INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PLAN FOR THE KERN REGION

FINAL DELIVERABLE NO. 12

REGIONAL ITS PLAN

MAY 2018

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EXECUTIVE SUMMARY

The Intelligent Transportation Systems (ITS) Plan for the Kern Region is a stakeholder driven plan to assist with addressing the transportation needs of the region by using technology. As travel demand on the freeway and arterial system increases, there is an increasing need to improve the system through better management of existing capacity. As such, the stakeholders in the Kern Region (bounded by Kern County) developed a vision statement for the ITS Plan to guide future technology investments in the region.

The project vision statement reads:

"Through community ITS investment, coordination and data sharing between transportation agencies, travel in Kern is safe and efficient."

The stakeholders provided a ranking of ITS needs in the region, which resulted in the following as the top five needs:

1. Provide routing (detour) information to travelers during incident, construction, weather events, special events, etc.
2. Provide/enhance road weather conditions information to travelers
3. Improve signal timing/coordination
4. Provide roadway closure/restriction information
5. Improve information exchange between Caltrans and local transportation agencies

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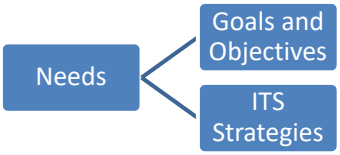
The ITS needs were used to develop goals and objectives and are linked to ITS strategies. ITS strategies are types of ITS applications that are used to identify the service areas in the Regional ITS Architecture. Examples of ITS strategies are Freight-Specific Dynamic Travel Planning and Transit Vehicle Tracking. A total of 66 ITS strategies arewere recommended in the ITS Plan.



The goals for the ITS Plan are shown below:

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

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Goal –#7: —Improve the mobility of people and freight; Maximize the efficiency and cost effectiveness of the existing and future transportation system.
The ITS Plan includes stakeholder roles and responsibilities ~~for the stakeholders~~ that are related to the goals of the Plan and include both existing and planned responsibilities to realize the ITS vision for the region. The roles and responsibilities are described at a high level to identify "who does what" regarding the operation of ITS and day-to-day activities for operating and maintaining ITS elements that enable services. The roles and responsibilities are tied to the eleven service areas in the ITS Architecture.

The ITS Plan includes the Regional ITS Architecture, which is a customized version of the National ITS Architecture. The Regional ITS Architecture consists of service packages, functional requirements, ITS standards, and interconnect and information flow diagrams. It shows both existing and planned ITS services to promote regional planning of ITS deployments. The details of the architecture can be found in the full ITS Plan.

Kern Council of Governments (Kern COG) will be responsible for housing and maintaining the Kern Regional ITS Architecture. Being responsible for maintaining the architecture requires Kern COG to be able to identify stakeholders, inventory, and service packages that are related to specific systems or projects when agencies request pertinent information. Updates~~This~~ will be done through a documented process whereby users submit a change request form to Kern COG to review. Changes or additions are approved by the Regional ITS Architecture maintenance committee, which is the Transportation Technical Advisory Committee.

The ITS Plan culminates in an ITS project sequencing table that identifies projects required to be developed to implement the regional ITS architecture. This project sequencing section balances what projects are feasible to implement within the Short-term (0-5 years) and Medium-term (5 to 10 years) timeframes. Projects that are likely to occur within the Long-term (greater than 10 years) are identified as such in this section and include areas that are still under development nationally, such as autonomous vehicle initiatives and connected vehicle initiatives. Project sequencing provides a phasing plan that recognizes that there are some projects that need to occur before others, to be effective in operations. Projects' priorities are assigned to the respective projects based on three primary factors.

1. **The need for a particular ITS function** - as outlined in the ITS User Needs summary. Information on High, Medium and Low priority needs have 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. **The logical ordering of projects** - to ensure that prerequisite projects or infrastructure is in place.

3. **The known maturity levels of ITS services throughout the region** - as summarized in the inventory summary section of the plan for existing or planned strategies.

Forty projects were developed for the ITS Plan. The prioritized project list~~identification~~ describes the sequencing, the stakeholders involved, the need, and the ITS service area. The projects are meant to guide stakeholders in the implementation of the ITS Plan and can be used in long range and capital planning for the region and the individual agencies.

1.0 INTRODUCTION

The Intelligent Transportation Systems (ITS) Plan for the Kern Region is a critical component in addressing the transportation needs of the region. As travel demand on the freeway and arterial system increases, there is an increasing need to improve the system through better management of existing capacity. In recognition of this, the Kern Council of Governments (Kern COG) and the local communities in the region continue to invest in ITS. The ITS Plan will ensure that these investments address the important needs in the region and bring the maximum benefit to travelers. The ITS Plan will include a specific implementation plan that reflects the changes in technology since the 1997 ITS Early Deployment Plan (EDP) was completed. This ITS Plan provides a framework for technology deployment, integration, and cooperation across service areas for the next 20 years.

1.1 PROJECT BACKGROUND

The EDP was developed for the Kern region in 1997, led by Kern COG. The EDP was developed in consultation with local Kern County agencies, and reflected the input and priorities of the local agencies. Subsequently, the San Joaquin Valley ITS Strategic Deployment Plan (SDP) was developed for the eight counties of the San Joaquin Valley: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. The 1997 EDP and the 2001 SDP documents are consistent with one another with regards to the Kern regions' inputs, needs, and plans.

A comprehensive update of the countywide EDP has not been completed since 1997. In the interim, Kern metropolitan area agencies have made significant investments in the planning, design, and implementation of ITS for the surface transportation and transit networks. There is an expectation, documented in the 1997 EDP and Architecture, that investment in ITS strategies will continue with a focus at the local level. At the same time, it is important that investments be made in reliable technologies that deliver proven benefit in a cost-effective manner. Toward this end, Kern COG is leading this countywide ITS Plan to direct ITS investments throughout the county over the next twenty years and beyond.

Concurrently, Kern COG is in the process of updating the Regional Transportation Plan (RTP) for 2018, including the development of an updated project list for implementation using local and federal funding. ITS strategies, particularly those related to operational improvements to the arterial street system, and to enhancing transit service are important elements of the RTP and can provide improvements that lend to the Sustainable Community Strategies (SCS). Updating the ITS Plan will provide timely input to the RTP and the SCS, and will improve consistency among the three planning documents.

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 development of the ITS Plan for the Kern Region included performance of the following tasks, and development of the accompanying deliverables:

Task 1: Project Initiation

Deliverable 1: Project Plan

- The Project Plan incorporates the Stakeholder Engagement Plan, the stakeholder governance structure, and the detailed master project schedule.

Task 2: Data Gathering

Deliverable 2: Existing Data Report

- The report identifies the ITS elements within the Kern region, existing and planned policies/projects combined with an understanding of the region's users to fully recognize the various opportunities and constraints.

Task 3: Assessment of the 1997 ITS Early Deployment Plan (EDP) and the Kern portion of the 2001 San Joaquin Valley ITS Strategic Deployment Plan (SDP)

Deliverable 3: Assessment of 1997 Early Deployment Plan (EDP) Report

- The report documents the findings of the assessment of the 1997 EDP and the 2001 SDP with the lessons learned from those efforts.

Task 4: Update Regional ITS Inventories

Deliverable 4: System Inventory Summary Report

- The report presents a summary of the findings from the Inventory Survey forms from various Stakeholders identifying existing and planned ITS elements within each jurisdiction.

Task 5: Stakeholder Consultation/Identification of ITS Needs, Vision, Goals, and Objectives

Deliverable 5: Vision, Goals, Objectives and Needs Technical Report

- The report identifies an ITS vision for the Kern region, set of goals and objectives, and identifies ITS needs after various exercises with Stakeholders.

Task 6: Develop Key Regional ITS Strategies

Deliverable 6: Regional ITS Strategies Report

- The report refines and presents a range of Intelligent Transportation Systems (ITS) components for inclusion in the ITS Plan.

Task 7: Determine Specific Needs, ITS Service Packages and Elements Based on Strategies

Deliverable 7: Regional Consolidated Needs Assessment Summary 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.

Task 8: Define Operational Roles and Responsibilities Consistent with Regional Vision, Goals, Objectives, and Strategies

Deliverable 8: Regional ITS Operational Roles and Responsibilities Report

- The report identifies Operational Roles and Responsibilities that are consistent with the Vision Statement and the Goals and Objectives identified and developed in Task 5 and are based on Strategies development in Task 6.

Task 9: Determine the Functional Requirements

Deliverable 9: Functional Requirements Report

- The report identifies Functional Requirements for ITS Architecture for the Kern region based on Federal Highway Administration's (FHWA) guidance

Task 10: Prepare Regional ITS Architecture

Deliverable 10: Draft and Final Electronic Copy of the RAD-IT Architecture Database

- The electronic RAD-IT Architecture database was developed consistent with latest available version of the National ITS Architecture, FHWA Rule 940.9, and Part V of the Federal Transit Administration (FTA) National ITS Architecture Policy for Transit Projects and provided to Kern COG.

Task 11: Develop an Architecture Maintenance Plan

Deliverable 11: Architecture Maintenance Plan

- The report develops an Architecture Maintenance Plan that describes how to use the Architecture. The Report provides project planning, project programming, project design, and maintenance procedures.

Task 12: Develop Kern Region ITS Plan

Deliverable 12: Regional ITS Plan

- The Plan takes all of the inputs from Tasks 2 through 11 and melds them together into a cohesive and comprehensive ITS Plan Report and Phasing Plan for the Kern Region.

Task 13: ITS Website for Regional Stakeholders

Deliverable 13: Draft and Final Website

- The Kern COG website ITS webpage provides background on the project, the deliverables, and links to meeting agendas and material during Draft ITS Plan development. The Final webpage will include the Final ITS Plan.

1.3 RELATIONSHIP TO 1997 EDP

As noted in Section 1.1, the ITS Early Deployment Plan (EDP) was completed for Kern County in 1997. That plan was comprehensive, in terms of both needs assessment and the development of recommendations. For this ITS Plan update, the 1997 EDP was reviewed and assessed. This assessment will provide some insight and guidance in the project process when considering project and program prioritization, which will also be influenced to varying degrees by the changes in technology since 1997. The assessment will provide a look back at prior ITS planning and implementation efforts and lessons learned from those efforts while moving forward with this most current ITS planning and implementation effort.

1.4 PURPOSE OF THE ITS PLAN

The ITS Plan for the Kern Region serves as a planning roadmap for ITS strategies and projects to be implemented in the region. This plan will provide guidance to stakeholders on the planning, development, and funding of ITS projects in the region for the next 20 years. The contents of this document include project and strategy prioritization and phasing, and then makes recommendations for the use and maintenance of the Regional ITS Architecture to ensure that the projects and strategies from the Plan are implemented

1.5 METHODOLOGY TO DEVELOP THE KERN REGIONAL ITS ARCHITECTURE

The process of developing a regional ITS architecture includes many inputs and review sessions with regional stakeholders to establish a consensus-based regional architecture. Given that, it is no surprise that stakeholder involvement and information sharing was foundational during the development of the Kern Regional ITS Architecture. Inputs included needs and focus areas identified by stakeholders. These needs and focus areas were combined with local knowledge of existing systems to develop a comprehensive inventory of ITS infrastructure that is existing, under-construction, programmed and desired in the region. This inventory is captured in the architecture database.

The Kern Regional ITS Architecture development process involved the development of the 'physical view' of the ITS architecture. The physical architecture defines how ITS systems and devices are currently being operated and provides a comprehensive picture of current ITS functions in the Kern Region. The physical view considers stakeholders, subsystems, information and data flows, connectivity among subsystems, and infrastructure, and these inputs are used to develop a well-documented and graphically diagrammed ITS architecture. Components of each relevant agency's ITS, such as devices, centers, and systems that help to efficiently manage the area's surface transportation network were identified and used during the development of the Kern Regional ITS Architecture.

In 2017, the U.S. Department of Transportation released the latest version of the National ITS Architecture framework, now known as Architecture References for Cooperative and Intelligent Transportation (ARC-IT) as well as supporting software Regional Architecture Development for Intelligent Transportation (RAD-IT) to guide the planning and deployment of ITS. ARC-IT version 8.0 was used as the basis for developing the physical architecture for the Kern Region. Some ITS elements within the Kern Region were customized to reflect actual agency and system names, as well as to clearly define the status of various elements and the connectivity between them.

RAD-IT™ is the software application that was used to develop the Kern Regional ITS Architecture. RAD-IT Architecture focuses on the physical view of the architecture and requires input such as regional stakeholders, the regional ITS inventory, relevant services packages, and requirements. After these inputs are added to the RAD-IT Architecture database, RAD-IT then facilitates the processes of assigning information/data flows to the various inventory entities and devices.

The software draws from the updated ARC-IT version 8.0 to provide standards and guidance when developing user-defined information flows and communications for a specific region. Additionally, RAD-IT Architecture can customize service packages to accurately display ITS infrastructure and communications. Stakeholders were able to view the customized service packages specific to their agency to confirm that they were accurate and correct.

This was the first time that the Kern Regional ITS Architecture was developed using RAD-IT Architecture, and it is anticipated that the use of the software will facilitate the process for future reviews and updates.

1.5.1 Systems Engineering

Systems Engineering uses an ITS architecture as a cornerstone for the process of developing ITS related projects within a region or state. Systems Engineering is a multi-step and iterative process that requires agencies to ask critical questions about the technical processes of the project that may have been overlooked. Figure 1-1~~Figure 1-1~~ illustrates the "Vee" diagram, which starts with the development of the regional ITS architecture, shows how each step of the systems engineering process builds on the previous one and is reliant on a system of back-checking to ensure that the project is being designed and constructed based on its originally intended purpose. Systems Engineering is a risk management tool – by taking critical measures of key metrics to identify project issues, benefits, risks and impacts, as well as going through a series of validation and approval points, there is less uncertainty about project objectives or expectations.

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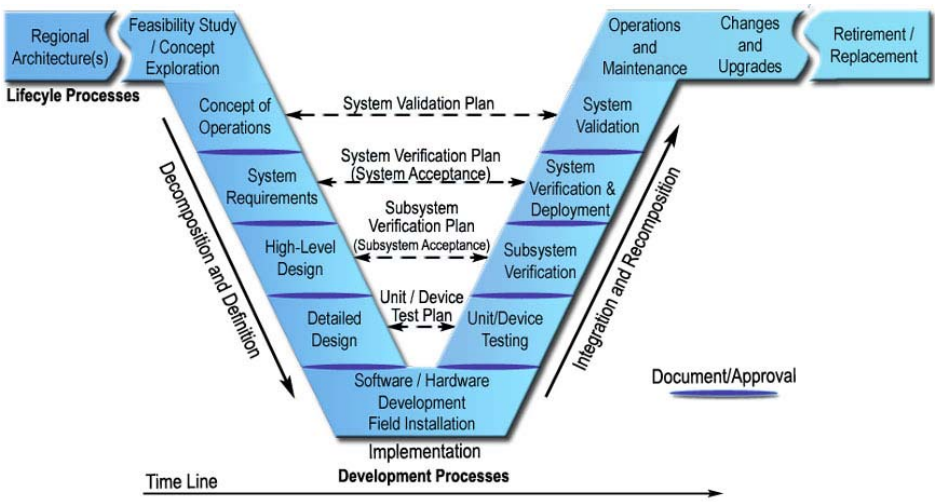
Figure 1-1. Systems Engineering "Vee" Process – Regional ITS Architecture is First Step



More information, such as training and publications, is available at: https://ops.fhwa.dot.gov/int_its_deployment/sys_eng.htm

System Engineering Guidebook for ITS is available at: https://www.fhwa.dot.gov/cadiv/segb/

2.0 ITS PLAN STUDY AREA

The study area for the ITS Plan is defined by the boundaries of Kern County as shown in Figure 2-1~~Figure 2-1~~. Kern County is located in California's Central Valley as shown in Figure 2-2~~Figure 2-2~~. There are 11 incorporated cities in Kern County: Arvin, Bakersfield, California City, Delano, Maricopa, McFarland, Ridgecrest, Shafter, Taft, Tehachapi and Wasco.

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2.1 POPULATION

The population of the County is approximately 886,500. The largest city is Bakersfield (population 379,000). Although two-thirds of Kern's population lives within 1/20th of the area of the county known as Metropolitan Bakersfield, many of the economic centers require long exurban commutes to areas that may not be conducive to urban development. Table 2-1~~Table 2-1~~ presents the population details of Kern County.

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Table 2-1: Kern County Population

City	1997 EDP Population	Population (2016)
Arvin	10,969	20,978
Bakersfield	214,554	379,110
California City	8,758	13,992
Delano	32,360	52,999
Maricopa	1,230	1,140
McFarland	8,013	14,658
Ridgecrest	28,693	28,064
Shafter	11,006	18,048
Taft	6,659	9,405
Tehachapi	6,491	12,217
Wasco	18,843	26,471
Unincorporated County	280,640	309,425
Total	**628,216**	**886,507**

Source: California Department of Finance 1/1/97 and 1/1/16

The Kern Region population has grown about 250,000 from 1997 to 2016. Per the Kern County 2014 Regional Transportation Plan and Sustainable Communities Strategy (RTP), the countywide population is forecasted to grow by more than ½ million persons to 1,444,100 in the forecast year 2040. Total employment is anticipated to grow to just over 500,000 by forecast year 2040.

2.2 REGIONAL AREA

Kern County, consists of about 8,200 square miles (the size of New Jersey). Kern County is 159 miles in length from the northwestern boundary to the southeastern boundary. Kern is bordered by nine counties: Inyo, Kings, Los Angeles, Monterey, San Bernardino, San Luis Obispo, Santa Barbara, Tulare, and Ventura. Kern County comprises separate regions based on significant variations in terrain, climate, geographic and environmental factors. The regions are identified as follows:

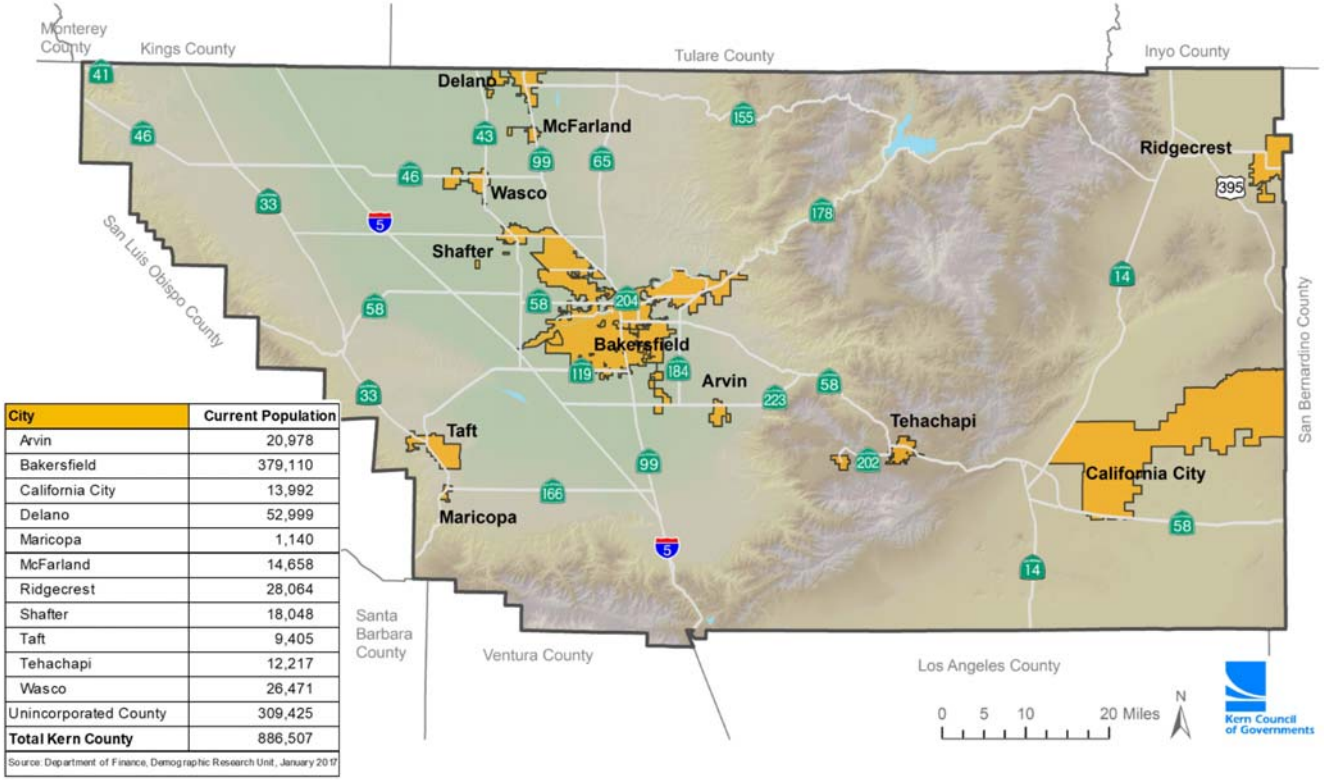
- Valley Region: The southern San Joaquin Valley below an elevation of 1,000 feet mean sea level.
- Mountain Region: The westernmost and central portion of the county above the 1,000-foot mean sea level contour in the valley and western region of the county and west of the primary alignment of the Los Angeles Aqueduct in the eastern county, including the southernmost portion of the county.
- Desert Region: The eastern section of the county, east of the primary alignment of the Los Angeles Aqueduct.

2.2.1 Regional Recreation Areas

Several recreation destinations are located in or adjacent to Kern County. These areas attract travelers from with the County and also the state, country, and world. Some of these areas include:

- Alta Sierra Ski Resort
- Auto Club Famoso Raceway
- Buena Vista Aquatic Recreation Area
- Kern County Raceway Park
- Kern River
- Lake Isabella (reservoir)
- National Parks: Bitter Creek National Wildlife Refuge; Carrizo Plain National Monument; Cesar E. Chavez National Monument; Kern River National Wildlife Refuge; Los Padres National Forest
- State Parks: Red Rock Canyon State Park; Fort Tejon State Historic Park; Tule Elk State Natural Reserve; Tomo-Kahni State Historic Park
- Tehachapi Loop

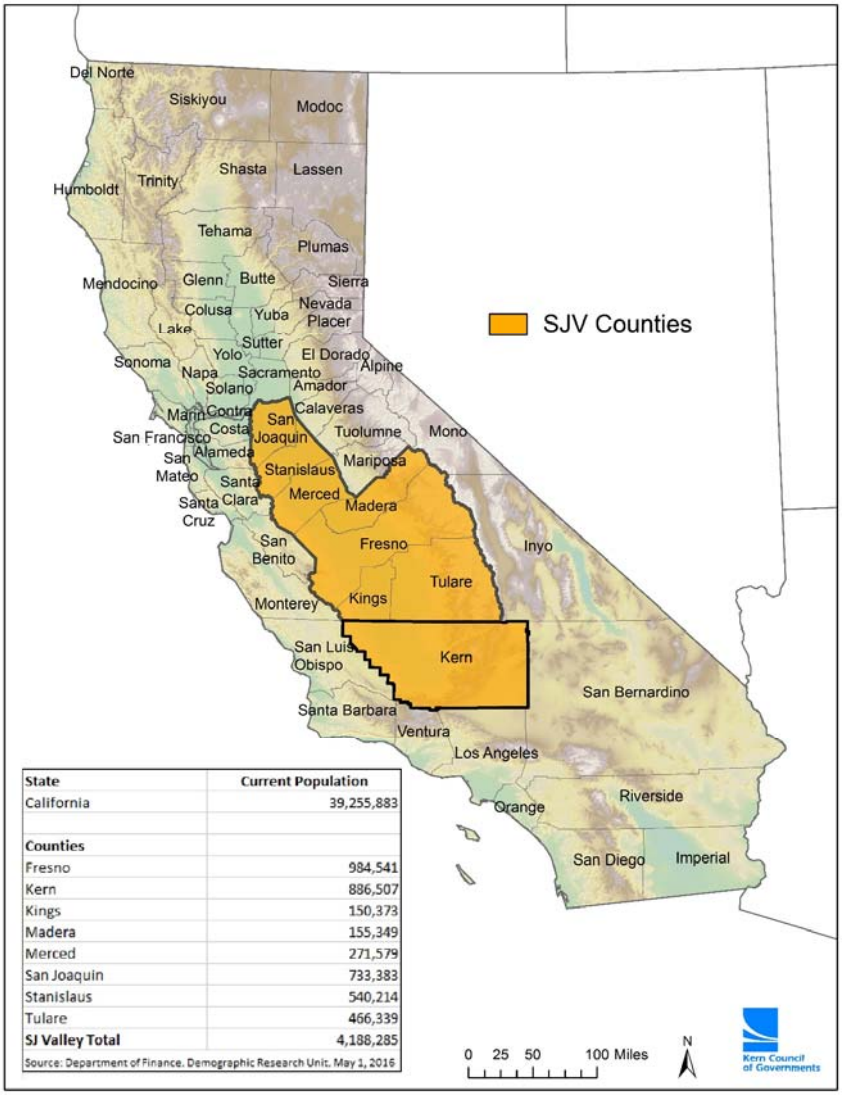
Figure 2-1. Map of the Kern Region



City	Current Population
Arvin	20,978
Bakersfield	379,110
California City	13,992
Delano	52,999
Maricopa	1,140
McFarland	14,658
Ridgecrest	28,064
Shafter	18,048
Taft	9,405
Tehachapi	12,217
Wasco	26,471
Unincorporated County	309,425
Total Kern County	886,507

Source: Department of Finance, Demographic Research Unit, January 2017

Figure 2-2. Map of the San Joaquin Valley Counties within the State of California



State	Current Population
California	39,255,883
Counties	
Fresno	984,541
Kern	886,507
Kings	150,373
Madera	155,349
Merced	271,579
San Joaquin	733,383
Stanislaus	540,214
Tulare	466,339
SJ Valley Total	4,188,285

Source: Department of Finance. Demographic Research Unit. May 1, 2016

3.0 PROJECT STAKEHOLDERS AND ENGAGEMENT

3.1 KERN REGION ITS STAKEHOLDERS

The success of a regional ITS architecture depends on participation by a diverse set of regional Stakeholders. Table 3-1~~Table 3-1~~ lists the agencies/organizations of approximately 28 key stakeholders that were engaged to provide input for the ITS Plan. Input from the Stakeholders as well as others, were instrumental in the development of the information presented in the final ITS Plan. These Stakeholders were instrumental to the development of the regional ITS architecture.

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Table 3-1. ITS Plan for the Kern Region Stakeholder List

Amtrak	City of Taft
Bureau of Land Management	City of Tehachapi
Burlington Northern Santa Fe Railroad	City of Wasco
Caltrans District 6	CommuteKern (Kern COG)
Caltrans District 9	County of Kern
Caltrans Headquarters	Delano Area Rapid Transit
City of Arvin	Federal Highway Administration California Division
City of Bakersfield	Federal Transit Administration Region 9
City of California City	Golden Empire Transit District (GET)
City of Delano	Kern Council of Governments (Kern COG)
City of Maricopa	Kern Motorist Aid Authority (Kern COG)
City of McFarland	Kern Transit
City of Ridgecrest	Tejon Indian Tribe
City of Shafter	Union Pacific Railroad

3.2 STAKEHOLDER ENGAGEMENT

3.2.1 Stakeholder Engagement Plan

The purpose of the Stakeholder Engagement Plan was to support the coordination of the collaborative efforts of regional stakeholders in order to develop a comprehensive plan for ITS in the Kern region. The ITS Plan will provide stakeholders with guidance for implementing systems that provide a safe, efficient surface transportation network for all users.

The various levels of involvement by stakeholders is a critical component of achieving this vision. The objectives of outreach and education are to collaborate with core stakeholders, consult and gain input from interested stakeholders, and provide information to the public. This approach to outreach and education is summarized in the table below.

Table 3-2. Outreach Approach

Stakeholder Groups	Levels of Involvement	Outreach Methods
Agency Stakeholders • Interdepartmental groups within Kern COG • 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	Kern COG Advisory Committees Workshops Project Website Interviews Surveys
General Public	Inform Explain plan and potential impacts on all modes of transportation	Project Team outreach to the General Public is not anticipated as part of this project.

3.2.2 Stakeholder Engagement Methods

These activities convey the toolset that the Project Team used to accomplish stakeholder engagement:

- Compile Stakeholder List.
- Conduct Project Team meetings with key personnel within Kern COG. The meetings will be designed to elicit ideas, background information, and concerns related to this project.
- Develop and distribute survey forms to stakeholders.
- Conduct Project Stakeholder Workshops (4 planned).
- Attend local and regional meetings (as appropriate).
- Distribute, collect, and compile Inventory Surveys.
- Conduct one-on-one contacts (as required).
- Develop project identity and logo.
- Create project introduction flyer. The flyer will be developed early in the project in the form of a "Fact Sheet" to explain the project. Kern COG will post flyer to website.
- Provide material for a Project Web Site, for dissemination of project background information, announcements, meeting materials, and deliverables.
- Send out email alerts (as needed).

4.0 ITS SYSTEM INVENTORY

The purpose of the ITS System Inventory is to summarize the existing and planned transportation circulation and ITS efforts. ITS inventory forms were provided to Stakeholders via email and posted to the Kern COG ITS website. The form was formatted to gather specific ITS related existing technologies and planned project information. In addition, document research provided in the Data Report (Deliverable 2) and the findings from the 1997 EDP were used as information sources.

The inventory is presented in the context of the existing transportation network. The network's ITS devices include traffic signals, transit signal priority, emergency vehicle preemption, vehicle detection, communication lines, changeable message signs, speed warning system, traffic management centers, and other devices and systems. Caltrans, Kern County, and local jurisdictions each operate and maintain several different types of ITS devices in the region. The following summarizes the Kern County region's transportation network, including its roadways, railways, air facilities, traffic operations management center, and services.

4.1 EXISTING TRANSPORTATION NETWORK

4.1.1 Freeways, Highways, and Streets

Several major routes serve Kern County, providing circulation within the County as well as access in and out of the County. Major routes and a brief description are listed below and illustrated in **Figure 4-1**.

Interstate 5: I-5 is the primary north-south route through the State of California, this interstate traverses the western portions of Kern County. I-5 provides connections to major routes in the Kern Region. I-5 is a gateway into the Central Valley for goods movement and for interstate and international transport.

State Route 14: SR-14 runs through the Eastern Kern desert terrain. The highway serves local, interregional, interstate and recreational traffic while providing access to Edwards Air Force Base and China Lake Naval Air Weapons Station.

State Route 33: SR-33 runs north-south in western Kern County and serves oil and agricultural industry traffic.

State Route 41: SR-41 runs through the northwest corner of Kern County and is designated as a truck route.

State Route 43: SR-43 is a north-south route that serves agricultural needs and as an alternate to SR 99.

State Route 46: SR-46 serves as a way to the Central Coast from the San Joaquin Valley for recreational and farm-to-market traffic.

State Route 58: SR-58 serves both interregional and interstate travel. The route crosses the Tehachapi Mountains. The route serves as an extension of the Interstate System by connecting I-5 in Bakersfield to I-15 in Barstow. I-15 connects to I-40 in Barstow,

providing a continuous east-west freeway route from Barstow to Wilmington, North Carolina.

State Route 65: SR-65 is a route that begins in Bakersfield and runs north. The route is primarily commercial and is adjacent to Meadows Field Airport.

State Route 99: A major north-south route through Kern County, SR-99 begins at I-5 near the base of the Grapevine and is generally parallel to I-5. This route connects each of the major urbanized areas in the San Joaquin Valley, and attracts high volumes of commercial truck traffic.

State Route 119: This east-west route begins in the City of Taft and ends at SR 99. This route serves the oil industry and recreational traffic.

State Route 155: This east-west route begins at SR 99 in the City of Delano and ends at SR 178 near Lake Isabella. This route is used primarily for recreational traffic.

State Route 166: SR-166 runs east-west from SR 99 through the City of Maricopa towards SR 101. This route serves as an alternate route when I-5 at the Grapevine is closed.

State Route 178: SR-178 runs east-west from the urban area of Bakersfield to San Bernardino County. It is a route for urban commuters in Bakersfield, connecting Bakersfield with East Bakersfield and Lake Isabella. This route serves recreational traffic.

State Route 184: This north-south route begins at SR 223 and ends at SR 178. This route connects less urbanized areas with the Bakersfield metropolitan area and serves agricultural and recreational traffic.

State Route 202: This route begins near the California Correction Institution in Kern County and runs easterly through the City of Tehachapi to SR 58.

State Route 223: This route begins at I-5 and runs east to SR 58. This route serves truck and others connecting I-5 with SR 58 while bypassing the City of Bakersfield. The route provides access to the Bakersfield National Cemetery.

U.S. Route 395: This north-south route begins in Eastern Kern County at the community of Johannesburg and continues north through Kern County into Inyo County. This route serves interregional and interstate goods movement and recreational traffic. The route connects at I-15 in Hesperia north to the Canadian border.

In additional to the major routes listed above, the 2014 Regional Transportation Plan (RTP) illustrates the streets and highways system. It includes interstate and state highway routes as well as some of the major arterials and regionally significant roadways. The regionally significant system was selected to maintain and improve access between cities, accommodate a high level-of-service access to and within the Bakersfield Metropolitan Area, and to link regionally significant commercial, educational, industrial and recreational facilities. **Figure 4-1**~~**Figure 4-1**~~ show both the regional roadways (highways and arterials) within the Bakersfield Metro area as well as Kern County.

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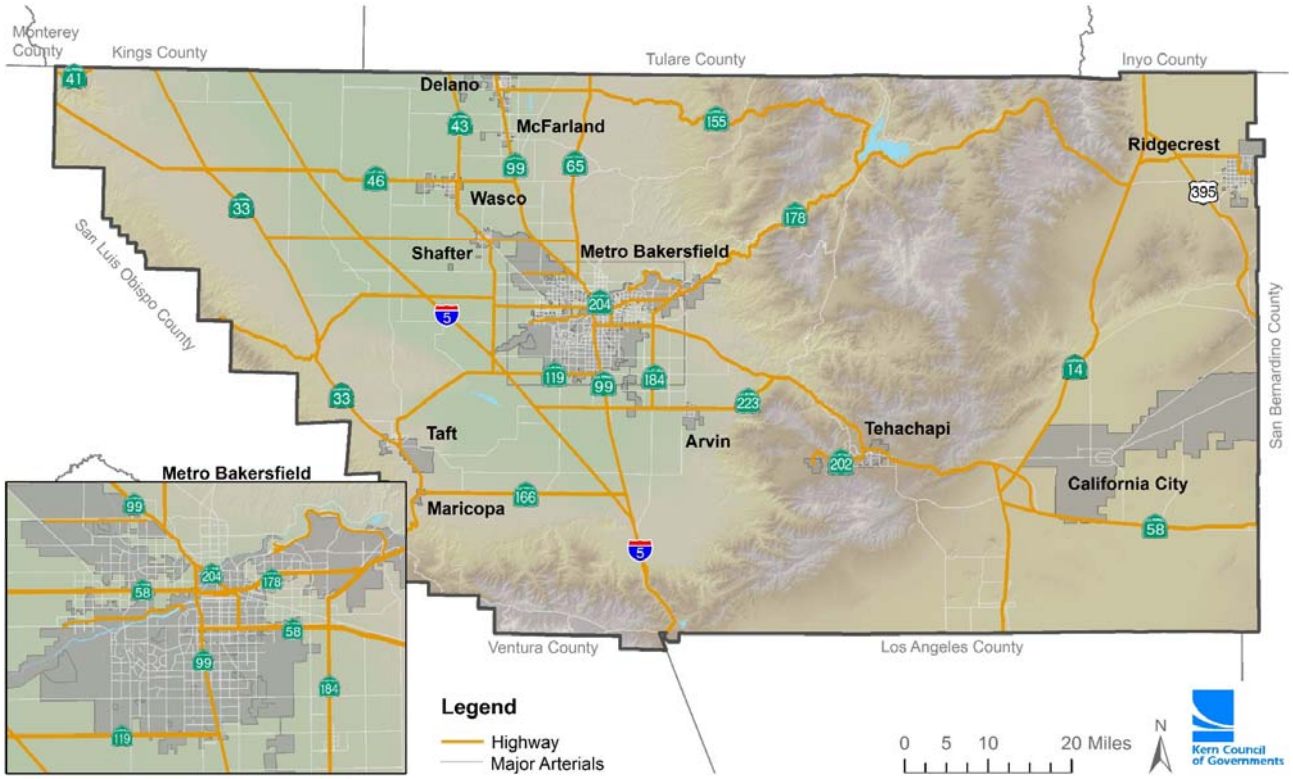
4.1.2 Region-wide

Kern County and local jurisdictions within the Kern region are responsible for collecting traffic data on roadways within their jurisdiction. Caltrans is responsible for collecting traffic data on State highways, and does so on a schedule and under procedures set at the State level. The Kern Council of Governments' Regional Traffic Count Program is limited to roadways under local jurisdiction. It is recommended that efforts be made to make Caltrans traffic count data available in conjunction with data collected under the Program.

Kern Council of Governments manages a uniform regional count program that improves the coverage throughout the Kern region, conserves resources by eliminating redundant count locations, facilitates analysis of historical trends, provides data on goods movement, allows for extrapolation through the establishment of control stations, and creates an understanding of seasonal variation. Most recently, pedestrian and bike counts have been added. All count data collected is available on the Kern Council of Governments website.

Figure 4-1. Regionally Significant Routes



4.1.3 Metropolitan Area

The City of Bakersfield operates approximately 400 traffic signals. Of those, about 340 are controlled by city traffic systems and can be timed to move traffic more effectively, while the rest have fixed cameras that record video that tells traffic control boxes when to change the lights. The traffic cameras are linked to the Traffic Operations Center located in City Hall South through fiber optic cable. Since June 2014, traffic engineers can retime Bakersfield intersections from the traffic operations center which also features six 50-inch flat screen monitors capable of displaying up to six cameras at once, or a mix of live feed and traffic map or timing information. The traffic system has signal pre-emption for emergency vehicles and signal priority for transit vehicles. The City of Bakersfield has been installing pedestrian countdown heads at intersections throughout the city. The traffic cameras are separate from the city's red-light traffic cameras, which are operated by Redflex Traffic Systems at 12 city intersections. The existing traffic signals for the City of Bakersfield are illustrated in **Figure 4-2**~~Figure 4-2~~ and also available at: http://www.bakersfieldcity.us/civicax/filebank/blobdload.aspx?BlobID=28916.

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The County of Kern operates over 100 traffic signals throughout the county. Existing traffic signals for the County are shown in **Figure 4-2**~~Figure 4-2~~. Some of these intersections are equipped with emergency vehicle preemption and signal priority for transit vehicles. The County of Kern has been installing pedestrian countdown heads at intersections throughout the county. The County operates a speed warning system and changeable message signs. Planned ITS elements include: roadway surveillance system, information management/archive system.

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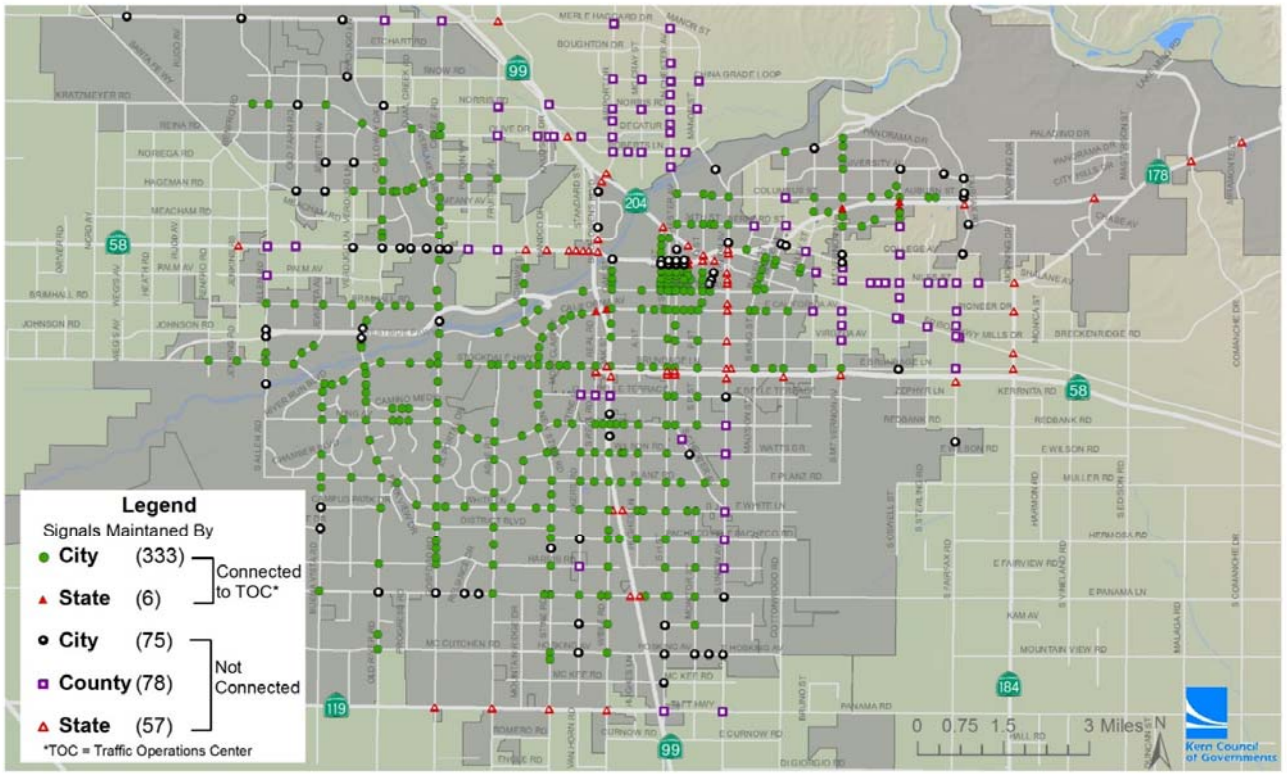
Figure 4-2. Bakersfield Traffic Signals



4.1.4 Incorporated Cities

The City of Arvin, located along SR 223, has traffic signals. In 2018, the City of Arvin in coordination with Caltrans and the San Joaquin Valley Railroad hope to install a traffic signal at SR 223/Derby St.

The City of Delano, located along SR 99, operates a traffic signal system and emergency vehicle traffic signal preemption.

The City of Maricopa, located along SR 33, in coordination with Caltrans installed a flashing beacon in 2016.

The City of McFarland, located along SR 99, installed their first traffic signal in 2017.

The City of Ridgecrest, located along US 395, has installed traffic signals that are set on an operating timing sequence for each turn pocket and intersection leg.

The City of Shafter, located along SR 43, has installed traffic signals.

The City of Tehachapi, located along SR 58 and SR 202, in coordination with Caltrans has installed traffic signals and share the cost for maintenance and operations. The signals are located partially in Caltrans right of way and partially in the City of Tehachapi right of way.

The City of Wasco, located along SR 43 and SR 46, has plans to install flashing beacons.

4.1.5 Transit System

Urban Area

Public transportation in Kern County consists of both public transit and AMTRAK rail passenger service. Service areas are shown in **Figure 4-3~~Figure 4-3~~.** The major provider of public transportation in the metropolitan Bakersfield area is Golden Empire Transit District (GET) and serves both fixed-route bus lines and a paratransit service with service on demand for those not able to use the regular bus service. GET has implemented many ITS transit applications. ~~Many~~ All of GET's fixed-route buses are equipped with on-board surveillance cameras. All vehicles are equipped with electronic fareboxes. Both fixed route and paratransit operations utilize computer-aided scheduling and dispatch computer software. GET provides information to customers on their website, printed materials, kiosks, and a staffed telephone information line. GET has an automatic vehicle location (AVL) system, a GPS-based system with mobile data terminals (MOTs). GET also has a trip planner powered by Google Maps on their website or using a mobile app.

The major provider of public transportation in the county is Kern Transit, a department of the County of Kern. Kern Transit operates 17 fixed-routes and offers dial-a-ride service. The fixed route service is scheduled to coincide with GET routes when possible to allow for easy transfers between the two services. The transit system offers intercity service between Arvin, Bakersfield, Bodfish, Boron, Buttonwillow, California City, Delano, Edwards, Frazier Park, Inyokern, Keene, Kernville, Lake Isabella, Lamont, Lebec, Lost Hills, McFarland, Mojave, Onyx, Ridgecrest, Rosamond, Shafter, Taft, Tehachapi, Wasco, Weldon, and Wofford Heights, along with local transit service. Connections to Metrolink in Lancaster are also available. Kern Transit routes are shown in **Figure 4-3~~Figure 4-3~~.**

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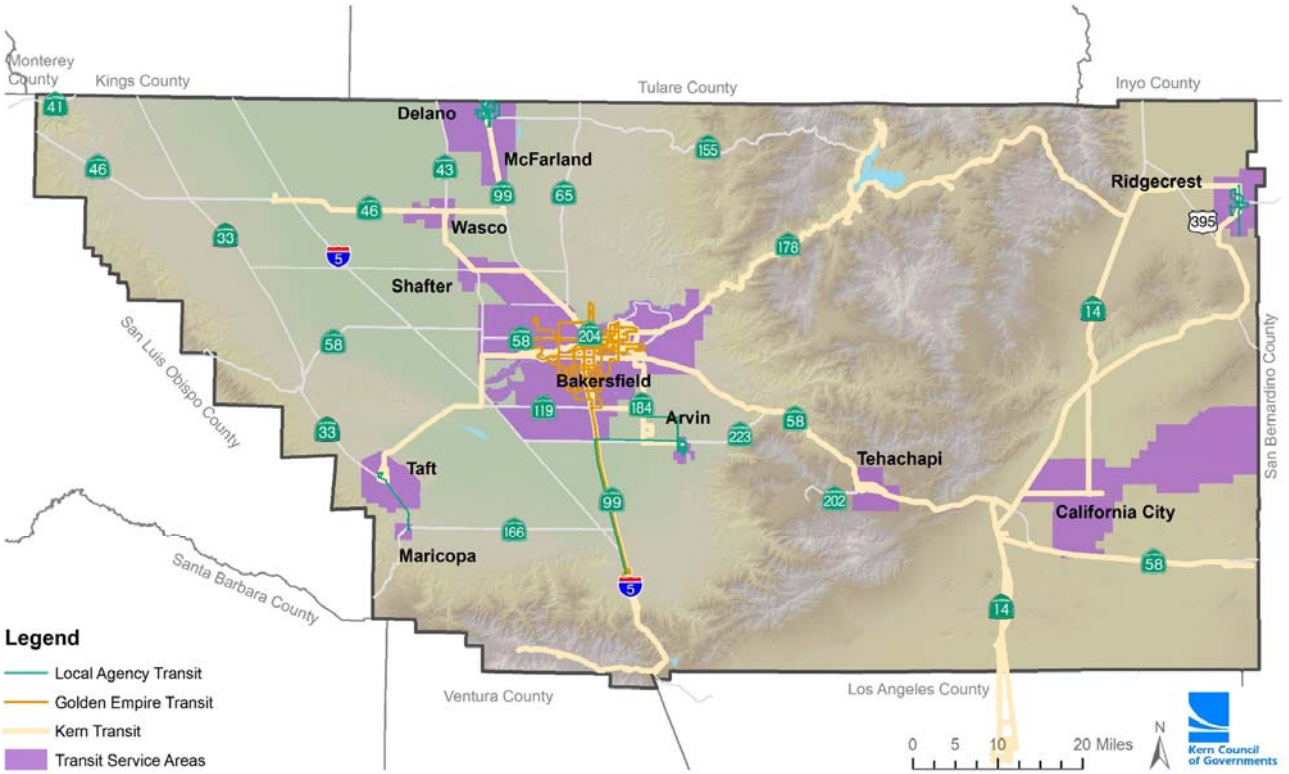
Figure 4-3. Countywide Transit Service Areas



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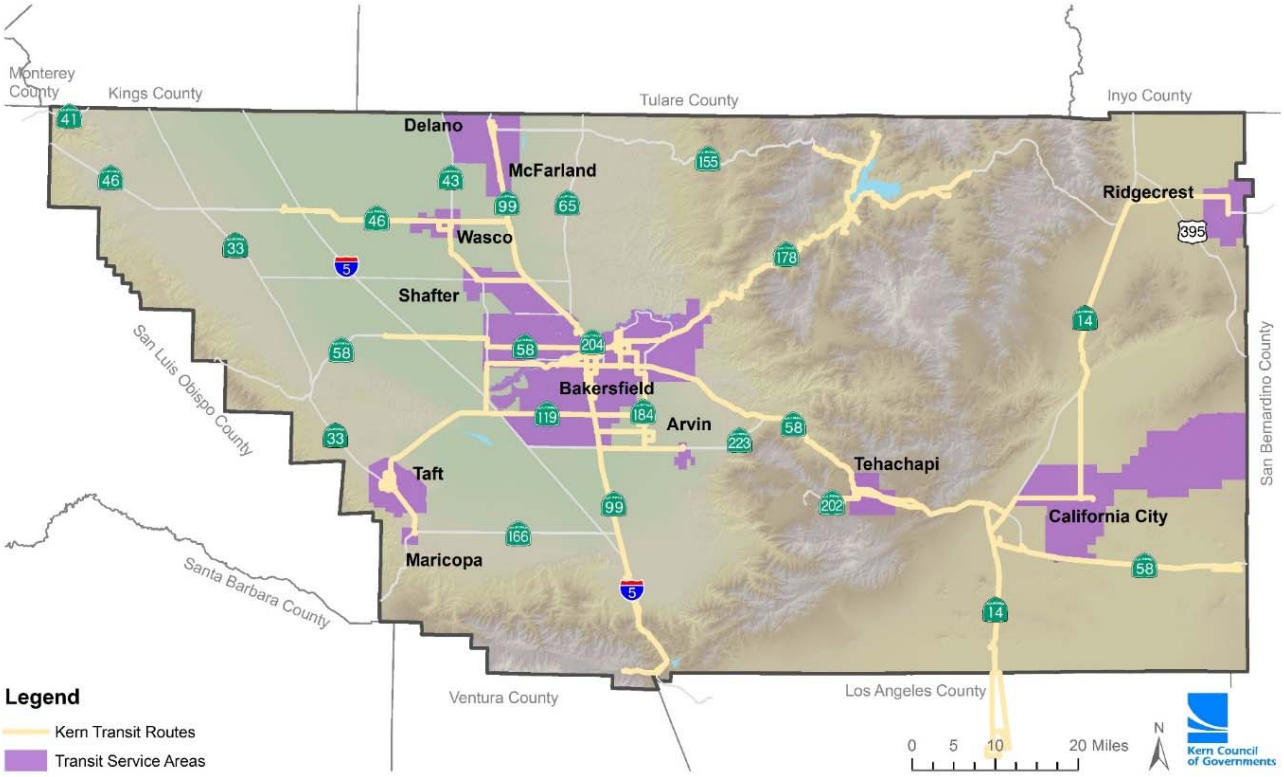
Monterey County
Kings County
Tulare County
Inyo County
San Luis Obispo County
San Bernardino County
Santa Barbara County
Ventura County
Los Angeles County
Delano
McFarland
Wasco
Shafter
Bakersfield
Arvin
Taft
Maricopa
Tehachapi
Ridgecrest
California City
Legend
Kern Transit Routes
Transit Service Areas
0 5 10 20 Miles
N
Kern Council of Governments

Rural Area

A map of the rural service area is also shown in **Figure 4-3~~Figure 4-3~~.**

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The City of Arvin transit services include demand response service from Monday to Friday. Fixed route service operates weekdays linking Arvin and Lamont six times a day, Arvin to the Tejon Industrial Complex twice a day, and Arvin to Bakersfield twice a day.

The City of California City operates a dial-a-ride system providing curb-to-curb transportation in the central core of the city on weekdays. Kern Transit provides links to surrounding communities through two routes Mojave-California City and Mojave-Ridgecrest.

Delano Area Rapid Transit provides intra-city fixed route service, with four interconnected routes and Delano Dial-A-Ride.

The City of McFarland offers dial-a-ride service on weekdays.

The City of Ridgecrest operates a dial-a-ride system in the Greater Ridgecrest Area and fulfills a contract for dial-a-ride service (on a reservation-basis only) to Randsburg and the Inyokern area. Service is Monday through Saturday.

The City of Shafter features a dial-a-ride service and an on-demand fixed route service to Minter Field, Mexican Colony, and North Kern Labor Camp. This weekday service provides four scheduled stops to each of the three locations on a reservation basis.

Taft Area Transit provides demand response service to Taft, Derby Acres, Fellows, Ford City, McKittrick, South Taft, and Taft Heights on weekdays. Kern Transit provides a connection to Bakersfield via the Westside Express fixed route service weekdays and Saturdays.

Kern Transit operates a dial-a-ride service covering a majority of the City of Tehachapi and unincorporated areas of Golden Hills. Kern Transit operates the fixed route East Kern Express between Bakersfield and Lancaster, with stops in Keene, Tehachapi, Mojave, and Rosamond, and with connections possible to other transit providers in each city on weekdays.

The City of Wasco features a dial-a-ride service on weekdays.

4.2 RAIL FACILITIES

4.2.1 Passenger Service

The City of Bakersfield and the City of Wasco are served by AMTRAK passenger service. AMTRAK operates trains daily between Bakersfield and Oakland as well as Bakersfield and Sacramento. Currently, two daily round trips run between Sacramento and Bakersfield and five daily trips run between Oakland and Bakersfield. Dedicated bus service connects rail stations with those cities not directly served by the train service.

The rail service is supplemented by AMTRAK Thruway Bus service to destinations not served directly by rail. At Bakersfield, many buses fan out to reach destinations all over Southern California and Nevada, including Santa Barbara, Ventura, Los Angeles, Orange County, San Diego, Palm Springs, and Las Vegas.

Federal law requires that a Positive Train Control (PTC) system be implemented by 2018. Caltrans Division of Rail and AMTRAK have completed work for the onboard installation of the PTC equipment on the cab control cars and locomotives. The Union Pacific Railroad (UP) and the Burlington Northern Santa Fe Railway (BNSF) are working to complete installation of the wayside PTC equipment. The entire PTC system will be tested and initiated to meet the 2018 federal deadline.

4.2.2 Freight Service

The Union Pacific Railroad (UP) and the Burlington Northern Santa Fe Railway (BNSF) both operate freight rail service in the area, and this service is used to transport a large number of goods throughout the region. UP operates trains daily through the San Joaquin Valley carrying food products, general freight, grain, and lumber. UP has teamed up with RailEx, a refrigerated railcar and warehousing service, to offer perishable-goods transportation from the San Joaquin Valley to New York. The San Joaquin Valley Railroad operates a regional freight service between Tulare, Fresno, and Kern counties on leased UP and BNSF branch lines connecting outlying areas to mainline carriers. They move freight comprised primarily of agricultural and petroleum-based products.

A major example of rail limitation is the route over Tehachapi Summit. Part of the route is single track, and although tunnels have been modified to allow double-stacked containers to pass through, traffic in the opposite direction is often diverted to sidings, creating a congested bottleneck. With the planned Tehachapi Pass capacity improvement project jointly funded by the State of California and the BNSF, the current 35 trains that pass through the summit daily, are forecasted to increase to 50 trains per day by 2020.

Figure 4-4~~Figure 4-4~~ depicts the regional railroad system.

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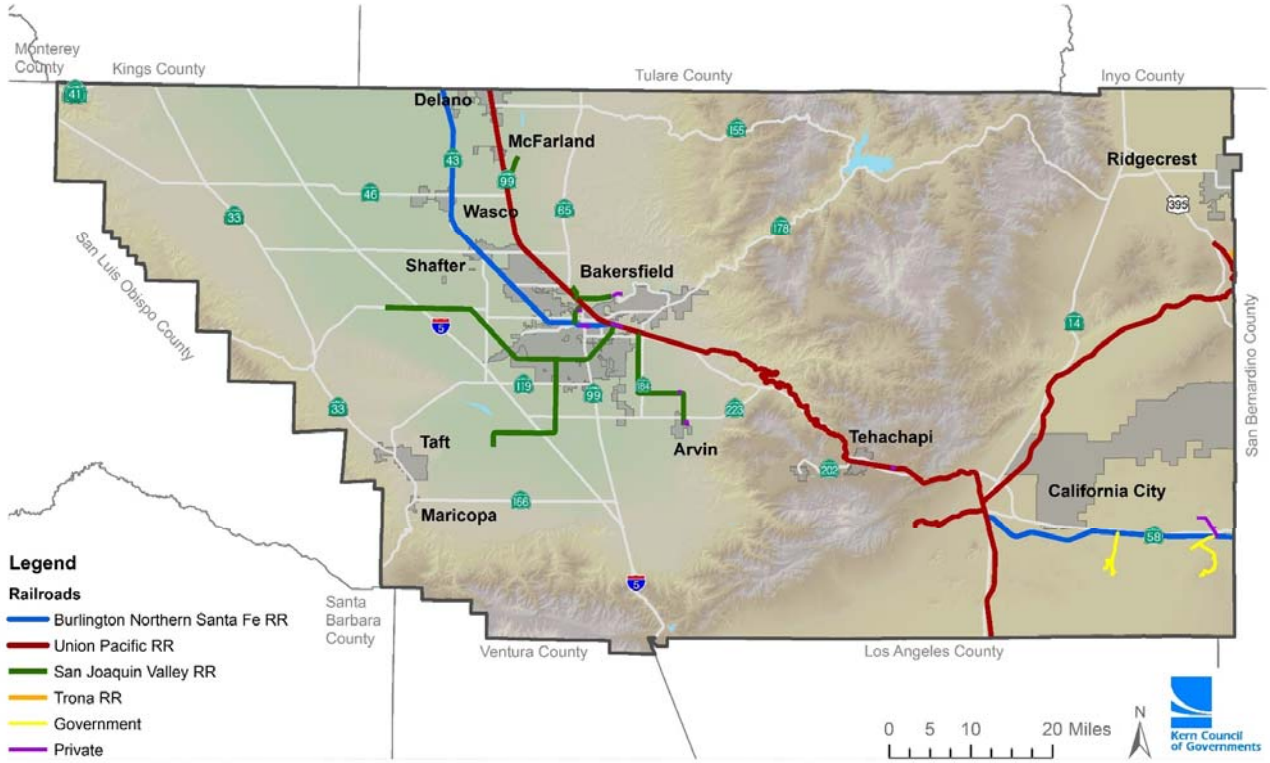
Figure 4-4. Regional Rail System



4.3 AIR FACILITIES

The airport system in Kern County includes a county-owned and operated airport, several municipally-owned airports, special airport district, numerous privately-owned airports, and two major military facilities.

Meadows Field Airport is owned by the County of Kern and is one of seven airports operated by the Department of Airports. "BFL" serves more than 700,000 people in or near the Southern San Joaquin Valley. There are flights to Denver and San Francisco on United Airlines. There are flights to Phoenix on American Airlines.

The William M. Thomas Passenger Terminal was opened on February 27, 2006. The terminal is located approximately 7 miles north of downtown Bakersfield. Highway 99 to Seventh Standard Road provides the most direct access to the passenger terminal. The airport is approximately 1,400 acres in size. The passenger terminal is open daily. The airport is served by an FAA air traffic control tower.

Air cargo operations for the Kern region are conducted primarily at Meadows Field. Federal Express, DHL/Airborne, and UPS currently provide air cargo service from Meadows Field. The Cities of Bakersfield, California City, Delano and Tehachapi each have municipal airports that serve business, personal, and recreational aviation needs.

The Bakersfield Municipal Airport (L45) is owned by the City of Bakersfield. The airport is a public use airport classified as a General Aviation Airport and is approximately 200 acres in size.

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California City Municipal Airport serves every part of aviation including sky diving, military jump training, gliding, flight training, personal flying, aerial mapping and surveying, County, State, and Civil Air Patrol Support, as well as stunt and filming areas for productions. The adjacent manufacturing zone is International Trade tax free.

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The City of Delano owns and operates the **Delano Municipal Airport**, an uncontrolled airfield sitting on 520 acres, open to the public.

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Elk Hills/Buttonwillow Airport serves seasonal agricultural aircraft and personal aviation needs of western Kern County. It is located near the intersection of I-5 and SR 58, a highway-oriented commercial area.

Inyokern Airport (IYK) is a public use airport located one mile northwest of Inyokern, California. It is owned and operated by the Indian Wells Valley Airport District and serves the northeastern Kern County communities of Inyokern, Ridgecrest, and Lake Isabella.

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Kern Valley Airport serves commercial, recreational, and occasional fire suppression activities in the Lake Isabella/Kern River Valley area, and 246 acres are~~is~~ on lease to the County of Kern from the US Forest Service (the County owns 8 acres). The airport is located south and east of the community of Kernville, with other nearby communities, including Wofford Heights, Lake

Isabella, Bodfish, Mountain Mesa, Onyx, and Weldon. Outdoor recreation is the prime attraction in this region, and aviation activity continues to increase.

Lost Hills Airport serves local and regional agricultural, business, and personal aviation needs in northwestern Kern County and is located near the intersection of I-5 and SR 46. This intersection is developing as a highway-oriented commercial area. SR 46 is the primary access to the central coast area from the southern San Joaquin Valley. The airport is an important base for agricultural aircraft operating over the area's extensive croplands.

Minter Field Airport District/Shafter Airport serves general aviation activities at the junction of SR 99 and Lerdo Highway. The Minter Field Air Museum is located at the Minter Field Airport.

Poso Airport, located approximately 20 miles north of Bakersfield, is used primarily for agricultural and training aircraft. The airport is also used for recreational purposes in conjunction with drag racing events at an adjacent paved strip.

Taft Airport serves business and personal aviation needs for the City of Taft and southwestern Kern County, an area of intensive oil production and processing.

Wasco Airport serves agricultural, business, and personal needs for the area around the City of Wasco. The airport is located 1 mile north of Wasco and 22 miles northwest of Bakersfield. The airport is an important base for agricultural aircraft operations.

East Kern Airport District/Mojave Air/Spaceport currently offers fixed-base operator facilities for airport users from Edwards Air Force Base, Rosamond, Mojave, Tehachapi, California City, and Boron. The airport serves as a civilian flight test center for business, military, civil, and home-built aircraft being developed for testing. It also serves as a base for modification of major military and civilian aircraft. The airport is located northeast of the community of Mojave and is within 1 mile of SR 14 and SR 58. A rail spur from the Union Pacific Railroad leads into the airport. In 2004 the Mojave Air/Spaceport became the first FAA approved civilian spaceport, and is home to the manufacturing and flight testing of Virgin Galactic's Spaceship One and Spaceship Two, the first manned civilian re-useable spacecraft.

China Lake Naval Air Weapons Station (NAWS) and Edwards Air Force Base (EAFB) are located in the eastern part of the Kern Region in an area referred to as "the R-2508 complex," which is used for the advancement of weapons systems technology and tactical training. The R-2508 complex consists of several restricted airspace areas.

Figure 4-5~~Figure 4-5~~ depicts the regional airport locations.

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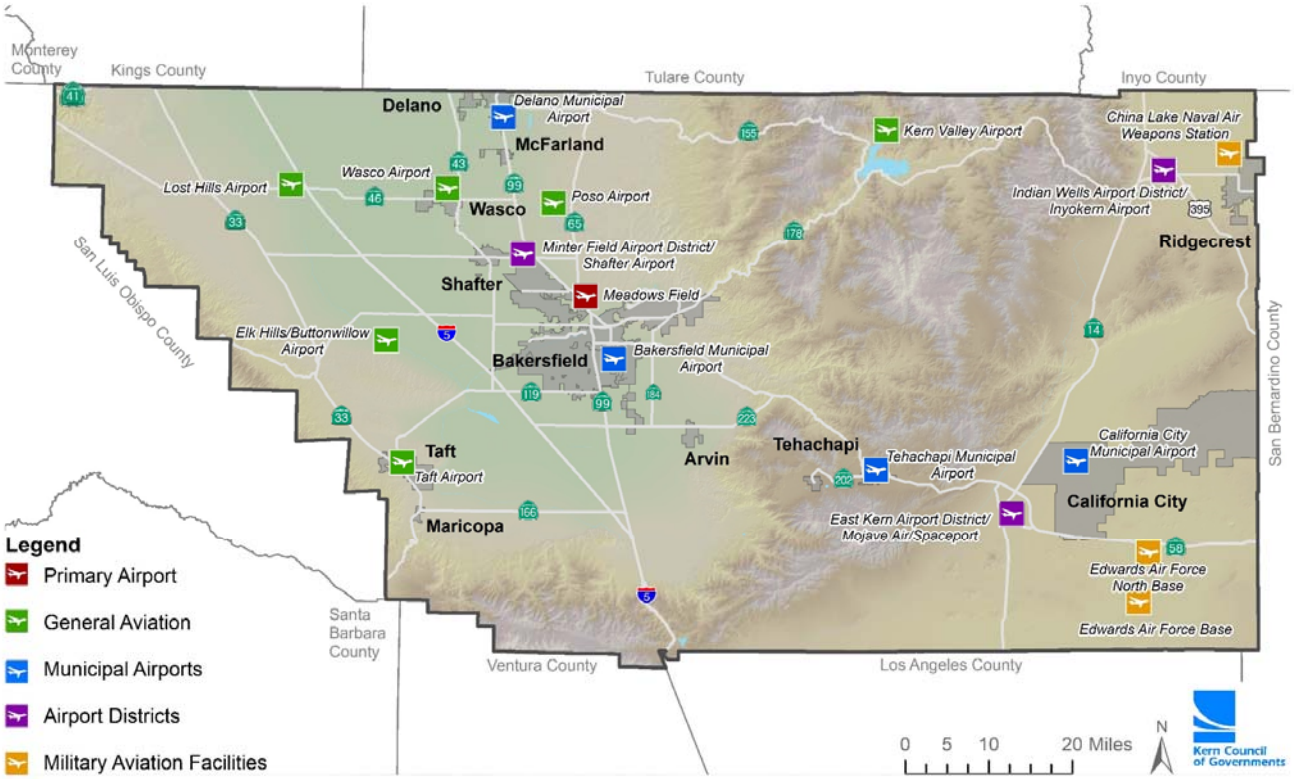
Figure 4-5. Regional Airports



4.4 TRAFFIC OPERATIONS MANAGEMENT CENTER

The California Department of Transportation (Caltrans) and the California Highway Patrol (CHP) opened the Central Valley Transportation Management Center (CVTMC) in December 1992 in Fresno, California. This center is a joint operation between the two agencies, with the goal of reducing traffic congestion, improving motorists' safety, and conserving fuel on state highways in Kern and other counties in District 6.

The CVTMC gathers information on state highways in the five counties (Fresno, Kern, Kings, Madera, Tulare) that make up District 6. Caltrans workers, CHP officers, and motorists provide first-hand information on the traffic in the area. This information supplements data collected from electronic equipment such as magnetic sensors linked to computers. If an incident is detected a team of highway workers is sent to aid in the resolution of the incident by removing debris or placing an appropriate sign to inform motorists of the conditions ahead. The CVTMC also uses closed-circuit cameras to monitor highway incidents. This technology helps speed up the response time to incidents, and helps staff determine what equipment and personnel are needed at the incident scene.

Other technology in use in District 6 includes changeable message signs, radio transmitters, traffic monitoring stations, and weather stations. Weather stations are used to determine the environmental conditions. The stations have sensors that measure highway visibility, wind speed and direction, humidity levels, precipitation, and moisture on the pavement. One application of this technology is the highly developed fog warning system, which detects dangerous fog conditions, during which travelers are warned of conditions via changeable message signs that was deployed in Fresno and Tulare. Information is provided to motorists through the changeable message signs, television broadcasts and through a Highway Radio Advisory (HAR). Signs are posted along the roads alerting motorists where to tune-in to receive information. In addition, daily television broadcasts are conducted from the TMC to local cable carriers and broadcast stations to provide current peak period traffic conditions.

Caltrans District 9 operates a smaller center. Caltrans District 9 Transportation Management Center/Satellite Operations Center opened in 1954.

4.5 ROADSIDE ASSISTANCE

4.5.1 Kern Motorist Aid Authority

The Kern Motorist Aid Authority (KMAA) is authorized to finance, implement, operate and maintain a motorist aid system and other services in coordination with the California Department of Transportation and the California Highway Patrol. KMAA work includes traveler information service, safety-related hazard and obstruction removal, and intelligent transportation system architecture and infrastructure.

The KMAA maintains the Kern 511 system, the traveler information service that provides traffic conditions, transit information and road work information in the Kern region via a toll-free phone number and website. Kern 511 provides real-time conditions like traffic alerts and accident information and is a resource for transit, train, neighboring 511 websites, rideshare information. Live Caltrans cameras can be viewed on the interactive map available on the website.

The KMAA funds a litter removal program on state highways. The Kern County Sheriff's Office uses inmate labor through the Lerdo Detention Facility, supervised by correctional officers to carry out the contract for safety-related hazard and obstruction removal. Debris is removed from state highways throughout the County of Kern including Arvin, California City, Delano, Maricopa, McFarland, Ridgecrest, Shafter, Taft, Tehachapi, and Wasco. The City of Bakersfield employs ~~uses~~ clients from the Bakersfield Homeless Shelter to carry out the contract for safety-related hazard and obstruction removal from the state highways within the City of Bakersfield providing employment opportunities.

The KMAA plans to acquire portable changeable message signs for local jurisdictions.

4.6 EMERGENCY SERVICES

4.6.1 Hall Ambulance

Hall Ambulance is the largest emergency service provider in the Kern region and has developed many ITS technologies for their fleet. Each vehicle is equipped with automatic vehicle location (AVL) technology. Hall Ambulance has a computer aided dispatch center. Hall Ambulance has both ground and air transport.

4.6.2 Kern County Emergency Operations Center

The Kern County Emergency Operations Center (EOC) is a centralized location to support multi-agency and/or multi-jurisdiction disaster response coordination and communication. Unique to the State of California is the definition of an Operational Area, which includes all political subdivisions within the County boundary. On behalf of the Kern Operational Area, the Kern County EOC will serve as the designated point of contact between the jurisdictions within the County, as well as between the State and the Operational Area.

5.0 ITS USER NEEDS ASSESSMENT AND RELEVANT SERVICE PACKAGES

This section describes the ITS User Needs Assessment to determine whether existing or planned ITS projects meet the needs of the region. The countywide ITS inventory consists of existing and planned (near term) systems owned and/or operated by Kern Region ITS stakeholders and the User Needs were developed with input from stakeholders. 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

The process of collecting direct stakeholder input on ITS Needs was carried out with the help of a comprehensive "strawman" list of ITS Needs. The strawman list of ITS Needs was used as a starting point to prompt input from the stakeholder group, rather than starting out with a blank sheet of paper. The strawman list was developed based on knowledge of the Kern Region, as well as experience in developing Regional ITS Architectures in other similar regions. Understanding documented long-term policies and goals, where they were available, was helpful in executing a sound needs analysis.

The ITS User Needs on the strawman list were broken into categories consistent with the National ITS Architecture service areas of:

- Archived Data Management
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Commercial Vehicle Operations
- Emergency Management
- Maintenance and Construction Management

In a workshop setting, project stakeholders were asked to provide their priority rankings on a series of wall charts that contained the strawman list. Stakeholders were given a set of color coded adhesive dots that they then placed on the wall charts. The different colored adhesive dots corresponded to different point values. Red dots were assigned a point value of 5; yellow dots were assigned appoint value of 3; green dots were assigned a point value of 1; and blue dots were assigned a point value of 0 (zero), which also corresponded to a more subjective "not needed" category. Stakeholders were also given the opportunity to provide verbal input, as well as written input after the February 2017 workshops concluded. Exercise worksheets were posted to the Kern

COG ITS website and therefore the report reflects responses received after the workshop via email as well. Stakeholders not able to attend the workshop were given the opportunity to comment. This exercise provided an objective scoring and ranking of ITS User Needs for the Kern Region.

The scores from the above described ranking process were tallied and an initial ranking of ITS User Needs was developed. During the review period, stakeholders were given an opportunity to provide additional input. The additional input resulted in some manual adjustments to the ranking of ITS User Needs. The employment of this secondary, subjective ranking opportunity ensured that the User Needs Assessment truly reflects the needs of the regional stakeholders.

Ultimately, regardless of the numerical ranking in this prioritization process, the ITS User Needs rankings, and other subsequent prioritization efforts on this project, were assigned a priority ranking either, "High," "Medium," or "Low." This grouping of priorities takes away the discrete numerical rankings and places the ITS User Needs into more relative priority categories.

5.2 ITS USER NEEDS ASSESSMENT RESULTS

The results of the ITS User Needs Assessment is shown in **Appendix A** and contains the listing of all the ITS Needs in the strawman list that received at least 1 point. The table is sorted by Total Points and ITS Needs appear in order from most Total Points to fewest (non-zero) Total Points. The category with the highest Total Points is Traveler Information, with over 75 percent of stakeholders assigning it a high priority. The total points range from a maximum score of 129 (Traveler Information: Provide routing (detour) information to travelers during incident, construction, weather events, special events, etc.) to a minimum score of 18 (Freeway Management: Implement automated/remote control gate systems).

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.

Service Packages in the National ITS Architecture are organized into eight service areas, which are as follows:

- Archived Data Management
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety

- Commercial Vehicle Operations
- Emergency Management
- Maintenance and Construction Management

The strawman list of ITS User Needs used to prioritize ITS User Needs was organized by the same eight service areas. Therefore, the results of the ITS User Needs Assessment generally translates into a prioritization, or ranking, of needed Service Packages for the Kern Region.

Table 5-1~~Table 5-1~~ is a diagram of a Service Package as taken from the National ITS Architecture. The "Traffic Management" and "Roadway" boxes represent Traffic Management and Roadway Subsystems in the National ITS Architecture. The boxes within the Traffic Management and Roadway Subsystems are Equipment Packages from the National ITS Architecture. Equipment packages group similar processes of a particular subsystem together into an implementable package. The yellow boxes with the rounded corners are Terminators in the National ITS Architecture. Terminators represent the people, systems, and general environment that interface to ITS. Terminators are identified in the National ITS Architecture, but do not have Functional Requirements defined within the National ITS Architecture.

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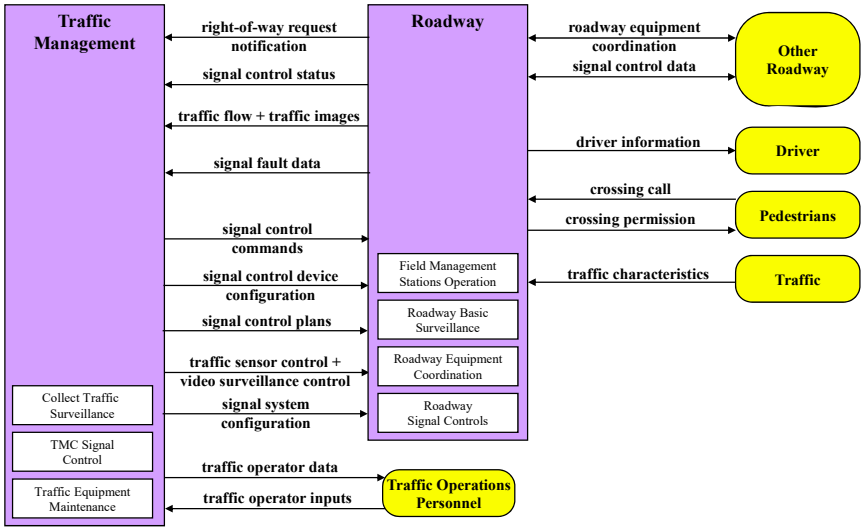
Table 5-1. Traffic Signal Control Service Package

ATMS03 – Traffic Signal Control



5.4 MAPPING ITS USER NEEDS TO ITS STRATEGIES

This section of the document describes the recommended ITS Strategies and their relationship to the ITS User Needs prioritized by the stakeholder group. It further describes the ITS Strategies in the context of the Regional ITS Architecture.

Table 5-2~~Table 5-2~~ shows the recommended ITS Strategies for the Kern Region and the ITS User Needs they address. These ITS User Needs are the ones that are considered priority ITS User Needs for the Kern Region.

As shown in Table 5-2~~Table 5-2~~, each recommended ITS Strategy addresses one or more of the ITS User Needs. Likewise, the table illustrates how each ITS User Need is addressed and/or supported by one or more ITS Strategies. For example, ITS Strategy 10 – ITS Data Warehouse addresses the ITS User Needs: "improve information exchange between Caltrans, local transportation agencies, and transit agencies," "use archived data for planning modeling, analysis, and traffic management strategy development," "improve data collection capabilities and archiving on freeways/expressways," and "implement a central information/data clearinghouse."

The next sections discuss the recommended ITS Strategies in the contexts of the ITS User Needs in accordance with the ITS Architecture. A total of 66 ITS Strategies were recommended to collectively address the User Needs identified by the stakeholder group. Specifically, each recommended ITS Strategy is described in terms of the Program Areas, the ITS User Needs addressed, and relevant ITS service packages.

A priority score cut-off of 70 was applied to the ITS Strategies, meaning that ITS Strategies that are associated with ITS User Needs with highest priority scores of 70 and above are considered high priority strategies. In Table 5-2~~Table 5-2~~Table 5-2, ITS Strategies with highest ITS User Needs corresponding with priority scores under 70 are greyed out. These lower priority ITS Strategies will continue to be considered in the future, but higher priority ITS Strategies will likely take precedent. The cut off was established at 70 because it represented a natural breaking point. The strategies that fell below the cut off were not mentioned as a high priority in the October workshop with stakeholders. When examining other cut off points, 80 points for example, it excluded strategies that the stakeholders represented as a priority.

Descriptions of each ITS Strategy are included in **Appendix B**.

~~**Appendix C** of the ITS User Needs to ITS Strategies for viewing on 11x17 size sheets.~~ Relationships ~~B~~between ITS User Needs and Recommended ITS Strategies may be viewed on 11" x 17" size sheets in **Appendix C.**

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Table 5-2: Relationships between ITS User Needs and Recommended ITS Strategies

			ITS User Needs																																
			Provide information and routing (detour) information to travelers during incident, construction, weather events, special events, etc.	Provide/enhance road weather conditions information to travelers	Improve signal timing/Coordination	Improve information exchange between Caltrans, local transportation agencies and transit agencies	Provide roadway closure/restriction information	Coordinate construction and maintenance project schedules within and between agencies	Reduce recurring traffic congestion	Provide incident and real-time traffic information to emergency responders and emergency management agencies	Warn work crews of errant vehicles	Share congestion information with other agencies	Improve a multi-agency, system-coordinated response to major incidents	Reduce incident clearance time	Receive real-time roadway congestion information	Provide/enhance congestion information to travelers	Use archived data for planning, modeling, analysis and traffic management strategy development	Provide more timely incident information to travelers and improve quality, consistency and thoroughness of traveler information	Improve communications in rural areas	Improve response to HAZMAT incidents	Improve incident notification to agencies and improve interagency communications	Provide information on roadway construction and maintenance activities	Monitor queue lengths in/near work zones and provide advisory to warn traffic of a stopped queue in/near work zones	Improve data collection capabilities and archiving on freeways/expressways	Monitor transportation infrastructure	Improve incident response	Provide/enhance enforcement in work zones	Provide/enhance speed enforcement at high risk locations	Use social media for traveler information dissemination	Improve 511 system/web site, enhance freeway/expressway traffic map, and enhance arterial traffic map	Share public safety/computer aided dispatch (CAD) data with transportation agencies	Provide travel times/delays through work zones
		User Priority Points	**129**	**122**	**118**	**116**	**116**	**113**	**107**	**103**	**102**	**99**	**99**	**97**	**96**	**96**	**95**	**95**	**95**	**93**	**93**	**93**	**93**	**92**	**91**	**91**	**91**	**90**	**89**	**89**	**89**	**89**
ITS Strategies	1	Intelligent Access Program – Weight Monitoring																																	
	2	Freight-Specific Dynamic Travel Planning																																	
	3	Road Weather Information for Freight Carriers																																	
	4	HAZMAT Management																		x															
	5	Carrier Operations and Fleet Management																		x															
	6	CV Administrative Processes																																	
	7	Roadside CVO Safety																																	
	8	Roadside HAZMAT Security Detection and Mitigation																		x															
	9	Smart Roadside and Virtual WIM																																	
	10	ITS Data Warehouse				x											x							x											
	11	Performance Monitoring															x							x	x										
	12	Transit Vehicle Tracking													x																				
	13	Multi-modal Coordination																																	
	14	Transit Connection Protection																																	
	15	Transit Traveler Information																																	
	16	Transit Fleet Management																																	
	17	Transit Security																																	
	18	Route ID for the Visually Impaired																																	
	19	Dynamic Transit Operations																																	
	20	Transit Signal Priority																																	
	21	Transit Passenger Counting																																	
	22	Transit Fixed-Route Operations													x																				
	23	Dynamic Ridesharing and Shared Use Transportation																																	
	24	Broadcast Traveler Information					x									x		x												x	x				

		ITS User Needs																																
		Coordinate timed transfers between routes, providers and modes	Expand coverage of environmental/weather/road conditions detection/monitoring systems	Develop mobile apps to provide static and real-time transit information	Implement regional smart card for transit fare payment	Expand/enhance/upgrade computer aided dispatch (CAD) system	Provide roadway flood warnings	Provide transit information using social media	Reduce traffic congestion during incidents	Send email alerts of major incidents to major employers	Implement a central information/data clearinghouse	Enhance 511 to provide static and real-time transit information	Upgrade signal hardware	Expand emergency vehicle preemption	Implement/enhance web-based trip planner	Share incident information with other agencies	Coordinate arterial and freeway management strategies	Provide real-time transit arrival/departure information on web site and at bus stops	Improve/implement ability to remotely modify signal timing	Provide/enhance mobile data terminals for emergency vehicles	Expand/enhance/upgrade automatic vehicle location (AVL) system	Provide better vehicle restrictions and roadway closure information to commercial vehicles	Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities	Provide freeway/expressway travel times and Provide arterial travel times (on major arterials)	Implement transit signal priority technology	Implement intersection collision warning/avoidance systems	Provide tracking of HAZMAT vehicles	Improve ridesharing program/website	Share surveillance video and data with PSAPs/emergency responders	Provide target enforcement at locations with history of violations	Expand CCTV camera coverage on arterials and freeways/expressways
User Priority Points		88	88	87	86	86	86	85	85	85	84	84	82	82	81	81	80	79	79	78	76	75	75	75	74	73	72	71	71	69	69
ITS Strategies	1	Intelligent Access Program – Weight Monitoring																																
	2	Freight-Specific Dynamic Travel Planning																				x												
	3	Road Weather Information for Freight Carriers																																
	4	HAZMAT Management																									x							
	5	Carrier Operations and Fleet Management																				x												
	6	CV Administrative Processes																																
	7	Roadside CVO Safety																																
	8	Roadside HAZMAT Security Detection and Mitigation																																
	9	Smart Roadside and Virtual WIM																															x	
	10	ITS Data Warehouse										x																						
	11	Performance Monitoring																																
	12	Transit Vehicle Tracking														x			x			x												
	13	Multi-modal Coordination	x																															
	14	Transit Connection Protection	x																															
	15	Transit Traveler Information			x				x				x			x			x															
	16	Transit Fleet Management																																
	17	Transit Security																						x										
	18	Route ID for the Visually Impaired																																
	19	Dynamic Transit Operations																																
	20	Transit Signal Priority																								x								
	21	Transit Passenger Counting																																
	22	Transit Fixed-Route Operations					x																											
	23	Dynamic Ridesharing and Shared Use Transportation																											x					
	24	Broadcast Traveler Information									x														x									

			ITS User Needs																																	
			Implement/improve incident detection capabilities	Implement Smart Work Zone technology	Implement/enhance remote monitoring of transit vehicle mechanical condition	Develop/implement system-wide arterial management strategies	Monitor/collect air quality data	Provide on-line reservation system for demand-responsive transit services	Provide curve speed warning	Provide on-board automated enunciators	Reduce vehicle delays at rail grade crossings, Provide health monitoring of traffic signal equipment at intersections and rail crossings	Provide vehicle-over-height detection/warnings	Reduce commercial vehicle weight, width and height violations	Expand/upgrade automated passenger counters	Provide information on commercial vehicle operations (CVO) permit restrictions	Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles and emergency vehicles	Provide interstate/inter-regional traveler information for commercial vehicles	Implement/expand dynamic message sign (DMS) installations on arterials and freeways	Implement/improve inter-jurisdictional signal coordination	Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol	Provide information on available truck parking facilities	Deploy weigh-in-motion/mobile weigh enforcement technology	Improve/expand vehicle detection coverage on freeways/expressways	Warn travelers about trucks entering/existing work zones	Implement variable speed limits	Monitor queue lengths at ramp locations	Expand highway advisory radio (HAR) coverage on freeways/expressways	Improve ramp metering operations	Track locations of maintenance fleet	Implement automated/remote control gate systems
		User Priority Points	**69**	**69**	**68**	**68**	**68**	**66**	**66**	**64**	**63**	**61**	**59**	**59**	**58**	**56**	**54**	**54**	**53**	**53**	**53**	**52**	**51**	**51**	**50**	**49**	**45**	**44**	**43**	**18**
ITS Strategies	1	Intelligent Access Program – Weight Monitoring											x		x							x								
	2	Freight-Specific Dynamic Travel Planning													x		x													
	3	Road Weather Information for Freight Carriers															x													
	4	HAZMAT Management																												
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	7	Roadside CVO Safety													x															
	8	Roadside HAZMAT Security Detection and Mitigation																												
	9	Smart Roadside and Virtual WIM																				x								
	10	ITS Data Warehouse																												
	11	Performance Monitoring																												
	12	Transit Vehicle Tracking																												
	13	Multi-modal Coordination																												
	14	Transit Connection Protection																												
	15	Transit Traveler Information								x																				
	16	Transit Fleet Management			x																									
	17	Transit Security																												
	18	Route ID for the Visually Impaired								x																				
	19	Dynamic Transit Operations						x																						
	20	Transit Signal Priority																												
	21	Transit Passenger Counting												x																
	22	Transit Fixed-Route Operations																												
	23	Dynamic Ridesharing and Shared Use Transportation																												
	24	Broadcast Traveler Information																									x			

			ITS User Needs																													
			Provide information and routing (detour) information to travelers during incident, construction, weather events, special events, etc.	Provide/enhance road weather conditions information to travelers	Improve signal timing/coordination	Improve information exchange between Caltrans, local transportation agencies and transit agencies	Provide roadway closure/restriction information	Coordinate construction and maintenance project schedules within and between agencies	Reduce recurring traffic congestion	Provide incident and real-time traffic information to emergency responders and emergency management agencies	Warn work crews of errant vehicles	Share congestion information with other agencies	Improve a multi-agency, system-coordinated response to major incidents	Reduce incident clearance time	Receive real-time roadway congestion information	Provide/enhance congestion information to travelers	Use archived data for planning, modeling, analysis and traffic management strategy development	Provide more timely incident information to travelers and improve quality, consistency and thoroughness of traveler information	Improve communications in rural areas	Improve response to HAZMAT incidents	Improve incident notification to agencies and improve interagency communications	Provide information on roadway construction and maintenance activities	Monitor queue lengths in/near work zones and provide advisory to warn traffic of a stopped queue in/near work zones	Improve data collection capabilities and archiving on freeways/expressways	Monitor transportation infrastructure	Improve incident response	Provide/enhance enforcement in work zones	Provide/enhance speed enforcement at high risk locations	Use social media for traveler information dissemination	Improve 511 system/web site, enhance freeway/expressway traffic map, and enhance arterial traffic map	Share public safety/computer aided dispatch (CAD) data with transportation agencies	Provide travel times/delays through work zones
		User Priority Points	129	122	118	116	116	113	107	103	102	99	99	97	96	96	95	95	95	93	93	93	93	92	91	91	91	90	89	89	89	89
ITS Strategies	25	Traffic Information Dissemination										x						x													x	
	26	Personalized Traveler Information														x		x														
	27	Dynamic Route Guidance	x				x									x																
	28	Traffic Incident Management System																													x	
	29	Regional Traffic Management			x				x			x																				
	30	Traffic Signal Control			x				x																							
	31	Connected Vehicle Traffic Signal System			x																											
	32	Infrastructure-Based Traffic Surveillance																														
	33	Speed Warning and Enforcement																										x				
	34	Traffic Metering							x																							
	35	Speed Harmonization							x																							
	36	Dynamic Lane Management and Shoulder Use							x																							
	37	Railroad Operations Coordination																														
	38	Advanced Railroad Grade Crossing																														
	39	Standard Railroad Grade Crossing																														
	40	Vehicle-Based Traffic Surveillance																														
	41	Roadway Closure Management																														
	42	Variable Speed Limits																														
	43	Routing Support for Emergency Responders								x				x												x						
	44	Vehicle Emergency Response								x				x												x						
	45	Emergency Call-Taking and Dispatch											x	x												x						
	46	Roadway Service Patrols												x																		

			ITS User Needs																																			
			Coordinate timed transfers between routes, providers and modes	Expand coverage of environmental/weather/road conditions detection/monitoring systems	Develop mobile apps to provide static and real-time transit information	Implement regional smart card for transit fare payment	Expand/enhance/upgrade computer aided dispatch (CAD) system	Provide roadway flood warnings	Provide transit information using social media	Reduce traffic congestion during incidents	Send email alerts of major incidents to major employers	Implement a central information/data clearinghouse	Enhance 511 to provide static and real-time transit information	Upgrade signal hardware	Expand emergency vehicle preemption	Implement/enhance web-based trip planner	Share incident information with other agencies	Coordinate arterial and freeway management strategies	Provide real-time transit arrival/departure information on web site and at bus stops	Improve/implement ability to remotely modify signal timing	Provide/enhance mobile data terminals for emergency vehicles	Expand/enhance/upgrade automatic vehicle location (AVL) system	Provide better vehicle restrictions and roadway closure information to commercial vehicles	Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities	Provide freeway/expressway travel times and Provide arterial travel times (on major arterials)	Implement transit signal priority technology	Implement intersection collision warning/avoidance systems	Provide tracking of HAZMAT vehicles	Improve ridesharing program/website	Share surveillance video and data with PSAPs/emergency responders	Provide target enforcement at locations with history of violations	Expand CCTV camera coverage on arterials and freeways/expressways
		User Priority Points	88	88	87	86	86	86	85	85	85	84	84	82	82	81	81	80	79	79	78	76	75	75	75	74	73	72	71	71	69	69
ITS Strategies	25	Traffic Information Dissemination						x									x								x							
	26	Personalized Traveler Information									x														x							
	27	Dynamic Route Guidance																														
	28	Traffic Incident Management System								x							x	x												x		
	29	Regional Traffic Management								x							x	x														
	30	Traffic Signal Control												x						x												
	31	Connected Vehicle Traffic Signal System												x													x					
	32	Infrastructure-Based Traffic Surveillance																		x												x
	33	Speed Warning and Enforcement																														
	34	Traffic Metering																														
	35	Speed Harmonization																														
	36	Dynamic Lane Management and Shoulder Use																														
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	41	Roadway Closure Management																														
	42	Variable Speed Limits																														
	43	Routing Support for Emergency Responders																			x											
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	45	Emergency Call-Taking and Dispatch																														
	46	Roadway Service Patrols																														

			ITS User Needs																														
			Implement/improve incident detection capabilities	Implement Smart Work Zone technology	Implement/enhance remote monitoring of transit vehicle mechanical condition	Develop/implement system-wide arterial management strategies	Monitor/collect air quality data	Provide on-line reservation system for demand-responsive transit services	Provide curve speed warning	Provide on-board automated enunciators	Reduce vehicle delays at rail grade crossings, Provide health monitoring of traffic signal equipment at intersections and rail crossings	Provide vehicle-over-height detection/warnings	Reduce commercial vehicle weight, width and height violations	Expand/upgrade automated passenger counters	Provide information on commercial vehicle operations (CVO) permit restrictions	Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles and emergency vehicles	Provide interstate/inter-regional traveler information for commercial vehicles	Implement/expand dynamic message sign (DMS) installations on arterials and freeways	Implement/improve inter-jurisdictional signal coordination	Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol	Provide information on available truck parking facilities	Deploy weigh-in-motion/mobile weigh enforcement technology	Improve/expand vehicle detection coverage on freeways/expressways	Warn travelers about trucks entering/existing work zones	Implement variable speed limits	Monitor queue lengths at ramp locations	Expand highway advisory radio (HAR) coverage on freeways/expressways	Improve ramp metering operations	Track locations of maintenance fleet	Implement automated/remote control gate systems
		User Priority Points	**69**	**69**	**68**	**68**	**68**	**66**	**66**	**64**	**63**	**61**	**59**	**59**	**58**	**56**	**54**	**54**	**53**	**53**	**53**	**52**	**51**	**51**	**50**	**49**	**45**	**44**	**43**	**18**
ITS Strategies	25	Traffic Information Dissemination																x												
	26	Personalized Traveler Information																												
	27	Dynamic Route Guidance																												
	28	Traffic Incident Management System				x																								
	29	Regional Traffic Management				x													x											
	30	Traffic Signal Control																	x											
	31	Connected Vehicle Traffic Signal System				x																								
	32	Infrastructure-Based Traffic Surveillance	x																				x							
	33	Speed Warning and Enforcement																												
	34	Traffic Metering																										x		
	35	Speed Harmonization																							x					
	36	Dynamic Lane Management and Shoulder Use																												
	37	Railroad Operations Coordination									x																			
	38	Advanced Railroad Grade Crossing									x																			
	39	Standard Railroad Grade Crossing									x																			
	40	Vehicle-Based Traffic Surveillance	x																				x							
	41	Roadway Closure Management																												x
	42	Variable Speed Limits																							x					
	43	Routing Support for Emergency Responders																												
	44	Vehicle Emergency Response																												
	45	Emergency Call-Taking and Dispatch																			x									
	46	Roadway Service Patrols														x					x									

			ITS User Needs																													
			Provide information and routing (detour) information to travelers during incident, construction, weather events, special events, etc.	Provide/enhance road weather conditions information to travelers	Improve signal timing/coordination	Improve information exchange between Caltrans, local transportation agencies and transit agencies	Provide roadway closure/restriction information	Coordinate construction and maintenance project schedules within and between agencies	Reduce recurring traffic congestion	Provide incident and real-time traffic information to emergency responders and emergency management agencies	Warn work crews of errant vehicles	Share congestion information with other agencies	Improve a multi-agency, system-coordinated response to major incidents	Reduce incident clearance time	Receive real-time roadway congestion information	Provide/enhance congestion information to travelers	Use archived data for planning, modeling, analysis and traffic management strategy development	Provide more timely incident information to travelers and improve quality, consistency and thoroughness of traveler information	Improve communications in rural areas	Improve response to HAZMAT incidents	Improve incident notification to agencies and improve interagency communications	Provide information on roadway construction and maintenance activities	Monitor queue lengths in/near work zones and provide advisory to warn traffic of a stopped queue in/near work zones	Improve data collection capabilities and archiving on freeways/expressways	Monitor transportation infrastructure	Improve incident response	Provide/enhance enforcement in work zones	Provide/enhance speed enforcement at high risk locations	Use social media for traveler information dissemination	Improve 511 system/web site, enhance freeway/expressway traffic map, and enhance arterial traffic map	Share public safety/computer aided dispatch (CAD) data with transportation agencies	Provide travel times/delays through work zones
		User Priority Points	129	122	118	116	116	113	107	103	102	99	99	97	96	96	95	95	95	93	93	93	93	92	91	91	91	90	89	89	89	89
ITS Strategies	47	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders								x				x												x						
	48	Emergency Vehicle Preemption												x												x						
	49	Mayday Notification																								x						
	50	Transportation Infrastructure Protection																							x							
	51	Wide-Area Alert																	x		x											
	52	Early Warning System											x								x											
	53	Evacuation and Reentry Management											x																			
	54	Disaster Response and Recovery											x								x											
	55	Maintenance and Construction Activity Coordination						x														x										
	56	Work Zone Management						x																			x					x
	57	Work Zone Safety Monitoring									x																					
	58	Maintenance and Construction Vehicle and Equipment Tracking																														
	59	Roadway Maintenance and Construction						x																								
	60	Curve Speed Warning																														
	61	Road Weather Motorist Alert and Warning		x																												
	62	Oversize Vehicle Warning																														
	63	Weather Information Processing and Distribution																														
	64	Weather Data Collection																														
	65	Spot Weather Impact Warning																														
	66	Parking Space Management																														

			ITS User Needs																																
			Coordinate timed transfers between routes, providers and modes	Expand coverage of environmental/weather/road conditions detection/monitoring systems	Develop mobile apps to provide static and real-time transit information	Implement regional smart card for transit fare payment	Expand/enhance/upgrade computer aided dispatch (CAD) system	Provide roadway flood warnings	Provide transit information using social media	Reduce traffic congestion during incidents	Send email alerts of major incidents to major employers	Implement a central information/data clearinghouse	Enhance 511 to provide static and real-time transit information	Upgrade signal hardware	Expand emergency vehicle preemption	Implement/enhance web-based trip planner	Share incident information with other agencies	Coordinate arterial and freeway management strategies	Provide real-time transit arrival/departure information on web site and at bus stops	Improve/implement ability to remotely modify signal timing	Provide/enhance mobile data terminals for emergency vehicles	Expand/enhance/upgrade automatic vehicle location (AVL) system	Provide better vehicle restrictions and roadway closure information to commercial vehicles	Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities	Provide freeway/expressway travel times and Provide arterial travel times (on major arterials)	Implement transit signal priority technology	Implement intersection collision warning/avoidance systems	Provide tracking of HAZMAT vehicles	Improve ridesharing program/website	Share surveillance video and data with PSAPs/emergency responders	Provide target enforcement at locations with history of violations	Expand CCTV camera coverage on arterials and freeways/expressways
		User Priority Points	88	88	87	86	86	86	85	85	85	84	84	82	82	81	81	80	79	79	78	76	75	75	75	74	73	72	71	71	69	69
ITS Strategies	47	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders																														
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	53	Evacuation and Reentry Management																														
	54	Disaster Response and Recovery																														
	55	Maintenance and Construction Activity Coordination																														
	56	Work Zone Management																														
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	58	Maintenance and Construction Vehicle and Equipment Tracking																														
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	62	Oversize Vehicle Warning																														
	63	Weather Information Processing and Distribution		x																												
	64	Weather Data Collection		x																												
	65	Spot Weather Impact Warning		x																												
	66	Parking Space Management																														

			ITS User Needs																																
			Implement/improve incident detection capabilities	Implement Smart Work Zone technology	Implement/enhance remote monitoring of transit vehicle mechanical condition	Develop/implement system-wide arterial management strategies	Monitor/collect air quality data	Provide on-line reservation system for demand-responsive transit services	Provide curve speed warning	Provide on-board automated enunciators	Reduce vehicle delays at rail grade crossings, Provide health monitoring of traffic signal equipment at intersections and rail crossings	Provide vehicle-over-height detection/warnings	Reduce commercial vehicle weight, width and height violations	Expand/upgrade automated passenger counters	Provide information on commercial vehicle operations (CVO) permit restrictions	Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles and emergency vehicles	Provide interstate/inter-regional traveler information for commercial vehicles	Implement/expand dynamic message sign (DMS) installations on arterials and freeways	Implement/improve inter-jurisdictional signal coordination	Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol	Provide information on available truck parking facilities	Deploy weigh-in-motion/mobile weigh enforcement technology	Improve/expand vehicle detection coverage on freeways/expressways	Warn travelers about trucks entering/existing work zones	Implement variable speed limits	Monitor queue lengths at ramp locations	Expand highway advisory radio (HAR) coverage on freeways/expressways	Improve ramp metering operations	Track locations of maintenance fleet	Implement automated/remote control gate systems
		User Priority Points	**69**	**69**	**68**	**68**	**68**	**66**	**66**	**64**	**63**	**61**	**59**	**59**	**58**	**56**	**54**	**54**	**53**	**53**	**53**	**52**	**51**	**51**	**50**	**49**	**45**	**44**	**43**	**18**
ITS Strategies	47	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders																												
	48	Emergency Vehicle Preemption																												
	49	Mayday Notification																												
	50	Transportation Infrastructure Protection																												
	51	Wide-Area Alert																												
	52	Early Warning System																												
	53	Evacuation and Reentry Management																												
	54	Disaster Response and Recovery																												
	55	Maintenance and Construction Activity Coordination																												
	56	Work Zone Management																						x						
	57	Work Zone Safety Monitoring		x																				x						
	58	Maintenance and Construction Vehicle and Equipment Tracking		x																									x	
	59	Roadway Maintenance and Construction																												
	60	Curve Speed Warning							x																					
	61	Road Weather Motorist Alert and Warning																												
	62	Oversize Vehicle Warning										x																		
	63	Weather Information Processing and Distribution																												
	64	Weather Data Collection																												
	65	Spot Weather Impact Warning																												
	66	Parking Space Management																			x									

6.0 VISION, GOALS, AND OBJECTIVES

The vision statement is important for bringing focus and structure to the ITS planning process. The project vision statement features a picture of what the regional ITS program can become in the future and is an important tool for communicating the intent of the ITS plan to agency management and staff, the public, and the funding decision makers.

The ITS objectives from the 2001 SDP were reviewed at stakeholder workshops in order to obtain input from the stakeholder group. There were 43 participants representing 18 agencies at the workshops. The statement reflects the work, input, and local knowledge of the group, and represents a common view of the role of ITS in addressing transportation issues in Kern Region.

During the first set of stakeholder workshops, the project stakeholders were presented the vision statement from the 2001 SDP and the 2015-2019 USDOT ITS Strategic Plan and asked to provide input on creating a vision statement. The following input was provided:

- Centralized and accurate real-time data source
- Ease of obtaining information while mobile
- Inter- and intra-region coordination and connectivity
- Transportation system must accommodate the three distinct geographies in the Kern region
- Integrate regional and local transit
- Explore shared mobility solutions
- Public/Private coordination throughout all phases of project delivery or emergency management through improved communication
- Sustainability
- Identify funding for ITS investment

The project vision statement reads:

"Through community ITS investment, coordination and data sharing between transportation agencies, travel in Kern is safe and efficient."

6.1 VISION ELEMENTS

The Vision Elements presented in the following paragraphs are based on vision statements developed in the 2001 SDP. By their very nature, these Vision Elements are future-based and are meant to provide direction to the Kern Region ITS stakeholder group. The Vision Elements remain somewhat generalized, and high-level, though some examples are provided where pertinent systems or capabilities exist in the Kern Region. The stakeholder group was invited to review the

current state of ITS in the Kern Region, and the direction in which the stakeholders would like to see ITS progress.

6.1.1 Freeway Management

Caltrans has deployed multi-faceted freeway management systems in Kern County. These systems provide the ability to quickly identify traffic accidents and other incidents, and adverse weather and pavement conditions, and convey this information to travelers and other transportation agencies. The vision for freeway management is to share traffic data with other freeway management centers or arterial management centers as well as enhance the Caltrans Central Valley Transportation Management Center by adding and upgrading equipment and capabilities.

6.1.2 Arterial Management

Caltrans, the City of Bakersfield and the County of Kern all have signal preemption for emergency vehicles. Previous efforts undertaken by Caltrans, the City of Bakersfield, and the County of Kern have focused on signal system improvements and/or traffic surveillance. This focus is expected to continue, but with a growing emphasis on other local traffic management technologies as well.

6.1.3 Incident Management

The incident management vision for the County is to enhance interagency incident response and coordination through the application of ITS technologies, and the continuance of the County Emergency Operations Center. This vision also includes the promotion of real-time data sharing to improve all aspects of incident management. Quick and accurate verification followed by rapid dissemination of motorist information by ITS means will prevent secondary collisions, improve traffic flow, and reduce emissions.

6.1.4 Public Transportation

The transit ITS vision for the area focuses around increasing the capabilities and scope of the existing technology deployments at Golden Empire Transit District, Delano Area Rapid Transit and Kern Transit while building a simple, effective system for smaller fixed route properties and dial-a-ride operations. The goal is to maximize compatibility between urban and rural systems throughout the valley. This vision also incorporates enhanced cooperation and coordination between local transit agencies, which includes the potential for consolidated transit services.

6.1.5 Traveler Information

The vision for traveler information in the area is to provide information based on the existing and expanding capabilities of the existing and planned transportation management systems, while at the same time, to prepare for statewide transportation information deployment efforts. Traveler information must be timely and useful, providing traffic and weather conditions for commuters, commercial vehicles and visitors to the region. Kern 511 is a free traveler information service that gives traffic conditions, transit information and roadwork information in the Kern County area via a toll-free phone number and website. People can call 511 or visit kern511.org to check real time traffic speeds, find traffic alerts, plan a trip on a bus or train, and even find a carpool or vanpool partner.

6.1.6 Agency Coordination and Systems Integration

The systems integration vision for the area is based on previous successes. The concept is to utilize the national and statewide architectures as a basis, and then provide for coordinated deployments and standards within the County.

6.1.7 Commercial Operations

In coordination with national and regional initiatives, commercial carriers will be able to drive along the I-5, SR 58, and SR 99 corridors with minimal delays at weigh and inspection stations. Systems will electronically weigh and inspect commercial vehicles, and collect other motor carrier information. Other systems will enable the electronic issuance and monitoring of permits from regulatory agencies. Commercial carriers will have access to traveler information systems that can assist with routing, scheduling and dispatching optimization, as well as guidance to available parking areas. Connected vehicle technology will allow for platooning. Autonomous vehicles will travel safely and efficiently.

6.1.8 Travel Demand

CommuteKern provides a free rideshare matching service. Users who wish to rideshare can immediately determine potential candidates and dynamically create carpools via online registration to help reduce the number of vehicles on the roadway. ITS technologies will allow for detailed traffic data collection and analysis. This information can support demand management techniques.

6.1.9 Emergency Management

ITS infrastructure, along with companion decision support systems, have the capability of notifying authorities of the need to dispatch emergency vehicles and other resources to the site of collisions or incidents. The ITS infrastructure is supplemented by information from the public, as well as agency staff monitoring decision support systems and traffic management systems. Systems will coordinate the response from fire, police and medical agencies for fast response in the most appropriate manner. Other systems will coordinate the removal of incidents to promote the timely return of the travel network to optimal performance.

6.1.10 Air Quality

Air quality will be improved through the increased efficiency and use of transportation systems including demand management strategies. Dynamic ride sharing systems will encourage the use of high occupancy vehicles. Traveler information systems will decrease the amount of vehicle miles traveled through better trip and travel planning. Public transportation systems have improved the availability of information to transit riders, and enhances the visibility and flexibility of transit, thereby increasing the use of transit. Traffic management systems smooth the flow of vehicles and reduce vehicle emissions due to inefficient traffic flow. Detection systems will monitor vehicle emissions and support inspection/maintenance efforts.

6.1.11 Intermodal and Multi-modal Cooperation

The future of the Kern Region starts with the mutual cooperation between transportation agencies. All agencies and transportation providers will work together to promote and encourage safe and efficient operation of the transportation network. These agencies and providers will work together to plan, design, implement and operate ITS systems.

6.2 GOALS AND OBJECTIVES

This section provides an overview of the development of the ITS Kern goals and objectives, and presents those goals and objectives.

6.2.1 Methodology to Develop Goals and Objectives

Prior to identifying goals and objectives to guide the ITS Plan effort and the ITS activities that will follow, goals and objectives from other California ITS plans and the 2014 Kern County Regional Transportation Plan were reviewed. Two distinct approaches were identified. The first approach is to identify broad, high-level goals and objectives such as "reduce traffic congestion". The second approach is to directly incorporate goals and objectives from other relevant local and regional sources, such as a regional transportation plan.

The Stakeholders determined the goals for the ITS Plan. The goals and objectives are expressed in a way that the general public can relate to and that would underscore that ITS will solve specific, real transportation problems. Each identified goal is followed by objective statements that focus on different aspects of the same overall issue or concern. A number of the transportation problems have been combined into single objectives, and in a few cases a single problem is listed slightly differently under multiple goals. Stakeholders were given the opportunity to Keep, Delete, or Edit the suggested objectives as well as provide new objectives.

6.2.2 ITS Goals and Objectives

To support the ITS vision the Stakeholders have reviewed and accepted a series of supporting ITS goals. Objectives were assigned to the seven overarching goals listed below.

Goal #1: Reduce Traffic Congestion

Supporting Objectives:

- Reduce the number and duration of accidents and incidents
- Minimize the congestion and delays imposed by slow moving vehicles on other traffic
- Provide local and long-distance travelers with real-time traffic and weather information they need to avoid congestion, or to anticipate congestion
- Reduce the delays and congestion at railroad crossings, especially for emergency vehicles
- Improve the management of traffic at incident scenes, including incident-related traffic diversions
- Increase system efficiency and throughput to maximize existing capacity, by identifying and correcting existing bottlenecks
- Support the deployment of emerging autonomous and connected vehicle technologies that have the potential to increase system efficiency and safety

Goal #2: Reduce the Number, Severity and Duration of Accidents and Incidents

Supporting Objectives:

- Reduce the number and severity of accidents and incidents:
    - Due to weather conditions,
    - Between trucks and autos,
    - Involving agricultural vehicles,
    - Involving pedestrians and bicycles
- Improve setting, monitoring, and enforcement of speed limits
- Improve red light running monitoring and enforcement
- Provide local and long-distance travelers with the information they need to avoid adverse weather conditions, or to anticipate them
- Improve the ability to quickly locate incident scenes, especially in rural areas
- Minimize the safety concerns associated with outdated roadway design
- Improve coordination among Caltrans, CHP and emergency responders to reduce the time needed for incident detection, verification and dispatch
- Improve the ability of travelers to find help quickly in highway emergencies
- Deploy detection technologies that could increase the visibility of bicycles and pedestrians

Goal #3: Improve Transportation and Transit Planning and Operations

Supporting Objectives:

- Promote coordination of transit services among providers to improve network connectivity
- Promote coordination of traffic management among jurisdictions, including traffic signals, construction management and incident management
- Increase the amount, accessibility and quality of data for planning and analysis, and develop new tools and applications that leverages the data that can be shared
- Improve the operation of existing traveler information systems that increases the breadth and reliability of data provided for various modes
- Promote interagency data sharing
- Support the operation of transit priority systems across jurisdictional boundaries

- Promote the usage of open standards to make technologies interoperable

Goal #4: Promote the Efficiency, Safety, Convenience, and Use of Alternative Travel Modes

Supporting Objectives:

- Establish common fare for trips requiring transfers between transit services, including local and intercity or regional, and between fixed-route and demand-responsive service
- Improve the quality, availability and utilization of fixed-route and demand-responsive transit service
- Provide traveler information services such as mobile apps that promote usage of pedestrian, bicycle and ridesharing facilities and services
- Improve safety and security on transit vehicles and at stations and stops
- Increase the availability, quality and ease-of-use of transit route and schedule information
- Improve transit on-time performance
- Support the provision of the multi-modal amenities that are necessary to attract riders who have other options

Goal #5: Improve the Safety and Efficiency of Goods Movement and Reduce the Impacts of Commercial Vehicles on other Traffic and Roadways

Supporting Objectives:

- Improve truck routing and enforcement to minimize damage to roadways
- Improve the availability and awareness of truck parking
- Improve the availability and promote the awareness and use of information for truckers on traffic and weather conditions, truck routes, and other services
- Reduce delays at commercial vehicle facilities, such as weigh stations
- Support future deployment of zero emission freight technology
- Provide freight-focused traveler information

Goal #6: Minimize the Environmental Impacts of Transportation

Supporting Objectives:

- Reduce transportation-related air pollution, including greenhouse gas (GHG) emissions
- Reduce need for roadway capacity expansion by maximizing throughput of existing transportation systems

- Promote and facilitate transportation demand management strategies to reduce vehicle miles traveled by single occupancy vehicle modes

- Promote alternative fuel vehicles and equipment use; provide necessary infrastructure and technology

Goal #7: Improve the mobility of people and freight; Maximize the efficiency and cost effectiveness of the existing and future transportation system.

Supporting Objectives:

- Support more-efficient use of the transportation system through the implementation of Intelligent Transportation Systems technology

- Build upon the momentum and stakeholder coalition generated through the San Joaquin Valley Goods Movement Strategy studies to pursue ITS commercial vehicle projects

- Investigate how ITS can support efforts to improve travel between the inland areas and coastal communities

- Build upon ITS planning efforts in the San Joaquin Valley in conjunction with federal rules (ITS architecture and standards conformity and statewide and metropolitan planning) to expand ITS actions

- Build upon the existing Caltrans District 6 Traffic Management Systems to fill gaps and complete coverage on major facilities, including expansion of their highway closures and restrictions database, to include other agencies

- Capitalize on the extensive ITS technology testing and standards development conducted by Caltrans by using, where appropriate, Caltrans approaches for local traffic management systems

- Build upon best practices from past and current transit ITS deployment experiences in the State of California

- Build upon Caltrans District 6 experience with sharing facilities, equipment, and information between traffic management and California Highway Patrol staff

- Provide traveler information for commercial vehicle operators at truck rest stops

- Improve visibility and access to existing Caltrans' valley-wide alternate route plans

- Coordinate the Bakersfield area Transportation Operations Center with Caltrans' District 6 Transportation Management Center via satellite

- Integrate the ITS capabilities being implemented at Golden Empire Transit (GET) with Bakersfield's traffic management system, including sharing information between the two centers during emergencies

- Facilitate the transfer of lessons learned from GET ITS deployment to other area transit operators, and look for opportunities for those agencies to better coordinate with GET using its ITS capabilities

- Expand the accident reduction campaigns on Kern's rural highways and County roads

7.0 OPERATIONAL ROLES AND RESPONSIBILITIES

The purpose of this section is to identify the roles and responsibilities of Kern 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" regarding 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

This section of the document identifies each operating agency's current and future roles and responsibilities in operating the ITS systems in the Kern Region. The clearly defined operational roles and responsibilities help the Kern Region realize the ITS vision for the region.

The operational roles and responsibilities are categorized in eleven transportation service areas. These transportation service areas provide general classifications of what functions the agencies are providing or will provide. The eleven service areas and their major functions are described below.

Data Management – Archived data systems provide the functions that collect, process, store and utilize transportation data including traffic data, accident data, maintenance and construction data, public transportation data, commercial vehicle data, emission data, parking data and others.

Commercial Vehicle Operations – Commercial vehicle operations represents the administrative functions that support commercial vehicle credentialing, commercial vehicle tax collection, and commercial vehicle safety records and regulations.

Public Safety – Public Safety represents the functions that provide emergency call taking, public safety dispatch, disaster response and evacuation, securing monitoring and other security and public safety-oriented services.

Maintenance and Construction – Maintenance and construction represents the functions that provide construction management and maintenance of roadways, including snow and ice removal.

Parking Management – Parking Management represents the functions that provide enhanced monitoring and management of parking facilities and coordination between parking facilities.

Traffic Management – Traffic management represents the functions that manage a broad range of transportation facilities including freeway systems, rural and suburban highway systems, and urban and suburban traffic control systems.

Public Transportation – Public Transportation represents the functions that plan, manage, operate and maintain transit services. It also includes the function that provides transit traveler information and collects and processes fare payments.

Sustainable Travel – Sustainable Travel represents the functions that use data and management tactics to improve the efficiency of travel or systems for economical purposes.

Traveler Information – Traveler information represents the functions that collect, process, store, and disseminate static and real-time transportation information to the traveling public.

Vehicle Safety – Vehicle Safety represents the use of connected and autonomous vehicle technologies including vehicle-to-vehicle and vehicle-to-infrastructure to enable safety warning applications.

Weather – Weather represents weather data collection, information processing and distribution.

Table 7-1~~Table 7-1~~ presents each operating agencies' current and future roles and responsibilities in operating the ITS systems in the Kern Region.

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Table 7-1: Operational Roles and Responsibilities

Stakeholder	Transportation Service Area	Roles and Responsibilities
California Highway Patrol	Commercial Vehicle Operations	• Exchange safety and/or security information with other agencies • Operate roadside inspection equipment for law and regulations enforcement • Participate in roadside vehicle inspection for law and regulations enforcement
California Highway Patrol	Data Management	• Collect incident and emergency data
California Highway Patrol	Public Safety	• Coordinate emergency response with local emergency management agencies, public safety agencies, and/or transportation agencies • Support disaster response and recovery, and disaster evacuation • Operate CHP Los Angeles Dispatch Center. Provide emergency call-taking and dispatching CHP vehicles. Communicate with Caltrans District offices when Caltrans personnel, equipment, or materials are needed to support incident management and response to emergency calls • Provide disaster-related information to the public • Routinely patrol major roadways including interstates, US highways, and state routes, and enforce motor vehicle laws • Coordinate incident response with Caltrans and local emergency management agencies, public safety agencies, and/or transportation agencies, including road closure
California Highway Patrol	Traffic Management	• Jointly operate the Central Valley TMC with Caltrans • Assist with traffic management during incidents and emergency events

Stakeholder	Transportation Service Area	Roles and Responsibilities
California Highway Patrol	Traveler Information	• Provide road conditions and incident information on public accessible website • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
Caltrans Districts 6 & 9	Data Management	• Collect traffic and incident data • Collect road weather conditions information
Caltrans Districts 6 & 9	Maintenance and Construction	• Communicate maintenance and construction schedule and other related information with local agencies • Perform construction management • Operate road weather information system (RWIS) and collect road weather information along major roadways • Monitor road weather conditions and distribute information to local public safety agencies and transportation agencies
Caltrans Districts 6 & 9	Public Safety	• Share information and personnel with County Emergency Operations Center for emergency response • Support disaster response and recovery, and disaster evacuation • Disseminate disaster-related information to the public • Operate closed-circuit television (CCTV) cameras to detect, verify and monitor traffic incidents • Communicate traffic and incident related information to other agencies
Caltrans District 6	Traffic Management	• Operate the Central Valley TMC
Caltrans District 9	Traffic Management	• Operate TMC/Satellite Operations Center

Stakeholder	Transportation Service Area	Roles and Responsibilities
Caltrans District 6	Traffic Management	• Operate traffic signals on State Highways • Responsible for traffic control on Interstates and State Highways • Communicate traffic related information to other agencies • Manage and control roadside equipment (including traffic signal system, CCTV, changeable message signs (CMS), highway advisory radio (HAR), detection sensors, ramp meters, road weather stations, and others) • Coordinate traffic signal timing (planned)
Caltrans District 9	Traffic Management	• Operate traffic signals on State Highways • Responsible for traffic control on Interstates and State Highways • Communicate traffic related information to other agencies • Manage and control roadside equipment (including traffic signal system, CCTV, CMS, HAR, detection sensors, road weather stations, and others)
Caltrans Districts 6 & 9	Traveler Information	• Operate CMS and HAR to disseminate traveler information • Provide traveler information to local media outlets • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
Caltrans Headquarters	Data Management	• Operate Caltrans Performance Monitoring System (PeMS) • Collect and archive traffic, incident and weigh-in-motion data across all metropolitan areas for the state • Operate Statewide Integrated Traffic Records System (SWITRS)
Caltrans Headquarters	Public Safety	• Provide statewide assistance to districts with managing contaminants and wastes encountered on highway projects and Caltrans properties

Stakeholder	Transportation Service Area	Roles and Responsibilities
Caltrans Headquarters	Traveler Information	• Operate Caltrans QuickMap • Provide travel conditions information to the public, including traffic congestion information, lane closures, incidents, posted CMS messages, and camera images
City of Bakersfield	Maintenance and Construction	• Maintain city streets • Operate and maintain agency vehicle fleet • Provide roadway construction and restriction information on website
City of Bakersfield	Public Transportation	• Operate Transit Signal Priority
City of Bakersfield	Traffic Management	• Operate Bakersfield Traffic Operations Center • Operate traffic signal systems within city jurisdiction • Operate CCTV cameras • Coordinate traffic signal timing within City limits • Coordinate traffic signal timing across jurisdictional boundaries with neighboring jurisdictions (planned) • Provide real time information to emergency responders (planned)
City of Bakersfield	Traveler Information	• Provide traffic advisories on city website, including roadway construction and restrictions • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
City of Bakersfield Police Department	Public Safety	• Manage red light enforcement cameras
City of Delano	Maintenance and Construction	• Maintain city streets, landscape, and hazard removal • Operate and maintain agency vehicle fleet

Stakeholder	Transportation Service Area	Roles and Responsibilities
City of Delano – Delano Area Rapid Transit	Public Transportation	• Operate fixed-route service • Operate demand response service • Manage and maintain bus fleet. Buses are equipped with automatic vehicle location (AVL). • Provide information to the public via internet and email. • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
City of McFarland	Maintenance and Construction	• Maintain city streets, landscape, and hazard removal • Operate and maintain agency vehicle fleet • Monitor work zone safety including detection of intrusions and crew monitoring
City of McFarland	Traffic Management	• Operate traffic signal system within city jurisdiction • Operate emergency vehicle preemption system • Coordinate traffic signal timing (planned) • Provide real time information to emergency responders (planned)
City of McFarland	Public Transportation	• Operate fixed-route service • Operate demand response service • Manage and maintain bus fleet • Operate security monitoring systems • Provide information to the public via changeable displays at transit stops (planned)
City of McFarland	Traveler Information	• Provide traveler information on city website and via email • Provide traveler information on kiosk (planned) • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)

Stakeholder	Transportation Service Area	Roles and Responsibilities
CommuteKern (Kern COG)	Traveler Information	• Maintain commuter ridesharing program • Maintain website with resources
County of Kern	Maintenance and Construction	• Maintain County roads, landscape, and hazard removal • Operate and maintain agency vehicle fleet • Operate changeable message signs
County of Kern	Public Safety	• Operate Kern County Emergency Operations Center – centralized location to support multi-agency and/or multi-jurisdiction disaster response coordination and communication • Operate ReadyKern (Emergency Alert Program) • Operate Emergency Communications Center (ECC) – receives and dispatches all fire, medical and rescue calls within Kern County (ECC receives transferred calls from 21 different law enforcement agencies and gives calls to 7 different private ambulance companies
County of Kern	Traffic Management	• Operate traffic signal systems within county jurisdiction • Coordinate traffic signal timing (planned) • Provide real time information to emergency responders (planned)
County of Kern	Traveler Information	• Provide information to the public via internet and social media. • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
County of Kern – Kern Transit	Data Management	• Collect transit operations data

Stakeholder	Transportation Service Area	Roles and Responsibilities
County of Kern – Kern Transit	Public Transportation	• Operate fixed-route service • Operate demand response service • Manage and maintain bus fleet. Buses are equipped with AVL • Operate surveillance cameras on-board buses • Provide information to the public via internet and social media • Operate a computer-aided dispatch system for fixed-route and paratransit services • Operate electronic fare payment system • Provide transit information via website, printed materials, kiosks, and a telephone information line • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
Golden Empire Transit	Data Management	• Collect transit operations data

Stakeholder	Transportation Service Area	Roles and Responsibilities
Golden Empire Transit	Public Transportation	• Operate fixed-route service • Operate demand response service • Manage and maintain bus fleet. Buses are equipped with AVL • Operate surveillance cameras on-board buses • Provide information to the public via internet and social media • Operate a computer-aided dispatch system for fixed-route and paratransit services • Operate electronic fare payment system • Provide transit information via website, printed materials, kiosks, and a telephone information line • Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)
Kern Council of Governments	Data Management	• Collect traffic count data countywide
Kern Motorist Aid Authority (Kern COG)	Public Safety	• Operate and maintain motorist aid system and other services in coordination with Caltrans and the California Highway Patrol • Provides funding for state highway litter removal program • Facilitate the purchase of safety equipment such as changeable message signs (planned)
Kern Motorist Aid Authority (Kern COG)	Traveler Information	• Maintain the 511 traveler information system in Kern County (telecommunication and website)
Local Jurisdictions	Maintenance and Construction	• Maintain city streets • Coordinate and share information for construction information (planned) • Coordinate and share information for work zone hazards (planned)
Local Jurisdictions	Traffic Management	• Operate traffic signal systems within city jurisdictions • Coordinate traffic signal timing (planned) • Provide real time information to emergency responders (planned)

Stakeholder	Transportation Service Area	Roles and Responsibilities
Local Jurisdictions	Data Management (planned)	• Collect and archive traffic management information
Local Jurisdictions	Traveler Information	• Provide routing information during incidents, construction, weather events, special events, etc. (planned) • Provide/enhance road weather conditions information to travelers (planned) • Provide roadway closure/restriction information (planned) • Provide information on planned special events (planned) • Provide incident information to travelers (planned)

8.0 FUNCTIONAL REQUIREMENTS

Once funding has been identified for an ITS project and the development is underway, the ITS Architecture is beneficial for providing a context in which the project will fit within the regional ITS implementations (either existing or planned). Agencies can use the ITS Architecture to determine the functionality for the project and also determine detailed communications and operating requirements of the project based on the functionality desired.

All functional requirements in this document are organized by inventory item in alphabetical order which aligns with the stakeholders the inventory items represent. When an inventory item is selected in this document, four very important types of information are displayed.

1. Physical Object Name – this provides context of what type of equipment or center or interface that inventory item has within the ITS Architecture.
2. Functional Object – This summarizes the type of service that is associated with the inventory item.
3. Requirement – This is a functional requirement that can be used to inform a Request for Proposals or in the development of Project Specifications for a project that would be accounted for in the ITS Architecture.
4. Status – This provides the currently-operating or planned status of the inventory item as it is represented in the ITS Architecture.

All of this information is applicable to find functional requirements for a project to help with the design of the project.

Functional requirements can be identified by first identifying the inventory name that is associated with the stakeholder involved with the project. Then, the type of service, or Functional Object, can be identified that best represents the purpose of the project that the agency is developing. Third, the functional requirements are ordered by number in a column that will help provide project specifications from which to procure or to support the development of RFP documentation for the project.

The full list of functional requirements for the Kern Regional ITS Architecture is provided in **Appendix D** of this document.

9.0 RAD-IT ARCHITECTURE

The Regional Architecture Development for Intelligent Transportation (RAD-IT) is a software tool provided by the US Department of Transportation as a national framework for developing regional and project ITS Architectures based on the National ITS Reference Architecture. RAD-IT enables regional architects to manipulate National ITS Reference Architecture content and produce regional architectures to support 'left side' systems engineering activities (Figure 1-1). RAD-IT was used for the development of the Kern Regional ITS Architecture. RAD-IT Version 8.1 was released in coordination with, and corresponds to, the National ITS Reference Architecture Version 8.1. For the Kern Regional ITS Architecture, RAD-IT was used as the formal collection of information in the region related to:

- Overview and scope of Regional ITS Architecture;
- Stakeholder agencies involved in ITS;
- Inventory (or elements) that are existing or planned;
- Services (or service packages) that are existing or planned for the region based on inventory identified in the RAD-IT file;
- Requirements (or functional requirements) serving as high-level design information for procuring ITS services or technologies to support specific functions in the region;
- Interfaces (or interconnects) that identify how inventory or elements relate to one another; and
- Standards that summarize the institutional standards by which inventory or elements interface.

RAD-IT provides a useful customization tool that allows the user to leverage the National ITS Reference Architecture to develop a customized regional architecture to match the specific requirements of the Kern region. 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, or technology neutral.

There are many reports and diagrams that are available from RAD-IT based on the customization entered into the program using the National ITS Reference Architecture. An Information Flow diagram shows the detailed information exchange between the elements. Information Flow Diagrams show Existing and Planned connections. 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 RAD-IT Architecture database to establishing that interconnect in the future. Functional Requirements are selected from the inventory and services selected to customize the regional architecture and are short and simple “shall” phrases that provide specifications for ITS technology and service procurement to meet a need in the region.

The Kern Regional ITS Architecture Information Flow Diagrams are contained in **Appendix E**.

10.0 ITS STANDARDS

Standards are an important tool that will allow efficient implementation of the elements in the regional ITS architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. Federally funded ITS projects are required to use applicable ITS standards officially adopted by the USDOT.

Keep in mind as technology continues to evolve, additional ITS standards will need to be developed to support the functional requirements identified. Table 10-1~~Table 10-1~~ identifies ITS standards that could apply to the regional ITS architecture.

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Table 10-1: ITS Standards

Document ID	Standard Title	SDO
NTCIP 1201	Global Object Definitions	AASHTO/ITE/NEMA
NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	AASHTO/ITE/NEMA
NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)	AASHTO/ITE/NEMA
NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)	AASHTO/ITE/NEMA
NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control	AASHTO/ITE/NEMA
NTCIP 1206	Object Definitions for Data Collection and Monitoring (DCM) Devices	AASHTO/ITE/NEMA
NTCIP 1207	Object Definitions for Ramp Meter Control (RMC) Units	AASHTO/ITE/NEMA
NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching	AASHTO/ITE/NEMA
NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)	AASHTO/ITE/NEMA
NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters	AASHTO/ITE/NEMA
NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)	AASHTO/ITE/NEMA
NTCIP 1214	Object Definitions for Conflict Monitor Units (CMU)	AASHTO/ITE/NEMA
ANSI TS813	Electronic Filing of Tax Return Data	ANSI
APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	APTA
ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems	ASTM

Document ID	Standard Title	SDO
ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	ASTM
GTFS	General Transit Feed Specification (GTFS) Static	GTFS Discussion Group
GTSF-Realtime	General Transit Feed Specification (GTFS) Realtime	GTFS Discussion Group
IEEE 1512 -2006	Standard for Common Incident Management Message Sets for use by Emergency Management Centers	IEEE
IEEE 1512.3-2006	Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers	IEEE
IEEE 1570-2002	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection	IEEE
ITE TMDD	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)	ITE
J2945/1	On-Board System Requirements for V2V Safety Communications	SAE
SAE J2313	On-Board Land Vehicle Mayday Reporting Interface	SAE
SAE J2354	Message Set for Advanced Traveler Information System (ATIS)	SAE
SAE J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary	SAE
SAE J3067	Candidate Improvements to Dedicated Short Range Communications (DSRC) Message Set Dictionary [SAE J2735] Using Systems Engineering Methods	SAE
143	Service Interface for Real-Time Information (SIRI)	CEN
83	Incident Management Standards Group	IEEE
P1	Wide Area Wireless using ASN.1 as encoding method	Profile
P10	eXtensible Markup Language	Profile
P11	NTCIP using DATEX	Profile
P17	Vehicle Communications via RSEs, Vehicle Destination	Profile
P19	Vehicle-to-Vehicle/Infrastructure using UDP	Profile

Document ID	Standard Title	SDO
P2	Vehicle Communications via RSEs, Vehicle Source	Profile
P22	Wide Area Wireless using XML as encoding method	Profile
P23	Wide Area Wireless using JSON as encoding method	Profile
P24	RSE - Center to Field Communications	Profile
P25	RSE - Center to Field Communications - SNMP	Profile
P26	Wide-Area-Broadcast-Via-WAID	Profile
P29	Legacy Short Range Comm Using IEEE 1455	Profile
P3	Vehicle-to-Vehicle/Infrastructure using WSMP	Profile
P31	Vehicle Cluster from Center	Profile
P5	NTCIP using SNMP	Profile
P6	NTCIP using SMTP	Profile
P8	Roadside Equipment to ITS Roadway Equipment	Profile
80	Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE
81	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group	SAE

11.0 ARCHITECTURE USE AND MAINTENANCE

This section provides stakeholders with guidance on how to use the regional ITS architecture for project planning and development, as well as how to maintain the architecture after the development process has completed. A regional ITS architecture is required to include assigned responsibilities for maintenance of the architecture. The following presents the procedures and responsibilities for the use and maintenance of the Kern Regional ITS Architecture.

11.1 USE OF THE ARCHITECTURE

11.1.1 Project Planning

Kern Council of Governments (Kern COG) will be responsible for housing and maintaining the Kern Regional ITS Architecture. Being responsible for the architecture requires Kern COG to be able to identify stakeholders, inventory, and service packages that are related to specific systems or projects when agencies request pertinent information.

In order to do this, the first step is to identify the type of service package(s) (e.g. transit, traveler information, emergency management, etc.) that are related to the project. Depending on the scope of the project, multiple types of service packages could be relevant and they should all be identified. For example, for a project involving the installation of dynamic message signs, the relevant service package types would be traveler information, public safety, and traffic management. After service package types are identified, the specific service package(s) that describe the project must be identified. In continuing the example, the specific service packages that relate to dynamic message sign installation would be TM06 Traffic Information Dissemination, TM07 Regional Traffic Management, MC06 Work Zone Management, and PS10 Wide Area Alert.

Once specific service packages have been identified, the service package diagrams must be reviewed to make sure they are correct and not duplicating functionality with another service package. For each project, the following items should be considered and inputted into RAD-IT:

- Make sure all specific service packages that relate to the project are identified (i.e. TM06, PS10, etc.);
- A specific service package may be associated with multiple agencies; therefore, multiple instances of that service package will need to be created – once for each of the stakeholder agencies for which that specific service package is associated (i.e. a TM03 for City of Bakersfield, and TM03 for County of Kern, etc.);
- Select the appropriate inventory items that are related to each specific service package;
- Select the appropriate stakeholder that owns the inventory item; and
- Check whether the data flow is planned or existing.

Following review of the service package diagrams, the updated diagrams should be passed along to the agencies who are implementing the project to ensure all stakeholders are involved and they have the proper information to determine if it will impact other projects. This is documented through the communications trail between the project sponsor and Kern COG. It would be further

documented in the change request form (discussed later in this document) and "before and after" versions of the service package diagrams.

11.1.2 Project Programming

The availability of an up-to-date regional ITS architecture allows jurisdictions to request federal project funding or programming as projects must be consistent with the area's regional ITS architecture to receive federal funds. This section discusses how stakeholders can determine if a project is consistent with the architecture.

In order to use the Kern 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 as a whole. As mentioned previously, this step is also required to meet the FHWA Architecture Rule/FTA Architecture Policy.

The architecture should be used as early in the project development lifecycle as possible 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 Kern Regional ITS Architecture. This opportunity may occur before or after programming/budgeting, depending on how specifically the ITS project is defined in the programming/budget documents.

11.1.2.1 Federal and State Funding for ITS Projects

Any agency 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 on the following key topic areas:

- The definition of ITS
- Required ITS project risk assessment procedures
- General ITS roles and responsibilities for the various funding, implementing, and oversight agencies in the region
- Step-by-step procedures of the funding process

As of March 2018, the most current version of the Caltrans Local Assistance Program Guidelines (LAPG) could be found on the Internet, at:
http://www.dot.ca.gov/hq/LocalPrograms/lam/lapg.htm

As of March 2018, Chapter 13 of the LAPG could be found at:
http://dot.ca.gov/hq/LocalPrograms/ITS/ITS.htm

11.1.3 Project Design

When designing a project, functionality and ITS standards provide guidance and criteria to identify how the project will serve and connect the region's overall operations. As projects grow in size,

the function and standards can become complicated and could require agreements between agencies. It is beneficial to be able to identify the agencies involved and the type(s) of agreement(s) needed early on in the project design.

This section will describe how functional requirements were developed and where they can be found. There will be discussion of standards that are in the Kern Regional ITS Architecture currently, standards that are envisioned to be needed or utilized in the future, and the applicability of the standards. Additionally, this section includes a discussion of agreements between stakeholders in the Kern 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

All stakeholders will find the Physical viewpoint informative. The Physical provides the basis for Service Packages, which communicate notions of service delivery, functionality, information exchange and concerns related to those concepts. The Physical Viewpoint enables the engineer to answer questions such as:

- What physical entities are involved in the delivery of a given service?
- What interfaces are required between different physical elements?
- What functionality is allocated to physical entities?
- What are the security considerations for information exchanged between physical elements?
- What are the security considerations for physical devices?

The Physical Viewpoint defines the **Physical Object (P-Object)** as person, place, or thing that participates in ITS. Physical Objects are defined in terms of the applications they support, the processing they include, and their interfaces with other physical objects. They are grouped into five classes: Center, Field, Support, Traveler and Vehicle. Table 11-1~~Table 11-1~~ provides class descriptions from ARC-IT and examples in the Kern Region.

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Table 11-1: Class Definitions

Class	Definition	Examples in Kern County
Center	An element that provides application, management, administrative, and support functions from a fixed location not in proximity to the road network. The terms "back office" and "center" are used interchangeably. Center is traditionally a transportation-focused term, evoking management centers to support transportation needs, while back office generally refers to commercial applications.	Traffic Operations Centers Emergency Operations Centers Police/Fire Dispatch Centers

Class	Definition	Examples in Kern County
Field	Infrastructure proximate to the transportation network which performs surveillance (e.g. traffic detectors, cameras), traffic control (e.g. signal controllers), information provision (e.g. Dynamic Message Signs (DMS)) and local transaction (e.g., tolling, parking) functions. Typically governed by transportation management functions running in centers. Field also includes connected vehicle roadside equipment and other non-DSRC wireless communications infrastructure that provides communications between mobile elements and fixed infrastructure.	Traffic Signals CCTV Cameras Dynamic Message Signs Vehicle Detection
Support	A center that provides a non-transportation specific service. Typically, these are enabling functions, such as communications facilitation, security or management.	Archived Data Administrator
Vehicle	Vehicles, including driver information and safety systems applicable to all vehicle types.	Maintenance and Construction Vehicles Public Safety Vehicles Incident Response Vehicles
Traveler	Equipment used by travelers to access transportation services pre-trip and en-route. This includes equipment owned and operated by the traveler as well as equipment owned by transportation and information providers.	Internet Web Sites Kern 511

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

The functional requirements are high-level requirements that can support system requirements development. The functional requirements can be found on the ARC-IT website (http://arc-it.net). The ARC-IT website is comprised of four views. The Physical View defines the physical objects (the systems and devices) that provide ITS functionality. Information flows define the flow of information between physical objects. Functional Objects organize the functionality that is required to support ITS within each physical object.

The following process is one method to access requirements for specific service packages items on the ARC-IT website:

- Select “Architecture” drop-down in the top left corner of the Home Page of the ARC-IT website
- Then select “Service Packages”
- Then select a “Service Package” link

- Then select the "Needs and Requirements" tab
- A list of requirements will be identified

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

The need to obtain specific functional requirements from the Kern Regional ITS Architecture related to a specific project can be accommodated by requesting the information directly from the Kern COG contact listed below. The Kern COG contact will utilize the method described in Section 3.1 Project Planning to collect the requirements specific to the request. This is documented through the communications trail between the project sponsor and Kern COG. It would be further documented in the change request form. One of the final products would be a comparison of the "before" functional requirements to the "after" functional requirements.

The specific request will need to include:

- Identifying which specific service packages where the project is represented;
- Provide scope/description of the project;
- List the infrastructure involved;
- List the stakeholders involved; and
- List the purpose of the project (if not already captured in the scope/description of the project).

Contact information for the Kern Regional ITS Architecture is:
Name: Raquel Pacheco
Email: rpacheco@kerncog.org

A complete listing of functional requirements for the Kern Regional ITS Architecture is provided in Deliverable 9 – Functional Requirements. Those functional requirements are an output from the Kern Regional ITS Architecture RAD-IT Architecture database. The functional requirements identified for this architecture are organized by inventory item in alphabetic order. When an inventory item is selected in the architecture, four types of information are displayed. 1. Physical Object Name – this provide context of what type of equipment or center or interface that inventory item has within the ITS Architecture. 2. Functional Object – This summarizes the type of service that is associated with the inventory item. 3. Requirement – This is a functional requirement that can be used to inform a Request for Proposals or in the development of Project Specifications for a project that would be accounted for in the ITS Architecture. 4. Status – This provides the currently operating or planned status of the inventory item as it is represented in the ITS Architecture.

Table 11-2~~Table 11-2~~ provides examples of various potential ITS project proposals in the Kern Region, to help agencies find the location of information within the architecture that might be needed during the project development process, such as pertinent subsystems, service packages, and functional requirements for a given project. This will be useful as an agency applies for funding for various types of ITS projects. This sample information may be used to identify a project within the Regional ITS Architecture to illustrate Kern Regional ITS Architecture compliance. The table is not intended to be the ITS Plan for the Kern Region listing of projects.

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The table is merely intended to provide project examples and guidance for the architecture maintainer to find various types of information on future project proposals based on the type of project proposal that is brought forward.

Table 11-2: Example Project Type Mapping to Kern ITS Architecture Components

Project Type	ITS Inventory	Subsystems	Associated Service Packages	Functional Requirements Example
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	TM01 – Infrastructure-Based Traffic Surveillance	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.
Installation of new DMS and integrating DMS to be operational from a control center.	DMS, TMC	Roadway Subsystem, Traffic Management	TM06 - 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).
Synchronization of traffic signals along key corridor and integrating system to be operational from a control center.	Traffic Signals, TMC	Roadway Subsystem, Traffic Management	TM03 – Traffic Signal Control	The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.
Deployment of traffic detection for use at mid-block locations and intersections.	Vehicle Detectors, TMC	Roadway Subsystem, Traffic Management	TM01 – Infrastructure-Based Traffic Surveillance	The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.
TMC to TMC communications installation to facilitate interagency coordination	TMC	Traffic Management	TM07 - 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.

Project Type	ITS Inventory	Subsystems	Associated Service Packages	Functional Requirements Example
Implement a project to archive data and send applicable information to a regional server for dissemination via 511 or another traveler information service.	TMC, County of Kern, Kern COG	Archived Data Management Subsystem	DM01 - ITS Data Warehouse	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.
Installation of tracking devices on transit vehicles to facilitate schedule adherence	Transit Detectors, Transit Operations Center	Transit Vehicle Subsystem	PT01 – Transit Vehicle Tracking	The transit vehicle shall track the current location of the transit vehicle.
Installation of environmental sensors along roadways that monitor weather and roadway conditions	Environmental Sensors, Maintenance and Construction Center	Roadway, Maintenance and Construction Management	WX01 – Weather Data Collection	The center shall remotely control environmental sensors that measure weather conditions including temperature, wind, humidity, precipitation, and visibility.
Implementing a connection with ITS devices and information service providers to disseminate pertinent information to the public.	Local Changeable Message Sign, Highway Advisory Radio, Kern 511	Information Service Provider, vehicle, personal information access, remote traveler support	PS10 – Wide Area Alert	The center shall track the availability of resources and coordinate resource sharing with allied agency centers including traffic, maintenance, or other emergency centers.

Project Type	ITS Inventory	Subsystems	Associated Service Packages	Functional Requirements Example
Installation of automated vehicle identification capabilities at port of entries to allow for higher speed weigh-in-motion process.	Caltrans Department of Motor Vehicles, Caltrans Weigh-In-Motion, Commercial Vehicles	Commercial Vehicle Check, Commercial Vehicle	CVO08 – Smart Roadside and Virtual WIM	The commercial vehicle shall respond to requests to provide the identity, status and other information from the electronic cargo lock tag, if so equipped, to roadside check facilities, including border crossings.
Implement a project to disseminate applicable information via 511 or another traveler information service to the public.	Kern 511, travelers, Kern Website, Other Information Service Providers	Information Service Provider, vehicle, personal information access, remote traveler support	TI02 – Personalized Traveler Information	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.

11.1.3.4 How to select communication standards that apply to the project

ITS standards define how system components interact within the overall framework of the National ITS Architecture. The use of standards ensures interoperability amongst various functions of an ITS project so that components or technologies from various vendors and at different scales (local, regional, and national) are still compatible. Standards also facilitate innovation in technology development without necessitating replacement of hardware or software systems that are needed to operate the new technology. Other purposes for ITS standards include:

- ITS standards used in a deployment can greatly reduce component development costs;
- ITS standards are open and non-proprietary, helping state and local transportation managers avoid costly single-source procurements and locked-in maintenance relationships with vendors;
- ITS standards support the deployment of interoperable ITS systems, helping agencies link together different types of ITS technologies and making system expansions easier to plan and implement; and
- ITS standards are being developed for many different types of ITS technologies and their use in project deployment is a key aspect of conformity with the Final Rule.

New standards that are developed go through an approval process before they are included in documents as formalized standards. Existing standards are amended and modified as needed based on new standards development or new technology development. Several national and international standards organizations are working toward developing ITS standards for communications, field infrastructure, messages and data dictionaries, and other areas. The organizations participating in ITS standards activities include:

- AASHTO (American Association of State Highway and Transportation Officials)
- ANSI (American National Standards Institute)
- APTA (American Public Transportation Association)
- ASTM (American Society for Testing and Materials)
- IEEE (Institute of Electrical and Electronics Engineers)
- ITE (Institute of Transportation Engineers)
- NEMA (National Electrical Manufacturers Association)
- SAE (Society of Automotive Engineers)

A listing of ITS standards that are pertinent to the Kern Regional ITS Architecture is contained in the ITS Plan for the Kern Region. That listing is taken from the Kern Regional ITS Architecture RAD-IT Architecture database, and represents ITS Standards that need to be considered in the Kern Region.

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

Intuitional agreements can support ITS functionality and project development in the region. Agreements allow agencies to document the roles and responsibilities of the particular service or

function that is being agreed to, as well as any obligations each agency has for maintenance, operations, or financial support.

Table 11-3~~Table 11-3~~ provides a list of potential agreements based on the types of interfaces identified in the Kern Regional ITS Architecture. It is important to note that as ITS services and 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 for implementation or operations. These agreements are not specified for specific projects because the possibility of coordination/sharing/joint operations should be evaluated on every project. The table also identifies the agency/agencies for which each agreement would be beneficial.

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Table 11-3: Potential Agreements that Support Existing/Future Coordination Shown in Architecture

Agreement and Agencies	Agreement Description
Data Sharing and Usage (Internal Public Divisions)	
TMC/EOC 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/EOC TMC/Airport	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/EOC	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 EOC, Fire, Police, County or State 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 KERN REGIONAL ITS ARCHITECTURE MAINTENANCE PLAN

The Kern Regional ITS Architecture is a dynamic plan that documents current and future ITS infrastructure and plans throughout Kern County, as well as the systems' relationships with other agencies and systems. To stay consistent with changing needs and evolving technologies, the architecture and database will require periodic updates as the ITS program evolves. In order to maintain and upkeep the architecture, regular maintenance should occur, especially as projects are implemented or expanded, agency priorities change, or other changes occur that impact ITS in the various jurisdictions. The architecture maintenance plan outlined in the following subsections acts as a control mechanism for maintaining order, while updating the architecture. It also outlines a process for keeping the architecture up-to-date over time.

This maintenance plan is laid out in two parts, both of which provide instructions for making changes to the architecture. The first section is built for stakeholders to use in order to identify when updates are needed in the architecture. The second section of the maintenance plan was built for the person in charge of maintaining the architecture and database; a Regional ITS Architecture Maintenance committee at Kern COG will assume this responsibility. The Transportation Technical Advisory Committee will serve as the Regional ITS Architecture Committee. This section of the plan proposes a process to be used when reviewing updates that are submitted by stakeholders.

11.2.1 Purpose for Maintenance

The Kern Regional ITS Architecture and database are dynamic planning tools that are subject to change as ITS needs and infrastructure evolve in the County. New projects that are planned or constructed each year may change the status or existence of inventory elements and information flows that are currently represented in the architecture. As changes occur, portions of the architecture documents and database will need to be updated accordingly. These changes should be initiated by the stakeholders as the need arises and should be submitted to Kern COG via e-mail for inclusion in the next ITS architecture update. The Kern Regional ITS Architecture would need to be updated for any of the following reasons:

- **New Stakeholders** – New stakeholders become active in ITS. If this occurs, 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 Considered** – The range of services that are provided in the region expands to new functionalities and new uses of technologies not already covered by the current architecture.
- **Changes in Other Architectures** – The Kern Regional ITS Architecture should be coordinated with the Caltrans Statewide ITS Architecture. Changes in the statewide ITS architecture may necessitate changes in the architecture for the Kern Region to maintain consistency between them. Changes to the Caltrans Statewide ITS Architecture should be communicated to Kern COG (and other affected stakeholders) by the maintainer of that architecture so that there can be coordination between the Caltrans Statewide ITS

Architecture and the Kern Regional ITS Architecture. Similarly, changes to the San Joaquin Valley ITS Architecture should be communicated to Kern COG (and other affected stakeholders) by the maintainer of that architecture so that there can be coordination between the San Joaquin Valley ITS Architecture and the Kern Regional ITS Architecture. Kern COG should also be cognizant of the need to notify the maintainers of neighboring and overlapping ITS architectures when changes are made to the Kern Regional ITS Architecture, so that those architectures can be assessed and updated as appropriate.

- **Changes due to Project Definition or Implementation** – A project may add, subtract, or modify elements, interfaces, or information flows when actually 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** – Occasionally a project will 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.

11.2.1.1 Frequency and Process of Review/Updates

There is no fixed time period or exact event dictating when the regional ITS Architecture **should** be updated. Even when a change occurs, it does not necessarily require that the architecture be updated immediately. For example, it is not necessary to update the architecture just because a new version of the U.S. National ITS Architecture is released. Similarly, if there are no significant changes in policies or in the status of the deployment of ITS in the region, it may not be necessary to update the architecture for several years. Kern COG, in association with the ITS stakeholders in the Kern Region, would determine what constitutes "significant changes" on a case by case basis. However, it is important to ensure that the architecture continues to accurately represent ITS in the region, and that the architecture remains 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** – The Kern Regional ITS Architecture will be checked annually, and updated if necessary, to make minor corrections and modifications to reflect any changes to existing or future ITS projects that might have occurred. These modifications may be a result of changes in project status, emergence of new stakeholders, or updates to agency agreements. Modifications may also result from projects being implemented (changing status of data flows from "planned" to "existing"). This review will be led by Kern COG. It is recommended that Kern COG compile and distribute any architecture Change Request Forms that have been received over the past year to stakeholders for review prior to the annual review meeting. This will provide stakeholders with the opportunity to discuss any changes needed to the architecture. Kern COG will consider changes stemming from the annual reviews in conjunction with more comprehensive updates to

the Kern Regional ITS Architecture that are coordinated with updates to the Regional Transportation Plan (RTP).

- **Comprehensive Update** – Kern COG will coordinate a more thorough update of the Kern Region ITS Architecture in coordination with the update of the RTP, as needed. With minor updates and modifications occurring in the interim, this Comprehensive Update would address new or adjusted projects outlined in the funding programs being included in the Kern Regional ITS Architecture, as well as identify significant changes or additions that could affect multiple stakeholders. It is recommended that this Comprehensive Update include input from the stakeholders, either through a workshop format, individual phone calls, or smaller focus groups. Proposed updates and revisions to the Kern Regional ITS Architecture should be reviewed by the affected stakeholders for consensus.

As mentioned in the first bullet, stakeholders should complete and submit a Change Request Form when they anticipate or identify a possible change to the architecture. This request should be submitted to Kern COG, 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 11-4~~Table 11-4~~**. A copy of the form can be sent via e-mail or fax to:
Name: Raquel Pacheco
Email: rpacheco@kerncog.org
Fax: 661-324-8215

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Kern COG 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 Kern Regional ITS Architecture. By default, the Regional ITS Architecture Maintenance Committee will be made up of a representative from the Transportation Technical Advisory Committee from each of the following agencies:

- Kern COG
- Caltrans
- City of Arvin
- City of Bakersfield
- City of California City
- City of Delano
- City of Maricopa
- City of McFarland
- City of Ridgecrest
- City of Shafter
- City of Taft
- City of Tehachapi
- City of Wasco
- County of Kern
- Golden Empire Transit District

The Regional ITS Architecture Maintenance Committee will operate in a transparent manner. Any parties that are impacted directly, or indirectly, by any matters that come before the Committee will be engaged in open discussion to ensure full understanding of all matters that come before the Committee, by all affected parties. All ITS stakeholders in the Kern Region will be notified about change requests that come before the Committee via the posting of the Transportation Technical Advisory Committee agenda to the Kern COG website (www.kerncog.org), and will be given an opportunity to provide input into the process. All ITS stakeholders in the Kern Region affected by changes will be notified of the final disposition of matters deliberated by the Committee. In addition, Kern COG will notify the maintainers of neighboring and overlapping ITS architectures when changes are made to the Kern Regional ITS Architecture, so that those architectures can be assessed and updated as appropriate.

A flow chart outlining the thought processes that the Committee should go through when reviewing a Change Request Form has been developed to assist the Kern COG Regional ITS Architecture Maintenance Committee in determining whether an architecture update is necessary. The flow chart has two questions to help identify if stakeholders agree on the change that is being requested, what impact the change will have to the physical architecture, and what discussions should occur in specific situations. For each change request form, both questions should be reviewed in their entirety.

The committee should use the following processes responding to two specific questions as described in **Figure 11-1**~~Figure 11-1~~ and **Figure 11-2**~~Figure 11-2~~ when reviewing each Change Request Form for approval.

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Table 11-4: Change Request Form

Stakeholder Proposing Change	**Name**		**Job Title**	
	Agency			
	Email			
	Phone No.		**Fax No.**	
Date				
Description of Change	**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			

Figure 11-1: Kern COG Architecture Update Review Process – Agreement Question

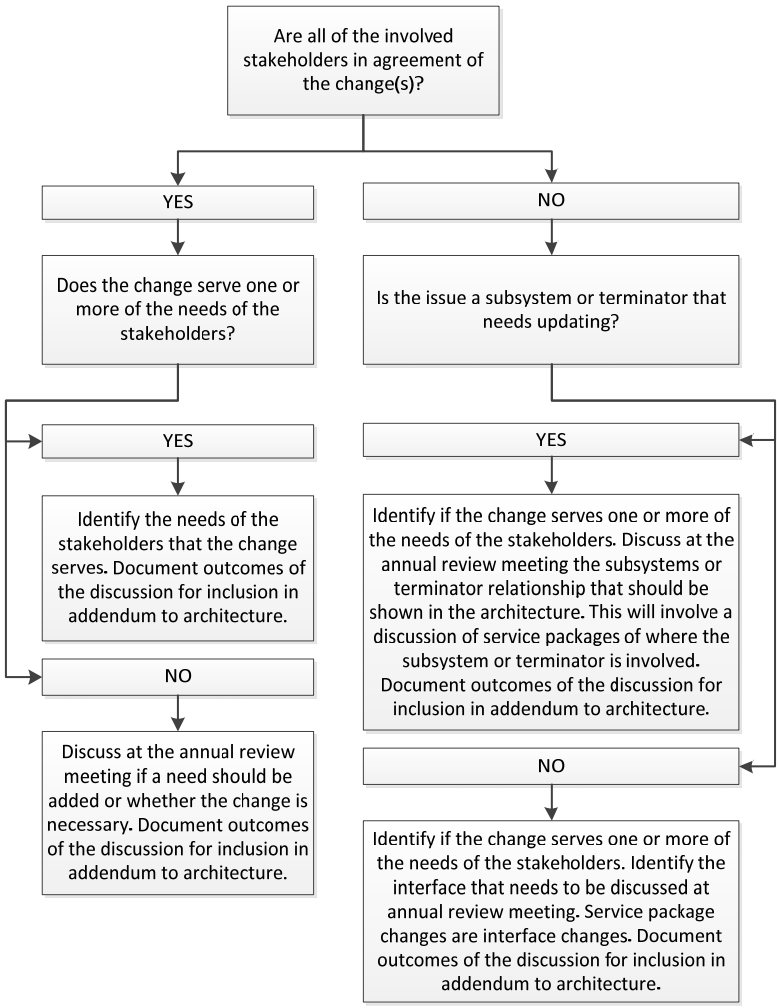
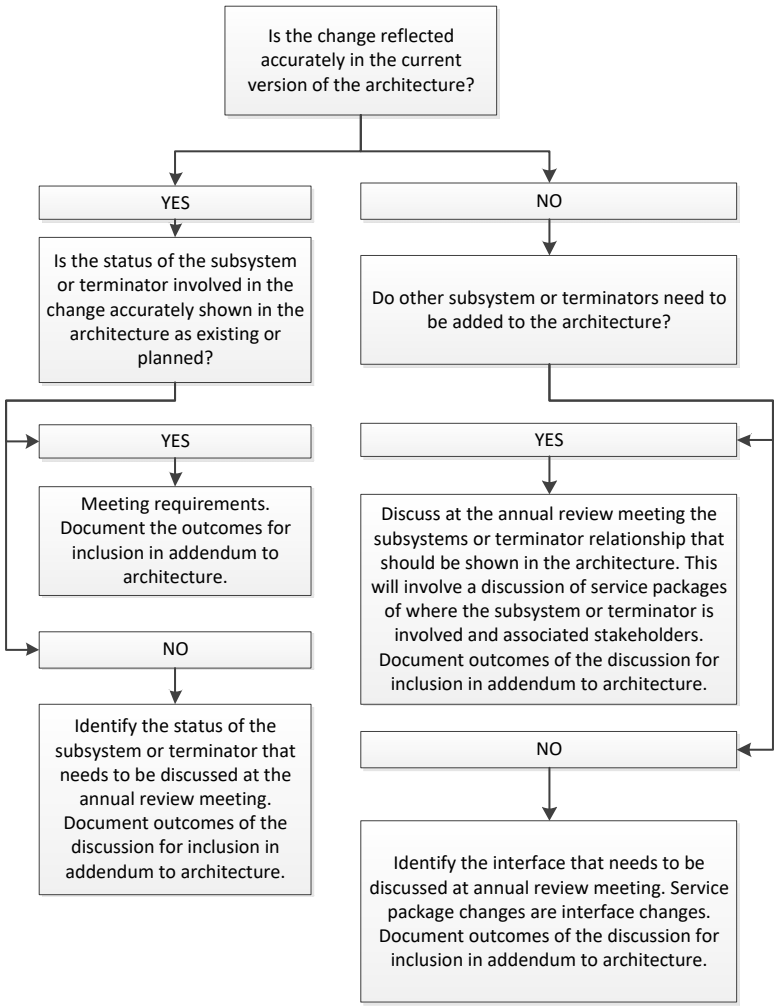


Figure 11-2: Kern COG Architecture Update Review Process – Architecture Question



11.2.1.2 Roles and Responsibilities

Kern COG will update the architecture (addition, deletion, or modification) as specified in the approved Change Request Form, which includes performing the following tasks:

- Evaluate how the changes affect the architecture documents, RAD-IT database, and website.
- Evaluate whether or not the change impacts multiple stakeholders or other elements within the regional ITS architecture. This step will also include coordinating with those stakeholders to obtain consensus on the proposed change.
- Ensure that changes are carried out in the most recent versions of the documents, databases, and graphics.
- Verify that all dependencies and updated and related documents are synchronized with each other.
- After changes are made, make sure that the revised documents are posted, stored online, or otherwise disseminated in "read-only" format to prevent any unauthorized changes from being made.
- Ensure that the most current RAD-IT Architecture file version and date/time are updated on the Start tab of the RAD-IT Architecture database file.
- Ensure file names, document titles, and website are consistent with the architecture name, version, and dates.
- Kern COG staff will periodically update the Transportation Technical Advisory Committee and Kern COG Board on matters concerning the ITS Architecture and ITS Plan for the Kern Region.

12.0 PROJECT SEQUENCING

The purpose of Project Sequencing is to develop a logical grouping and sequence of ITS projects for the Region that will implement the Architecture, in particular for activities that would bolster the region's ITS capabilities beyond what exists today. As part of the FHWA ITS Architecture and Standards Rule, and the accompanying FTA Policy, a list of projects is required to be developed to implement the regional ITS architecture. The listing of projects is identified in this plan in the form of "strategies". That list of projects accounts for existing ITS inventory and identified future projects. The project sequencing, or prioritization, for the projects should also be identified to provide a path to full implementation for the region. This includes not only larger and more robust and capable cities implementing innovation, but also for the smaller cities that are just getting started in ITS. This project sequencing section balances what projects are feasible to implement within the Short-term (0-5 years) and Medium-term (5 to 10 years) timeframes. Projects that are likely to occur within the Long-term (greater than 10 years) are identified as such in this section and include areas that are still under development nationally, such as autonomous vehicle initiatives and connected vehicle initiatives. Project sequencing provides a phasing plan that recognizes that there are some projects that need to occur before others, to be effective in operations.

12.1 PROJECT IDENTIFICATION PROCESS

Developed as part of the strategies task, a listing of "strategies", or projects, provided a foundation from which stakeholders selected or removed service areas they know to either be existing, are captured in existing regional plans, are existing programs or studies, are planned/programmed with funding, or are planned for and envisioned to exist in the future. Planned projects do not necessarily all have to occur within the scope of the timeframe of the regional ITS architecture, but are desired to be reasonable in their consideration for implementation in the coming decade or so. Some planned projects were intentionally removed because there are no active conversations or efforts underway that would indicate their inclusion in the regional ITS architecture planning horizon.

The objective of this project sequencing 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. Project prioritization is an important part of sequencing ITS deployments. The Architecture can be used to determine the antecedents necessary for project deployment. There are also several sources that can be used to determine approximate benefit cost ratios.

The list of ITS projects for the Kern Region is summarized in the tables in this section and organized by their project sequencing. The list represents all ITS projects that are captured as strategies either existing or planned in this region. The US DOT has developed an ITS benefit cost database that can be used for reference. The website is found here https://www.itsbenefits.its.dot.gov/its/benecost.nsf/BenefitsHome. It is searchable by application, for example Freeway Management or location. It also has a separate database found in the same location for connected vehicle benefits and costs.

12.2 PROJECT SEQUENCING PROCESS

Project prioritization was based on several factors, including:

- Project need;
- Funding availability;
- Maturity of the technology;
- Project readiness;
- Stakeholder buy-in;
- Multi-agency benefits;
- Relative costs and benefits;
- Project dependencies (if the project depends on other projects or technologies to be in place first); and
- Compatibility/compliance with other plans and programs.

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 into packages rather than individual projects which feasibly may be procured along with other types of projects in a package. This is also 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 three primary factors.

1.4. **The need for a particular ITS function** - as outlined in the ITS User Needs summary. Information on High, Medium and Low priority needs have 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.

2.5. **The logical ordering of projects** - to ensure that prerequisite projects or infrastructure is in place.

3.6. **The known maturity levels of ITS services throughout the region** - as summarized in the inventory summary section of the plan for existing or planned strategies.

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. If there are opportunities to advance a project that is identified in a later timeframe (if a technology or system advances more quickly than was originally anticipated), the Kern region stakeholders should take those opportunities as they become available.

12.3 PRIORITIZED LISTING OF ITS PROJECTS

Table 12-1~~Table 12-1~~ provides a prioritized list of ITS projects for the Kern region.

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Table 12-1: Kern Region Prioritized Project List

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
SHORT TERM								
1	ITS Data Warehouse (Phase 1)	As part of Phase 1, this system will develop an ITS historical data archive for all relevant ITS data and provide a centralized system to share data between Caltrans and other local transportation 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.	Short Term	116	Improve information exchange between Caltrans and local transportation agencies	Data Management Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on a vehicle detection system • The system will depend on the collection and sharing of video and traffic data • The system will depend on robust communications in the Region • The system will depend on willingness of multiple agencies to connect and share data

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
2	Construction and Maintenance Coordination	This system will be used to share information between all agencies to coordinate any construction and maintenance efforts.	Short Term	113	Coordinate construction and maintenance project schedules within and between agencies	Maintenance and Construction Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on willingness of multiple agencies to connect and share data
3	Work Zone Technology	This proposed system will provide the deployment of technology to collect and distribute warning information about potential work zone hazards.	Short Term	102	Warn work crews of errant vehicles	Maintenance and Construction Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the deployment of technologies capable of communicating with a central system or internet to access third party data/management system
4	Traffic Signal System (Phase 1)	This project will implement signal timing and coordination improvements to help reducing traffic congestion.	Short Term	118	Improve signal timing/coordination	Traffic Management Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the jurisdictions having a traffic signal control system
				107	Reduce recurring traffic congestion			
5	Regional Transportation Management Center (TMC) Coordination and Traveler	This project supports the ITS data warehouse project. The links would enable data sharing among the transportation agencies and emergency response to provide up to date information to travelers.	Short Term	129	Provide routing (detour) information to travelers during incident, construction, weather events, special events, etc.	Traveler Information Program	Airports Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland	• The system will depend on a robust traffic signal control system • The system will depend on

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
	Information (Phase 1)			122	Provide/enhance road weather conditions information to travelers		City of Shafter City of Taft City of Tehachapi County of Kern Delano Area Rapid Transit (DART) Golden Empire Transit District (GET) Kern Transit Media National Weather Service Private Sector Data Collector	willingness of multiple agencies to connect and share data
				116	Provide roadway closure/restriction information			
				129	Provide information on planned special events			
				103	Provide incident information to travelers			
6	Traffic Information to Emergency Responders	This system will provide technology to distribute traffic information to emergency responders.	Short Term	103	Provide real-time traffic information to emergency responders	Public Safety Program		• The system will depend on willingness of multiple agencies to connect and share data • The system will depend on having a central management system from which to monitor and manage technology
7	Efficient Incident Clearance Education	Work with all emergency responders in the region to establish a plan to reduce incident clearance time.	Short Term	97	Reduce incident clearance time	Public Safety Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division Private Emergency Service Providers	• The system will depend on willingness of multiple agencies to connect and share data
MEDIUM TERM								

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
8	HAZMAT Response and Tracking	This system will support commercial vehicle operations to improve response time to the Emergency Management Center and develop tracking for HAZMAT vehicles.	Medium Term	93	Improve response to HAZMAT incidents	Commercial Vehicle Operations Program	Caltrans Districts Commercial Vehicle Companies	• The system will depend on willingness of multiple agencies to connect and share data
				72	Provide tracking of HAZMAT vehicles			
9	Commercial Vehicle Tracking	This system will implement tracking technology for commercial vehicles that has the capabilities of providing routing information.	Medium Term	75	Provide better vehicle restrictions and roadway closure information to commercial vehicles	Commercial Vehicle Operations Program	CHP Central Division	• The system will depend on willingness of multiple agencies to connect and share data
10	ITS Data Warehouse (Phase 2)	As part of Phase 2, the system established in Phase 1 will be integrated to provide an ITS historical data archive for all relevant ITS data and provide a centralized system to share data between the transportation and transit 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.	Medium Term	95	Improve information exchange between transportation and transit agencies	Data Management Program		• The system will depend on willingness of multiple agencies to connect and share data
				92	Improve data collection and archiving			
				84	Implement a central information/data clearinghouse			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
11	ITS Data Implementation	This strategy will use information gathered from connected vehicles and the ITS Data warehouse to planning, modeling, and other analysis purposes.	Medium Term	95	Use archived data for planning, modeling, analysis and traffic management strategy development	Data Management Program		• The system will depend on the implementation of an ITS Data Warehouse from which analysis can be performed
12	Infrastructure Conditions Monitoring	This proposed system will implement technology to collect infrastructure condition information.	Medium Term	91	Monitor transportation infrastructure	Data Management Program		• The system will depend on having a central management system from which to monitor and manage technology
13	Work Zone Monitoring and Information Distribution	This system will manage work zones, control traffic in work zone areas. Traffic conditions will be monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information will be coordinated with other transportation agencies. The system will provide information about work zone speeds and delays to motorist prior to the work zones.	Medium Term	91	Provide/enhance enforcement in work zones	Maintenance and Construction Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the collection and sharing of video and traffic data • The system will depend on regional TMC coordination
				89	Provide travel times/delays through work zones			
14	Emergency Communication System	Upgrade emergency communications to have the ability to share real-time condition information with emergency responders and public safety to support faster emergency response. This may involve CAD system center-to-center interfaces, list serves, or other standardized methods of communicating conditions between services in the region.	Medium Term	99	Improve a multi-agency, system-coordinated response to major incidents	Public Safety Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division Private Emergency Service Providers	• The system will depend on robust communications in the Region • The system will depend on willingness of multiple agencies to connect and share data
				97	Provide incident information to emergency management agencies			
				95	Improve communications in rural areas			
				93	Improve interagency communications			
				93	Improve incident notification to agencies			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
				91	Improve incident response			
15	Emergency Vehicle Technology	This system will update emergency vehicle technologies to include preemption and provide more robust information sharing technologies.	Medium Term	82	Expand emergency vehicle preemption	Public Safety Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division Private Emergency Service Providers	• Future EVP deployments may utilize appropriate connected vehicle communications infrastructure and technologies
				78	Provide/enhance mobile data terminals for emergency vehicles			
				76	Provide/enhance automatic vehicle location (AVL) for emergency vehicles			
16	Transit Management System	Upgrade and or install computer aided (CAD) and automated vehicle location (AVL) systems in transit vehicles, including interfaces with other transit management systems. The system should be able to receive and send out location and any emergency information.	Medium Term	96	Receive real-time roadway congestion information	Public Transportation Program	DART Golden Empire Transit District (GET) Kern Transit	• The system will depend on the jurisdictions having a traffic signal control system • The system will depend on robust communications in the Region
				88	Coordinate timed transfers between routes, providers and modes			
				87	Develop mobile apps to provide static and real-time transit information			
				86	Expand/enhance/upgrade computer aided dispatch (CAD) system			
				85	Provide transit information using social media			
				84	Enhance 511 to provide static and real-time transit information			
				83	Receive roadway incident information			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
				81	Implement/enhance web-based trip planner			
				79	Provide real-time transit arrival/departure information on web site			
				76	Expand/enhance/upgrade automatic vehicle location (AVL) system			
				75	Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities			
				74	Implement transit signal priority technology			
17	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.	Medium Term	90	Provide/enhance speed enforcement at high risk locations	Traffic Management Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division	• The system will depend on having a central management system from which to monitor and manage technology
18	Traffic Congestion Data Collection	This system will work to share congestion, public safety data, incident information, and surveillance video among different traffic management centers.	Medium Term	99	Share congestion information with other agencies	Traffic Management Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division	• The system will depend on the jurisdictions having a traffic signal control system
				89	Share public safety/computer aided dispatch (CAD) data with transportation agencies			
				81	Share incident information with other agencies			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
				71	Share surveillance video and data with PSAPs/emergency responders			
19	Arterial Traffic Congestion Warning	This project will work in conjunction with the Regional TMC Coordination and Traveler Information (Phase 1) and the Freeway Traffic Congestion Warning systems to provide motorists with advance notice of traffic congestion and suggestion of alternate routes during incidents.	Medium Term	85	Reduce traffic congestion during incidents	Traffic Management Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern CHP Central Division	• The system will depend on the jurisdictions collecting traffic congestion data • The system will depend on a robust traffic signal control system
20	Traffic Signal System (Phase 2)	Upgrade traffic signal hardware and provide technology to provide the ability to control signal timing remotely.	Medium Term	82	Upgrade signal hardware	Traffic Management Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the jurisdictions having a traffic signal control system
				80	Coordinate arterial and freeway management strategies			
				79	Improve/implement ability to remotely modify signal timing			
21	Intersection Warning System	This system will warn approaching vehicles of upcoming crashes at an upcoming intersection.	Medium Term	73	Implement intersection collision warning/avoidance systems	Traffic Management Program		• The system will depend on a robust traffic signal control system
22	Incident Response System	This project will work in coordination with emergency responders to provide incident detection technology and provide updated computer aided dispatch (CAD) systems.	Medium Term	91	Improve incident detection	Traffic Management Program		• The system will depend on having a central management system from which to monitor and manage technology • The system will depend on willingness of multiple agencies to
				86	Enhance computer aided dispatch (CAD) systems			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
								connect and share data
23	Freeway Traffic Congestion Warning	This project will work in conjunction with the Regional TMC Coordination and Traveler Information (Phase 1) and the Arterial Traffic Congestion Warning systems to provide motorists with advance notice of traffic congestion and suggestion of alternate routes during incidents.	Medium Term	96	Reduce recurring traffic congestion	Traffic Management Program		• The system will depend on a robust traffic signal control system
				85	Reduce traffic congestion during incidents			
				90	Provide/enhance speed enforcement at high risk locations			
24	Roadway Hazard Warning System	This system will implement sensors and other technology to provide warning to transportation agencies, emergency management centers, and motorists on flooding on roadways.	Medium Term	86	Provide roadway flood warnings	Traffic Management Program		• The system will depend on a robust traffic signal control system
25	Regional Transportation Management Center (TMC) Coordination and Traveler Information (Phase 2)	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.	Medium Term	96	Provide/enhance congestion information to travelers	Traveler Information Program	Airports Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern DART Golden Empire Transit District Kern Motorist Aid Authority Kern Transit Media Private Sector Data Collector	• The system will depend on robust communications in the Region • The system will depend on a robust traffic signal control 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
				95	Improve quality, consistency and thoroughness of traveler information			
				94	Provide more timely incident information to travelers			
				93	Provide information on roadway construction and maintenance activities			
				89	Use social media for traveler information dissemination			
				89	Improve 511 system/web site			
				89	Enhance freeway/expressway traffic map			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
				85	Send email alerts of major incidents to major employers			
				75	Provide freeway/expressway travel times			
				75	Provide arterial travel times (on major arterials)			
				71	Improve ridesharing program/website			
				70	Enhance arterial traffic map			
26	Queue Length Warning System	This proposed system will monitor and advice motorists of upcoming queues in and near work zones.	Medium Term	93	Provide advisory to warn traffic of a stopped queue in/near work zones	Vehicle Safety Program		• The system will depend on having a central management system from which to monitor and manage technology
				70	Monitor queue lengths in/near work zones			
27	Environmental Detection System	This proposed system will establish technology for detection and monitoring of environmental, weather, and road conditions throughout the region. The system will detect environmental hazards and alert drivers of unsafe conditions or road closures.	Medium Term	88	Expand coverage of environmental/weather /road conditions detection/monitoring systems	Weather Program	Caltrans Districts County of Kern National Weather Service	• The system will depend on having a central management system from which to monitor and manage technology
28	Establish Freeway Service Patrol System	Establish a freeway service patrol system service including staff, vehicles, and equipment to support the service.	Medium Term	56	Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles	Public Safety Program	Caltrans Districts	• The system will depend on having a central management system from which to monitor and manage technology
LONG TERM								
29	Upgraded 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	Long Term	69	Expand CCTV camera coverage on arterials	Traffic Management Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter	• The system will depend on the collection and sharing of video and traffic data
				68	Develop/implement system-wide arterial management strategies			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
		advisory radio (HAR) systems and transmitters, arterial changeable message signs (CMS), traffic monitoring stations (TMS), and communications infrastructure.		63	Reduce vehicle delays at rail grade crossings		City of Taft City of Tehachapi County of Kern	• The system will depend on the jurisdictions having a traffic signal control system • The system will depend on robust communications in the Region • The system will depend on regional TMC coordination
				54	Implement/expand dynamic message sign (DMS) installations on arterials			
				53	Implement/improve inter-jurisdictional signal coordination			
				63	Provide health monitoring of traffic signal equipment at intersections and rail crossings			
30	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.	Long Term	69	Implement/improve incident detection capabilities	Traffic Management Program	Caltrans Districts	• The system will depend on the collection and sharing of video and traffic data
				54	Expand freeway/expressway dynamic message signs (DMS)			
				45	Expand highway advisory radio (HAR) coverage on freeways/expressways			
				69	Expand CCTV coverage on freeways/expressways			
				51	Improve/expand vehicle detection coverage on freeways/expressways			
				50	Implement variable speed limits			
				44	Improve ramp metering operations			
				18	Implement automated/remote control gate systems			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
31	Roadway Condition Warning System	This system will provide roadway warnings including curve speed, vehicle-over-height detection, and provide monitoring technology for queue lengths at ramps.	Long Term	66	Provide curve speed warning	Vehicle Safety Program	City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on having a central management system from which to monitor and manage technology
				61	Provide vehicle-over-height detection/warnings			
				49	Monitor queue lengths at ramp locations			
32	Commercial Vehicle Enforcement	This proposed system will monitor commercial vehicle violations with the deployment of weigh-in-motion technologies especially in areas with a history of violations. The system shall also provide information on commercial vehicle operations permit restrictions.	Long Term	69	Provide target enforcement at locations with history of violations	Commercial Vehicle Operations Program	CHP Central Division	• The system will depend on the collection and sharing of commercial vehicle information with private fleets and CHP/DMV
				59	Reduce commercial vehicle weight, width and height violations			
				58	Provide information on commercial vehicle operations (CVO) permit restrictions			
				52	Deploy weigh-in-motion/mobile weigh enforcement technology			
33	Commercial Vehicle Traveler Information	This system will implement traveler information services that provide both pre-trip and en-route information to commercial vehicles which can include information such as truck parking locations.	Long Term	54	Provide interstate/inter-regional traveler information for commercial vehicles	Commercial Vehicle Operations Program	CHP Central Division	• The system will depend on the collection and sharing of commercial vehicle information with private fleets and CHP/DMV • The system will depend on willingness of multiple agencies to connect and share data

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
34	Data Collection for Roadway Network	This system will provide a framework to improve data collection capabilities for the arterial and freeway management systems.	Long Term	65	Improve data collection capabilities	Data Management Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the collection and sharing of video and traffic data • The system will depend on willingness of multiple agencies to connect and share data
				57	Improve data collection on freeways/expressways			
35	Smart Work Zone Technology	This system improves the work zone technology to provide smart technology where data is collected and distributed to provide warning information about potential work zone hazards. The smart work zone technology should also be able to warn travelers about trucks that are entering and exiting work zones and be able to track work zone maintenance fleets.	Long Term	69	Implement Smart Work Zone technology	Maintenance and Construction Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on having a central management system from which to monitor and manage technology
				51	Warn travelers about trucks entering/existing work zones			
				43	Track locations of maintenance fleet			
36	Parking Management System	This proposed system will monitor and provide information on available parking facilities and parking availability. This system monitors and manages parking spaces in lots, garages, and other parking areas and facilities.	Long Term	53	Provide information on available truck parking facilities	Parking Management Program	Caltrans Districts City of Bakersfield	• The system will depend on having a central management system from which to monitor and manage technology
37	Upgrade Freeway Service Patrol System	Provide technology upgrades to the freeway service patrol system.	Long Term	56	Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles	Public Safety Program	Caltrans Districts	• The system will depend on having a central management system from which to monitor and manage technology
				53	Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol			

Project ID	Project	Project Description	Term	Total	Need	Program Area	Planned Participating Entities	Interdependencies
38	Transit Vehicle Technologies System	Upgrade transit vehicles with enhanced remote for monitoring mechanical conditions, upgrade to automated enunciators and automatic passenger counters.	Long Term	68	Implement/enhance remote monitoring of transit vehicle mechanical condition	Public Transportation Program	DART Golden Empire Transit District Kern Transit	• The system will depend on having a central management system from which to monitor and manage technology
				66	Provide on-line reservation system for demand-responsive transit services			
				64	Provide on-board automated enunciators			
				59	Expand/upgrade automated passenger counters			
39	Air Quality Data Collection and Monitoring	This proposed system would implement data collection and monitoring of air quality throughout the region.	Long Term	68	Monitor/collect air quality data	Sustainable Travel Program	Caltrans Districts County of Kern Kern COG	• The system will depend on having a central management system from which to monitor and manage technology
				57	Monitor/collect air quality data			
40	Traffic Signal System (Phase 3)	Upgrade traffic signal hardware and provide autonomous commercial vehicle and autonomous passenger vehicle technology.	Long Term	82	Upgrade signal hardware	Traffic Management Program	Caltrans Districts City of Arvin City of Bakersfield City of Delano City of McFarland City of Shafter City of Taft City of Tehachapi County of Kern	• The system will depend on the jurisdictions having a traffic signal control system
				80	Coordinate arterial and freeway management strategies			
				79	Improve/implement ability to remotely modify signal timing			

12.4 MONITORING PROGRAM

As part of the ITS Plan development, it is recommended that Kern COG implement a monitoring program to track the progress of projects recommended in the ITS Plan. This will ensure that the milestones and objectives of the ITS Plan continue to be met over time. ~~It is envisioned that annually.~~ Annually, a listing of the projects recommended in the ITS Plan ~~would~~ will be produced and ~~the status of every project would be recorded~~ a project status update will be requested. A status report would be provided to the Transportation Technical Advisory Committee and Kern COG Board.

13.0 SAN JOAQUIN VALLEY ITS ARCHITECTURE RECOMMENDATIONS

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 ~~had~~ 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 and Tulare County recently completed individual developments of a Regional ITS Architecture and Strategic Deployment Plan for their jurisdictions.

Since 2001, many updates have occurred to the National ITS Reference Architecture and all tools associated with the customization of a regional ITS architecture. As such, there are fundamental updates that would be required to the San Joaquin Valley Regional ITS Architecture to get it "ready" for recommendations from the Kern Regional ITS Architecture update cited in this section. These fundamental updates include:

- Working with stakeholders to garner input on updated existing service areas as well as planned service areas considering the landscape and technology abilities involved in transportation have changed considerably in the last 15 years. Also, many of the deployment projects identified in the architecture either have been completed, or the direction of technology and agency cooperation has evolved to make the planned projects out-of-date.

- Including all, or as much information as possible, from the San Joaquin Regional ITS Architecture into RAD-IT to link directly from the National ITS Reference Architecture.

- Determining what level of information is necessary to capture the relationship to the Kern Regional ITS Architecture. An example of this is understanding that the Kern Regional ITS Architecture captures and includes individual cities, individual inventory owned by those cities, every transit service and is fairly detailed in capturing very localized service areas for the Kern Region. For a broader San Joaquin Region, it may not be necessary to capture the local specificity desired in the Kern Region, but it is necessary to capture the more regional stakeholders and inventory that have broader regional service areas or may travel or serve in a multi-region capacity, such as transit or Caltrans freeway service.

- Updating standards and agreements that are necessary to facilitate data exchange and cooperation between agencies in implementing the ITS Architecture planned components. Again, with the growth of technology in the past 15 years, much as changed related to standards and operating agreements necessary to facilitate needed service areas.

Based on the Kern Regional ITS Architecture, the following inventories are recommended to be incorporated into an update of the San Joaquin Valley Regional ITS Architecture, organized by Kern-specific elements and region-wide inventory that will impact more areas than just within the Kern region:

Kern Regional ITS Architecture:

- Kern COG
- County of Kern
- Caltrans Districts 6 and 9

Regional Activities:

- AMTRAK
- Airports
- Federal Military Bases
- Kern 511
- Private Sector Data Collector
- Railroad Operations
- Recreational Areas
- Media

Kern and its neighboring counties should use national and statewide ITS architectures as a basis for coordinated project deployments and technology standards within the Kern Region 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.