Intelligent Transportation Systems

Urban Area Strategic Deployment Plan

PREPARED FOR

TCAG
Tulare County Association of Governments

PREPARED BY

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Expect More. Experience Better.

Intelligent Transportation Systems Urban Area Strategic Deployment Plan

Deliverable No. 12
Final Regional Strategic Deployment Plan

Prepared for:

Prepared by:

Kimley»Horn

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TABLE OF CONTENTS

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

APC	Automatic Passenger Counters
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
BNSF	Burlington Northern Santa Fe Railway
CAD	Computer Aided Dispatch
CFR	Code of Federal Regulations
CHP	California Highway Patrol
CMP	Congestion Management Program
CMS	Changeable Message Sign
DART	Dinuba Area Regional Transit
EVP	Emergency Vehicle Preemption
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GPS	Global Positioning Systems
HAR	Highway Advisory Radio
HSR	High Speed Rail
ITS	Intelligent Transportation Systems
LOS	Level of Service
PeMS	Freeway Performance Measurement System
PTC	Positive Train Control
RTP	Regional Transportation Plan
SDP	Strategic Deployment Plan
SJVRR	San Joaquin Valley Railroad
TCAG	Tulare County Association of Governments
TCat	Tulare County Area Transit
TIME	Tulare Intermodal Express
TMC	Traffic Management Center
TMCAL	Transportation Management Center Activity Logging
TMS	Traffic Management System
TSP	Transit Signal Priority
UP	Union Pacific
VDS	Vehicle Detection Station
VECC	Visalia Emergency Communication Center

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1. INTRODUCTION

The Tulare County Association of Governments (TCAG) is developing an Intelligent Transportation Systems (ITS) Strategic Deployment Plan to address the expanded realm of ITS in the urban areas of Tulare County, which consist primarily of the cities of Visalia, Tulare and Porterville. From a policy standpoint, the final results of this study bring Tulare County into compliance with 23 Code of Federal Regulations (CFR) 940 pertaining to conformance with the National Intelligent Transportation Systems Architecture and Standards. Specifically, this study addresses the requirement for the development and use of a Regional ITS Architecture for the Tulare County Region. The Strategic Deployment Plan (SDP) element of the study provides a vision for ITS and outlines an orderly program of high, medium, and low priority projects in the region that will be implemented over a 20- year horizon.

1.1 Project Background

A comprehensive ITS SDP was completed for the Visalia-Tulare-Goshen Focused Urban Area in 2001. The Visalia-Tulare-Goshen Focused Urban Area ITS Strategic Deployment Plan was one of four Focused Urban Area SDPs developed in conjunction with the San Joaquin Valley ITS Strategic Deployment Plan. The San Joaquin Valley ITS Strategic Deployment Plan, sometimes known as the Valleywide ITS Plan, was developed for the eight counties of the San Joaquin Valley: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare.

The Valleywide ITS Plan has not had a comprehensive update since its initial completion in 2001. Some counties and smaller urban areas have had to update their own elements of the Valleywide Plan over the years, especially as the Valleywide Plan ages. Fresno County has recently completed development of a Regional ITS Architecture and Strategic Deployment Plan, and Kern County is contemplating a similar update to their own ITS planning documents.

Within Tulare County, several ITS initiatives have been undertaken, including ITS deployments in Porterville and the Visalia ITS Strategic Plan. The ITS deployments in Porterville included transit signal priority and an integrated security system. In Visalia, the ITS Strategic Plan outlines short, medium, and long term strategies for implementing an ITS Vision for the City.

The 2014 Regional Transportation Plan (RTP) is a 26-year planning document that guides the development of the transportation system in Tulare County. An RTP is required by state and federal law, is comprehensively updated every four years, and includes programs to better maintain, operate, and expand transportation, including ITS. The 2014 RTP is complete and has been approved by the TCAG Board. Work on the 2018 RTP is underway. Results and outputs from this ITS Plan will be incorporated into the 2018 RTP.

1.2 ITS Planning Process

The ITS planning process is much like any other transportation planning activity, with the primary difference being the focus on technological solutions. One of the primary areas of emphasis of ITS planning is the extensive involvement and participation by the stakeholders of the region. This is especially important to ensure interagency systems integration, address potential institutional issues early, and to provide the necessary education and awareness of advanced technology transportation solutions.

Using the federal ITS planning process as a guideline, the overall approach to achieving the stated project goals will be performance of the following tasks (the bolded text indicates the current task and/or deliverable in process):

- Task 1: Project Initiation
- Task 2: Data Gathering
- Task 3: Assessment of the 2001 ITS Strategic Plan
- Task 4: Update Regional ITS Inventories
- Task 5: Stakeholder Consultation/Identify ITS Needs, Vision, Goals, and Objectives
- Task 6: Develop Key Regional ITS Strategies
- Task 7: Determine Specific Needs, ITS Service Packages and Elements Based on Strategies
- Task 8: Define Operational Roles and Responsibilities Consistent with Regional Vision, Goals, Objectives, and Strategies
- Task 9: Determine the Functional Requirements
- Task 10: Prepare Regional ITS Architecture
- Task 11: Develop an Architecture Use Plan
- **Task 12: Develop Regional Strategic Deployment Plan**
- Task 13: ITS Website for Regional Stakeholders
- Task 14: Presentations

The resulting products of these tasks will be the following (the bolded text indicates the current task and/or deliverable in process):

- Deliverable 1: Project Plan
    - The Project Plan will incorporate the Outreach Plan, the stakeholder governance structure, the detailed master project schedule, a narrative that will define success factors, project risks, and mitigation strategies to deal with the identified project risks.
- Deliverable 2: Draft and Final Existing Data Report
    - The Report identifies the ITS elements within the County, existing and planned policies/projects, and combine that with an understanding of the regions users to fully understand the various opportunities and constraints within the County.
- Deliverable 3: Report assessing the 2001 Visalia Tulare Goshen Focused Urban Area ITS Development Plan
    - The report documents the findings of the assessment of the 2001 SDP and the lessons learned in the interviews with project stakeholders.
- Deliverable 4: System Inventory Summary Report
    - The will report presents a summary of the findings from the Inventory Survey forms from various Stakeholders identifying existing and planned ITS elements within each jurisdiction.
- Deliverable 5: Visions, Goals, Objectives and Needs Technical Report

  - The report will identify an ITS vision for Tulare County, set of goals and objectives, and identify ITS needs after various exercises with Stakeholders.

- Deliverable 6: Draft and Final Regional ITS Strategies Report
  - The report refines and presents a range of ITS components for inclusion in the ITS SDP.
- Deliverable 7: Regional Consolidated Needs Assessment Summary Technical Report
  - The report will translate generic ITS needs into the National ITS Architecture framework. ITS Elements will also be identified as part of the process of identifying and selecting Service Packages for the region.
- Deliverable 8: Regional ITS Operational Roles and Responsibilities Technical Report
  - The report will identify Operational Roles and Responsibilities that are consistent with the Vision Statement and the Goals and Objectives identified and developed in Task 5 and will also be based on the Strategies development in Task 6.
- Deliverable 9: Draft and Final Functional Requirements
  - The report will identify Functional Requirements for ITS Architecture for the TCAG region based on FHWA's guidance
- Deliverable 10: Draft and Final Electronic Copy of the Turbo Architecture Database
  - The electronic Turbo Architecture database will be developed consistent with Version 7 of the National ITS Architecture, Federal Highway Administration (FHWA) Rule 940.9, and Part V of the Federal Transit Administration (FTA) National ITS Architecture Policy for Transit Projects and provided to TCAG.
- Deliverable 11: Draft and Final Architecture Use and Maintenance Plan
  - The report will develop an Architecture Use Plan that will describe how to use the Architecture. The Report will provide project planning, project programming, project design, and maintenance plans and procedures.
- **Deliverable 12: Draft Strategic Deployment Plan**
  - **The report will take all of the inputs from Tasks 2 through 11 and meld them together into a cohesive and comprehensive ITS Strategic Deployment Plan Report and Phasing Plan for Tulare County.**
- Deliverable 13: Draft and Final website
  - The project website will provide background on the project, the stakeholder roster, and links to meeting agendas and minutes and will be housed on the TCAG server.
- Deliverable 14: PowerPoint Presentations
  - The two presentations will provide the overall ITS strategic plan for the key stakeholders' use, one on the executive summary and one on the overall Plan.

1.3 Relationship to the 2001 Visalia-Tulare-Goshen Focused Urban Area ITS Strategic Deployment Plan

As noted in Section 1.1, an ITS SDP was completed for the Visalia-Tulare-Goshen Focused Urban Area in 2001. That Plan was comprehensive, in terms of both needs assessment and the development of recommendations. For this ITS Plan development, the 2001 ITS Plan will be reviewed and assessed to determine progress in implementing elements of that plan. Tulare County ITS stakeholder agencies will be contacted to discuss and document successes and lessons learned coming out of the 2001 ITS Plan. This assessment will provide some insight and guidance in this SDP development process, when considering project and program prioritization. The assessment will provide a look back at prior ITS planning and implementation efforts and lessons learn from those efforts while moving forward with this most current ITS planning and implementation effort.

1.4 Purpose of the Regional Strategic Deployment Plan

The Regional Strategic Deployment Plan will serve as a planning blueprint for how ITS projects and strategies are implemented in the region. The Deployment Plan will provide guidance to stakeholders on the planning, development and funding of ITS project planning in Tulare County over the next 20 years. The phasing element of the Plan groups projects and strategies by priority in suggested phases – Short Term (0-5 years), Medium Term (5-10 years) and Long Term (greater than 10 years). A prioritization process is employed that considers factors such as project need, expected benefits and funding availability among other considerations.

1.5 High-level Architecture and Strategic Deployment Plan Development Summary

This project developed the Tulare County Regional ITS Architecture, as required by the Final Rule / Policy on ITS Architecture and Standards Conformity for federally funded Intelligent Transportation Systems projects. Initial project activities focused on development of a comprehensive list of project stakeholders that would be invited to participate in the project. An Outreach Plan was developed which categorized stakeholders into various groups as each had their own set of priorities and agency goals.

A needs assessment and several conversations with project stakeholders (both in group settings and one-on-one) led to the development of interagency operational concepts that describe agency roles and responsibilities in providing ITS services to the region.

Then, activities turned to the development of a transportation systems inventory and the categorization of ITS elements in Tulare County. The systems inventory leveraged existing documents like the 2001 Plan, the 2014 RTP, Visalia ITS Strategic Plan, and the San Joaquin Valley Regional ITS Architecture. As part of the ITS inventory a map was created of existing and planned ITS projects within Tulare County to visualize the locations of ITS elements and projects throughout the County.

The next step was to develop and document the vision, goals and objectives that came from the stakeholder group. Workshops were held along with online surveys to garner input from the stakeholder group on the vision goals and objectives. An objective screening method was used to developpe the initial prioritization list of programs and projects from the stakeholder input.

Using the input from the vision, goals and objectives a range of ITS strategies was developed to be included in the SDP. The selected strategies integrated with those that came out of the ITS SDP from the City of Visalia. These strategies were based on the National ITS Architecture, version 7.1. The strategies were categorized into short, medium, and long term for the region.

Building upon the information gathered through stakeholder engagement and the ITS strategies specific needs were developed that mapped to the National ITS Architecture. These needs were then correlated to the ITS User Services. The ITS needs and strategies were then mapped to the specific stakeholders and ITS National Architecture Service Packages.

The information that was gathered through earlier tasks was then used to identify the Operational Roles and Responsibilities that were consistent with the Vision Statement and the Goals and Objectives. The roles and responsibilities were kept at a high level and focused on specific subject areas. They were then reviewed by the stakeholders to obtain their buy-in through a series of meetings.

The next key piece of the system engineering process was the development of Functional Requirements which were essential to the development of systems and sub systems. The Functional Requirements explained the what a system is supposed to do. Whenever available actual function requirements from regional projects were used. Next high level functional requirements were developed for the major categories of ITS projects. Outputs from the Turbo Architecture database were used to develop requirements. All functional requirements were circulated with the stakeholders for review and comment.

Using version 7.1 of the National ITS Architecture a consistent Regional ITS Architecture was prepared. All of the past deliverables like the Inventory and the stakeholder workshops were used to develop the ITS Architecture. Diagrams were prepared that were circulated among the stakeholders for review.

Use of the Architecture was the next focus and an Architecture Use Plan was developed. This plan used standard terminology to get a broader audience use to understanding the concepts of the National ITS Architecture. An Architecture Maintenance Plan and Procedures was developed to guide the process for updating the Architecture and includes a process to submit projects into the Architecture. This plan placed the responsibility of updating regional efforts and maintaining consistency with the National ITS Architecture on TCAG.

2. REGIONAL ARCHITECTURE TIMEFRAME AND LOCALE

The process of developing a regional ITS architecture for Tulare County began with a focus on the project stakeholders, architecture timeframe and architecture locale:

1. Stakeholders are the core set of agencies with transportation-related oversight, responsibility, and / or duties in the Region.
2. Timeframe refers to the planning horizon that the regional ITS architecture will address.
3. Locale refers to the geographic area covered by the ITS architecture and describes the region.

The following subsections discuss the architecture timeframe and a description of the Tulare County Region, as it pertains to this project.

2.1 Timeframe

A regional ITS architecture needs to plan far enough into the future to guide the integration of systems over time. The Tulare County Region timeframe was established based on timeframes of similar plans in the region. If the time frame is too short it reduces the value of the regional ITS architecture as a planning tool. If the timeframe is too long, it increases the effort involved because long range forecasts are difficult to make and are subject to technology developments.

The initial timeframe selected for the Tulare County ITS Architecture is twenty years. A twenty-year horizon is sufficient enough to include most of the system integration opportunities that can be anticipated by the region's Stakeholders. A twenty-year timeframe is also sufficient to support Transportation Improvement Program (TIP) generation.

As the regional ITS architecture matures and technology develops the initial timeframe may be reevaluated. As the architecture is built out, a timeframe is normally a secondary consideration when determining whether to include a particular system or technology. It is best to include the interfaces that are supported by the Stakeholders, but understand that the timeframe is flexible and can be adjusted as necessary to match the vision of the Stakeholders. The timeframe should not be used to constrain the Stakeholders to near-term options since it is difficult to anticipate exactly when a well-supported idea will be implemented or how technology will develop overtime. Viable integration opportunities can be reevaluated periodically as the architecture is maintained over time.

2.2 Regional ITS Architecture Service Scope

The previous ITS plan and architecture for Tulare County was completed in 2001. Elements of the original plan may be reflected in this ITS plan and architecture, because they are still relevant. This updated ITS plan and architecture captures all known existing and planned ITS services within the Tulare County Region. Additionally, this ITS plan and architecture acknowledges adjoining and overlapping ITS architectures.

2.3 Locale

The project study area is focused on the urbanized areas consisting of the cities of Visalia, Tulare and Porterville located in the western half of Tulare County. Tulare County is located in the San Joaquin Valley and is approximately 180 miles north of Los Angeles and 200 miles south of San Francisco. The boundary of Tulare County within the San Joaquin Valley region is shown in **Figure 1**.

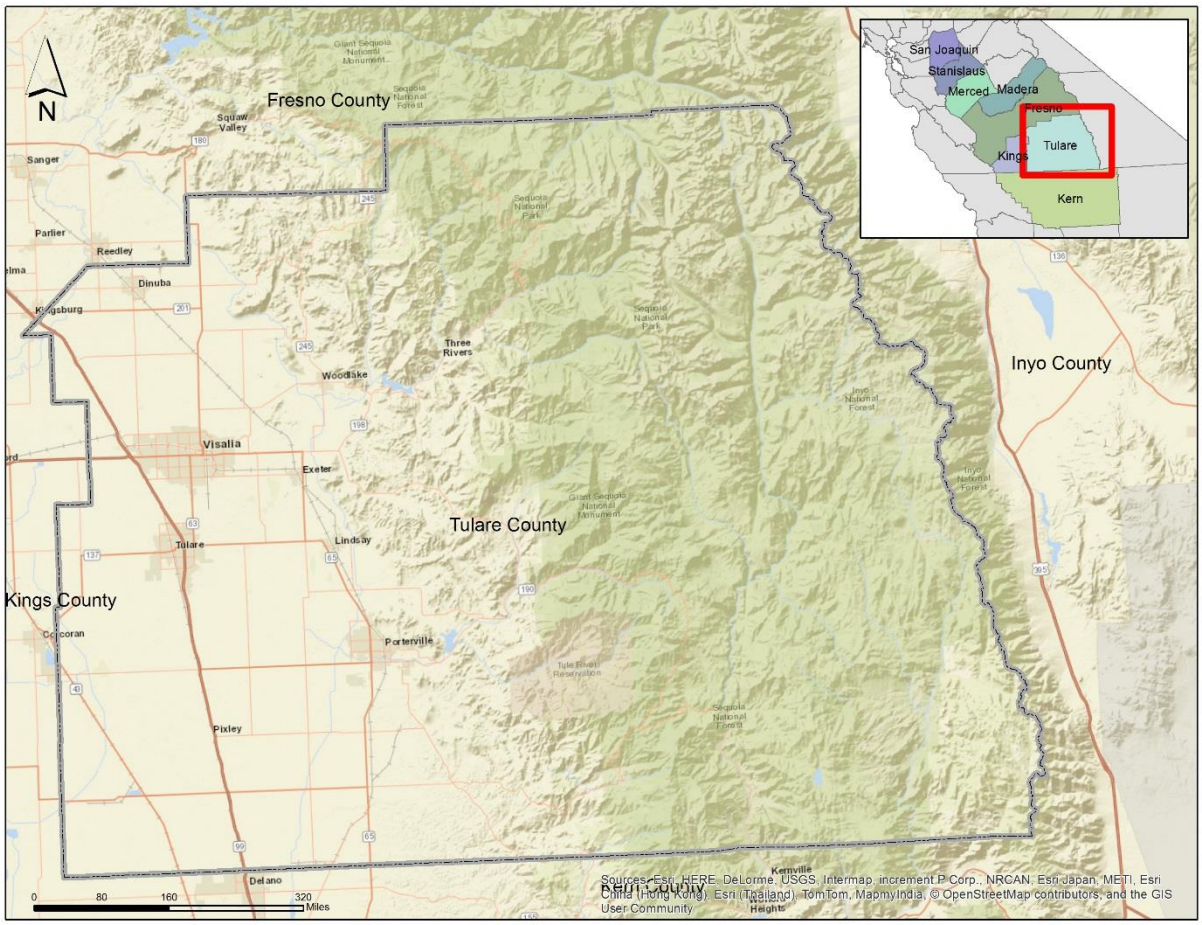


Figure 1 – Tulare County Location

Rural communities outside of the urbanized areas in Tulare County include the following incorporated cities:

- The City of Dinuba located east of SR-99 and north of the City of Visalia
- The City of Exeter located on SR-65, south of SR-198, and east of SR-99
- The City of Farmersville located east of Visalia
- The City of Lindsay located southeast of Visalia and north of Porterville
- The City of Woodlake is located on SR-245 and north of SR-216.

2.3.1 Regional Area and Major Trip Generators

The eastern portion of the County is comprised of public lands situated at the base of the Sierra Nevada Mountain range. Recreational areas such as the Giant Sequoia National Monument and the Sequoia and Kings Canyon National Parks are major attractions drawing visitors from afar year-round.

In the urban areas, major employment and retail centers in the cities of Tulare and Visalia generate traffic along the highway corridors between them and with the smaller cities in the rural areas.

Tulare County roadways handle a large proportion of commercial vehicle trips associated with the agricultural industry that forms the economic base of the San Joaquin Valley. Food processors and packing operations are located throughout the County as well as distribution centers for big box retailers.

2.3.2 Population

The population of Tulare County in 2016 was 466,339 according to California Department of Finance estimates[1]. The combined population for the cities of Visalia, Tulare and Porterville in the urbanized areas of the County represents over half of the total population.

Table 1 list the population by city and for the unincorporated areas of the County.

Table 1 – Tulare County Population

City	Population in 2016
Dinuba	24,657
Exeter	11,047
Farmersville	11,161
Lindsay	12,960
Porterville	60,070
Tulare	63,515
Visalia	130,231
Woodlake	7,648
Unincorporated County	145,050
Total Tulare County	466,339

Source: State of California, Department of Finance.

[1] State of California, Department of Finance, E-5 Population and Housing Estimates for Cities, Counties, and the State, 2011-2016. Sacramento, California, May 2016.

3. PROJECT STAKEHOLDERS AND OUTREACH

3.1 Tulare County Region ITS Stakeholders

The success of this ITS plan will be determined by the contributions from a diverse set of Stakeholders. **Table 2** lists the agencies/organizations of key stakeholders that have been engaged to provide input for the Tulare ITS Plan Update.

The Stakeholders provide the insight to develop a vision, goals and objectives that sets priorities and needs for the region. A one-day workshop was held on September 27, 2016 to engage Plan stakeholders representing local and regional agencies in Tulare County including Caltrans and neighboring Kern County.

Table 2 – Tulare County ITS plan Update Stakeholder List

California Highway Patrol	City of Woodlake
Caltrans District 6	County of Tulare
Caltrans Headquarters	FHWA CA Division
City of Dinuba	Fresno Council of Governments
City of Exeter	Kern Council of Governments
City of Lindsay	San Joaquin Valley Railroad
City of Porterville	Tulare County
City of Porterville (Transit)	Tulare County (Transit)
City of Tulare	Tulare County Association of Governments
City of Tulare (Transit)	Tulare County Office of Emergency Services
City of Visalia	Youngs Commercial Transfer, Inc.
City of Visalia (Transit)	City of Visalia IT
City of Visalia Fire Dept.	City of Visalia Police Department
CalVans	

3.2 Stakeholder Outreach and Engagement

3.2.1 Outreach Plan

The Outreach Plan supported the coordination and collaboration efforts of the regional stakeholders in the development of a regional ITS architecture and strategic deployment plan for Tulare County. The plan provided stakeholders with guidance on which systems could be implemented.

The involvement of stakeholders at various levels is a critical component of achieving this vision. The objective of outreach and education is to establish a process to collaborate with core stakeholders, consult with and gain input from interested stakeholders, and provide information to the general public, as necessary. This approach to outreach and education is summarized in **Table 3**.

Table 3 – Outreach Approach

Stakeholder Groups	Levels of Involvement	Outreach Methods
Agency Stakeholders • Interdepartmental groups within TCAG • Caltrans • Other impacted urban and rural public agencies that own or operate surface transportation facilities or assets (cities, county, transit operators, etc.) • Public agencies in nearby regions • Groups or institutions impacted by or involved in the operation of surface transportation facilities	**Inform and Consult** • Explain the project and gain input regarding inventories, needs, and any related issues Collaborate • Work jointly to share information and reach consensus on key aspects of the project	• Email communications • Interactive workshop • Surveys • Telephone calls • Interviews • Project Website
Project Advisory Committee	**Strategic Guidance** • Provide strategic guidance to the Consultant Team and to the larger stakeholder group **Collaborate** • Work jointly to share information and reach consensus on key aspects of the project	• Email communications • Telephone calls • Interviews • Routine status meetings (via teleconference)
General Public	**Inform** • Provide support to TCAG in explaining the project and potential impacts on all modes of transportation	Consultant Team outreach to the General Public is not anticipated as part of this project.

3.2.2 Outreach Methods

These activities convey the toolset used to accomplish outreach:

- Compile Stakeholder List.
- Conduct Project Advisory Committee (PAC) meetings with key personnel within TCAG and other key project stakeholders. These meetings will most typically be conference calls with some potentially being held in person in conjunction with the stakeholder meetings. The meetings will be designed to elicit ideas, background information, and concerns related to this project and are expected to last between thirty and ninety minutes.
- Develop and distribute survey forms to stakeholders.
- Conduct Project Stakeholder Workshops / Meetings.

- Monitor local and regional meetings.
- Distribute, collect, and compile Inventory Surveys.
- Conduct one-on-one contacts.
- Assist TCAG staff with development of language that explains the project to project stakeholders, and informs them of their role(s) in the project.
- Provide material for a Project Web Site, for dissemination of project background information, announcements, meeting materials, and deliverables.
- Send out email alerts.

4. ITS INVENTORY

The purpose of the System Inventory Summary Report is to assess the transportation setting in Tulare County and the related ITS planning and development activities in the region that have occurred since 2001. Inventory surveys were conducted with stakeholders to determine existing and planned ITS capabilities by identifying the deployment of specific technologies or service and projects. In addition, information from planning documents such as the 2014 RTP is referenced. The inventory information gathered from the surveys and this report will be used to inform the update to the Regional ITS Architecture and the development of the ITS SDP.

4.1 Inventory Collection Methodology

The methodology used to compile an ITS inventory for the Tulare County Region consisted of reaching out to the appropriate Stakeholders, and reviewing documents that provided additional information concerning existing ITS elements in the region such as the 2001 Plan, the 2014 RTP, Visalia ITS Strategic Plan, and the San Joaquin Valley Regional ITS Architecture. The list of pertinent documents and plans was reviewed with the TCAG staff and then used to populate the inventory.

4.2 Tulare County Region ITS Inventory

To manage congestion on state highways and local roadways, various types of ITS devices and systems has already been deployed by the cities and Caltrans in Tulare County.

Throughout the state, Caltrans has deployed the Transportation Management System (TMS) infrastructure consisting of ITS field elements such as traffic signals, ramp meters, CCTV cameras, vehicle detection stations (VDS), highway advisory radio (HAR) and weather monitoring stations. Field-to-center communications transmit data between the TMS elements and the Advanced Transportation Management System (ATMS) at the District Transportation Management Center (TMC). The integrated system allows Caltrans to centralize traffic monitoring, traffic control, incident management, lane closure operations and traveler information dissemination on state highways in Tulare County from the District 6 TMC.

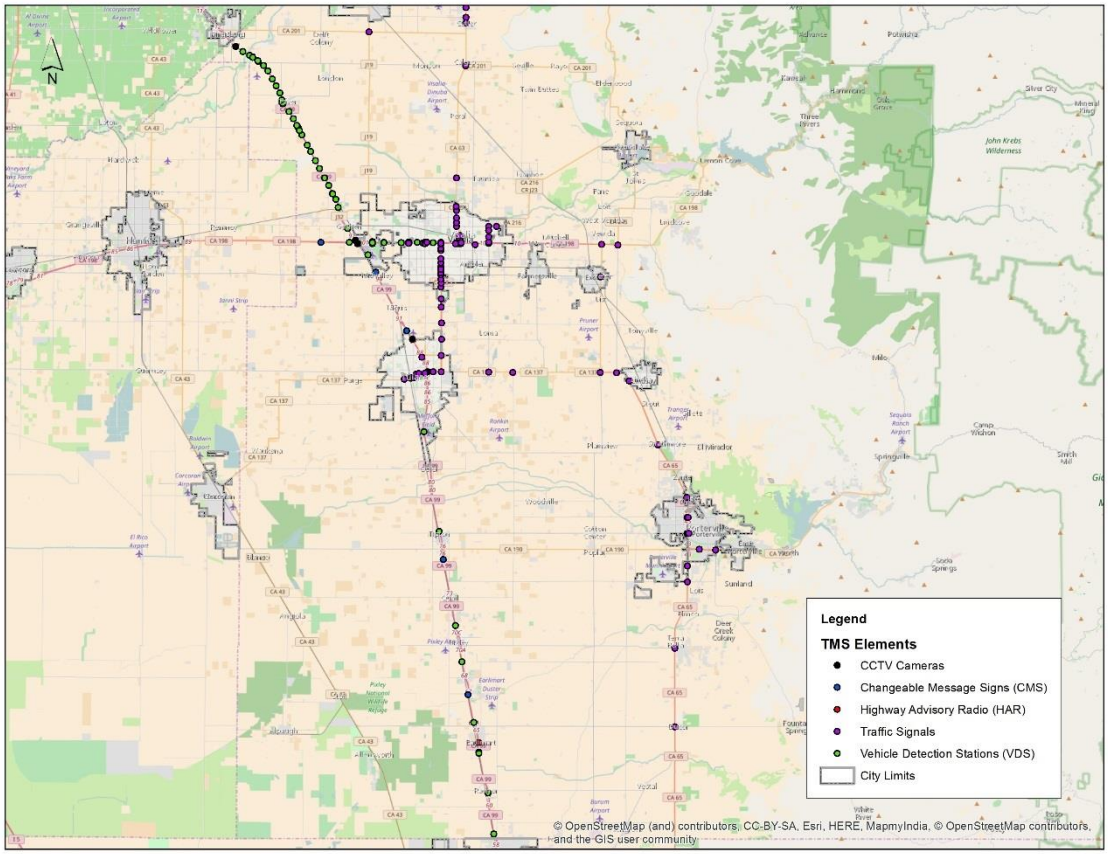
TMS elements deployed in Tulare County is summarized by route in **Table 4.**

Table 4 – Caltrans Traffic Management System (TMS) Elements in Tulare County

Route	CCTV Cameras	Changeable Message Signs (CMS)	Highway Advisory Radio (HAR)	Signals	Vehicle Detection Stations (VDS)
63	0	0	0	43	0
65	0	0	0	15	0
99	8	9	3	3	36
137	0	0	0	10	0
190	0	0	0	2	0
198	3	2	0	17	6
201	0	0	0	1	0
216	0	0	0	5	0
Grand Total	**11**	**11**	**3**	**96**	**42**

Corridors such as SR-63, SR-99 and SR-198 are instrumented with most of the TMS elements used to manage traffic, collect data and to monitor traffic conditions. Forty-two VDS are located on both directions of SR-99 and SR-198 utilizing inductive loop detection to collect real-time data on vehicle flow and occupancy that is transmitted to the District 6 TMC. Eleven CCTV cameras are deployed along SR-99 and SR-198 to provide video streams to the TMC to monitor traffic conditions at key locations such as the SR-99/SR-198 interchange west of the City of Visalia, the SR-99/SR-137 interchange in the City of Tulare, along SR-99 near the Fresno County line and along SR-198 through Visalia. Caltrans also operates ninety-six traffic signals in Tulare County, with most signals located along SR-63 in the City of Visalia.

Figure 2 shows the location of the TMS elements deployed in Tulare County.



Source: Caltrans District 6 TMC.

Figure 2 – Caltrans Traffic Management System (TMS) Elements in Tulare County

The Central Valley TMC is located in Fresno and is operated jointed by Caltrans District 6 and the CHP (California Highway Patrol). The TMC is responsible for traffic management operations, incident clearance, planned lane closures and traveler information dissemination for the state highway system. The Central Valley TMC covers the five-county area of District 6 including Tulare, Madera, Fresno, Kings, and Kern Counties.

Roadway sensors deployed in the field consisting primarily of loop detectors are used to transmit real-time traffic data back to the Central Valley TMC. TMC operators monitor traffic conditions through video feeds from CCTV cameras in the field. The detector data and camera images are

used to detect and verify incidents. CHP and Caltrans maintenance crews are dispatched by the TMC to respond to incidents, close lanes as needed and clear debris and spills from roadways.

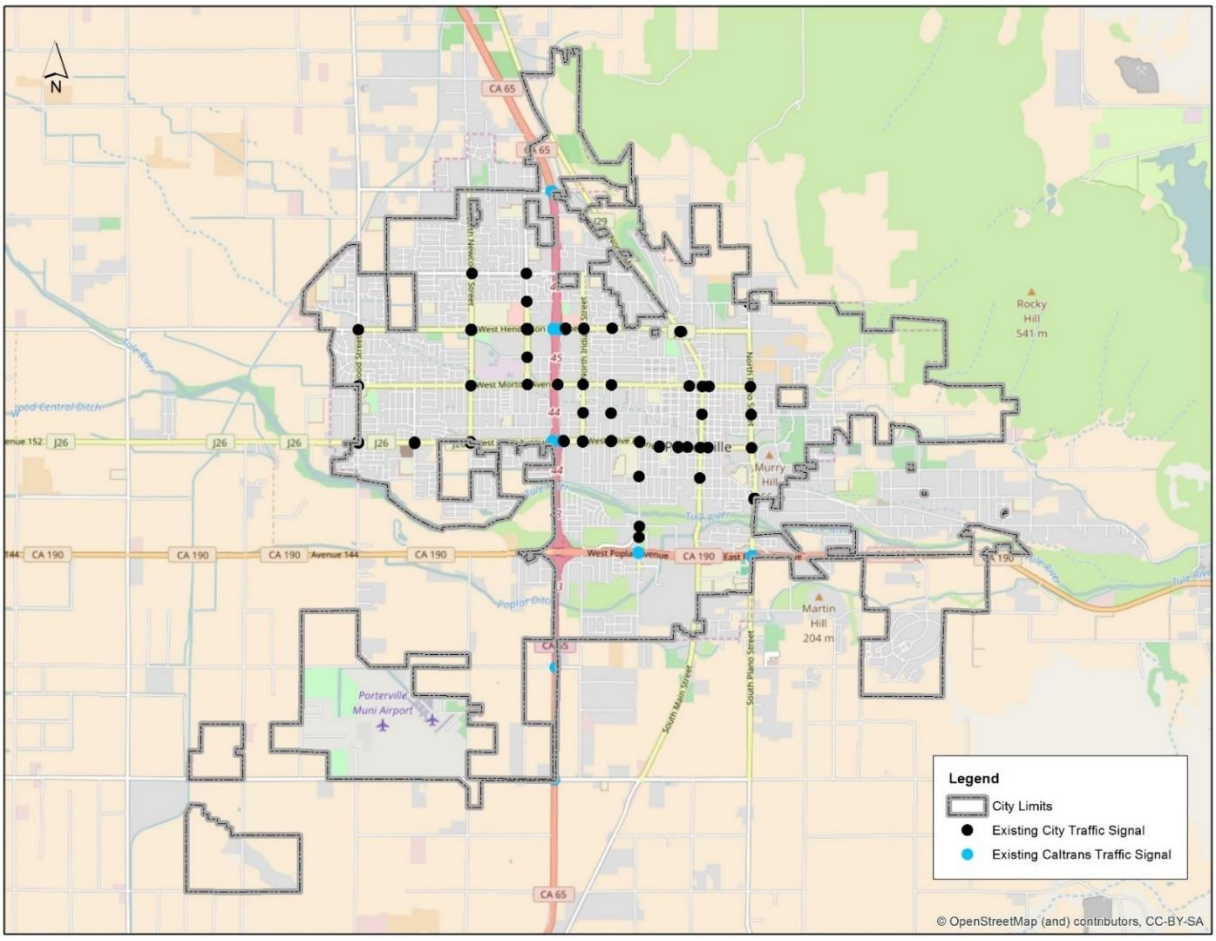
Inclement weather particularly in rural areas can create hazardous driving conditions. Weather conditions are monitored by the District 6 TMC using sensors at weather stations to measure factors such as visibility, precipitation levels and wind speed. The fog detection system uses this data to warn travelers by posting information on changeable message signs (CMS).

The TMC uses the following tools to report, monitor and share information on incidents on state highways: Transportation Management Center Activity Logging (TMCAL), ATMS and CHP CAD. Traveler information aggregated at the TMC is broadcasted to the public using, HAR, roadside CMS, online outlets such as QuickMap and the Performance Measurement System (PeMS) and 511 traveler information services.

4.2.1 City of Porterville

The City of Porterville's ITS infrastructure includes forty-five traffic signals that are owned and operated by the City. In addition, there are nine traffic signals that are owned and operated by Caltrans within the City. The City has recently installed (EVP) and Transit Signal Priority (TSP) at twelve intersections along Henderson Ave and Morton Ave to improve bus schedule adherence as part of a Phase 1 deployment; to date, sixteen intersection locations are TSP/EVP enabled. Phase 2 deployment will implement TSP at four additional intersections in downtown Porterville[2].

[2] City of Porterville/Kimley-Horn, Transit Signal Priority System (TSP) Evaluation and Recommendations (2014)



Source: City of Porterville

Figure 3 – City of Porterville Existing ITS Infrastructure

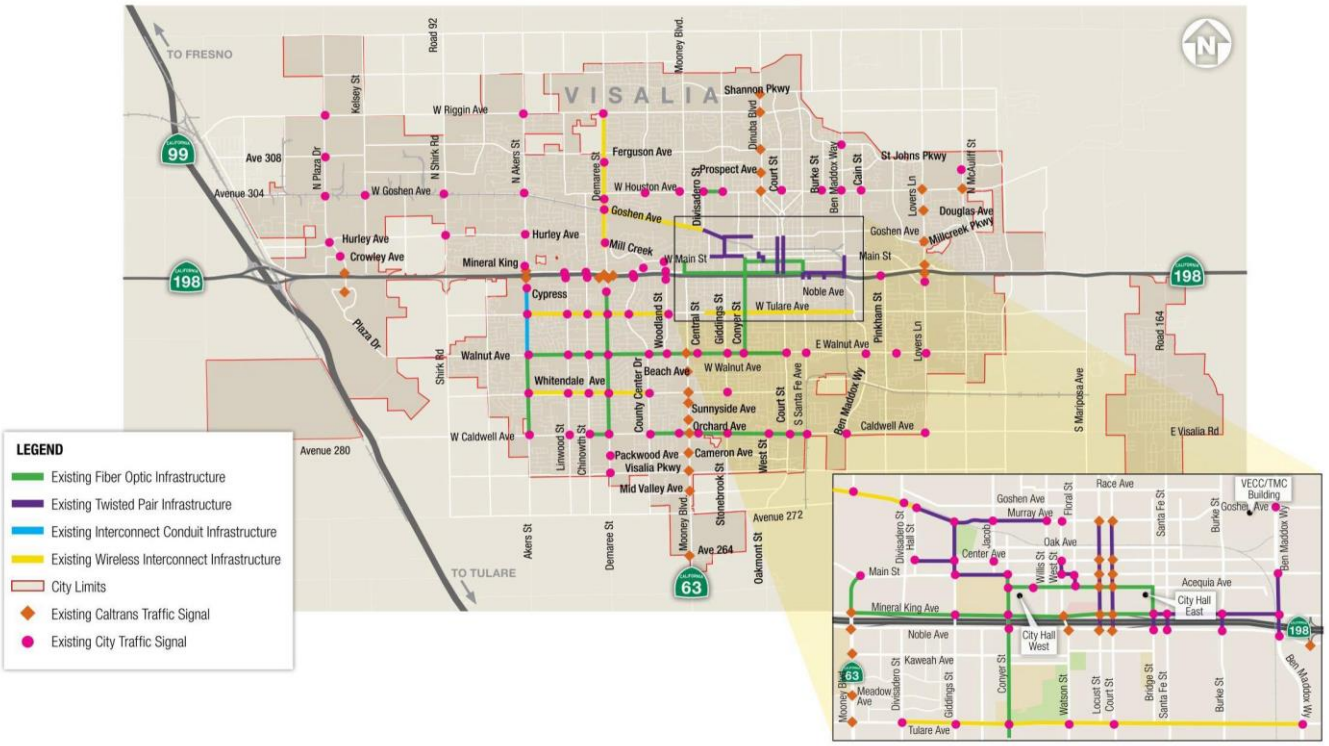
4.2.2 City of Visalia

The City of Visalia's ITS infrastructure includes one hundred twenty-six traffic signals that are owned and operated by the City. About two-thirds of the signals are networked with communications between signals over fiber optics, twisted pair copper, and wireless media. There are also forty-two Caltrans-owned and operated traffic signals within the City. Sixteen of those intersections on Court Street/Locust Street are interconnected by City-owned conduit, but are not coordinated by the City of Visalia[3].

The City is currently in the process of building an Emergency Communications Center, which will house the City's new TMC. The TMC will serve as the focal point for all traffic-related elements deployed throughout the City. Once the TMC is added to the City's fiber communications network, TMC staff will have the ability to communicate with all of the traffic signals that are online, from one central location. The existing communications network ties in several key corridors throughout the City, including Demaree Street, Tulare Avenue, and Walnut Avenue outside of the City core. A number of downtown corridors are on the City network including Goshen Avenue/Murray Avenue, Acequia Avenue, and Mineral King Avenue, along with the corresponding traffic signals

[3] City of Visalia/Kimley-Horn, Intelligent Transportation Systems Strategic Plan (2016), p. 9

along Noble Avenue on the south side of State Route 198.The Caltrans-owned signals on Court Street/Locust Street are also interconnected on the City network, but are operated by Caltrans.



Source: City of Visalia/Kimley-Horn, Intelligent Transportation Systems Strategic Plan

Figure 4 – City of Visalia Existing ITS Infrastructure

The future City of Visalia TMC will be located within the new Visalia Emergency Communication Center (VECC). In addition to the TMC, the VECC will house the City's 911 communications center, emergency operations center, fire administration and information services. The TMC will serve as the focal point for all traffic-related elements deployed throughout the City. Once the TMC is added to the City's fiber communications network, TMC staff will have the ability to communicate with all of the traffic signals that are online from a centralized location. This capability will allow TMC operators to manage recurring traffic congestion by making operational changes based on traffic conditions monitored remotely in real-time using video feeds from CCTV cameras. The City's TMC will serve as the platform for center-to-center data sharing with the Caltrans TMC to coordinate traffic management operations. Data interfaces would be established to share traffic signal information and CCTV video feeds.

Since the TMC is collocated with emergency services, TMC operations will be coordinated with first responders to manage major highway closures during and evacuation routes. The data collected at the TMC from the City's ITS infrastructure will be disseminated as information alerts and travel advisories to the public.

4.2.1 City of Tulare

The City of Tulare's ITS infrastructure includes forty-seven traffic signals that are owned and operated by the City. Currently none of the signals have communications interconnect. All signals are equipped with TSP/EVP. In addition, there are thirteen traffic signals that are owned and operated by Caltrans with the City.

4.2.2 Transit Systems

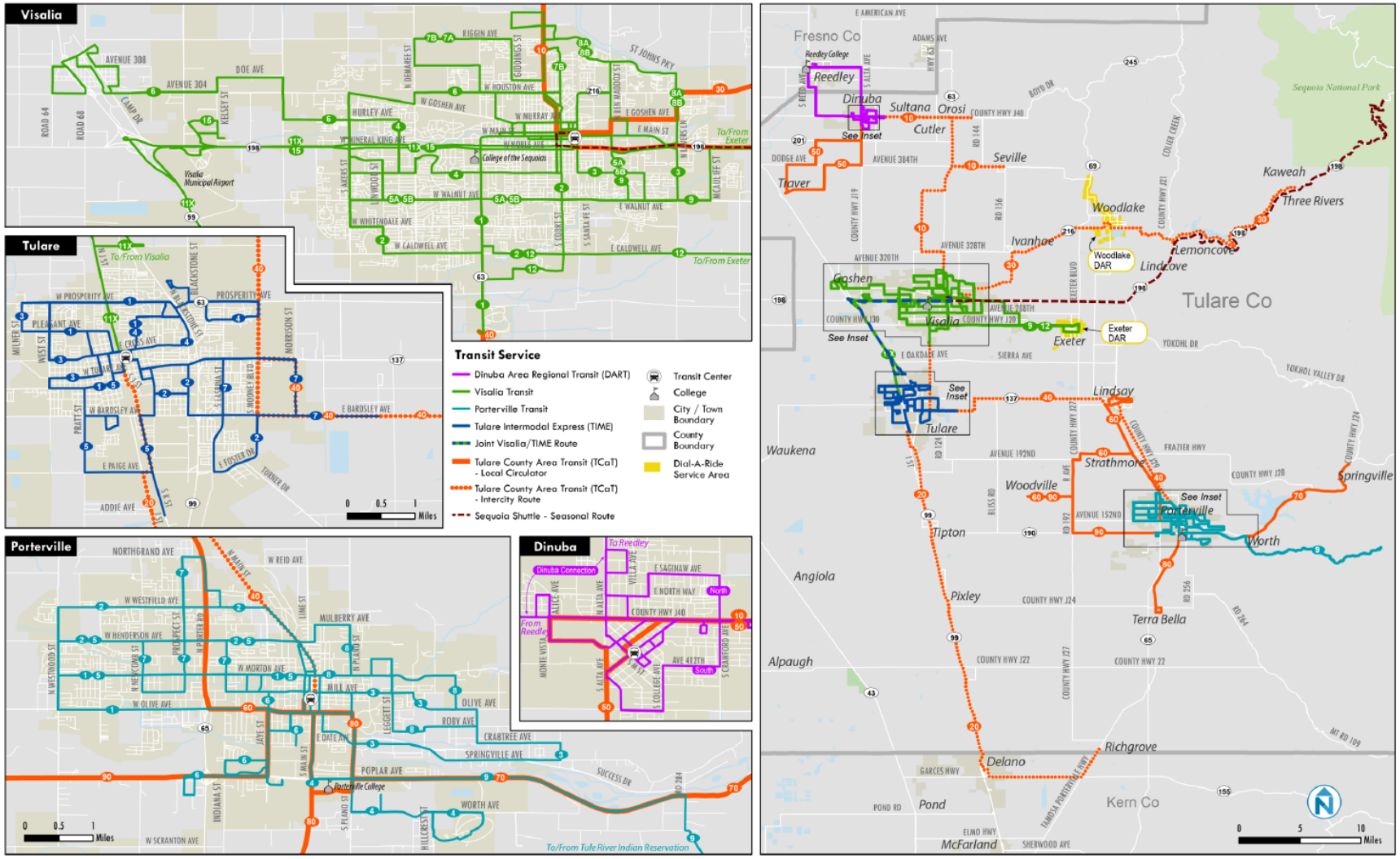
Transit in Tulare County is provided primarily through fixed route bus service that operate in the urbanized areas and demand responsive transit such as dial-a-ride and paratransit that serve rural communities.

provides a system map showing the bus transit routes in Tulare County operated locally by the cities of Visalia, Porterville, Tulare and Dinuba and inter-city routes operated by the County of Tulare. Local dial-a-ride service areas in Woodlake and Exeter are also highlighted.

The following provides a brief description of the transit services in Tulare County.

- Tulare County Area Transit (TCaT) covers all quadrants of the County and operates a combination of fixed-route, inter-city service between cities and towns and dial-a-ride service in many rural areas. TCaT operates four inter-city routes and five local circulator routes. Dial-a-ride serves rural communities in one of four service areas.
- Visalia Transit provides both fixed route and dial-a-ride service within the Visalia Urbanized Area that includes adjacent communities such as Goshen, Farmersville and Exeter. Visalia Transit operates eleven local area routes, one downtown circulator and one inter-city route operated jointly with Tulare Intermodal Express (TIME). Visalia Transit also operates the V-Line, a shuttle service that connects Visalia to Fresno.
- TIME operates both fixed route and dial-a-ride service. Six fixed routes connect communities within the City of Tulare and East Tulare and one inter-city route is operated jointly with Visalia Transit.
- Porterville Transit operates nine-fixed routes, including service to the Tule River Tribe, and dial-a-ride service within the City of Porterville.
- Dinuba Area Regional Transit (DART) operates two flex routes (fixed-routes combined with dial-a-ride), the Jolly Trolley circulator service and the Dinuba Connection providing fixed route service between downtown Dinuba and Reedley College in Fresno County.
- The Woodlake dial-a-ride service operates within the city limits and in some unincorporated areas.

The Exeter dial-a-ride service operates only within the city limits In 2016, the cities of Tulare, Visalia and Porterville embarked on a shared procurement of an automatic vehicle location (AVL) and real-time passenger information system. The ITS package includes the implementation of transit management and reporting software, on-board equipment and traveler information enhancements. Route management and scheduling software, on-board AVL, computer aided dispatch (CAD), mobile data terminals and automated passenger counters (APCs) will be deployed to improve operational efficiency and reporting for fixed route services. Traveler information enhancements include providing information signage, a customer information web site and automated voice annunciation. The dial-a-ride services will see the implementation of mobile data terminals and software to automate paratransit dispatching, scheduling and ride reservations.



Source: Nelson Nygaard/Tulare County, Tulare County Long Range Transit Plan – State of the System Report, 2015, page 5-2

Figure 5 –Transit Systems in Tulare County

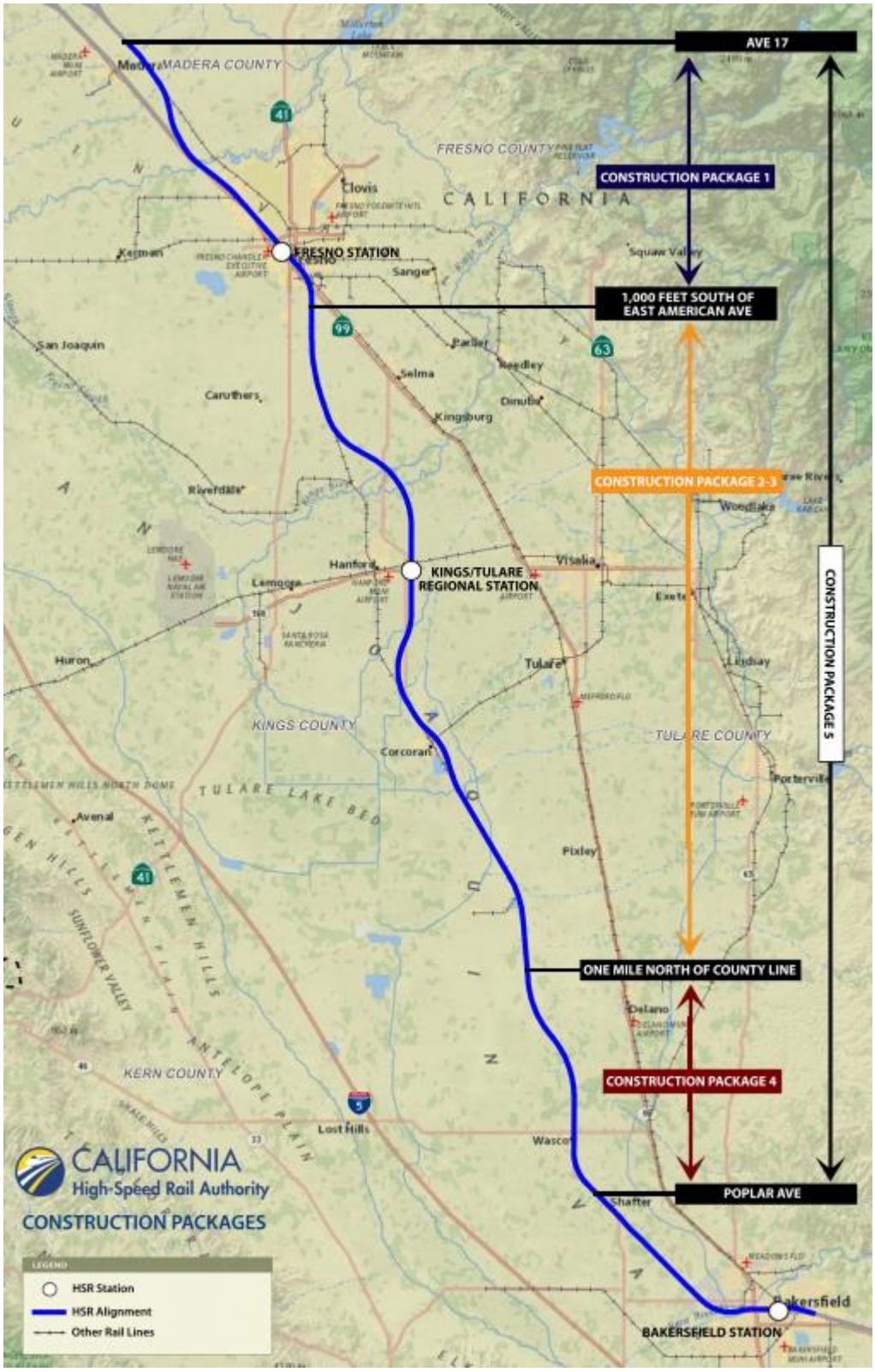
4.2.3 Rail Facilities

4.2.3.1 **Passenger Service**

Tulare County currently lacks direct passenger rail service. Amtrak operates a bus service between the Visalia Transit Center and the Amtrak station in the City of Hanford in Kings County that is served by the San Joaquin route between Sacramento and Bakersfield. An Amtrak bus can be taken from Bakersfield to Union Station in Los Angeles that is served by the Pacific Surfliner route.

The California High Speed Rail (HSR) Authority is proposing an alignment through the Central Valley between Fresno and Bakersfield that will connect Tulare County residents with the overall HSR network linking Sacramento to San Diego. The future King/Tulare HSR station will be located at the junction of SR-198 and SR-43 west of Visalia near Hanford.

Figure 6 shows the alignment of the Central Valley HSR segment and the location of the future King/Tulare HSR station.



Source: California High-Speed Rail Authority

Figure 6 – Central Valley High Speed Rail (HSR) Alignment

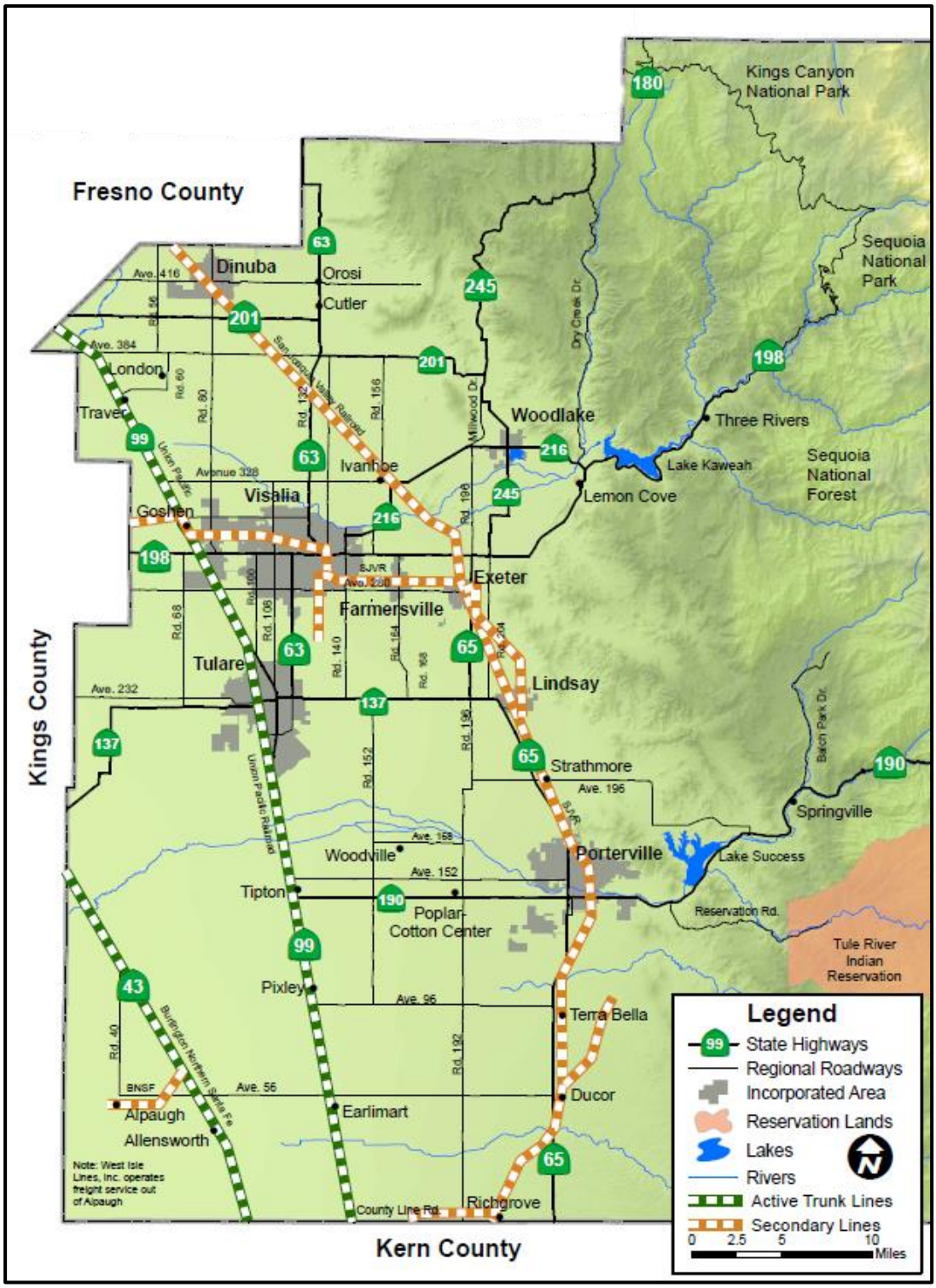
4.2.3.2 **Freight Service**

Freight rail service in Tulare County is operated by Union Pacific (UP), the Burlington Northern Santa Fe Railway (BNSF) and the San Joaquin Valley Railroad (SJVRR). The main lines that run parallel to the SR-99 corridor are important segments for regional goods movement by rail. Branch lines and spurs connect industries throughout the County to the rail network. **Figure 7** shows the rail trunk lines traversing Tulare County.

Federally mandated Positive train control (PTC) will be operational in Tulare County by the end of 2018[4]. A PTC system is designed to improve safety for freight and passenger railroads by using Global Positioning Systems (GPS) tracking technology to remotely monitor train movements. In a typical PTC system, onboard equipment on the train uses GPS satellites to transmit speed and location data over wireless or hard line communications links to an operations center. A back office system at the operations center analyzes the data using software that determines the likelihood of a collision or derailment. An advance alert is sent by the dispatch center to the locomotive and brakes are automatically engaged if the warnings are not acted upon by the train engineer. Federal regulations do not prescribe the type of technology a PTC system uses as long as it can accomplish the following functions: preventing train-to-train collisions, derailment from over speeding, incursions into designated work zone areas, and train movements caused by switches left in the wrong position.

The Central Valley segment of the California HSR system will include the implementation of a PTC system to prevent conflicts with freight rail.

[4] U.S. Department of Transportation Federal Rail Administration, *Positive Train Control Overview*.



Source: Tulare County Association of Governments (TCAG) Regional Transportation Plan, 2014, p.3-91

Figure 7 – Freight Rail Service in Tulare County

5. ITS USER NEEDS ASSESSMENT AND RELEVANT SERVICE PACKAGES

This section describes the ITS User Needs Assessment to determine whether existing or planned ITS projects are met in the region. A scoring process is used to objectively screen the needs of the region based on input from the stakeholders. The result is a prioritized list of needs that will inform the identification of ITS strategies and the development of supporting concepts in the regional ITS architecture.

5.1 ITS User Needs Assessment Methodology

At the September workshop, the ITS SDP stakeholders were asked to review and weigh a list of needs that correlates to the ITS User Services in the National ITS Architecture. The ITS User Services describe what an ITS application or system will do from the user's perspective. The ITS User Needs is organized into the following categories representing related transportation services or functionalities:

- Arterial Management
- Freeway Management
- Transit Management
- Traveler Information
- Road Weather
- Data Management and Sharing
- Emergency Management
- Commercial Vehicle Operations

The stakeholders at the workshop prioritized the list by marking one of the following columns in a table: High Importance; Medium Importance; Low Importance; and Not Needed. A total score is tallied for each ITS User Need that applies a weighting factor times the number of values assigned by the stakeholders in each column.

5.2 ITS User Needs Assessment Results

The results of the ITS User Needs Assessment can be found in Appendix A and contains a series of tables for each ITS service category and list the needs in order from the highest score to the lowest. The category that has the highest point total is Transit Management with nearly eighty percent of stakeholders assigning a priority that is either a High or Medium level of importance.

The results in Appendix A show the same scoring that orders the entire list of ITS User Needs from the highest score to the lowest across all categories. The total points range from a max score of 152 (Traffic Management: Improve signal timing/coordination) to a minimum score of 12 (Freeway Management: Implement automated/remote control gate systems). The average score is 56, the median score is 47.5 and the 85th percentile is a score of 92.15. The needs that scored in the 85th percentile or better belong either in the Arterial Management or Transit Management categories, signaling the importance of these services to the stakeholders in Tulare County.

5.3 Relationship to the Framework of the ITS Architecture

The prioritized list of ITS User Needs serves as an entry point for developing the regional ITS architecture. The needs correspond to ITS User Services defined in the National ITS Architecture

that in turn, translated into architecture concepts known as Service Packages. Service Packages represents the pieces of the National ITS Architecture that are required to implement a particular ITS service in the real world, and thus, satisfy an identified ITS need. Service Packages are implemented through projects (or groups of projects) and in transportation planning, are directly related to ITS strategies that are used to meet goals and objectives identified by local and regional project stakeholders.

5.4 Applicable Service Packages

Table 5 shows the list of prioritized ITS User Needs and the corresponding Service Packages in the National ITS Architecture.

Table 5 – Applicable ITS Service Packages

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Improve signal timing/coordination	Arterial Management	152	ATMS03 – Traffic Signal Control
Expand/enhance/upgrade automatic vehicle location (AVL) system	Transit Management	144	APTS01 – Transit Vehicle Tracking
Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities	Transit Management	132	APTS05 – Transit Security
Provide real-time transit arrival/departure information at bus stops	Transit Management	128	APTS01 – Transit Vehicle Tracking APTS08 – Transit Traveler Information
Reduce recurring traffic congestion	Arterial Management	117	ATMS03 – Traffic Signal Control ATMS04 – Traffic Metering
Implement regional smart card for transit fare payment	Transit Management	116	APTS04 – Transit Fare Collection Management
Provide real-time transit arrival/departure information on web site	Transit Management	114	APTS01 – Transit Vehicle Tracking APTS08 – Transit Traveler Information
Upgrade signal hardware	Arterial Management	106	ATMS03 – Traffic Signal Control
Develop mobile apps to provide static and real-time transit information	Transit Management	106	APTS08 – Transit Traveler Information ATIS02 – Interactive Traveler Information
Receive roadway incident information	Transit Management	102	APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations ATIS06 –Transportation Operations Data Sharing ATMS08 – Traffic Incident Management System

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Expand/enhance/upgrade computer aided dispatch (CAD) system	Transit Management	102	APTS01 – Transit Vehicle Tracking APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations
Improve data collection capabilities	Arterial Management	100	ATMS01 – Network Surveillance ATMS02 – Traffic Probe Surveillance
Provide/enhance speed enforcement at high risk locations	Arterial Management	99	ATMS19 – Speed Warning and Enforcement
Develop/implement system-wide arterial management strategies	Arterial Management	97	ATMS03 – Traffic Signal Control ATMS07 – Regional Traffic Management
Receive roadway construction/closure/detour information	Transit Management	96	APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations ATIS06 – Transportation Operations Data Sharing ATMS06 – Traffic Information Dissemination ATMS21 – Roadway Closure Management
Coordinate timed transfers between routes, providers and modes	Transit Management	93	APTS07 Multi-Modal Coordination APTS11 Multimodal Connection Protection
Provide transit information using social media	Transit Management	93	APTS08 Transit Traveler Information
Receive real-time roadway congestion information	Transit Management	93	ATIS06 – Transportation Operations Data Sharing
Coordinate arterial and freeway management strategies	Arterial Management	92	ATMS01 – Network Surveillance ATMS03 – Traffic Signal Control ATMS04 – Traffic Metering ATMS07 – Regional Traffic Management

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Reduce traffic congestion during incidents	Arterial Management	92	ATMS08 – Traffic Incident Management System
Implement/enhance web-based trip planner	Transit Management	92	APTS08 – Transit Traveler Information ATIS05 – ISP Based Trip Planning and Route Guidance
Implement transit signal priority technology	Transit Management	92	APTS09 – Transit Signal Priority
Staffing	Arterial Management	87	N/A
Improve ridesharing program/website	Transit Management	85	ATIS08 – Dynamic Ridesharing
Implement intersection collision warning/avoidance systems	Arterial Management	83	AVSS05 – Intersection Safety Warning
Improve/implement ability to remotely modify signal timing	Arterial Management	83	ATMS03 – Traffic Signal Control AVSS10 – Intersection Collision Avoidance
Provide on-line reservation system for demand-responsive transit services	Transit Management	81	APTS03 – Demand Response Transit Operations APTS08 – Transit Traveler Information
Expand CCTV camera coverage on arterials	Arterial Management	79	ATMS01 – Network Surveillance
Provide on-board automated enunciators	Transit Management	78	APTS08 – Transit Traveler Information
Implement red-light running technology	Arterial Management	72	ATMS01 – Network Surveillance ATMS03 – Traffic Signal Control AVSS05 – Intersection Safety Warning
Provide health monitoring of traffic signal equipment at intersections and rail crossings	Arterial Management	70	ATMS03 – Traffic Signal Control ATMS13 – Standard Railroad Grade Crossing ATMS14 – Advanced Railroad Grade Crossing

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Implement/improve inter-jurisdictional signal coordination	Arterial Management	65	ATIS06 – Transportation Operations Data Sharing ATMS03 – Traffic Signal Control ATMS07 – Regional Traffic Management
Expand/upgrade automated passenger counters	Transit Management	62	APTS10 – Transit Passenger Counting
Implement/enhance remote monitoring of transit vehicle mechanical condition	Transit Management	61	APTS06 – Transit Fleet Maintenance
Improve information exchange between transportation and transit agencies	Data Management and Sharing	60	ATIS06 – Transportation Operations Data Sharing
Provide incident information to emergency management agencies	Data Management and Sharing	60	ATIS06 – Transportation Operations Data Sharing ATMS08 – Traffic Incident Management System
Provide roadway closure/restriction information	Traveler Information	59	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Provide real-time traffic information to emergency responders	Emergency Management	59	ATIS06 – Transportation Operations Data Sharing ATMS08 – Traffic Incident Management System
Reduce vehicle delays at rail grade crossings	Arterial Management	58	ATMS03 – Traffic Signal Control ATMS06 – Traffic Information Dissemination ATMS13 – Standard Railroad Grade Crossing ATMS14 – Advanced Railroad Grade Crossing

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Improve incident response	Emergency Management	57	ATMS08 – Traffic Incident Management System EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing
Provide/enhance automatic vehicle location (AVL) for emergency vehicles	Emergency Management	57	EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing EM04
Reduce recurring traffic congestion	Freeway Management	56	ATMS04 – Traffic Metering ATMS05 – HOV Lane Management ATMS06 – Traffic Information Dissemination ATMS07 – Regional Traffic Management ATMS09 – Transportation Decision Support and Demand Management ATMS18 – Reversible Lane Management ATMS23 – Dynamic Lane Management and Shoulder Use
Provide more timely incident information to travelers	Traveler Information	56	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Share incident information with other agencies	Data Management and Sharing	56	ATIS06 – Transportation Operations Data Sharing ATMS08 – Traffic Incident Management System
Provide routing (detour) information to travelers during incident, construction, weather events, special events, etc.	Traveler Information	55	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
			ATMS08 – Traffic Incident Management MC08 – Work Zone Management
Improve information exchange between Caltrans and local transportation agencies	Data Management and Sharing	55	ATIS06 – Transportation Operations Data Sharing
Provide information on roadway construction and maintenance activities	Traveler Information	53	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination MC08 – Work Zone Management
Coordinate construction and maintenance project schedules within and between agencies	Road Weather	52	MC10 – Maintenance and Construction Activity Coordination
Improve data collection and archiving	Data Management and Sharing	52	AD1 – ITS Data Mart AD2 – ITS Data Warehouse ATMS01 Network Surveillance
Monitor/collect air quality data	Arterial Management	50	ATMS11 – Emissions Monitoring and Management MC11 – Environmental Probe Surveillance
Provide advisory to warn traffic of a stopped queue in/near work zones	Road Weather	50	ATMS24Dynamic Roadway Warning MC08 – Work Zone Management
Share public safety/computer aided dispatch (CAD) data with transportation agencies	Data Management and Sharing	50	ATIS06 – Transportation Operations Data Sharing ATMS08 – Traffic Incident Management
Share congestion information with other agencies	Data Management and Sharing	50	ATIS06 – Transportation Operations Data Sharing
Use archived data for planning, modeling, analysis and traffic management strategy development	Data Management and Sharing	50	AD1 – ITS Data Mart AD2 – ITS Data Warehouse ATIS06 – Transportation Operations Data Sharing ATMS09 – Transportation Decision Support and Demand Management

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Provide/enhance congestion information to travelers	Traveler Information	49	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination
Improve quality, consistency and thoroughness of traveler information	Traveler Information	49	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination
Implement/expand dynamic message sign (DMS) installations on arterials	Arterial Management	48	ATMS06 – Traffic Information Dissemination
Warn work crews of errant vehicles	Road Weather	48	MC09 – Work Zone Safety Monitoring
Implement a central information/data clearinghouse	Data Management and Sharing	48	AD1 – ITS Data Mart AD2 – ITS Data Warehouse AD3 – ITS Virtual Data Warehouse
Share surveillance video and data with PSAPs/emergency responders	Data Management and Sharing	48	ATIS06 – Transportation Operations Data Sharing ATMS08 – Traffic Incident Management
Improve data collection on freeways/expressways	Freeway Management	47	ATMS01 – Network Surveillance ATMS02 – Traffic Probe Surveillance
Improve incident detection	Emergency Management	47	ATMS01 – Network Surveillance ATMS08 – Traffic Incident Management
Reduce traffic congestion during incidents	Freeway Management	46	ATMS04 – Traffic Metering ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management ATMS23 – Dynamic Lane Management and Shoulder Use ATMS24 – Dynamic Roadway Warning

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Provide information on planned special events	Traveler Information	46	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination
Improve incident notification to agencies	Emergency Management	46	ATMS08 – Traffic Incident Management EM01 – Emergency Call-Taking and Dispatch
Enhance computer aided dispatch (CAD) systems	Emergency Management	46	EM01 – Emergency Call-Taking and Dispatch EM04 – Roadway Service Patrols
Improve ramp metering operations	Freeway Management	45	ATMS04 – Traffic Metering
Monitor transportation infrastructure	Road Weather	45	EM05 – Transportation Infrastructure Protection MC12 – Infrastructure Monitoring
Send email alerts of major incidents to major employers	Traveler Information	44	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information
Enhance 511 to provide static and real-time transit information	Traveler Information	44	APTS08 – Transit Traveler Information ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information
Provide incident information to travelers	Traveler Information	43	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination
Conduct outreach/education activities to promote awareness of traveler information services	Traveler Information	43	N/A
Warn travelers about trucks entering/existing work zones	Road Weather	43	MC08 – Work Zone Management
Monitor queue lengths at ramp locations	Freeway Management	42	ATMS04 – Traffic Metering ATMS24 – Dynamic Roadway Warning
Provide/enhance road weather conditions information to travelers	Traveler Information	41	ATIS01 – Broadcast Traveler Information

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
			ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination MC03 – Road Weather Data Collection MC04 – Weather Information Processing and Distribution
Provide curve speed warning	Road Weather	41	ATMS19 – Speed Warning and Enforcement
Provide/enhance enforcement in work zones	Road Weather	41	ATMS19 – Speed Warning and Enforcement
Improve a multi-agency, system-coordinated response to major incidents	Emergency Management	41	ATMS08 – Traffic Incident Management System
Improve interagency communications	Emergency Management	41	ATMS08 – Traffic Incident Management System
Implement/improve incident detection capabilities	Freeway Management	39	ATMS01 – Network Surveillance ATMS08 – Traffic Incident Management System
Provide roadway flood warnings	Road Weather	39	ATMS24 – Dynamic Roadway Warning
Reduce incident clearance time	Emergency Management	39	ATMS08 – Traffic Incident Management System EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing
Improve/expand vehicle detection coverage on freeways/expressways	Freeway Management	38	ATMS01 – Network Surveillance ATMS02 – Traffic Probe Surveillance
Enhance freeway/expressway traffic map	Traveler Information	37	ATIS01 – Broadcast Traveler Information
Enhance arterial traffic map	Traveler Information	37	ATIS01 – Broadcast Traveler Information

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
Improve communications in rural areas	Emergency Management	37	ATMS08 – Traffic Incident Management System EM01 – Emergency Call-Taking and Dispatch EM08 – Disaster Response and Recovery
Expand freeway/expressway dynamic message signs (DMS)	Freeway Management	36	ATMS06 – Traffic Information Dissemination
Provide travel times/delays through work zones	Traveler Information	36	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information ATMS06 – Traffic Information Dissemination MC08 – Work Zone Management
Expand coverage of environmental/weather/road conditions detection/monitoring systems	Road Weather	36	MC03 – Road Weather Data Collection MC11 – Environmental Probe Surveillance
Monitor queue lengths in/near work zones	Road Weather	36	MC08 – Work Zone Management
Provide vehicle over height detection/warnings	Road Weather	36	ATMS24 – Dynamic Roadway Warning
Provide/enhance mobile data terminals for emergency vehicles	Emergency Management	36	EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing EM04 – Roadway Service Patrols
Expand CCTV coverage on freeways/expressways	Freeway Management	35	ATMS01 – Network Surveillance
Provide/enhance speed enforcement at high risk locations	Freeway Management	35	ATMS19 – Speed Warning and Enforcement
Use social media for traveler information dissemination	Traveler Information	35	ATIS01 – Broadcast Traveler Information
Provide freeway/expressway travel times	Traveler Information	34	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
			ATMS06 – Traffic Information Dissemination
Implement Smart Work Zone technology	Road Weather	34	MC08 – Work Zone Management MC09 – Work Zone Safety Monitoring
Expand emergency vehicle preemption	Emergency Management	34	EM02 – Emergency Routing
Implement advanced parking management systems	Arterial Management	33	ATMS16 – Parking Facility Management
Improve response to HAZMAT incidents	Emergency Management	32	CVO10 – HAZMAT Management CVO11 – Roadside HAZMAT Security Detection and Mitigation EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing EM08 – Disaster Response and Recovery
Improve 511 system/web site	Traveler Information	31	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information
Provide information on available truck parking facilities	Traveler Information	31	ATIS07 – Travel Services Information and Reservation
Provide better vehicle restrictions and roadway closure information to commercial vehicles	Commercial Vehicle Operations	31	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information CVO01 – Carrier Operations and Fleet Management CVO04 – CV Administrative Processes
Provide target enforcement at locations with history of violations	Commercial Vehicle Operations	31	CVO06 – Weigh-In-Motion CVO07 – Roadside CVO Safety
Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles	Freeway Management	30	EM04 – Roadway Service Patrols
Provide arterial travel times (on major arterials)	Traveler Information	30	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
			ATMS06 – Traffic Information Dissemination
Provide information on truck parking and availability	Commercial Vehicle Operations	30	ATIS01 – Broadcast Traveler Information ATIS07 – Travel Services Information and Reservation
Provide directions to parking facilities	Traveler Information	26	ATMS16 – Parking Facility Management ATIS02 – Interactive Traveler Information
Provide interstate/inter-regional traveler information for commercial vehicles	Commercial Vehicle Operations	26	ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information CVO01 – Carrier Operations and Fleet Management
Provide tracking of HAZMAT vehicles	Commercial Vehicle Operations	26	CVO10 – HAZMAT Management CVO13 – Freight Assignment Tracking
Deploy weigh-in-motion/mobile weigh enforcement technology	Commercial Vehicle Operations	26	CVO06 – Weigh-In-Motion
Monitor/collect air quality data	Freeway Management	24	ATMS11 – Emissions Monitoring and Management
Track locations of maintenance fleet	Road Weather	23	MC01 – Maintenance and Construction Vehicle and Equipment Tracking
Expand highway advisory radio (HAR) coverage on freeways/expressways	Freeway Management	22	ATMS06 – Traffic Information Dissemination
Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol	Freeway Management	22	EM04 – Roadway Service Patrols
Implement variable speed limits	Freeway Management	22	ATMS22 – Variable Speed Limits
Provide information on parking availability	Traveler Information	22	ATMS16 – Parking Facility Management
Reduce commercial vehicle weight, width and height violations	Commercial Vehicle Operations	21	CVO04 – CV Administrative Processes CVO06 – Weigh-In-Motion

ITS User Needs	Category/ Service Area	Total Points	Applicable IT Service Package(s)
			CVO07 – Roadside CVO Safety
Provide information on commercial vehicle operations (CVO) permit restrictions	Commercial Vehicle Operations	20	CVO01 – Carrier Operations and Fleet Management CVO04 – CV Administrative Processes
Implement automated/remote control gate systems	Freeway Management	12	ATMS21 – Roadway Closure Management

6. TULARE COUNTY REGION VISION STATEMENT

In the strategic planning process, the vision describes the outcome that the region wants to accomplish by investing in ITS solutions. A vision sets the stage for articulating goals and objectives that serve as measurable outcomes that track the progress in achieving the vision. Together, the vision, goals and objectives are used to assess the unmet ITS needs of the region, and in turn, provide the basis for stakeholders to develop consensus around the priority programs and projects that will be implemented with the ITS SDP serving as a blueprint for ITS investments in Tulare County.

At the September workshops, agency staff was asked to provide input to an updated vision statement for the ITS SDP. The stakeholder discussion highlighted the following themes that should be reflected in the vision statement:

- Address cost-effectiveness through investment in technology that can be maintained and upgraded
- Address all forms of transportation, particularly those that can increase transit ridership
- Address mobility, the environment and quality of life in Tulare County
- Address regional integration by promoting greater data sharing, coordinated planning, synchronization of modes and interoperability among agency systems

The updated vision statement for the ITS SDP reads as follows:

> **"Intelligent Transportation Systems will enhance mobility for all transportation users to improve the quality of life and the environment in Tulare County through the optimization, coordination, communication and integration of roadway and public transportation systems by investing in cost-effective technologies and solutions."**

6.1 Vision Elements

Six vision elements that support the vision statement are articulated below. Each vision statement focuses on a different aspect of ITS and its transportation role in Tulare County. These six focus areas are adapted and expanded from the vision statements associated with the program areas in the 2001 Plan. Each vision element combines a high-level description of the intended results of ITS deployment with a summary of how those results will be achieved. The vision statement is in turn, supported and expanded upon in the ITS goals and objectives in **Section 4** of this report.

6.1.1 Vision for Arterial Traffic Management Systems

The urban areas of Visalia, Tulare and Porterville have deployed ITS traffic management systems and strategies. Efforts to date have focused on signal system improvements and traffic surveillance with a growing emphasis on traffic management technologies, such as traffic signal priority for transit and emergency vehicles and real-time agency and traveler information. The overall vision for arterial management in the urbanized areas of the county focuses on continued integration and coordination of arterial management between the cities (including transit agencies) in the larger urban areas. The vision also entails the extension and adaptation of key ITS components to the needs of the smaller cities in more rural areas.

6.1.2 Vision for Freeway Traffic Management Systems

The vision for freeway management is to expand the geographic coverage of the Caltrans transportation management system (TMS) infrastructure. It envisions ongoing enhancement of Caltrans TMS on State Highways within the County through additional and upgraded equipment and capabilities, and closer coordination between Caltrans and local Tulare County traffic management staff. This vision also entails more effective utilization of ITS equipment currently deployed. Ultimately, this vision includes deployment of an integrated corridor management system (ICM) to optimize utilization of the transportation network across facilities and modes.

6.1.3 Vision for Incident Management/Emergency Services

This vision for the continual enhancement of Tulare County's interagency incident response and coordination is achieved through the application of ITS technologies and the operations of the new Visalia Emergency Communications Center (VECC). This vision includes the promotion of real-time data sharing to improve all aspects of incident management with the VECC acting as focal point. Quick and accurate verification followed by rapid dissemination of incident information to motorists by ITS can prevent secondary collisions, improve traffic flow, and reduce emissions.

6.1.4 Vision for Transit Management Systems

This vision for countywide transit management includes striving for ongoing improvements in the efficiency of fixed route and paratransit operations. Underlying technologies can provide accurate real-time information and tools to the public to empower transit patrons to make travel choices that fulfill their daily needs. Transit management systems should be standardized throughout the County and the Valley both to avoid duplication of agency effort and to maximize compatibility between urban and rural systems. This vision also includes greater cooperation and coordination between local transit agencies, with the potential to consolidate transit services and technology and equipment procurement.

6.1.5 Vision for Traveler Information Systems

The vision for traveler information in Tulare County is to evolve with the expanding capabilities of ITS technologies to deliver data rich information and applications. Traveler information will be timely and useful, providing actionable information on traffic, transit, and weather conditions for commuters, commercial vehicles and visitors. Regional traveler information is disseminated via outlets such as 511, social media and 3rd party apps. Traveler information will enable commuters who wish to rideshare to immediately determine potential candidates and dynamically create carpools. Devices such as smart phones will allow users to communicate with each other and work together to share rides and reduce the number of vehicles on the roadway.

6.1.6 Vision for Interagency Coordination and Planning

This vision sees greater mutual cooperation between transportation agencies throughout Tulare County and the Valley. Interagency coordination is strengthened through outreach, education, training and teamwork. All agencies and transportation providers will work together to promote and encourage safe and efficient operation of the transportation network, including ITS projects that cross jurisdictional boundaries. Tulare and its neighboring counties will use national and statewide ITS architectures as a basis for coordinated project deployments and technology standards within the County and the larger San Joaquin Valley Region. The coordinated deployment of ITS will allow agencies to share real-time data for

traffic management, emergency response and transit operations. The result is a regional, integrated system that provides a technological platform to support regional active traffic management and active response strategies.

7. OPERATIONAL CONCEPTS

The purpose of this section is to identify roles/responsibilities of Tulare County agencies for the operations and deployment of key ITS projects and strategies that support the Goals and Objectives of the region. The roles and responsibilities are described at a high-level to identify "who does what" with regard to the operation of ITS. Also described are day-to-day activities for operating and maintaining ITS elements that enable services.

7.1 Roles and Responsibilities

- In this section, agencies and their roles and responsibilities for operating ITS systems in Tulare County are described. Specifically, it describes operational roles and responsibilities for agencies involved in the following ITS Service Areas representing transportation management and interagency functions that are provided now or in the future:

- Traffic Management – Traffic management involves the operation of traffic control and network surveillance systems to manage the flow of vehicles, goods and people across the transportation system. ITS devices such as traffic signals, cameras, changeable message signs (CMS) and roadway sensors are deployed on freeways, rural/suburban highways and arterials. Staff at local and regional traffic management centers (TMCs) monitor travel conditions and interface with field devices to support operational strategies such as traffic signal coordination, ramp metering, and TSP.

- Incident Management – Incident management involves agency functions to minimize impacts to the transportation network and safety that is attributed to unplanned and planned events. Incident management involves interagency coordination on several fronts – sharing traffic data and video, disseminating travel advisories to the public, implementing traffic control plans and dispatching first responders and work crews. By working together, Caltrans, California Highway Patrol (CHP), local transportation management agencies and fire and police departments can quickly identify and verify incidents, thereby reducing incident clearance time and the likelihood of secondary crashes.

- Transit Management – Transit management involves the operation of in-vehicle technologies, as well as back office and customer facing applications that work together in an integrated fashion to improve the efficiency of fixed route and paratransit operations. Vehicle tracking systems using GPS technology collect real-time data to monitor schedule adherence and generate predictive arrivals times. At a regional level, transit operators can share data to coordinate transit routes and schedules to reduce service gaps. Transit agencies can also administer a single fare payment system to allow transit fare products to work seamlessly on different transit agency vehicles.

- Traveler Information – Traveler information involves the aggregation, transformation and dissemination of transportation data that is collected primarily from agency operated sensors and detection systems. The data is provided to the public in the form of trip planning and travel advisory information. Platforms for disseminating traveler information includes CMS, 511 branded websites, 511 interactive phone services and smartphone apps. Users provided with traveler information can make informed decisions on travel mode or route that reduces congestion and balances system demand.

- Maintenance and Construction Management – Maintenance and construction management involves agency functions to reduce travel impacts from work zone activities. Information on anticipated road closures, alternative routes, anticipated delays, closure times and durations

is shared among management centers (traffic, emergency, transit), traveler information providers and the media.

- Data Management and Sharing – Data collected and managed by a single agency can be exchanged with other agencies to support regional operations and transportation management strategies that enable the ITS Services Areas to function across jurisdictional boundaries. Data sharing involves system integration efforts to interface with and retrieve data from different systems and the development of standards to normalize various data structures and formats. Data collected from multiple sources can be archived in an online repository that is used for data mining, decision support and performance measurement.

- Emergency Management – Emergency management involves agency functions to improve emergency and incident management capabilities. Traffic management centers can play a key role in facilitating the movement of emergency response vehicles to the scene by providing signal preemption. Traffic management and emergency operations centers can share information to coordinate detection, verification and dispatch activities, especially for large scale incidents and disasters. Traveler information services can be leveraged to broadcast area wide alerts and travel advisories to the public.

- Commercial Vehicle Operations – Commercial vehicle operations (CVO) involves agency functions to facilitate goods movement through administration, enforcement and traffic management. Congestion, safety issues and pollution associated with CVO can be managed and coordinated with ITS applications that support vehicle credentialing, routing, scheduling and inspections.

7.2 Roles and Responsibilities

The ITS Service Areas described earlier in turn, support the following goals identified by stakeholders in Tulare County as the priorities to guide ITS planning and investments for the region:

- Goal #1: Reduce Traffic Congestion
- Goal #2: Reduce the Number, Severity and Duration of Accidents and Incidents
- Goal #3: Improve Transportation and Transit Planning and Operations
- Goal #4: Promote the Efficiency, Safety, Convenience and Use of Alternative Travel Modes
- Goal #5: Improve the Safety and Efficiency of Goods Movement and Reduce the Impacts of Commercial Vehicles on other Traffic and Roadways
- Goal #6: Minimize the Environmental Impacts of Transportation

Table 6 maps the ITS Service Areas to the ITS Goals identified for Tulare County. The ITS Service Areas represents the core functionalities for achieving the ITS Goals, Objectives and Vision for the region. The agency roles and responsibilities associated with each ITS Service Area in Section 2.2 can then be traced back to the ITS goals.

Table 6 – Mapping ITS Service Areas to Goals

ITS Service Areas	Goal#1 Reduce Traffic Congestion	Goal #2 Reduce the Number, Severity, and Duration, of Accidents and Incidents	Goal #3 Improve Transportation and Transit Planning and Operations	Goal #4 Promote Efficiency, Safety, Convenience and Use of Alternative Transport	Goal #5 Improve, Safety, and Efficiency of Goods Movement; Reduce Impact of Commercial Vehicles on Other Traffic/Roadways	Goal #6 Minimize Environmental Impacts of Transportation
Traffic Management	✓	✓	✓		✓	✓
Incident Management	✓	✓			✓	
Transit Management			✓	✓		✓
Traveler Information	✓	✓	✓	✓	✓	✓
Maintenance and Construction Management		✓		✓		
Data Management and Sharing	✓	✓	✓			
Emergency Management		✓				✓
Commercial Vehicle Operations	✓				✓	✓

7.3 Agency Roles and Responsibilities

The regional and local agencies in Tulare County that have roles and responsibilities for ITS operations are identified below:

- Caltrans District 6
- CHP
- TCAG
- County of Tulare
- Urban and rural cities consisting of:
    - Dinuba
    - Exeter

- Farmersville
- Lindsay
- Porterville
- Tulare
- Visalia
- Woodlak

Transit services operated by the county and cities:

- Visalia Transit
- Porterville Transit
- Dinuba Area Regional Transit (DART)
- Tulare Intermodal Express (TIME)
- Tulare County Area Transit (TCAT)
- Woodlake Dial-a-ride
- Exeter Dial-a-ride

These role and responsibilities of Tulare County agencies for current and future ITS operations are identified in **Table 7**

Table 7 – Agency Roles and Responsibilities for ITS Operations

Agency	ITS Service Area	Roles and Responsibilities
Caltrans District 6	Traffic Management	▪ Operate the Central Valley TMC ▪ Operate signals on state highways ▪ Coordinate signals with local agencies to optimize corridor operations ▪ Operate roadside ITS elements: CCTV cameras, vehicle detection stations (VDS), CMS, weather stations, fog warning systems and ramp meters ▪ Monitor travel conditions on state highways ▪ Implement center-to-center information sharing between Caltrans and local traffic management systems (Future) ▪ Deploy integrated corridor management strategies along major travel corridors in the county such as SR-99 (Future)
Caltrans District 6	Incident Management	▪ Detect and verify incidents using roadside ITS elements ▪ Log incidents into the Traffic Management Center Activity Database (TMCAD) ▪ Coordinate incident response with CHP ▪ Communicate incident information with other agencies ▪ Dispatch work crews

		▪ Operate Freeway Service Patrol (FSP) jointly with CHP ▪ Coordinate with other Caltrans TMCs to manage large scale incidents ▪ Coordinate with the new Visalia Emergency Communication Center (VECC), (Future)
Caltrans District 6	Maintenance and Construction Management	▪ Maintain signals on state highways ▪ Maintain roadside ITS devices and communications on state highways ▪ Communicate planned roadway closures with other agencies ▪ Coordinate and implement traffic control plans for maintenance and construction ▪ Debris and spill cleanup on state highways
Caltrans District 6	Data Management and Sharing	▪ Send data collected from VDS to the Freeway Performance Measurement System (PeMS)
Caltrans District 6	Traveler Information	▪ Operate Caltrans QuickMap ▪ Disseminate information using CMS ▪ Share traffic and incident information and CCTV camera images with San Joaquin Valley 511
Caltrans District 6	Emergency Management	▪ Coordinate with other Caltrans TMCs to manage regional emergency events ▪ Coordinate operations with the new VECC (Future)
CHP	Commercial Vehicle Operations	▪ Operate weigh stations ▪ Roadside safety inspections ▪ Enforcement
CHP	Incident Management	▪ Provide primary incident response and clearance ▪ Coordinate incident response with Caltrans ▪ Operate CHP computer aided dispatch (CAD)
TCAG	Data Management and Sharing	▪ Coordinate ITS planning among Tulare jurisdictions ▪ Develop data exchange standards and formats (Future) ▪ Use archive data for planning, reporting and analysis (Future)
TCAG	Traveler Information	▪ San Joaquin Valley 511 stakeholder
County of Tulare	Transit Management	▪ Operate fixed route and demand responsive service ▪ Standardize fare collection systems throughout the region (Future)

		▪ Integrate on-board automatic vehicle location (AVL) and transit central systems to offer real-time bus arrival information (Future) ▪ Expand/upgrade AVL systems (Future)
City of Visalia	Traffic Management	▪ Operate and maintain traffic signal systems ▪ Upgrade/expand signal communications ▪ Operate emergency vehicle preemption (EVP) ▪ Implement signal synchronization improvements (Future) ▪ Upgrade signal hardware (Future) ▪ Expand CCTV coverage on arterials (Future) ▪ Collect arterial traffic data (Future) ▪ Operate the new Visalia TMC (Future)
City of Visalia	Incident Management	▪ Implement traffic control plans from the new Visalia TMC during major incidents (Future) ▪ Coordinate operations with the Caltrans TMC (Future)
City of Visalia	Emergency Management	▪ Coordinate operations with the Caltrans TMC ▪ Coordinate traffic and emergency operations at the VECC
Local Jurisdictions	Traffic Management	▪ Operate and maintain traffic signal systems (Future) ▪ Operate emergency vehicle preemption (EVP) (Future) ▪ Implement signal synchronization improvements (Future) ▪ Upgrade signal hardware (Future) ▪ Upgrade/expand signal communications (Future) ▪ Expand CCTV coverage on arterials (Future) ▪ Collect arterial traffic data (Future)
Local Transit Agencies	Transit Management	▪ Operate fixed route and demand responsive service ▪ Operate dial-a-ride service ▪ Operate electronic fare payment system ▪ Operate on-board AVL equipment ▪ Operate real time transit information systems ▪ Operate TSP systems ▪ Develop mobile apps

8. FUNCTIONAL REQUIREMENTS

Functional requirements provide a clear and concise explanation of what an ITS project or system will accomplish. It describes the "What" rather than the "How" a system is implemented. The purpose of developing functional requirements for an ITS architecture is to provide project sponsors with a starting point for developing specific requirements that shape the design and development of systems and subsystems to support regional integration. Project sponsors may use the requirements during acceptance testing and system verification as part of the systems engineering process to determine if the deployed system meets the intended needs and objectives of its users.

The functional requirements in this report represents the ITS inventory elements for planned and existing projects in the region. The functional requirements can be incorporated into specific requirements that are defined by project sponsors in Tulare County with the purpose of aligning the functionality of their systems with regional goals and objectives for integration and data sharing.

8.1 Functional Requirements Overview

The Turbo Architecture database includes an inventory of the ITS systems owned, operated and maintained by the agencies in Tulare County for existing and planned projects. The systems in the inventory are represented by ITS elements that represents field equipment, operations centers, vehicles and transportation facilities and other components that make up a system.

Functional requirements can be project based if the project sponsor has written requirements that are product or technology specific. In the case of the ITS architecture, the functional requirements in the ITS architecture are more generic and high-level with the purpose of providing a starting point for project sponsors to develop specific requirements. They can be used by the project sponsor to develop and procure services and solutions by using simple statements that describe what the system must do to accomplish a user need.

Using the Turbo Architecture database, users can locate functional requirements for the ITS elements that they choose to implement. For example, Caltrans is installing CCTV cameras. First, the architecture user would locate the "Caltrans D6 CCTV" element in the inventory. The element references two functional areas (e.g., "Roadway Basic Surveillance" and "Roadway Equipment Coordination") that identifies the user services provided by the cameras, along with a list of functional requirements that describes each function that the CCTV camera accomplishes. More information about how the Regional ITS Architecture can be used for project design will be discussed in the Architecture Use and Maintenance Plan.

A complete listing of functional requirements for the Tulare County Regional ITS Architecture is provided in Appendix B of this document, which is a direct output from the Tulare County Regional ITS Architecture Turbo Architecture database.

9. INTERFACES / INFORMATION FLOWS

This section provides an overview of the interfaces and information flows represented in the Tulare County Regional ITS Architecture. Interfaces are the physical and logical connections between systems and subsystems when speaking in terms of National ITS Architecture. In addition to this, information flows are the information exchanged between interconnected systems and subsystems.

9.1 Use of Turbo Architecture

The software application, Turbo Architecture (Turbo) supports the development of ITS architectures using the National ITS Architecture as a starting point. Turbo Version 7.1 was released in coordination with, and corresponds to, the National ITS Architecture Version 7.1. Version 8.0 of the National ITS Architecture was released in the summer of 2017, however for the purposes of this project Version 7.1 will be used since all the stakeholder outreach and deliverables to date have been prepared under assumptions associated with Version 7.1.

Existing and planned ITS systems can be entered into Turbo to represent the state of ITS within that region. After the initial data input is done, Turbo provides useful customization tools that allow users to customize the regional architecture to match their specific requirements. There are a number of reports and diagrams that are available from Turbo. The following subsections describe some of those reports and diagrams.

9.2 High-Level Tulare County Region Architecture

Using the systems inventory and the Service Package analysis, **Figure 8** shows a high-level view of the Tulare County Regional ITS Architecture. This figure is typically referred to as the "sausage diagram". This figure shows the four types of subsystems (Travelers, Centers, Vehicles and Field) represented in the Tulare County Regional ITS Architecture.

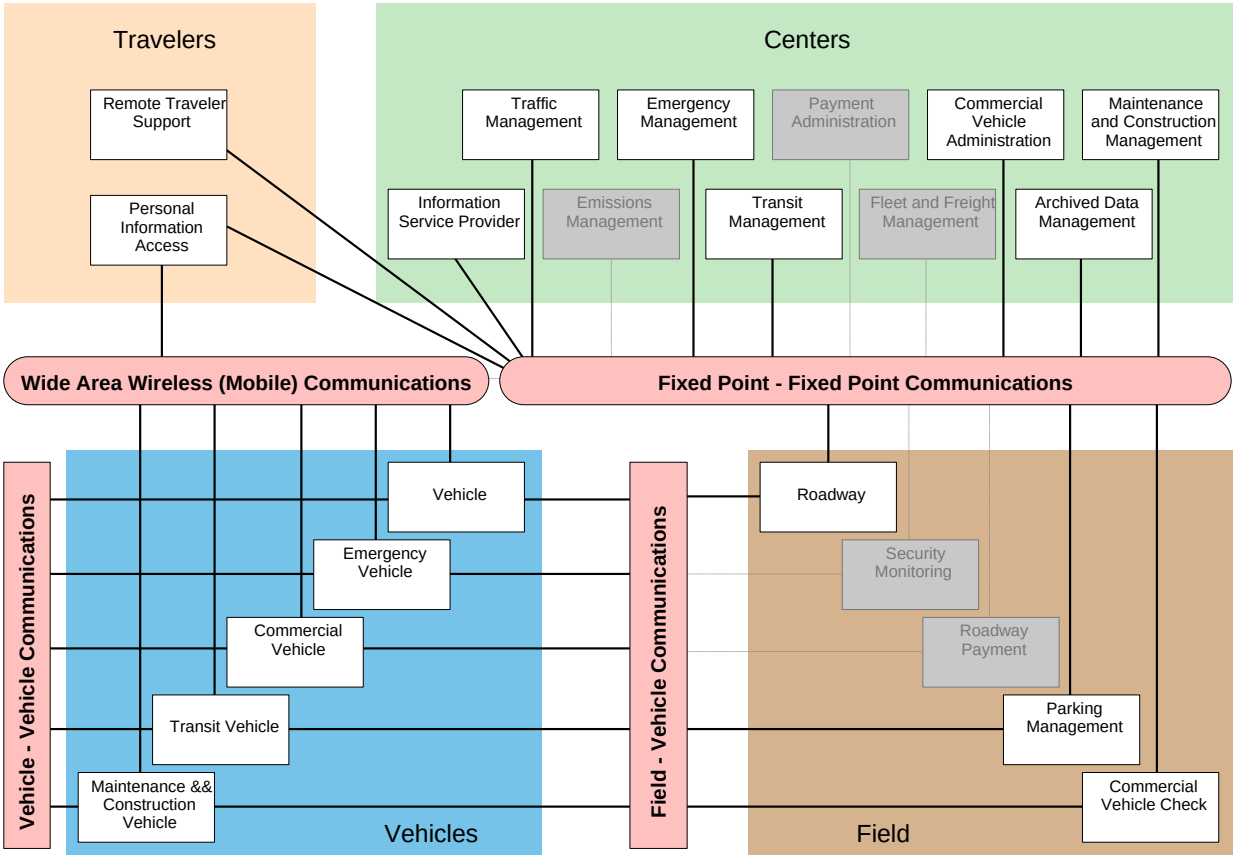


Figure 8 – Tulare County Region High-Level Architecture

9.3 Tulare County Regional ITS Architecture Interconnect Diagrams and Information Flow Diagrams

Interconnect Diagrams and Information Flow Diagrams are standard outputs from Turbo. The Interconnect Diagram shows how elements of a regional ITS architecture interconnects to other elements in the regional architecture. Interconnect diagrams are less detailed than Information Flow diagrams. The Interconnect Diagram simply shows a physical or logical connection between two or more elements in the architecture. An Information Flow diagram, on the other hand, shows the detailed information exchange between the elements. One line on an Interconnect Diagram between two systems may represent many lines on the Information Flow Diagram between the same systems.

The Interconnect Diagrams and Information Flow Diagrams show Existing and Planned connections. It should be noted that, in the context of these diagrams, the term "Planned" does not necessarily indicate that a commitment has been made to establish the Planned interconnect in the future. More importantly, it does not commit any of the agencies to establishing the interconnect in the future. The term "Planned" indicates that the interconnect does not exist today; and that some consideration has been given by the stakeholders and/or the developers of the Turbo Architecture database to establishing that interconnect in the future.

The Tulare County Information Flow Diagrams are contained in **Appendix C.**

10. ITS STANDARDS

The purpose of this section is to identify the ITS Standards that are relevant to, and recommended for the Tulare County Region. Identifying the ITS standards needed to implement a regional ITS architecture is a required element of the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) Final Rule/Policy on ITS Architecture and Standards. The resulting list of ITS standards is to be considered during deployment and implementation of ITS projects in the region.

10.1 Recommended ITS Standards for Tulare County

Exchanging information between centers and field devices is a key component of any reginal architecture. In a regional network a needed requirement is to allow for joint control of field devices such as cameras and changeable message signs. Communications protocols that can be understood by different centers and devices is a must for proper information exchange and control. Common protocols such as the National Transportation Communications for Intelligent Transportation System (ITS) Protocol (NTCIP) are recommended for use in the Tulare County Region.

NTCIP standards provide the rules for communicating and the vocabulary, also known as the protocols and objects. By using these standard protocols and objects ITS equipment from different manufacturers can interact with each other as a system. NTCIP is the first set of standards for the transportation industry that allows ITS networks to be built using a "mix and match" approach with equipment from different manufacturers.

10.2 Overview of ITS Architecture and Standards

A goal envisioned by the U.S. Department of Transportation (USDOT) was to establish an open ITS environment. As a result the use of non-proprietary standards allows for interoperability within a system and between systems without impeding innovation as technology advances. The National ITS Architecture is “technology neutral;” ITS standards for Architecture Flows between systems ensure compatibility between systems.

It is important from an interoperability stand point to establish national and regional ITS standards, doing so also reduces risk and cost to a project. Establishing ITS standards allows a region to select multiple vendors for products and applications since they all communicate using the same standard language. Additionally competition among vendors and technology providers is fostered when there are national and regional ITS standards for exchanging information, and this results in better products and, possibly lower prices.

The FHWA / FTA Final Rule / Policy on ITS Architecture and Standards, the regional ITS architecture requires that standards applicable to the region be referenced based on the types of information that will be exchanged between Elements in the regional architecture. The information being exchanged is based on the selected Architecture Flows between ITS Elements.

10.3 Standards Development Organizations (SDOs)

Here is a list of the SDOs that are developing ITS standards.:

- American Association of State Highway and Transportation Officials (AASHTO)
    - http://www.transportation.org
    - AASHTO publishes specifications, test protocols, and guidelines used in highway design and construction in the US. The association also represents air, rail, water, and public transportation modes in addition to highways.

- American National Standards Institute (ANSI)
  - http://www.ansi.org
  - ANSI oversees the creation, publicizing and use of many standards that impact businesses in almost every sector nationally and internationally. ANSI administers and coordinates the US voluntary standardization and conformity assessment system.
- ASTM International
  - http://www.astm.org
  - ASTM is the source for technical standards for materials, products, systems, and services.
- Institute of Electrical and Electronics Engineers (IEEE)
  - www.ieee.org
  - IEEE standards impact a range of industries including IT, telecommunications, and transportation.
- Institute of Transportation Engineers (ITE)
  - www.ite.org
  - ITE is responsible for developing standards to meet mobility and safety needs. ITE facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of ground transportation. ITE is the standards development organization designated by the U.S. Department of Transportation.
- National Electrical Manufacturers Association (NEMA)
  - www.nema.org
  - NEMA represents electrical equipment and medical imaging manufacturers. Member companies are represented by power transmission and distribution, lighting, factory automation and control, and medical imaging companies.
- Society of Automotive Engineers (SAE)
  - www.sae.org
  - SAE International, is focused on standards development for transport industries such as automotive, aerospace, and commercial vehicles.

11. REGIONAL ARCHITECTURE USE AND MAINTENANCE

The Architecture Use and Maintenance Plan provides guidance to the TCAG stakeholders on how to use the regional ITS architecture for project planning and development, as well as how to maintain the architecture once this development process is completed. One of the required elements of a regional ITS Architecture is the development and implementation of procedures and assigned responsibilities for maintaining the architecture. This section describes the procedures and responsibilities for the use and maintenance of the Tulare County Regional ITS Architecture.

11.1 Use of the Regional Architecture

11.1.1 Project Planning

As the designated Metropolitan Planning Organization (MPO) for the region, TCAG is the lead agency responsible for maintaining the Tulare County Regional ITS Architecture. Being champion of the architecture requires TCAG to be able to identify stakeholders, inventory, and service packages that are related to specific systems or projects when agencies request pertinent information during the process of project development and implementation.

Widespread use of the Tulare County Regional ITS Architecture as a planning tool will allow the region's ITS infrastructure projects to each be integral parts of the greater envisioned ITS system. Each planned project will build the system piece by piece in a coordinated fashion.

To effectively use the architecture as a planning tool, the first step in project planning is to identify the type of service package(s) (e.g. commercial vehicle operations, data management, traveler information, etc.) that are related to the identified project. For many projects' scopes, multiple types of service packages could be relevant and they should all be identified. As an example, for a project involving the installation of a parking guidance system in a parking garage, the relevant service package types would be traveler information and parking management. After service package types are identified, the specific service package(s) that describe the project must be identified. Continuing the example, the specific service packages that relate to parking guidance systems could be ATIS04 – Dynamic Route Guidance and ATMS16 – Parking Facility Management.

After service packages have been identified, the service package diagrams should be reviewed to check against duplication of functionality with other service packages. When planning each project, the following considerations should be inputted into Turbo:

- Ensure all service packages that relate to the project are identified;
- If the project spans across jurisdictions and agencies, specific service packages related to the project should be created multiple times, each for the stakeholder agencies for which the service package is associated (i.e. ATMS03 for City of Visalia and ATMS03 for City of Tulare, etc);
- Choose appropriate inventory items that are related to each specific service package;
- Select appropriate stakeholders that own the inventory items; and
- Confirm if data flows are existing or planned.

Once the service package diagrams have been reviewed, the updated diagrams should be passed on to each agency that is implementing a project to ensure all stakeholders are involved and they have the proper information to determine if it will impact other projects. This should be documented via

a communications trail between the project sponsor and TCAG. It will be further documented in the change request form and "before and after" versions of the service package diagrams.

11.1.2 Project Programming

An up-to-date regional ITS architecture is important as it allows jurisdictions to request federal funding, because projects must be consistent with the area's regional ITS architecture to receive federal funds. This section describes how stakeholders are able to determine if a project is consistent with the approved architecture.

To use the Tulare County Regional ITS Architecture to support project development, the agency must identify how the project contributes to or aligns with a portion of the architecture. This is a key step when using the architecture because it requires the agency to view the ITS project in the broader context of the entire architecture. Having an agency consider the wider architecture while the project's scope is being defined forces them to consider the services, functionality, and integration opportunities that are envisioned by the Region in long range planning. As mentioned previously, this step is also required to meet the FHWA Architecture Rule/FTA Architecture Policy.

The architecture should be used at the beginning of project development so that integration opportunities are considered. The architecture should be reviewed before firm project cost estimates are established so that there is still opportunity to adjust the scope to accommodate the regional functionality and interfaces identified in the Tulare County Regional ITS Architecture.

11.1.2.1 **Federal and State Funding for ITS Projects**

Agencies applying for and/or using, federal and/or state funds for ITS planning, design, and deployment will need to be familiar with, and utilize, administrative, programming, and project development procedures from Chapter 13 of the Caltrans Local Assistance Program Guidelines (LAPG). Chapter 13 of the LAPG provides guidance for the ITS Program in California, with topics covered including:

- Instructions for implementing ITS Program Guidelines;
- The three types of ITS projects, Exempt, Low-Risk, and High-Risk projects and the definitions of each type;
- Considerations of ITS project risk assessment based on the project type;
- Delineations of responsibilities from the Regional/Metropolitan Transportation Planning Agency, Local Agency, FHWA and Caltrans ITS engineers and coordinators;
- Funding process for each type of ITS Project; and
- Miscellaneous considerations including environmental, Americans with Disabilities Act (ADA), right-of-way, procurement/construction, and record keeping.

As of July 2017, the most current version of the Caltrans LAPG could be found on the Internet, at the following Uniform Resource Locator (URL):

http://www.dot.ca.gov/hq/LocalPrograms/lam/lapg.htm

As of July 2017, Chapter 13 of the LAPG, which covers ITS programs, could be found at the following URL:

http://www.dot.ca.gov/hq/LocalPrograms/ITS/ITS.htm

11.1.3 Project Design

During the design stage, functionality and ITS standards provide guidance and criteria to identify how the project will serve the region's overall operations. For larger projects, functions and standards can become complicated and may require agreements between multiple agencies. It is beneficial to be able to identify the agencies involved and the type(s) of agreement(s) needed early in the project design.

This section will describe how functional requirements were developed and where they can be found. Additionally, this section includes information on agreements between stakeholders in the Tulare County Region that are currently in place, as well as those that may need to be developed to facilitate operations, coordination, information sharing, and integration.

11.1.3.1 **How ITS infrastructure is shown in the architecture**

Service Packages are used by the National ITS Architecture to depict current and future functionalities of ITS infrastructure, systems, management centers, and people to include travelers and system operators. A subsystem represents multiple levels of information transfer. These subsystems are grouped into four classes: centers, fields, vehicles, and travelers. **Table 8** has descriptions for each subsystem and identifies examples of those subsystems in the Tulare County Region.

Table 8 – Subsystem Definitions

Subsystem	National ITS Architecture Definition	Examples in Tulare County
Center	Provides management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions.	Transportation Management Centers (TMC) Emergency Communications Centers (ECC) Police/Fire Dispatch Centers
Traveler	Equipment used by travelers to access ITS services prior to a trip, including information service providers.	Internet Web Sites Mobile Phone Applications 511 Traveler Information Displays
Field	Intelligent infrastructure distributed along the transportation network which perform surveillance, information gathering, and information dissemination and whose operation is governed by the center subsystem.	Traffic Signals CCTV Cameras Dynamic Message Signs Vehicle Detection
Vehicle	Covers ITS related elements on vehicle platforms such as automatic vehicle location equipment and operations capabilities for portable field equipment.	Transit Vehicles Public Safety Vehicles Incident Response Vehicles

11.1.3.2 **How to find general functional requirements related to a proposed project**

A functional requirement is the detailed description of inventory items to provide the services that are described by their equipment packages. The equipment packages group inventory items based on the overall function they serve. Furthermore, the equipment packages are deployment-sized projects like an emergency dispatch system or a traffic data collection system.

The functional requirements identified for this project were developed from the inventory elements that were identified and the subsequent customization of the service packages.

The functional requirements can be found on the National ITS Architecture website (http://www.iteris.com/itsarch/). The following process should be followed to access requirements for specific inventory items:

1. Select "Architecture" then "Views" and "Physical" in the top left corner of the Home Page of the National ITS Architecture website
2. The select the "Functional Objects" link in the text.
3. From the two columns on the Functional Objects web page, select the functional object for which you are seeking functional requirements
4. Click on the functionality tab to show a list of requirements.

11.1.3.3 How to obtain specific functional requirements from the Tulare County Regional ITS Architecture

As projects are planned, specific functional requirements will need to be extracted from the Tulare County Regional ITS Architecture. The information can be requested directly from the TCAG contact listed below. The TCAG contact will use the steps outlined in Section 3.1 Project Planning to find the requirements specific to the service packages related to the project. As the project sponsor and TCAG mutually document the communications trail, the TCAG contact should also ensure the changes are documented in the change request form.

The specific request will need to identify:

- Applicable service packages for the project;
- Project scope and description;
- Infrastructure and devices involved;
- Stakeholders involved; and
- Project purpose (if not already captured in the scope/description of the project).

Contact information for the Tulare County Regional ITS Architecture is:

Name: Mark Hays

Email: mhays@tularecog.org

A listing of functional requirements for the Tulare County Regional ITS Architecture was provided in Deliverable 9 – Functional Requirements. Functional requirements are available as outputs from the Turbo database. The requirements are organized in the following hierarchy: stakeholder, inventory item, equipment package, and applicable functional requirements for that equipment package.

Table 9 shows some examples of possible ITS projects that could be proposed in the Tulare County Region. This will be helpful as an agency applies for funding for various types of ITS projects. The sample information may be used to identify a project within the Regional ITS Architecture to illustrate Tulare County Regional ITS Architecture compliance. The table is not intended to be the SDP list of projects. Instead the table is intended to provide project examples and guidance for the maintainer of the architecture.

Table 9 – Existing Project Type Mapping to TCAG ITS Architecture Components

Project Type	ITS Inventory	Subsystems	Associated Service Packages	Equipment Packages	Functional Requirements Example	User Services
Installation of new CCTV cameras/expansion of existing camera system and integrating the cameras to be operational from a control center.	CCTV, TMC	Roadway Subsystem, Traffic Management	ATMS01 - Network Surveillance	Roadway Basic Surveillance	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	1.6 Traffic Control 1.7 Incident Management
Installation of new DMS and integrating DMS to be operational from a control center.	DMS, TMC	Roadway Subsystem, Traffic Management	ATMS06 - Traffic Information Dissemination	Roadway Traffic Information Dissemination	The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	1.2 En-Route Driver Information
Synchronization of traffic signals along key corridor and integrating system to be operational from a control center.	Traffic Signals, TMC	Roadway Subsystem, Traffic Management	ATMS03 – Traffic Signal Control	Roadway Signal Controls	The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.	1.6 Traffic Control
TMC to TMC communications installation to facilitate interagency coordination	TMC	Traffic Management	ATMS07 - Regional Traffic Management	TMC Regional Traffic Management	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.	1.6 Traffic Control 1.7 Incident Management

Project Type	ITS Inventory	Subsystems	Associated Service Packages	Equipment Packages	Functional Requirements Example	User Services
Implement a project to archive data and send applicable information to a regional server for dissemination via 511 or another traveler information service.	TMC, Caltrans Department of Emergency Operations Center	Archived Data Management Subsystem	AD1 - ITS Data Mart AD2 - ITS Data Warehouse	ITS Data Repository	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.	7.1 Archived Data
Installation of tracking devices on transit vehicles to facilitate schedule adherence	Transit Detectors, Transit Operations Center	Transit Vehicle Subsystem	APTS01 – Transit Vehicle Tracking	On-Board Transit Trip Monitoring	The transit vehicle shall track the current location of the transit vehicle.	2.1 Public Transportation Management
Implement a project to disseminate applicable information via 511 or another traveler information service to the public.	San Joaquin Valley 511, travelers, TCAG Website, Other Information Service Providers	Information Service Provider, vehicle, personal information access, remote traveler support	ATIS 02 – Interactive Traveler Information	Interactive infrastructure information, ISP traveler data collection	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.	1.1 Pre-trip Traveler Information

11.1.3.4 How to select communication standards that apply to the project

Selecting the appropriate and compatible ITS standard for the identified projects is important to facilitate overall system integration. ITS communication standards dictate the language in which different ITS components and systems communicate with one another. By selecting the appropriate ITS standard to use on a project system integration can be less costly both from a time and monetary standpoint. ITS communication standards ensure interoperability between one system to another.

There is a large body of work that has established ITS standards to facilitate interoperability between ITS technologies and there are many benefits that can be derived from using ITS standards. In addition to the reduced development costs when ITS standards are used, there is less need to do single-source procurements since ITS standards are open and non-proprietary. The challenge with single-source procurements is that it can typically lock a municipality into maintenance relationships with a single vendor. ITS standards also facilitate future expansion of systems, and connections with nearby jurisdictions.

ITS standards are developed by Standards Development Organizations (SDOs) which are appointed by USDOT and accredited by the American National Standards Institute (ANSI). Much like this planning process standards are developed in a process that involves discussion and consensus-building between a diverse group of technical experts, deployment professionals, and systems integrators from both the public and private sector.

ITS standards that are pertinent to the Tulare County Regional ITS Architecture can be found in Section 10 of this document. These standards are taken from the Tulare County Regional ITS Architecture Turbo Architecture database, and represents ITS Standards that need to be considered in the Tulare County Region.

11.1.3.5 What agreements may be needed to support a proposed project?

Projects that span multiple jurisdictions or require operation and maintenance responsibilities shared among agencies require institutional agreements, which support ITS functionality and efficient project development in the region. Agreements allow agencies to document the roles and responsibilities of the service or function that is being agreed to, as well as any obligations each agency has for maintenance, operations, or financial support.

Table 10 shows a list of possible agreements that are based on the types of interfaces identified in the Tulare County Regional ITS Architecture. It should be noted that as ITS systems are implemented or expanded in the region, part of the planning and review process for those projects should include a review of potential agreements that would be needed. The agreements are not specified for specific projects since the possibility of coordination should be evaluated on every project. The table also identifies the agency/agencies for which each agreement may be beneficial.

Table 10 – Potential Agreements that Support Existing/Future Coordination Shown in Architecture

Agreement and Agencies	Agreement Description
Data Sharing and Usage (Internal Public Divisions)	
TMC/ECC **TMC/Police** **TMC/Fire** **TMC/Public Works**	This agreement would define the parameters, guidelines, and policies for intra-agency ITS data, road restriction, maintenance activity and work zone activity information sharing. This data sharing would support regional activities related to traffic management, incident management, work zone notifications, traveler information, and other functions. The terms of this agreement should generally address such items as: ▪ Types of data and information to be shared – camera feeds, roadway restrictions, detector information, incident and special event information, maintenance activity ▪ How the information will be used (traffic incident management, displayed on web site for travel information, distributed to private media, etc.) ▪ Parameters for data format, quality, security ▪ Frequency of sharing data
Data Sharing and Usage (Public Agency-Public Agency)	
TMC/TMC **TMC/Transit** **TMC/Police** **TMC/Fire** **TMC/ECC**	This agreement would define the parameters, guidelines, and policies for data sharing and usage of ITS-related information from public agency to public agency. Because this agreement is with external entities, it will likely be in the form of a Memorandum of Understanding or Inter-Governmental Agreement. This type of agreement is recommended to define terms of use for distributing public-agency information regarding: ▪ Traffic conditions ▪ Traffic signal timing plans ▪ Road closures and restrictions ▪ CCTV camera images ▪ Data sent to data warehouses or data archive servers ▪ Work zone information ▪ Public safety coordination with traffic management ▪ Transit coordination with traffic management In specific, coordination among jurisdictions for traffic signal timing to improve overall flow and progression along multi-jurisdictional corridors is a priority for this region.

Agreement and Agencies	Agreement Description
Shared Video Monitoring (Public Agency-Public Agency)	
TMC/Police TMC/Fire TMC/ECC	This agreement would enable shared video monitoring of CCTV by public safety and neighboring jurisdictions for incident and traffic management purposes. This agreement would define the parameters and policies for public safety and other transportation agencies to access video images. It is recommended that the agreement include any established or newly developed policies relating to video images (including archiving, privacy, disclaimers, use of video and redistribution) as well as processes for agency requests for specific views. Shared video monitoring does not address shared use or shared control of video equipment functions. There might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies, particularly with the high bandwidth required for transmitting live video images. Lower bandwidth video images such as screen-shots could also be considered for sharing.
Joint Operations/Shared Control Agreements (Public Agency-Public Agency)	
TMC/TMC TMC/Police	This agreement is a formal arrangement to allow joint operations or control of certain systems and equipment. This agreement will allow the other TMCs or public safety to control certain devices such as permanent DMS and CCTV cameras in incident or emergency situations and in after-hours operations. The agreement would need to define the terms of this arrangement, such as hours of operation and time of day/day of week where shared control would take effect, circumstances or incidents where shared control would take effect, system requirements for each agency to be able to share device control, definition of permissions with device control, etc. Traffic signals are typically not included as part of a joint operations strategy. Agencies have typically determined that sharing access to traffic signal timing plans will enable enhanced corridor management and operations among multiple partners, but that actual control of signals or changing timing plans on traffic signals by another jurisdiction is not permitted.
Emergency Coordination Agreements (Public Agency-Public Agency)	
TMC/Local ECC, Fire, Police, County or State Emergency Operations Center (EOC)	This agreement would establish the roles and responsibilities of a TMC in supporting emergency coordination for disasters or threats requiring evacuation or other mass coordination efforts. May include sharing requirements of CCTV video images by emergency management agencies.
Fiber Sharing Agreements (Public Agency-Public Agency)	
TMC/TMC	This agreement would establish the requirements and security needs of each agency in sharing fiber cable to connect to their respective devices. Cost sharing should be delineated in the agreement as well as network maintenance / management on the fiber infrastructure. These agreements are developed to define the roles and responsibilities of the agencies for the actual sharing of fiber and should outline cost sharing that established the fiber sharing path.

11.2 Regional ITS Architecture Maintenance

As new projects are planned and implemented in Tulare County, the Regional ITS Architecture should be updated to reflect the changes. The architecture should dynamically document current and future ITS infrastructure and plans throughout Tulare County, and the systems' relationships

with other systems and agencies. This requires regular maintenance of the architecture, updating the database as projects are implemented or expanded, agency priorities change, federal or state standards and guidelines are updated, or other changes occur that impact ITS in the region. The architecture maintenance plan in the following subsections documents how the architecture maintainers can keep the database up-to-date while keeping consistency and order in the architecture.

11.2.1 Purpose for Maintenance

The Tulare County Regional ITS Architecture and its corresponding database are planning tools meant to dynamically change as ITS needs and infrastructure evolve in the County. ITS technologies evolve rapidly and ITS planners cannot predict the future, so the process of ITS architecture maintenance is important to keep the architecture useful and current. New projects planned and implemented each year may change the status or existence of inventory elements and information flows represented in the architecture. The changes need to be updated in the architecture database and corresponding documents. When stakeholders plan and implement ITS projects, necessary changes to the ITS architecture should be communicated to TCAG via e-mail for inclusion in the next ITS architecture update. The Tulare County Regional ITS Architecture would need to be updated for any of the following reasons:

- **Addition of Stakeholders** – If new stakeholders in the region become active in ITS, the architecture documents and database should be updated to reflect the new stakeholder's place in the local network of ITS elements, interfaces, information flows, and participation in regional activities. For example, new transportation modes and new transportation services might arise that touch the systems of additional stakeholders.

- **Changes in Scope of Services** – The region's ITS services expands to include new functionalities and new technologies not already included in the current architecture.

- **Changes in Other Architectures** – Because the Tulare County Regional ITS Architecture must be coordinated with the San Joaquin Valley ITS Architecture, Caltrans Statewide ITS Architecture, and the National ITS Architecture, when changes are made in any of the listed architectures, it usually requires the Tulare County Regional ITS Architecture to change in accordance. When changes are made to each of these Architectures that cover a wider area, but includes Tulare County, it is the architectures' maintainers' job to notify the Tulare County ITS Architecture maintainer to ensure all architectures maintain consistency and coordination. Similarly, since ITS does not work in a vacuum within counties, when changes occur in the ITS architectures of neighboring and overlapping jurisdictions, the Tulare County maintainer must be up-to-date on those ITS architectures as well. The maintainer should have an open communication channel with maintainers and coordinators of relevant ITS architectures and make judgement calls on whether the updates impacts the Tulare County ITS Architecture.

- **Changes due to Project Definition or Implementation** – A project may add, subtract, or modify elements, interfaces, or information flows when defined or implemented, and these changes need to be reflected in the architecture. The architecture is meant to describe the current, as well as future implementation of ITS, thus it must be updated to accurately reflect how any newly deployed projects integrate into the region's systems.

- **Changes due to Project Addition/Deletion** – A project may be added or deleted from the architecture due to funding, planning processes, or through project delivery. This could change the status or existence of inventory items, information flows, and service packages in the architecture and database, which need to be updated to reflect the changes.

11.2.2 Frequency and process of Review/Updates

The times and events that trigger updates to the Tulare County Regional ITS Architecture is not mandated or regulated in any way. With limited resources, updates do not necessarily need to be made to the architecture as soon as changes occur in the regional ITS landscape. It is not necessary to update the architecture as soon as the next version of the National ITS Architecture is released and similarly, if there are no significant changes to the policies or status of deployment of ITS in the region, it may not be necessary to update the architecture for several years. TCAG, in association with stakeholders in the Tulare County region, would determine what is considered a "significant change" on a case-by-case basis. However, the architecture must continue to represent ITS in the region accurately and ensure it is compliant with federal requirements.

It will be important to periodically review the architecture, even though a major update might not necessarily be warranted. A recommended review and update cycle is presented below:

- **Annual Review –** TCAG will assign a maintainer to check the Tulare County Regional ITS Architecture annually to determine if modifications need to be made. Updates are made as necessary, as a result of changes in project status (e.g. from "planned" to "existing"), emergence of new stakeholders, or updates to agency agreements. The review will be led by TCAG, with coordination and assistance in data gathering from stakeholders involved in ITS in the region. This process can be made more efficient if TCAG distributes architecture Change Request Forms to each stakeholder, then compiles the information to be made available for review to the stakeholders prior to the annual review meeting. If stakeholders are made aware of the forthcoming changes to the ITS architecture before the meeting, they will have the opportunity to discuss any changes needed. TCAG will consider changes stemming from the annual reviews along with more comprehensive updates to the Tulare County Regional ITS Architecture coordinated with updates to the Regional Transportation Plan (RTP).

- **Comprehensive Update –** A Comprehensive Update is a thorough update of the Tulare County Regional ITS Architecture initiated by TCAG in coordination with the update of the RTP, as needed. The process will address new or adjusted projects outlined in the funding programs included in the Tulare County Regional ITS Architecture and identify significant changes or additions that could affect multiple stakeholders. This process should involve all stakeholders, soliciting input from each stakeholder through a workshop, individual phone calls and follow ups, or smaller focus groups. Proposed updates and revisions to the Tulare County Regional ITS Architecture will be presented to all stakeholders to reach consensus.

The Change Request Form mentioned above will be filled out by stakeholders when they anticipate or identify a possible change to the architecture. The form should be submitted to TCAG, and should include the following information:

- Contact information of the individual proposing the change: name, title, agency, email, fax number, and phone number;
- Date;
- Short description of proposed change (a title up to 25 characters);
- Detailed description of proposed change. (What is to be added, deleted, or modified?);
- Type of change proposed (e.g. new project, new stakeholder, etc.);

- Name of system(s) or project(s) being implemented or modified (if applicable);
- Status:
    - Proposed (want to implement but has not yet secured funding for the project);
    - Planned (secured funding for the project);
    - Under Construction (currently deploying the system); or
    - Existing (deployed the system and it is currently operational).

The Change Request Form is included in **Table 11** A copy of the form can be sent via e-mail to:

Name: Mark Hays

Email: mhays@tularecog.org

Table 11 – Change Request Form

Stakeholder Proposing Change	**Name**		**Job Title**	
	Agency			
	Email			
	Phone No.		**Fax No.**	
Date				
Description of Change	**Change Request Title**	*Short Description (up to 25 characters)*		
	Detailed Description	*(What is to be added, deleted, or modified? Attach additional documentation if necessary)*		
	Type of Change	☐ New Service Package ☐ Deleted Service Package ☐ Modified Service Package or Data Flow (attach mark up or sketch)	☐ New/Changed Stakeholder ☐ Change in Project Status (planned now existing) ☐ Other	
	Systems or Projects	*Name of System(s) or Project(s) being implemented or modified (if applicable)*		
Project Status	☐ PROPOSED (funding not yet secured) ☐ PLANNED (funding secured) ☐ UNDER CONSTRUCTION (stakeholder is currently deploying system/project) ☐ EXISTING			

TCAG will designate a Regional ITS Architecture Maintenance Committee that will be responsible for reviewing information contained in the submitted Change Request Forms and approving and/or recommending the corresponding updates within the Tulare County Regional ITS Architecture. By default, the Regional ITS Architecture Maintenance Committee will be made up of a representative from each of the following agencies:

- Tulare County Association of Governments
- Caltrans District 6
- City of Visalia
- City of Tulare
- City of Porterville
- County of Tulare
- Transit Operators (Visalia. TCaT, Tulare, Porterville, and at least one smaller operator)
- TCAG should also encourage the participation of at least one representative from the among the smaller cities in the County.

The Maintenance Committee will operate in a transparent manner, actively conducting outreach to affected stakeholders. As change requests are submitted to the Committee, all affected stakeholders will be notified by the Committee and given a chance to provide input. The Committee will allow parties that are impacted by the ITS architecture to engage with the Committee in open discussion to ensure full understanding between the Committee and the parties. The Committee will make known to all ITS

stakeholders in the Tulare County Region the final result of matters deliberated by the Committee. In the event of an update to the Tulare County Regional ITS Architecture, TCAG will notify agencies that maintain neighboring and overlapping ITS architectures to ensure consistency among architectures.

The flow charts in **Figure 9** and **Figure 10** were developed to facilitate the decision-making process for the Committee when reviewing Change Request Forms and determining whether updates are necessary to the architecture. Both the Agreement Question and the Architecture Question should be answered through completion of the flow chart prior to approving each Change Request Form.

11.3 Roles and Responsibilities

TCAG leads the architecture maintenance effort, responsible for updating the architecture with additions, deletions, and modifications, as needed, specified in the approved Change Request Forms. The following tasks are to be performed by TCAG:

- Evaluate how changes affect the architecture documents, Turbo database, and website.
- Evaluate whether updates impact multiple stakeholders or other elements within the regional ITS architecture, coordinating with affected stakeholders to obtain consensus on the proposed changes.
- Ensure that changes are made globally, in all the most recent versions of the documents, databases, and graphics.
- Verify that all dependencies are updated and related documents are synchronized with each other.
- After changes are made, make sure that he revised documents are posted, stored online, or otherwise disseminated in “read-only” format to prevent any unauthorized changes from being made.
- TCAG staff will periodically update its Transportation Technical Advisory Committee and Policy Board on matters concerning the ITS Architecture and Strategic Deployment Plan.

Figure 9 – TCAG Architecture Update Review Process – Agreement Question

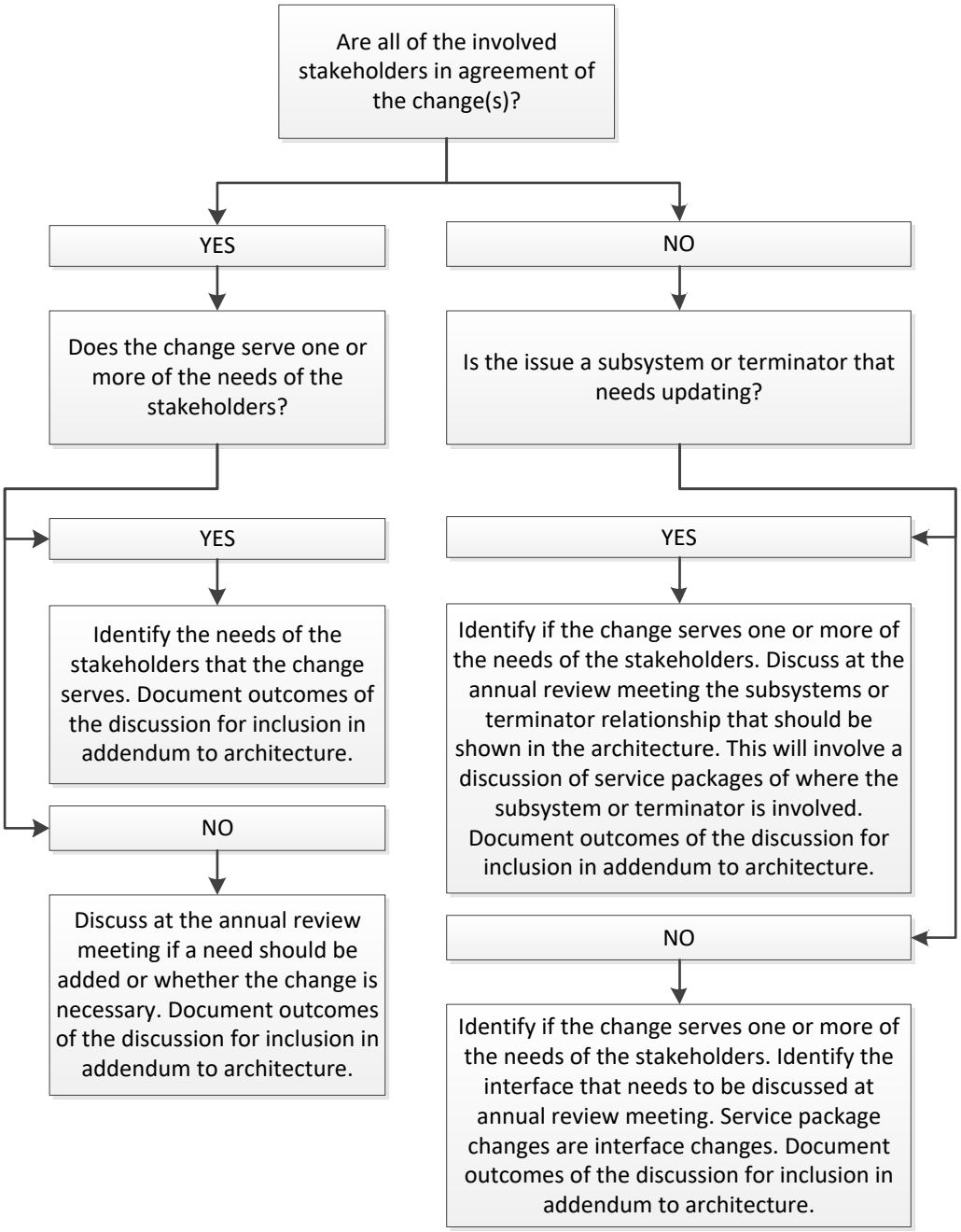
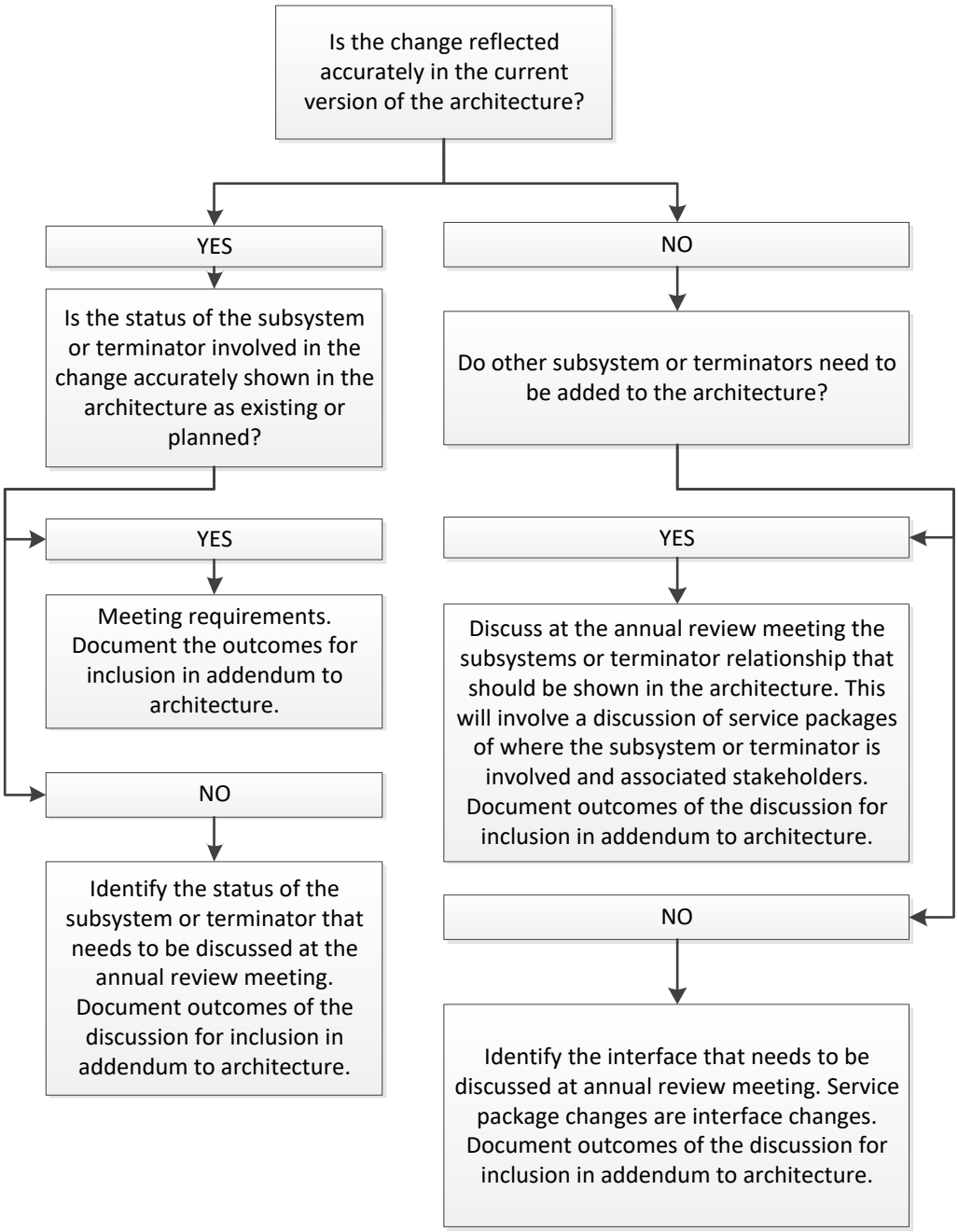


Figure 10 – TCAG Architecture Update Review Process – Architecture Question



12. PROJECT SEQUENCING (STRATEGIC DEPLOYMENT PLAN)

The purpose of Project Sequencing is to develop a logical grouping and sequence of ITS projects for the Region that will implement the Architecture defined as part of the overall ITS Plan project. FHWA ITS Architecture and Standards Rule, and the accompanying FTA Policy, requires that a list of projects be developed to implement the regional ITS architecture. That list of projects should account for existing ITS inventory and identified future projects. Priority for the projects should also be identified in the project sequence.

12.1 Project Identification Process

In this step a list of implemental projects is developed along with a sequence of the ITS projects.

The planning process is focused on using local knowledge and a consensus process with stakeholders to choose the best sequence of projects that meets the needs of the region. The objective of this process is to create an efficient list of ITS projects, to build out the ITS architecture, and to fill in system gaps, all based on regional needs, project readiness, and the capacity to deploy.

Building out the architecture is the process of deploying the system interconnections and establishing the information flows from a center-to-center perspective. The architecture is not focused on technologies or equipment solutions; it is technology-independent.

The list of ITS projects for the Tulare County Region was developed in an iterative process. Existing regional plans were reviewed first along with existing programs and studies. This step identified the ITS projects already planned and/or programmed and made sure that they were included in the new plan.

12.2 Project Sequencing Process

Each of the projects identified was assigned a relative priority, designated as Short Term, Medium Term, and Long Term. The phasing allowed for groupings of projects rather than attempting to establish a specific ranking for all projects. This is desirable because it does not identify "Project A" as being a higher priority than "Project B," and eliminates the pitting of one project against another when competing for funding. The method of phasing projects also brings about structure to the planning process.

Projects priorities are assigned to the respective projects based on two primary factors. The

1. **Need for a particular ITS function** - as outlined in Deliverable #5 – Visions, Goals, Objectives and Needs Technical Report. Information on High, Medium and Low priority needs identified in Deliverable #5 has been carried forward in the project prioritization process; with High Priority equating to Short Term, Medium Priority equating to Medium Term, and Low Priority equating to Long Term.
2. **Logical ordering of projects** - to ensure that prerequisite projects or infrastructure is in place.

The Tulare County Region ITS stakeholders had the opportunity to provide manual adjustments on project time frames in the process of reviewing and commenting on the Draft Strategic Deployment Plan. This plan should provide flexibility to the region in project deployment and not necessarily restrictions It is recommended that the prioritization of projects should be used as a guide and not the rule. There may be opportunities to implement a medium term project if a technology or system advances more quickly than was originally anticipated. .

12.3 Prioritized Listing of ITS Projects

Table 12 – Tulare County Strategic Deployment Plan Project List

Project ID #	Project Description	Participating Entities	Program Area	Interdependencies/Other Notes
		Short Term (0 - 5 years)		
1	**Arterial Management System** - This system may include the following elements, but is not limited to: enhancements to the central system(s), closed circuit television (CCTV) cameras and systems, highway advisory radio (HAR) systems and transmitters, arterial changeable message signs (CMS), traffic monitoring stations (TMS), and communications infrastructure.	• City of Porterville • City of Visalia • City of Tulare • City of Dinuba • Tulare County	Arterial Management	• The system will depend on the collection and sharing of video and traffic data. • The system will depend on the jurisdictions having a traffic incident management system • The system will depend on the jurisdictions having a traffic signal control system • The system will depend on robust communications in the Region
2	**Collect and Share Video and Traffic Data** - This system will collect and share video and traffic detector data among local jurisdictions. This system will also include the collection of probe based data that is shared with local TMCs and Caltrans. Incident and traffic images are also planned to be shared among entities. This system will rely on robust data collection systems and technologies within the region.	• City of Porterville • City of Visalia • City of Tulare • Caltrans • Tulare County • City of Dinuba • Visalia TMC/Emergency Communications Center • Caltrans Central Valley TMC • Porterville TMC	Traffic Management	• The system will depend on regional TMC coordination and traveler information systems • The system will depend on upgraded freeway management systems • The system will depend on work zone management and monitoring system

3	**Emergency Vehicle Preemption System -** Deploy emergency vehicle preemption technology(ies) in key corridors around the region. Consideration should be given to technologies that may also provide transit signal priority (TSP) functionality.	• City of Dinuba • City of Porterville • Tulare County • City of Tulare • City of Visalia • Visalia TMC/Emergency Communications Center • Tulare County Emergency Services Vehicles • Visalia Emergency Services Vehicles • Porterville Police and Fire Departments • Dinuba Emergency Services Vehicles	Public Safety	• The system will depend on a robust traffic signal control system • Future EVP deployments may utilize appropriate connected vehicle communications infrastructure and technologies
4	**Speed Warning and Enforcement System -** This proposed system will monitor vehicle speeds and supports warning drivers when their speed is excessive. The system can also include notifications to an enforcement agency to enforce the speed limits at a location. Roadside equipment and communications will need to be installed to support this system.	• City of Porterville	Traffic Management	• The system will depend on robust communications in the Region
5	**Railroad Grade Crossing System -** This system includes the implementation of active and passive warning systems which may be augmented with other standard traffic management devices. The system is activated on notification of approaching trains using roadside equipment. The equipment may also be interconnected with adjacent signalized intersections. Health monitoring of the equipment is an option and maybe done through using communication back to a TMC.	• City of Visalia • City of Dinuba • City of Porterville • City of Tulare • Tulare County • Caltrans	Traffic Management	• The system will depend on robust communications in the Region • The system will depend on the jurisdictions having a traffic signal control system

6	**Intersection Warning System -** This system will warn approaching vehicles that they are approaching a signalized intersection. The system will actuate based on approaching vehicles and the status of the signal.	• City of Porterville • City of Visalia • City of Tulare • City of Dinuba • Tulare County	Arterial Management	• The system will depend on a vehicle detection system • The system will depend on robust communications in the Region
7	**ITS Data Warehouse -** Develop an ITS historical data archive for all relevant ITS data and provide a centralized system to share data between agencies. Data collected can provide information for use in monitoring and evaluating the performance and safety of the transportation system, fulfilling data reporting requirements, and other planning or operational functions. Such a data archive could be utilized as the foundation for real time data and information exchange and/or for providing content to a real-time traveler information system. This system would also interconnect transit management systems and centers within the Region. This project would enable transit agencies to exchange incident, vehicle location, and arrival status information among multiple transit operators. This would enable the agencies to share vehicle location information to better coordinate service at common service boundaries.	• Tulare County Association of Governments (TCAG) • City of Porterville • City of Visalia • City of Tulare • City of Dinuba • Tulare County • Visalia TMC/Emergency Communications Center • Caltrans Performance Monitoring System (PeMS) • Porterville TMC • DART Transit Center • Porterville Transit Center • TIME Transit Center • Tulare Police and Fire Departments • Tulare Operating Office • TCaT Transit Center • Visalia Transit Center • Visalia Greenline Call Center • San Joaquin Valley 511 • Central Valley TMC • TCAG Data Warehouse	Data Management	• The system will depend on an arterial management system • The system will depend on the collection and sharing of video and traffic detector data • The system will depend on a traffic incident management system • The system will depend on a traffic signal control system • The system will depend on a transit passenger counting system • The system will depend on a transit traveler information system • The system will depend on an upgraded freeway management system • The system will depend on willingness of multiple agencies to connect and share data • The system will depend on transportation management entities having robust, modern, full function transportation management systems

8	**Regional TMC Coordination and Traveler Information Systems -** This project supports the ITS data warehouse project. The links would enable data sharing among a wide variety of traffic, transit and emergency management agencies in the Region. Communications links may interconnect all local jurisdictions and agencies, emergency operations centers, and public safety agencies, such as law enforcement and other emergency responder entities. This project would also provide interfaces to traveler information systems, from which the public can access traveler information via cell phones, land lines, websites, and personal electronic devices.	• City of Porterville • City of Visalia • City of Tulare • City of Dinuba • Tulare County • Caltrans	Traffic Management	• The system will depend on an upgraded freeway management system • The system will depend on an arterial management system • The system will depend on an ITS data warehouse • The system will depend on a work zone management and monitoring system
9	**Traffic Incident Management System -** This system will manage both planned and unexpected incidents. This includes incident detection capabilities through roadside equipment and coordination with other TMCs. This system will support traffic operations personnel to develop response in coordination with emergency management and maintenance operations. Incident response may include recommended messaging and road closures or detours based on the severity and size of impact. Coordination through a CAD system and communication with emergency personnel is included in this system.	• City of Porterville • Tulare County • City of Visalia • City of Dinuba • City of Tulare • Porterville Emergency Services Vehicles • Porterville TMC • Dinuba Emergency Services • Visalia TMC/Emergency Communications Center • Tulare County Office of Emergency Management	Public Safety	• The system will depend on an upgraded freeway management system • The system will depend on an arterial management system

10	**Traffic Information System -** This system will include information dissemination to drivers using roadside equipment such as dynamic message signs or highway advisory radio. A wide range of information may be communicated such as road closures, travel times, road conditions and detours. This system will also include information dissemination to other information providers and TMCs. Interfaces to transit management systems and emergency management systems to provide traffic information is also included in this system.	• City of Dinuba • City of Porterville • Tulare County • City of Visalia • Visalia TMC/Emergency Communications Center	Traffic Management	• The system will depend on an ITS data warehouse • The system will depend on an arterial management system • The system will depend on the collection and sharing of video and traffic detector data • The system will depend on an upgraded freeway management system • The system will depend on work zone management and monitoring system
11	**Traffic Signal Control System -** Install communication systems (wireless and wireline) to connect advanced traffic signal controllers to a central control traffic signal system. Upgrade traffic signal controllers to accommodate adaptive signal control.	• City of Porterville • City of Visalia • City of Tulare • City of Dinuba • Tulare County • Caltrans • Visalia TMC/Emergency Communications Center • Dinuba Operating Office • Porterville TMC	Traffic Management	• The system will depend on a robust traffic signal control system
12	**Transit Vehicle Tracking System -** Upgrade and or install computer aided dispatch (CAD) and automated vehicle location (AVL) systems in transit vehicles, including interfaces with other transit management systems.	• City of Dinuba • City of Porterville • City of Visalia • City of Tulare • Tulare County • DART • COLT • TCaT • TIME	Public Transportation	• The system will depend on robust communications to transit vehicles

13	**Upgraded Freeway Management System -** This project includes the expansion of the many and varied Caltrans freeway management systems and field elements that are monitored and controlled by Caltrans. System elements referenced by this project include, but are not limited to: enhancements to the central system(s), closed circuit television (CCTV) cameras and systems, highway advisory radio (HAR) systems and transmitters, road weather information systems (RWIS) and field sensors, changeable message signs (CMS), traffic monitoring stations (TMS) and communications infrastructure. This project also includes deploying robust communications infrastructure capable of providing backbone, interconnect, and redundant communications between ITS field devices and a central system, and between ITS filed devices in the field.	• City of Dinuba • City of Porterville • City of Visalia • City of Tulare • Tulare County • Caltrans	Traffic Management	• The system will depend on robust communications in the Region • The system will depend on a work zone management and monitoring system
14	**Work zone Management and Monitoring System -** This system includes controlling traffic in areas where maintenance and construction is occurring. The traffic conditions are to be monitored by CCTV and traffic controlled by DMS and HAR. The work zone information dissemination is coordinated with local TMCs. This system will include the deployment of temporary roadside equipment such as DMS and Cactus to provide control and observation capabilities.	• Tulare County • City of Tulare • Caltrans • City of Porterville	Maintenance and Construction	• The system will depend on robust communications in the Region

	Medium Term (6 - 10 years)			
15	**Transit Fare Collection System** - Implement a regional farebox system that would allow use of universal fare media among the transit operators in the Region.	• City of Porterville • City of Visalia • TCAG Regional Transit Fare Card • Porterville Transit Smart Card • TCAG Regional Transit Traveler Information Service • Tulare County Association of Governments (TCAG) • City of Tulare	Public Transportation	• The system will depend on coordination between all transit operations in the region • The system will depend on robust communications to transit vehicles • The system will be dependent on institutional agreements for regional fare media • The system will be dependent on each transit operator possessing modern, full function fare box systems, with universal fare media readers
16	**Transit Passenger Counting System -** This system includes the deployment of sensors and systems in transit vehicles to collect passenger boarding and alighting data and transmit it back to the transit management center for analysis.	• City of Porterville	Public Transportation	• The system will depend on robust communications to transit vehicles
17	**Transit Signal Priority System** - Implement TSP at intersections and along corridors with high volume transit routes.	• City of Dinuba • Fresno County Rural Transit Agency • City of Porterville • City of Visalia • City of Tulare • Tulare County • Tulare Operating Office • Porterville TMC • DART • COLT • TCaT	Public Transportation	• The system will depend on a traffic signal control system • The system will depend on a transit vehicle tracking system • The system will depend on robust communications to transit vehicles

18	**Transit Traveler Information System** - Implement a transit traveler information system that may include static and/or real time information that can be sent to transit users prior to, or during a trip. Information may include real time bus arrival times, schedules, routes, maps, fares, park-and-ride lot locations, transit trip itineraries, etc. Information can be communicated through a variety of channels, such as smart phone, landline telephone, Internet website, electronic kiosks, television, etc. A subscriber feature can tailor information distribution to a specific user.	• City of Tulare • City of Dinuba • Tulare County • DART • COLT • TCaT • Tulare County Association of Governments (TCAG) • City of Porterville • TCAG Regional Transit Traveler Information Service • Porterville Transit Information Services • Porterville Transit Center • TCaT Transit Center • Visalia Transit Center • TIME Transit Center • DART Transit Center	Traveler Information	• The system will depend on a transit vehicle tracking system • The system will depend on full function transit management system(s), with capability to interface with external information delivery systems
19	**Transit Vehicle Maintenance System -** This system includes on-board condition sensors that monitor the system status and transmit critical status information to a transit management center. The system can book and process data and schedules for preventative and corrective maintenance. The system will also support the day to day management of transit fleet inventory too.	• DART • TCaT • COLT • City of Porterville • Tulare County • City of Visalia • City of Dinuba • City of Tulare	Public Transportation	• The system will depend on robust communications to transit vehicles

20	**Transit Vehicle Security System** - Implement transit security and safety technologies on buses and at transit stations/stops and facilities, including: building and lot access control, video surveillance, fire safety systems, and potentially other technologies.	• City of Dinuba • City of Porterville • Tulare County • City of Tulare • Porterville Transit Center • Tulare County Office of Emergency Management • TCaT Transit Center • COLT • TIME • Visalia Greenline Call Center • TIME Transit Center • Porterville Police and Fire Departments	Public Transportation	• The system will depend on a transit vehicle tracking system • The systems will depend on modern, full function communications systems (wireless and wireline)
	Long Term (11 - 20 years)			
21	**Parking Facility Management System -** This system will monitor and manage parking spaces in lots. It assists in the management of parking operations by monitoring parking lot ingress and egress, space occupancy and availability. This system includes infrastructure based detectors that monitor occupancy and disseminate that parking information to drivers.	• City of Visalia	Traffic Management	• The systems will depend on modern, full function communications systems (wireless and wireline)

22	**Electronic Clearance System for Commercial Vehicles -** This system includes automated clearance of commercial vehicles at roadside check facilities. This system will retrieve data from roadside infrastructure and analyze it against driver data and vehicle data from the DMV. The roadside check facilities may be equipped with automated vehicle identification and weigh stations to assist with the electronic clearance of commercial vehicles.	• Caltrans	Commercial Vehicle Operations	• The system will depend on the installation of weigh in motion equipment • The system will depend on the California DMV Vehicle Credentialing System
23	**Commercial Vehicle Operations Roadside and On-Board Systems -** This system includes the installation of automated roadside safety monitoring and reporting for commercial vehicles. It automates the commercial vehicle safety inspections at roadside check locations.	• Caltrans	Commercial Vehicle Operations	• The system will depend on the installation of weigh in motion equipment • The system will depend on the California DMV Vehicle Credentialing System • The system will depend on robust communications in the Region

12.4 Monitoring Program

As part of the Plan development, it is recommended that TCAG or the Steering Committee implement a monitoring program to track the progress of projects recommended in the Plan. This will ensure that the milestones and objectives of the ITS Plan continue to be met over time. It is envisioned that annually a listing of the projects recommended in the Plan would be produced and the status of every project would be recorded. This would be a status report provided to a technical advisory committee. This type of status report could also be provided to TCAG Board Committees or the full Association of Governments Board, as appropriate.

13. FUNDING

One of the greatest benefits of the Tulare County Regional ITS Architecture is that it readily positions Tulare County to be competitive as funding opportunities arise. With a coherent Phasing Plan for projects provided in this document and a regional ITS architecture that is developed and maintained with stakeholder approval, preparers of funding applications for ITS projects will be able to point to identified projects with stakeholder buy-in, system connectivity, and proof of need.

Funding sources at the federal, state, regional, and local levels typically include user fees, property related charges, and other subsidies. ITS projects require higher levels of planning prior to project initiation, since ITS projects carry a higher risk of not being successful, meaning not being delivered on time, within budget, and delivers all capabilities required. Thus, federally funded ITS projects require ITS projects funded with the Highway Trust Fund to conform to the National ITS Architecture and Standards, be guided by a regional architecture with geographic boundaries defined by stakeholder needs, and use the systems engineering process (23 Code of Federal Regulations, Parts 655 and 940, ITS Architecture and Standards; Final Rule).

Transportation funding availability changes frequently, and it is the local and regional government's responsibility to be prepared for future funding opportunities as they arise. The funding matrix provided below of available Local, State, and Federal grant funding for ITS projects can change as the administration changes in the political cycle. To be up-to-date on transportation funding, staff should be aware of Notices of Funding Opportunity (NOFO) from all levels of government.

Table 13 - Local Funding Sources

Funding Source & Annual Amount (Approx.)	Description	Eligible Uses
Measure R $21.7 million	In 2006, the voters in Tulare County approved Measure R, a ½ cent sales tax for transportation in Tulare County for the next 30 years, generating more than $652 million for local and regional transportation needs. The measure distributes funds to four categories of programs, Administration and Planning Program (1%), Local Programs (35%), Regional Projects (50%), and Transit/Bike/Environmental (14%).	The Regional Projects funds will be used for projects that enhance mobility in the region, including specific funding for interchange improvements, regional bridges, regional railroad crossings, regional signals, regional widening projects, and signal synchronization projects. The 35% allocated to Local Projects will be disbursed to each city and county based on a formula that considers population, maintained miles, and vehicle miles traveled (VMT). Each jurisdiction may use these funds for ITS projects, such as traffic signal improvements and communications gap closures. Transit/Bikes/Environmental Mitigation Program funds are intended to expand or enhance public transit and active transportation programs that address the transit dependent population, improve active transportation mobility, and encourage mode shift to transit and walking/biking. Potential ITS applications of these funds include improving transit operations through transit signal priority (TSP) or providing real-time information on bus arrivals. The Measure R website can be accessed here: http://www.tcmeasurer.com/

Table 14 - State Funding Sources

Funding Source & Annual Amount (Approx.)	Description	Eligible Uses
Greenhouse Gas Reduction Fund (GGRF) (Cap & Trade) $(varies)	The GGRF, or better known as Cap-and-Trade Program, is a Statewide program administered by the Air Resources Board (ARB) initiated in 2012 to reduce greenhouse gas (GHG) emissions affecting climate change. The Cap-and-Trade program includes an auction system where tradable permits (allowances) can be purchased by GHG emitters regulated under AB 32 from the State at quarterly auctions. The proceeds are deposited in the GGRF. This is a strategy for achieving AB 32 goals of reducing GHG emissions to 1990 levels by the year 2020 and achieving an 80% reduction from 1990 levels by 2050. The ARB distributes GGRF funds to various state agencies for investment in projects that meet specific funding guidelines, with a focus on reducing GHG emissions and maximizing benefits to disadvantaged communities.	Programs relating to transportation include: • Affordable Housing and Sustainable Communities (AHSC) • High-Speed Rail Project • Low Carbon Transit Operations Program (LCTOP) • Low Carbon Transportation Program • Transit and Intercity Rail Capital Program (TICRP) The program website is: https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm To see projects funded with auction proceeds: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/auctionproceedsmap.htm

Proposition 1B Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006 $(varies)	Proposition 1B authorized the issuance of $19.925 billion in state general obligation bonds for specific transportation programs intended to relieve congestion, facilitate goods movement, improve air quality, and enhance the safety of the state's transportation system. These transportation programs included: • Corridor Mobility Improvement Account (CMIA) - $4.5 billion (100% allocated); • SR 99 Corridor Account - $1.0 billion (100% allocated); • Trade Corridors Improvement Fund (TCIF); • State Local Partnership Programs (SLPP); • Local Bridge Seismic Retrofit Account (LBSRA); • Highway-Railroad Crossing Safety Account (HRCSA); • Traffic Light Synchronization Program (TLSP); and • the augmentations of the existing STIP and the SHOPP.	Bond categories are either discretionary or are allocated by formula. Each category has specific formulas and/or guidelines. Roughly three-fourths of the allocations have been made. http://www.catc.ca.gov/programs/Prop1B.htm
State Gas Tax Apportionments $9.8 million (FY2016-2017)	The Highway User Tax is sourced from gas taxes that are directly disbursed by the State Controller to the cities and counties.	Recipient chooses street and highway projects that increase capacity, busways, and repaving. http://sco.ca.gov/ard_payments_highway.html

State Highway Operation and Protection Program (SHOPP) $69.8 million programmed for Tulare County projects (over 4 years); $150 million split among all Caltrans districts for Minor Programs	The SHOPP is administered by Caltrans and aims to maintain the safety and integrity of the State Highway System through funding for pavement rehabilitation, operations, and safety improvements on state highways and bridges. It is funded by state and federal gas taxes and bond measures. SHOPP funds several program categories, of which ITS projects are funded through the "Mobility" component. The 2016 SHOPP, applicable from Fiscal Years 2016-17 through 2019-2020, includes a performance based funding criteria and performance targets focused on specific asset classes, pavement, bridge, culverts, and ITS.	Programs Categories funded by the 2016 SHOPP include Major Damage Restoration, Collision Reduction, Mandates, Bridge Preservation, Roadway Preservation, Mobility, Roadside Preservation, and Facilities. In addition, the fund sets aside money for "Minor Programs," providing $610 million to Caltrans Districts to implement relatively low cost (less than $1 million) capital projects that are SHOPP eligible. The Mobility category has $652 million earmarked. Programming for the 2016 SHOPP is based upon the highest priority statewide needs, instead of county shares, historical percentages, or a predetermined formula (except for specific mandates). http://www.dot.ca.gov/hq/transprog/shopp.htm
State Transit Assistance (STA) $1.95 million (FY 2017-18)	RTPAs receive STA funding based on 50% population proportions and 50% on transit operations. The funding is based on diesel fuel sales taxes, and thus fluctuates year-to-year.	Claims must be consistent with the claimant's Short Range Transit Plan and Short Range Transportation Improvement Program. Funds can be used for operations or capital. Apportionments data per fiscal year is found here: http://www.sco.ca.gov/ard_payments_transit.html

State Transportation Improvement Program (STIP)	The STIP is a multi-year capital improvement program, with programming adopted every two years, of transportation projects on and off the State Highway System. The fund estimate and programming begins in odd years, and the adoption of funds and programming occurs in April in even years. Caltrans prepares the Interregional Transportation Improvement Plan (ITIP), which receives 25% of the funding, and regional agencies prepare Regional Transportation Improvement Plans (RTIPs), which receive 75% of the funding. Each regional agency submits projects for approval in their RTIPs. The Interregional Improvement Program (IIP), funded through the ITIP, consist of highway and intercity rail projects that improve interregional mobility for people and goods across the State on highway and rail corridors of strategic importance. The Regional Improvement Program (RIP), funded through inclusion in the RTIP, funds capital projects needed to improve transportation in the region. Each RTPA proposes regional projects to be approved by CTC through the RTIP. “Interregional road systems” and “flexible congestion relief” http://www.dot.ca.gov/hq/LocalPrograms/STIP.htm	Projects funded through the STIP must be approved by the California Transportation Commission (CTC). IIP projects are nominated by Caltrans, and these projects improve state highways, intercity passenger rail systems, and interregional movement of people, vehicles, and goods. RIP projects may include, but are not limited to, improving State highways, local roads, public transit (including buses), intercity rail, pedestrian and bicycle facilities, grade separations, transportation system management, transportation demand management, soundwalls, intermodal facilities, and safety. The non-capital costs funded by the STIP must demonstrate that the projects funded are a cost-effective substitute for capital expenditures. These include transportation system management or transportation demand management projects, which often contain ITS components. More guidance on the STIP from the CTC can be found here: http://www.catc.ca.gov/programs/stip.htm

Senate Bill 1 (SB1) – The Road Repair and Accountability Act of 2017 $(unknown, wait for guidelines)	SB1 was passed in April, 2017 and increases transportation funding significantly statewide through gradual increases in gasoline and diesel taxes and annual vehicle registration fees. Over 10 years, SB1 will fund several local and state programs, focusing on keeping State highways and local streets and roads in a state of good repair. The Bill includes a number of reform measures to hold Caltrans and CTC accountable for spending the funds efficiently and affect measurable improvements to transportation assets. Additional funding opportunities include the competitive grant, Solutions for Congested Corridors, providing an annual $250 million for projects designed to achieve a balanced set of transportation, environmental, and community access improvement within highly congested travel corridors throughout the state and that are part of a comprehensive corridor plan. The Self-Help Counties Fund also contributes an additional annual $200 million distributed among counties that have voter approved taxes for transportation purposes. The Trade Corridor Enhancement Fund contributes an annual $300 million to corridor-based freight projects, which can be nominated by local agencies and the state.	SB1 will fund several local programs, including local street and road maintenance and rehabilitation; transit operations and capital projects; local partnership program; active transportation program; STIP (regional share); and local planning grants. It will also fund statewide programs, including State highway maintenance and rehabilitation; high priority freight corridors; congested corridor relief program; parks, off-highway vehicle, boating, and agricultural programs; STIP (interregional share); Freeway Service Patrol (FSP) programs; and California university transportation research programs. ITS projects may be funded under the congested corridor relief program, the additional funding in the STIP and SHOPP, or as components of other programs. http://catc.ca.gov/programs/SB1.html

Table 15 - Federal Funding Sources

Funding Source & Annual Amount (Approx.)	Description	Eligible Uses
Bus and Bus Facilities Formula Grants $0.78 million	A Federal Transit Administration (FTA) grant that funds bus and bus facility related capital projects. The program is comprised of three components of funding allocation. One is based on a formula based on population, vehicle revenue miles, and passenger miles. The remaining two include the bus and bus facilities competitive program based on asset age and condition, and a low or no emissions bus deployment program. A pilot provision allows recipients in urbanized areas with population over 200,000 and under 999,999 to participate in voluntary state pools to allow transfers of formula funds between designated recipients. The federal share is 80%.	Eligible activities are capital projects that rehabilitate and purchase buses, vans, and related equipment, and to construct bus-related facilities, including technological changes or innovations to modify low or no emission vehicles or facilities. https://www.transit.dot.gov/funding/grants/bus-bus-facilities-infrastructure-investment-program

Congestion Mitigation and Air Quality Improvement Program (CMAQ) $4.5 million	The Federal Highway Administration (FHWA) reauthorized the CMAQ program through the FAST Act, providing funding to areas in nonattainment or maintenance for ozone, carbon monoxide, and/or particulate matter. The FAST Act provides from $2.3 to $2.5 billion in CMAQ funding for each year of the authorization, from 2016 to 2020. CMAQ funds are flexible, allowing transportation projects and programs that help meet the requirements of the Clean Air Act. Funds are apportioned by the State by formula based on population and severity of pollution in ozone and carbon monoxide areas. Tulare County is a non-attainment area. TCAG receives CMAQ funding to be distributed to the Cities and County. TCAG administers a Call for Projects every two years for CMAQ funds and programs funds to projects in accordance to CMAQ policies. Projects that are the most cost effective and shown to be successful at improving air quality are typically given funding priority.	CMAQ funds may be used for a transportation project or program that is likely to contribute to the attainment or maintenance of a national ambient air quality standard, with a high level of effectiveness in reducing air pollution, and that is included in TCAG's current transportation plan and transportation improvement plan (TIP). The FAST Act added eligibility specifically for the installation of vehicle-to-infrastructure (V2I) communications equipment. It also continues eligibility for electric vehicle and natural gas vehicle infrastructure and adds priority for infrastructure located on designated priority corridors. Caltrans guidance for the CMAQ program: http://www.dot.ca.gov/hq/transprog/federal/cmaq/Official_CMAQ_Web_Page.htm

Formula Grants for Rural Areas $0.82 million	The Formula Grants for Rural Areas program provides capital, planning, and operating assistance to states to support public transportation in rural areas with populations of less than 50,000, where many residents often rely on public transit to reach their destinations. The program also provides funding for state and national training and technical assistance through the Rural Transportation Assistance Program. Funds are distributed to States based on a formula that includes land area, population, revenue vehicle miles, and low-income individuals in rural areas.	Eligible activities include planning, capital, operating, job access and reverse commute projects, and the acquisition of public transportation services. Information on the grant can be found here: https://www.transit.dot.gov/rural-formula-grants-5311
Urbanized Area Formula Grants $10.4 million	Urbanized Area Formula Grants fund projects in urbanized areas, incorporated areas with a population of 50,000 or more. In areas with populations between 50,000 and 200,000, the governor acts as the designated recipient, and in areas with populations greater than 200,000, the funds are received by a designated recipient. The Tulare-Visalia-Porterville urbanized area houses a population of over 200,000, meaning the amount of funding is based on a formula that considers bus revenue vehicle miles, bus passenger miles, fixed guideway revenue vehicle miles, and fixed guideway route miles as well as population and population density.	Eligible activities include: planning, engineering, design and evaluation of transit projects and other technical transportation-related studies; capital investments in bus and bus-related activities such as replacement, overhaul and rebuilding of buses, crime prevention and security equipment and construction of maintenance and passenger facilities; and capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software. In addition, associated transit improvements and certain expenses associated with mobility management programs are eligible under the program. All preventive maintenance and some Americans with Disabilities Act complementary paratransit service costs are considered capital costs. https://www.transit.dot.gov/funding/grants/urbanized-area-formula-grants-5307
Transportation Investment Generating	USDOT has funded eight rounds of TIGER programs, which are transportation-focused, economic-generating projects that are chosen in a highly competitive grant process. These are often innovative projects, including	TIGER funds transit, planning, rail, road, port, and bicycle and pedestrian programs. USDOT evaluates each project application on safety, economic competitiveness, state of good repair, quality of life, and environmental

Economic Recovery (TIGER) Program	multi-modal and multi-jurisdictional projects, which are difficult to fund through traditional federal programs.	sustainability. The flexible nature of TIGER grants allows for funding of multi-modal, multi-jurisdictional projects, which can include ITS elements. https://www.transportation.gov/tiger
Infrastructure for Rebuilding America (INFRA) Grants $1.5 billion (total)	The INFRA program provides dedicated, discretionary funding for transportation infrastructure. The program is based on the FAST Act's FASTLANE grant program, but focuses on increasing the impact of projects by leveraging capital and allowing innovation in the project delivery and permitting processes, including public-private partnerships. Criteria are also updated, evaluating projects in their alignment of national and regional economic vitality goals and access to non-federal funding. The program makes available approximately $1.5 billion. INFRA retains a statutory requirement to award at least 25% of funding towards rural projects.	INFRA focuses on infrastructure projects that generate national or regional economic, mobility, and safety benefits. The criteria for evaluating project merit focus on national and regional economic vitality; potential for innovation in safety, project delivery approach, and environmental review and permitting; leveraging of federal funding; and performance and accountability. It will also consider geographic diversity among recipients and project readiness. https://www.transportation.gov/buildamerica/infragrants
Surface Transportation Block Grant (STBG) Program $11.7 billion nationwide	As a FAST program, FHWA apportions funding as a lump sum to each State, which then divides that towards apportioned programs. Each State must also provide set-asides for funding for Transportation Alternatives, 2% for State Planning and Research, and funding for bridges not on Federal-aid highways. For urbanized areas with population greater than 200,000, the State divides the fund based upon the relative share of population in these areas. In rural areas, the State identifies projects for funding, in consultation with regional planning organizations.	Projects eligible for STBG funding related to ITS may include projects relating to: infrastructure-based ITS capital improvements, including the installation of V2I communication equipment; operational improvements and capital and operating costs for traffic monitoring, management, and control facilities and programs; and as supporting ITS components to other eligible projects. https://www.fhwa.dot.gov/specialfunding/stp/160307.cfm#j

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