support a similar function.

Implementation Schedule

- Medium Term (4-6 years): Deploy both Bluetooth and Connected Vehicle application based roadside infrastructure to implement this functionality.

5.4.3 TM3 – Traffic Information Dissemination

This system provides en-route driver information at specific equipped locations on the roadway network using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This strategy also covers the equipment and interfaces that provide traffic information from a traffic management center to the media, Transit Management, Emergency Management, and Transportation Information Centers. Some of the safety-based Connected Vehicle applications can provide this functionality to varying degrees.

This functionality is largely in place along Orange County freeways, but much less so on arterial roadways. Some local agencies indicated a desire to provide more roadside en-route traffic information but it was not as high a priority as some other ITS Needs.

Implementation Schedule

- Medium Term (4-6 years): Incremental, strategic deployment of this functionality on the arterial roadway network in Orange County. Coordinate Integrated Corridor Management (ICM) development efforts to achieve this strategic deployment. Also consider Connected Vehicle applications to achieve some level of this functionality.

5.4.4 TM4 – Regional Traffic Management

In urban areas, the traffic interaction between freeway systems and local arterials is key to congestion release and delay savings. When incidents or congestion occur on freeway systems, coordination is needed to adjust local arterial signals. Much of this coordination can take place under the umbrella of Integrated Corridor Management (ICM). ICM is an approach designed to actively monitor for atypical recurring and nonrecurring events that impact traffic on the most visibly congested highways or freeways that define a corridor. Because of near constant congestion, even minor events on an anchor facility can have a huge impact. ICM requires the institutional, operational, and technical integration of as many participating agencies as are available to combine their assets into one unified real-time response.

ICM is currently being planned in Orange County, in an around Anaheim, with the Triangle ICM. The Triangle ICM is an area bounded by I-5, SR-57, and SR-91. Caltrans and the local agencies in and around the Triangle ICM area are planning and designing ICM improvements, including technical and institutional strategies. It is recommended that additional corridors be identified in Orange County in which to plan and develop ICM systems, techniques, and institutional relationships. On a statewide basis, Caltrans has identified a priority list of the “Top 25” candidate corridors for ICM planning and implementation. Four corridors in Orange County appear on that priority list. They are State Route (SR) 57, SR 91, Interstate (I) 5, and I 405. The Implementation Schedule includes:

Implementation Schedule

- Short Term (0-3years): Continue development of the Triangle ICM infrastructure, systems, and functionality.
- Medium Term (4-6 years): Identify additional ICM corridors in Orange County, and initiate development of ICM infrastructure, systems, functionality, and institutional arrangements.

5.4.5 TM5 – Traffic Incident Management

Traffic Incident Management systems typically utilize a suite of technologies and/or systems, such as: Closed Circuit Television (CCTV) Surveillance/Monitoring System, Enhanced Roadway Detection, Freeway Service patrol (FSP), and Response Coordination. Much of this functionality is in place for Orange County freeways, but not the arterial roadway network. Much of this functionality could be implemented on arterial roadways under the umbrella of Integrated Corridor Management (ICM).

It is recommended that the ICM currently being planned, in an around Anaheim, the Triangle ICM be established and operational before expanding the incident management system functionality elsewhere on arterial roadways in Orange County. This would allow technical and institutional arrangements to be in place as a model deployment for additional similar deployments. Additional candidate corridors for ICM planning and implementation are being considered, which would provide additional opportunities to deploy this functionality.

Implementation Schedule

- Medium Term (4-6 years): Allow establishment of the Triangle ICM, then observe incident management operations and develop lessons learned to replicate successful strategies and functionality elsewhere in the county.

5.4.6 TM6 – Electronic Toll Collection

The Electronic Toll Collection (ETC) strategy provides toll operators with the ability to collect tolls electronically, at main line speeds, and also to detect and process violations. Tolls may be implemented to better manage demand on a given facility. ETC is currently being performed in Orange County on the toll roads by the Transportation Corridor Agencies (TCA), and on the 91 Express Lanes by OCTA. ETC will be implemented on the 405 Express Lanes when those lanes open, in approximately 2023.

ETC technologies are largely dictated by the California Code of regulations, Title 21 requirements for Automatic Vehicle Identification Equipment. This ensures the interoperability of ETC systems statewide. TCA and OCTA have traditionally utilized a largely similar “hard case” in-vehicle transponder for ETC operation. In 2019, TCA distributed Title 21 compliant “sticker” transponders that are smaller than the hard case transponder, with three distinct advantages over the hard case transponder: 1) the sticker transponders are less expensive to produce; 2) the logistics of handling and distribution are far simplified and less expensive; and 3) the sticker transponder is anticipated to be less vulnerable to battery life issues than the hard case transponder. Newer hard case transponders have a switch that allows the user to declare vehicle occupancy (single occupant, 2 occupants, 3+ occupants) on those facilities that offer such discounts. One drawback to the sticker transponder is the lack of ability to self-declare vehicle occupancy on toll facilities that offer discounts for higher vehicle occupancy. OCTA has indicated that it will distribute sticker transponders after required toll system upgrades are completed, probably in early 2020.

Implementation Schedule

- Short-Term (0-3 years): Continue upgrades from older technologies to newer technologies

- Medium Term (4-6 years): Monitor toll collection technologies nationwide and be prepared to work with the state legislature and other California toll operators to implement technology upgrades

5.5 Traveler Information

5.5.1 TI1 – Traveler Information Systems/Trip Planning

Traveler information systems inform travelers about the expected travel times, traffic incidents, transit performance, and, potentially, possible alternative routes and travel modes. In many cases, these systems attempt to influence traveler route and mode choice. Modern traveler information systems try to direct drivers to less congested alternative routes, and in this way to relieve congestion. Modern traveler information systems are delivered through a variety of channels, including: Internet websites, telephone/511 systems, television, radio, and smart phone applications.

OCTA currently participates in a regional 511- telephone traveler information system known as Southern California 511. The 511 system and associated public facing computer applications is a free traveler information service that provides live traffic reports, transit planning, commuter service information, motorist aid, or FasTrak information in the Southern California area. 511 is operated and funded by a coalition of Southern California transportation agencies, including OCTA. It is anticipated that OCTA will continue its involvement in this system and coalition for the foreseeable future.

Implementation Schedule

- Short Term (0-3years): Continue participation in, and shared funding of the Southern California 511 system.

5.5.2 TI2 – Dynamic Ridesharing and Shared Use Transportation

This strategy addresses dynamic ridesharing/ride matching services to travelers and other forms of shared use transportation. Dynamic ridesharing allows travelers to arrange carpool trips through a personal device with a wireless connection to a ride matching system (e.g., a web-based application). It uses inputs from both passengers and drivers pre-trip, during the trip, and post-trip. These inputs are then translated into "optimal" pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations.

The shared use aspect of the strategy addresses three types of shared use that may be arranged using an internet connected personal device. In the first type, a traveler arranges for the temporary use of a vehicle. In the second type of shared use, a traveler arranges for a vehicle to pick them up at a specific location and take them to another location. The second type of shared use may be implemented as a ride matching or ridesharing service, including those provided by currently popular ride-hailing services. The third type of shared use is a bikeshare capability.

Rideshare matching services are available in Orange County, though they are largely not dynamic, and ad hoc. They typically require a registration and listing to be able to participate in more static, routine ridematching arrangements. Public sector shared use transportation has largely been limited to bike

share programs, implemented on a fairly limited basis. OCTA may in the future consider enhancing ridematching services to be more dynamic. Ride-hailing services are largely private sector ventures. OCTA may also participate in future bike share programs with local agency partners taking a lead role.

Implementation Schedule

- Medium Term (4-6 years): Investigate the feasibility of implementing more dynamic ridematching functionality. Investigate opportunities for additional bike share programs, with local agency partners.

5.5.3 TI3 – Parking Management

This strategy monitors and manages parking spaces in lots, garages, and other parking areas and facilities. It assists in the management of parking operations by monitoring parking lot ingress and egress, parking space occupancy and availability. Infrastructure-based detectors and/or connected vehicles may be used to monitor parking occupancy. These systems share collected parking information with local drivers and information providers for broader distribution. Additional functionality/ communications infrastructure could support coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems.

Parking availability and guidance systems in Orange County are fairly limited, and are mostly deployed at a spot location, or for a small area. In the ITS Needs survey performed in support of this Plan update several local agencies indicated interest in deploying parking management systems in their jurisdiction.

Implementation Schedule

- Short Term (0-3 years): Local agencies to determine specific parking management system needs; then plan and deploy appropriate systems.
- Medium Term (4-6 years): Parking management system operators to work cooperatively to integrate systems and enable regional parking information dissemination to the public.

5.6 Transit and Multimodal Management

5.6.1 MM1 – Transit Vehicle Tracking/Fleet Management

This strategy monitors current transit vehicle location using an Automated Vehicle Location (AVL) System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. These systems are also a foundational element of a real time transit traveler information system. AVL technologies are mature, and can be implemented as a service, with low up front implementation costs and recurrent monthly “subscription fees.

OCTA currently utilizes an AVL system that has been in place for several years. OCTA’s intends to continue utilization of the system, with periodic upgrades and “refresh” of technologies. Several local agencies that operate local transit service indicated interest in AVL systems in the ITS Needs survey performed in support of this Plan update.

Implementation Schedule

- Short Term (0-3years): OCTA to continue operation of its AVL system, with periodic upgrades
- Short Term (0-3years): Local agencies to plan and deploy AVL technologies on their transit vehicles
- Medium Term (4-6 years): Investigate need for, and feasibility of interagency sharing of location data to improve service coordination

5.6.2 MM2 – Transit Signal Priority

Transit Signal Priority (TSP) systems give transit vehicles priority over other vehicles at signalized intersections. TSP holds the traffic signal green (green extension), or turns it green earlier than scheduled (early green), to provide priority passage to transit vehicle.

OCTA is implementing TSP for the OC Streetcar system, which is currently under construction and expected to be in operation in 2022. OCTA has also investigated the implementation of TSP on its Bravo! Route 529 limited stop service on Beach Boulevard. However, there are no immediate plans to implement TSP for any of OCTA's fixed route services.

Implementation Schedule

- Short Term (0-3years): Complete construction of the OC Streetcar system, including operation of TSP
- Medium Term (4-6 years): Investigate and identify opportunities to deploy TSP on OCTA fixed route bus service
- Medium Term (4-6 years): Support local agency initiatives to deploy TSP on their local transit services

5.6.3 MM3 – Multi-Modal Coordination

This strategy establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transit transfer points and clusters (a collection of stops, stations, or terminals where transfers can be made conveniently) and also improve operating efficiency.

Multiagency transit trip planning is currently available. However, real time coordination between/among transit operators and traffic management agencies/systems is currently limited, and ad hoc. It does not appear that there are any immediate plans to develop systems that formalize this coordination, but it is recommended that OCTA investigate the utility and feasibility of developing such coordination capabilities with neighboring transit operators, as well as local agency transit operators. The Implementation Schedule includes:

Implementation Schedule

- Medium Term (4-6 years): Investigate and identify opportunities to develop and implement systems that perform real time multimodal coordination.

5.6.4 MM4 – Integrated Multimodal Electronic Payment

The Integrated Multi-Modal Electronic Payment strategy provides electronic payment capability for transit fares, tolls, road use, parking, and other areas requiring electronic payments. There is no system currently in place, nor are there any short term plans to develop this capability. A common fare payment capability among OCTA and local transit operators is the most likely feasible functionality in the medium to long term. Development of that capability may open the door to other integrated electronic payment opportunities, such as tolls and parking.

Implementation Schedule

- Long Term (7-10years): Investigate the need for, and feasibility of developing multimodal electronic payment capabilities.

5.7 Communication and Connectivity

5.7.1 CC1 – Fixed-Point to Fixed-Point (FP2FP) Communications

This strategy mainly refers to communications links serving stationary entities. Common uses for FP2FP communications include, but are not limited to communications between management centers (Center-to-Center), communications between a management center and a fixed-location field device (Center-to-Field), and communications between a management center and the general public. These communications links may be implemented using a variety of public or private communication networks and technologies – and/or some combination of public and private networks. The communications infrastructure would typically be made up of twisted wire pair (copper), coaxial cable, fiber optic cable, microwave relay networks, spread spectrum radio, public networks (leased lines and cellular networks), etc. In FP2FP communications the important point is that it serves stationary entities, and not mobile entities.

Varying levels of traffic signal interconnect exist throughout Orange County. Most local agencies have some capability to communicate between a central system and at least some portion of their existing field infrastructure. Even with the existing capabilities in place, three ITS Communications User Needs emerged as High Priority in the ITS Needs survey; they are 1) Expansion of signal interconnect/ITS communications network(s); 2) Reduce dependency on proprietary systems, and; 3) Implement/utilize ITS communications standards.

In 2015, OCTA completed the *Orange County Countywide Communications Study for Intelligent Transportation Systems*. The study explored the capacity and interest of Orange County transportation agencies to advance a regional communications network that would support sharing of data and video, with the intention of actively managing and operating the region's transportation system.

The Countywide Communications Study specifically looked at the existing fiber communications infrastructure throughout Orange County, primarily owned and operated by cities and the County. That review identified opportunities to close physical and municipal gaps between individual fiber optic networks, effectively creating a regional ITS communications network throughout Orange County. The Study includes a list of projects and further studies to be completed over the next ten years in support of

the envisioned shared network. At this point in the ITS Plan update process, it is envisioned that those projects and studies will be included in the final listing of projects in the Final updated ITS Plan.

Implementation Schedule

- Short Term (0-3 years): Continue implementation and expansion of traffic signal interconnect.
- Short Term (0-3 years): Expand center to field communications for local agencies that already have the capability.
- Medium Term (4-6 years): Expand center to field communications for local agencies that do not currently have the capability.
- Medium Term (4-6 years): Continue to investigate the feasibility of interconnecting local agency field communications infrastructure, with the ultimate goal of developing a countywide center-to-center communications network. Update the Countywide Communications Study.

5.7.2 CC2 – Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications

Vehicle-to-Vehicle (V2V) communications refer to dedicated, two-way wireless communications, handling high data rate, low latency, low probability of error, line of sight communications among vehicles. The foundation of V2V communications is on-board equipment that communicates speed, position, and likely other vehicle sensor information, with surrounding vehicles, with the goal of collision avoidance functionality and easing of traffic congestion.

Vehicle-to-Infrastructure (V2I) communication is the wireless two-way exchange of data and information between properly equipped vehicles and roadside infrastructure. Connected Vehicle (CV) Applications will use this communications medium to support infrastructure-based collision avoidance implementations, road condition advisories, and other information sharing functionality. Those safety advisories will inform drivers of traffic and road conditions that the driver may encounter in its current projected path of travel.

Connected Vehicle applications will use V2I communications to support vehicle-based advanced collision avoidance implementations, road condition information sharing, and active coordination to advanced control systems. Though the public sector has been heavily involved in V2V communications research, the private sector is leading its implementation. Aside from Connected Vehicle applications, many in the traffic management industries – both private sector and public sector – believe that autonomous (driverless) vehicles may achieve greater deployment penetration and success with a standardized V2V and V2I component.

Two communications technologies are generally believed to be viable for use in V2V communications – Dedicated Short Range Communications (DSRC) and cellular 5G. DSRC was generally considered to be the de facto standard for safety and mobility applications (Connected Vehicle applications), but it has taken more than a decade for the transportation industry to establish and agree upon application and messaging standards for use of DSRC in the mobile environment.

Some elements of the private sector are currently promoting emerging cellular technologies and referring to them as “Cellular V2X,” with the V2X referring to communications between the vehicle and other vehicles, as well as between the vehicle and the infrastructure. Some in the industry simply refer to

the potential to use cellular services for the V2X communications as 5G. However, the rollout of true 5G service by the cellular providers is also uncertain, as in some instances the term 5G is a marketing term and not necessarily a technical standard for V2X implementation. OCTA has indicated that it sees the two technologies as complementary, and not competing. OCTA does not position this technology discussion as, "DSRC versus cellular 5G," but rather "DSRC and cellular 5G."

Implementation Schedule

- Short Term (0-3 years): Support pilot DSRC deployments around Orange County.
- Medium Term (4-6 years): Investigate and identify opportunities to deploy – or support deployment of – Connected Vehicle applications around Orange County.
- Medium Term (4-6 years): Monitor the DSRC/cellular 5G technology discussion and be prepared to support local agencies in navigating technology selection for local agency Connected Vehicle applications deployments.

5.8 Institutional

5.8.1 IN1 – Pooled Purchasing Agreements

The local agencies – the primary owner-operators of traffic signal systems – have expressed interest in developing a mechanism to engage in pooled procurement of equipment – controllers, cabinets, CCTV etc. to perhaps leverage suppliers into more favorable pricing. This pooled resources concept also extends into maintenance activities, especially for smaller agencies. Many local agencies struggle with timely response to issues with the most basic element of signal operations – detector failures – which are commonplace and adversely affect signal operations more than may be realized. The thought is that a multiagency resource pool for maintenance may allow more timely response to maintenance issues, at a more favorable prices.

Implementation Schedule

- Short Term (0-3 years): Continue discussion of pooling resources for procurement and maintenance activities with/among local agencies. Support where appropriate.
- Medium Term (4-6 years): Investigate and identify opportunities to deploy – or support deployment of – Connected Vehicle applications around Orange County.
- Medium Term (4-6 years): Monitor the DSRC/cellular 5G technology discussion and be prepared to support local agencies in navigating technology selection for local agency Connected Vehicle applications deployments.

5.8.2 IN2 – Subregional Partnerships

Similar in concept to the Pooled Purchasing Agreements discussed above, Subregional Partnerships is envisioned to be a mechanism for groups of local agencies to enter into agreements to work cooperatively on traffic signal operations. Cooperation on traffic signal operations could include relinquishment of day-to-day operational oversight of traffic signal operations to another local agency that may operate traffic signal for multiple local agencies. Such an arrangement may allow the placement of dedicated staffing and more proactive management of traffic signal operations on a day-

to-day basis. This has been a topic of discussion at multiple Traffic Forum meetings in the past, though there does not appear to be any forward movement on such an arrangement.

A small-scale version of this kind of arrangement is currently in place in south Orange County. There is an intertie in place between the City of Laguna Hills and the City of Lake Forest. The City of Laguna Hills, 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 Laguna Hills ATMS server; the agencies may view each other signals on the server, but are restricted from acquiring operational control. However, there does not appear to be any relinquishment of traffic signal operations by either agency.

Implementation Schedule

- Short Term (0-3 years): Determine if there are any groups of local agencies that are interested in entering into a shared traffic signal operations arrangement. Support where appropriate.
- Short Term (0-3 years): Assist with development of interagency agreements, as appropriate.

5.8.3 IN3 – Integrated Corridor Management

Integrated Corridor Management (ICM) is both an institutional strategy and a technical strategy. ICM provides an organizational structure for sharing of information and, in some cases, a technical structure for shared or cooperative control among traffic management centers and agencies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic control and coordination between freeway facilities and arterial roadway networks, within a defined corridor area. The Triangle ICM in north Orange County, which is currently under development, is the first such effort to be initiated in Orange County.

The nature of optimization and extent of information and control sharing is determined through institutional working arrangements between/among jurisdictions. ICM relies principally on roadside instrumentation, supported by the Traffic Signal Control strategy and Freeway Operations strategies. ICM may add hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers. An ITS communications network would be at the heart of ICM technical solutions. A Triangle ICM communications system could be a first step in the implementation of the proposed countywide communications infrastructure identified in the Countywide Communications Study (OCTA, 2015).

Implementation Schedule

- Short Term (0-3 years): Monitor Triangle ICM developments and support where appropriate.
- Short Term (0-3 years): Assist with development of interagency agreements where appropriate.
- Short Term (0-3 years): Work with Caltrans and other local agency stakeholders to identify additional ICM corridor opportunities.

6 PLANNED AND RECOMMENDED PROJECTS

Currently planned/programmed ITS projects as well as additional projects and strategies intended to meet the ITS 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 are not yet defined in detail.

6.1 Project Sequencing

Project sequencing in the Strategic Deployment Plan is used to maximize the benefits of ITS projects by building on existing infrastructure and projects to enhance and expand systems, in a building block approach. Projects are sequenced in terms of increasing system functionality and information exchange with a foundation of base infrastructure. The sequencing can be divided into tiers, with each successive tier building upon the previous to propagate functionality and information exchange throughout the county. The project sequencing tiers are:

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

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

A listing of baseline projects that are already programmed in the Federal Transportation Improvement Program (FTIP) – some in the planning stages, some already under construction – in the county and in the region, is shown in **Table 6-1**. The FTIP is a federally mandated four year program of all surface transportation projects that will receive federal funding or are subject to a federally required action. Not all of the projects shown in Table 6-1 are “pure ITS” projects. Some of the projects appear in this table because ITS has been deemed to be a significant, or important component of the project; and are important to the structured propagation of ITS in Orange County. These projects span the range of “Tiers” – from 1 through 4 – described above. A Tier number is assigned to each of the projects shown in Table 6-1. The sequencing of additional planned ITS projects follows Table 6-1.

Table 6-1: Currently Planned/Programmed Projects

FUNDING LIST	CATEGORY	PROJECT	DESCRIPTION	PROJECT SEQUENCING/TIER
2018 LRTP - Trend 2040 Projects	Public Safety	OC Go - Project N - Freeway Service Patrol (FSP)	Funds FSP for the duration of OC Go (Measure M2). FSP is a team of tow trucks that travel Orange County freeways during peak commuting hours to help motorists with disabled vehicles.	Tier 2
2018 LRTP - Trend 2040 Projects	Traveler Information	Motorist services (511 service and call box network)	Operations and maintenance of the Orange County roadside Call Box network, and participation in the Southern California 511 Program.	Tier 3
2018 LRTP - Trend 2040 Projects	Traffic Management	OC Go - Project P - Regional Traffic Signal Synchronization Program (RTSSP)	Provides funding and assistance to implement multi-agency signal synchronization throughout Orange County.	Tier 3
2018 LRTP - Trend 2040 Projects	Transit	OC Go - Project S - OC Streetcar	OC Streetcar project currently under construction. ITS interest is the Transit Signal Priority (TSP) element.	Tier 3
2018 LRTP - Trend 2040 Projects	Transit/Public Safety	Additional Projects	Transit Security and Operations Center (TSOC) - Plan, design, and construct a new transit operations center.	Tier 3
Federal Transportation Improvement Program (FTIP)	Traffic Management	ORA102904	Image Based Toll Collection System - demonstration project (ITS)	Tier 2
Federal Transportation Improvement Program (FTIP)	Traffic Management	ORA001105 and ORA001102 and SCAG015 and SCAG016	Grouped projects for safety improvements - SHOPP Mobility Program. Scope: … traffic control devices ops assistance. Intersection signalization projects, …	Tier 1
Federal Transportation Improvement Program (FTIP)	Transit	ORA080908	ITS elements of a transit corridor for the city of Anaheim - Anaheim Rapid Connection (ARC) fixed guideway system connecting the Anaheim Regional Transportation Intermodal Center (ARTIC) the Platinum Triangle, and the Anaheim Resort.	Tier 3

FUNDING LIST	CATEGORY	PROJECT	DESCRIPTION	PROJECT SEQUENCING/TIER
Federal Transportation Improvement Program (FTIP)	Transit	ORA020820	Metrolink Service Track Expansion and Grade Crossing Improvements. (turnback facilities, layover facilities, and or reliability improvements) between Fullerton and Laguna Niguel/Mission Viejo	Tier 2
Federal Transportation Improvement Program (FTIP)	Active Transportation	ORA112005	Implement bike stations and bike sharing program in Orange County	Tier 2
Federal Transportation Improvement Program (FTIP)	Multimodal	ORA65002	Rideshare Services Rideguide, database, customer info, and marketing (Orange County portion).	Tier 2
Federal Transportation Improvement Program (FTIP)	Traffic Management	ORA030605A	ITS and new electronic toll collection elements: I-405 from SR-73 to I-605. Convert existing HOV to HOT. Add 1 additional HOT lane each direction… (and other major capital elements) (BY 2035).	Tier 3
Federal Transportation Improvement Program (FTIP) - Financially Constrained	Traffic Management	2A0705	Synchronize signals across jurisdictions and Smart Streets	Tier 3
Federal Transportation Improvement Program (FTIP) - Financially Constrained	Motorist Aid	2L149	Freeway Service Patrol and Callbox Program	Tier 2
Federal Transportation Improvement Program (FTIP) - Financially Constrained	Traffic Management	7120005	Additional TSM investments – Regionwide (includes CSMP improvements)	Tier 1
Federal Transportation Improvement Program (FTIP) - Financially Constrained	Traffic Management	N/A	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 1

6.2 Strategic ITS Projects

Additional projects representing ITS strategies that fulfill user and regional needs are listed in the sections below. These strategies, which were largely derived based on input from local agency staff and OCTA staff, support the development of the ITS Strategic Deployment Plan (SDP). Projects are strategically phased in three time frames: Short Term (0-3 years); Medium Term (4-6 years); and Long Term (7-10 years).

6.2.1 Data Management and Performance Monitoring

DPM1	Implement Signal System Performance Monitoring System at the Local Agencies	Short Term	Tier 2
DPM2	Upgrade/Expand Signal System Performance Monitoring System at the Local Agencies	Short Term	Tier 2
DMP3	Develop the capability for OCTA to be able to monitor traffic signal system performance countywide (Dashboard configuration)	Medium Term	Tier 4

6.2.2 Public Safety

PS1	Expand/Upgrade Emergency Vehicle Preemption (EVP) System(s)	Short Term	Tier 3
PS2	Implement Incident Detection System(s)	Medium Term	Tier 3
PS3	Expand Technologies to Support FSP Operations	Medium Term	Tier 2

6.2.3 Vehicle Safety

VS1	Implement/Expand CAV Supporting Infrastructure (deploy Connected Vehicle RSUs and other Connected Vehicle Roadside Equipment (RSE))	Short Term	Tier 1
VS2	Implement/Upgrade/Expand Pedestrian/Bicycle Safety Devices	Short Term	Tier 1
VS3	Work with Local Agencies to implement basic Connected Vehicle applications, with the intent of expanding capabilities and functionality (Intelligent Traffic Signal System and Reduced Speed/Work Zone Warning)	Medium Term	Tier 2
VS4	Upgrade rail grade crossing technologies	Medium Term	Tier 1
VS5	Implement Technology to Implement Pedestrian/Bicycle Counting Program (Support Participation in Regional Program)	Medium Term	Tier 1
VS6	Develop systems for Local Agencies that provide travelers with advanced notification of work zones, and that also automate traffic monitoring in work zones	Medium Term	Tier 3
VS7	Support Implementation of CVO Systems	Long Term	Tier 2
VS8	Implement devices and systems can also provide Work Zone Intrusion detection and alerts to workers in the work zone to potential danger from errant vehicles in the work zone (Local Agencies and Caltrans)	Long Term	Tier 2

6.2.4 Traffic Management

TM1	Upgrade Local Agency Advanced Traffic Management Systems	Short Term	Tier 2
TM2	Upgrade/Expand Vehicle Detection Systems	Short Term	Tier 1
TM3	Complete a Phased Implementation/Upgrade of all Traffic Signal Controllers Countywide to ATC Standards	Short Term	Tier 2/Tier 3
TM4	Fund, administer, and implement multi-agency Traffic Signal Synchronization Projects throughout the county	Short Term	N/A

TM5	Conduct a study to determine the feasibility of sector-based traffic signal timing as opposed to corridor-based traffic signal timing	Short Term	N/A
TM6	Upgrade/Expand Local Agency CCTV Surveillance Systems	Short Term	Tier 2
TM7	Procure and Deploy Portable Traffic Control (with remote monitoring and management capabilities)	Medium Term	Tier 1
TM8	Local Agency participation in, and support for Freeway/Arterial ICM Activities	Medium Term	Tier 3
TM9	Implement Freeway Components of ICM	Medium Term	Tier 3
TM10	Develop the Triangle ICM Program. Design, Deploy, and Operate the Freeway and Arterial Components of the Triangle ICM Program	Short Term	Tier 4
TM11	Upgrade/Expand Deployment of Probe Readers for Travel Times on Arterials	Medium Term	Tier 1
TM12	Implement Local Agency Parking Management Systems	Long Term	Tier 2
TM13	Implement Local Agency Electronic Payment Systems for Parking	Long Term	Tier 2
TM14	Implement a Maintenance/Construction Vehicle Management System for Local Agency Fleet(s)	Long Term	Tier 2
TM15	Implement Local Agency CMS Systems	Long Term	Tier 2

6.2.5 Traveler Information

TI1	Provide road construction information and notification on local roads	Short Term	Tier 2
TI2	Implement Advanced Traveler Information System Element(s)	Short Term	Tier 2
TI3	Upgrade Advanced Traveler Information System Element(s) (Regional 511 system)	Medium Term	Tier 3
TI4	Deploy Traveler Information Kiosks as part of OC Streetcar System	Medium Term	Tier 3
TI5	Work cooperatively with state and regional partners to provide more travel information specifically geared toward commercial vehicle operators	Long Term	Tier 3

6.2.6 Transit and Multimodal Management

MM1	Upgrade/Expand/Migrate OCTA Transit Traveler Information System(s)	Short Term	Tier 3
MM2	Disseminate/display bus arrival times at bus stops	Short Term	Tier 2
MM3	Implement Transit Signal Priority (TSP) for OC Street Car	Short Term	Tier 3
MM4	Upgrade/Expand OCTA Transit AVL System (CAD/AVL component of ITMS)	Short Term	Tier 2
MM5	Implement Transit Signal Priority on Bravo! Limited Stop Routes	Medium Term	Tier 3
MM6	Implement Transit AVL, and other back office management systems on local agency transit systems	Medium Term	Tier 2
MM7	Implement Transit Traveler Information Systems on local agency transit systems	Medium Term	Tier 2
MM8	Implement Paratransit Transit Management System for local agency paratransit operations	Medium Term	Tier 2
MM9	Implement Transit Vehicle Security System(s) for Local Agency transit operations	Medium Term	Tier 2
MM10	Local Agency implementation of Bike Share Systems	Medium Term	Tier 3
MM11	Support implementation of a countywide, or regional Ridesharing System	Medium Term	Tier 3
MM12	Upgrade/Expand OCTA Transit Vehicle Security System(s)	Medium Term	Tier 2
MM13	Upgrade Transit Vehicle Security System(s) (on-board and central systems)	Medium Term	Tier 2
MM14	Upgrade/Expand OCTA Transit Management Systems (non-CAD/AVL components of ITMS, and other transit operations back office systems)	Medium Term	Tier 2

MM15	Upgrade OCTA Electronic Fare Payment System(s) (on-board and central systems)	Medium Term	Tier 2
MM16	Expand OCTA Electronic Fare Payment System(s) to other Local Agency Transit Operators	Long Term	Tier 2
MM17	Implement TSP for local agency transit operations	Long Term	Tier 3
MM18	Upgrade/Expand OCTA Paratransit Transit Management System(s) (on-board and central systems)	Long Term	Tier 2

6.2.7 Communications and Connectivity

CC1	Expand deployment of ATCs that are more fully capable of exchanging data through standardized interfaces, using utilizing national standards for communications and interoperability	Short Term	Tier 1
CC2	Implement more traffic signal interconnect, that is high bandwidth and low latency that will also accommodate more data intensive applications such as signal performance, video, and potentially CV applications	Short Term	Tier 1
CC3	Study Feasibility of Installing Fiber Optic Communications Infrastructure in the Pacific Electric Right-of-way for Countywide Inter-agency Communications	Short Term	N/A
CC4	Develop Policy Language that Recommends Additional Fiber Optic Capacity (dark fiber) be Included in all OCTA Funded Traffic Signal Synchronization and ITS Projects (where appropriate)	Short Term	N/A
CC5	Update the Orange County Countywide Communications Study for ITS	Medium term	N/A
CC6	Perform the Connectivity Study, as Recommended in the 2015 Countywide Communications Study for ITS	Medium Term	N/A
CC7	Develop the capability to share transportation data with Private Sector Information Service Providers (Waze, etc.)	Medium Term	Tier 3
CC8	Develop data sharing capabilities among Caltrans and Local Agencies in support of Integrated Corridor Management (ICM) operations	Medium Term	Tier 4
CC9	Plan and Design a Communications Link Among County Agencies (OCTA, OCSD, OCFA, OC Public Works, etc.)	Long Term	Tier 3
CC10	Implement a Transportation Data Archive System - AND/OR - Participate in a Multi-agency Transportation Data Archive System	Long Term	Tier 3

6.2.8 Institutional

IN1	Work with Triangle ICM Local Agencies to Develop ICM Operations for the Triangle ICM area.	Short Term	N/A
IN2	Investigate the feasibility of pooling of staff, or staff augmentation to perform remote monitoring and operations for Local Agency traffic signal operations	Short Term	N/A
IN3	Work with Local Agencies to Develop ICM Operations	Medium Term	N/A
IN4	Conduct a Study to Re-examine the Interest of the Local Agencies, and the Feasibility, of Implementing Multi-agency (or Sub-regional) Traffic Signal Control	Medium Term	N/A
IN5	Work cooperatively to identify additional corridors in Orange County in which to plan and develop ICM systems, techniques, and institutional relationships	Long Term	N/A

7 COUNTYWIDE COMMUNICATIONS INFRASTRUCTURE REVIEW

The primary purpose of the Countywide Communications Infrastructure Review was to update ITS and Traffic Signal Systems (TSS) communications infrastructure maps that were initially developed for the 2013 ITS Plan Update, and subsequently updated for the 2015 Countywide Communications Study. All of the local agencies, including the county, were engaged in this effort, and the updated individual local agency maps are found in **Appendix F** of this document.

7.1 Communication Infrastructure Review

By way of background, one of the outputs of the 2015 Countywide Communications Study was a concept for a countywide ITS and TSS communications network. The purpose of the network is to enable local agencies to share data and information between and among the local agencies. The network could conceivably be used for other purposes, such as allowing of interoperation of systems among agencies, development of a transportation data archive, enabling countywide traffic signal performance measurement and monitoring, and potentially, providing data to traveler information systems.

The basic premise behind the countywide network was to physically interconnect existing ITS and TSS communications infrastructure already deployed. The initial challenge to this concept is connected many disconnected communications networks. So another output of the 2015 Countywide Communications Study was a list of “gap closure” projects. These gap closure projects identified locations where gaps between the various disconnected local agency communications networks could be filled to build out the countywide ITS and TSS communications network.

One aim of this current communications infrastructure map update was to review the gap closure projects identified in the 2015 Countywide Communications Study, and to update them wherever necessary. An additional effort was undertaken to eliminate dependence on Caltrans trunkline fiber optic communications infrastructure wherever possible. To that end, some emphasis is placed on the potential for placement of fiber optic communications infrastructure in the Pacific Electric right-of-way (PEROW) and also in the Los Angeles - San Diego - San Luis Obispo Rail Corridor (LOSSAN Corridor) right-of-way.

A map depicting the Center-to-Center (C2C) connections throughout the county is provided in **Appendix G**. Companion to the map in Appendix G are text descriptions of the locations/route for the C2C connections. The locations/routes are subdivided into Tier 1 and Tier 2. Tier 1 locations/routes are primary routes for C2C communications within the countywide network. Tier 2 locations/routes are secondary routes/locations within the countywide network. Tier 2 locations/routes may also provide some level of network redundancy to reduce the likelihood that a single point of failure would impact the entire countywide network; or major portions of it. And finally, two lists of Gap Closure projects are provided that indicate where there are gaps in the fiber optic communications infrastructure that would need to be completed in order to fill-out the county wide ITS/TSS communications network. Tier 1 Gap Closures are those that are deemed primary priority, and the Tier 2 Gap Closures are those that are deemed secondary priority.

7.2 Opportunities and Challenges to Countywide Integration

7.2.1 Pacific Electric Right-of-Way (PEROW)

Regionally, the PEROW runs approximately 24 miles in a southeast/northwest diagonal alignment between the Watts area of south Los Angeles County and the city of Santa Ana in Orange County. The Orange County portion of the PEROW is approximately 12 miles in length, between the Los Angeles-Orange County border in the city of Cypress and the intersection of North Raitt Street and West Santa Ana Boulevard in the city of Santa Ana. OCTA owns the Orange County portion of the PEROW. Some portions of the right-of-way in Orange County have been developed, mostly with commercial uses. A portion of OCTA's Garden Grove bus base sits on the PEROW.

It may be possible for OCTA and/or the corridor cities to place communications media, presumably fiber optic cable, in the PEROW for development a countywide traffic signal and ITS communications network. The PEROW passes through seven cities in northwest Orange County – Cypress, La Palma, Buena Park, Anaheim, Stanton, Garden Grove, and Santa Ana. Six of the seven cities have communications media in at least one street that crosses the PEROW. Four of those six cities have fiber optic cable in streets that cross the PEROW corridor, two of the six cities have twisted-pair copper wire in at least one street streets that crosses the PEROW. The one city that does not have communications media in a street that crosses the PEROW has twisted-pair copper communications media within 400 feet of the PEROW. Having an OCTA property occupy a portion of the PEROW provides an opportunity to locate network resources in close proximity to the PEROW, and that is connected to the proposed countywide network.

The feasibility of placing fiber optic communications media in the PEROW would need to be studied more closely, both from a policy standpoint and a constructability standpoint. It is likely that fiber optic conduit and cable would not have to be constructed for the entire 12-mile length of the PEROW in Orange County. One or more private entities may be interested in partnering with the public agencies (OCTA and/or the cities) to construct, install, and in some manner, share the fiber optic communications facilities.

7.2.2 Los Angeles - San Diego - San Luis Obispo Rail Corridor (LOSSAN Corridor) Right-of-Way

The LOSSAN Rail corridor is approximately 351 miles long, and passes through six counties in Southern California (San Diego, Orange, Los Angeles, Ventura, Santa Barbara, and San Luis Obispo). OCTA owns approximately 42 miles of the corridor within Orange County, between Fullerton and San Clemente. The corridor passes through 13 cities, including: Fullerton, Anaheim, Orange, Santa Ana, Tustin, Irvine, Lake Forest, Mission Viejo, Laguna Hills, Laguna Niguel, San Juan Capistrano, Dana Point, and San Clemente.

It may be possible for OCTA and/or the cities to place communications media, presumably fiber optic cable, in the LOSSAN corridor right-of-way for development a countywide traffic signal and ITS communications network. Nine of the thirteen corridor cities have communications media in at least one street that crosses the LOSSAN corridor right-of-way. Seven of those nine cities have fiber optic cable in at least one street that crosses the right-of-way, and two of the nine cities have twisted-pair copper wire it at least one street that crosses the right-of-way. Two of the thirteen cities that have no communications media that cross the right-of-way do have twisted pair copper wire within 150 feet of

the right-of-way. Two other cities that have no communications media crossing the right-of-way have communications media that is between 1,300 feet and 2,200 feet of the right-of-way.

The feasibility of placing fiber optic communications media in the LOSSAN corridor right-of-way would need to be studied more closely, both from a policy standpoint and a constructability standpoint. Some preliminary information from OCTA staff indicate that there may already be fiber optic communications media for a significant portion of the corridor in Orange County. If this is the case, it may be possible for OCTA and/or the cities to enter into an agreement to share that communications media for the purpose of implementing a countywide traffic signal and ITS communications network. Fiber optic conduit and cable would likely not have to be constructed for the entire 42-mile length of the LOSSAN corridor in Orange County. In addition, one or more private entities may be interested in partnering with the public agencies (OCTA and/or the cities) to construct, install, and in some manner, share the fiber optic communications facilities.

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 countywide 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 Department of Transportation (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 is currently evaluating Traffic SPM on limited traffic signal synchronization corridors; and is interested in more widespread deployment of SPM to be able to monitor the performance of Project P investments.

- OCTA monitors the Freeway Service Patrol (FSP) program on an annual basis in order to evaluate and optimize 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.).
- 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 countywide performance monitoring program will help establish a baseline understanding of how well the surface transportation system is performing from a multimodal 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, operational efficiencies, 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 (or systems) with the resultant data integrated into a single, searchable front end. Data visualization tools help to simplify presentation of large, complex data sets. 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 sources such as through Bluetooth readers, GPS cellular data, etc.) 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 network. 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 Geographic Information Systems (GIS) database system 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 8-1** summarizes the performance monitoring strategy described above in a phased approach.

Table 8-1: Performance Monitoring Phased Approach

CATEGORY	PHASED APPROACH
Data collection infrastructure	**Short-term:** Supplement arterial data collected from manual counts using SPM software, and vehicle probe data from cellular 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 data collection 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 8-2 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 the 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 8-2: 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 • Person throughput on key corridors • Transit ridership

GOAL	OBJECTIVES	MEASURES OF EFFECTIVENESS (MOEs)
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 feedback • 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

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 8-3**. 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 8-3: Data Needs

FUNCTIONAL AREA	DATA INPUTS	TIER 1 (MOES)	TIER 2 (MOEs)
• Arterial system Performance	• Manual vehicle counts • Floating car travel time runs • Vehicle probe data (Bluetooth, Connected Vehicle data, etc.) • Crowd-sourced data (WAZE, cellular GPS, HERE, etc.) • SPM 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

FUNCTIONAL AREA	DATA INPUTS	TIER 1 (MOES)	TIER 2 (MOEs)
• Highway System Performance	• PeMS loop detector data • Vehicle probe data (Bluetooth, Connected Vehicle data, etc.) • Crowd-sourced data (WAZE, cellular GPS, HERE, etc.)	• 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
• Local agency bus performance • Paratransit service performance • Local agency transit 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 feedback • Transit vehicle on-time performance • Transit vehicle service calls	• Fare box recovery ratio • Travel time savings (dollar equivalent) • Person throughput on key corridors • 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 systems status and metrics • Maintenance logs • Asset management records • Detector diagnostics	• Communications system up-time/down-time • Detection up-time/down-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 programs have been identified for implementing the monitoring program in the phases shown in **Table 8-4**.

Table 8-4: 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	• Expand deployment of ATCs • Address detection technologies in a future countywide or regional NTCIP specification to standardize data transmission for field-to-center communications • Address center-to-center data transmission in a future countywide or 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 local and regional benefits. This ITS SDP has identified strategies and projects to realize OCTA's vision and positions Orange County 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 9-1 illustrates the deployment plan for implementing the projects proposed in this ITS SDP. The timeline organizes the deployment of the sixty-seven ITS projects/strategies described in Section 6 into three distinct time frames.

- Short-term: these strategies and projects are taking place now or within three years from now (0-3 years);
- Medium-term: these strategies and projects would take place between 3 to 6 years from now (4-6 years); and
- Long-term: these strategies and projects would take place between 6 to 10 years from now (7-10 years).

Figure 9-1 – Recommended ITS SDP Implementation Timeline

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Data Management and Performance Monitoring											
DPM1	Implement Signal System Performance Monitoring System at the Local Agencies										
DPM2	Upgrade/Expand Signal System Performance Monitoring System at the Local Agencies										
DMP3	Multiagency (countywide) Signal System Performance Monitoring (Dashboard)										
Public Safety											
PS1	Expand/Upgrade Emergency Vehicle Preemption (EVP) System(s)										
PS2	Implement Incident Detection System(s)										
PS3	Expand Technologies to Support Freeway Service Patrol (FSP) Operations										
Vehicle Safety											
VS1	Implement/Expand Connected and Autonomous Vehicle (CAV) Supporting Infrastructure										
VS2	Implement/Upgrade/Expand Pedestrian/Bicycle Safety Devices										
VS3	Implement basic Connected Vehicle applications (local agency/OCTA)										
VS4	Upgrade rail grade crossing technologies										
VS5	Implement Technology for Pedestrian/Bicycle Counting Program										
VS6	Implement work zone safety oriented Connected Vehicle applications (local agency)										
VS7	Support Implementation of Commercial Vehicle Operations (CVO) Systems										
VS8	Implement Work Zone Intrusion detection and alerts to workers (Local Agencies and Caltrans)										
Traffic Management											
TM1	Upgrade Local Agency Advanced Traffic Management Systems										
TM2	Upgrade/Expand Vehicle Detection Systems										
TM3	Complete a Phased Implementation/Upgrade of all Traffic Signal Controllers Countywide to Advanced Transportation Controller (ATC) Standards										
TM4	Fund, administer, and implement multi-agency Traffic Signal Synchronization Projects throughout the county										
TM5	Conduct feasibility study on sector-based traffic signal timing versus corridor-based traffic signal timing										
TM6	Upgrade/Expand Local Agency Closed Circuit Television (CCTV) Surveillance Systems										
TM7	Procure and Deploy Portable Traffic Control (with remote monitoring and management capabilities)										
TM8	Local Agency participation in, and support for Freeway/Arterial Integrated Corridor Management (ICM) Activities										
TM9	Implement Freeway Components of Integrated Corridor Operations (Integrated Corridor Management (ICM))										
TM10	Develop the Triangle ICM Program.										
TM11	Upgrade/Expand Deployment of Probe Readers for Travel Times on Arterials										
TM12	Implement Local Agency Parking Management Systems										
TM13	Implement Local Agency Electronic Payment Systems for Parking										

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
TM14	Implement a Maintenance/Construction Vehicle Management System for Local Agency Fleet(s)										
TM15	Implement Local Agency Changeable Message Sign (CMS) Systems										
Traveler Information											
TI1	Provide road construction information and notification on local roads										
TI2	Implement Advanced Traveler Information System Element(s)										
TI3	Upgrade Advanced Traveler Information System Element(s) (Regional 511 system)										
TI4	Deploy Traveler Information Kiosks as part of OC Streetcar System										
TI5	Work with state and regional partners to provide travel information for commercial vehicle operators										
Transit and Multimodal Management											
MM1	Upgrade/Expand/Migrate OCTA Transit Traveler Information System(s)										
MM2	Disseminate/display bus arrival times at bus stops										
MM3	Implement Transit Signal Priority (TSP) for OC Street Car										
MM4	Upgrade/Expand OCTA Transit AVL System (CAD/AVL component of ITMS)										
MM5	Implement Transit Signal Priority on Bravo! Limited Stop Routes										
MM6	Implement Transit AVL, and other management systems on local agency transit systems										
MM7	Implement Transit Traveler Information Systems on local agency transit systems										
MM8	Implement Paratransit Transit Management System for local agency paratransit operations										
MM9	Implement Transit Vehicle Security System(s) for Local Agency transit operations										
MM10	Local Agency implementation of Bike Share Systems										
MM11	Support implementation of a countywide, or regional Ridesharing System										
MM12	Upgrade/Expand OCTA Transit Vehicle Security System(s)										
MM13	Upgrade Transit Vehicle Security System(s) (on-board and central systems)										
MM14	Upgrade/Expand OCTA Transit Management Systems (non-CAD/AVL components)										
MM15	Upgrade OCTA Electronic Fare Payment System(s) (on-board and central systems)										
MM16	Expand OCTA Electronic Fare Payment System(s) to other Local Agency Transit Operators										
MM17	Implement Transit Signal Priority (TSP) for local agency transit operations										
MM18	Upgrade/Expand OCTA Paratransit Transit Management System(s)										
Communications and Connectivity											
CC1	Expand deployment of Advanced Transportation Controllers (ATCs)										
CC2	Implement more traffic signal interconnect (high bandwidth/low latency)										

Strategic Deployment Plan - Proposed Project Sequencing		Short Term (0-3 Yrs.)			Medium Term (4-6 Yrs.)			Long Term (7-10 Yrs.)			
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CC3	Study Feasibility of Installing Fiber Optic Communications Infrastructure in the Pacific Electric right-of-way and the LOSSAN corridor right-of-way for Countywide Inter-agency Communications										
CC4	Develop Policy Language that Recommends Additional Fiber Optic Capacity (dark fiber) be Included in all OCTA Funded Traffic Signal Synchronization and ITS Projects (where appropriate)										
CC5	Update the Orange County Countywide Communications Study for ITS										
CC6	Perform the Connectivity Study, as Recommended in the 2015 Countywide Communications Study										
CC7	Develop the capability to share data with Private Sector (Waze, etc.)										
CC8	Develop data sharing capabilities among Caltrans and Local Agencies to support Integrated Corridor Management (ICM) operations										
CC9	Plan and Design a Communications Link Among County Agencies (OCTA, OCSD, OCFA, OC Public Works, etc.)										
CC10	Implement a Transportation Data Archive System - AND/OR - Participate in a Multi-agency Transportation Data Archive System										
Institutional											
IN1	Work with Triangle ICM Local Agencies to Develop Integrated Corridor Management (ICM) Operations for the Triangle ICM area.										
IN2	Investigate the feasibility of pooling of staff, or staff augmentation to perform remote monitoring and operations for Local Agency traffic signal operations										
IN3	Work with Local Agencies to Develop Integrated Corridor Management (ICM) Operations										
IN4	Conduct a Study to Re-examine the Interest of the Local Agencies, and the Feasibility, of Implementing Multi-agency (or Sub-regional) Traffic Signal Control										
IN5	Work cooperatively to identify additional corridors in Orange County in which to plan and develop ICM systems, techniques, and institutional relationships										

APPENDIX A: REGIONAL ITS ARCHITECTURE STAKEHOLDERS

Stakeholder Summary

Architecture Type	Architecture	Stakeholder Name	Stakeholder Description	Group	Group Members
Region	Orange County	California Highway Patrol (CHP)	The CHP is a state public safety agency that provides uniform traffic law enforcement throughout the state. CHP works cooperatively with Caltrans to ensure safe and efficient operations on state highways throughout Orange County and the rest of the state. CHP personnel are co-located in the Caltrans District 12 Transportation Management Center (TMC) to coordinate response to incidents, and to assist with traffic management and public safety in roadway construction and maintenance zones on state highways.	No	
Region	Orange County	Caltrans	Caltrans is the California State Department of Transportation. Caltrans owns and operates the state highway and Interstate system in California. Caltrans is subdivided into 12 geographic districts. This stakeholder represents all of Caltrans outside of Caltrans District 12 (Orange County). The Inventory Elements associated with this Stakeholder are present in this Architecture to represent the inter-district coordination between Caltrans District 12 and the surrounding Caltrans Districts - District 7 (Los Angeles and Ventura Counties); District 8 (Riverside and San Bernardino Counties); District 11 (San Diego and Imperial Counties) - and Caltrans Headquarters.	No	
Region	Orange County	Caltrans District 12	Caltrans is the California State Department of Transportation. Caltrans owns and operates the state highway and Interstate system in California. Caltrans is subdivided into 12 geographic districts. Caltrans District 12 is the local Caltrans District office, whose jurisdictional boundaries are contiguous with Orange County. The primary responsibility of Caltrans District 12 is the operation and maintenance of the state highway system in Orange County, in close coordination with CHP. Caltrans District 12 also works with OCTA and local agencies to coordinate traffic operations and the interface between the state highway system and the local road network in Orange County.	No	
Region	Orange County	County of Orange	The County of Orange is a public agency that provides public safety, public health, environmental protection, regional planning, public assistance, social services and aviation in Orange County. With regards to traffic, transportation, and ITS, the County of Orange owns public roadways in the unincorporated areas of Orange County. The County, through its Public Works Department, operates several roads in the larger unincorporated areas in the northeast sector of the County, and in the southeast sector of the County. The County also works with Caltrans District 12, OCTA, and local agencies to coordinate traffic operations and the interface between the roadways located in unincorporated areas and the local road network, as well as the state highway system in Orange County.	No	
Region	Orange County	Financial Institutions	This Stakeholder generically represents financial institutions that participate in the processing of transit and toll payments.	No	

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Architecture Type	Architecture	Stakeholder Name	Stakeholder Description	Group	Group Members
Region	Orange County	General Public	This stakeholder represents users of surface transportation infrastructure throughout Orange County, including drivers of private vehicles, transit patrons, bicyclists, and pedestrians.	No	
Region	Orange County	Local Jurisdictions	This is a generic stakeholder in the Orange County ITS Architecture that represents the incorporated cities throughout orange County. Aliso Viejo, Anaheim, Brea, Buena Park, Costa Mesa, Cypress, Dana Point, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, Irvine, La Habra, La Palma, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Los Alamitos, Mission Viejo, Newport Beach, Orange, Placentia, Rancho Santa Margarita, San Clemente, San Juan Capistrano, Santa Ana, Seal Beach, Stanton, Tustin, Villa Park, Westminster, Yorba Linda.	No	
Region	Orange County	Los Angeles County Dept of Public Works	This stakeholder represents the Los Angeles County Department of Public Works (LADPW). LADPW is responsible for the design, construction, operation, and maintenance of roads, traffic signals, bridges, airports, sewers, flood control, water supply, water quality, and water conservation facilities in Los Angeles County. Some of LADPW's responsibilities include monitoring and controlling traffic signals countywide from its Traffic Management Center in Alhambra. LADPW owns, operates, and maintains the Information Exchange Network (IEN), which is a coordinated network for sharing information and control of the various traffic control systems throughout LA County using a common network backbone. Some Orange County jurisdictions bordering LA County have, in the past, expressed interest in connecting to the LA County IEN to coordinate traffic signal operations and share information with adjacent LA County jurisdictions.	No	
Region	Orange County	OCTA	The Orange County Transportation Authority (OCTA) performs several functions in Orange County. OCTA is the county's primary transportation planning agency, focusing on freeways, streets and transit. OCTA is the primary transit operator in Orange County, providing fixed route and paratransit bus service throughout Orange County. OCTA is a member (and funding partner) of the Southern California Regional Rail Authority (SCRRA), a joint powers authority that operates Metrolink Commuter Rail in a six county area in Southern California. OCTA administers OC Go, the half-cent sales tax measure that funds in whole or in part several transportation funding programs in Orange County. OCTA manages Project P, the Regional Traffic Signal Synchronization Program element of OC Go, which coordinates multi-jurisdictional traffic signal synchronization on major corridors throughout Orange County.	No	

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Architecture Type	Architecture	Stakeholder Name	Stakeholder Description	Group	Group Members
Region	Orange County	Southern California Association of Governments (SCAG)	The Southern California Association of Governments (SCAG) is the designated metropolitan planning agency for the Southern California region encompassing Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties. It is represented in this architecture to accommodate regional data archive(s), generally used for local, state, regional, and federal data and statistical reporting.	No	
Region	Orange County	Southern California Regional Rail Authority (SCRRA)	The Southern California Regional Rail Authority (SCRRA) is formed as a Joint Powers Authority (JPA), and uses Metrolink as the official operating brand name for Southern California's commuter rail service. The regional passenger commuter rail service serves the counties of Los Angeles, Orange, Riverside, San Bernardino, Ventura, and San Diego. SCRRA was formed to plan, design, construct and administer the commuter rail operation. SCRRA member agencies are LACMTA, VCTC, OCTA, SANBAG, and RCTC. Metrolink trains re dispatched and managed from 2 Centers: the Operations Center in Pomona, and the main Maintenance Facility in Glendale.	No	
Region	Orange County	State Office of Emergency Services	The California Governor's Office of Emergency Services (CalOES) is a California cabinet-level agency responsible for overseeing and coordinating emergency preparedness, response, recovery, and homeland security activities within the state. California State Office of Emergency Services operates the State Emergency Operations Center.	No	
Region	Orange County	Toll Operators Statewide	This Stakeholder represents the collection of toll facility operators statewide that interact with one another to reconcile toll charges between and among toll facility operators statewide. FasTrak is the statewide toll collection system used to pay tolls electronically in California. With a FasTrak transponder or sticker and an account with a toll facility operator, toll road and Express Lanes users can pay tolls electronically on every tolled bridge, lane, and road in California, eliminating the need to stop and pay cash at toll booths.	No	
Region	Orange County	Transportation Corridor Agencies (TCA)	The Transportation Corridor Agencies (TCA) are two Joint Powers Authorities (JPAs) that were created to plan, design, finance, construct and operate publicly-owned toll roads as a part of the state highway system. The Foothill/Eastern Transportation Corridor Agency JPA members include the County of Orange and the cities of Anaheim, Dana Point, Irvine, Lake Forest, Mission Viejo, Orange, Rancho Santa Margarita, San Clemente, San Juan Capistrano, Santa Ana, Tustin and Yorba Linda. The San Joaquin Hills Transportation Corridor Agency JPA members include the County of Orange and the cities of Aliso Viejo, Costa Mesa, Dana Point, Irvine, Laguna Hills, Laguna Niguel, Laguna Woods, Mission Viejo, Newport Beach, San Clemente, San Juan Capistrano and Santa Ana. The toll roads under the jurisdiction of TCA are the toll road portions of State Routes 73 and 133, as well as the entirety of State Routes 241 and 261.	No	

APPENDIX B: REGIONAL ITS ARCHITECTURE – LIST OF AGREEMENTS

Agreements

Agreement Number	Agreement Title	Agreement Type	Agreement Status	Description	Lead Stakeholder	Associated Stakeholders
01	Interjurisdictional Traffic Management	Unspecified	Existing	Provides for local agencies to maintain signal timing improvements in exchange for Project P funds and field equipment upgrades.	Local Jurisdictions	Caltrans District 12
01	Interjurisdictional Traffic Management	Unspecified	Existing	Provides for local agencies to maintain signal timing improvements in exchange for Project P funds and field equipment upgrades.	Local Jurisdictions	County of Orange
01	Interjurisdictional Traffic Management	Unspecified	Existing	Provides for local agencies to maintain signal timing improvements in exchange for Project P funds and field equipment upgrades.	Local Jurisdictions	Local Jurisdictions
01	Interjurisdictional Traffic Management	Unspecified	Existing	Provides for local agencies to maintain signal timing improvements in exchange for Project P funds and field equipment upgrades.	Local Jurisdictions	OCTA
02	Regional Traffic Management and Emergency Services	Unspecified	Existing	Provides for signal operations and coordination and local incident management.	Caltrans District 12	California Highway Patrol (CHP)
02	Regional Traffic Management and Emergency Services	Unspecified	Existing	Provides for signal operations and coordination and local incident management.	Caltrans District 12	Caltrans District 12
02	Regional Traffic Management and Emergency Services	Unspecified	Existing	Provides for signal operations and coordination and local incident management.	Caltrans District 12	Local Jurisdictions
03	Emergency Vehicle Signal Pre-emption	Unspecified	Planned	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.	County of Orange	County of Orange
03	Emergency Vehicle Signal Pre-emption	Unspecified	Planned	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.	County of Orange	Local Jurisdictions
03	Emergency Vehicle Signal Pre-emption	Unspecified	Planned	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.	County of Orange	OCTA

RAD-IT Table

Agreement Number	Agreement Title	Agreement Type	Agreement Status	Description	Lead Stakeholder	Associated Stakeholders
04	Transit Signal Priority	Unspecified	Future	Documents details on roles, responsibilities, and functions for transit vehicle priority at signalized intersection within a city for a transit agency.	OCTA	County of Orange
04	Transit Signal Priority	Unspecified	Future	Documents details on roles, responsibilities, and functions for transit vehicle priority at signalized intersection within a city for a transit agency.	OCTA	Local Jurisdictions
04	Transit Signal Priority	Unspecified	Future	Documents details on roles, responsibilities, and functions for transit vehicle priority at signalized intersection within a city for a transit agency.	OCTA	OCTA
05	Freeway Service Patrol	Unspecified	Existing	Documents details on roles, responsibilities, and functions for providing freeway service patrol activities	OCTA	California Highway Patrol (CHP)
05	Freeway Service Patrol	Unspecified	Existing	Documents details on roles, responsibilities, and functions for providing freeway service patrol activities	OCTA	Caltrans District 12
05	Freeway Service Patrol	Unspecified	Existing	Documents details on roles, responsibilities, and functions for providing freeway service patrol activities	OCTA	OCTA
06	Transit Fare Management	Unspecified	Future	Provides details on the usage of a common regional fare card and the cost allocation formulas.	OCTA	Local Jurisdictions
06	Transit Fare Management	Unspecified	Future	Provides details on the usage of a common regional fare card and the cost allocation formulas.	OCTA	OCTA
07	Traveler Information	Unspecified	Future	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.	OCTA	Caltrans District 12
07	Traveler Information	Unspecified	Future	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.	OCTA	County of Orange

RAD-IT Table

Agreement Number	Agreement Title	Agreement Type	Agreement Status	Description	Lead Stakeholder	Associated Stakeholders
07	Traveler Information	Unspecified	Future	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.	OCTA	Local Jurisdictions
07	Traveler Information	Unspecified	Future	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.	OCTA	OCTA
08	Shared Use of Communications Infrastructure	Unspecified	Future	Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.	Caltrans District 12	Caltrans District 12
08	Shared Use of Communications Infrastructure	Unspecified	Future	Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.	Caltrans District 12	County of Orange
08	Shared Use of Communications Infrastructure	Unspecified	Future	Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.	Caltrans District 12	Local Jurisdictions
08	Shared Use of Communications Infrastructure	Unspecified	Future	Documents provisions for design, development, maintenance, and revenue sharing (if applicable) with regards to shared use of fiber.	Caltrans District 12	OCTA
09	Archived Data Management	Unspecified	Future	Documents expectations, roles, and responsibilities for the dissemination of transportation-related data and information for archive purposes.	OCTA	County of Orange
09	Archived Data Management	Unspecified	Future	Documents expectations, roles, and responsibilities for the dissemination of transportation-related data and information for archive purposes.	OCTA	Local Jurisdictions
09	Archived Data Management	Unspecified	Future	Documents expectations, roles, and responsibilities for the dissemination of transportation-related data and information for archive purposes.	OCTA	OCTA

RAD-IT Table

Agreement Number	Agreement Title	Agreement Type	Agreement Status	Description	Lead Stakeholder	Associated Stakeholders
10	Real Time Transit Information	Unspecified	Future	Documents provisions for funding with stipulations for data sharing and maintenance	OCTA	Local Jurisdictions
10	Real Time Transit Information	Unspecified	Future	Documents provisions for funding with stipulations for data sharing and maintenance	OCTA	OCTA
10	Real Time Transit Information	Unspecified	Future	Documents provisions for funding with stipulations for data sharing and maintenance	OCTA	Southern California Regional Rail Authority (SCRRA)

APPENDIX C: REGIONAL ITS ARCHITECTURE – FUNCTIONAL REQUIREMENTS

RAD-IT Table

Requirements

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC	Traffic Management Center	TMC Basic Surveillance	01	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Basic Surveillance	02	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Basic Surveillance	03	The center shall monitor, analyze, and store multimodal crossing, high occupancy vehicle (HOV) and high occupancy toll (HOT) lane sensor data under remote control of the center.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Basic Surveillance	04	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Basic Surveillance	05	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC HOV Lane Management	01	The center shall remotely control sensors to detect high-occupancy vehicle (HOV) lane usage.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC HOV Lane Management	03	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC HOV Lane Management	04	The center shall collect traffic flow measures and information regarding vehicle occupancy (i.e., lane usage) in HOV lanes.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC HOV Lane Management	06	The center shall collect operational status for the freeway control devices associated with HOV lane control.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC	Traffic Management Center	TMC HOV Lane Management	07	The center shall collect fault data for the freeway control devices associated with HOV lane control for repair.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Detection	02	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Detection	04	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Detection	05	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Detection	06	The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Detection	07	The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Incident Dispatch Coordination	01	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Regional Traffic Management	01	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC	Traffic Management Center	TMC Roadway Equipment Monitoring	03	The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Roadway Equipment Monitoring	04	The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Roadway Equipment Monitoring	07	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Roadway Warning	01	The center shall monitor data on traffic, environmental conditions, and other hazards collected from sensors along the roadway.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Signal Control	01	The center shall remotely control traffic signal controllers.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	01	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	02	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	03	The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	04	The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	06	The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, parking facilities, and traveler information providers.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	07	The center shall distribute traffic data to the media.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Information Dissemination	08	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Management Decision Support	01	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Management Decision Support	04	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Metering	01	The center shall remotely control systems to manage use of the freeways, including ramp, interchange, and mainline metering.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Metering	02	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	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Metering	03	The center shall collect fault data from ramp meters, interchange meters, and mainline meters.	Existing	ARC-IT
Caltrans D12 TMC	Traffic Management Center	TMC Traffic Metering	04	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	01	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	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	02	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	03	The field element shall collect, digitize, and send multimodal crossing and high occupancy vehicle (HOV), and high occupancy toll (HOT) lane sensor data to the center for further analysis and storage.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	04	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	05	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Incident Detection	01	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Incident Detection	03	The field element's video devices shall be remotely controlled by a traffic management center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	01	The field element shall control traffic signals under center control.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	02	The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	03	The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	04	The field element shall report the current signal control information to the center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	06	The field element shall return traffic signal controller operational status to the center.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	07	The field element shall return traffic signal controller fault data to the center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Information Dissemination	01	The field element shall include dynamic message 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	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Metering	01	The field element shall regulate the flow of traffic on ramps, interchanges, and the mainline, under center control.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Metering	02	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	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Metering	03	The field element shall return ramp, interchange, and mainline meter operational status to the controlling center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Warning	01	The field element shall monitor for hazardous traffic conditions, including queues.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Warning	02	The field element shall monitor for hazardous road surface and local weather conditions.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Warning	04	The field element shall provide collected sensor data to the controlling center.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Warning	06	The field element shall receive commands from the controlling center that activate warning signs to approaching motorists.	Existing	ARC-IT
Caltrans D12 TMC - Roadside Equipment	ITS Roadway Equipment	Roadway Work Zone Traffic Control	02	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	01	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	02	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	03	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	04	The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	05	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	06	The center shall exchange road network status assessment information with emergency management and traffic management 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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	07	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Incident Management	08	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Infrastructure Monitoring	02	The center shall monitor maintenance vehicle-based mobile sensors and data logging devices that collect information on current infrastructure conditions.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Infrastructure Monitoring	04	The center shall process the collected infrastructure information and use it to monitor the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Vehicle Tracking	01	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Activity Coordination	01	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Activity Coordination	02	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Activity Coordination	03	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Activity Coordination	06	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Management	01	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Management	02	The center shall control the collection of work zone status information including video images from cameras located in or near the work zone.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Management	03	The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information centers, and the media.	Existing	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Management	04	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Management	05	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Safety Management	01	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	ARC-IT
Caltrans Maintenance Dispatch	Maint and Constr Management Center	MCM Work Zone Safety Management	02	The center shall provide remote monitoring and control of intrusion alert devices that have been installed in work zones or maintenance areas.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Caltrans MCO Vehicles	Maint and Constr Vehicle OBE	MCV Work Zone Support	01	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	ARC-IT
Caltrans MCO Vehicles	Maint and Constr Vehicle OBE	MCV Work Zone Support	02	The maintenance and construction vehicle shall provide an interface for field personnel to input status of their work zone activities.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	01	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	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	02	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	03	The center shall receive emergency call information from vehicles and present the possible incident information to the emergency system operator.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	05	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	06	The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	07	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	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	08	The center shall send a request for remote control of Closed-circuit Television (CCTV) systems from a traffic management center in order to verify the reported incident.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	09	The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
CHP Dispatch Operations	Emergency Management Center	Emergency Call-Taking	10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	02	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	03	The center shall relay location and incident details to the responding vehicles.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	04	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	05	The center shall store and maintain the emergency service responses in an action log.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Dispatch	07	The center shall receive traffic images to support dispatch of emergency vehicles.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	01	The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	02	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	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	03	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	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	04	The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	05	The center shall track the availability of resources and coordinate resource sharing with allied agency centers including traffic, maintenance, or other emergency centers.	Existing	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	06	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	ARC-IT
CHP Dispatch Operations	Emergency Management Center	Emergency Response Management	12	The center shall provide information to the media concerning the status of an emergency response.	Existing	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	01	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	02	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	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	03	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	04	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	05	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	06	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	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board Incident Management Communication	01	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	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board Incident Management Communication	02	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	ARC-IT
CHP Vehicles	Emergency Vehicle OBE	EV On-Board Incident Management Communication	03	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	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Call-Taking	01	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	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Call-Taking	02	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Call-Taking	05	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	02	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	03	The center shall relay location and incident details to the responding vehicles.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	04	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	05	The center shall store and maintain the emergency service responses in an action log.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Dispatch	06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Evacuation Support	01	The center shall manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Evacuation Support	02	The center shall develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Evacuation Support	04	The center shall coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Evacuation Support	05	The center shall provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Incident Command	01	The center shall provide tactical decision support, resource coordination, and communications integration for first responders to support local management of an incident.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
County Emergency Management Service	Emergency Management Center	Emergency Incident Command	02	The center shall provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Incident Command	03	The center shall track and maintain resource information and action plans pertaining to the incident command.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Incident Command	04	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	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Incident Command	05	The center shall assess the status of responding emergency vehicles as part of an incident command.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Response Management	01	The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters.	Existing	ARC-IT
County Emergency Management Service	Emergency Management Center	Emergency Response Management	02	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	ARC-IT
County Emergency Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	01	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing	ARC-IT
County Emergency Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	02	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	ARC-IT
County Emergency Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	03	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing	ARC-IT
County Emergency Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	05	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Planned	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	01	The center shall collect data from centers.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	02	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	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	03	The center shall store collected data in an information repository.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	04	The center shall perform quality checks on collected data.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	05	The center shall notify the system operator of errors related to data collection, analysis and archival.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	06	The center shall include capabilities for archive to archive coordination.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	07	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	08	The center shall collect data from data distribution systems and other data sources.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	09	The center shall respond to requests from the administrator interface function to manage center-sourced data collection.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	10	The center shall respond to requests from the administrator interface function to manage the archive data.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Data Repository	11	The center shall respond to requests for archive data from archive data users (centers, field devices).	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Situation Data Archival	01	The center shall collect data from roadside devices.	Future	ARC-IT
Countywide Communications Network and Data Archive	Archived Data System	Archive Situation Data Archival	02	The center shall respond to requests from the administrator interface function to manage field-sourced data collection.	Future	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Payment Administration	03	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	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Payment Administration	04	The center shall register vehicles for road or parking use payment, establishing accounts that identify owner billing information and preferences.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Express Lanes Customer Administration Center	Payment Administration Center	PAC Payment Administration	11	The center shall report payment violations including vehicle information and vehicle image to the designated Enforcement Agency.	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	04	This center shall maintain and publish road use prices, as configured by the Payment Administrator.	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	05	The center shall receive road pricing data (time stamped log of roadways used by the vehicle) and compute the total cost to the vehicle owner.	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	06	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	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	07	The center shall access and use registration and odometer information from the DMV to verify and audit collected road pricing data	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	08	The center shall process and clear payments from vehicle owners and operators as well as payments to other Center Road Pricing Payment Administration through clearing houses provided by financial institutions.	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	09	The center shall coordinate with other Road Pricing Payment Administration systems to reconcile and apportion payments for vehicles registered in other jurisdictions	Existing	ARC-IT
Express Lanes Customer Administration Center	Payment Administration Center	PAC Road Pricing Administration	10	The center shall monitor the operational status of road pricing field equipment and identify equipment faults.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Center	Center Data Collection	01	The center shall collect transportation data such as traffic operational data, transit data, vehicle data, weather data, freight data, event logs, etc. and make it available for ITS Archives upon request.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Center	Center Data Collection	03	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	01	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	02	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	03	The center shall monitor, analyze, and store multimodal crossing, high occupancy vehicle (HOV) and high occupancy toll (HOT) lane sensor data under remote control of the center.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	04	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	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	05	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Basic Surveillance	06	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	ARC-IT
Express Lanes Toll Collection and Traffic Management Center	Traffic Management Center	TMC Demand Management Coordination	01	The center shall collect and store toll pricing data from payment administration centers, including the price for each road segment to which a toll applies, with the time and date for when it applies.	Existing	ARC-IT
Freeway Service Patrol (FSP)	Emergency Vehicle OBE	EV On-Board En Route Support	01	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing	ARC-IT
Freeway Service Patrol (FSP)	Emergency Vehicle OBE	EV On-Board En Route Support	02	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	ARC-IT
Freeway Service Patrol (FSP)	Emergency Vehicle OBE	EV On-Board En Route Support	03	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
John Wayne Airport	Traffic Management Center	TMC Regional Traffic Management	01	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	ARC-IT
John Wayne Airport	Traffic Management Center	TMC Regional Traffic Management	02	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	ARC-IT
John Wayne Airport	Traffic Management Center	TMC Traffic Information Dissemination	05	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	ARC-IT
Limited Stop Bus Service Corridor Infrastructure	Connected Vehicle Roadside Equipment	RSE Traffic Monitoring	01	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	ARC-IT
Local Agency Roadside Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	01	The field element shall distribute traveler information including traffic and road conditions or upcoming work zones to passing vehicles using short range communications, under center control.	Future	ARC-IT
Local Agency Roadside Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	02	The field element shall distribute advisory information, such as evacuation information, wide-area alerts, incident information, work zone intrusion information, recommended speed limit and other special information to passing vehicles using short range communications, under center control.	Future	ARC-IT
Local Agency Roadside Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	03	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	ARC-IT
Local Agency Roadside Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	04	The field element shall return system operational status to the controlling center.	Future	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Roadside Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	05	The field element shall return system fault data to the maintenance center for repair.	Future	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	01	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	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	02	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	04	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Basic Surveillance	05	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Data Collection	01	The field element shall collect traffic, road, and environmental conditions information.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Data Collection	02	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	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Data Collection	03	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	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Incident Detection	01	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Incident Detection	02	The field element shall remotely process video data and provide an indication of potential incidents to the traffic management center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Incident Detection	03	The field element's video devices shall be remotely controlled by a traffic management center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	01	The field element shall control traffic signals under center control.	Existing	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	02	The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	03	The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	04	The field element shall report the current signal control information to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	05	The field element shall report current preemption status to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	06	The field element shall return traffic signal controller operational status to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	07	The field element shall return traffic signal controller fault data to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Control	08	The field element shall report current transit priority status to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Signal Preemption	01	The field element shall respond to signal preemption requests from emergency vehicles.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Speed Monitoring and Warning	01	The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Speed Monitoring and Warning	03	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	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Information Dissemination	01	The field element shall include dynamic message 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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Information Dissemination	02	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	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Traffic Information Dissemination	03	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	01	The field element shall monitor for hazardous traffic conditions, including queues.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	02	The field element shall monitor for hazardous road surface and local weather conditions.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	03	The field element shall monitor for debris, animals, or other objects in the travel lanes.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	04	The field element shall provide collected sensor data to the controlling center.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	05	The field element shall autonomously identify potentially hazardous conditions and activate warning signs to approaching motorists.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	06	The field element shall receive commands from the controlling center that activate warning signs to approaching motorists.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	07	The field element shall collect operational status of the warning system field equipment and report the operational status to the controlling center.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Warning	08	The field element shall monitor and report faults to the controlling center.	Planned	ARC-IT
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Work Zone Traffic Control	01	The field element shall collect, process, and send work zone images to the center for further analysis and distribution, under center control.	Future	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Roadside Equipment	ITS Roadway Equipment	Roadway Work Zone Traffic Control	02	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Basic Surveillance	01	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Basic Surveillance	02	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Basic Surveillance	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Basic Surveillance	05	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Basic Surveillance	06	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Evacuation Support	01	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Evacuation Support	02	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Evacuation Support	03	The center shall coordinate evacuation information and controls with other traffic management centers.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Evacuation Support	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Detection	02	The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Detection	03	The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters and traveler information service providers.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Detection	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Detection	06	The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	01	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	02	The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	03	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	05	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	06	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	07	The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	Future	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	08	The center shall monitor incident response performance and calculate incident response and clearance times.	Future	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	09	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	10	The center shall coordinate information and controls with other traffic management centers.	Future	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Incident Dispatch Coordination	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Multi-Modal Coordination	01	The center shall respond to requests from transit management centers for signal priority at one or more intersections along a particular transit route.	Future	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Multi-Modal Coordination	02	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Regional Traffic Management	01	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Regional Traffic Management	02	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	01	The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	02	The center shall collect and store CCTV surveillance system (traffic, pedestrian) operational status.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	03	The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	04	The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	05	The center shall collect environmental sensor operational status.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	06	The center shall collect environmental sensor equipment fault data and send to the maintenance center for repair.	Planned	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Equipment Monitoring	07	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Warning	01	The center shall monitor data on traffic, environmental conditions, and other hazards collected from sensors along the roadway.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Warning	02	The center shall identify hazardous road weather and surface conditions.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Roadway Warning	03	The center shall identify hazardous traffic conditions including queues.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	01	The center shall remotely control traffic signal controllers.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	02	The center shall accept notifications of pedestrian calls.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	03	The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	04	The center shall collect traffic signal controller fault data from the field.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	05	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	06	The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	07	The center shall manage boundaries of the control sections used within the signal system.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Signal Control	08	The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Information Dissemination	01	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Information Dissemination	03	The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Information Dissemination	04	The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Information Dissemination	05	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	01	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	02	The center shall identify network imbalances and potential courses of action.	Planned	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	03	The center shall compare the impact of potential courses of action and make recommendations to the operator.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	05	The recommended actions shall include multimodal strategies that include suggested transit strategies and suggested route and mode choices for travelers.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Management Decision Support	06	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	01	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	02	The center shall collect wide-area pollution data from emissions management centers to support overall network performance evaluations.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	03	The center shall collect and store anticipated route information from traveler information centers to support overall network performance evaluations and predictions.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	04	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	05	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	06	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Traffic Network Performance Evaluation	07	This center shall use the collected information to measure overall current and forecast network performance and predict travel demand patterns.	Planned	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Work Zone Traffic Management	03	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	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Work Zone Traffic Management	04	The center shall collect operational status for the driver information systems equipment in work zones.	Future	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Work Zone Traffic Management	05	The center shall collect fault data for the driver information systems equipment in work zones for repair.	Future	ARC-IT
Local Agency Traffic Management Systems	Traffic Management Center	TMC Work Zone Traffic Management	06	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	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Data Collection	01	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	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Data Collection	03	The center shall collect, process, and store maintenance and construction information, including scheduled maintenance and construction work activities and work zone activities.	Future	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Data Collection	05	The center shall collect, process, and store parking information, including location, availability, and fees.	Future	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Data Collection	07	The center shall collect, process, and store current and forecast road conditions and surface weather conditions.	Future	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Traffic Management Systems	Transportation Information Center	TIC Data Collection	08	The center shall collect, process, and store event information.	Future	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Emergency Traveler Information	01	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	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Emergency Traveler Information	02	The center shall provide evacuation information to shelter providers.	Future	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Emergency Traveler Information	03	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	ARC-IT
Local Agency Traffic Management Systems	Transportation Information Center	TIC Emergency Traveler Information	04	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	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Fare Management	01	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Future	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Trip Monitoring	01	The transit vehicle shall track the current location of the transit vehicle.	Future	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Trip Monitoring	02	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	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Trip Monitoring	03	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Future	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Passenger Counting	01	The transit vehicle shall count passengers boarding and alighting.	Future	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Passenger Counting	02	The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops.	Future	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Passenger Counting	03	The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	Future	ARC-IT
Local Agency Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Passenger Counting	04	The transit vehicle shall send the collected passenger count information to the transit center.	Future	ARC-IT
Metrolink Operations Center	Transit Management Center	Transit Center Fare Management	04	The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Future	ARC-IT
Metrolink Operations Center	Transit Management Center	Transit Center Multi-Modal Coordination	01	The center shall coordinate schedules and services with traffic management, parking management, and event planning systems.	Future	ARC-IT
OCTA Fixed Route Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Fare Management	01	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing	ARC-IT
OCTA Fixed Route Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Signal Priority	01	The transit vehicle shall determine the schedule deviation and estimated times of arrival (ETA) at transit stops.	Future	ARC-IT
OCTA Fixed Route Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Signal Priority	02	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	ARC-IT
OCTA Fixed Route Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Signal Priority	03	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
OCTA Fixed Route Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Signal Priority	04	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	ARC-IT
OCTA Paratransit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Paratransit Operations	02	The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing	ARC-IT
OCTA Paratransit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Paratransit Operations	03	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	ARC-IT
OCTA Transit Data Warehouse	Archived Data System	Archive Data Repository	01	The center shall collect data from centers.	Existing	ARC-IT
OCTA Transit Data Warehouse	Archived Data System	Archive Data Repository	02	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	ARC-IT
OCTA Transit Data Warehouse	Archived Data System	Archive Data Repository	04	The center shall perform quality checks on collected data.	Existing	ARC-IT
OCTA Transit Data Warehouse	Archived Data System	Archive Data Repository	09	The center shall respond to requests from the administrator interface function to manage center-sourced data collection.	Future	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Data Collection	01	The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Planned	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Data Collection	02	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Data Collection	03	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Fixed-Route Operations	01	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Fixed-Route Operations	02	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Fixed-Route Operations	04	The center shall dispatch fixed route or flexible route transit vehicles.	Future	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Fixed-Route Operations	05	The center shall collect transit operational data for use in the generation of routes and schedules.	Future	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Information Services	01	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Information Services	03	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Information Services	04	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	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Assignment	02	The center shall download vehicle assignments to the transit vehicle prior to the start of the day's operations.	Planned	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Assignment	03	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Assignment	05	The center shall generate transit vehicle availability listings, current and forecast, to support transit vehicle assignment planning.	Planned	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Tracking	01	The center shall monitor the locations of all transit vehicles within its network.	Existing	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Tracking	02	The center shall determine adherence of transit vehicles to their assigned schedule.	Planned	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Tracking	03	The center shall provide transit operational data to traveler information service providers.	Future	ARC-IT
OCTA Transit Management Center and Systems	Transit Management Center	Transit Center Vehicle Tracking	04	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	ARC-IT
OCTA.net - Trip Planner	Transit Management Center	Transit Center Information Services	01	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.	Existing	ARC-IT
OCTA.net - Trip Planner	Transit Management Center	Transit Center Information Services	03	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.	Existing	ARC-IT
OCTA.net - Trip Planner	Transit Management Center	Transit Center Information Services	04	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.	Existing	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	01	The center shall accept requests from traveler interface systems for ridesharing as part of a trip plan request.	Planned	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	02	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	03	The center shall process rideshare requests by balancing the relative benefits of the rideshare to each rideshare participant.	Future	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	04	The center shall arrange connections to transit or other multimodal services for portions of a multi-segment trip that includes ridesharing.	Future	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	05	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Dynamic Ridesharing	06	The center shall store all rideshare matches and traveler eligibility data.	Future	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Interactive Traveler Information	01	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Interactive Traveler Information	02	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Interactive Traveler Information	03	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Interactive Traveler Information	04	The center shall disseminate customized parking information to travelers, including location, availability, and fees upon request.	Planned	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
OCTA.net - Trip Planner	Transportation Information Center	TIC Interactive Traveler Information	05	The center shall disseminate customized toll fee information to travelers upon request.	Planned	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Travel Services Information and Reservation	01	The center shall disseminate yellow pages information (such as lodging, restaurants, theaters, bicycle facilities, and other tourist activities) to travelers upon request.	Future	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Traveler Telephone Information	01	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	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Traveler Telephone Information	02	The center shall provide the capability to process dual-tone multi-frequency (DTMF)-based requests (touch-tone) for traveler information from a traveler telephone information system.	Existing	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Traveler Telephone Information	03	The center shall provide the capability to process traveler information requests from a traveler telephone information system.	Existing	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Traveler Telephone Information	08	The center shall provide transit service information in the requested voice format and for the requested location.	Existing	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Trip Planning	01	The center shall provide the capability to provide specific pre-trip and en route directions to travelers (and drivers), including costs, arrival times, and transfer points.	Existing	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Trip Planning	02	The center shall include bicycle routes, walkways, skyways, and multi-use trails in the pre-trip and en route directions it provides to travelers.	Planned	ARC-IT
OCTA.net - Trip Planner	Transportation Information Center	TIC Trip Planning	03	The center shall support on-line route guidance for travelers using personal devices (such as PDAs).	Planned	ARC-IT
Parking Guidance Systems	Parking Management System	Parking Coordination	01	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	ARC-IT

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Parking Guidance Systems	Parking Management System	Parking Coordination	02	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	ARC-IT
Parking Guidance Systems	Parking Management System	Parking Coordination	03	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	ARC-IT
Parking Guidance Systems	Parking Management System	Parking Coordination	04	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	ARC-IT
Parking Guidance Systems	Parking Management System	Parking Coordination	05	The parking element shall distribute parking lot information upon request to traveler information providers to support travel planning.	Future	ARC-IT
Parking Guidance Systems	Parking Management System	Parking Coordination	06	The parking element shall support requests for parking reservations.	Future	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Call-Taking	02	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Call-Taking	07	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	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Call-Taking	10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Dispatch	03	The center shall relay location and incident details to the responding vehicles.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Dispatch	04	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Response Management	02	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	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Response Management	04	The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Response Management	07	The center shall receive event scheduling information from Event Promoters.	Existing	ARC-IT
Public Safety Agencies - Cities/County	Emergency Management Center	Emergency Routing	01	The center shall collect current traffic and road condition information for emergency vehicle route calculation.	Existing	ARC-IT
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board En Route Support	01	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing	ARC-IT
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board En Route Support	02	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	ARC-IT
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board En Route Support	03	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board Incident Management Communication	01	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	ARC-IT
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board Incident Management Communication	02	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	ARC-IT
Public Safety Vehicles - Cities/County	Emergency Vehicle OBE	EV On-Board Incident Management Communication	03	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	01	The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Future	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	02	The field element shall determine whether the highway-rail intersection (HRI) is blocked by traffic in the roadway or some other obstruction.	Future	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	03	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	04	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	05	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	06	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	07	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	08	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	09	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	11	The field element shall forward rail traffic advisories received from the Wayside Equipment to the traffic management center.	Future	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Advanced Rail Crossing	12	The field element shall provide approaching train advisories using field-vehicle communications to vehicles approaching the grade crossing.	Future	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Barrier System Control	01	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Barrier System Control	02	The field element shall return barrier system operational status to the controlling center.	Existing	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	02	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	03	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	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	04	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	07	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	08	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	ARC-IT
Rail Grade Crossing Equipment	ITS Roadway Equipment	Roadway Standard Rail Crossing	09	The field element shall forward rail traffic advisories received from the Wayside Equipment to the traffic management center.	Planned	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Transit Stop Information Services	01	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Transit Stop Information Services	02	The public interface for travelers shall collect and present to the transit traveler information on transit routes, schedules, and real-time schedule adherence.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Transit Stop Information Services	03	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Transit Stop Information Services	04	The public interface for travelers shall present information to the traveler in a form suitable for travelers with physical disabilities including travelers who are visually impaired.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Information Reception	05	The public interface for travelers shall receive wide-area alerts and present it to the traveler.	Planned	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	01	The public interface for travelers shall receive traffic information from a center and present it to the traveler upon request.	Planned	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	02	The public interface for travelers shall receive transit information from a center and present it to the traveler upon request.	Existing	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	03	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	04	The public interface for travelers shall receive event information from a center and present it to the traveler upon request.	Existing	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	05	The public interface for travelers shall receive evacuation information from a center and present it to the traveler.	Planned	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	06	The public interface for travelers shall accept reservations for confirmed trip plans.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	07	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	08	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	09	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	10	The public interface for travelers shall support traveler input in audio or manual form.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	11	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	12	The public interface for travelers shall be able to store frequently requested data.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Interactive Information	13	The public interface for travelers shall provide an interface to establish and manage user road pricing accounts, process road pricing payments, and access road pricing reports under user control.	Future	ARC-IT

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Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Security	01	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Security	02	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	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Security	03	The public interface for travelers shall provide the capability to broadcast a message to advise or warn a traveler.	Future	ARC-IT
Remote Traveler Support - OCTA	Traveler Support Equipment	Traveler Security	04	The public interface for travelers shall accept input and provide information to the traveler in a form suitable for travelers with physical disabilities.	Future	ARC-IT
Security Monitoring Field Equipment - County	Security Monitoring Equipment	Field Secure Area Sensor Monitoring	01	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	ARC-IT
Security Monitoring Field Equipment - County	Security Monitoring Equipment	Field Secure Area Sensor Monitoring	02	The field element shall be remotely controlled by a center.	Existing	ARC-IT
Security Monitoring Field Equipment - County	Security Monitoring Equipment	Field Secure Area Surveillance	01	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	ARC-IT
Security Monitoring Field Equipment - County	Security Monitoring Equipment	Field Secure Area Surveillance	02	The field element shall be remotely controlled by a center.	Existing	ARC-IT
Security Monitoring Field Equipment - County	Security Monitoring Equipment	Field Secure Area Surveillance	04	The field element shall provide raw video or audio data.	Existing	ARC-IT

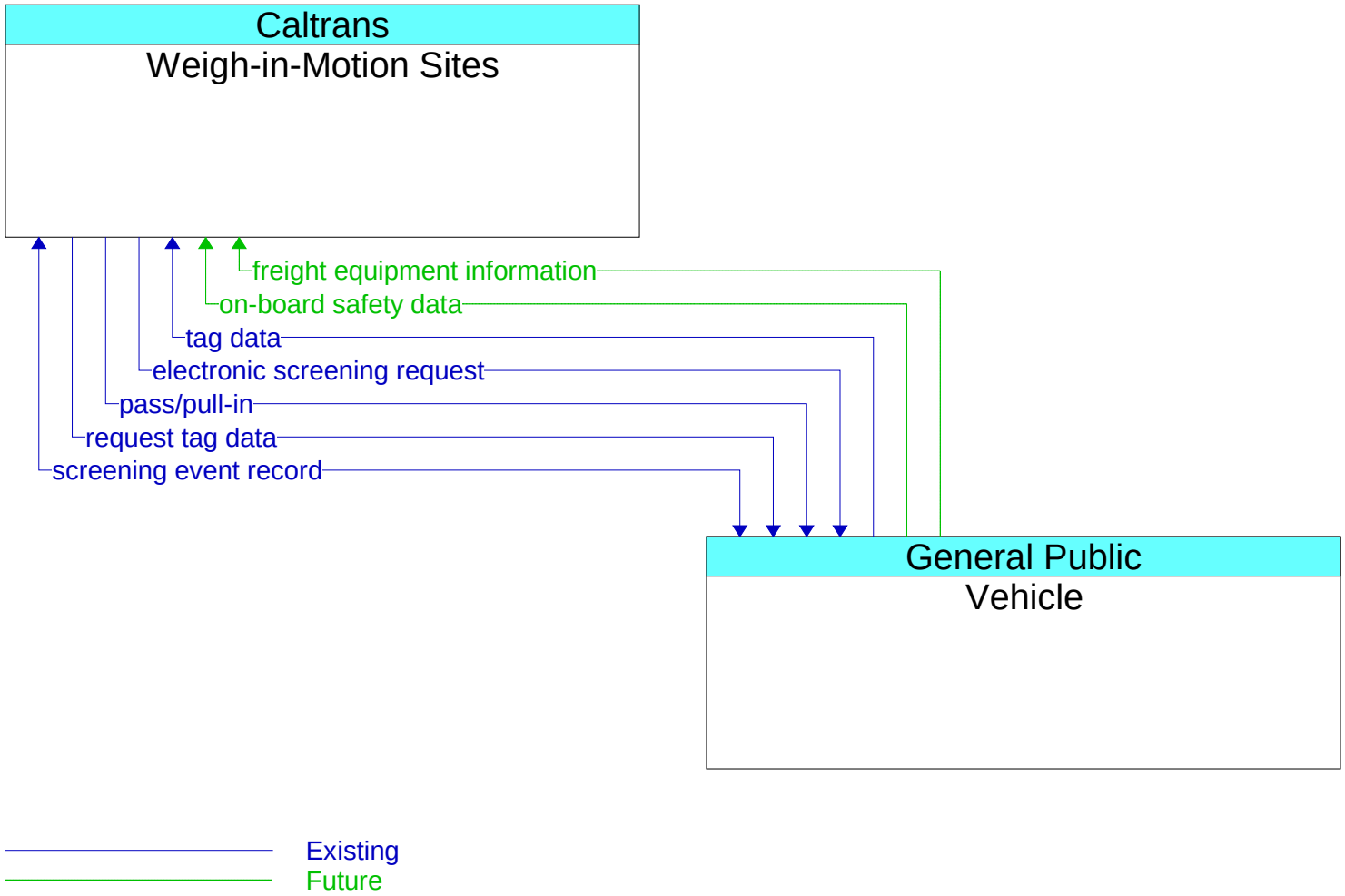
RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
Security Monitoring Field Equipment - County	Traveler Support Equipment	Traveler Security	01	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	ARC-IT
Security Monitoring Field Equipment - County	Traveler Support Equipment	Traveler Security	02	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	ARC-IT
Security Monitoring Field Equipment - County	Traveler Support Equipment	Traveler Security	03	The public interface for travelers shall provide the capability to broadcast a message to advise or warn a traveler.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Payment Administration	03	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	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Payment Administration	04	The center shall register vehicles for road or parking use payment, establishing accounts that identify owner billing information and preferences.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Payment Administration	11	The center shall report payment violations including vehicle information and vehicle image to the designated Enforcement Agency.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	04	This center shall maintain and publish road use prices, as configured by the Payment Administrator.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	05	The center shall receive road pricing data (time stamped log of roadways used by the vehicle) and compute the total cost to the vehicle owner.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	06	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	ARC-IT

RAD-IT Table

Element Name	Physical Object Name	Functional Object	Requirement #	Requirement	Status	Requirement Source
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	07	The center shall access and use registration and odometer information from the DMV to verify and audit collected road pricing data	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	08	The center shall process and clear payments from vehicle owners and operators as well as payments to other Center Road Pricing Payment Administration through clearing houses provided by financial institutions.	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	09	The center shall coordinate with other Road Pricing Payment Administration systems to reconcile and apportion payments for vehicles registered in other jurisdictions	Existing	ARC-IT
TCA Toll Collection and Traffic Management Center	Payment Administration Center	PAC Road Pricing Administration	10	The center shall monitor the operational status of road pricing field equipment and identify equipment faults.	Existing	ARC-IT
Weigh-in-Motion Sites	Commercial Vehicle Check Equipment	CVCE Weigh-In-Motion	01	The roadside check facility equipment shall detect the presence of commercial vehicles and freight equipment approaching a facility.	Existing	ARC-IT
Weigh-in-Motion Sites	Commercial Vehicle Check Equipment	CVCE Weigh-In-Motion	02	The roadside check facility equipment shall request and input electronic screening data from the commercial vehicle's electronic tag data.	Existing	ARC-IT
Weigh-in-Motion Sites	Commercial Vehicle Check Equipment	CVCE Weigh-In-Motion	03	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	ARC-IT

APPENDIX D: REGIONAL ITS ARCHITECTURE – SERVICE PACKAGE DIAGRAMS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Weigh-in-Motion Sites
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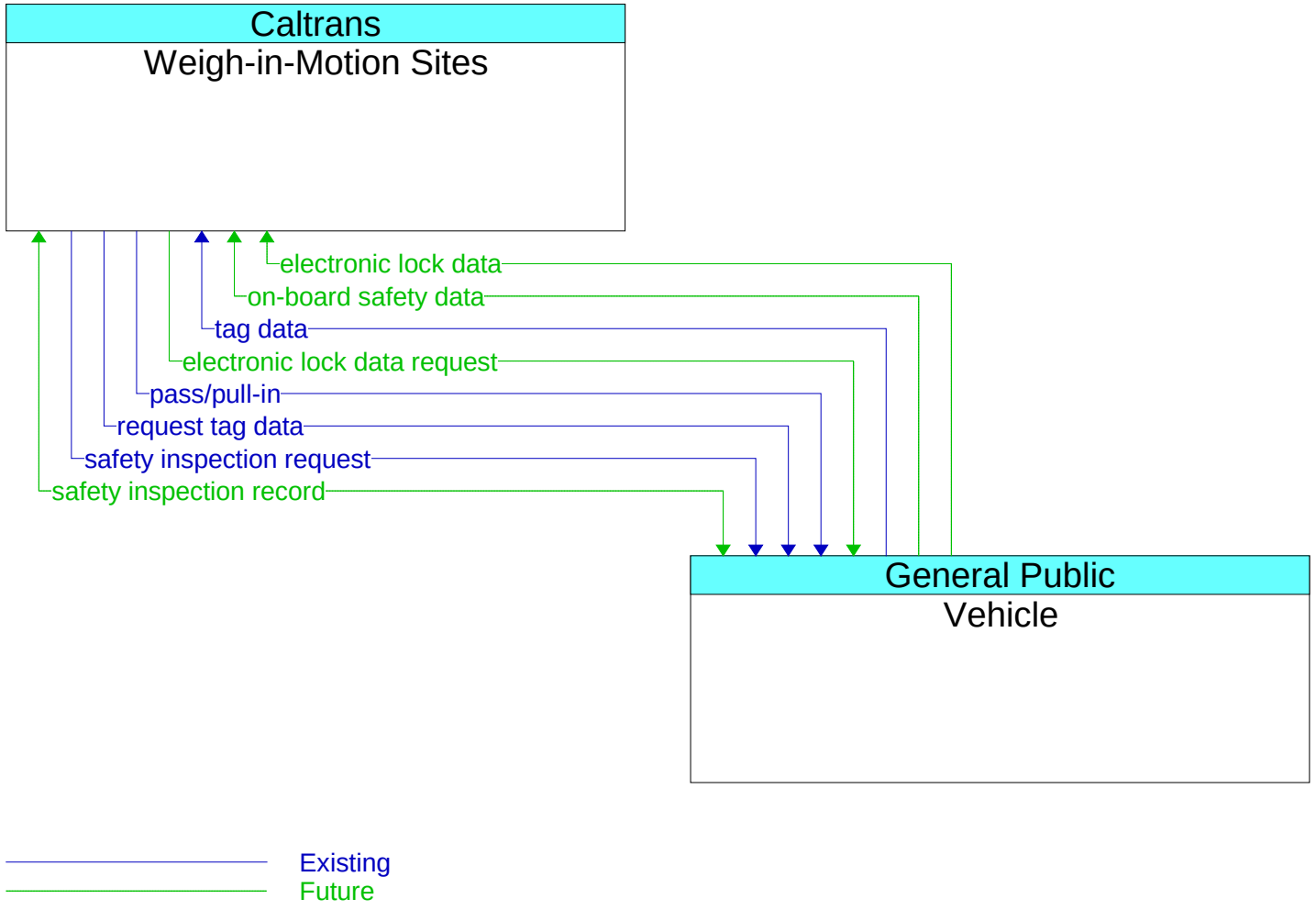
on-board safety data
tag data
electronic screening request
pass/pull-in
request tag data
screening event record
General Public
Vehicle
Existing
Future


Caltrans
Weigh-in-Motion Sites
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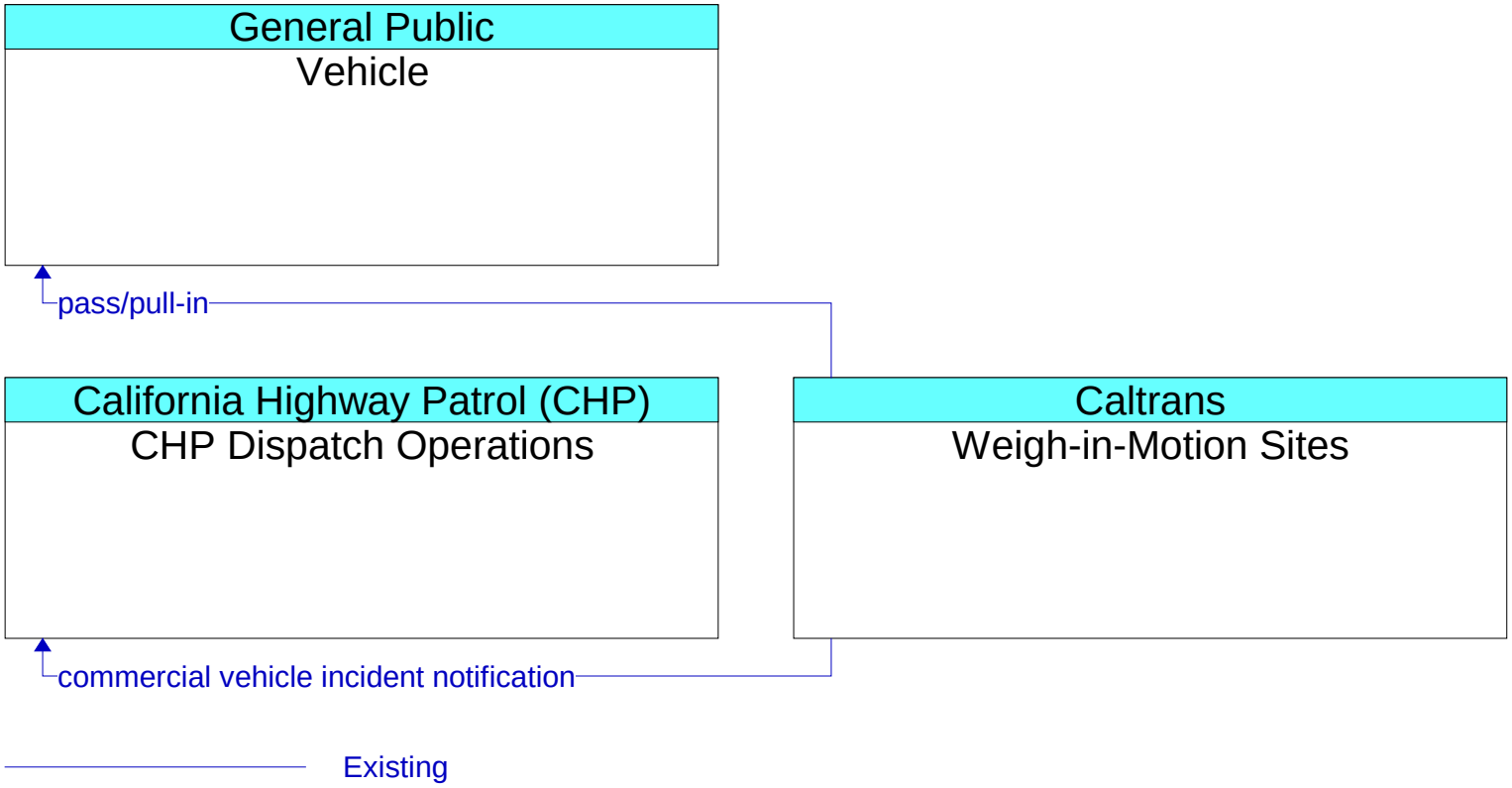
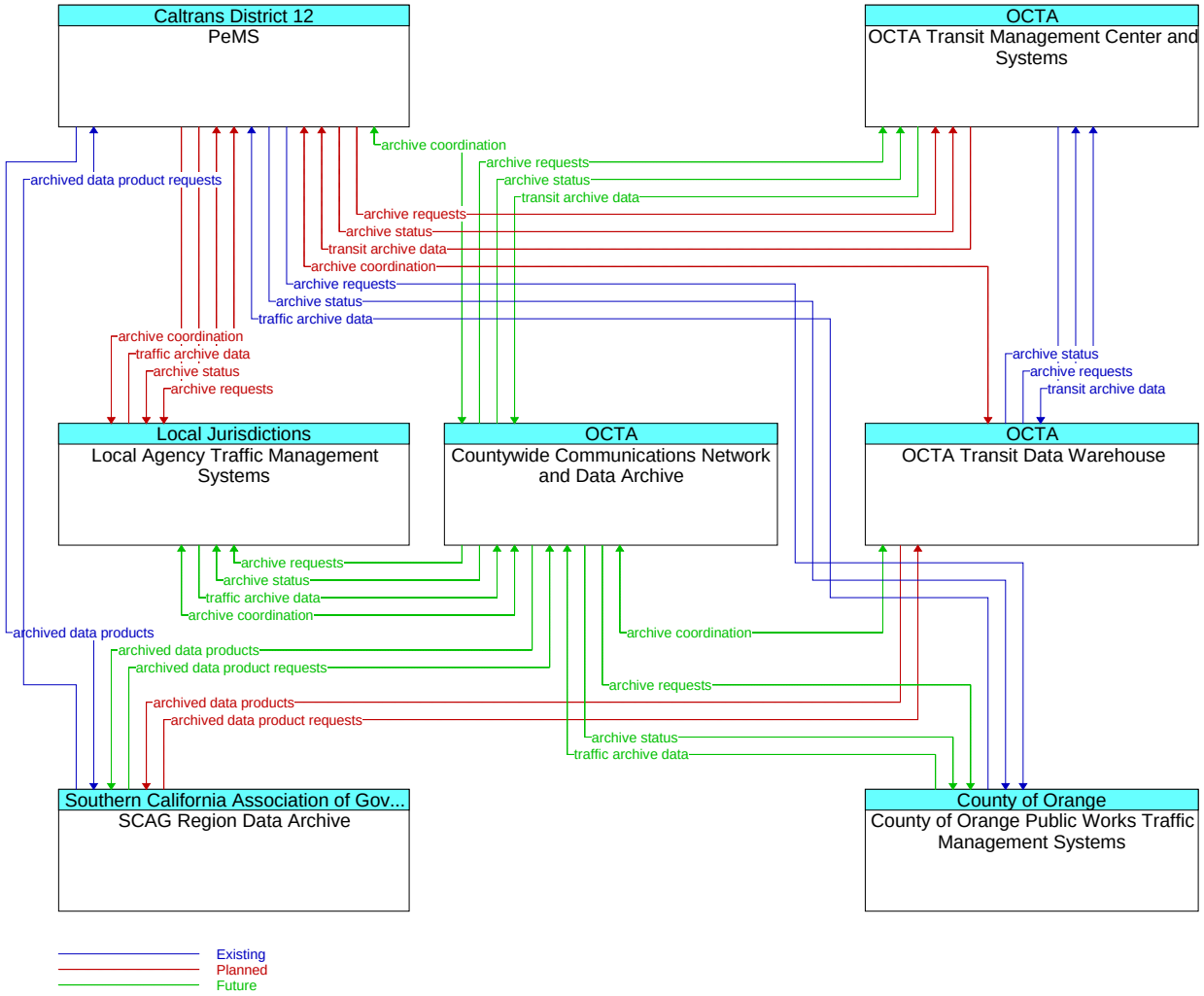
on-board safety data
tag data
electronic lock data request
pass/pull-in
request tag data
safety inspection request
safety inspection record
General Public
Vehicle
Existing
Future


General Public
Vehicle
pass/pull-in
California Highway Patrol (CHP)
CHP Dispatch Operations
Caltrans
Weigh-in-Motion Sites
commercial vehicle incident notification
Existing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PeMS
OCTA
OCTA Transit Management Center and Systems
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archived data product requests
archive requests
archive status
transit archive data
archive coordination
archive requests
archive status
traffic archive data
archive coordination
traffic archive data
archive status
archive requests
archive status
archive requests
transit archive data
Local Jurisdictions
Local Agency Traffic Management Systems
OCTA
Countywide Communications Network and Data Archive
OCTA
OCTA Transit Data Warehouse
archive requests
archive status
traffic archive data
archive coordination
archive coordination
archived data products
archived data products
archived data product requests
archive requests
archived data products
archived data product requests
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traffic archive data
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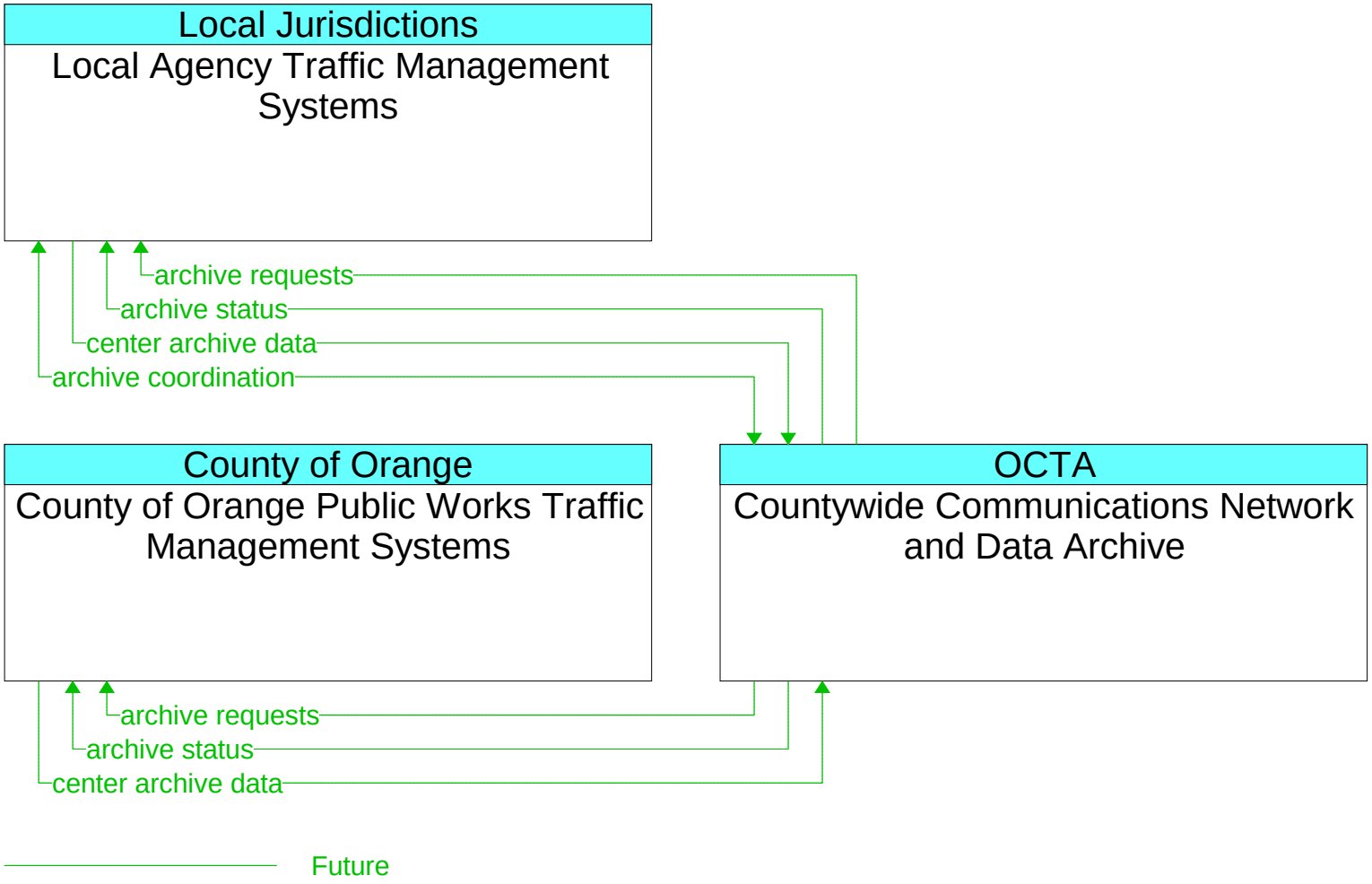
SCAG Region Data Archive
County of Orange
County of Orange Public Works Traffic Management Systems
Existing
Planned
Future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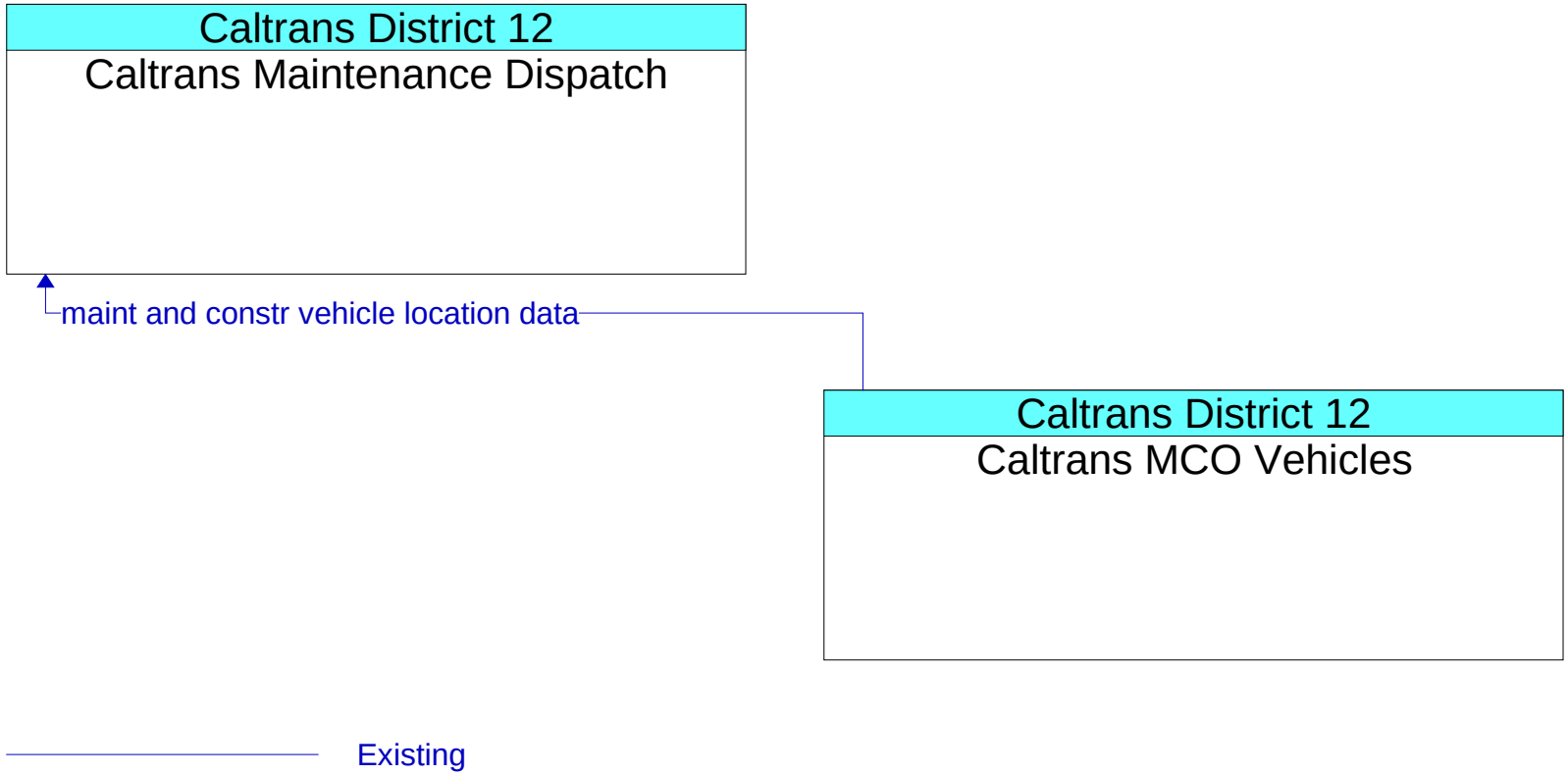
archive coordination
County of Orange
County of Orange Public Works Traffic Management Systems
OCTA
Countywide Communications Network and Data Archive
archive requests
archive status
center archive data
Future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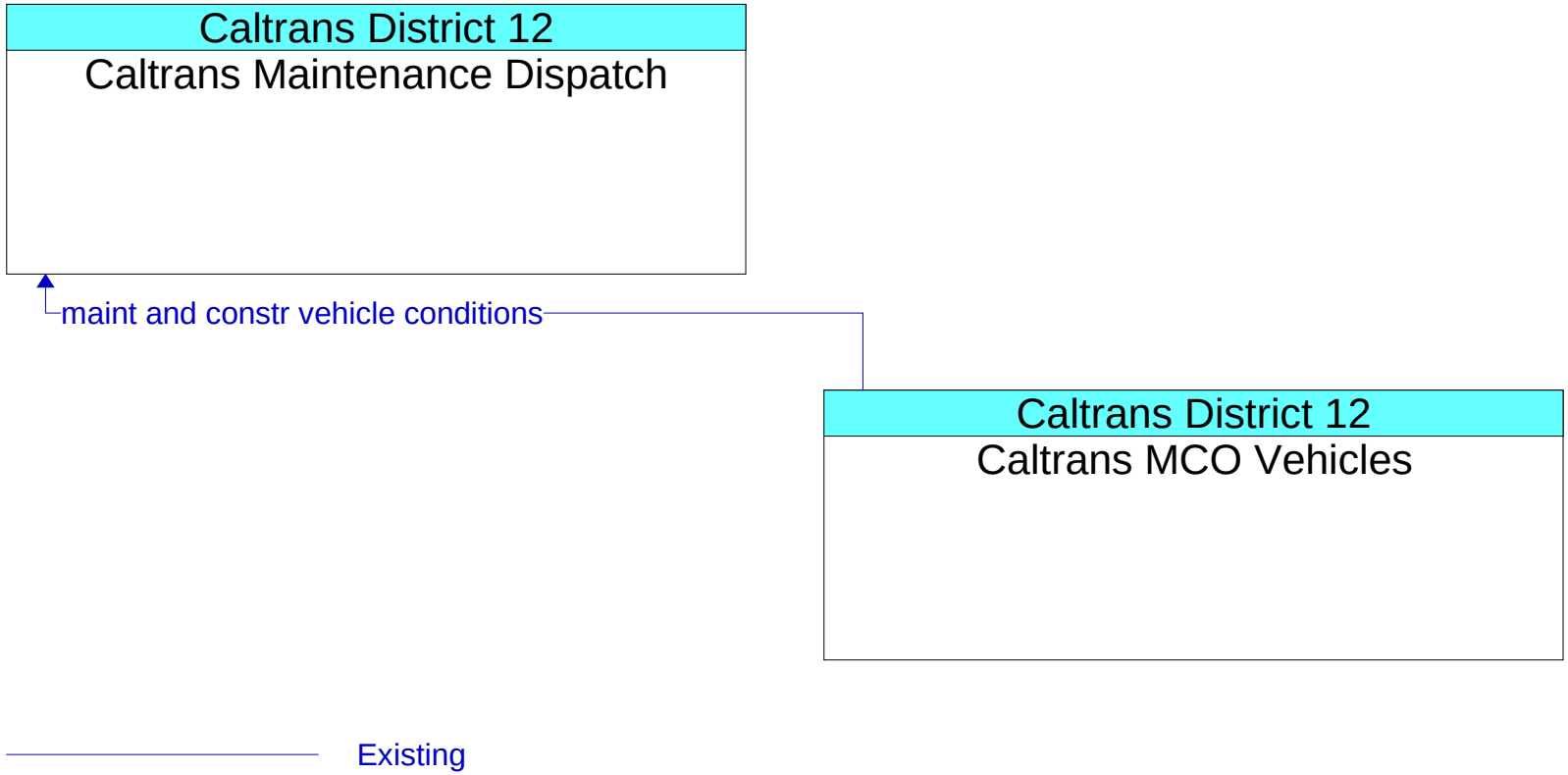
Caltrans District 12
Caltrans MCO Vehicles
Existing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Caltrans Maintenance Dispatch
maint and constr vehicle conditions
Caltrans District 12
Caltrans MCO Vehicles
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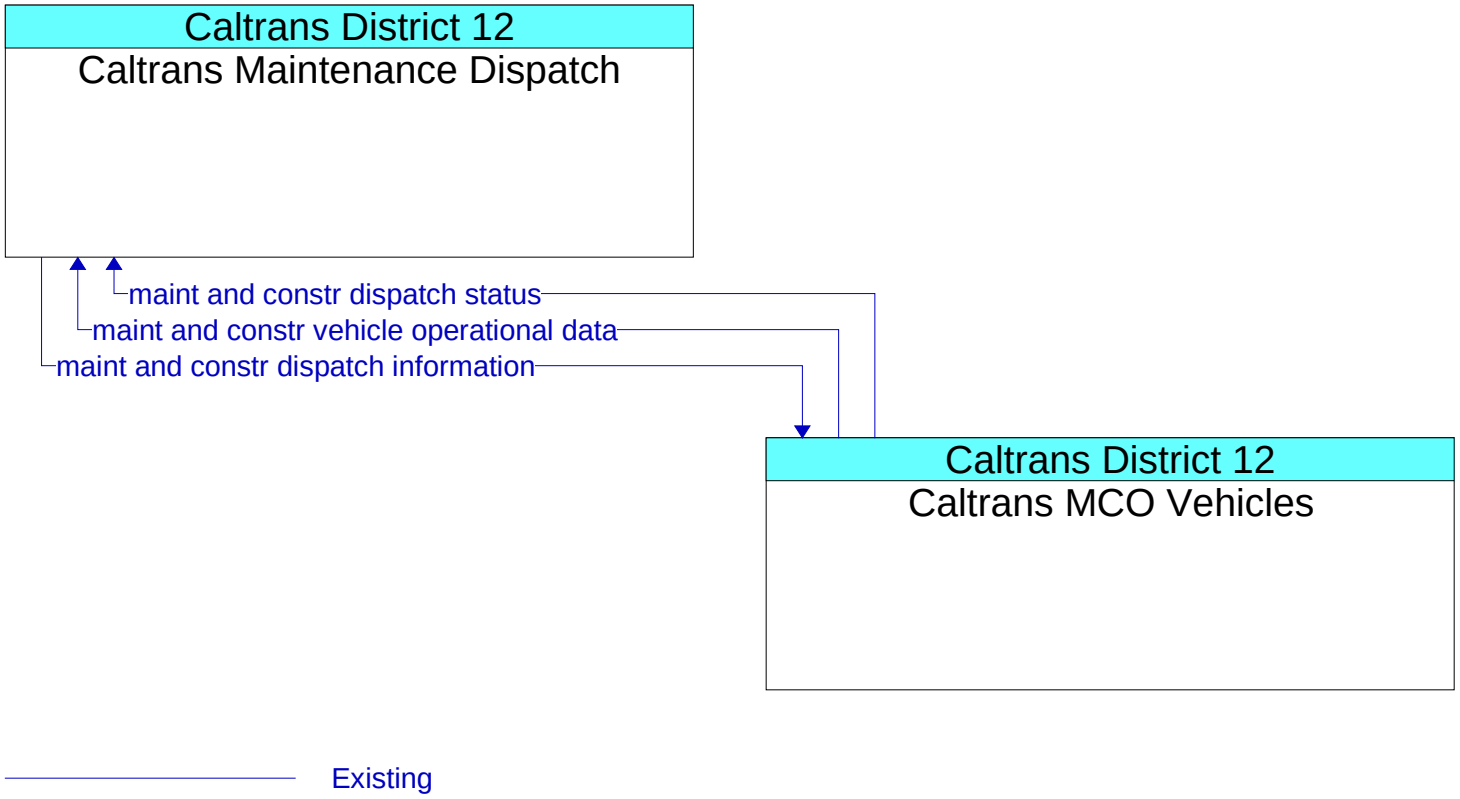
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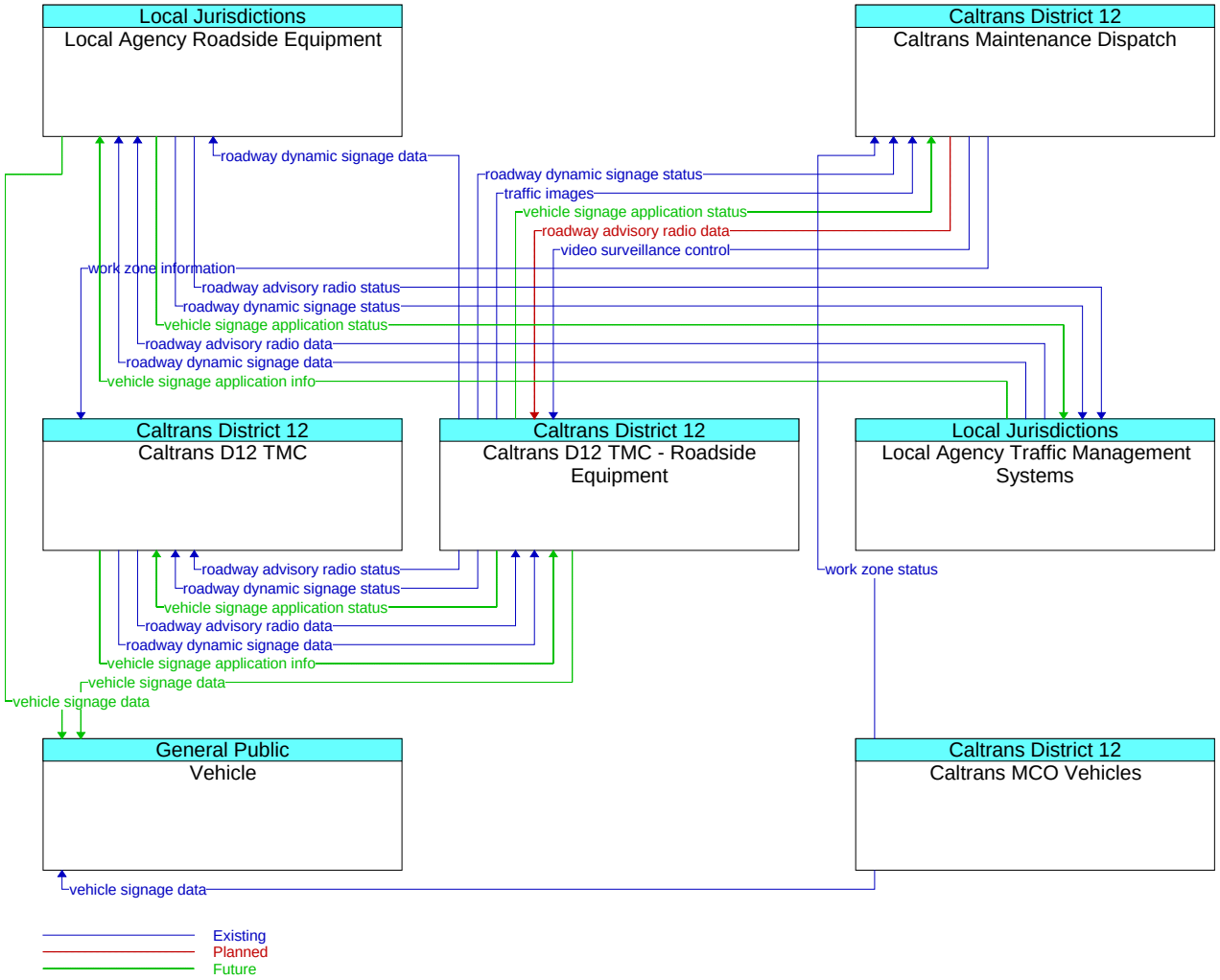
maint and constr vehicle operational data
maint and constr dispatch information
Caltrans District 12
Caltrans MCO Vehicles
Existing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Local Agency Roadside Equipment
Caltrans District 12
Caltrans Maintenance Dispatch
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vehicle signage application status
roadway advisory radio data
video surveillance control
work zone information
roadway advisory radio status
roadway dynamic signage status
vehicle signage application status
roadway advisory radio data
roadway dynamic signage data
vehicle signage application info
Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Local Jurisdictions
Local Agency Traffic Management Systems
roadway advisory radio status
roadway dynamic signage status
vehicle signage application status
roadway advisory radio data
roadway dynamic signage data
vehicle signage application info
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work zone status
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Caltrans MCO Vehicles
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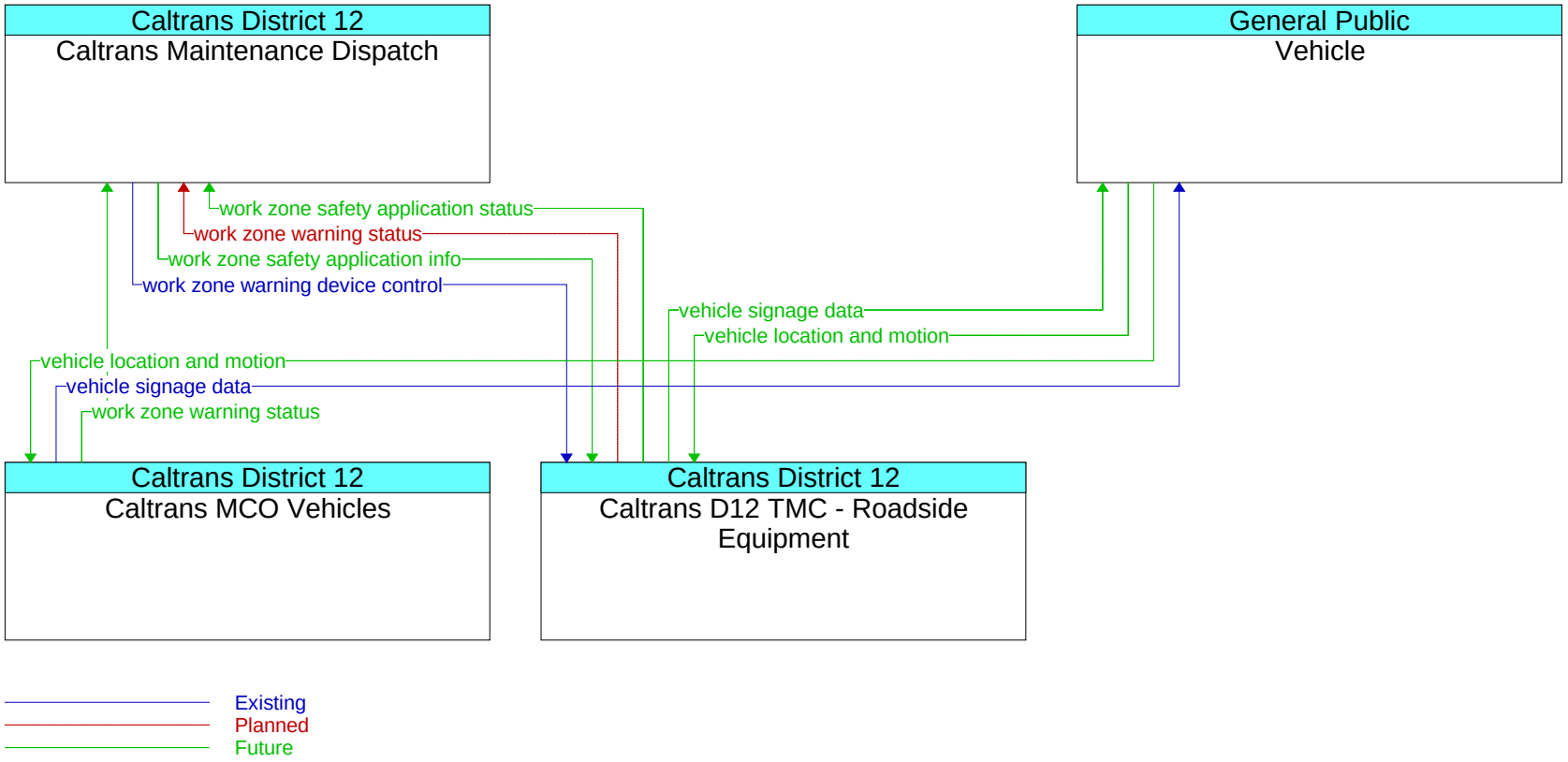
Existing
Planned
Future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General Public
Vehicle
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work zone safety application info
work zone warning device control
vehicle signage data
vehicle location and motion
vehicle location and motion
vehicle signage data
work zone warning status
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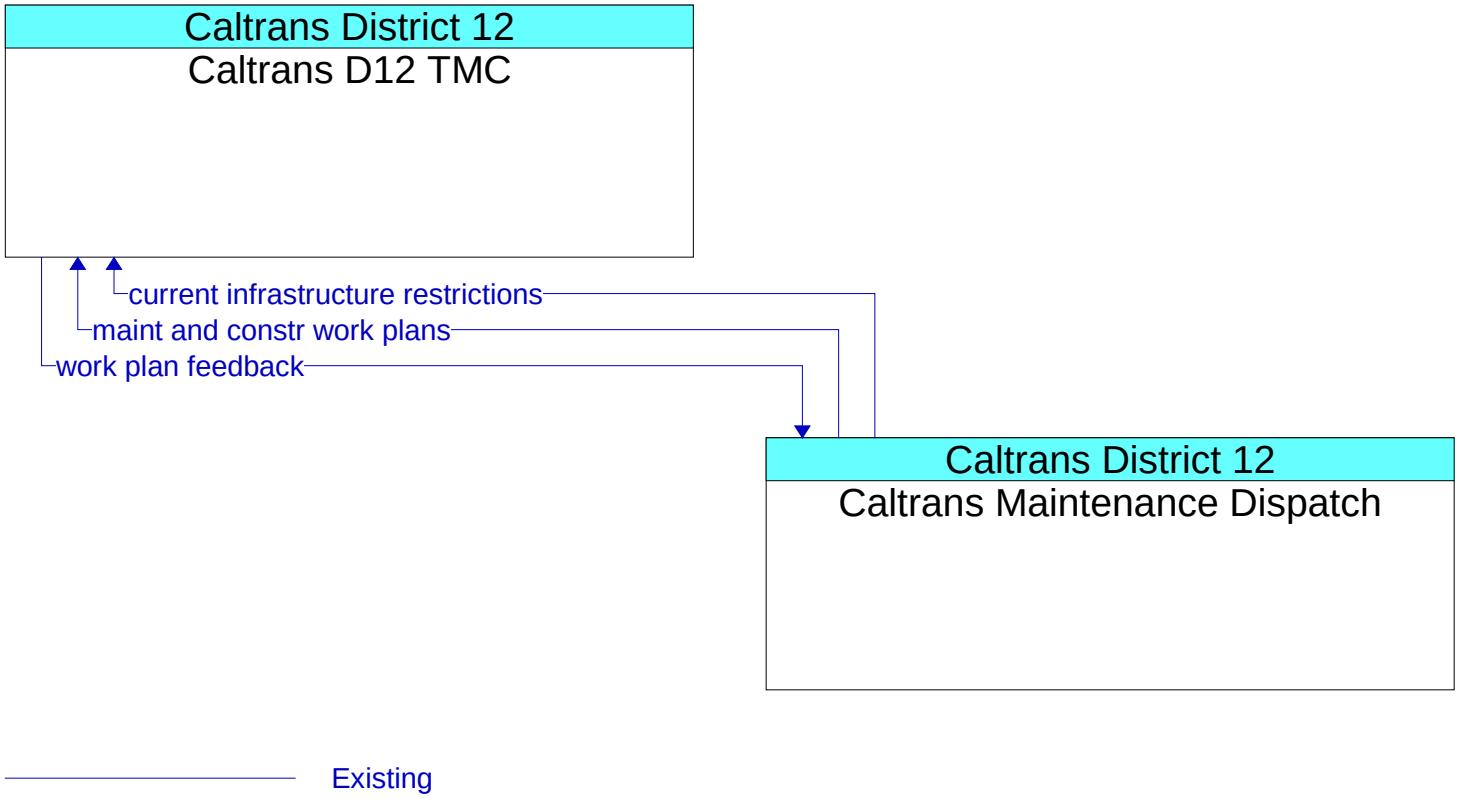
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing
Planned
Future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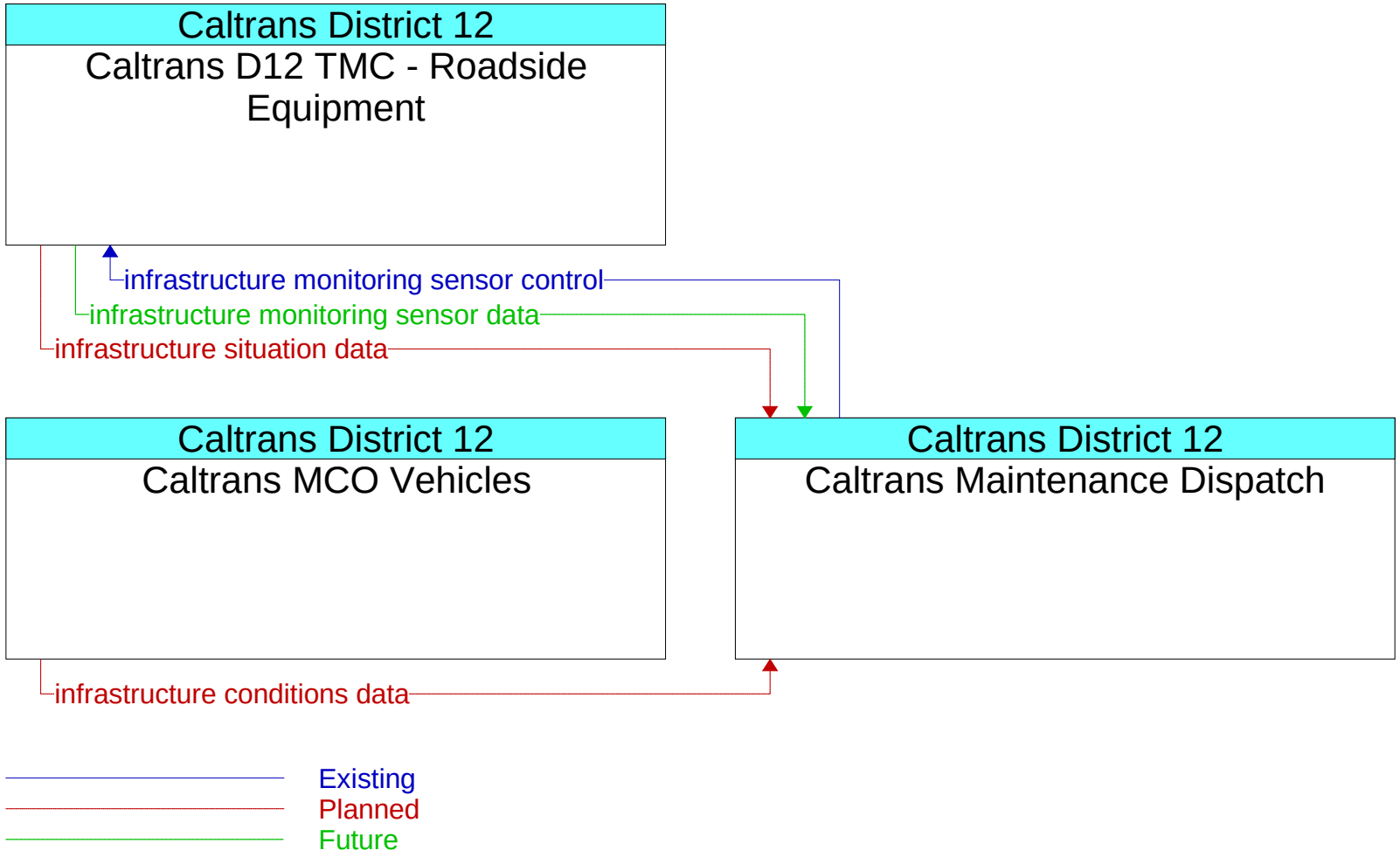
Existing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Caltrans D12 TMC - Roadside Equipment
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Caltrans Maintenance Dispatch
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Planned
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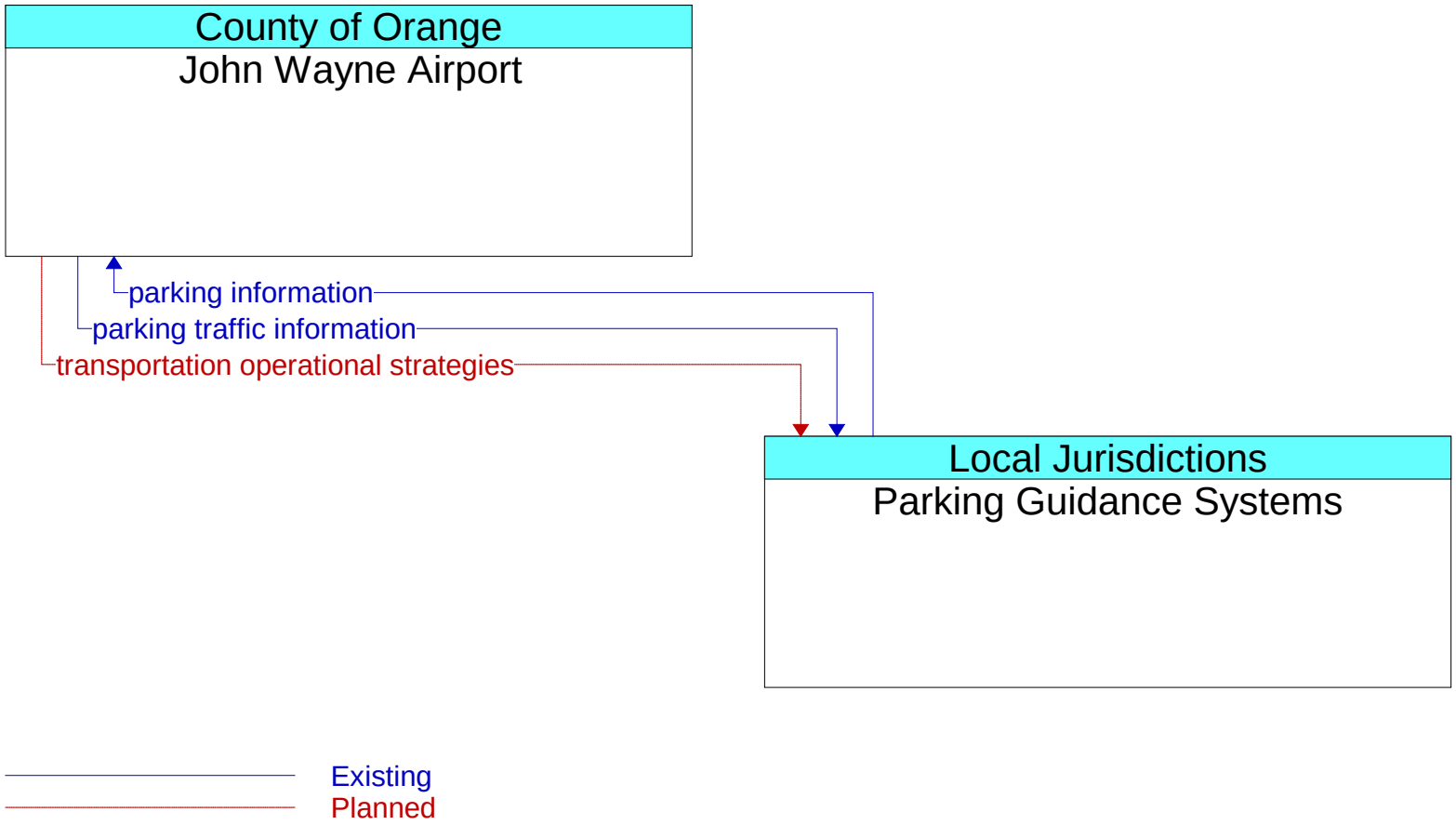
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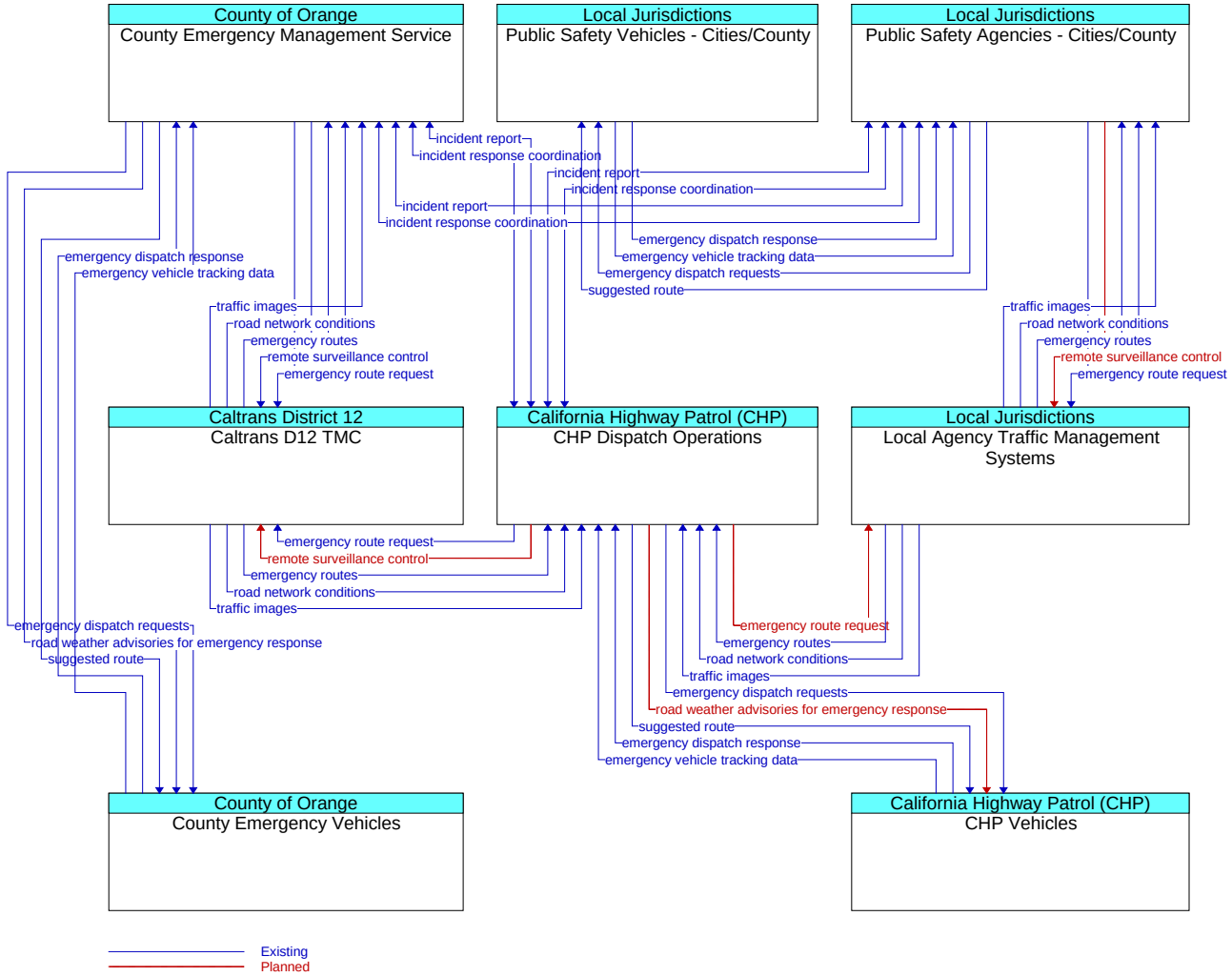
Parking Guidance Systems
Existing
Planned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County Emergency Management Service
Local Jurisdictions
Public Safety Vehicles - Cities/County
Local Jurisdictions
Public Safety Agencies - Cities/County
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incident report
incident response coordination
incident report
incident response coordination
emergency dispatch response
emergency vehicle tracking data
emergency dispatch requests
suggested route
emergency dispatch response
emergency vehicle tracking data
traffic images
road network conditions
emergency routes
remote surveillance control
emergency route request
traffic images
road network conditions
emergency routes
remote surveillance control
emergency route request
Caltrans District 12
Caltrans D12 TMC
California Highway Patrol (CHP)
CHP Dispatch Operations
Local Jurisdictions
Local Agency Traffic Management Systems
emergency route request
remote surveillance control
emergency routes
road network conditions
traffic images
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road weather advisories for emergency response
suggested route
emergency route request
emergency routes
road network conditions
traffic images
emergency dispatch requests
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County of Orange
County Emergency Vehicles
California Highway Patrol (CHP)
CHP Vehicles
Existing
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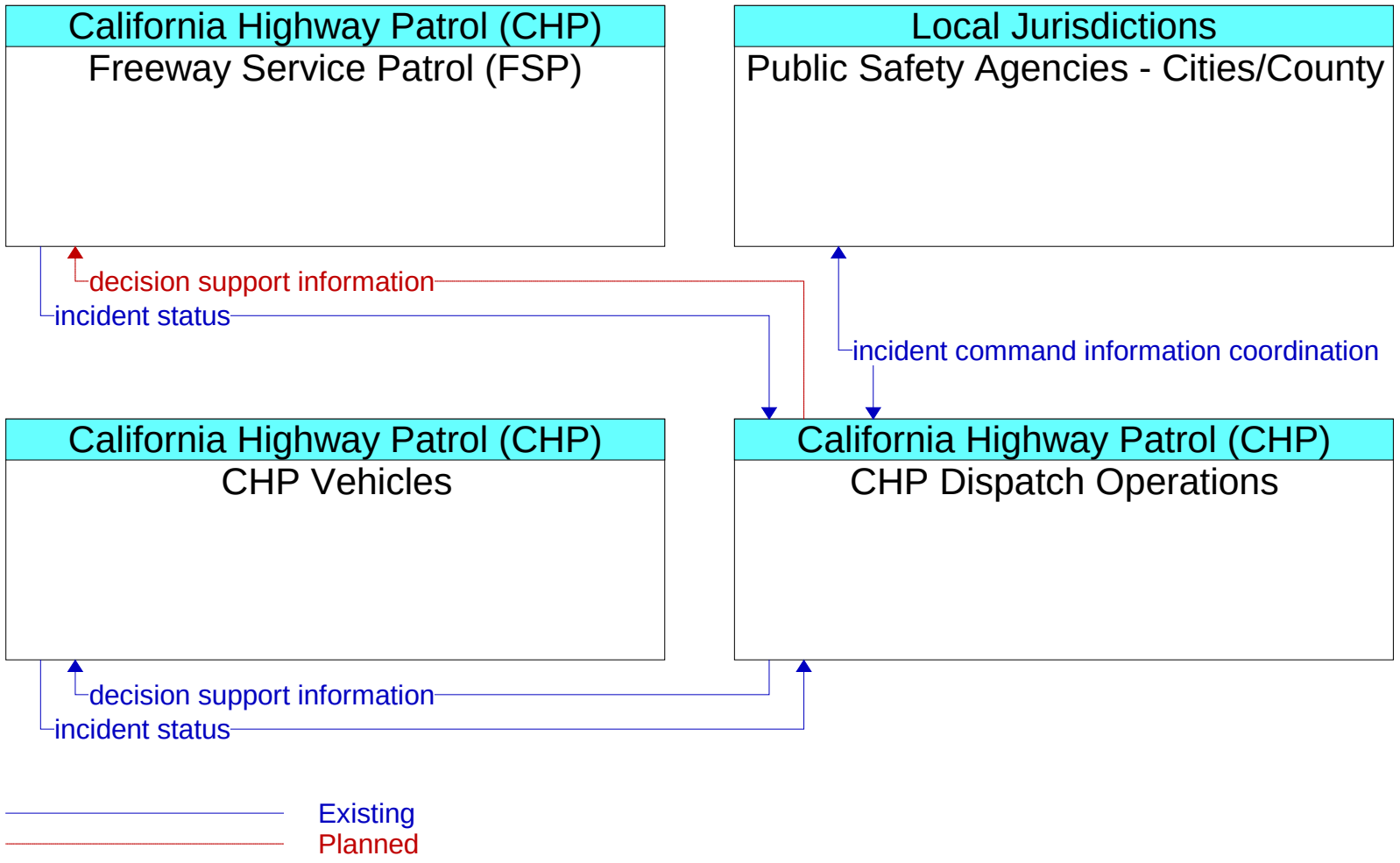
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Freeway Service Patrol (FSP)
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Public Safety Agencies - Cities/County
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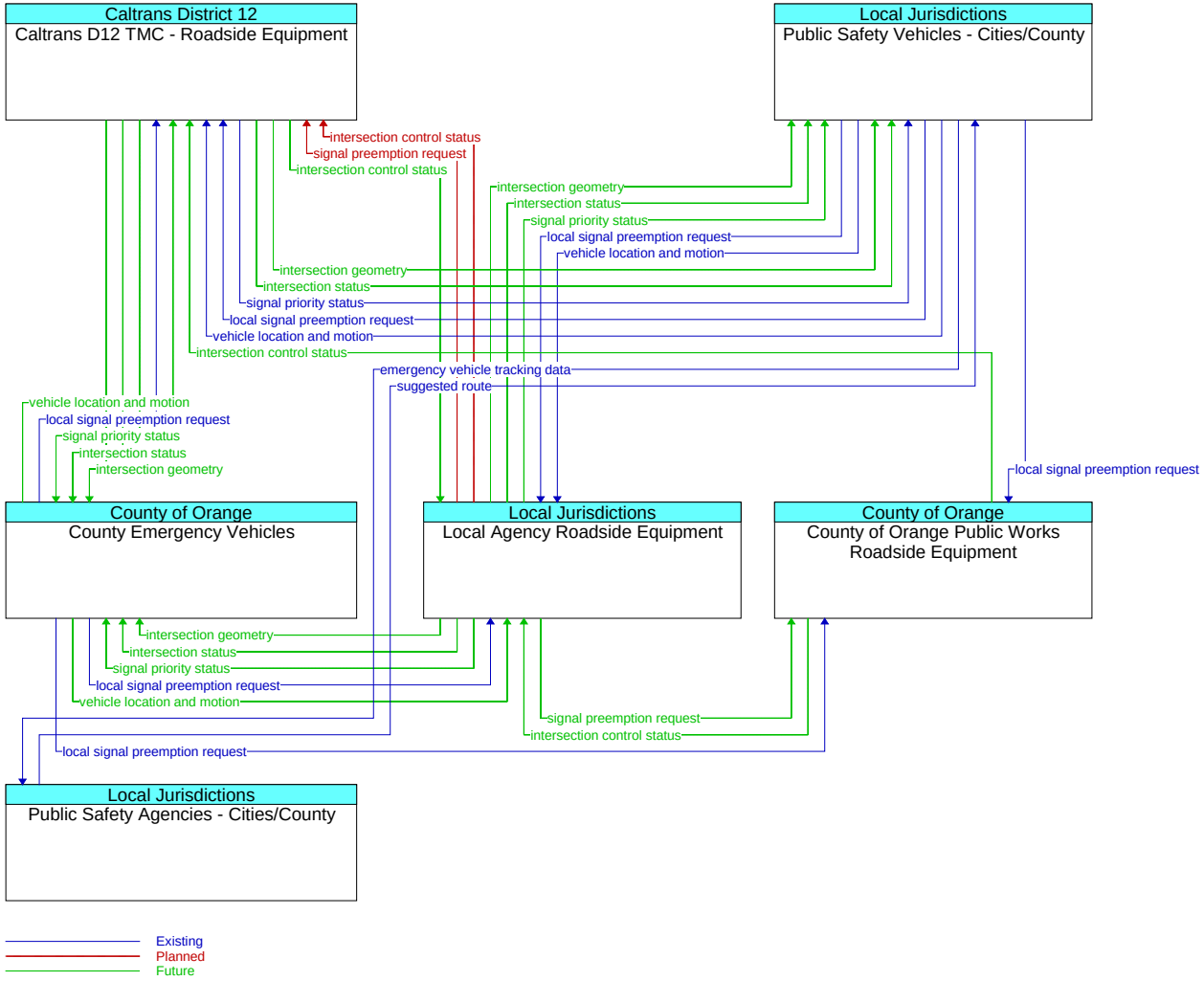
CHP Vehicles
California Highway Patrol (CHP)
CHP Dispatch Operations
decision support information
incident status
Existing
Planned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local signal preemption request
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signal priority status
local signal preemption request
vehicle location and motion
intersection control status
emergency vehicle tracking data
suggested route
vehicle location and motion
local signal preemption request
signal priority status
intersection status
intersection geometry
local signal preemption request
County of Orange
County Emergency Vehicles
Local Jurisdictions
Local Agency Roadside Equipment
County of Orange
County of Orange Public Works
Roadside Equipment
intersection geometry
intersection status
signal priority status
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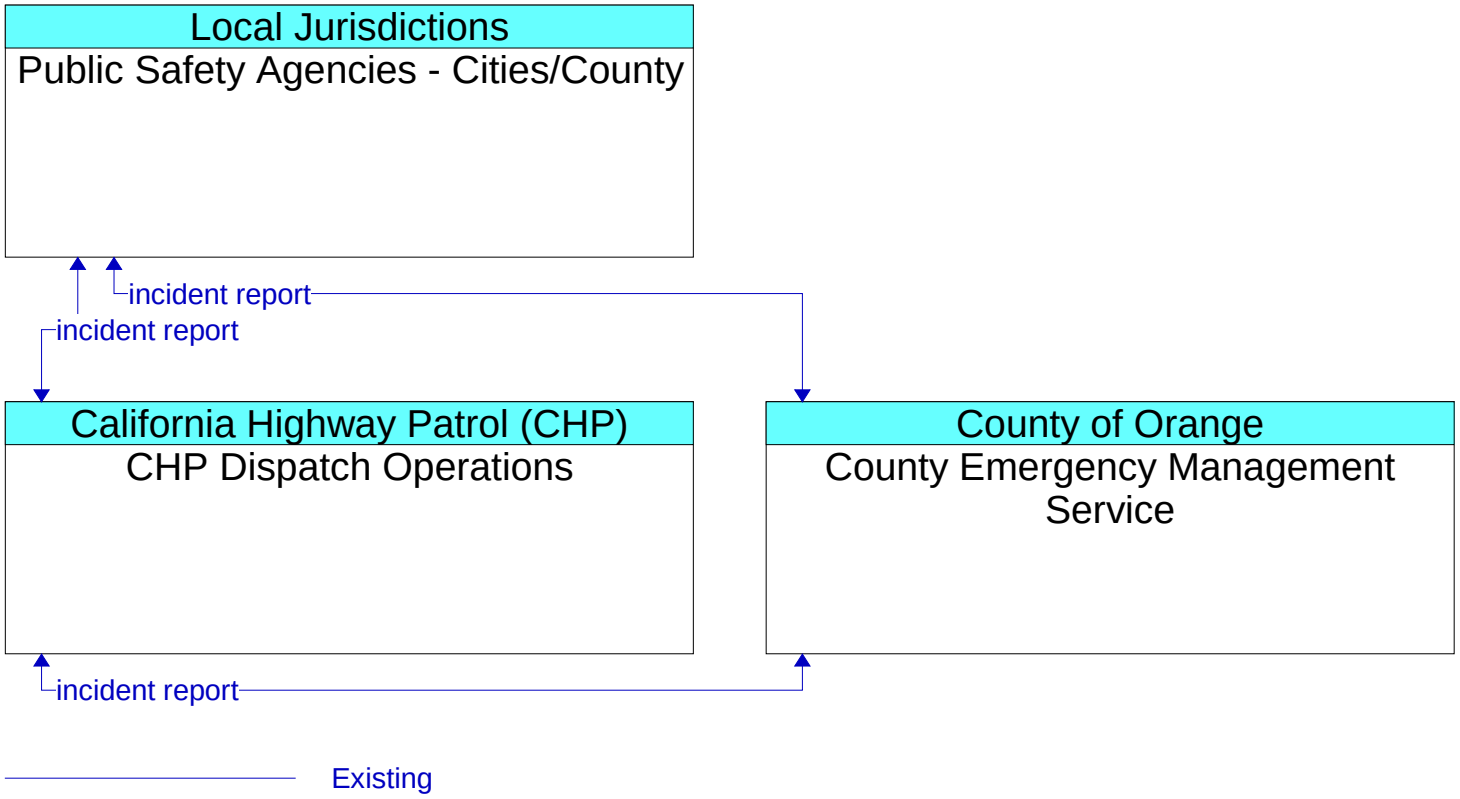
Public Safety Agencies - Cities/County
Existing
Planned
Future


Local Jurisdictions
Public Safety Agencies - Cities/County
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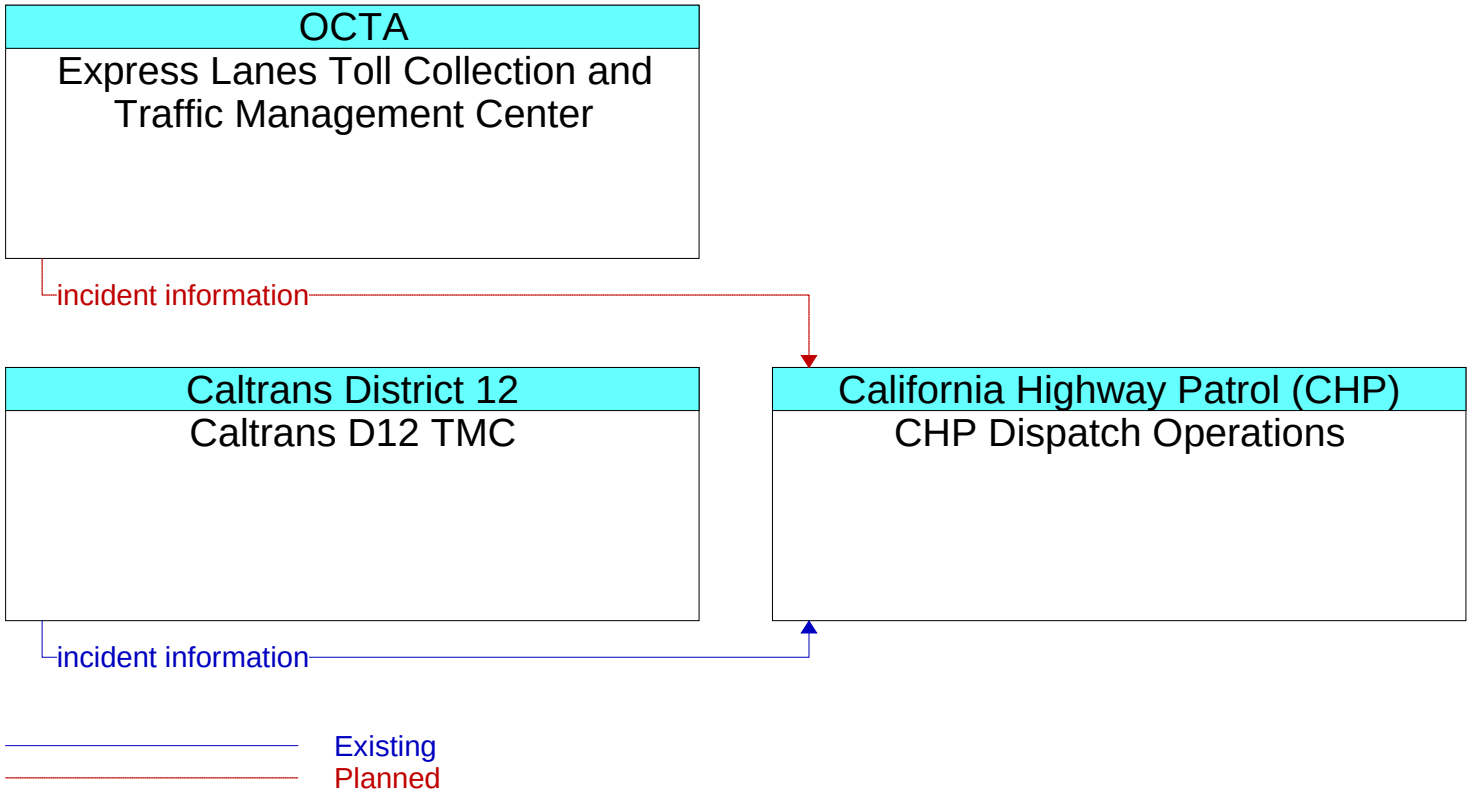
CHP Dispatch Operations
County of Orange
County Emergency Management Service
incident report
Existing


OCTA
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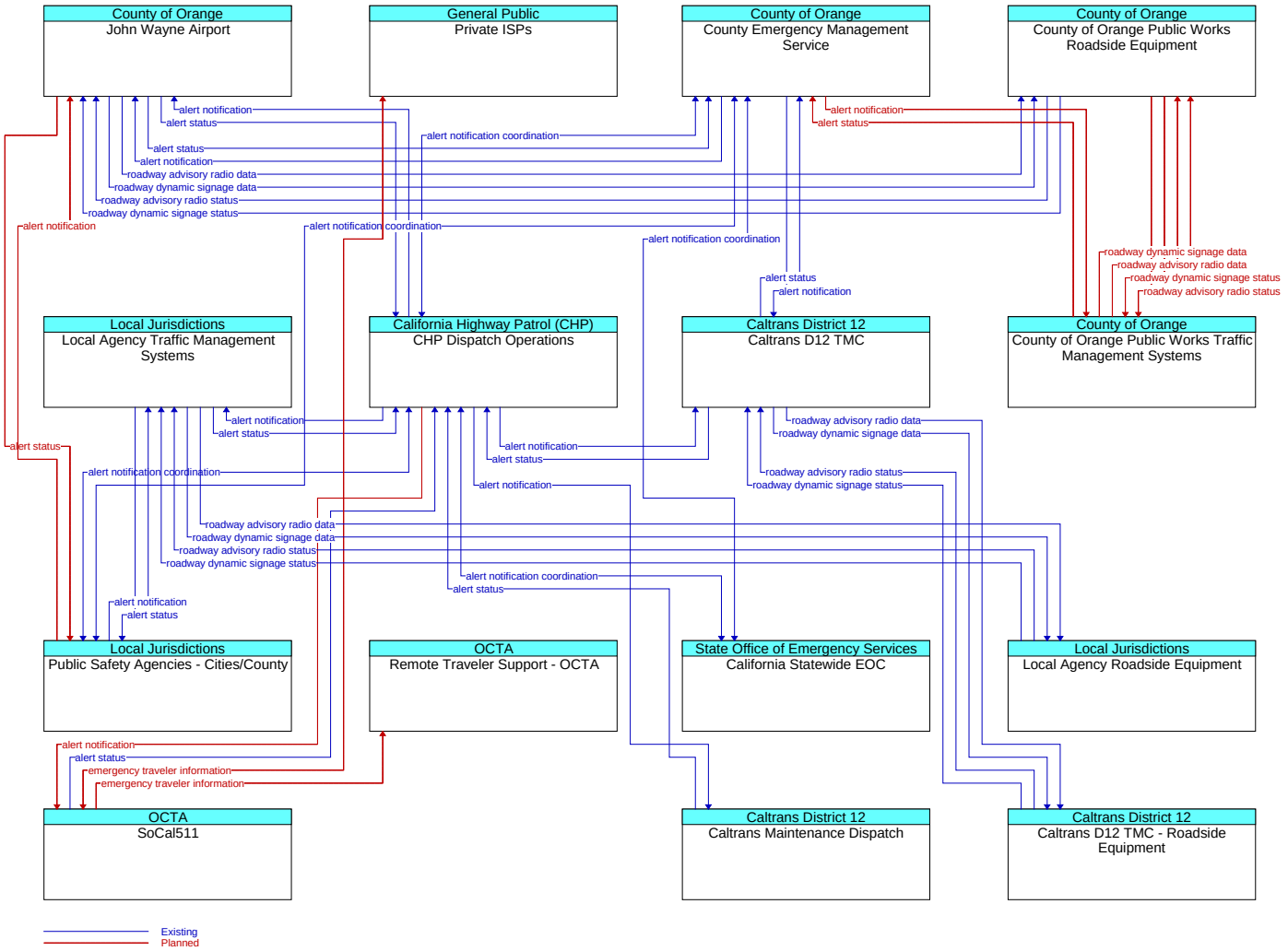
Caltrans D12 TMC
California Highway Patrol (CHP)
CHP Dispatch Operations
incident information
Existing
Planned


County of Orange
John Wayne Airport
General Public
Private ISPs
County of Orange
County Emergency Management Service
County of Orange
County of Orange Public Works Roadside Equipment
Local Jurisdictions
Local Agency Traffic Management Systems
California Highway Patrol (CHP)
CHP Dispatch Operations
Caltrans District 12
Caltrans D12 TMC
County of Orange
County of Orange Public Works Traffic Management Systems
Local Jurisdictions
Public Safety Agencies - Cities/County
OCTA
Remote Traveler Support - OCTA
State Office of Emergency Services
California Statewide EOC
Local Jurisdictions
Local Agency Roadside Equipment
OCTA
SoCal511
Caltrans District 12
Caltrans Maintenance Dispatch
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
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roadway dynamic signage status
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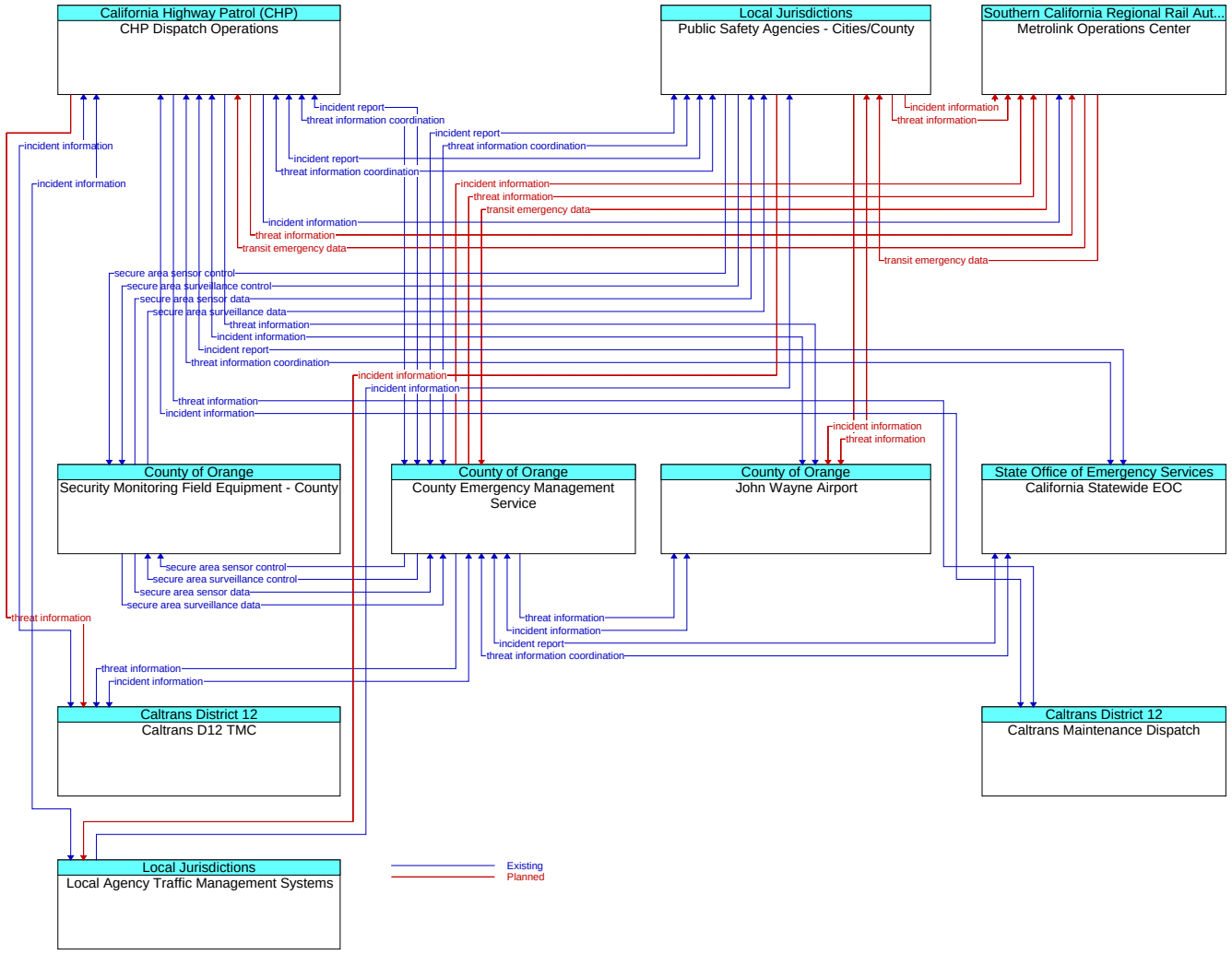
Planned


California Highway Patrol (CHP)
CHP Dispatch Operations
Local Jurisdictions
Public Safety Agencies - Cities/County
Southern California Regional Rail Aut...
Metrolink Operations Center
County of Orange
Security Monitoring Field Equipment - County
County of Orange
County Emergency Management Service
County of Orange
John Wayne Airport
State Office of Emergency Services
California Statewide EOC
Caltrans District 12
Caltrans D12 TMC
Caltrans District 12
Caltrans Maintenance Dispatch
Local Jurisdictions
Local Agency Traffic Management Systems
Existing
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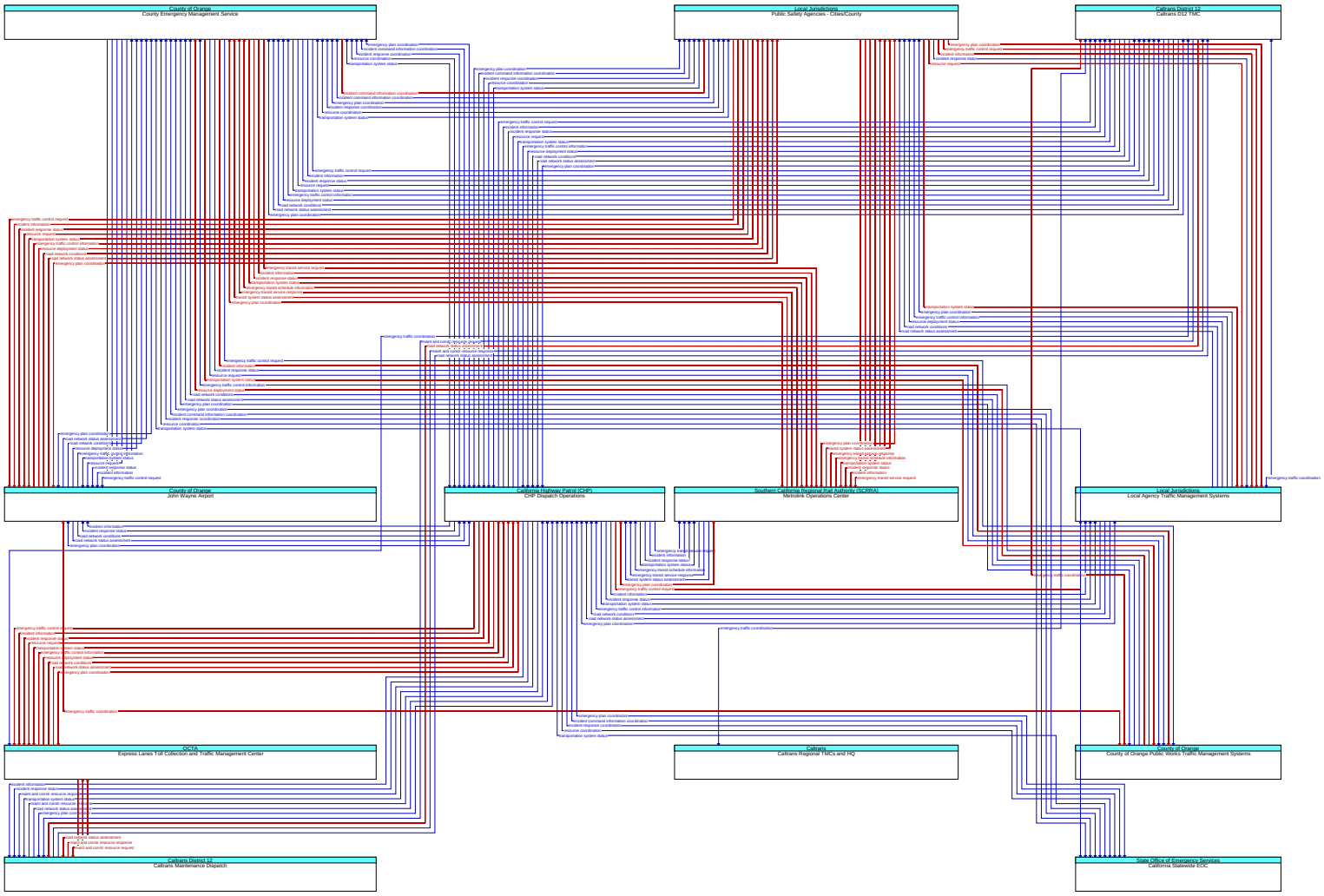
incident information
threat information
transit emergency data
secure area sensor control
secure area surveillance control
secure area sensor data
secure area surveillance data


County of Orange
County Emergency Management Service
Local Jurisdictions
Public Safety Agencies - Cities/County
Caltrans District 12
Caltrans D12 TMC
County of Orange
John Wayne Airport
California Highway Patrol (CHP)
CHP Dispatch Operations
Southern California Regional Rail Authority (SCRRA)
Metrolink Operations Center
Local Jurisdictions
Local Agency Traffic Management Systems
OCTA
Express Lanes Toll Collection and Traffic Management Center
Caltrans
Caltrans Regional TMCs and HQ
County of Orange
County of Orange Public Works Traffic Management Systems
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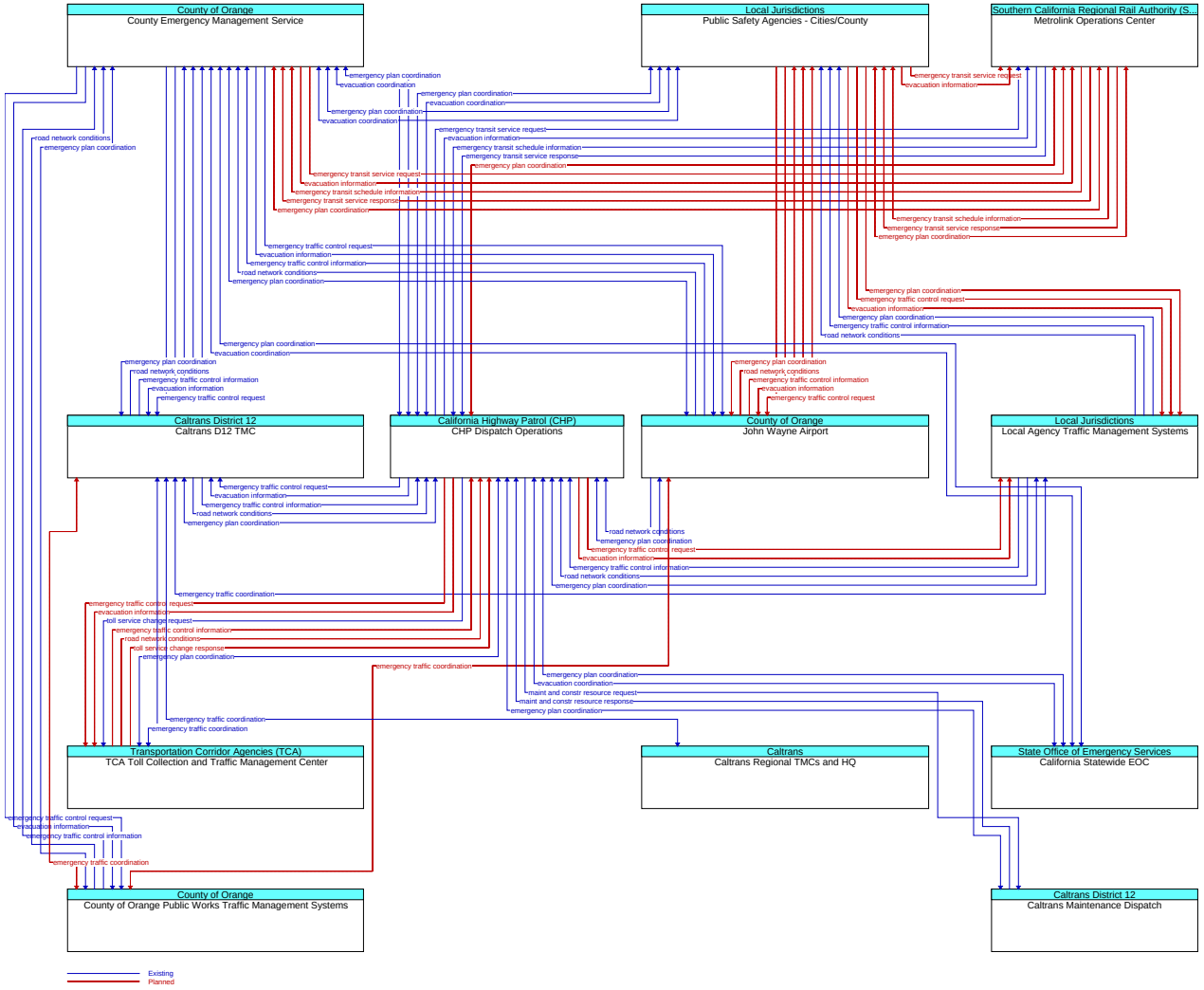
Caltrans Maintenance Dispatch
State Office of Emergency Services
California Statewide EOC
Existing
Planned


County of Orange
County Emergency Management Service
Local Jurisdictions
Public Safety Agencies - Cities/County
Southern California Regional Rail Authority (S...
Metrolink Operations Center
Caltrans District 12
Caltrans D12 TMC
California Highway Patrol (CHP)
CHP Dispatch Operations
County of Orange
John Wayne Airport
Local Jurisdictions
Local Agency Traffic Management Systems
Transportation Corridor Agencies (TCA)
TCA Toll Collection and Traffic Management Center
Caltrans
Caltrans Regional TMCs and HQ
State Office of Emergency Services
California Statewide EOC
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County of Orange Public Works Traffic Management Systems
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Caltrans Maintenance Dispatch
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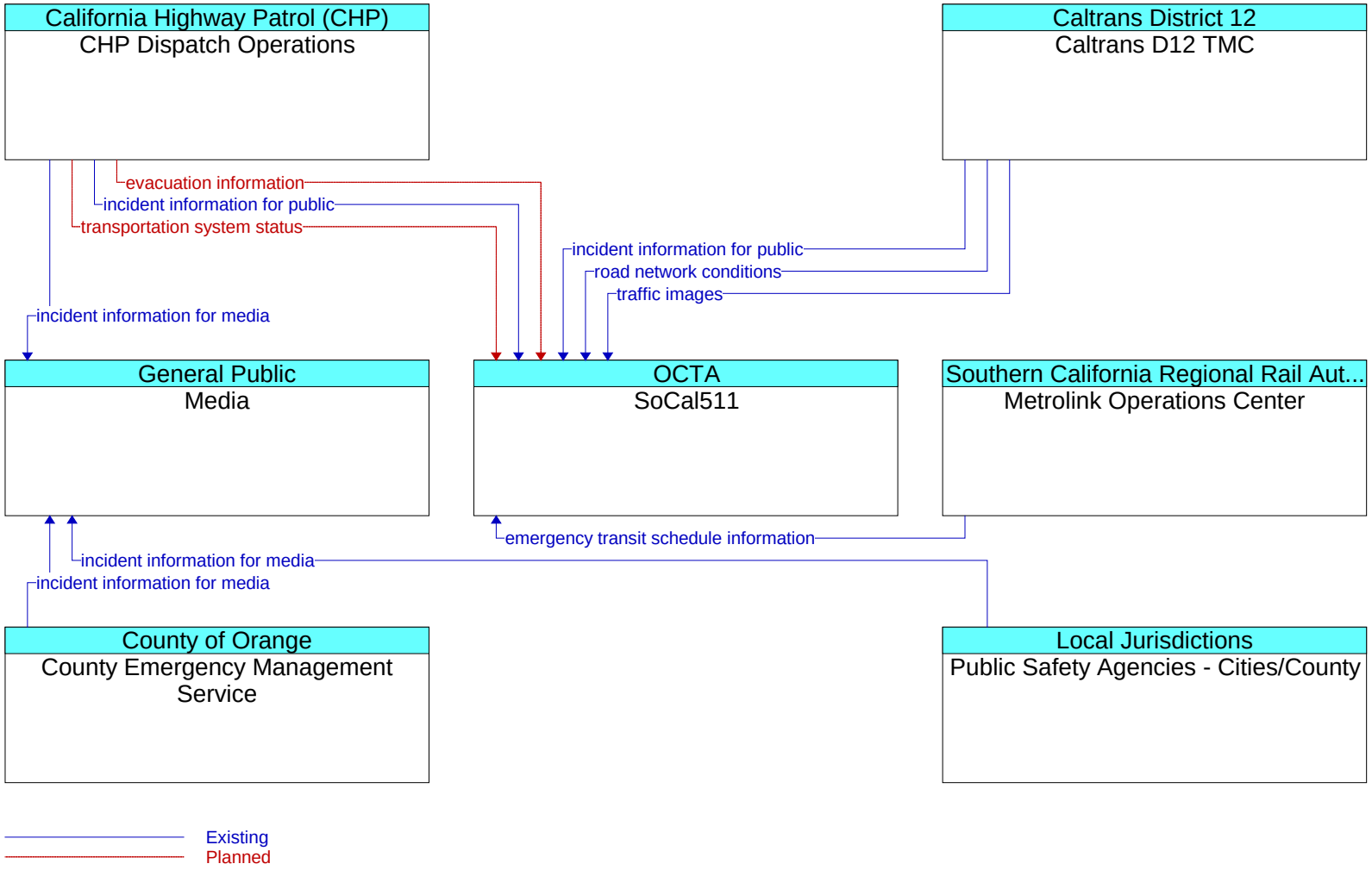
Planned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CHP Dispatch Operations
Caltrans District 12
Caltrans D12 TMC
evacuation information
incident information for public
transportation system status
incident information for public
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traffic images
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General Public
Media
OCTA
SoCal511
Southern California Regional Rail Aut...
Metrolink Operations Center
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incident information for media
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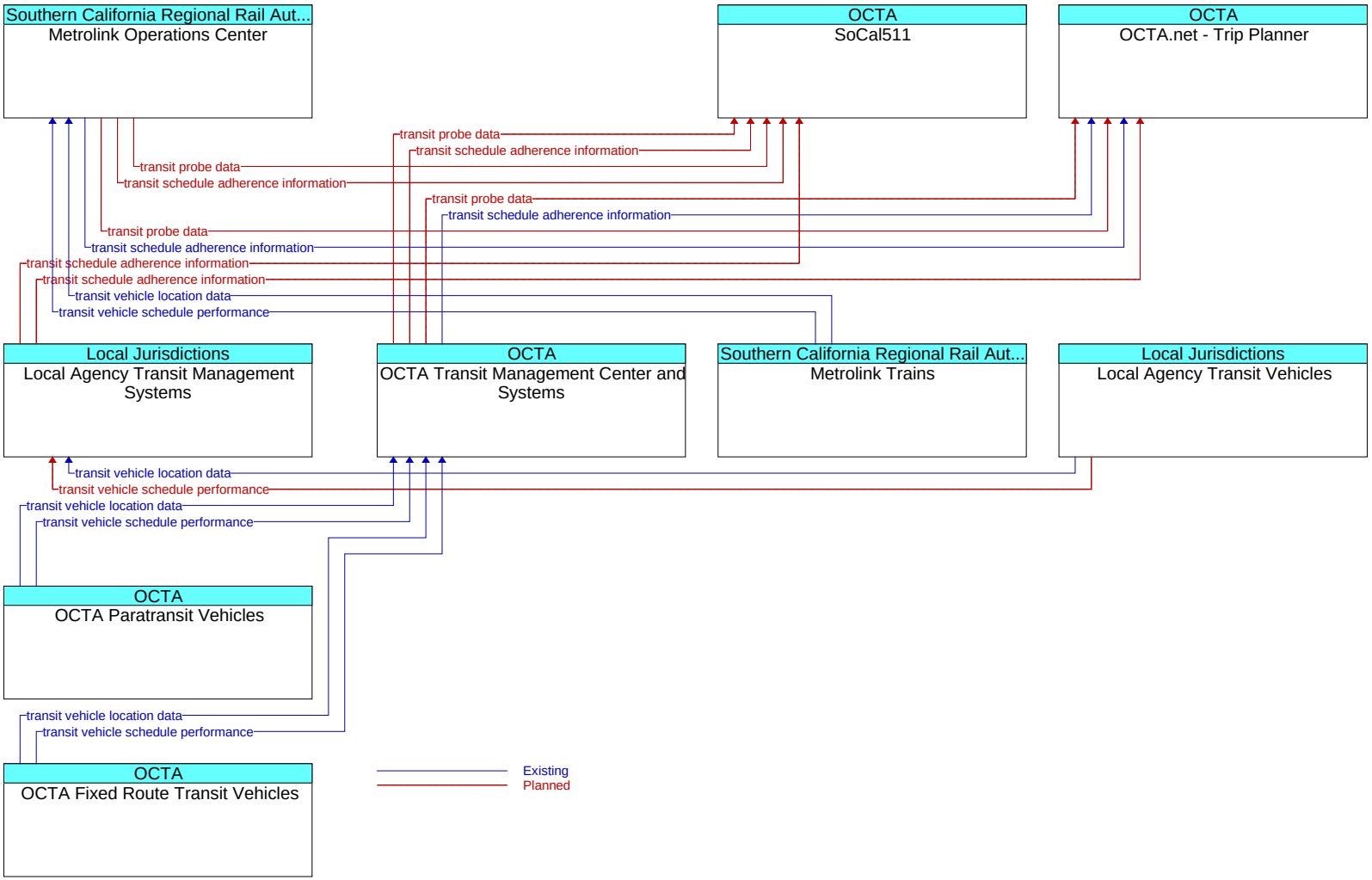
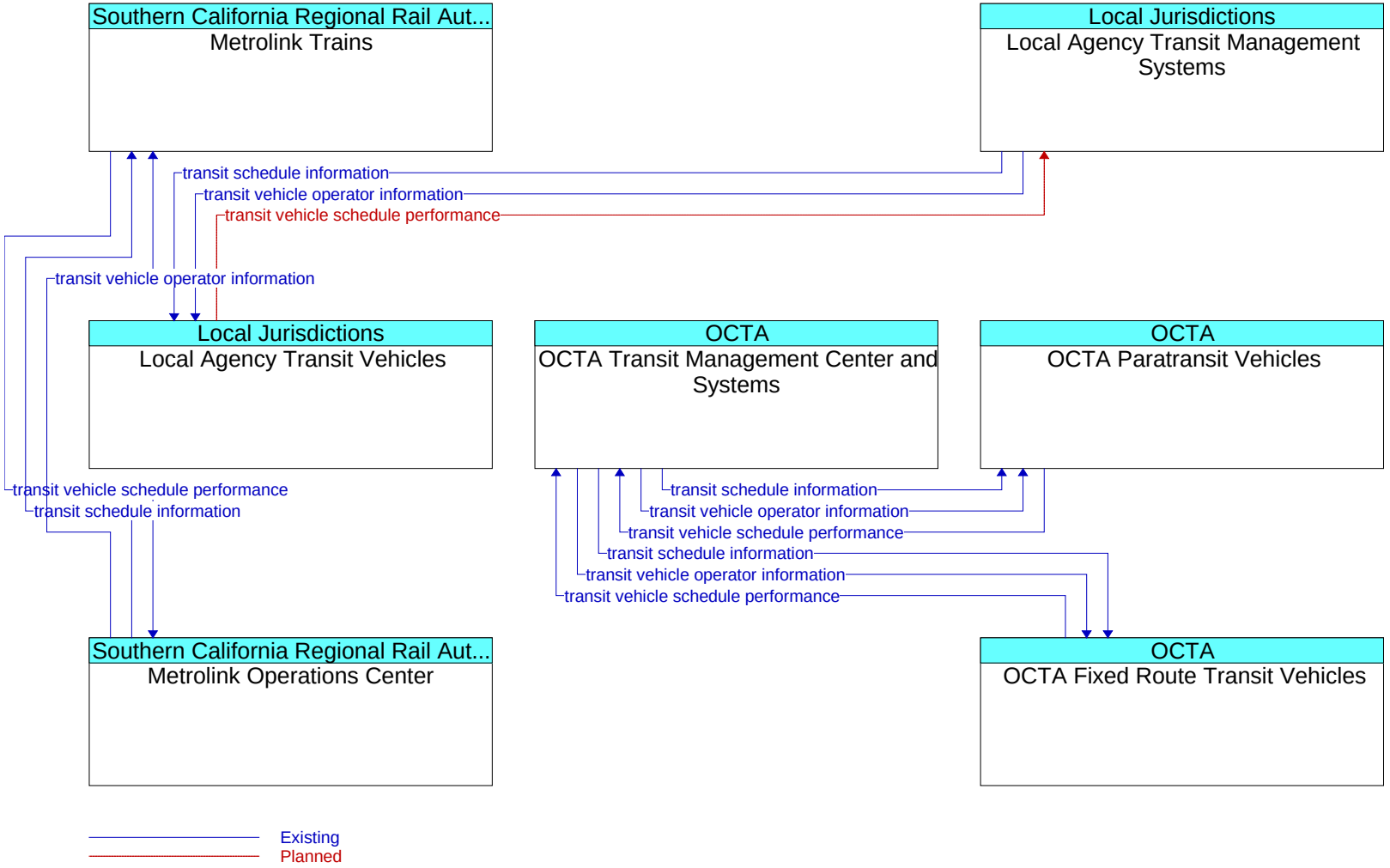
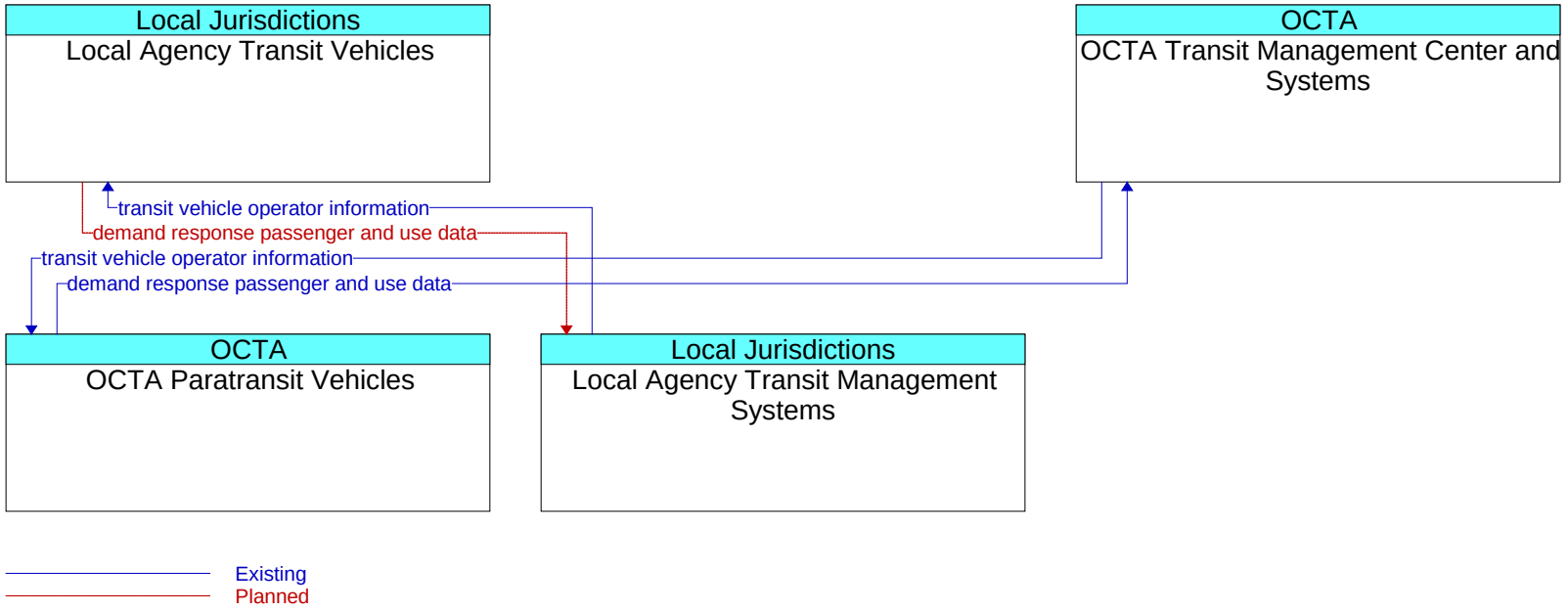
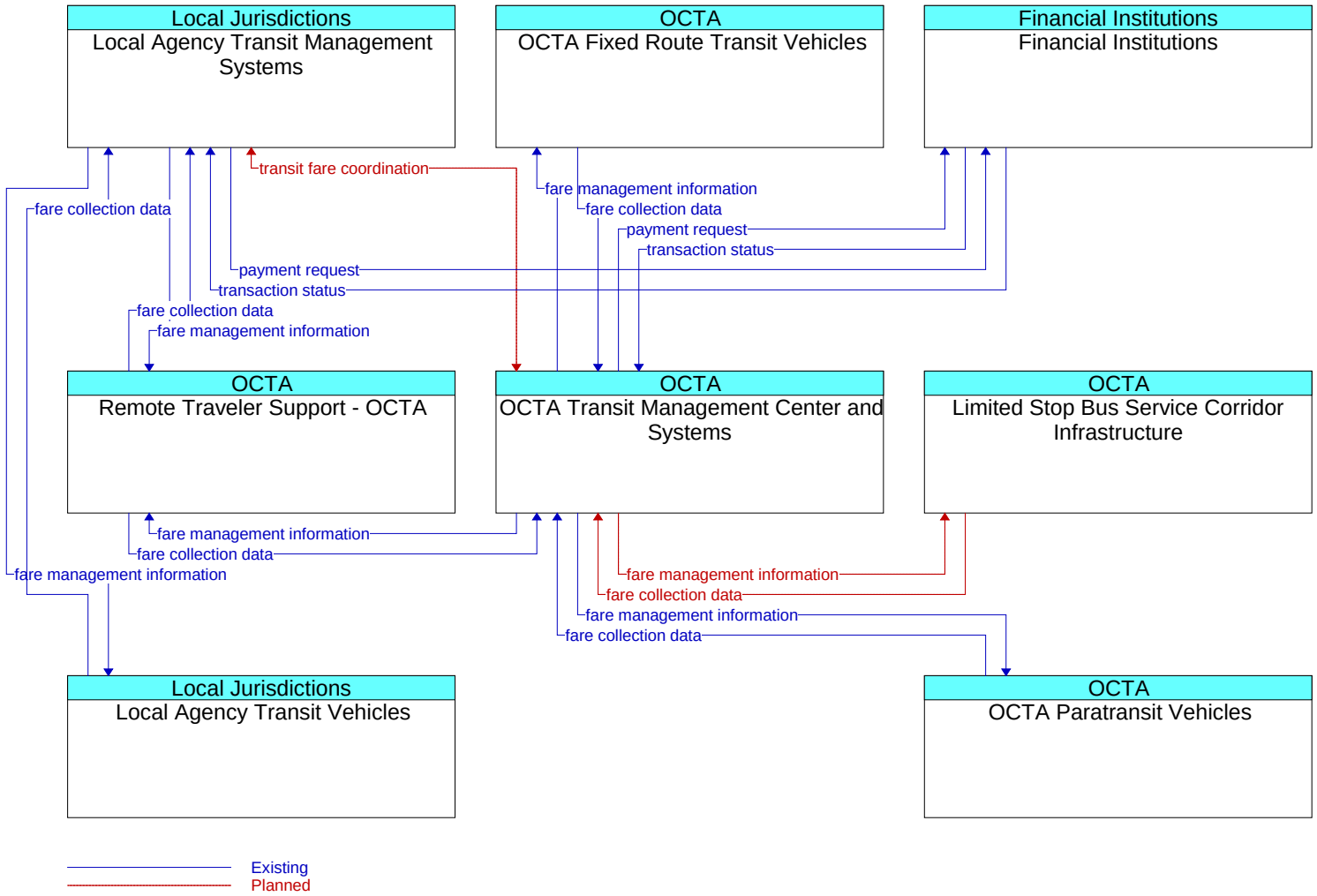
County Emergency Management Service
Local Jurisdictions
Public Safety Agencies - Cities/County
Existing
Planned


Southern California Regional Rail Aut...
Metrolink Operations Center
OCTA
SoCal511
OCTA
OCTA.net - Trip Planner
transit probe data
transit schedule adherence information
transit probe data
transit schedule adherence information
transit probe data
transit schedule adherence information
transit probe data
transit schedule adherence information
transit schedule adherence information
transit schedule adherence information
transit vehicle location data
transit vehicle schedule performance
Local Jurisdictions
Local Agency Transit Management Systems
OCTA
OCTA Transit Management Center and Systems
Southern California Regional Rail Aut...
Metrolink Trains
Local Jurisdictions
Local Agency Transit Vehicles
transit vehicle location data
transit vehicle schedule performance
transit vehicle location data
transit vehicle schedule performance
OCTA
OCTA Paratransit Vehicles
transit vehicle location data
transit vehicle schedule performance
OCTA
OCTA Fixed Route Transit Vehicles
Existing
Planned


Southern California Regional Rail Aut...
Metrolink Trains
Local Jurisdictions
Local Agency Transit Management Systems
transit schedule information
transit vehicle operator information
transit vehicle schedule performance
transit vehicle operator information
Local Jurisdictions
Local Agency Transit Vehicles
OCTA
OCTA Transit Management Center and Systems
OCTA
OCTA Paratransit Vehicles
transit vehicle schedule performance
transit schedule information
transit schedule information
transit vehicle operator information
transit vehicle schedule performance
transit schedule information
transit vehicle operator information
transit vehicle schedule performance
Southern California Regional Rail Aut...
Metrolink Operations Center
OCTA
OCTA Fixed Route Transit Vehicles
Existing
Planned


Local Jurisdictions
Local Agency Transit Vehicles
OCTA
OCTA Transit Management Center and Systems
transit vehicle operator information
demand response passenger and use data
transit vehicle operator information
demand response passenger and use data
OCTA
OCTA Paratransit Vehicles
Local Jurisdictions
Local Agency Transit Management Systems
Existing
Planned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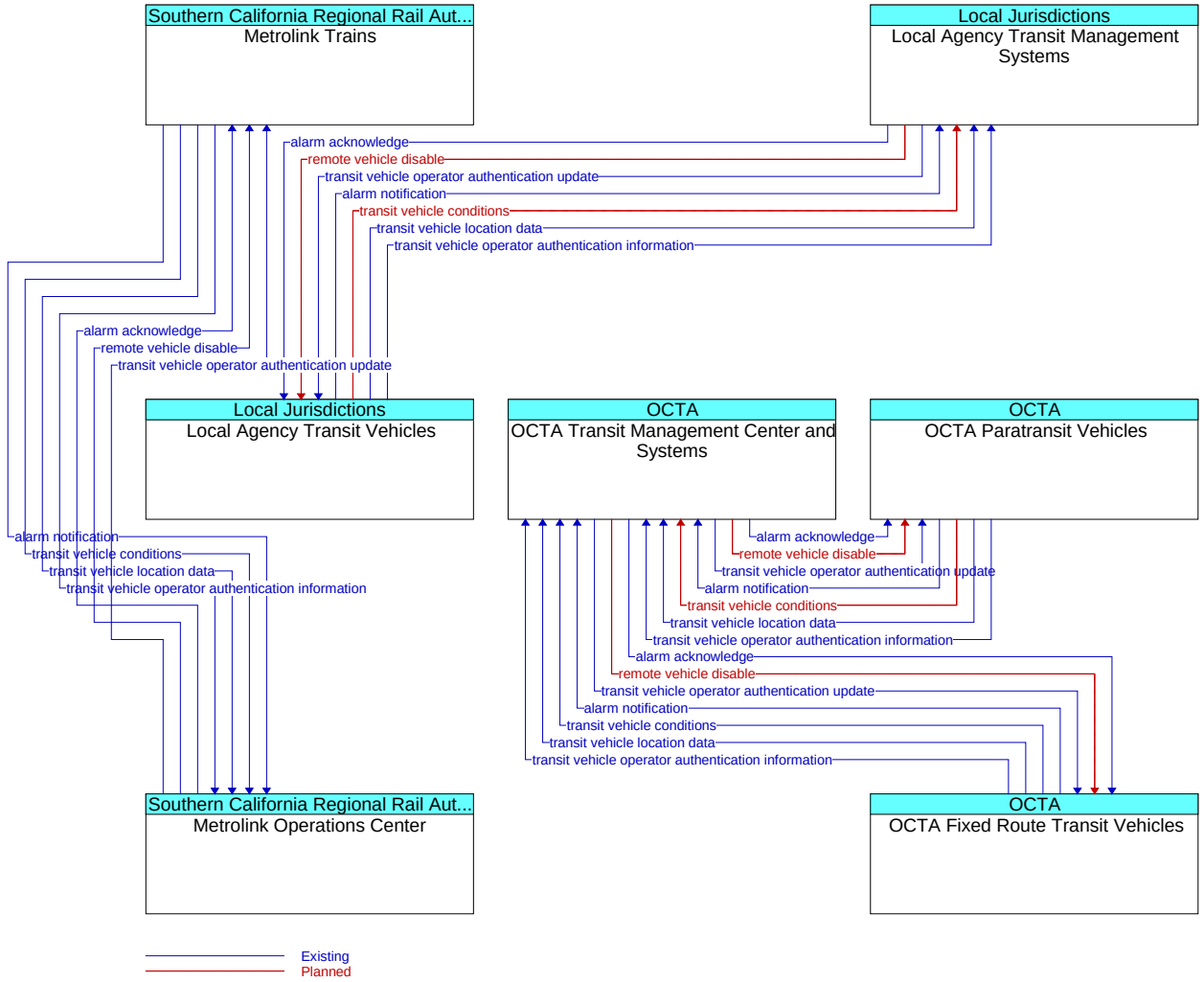
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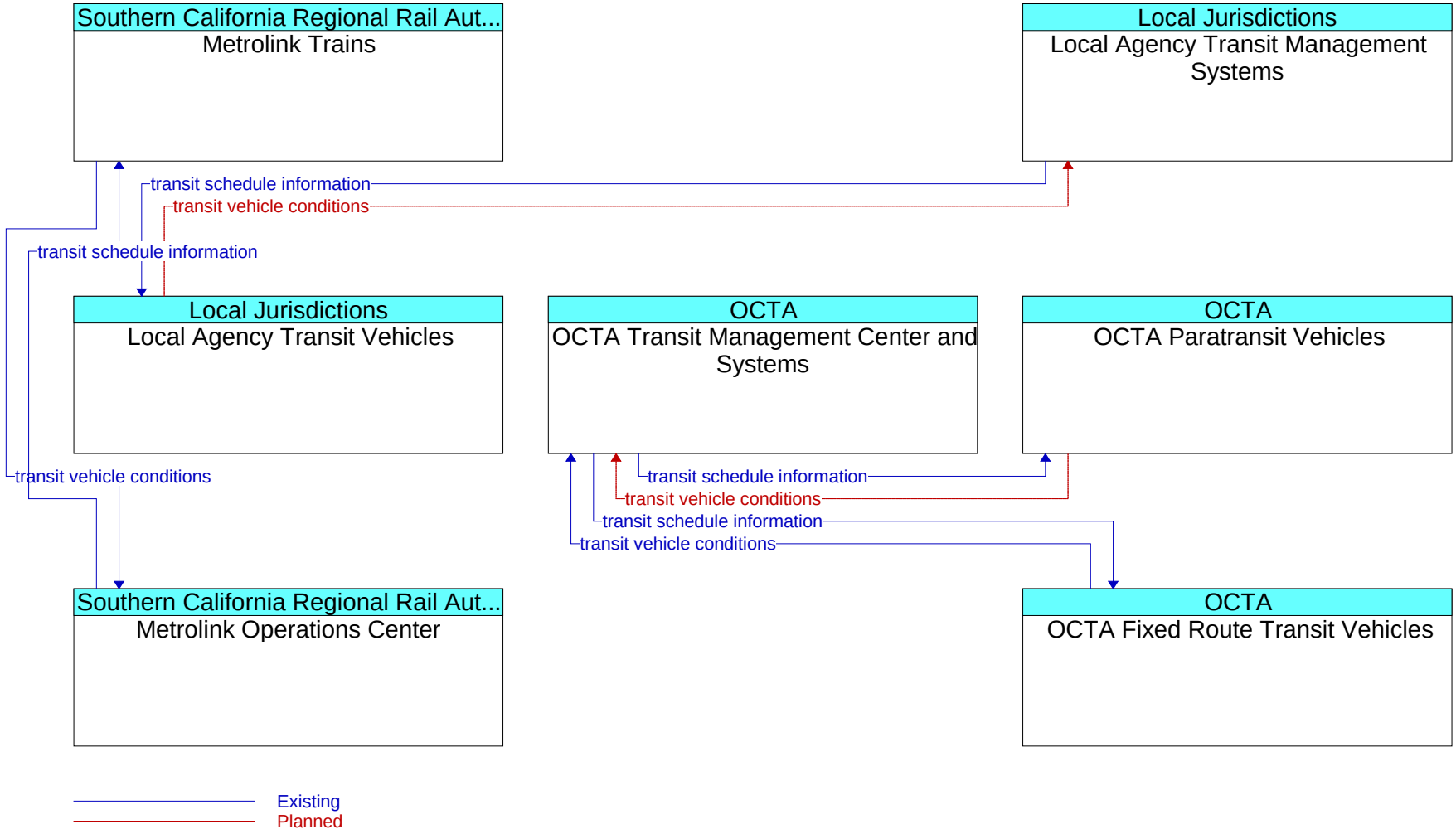
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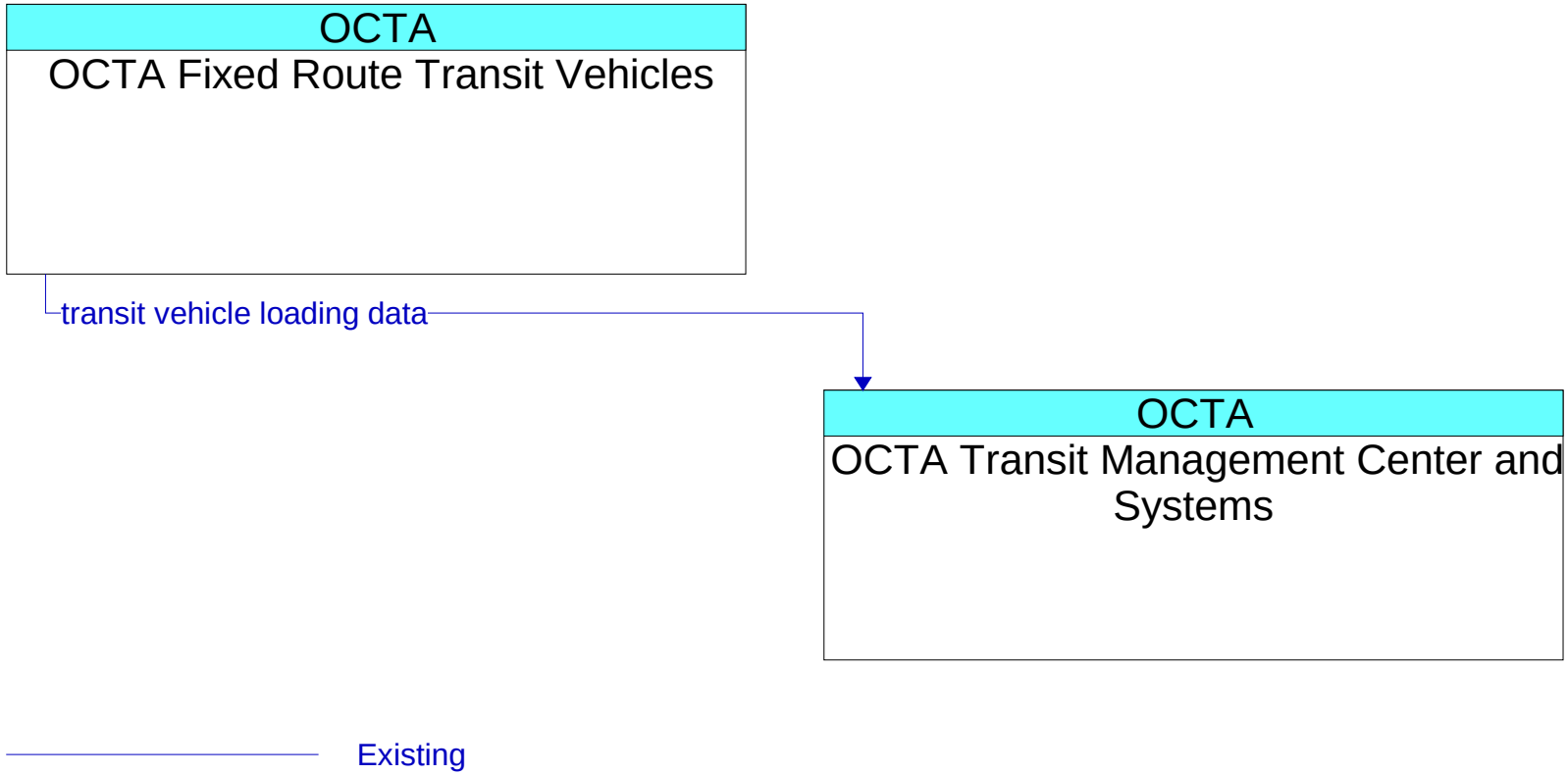
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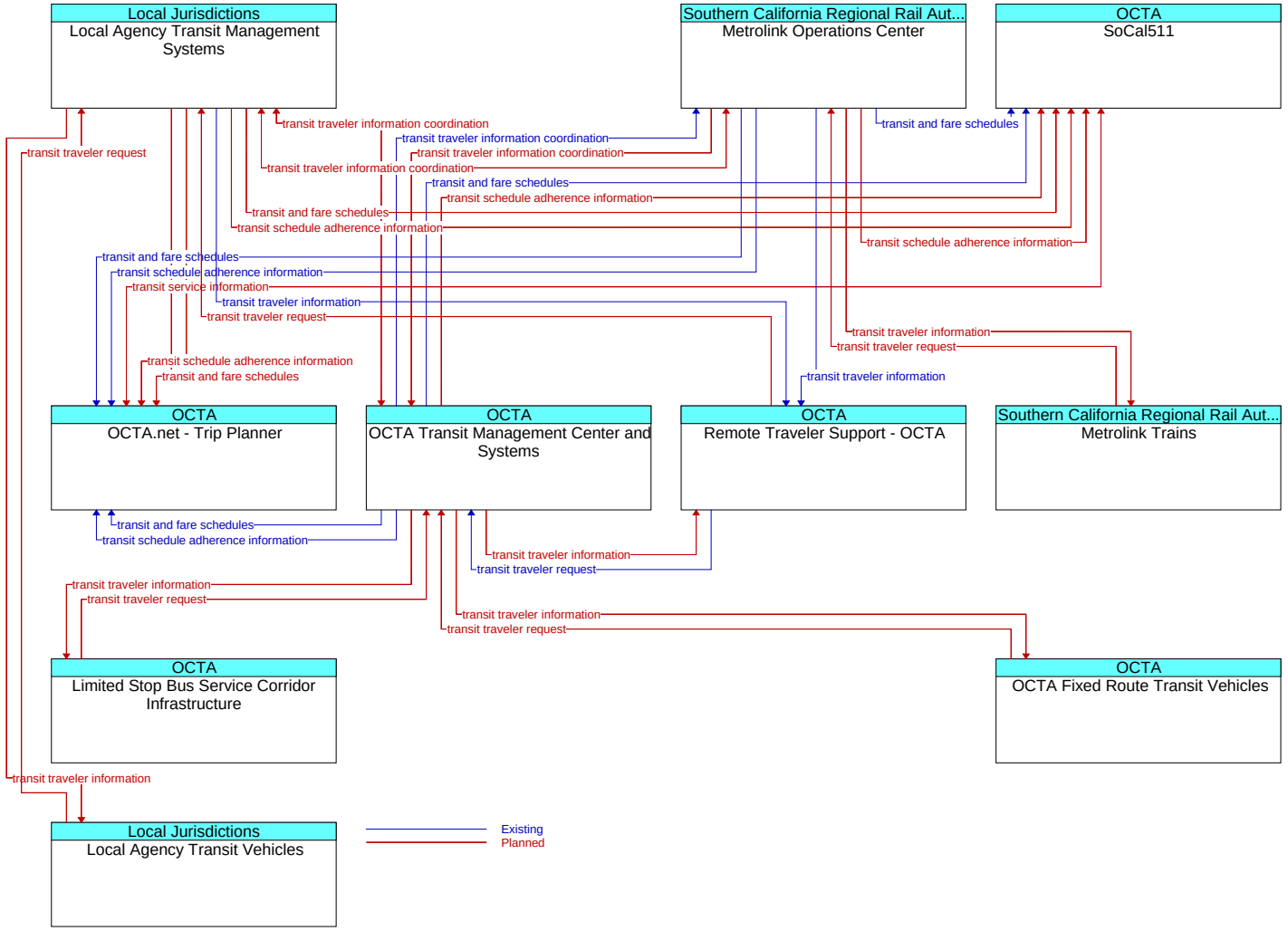
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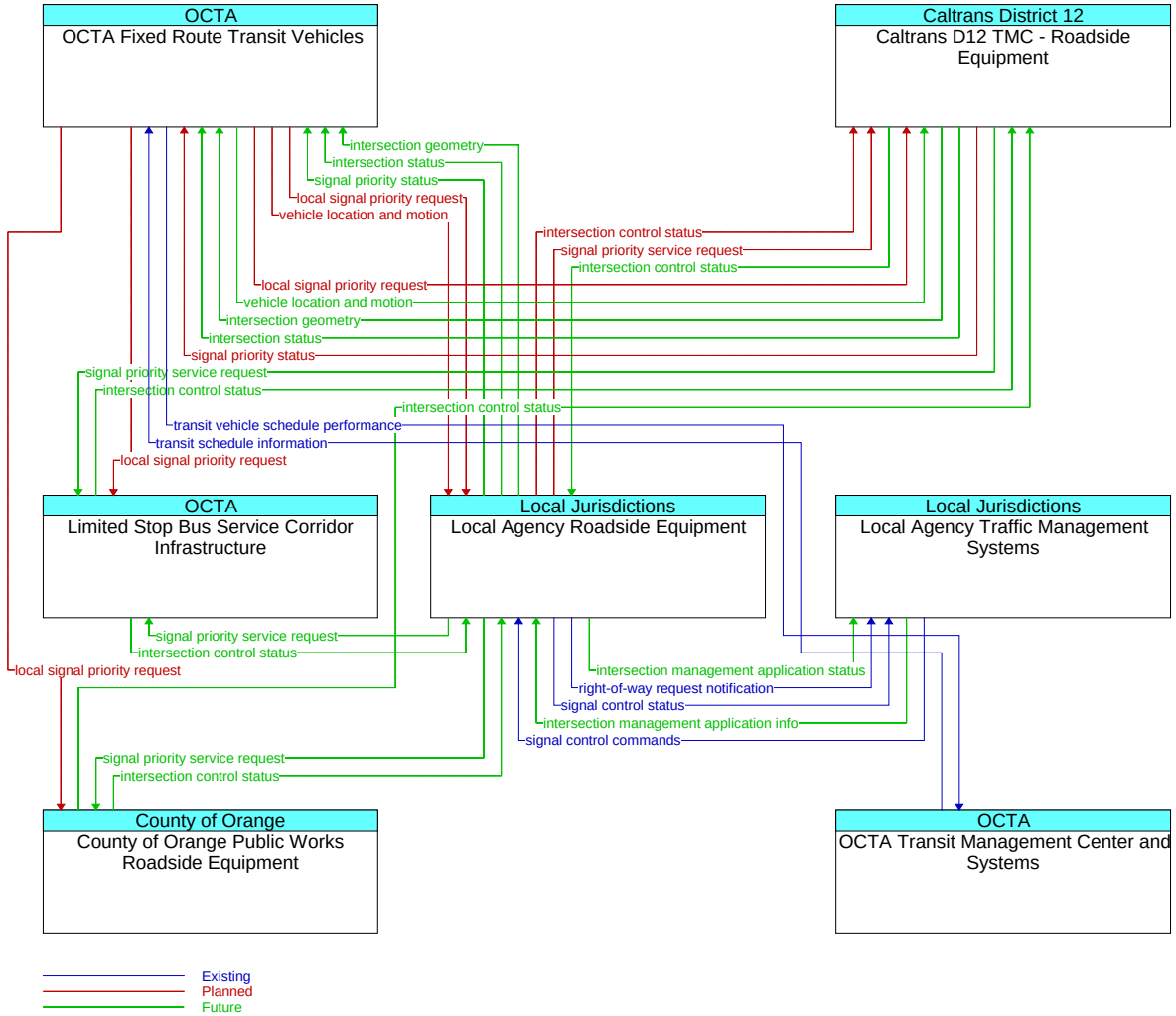
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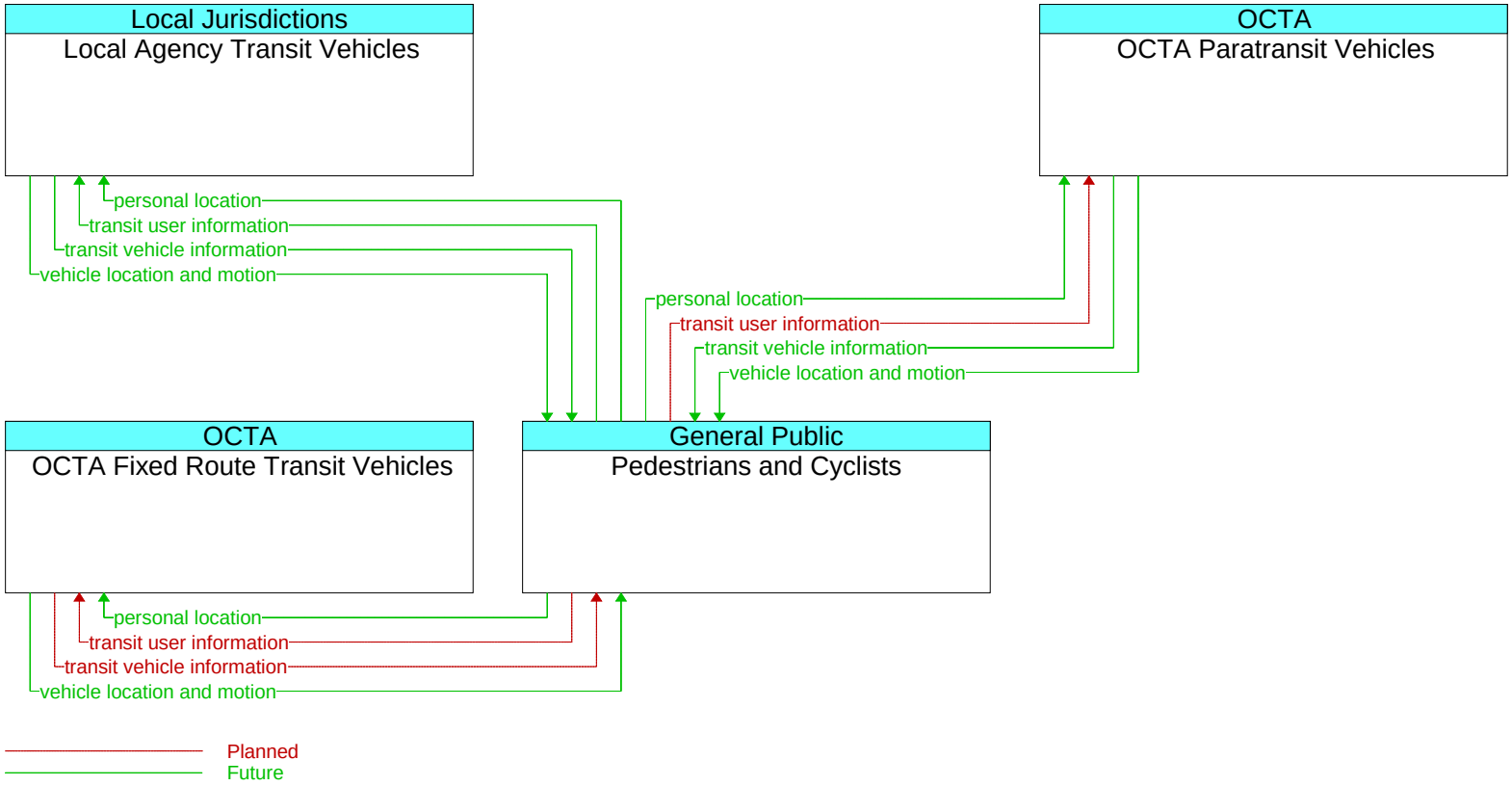
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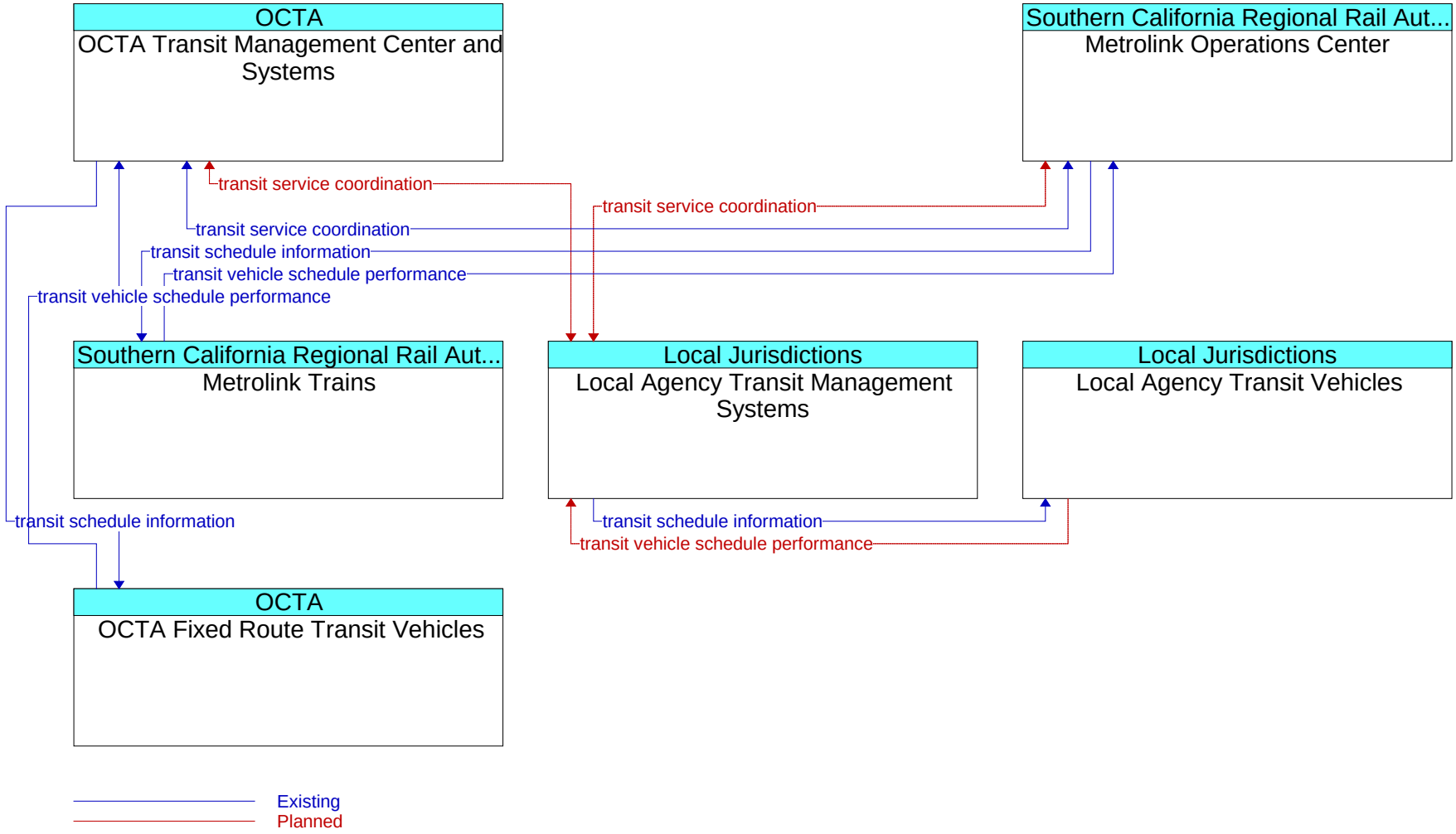
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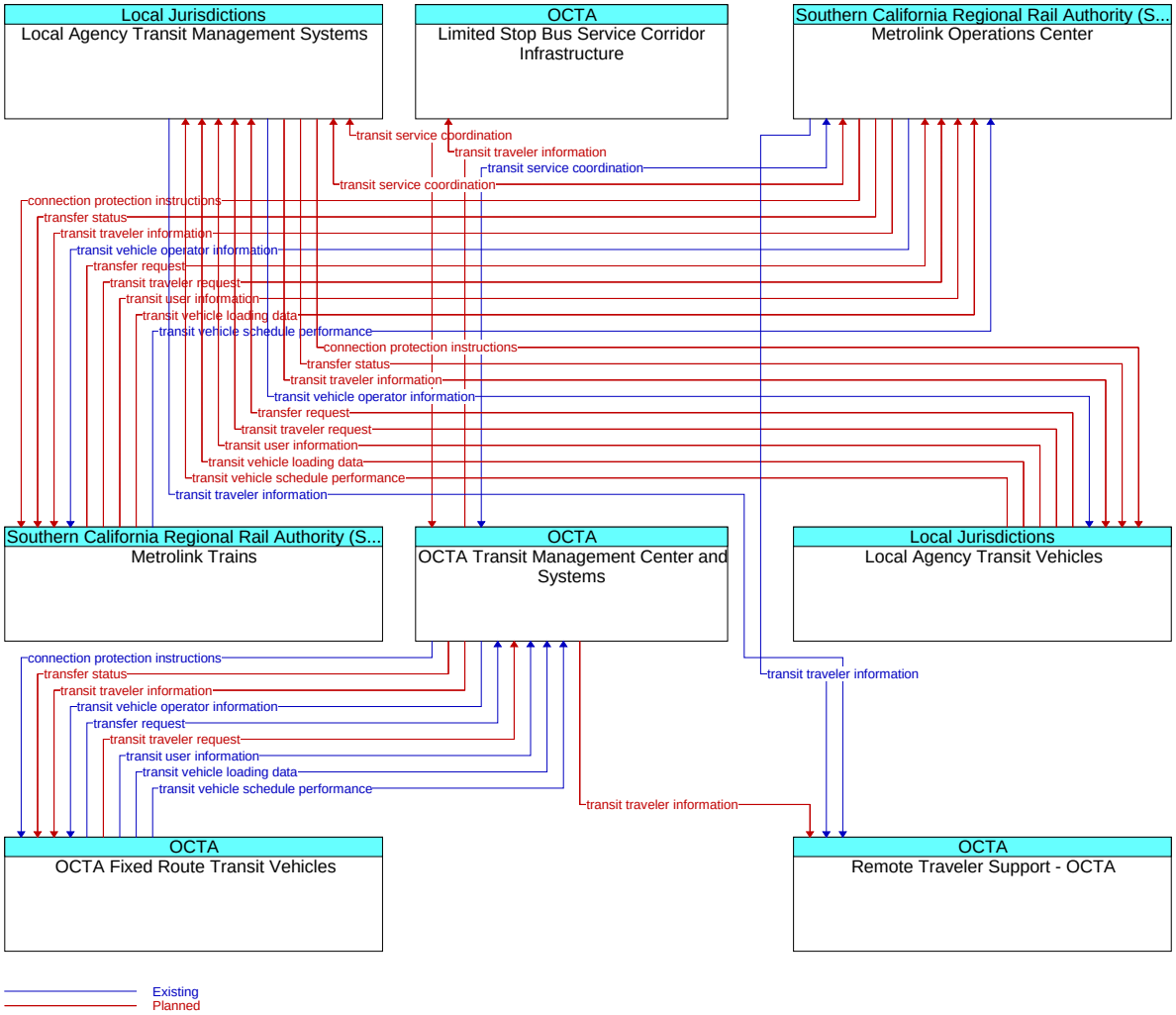
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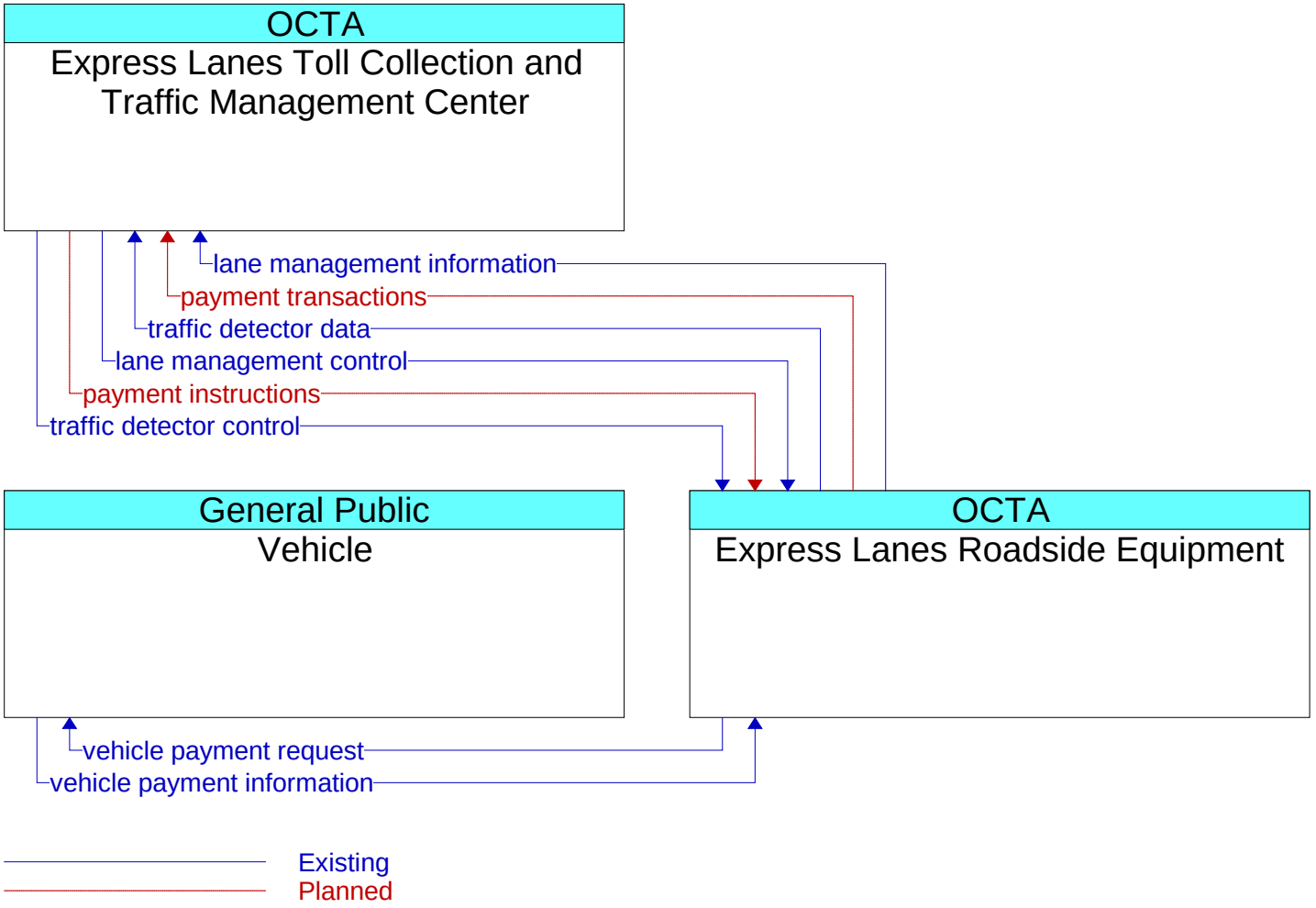
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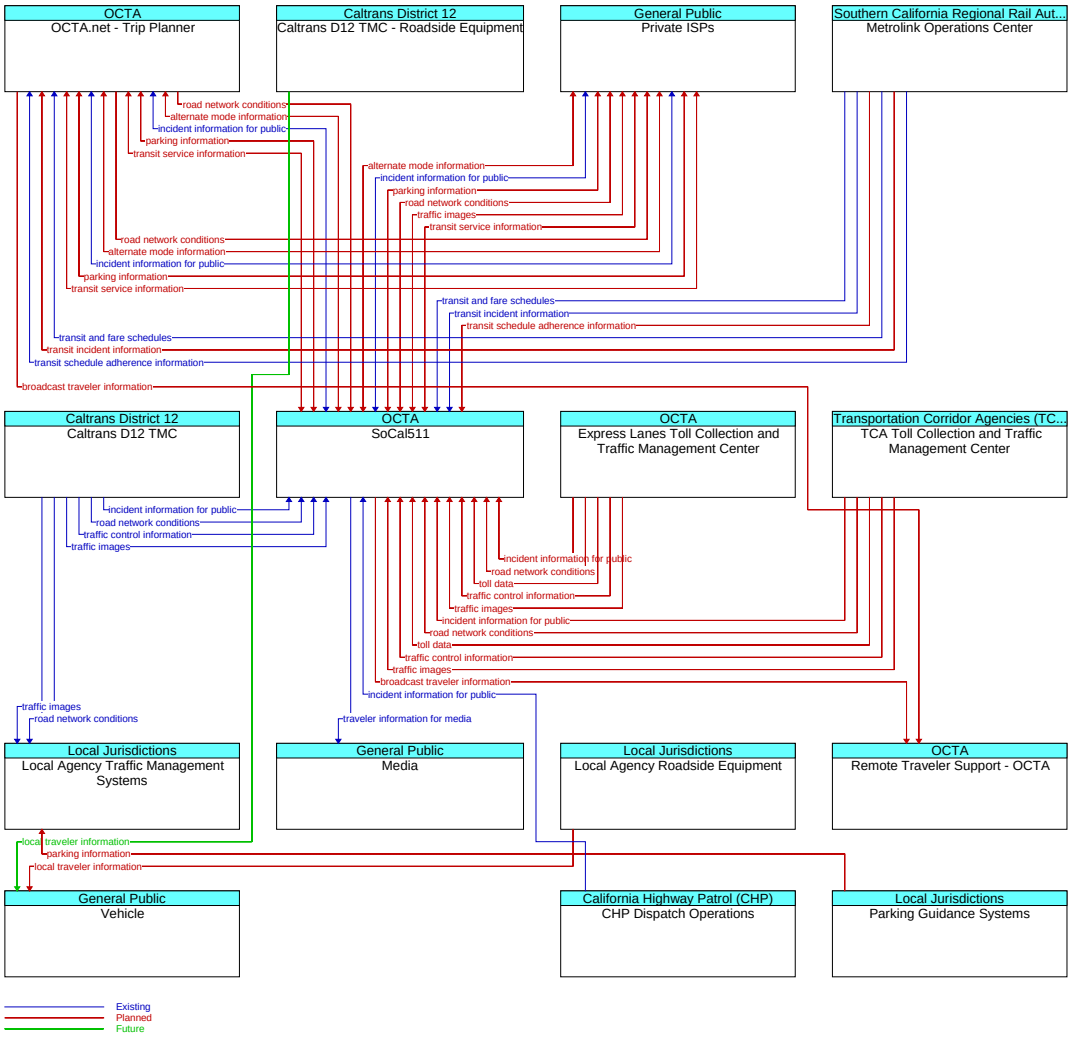
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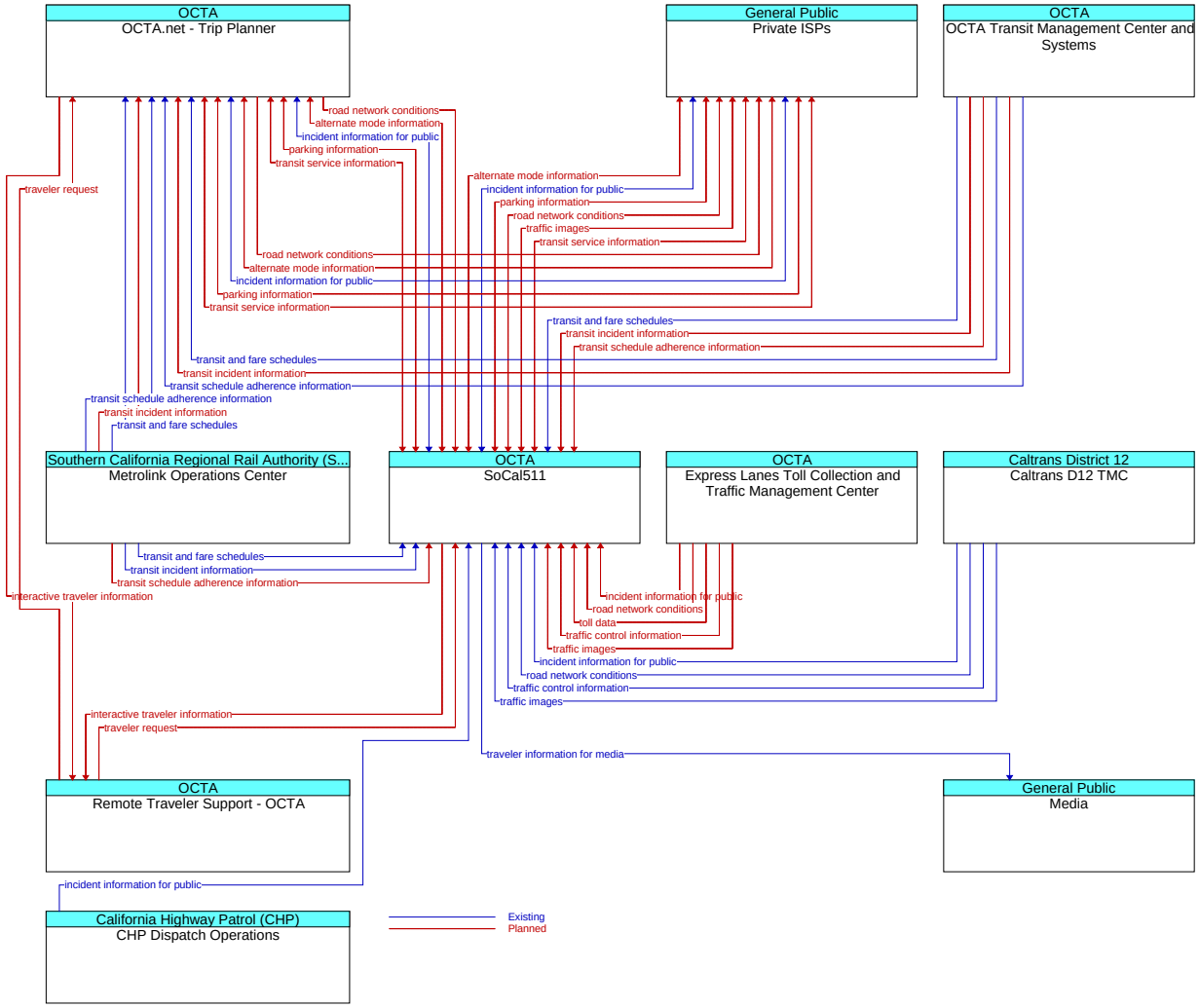
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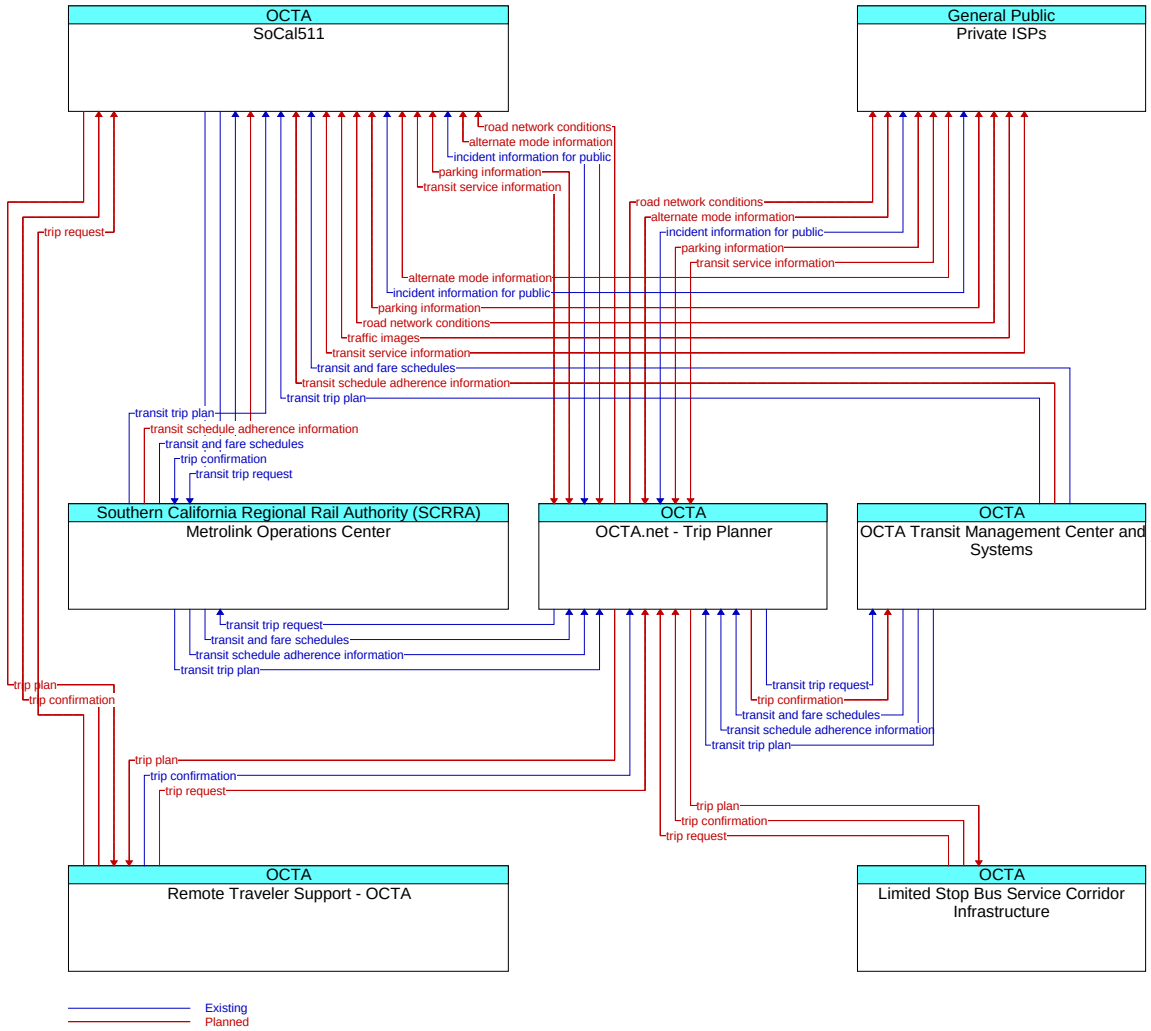
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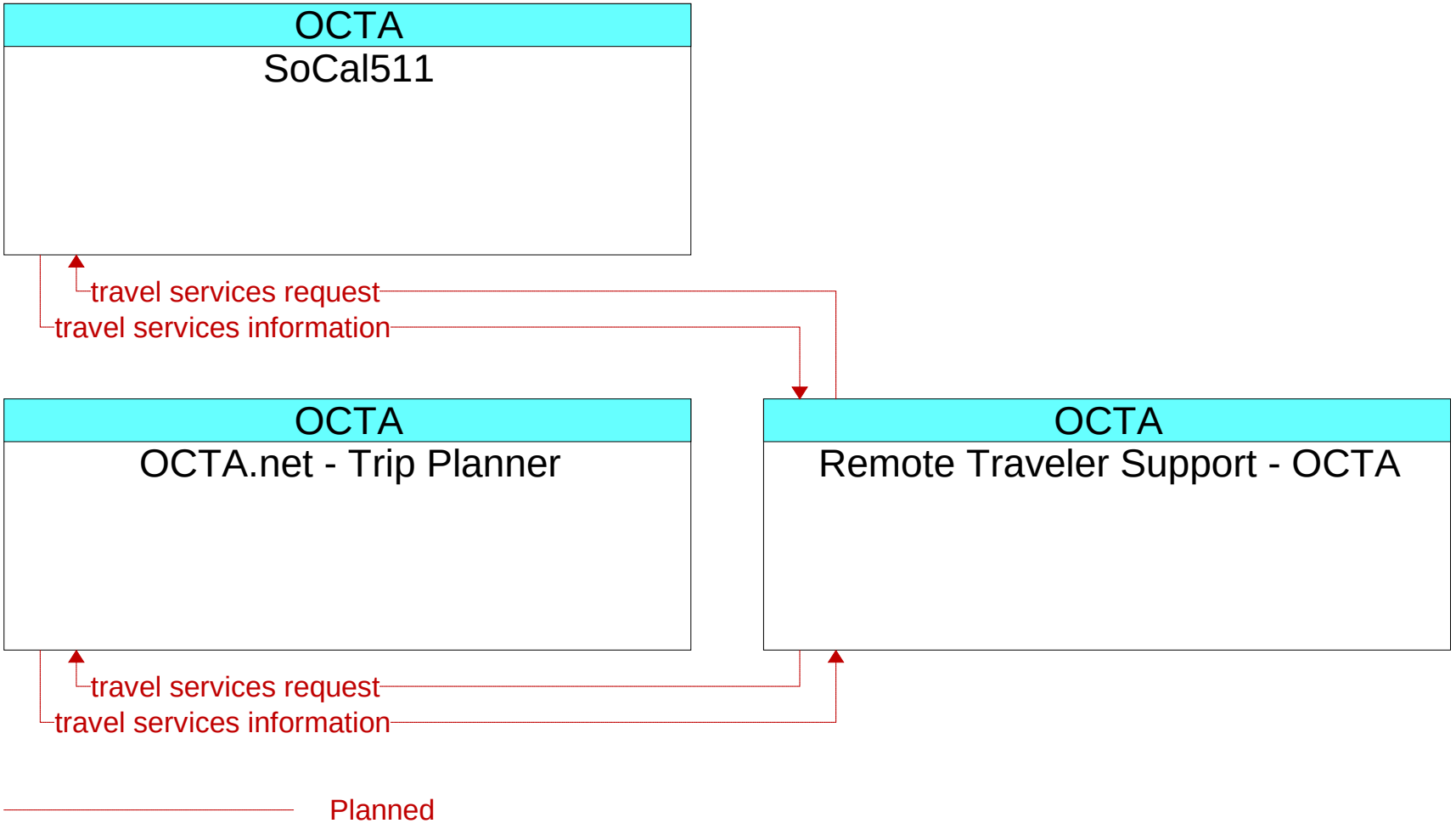
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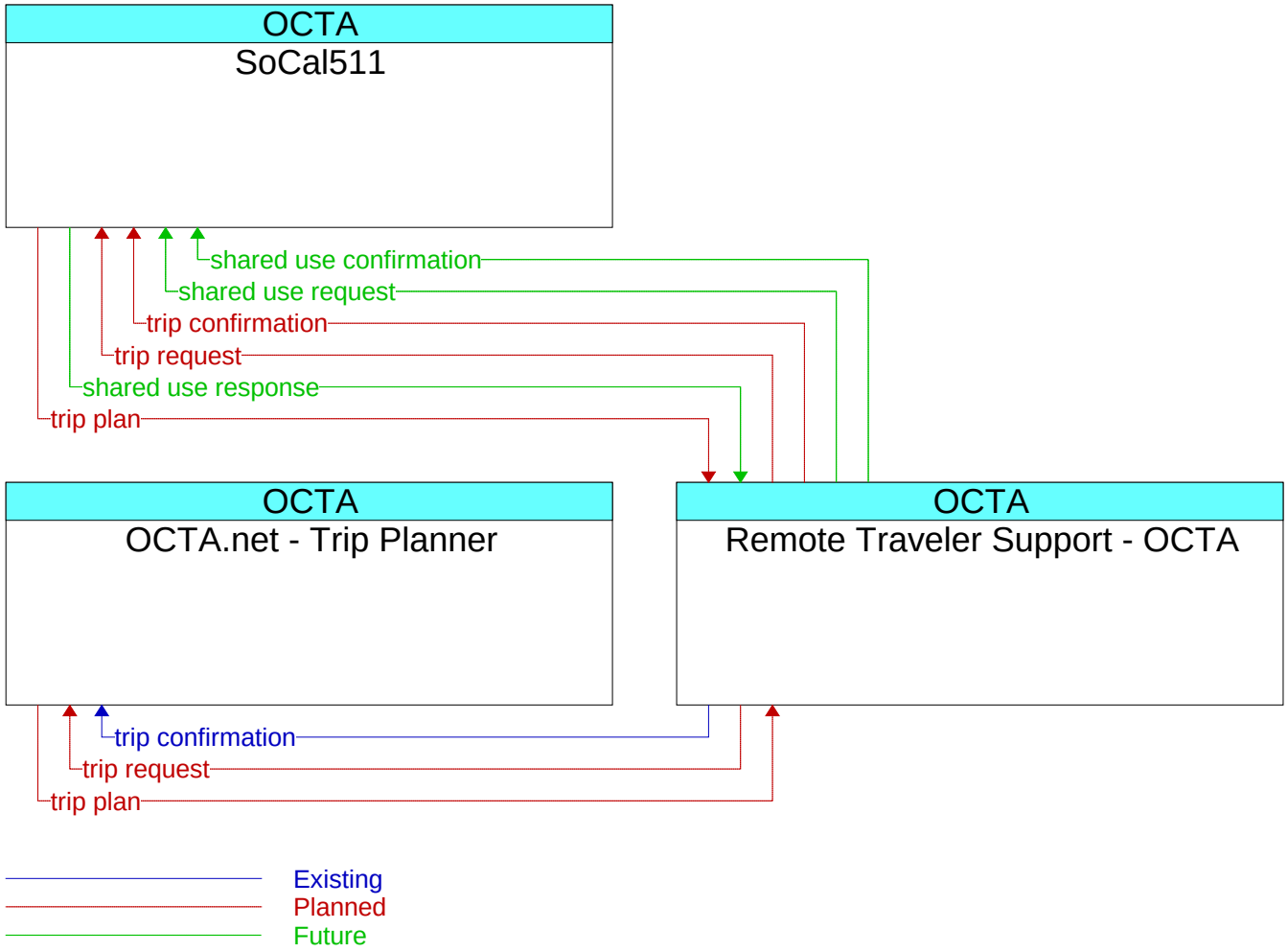
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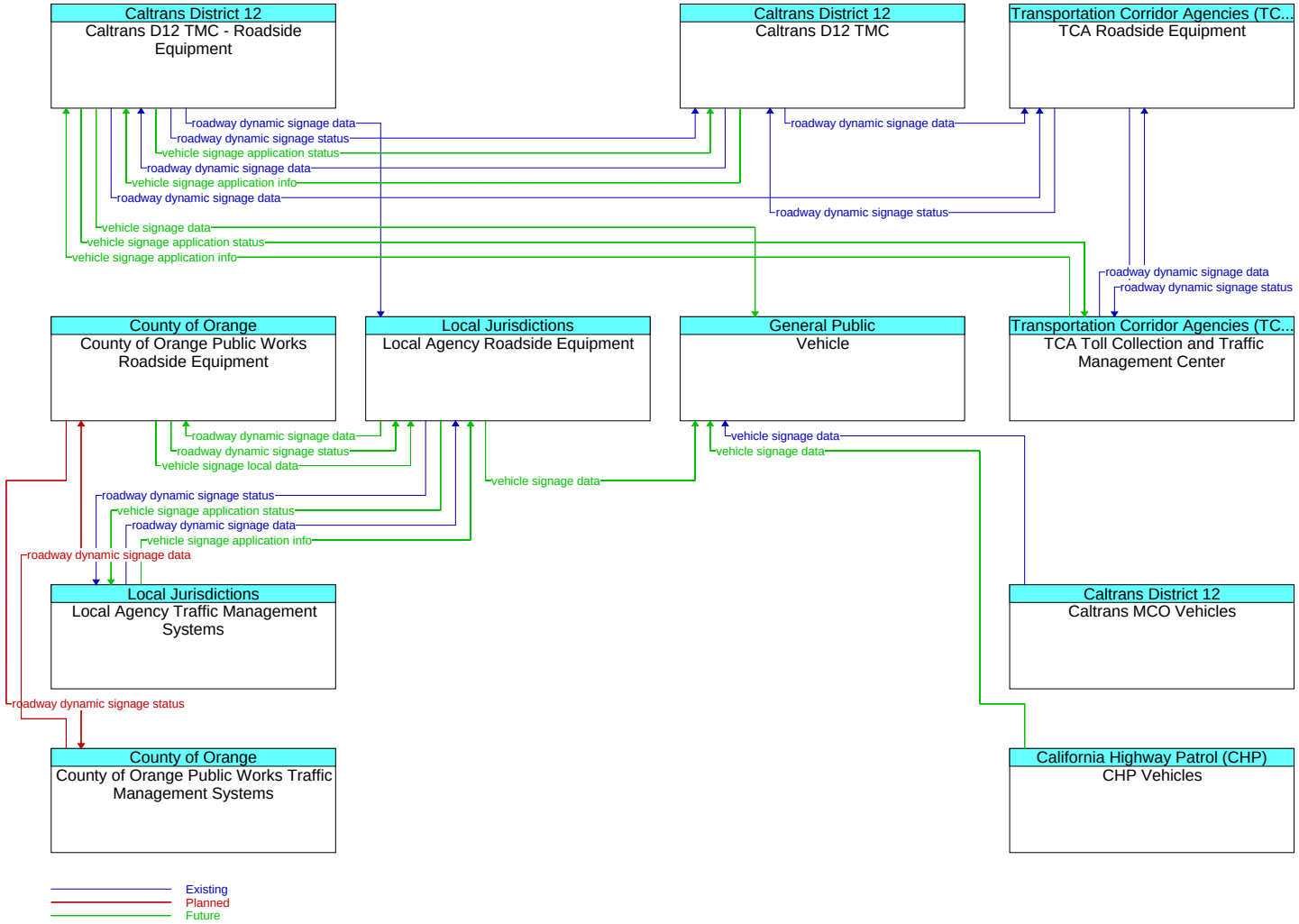
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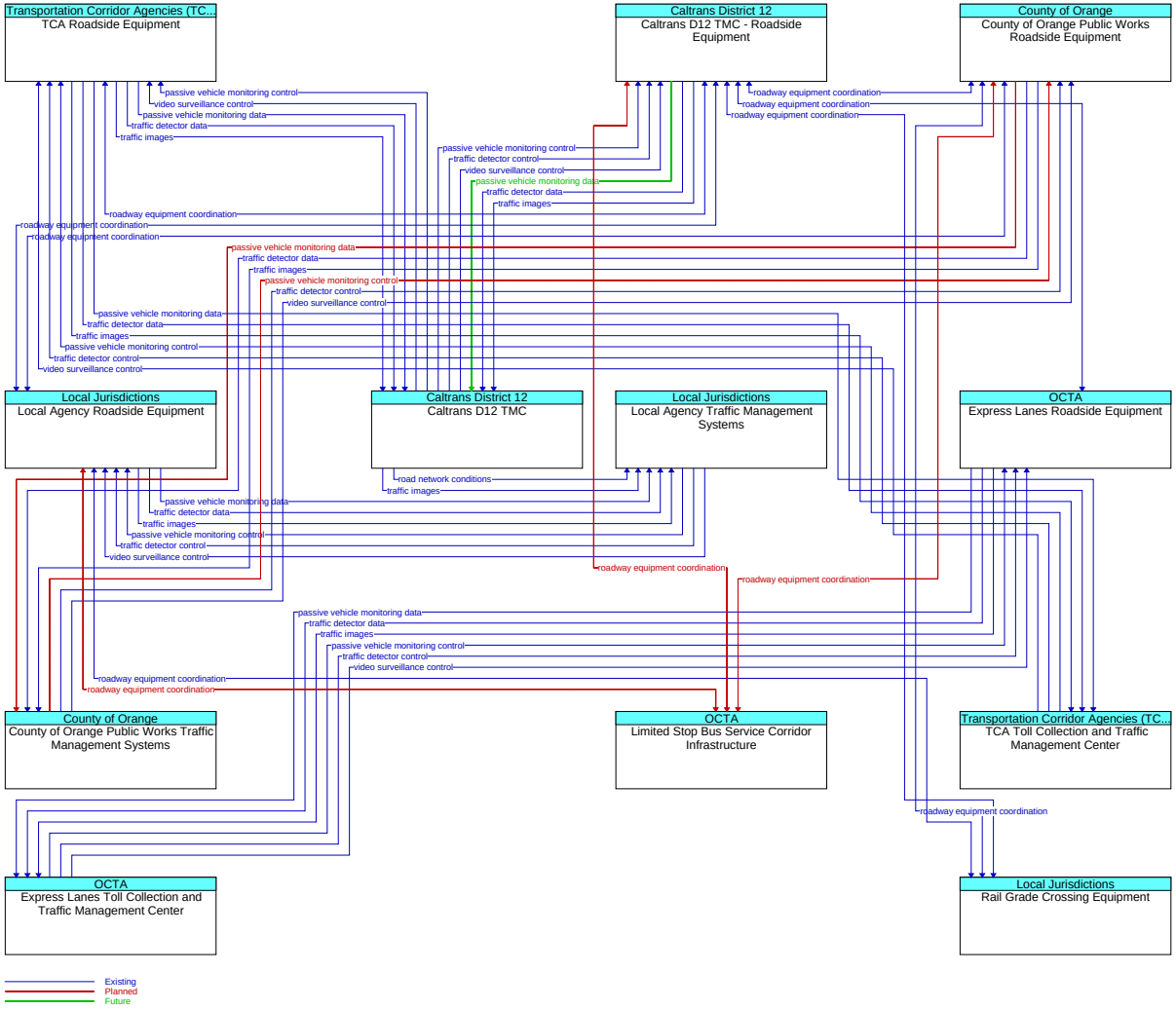
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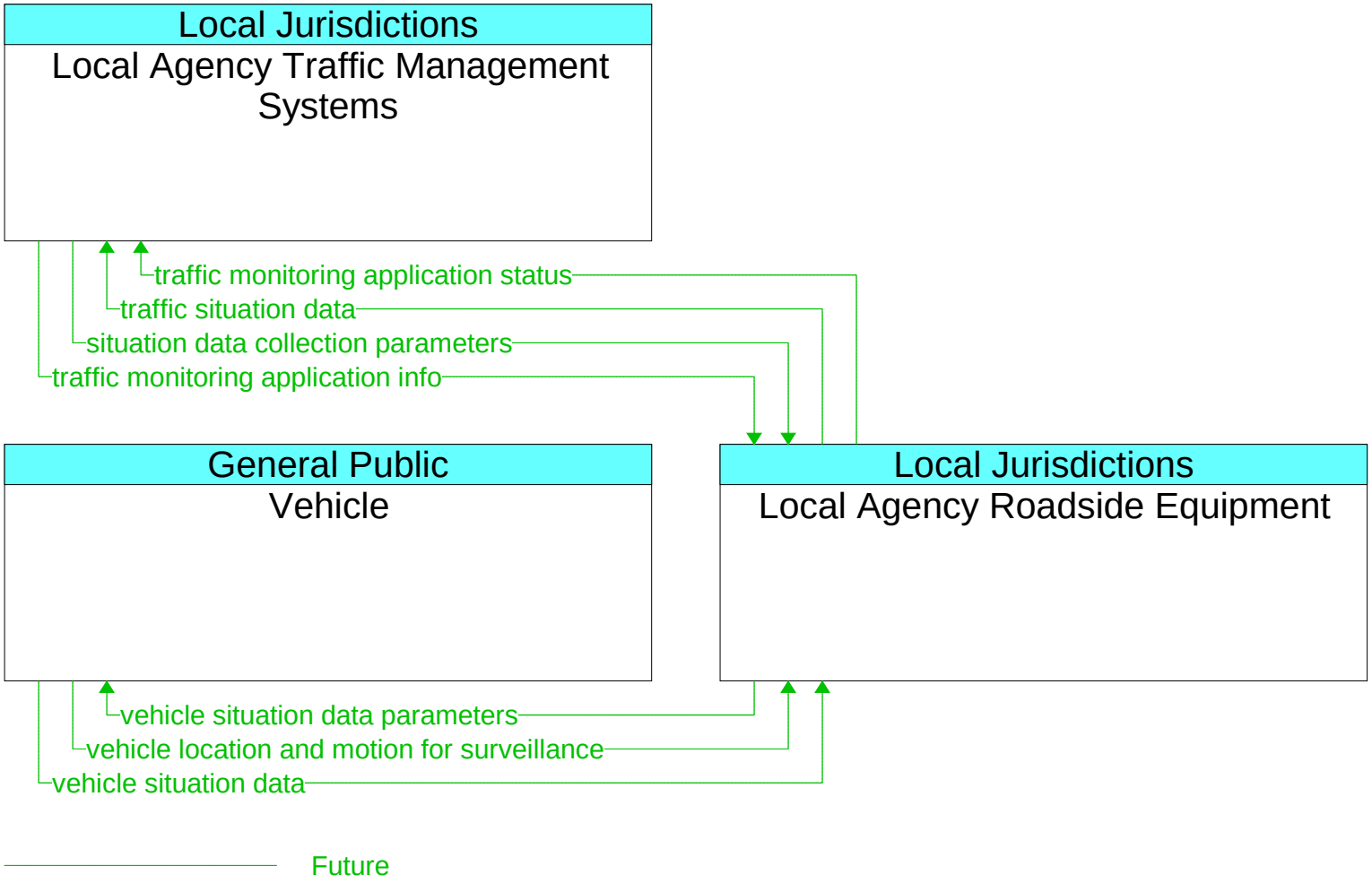
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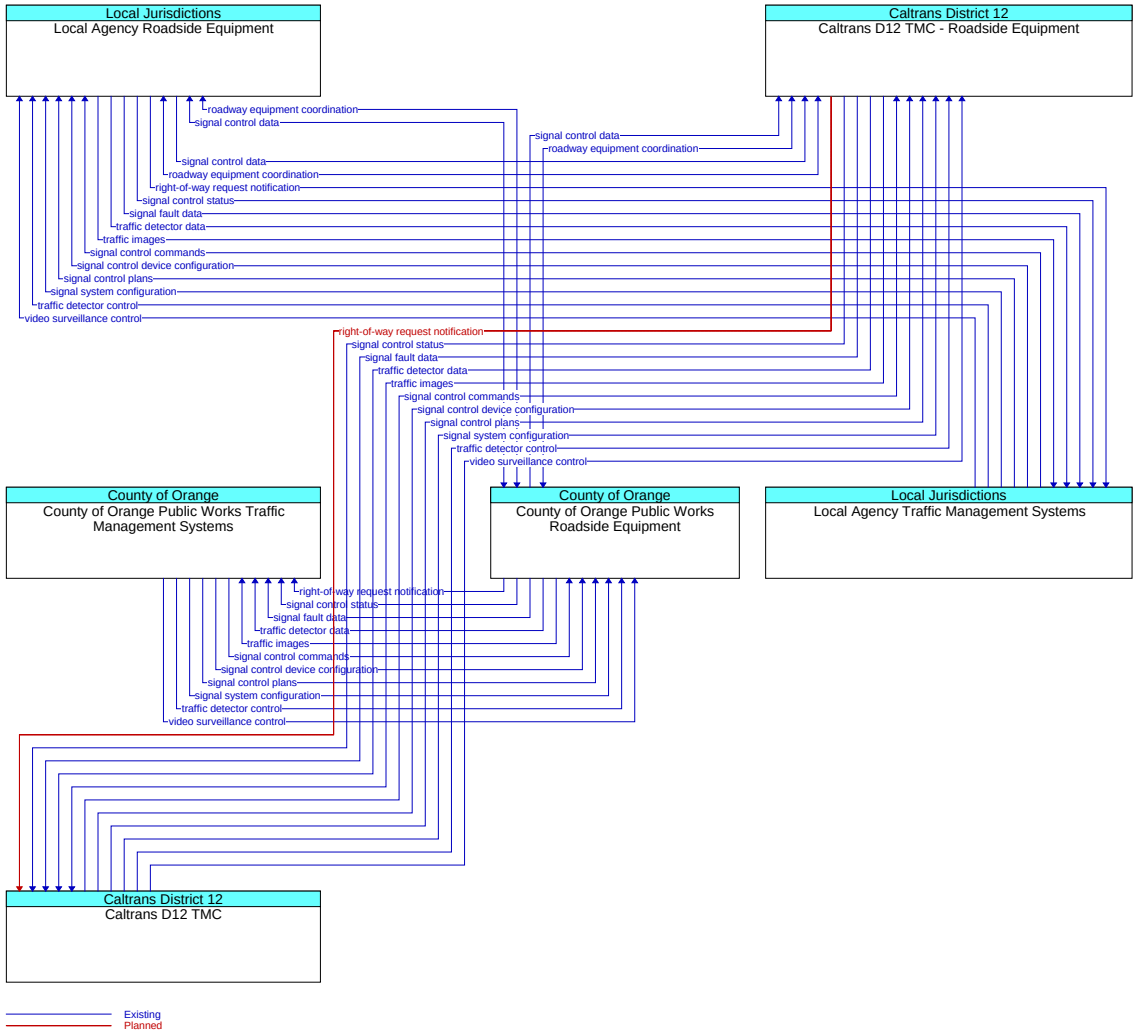
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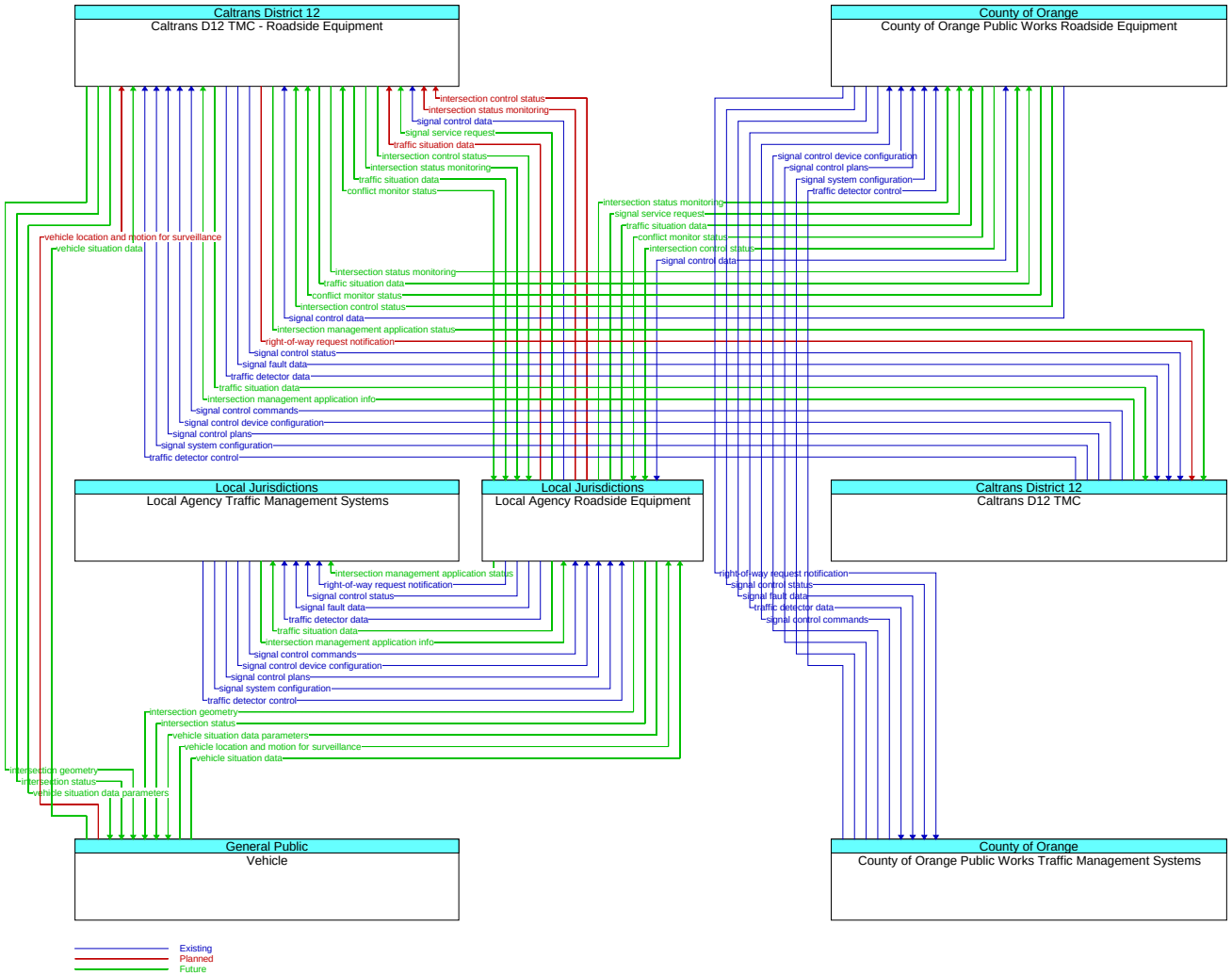
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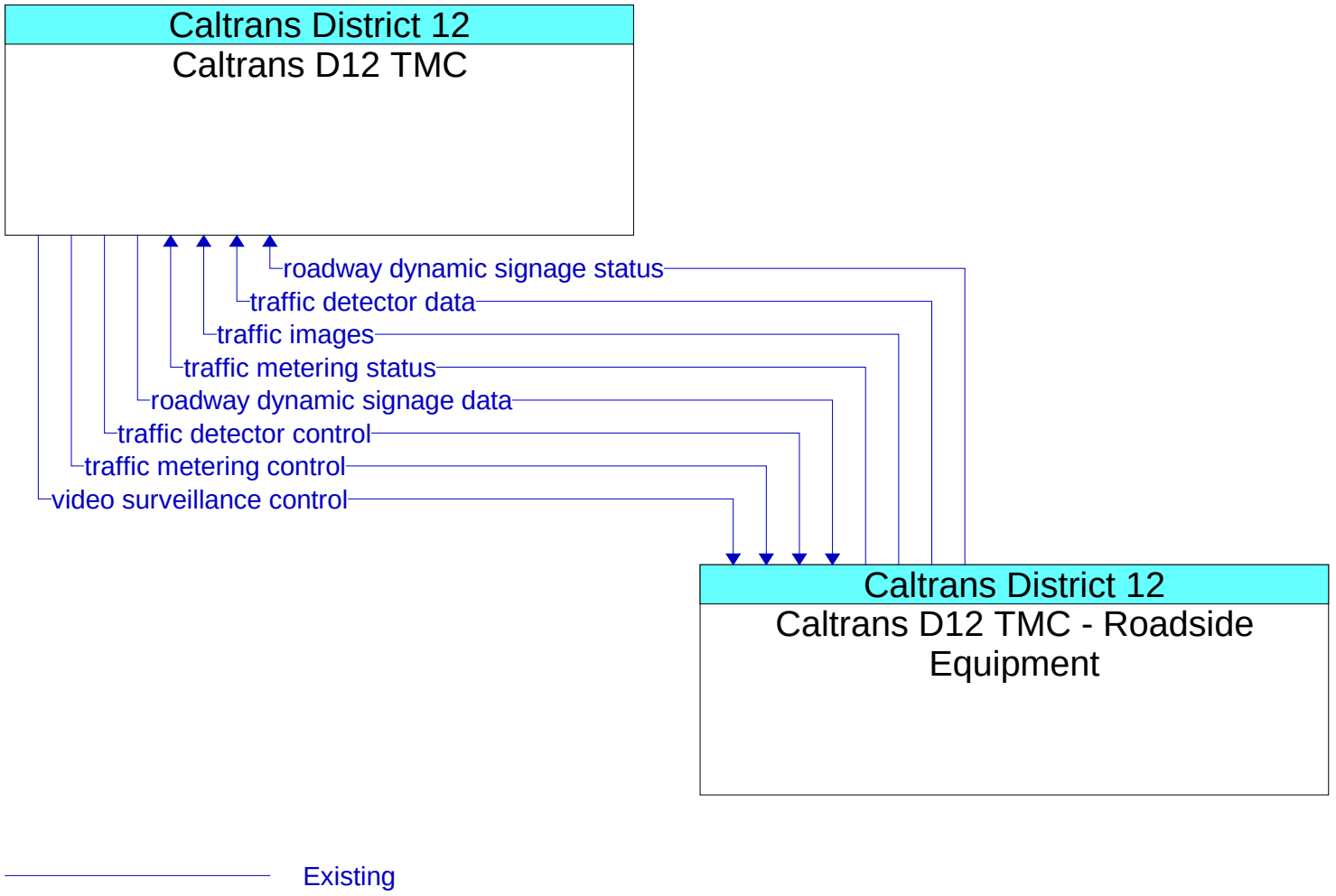
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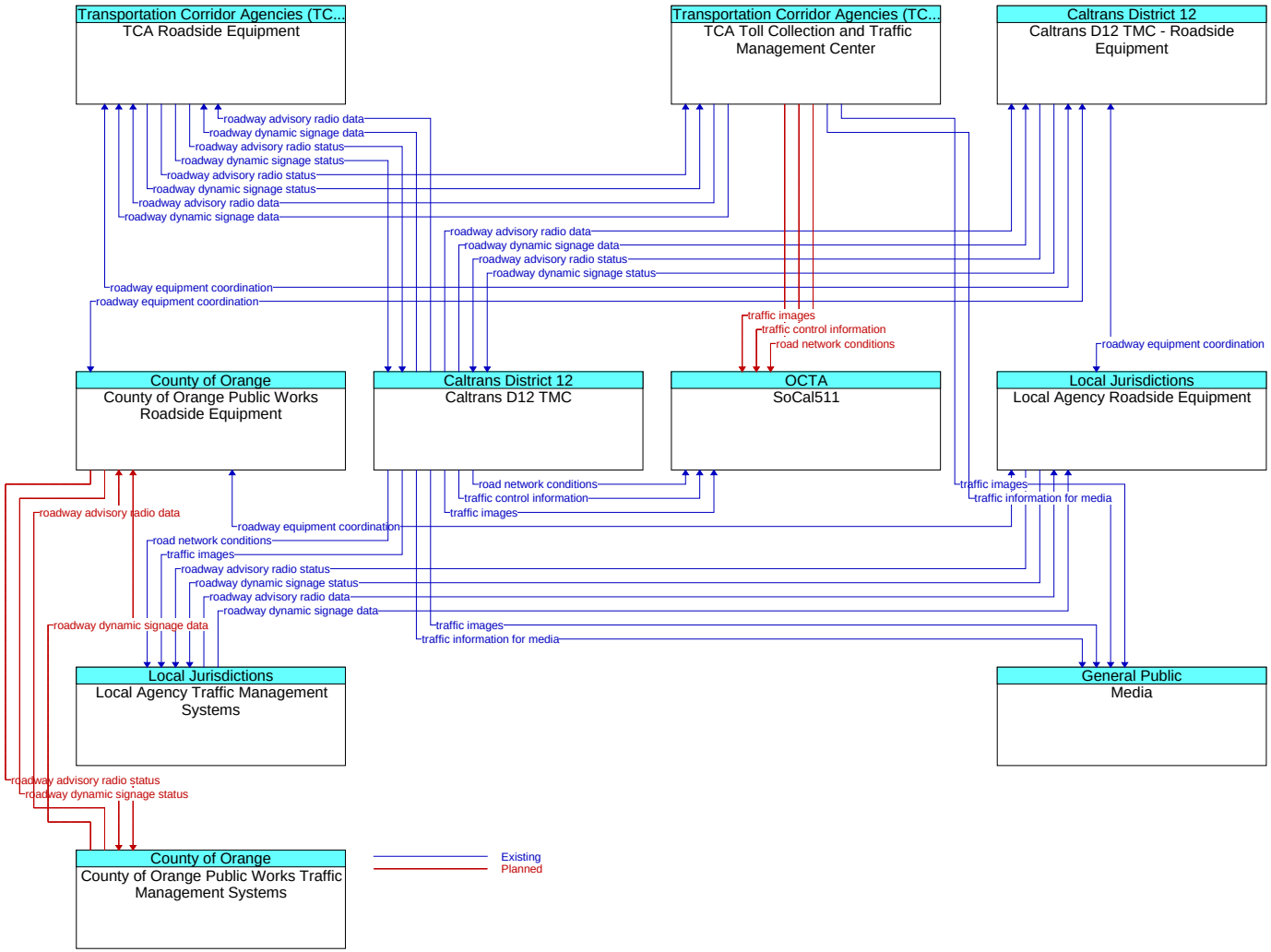
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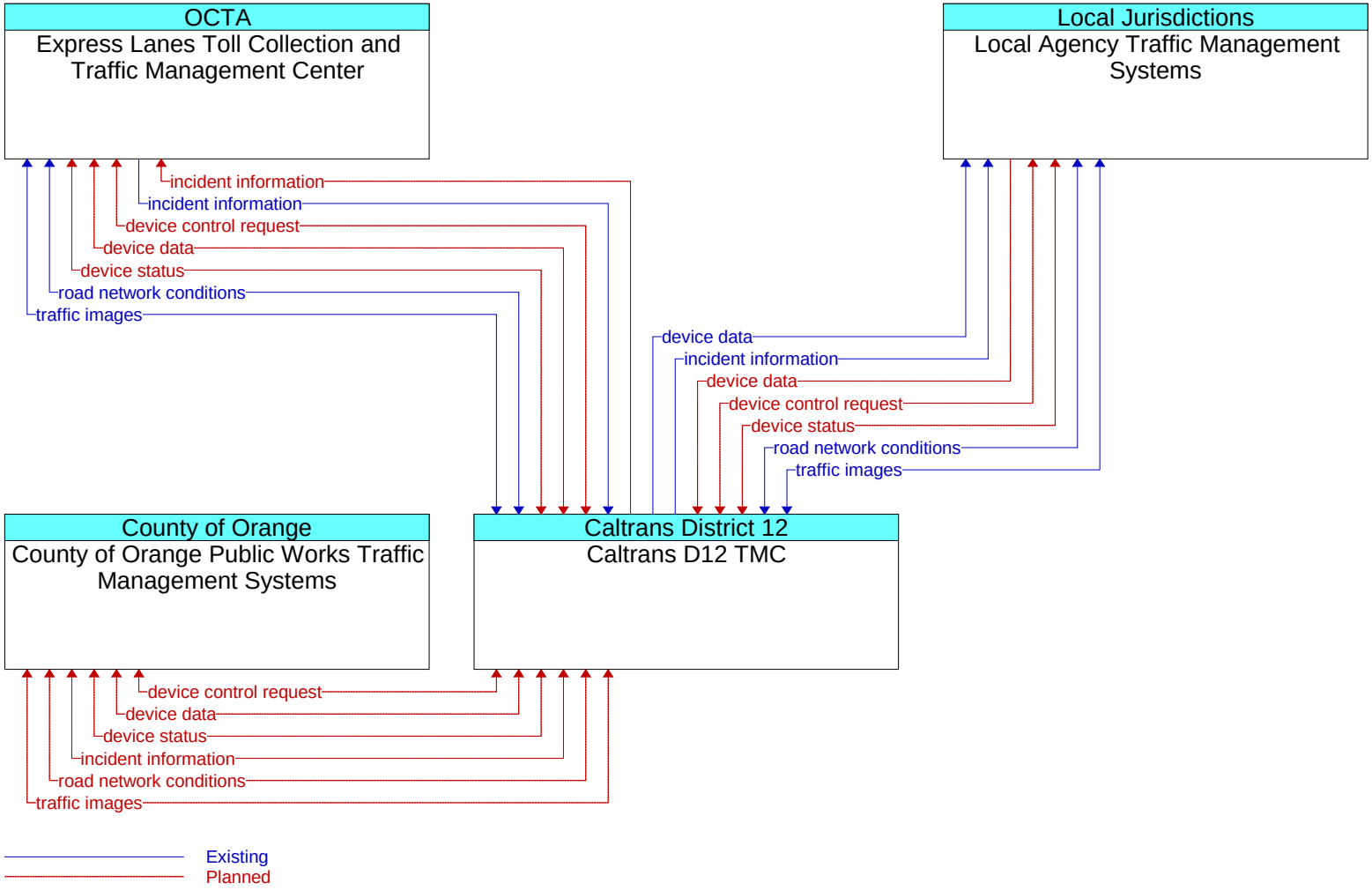
OCTA
Express Lanes Toll Collection and Traffic Management Center
Local Jurisdictions
Local Agency Traffic Management Systems
incident information
incident information
device control request
device data
device status
road network conditions
traffic images
device data
incident information
device data
device control request
device status
road network conditions
traffic images
County of Orange
County of Orange Public Works Traffic Management Systems
Caltrans District 12
Caltrans D12 TMC
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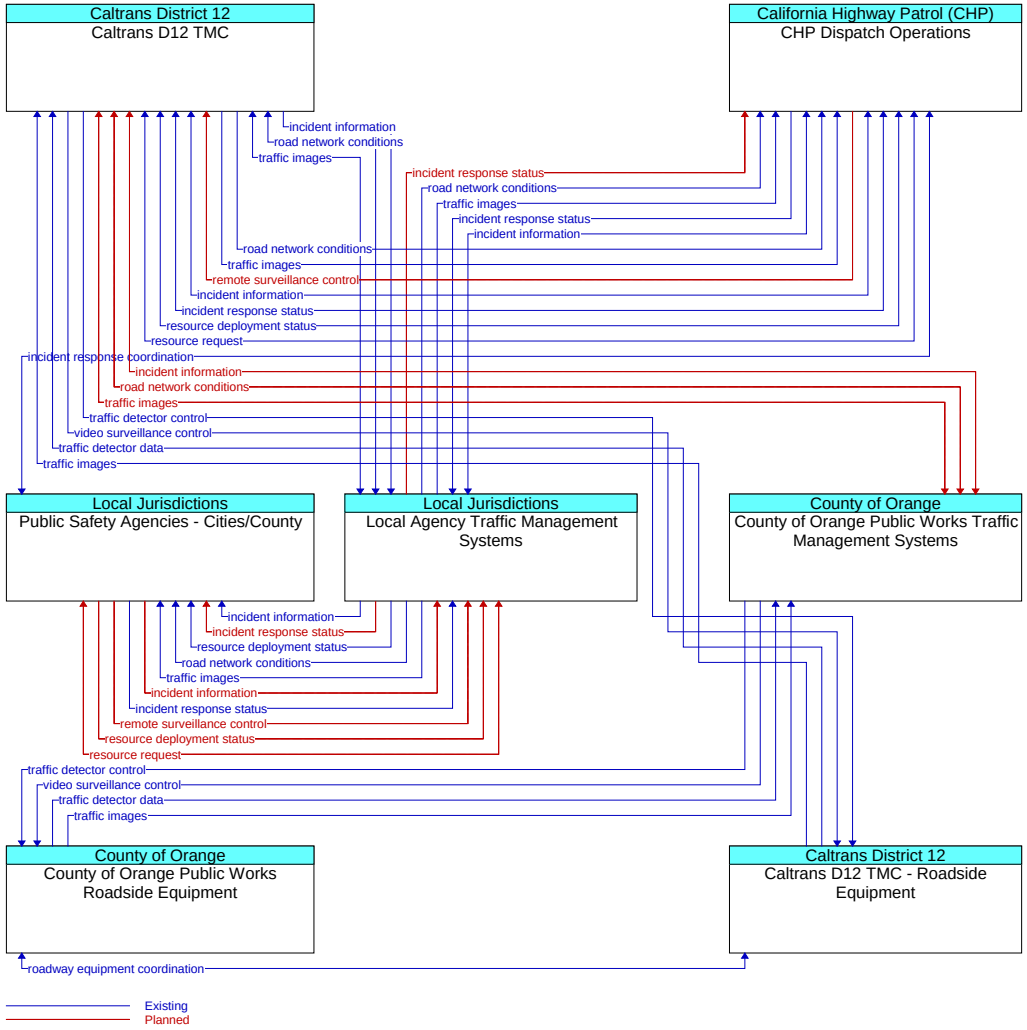
device data
device status
incident information
road network conditions
traffic images
Existing
Planned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Caltrans D12 TMC
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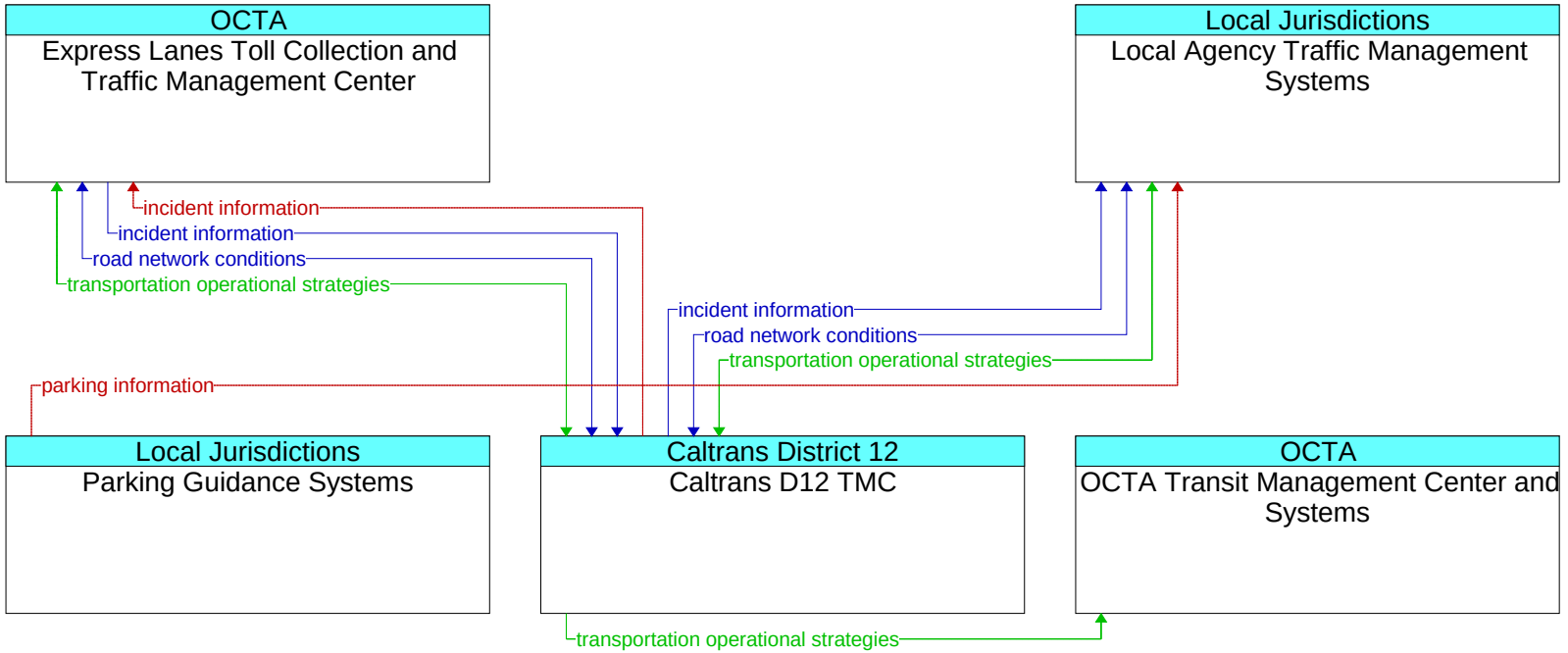
CHP Dispatch Operations
incident information
road network conditions
traffic images
incident response status
road network conditions
traffic images
incident response status
incident information
road network conditions
traffic images
remote surveillance control
incident information
incident response status
resource deployment status
resource request
incident response coordination
incident information
road network conditions
traffic images
traffic detector control
video surveillance control
traffic detector data
traffic images
Local Jurisdictions
Public Safety Agencies - Cities/County
Local Jurisdictions
Local Agency Traffic Management Systems
County of Orange
County of Orange Public Works Traffic Management Systems
incident information
incident response status
resource deployment status
road network conditions
traffic images
incident information
incident response status
remote surveillance control
resource deployment status
resource request
traffic detector control
video surveillance control
traffic detector data
traffic images
County of Orange
County of Orange Public Works Roadside Equipment
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
roadway equipment coordination
Existing
Planned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Local Jurisdictions
Local Agency Traffic Management Systems
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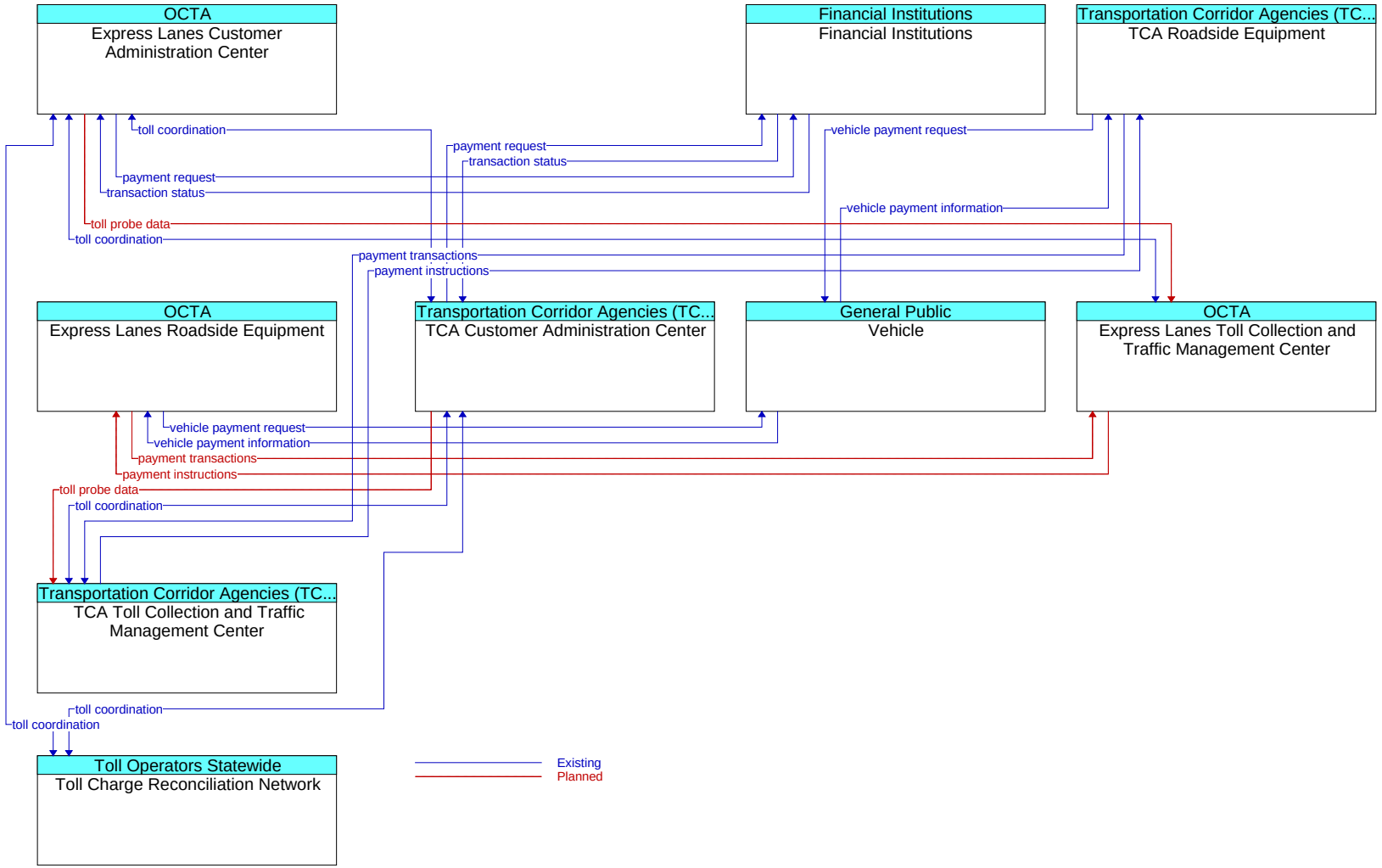
incident information
road network conditions
transportation operational strategies
incident information
road network conditions
transportation operational strategies
parking information
Local Jurisdictions
Parking Guidance Systems
Caltrans District 12
Caltrans D12 TMC
OCTA
OCTA Transit Management Center and Systems
transportation operational strategies
Existing
Planned
Future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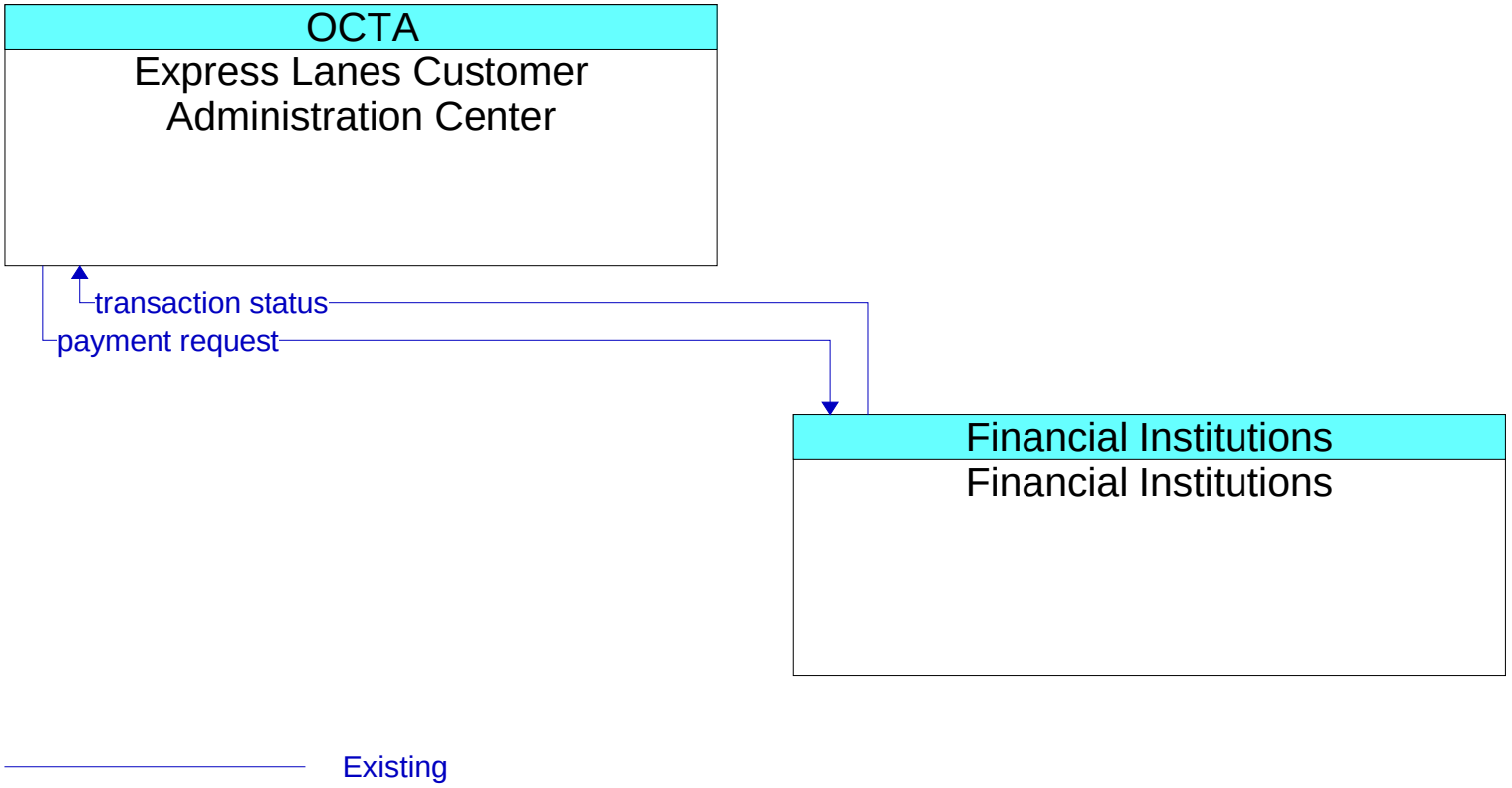
Financial Institutions
Financial Institutions
Transportation Corridor Agencies (TC...
TCA Roadside Equipment
toll coordination
payment request
transaction status
vehicle payment request
payment request
transaction status
vehicle payment information
toll probe data
toll coordination
payment transactions
payment instructions
OCTA
Express Lanes Roadside Equipment
Transportation Corridor Agencies (TC...
TCA Customer Administration Center
General Public
Vehicle
OCTA
Express Lanes Toll Collection and Traffic Management Center
vehicle payment request
vehicle payment information
payment transactions
payment instructions
toll probe data
toll coordination
Transportation Corridor Agencies (TC...
TCA Toll Collection and Traffic Management Center
toll coordination
toll coordination
Toll Operators Statewide
Toll Charge Reconciliation Network
Existing
Planned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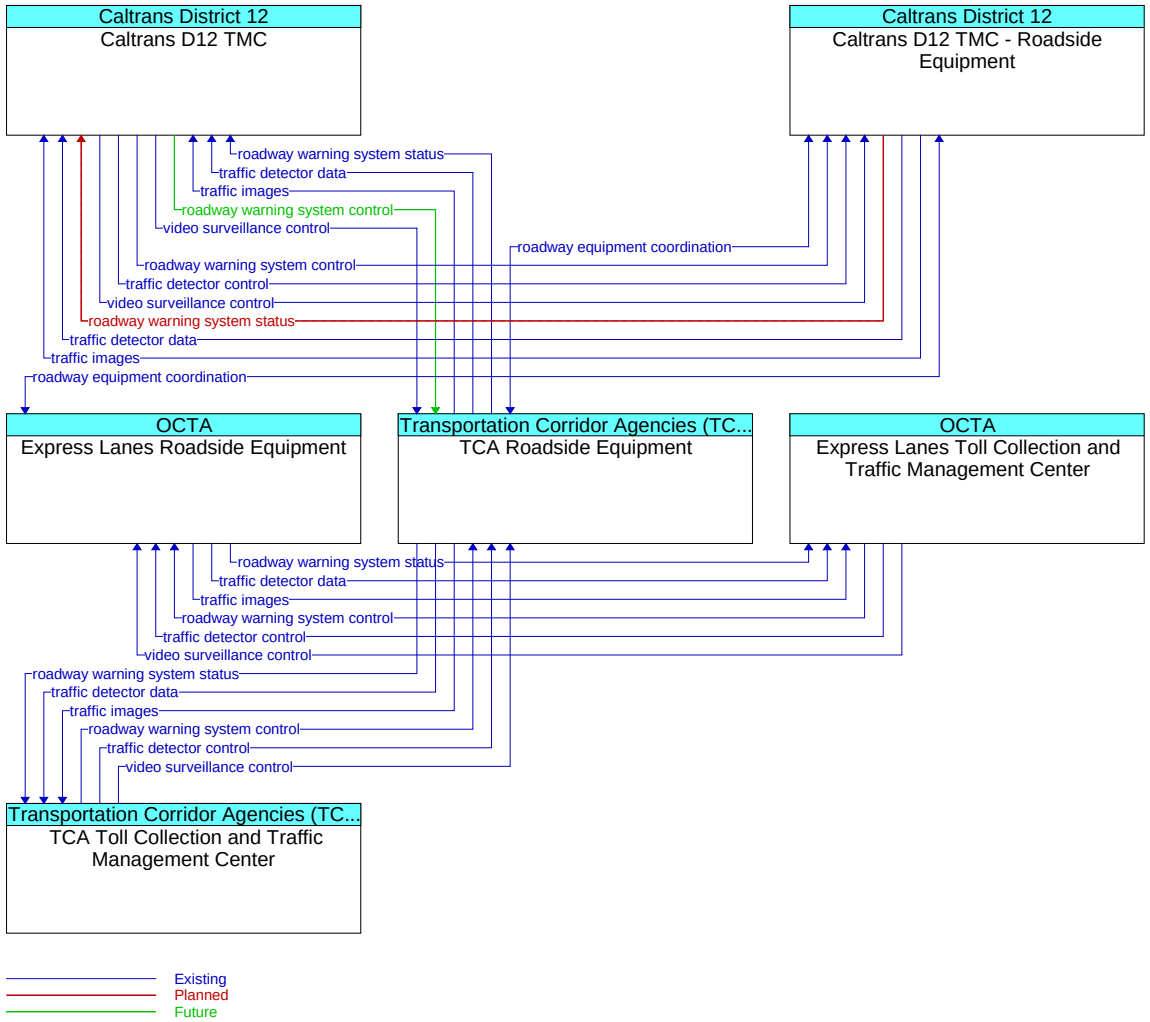
Express Lanes Customer Administration Center
transaction status
payment request
Financial Institutions
Financial Institutions
Existing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Caltrans D12 TMC
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
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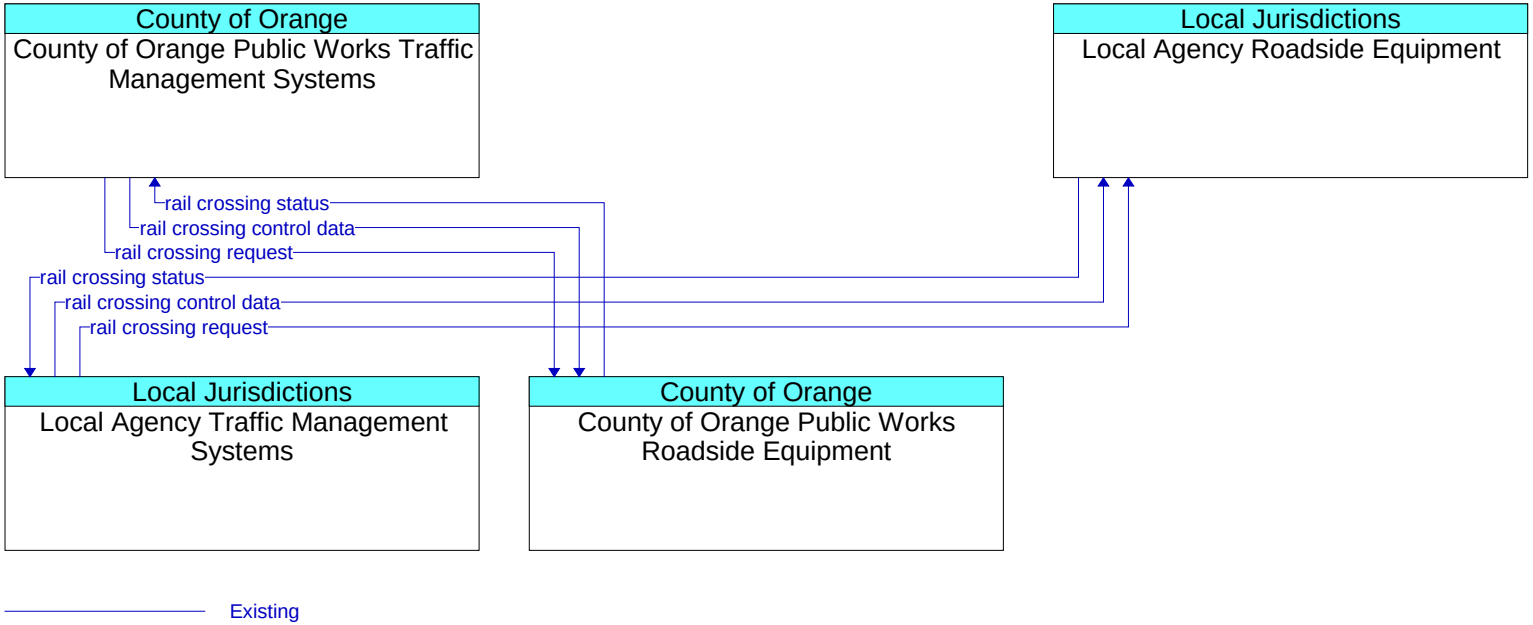
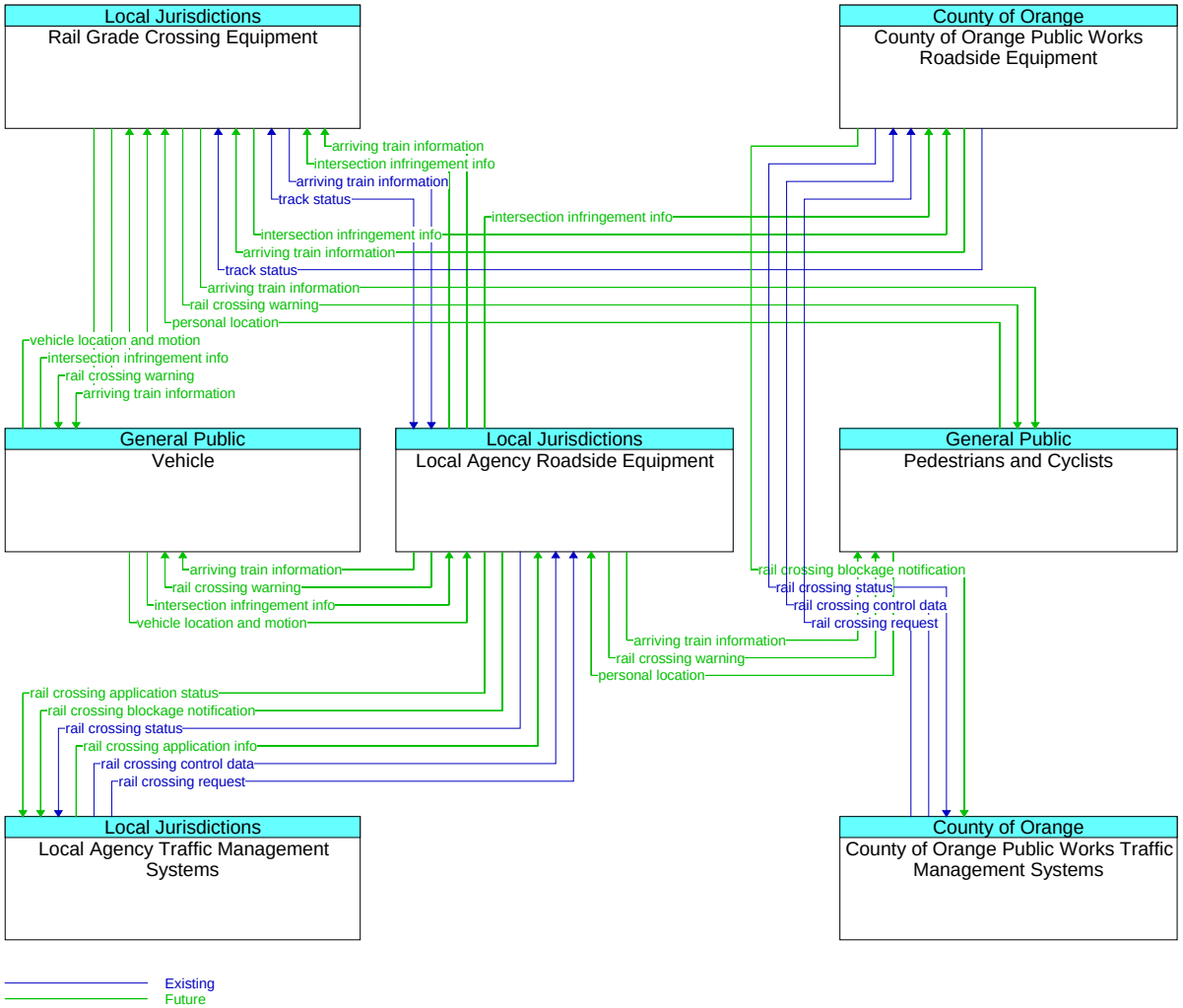
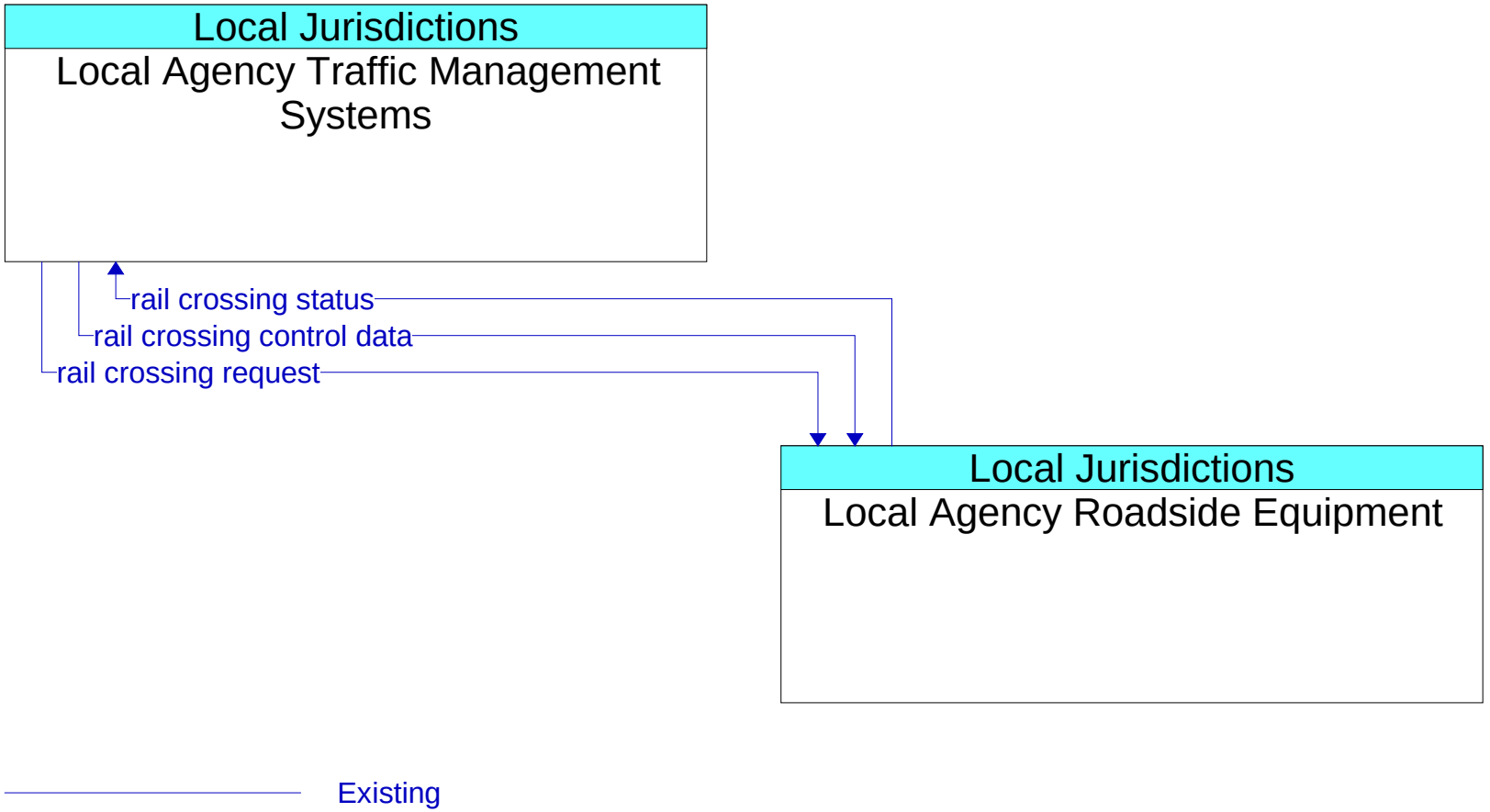
traffic detector data
traffic images
roadway warning system control
video surveillance control
roadway equipment coordination
roadway warning system control
traffic detector control
video surveillance control
roadway warning system status
traffic detector data
traffic images
roadway equipment coordination
OCTA
Express Lanes Roadside Equipment
Transportation Corridor Agencies (TC...
TCA Roadside Equipment
OCTA
Express Lanes Toll Collection and Traffic Management Center
roadway warning system status
traffic detector data
traffic images
roadway warning system control
traffic detector control
video surveillance control
roadway warning system status
traffic detector data
traffic images
roadway warning system control
traffic detector control
video surveillance control
Transportation Corridor Agencies (TC...
TCA Toll Collection and Traffic Management Center
Existing
Planned
Future


County of Orange
County of Orange Public Works Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
rail crossing status
rail crossing control data
rail crossing request
rail crossing status
rail crossing control data
rail crossing request
Local Jurisdictions
Local Agency Traffic Management Systems
County of Orange
County of Orange Public Works Roadside Equipment
Existing


Local Jurisdictions
Rail Grade Crossing Equipment
County of Orange
County of Orange Public Works Roadside Equipment
arriving train information
intersection infringement info
arriving train information
track status
intersection infringement info
arriving train information
track status
arriving train information
rail crossing warning
personal location
intersection infringement info
arriving train information
vehicle location and motion
intersection infringement info
rail crossing warning
arriving train information
General Public
Vehicle
Local Jurisdictions
Local Agency Roadside Equipment
General Public
Pedestrians and Cyclists
arriving train information
rail crossing warning
intersection infringement info
vehicle location and motion
rail crossing blockage notification
rail crossing status
rail crossing control data
rail crossing request
arriving train information
rail crossing warning
personal location
rail crossing application status
rail crossing blockage notification
rail crossing status
rail crossing application info
rail crossing control data
rail crossing request
Local Jurisdictions
Local Agency Traffic Management Systems
County of Orange
County of Orange Public Works Traffic Management Systems
Existing
Future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Local Agency Traffic Management Systems
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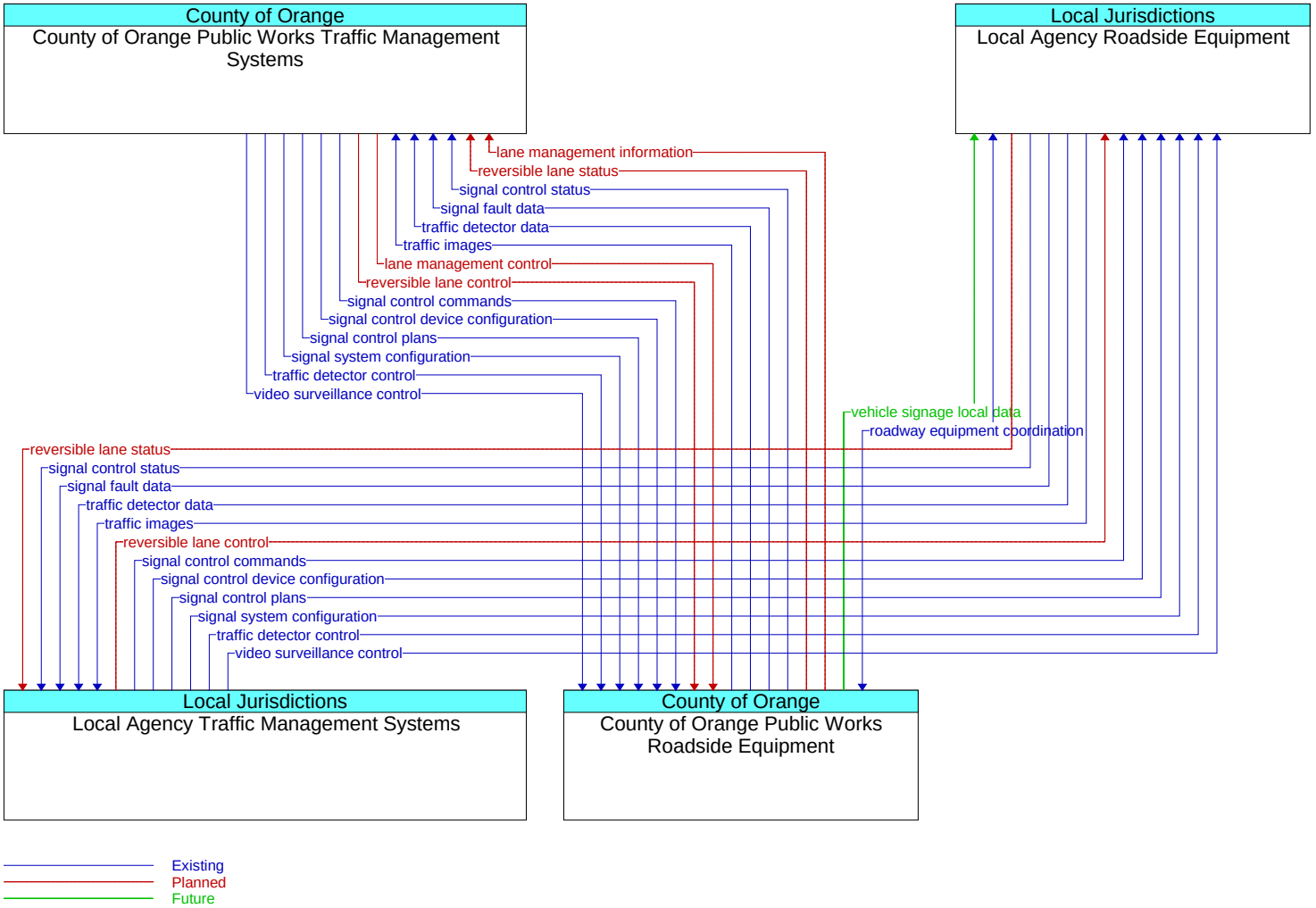
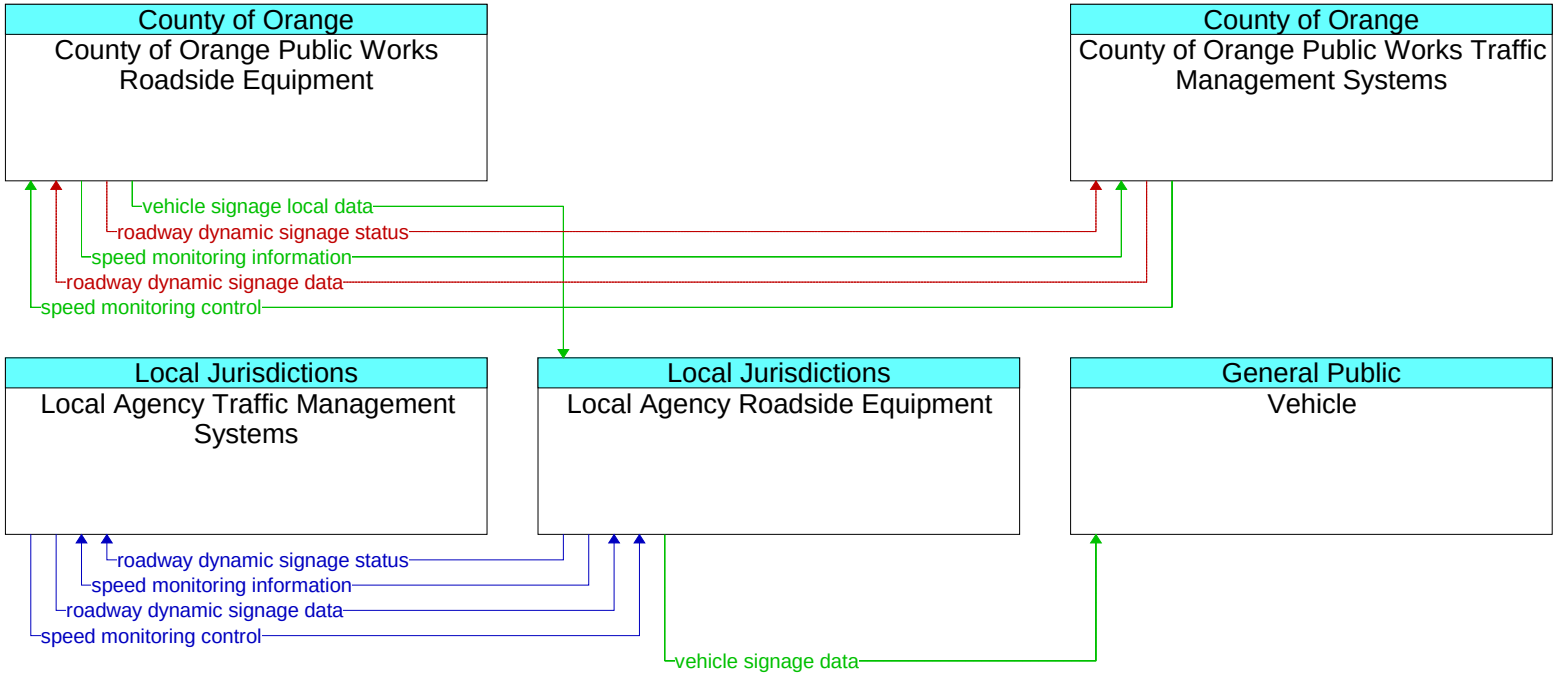
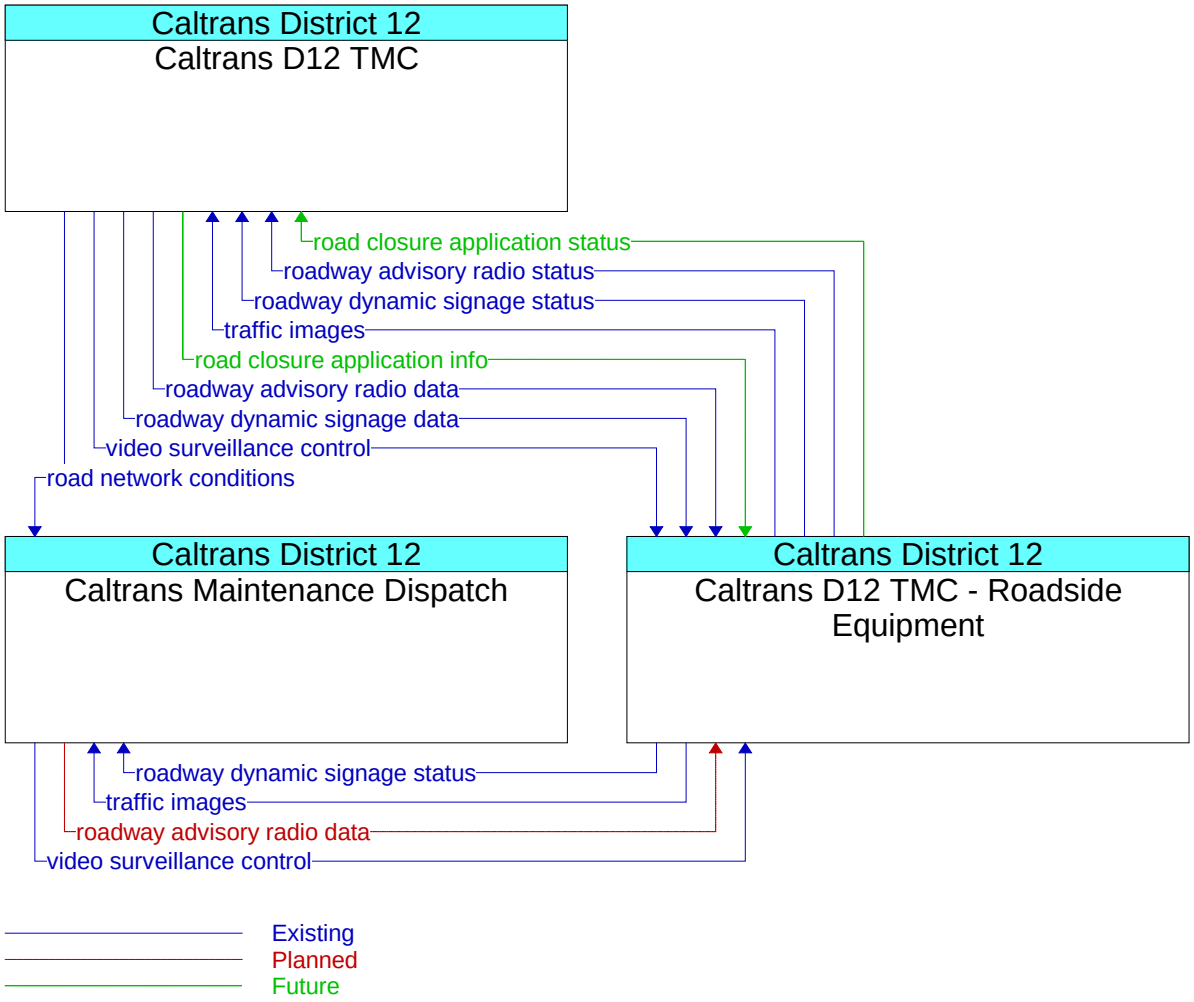
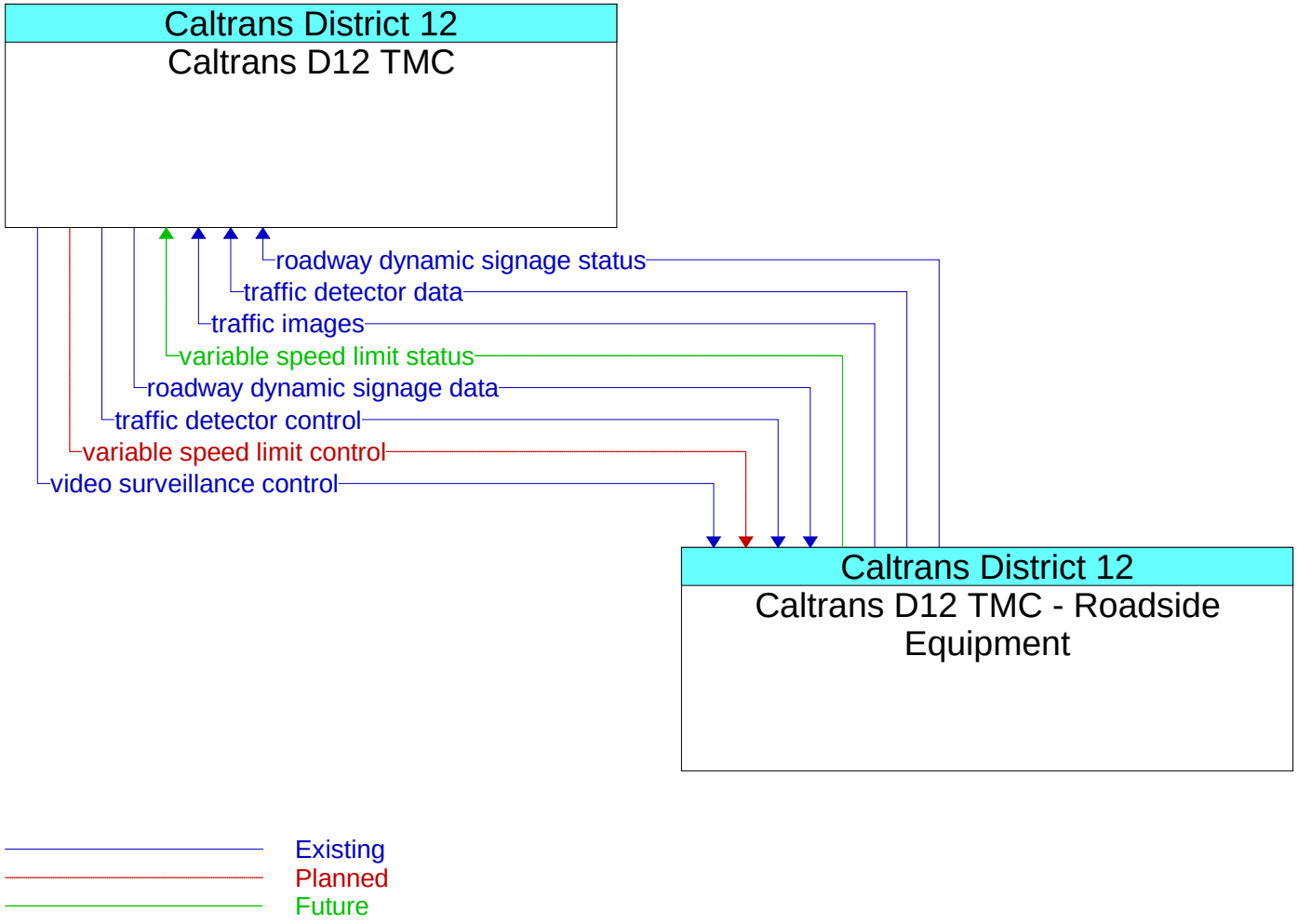
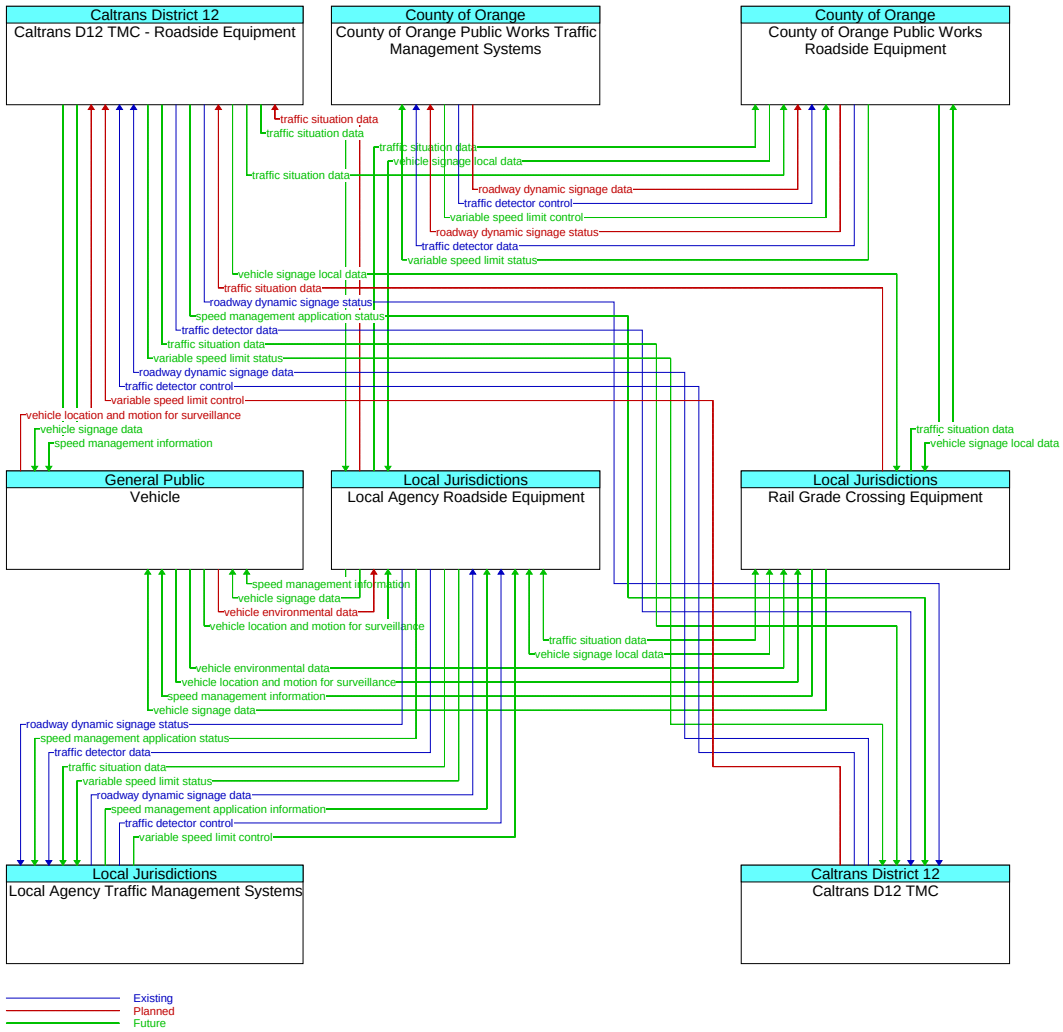
rail crossing control data
rail crossing request
Local Jurisdictions
Local Agency Roadside Equipment
Existing


County of Orange
County of Orange Public Works Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
lane management information
reversible lane status
signal control status
signal fault data
traffic detector data
traffic images
lane management control
reversible lane control
signal control commands
signal control device configuration
signal control plans
signal system configuration
traffic detector control
video surveillance control
vehicle signage local data
roadway equipment coordination
reversible lane status
signal control status
signal fault data
traffic detector data
traffic images
reversible lane control
signal control commands
signal control device configuration
signal control plans
signal system configuration
traffic detector control
video surveillance control
Local Jurisdictions
Local Agency Traffic Management Systems
County of Orange
County of Orange Public Works Roadside Equipment
Existing
Planned
Future


County of Orange
County of Orange Public Works Roadside Equipment
County of Orange
County of Orange Public Works Traffic Management Systems
vehicle signage local data
roadway dynamic signage status
speed monitoring information
roadway dynamic signage data
speed monitoring control
Local Jurisdictions
Local Agency Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
General Public
Vehicle
roadway dynamic signage status
speed monitoring information
roadway dynamic signage data
speed monitoring control
vehicle signage data
Existing
Planned
Future


Caltrans District 12
Caltrans D12 TMC
road closure application status
roadway advisory radio status
roadway dynamic signage status
traffic images
road closure application info
roadway advisory radio data
roadway dynamic signage data
video surveillance control
road network conditions
Caltrans District 12
Caltrans Maintenance Dispatch
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
roadway dynamic signage status
traffic images
roadway advisory radio data
video surveillance control
Existing
Planned
Future


Caltrans District 12
Caltrans D12 TMC
roadway dynamic signage status
traffic detector data
traffic images
variable speed limit status
roadway dynamic signage data
traffic detector control
variable speed limit control
video surveillance control
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing
Planned
Future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Caltrans D12 TMC - Roadside Equipment
County of Orange
County of Orange Public Works Traffic Management Systems
County of Orange
County of Orange Public Works Roadside Equipment
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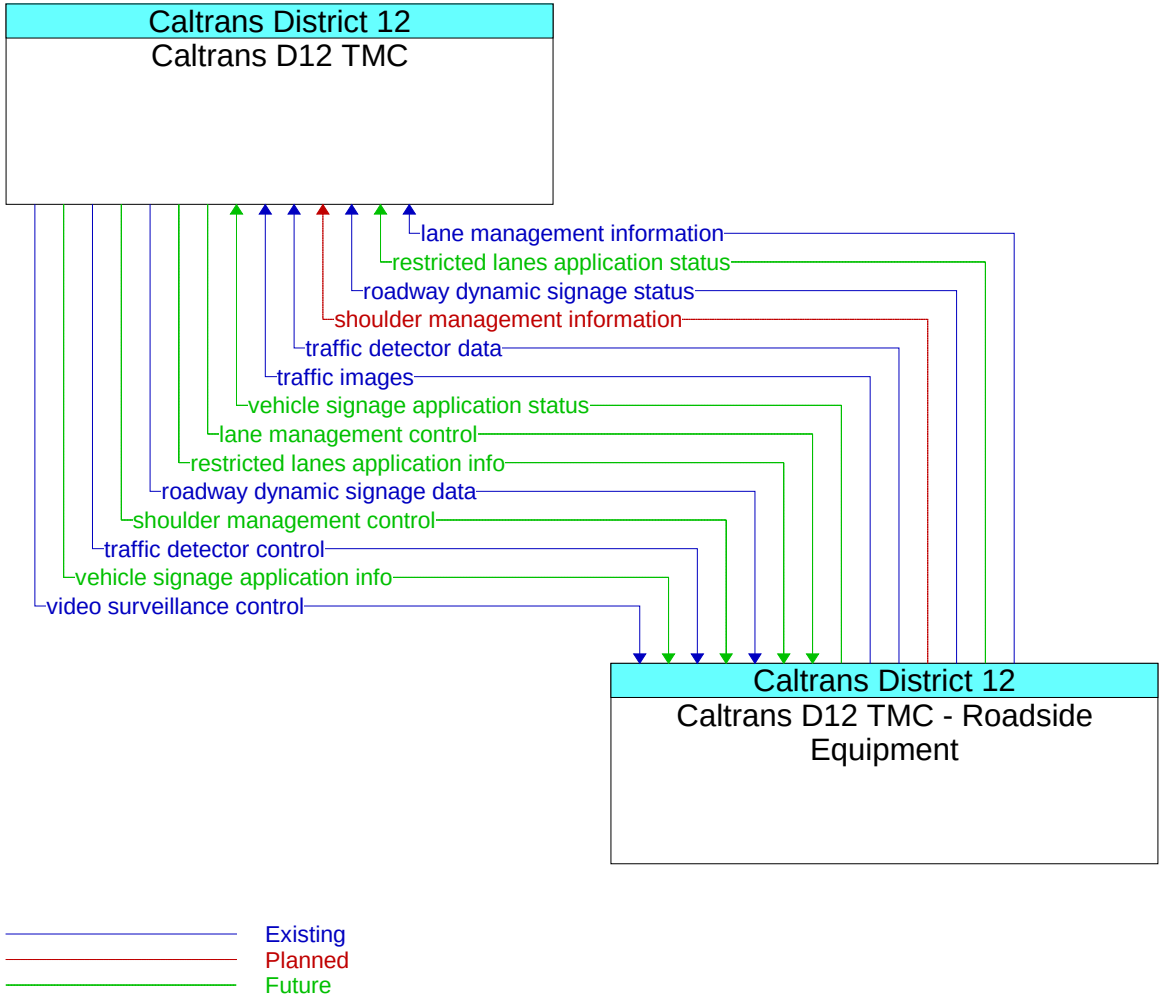
traffic situation data
vehicle signage local data
traffic situation data
roadway dynamic signage data
traffic detector control
variable speed limit control
roadway dynamic signage status
traffic detector data
variable speed limit status
vehicle signage local data
traffic situation data
roadway dynamic signage status
speed management application status
traffic detector data
traffic situation data
variable speed limit status
roadway dynamic signage data
traffic detector control
variable speed limit control
vehicle location and motion for surveillance
vehicle signage data
speed management information
traffic situation data
vehicle signage local data
General Public
Vehicle
Local Jurisdictions
Local Agency Roadside Equipment
Local Jurisdictions
Rail Grade Crossing Equipment
speed management information
vehicle signage data
vehicle environmental data
vehicle location and motion for surveillance
traffic situation data
vehicle signage local data
vehicle environmental data
vehicle location and motion for surveillance
speed management information
vehicle signage data
roadway dynamic signage status
speed management application status
traffic detector data
traffic situation data
variable speed limit status
roadway dynamic signage data
speed management application information
traffic detector control
variable speed limit control
Local Jurisdictions
Local Agency Traffic Management Systems
Caltrans District 12
Caltrans D12 TMC
Existing
Planned
Future


Caltrans District 12
Caltrans D12 TMC
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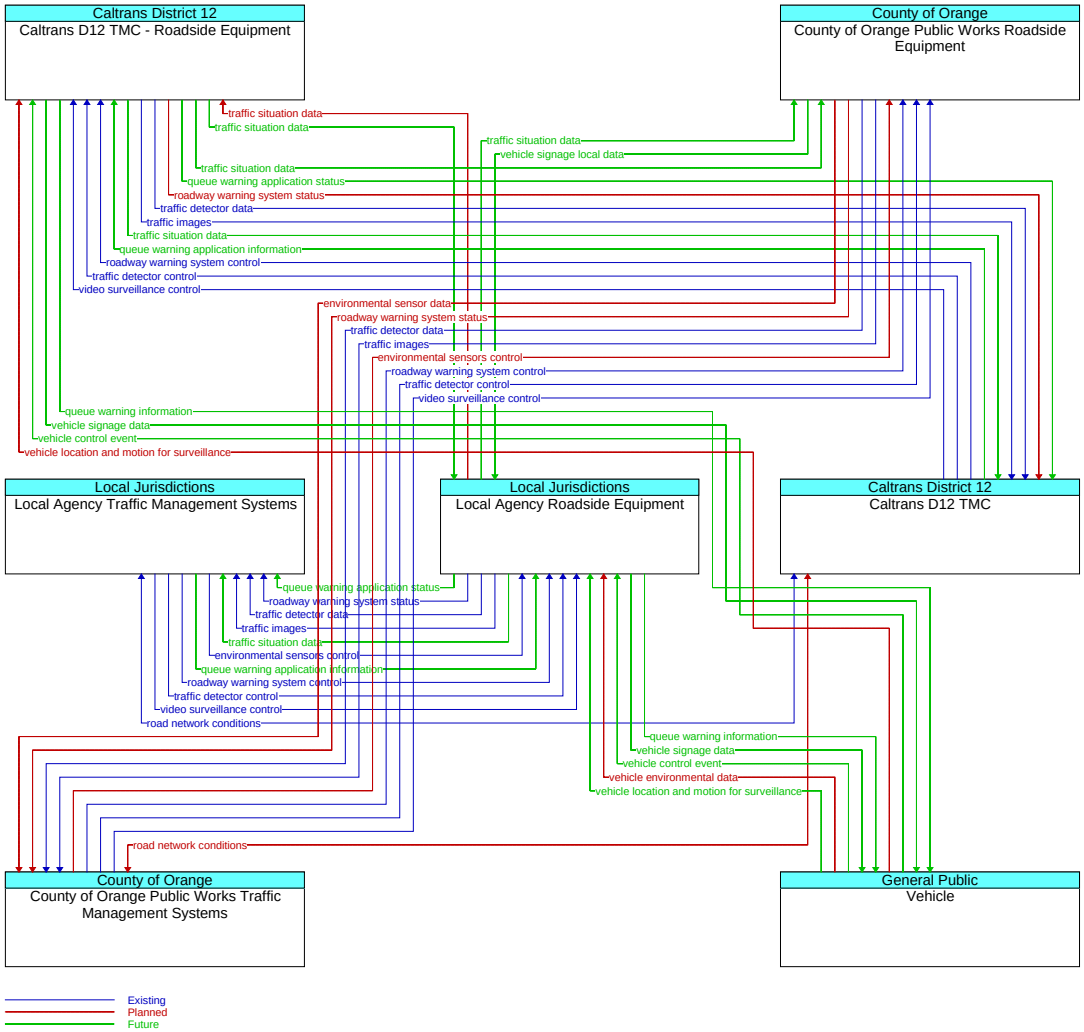
restricted lanes application status
roadway dynamic signage status
shoulder management information
traffic detector data
traffic images
vehicle signage application status
lane management control
restricted lanes application info
roadway dynamic signage data
shoulder management control
traffic detector control
vehicle signage application info
video surveillance control
Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
Existing
Planned
Future


Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
County of Orange
County of Orange Public Works Roadside Equipment
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traffic situation data
vehicle signage local data
traffic situation data
queue warning application status
roadway warning system status
traffic detector data
traffic images
traffic situation data
queue warning application information
roadway warning system control
traffic detector control
video surveillance control
environmental sensor data
roadway warning system status
traffic detector data
traffic images
environmental sensors control
roadway warning system control
traffic detector control
video surveillance control
queue warning information
vehicle signage data
vehicle control event
vehicle location and motion for surveillance
Local Jurisdictions
Local Agency Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
Caltrans District 12
Caltrans D12 TMC
queue warning application status
roadway warning system status
traffic detector data
traffic images
traffic situation data
environmental sensors control
queue warning application information
roadway warning system control
traffic detector control
video surveillance control
road network conditions
queue warning information
vehicle signage data
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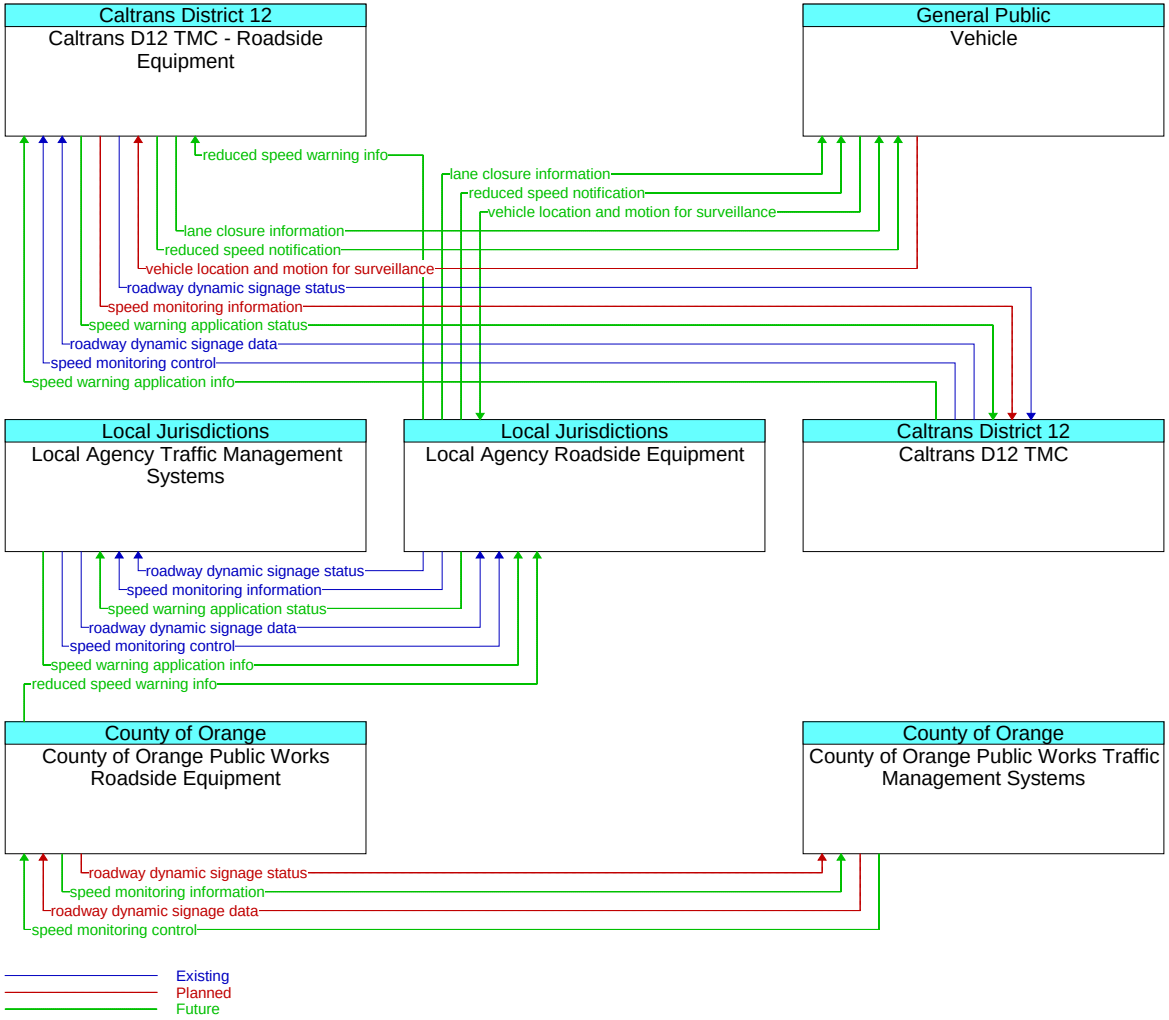
vehicle location and motion for surveillance
road network conditions
County of Orange
County of Orange Public Works Traffic Management Systems
General Public
Vehicle
Existing
Planned
Future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Caltrans D12 TMC - Roadside Equipment
General Public
Vehicle
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reduced speed notification
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lane closure information
reduced speed notification
vehicle location and motion for surveillance
roadway dynamic signage status
speed monitoring information
speed warning application status
roadway dynamic signage data
speed monitoring control
speed warning application info
Local Jurisdictions
Local Agency Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
Caltrans District 12
Caltrans D12 TMC
roadway dynamic signage status
speed monitoring information
speed warning application status
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speed monitoring control
speed warning application info
reduced speed warning info
County of Orange
County of Orange Public Works Roadside Equipment
County of Orange
County of Orange Public Works Traffic Management Systems
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roadway dynamic signage data
speed monitoring control
Existing
Planned
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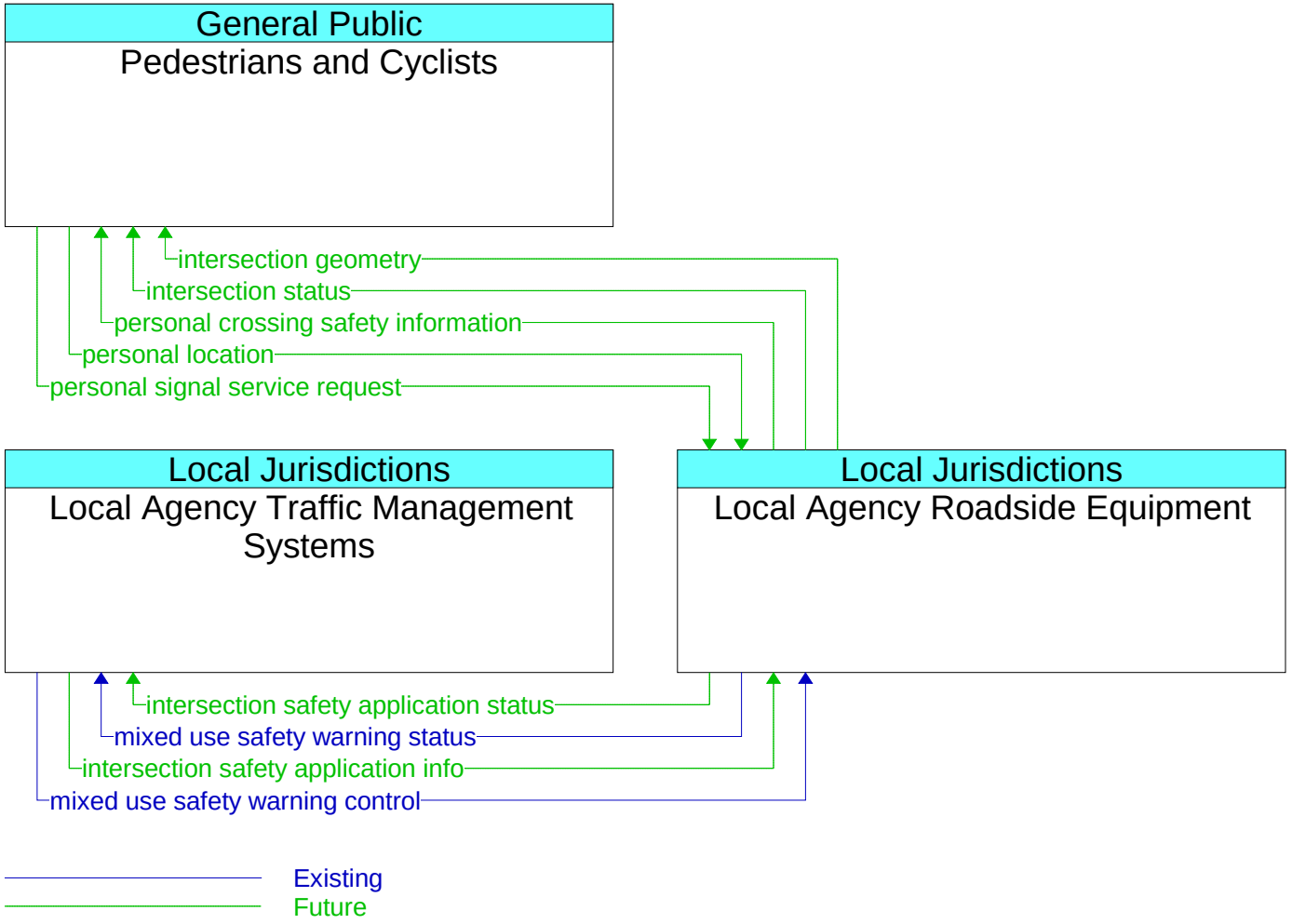
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Pedestrians and Cyclists
intersection geometry
intersection status
personal crossing safety information
personal location
personal signal service request
Local Jurisdictions
Local Agency Traffic Management Systems
Local Jurisdictions
Local Agency Roadside Equipment
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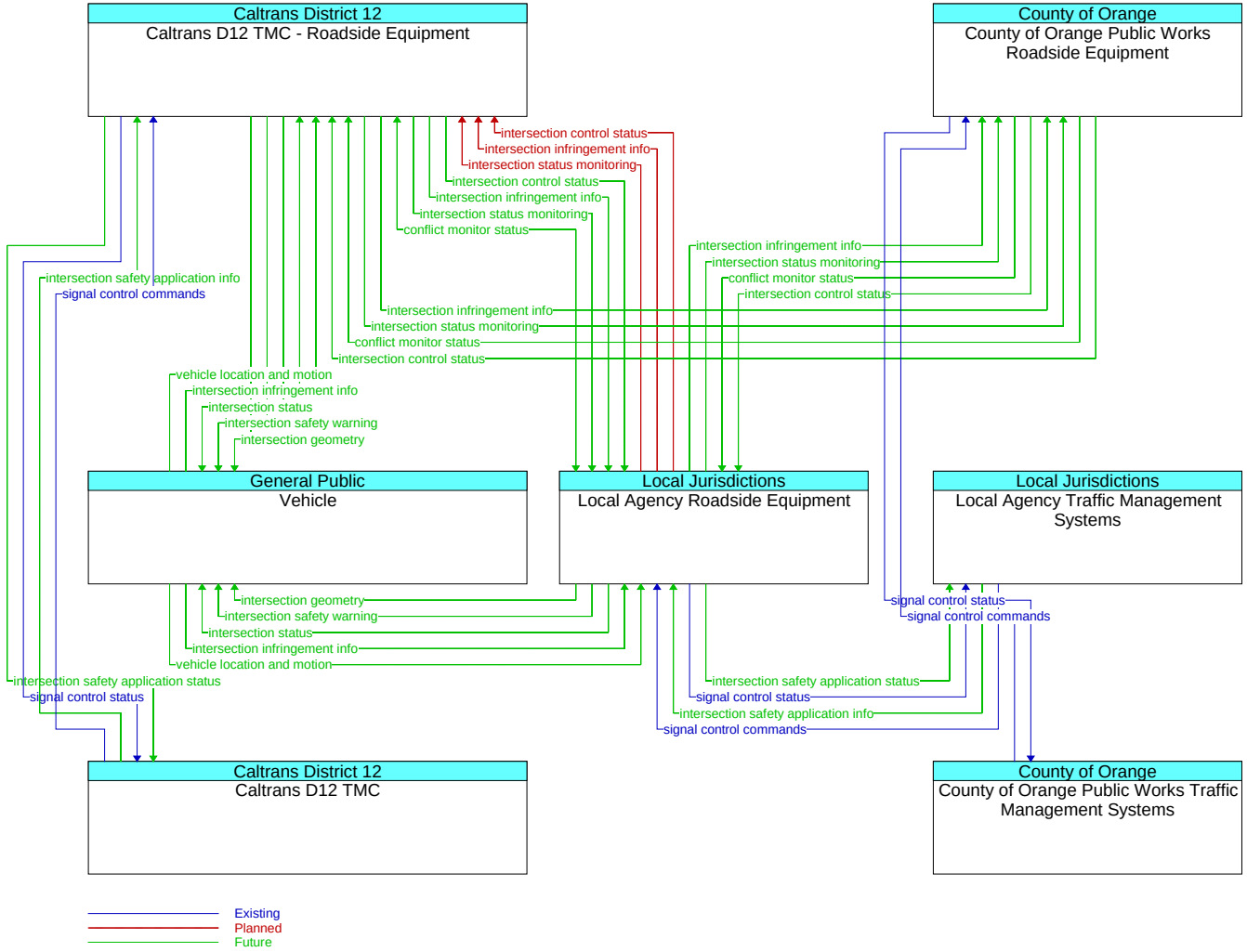
intersection safety application info
mixed use safety warning control
Existing
Future


Caltrans District 12
Caltrans D12 TMC - Roadside Equipment
County of Orange
County of Orange Public Works Roadside Equipment
intersection control status
intersection infringement info
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intersection control status
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intersection status monitoring
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intersection infringement info
intersection status monitoring
conflict monitor status
intersection control status
intersection safety application info
signal control commands
intersection infringement info
intersection status monitoring
conflict monitor status
intersection control status
vehicle location and motion
intersection infringement info
intersection status
intersection safety warning
intersection geometry
General Public
Vehicle
Local Jurisdictions
Local Agency Roadside Equipment
Local Jurisdictions
Local Agency Traffic Management Systems
intersection geometry
intersection safety warning
intersection status
intersection infringement info
vehicle location and motion
signal control status
signal control commands
intersection safety application status
signal control status
intersection safety application info
signal control commands
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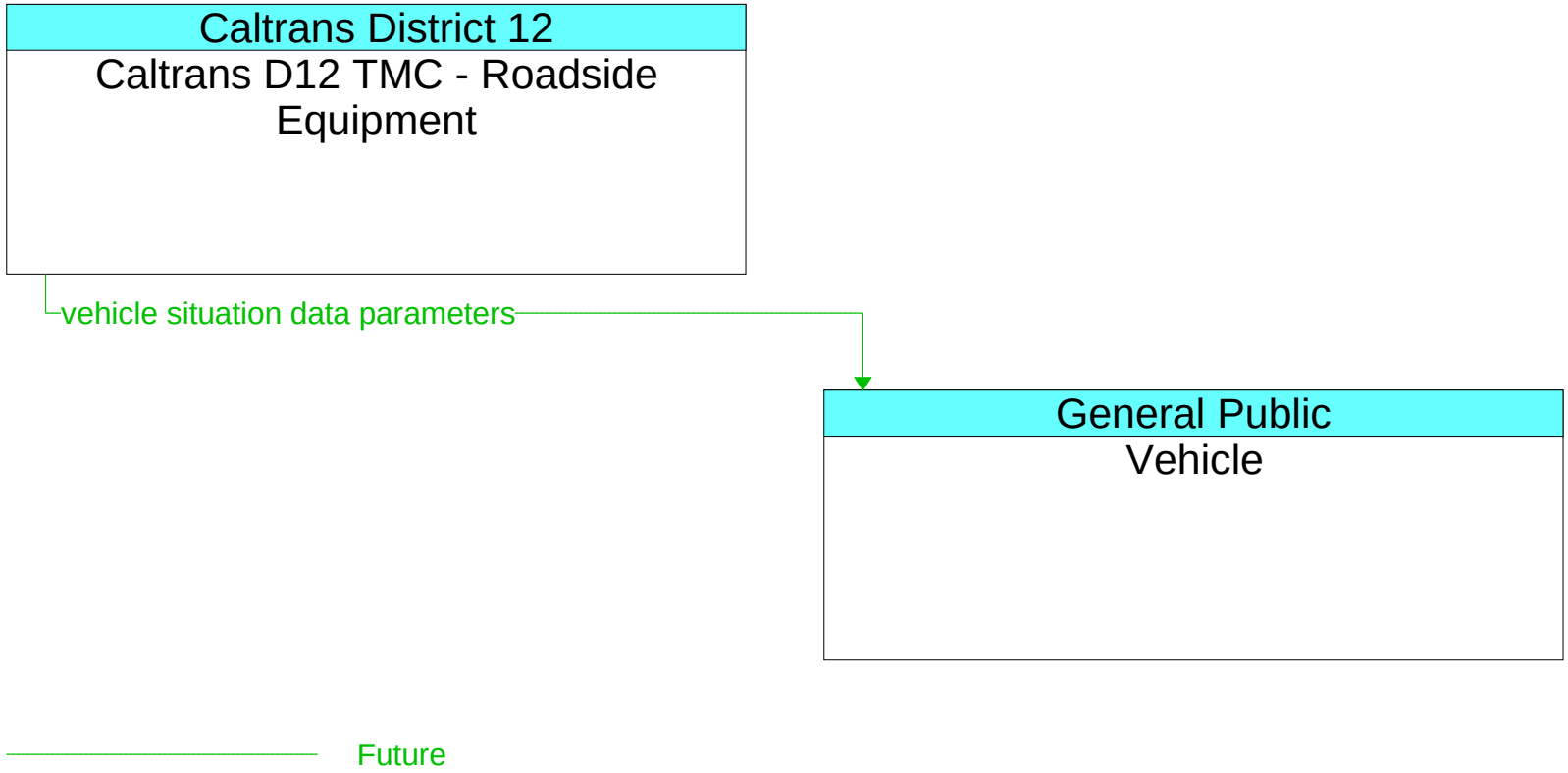
signal control status
Caltrans District 12
Caltrans D12 TMC
County of Orange
County of Orange Public Works Traffic Management Systems
Existing
Planned
Future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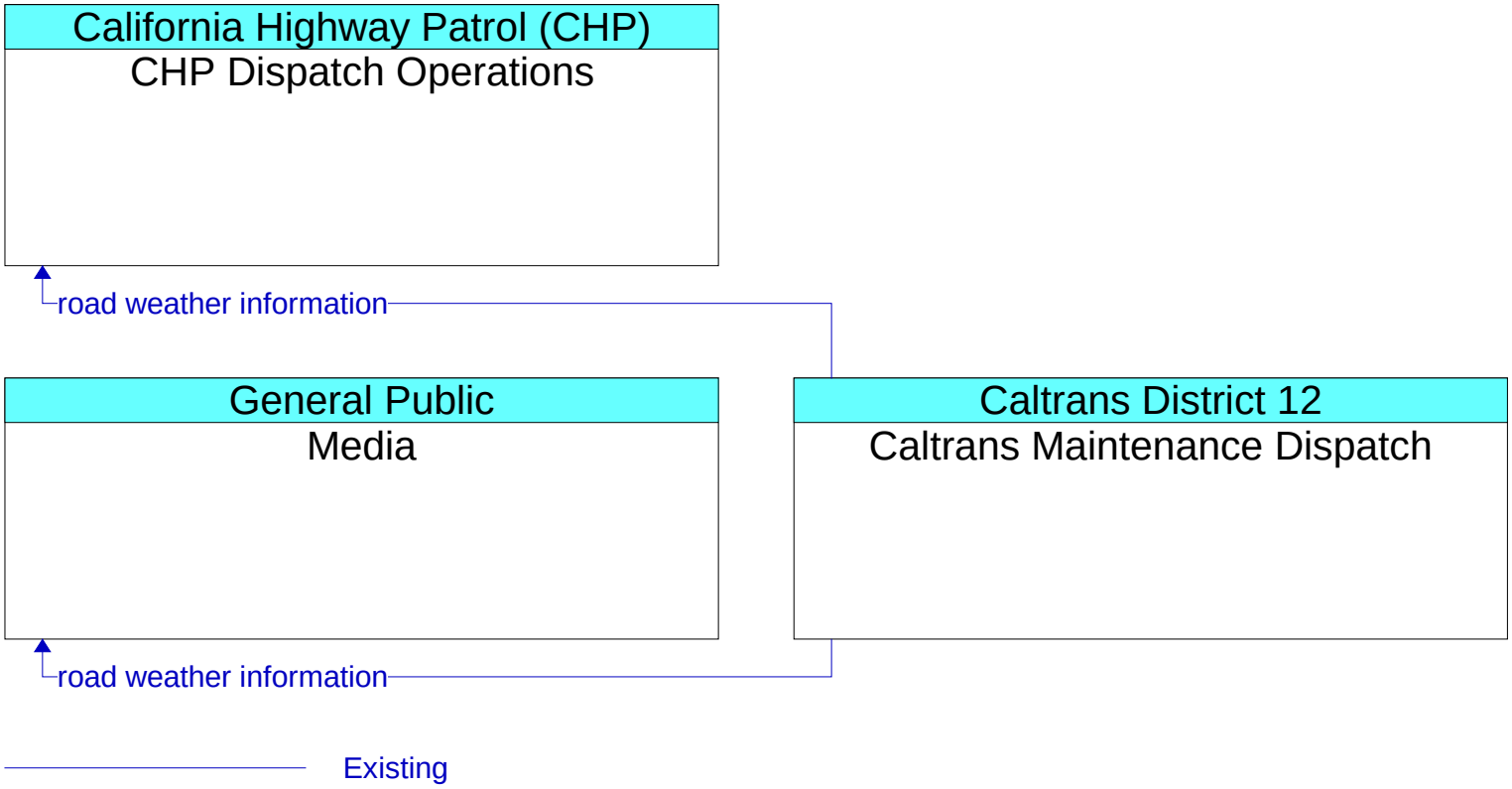
Caltrans D12 TMC - Roadside Equipment
vehicle situation data parameters
General Public
Vehicle
Future


California Highway Patrol (CHP)
CHP Dispatch Operations
road weather information
General Public
Media
Caltrans District 12
Caltrans Maintenance Dispatch
road weather information
Existing

APPENDIX E: REGIONAL ITS ARCHITECTURE – ITS STANDARDS

Standards (Interface)

Group	SDO	Document ID	Standard Title	Standard Type	Standard Version
No	American Public Transportation Association	APTA TCIP-S-001	Standard for Transit Communications Interface Profiles	Message/Data	
No	American Society for Testing and Materials	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems	Message/Data	
No	American Society for Testing and Materials	ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1206	Object Definitions for Data Collection and Monitoring (DCM) Devices	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1207	Object Definitions for Ramp Meter Control (RMC) Units	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters	Message/Data	
No	Consortium of AASHTO, ITE, and NEMA	NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)	Message/Data	

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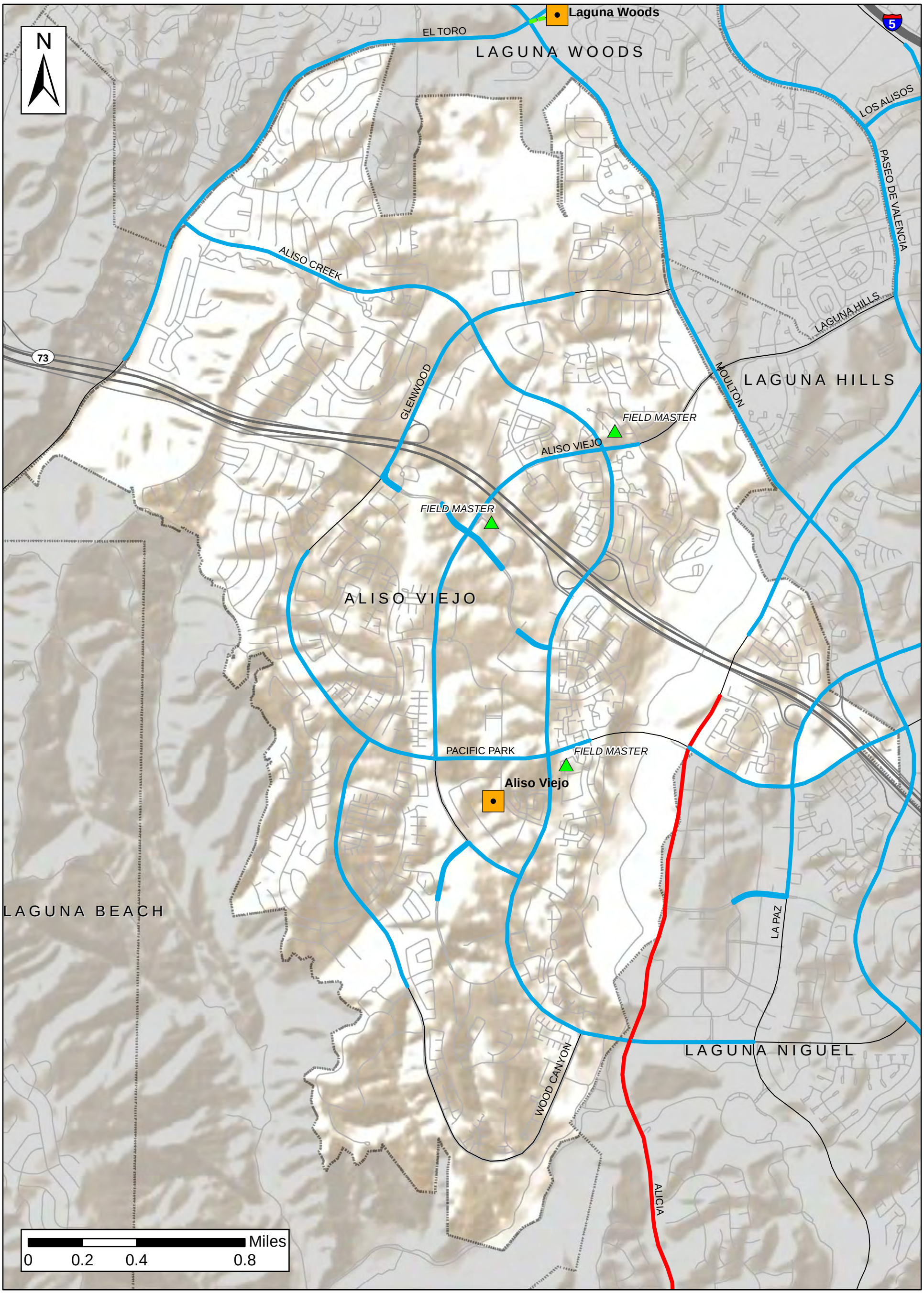
Group	SDO	Document ID	Standard Title	Standard Type	Standard Version
No	European Committee for Standardization	CEN - EN 15531-1	Service Interface for Real-Time Information (SIRI)	Message/Data	
No	General Transit Feed Specification Discussion Group	GTFS	General Transit Feed Specification (GTFS) Static	Message/Data	
No	General Transit Feed Specification Discussion Group	GTFS-Realtime	General Transit Feed Specification (GTFS) Realtime	Message/Data	
No	Institute of Electrical and Electronics Engineers	IEEE 1512	Standard for Common Incident Management Message Sets for use by Emergency Management Centers	Message/Data	
No	Institute of Electrical and Electronics Engineers	IEEE 1570	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection	Message/Data	
No	Institute of Electrical and Electronics Engineers	IEEE 1609.11	Standard for Wireless Access in Vehicular Environments (WAVE) - Over- the-Air Data Exchange Protocol for Intelligent Transportation Systems (ITS)	Message/Data	
No	Institute of Transportation Engineers	ITE TMDD	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)	Message/Data	
No	International Organization for Standardization	ISO 19091	Intelligent transport systems -- Cooperative ITS -- Using V2I and I2V communications for applications related to signalized intersections	Other Standard	
No	Society of Automotive Engineers	SAE J2354	Message Set for Advanced Traveler Information System (ATIS)	Message/Data	
No	Society of Automotive Engineers	SAE J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary	Message/Data	
No	Society of Automotive Engineers	SAE J2945/1	On-Board System Requirements for V2V Safety Communications	Communications Protocol	
No	Society of Automotive Engineers	SAE J2945/2	Dedicated Short Range Communications (DSRC) Performance Requirements for V2V Safety Awareness	Other Standard	
No	Society of Automotive Engineers	SAE J2945/9	Vulnerable Road User Safety Message Minimum Performance Requirements	Other Standard	
No	Society of Automotive Engineers	SAE J3067	Candidate Improvements to Dedicated Short Range Communications (DSRC) Message Set Dictionary [SAE J2735] Using Systems Engineering Methods	Message/Data	

RAD-IT Table

Group	SDO	Document ID	Standard Title	Standard Type	Standard Version
Yes	Profile	DSRC-UDP	Vehicle-to-Vehicle/Infrastructure using UDP	Standard Profile	
Yes	Profile	DSRC-WSMP	Vehicle-to-Vehicle/Infrastructure using WSMP	Standard Profile	
Yes	Profile	NTCIP-DATEX	NTCIP using DATEX	Standard Profile	
Yes	Profile	NTCIP-SNMPv1	NTCIP using SNMPv1	Standard Profile	
Yes	Profile	NTCIP-SNMPv1 Secure	NTCIP-SNMPv1 Secure	Standard Profile	
Yes	Profile	NTCIP-SNMPv3	NTCIP-SNMPv3	Standard Profile	
Yes	Profile	NTCIP-STMP	NTCIP using STMP	Standard Profile	
Yes	Profile	ProtoBuf	ProtoBuf	Standard Profile	
Yes	Profile	RSE-C2F	RSE - Center to Field Communications	Standard Profile	
Yes	Profile	RSE-C2F-SNMP	RSE - Center to Field Communications - SNMP	Standard Profile	
Yes	Profile	RSE-F2F	Roadside Equipment to ITS Roadway Equipment	Standard Profile	
Yes	Profile	RSEGateway-VehicleDestination	Vehicle Communications via RSEs, Vehicle Destination	Standard Profile	
Yes	Profile	RSEGateway-VehicleSource	Vehicle Communications via RSEs, Vehicle Source	Standard Profile	
Yes	Profile	SRC-Legacy	Legacy Short Range Comm Using IEEE 1455	Standard Profile	
Yes	Profile	WAB-Via-WAID	Wide-Area-Broadcast-Via-WAID	Standard Profile	
Yes	Profile	WAW-ASN1	Wide Area Wireless using ASN.1 as encoding method	Standard Profile	
Yes	Profile	WAW-WWWBrowser-JSON	Wide Area Wireless using JSON as encoding method	Standard Profile	
Yes	Profile	WAW-XML	Wide Area Wireless using XML as encoding method	Standard Profile	
Yes	Profile	XML	eXtensible Markup Language	Standard Profile	

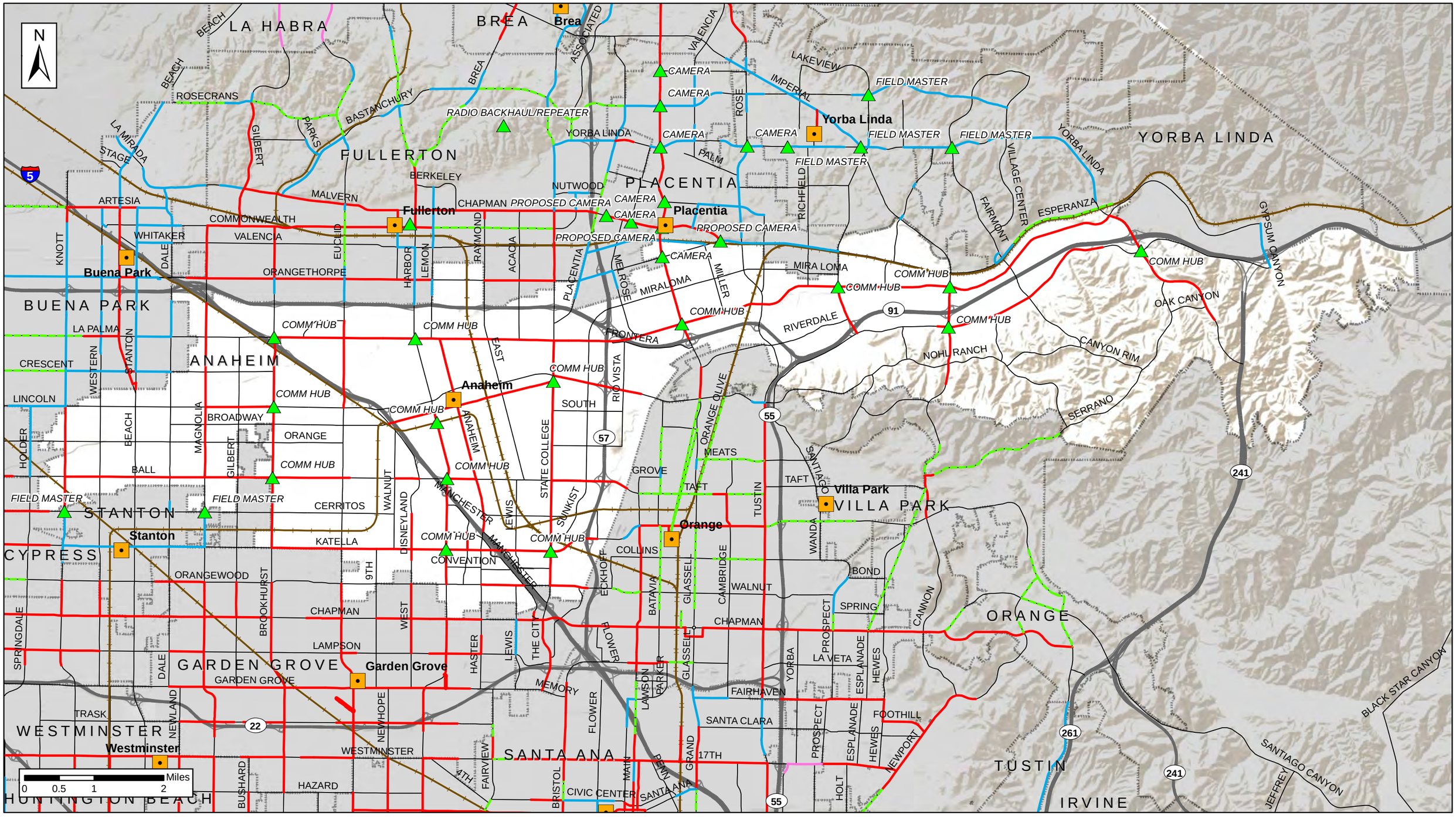
APPENDIX F: LOCAL AGENCY COMMUNICATIONS INVENTORY MAPS



OCTA ITS Plan Update Countywide Communications - Aliso Viejo

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

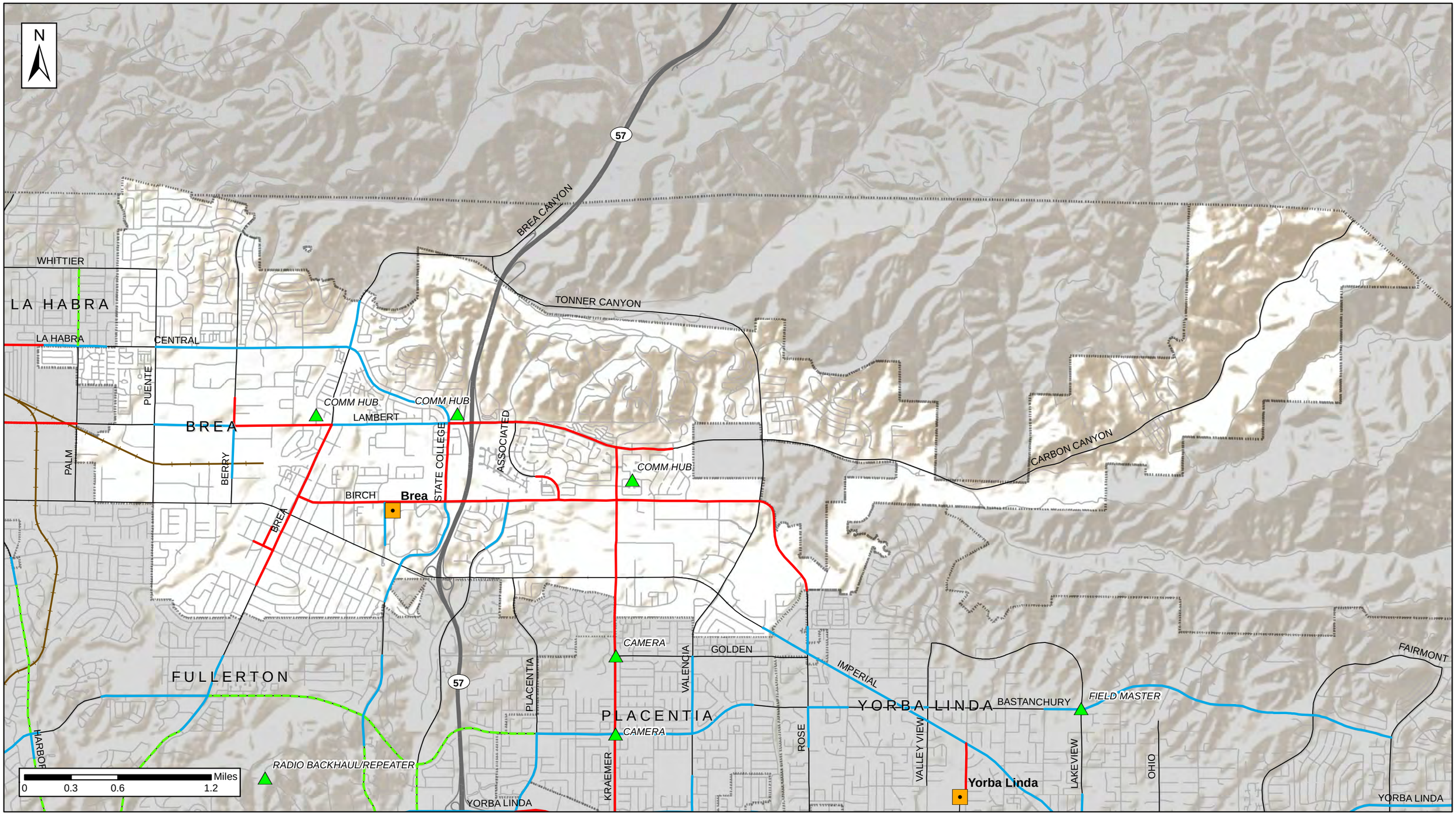


OCTA ITS Plan Update
Countywide Communications
Anaheim

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

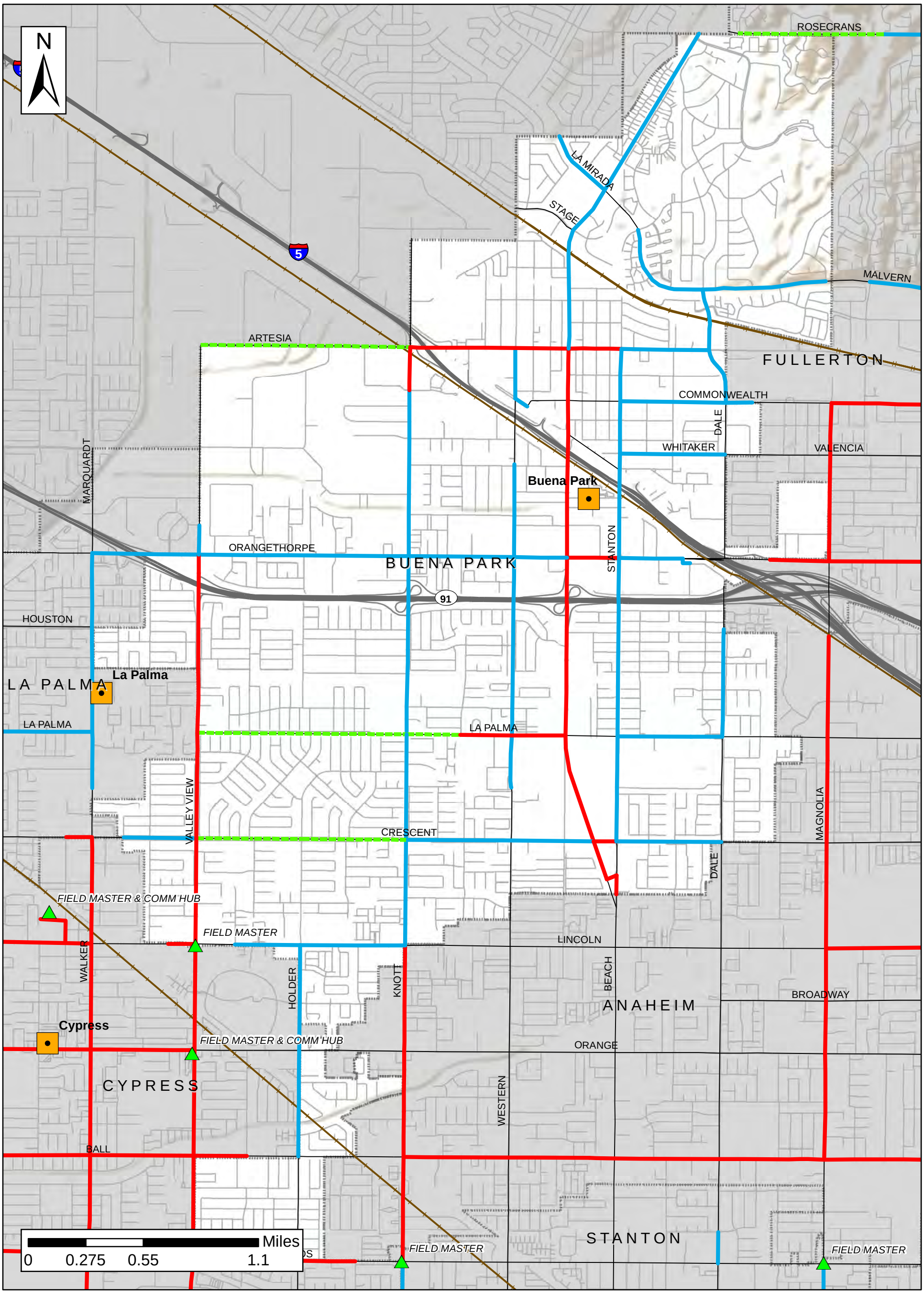


OCTA ITS Plan Update
Countywide Communications
Brea

Communications

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

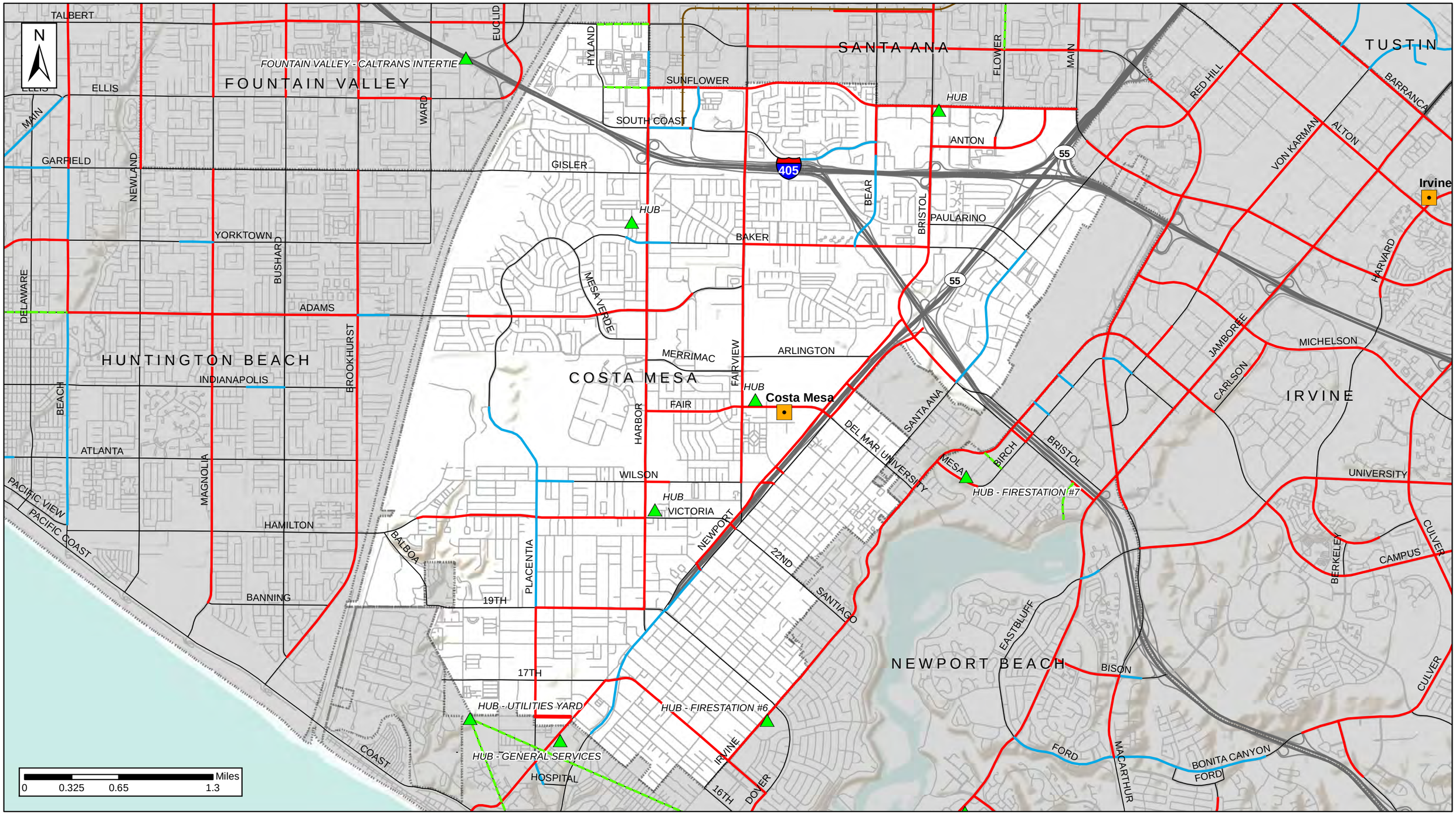
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Buena Park

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



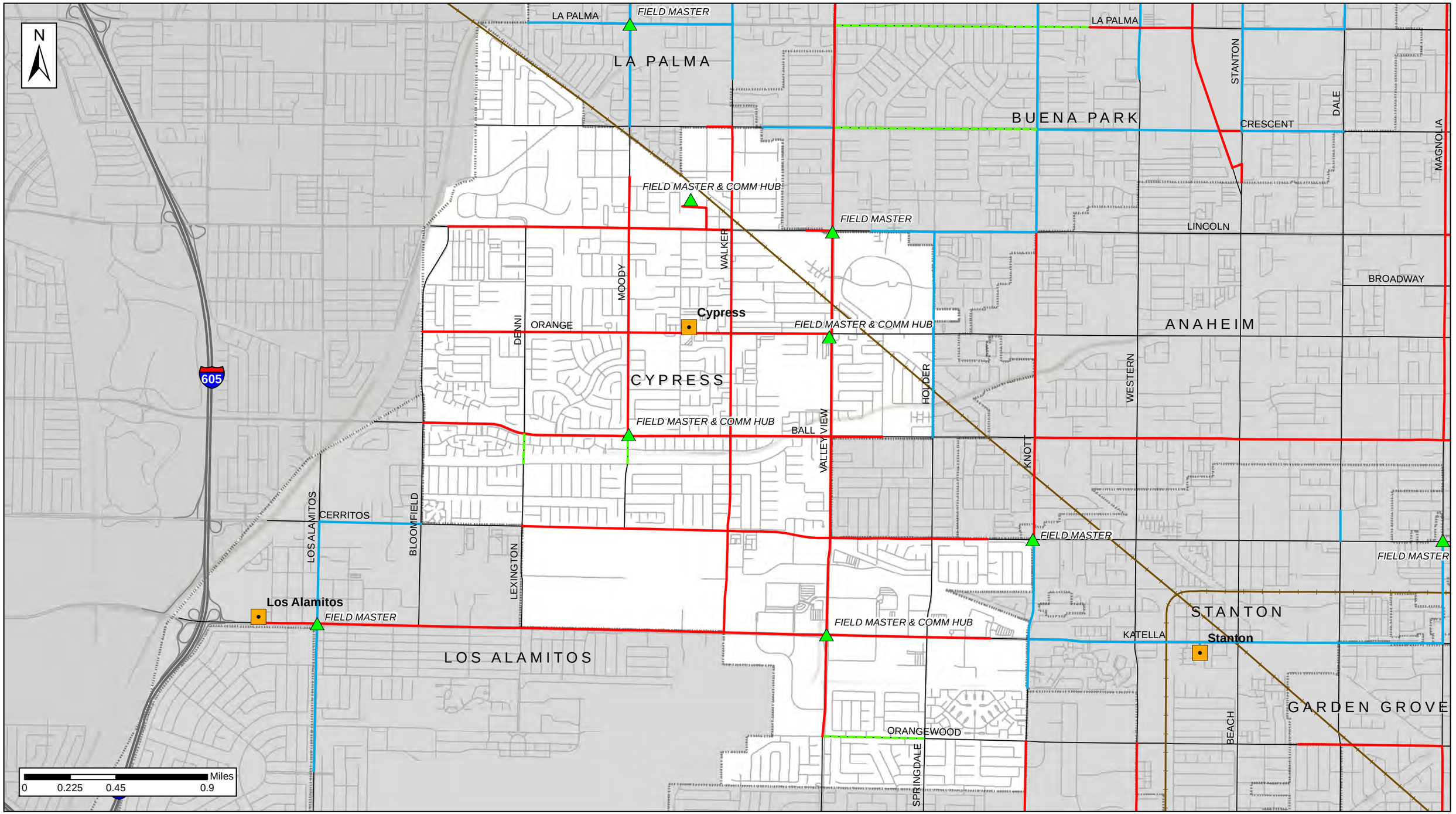
OCTA ITS Plan Update
Countywide Communications
Costa Mesa

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

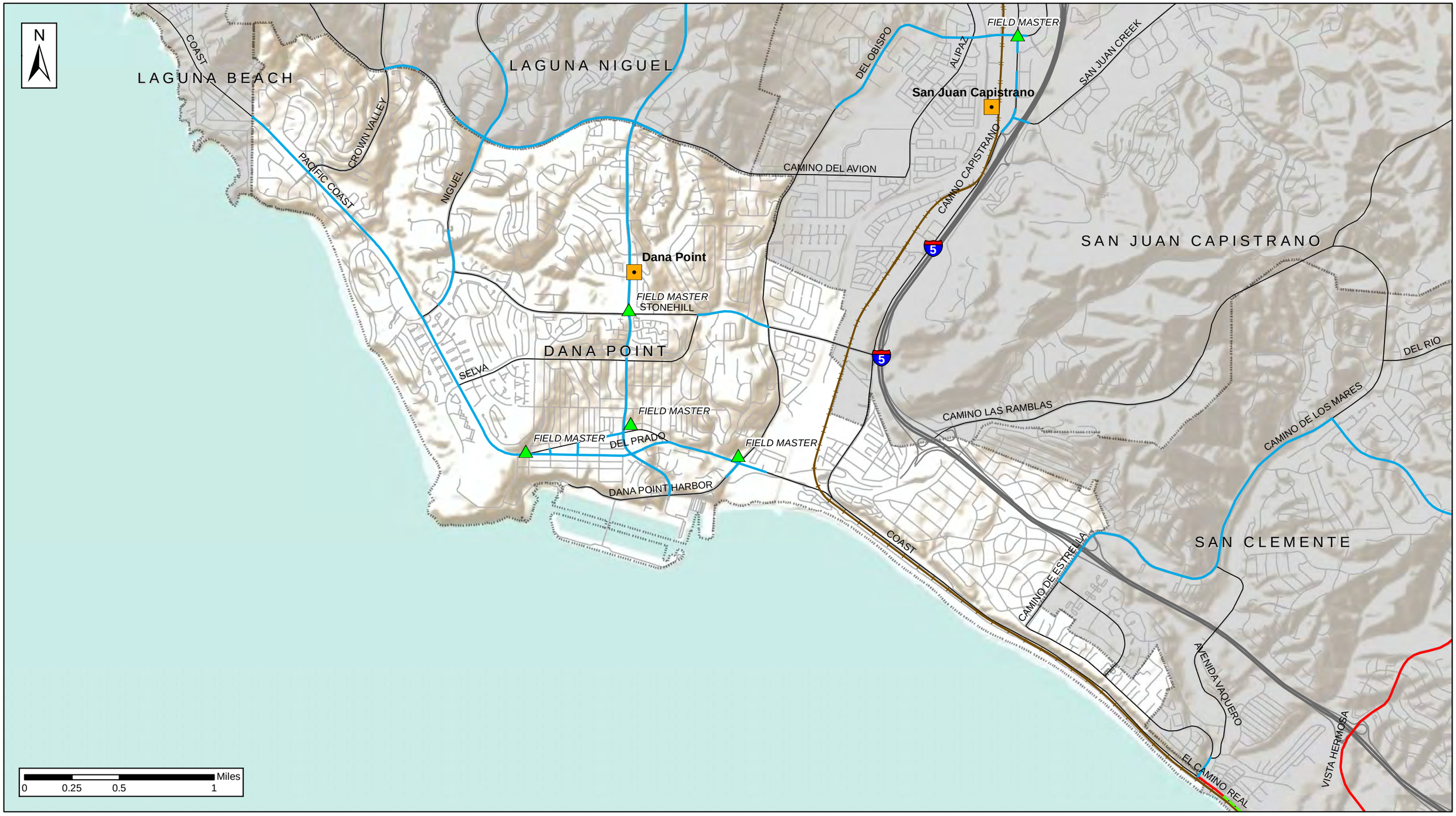
OCTA ITS Plan Update
Countywide Communications
Cypress



Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

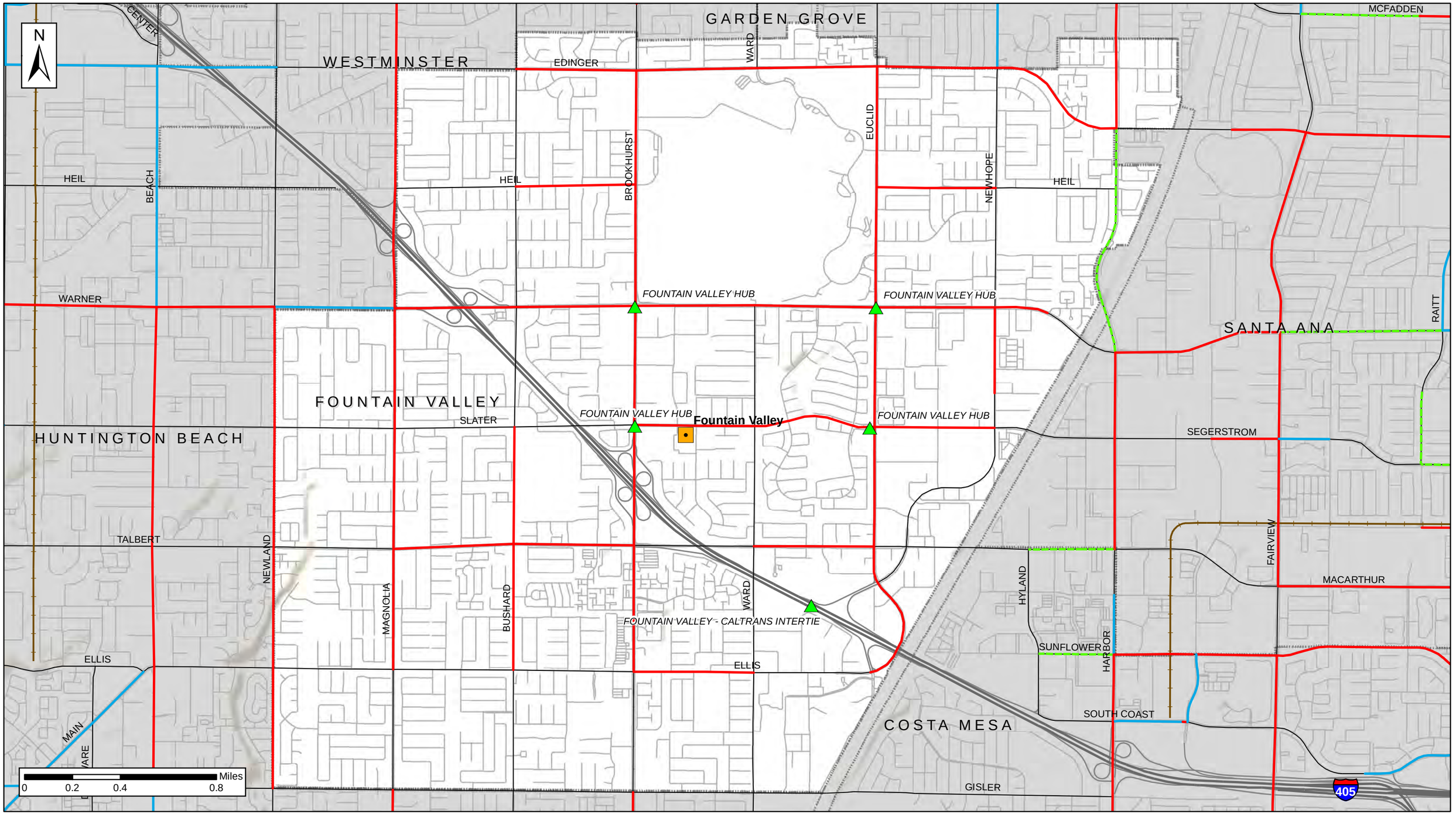


OCTA ITS Plan Update
Countywide Communications
Dana Point

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

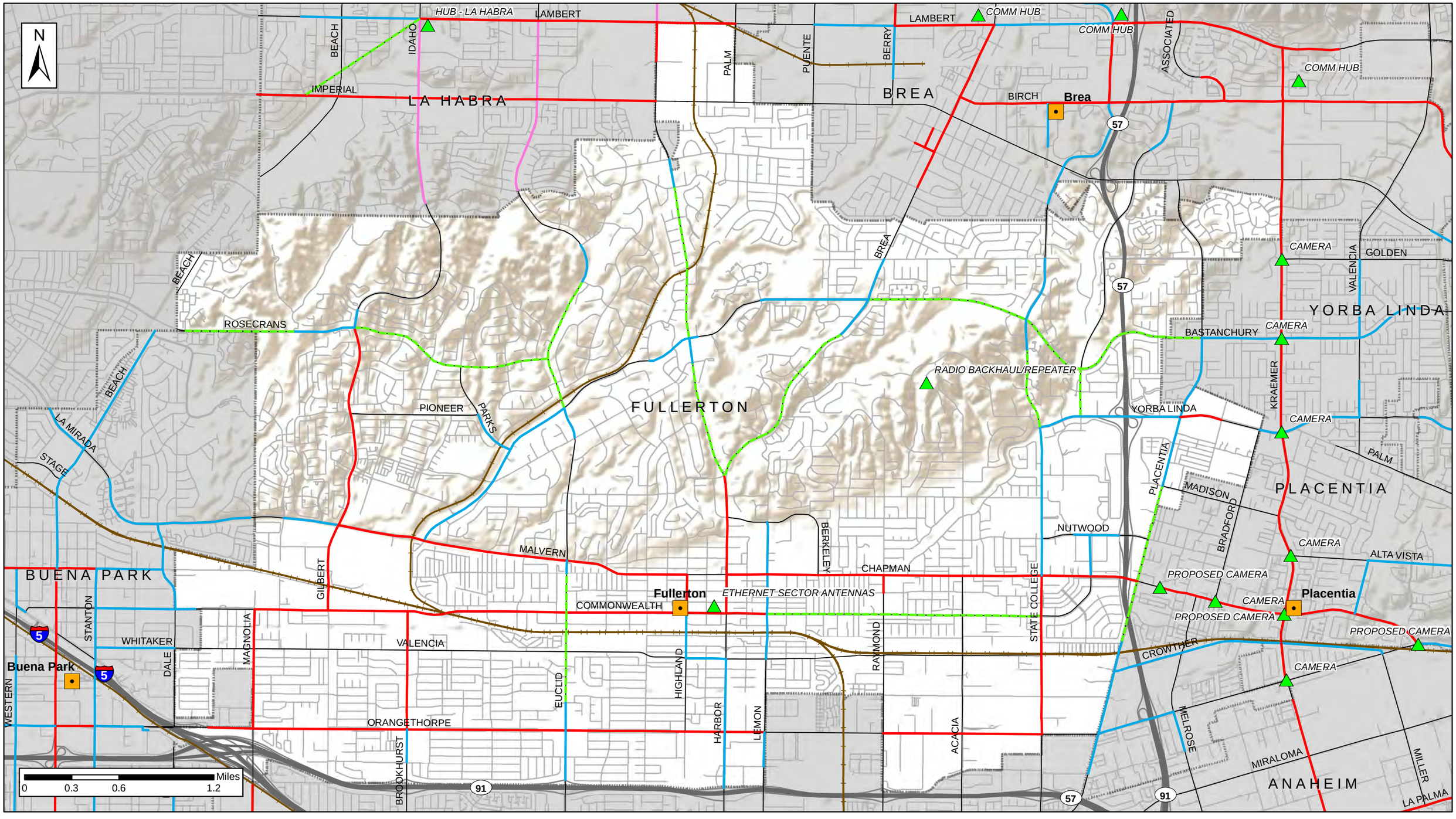


OCTA ITS Plan Update
Countywide Communications
Fountain Valley

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update
Countywide Communications
Fullerton

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

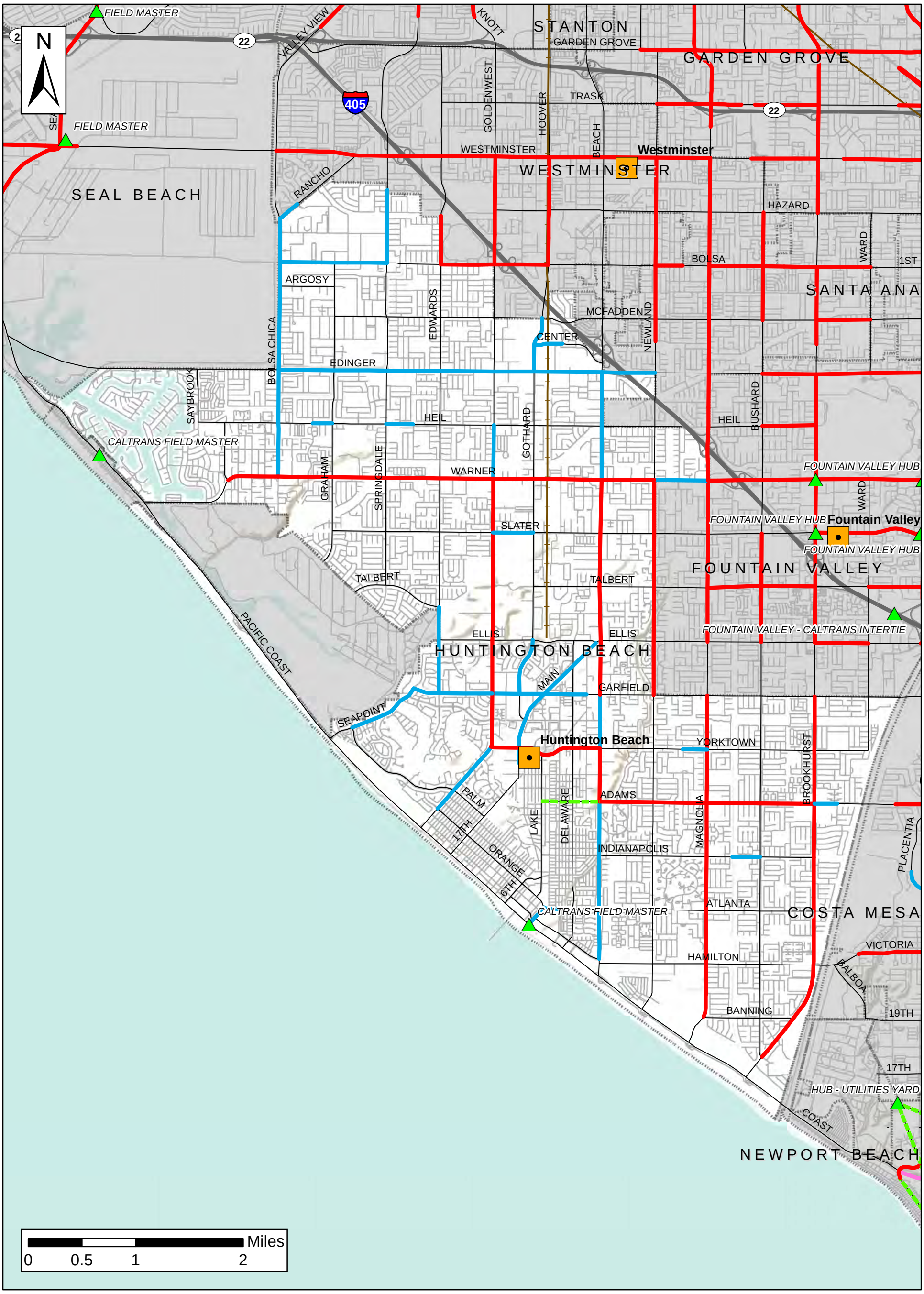
OCTA ITS Plan Update
Countywide Communications
Garden Grove

Communications

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

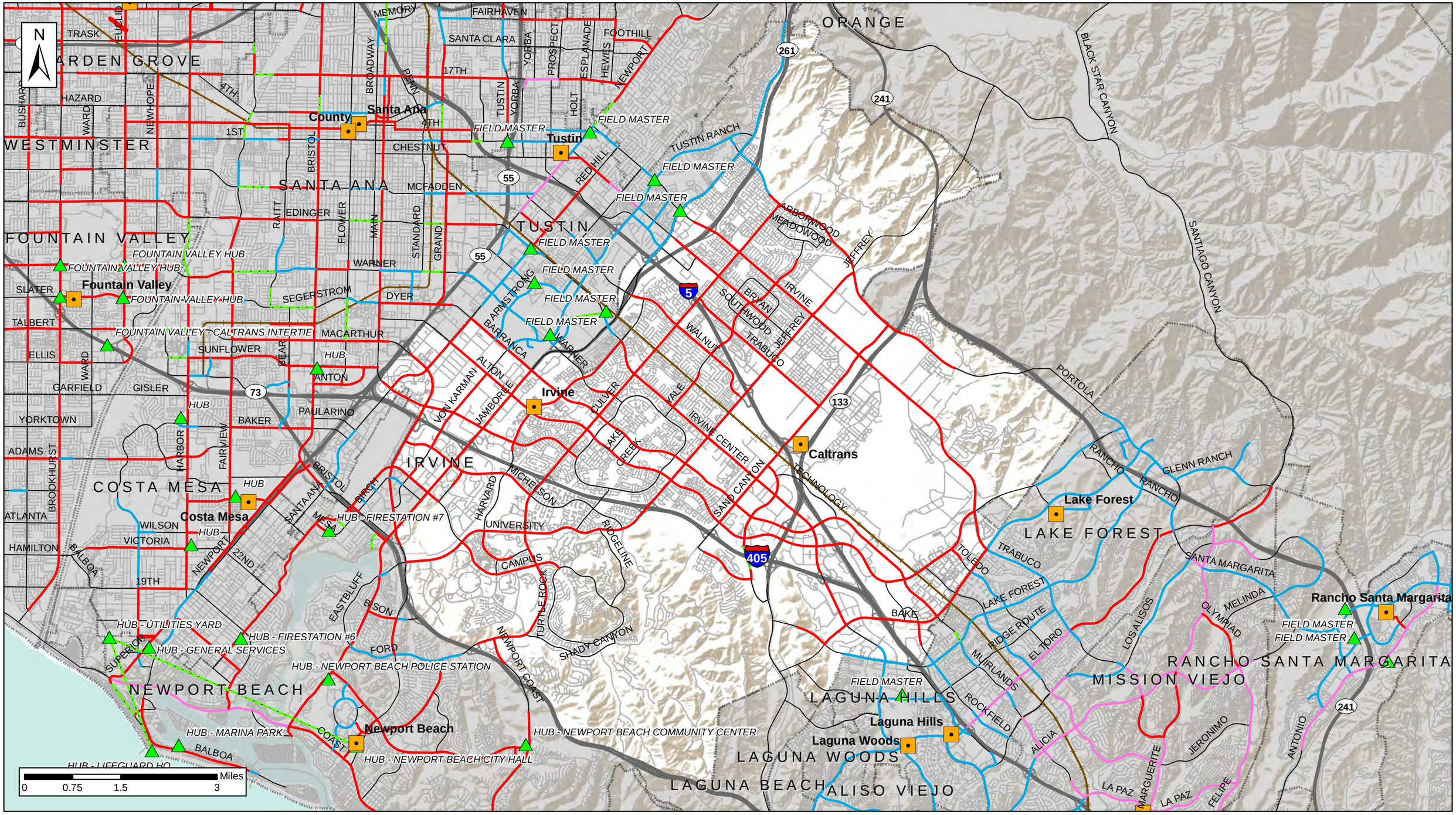
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

OCTA ITS Plan Update Countywide Communications - Huntington Beach



Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

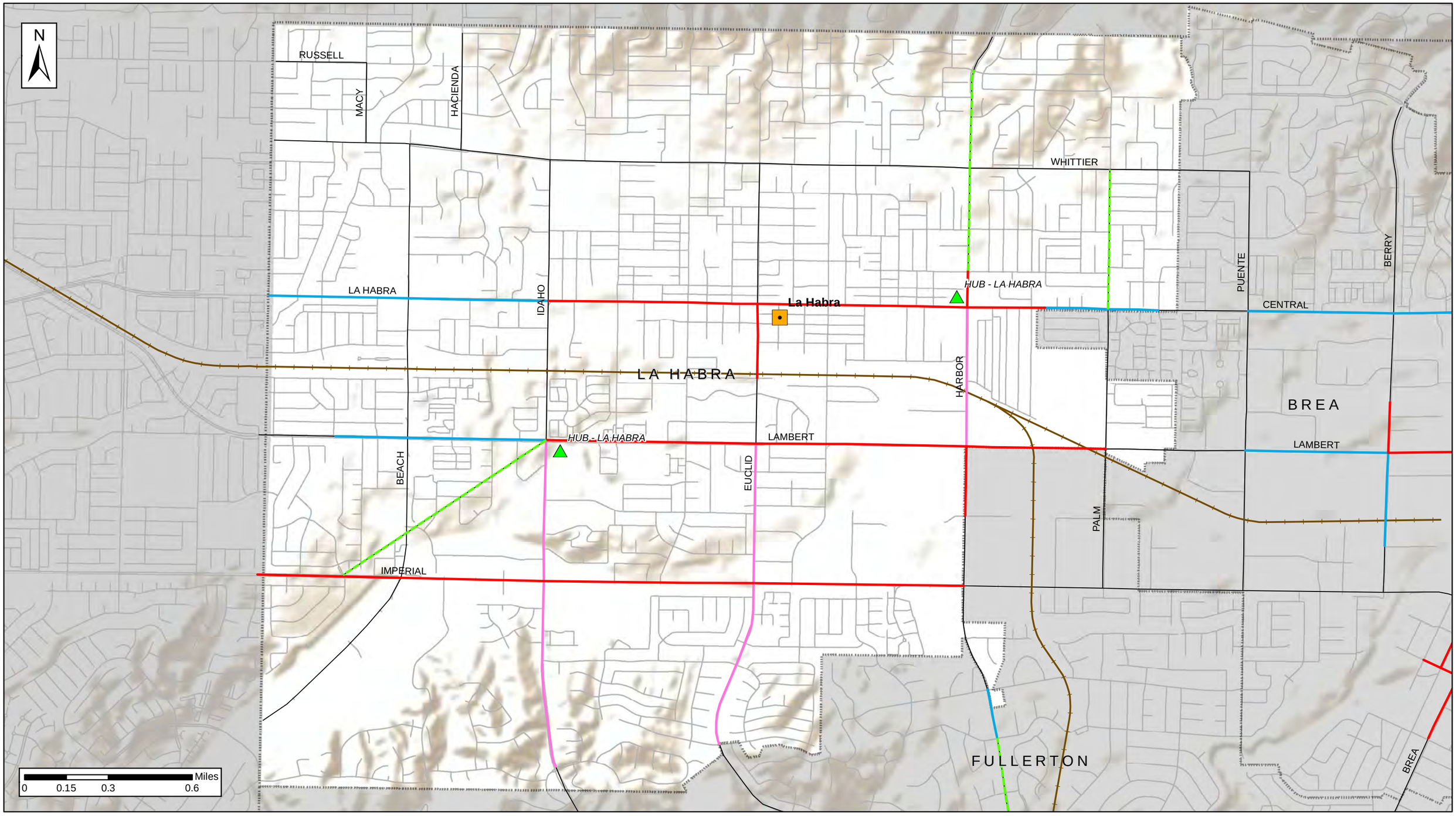


OCTA ITS Plan Update
Countywide Communications
Irvine

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

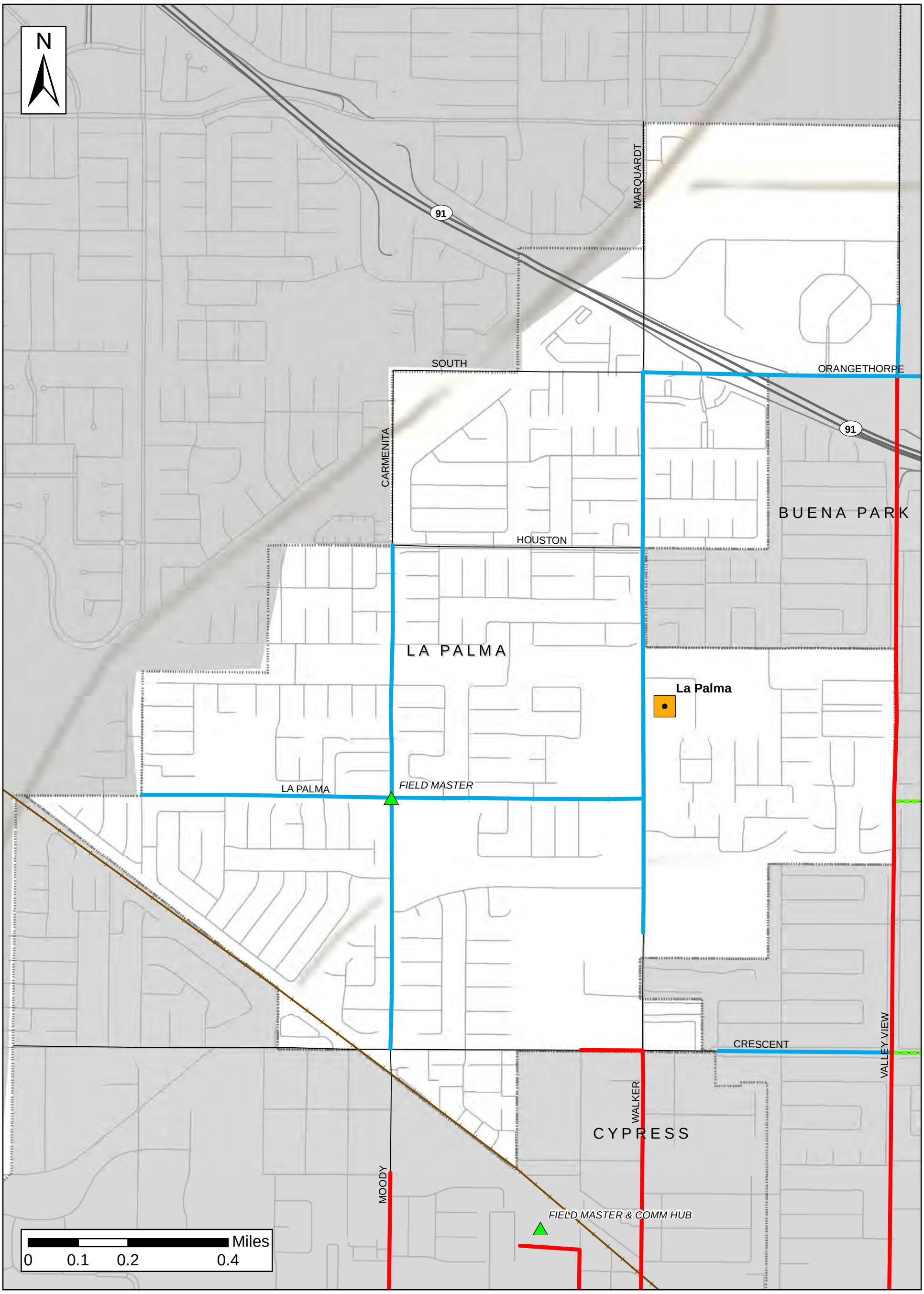


OCTA ITS Plan Update
Countywide Communications
La Habra

Communications

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

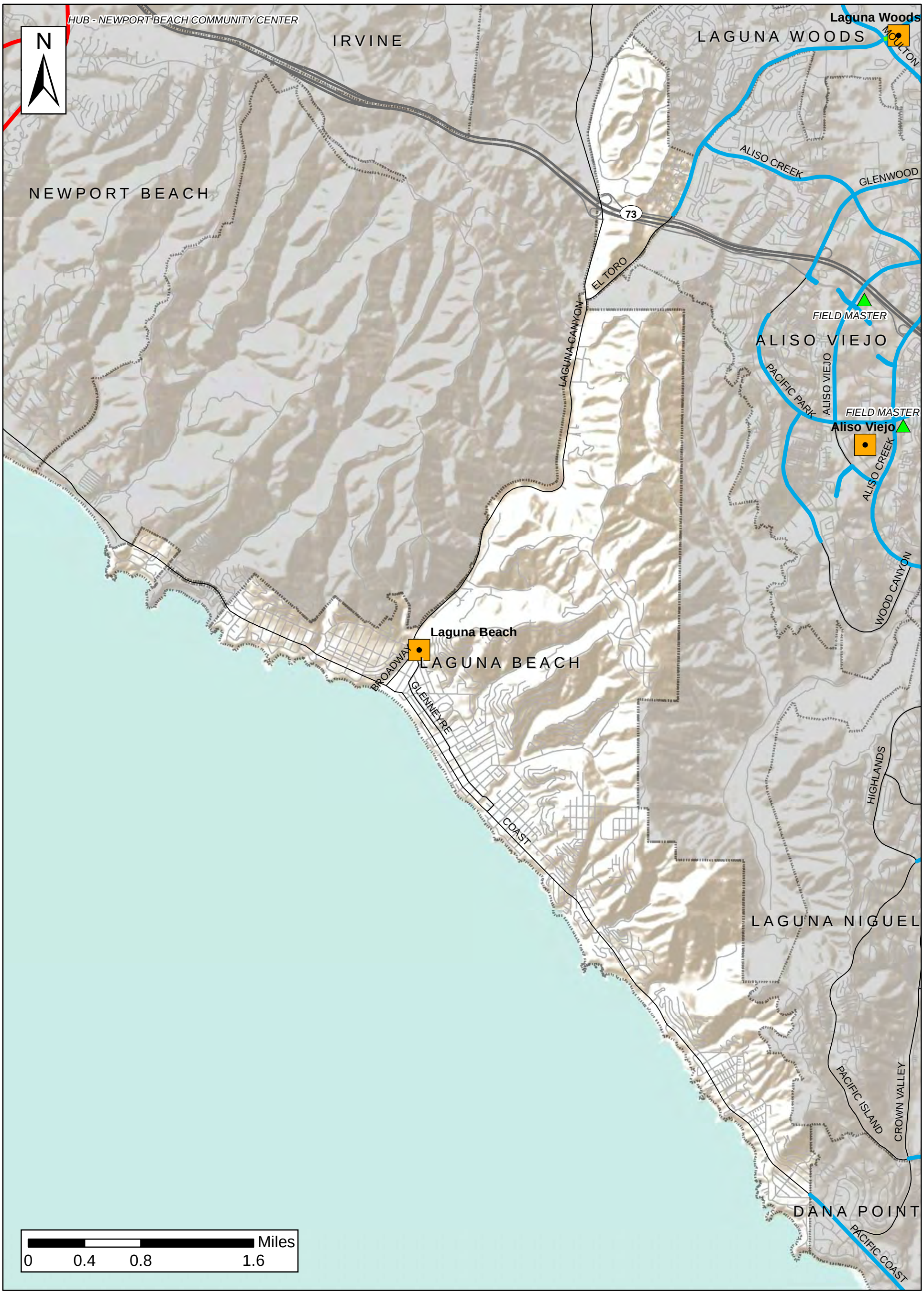
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - La Palma

Communications

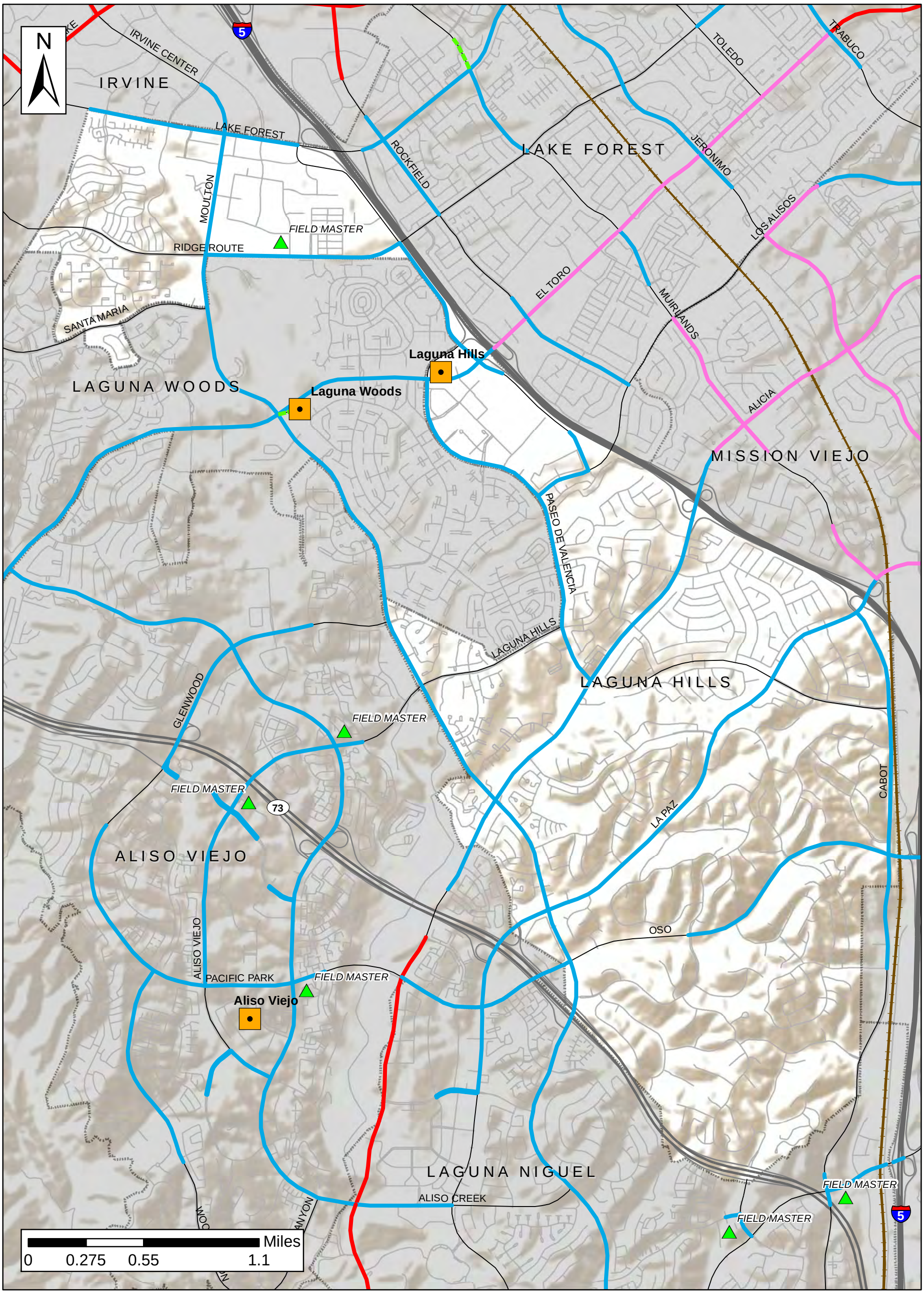
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Laguna Beach

Communications

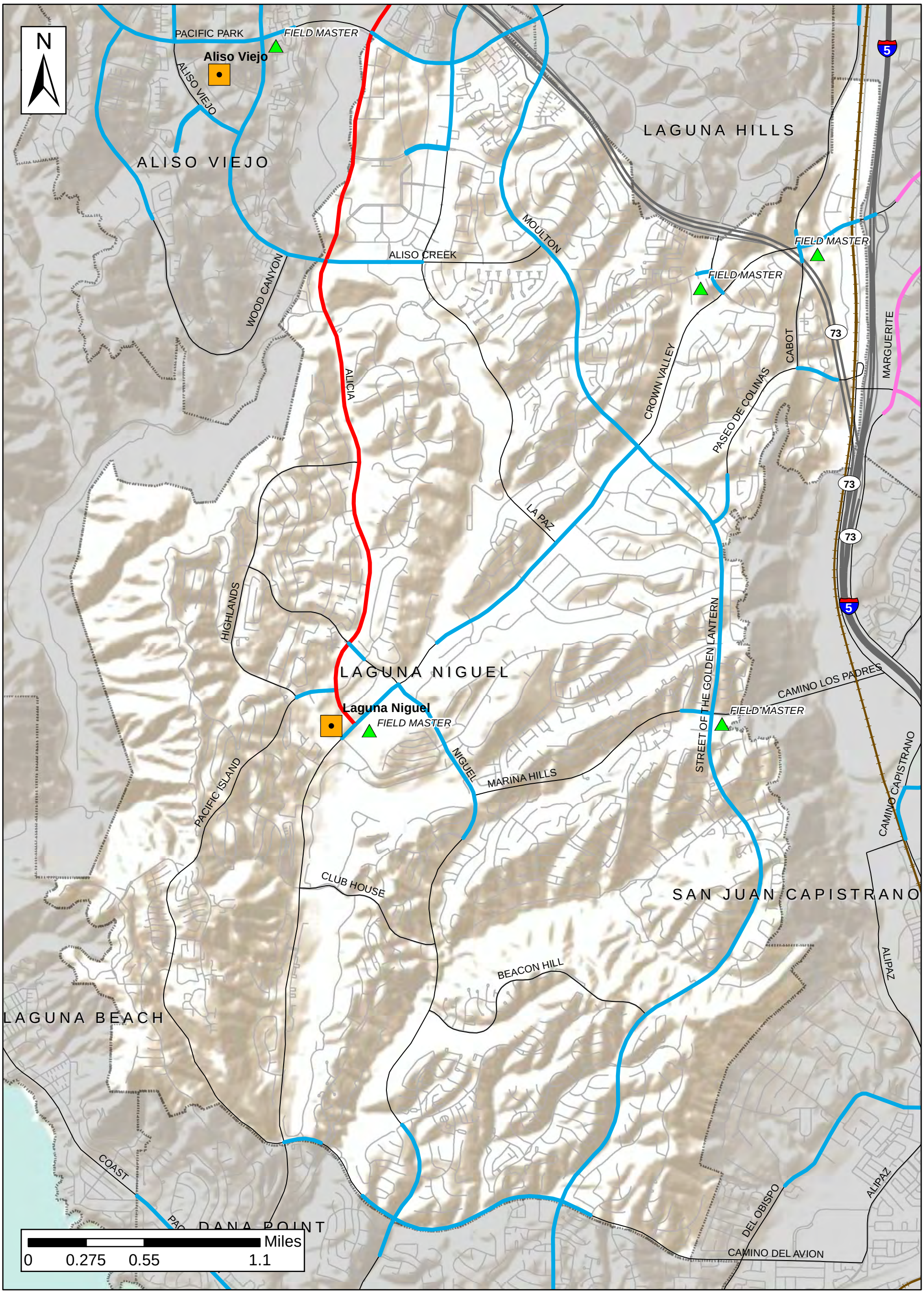
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Laguna Hills

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Laguna Niguel

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

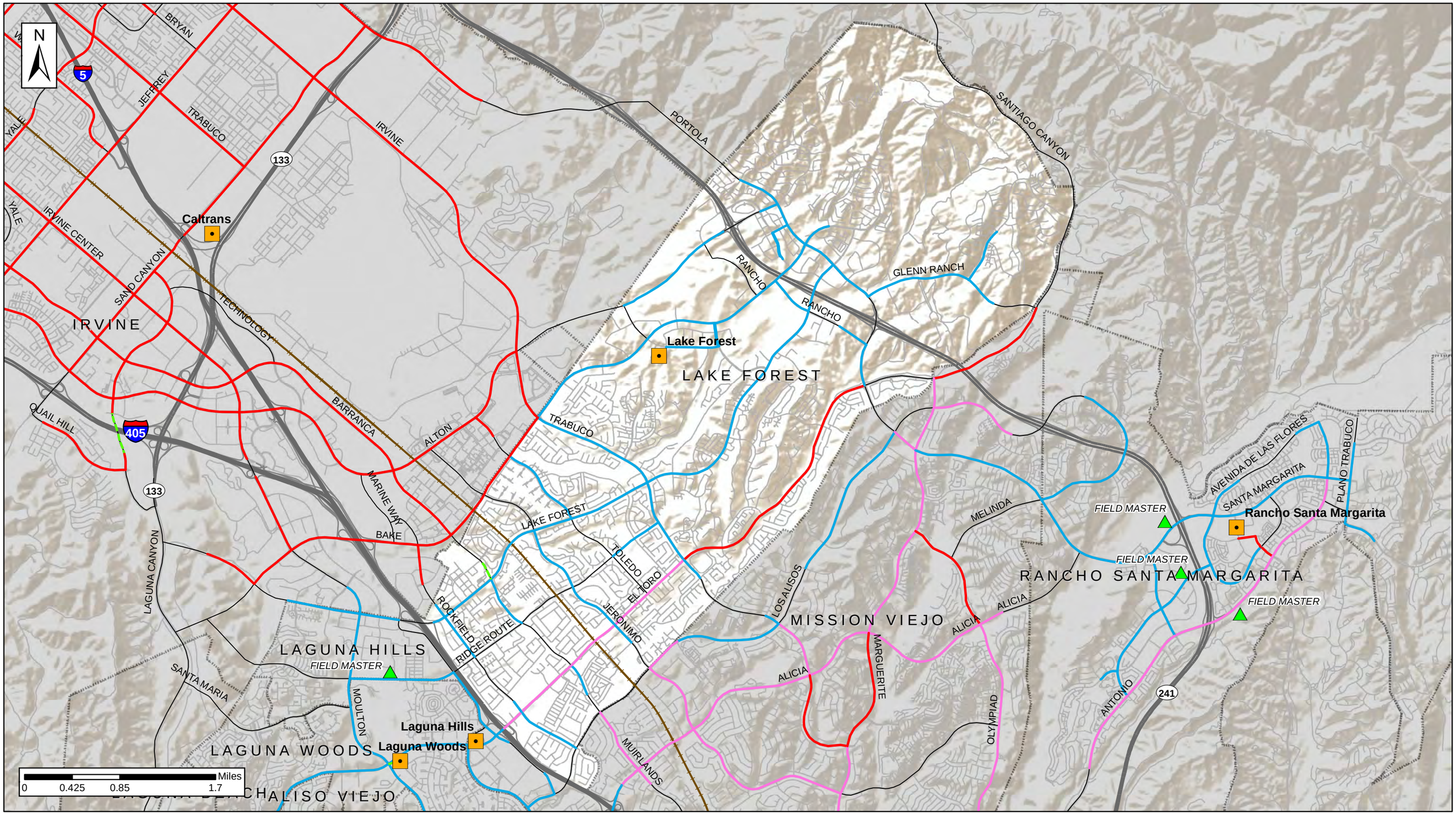
OCTA ITS Plan Update
Countywide Communications
Laguna Woods

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

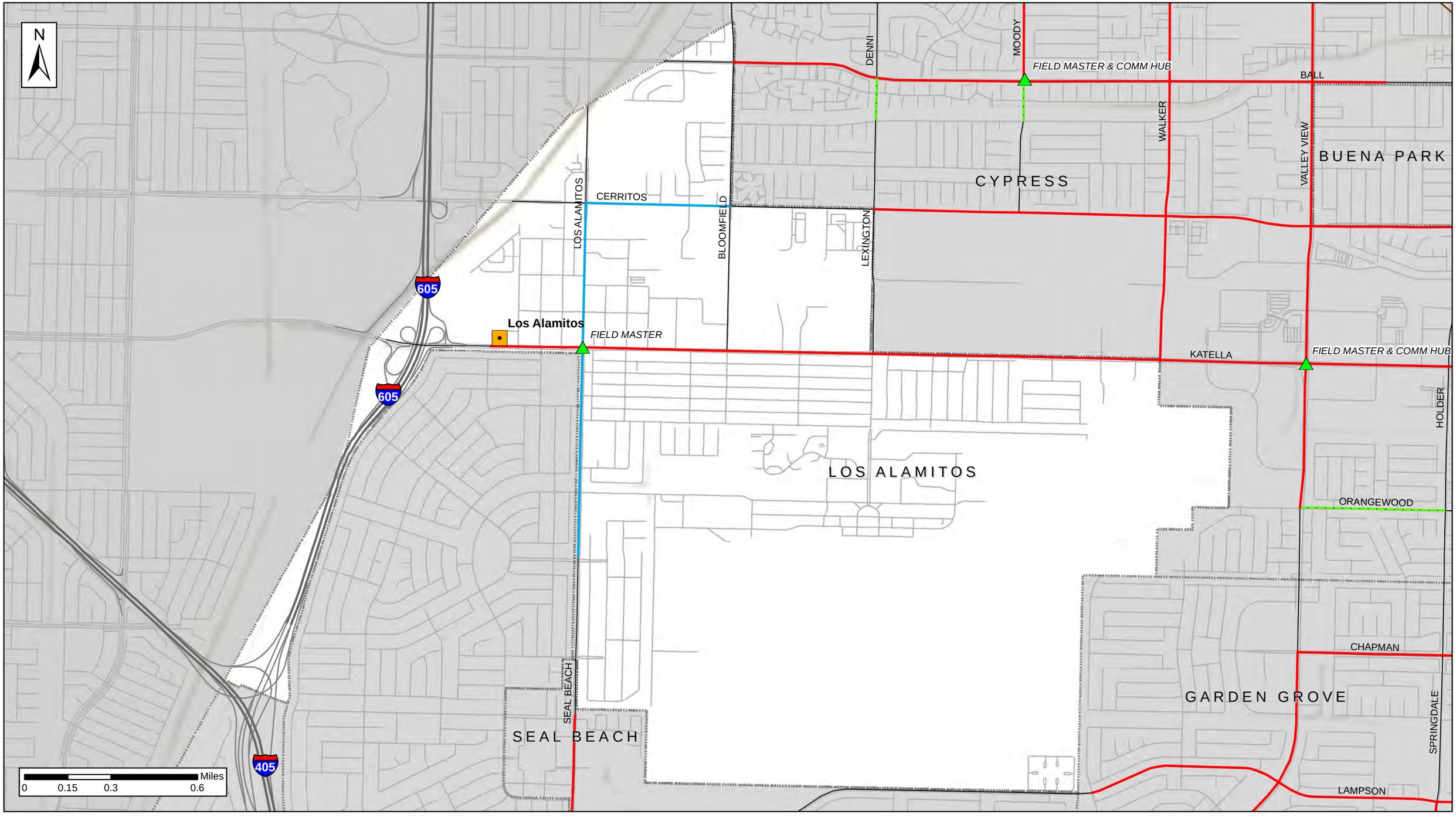
OCTA ITS Plan Update
Countywide Communications
Lake Forest



Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

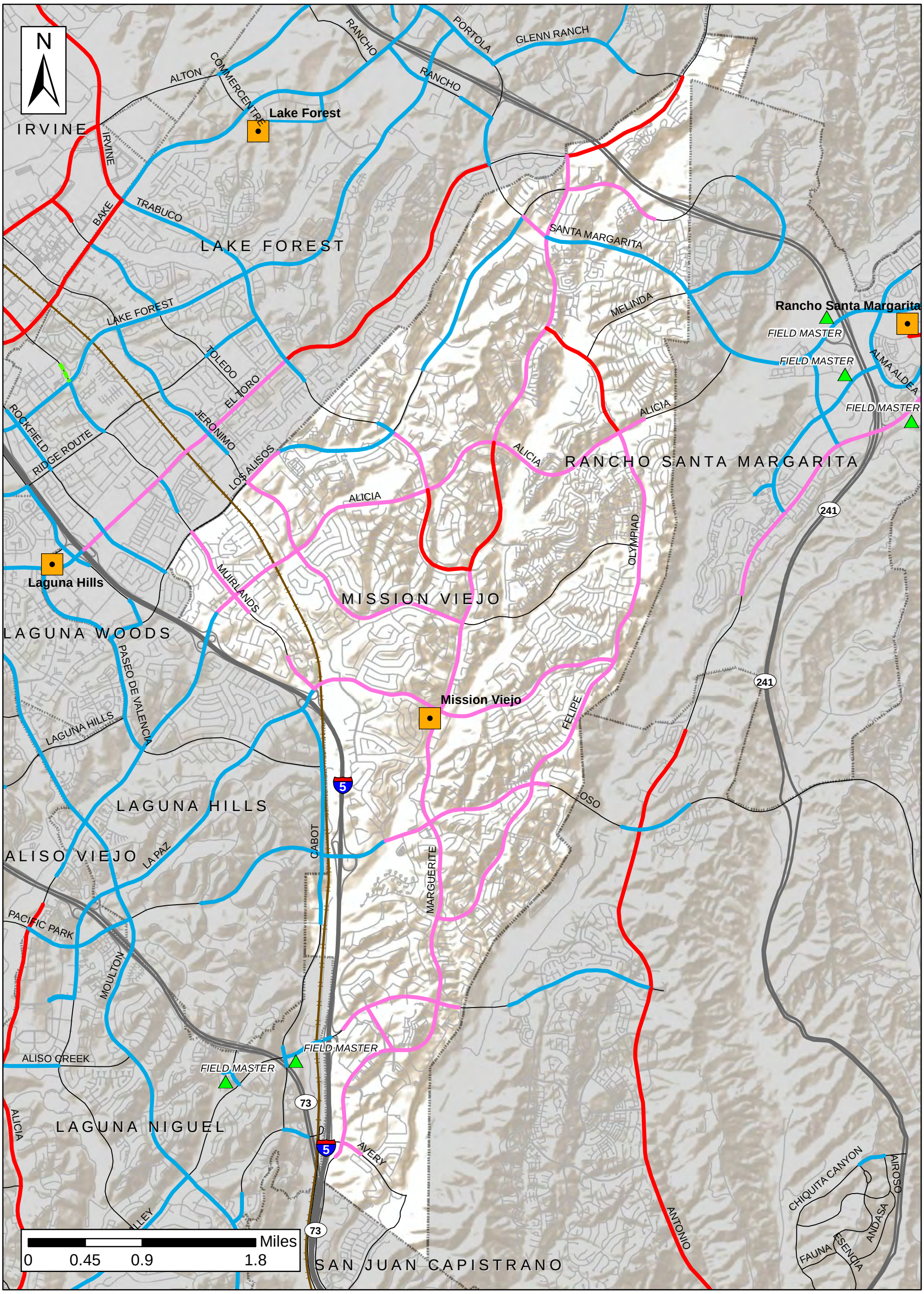


OCTA ITS Plan Update
Countywide Communications
Los Alamitos

Communications

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

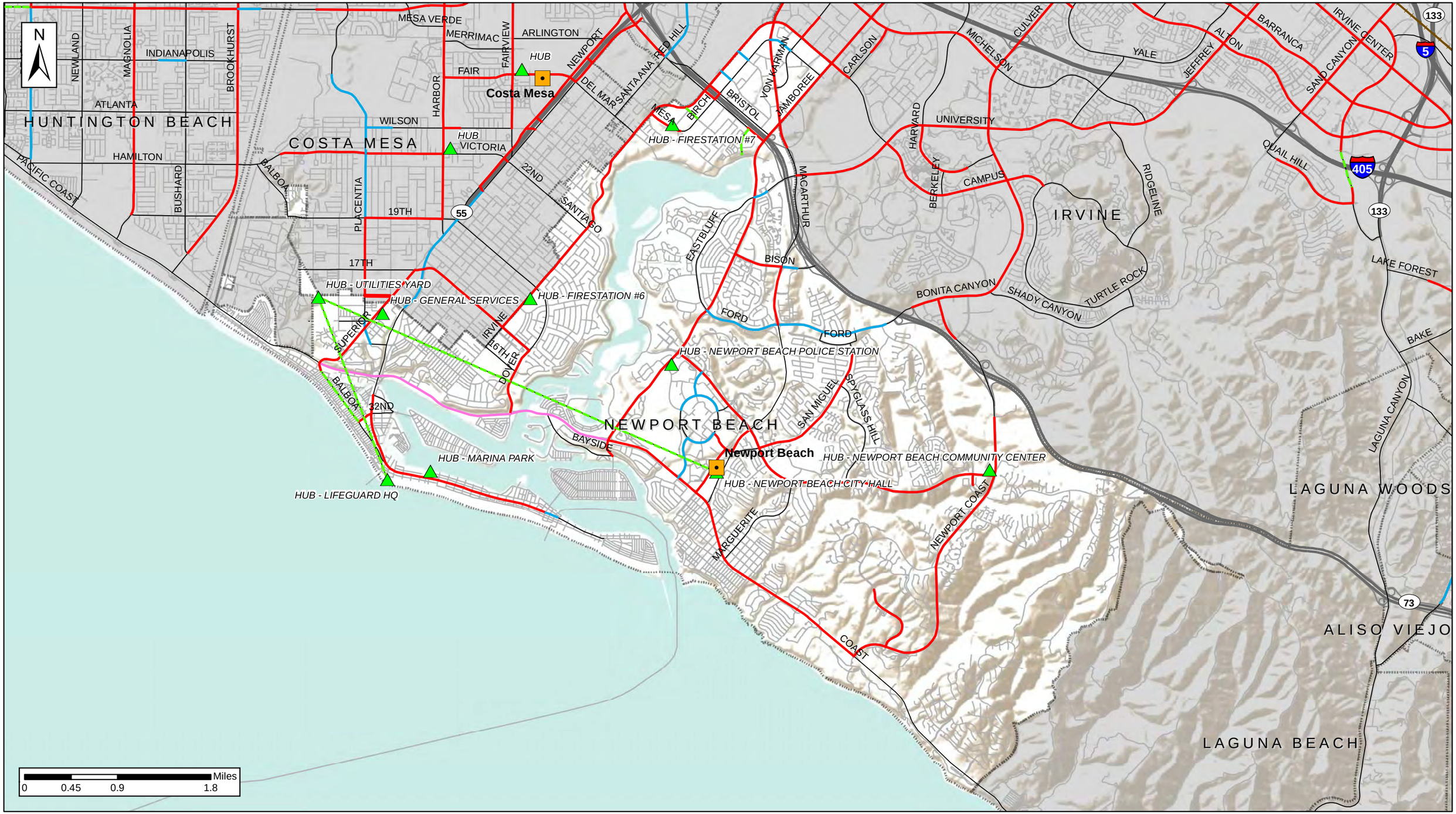
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Mission Viejo

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

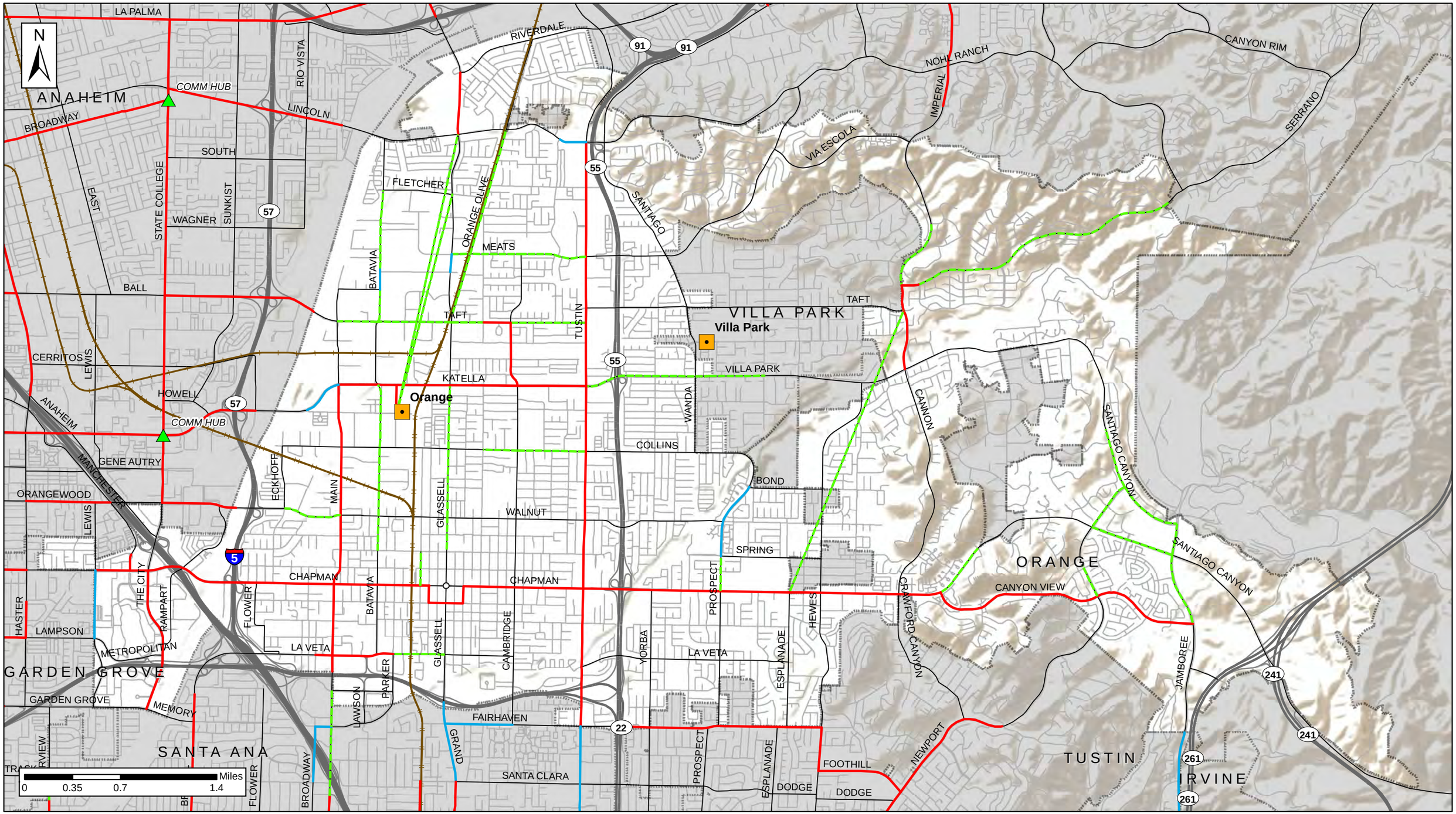


OCTA ITS Plan Update
Countywide Communications
Newport Beach

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

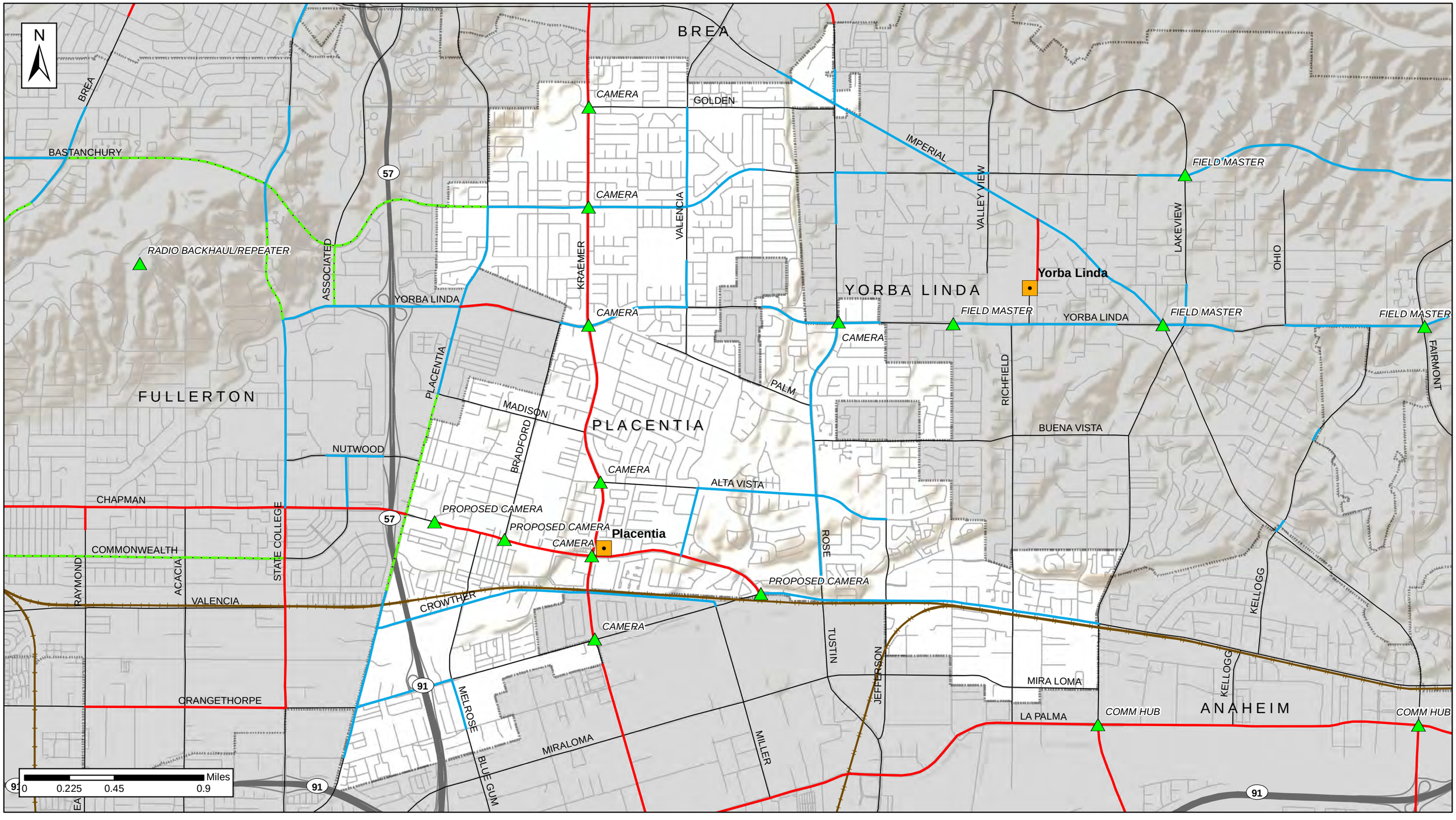


OCTA ITS Plan Update
Countywide Communications
Orange

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

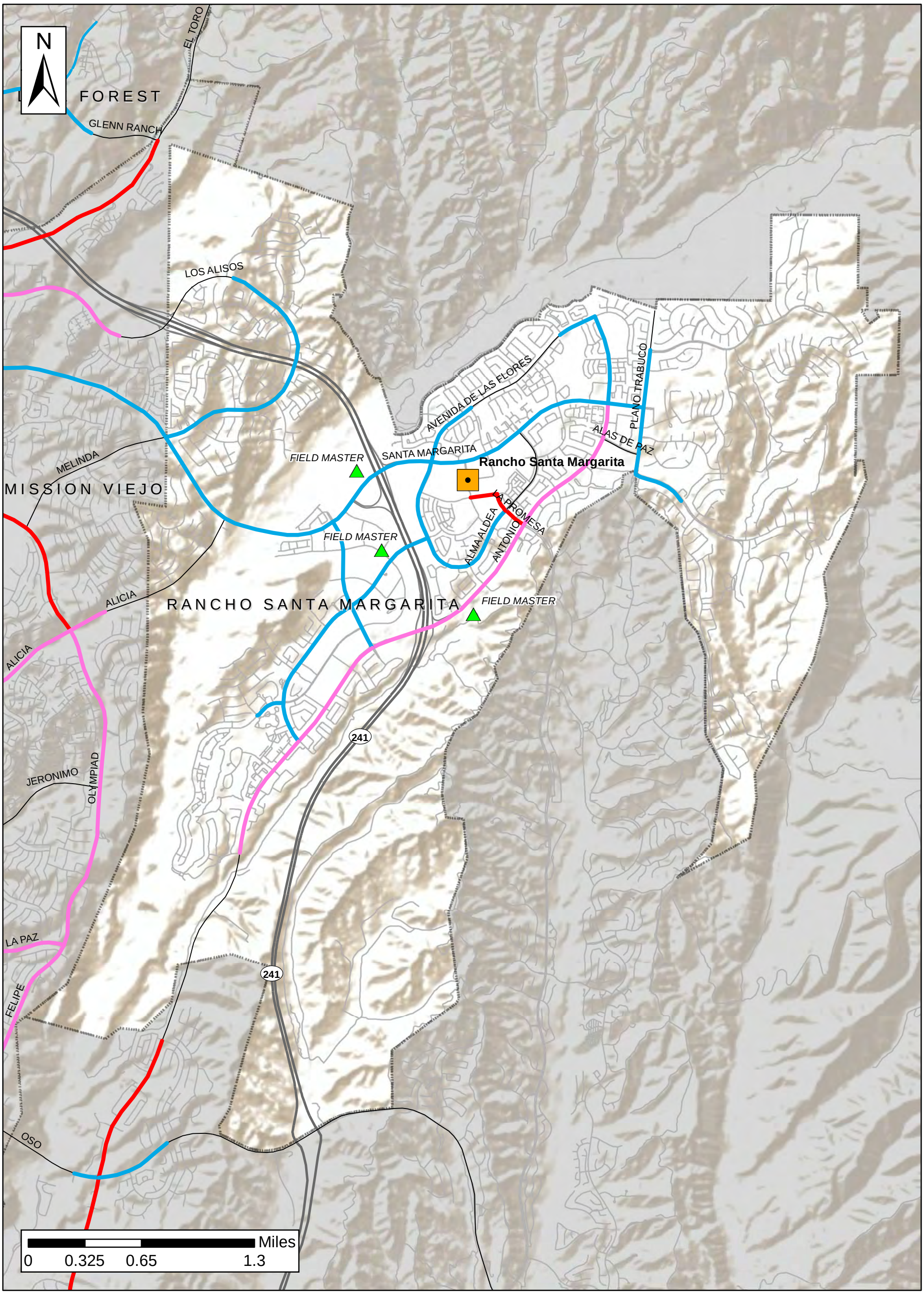


OCTA ITS Plan Update
Countywide Communications
Placentia

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Rancho Santa Margarita

Communications

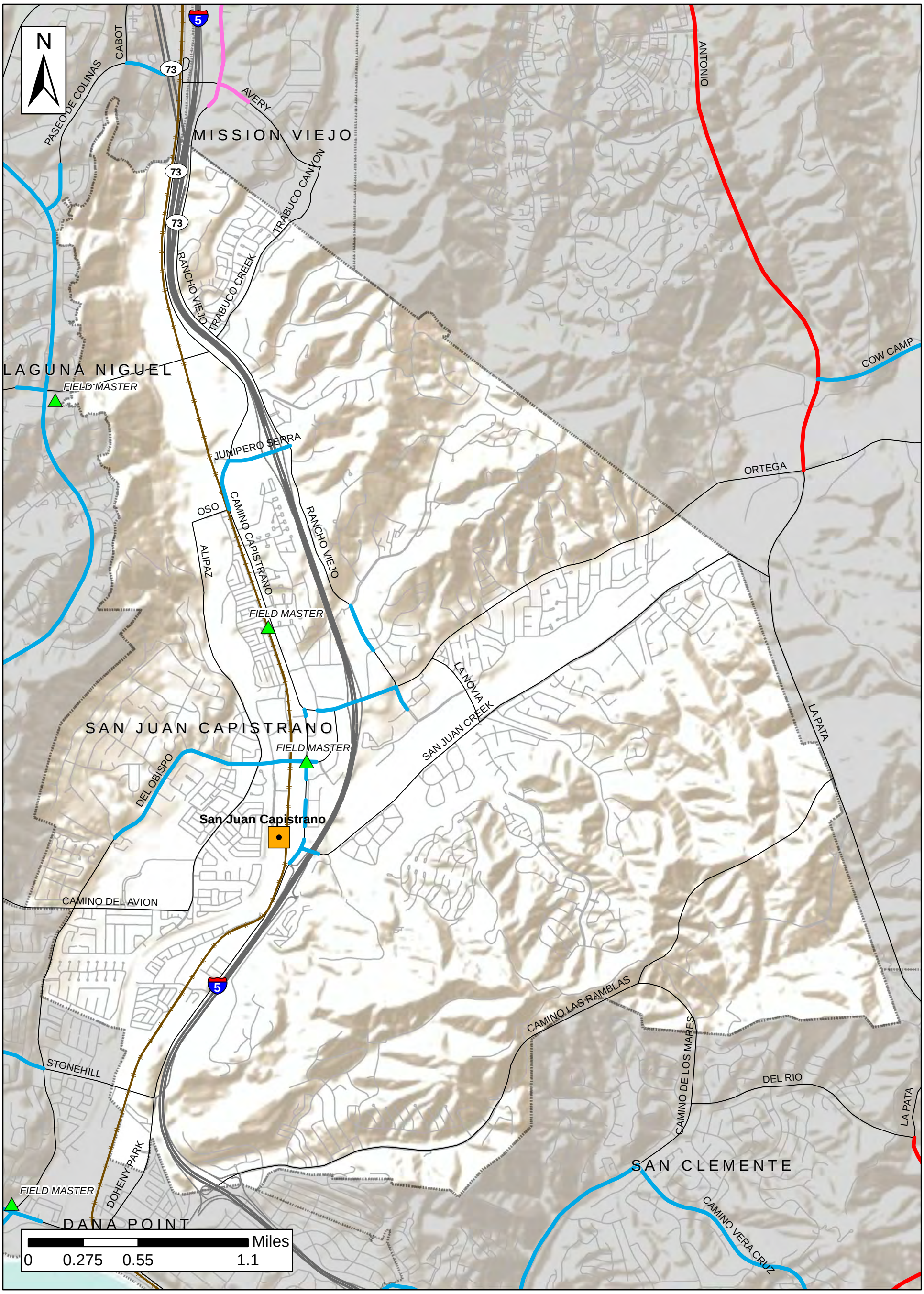
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

OCTA ITS Plan Update Countywide Communications - San Clemente

Communications

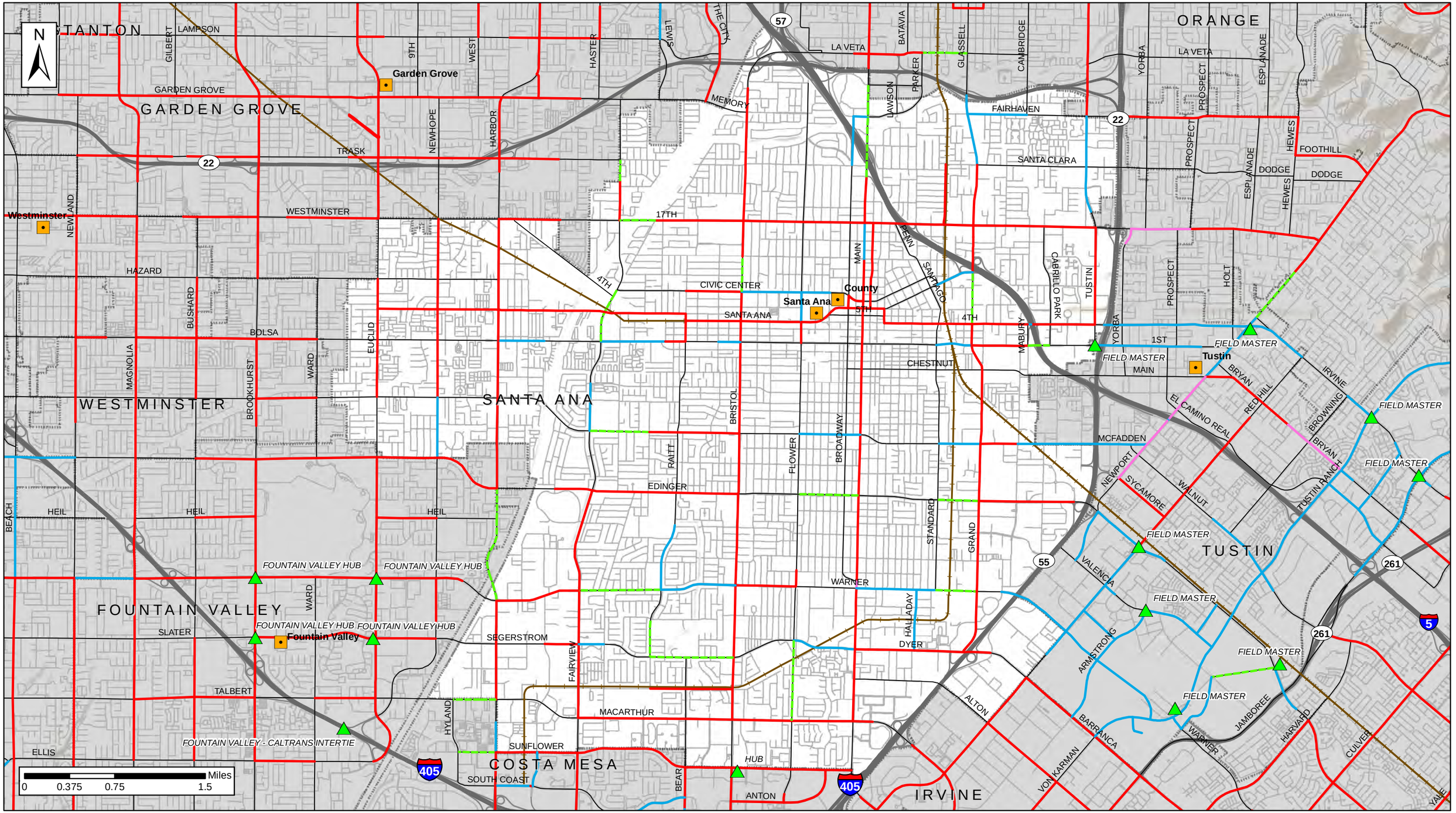
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

OCTA ITS Plan Update Countywide Communications - San Juan Capistrano



Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update
Countywide Communications
Santa Ana

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

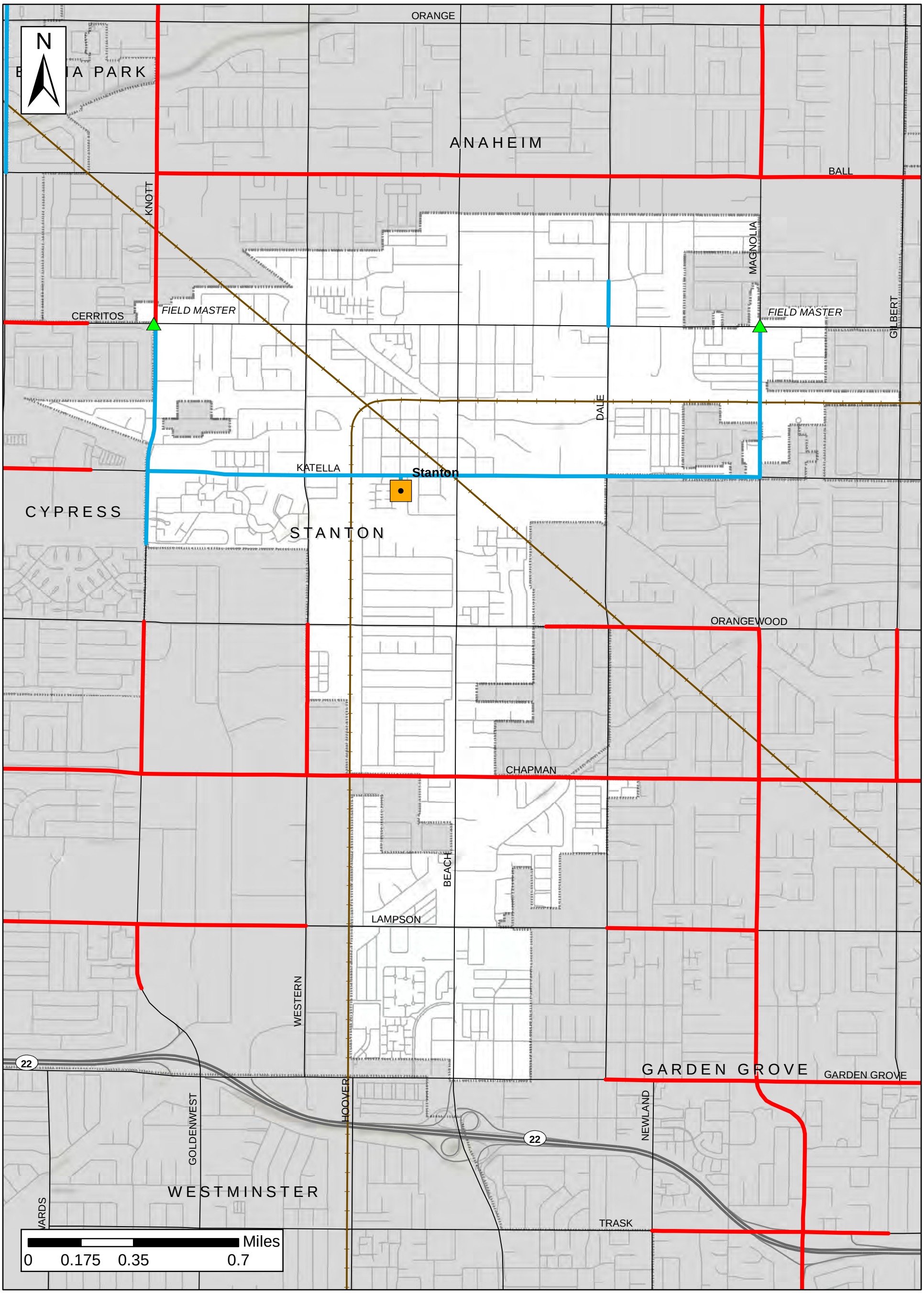
OCTA ITS Plan Update
Countywide Communications
Seal Beach

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

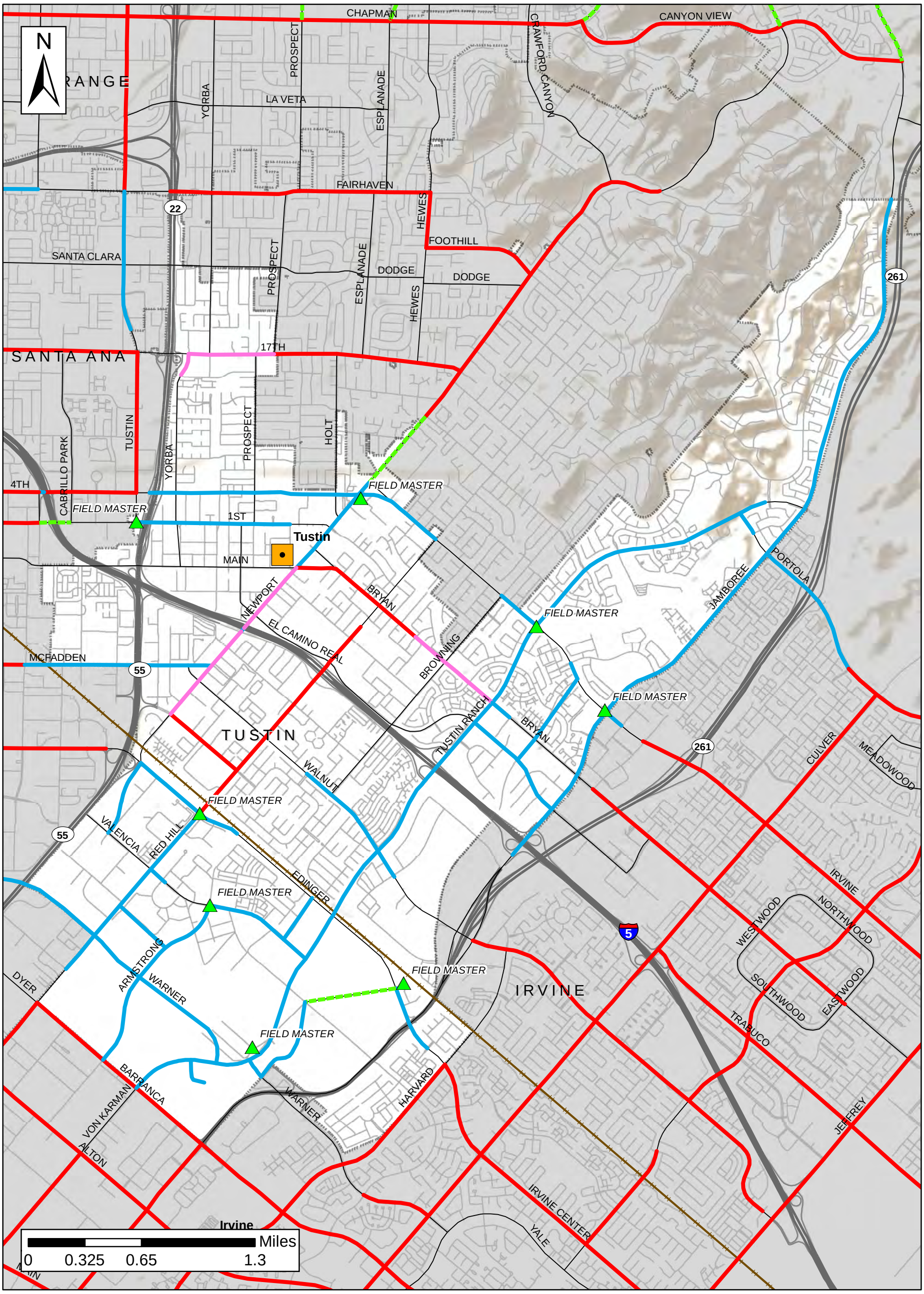
OCTA ITS Plan Update Countywide Communications - Stanton



Communications

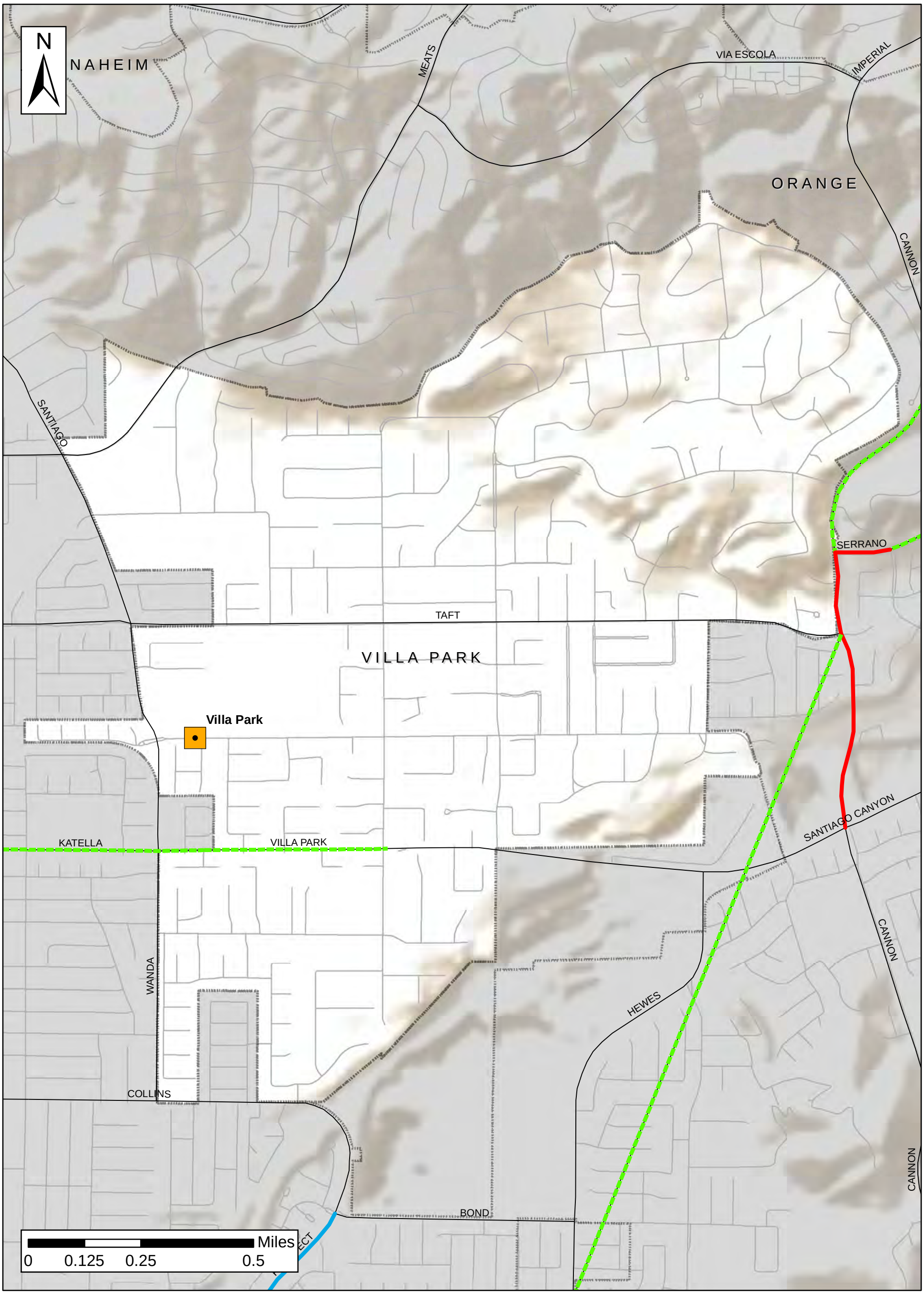
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

OCTA ITS Plan Update Countywide Communications - Tustin



Communications

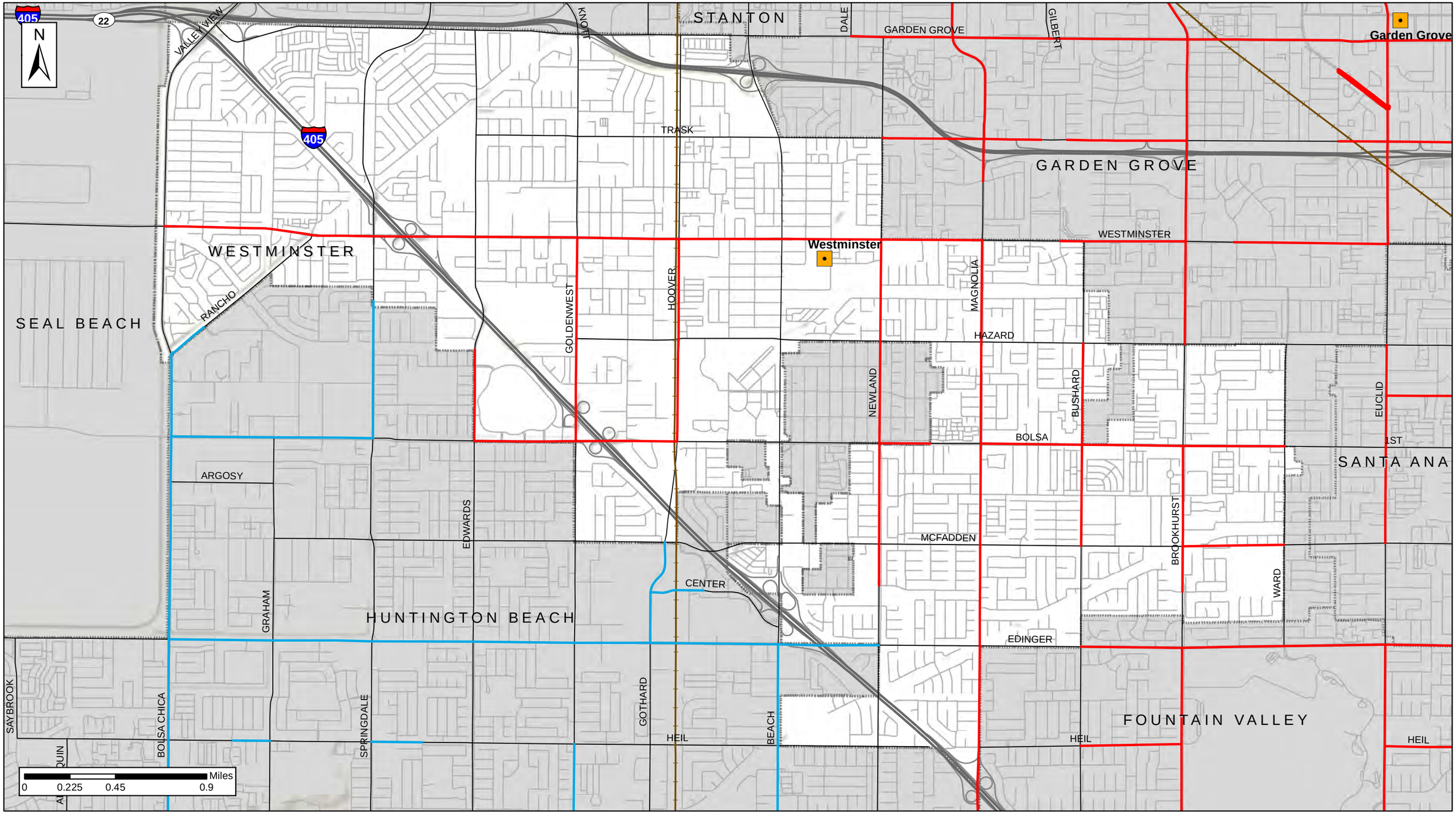
- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary



OCTA ITS Plan Update Countywide Communications - Villa Park

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

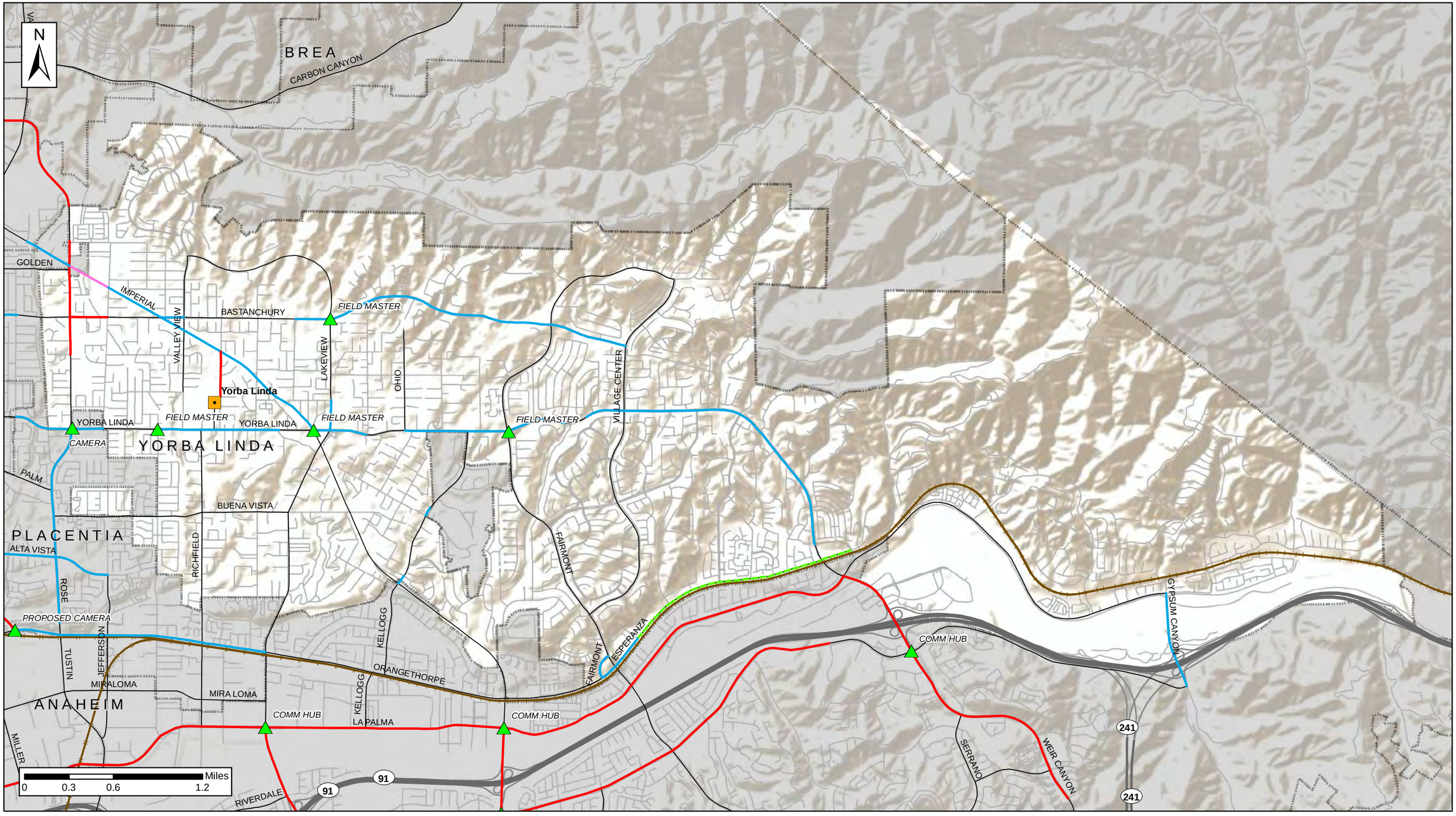


OCTA ITS Plan Update
Countywide Communications
Westminster

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

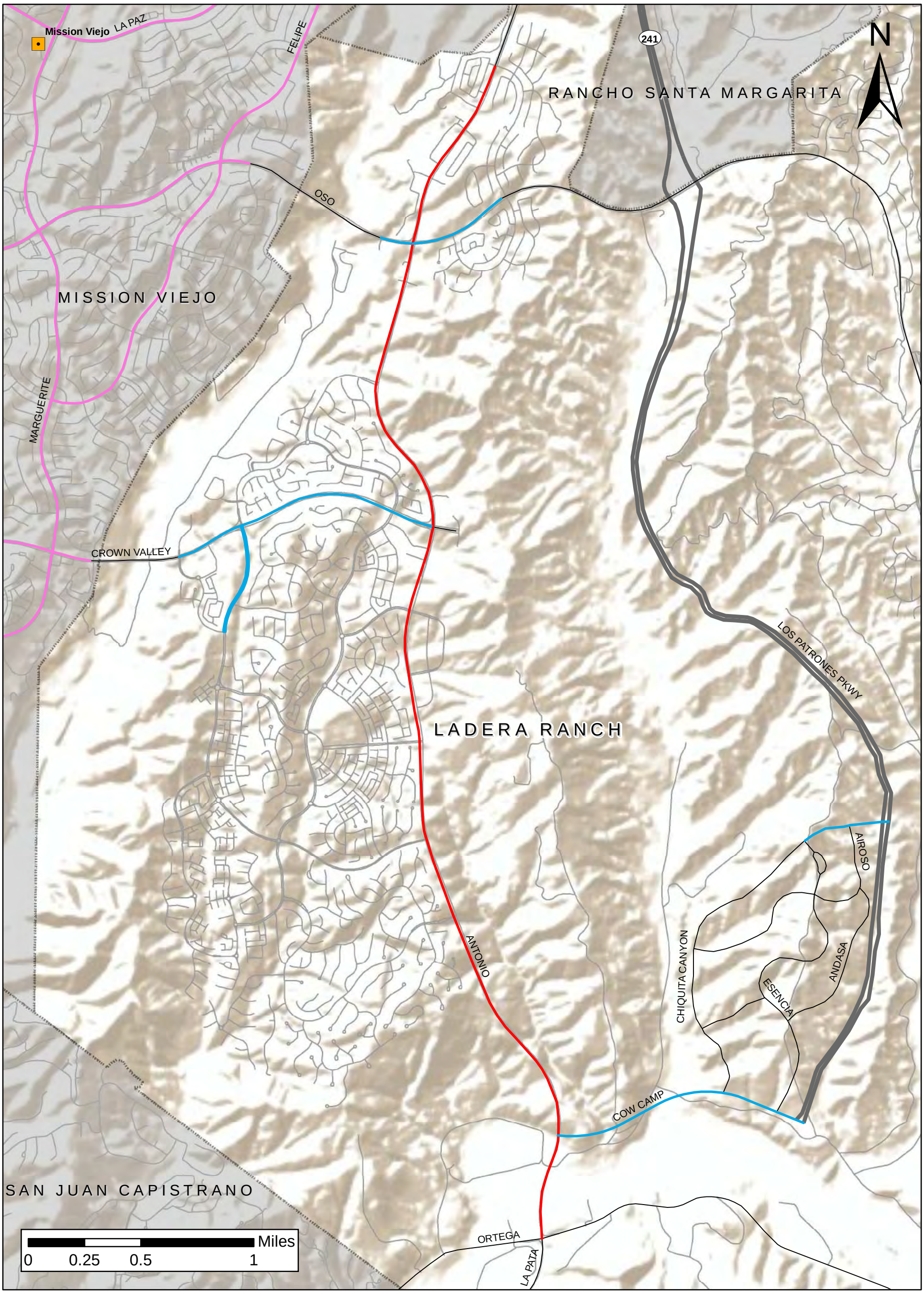


OCTA ITS Plan Update
Countywide Communications
Yorba Linda

Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

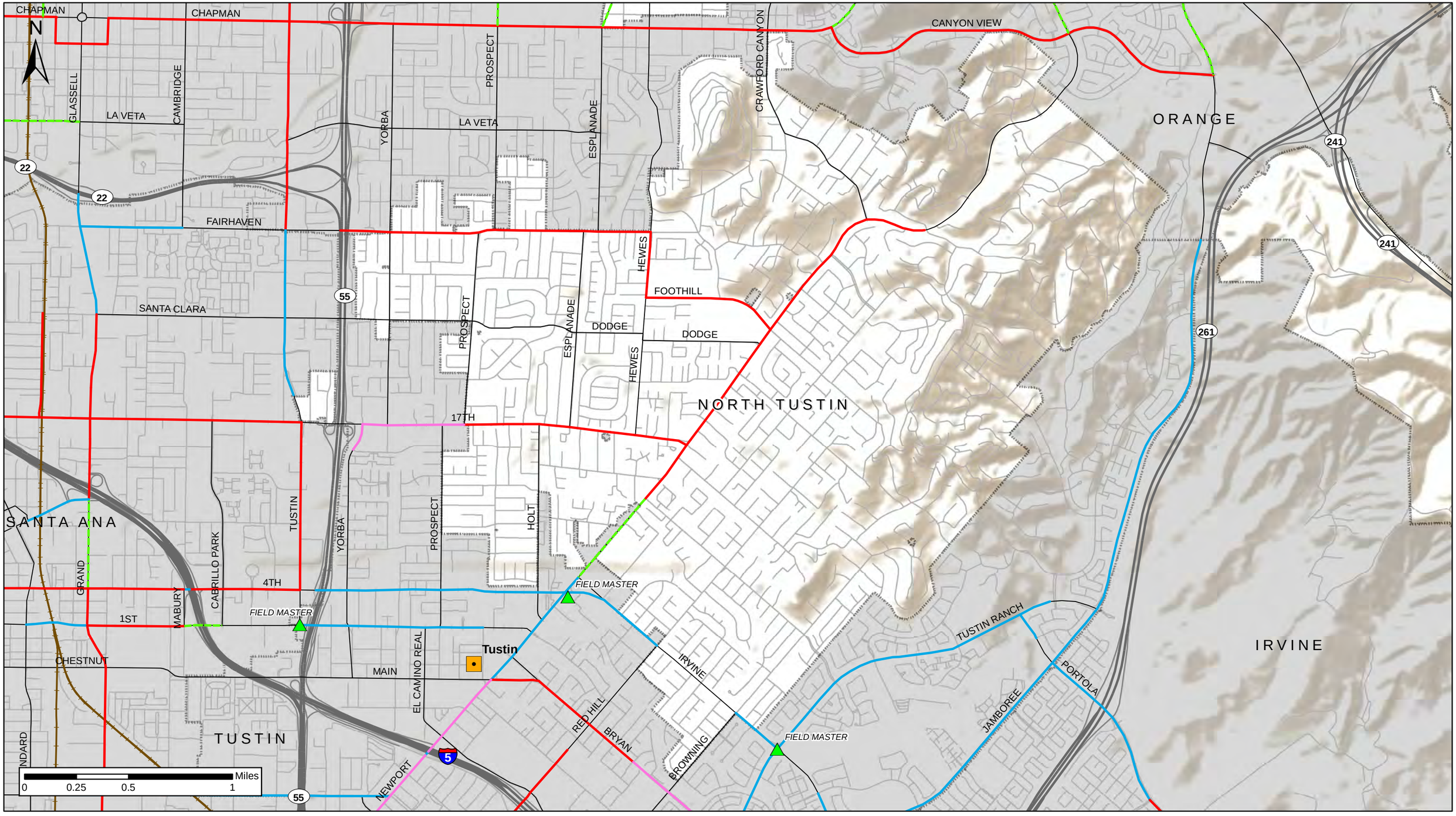


OCTA ITS Plan Update Countywide Communications - Ladera Ranch

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

OCTA ITS Plan Update
Countywide Communications
North Tustin



Communications

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

- TMC Location
- ITS Field Elements
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundary

APPENDIX G: COUNTYWIDE COMMUNICATIONS NETWORK

N

Communications

- 1 - Twisted Pair
- 2 - Fiber
- 3 - Twisted Pair and Fiber
- 4 - Wireless Link
- Proposed Tier 1 County Link (Primary)
- Proposed Tier 2 County Link (Secondary)

- TMC Location
- Railroads
- Master Plan of Arterial Highways (MPAH)
- Freeways
- City Boundaries

Miles
0 2.5 5 10

Sources: Esri, USGS, NOAA

OCTA ITS Plan Update - Existing & Proposed Countywide Communications

iteris

Location / Route of **Tier 1** Countywide TSS and ITS Communications Network Segments

Yellow highlight overlay

Project No.	Project Description	Route
1	La Habra TMC to Brea TMC	• EB La Habra Blvd • SB Harbor Blvd • EB Lambert Rd • SB Brea Blvd • EB Birch St
2	Brea TMC to Yorba Linda TMC	• EB Birch St • SB Kraemer Blvd • EB Yorba Linda Blvd
3	Yorba Linda TMC to Placentia TMC	• WB Yorba Linda Blvd • SB Kraemer Blvd
4	Placentia TMC to Fullerton TMC	• WB Chapman Ave • SB Harbor Blvd • WB Commonwealth Ave
5	Villa Park City Hall to Orange TMC	• SB Wanda Rd • WB Katella Ave
6	Orange TMC to Anaheim TMC	• WB Katella Ave • NB State College Blvd • WB Broadway
7	Fullerton TMC to Buena Park TMC	• NB Highland Ave • WB Chapman Ave / Malvern Ave • SB Dale St • WB Artesia Blvd • SB Beach Blvd
8	Fullerton TMC to Anaheim TMC	• SB Highland Ave • EB Valencia Dr • SB Harbor Blvd • EB La Palma Ave • SB Anaheim Blvd
9	Buena Park TMC to La Palma TMC	• SB Beach Blvd • WB Orangethorpe Ave • SB Walker St
10	La Palma TMC to Cypress TMC	• SB Walker St • WB Orange Ave
11	Cypress TMC to Los Alamitos TMC	• EB Orange Ave • SB Walker St • WB Katella Ave
12	Los Alamitos TMC to Stanton TMC	• WB Katella

Project No.	Project Description	Route
13	Los Alamitos TMC to Seal Beach TMC	• EB Katella Ave • SB Los Alamitos Blvd / Seal Beach Blvd • WB Bolsa Ave • SB Main St
14	Stanton TMC to Garden Grove TMC	• WB Katella Ave • SB Knott St • EB Chapman Ave • SB Magnolia St • EB Garden Grove Blvd
15	Westminster TMC to Garden Grove TMC	• EB Westminster Blvd • NB Brookhurst St • EB Garden Grove Blvd
16	Garden Grove TMC to Santa Ana TMC	• EB Garden Grove Blvd • SB Harbor Blvd • EB 5th St • SB Raitt St • EB Santa Ana Blvd
17	Orange County TMC to Santa Ana TMC	• East / West crossing of N Ross St
18	Orange TMC to Santa Ana TMC	• EB Katella Ave • SB Tustin St / Tustin Ave • WB 4th St • NB French St • WB Santa Ana Blvd
19	Fountain Valley TMC to Westminster TMC	• WB Slater St • NB Brookhurst St • WB Westminster Blvd
20	Fountain Valley TMC to Santa Ana TMC	• WB Slater St • NB Brookhurst St • EB Edinger Ave • NB Harbor Blvd • EB 5th St • SB Raitt St • EB Santa Ana Blvd
21	Huntington Beach TMC to Fountain Valley TMC and Westminster TMC	• EB Yorktown Ave • SB Beach Blvd • EB Adams Ave • NB Brookhurst St • EB Slater St (to Fountain Valley TMC) • NB Brookhurst • WB Westminster Blvd

Project No.	Project Description	Route
22	Huntington Beach TMC to Costa Mesa TMC	• EB Yorktown Ave • SB Beach Blvd • EB Adams Ave • SB Harbor Blvd • EB Fair Dr
23	Costa Mesa TMC to Newport Beach TMC	• EB Fair Dr • SB Newport Blvd • EB 17th St • SB Dover Dr • SB Pacific Coast Highway • NB Avocado Ave
24	Newport Beach TMC to Irvine TMC	• NB Avocado Ave • SB San Miguel Dr • NB MacArthur Blvd • NB San Joaquin Hills Rd • NB Jamboree Rd • SB Alton Pkwy
25	Santa Ana TMC to Tustin TMC	• EB Santa Ana Blvd • SB French St • EB 4th St / Irvine Blvd • SB Newport Ave • EB Main St
26	Tustin TMC to Irvine TMC	• EB Main St • SB Newport Ave • EB Sycamore Ave • SB Red Hill Ave • EB Alton Pkwy
27	Irvine TMC to Caltrans TMC	• NB Harvard Ave • SB Irvine Center Dr • NB Sand Canyon Ave
28	Irvine TMC to Lake Forest City Hall	• NB Harvard Ave • SB Irvine Center Dr • NB Bake Pkwy
29	Lake Forest City Hall to Rancho Santa Margarita City Hall	• SB Bake Pkwy • SB Trabuco Rd • NB El Toro Rd • SB Santa Margarita Pkwy
30	Lake Forest City Hall to Mission Viejo TMC	• SB Bake Pkwy • SB Trabuco Rd • SB Marguerite Pkwy
31	Lake Forest City Hall to Laguna Hills City Hall	• SB Bake Pkwy • SB Trabuco Rd • SB El Toro Rd

Project No.	Project Description	Route
32	Mission Viejo TMC to Rancho Santa Margarita City Hall	• NB Marguerite Pkwy • SB Santa Margarita Pkwy
33	Laguna Hills City Hall to Laguna Woods City Hall	• SB El Toro Rd
34	Laguna Woods City Hall to Aliso Viejo	• SB El Toro Rd • SB Aliso Creek Rd
35	Aliso Viejo City Hall to Laguna Niguel City Hall	• SB Aliso Creek Rd • SB Alicia Pkwy
36	Laguna Niguel City Hall to Dana Point TMC	• NB Crown Valley Pkwy • SB Golden Lantern
37	Dana Point TMC to San Juan Capistrano TMC	• NB Golden Lantern • EB Camino Del Avion • NB Del Obispo St • SB Camino Capistrano
38	Dana Point TMC to San Clemente TMC	• SB Golden Lantern • EB / SB Del Prado • SB Pacific Coast Hwy • SB Coast Hwy / N El Camino Real • OR – SB LOSSAN Rail Corridor • NB Avenida Pico

Tier 1 Gap Closures

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
1	La Habra TMC to Brea TMC	1A	La Habra	Lambert Rd	Palm St to City limit
		1B	Brea	Lambert Rd	City limit to Puente St
2	Brea TMC to Yorba Linda TMC	2A	Yorba Linda	Yorba Linda Blvd	Valencia Ave to Hamer Ln
		2B	Yorba Linda	Yorba Linda Blvd	Prospect Ave to Van Buren St
3	Yorba Linda TMC to Placentia TMC	3A	Yorba Linda	Yorba Linda Blvd	Valencia Ave to Hamer Ln
		3B	Yorba Linda	Yorba Linda Blvd	Prospect Ave to Van Buren St
4	Villa Park City Hall to Orange TMC	4A	Villa Park	Wanda Rd	Santiago Blvd to City limit
		4B	Orange	Wanda Rd	City limit to Katella Ave
		4C	Orange	Katella Ave	Wanda Rd to Tustin St
5	Fullerton TMC to Buena Park TMC	5	Fullerton	Malvern Ave	Burning Tree Rd to City limit
6	Fullerton TMC to Anaheim TMC	6	Anaheim	Harbor Blvd	City limit to La Palma Ave
7	La Palma TMC to Cypress TMC	7	La Palma	Walker St	Los Palos Cir to Crescent Ave
8	Stanton TMC to Garden Grove TMC	8	Garden Grove	Knott Ave	City limit to Orangewood Ave
9	Los Alamitos TMC to Seal Beach TMC	9	Los Alamitos	Los Alamitos Blvd	Rossmoor Way to Rossmoor Center Way
10	Westminster TMC to Garden Grove TMC	10	Westminster	Westminster Ave	Magnolia St to Deodara Dr
11	Garden Grove TMC to Santa Ana TMC	11	Garden Grove	Harbor Blvd	Cardinal Cir to Westminster Ave

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
12	Orange County TMC to Santa Ana TMC	12	Santa Ana / County of Orange	Ross St	East / west crossing of Ross St between county and city buildings
13	Orange TMC to Santa Ana TMC	13	Santa Ana	Tustin Ave	City limit to 17th St
14	Fountain Valley TMC to Westminster TMC	14A	Fountain Valley	Brookhurst St	Edinger Ave to City limit
		14B	Westminster	Brookhurst St	City limit to Margo Ln
		14C	Westminster	Brookhurst St	Bolsa Ave to Hazard Ave
		14D	Westminster	Westminster Ave	Magnolia St to Deodara Dr
15	Huntington Beach TMC to Westminster TMC	15A	Fountain Valley	Brookhurst St	Garfield Ave to Ellis Ave
		15B	Fountain Valley	Brookhurst St	Edinger Ave to City limit
		15C	Westminster	Brookhurst St	City limit to Margo Ln
		15D	Westminster	Brookhurst St	Bolsa Ave to Hazard Ave
		15E	Westminster	Westminster Ave	Magnolia St to Deodara Dr
16	Huntington Beach TMC to Costa Mesa TMC	16A	Huntington Beach	Adams Ave	Ranger Ln to City limit
		16B	Costa Mesa	Adams Ave	City limit to Shantar Dr / Albatross Dr
17	Santa Ana TMC to Tustin TMC	17	Santa Ana	4th St	Tustin Ave to SR-55 ramps
18	Tustin TMC to Irvine TMC	18	Santa Ana / Tustin	Red Hill Ave	Carnegie Ave to Barranca Pkwy
19	Lake Forest City Hall to Rancho Santa Margarita City Hall	19A	Lake Forest	Santa Margarita Pkwy	El Toro Rd to City limit
		19B	Mission Viejo	Santa Margarita Pkwy	City limit to Los Alisos Blvd
20	Lake Forest City Hall to Mission Viejo TMC	20A	Lake Forest	Trabuco Rd	Cherry Ave to City limit
		20B	Mission Viejo	Trabuco Rd	City limit to Modesto Dr
21	Dana Point TMC to San Juan Capistrano TMC	21A	Dana Point / Laguna Niguel	Camino Del Avion	Park Crest to City limit

Project No.	Project Description	Location			
		No	**Agency**	**Roadway**	**Limits**
		21B	San Juan Capistrano	Camino Del Avion	City limit to Del Obispo St
		21C	San Juan Capistrano	Del Obispo St	Camino Del Avion to Via Vermuelen
22	Dana Point TMC to San Clemente TMC	22A – Option 1	Dana Point	Pacific Coast Hwy	Doheny Park Plaza to Coast Hwy
		22B – Option 1	Dana Point	Coast Hwy	Pacific Coast Hwy to City limit
		22C – Option 1	San Clemente	El Camino Real	City limit to Avenida Estacion
		22D – Option 2	Dana Point	Pacific Coast Hwy	Doheny Park Plaza to LOSSAN Rail Corridor
		22E – Option 2	Dana Point	LOSSAN Rail Corridor	Pacific Coast Hwy to City limit
		22F – Option 2	San Clemente	LOSSAN Rail Corridor	City limit Avenida Estacion

Location / Route of **Tier 2** Countywide TSS and ITS Communications Network Segments

Light purple highlight overlay

Project No.	Project Description	Route
1	La Habra TMC to Brea TMC	• EB La Habra Blvd / W Central Dr / State College Blvd; • WB E Birch St
2	La Habra TMC to Yorba Linda TMC	• EB La Habra Blvd / W Central Dr / State College Blvd; • EB E Birch St / N Rose St; • EB / SB Imperial Hwy; • SB Casa Loma Ave
3	Brea TMC to Yorba Linda TMC	• EB E Birch St / N Rose St; • EB / SB Imperial Hwy; • SB Casa Loma Ave
4	La Habra TMC to Fullerton TMC	• EB La Habra Blvd; • SB Harbor Blvd; • WB Commonwealth Ave
5	Brea TMC to Fullerton TMC	• WB E Birch St; • SB Brea Blvd; • SB Harbor Blvd; • WB Commonwealth Ave
6	Fullerton TMC to Stanton TMC	• WB Commonwealth Ave • SB Magnolia St; • WB Katella Ave
7	Anaheim TMC to Stanton TMC	• NB Anaheim Blvd; • WB La Palma Ave; • SB Brookhurst St; • WB Lincoln Ave; • SB Magnolia St; • WB Katella Ave
8	Cypress TMC to Stanton TMC to Garden Grove TMC via Pacific Electric Right-of-way (PEROW)	• PEROW Southeast bound from Walker St to Katella Ave; • WB Katella Ave to Stanton TMC; • PEROW Southeast bound from Katella Ave to Garden Grove Blvd; • EB Garden Grove Blvd
9	Orange TMC to Santa Ana TMC	• WB Katella Ave; • SB Batavia St; • WB Chapman Ave; • SB The City Dr; • EB Memory Ln; • SB Bristol St; • EB Santa Ana Blvd

Project No.	Project Description	Route
10	Westminster TMC to Huntington Beach TMC	• WB Westminster Blvd; • Southwest-bound Rancho Rd; • SB Bolsa Chica Rd; • EB Warner Ave; • SB Goldenwest St; • EB Yorktown Ave
11	Fountain Valley TMC to Santa Ana TMC	• EB Slater Ave; • NB Newhope St; • EB Warner Ave; • NB Bristol St; • EB Santa Ana Blvd
12	Fountain Valley TMC to Costa Mesa TMC	• EB Slater Ave; • NB Newhope St; • EB Warner Ave; • SB Bristol St; • SB Newport Blvd; • WB Fair Dr
13	Tustin TMC to Irvine TMC	• EB Main St / Bryan Ave; • SB Culver Dr; • WB Irvine Center Dr; • SB Harvard Ave
14	Tustin TMC to Caltrans TMC	• EB Main St / Bryan Ave; • NB Culver Dr; • EB Irvine Blvd; • SB Sand Canyon Ave
15	Caltrans TMC to Lake Forest City Hall	• NB Sand Canyon Ave; • SB Irvine Blvd; • NB Bake Pkwy
16	Lake Forest City Hall to Rancho Santa Margarita City Hall	• NB Bake Pkwy; • SB / EB Portola Pkwy / Santa Margarita Pkwy
17	Laguna Woods City Hall to Lake Forest City Hall	• NB Moulton Pkwy / Irvine Center Dr; • NB Bake Pkwy
18	Aliso Viejo City Hall to Mission Viejo TMC	• SB Aliso Creek Rd; • NB Alicia Pkwy; • EB Pacific Park Rd; • NB La Paz Rd;
19	Aliso Viejo City Hall to Dana Point TMC	• SB Aliso Creek Rd; • NB Alicia Pkwy; • EB Pacific Park Rd; • SB Moulton Pkwy / Golden Lantern

Tier 2 Gap Closures

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
1	La Habra TMC to Brea TMC	1	Brea	Central	Roscoe St to Puente St
2	La Habra TMC to Yorba Linda TMC	2A	Brea	Central	Roscoe St to Puente St
		2B	Yorba Linda	Rose St	City limit to Wabash Ave
3	Brea TMC to Yorba Linda TMC	3	Yorba Linda	Rose St	City limit to Wabash Ave
4	La Habra TMC to Fullerton TMC	4A	Brea	Harbor Blvd	Edwards Dr to Imperial Hwy (SR-90)
		4B	La Habra	Harbor Blvd	City limit to City limit
		4C	Fullerton	Harbor Blvd	City limit to Las Palmas Dr
		4D	Fullerton	Harbor Blvd	Hermosa Dr to Bastanchury Rd
		4E	Fullerton	Harbor Blvd	Valencia Mesa Dr to Brea Blvd
5	Brea TMC to Fullerton TMC	5A	Brea	Brea Blvd	Fir St to City limit
		5B	Fullerton	Brea Blvd	City limit to Rolling Hills Dr
		5C	Fullerton	Brea Blvd	Ashburn Tr to Harbor Blvd
6	Fullerton TMC to Stanton TMC	6A	Fullerton	Magnolia St	Orangethorpe Ave to I-5 ramps / City limit
		6B	Anaheim	Magnolia St	Ball Rd to City limit
		6C	Stanton	Magnolia St	City limit to Cerritos Ave
7	Anaheim TMC to Stanton TMC	7A	Anaheim	Magnolia St	Ball Rd to City limit
		7B	Stanton	Magnolia St	City limit to Cerritos Ave
8	Cypress TMC to Stanton TMC to Garden Grove TMC via Pacific Electric Right-of-way (PEROW)	8A	Cypress	PEROW	Walker St to City limit
		8B	Buena Park	PEROW	City limit to City limit
		8C	Anaheim	PEROW	City limit to City limit
		8D	Stanton	PEROW	City limit to City limit
		8E	Garden Grove	PEROW	City limit to Garden Grove Blvd

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
9	Orange TMC to Santa Ana TMC	9A	Orange	Memory Ln	The City Dr to City limit
		9B	Santa Ana	Memory Ln	City limit to Bristol St
		9C	Santa Ana	Bristol St	Washington Ave to Civic Center Dr
10	Westminster TMC to Huntington Beach TMC	10	Westminster	Rancho Rd	Westminster Blvd to Astronautics Dr
11	Fountain Valley TMC to Santa Ana TMC	11A	Fountain Valley	Newhope St	Slater Ave to Los Caballeros Village
		11B	Fountain Valley	Warner Ave	Wintersburg Ave to City limit
		11C	Santa Ana	Warner Ave	City limit to Harbor Blvd
		11D	Santa Ana	Warner Ave	Fairview St to Raitt St
12	Fountain Valley TMC to Costa Mesa TMC	12A	Fountain Valley	Newhope St	Slater Ave to Los Caballeros Village
		12B	Fountain Valley	Warner Ave	Wintersburg Ave to City limit
		12C	Santa Ana	Warner Ave	City limit to Harbor Blvd
		12D	Santa Ana	Bristol St	MacArthur Blvd to Sunflower Ave
13	Tustin TMC to Irvine TMC	13	Tustin	Red Hill Ave	Carnegie Ave to Barranca Pkwy
14	Tustin TMC to Caltrans TMC	14	Tustin	Bryan Ave	Market St to Jamboree Rd
15	Lake Forest City Hall to Rancho Santa Margarita City Hall	15A	Lake Forest	Portola Pkwy	Glen Ranch Rd to Rancho Pkwy
		15B	Lake Forest	Santa Margarita Pkwy	El Toro Rd to City limit
16	Laguna Woods City Hall to Lake Forest City Hall	16	Irvine	Irvine Center Dr	Scientific to Bake Pkwy

Tier 1 Gap Closures

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
1	La Habra TMC to Brea TMC	1A	La Habra	Lambert Rd	Palm St to City limit
		1B	Brea	Lambert Rd	City limit to Puente St
2	Brea TMC to Yorba Linda TMC	2A	Yorba Linda	Yorba Linda Blvd	Valencia Ave to Hamer Ln
		2B	Yorba Linda	Yorba Linda Blvd	Prospect Ave to Van Buren St
3	Yorba Linda TMC to Placentia TMC	3A	Yorba Linda	Yorba Linda Blvd	Valencia Ave to Hamer Ln
		3B	Yorba Linda	Yorba Linda Blvd	Prospect Ave to Van Buren St
4	Villa Park City Hall to Orange TMC	4A	Villa Park	Wanda Rd	Santiago Blvd to City limit
		4B	Orange	Wanda Rd	City limit to Katella Ave
		4C	Orange	Katella Ave	Wanda Rd to Tustin St
5	Fullerton TMC to Buena Park TMC	5	Fullerton	Malvern Ave	Burning Tree Rd to City limit
6	Fullerton TMC to Anaheim TMC	6	Anaheim	Harbor Blvd	City limit to La Palma Ave
7	La Palma TMC to Cypress TMC	7	La Palma	Walker St	Los Palos Cir to Crescent Ave
8	Stanton TMC to Garden Grove TMC	8	Garden Grove	Knott Ave	City limit to Orangewood Ave
9	Los Alamitos TMC to Seal Beach TMC	9	Los Alamitos	Los Alamitos Blvd	Rossmoor Way to Rossmoor Center Way
10	Westminster TMC to Garden Grove TMC	10	Westminster	Westminster Ave	Magnolia St to Deodara Dr
11	Garden Grove TMC to Santa Ana TMC	11	Garden Grove	Harbor Blvd	Cardinal Cir to Westminster Ave

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
12	Orange County TMC to Santa Ana TMC	12	Santa Ana / County of Orange	Ross St	East / west crossing of Ross St between county and city buildings
13	Orange TMC to Santa Ana TMC	13	Santa Ana	Tustin Ave	City limit to 17th St
14	Fountain Valley TMC to Westminster TMC	14A	Fountain Valley	Brookhurst St	Edinger Ave to City limit
		14B	Westminster	Brookhurst St	City limit to Margo Ln
		14C	Westminster	Brookhurst St	Bolsa Ave to Hazard Ave
		14D	Westminster	Westminster Ave	Magnolia St to Deodara Dr
15	Huntington Beach TMC to Westminster TMC	15A	Fountain Valley	Brookhurst St	Garfield Ave to Ellis Ave
		15B	Fountain Valley	Brookhurst St	Edinger Ave to City limit
		15C	Westminster	Brookhurst St	City limit to Margo Ln
		15D	Westminster	Brookhurst St	Bolsa Ave to Hazard Ave
		15E	Westminster	Westminster Ave	Magnolia St to Deodara Dr
16	Huntington Beach TMC to Costa Mesa TMC	16A	Huntington Beach	Adams Ave	Ranger Ln to City limit
		16B	Costa Mesa	Adams Ave	City limit to Shantar Dr / Albatross Dr
17	Santa Ana TMC to Tustin TMC	17	Santa Ana	4th St	Tustin Ave to SR-55 ramps
18	Tustin TMC to Irvine TMC	18	Santa Ana / Tustin	Red Hill Ave	Carnegie Ave to Barranca Pkwy
19	Lake Forest City Hall to Rancho Santa Margarita City Hall	19A	Lake Forest	Santa Margarita Pkwy	El Toro Rd to City limit
		19B	Mission Viejo	Santa Margarita Pkwy	City limit to Los Alisos Blvd
20	Lake Forest City Hall to Mission Viejo TMC	20A	Lake Forest	Trabuco Rd	Cherry Ave to City limit
		20B	Mission Viejo	Trabuco Rd	City limit to Modesto Dr
21	Dana Point TMC to San Juan Capistrano TMC	21A	Dana Point / Laguna Niguel	Camino Del Avion	Park Crest to City limit

Project No.	Project Description	Location			
		No	**Agency**	**Roadway**	**Limits**
		21B	San Juan Capistrano	Camino Del Avion	City limit to Del Obispo St
		21C	San Juan Capistrano	Del Obispo St	Camino Del Avion to Via Vermuelen
22	Dana Point TMC to San Clemente TMC	22A – Option 1	Dana Point	Pacific Coast Hwy	Doheny Park Plaza to Coast Hwy
		22B – Option 1	Dana Point	Coast Hwy	Pacific Coast Hwy to City limit
		22C – Option 1	San Clemente	El Camino Real	City limit to Avenida Estacion
		22D – Option 2	Dana Point	Pacific Coast Hwy	Doheny Park Plaza to LOSSAN Rail Corridor
		22E – Option 2	Dana Point	LOSSAN Rail Corridor	Pacific Coast Hwy to City limit
		22F – Option 2	San Clemente	LOSSAN Rail Corridor	City limit Avenida Estacion

Location / Route of **Tier 2** Countywide TSS and ITS Communications Network Segments

Light purple highlight overlay

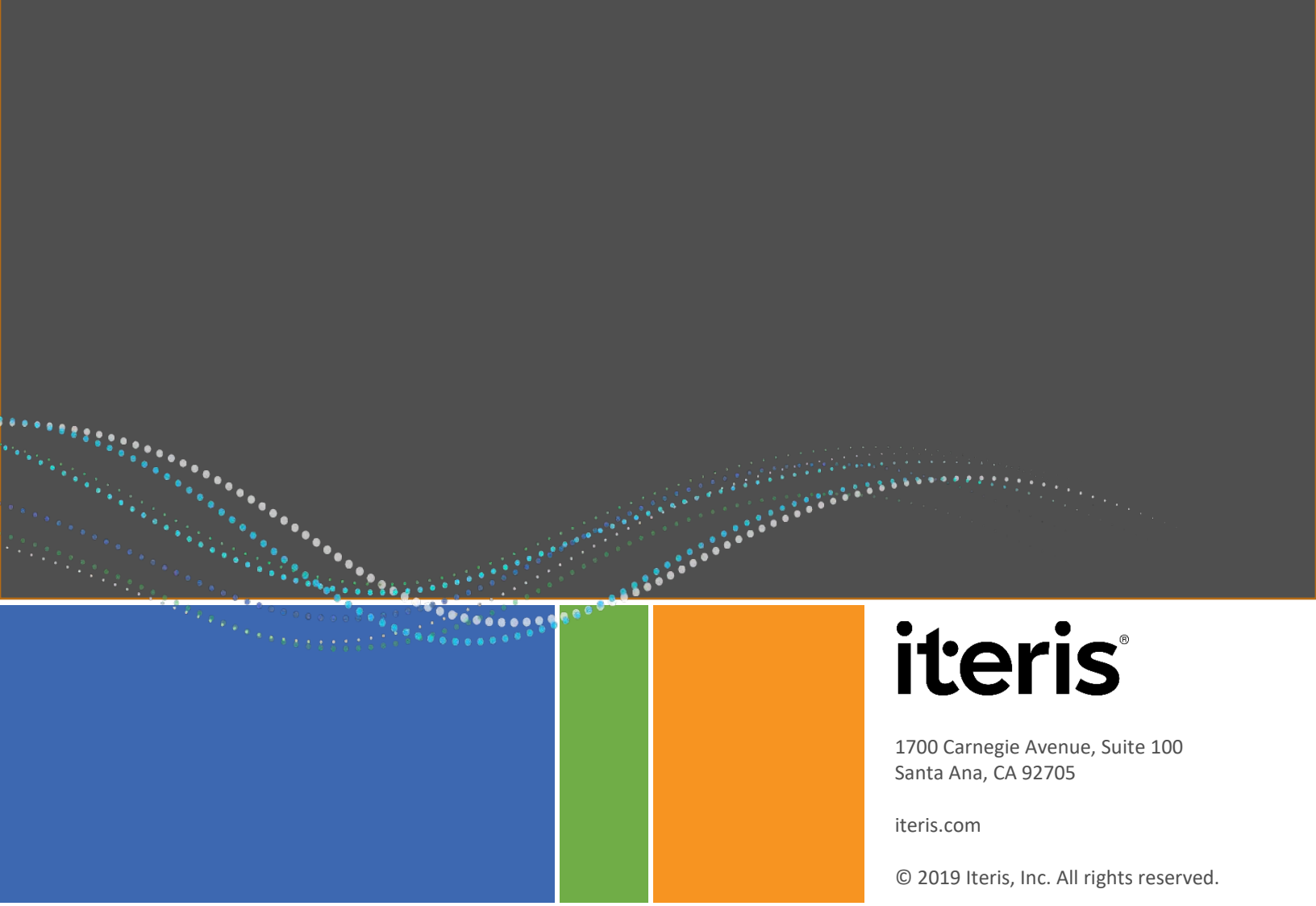
Project No.	Project Description	Route
1	La Habra TMC to Brea TMC	• EB La Habra Blvd / W Central Dr / State College Blvd; • WB E Birch St
2	La Habra TMC to Yorba Linda TMC	• EB La Habra Blvd / W Central Dr / State College Blvd; • EB E Birch St / N Rose St; • EB / SB Imperial Hwy; • SB Casa Loma Ave
3	Brea TMC to Yorba Linda TMC	• EB E Birch St / N Rose St; • EB / SB Imperial Hwy; • SB Casa Loma Ave
4	La Habra TMC to Fullerton TMC	• EB La Habra Blvd; • SB Harbor Blvd; • WB Commonwealth Ave
5	Brea TMC to Fullerton TMC	• WB E Birch St; • SB Brea Blvd; • SB Harbor Blvd; • WB Commonwealth Ave
6	Fullerton TMC to Stanton TMC	• WB Commonwealth Ave • SB Magnolia St; • WB Katella Ave
7	Anaheim TMC to Stanton TMC	• NB Anaheim Blvd; • WB La Palma Ave; • SB Brookhurst St; • WB Lincoln Ave; • SB Magnolia St; • WB Katella Ave
8	Cypress TMC to Stanton TMC to Garden Grove TMC via Pacific Electric Right-of-way (PEROW)	• PEROW Southeast bound from Walker St to Katella Ave; • WB Katella Ave to Stanton TMC; • PEROW Southeast bound from Katella Ave to Garden Grove Blvd; • EB Garden Grove Blvd
9	Orange TMC to Santa Ana TMC	• WB Katella Ave; • SB Batavia St; • WB Chapman Ave; • SB The City Dr; • EB Memory Ln; • SB Bristol St; • EB Santa Ana Blvd

Project No.	Project Description	Route
10	Westminster TMC to Huntington Beach TMC	• WB Westminster Blvd; • Southwest-bound Rancho Rd; • SB Bolsa Chica Rd; • EB Warner Ave; • SB Goldenwest St; • EB Yorktown Ave
11	Fountain Valley TMC to Santa Ana TMC	• EB Slater Ave; • NB Newhope St; • EB Warner Ave; • NB Bristol St; • EB Santa Ana Blvd
12	Fountain Valley TMC to Costa Mesa TMC	• EB Slater Ave; • NB Newhope St; • EB Warner Ave; • SB Bristol St; • SB Newport Blvd; • WB Fair Dr
13	Tustin TMC to Irvine TMC	• EB Main St / Bryan Ave; • SB Culver Dr; • WB Irvine Center Dr; • SB Harvard Ave
14	Tustin TMC to Caltrans TMC	• EB Main St / Bryan Ave; • NB Culver Dr; • EB Irvine Blvd; • SB Sand Canyon Ave
15	Caltrans TMC to Lake Forest City Hall	• NB Sand Canyon Ave; • SB Irvine Blvd; • NB Bake Pkwy
16	Lake Forest City Hall to Rancho Santa Margarita City Hall	• NB Bake Pkwy; • SB / EB Portola Pkwy / Santa Margarita Pkwy
17	Laguna Woods City Hall to Lake Forest City Hall	• NB Moulton Pkwy / Irvine Center Dr; • NB Bake Pkwy
18	Aliso Viejo City Hall to Mission Viejo TMC	• SB Aliso Creek Rd; • NB Alicia Pkwy; • EB Pacific Park Rd; • NB La Paz Rd;
19	Aliso Viejo City Hall to Dana Point TMC	• SB Aliso Creek Rd; • NB Alicia Pkwy; • EB Pacific Park Rd; • SB Moulton Pkwy / Golden Lantern

Tier 2 Gap Closures

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
1	La Habra TMC to Brea TMC	1	Brea	Central	Roscoe St to Puente St
2	La Habra TMC to Yorba Linda TMC	2A	Brea	Central	Roscoe St to Puente St
		2B	Yorba Linda	Rose St	City limit to Wabash Ave
3	Brea TMC to Yorba Linda TMC	3	Yorba Linda	Rose St	City limit to Wabash Ave
4	La Habra TMC to Fullerton TMC	4A	Brea	Harbor Blvd	Edwards Dr to Imperial Hwy (SR-90)
		4B	La Habra	Harbor Blvd	City limit to City limit
		4C	Fullerton	Harbor Blvd	City limit to Las Palmas Dr
		4D	Fullerton	Harbor Blvd	Hermosa Dr to Bastanchury Rd
		4E	Fullerton	Harbor Blvd	Valencia Mesa Dr to Brea Blvd
5	Brea TMC to Fullerton TMC	5A	Brea	Brea Blvd	Fir St to City limit
		5B	Fullerton	Brea Blvd	City limit to Rolling Hills Dr
		5C	Fullerton	Brea Blvd	Ashburn Tr to Harbor Blvd
6	Fullerton TMC to Stanton TMC	6A	Fullerton	Magnolia St	Orangethorpe Ave to I-5 ramps / City limit
		6B	Anaheim	Magnolia St	Ball Rd to City limit
		6C	Stanton	Magnolia St	City limit to Cerritos Ave
7	Anaheim TMC to Stanton TMC	7A	Anaheim	Magnolia St	Ball Rd to City limit
		7B	Stanton	Magnolia St	City limit to Cerritos Ave
8	Cypress TMC to Stanton TMC to Garden Grove TMC via Pacific Electric Right-of-way (PEROW)	8A	Cypress	PEROW	Walker St to City limit
		8B	Buena Park	PEROW	City limit to City limit
		8C	Anaheim	PEROW	City limit to City limit
		8D	Stanton	PEROW	City limit to City limit
		8E	Garden Grove	PEROW	City limit to Garden Grove Blvd

Project No.	Project Description	Location			
		No	Agency	Roadway	Limits
9	Orange TMC to Santa Ana TMC	9A	Orange	Memory Ln	The City Dr to City limit
		9B	Santa Ana	Memory Ln	City limit to Bristol St
		9C	Santa Ana	Bristol St	Washington Ave to Civic Center Dr
10	Westminster TMC to Huntington Beach TMC	10	Westminster	Rancho Rd	Westminster Blvd to Astronautics Dr
11	Fountain Valley TMC to Santa Ana TMC	11A	Fountain Valley	Newhope St	Slater Ave to Los Caballeros Village
		11B	Fountain Valley	Warner Ave	Wintersburg Ave to City limit
		11C	Santa Ana	Warner Ave	City limit to Harbor Blvd
		11D	Santa Ana	Warner Ave	Fairview St to Raitt St
12	Fountain Valley TMC to Costa Mesa TMC	12A	Fountain Valley	Newhope St	Slater Ave to Los Caballeros Village
		12B	Fountain Valley	Warner Ave	Wintersburg Ave to City limit
		12C	Santa Ana	Warner Ave	City limit to Harbor Blvd
		12D	Santa Ana	Bristol St	MacArthur Blvd to Sunflower Ave
13	Tustin TMC to Irvine TMC	13	Tustin	Red Hill Ave	Carnegie Ave to Barranca Pkwy
14	Tustin TMC to Caltrans TMC	14	Tustin	Bryan Ave	Market St to Jamboree Rd
15	Lake Forest City Hall to Rancho Santa Margarita City Hall	15A	Lake Forest	Portola Pkwy	Glen Ranch Rd to Rancho Pkwy
		15B	Lake Forest	Santa Margarita Pkwy	El Toro Rd to City limit
16	Laguna Woods City Hall to Lake Forest City Hall	16	Irvine	Irvine Center Dr	Scientific to Bake Pkwy



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