COACHELLA VALLEY ASSOCIATION OF GOVERNMENTS (CVAG)
REGIONAL TRAFFIC SIGNAL SYNCHRONIZATION PROJECT

TRAFFIC SIGNAL INTERCONNECT MASTER PLAN

EVALUATION OF SURROUNDING SYSTEMS

Prepared for:
Coachella Valley Association of Governments

Prepared by:
ADVANTEC Consulting Engineers
TRAFFIC SIGNAL INTERCONNECT MASTER PLAN

Evaluation of Surrounding Systems

Prepared for:
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Prepared by:
ADVANTEC Consulting Engineers
1200 Roosevelt
Irvine, CA 92620
January 11, 2017
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Prepared By

ADVANTEC Consulting Engineers

Under the Supervision of:

_______________________________ Date: _______
Carlos A. Ortiz, P.E., T.E., P.T.O.E.

January 11, 2017
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PROJECT WEBSITE

An electronic copy of this report can be found at: [http://cvag-regionaltssp.com/](http://cvag-regionaltssp.com/)
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# LIST OF ACRONYMS

<table>
<thead>
<tr>
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<th>Description</th>
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<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
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<td>ARTIC</td>
<td>Anaheim Regional Transportation Intermodal Center</td>
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<tr>
<td>ATC</td>
<td>Advanced Transportation Controller</td>
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<tr>
<td>ATMS</td>
<td>Advanced Traffic Management System</td>
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<tr>
<td>C2C</td>
<td>Center-to-Center communications</td>
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<td>C2F</td>
<td>Center-to-Field communications</td>
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<tr>
<td>CAD</td>
<td>Computer Aided Dispatch</td>
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<td>Caltrans</td>
<td>California State Department of Transportation</td>
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<td>CCTV</td>
<td>Closed-Circuit Television</td>
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<td>CMS</td>
<td>Changeable Message Sign</td>
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<td>DOT</td>
<td>Department of Transportation</td>
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<tr>
<td>DSRC</td>
<td>Dedicated Short Range Communication</td>
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<tr>
<td>EAS</td>
<td>Ethernet Access Switch</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
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<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>ICM</td>
<td>Integrated Corridor Management</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>ITE</td>
<td>Institute of Transportation Engineers</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transportation Systems</td>
</tr>
<tr>
<td>MAP-21</td>
<td>Moving Ahead for Progress in the 21st Century Act</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MPAH</td>
<td>Master Plan of Arterial Highways</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>NTCIP</td>
<td>National Transportation Communications for ITS Protocol</td>
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<tr>
<td>SDP</td>
<td>Strategic Deployment Plan</td>
</tr>
<tr>
<td>SR</td>
<td>State Route</td>
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<tr>
<td>TLSC</td>
<td>Traffic Light Synchronization Program</td>
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<tr>
<td>TMC</td>
<td>Traffic Management Center</td>
</tr>
<tr>
<td>TMS</td>
<td>Traffic Management System</td>
</tr>
<tr>
<td>TSS</td>
<td>Traffic Signal Synchronization</td>
</tr>
<tr>
<td>V2I</td>
<td>Connected Vehicle to Infrastructure</td>
</tr>
<tr>
<td>V2V</td>
<td>Connected Vehicle to Vehicle</td>
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<td>VMS</td>
<td>Video Management System</td>
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Evaluation of Surrounding Systems

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2-1 INTRODUCTION

The purpose of this Chapter is to provide CVAG and cities/agencies with evaluations of the surrounding cities/agencies traffic signal systems, traffic signal communication systems, and Intelligent Transportation Systems (ITS) for information sharing and inter-agency coordination purposes. The surrounding cities/agencies include the partner cities within the Coachella Valley, County of Riverside, and Caltrans District 8.

The objective for having an understanding of the existing/future surrounding systems are for planning purposes in order to share traffic data and video images between cities/agencies within the Coachella Valley in the near future. The outcome is to provide inter-agency traffic signal synchronization along major corridors and to provide real-time solutions for intersection management, arterial management, incident management, emergency management, operations and maintenance management, and special event management through the use of Intelligent Transportation Systems (ITS). This will allow the local cities/agencies to enhance the transportation system on a regional level in the Coachella Valley with a common goal to improve the environment by reducing congestion and greenhouse gas emissions, and improve safety and mobility, and the overall quality of life in the Coachella Valley.

Sharing information between agencies is a key component to fully utilize ITS capabilities. Recent transportation technologies allow agencies with the opportunity to share information between agencies; and between agencies and the community and motorists. Technologies such as: center-to-center (C2C) communications, performance measurement tools (arrival on red, arrival on green, travel times, congestion mapping, etc.), arterial management systems, changeable message signs (CMS), video surveillance systems, and transportation/transit mobile applications are some of the technologies available in the market today. Upcoming transportation technologies will provide the opportunity to share information more rapidly to the motorists and vehicles in real-time, such as communications between vehicles and the roadway infrastructure (e.g. connected vehicle and autonomous vehicle technologies), parking/payment management systems, and other smart cities transportation technologies.

Sharing information between agencies will facilitate and enhance traffic management, roadway/intersection operations, and emergency operations at all times, especially when major events are planned in the valley. Agencies will have the capability to change signal synchronization timing plans, view traffic patterns/demand in real-time at the agencies...
Traffic Management Centers provide messages to motorists via CMS, agencies websites, and/or mobile phones/mobile phone apps/tablets, and share information with their local police and fire departments. Information can be provided to Caltrans District 8, so they can disseminate travel information to motorists traveling along I-10 and SR-86 prior to entering the Coachella Valley.

Also, a critical component for transportation grants is to provide inter-agency signal synchronization, data and video sharing, and planning for integration of smart transportation technologies. Therefore, the preparation of the valley-wide Traffic Signal Interconnect Master Plan is an excellent start for CVAG and the local agencies to begin planning and implementing ITS solutions at a regional level, and it will provide a path for CVAG and local agencies to pursue and obtain future transportation grants.

The evaluation of surrounding systems includes an inter-agency communication assessment that identifies the communication needs for inter-agency coordination with cities, Riverside County, and Caltrans District 8. The ADVANTEC Team will identify the framework for future inter-agency coordination in order to provide a common structure for the design and deployment of future ITS systems. Future inter-agency ITS projects may include corridor signal coordination, traveler information system, arterial and freeway management systems, and transit systems including Bus Rapid Transit (BRT).

A key consideration in performing the regional signal synchronization project is to ensure that the ITS Systems Planning process is followed closely. This process is a systems engineering process by FHWA that outline the steps to develop a successful system involving multiple agencies, multiple travel modes, and different operators. It starts with identifying the systems engineering management plan framework, developing a Concept of Operations, identifying system requirements and project architecture, designing components and infrastructure, and conducting software development, testing, systems integration and validation, leading to an operations and maintenance manual.
process is a common theme and be will used throughout the life of this project.

2-1.1. Study Area

The study area consists of analyzing the local cities/agencies traffic management systems, communication systems, and intelligent transportation systems (ITS) within the Coachella Valley area, as shown in Figure 2.1. This includes the County of Riverside and Caltrans District 8.
Evaluation of Surrounding Systems

Figure 2.1 Existing Regional Intersection & Arterial Network

EXISTING CONDITIONS
PROJECT TRAFFIC SIGNAL LOCATIONS
2-2 EVALUATION OF SURROUNDING SYSTEMS

2-2.1. General

An inventory of the surrounding systems has been conducted for the following local cities/agencies:

- City of Cathedral City
- City of Coachella
- City of Desert Hot Springs
- City of Indian Wells
- City of Indio
- City of La Quinta
- City of Palm Desert
- City of Palm Springs
- City of Rancho Mirage
- Caltrans District 8
- County of Riverside

The inventory of the surrounding systems consists of obtaining the following information from the local cities/agencies:

- Traffic signal systems (e.g. controllers, cabinets, detection systems, emergency vehicle pre-emption systems)
- Signal communication systems (telephone, twisted pair/hardwired, fiber optic, wireless radio)
- Master Controllers/Local Controllers
- Traffic Management Systems (TMS): Centralized or Distributed with Master Controllers
- Traffic Management Centers (TMC)
- Closed Circuit Television (CCTV) Systems
- Changeable Message Sign (CMS) Systems
- Arterial Management Systems
- Ramp Metering Systems (Caltrans only)
- Traffic Monitoring Stations (Caltrans only)
- Other Intelligent Transportation Systems (ITS) Technologies

This section also includes an evaluation of the operation of the following surrounding systems:

- Existing Synchronized Corridors/Corridors with Time of Day Plans
- Multi-Modal Transit
- Traveler Information System
- Arterial and Freeway Management Systems
- Integrated Corridor Management

2-2.2. Existing Conditions

An inventory of existing conditions has been conducted. Table 2.1 summarizes the local cities/agencies existing traffic management systems (TMS) and communication systems including traffic management system software, local traffic signal controller software, type of traffic management system, traffic signal controller manufacturer, traffic signal controller type/model, traffic signal controller cabinet type, traffic
Evaluation of Surrounding Systems

management center (TMC), emergency vehicle pre-emption, CCTV system, ITS elements and communication system (telephone, twisted pair/hardwired, fiber optic, wireless).
### Table 2.1 Existing Surrounding Traffic Signal, Traffic Management & Communication Systems

<table>
<thead>
<tr>
<th>No.</th>
<th>City / Agency</th>
<th>Type of TMS</th>
<th>Traffic Management System</th>
<th>Traffic Signal Controller Type</th>
<th>Local Traffic Signal Controller Software</th>
<th>ITS Elements</th>
<th>Communication System</th>
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<td>1</td>
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<td>Centralized</td>
<td>McCain Transparity</td>
<td>Econolite Aries</td>
<td>Econolite QuicNet</td>
<td>CCTV System</td>
<td>Fiber Optic</td>
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<td>McCain Quicknet Pro 2</td>
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<td>Desert Hot Springs</td>
<td>Proposed</td>
<td>Econolite Aries</td>
<td>Econolite QuicNet</td>
<td>Econolite QuicNet Pro 2</td>
<td></td>
<td>Wireless</td>
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<td>4</td>
<td>Indian Wells</td>
<td>Proposed</td>
<td>Econolite Aries</td>
<td>Econolite QuicNet</td>
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<tr>
<td>5</td>
<td>Indio</td>
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<td>Econolite QuicNet</td>
<td>Econolite QuicNet Pro 2</td>
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<td>Wireless</td>
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<td>6</td>
<td>La Quinta</td>
<td>Proposed</td>
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<td>Econolite QuicNet</td>
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<td>Econolite QuicNet</td>
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<td>Econolite QuicNet</td>
<td>Econolite QuicNet Pro 2</td>
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<td>Wireless</td>
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2.2.1. Traffic Signal Controllers / Firmware / Traffic Management System

The following summarizes the local agencies' traffic signal controllers, local controller firmware and whether each City/agency utilizes a centralized traffic management system. There are several out-of-date technologies that exist and are labeled as "legacy" systems or discontinued by the manufacturer. It also indicates whether or not these legacy systems are still supported by its manufacturer. Most manufacturers support their legacy systems with backwards compatibility, but they will not install a new legacy equipment or firmware.

- **Type 170E with Bi-Tran 200/ 233**: Legacy. Bi-Tran 233 still supported
- **Type 170 ATC Coldfire with McCain 750 control software**: Supported
- **Type 170 Field Master**: Legacy. Field masters are no longer being deployed
- **TMS**: No centralized Traffic Management System

The City of Cathedral City has the following local traffic control hardware:

- **IDC (Traconex) with IDC firmware**: Discontinued
- **Type 170E with Bi-Tran 200/ 233**: Legacy. Bi-Tran 233 still supported
- **Type 170 ATC Coldfire with McCain 750 control software**: Supported
- **Type 170 Field Master**: Legacy. Field masters are no longer being deployed
- **TMS**: No centralized Traffic Management System

The City of Cathedral City has several different types of state standard 170E/170 ATC and NEMA based Traconex local controller assemblies. For interoperability and alliance with a centralized traffic control system, a singular 2070 ATC traffic signal controller standard should be established moving forward.

The City should establish a centralized traffic management system for remote command/control, such as McCain Transparity. These types of upgrades will also require Ethernet/IP-based communications and a communication network, which can be established over fiber optic cable, twisted-pair/hardwired cable, and/or wireless radios.

The City of Coachella has the following local traffic control hardware:

- **Type 170E with Bi-Tran 200**: Legacy
- **ASC/2 with ASC/2 firmware**: Discontinued
- **Type 2070 with McCain 2033 firmware**: Supported
- **Type 2070 ATC with McCain Omni eX firmware**: Supported (in progress)
- **TMS**: McCain TRANSPARITY (in progress)

The City of Coachella currently in the middle of a citywide ITS upgrade project that includes all new Type 2070 ATC specification controller assemblies using McCain Omni eX local control firmware. The new ATC controller assemblies will interface to the City’s new centralized ATMS system, McCain Transparity. The upgrades also include establishing an Ethernet/IP-based communication network.
The City of Desert Hot Springs has the following local traffic control hardware:

- **Type 170E with Bi-Tran 200/233**: Legacy Bi-Tran 233 still supported
- **Type 170 Field Master**: Legacy. Field masters are no longer being deployed
- **ASC/2 with Econolite ASC/2 firmware**: Discontinued
- **ASC/3 with Econolite ASC/3 firmware**: Supported
- **TMS**: No centralized Traffic Management System

Desert Hot Springs has several different types of state standard 170E and NEMA based ASC/2, ASC/3 Econolite local controller assemblies. For interoperability and alliance with a centralized traffic control system, a singular traffic signal controller standard should be established moving forward.

The City should begin replacing/migrating to Econolite Cobalt ATC signal controllers and establish a centralized traffic management system for remote command/control, such as Econolite Centracs. An alternate option is to begin replacing/migrating to type 2070 ATC traffic signal controllers and establish a centralized traffic management system for remote command/control, such as McCain Transparity. These types of upgrades will also require Ethernet/IP-based communications and a communication network, which can be established over fiber optic cable, twisted-pair/hardwired cable, and/or wireless radios.

The City of Indian Wells has the following local traffic control hardware:

- **ASC/2 with Econolite ASC/2 firmware**: Discontinued
- **ASC/3 with Econolite ASC/3 firmware**: Supported
- **ASC/2M Master Controller**: Legacy. Field masters are no longer being deployed
- **TMS**: Econolite ARIES system: Legacy/Non-Supported

The City should begin replacing/migrating to Econolite Cobalt ATC signal controllers and upgrade to an advanced traffic management system, such as Econolite Centracs. These types of upgrades will also require Ethernet/IP-based communications and a communication network, which can be established over fiber optic cable, twisted-pair/hardwired cable, and/or wireless radios.

The City of Indio has the following local traffic control hardware:

- **Type 170E with Bi-Tran 200 firmware**: Legacy
- **TMS**: McCain QUICNET system: Legacy/Supported
Evaluation of Surrounding Systems

The City's existing 170E controllers communicate via legacy analog signal, not digital. Therefore, Ethernet IP is not supported directly to the controller. An extra 170 controller Ethernet module needs to be configured separately to establish communication. Recently, the City has upgraded their traffic signal controller standard specifications to Type 2070 ATC controller with McCain’s Omni eX firmware.

The City should begin replacing/migrating to McCain’s Type 2070 ATC with McCain’s Omni eX firmware signal controllers and new advanced traffic management system, McCain Transparity. These types of upgrades will also require Ethernet/IP-based communications and a communication network, which can be established over fiber optic cable, twisted-pair/hardwired cable, and/or wireless radios.

The City of La Quinta has the following local traffic control hardware:

- **ASC/2 with Econolite ASC/2 firmware**: Discontinued
- **ASC/3 with Econolite ASC/3 firmware**: Supported
- **COBALT ATC with Econolite Cobalt ASC firmware**: Supported
- **ASC/2M Master Controller**: Legacy. Field masters are no longer being deployed
- **TMS**: Econolite ARIES system. Legacy/Non-Supported

The City of La Quinta currently in the design phase of a citywide ITS upgrade project that includes new IP compatible ATC specification controller assemblies and fiber optic communications. The ITS project includes new IP compatible local control software that will interface the City’s existing legacy ATMS system via fiber optic cable.

Once fully migrated to Econolite Cobalt ATC signal controllers and fiber optic Ethernet IP based communications, the City should transition to an advanced traffic management system, Econolite Centracs. When transitioning over to the Centracs system, further upgrades will also be required to their communications system to establish a “true” Ethernet/IP-based communications network. This is primary due to the removal of the master controllers and providing direct communications to the local controllers at each intersection. Therefore, the work will primarily be conducted on the systems integration side.

The City of Palm Desert has the following local traffic control hardware:

- **ASC/2 with Econolite ASC/2 firmware**: Discontinued
- **ASC/3 with Econolite ASC/3 firmware**: Supported
- **COBALT ATC with Econolite Cobalt ASC firmware**: Supported
- **ASC/2M Master Controller**: Legacy. Field masters are no longer being deployed.
- **TMS**: Econolite ARIES system. Legacy/Non-Supported

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January 2017 2-10

[ADVANTEC Consulting Engineers]
Evaluation of Surrounding Systems

The City should begin replacing/migrating to Econolite Cobalt ATC signal controllers and Centracs traffic management system. An extensive fiber optic backbone throughout the City provides opportunity to intertie a large number of its existing traffic signals to the central ATMS system. When transitioning over to the Centracs system, further upgrades will also be required to their communications system to establish a “true” Ethernet/IP-based communications network. This is primarily due to the removal of the master controllers and providing direct communications to the local controllers at each intersection. Therefore, the work will primarily be conducted on the systems integration side.

The City of Palm Springs has the following local traffic control hardware:

- **Type 170E with Bi-Tran 200 firmware**: Legacy
- **TMS**: McCain QUICNET PRO system. Legacy/Supported

The City's existing 170E controllers communicate via legacy analog signal, not digital. Therefore, Ethernet IP is not supported directly to the controller. An extra 170 controller Ethernet module needs to be configured separately to establish communication. It is recommended a new ATC controller specification is established moving forward.

The City should begin replacing/migrating to Type 2070 ATC signal controllers and new traffic management system, McCain Transparity. The City has an existing Ethernet/IP-based communications network, which will require additional work on the systems integration side.

The City of Rancho Mirage has the following local traffic control hardware:

- **ASC/2 with Econolite ASC/2 firmware**: Discontinued
- **ASC/3 with Econolite ASC/3 firmware**: Supported
- **COBALT ATC with Econolite Cobalt ASC firmware**: Supported
- **ASC/2M Master Controller**: Legacy. Field masters are no longer being deployed.
- **TMS**: Econolite ARIES system. Legacy/Non-Supported

The City should begin replacing/migrating to Econolite Cobalt ATC signal controllers and transition to an advanced traffic management system, Econolite Centracs. These types of upgrades will also require Ethernet/IP-based communications and a communication network, which can be established over fiber optic cable, twisted-pair/hardwired cable, and/or wireless radios.
Caltrans District 8 has the following local traffic control hardware:

- **Type 2070 with CNET firmware**: Supported
- **Type 170 Field Master**: Legacy. Field masters are no longer being deployed
- **TMS**: TransSuite ATMS: Supported

Caltrans should begin considering inter-agency communication with all local agencies that border Interstate 10, State Route 86 and Highway 111. Opportunities exist for exchanging two-way information, such as traffic data, video images, and weather messages that can benefit both agencies. For instance, local agencies can view the off-ramps/ramp metering within their cities and/or CMS messages; and Caltrans could have the ability to view (only) the local agency traffic signal system and video images and identify traffic operations improvements along their facilities due to traffic congestion, major incidents and/or special events in the Coachella Valley.

The County of Riverside has the following local traffic control hardware:

- **Type 170E with Bi-Tran 200/233**: Legacy. Bi-Tran 233 still supported
- **Type 170 Field Master**: Legacy. Field masters are no longer being deployed
- **TMS**: No centralized Traffic Management System

The County should begin replacing/migrating to 2070 ATC signal controllers and provide a centralized advanced traffic management system.

Once the County has a centralized advanced traffic management system, the next steps are to consider how communications will be provided back to the central system. There are a variety of options to consider including cellular modems – this provides direct connectivity; with the proper coordination and agreements in place, there may also be opportunities to have a shared system with a local agency and/or have a local agency house the County’s equipment at their TMC. In this case, the County can connect remotely and it provides the opportunity for the host agency to view the County’s signal operations and communications status, which benefits both agencies.
2-2.2.2. Traffic Signal Cabinets

There are several different cabinet styles throughout the Coachella Valley. Most cities/county can be defined as being either a Caltrans standards based city (Type 332 or 333) or alternatively being a NEMA controller cabinet standardized city (Type P, R or O). However, a few City's have a combination of both styles.

- **Caltrans Standard Type 332**: The benefit of 332 cabinets is their cost effective deployment, standardization across vendors and being readily available for knock-downs, etc. The cities of Coachella, Indio, Palm Springs, Caltrans and County of Riverside primarily use Type 332 traffic signal cabinets throughout their respective cities/agencies. The cities of Indio, Desert Hot Springs, Palm Desert, and Indian Wells also have Type 332 traffic signal cabinets at select locations.

- **Caltrans Standard Type 333**: Type 333 'Jumbo P' (JP) cabinets provide ample room for traffic signal and other ITS components. The cities of Cathedral City, Desert Hot Springs, Palm Springs and County of Riverside utilize Type 333JP cabinets at various locations. The Type 333JP can also use the same foundations as a Type P foundation. Therefore, agencies that are transitioning from NEMA (Type P controller cabinets) to new Type 170/2070 based infrastructure have the option to use their existing Type P controller cabinet foundations.

- **NEMA Standard**: Generally, NEMA style cabinets offer more room than Type 332 cabinets to house traffic signal and other ITS components. They can also be customized for use at a specific location. The cities of Indian Wells, La Quinta, Palm Desert and Rancho Mirage are primarily NEMA based and use Type P, Type R and/or Type O cabinets. The cities of Cathedral City and Desert Hot Springs also have NEMA style cabinets at select locations.
Future ATC Cabinet Specification: These cabinets provide many advantages over both 332 and NEMA cabinets alike. The cities of Coachella, Indio and Palm Springs are currently under either design or construction of traffic signal modifications that specify new low-voltage style ATC style cabinets, such as the Type 352 ATC cabinet.

Type 352 ATC Cabinet
2-2.2.3. Traffic Management Center (TMC)

Caltrans District 8, City of Palm Springs, City of La Quinta, City of Palm Desert and City of Coachella (in progress) are the only agencies with a fully operational traffic management centers (TMC), which consists of a designated room, video wall/wall mounted video monitors, workstation(s) with monitor(s), and operational staff. The traffic management center (TMC) is typically a centralized command and control center that integrates traffic operations, maintenance, and area-wide communications. Each TMC provides the infrastructure for communications and surveillance necessary to manage in real-time the traffic signal network.

The remaining cities/agencies typically manage their traffic signal system and communications network via their traffic management system (TMS), which consists of a workstation(s) and monitor(s) located in an office or at the city’s public works yard. Cities without a TMS system typically manage traffic signal operations via distributed on-street field master controllers or at stand-alone intersections.

- **Caltrans District 8 TMC** is located in the City of Fontana off the I-15 freeway. Caltrans and emergency responders utilize their Advanced Traffic Management System (ATMS) for monitoring and control of their traffic monitoring stations, ramp metering systems, changeable message signs (CMS), and closed circuit television (CCTV) camera systems. Caltrans has two separate traffic management systems (TMS) to monitor and control of their traffic signals: 1) their existing TMS that was developed in-house called CTNET, and 2) their new ATMS called TransSuite, which is manufactured by TransCore. They are currently in transition of migrating all of their signals to the new ATMS, TransSuite. All freeway data collected in the Coachella Valley communicates back to the Caltrans TMC via leased line/dial-up and 3G/4G cellular wireless communication. There are no direct connections (hardwire/conduit/communication) between Caltrans TMC and the Coachella Valley.

- **The City of Palm Springs** has a recently completed Traffic Management Center (TMC) operations room located within City Hall. The TMC room utilizes dual workstations, large overhead LCD monitor and a dedicated server rack for remote monitoring and maintenance of the citywide traffic network. All local intersections and roadside ITS components interface to this room for remote access and control by City staff. The City of Palm Springs utilizes a McCain “QuicNET Pro” central system for command and control of all traffic...
signal operations. QuicNET Pro communicates directly to the City's model 170E controllers that supply traffic signal timing/Time-of-Day (TOD) operation, local intersection timing, signal coordination parameters, and provides real-time display through the system's Graphic User Interface (GUI). All citywide traffic data and video is communicated back to the TMC via the private wide area wireless Ethernet network and high bandwidth Ethernet switches.

- **The City of La Quinta** TMC is located at City Hall in a designated room with an operator/interface workstation and two (2) wall mounted LED video monitors for traffic surveillance. The City of La Quinta utilizes an Econolite "ARIES" central system for command and control of all traffic signal operations. ARIES communicates to the City's six (6) on-street master controllers that supply traffic signal timing/Time-of-Day (TOD) operation and provides real-time display through the system's Graphic User Interface (GUI). Connection to all six (6) on-street master controllers occurs over spread spectrum 5.8GHz wireless broadband through a quad spectral radio mounted atop City Hall. No hardware communication enters City Hall.

- **The City of Palm Desert** TMC is located at City Hall in a partitioned room with a workstation. The room houses a dedicated traffic workstation and rack mounted communications equipment including three (3) master controllers for communications to the field. Palm Desert utilizes an Econolite "ARIES" central system for command and control of all traffic signal operations. ARIES central system communicates to the City's total of eight (8) master controllers that supply traffic signal timing/Time-of-Day (TOD) operation and provides real-time display through the system's Graphic User Interface (GUI). All citywide traffic data is communicated back to the TMC via fiber optic cable, leased line/dial-up connection and 900 MHz wireless hybrid link to City Hall. The City Yard has remote access connection to the Econolite ARIES central system via fiber optic link.

- **The City of Coachella (in progress)** is in the construction phase for a new TMC that will be comprised of two workstations and a LCD monitor dedicated to traffic operations. The project will establish a new TMC room located at the City Yard with back-haul communications from the field elements over fiber optic cable. The City has chosen to implement McCain's new Advanced
Evaluation of Surrounding Systems

Traffic Management System (ATMS), Transparity. This will allow signal technicians and City staff to remotely monitor and maintain traffic signal operations in real-time.

Agencies with legacy systems or Agencies that do not have a central system who are considering upgrading to new ATMS and Ethernet/IP-based communications, needs to address following:

- The physical communication link from the field to the communication room
- The physical location where communication equipment and ATMS hardware/servers are housed. They are typically stored air conditioned rooms, rack mounted with uninterrupted power supplies (e.g. communication room)
- The physical location where workstations (computer/monitors) are located for operators and/or managers that require access to the system. This requires physical communication link from the workstation to the communication room

Agencies that do not have a Traffic Management Center who are considering a new TMC need to address the same requirements as agencies with legacy systems above, but with the following in addition:

- Establishing a dedicated room or space for remote traffic signal operations and maintenance
- Other physical factors, such as: architectural enhancements to the room, furniture, lighting, HVAC, electrical, mechanical, plumbing, accessibility and security

2-2.2.4. Regional Traffic Management Center

For a successful deployment, monitoring and maintenance of corridor synchronization and signal operations across adjacent agencies, a regional and/or area-wide Traffic Management Center (TMC) should be considered. Many local cities/agencies traffic signal systems operate on different traffic controller firmware and/or TMS systems; therefore, center-to-center (C2C) communication or an area-wide TMC would provide shared traffic signal information, roadway conditions, incident information, special event traffic conditions, and video images across jurisdictional boundaries.
An area-wide TMC would provide optimization and coordination of traffic signals between agencies, shared data on major arterials including performance measure reporting, shared maintenance practices and resources, and unified communication to both the public and elected officials with a consistent message. It is envisioned that the local agencies will maintain control of their systems and through cooperative agreements (e.g. memorandums of understanding), data and video may be shared with partner agencies and stakeholders. This may be accomplished by implementing strategies like C2C communications, sharing communications over fiber optic, copper or wireless, and remote access to traffic and/or video management systems. All local cities/ agencies would maintain traffic signal timing and operations control. They would only be providing traffic data and video to the regional and/or an area-wide TMC. This would be an effective use of the traffic information being collected during weekday peak hours, special events, or peak times in the Coachella Valley. Overall, there is a potential cost/time savings by sharing communication resources, and shared data and video in order to improve traffic flow across jurisdictional boundaries. This will require coordination and cooperation with partner agencies that have major arterial roadways crossing through their jurisdictions. Overall this approach provides maximum benefit to the motoring public, reduction in congestion, and better air quality throughout the Coachella Valley.

2-2.2.5. Traffic Signal Communication Systems

The following summarizes the traffic signal communications for each city/agency within the surrounding areas:

- **Twisted-Pair copper interconnect cable (SIC)**
  All cities, County and Caltrans use twisted pair/hardwired signal interconnect cable (SIC) for traffic signal communications on selected corridors. Communication occurs by use of analog data modems or Ethernet-over-Copper (VDSL) during transmission and receiving data. Low data rates and analog protocol means this communication should be upgraded wherever possible.

- **Leased Line/Dial-up connection**
  The cities of Cathedral City, Indian Wells, Palm Desert, Rancho Mirage, and Caltrans use telephone drops for traffic signal communications at selected signalized intersections (minimal locations).
Evaluation of Surrounding Systems

- **Ethernet-over-Copper (VDSL)**
  The cities of Palm Springs and Palm Desert utilize existing twisted pair/hardwired signal interconnect cable (SIC) for IP-based Ethernet-over-Copper (VDSL) communication. This type of communication is a cost-effective approach for areas with existing SIC cable and still provides Ethernet IP-based communications.

- **Fiber Optic Cable**
  The cities of Palm Desert and Palm Springs are using fiber optic cable for their traffic signal communications system. Fiber optic communication systems are the most reliable communication system and provide the highest bandwidth to accommodate multiple ITS systems. Fiber optic cable should be considered as the standard for new hardwire cable installations as it provides high-bandwidth capabilities and is not susceptible to electrical interference or shorts similar to copper signal interconnect (SIC) cable. The cities of Coachella, La Quinta and Rancho Mirage are slated to have fiber optic installations in the near future.

- **Wireless Spread Spectrum (900 MHz)**
  The cities of Cathedral City, Desert Hot Springs, Indio, La Quinta, Palm Desert and Rancho Mirage, and Caltrans use spread spectrum wireless communications on selected corridors. This type of wireless communication is adequate for serial data transfer only; however, it is not suitable for streaming video or IP Ethernet data transfer.

- **Wireless Ethernet Broadband (5.8GHz)**
  The cities of Palm Springs, Indio and La Quinta utilize 5.8GHz wireless Ethernet broadband communication systems in a point-to-point and point-to-multipoint network for local and backhaul communications for traffic signal communications on most corridors. The City of Palm Springs also uses their wireless communications to stream video and control of their CCTV camera system. The City of Coachella is in the process of implementing the 5.8GHz wireless Ethernet broadband communication systems.

- **Managed Ethernet Access Switch (EAS)**
  The cities of Palm Springs and Palm Desert currently have IP-based managed Ethernet Access Switches (EAS) locally at traffic signal cabinets and at the TMC level. These managed EAS switches allow the City to effectively provide two-way communication from the TMC to traffic signals, CCTV cameras, battery backup systems (BBS), and other field elements.

- **Microwave Wireless (back-haul)**
  The City of Palm Springs uses microwave wireless in a licensed band for its backhaul communication to central. The microwave wireless is used as a backbone for all traffic signals, CCTV cameras, Bluetooth systems, and ITS data citywide.
Evaluation of Surrounding Systems

- **General Packet Radio Service (3G/4G cellular wireless)**
  Caltrans District 8 uses wireless 3G/4G for most of its backhaul communication to central since they have no hardwire conduit/communication in the Coachella Valley. The wireless 3G/4G cellular service is used for traffic signals, CMS, traffic monitoring stations and “snapshots” of CCTV camera images for access, command and control, and monitoring.

2-2.2.6. ITS Technologies

- **Emergency Vehicle Pre-emption (EVP) System**
  - All cities in the valley, County of Riverside, and Caltrans have EVP systems, which allow emergency vehicles to have priority through the intersection. The City of Indio uses a more advanced form of EVP with the use of GPS based detection in addition to infrared (IR) transmitters.

- **Closed Circuit Television (CCTV) Camera Systems**
  - Closed circuit television (CCTV) camera systems are used to monitor traffic conditions along freeways, at major interchanges, and intersections in order to view traffic conditions and to report incidents in real-time.
  - The City of Palm Springs uses both HD IP PTZ cameras and Infrared CCTV camera systems. The infrared CCTV cameras are used to monitor flash flood conditions at three roadway segments – additional information is provided below.

- **Video Detection System**
  - Video Detection Systems are useful as they are a user-defined configurable tool for assigning detection zones for vehicles and bicycles.
  - All the cities in the Coachella Valley have video detection systems at select localized intersections. The Cities of Indio, La Quinta, and Palm Springs utilize edge processor equipment to further provide remote monitoring and video streams to their respective TMC locations.

- **Hybrid Video/Radar Detection System**
  - These systems are the next generation of video detection as they are easy to configure for assigning detection zones for vehicles and bicycles.
  - Hybrid Video/Radar Detection Systems uses a combination of video and radar sensing technology. The video is used for stop bar vehicle detection and the radar is used for advance vehicle detection, and has a detection area up to 600 feet.
  - The City La Quinta currently uses this system. The cities of Coachella and Indio recently updated their standard specifications to utilize this system as well.
Bluetooth Arterial Management System
- Bluetooth Arterial Management Systems are becoming more mainstream in the ITS field. These systems are used as a tool to measure origin-destination timestamps by the use of modern day Bluetooth devices normally found in driver's smart phones and onboard vehicle systems.
- The City of Palm Springs utilizes an Iteris Vantage Velocity Bluetooth system for travel time performance along Ramon Road.

Changeable Message Sign (CMS) Systems
- Changeable Message Sign (CMS) systems are used to provide real-time traffic information to the traveling public including travel time to nearest destination or major routes, freeway conditions, freeway incidents, freeway construction, traffic management for special events, and to provide alternate route selection to facilitate motorist decisions.
- CMS systems are also used to broadcast Amber Alerts or other public alert broadcasts.
- Caltrans is the only agency in the Coachella Valley that utilizes CMS.
- Communications for Caltrans CMS systems to their TMC is provided via telephone drop or 3G/4G cellular wireless.

Ramp Metering Systems
- Ramp metering systems are used as an operations tool to maximize the efficiency of freeway on-ramps, freeway connectors and/or freeway mainlines. The primary objective of ramp metering is to reduce congestion and the overall travel time of the total traffic stream on both freeway and surface streets. Ramp meters allow traffic to enter the freeway at a rate dependent on the conditions of the freeway traffic, while a typical driver might be delayed at the meter, overall travel and freeway speeds are improved.
- Caltrans is the only agency in the Coachella Valley that utilizes ramp metering systems.

Traffic Monitoring Stations
- Traffic monitoring stations are installed along the freeway to monitor traffic conditions on a freeway segment in real-time. The real-time data collected at these stations account for traffic volumes and occupancy. The data is used for incident detection, ramp metering control, and data collection/analysis for efficient incident response.
- Communications for traffic monitoring systems are provided via wireless 900 MHz radio or general packet radio service (GPRS), 3G/4G cellular communications.
- Caltrans is the only agency in the Coachella Valley that utilizes traffic monitoring stations. These stations also include fixed CCTV camera systems, which allow “snapshot” images to be downloaded and viewed from their TMC.
<p><strong>Closed Circuit Television (CCTV) Weather Camera Systems</strong></p>

- CCTV weather camera systems allow real-time monitoring of weather and road conditions.
  - There are three CCTV weather cameras installed in the City of Palm Springs. These CCTV weather cameras are installed in order to monitor the water levels and water run-off on roadways where flooding occurs along Indian Canyon Drive, Vista Chino and Gene Autry Trail. These CCTV weather cameras are used to provide the City notice when water level thresholds are exceeded, which allows the City to mobilize maintenance and police staff to provide appropriate roadway closures and detours. The CCTV weather cameras are linked to the Palm Springs TMC for remote alarms and viewing of flooding conditions. These cameras are located at:
    1. <strong>Palm Springs Amtrak Train Station</strong> parking lot in order to view/monitor common flooding areas along Indian Canyon Drive
    2. <strong>Vista Chino/Clubhouse View Drive</strong> in order to view/monitor common flooding areas along Vista Chino
    3. <strong>Gene Autry Trail north of Vista Chino</strong> in order to view/monitor common flooding areas along Gene Autry Trail

Table 2.2 summarizes our assessment of the existing surrounding traffic signal systems and Intelligent Transportation Systems (ITS) for each city/agency within the region in the following categories: controller assembly capabilities, communication network equipment types, video surveillance types, types of smart detection, types of Advanced Traffic Management Systems (ATMS), and other types of ITS Systems.

Figure 2.2 illustrates the Coachella Valley's existing traffic signal, communications, and Intelligent Transportation Systems (ITS).
### Table 2.2 Assessment of Existing Surrounding Traffic Signal & Intelligent Transportation Systems

<table>
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<th>No.</th>
<th>City / Agency</th>
<th>Controller Assembly Capabilities</th>
<th>Communication Network Equipment</th>
<th>Video Surveillance</th>
<th>Smart Detection</th>
<th>Advanced Traffic Management System (ATMS)</th>
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Evaluation of Surrounding Systems

Figure 2.2 Existing Surrounding Traffic Signal, Communications & Intelligent Transportation Systems
2-2.3. Future Conditions

A survey of future funded upgrade projects was conducted from the local cities/agencies in order to understand near-term/future traffic signal system and ITS improvements. The following identifies the local cities/agencies future upgrades including: traffic management systems, traffic signal controllers, traffic signal cabinets, TMC improvements, CCTV camera systems, vehicle detection systems, and communication systems.

- **City of Cathedral City**
  - No future funded upgrades

- **City of Coachella (in progress)**
  - Upgrade to Type 2070 ATC controllers with Omni eX firmware
  - Upgrade traffic management system to McCain Transparity ATMS
  - Upgrade communications to fiber optic cable
  - Install wireless 5.8GHz communications system
  - Ethernet/IP-based communications
  - Install HD IP CCTV camera systems
  - Install hybrid video/radar detection systems
  - Installation of five new traffic signals at: Van Buren Street and Avenue 49, Van Buren Street and Avenue 51, Van Buren Street and Avenue 52, Calhoun Street and Avenue 50, Frederick Street and Avenue 50

- **City of Desert Hot Springs**
  - No future funded upgrades

- **City of Indian Wells**
  - One (1) traffic signal modification project under design phase at Highway 111 and El Dorado Drive

- **City of Indio (in progress)**
  - Traffic signal modification project at Doctor Carreon Boulevard and Oasis Street
  - Traffic signal improvements along Monroe Street between Oleander Avenue and Comet Lane
  - City has adopted new specifications:
    - Upgrade existing Type 170/170E controllers to Type 2070 ATC controllers with Omni eX software
    - Upgrade wireless communications system to high bandwidth 5.8GHz wireless system
    - Upgrade existing Type 332 traffic signal cabinets to new Type 352 ATC specification
    - Upgrade video detection to the latest hybrid video/radar detection
Evaluation of Surrounding Systems

City of La Quinta (in progress)
- Upgrade all existing twisted pair/hardwired communications to fiber optic cable
- Provide EAS switch and upgrade communication system to Ethernet/IP based communications
- Upgrade/modify traffic signal controllers to Ethernet/IP-based communications
- Upgrade/modify video detection systems to Ethernet/IP-based communications

City of Palm Desert
- Installation of new conduit and pull rope at 4 locations (Fred Waring Drive between Highway 111 and Town Center Way; Town Center Way between Highway 111 and Hahn Road; Monterey Avenue between Highway 111 and San Gorgonio Way; and San Pablo Avenue between El Paseo and Highway 111)
- New fiber optic cable on Dinah Shore Drive between Miriam Way and Monterey Avenue

City of Palm Springs
- Traffic signal modifications at 19 intersections
- Installation of additional CCTV camera systems
- Installation of vehicle dilemma zone detection

City of Rancho Mirage
- Fiber optic communications upgrade and signal synchronization: Highway 111 within the City limits (from One Mirage Place to Magnesia Falls Drive); Bob Hope Drive between Highway 111 and Rancho Las Palmas Drive; Bob Hope Drive between Sunrise Drive and Frank Sinatra Drive; and Country Club Drive between Bob Hope Drive and Vista Dune Road
- Fiber optic communications upgrade: Miriam Way and Monterey Avenue (for shared signals with the City of Palm Desert)
- Implementation of signal coordination/timing improvements and the installation of pedestrian indications on Monterey Avenue between Gran Via/Avenida Las Palmas to Dinah Shore Drive, and on Dinah Shore Drive from Monterey Avenue to Key Largo Avenue
- Bob Hope Drive and Frank Sinatra Drive traffic signal modification; upgrades include new Cobalt ATC traffic signal controller
Caltrans District 8 (within Coachella Valley)
- The installation of two full LED Changeable Message Signs (CMS). One CMS will be located on I-10 facing eastbound traffic between Monroe Street and Jackson Street, and the other CMS will be located on SR-86 facing northbound traffic between Avenue 52 and Avenue 50
- Portola Avenue at I-10 interchange is a future project that will include traffic signals, communication system, and other ITS technologies
- Jefferson Street at I-10 interchange project is currently under construction and it will include new traffic signals, communication system, ramp metering system, and other ITS technologies

County of Riverside
- The County of Riverside has an approved set of plans for a new County office building that includes a dedicated room for the installation of a TMC. The new building installation and new TMC will depend on future funding. Otherwise, the County has no ITS or traffic signal related improvements planned in the near future within the Coachella Valley
2-3 EXISTING SYNCHRONIZED CORRIDORS

The purpose of this section is to provide an evaluation of the existing project corridors that are currently synchronized and/or have time of day plans throughout the Coachella Valley. This was based on the traffic signal timing sheets provided by agency staff and during our project meetings with each agency. This information will be used as our baseline conditions in order to understand which corridors are currently synchronized and/or have time of day plans and which corridors do not. This will be our starting point for our evaluation and prompt discussions with City staff in order to select the priority corridors, identify proposed improvements, and to address operational concerns.

Figure 2.3 illustrates the existing corridors and the limits of each corridor that are that are synchronized and/or have time of day plans.
2-3.1.1. Evaluation of the Existing Synchronized Corridors/Corridors with Time of Day Plans

The following summarizes our evaluation of the existing synchronized corridors/corridors with time of day plans along the regional roadway network:

➢ **Time of Day (TOD) Plans:** It should be noted that just because an agency has time of day plans it does not mean that the corridors have been synchronized optimally or that they are up-to-date to meet the current demands. Based on our review of the signal timing plans, some of the last updated timing sheets are over 10 years old.

Depending on the agency, the number of TOD plans ranged from having only one TOD plan that is programmed to be activated during peak hour(s), to having up to four TOD plans that is programmed to be activated during a.m., mid-day, and p.m. peak hours including a separate plan for a weekend day.

Typically, TOD plans should be updated every three years due to change in travel patterns and possible increase in traffic. Due to different traffic patterns/demand throughout the year in the Coachella Valley, there should additional TOD plans for the winter season, summer season, and special events.

➢ **Traffic Signal Synchronization Across Jurisdictional Boundaries:**
  - Highway 111 from Frank Sinatra Drive to Jefferson Street
    - Cities of Rancho Mirage, Indian Wells, Palm Desert, and La Quinta
  - Monterey Avenue from Highway 111 to Dinah Shore Drive
    - Cities of Rancho Mirage and Palm Desert
  - Washington Street from Calle Tampico to Dinah Shore Drive
    - Cities of La Quinta, Indian Wells and Palm Desert

➢ **Traffic Signal Synchronization within Each Jurisdiction:**
  - Cathedral City
  - Coachella
  - Desert Hot Springs
  - Indian Wells
  - Indio
  - La Quinta
  - Palm Desert
  - Palm Springs
  - Rancho Mirage
  - Caltrans District 8
Evaluation of Surrounding Systems

Typically, synchronized corridors across city boundaries are programmed to run off the same cycle length and programmed to run off a single clock, or universal time of day source. Unfortunately, different agencies provide alternate ways to update time of day information to their controllers; therefore, time drift occurs and causes delays in the intended coordination program.

Based on our evaluation of the existing synchronized corridors/corridors with time of day plans along the regional roadway network, all corridors should be re-evaluated since a majority of the TOD plans have not been updated within the past three years and have not been updated to meet current traffic conditions. There are four agencies that have coordinated efforts in order to provide traffic signal synchronization on major corridors that cross jurisdictional boundaries. This type of coordination and cooperation should continue and be considered on other arterial roadways through multiple jurisdictions throughout the Coachella Valley.

2-3.1.2. Surrounding Traffic Signal Synchronization Programs

There are several regional traffic signal synchronization programs in surrounding areas that are ongoing with proven records of success. Although each region is unique, there is an overall acceptance by the stakeholders and motorists, an understanding of the value of implementing, maintaining, and continuing these traffic signal synchronization programs. The following summarizes some of the regional traffic signal synchronization programs.

Orange County Transportation Authority (OCTA) – Regional Traffic Synchronization Program (RTSSP)/(Project P). Through the M2 program, OCTA has developed an M2020 mobility plan for this decade, part of which included a Regional Traffic Signal Synchronization program called Project P. As outlined in the M2 budgetary line item that voters approved, Project P commits to spending $15 million a year for 30 years to improve Orange County’s traffic operations on surface streets. OCTA administers a grant application every year whereby local agencies can apply for funding to improve its traffic signal and ITS infrastructure as well as synchronize the traffic signals. The key criteria for these grants is that it should be for arterial corridors along the Master Plan of Arterial Highways (MPAH) which serves as the backbone of Orange County’s arterials, and that local agencies along each arterial corridor need to join together to apply for the grant. In this manner, OCTA has funded over 80 arterial corridors since 2008. Some of the program details include:

- Includes 34 cities, the County of Orange and Caltrans District 12
- Each corridor is managed by either a lead agency or OCTA. Through On-call Traffic Engineering benches, or solicitation of the Request-For-Proposals (RFPs) and selection of qualified firms are contracted to complete the work. This includes a two year monitoring and maintenance program for each corridor
A Technical Committee (Traffic Forum) has been established and meet on a bi-annual basis in order to maintain compliance and provide consensus building with participating agencies.

- Interjurisdiction coordination/Memorandums of Understanding (MOUs)
- Improvements include, but not limited to, updated traffic signal timing and synchronization plans, traffic management systems, traffic signal controllers, Ethernet/IP-based communications (fiber, twisted-pair/hardwired/wireless), CCTV camera systems, vehicle detection systems (video/loops), arterial management systems, other traffic signal equipment, and ITS elements.
- Overall benefits include: 13% reduction in travel time, 15% improvement in travel speed, 20% better travel experience, 33 million gallons of gas consumption reduced, and 667 million pound of greenhouse gas (GHG) reduction.

**Los Angeles County, Countywide Traffic Signal Synchronization Program (TSSP)** – The Los Angeles County Metropolitan Authority (METRO) has led the Measure R half-cent sales tax for Los Angeles County to finance new transportation projects and programs, and accelerate those already programmed. The tax took effect July 2009, and is a $40 billion program of which 15% or $5.91 billion are ‘local return’ projects whereby the local agencies may use to improve the surface streets and implement traffic signal synchronization. METRO administers a bi-annual grant application process where local agencies may apply for this grant, divided into 3 categories – one of which is ‘Traffic Signal Synchronization’. Through this program, METRO has awarded over $200 million to Los Angeles County, which is the lead agency for implementing a Traffic Signal Synchronization Program (TSSP) for all the 88 cities within the County. Some of the program details include:

- In the past 10 years, Los Angeles County has conducted over 100 TSSP projects, each one includes design and upgrade of traffic signal equipment as well as synchronization of the signal timings along a major arterial corridor crossing multiple jurisdictions.
- Each corridor is managed by County and the work is performed by qualified firms from their On-call Traffic Engineering bench.
- Technical Committees (Traffic Forums) have been established through their Council of Governments (COG) and meet in order to maintain compliance and provide consensus building with participating agencies.
- Interjurisdiction coordination/Memorandums of Understanding (MOUs)
- Improvements also include, but not limited to, updated traffic signal timing and synchronization plans, traffic management systems, traffic signal controllers, Ethernet/IP-based communications (fiber, twisted-pair/hardwired/wireless), CCTV camera systems, vehicle detection systems (video/loops), upgrade traffic signal equipment, and other ITS elements including signing/striping and minor roadway improvements.
Estimates show that this program has saved motorists, on an annual basis, $468 million in vehicle costs, 31.9 million travel hours, 38.6 million gallons of fuel, and 10,100 tons of pollutants to date. Travel times were reduced by as much as 24 to 29 percent. The second phase of this program is on-going and involves 135 projects on 102 routes, consisting of 2,670 signalized intersections along nearly 610 miles.

San Bernardino Association of Governments (SANBAG) – On September 1, 1999, SANBAG approved development of the San Bernardino Valley Coordinated Traffic Signal System (SBVCTSS) in order to work with local agencies and Caltrans to implement a multi-jurisdictional plan for coordinating traffic signals in the San Bernardino Valley. The goal of the SBVCTSS was to decrease arterial travel times, maximize arterial system capacity, and improve multi-modal operational efficiency, safety, air quality, and the quality of travel in the San Bernardino Valley. In 2002, starting with the SBVCTSS Master Plan, SANBAG implemented signal coordination on major arterial corridors on a valley-wide scale in various phases designated as Tiers 1, 2, 3 and 4, and included over 1,250 signalized intersections controlled by 15 cities, the County of San Bernardino and Caltrans. Both the Tiers 1 and 2 phase (completed in 2008) and Tiers 3 and 4 phase (completed in 2012), at system “turn-on”, showed significant improvements in arterial travel times and reductions in stops and delays. In July 2011, SANBAG entered into individual Memorandums of Understanding (MOU) with local agencies, which defined the roles and responsibilities for the continual operation and maintenance of the SBVCTSS. SANBAG and local agencies are currently entering into another cooperative agreement to ensure the SBVCTSS continues to operate in an efficient manner, including maintaining traffic signal coordination timing across jurisdictional boundaries, in a continual effort to reduce delays and improve travel times, mobility and air quality in the San Bernardino Valley. Their current program includes:

- Design and upgrade of traffic signal equipment as well as synchronization of the signal timings along a major arterial corridor crossing multiple jurisdictions
- Performing semi-annual assessments
- Providing on-call system support

Based on our evaluation of the existing regional programs, these programs should be used as examples in order to protect the investments provided by the partner agencies and CVAG in order to maintain the regional traffic signal synchronization within the Coachella Valley, and continue the program. The common theme for all of these programs is that the primary funding agency will administer these projects, work with agencies on their requested upgrades, and after implementation provide continued funding to monitor and maintain the system. Overall, the local agencies will maintain traffic signal synchronization at a regional and local level, will share data and video between agencies, and provide on-going communications and coordination with partner agencies through a regional traffic committee that meets on a bi-annual or quarterly basis.
Multi-modal transit and planning refers to various modes (e.g. walking, cycling, automobile, public transit, etc.) and connections among modes. The benefits minimize impacts to certain modes including reduced costs to government, vehicle operating costs, travel time and reduced crashes per-mile. By evaluating certain modes and coordinating efforts between the Traffic Signal Interconnect Master Plan and other near term surrounding projects, opportunities exist for coordinating improvements that provide mutual benefit.

An example of this is Bus Rapid Transit (BRT). BRT is a bus-based transit system that delivers fast and comfortable services, ultimately displacing fewer cars on the roadway and emitting less emissions in the air. Because BRT contains features similar to a light rail system, it is much more reliable, convenient and faster than regular bus services. There are five essential features that define BRT:

- **Dedicated Right-of-Way**
  - Although, BRT can be provided on mixed flow travel lanes, bus-only lanes make for faster travel and ensure that buses are never delayed due to mixed traffic congestion

- **Busway Alignment**
  - The options of using the center of roadway or bus-only corridors keep buses away from congestion

- **Off-board Fare Collection**
  - Fare payment at the station, instead of on the bus, eliminates the delay caused by passengers waiting to pay on board

- **Intersection Treatments**
  - BRT vehicles receive priority at intersections

- **Platform-level Boarding**
  - The station should be at level with the bus for quick and easy boarding. This also makes it fully accessible for wheelchairs, disabled passengers, strollers and carts with minimal delays

Due to the nature of Coachella Valley and corridor alignments, substantial right-of-way costs would be needed to design and deploy a BRT on dedicated right-of-way. Additional planning and research would be needed to define the viability of such system.

In lieu of dedicated BRT line, Bus Service Priority (BSP) offers local transit agencies like Sunline Transit Agency priority at signalized intersections or along dedicated project corridors. BSP uses the similar technology to Emergency Vehicle Pre-emption (EVP), however, modern day BSP programs typically use Wi-Fi and GPS type systems that provide local interfaces to the traffic signal controller to trigger a bus pre-emption event with minimum impacts to a synchronized corridor. In addition, BSP equipped buses are able to pre-empt a signalized intersection while traveling through a corridor and announcing itself to the upstream intersections. Therefore, the result is a continuous steady green band throughout the...
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corridor. Local agencies would have to install additional equipment at the signal controller cabinet level. Furthermore, the system is typically operated separate from a centralized traffic management system and requires its own centralized hardware and software. Currently there is no BSP system in the Coachella Valley.

The ADVANTEC Team has performed a general evaluation of the existing multi-modal systems capabilities, deficiencies, and opportunities. The following summarizes our evaluation of various multi-modal alternative transportation facilities within the Coachella Valley, including freeway, arterial, bus and rail systems:

- **SunLine Transit Agency** provides public transit service throughout the Coachella Valley area. It operates fifteen (15) transit routes along major streets and to popular destinations in the area. Highway 111 traverses the Coachella Valley from the City of Palm Springs to the City of Coachella. Currently, the transit buses do not have transit signal priority (TSP) along any of the traffic signals in the Coachella Valley. SunLine has expressed interest in implementing TSP and Bus Service Priority (BSP) on Highway 111 to reduce overall bus travel times on this frequently traveled corridor.

- **Greyhound Bus Transit** is one of the national intercity bus service providers in the Coachella Valley. Greyhound’s bus station is located in the City of Indio’s Transportation Center. The Greyhound bus service serves many US cities through direct buses or bus transferring.

- **Amtrak Passenger Railroad** currently provides service to the Coachella Valley at Palm Springs Train Station with two trains stopping at the station daily. The train station also uses a wireless bridge connection to the City of Palm Springs TMC to provide two-way weather station information.

- **Coachella Valley Bicycle Facilities** are provided throughout the area. These facilities are a mixture of Class 1, 2, and 3 bikeways. Some agencies provide shared usage of their bike lanes to include golf carts. These are dual mode lanes that provide dedicated routes for golf carts to traverse along the roadway network.

- **CVLink** or Coachella Valley Alternative Transportation Route will be a multi-modal facility for alternative transportation throughout the entire Coachella Valley. The total length of the facility spans 50 miles and includes dual pathways for pedestrians, bicycles and low-speed electric vehicles with other
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various roadside amenities. The project is expected to begin construction in year 2017 and it will be a multi-phase project. SunLine Transit Agency has expressed interest in operating a transit service with autonomous buses on dedicated CVLink routes.

2-5 TRAVELER INFORMATION SYSTEM EVALUATION

Traveler information systems such as 511 is a free traveler information service that gives you live traffic reports, transit planning, commuter service information, motorist aid, or FasTrak information in the Southern California area through a toll-free phone number, website and mobile application, which can also be distributed over several mediums including, but not limited to changeable message signs, SMS text message alerts, 511 transportation information hotline, and city websites.

Locally, 511 and www.IE511.org is a one-stop phone and web service for transportation information in Southern California’s Inland Empire. Both the telephone service and website are owned and operated through a partnership of the Riverside County Transportation Commission (RCTC) and the San Bernardino County Transportation Authority (SBCTA). Although the IE511 system is an excellent tool for the public traveler, limited information is provided through the Coachella Valley. With upgraded communications systems and ITS technologies within the Coachella Valley, it provides the opportunity to provide data feeds to the 511 system, which allows for more accurate information about the regional arterials that can be accessed by the public and the local agencies.

Other traveler information and/or event management systems can be used to monitor, detect and respond to multiple types of "events" that can occur, such as singular incidents, emergency closures, or special events. These types of events would often trigger a response plan generation, which could be automatically generated or manually generated. Event details and trigger alarms would indicate the type of incident that occurred and then set in motion the appropriate action, which could include coordination with local police and fire departments. Additionally, operators would post similar warning messages on CMS signs, Highway Advisory Radio (HAR) and output advisories to city websites to inform travelers of the incident.

2-6 ARTERIAL AND FREEWAY MANAGEMENT SYSTEMS EVALUATION

Arterial and Freeway Management Systems are becoming more mainstream for operating and managing signalized intersections and roadway system. These systems are used as a tool to measure origin-destination timestamps, travel time and speed reports by the use of modern day Bluetooth devices normally found in driver's smart phones, tablets, lap tops, and onboard vehicle systems. The City of Palm Springs currently utilizes this system for performance measures along Ramon Road. More traditional detection systems, such as inductive loop system, are utilized by Caltrans District 8 along Interstate 10. Additional arterial management systems include video, Wi-Fi, radar, and magnetometer based detection.
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These types of systems can generate volume, occupancy and speed reports that can be used in order to assess arterial and freeway status and congestion. These real-time traffic data measures enable monitoring of congestion to optimize traffic operations.

By utilizing vehicle detection stations and exporting data to centralized TMC’s, local agencies are able monitor the performance of their intersections 24-7 with this unique high-resolution traffic data system. By capturing and analyzing detailed performance measures such as volume-to-capacity (V/C) ratios, arrivals on green, and even accurate turn movement counts, agencies can not only see how their intersections are performing, but use the data to retime and optimize their traffic signals. Most of these subsystems can be operated as stand-alone, or are able to interface with the latest ATMS systems available today for monitoring and reporting under one system.

2-7 INTEGRATED CORRIDOR MANAGEMENT

Integrated Corridor Management (ICM) is an approach to improve mobility by integrating various networks together, so that partner agencies can manage the transportation corridor as a unified multi-modal system. The key to ICM is integrating existing ITS and management efforts with new concepts and relationships to develop a coherent multi-modal, multi-jurisdiction, corridor-wide transportation management system. ICM promotes multimodal management that supports real-time traffic management, cooperatively develop and implement real-time (active) traffic management to optimize flow, safety and aid regions and the State to meet greenhouse gas (GHG) reduction targets from transportation.

Key multi-agency support and commitment is required in order to successfully deliver an ICM Project, including: Institutional Integration—Coordination to collaboration between Caltrans, CVAG, and the local cities/County will be very essential if the corridor is to be managed as a cohesive system, and a large part of ICM involves developing a community of stakeholders who can address corridor needs in a collaborative way. This active collaboration, ongoing organizational cooperation and a more "corridor-centric" perspective, is at least as important as the technical tools available to manage the corridor. Operation Integration – Joint multi-agency operational objectives and strategies to manage and balance the total capacity and demand of the corridor multi-agency and cross-network operational strategies; and Technical Integration – Sharing and distribution of information, and system operations and control functions to support the immediate analysis and response.
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The initial steps of an ICM Program is to plan the project properly and it will include engaging with internal and external project stakeholders, defining the project goals and scope, understand basic system concepts and components, develop a project management plan, analyze the corridors’ attributes and current operations, assess the potential benefits of an ICM project-Analysis, Modeling and Simulation (AMS), develop a framework for building the ICM System – System Engineering Management Plan (SEMP), and defining the vision and rationale for the system ConOps. A key institutional element is to build consensus with the local jurisdictions that operate the arterials and maintain all the traffic control and ITS infrastructure.

In order to achieve ICM goals to increased corridor throughput, improved travel time reliability, improved incident management, and enabled intermodal travel decisions, any potential ICM project will need to define performance requirements, including a decision support system and a set of performance metrics that reflects the characteristics of the Coachella Valley and the needs of the corridor users. Performance requirements already developed by current and previous ICM/Connected Corridor projects will need to be presented to the project stakeholders to facilitate the understanding and development of an ICM system with an initial focus on managing incidents and events, with gradual expansion to demand management and commute congestion. Any potential ICM project should be a well-balanced system that can provide optimal operational viability, proactively avoid flow breakdown, detect and respond to congestion events faster, improve safety and security, manage congested flow when it does occur, promote transit ridership and mode shifts, and protect local arterials from unnecessary diversion.
2-8 CONCLUSION

Regionally, the Coachella Valley and its local agencies operate as separate stand-alone entities with only a few corridors providing synchronization across jurisdictional boundaries. While most local agencies have a large portion of their traffic signal system interconnected, most utilize antiquated copper interconnect cable or analog wireless communications that connect to legacy traffic signal controllers and interface to traffic management systems that may no longer be supported. Additionally, little to no video surveillance is deployed for real-time traffic monitoring and surveillance in the Coachella Valley. Some cities have made an effort to update their traffic signal infrastructure and have begun replacing aging equipment as part of their own ITS master plans, intersection widening/street improvements projects, or as a one-to-one direct replacement. The Regional Traffic Signal Interconnect (TSI) Master Plan provides the local cities and surrounding agencies an opportunity to provide improvements as identified in this chapter and previous chapters, such as ATC traffic signal controllers, Advanced Traffic Management Systems (ATMS) and other advanced ITS technologies, such as HD IP CCTV camera system, arterial management systems, and Ethernet/IP-based communication systems on a regional level and not just locally in their agency.

The following summarizes a high level evaluation of surrounding systems based on the topics discussed in this chapter:

- **Traffic Signal Controllers / Firmware / Traffic Management System**
  - All local agencies should begin replacing/migrating to type ATC traffic signal controllers and new Advanced Traffic Management Systems (ATMS)

- **Traffic Signal Cabinets**
  - ATC low voltage specification cabinets should be considered for all new installations/replacements

- **Traffic Management Center (TMC)**
  - Currently four (4) of the eleven (11) agencies in the valley have a TMC
  - Three (3) agencies have a central TMS system, but do not have a TMC
  - Four (4) agencies do not have a central TMS or a TMC
    - One (1) agency is currently under construction of a new TMC
  - All local agencies without TMCs should consider the installation of a new TMC
  - All local agencies with TMCs should consider upgrades to their existing TMC

- **Regional Traffic Management Center**
  - Currently, there is no central traffic management center in the valley. CVAG and local agencies have expressed an interest in establishing a Regional TMC, and/or sub-regional TMCs for monitoring and managing traffic operations throughout the valley
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- **Traffic Signal Communication Systems**
  - Local communications offer a wide range of hardwire/wireless communications
  - Existing copper SIC cable should be replaced with fiber optic cable
  - Existing legacy wireless should be replaced with new 5.8GHz wireless or higher, such as 5.9GHz DSRC wireless
  - All local and back-haul communications should be upgraded to Ethernet/IP-based protocol

- **ITS Technologies**
  - New HD IP CCTV cameras with analytics should be evaluated and deployed for traffic operations and management of the synchronized corridors
  - Video Management Systems (VMS) should be evaluated and deployed for multi-modal detection and the signalized intersections
  - Changeable Message Signs (CMS) should be evaluated and deployed for disseminate real-time traffic information to motorists
  - All local agencies should consider the installation of various ITS technologies in order to enhance their traffic management system, response to traffic conditions, and to obtain performance measurements to improve and/or monitor operations

- **Synchronized/Non-Synchronized Corridors**
  - All existing synchronized corridors should be re-evaluated based on a regional synchronization and to meet current day traffic demands
  - All non-synchronized corridors should be evaluated based on a regional corridor/synchronization level and to meet current day traffic demands
  - Cities and agencies should evaluate the
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existing regional traffic signal synchronization programs from other agencies including lessons learned as examples in order to support the development of the Coachella Valley's Regional Traffic Signal Synchronization Program

- **Multi-Modal Transit Evaluation**
  - Bus Service Priority (BSP) should be evaluated for possible deployment in the future

- **Traveler Information System**
  - Integration of local or regional TMC centers should interface to traveler information systems, such as 511

- **Arterial / Freeway Management System**
  - Current arterial management systems available today should be evaluated and deployed based on latest Bluetooth/Wi-Fi/Radar or magnetometer detection systems

- **Integrated Corridor Management**
  - Integrated Corridor Management (ICM) should be evaluated to improve mobility between Caltrans and the local cities/agencies by integrating various networks together, so that partner agencies can manage the transportation corridor as a unified multi-modal system. In order to achieve ICM goals to increased corridor throughput, improved travel time reliability, improved incident management, and enabled intermodal travel decisions, any potential ICM project will need to define performance requirements, including a decision support system and a set of performance metrics that reflects the characteristics of the Coachella Valley and the needs of the corridor users.

Overall, the regional evaluation of local cities/agencies existing and future traffic management systems, communication systems, ITS elements, and TMCs, provide opportunities that exist for inter-agency and regional communication in the form of sharing traffic data/video between the local cities/agencies and providing a framework for other forms of shared data, or cloud-based connectivity. This can be accomplished by establishing key connection points between agency boundaries and dedicating a percentage of available networking resources for future use. Existing infrastructure such as wireless radio back-haul and citywide fiber optic communications; and near-term fiber optic and high-bandwidth wireless radio improvements, provides the Ethernet/IP-based communications needed to provide connectivity between agencies for data and video sharing, which can expandable and scalable for new ITS and ATMS deployments. Once these systems are deployed, it provides the infrastructure and greater opportunity to maintain synchronized corridors; and the communication backbone to provide, implement and manage bus service priority (BSP), traveler information systems, arterial freeway management systems, and integrated corridor management systems on a regional level. These type of technologies and opportunities will be discussed in further detail in subsequent chapters of the Regional TSI Master Plan.