INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PLAN FOR THE KERN REGION

DRAFT DELIVERABLE NO. 6

DRAFT STRATEGIES REPORT

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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.

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's 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 achieving the stated project goals will be performance of the following tasks (the **bolded text** indicates the current task and/or deliverable):

Task 1: Project Initiation

Deliverable 1: Project Plan

- The Project Plan will incorporate 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: Report assessing the 1997 EDP and the Kern portion of the 2001 SDP

- The report documents the findings of the assessment of the 1997 EDP and the 2001 SDP with the lessons learned in the interviews with project stakeholders.

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 will identify an ITS vision for the Kern region, set of goals and objectives, and identify ITS needs after various exercises with Stakeholders.

Task 6: Develop Key Regional ITS Strategies

Deliverable 6: Regional ITS Strategies Report

- **The report will refine and present 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 Technical Report

- The report will translate generic ITS needs into the National ITS Architecture framework. ITS Elements will also be identified as part of the process of identifying and selecting Service Packages for the region.

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

Deliverable 8: Regional ITS Operational Roles and Responsibilities Technical Report

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

Task 9: Determine the Functional Requirements

Deliverable 9: Functional Requirements Report

- The report will identify 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 Turbo Architecture Database

- The electronic Turbo Architecture database will be developed consistent with Version 7.1 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 will develop an Architecture Maintenance Plan that will describe how to use the Architecture. The Report will provide project planning, project programming, project design, and maintenance procedures.

Task 12: Develop Kern Region ITS Plan

Deliverable 12: Kern Region ITS Plan

- The report will take all of the inputs from Tasks 2 through 11 and meld them together into a cohesive and comprehensive ITS Plan Report and Phasing Plan for Kern County.

Task 13: ITS Website for Regional Stakeholders

Deliverable 13: Draft and Final Website

- The Kern COG website ITS webpage will provide 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 STAKEHOLDER PARTICIPANTS

The success of a regional ITS architecture depends on participation by a diverse set of regional Stakeholders. **Table 1-1** lists the agencies/organizations of approximately 28 key stakeholders that will be engaged to provide input for the ITS Plan. Input from the Stakeholders as well as others, will be instrumental in the development of the information presented in the final ITS Plan. These stakeholders, and any others that join the project along the way, will be instrumental to the

development of the regional ITS architecture. The stakeholder list will be updated periodically throughout the life of the project.

Table 1-1. 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

1.4 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 in Task 3. 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.

1.5 PURPOSE OF DRAFT STRATEGIES REPORT

The purpose of the ITS Strategies Report is to present a range of ITS strategies that is relevant to the Region, and is based on the ITS User Needs Assessment conducted as part of the ITS Plan update. The regional ITS strategies have been developed to address the needs of the Region, and will later be prioritized for the short, medium and long terms.

2.0 ITS PROGRAM AREAS AND STRATEGIES

In the 1997 ITS Early Deployment Plan (EDP), project recommendations for the Kern Region were organized by a set of program areas:

- Kern Traveler Safety Program
- Kern Informed Traveler Program (TravelKIT)
- Enhanced Emergency Response Program
- Kern Smart Transit Program
- Traffic and Incident Management Program
- Communication Network Development Program

However, with the evolution of the National ITS Architecture, and the more structured manner in which ITS is planned, designed, and deployed, this ITS Plan will expand the Program Areas under consideration for deployment of ITS in the Kern Region. The following ITS program areas and recommended strategies have been selected from the National ITS Architecture (ARC-IT or Architecture Reference for Cooperative and Intelligent Transportation), version 8.0. Planning efforts to date have used an earlier version of the National ITS Architecture, as Version 8.0 was just released in July 2017.

- Commercial Vehicle Operations Program Area
- Data Management Program Area
- Public Transportation Program Area
- Traveler Information Program Area
- Traffic Management Program Area
- Public Safety Program Area
- Sustainable Travel Program Area
- Maintenance and Construction Program Area
- Vehicle Safety Program Area
- Weather Program Area
- Parking Management Program Area

The strategies organized under each program area reflect the stakeholder needs that were identified in the ITS Vision, Goals, Objectives and User Needs Report (Deliverable No. 5). The selected program areas and strategies also took into consideration program areas identified in past planning efforts like the ITS EDP and the San Joaquin Valley ITS Strategic Deployment Plan which have remained priorities. This allows the stakeholder group to focus on ITS strategies that are relevant to the region and that are a need in the region.

2.1 COMMERCIAL VEHICLE OPERATIONS PROGRAM AREA

ITS User Needs from the Commercial Vehicle Operations Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.1.1 ITS User Need: Reduce commercial vehicle weight, width and height violations

2.1.1.1 ITS Strategy: Intelligent Access Program - Weight Monitoring

The Intelligent Access Program - Weight Monitoring strategy enables commercial vehicle operators simplified access to permit operations in exchange for remote weight monitoring.

2.1.2 ITS User Need: Provide interstate/inter-regional traveler information for commercial vehicles

2.1.2.1 ITS Strategy: Freight-Specific Dynamic Travel Planning

This strategy provides both pretrip and enroute travel planning, routing, and commercial vehicle related traveler information, which includes information such as truck parking locations and current status. The information will be based on data collected from the commercial fleet as well as general traffic data collection capabilities. The information, both real time and static can be provided directly to fleet managers, to mobile devices used by commercial vehicle operators, or directly to in vehicle systems as commercial vehicles approach roadway exits with key facilities such as parking. The strategy can also provide oversize/ overweight permit information to commercial managers.

2.1.2.2 ITS Strategy: Road Weather Information for Freight Carriers

This strategy provides the capability to collect road weather data from connected vehicles and using that data to develop short term warnings or advisories that can be provided to individual commercial vehicles or to commercial vehicle dispatchers. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather commercial vehicle alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial vehicle dispatchers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.

2.1.3 ITS User Need: Provide information on commercial vehicle operations (CVO) permit restrictions

2.1.3.1 ITS Strategy: Intelligent Access Program - Weight Monitoring

The Intelligent Access Program - Weight Monitoring strategy enables commercial vehicle operators simplified access to permit operations in exchange for remote weight monitoring.

2.1.3.2 ITS Strategy: Intelligent Access Program

The Intelligent Access Program strategy enables commercial vehicle operators simplified access to permit operations in exchange for remote compliance monitoring.

2.1.3.3 ITS Strategy: Freight-Specific Dynamic Travel Planning

This strategy provides both pretrip and enroute travel planning, routing, and commercial vehicle related traveler information, which includes information such as truck parking locations and current status. The strategy can also provide oversize/ overweight permit information to commercial managers. The information will be based on data collected from the commercial fleet as well as general traffic data collection capabilities. The information, both real time and static can be provided directly to fleet managers, to mobile devices used by commercial vehicle operators.

2.1.4 ITS User Need: Provide tracking of HAZMAT vehicles

2.1.4.1 ITS Strategy: HAZMAT Management

This strategy integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Center. The Emergency Management Center is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Center. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

2.1.5 ITS User Need: Improve response to HAZMAT incidents

2.1.5.1 ITS Strategy: HAZMAT Management

This strategy integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Center. The Emergency Management Center is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Center. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

2.1.5.2 ITS Strategy: Carrier Operations and Fleet Management

This strategy manages a fleet of commercial vehicles. The Fleet and Freight Management Center monitors the vehicle fleet and can provide routes using either an in-house capability or an external provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). A route would be electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management Center and routing changes can be made depending on current road network conditions.

2.1.5.3 ITS Strategy: Roadside HAZMAT Security Detection and Mitigation

This strategy provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology. Credentials information can be accessed to verify if the commercial driver, vehicle and carrier are permitted to transport the identified HAZMAT. If the credentials analysis and sensed HAZMAT information do not agree, the vehicle can be signaled to pull off the highway, and if required, an alarm can be sent to Emergency Management to request they monitor, traffic stop or disable the vehicle.

2.1.6 ITS User Need: Provide better vehicle restrictions and roadway closure information to commercial vehicles

2.1.6.1 ITS Strategy: Carrier Operations and Fleet Management

This strategy manages a fleet of commercial vehicles. The Fleet and Freight Management Center monitors the vehicle fleet and can provide routes using either an in-house capability or an external provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). A route would be electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management Center and routing changes can be made depending on current road network conditions.

2.1.6.2 ITS Strategy: Freight-Specific Dynamic Travel Planning

This strategy provides both pretrip and enroute travel planning, routing, and commercial vehicle related traveler information, which includes information such as truck parking locations and current status. The strategy can also provide oversize/ overweight permit information to commercial managers. The information will be based on data collected from the commercial fleet as well as general traffic data collection capabilities. The information, both real time and static can be provided directly to fleet managers, to mobile devices used by commercial vehicle operators, or directly to in vehicle systems as commercial vehicles approach roadway exits with key facilities such as parking.

2.1.7 ITS User Need: Deploy weigh-in-motion/mobile weigh enforcement technology

2.1.7.1 ITS Strategy: Smart Roadside and Virtual WIM

This strategy includes the delivery of capabilities related to wireless roadside inspections and electronic screening/virtual weigh stations. Wireless roadside inspection is defined by a safety screening capability that employs communications technologies to obtain information from a commercial vehicle that will allow safety screening of the vehicle and its driver. This capability provides for the interrogation at mainline speeds of a commercial vehicle when it has entered a control segment or geofenced area. Vehicle identification and driver information are provided to the roadside unit. The information communicated can be used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. A more advanced version of this strategy would download safety information measured on the vehicle including driver related information such as the driver log allowing real time evaluation that the vehicle and driver are meeting safety requirements. The electronic screening/virtual weigh stations capability employs communications technologies to

obtain information from a commercial vehicle that will allow verification of permits or credentials for the vehicle. The information communicated is used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. This strategy can also be used to verify that the commercial vehicle meets vehicle weight (via weigh in motion capability) or dimension requirements.

2.1.7.2 ITS Strategy: Intelligent Access Program - Weight Monitoring

The Intelligent Access Program - Weight Monitoring strategy enables commercial vehicle operators simplified access to permit operations in exchange for remote weight monitoring.

2.1.7.3 ITS Strategy: Roadside CVO Safety

This strategy provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at roadside check locations. The basic option, directly supported by this strategy, facilitates safety inspection of vehicles that have been pulled off the highway, perhaps as a result of the automated screening process provided by the Electronic Clearance strategy. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations collect additional data from commercial vehicles.

2.1.8 ITS User Need: Provide target enforcement at locations with history of violations

2.1.8.1 ITS Strategy: Smart Roadside and Virtual WIM

This strategy includes the delivery of capabilities related to wireless roadside inspections and electronic screening/virtual weigh stations. Wireless roadside inspection is defined by a safety screening capability that employs communications technologies to obtain information from a commercial vehicle that will allow safety screening of the vehicle and its driver. This capability provides for the interrogation at mainline speeds of a commercial vehicle when it has entered a control segment or geofenced area. Vehicle identification and driver information are provided to the roadside unit. The information communicated can be used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. A more advanced version of this strategy would download safety information measured on the vehicle including driver related information such as the driver log allowing real time evaluation that the vehicle and driver are meeting safety requirements. The electronic screening/virtual weigh stations capability employs communications technologies to obtain information from a commercial vehicle that will allow verification of permits or credentials for the vehicle. The information communicated is used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. This strategy can also be used to verify that the commercial vehicle meets vehicle weight (via weigh in motion capability) or dimension requirements.

2.1.9 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user need and strategies discussed within the Commercial Vehicle Operations Program Area include the following:

- CVO01 Carrier Operations and Fleet Management
- CVO07 Roadside CVO Safety
- CVO08 Smart Roadside and Virtual WIM
- CVO09 Freight-Specific Dynamic Travel Planning
- CVO10 Road Weather Information for Freight Carriers
- CVO12 HAZMAT Management
- CVO13 Roadside HAZMAT Security Detection and Mitigation
- CVO18 Intelligent Access Program – Weight Monitoring

2.2 DATA MANAGEMENT PROGRAM AREA

ITS User Needs from the Data Management Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.2.1 ITS User Need: Improve information exchange between Caltrans, local transportation agencies and transit agencies

2.2.1.1 ITS Strategy: ITS Data Warehouse

This strategy provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse strategy, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse strategy are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

2.2.2 ITS User Need: Monitor transportation infrastructure

2.2.2.1 ITS Strategy: Performance Monitoring

The Performance Monitoring strategy uses information collected from connected vehicles to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data.

2.2.3 ITS User Need: Improve data collection capabilities and archiving on freeways/expressways

2.2.3.1 ITS Strategy: ITS Data Warehouse

This strategy provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse strategy, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse strategy are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

2.2.3.2 ITS Strategy: Performance Monitoring

The Performance Monitoring strategy uses information collected from connected vehicles to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data.

2.2.4 ITS User Need: Implement a central information/data clearinghouse

2.2.4.1 ITS Strategy: ITS Data Warehouse

This strategy provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse strategy, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse strategy are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

2.2.5 ITS User Need: Use archived data for planning, modeling, analysis and traffic management strategy development

2.2.5.1 ITS Strategy: Performance Monitoring

The Performance Monitoring strategy uses information collected from connected vehicles to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data.

2.2.5.2 ITS Strategy: ITS Data Warehouse

This strategy provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse strategy, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse strategy are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

2.2.6 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed within the Data Management Program Area include the following:

- DM01 ITS Data Warehouse
- DM02 Performance Monitoring

2.3 PUBLIC TRANSPORTATION PROGRAM AREA

ITS User Needs from the Public Transportation Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.3.1 ITS User Need: Expand/enhance/upgrade automatic vehicle location (AVL) system

2.3.1.1 ITS Strategy: Transit Vehicle Tracking

This strategy monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.

2.3.2 ITS User Need: Coordinate timed transfers between routes, providers and modes

2.3.2.1 ITS Strategy: Multi-modal Coordination

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

2.3.2.2 ITS Strategy: Transit Connection Protection

This strategy allows travelers to initiate a request for connection protection anytime during the trip using a personal device or on-board equipment and receive a confirmation indicating whether the request is accepted. Connection protection uses real time data to examine the arrival status of a transit vehicle and to transmit a hold message to a vehicle or other mode of transportation (e.g. rail) in order for the traveler to make a successful transfer from one vehicle to another. Connection protection can be performed within a single agency, across multiple agencies, and across multiple modes. In an intermodal, multimodal or interagency environment, a transfer request brokerage system, represented by the Transit Management System, can be used to determine the feasibility of a connection protection request and support schedule coordination between agencies.

2.3.3 ITS User Need: Implement/enhance web-based trip planner

2.3.3.1 ITS Strategy: Transit Vehicle Tracking

This strategy monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.

2.3.3.2 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.4 ITS User Need: Implement regional smart card for transit fare payment

2.3.4.1 ITS Strategy: Integrated Multi-Modal Electronic Payment

This strategy provides electronic payment capability for transit fares, tolls, road use, parking, and other areas requiring electronic payments.

2.3.4.2 ITS Strategy: Transit Fare Collection Management

This strategy manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device such as a smart phone. Readers located either in the infrastructure or on-board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Center.

2.3.5 ITS User Need: Implement/enhance remote monitoring of transit vehicle mechanical condition

2.3.5.1 ITS Strategy: Transit Fleet Management

This strategy supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Center. The Transit Management Center processes this data and schedules preventative and corrective maintenance. The strategy also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks.

2.3.6 ITS User Need: Provide real-time transit arrival/departure information on web site and at bus stops

2.3.6.1 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.6.2 ITS Strategy: Transit Vehicle Tracking

This strategy monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.

2.3.7 ITS User Need: Expand security cameras on transit vehicles, at transit stations/stops and park-and-ride facilities

2.3.7.1 ITS Strategy: Transit Security

This strategy provides for the physical security of transit passengers and transit vehicle operators. On-board equipment performs surveillance and sensor monitoring in order to identify potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio

systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this strategy provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).
Most of the surveillance and sensor data that is collected by this strategy may be monitored by either the Emergency Management Center or the Transit Management Center, providing two possible approaches to implementing this strategy. This strategy also supports remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.

2.3.8 ITS User Need: Provide on-board automated enunciators

2.3.8.1 ITS Strategy: Route ID for the Visually Impaired

This strategy assists visually impaired travelers to identify the appropriate bus and route to their intended destination. It provides information from bus stop infrastructure to visually impaired travelers portable devices that can be converted to audible information regarding the appropriate bus and route. It also allows the visually impaired traveler to query the portable device to identify route options.

2.3.8.2 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.9 ITS User Need: Provide on-line reservation system for demand-responsive transit services

2.3.9.1 ITS Strategy: Dynamic Transit Operations

This strategy allows travelers to request trips and obtain itineraries using a personal device such as a smart phone, tablet, or personal computer. The trips and itineraries cover multiple transportation services (public transportation modes, private transportation services, shared-ride, walking and biking). This strategy builds on existing technology systems such as computer-aided dispatch/ automated vehicle location (CAD/AVL) systems and automated scheduling software, providing a coordination function within and between transit providers that would dynamically schedule and dispatch or modify the route of an in-service vehicle by matching compatible trips together. TI06 covers other shared use transportation options.

2.3.10 ITS User Need: Provide transit information using social media

2.3.10.1 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.11 ITS User Need: Implement transit signal priority technology

2.3.11.1 ITS Strategy: Transit Signal Priority

This strategy uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The strategy provides feedback to the transit driver indicating whether the signal priority has been granted or not. This strategy can contribute to improved operating performance of the transit vehicles by reducing the time spent stopped at a red light.

2.3.12 ITS User Need: Expand/upgrade automated passenger counters

2.3.12.1 ITS Strategy: Transit Passenger Counting

This strategy counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.

2.3.13 ITS User Need: Develop mobile apps to provide static and real-time transit information

2.3.13.1 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.14 ITS User Need: Expand/enhance/upgrade computer aided dispatch (CAD) system

2.3.14.1 ITS Strategy: Transit Fixed-Route Operations

This strategy performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service monitors the transit vehicle trip performance against the schedule and provides information displays at the Transit Management Center.

2.3.15 ITS User Need: Receive real-time roadway congestion information

2.3.15.1 ITS Strategy: Transit Vehicle Tracking

This strategy monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.

2.3.15.2 ITS Strategy: Transit Fixed-Route Operations

This strategy provides automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service monitors the transit vehicle trip performance against the schedule and provides information displays at the Transit Management Center.

2.3.16 ITS User Need: Enhance 511 to provide static and real-time transit information

2.3.16.1 ITS Strategy: Transit Traveler Information

This strategy provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this strategy.

2.3.17 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed within the Public Transportation Program Area include the following:

- PT01 Transit Vehicle Tracking
- PT02 Transit Fixed-Route Operations
- PT03 Dynamic Transit Operations
- PT04 Transit Fare Collection Management
- PT05 Transit Security
- PT06 Transit Fleet Management
- PT07 Transit Passenger Counting
- PT08 Transit Traveler Information
- PT09 Transit Signal Priority
- PT14 Multi-modal Coordination
- PT16 Route ID for the Visually Impaired
- PT17 Transit Connection Protection
- PT18 Integrated Multi-Modal Electronic Payment

2.4 TRAVELER INFORMATION PROGRAM AREA

ITS User Needs from the Traveler Information Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.4.1 ITS User Need: Promote the use of and facilitate the use of shared mobility

2.4.1.1 ITS Strategy: Dynamic Ridesharing and Shared Use Transportation

This strategy addresses dynamic ridesharing/ride matching services to travelers and other forms of shared use transportation. Dynamic ridesharing allows travelers to arrange carpool trips through a personal device with a wireless connection to a ride matching system (e.g., a web-based application). It uses inputs from both passengers and drivers pre-trip, during the trip, and post-trip. These inputs are then translated into "optimal" pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations. After the trip, information is provided back to the strategy to improve the user's experience for future trips.
The shared use aspect of the strategy addresses three types of shared use that may be arranged using an internet connected personal device. In the first type, a traveler arranges for the temporary use of a vehicle. In the second type of shared use, a traveler arranges for a vehicle to pick them up at a specific location and take them to another location. The second type of shared use may be implemented as a ride matching or ridesharing service, including those provided by Uber and Lyft. The third type of shared use is a bikeshare capability.

2.4.2 ITS User Need: Improve ridesharing program/website

2.4.2.1 ITS Strategy: Dynamic Ridesharing and Shared Use Transportation

This strategy addresses dynamic ridesharing/ride matching services to travelers and other forms of shared use transportation. Dynamic ridesharing allows travelers to arrange carpool trips through a personal device with a wireless connection to a ride matching system (e.g., a web-based application). It uses inputs from both passengers and drivers pre-trip, during the trip, and post-trip. These inputs are then translated into "optimal" pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations. After the trip, information is provided back to the strategy to improve the user's experience for future trips.
The shared use aspect of the strategy addresses three types of shared use that may be arranged using an internet connected personal device. In the first type, a traveler arranges for the temporary use of a vehicle. In the second type of shared use, a traveler arranges for a vehicle to pick them up at a specific location and take them to another location. The second type of shared use may be implemented as a ride matching or ridesharing service, including those provided by Uber and Lyft. The third type of shared use is a bikeshare capability.

2.4.3 ITS User Need: Expand highway advisory radio (HAR) coverage on freeways/expressways

2.4.3.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and

construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

2.4.3.2 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.4.4 ITS User Need: Provide more timely incident information to travelers and Improve quality, consistency and thoroughness of traveler information

2.4.4.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

This strategy also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility strategies for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This strategy provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

2.4.4.2 ITS Strategy: Personalized Traveler Information

This strategy provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may

be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.

2.4.4.3 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.4.5 ITS User Need: Provide/enhance congestion information to travelers

2.4.5.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

This strategy also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility strategies for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This strategy provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

2.4.5.2 ITS Strategy: Dynamic Route Guidance

This strategy offers advanced route planning and guidance that is responsive to current conditions. The package augments a user's navigation system equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information, which is used by the user equipment to provide real-time route guidance that factors in current conditions.

2.4.5.3 ITS Strategy: Personalized Traveler Information

This strategy provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain

current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.

2.4.6 ITS User Need: Provide freeway/expressway travel times and Provide arterial travel times (on major arterials)

2.4.6.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

This strategy also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility strategies for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This strategy provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

2.4.6.2 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.4.6.3 ITS Strategy: Personalized Traveler Information

This strategy provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain

current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.

2.4.7 ITS User Need: Use social media for traveler information dissemination

2.4.7.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.
This strategy also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility strategies for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This strategy provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

2.4.8 ITS User Need: Provide roadway closure/restriction information

2.4.8.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.
This strategy also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility strategies for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This strategy provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

2.4.8.2 ITS Strategy: Dynamic Route Guidance

This strategy offers advanced route planning and guidance that is responsive to current conditions. The package augments a user's navigation system equipment with a digital receiver capable of

receiving real-time traffic, transit, and road condition information, which is used by the user equipment to provide real-time route guidance that factors in current conditions.

2.4.9 ITS User Need: Provide information and routing (detour) information to travelers during incident, construction, weather events, special events, etc.

2.4.9.1 ITS Strategy: Dynamic Route Guidance

This strategy offers advanced route planning and guidance that is responsive to current conditions. The package augments a user's navigation system equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information, which is used by the user equipment to provide real-time route guidance that factors in current conditions.

2.4.10 ITS User Need: Send email alerts of major incidents to major employers

2.4.10.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

2.4.10.2 ITS Strategy: Personalized Traveler Information

This strategy provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.

2.4.11 ITS User Need: Improve 511 system/web site, enhance freeway/expressway traffic map, and enhance arterial traffic map

2.4.11.1 ITS Strategy: Broadcast Traveler Information

This strategy provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies.

2.4.12 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed within the Traveler Information Program Area include the following:

- TI01 Broadcast Traveler Information
- TI02 Personalized Traveler Information
- TI03 Dynamic Route Guidance
- TI06 Dynamic Ridesharing and Shared Use Transportation
- TM06 Traffic Information Dissemination

2.5 TRAFFIC MANAGEMENT PROGRAM AREA

ITS User Needs from the Traffic Management Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.5.1 ITS User Need: Share incident information with other agencies

2.5.1.1 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.1.2 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that

provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.1.3 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.2 ITS User Need: Share congestion information with other agencies

2.5.2.1 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.2.2 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes

to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.3 ITS User Need: Share surveillance video and data with PSAPs/emergency responders

2.5.3.1 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.4 ITS User Need: Share surveillance video and data with PSAPs/emergency responders

2.5.4.1 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.4.2 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.5 ITS User Need: Share public safety/computer aided dispatch (CAD) data with transportation agencies

2.5.5.1 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.5.2 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific

equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.6 ITS User Need: Improve signal timing/coordination

2.5.6.1 ITS Strategy: Traffic Signal Control

This strategy provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this strategy ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This strategy is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management strategy. This strategy is consistent with typical traffic signal control systems.

2.5.6.2 ITS Strategy: Connected Vehicle Traffic Signal System

This strategy uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The strategy utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other strategies provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.

2.5.6.3 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers.

Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.7 ITS User Need: Improve/implement ability to remotely modify signal timing

2.5.7.1 ITS Strategy: Traffic Signal Control

This strategy provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this strategy ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This strategy is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management strategy. This strategy is consistent with typical traffic signal control systems.

2.5.7.2 ITS Strategy: Infrastructure-Based Traffic Surveillance

This strategy includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this strategy enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

2.5.8 ITS User Need: Provide/enhance speed enforcement at high risk locations

2.5.8.1 ITS Strategy: Speed Warning and Enforcement

This strategy monitors vehicle speeds and supports warning drivers when their speed is excessive. Also the service includes notifications to an enforcement agency to enforce the speed limit of the roadway. Speed monitoring can be made via spot speed or average speed measurements. Roadside equipment can display the speed of passing vehicles and/or suggest a safe driving speed. Environmental conditions and vehicle characteristics may be monitored and factored into the safe speed advisories that are provided to the motorist. For example, warnings can be generated recognizing the limitations of a given vehicle for the geometry of the roadway such as rollover risk for tall vehicles.

This service focuses on monitoring of vehicle speeds and enforcement of the speed limit while the variable speed limits service focuses on varying the posted speed limits to create more uniform speeds along a roadway, to promote safer driving during adverse conditions (such as fog) and/or to reduce air pollution.

2.5.9 ITS User Need: Implement/expand dynamic message sign (DMS) installations on arterials and freeways

2.5.9.1 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.9.2 ITS Strategy: Dynamic Roadway Warning

This strategy includes systems that dynamically warn drivers approaching hazards on a roadway. Such hazards include roadway weather conditions, road surface conditions, traffic conditions including queues, obstacles or animals in the roadway and any other transient event that can be sensed. These dynamic roadway warning systems can alert approaching drivers via warning signs, flashing lights, in-vehicle messages, etc. Such systems can increase the safety of a roadway by reducing the occurrence of incidents. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.

2.5.10 ITS User Need: Upgrade signal hardware

2.5.10.1 ITS Strategy: Traffic Signal Control

This strategy provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this strategy ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This strategy is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management strategy. This strategy is consistent with typical traffic signal control systems.

2.5.10.2 ITS Strategy: Connected Vehicle Traffic Signal System

This strategy uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The strategy utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other strategies provide related mobility services such as Transit

Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.

2.5.11 ITS User Need: Coordinate arterial and freeway management strategies

2.5.11.1 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.11.2 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.11.3 ITS Strategy: Integrated Decision Support and Demand Management

This strategy recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this strategy may also recommend lane restrictions, transit, parking, and toll

strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This strategy also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

2.5.12 ITS User Need: Reduce traffic congestion during incidents

2.5.12.1 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.12.2 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.12.3 ITS Strategy: Integrated Decision Support and Demand Management

This strategy recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this strategy may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This strategy also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

2.5.13 ITS User Need: Reduce recurring traffic congestion

2.5.13.1 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.13.2 ITS Strategy: Integrated Decision Support and Demand Management

This strategy recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this strategy may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This

strategy also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

2.5.13.3 ITS Strategy: Traffic Metering

This strategy provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the TM01 strategy (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.

2.5.13.4 ITS Strategy: Traffic Signal Control

This strategy provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this strategy ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This strategy is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management strategy. This strategy is consistent with typical traffic signal control systems.

2.5.13.5 ITS Strategy: Reversible Lane Management

This strategy provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this strategy includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This strategy also includes the equipment used to electronically reconfigure intersections and manage right-of-way to address dynamic demand changes and special events.

2.5.13.6 ITS Strategy: Speed Harmonization

This strategy determines speed recommendations based on traffic conditions and weather information and uses connected vehicle technologies to assist in harmonizing speeds to these recommendations. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events, and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The strategy utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies

for upstream traffic, and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.

2.5.13.7 ITS Strategy: Dynamic Lane Management and Shoulder Use

This strategy provides for active management of travel lanes along a roadway. The package includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control specific lanes and/or the shoulders. This equipment can be used to change the lane configuration on the roadway according to traffic demand and lane destination along a typical roadway section or on approach to or access from a border crossing, multimodal crossing or intermodal freight depot. This package can be used to allow temporary or interim use of shoulders as travel lanes. The equipment can be used to electronically reconfigure intersections and interchanges and manage right-of-way dynamically including merges. Also, lanes can be designated for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. Prohibitions or restrictions of types of vehicles from using particular lanes can be implemented.
The lane management system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.

2.5.14 ITS User Need: Implement intersection collision warning/avoidance systems

2.5.14.1 ITS Strategy: Connected Vehicle Traffic Signal System

This strategy uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The strategy utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other strategies provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.

2.5.15 ITS User Need: Implement/improve inter-jurisdictional signal coordination

2.5.15.1 ITS Strategy: Traffic Signal Control

This strategy provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this strategy ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This strategy is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management strategy. This strategy is consistent with typical traffic signal control systems.

2.5.15.2 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.16 ITS User Need: Provide roadway flood warnings

2.5.16.1 ITS Strategy: Traffic Information Dissemination

This strategy provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

2.5.17 ITS User Need: Expand CCTV camera coverage on arterials and freeways/expressways

2.5.17.1 ITS Strategy: Infrastructure-Based Traffic Surveillance

This strategy includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this strategy enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

2.5.18 ITS User Need: Develop/implement system-wide arterial management strategies

2.5.18.1 ITS Strategy: Regional Traffic Management

This strategy provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This strategy advances the Traffic Signal Control and Traffic Metering strategies by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering strategies and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

2.5.18.2 ITS Strategy: Integrated Decision Support and Demand Management

This strategy recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this strategy may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This strategy also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

2.5.18.3 ITS Strategy: Traffic Incident Management System

This strategy manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The strategy includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this strategy to detect and verify incidents and implement an appropriate response. This strategy supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic

Information Dissemination strategy and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information strategies. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

2.5.18.4 ITS Strategy: Connected Vehicle Traffic Signal System

This strategy uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The strategy utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other strategies provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.

2.5.19 ITS User Need: Reduce vehicle delays at rail grade crossings, Provide health monitoring of traffic signal equipment at intersections and rail crossings

2.5.19.1 ITS Strategy: Railroad Operations Coordination

This strategy provides an additional level of strategic coordination between freight rail operations and other transportation centers. Rail operations provides train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.

2.5.19.2 ITS Strategy: Advanced Railroad Grade Crossing

This strategy manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This strategy includes all capabilities from the Standard Railroad Grade Crossing strategy and augments these with additional safety features to mitigate the risks associated with higher rail speeds and leverage Connected Vehicle technologies. The active warning systems supported by this strategy include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this strategy, the wayside equipment provides additional information about the arriving train so that the train's direction of travel, estimated time of arrival, and estimated duration of closure may be derived. This strategy will alert and/or warn drivers who are approaching an at-grade railroad crossing if they are on a crash-imminent trajectory to collide with a crossing or approaching train. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This strategy also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

2.5.19.3 ITS Strategy: Standard Railroad Grade Crossing

This strategy manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the ITS Roadway Equipment and the Driver in the physical view.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification of an approaching train by interfaced wayside equipment. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the Traffic Management Center.

2.5.20 ITS User Need: Improve/expand vehicle detection coverage on freeways/expressways

2.5.20.1 ITS Strategy: Infrastructure-Based Traffic Surveillance

This strategy includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this strategy enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

2.5.20.2 ITS Strategy: Vehicle-Based Traffic Surveillance

This strategy uses probe data information obtained from vehicles in the network to support traffic operations, including incident detection and the implementation of localized operational strategies. Since traffic data is collected from vehicles, travel times and other related traffic performance measures are available. This strategy includes the capability to collect data from Connected Vehicles so that "probe" data can be collected from all equipped vehicles, providing access to a large vehicle population as penetration increases. Incident detection enables transportation agencies to determine the location of potential incidents so the agencies can respond more quickly to the incident and mitigate any negative impacts to the transportation network. Vehicle data that can be used to detect potential incidents include changes in vehicle speeds indicating the disruption of traffic flow, when a vehicle's safety systems have been activated or deployed, or sudden vehicle turns or deceleration at a specific location (indicating a potential obstacle in the roadway).

2.5.21 ITS User Need: Improve ramp metering operations

2.5.21.1 ITS Strategy: Traffic Metering

This strategy provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp,

interchange, and mainline metering. This package incorporates the instrumentation included in the TM01 strategy (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.

2.5.22 ITS User Need: Implement/improve incident detection capabilities

2.5.22.1 ITS Strategy: Infrastructure-Based Traffic Surveillance

This strategy includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this strategy enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

2.5.22.2 ITS Strategy: Vehicle-Based Traffic Surveillance

This strategy uses probe data information obtained from vehicles in the network to support traffic operations, including incident detection and the implementation of localized operational strategies. Since traffic data is collected from vehicles, travel times and other related traffic performance measures are available. This strategy includes the capability to collect data from Connected Vehicles so that "probe" data can be collected from all equipped vehicles, providing access to a large vehicle population as penetration increases. Incident detection enables transportation agencies to determine the location of potential incidents so the agencies can respond more quickly to the incident and mitigate any negative impacts to the transportation network. Vehicle data that can be used to detect potential incidents include changes in vehicle speeds indicating the disruption of traffic flow, when a vehicle's safety systems have been activated or deployed, or sudden vehicle turns or deceleration at a specific location (indicating a potential obstacle in the roadway).

2.5.22.3 ITS Strategy: Integrated Decision Support and Demand Management

This strategy recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this strategy may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and

forecast of the roadway network performance based on predicted travel demand patterns. This strategy also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

2.5.23 ITS User Need: Implement automated/remote control gate systems

2.5.23.1 ITS Strategy: Roadway Closure Management

This strategy closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The strategy includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this strategy includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This strategy covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other Traffic Management strategies.

2.5.24 ITS User Need: Implement variable speed limits

2.5.24.1 ITS Strategy: Speed Harmonization

This strategy determines speed recommendations based on traffic conditions and weather information and uses connected vehicle technologies to assist in harmonizing speeds to these recommendations. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events, and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The strategy utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies for upstream traffic, and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.

2.5.24.2 ITS Strategy: Variable Speed Limits

This strategy sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog), and/or to reduce air pollution. Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits, usually by lane. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.

2.5.25 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed within the Traffic Management Program Area include the following:

- TM01 Infrastructure-Based Traffic Surveillance
- TM02 Vehicle-Based Traffic Surveillance
- TM03 Traffic Signal Control
- TM04 Connected Vehicle Traffic Signal System
- TM05 Traffic Metering
- TM06 Traffic Information Dissemination
- TM07 Regional Traffic Management
- TM08 Traffic Incident Management System
- TM09 Integrated Decision Support and Demand Management
- TM12 Dynamic Roadway Warning
- TM13 Standard Railroad Grade Crossing
- TM14 Advanced Railroad Grade Crossing
- TM15 Railroad Operations Coordination
- TM16 Reversible Lane Management
- TM17 Speed Warning and Enforcement
- TM19 Roadway Closure Management
- TM20 Variable Speed Limits
- TM21 Speed Harmonization
- TM22 Dynamic Lane Management and Shoulder Use

2.6 PUBLIC SAFETY PROGRAM AREA

ITS User Needs from the Public Safety Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.
The ITS Needs results contained in this draft deliverable do not yet reflect the ITS Needs of the public safety community. However, the results of that process will be discussed in upcoming stakeholder correspondence and may be captured in the final version of this deliverable or in the final ITS Plan.

2.6.1 ITS User Need: Provide/enhance mobile data terminals for emergency vehicles

2.6.1.1 ITS Strategy: Routing Support for Emergency Responders

This strategy provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

2.6.1.2 ITS Strategy: Vehicle Emergency Response

This strategy provides arriving public safety vehicles with information from connected vehicles involved in a crash. Emergency responders need information about the vehicles involved in a crash to respond safely and effectively to the vehicle crash. Information such as HAZMAT data can assist the responders. Information about air bag activations and other measures indicating the severity of the crash can provide useful input to ambulance staff. In addition information about the power system of the vehicle (e.g. hybrid, electric, or internal combustion engine) can affect the response.

2.6.2 ITS User Need: Implement/upgrade computer aided dispatch (CAD) system for freeway service patrol

2.6.2.1 ITS Strategy: Emergency Call-Taking and Dispatch

This strategy provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

2.6.2.2 ITS Strategy: Roadway Service Patrols

This strategy supports roadway service patrol vehicles that monitor roads and aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The strategy monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

2.6.3 ITS User Need: Install/upgrade automatic vehicle location (AVL) on freeway service patrol vehicles and emergency vehicles

2.6.3.1 ITS Strategy: Roadway Service Patrols

This strategy supports roadway service patrol vehicles that monitor roads and aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The strategy monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

2.6.4 ITS User Need: Provide incident and real-time traffic information to emergency responders and emergency management agencies

2.6.4.1 ITS Strategy: Routing Support for Emergency Responders

This strategy provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

2.6.4.2 ITS Strategy: Vehicle Emergency Response

This strategy provides arriving public safety vehicles with information from connected vehicles involved in a crash. Emergency responders need information about the vehicles involved in a crash to respond safely and effectively to the vehicle crash. Information such as HAZMAT data can assist the responders. Information about air bag activations and other measures indicating the severity of the crash can provide useful input to ambulance staff. In addition information about the power system of the vehicle (e.g. hybrid, electric, or internal combustion engine) can affect the response.

2.6.4.3 ITS Strategy: Incident Scene Pre-Arrival Staging Guidance for Emergency Responders

This strategy provides situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en-route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The strategy also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).

2.6.5 ITS User Need: Improve incident response

2.6.5.1 ITS Strategy: Emergency Vehicle Preemption

This strategy provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.

2.6.5.2 ITS Strategy: Routing Support for Emergency Responders

This strategy provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle

routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

2.6.5.3 ITS Strategy: Incident Scene Pre-Arrival Staging Guidance for Emergency Responders

This strategy provides situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en-route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The strategy also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).

2.6.5.4 ITS Strategy: Vehicle Emergency Response

This strategy provides arriving public safety vehicles with information from connected vehicles involved in a crash. Emergency responders need information about the vehicles involved in a crash to respond safely and effectively to the vehicle crash. Information such as HAZMAT data can assist the responders. Information about air bag activations and other measures indicating the severity of the crash can provide useful input to ambulance staff. In addition information about the power system of the vehicle (e.g. hybrid, electric, or internal combustion engine) can affect the response.

2.6.5.5 ITS Strategy: Emergency Call-Taking and Dispatch

This strategy provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

2.6.5.6 ITS Strategy: Mayday Notification

This strategy provides the capability for a vehicle to automatically transmit an emergency message when the vehicle has been involved in a crash or other distress situation. An automatic crash notification feature transmits key data on the crash recorded by sensors mounted in the vehicle (e.g. deployment of airbags) without the need for involvement of the driver. The emergency message is sent to emergency response services, which determines and carries out the appropriate response. This strategy allows passing vehicles to receive and forward mayday requests in areas where no communications infrastructure exists. Emergency notifications from personal devices are also supported.

2.6.6 ITS User Need: Improve communications in rural areas

2.6.6.1 ITS Strategy: Wide-Area Alert

This strategy uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

2.6.7 ITS User Need: Reduce incident clearance time

2.6.7.1 ITS Strategy: Roadway Service Patrols

This strategy supports roadway service patrol vehicles that monitor roads and aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The strategy monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

2.6.7.2 ITS Strategy: Emergency Vehicle Preemption

This strategy provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.

2.6.7.3 ITS Strategy: Routing Support for Emergency Responders

This strategy provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

2.6.7.4 ITS Strategy: Incident Scene Pre-Arrival Staging Guidance for Emergency Responders

This strategy provides situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects

a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en-route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The strategy also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).

2.6.7.5 ITS Strategy: Vehicle Emergency Response

This strategy provides arriving public safety vehicles with information from connected vehicles involved in a crash. Emergency responders need information about the vehicles involved in a crash to respond safely and effectively to the vehicle crash. Information such as HAZMAT data can assist the responders. Information about air bag activations and other measures indicating the severity of the crash can provide useful input to ambulance staff. In addition information about the power system of the vehicle (e.g. hybrid, electric, or internal combustion engine) can affect the response.

2.6.7.6 ITS Strategy: Emergency Call-Taking and Dispatch

This strategy provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

2.6.8 ITS User Need: Improve a multi-agency, system-coordinated response to major incidents

2.6.8.1 ITS Strategy: Emergency Call-Taking and Dispatch

This strategy provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

2.6.8.2 ITS Strategy: Early Warning System

This strategy monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The strategy monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and

emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.

2.6.8.3 ITS Strategy: Evacuation and Reentry Management

This strategy supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The strategy addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.

This strategy supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.

2.6.8.4 ITS Strategy: Disaster Response and Recovery

This strategy enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).

The strategy supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The strategy provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this strategy tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.

The strategy identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this strategy, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and

manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this strategy supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

2.6.9 ITS User Need: Improve incident notification to agencies and improve interagency communications

2.6.9.1 ITS Strategy: Wide-Area Alert

This strategy uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

2.6.9.2 ITS Strategy: Early Warning System

This strategy monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The strategy monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.

2.6.9.3 ITS Strategy: Disaster Response and Recovery

This strategy enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).

The strategy supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The strategy provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In

addition, this strategy tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.
The strategy identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this strategy, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this strategy supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

2.6.10 ITS User Need: Expand emergency vehicle preemption

2.6.10.1 ITS Strategy: Emergency Vehicle Preemption

This strategy provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.

2.6.11 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed within the Public Safety Program Area include the following:

- PS01 Emergency Call-Taking and Dispatch
- PS02 Routing Support for Emergency Responders
- PS03 Emergency Vehicle Preemption
- PS04 Mayday Notification
- PS05 Vehicle Emergency Responders
- PS06 Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
- PS08 Roadway Service Patrols
- PS10 Wide-Area Alert
- PS11 Early Warning System
- PS12 Disaster Response and Recovery
- PS13 Evacuation and Reentry Management

2.7 SUSTAINABLE TRAVEL PROGRAM AREA

ITS User Needs from the Sustainable Travel Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.7.1 ITS User Need: Monitor/collect air quality data

2.7.1.1 ITS Strategy: Emissions Monitoring

This strategy monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the Emissions Management Center for processing. Both area wide air quality monitoring and point emissions monitoring are supported by this strategy. For area wide monitoring, this strategy measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this strategy collects data from on-board diagnostic systems and measures tail pipe emissions to identify vehicles that exceed emissions standards and/or clean vehicles that could be released from standard emissions tests, depending on policy and regulations. Summary emissions information or warnings can also be displayed to drivers. The gathered information can be used to implement environmentally sensitive travel demand management (TDM) programs, policies, and regulations.

2.7.1.2 ITS Strategy: Low Emissions Zone Management

This strategy supports the operation of a low emissions zone that is responsive to real-time traffic and environmental conditions. Low emissions zones are geographic areas that seek to restrict or deter access by specific categories of high-polluting vehicles into the area to improve the air quality within the geographic area. The strategy uses data collected from vehicles using connected vehicle technologies and from roadside equipment as input to the system. The Low Emissions Zone Management strategy supports the geo-fencing of a cordon that may be scalable and moveable (e.g., created for a day, removable, flexible in its boundaries) and would be less dependent on conventional ITS infrastructure. The strategy would establish parameters including the types of vehicles permitted to enter the zone, exemptions for transit vehicles, emissions criteria for entering the zone, fees or incentives for vehicles based on emissions data collected from the vehicle, and geographic boundaries for the low emissions zone. The strategy would also include electronic toll collection functions that support payments of fees or collection of incentives for registered vehicles using connected vehicle technologies. Finally, this strategy provides information about the low emissions zone to traveler information centers, including information about criteria for entering the zone, expected fees and incentives, current and predicted traffic conditions, and geographic boundaries of the zone.

2.7.2 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user need and strategies discussed within the Sustainable Travel Program Area include the following:

- ST01 Emissions Monitoring
- ST10 Low Emissions Zone Management

2.8 MAINTENANCE AND CONSTRUCTION PROGRAM AREA

ITS User Needs from the Maintenance and Construction Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.8.1 ITS User Need: Provide information on roadway construction and maintenance activities

2.8.1.1 ITS Strategy: Maintenance and Construction Activity Coordination

This strategy supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to Transportation Information Centers who can provide the information to travelers. Center to center coordination of work plans supports adjustments to reduce disruption to regional transportation operations.

2.8.2 ITS User Need: Provide travel times/delays through work zones

2.8.2.1 ITS Strategy: Work Zone Management

This strategy manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This strategy provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

2.8.3 ITS User Need: Implement Smart Work Zone technology

2.8.3.1 ITS Strategy: Work Zone Safety Monitoring

This strategy provides warnings to maintenance personnel within a work zone about potential hazards within the work zone. It enables vehicles or the infrastructure to provide warnings to workers in a work zone when a vehicle is moving in a manner that appears to create an unsafe condition (e.g., moving at high speed or entering the work zone).

2.8.3.2 ITS Strategy: Maintenance and Construction Vehicle and Equipment Tracking

This strategy tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Checks can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

2.8.4 ITS User Need: Warn work crews of errant vehicles

2.8.4.1 ITS Strategy: Work Zone Safety Monitoring

This strategy provides warnings to maintenance personnel within a work zone about potential hazards within the work zone. It enables vehicles or the infrastructure to provide warnings to workers in a work zone when a vehicle is moving in a manner that appears to create an unsafe condition (e.g., moving at high speed or entering the work zone).

2.8.5 ITS User Need: Coordinate construction and maintenance project schedules within and between agencies

2.8.5.1 ITS Strategy: Maintenance and Construction Activity Coordination

This strategy supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to Transportation Information Centers who can provide the information to travelers. Center to center coordination of work plans supports adjustments to reduce disruption to regional transportation operations.

2.8.5.2 ITS Strategy: Roadway Maintenance and Construction

This strategy supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.

2.8.5.3 ITS Strategy: Work Zone Management

This strategy manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This strategy provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

2.8.6 ITS User Need: Provide/enhance enforcement in work zones

2.8.6.1 ITS Strategy: Work Zone Management

This strategy manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This strategy provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

2.8.7 ITS User Need: Track locations of maintenance fleet

2.8.7.1 ITS Strategy: Maintenance and Construction Vehicle and Equipment Tracking

This strategy tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Checks can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

2.8.8 ITS User Need: Warn travelers about trucks entering/existing work zones

2.8.8.1 ITS Strategy: Work Zone Management

This strategy manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This strategy provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

2.8.8.2 ITS Strategy: Work Zone Safety Monitoring

This strategy provides warnings to maintenance personnel within a work zone about potential hazards within the work zone. It enables vehicles or the infrastructure to provide warnings to workers in a work zone when a vehicle is moving in a manner that appears to create an unsafe condition (e.g., moving at high speed or entering the work zone).

2.8.9 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user needs and strategies discussed with the Maintenance and Construction Management Program Area include the following:

- MC01 Maintenance and Construction Vehicle and Equipment Tracking
- MC05 Roadway Maintenance and Construction
- MC06 Work Zone Management
- MC07 Work Zone Safety Monitoring
- MC08 Maintenance and Construction Activity Coordination

2.9 VEHICLE SAFETY PROGRAM AREA

ITS User Needs from the Vehicle Safety Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.9.1 ITS User Need: Monitor queue lengths in/near work zones and provide advisory to warn traffic of a stopped queue in/near work zones

2.9.1.1 ITS Strategy: Queue Warning

This strategy utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications, to enable vehicles within the queue event to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to centers (such as the TMC). The infrastructure will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions. This strategy is not intended to operate as a crash avoidance system. In contrast to such systems, this strategy will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. It performs two essential tasks: queue determination (detection and/or prediction) and queue information dissemination using vehicle-based, infrastructure-based, or hybrid solutions.

2.9.2 ITS User Need: Provide curve speed warning

2.9.2.1 ITS Strategy: Curve Speed Warning

This strategy allows connected vehicles to receive information that it is approaching a curve along with the recommended speed for the curve. This capability allows the vehicle to provide a warning to the driver regarding the curve and its recommended speed. In addition, the vehicle can perform additional warning actions if the actual speed through the curve exceeds the recommended speed.

2.9.3 ITS User Need: Provide/enhance road weather conditions information to travelers

2.9.3.1 ITS Strategy: Road Weather Motorist Alert and Warning

This strategy collects road weather data from connected vehicles and uses that data to develop short term warnings or advisories that can be provided to individual motorists. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather motorist alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial service providers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.

2.9.4 ITS User Need: Monitor queue lengths at ramp locations

2.9.4.1 ITS Strategy: Queue Warning

This strategy utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications, to enable vehicles within the queue event to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to centers (such as the TMC). The infrastructure

will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions. This strategy is not intended to operate as a crash avoidance system. In contrast to such systems, this strategy will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. It performs two essential tasks: queue determination (detection and/or prediction) and queue information dissemination using vehicle-based, infrastructure-based, or hybrid solutions.

2.9.5 ITS User Need: Provide vehicle-over-height detection/warnings

2.9.5.1 ITS Strategy: Oversize Vehicle Warning

The strategy uses external measurements taken by the roadside infrastructure, and transmitted to the vehicle, to support in-vehicle determination of whether an alert/warning is necessary. Specifically, the infrastructure data equipment detects and measures the approaching vehicle's height and width. The infrastructure component of the strategy transmits the vehicle measurements, along with bridge, overpass, or tunnel geometry, to the oversize vehicle. The vehicle application utilizes this data to determine whether the vehicle can clear the bridge or tunnel. If deemed necessary, the driver is alerted to the impending low height and/or narrow horizontal clearance bridge or tunnel prior to a decision point, enabling the vehicle to reroute and avoid a collision. If the driver ignores the alert and continues along the route, the vehicle will generate a warning indicating an impending collision at a point near the bridge or tunnel approach. To support unequipped vehicles the infrastructure will display warning or reroute information when the measurements indicate that a vehicle does not have adequate height or width clearance. This strategy can be expanded to consider weight as well as height and width.

2.9.6 ITS User Need: Implement intersection collision warning/avoidance systems

2.9.6.1 ITS Strategy: Intersection Safety Warning and Collision Avoidance

This strategy enables a connected vehicle approaching an instrumented signalized intersection to receive information from the infrastructure regarding the signal timing and the geometry of the intersection. The vehicle uses its speed and acceleration profile, along with the signal timing and geometry information to determine if it appears likely that the vehicle will be able to pass safely through the intersection without violating the signal or colliding with other vehicles. If the vehicle determines that proceeding through the intersection is unsafe, a warning is provided to the driver and/or collision avoidance actions are taken, depending on the automation level of the vehicle.

2.9.7 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user need and strategies discussed within the Vehicle Safety Program Area include the following:

- VS05 Curve Speed Warning
- VS07 Road Weather Motorist Alert and Warning
- VS11 Oversize Vehicle Warning
- VS13 Intersection Safety Warning and Collision Avoidance

2.10 WEATHER PROGRAM AREA

ITS User Needs from the Weather Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.10.1 ITS User Need: Expand coverage of environmental/weather/road conditions detection/monitoring systems

2.10.1.1 ITS Strategy: Weather Information Processing and Distribution

This strategy processes and distributes the environmental information collected from the Weather Data Collection strategy. This strategy uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so operational centers and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination strategy, and aid operators in scheduling work activity.

2.10.1.2 ITS Strategy: Weather Data Collection

This strategy collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. It also collects data from vehicles in the road network that can be used to directly measure or infer current environmental conditions. It leverages vehicle on-board systems that measure temperature, sense current weather conditions (rain and sun sensors) and also can monitor aspects of the vehicle operational status (e.g., use of headlights, wipers, and traction control system) to gather information about local environmental conditions. In addition, environmental sensor systems located on Maintenance and Construction Vehicles are also potential data sources. The collected environmental data is used by the Weather Information Processing and Distribution strategy to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The strategy may also request and receive qualified data sets from meteorological systems.

2.10.1.3 ITS Strategy: Spot Weather Impact Warning

This strategy will alert drivers to unsafe conditions or road closure at specific points on the downstream roadway as a result of weather-related impacts, which include, but are not limited to high winds, flood conditions, ice, or fog. The strategies is designed to use standalone weather systems to warn drivers about inclement weather conditions that may impact travel conditions. Real time weather information is collected from fixed environmental sensor stations and vehicle based sensors. The information is processed to determine the nature of the alert or warning to be delivered and then communicated to connected vehicles. If the warning includes road closure then diversion information can be provided. For non-equipped vehicles the alerts or warnings will be provided via roadway signage. In addition, the roadway equipment may calculate the appropriate speed for current weather conditions and provide this information to the connected vehicle or on roadway signage.

2.10.2 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user need and strategies discussed within the Weather Program Area include the following:

- WX01 Weather Data Collection
- WX02 Weather Information Processing and Distribution
- WX03 Spot Weather Impact Warning

2.11 PARKING MANAGEMENT PROGRAM AREA

ITS User Needs from the Parking Management Program Area that were identified as a priority for the Kern region are listed in this subsection. Following each ITS User Need is a recommended strategy, or strategies, that could be implemented to address the ITS User Need.

2.11.1 ITS User Need: Provide information on available truck parking facilities

The following ITS strategies are listed to support providing information on available truck parking.

2.11.1.1 ITS Strategy: Parking Space Management

This strategy monitors and manages parking spaces in lots, garages, and other parking areas and facilities. It assists in the management of parking operations by monitoring parking lot ingress and egress, parking space occupancy and availability. Infrastructure-based detectors and/or connected vehicles may be used to monitor parking occupancy. The strategy shares collected parking information with local drivers and information providers for broader distribution

2.11.2 Supporting ITS Architecture Service Packages

ITS Architecture Service Packages that support the user need and strategies discussed within the Parking Management Program Area include the following:

- PM01 Parking Space Management

3.0 NEXT STEPS

The next step in the overall project is to continue to develop a listing of ITS projects for inclusion in the Regional ITS Architecture and the ITS Plan. The basis of the ITS project listing includes the 1997 ITS EDP, 2001 San Joaquin Valley Strategic Deployment Plan, the 2014 Regional Transportation Plan (RTP), as well as stakeholder input. Concurrently, the consultant team and project team has been learning more about RAD-IT (Regional Architecture Development for Intelligent Transportation), the latest update to the software tool previously known as Turbo Architecture™.