CALIFORNIA/OREGON ADVANCED TRANSPORTATION SYSTEMS

PROJECT INFRASTRUCTURE

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INTRODUCTION

Purpose of Document

The purpose of this document is to propose a list of potential infrastructure that can be implemented in the California Oregon Advanced Transportation System (COATS) study area. This document considered input from organizations within the project limits responsible for transportation, enforcement, tourism, commercial vehicle operations, transit and fleet management, and incorporated their needs in order to prioritize infrastructure, early–winners and ultimately strategic deployment.

Document Contents

This document details the potential ITS infrastructure elements within the project limits. For each infrastructure element, this report provides

- a description of the proposed ITS technologies,
- a list of objectives that these technologies attempt to address,
- location selection criteria,
- maps of potential locations, and
- an appendix detailing locations of infrastructure shown on the maps.

Potential infrastructure elements were identified based on the qualitative (e.g. stakeholder workshops) and quantitative (Performance and Conditions Technical Memorandum) challenges identified in other project tasks, and the Legacy System Technical Memorandum within the COATS study area.

Critical Program Areas

The potential projects are categorized to fit within one of the seven Critical Program Areas (CPAs) as developed by Advanced Rural Transportation Systems (ARTS) program. The following general descriptions are provided to inform reviewers of program focus areas that are being concentrated on for deployment. These CPAs are described as follows:

1. ***Traveler Safety and Security***: Addresses the need for improving driver ability to operate a vehicle in a safe and responsible way and for improving driver notification of potentially hazardous driving conditions.

2. ***Emergency Services***: Focuses on improving communications, management of emergency service fleets and critical information transmission. This CPA also deals with improving coordination efforts between service providers and improving real-time emergency information.

3. ***Tourism and Traveler Information Services***: Focuses on providing traveler information and mobility services to travelers unfamiliar with the rural area.

4. ***Public Traveler/Mobility Services***: Focuses on improving accessibility, addressing congestion issues associated with transit operations and reducing isolation of travelers using/relying on public transportation.

5. ***Infrastructure Operations & Maintenance***: Focuses on improving the efficiency and operation activities of rural transportation systems.

6. ***Fleet Operations and Maintenance***: Provides for efficient scheduling, routing, locating, and maintaining of rural fleets.

7. ***Commercial Vehicle Operations***: Addresses regulation, management, and logistics of commercial fleets, including hazardous material identification and management, to meet the needs of rural commercial operators.

Document Organization

Within each of the sections of this document, corresponding to the Critical Program Areas discussed above, are several potential ITS projects or Infrastructure. Details of each of these infrastructure elements are provided to give the reader an idea of the system's purpose and possible examples of its uses. Complimenting this discussion is a list of objectives that the system is trying to fulfill. Finally, a list of potential locations for each infrastructure element is provided.

Potential locations are often times linked to specific criteria. These criteria are categorized by the types of challenges that the COATS study area faces. These challenges are:

- emergency medical service response and notification times,
- traveler mobility,
- tourism,
- environmental impacts,
- safety, related to
- construction zones;
- bicycle/pedestrian conflicts;
- drowsy drivers;
- animal/vehicle collision;
- speed and slippery surfaces;
- alcohol;
- intersections;
- limited visibility; and
- narrow lane widths/clear zones
- lack of seat belt use

multi-jurisdictional incidents (common road closures), including

- slides;
- floods;
- weather;
- objects in the roadway; and
- vehicle accident related closures.

The following table (Table 1) lists each of these challenges with the respective performance criteria and corresponding limiting factors.

Table 1: Performance Criteria

CHALLENGE	TYPE	PERFORMANCE CRITERIA	LIMITING FACTORS	
Emergency Services	**Notification Times**	Time AND Frequency for Major Segment	>20 Minutes >2 Incidents/Segment	
	Response Times	Time AND Frequency for Major Segment	>40 Minutes >2 Incidents/Segment	
Mobility	**Transit Availability**	Percent of Potential Transportation Dependent Population	>35%	
Tourism	**High Recreation Traffic**	Annual Visitor Counts	>200K Visitors	
Safety	**- Speed & Slip Surf** **- Clear Zone**	No. of Accidents in 1/2 Mile Segment AND >1/2 Mile Segment Rates	**# of Accidents**	**½-Mile Segment Rate**
			>4	CA 4.98 OR 2.88 CA I-5 1.18 OR 1.5 0.62
	- Intersection **- Visibility**	No. of Accidents in 1/2 Mile Segment AND >1/2 Mile Segment Rates	>10	
	- Drowsy Driver **- Animal Collision**	No. of Accidents in Major Segment AND >Major Segment Rates	**# of Accidents**	**Major Segment Rate**
			>10	CA & OR 0.1
	- Bicycle/Pedestrian	No. of accidents in city limits	>4	
	- Alcohol **- Lack of Seat Belt**	Area Wide (not clustered)		
	- Construction **- Passing Maneuver** **- Poor Alignment** **- RR Grade Crossing**	Determined by Stakeholders		

		Weighted Closures {Per Major Segment Per Year}	Weighted Duration {Days Per Major Segment Per Year}
Road Closures	**Slide**	3	10
	Flood	1	2
	Weather	2	0.5
	Object	2	0.5
	Vehicle Crash	2	0.5

To ensure that potential locations for infrastructure have the greatest potential for benefit, many of the criteria used to find locations are based on previously identified challenges. To avoid restating the criteria from a specific challenge within each infrastructure element this discussion is included in the introduction. In addition to the criteria described below, locations were occasionally modified to include stakeholder and steering committee input on problem areas. The following discussions contain a brief summary of the challenges that were previously identified in Technical Memorandum One, Volume Two, the Conditions and Performance report. For a more detailed discussion of these challenges, data collected and areas of focus, please refer to that document.

Emergency Service Notification and Response

When a vehicle accident occurs and someone is seriously injured, a quick response time by emergency service may reduce several risks associated with vehicle accidents. To determine response times which were thought to be above average, three years of accident data that included both notification times and response times for fatal vehicle accidents was collected. Notification times refer to the time elapsed from the moment that the incident occurred to when the proper authorities were notified. The response time is the elapsed time between notification of the incident and arrival of emergency services to the incident location. For evaluation purposes, the highways within the COATS study area were divided into highway segments that joined two junctions and evaluated using one or both of the following criteria:

1. more than two fatal accidents with notification times greater than 20 minutes, **OR**
2. more than two fatal accidents with response times greater than 40 minute.

These criteria were designated based the "golden hour", that is the critical hour following an incident. The "golden hour" following an accident may be critical to the treatment of those involved. Any road segments where notification and response times exceed the cutoffs repeatedly need to be examined for mitigation.

Mobility

Transit availability is a mobility challenge that many people face throughout the COATS study area. The potential targets of the study of this challenge are those dependent on transit and its availability. Those within the population that are potentially transportation dependent are either, 65 years old and over, living below the poverty level, or have limited physical mobility. Areas of focus for this challenge include the counties where greater than 35% of the population potentially transportation dependent. This limit justified that the areas of focus are Lake county, California and Josephine county, Oregon.

Tourism

Large volumes of recreational traffic can lead to congestion and reduced mobility. Data regarding common recreational destinations and annual visitorship numbers were collected from a variety of sources. Tourist destinations with greater than 200,000 visitors annually were of specific interest to this study. The greater majority of these destinations were located on Route 101 and National Parks creating obvious areas of focus. A summary of these locations can be found in the following table (Table 2).

Table 2: Tourist destinations with greater than 200,000 visitors annually.

On Route 101				
Destination	**State**	**Route/State Route**	**Post Mile**	**Annual Attendance**
Humboldt Redwoods State Park	CA	101	35.11	577,250
Humboldt Lagoons State Park	CA	101	108.22	239,047
Prairie Creek Redwoods State Park	CA	101	126.10	237,148
The Mill Casino, North Bend	OR	9	234.03	900,000
Harris Beach State Park	OR	9	358.00	846,720
Sunset Bay State Park	OR	9	251.00	809,049
S.H. Boardman State Scenic Corridor	OR	9	345.00	726,310
Bullards Beach State Park	OR	9	273.00	437,897
Bandon State Natural Area	OR	9	275.00	358,189
Face Rock State Scenic Viewpoint	OR	9	277.00	328,733
Shore Acres State Park	OR	9	253.00	327,824
Oregon Dunes Nation Rec Area	OR	9	205.00	250,000
Cape Arago State Park	OR	9	255.00	242,749
Bandon Cheese Factory	OR	9	260.64	200,000
Off Route 101				
Mackerricher State Park	CA	1	64.86	789,270
Lassen Volcanic National Park	CA	89	0.00	450,000
Jediah Smith Redwoods State Park	CA	199	9.00	201,292
Valley of the Rogue State Park	OR	1	50.00	1,419,781
Seven Feathers Hotel and Gaming Resort, Canyonville	OR	1	99.09	647,500
Oregon Shakespeare Festival	OR	1	19.10	355,554
Collier Memorial State Park	OR	4	244.00	444,675
Kla-Mo-Ya Casino	OR	4	247.44	200,000
Tou Velle State Recreation Site	OR	22	6.00	331,048
Joseph Stewart State Park	OR	22	27.00	290,628
Casey State Recreation Site	OR	22	24.00	237,385
Crater Lake National Park	OR	425	1.00	534,584

Safety Challenges

Accident records for the entire corridor were analyzed to identify and quantify specific safety challenges. These records were analyzed by 1) identifying half-mile high accident locations (HALs), 2) determining significant factors at each HAL and 3) determining significant factors for major segments.

To gauge the extent of each challenge, an accident rate was determined for half-mile segments of the highways. Accident rates were calculated using the following equation:

$$Rate = \frac{n * c}{ADT * t * L} \qquad \text{Equation 1}$$

where n is the number of accidents within a 3 year period, c is a constant (1,000,000), ADT is the average number of automobiles per day on a particular segment, t is the number of days in 3 years and L is the length of the segment (0.5 miles).

Segments having accident rates greater than two standard deviations above the mean were considered high accident locations (HALs). Due to noticeable differences in average rates, standard deviations and means were analyzed separately for each state. Cutoff rates for California and Oregon were 4.98 and 2.88 accidents per million vehicle miles traveled, respectively. Because Interstate highways have different design standards, accident rates were analyzed separately. The cutoff rates accident rate for Interstate 5 in California is 1.18 and for Interstate 5 in Oregon, 0.62. The differences between California and Oregon accident rates fall in line with the national fatal accident report which shows a 70% higher fatal accident rate in rural California as compared to rural Oregon. Reasons for these different rates may be differences in each state's reporting techniques (e.g., accident recording and traffic volume recording) or simply a reflection of actual accident frequencies between the two states.

Highway accidents typically involve several different causes and factors. Some of these may include:

- roadway surface conditions
- types of vehicles
- driver error
- weather
- type of collision
- other contributing factors

Each HAL was analyzed to identify prevalent accident types. If a particular type of accident occurred more than four times and accounted for 20% or more of the total accidents in a given half-mile segment, it was considered a focus area. The types of accidents that were considered in this category were caused by 1) icy or wet roads caused by inclement weather and 2) accidents that were caused by narrow clear zones and shoulders. For more common types of

accidents, such as intersection related accidents, the number of accidents was changed from four to ten accidents to further focus problem areas. Accident types that were considered using these criteria were those related to 1) poor visibility due to inclement weather and 2) accidents at intersections. More detailed discussions of these types of accidents is provided in the Conditions and Performance report, Volume 2 of Technical Memorandum One.

Accident types that were spread over major highway segments by county rather than clustered in half-mile segments were grouped and analyzed separately. After dividing the accidents into major categories, Equation 1 was used to calculate rates using the actual length of the major section. Major highway segments having greater than ten accidents and accident rates greater than 0.1 for both California and Oregon were considered areas of focus. Accident types considered in this category were 1) accidents involving animals and 2) accidents related to driver fatigue.

There were various types of accidents occurred in the study area that were not concentrated into a half-mile segment or major highway segment, yet still accounted for a significant number of accidents. These accidents were considered an area-wide challenge and were treated as such in the analysis. Accident types that were considered in this category were accidents related to 1) alcohol and 2) lack of seat belt use. Bicycle and pedestrian accidents were analyzed separately because consistent traffic volumes available. Cities and towns that had a significant number of bicycle and pedestrian/vehicle accidents were considered areas of focus. The cities of focus including the quantity of accidents are listed in the following table (Table 3).

Table 3: Cities of focus for bicycle and pedestrian accidents.

State	City	Population	Route	No. of Accidents
CA	Cresect City	6866	101	5
CA	Eureka	26,202	101	47
CA	Arcata	16,261	101	4
CA	Susanville	13,089	36	10
CA	Willits	4953	101	17
CA	Redding	76,616	299	9
CA	Yreka	6934	3	4
CA	Red Bluff	13,290	36	7
OR	Creswell/Goshen	2721	I-5	4
OR	Eugene	123,718	I-5	10
OR	Bend	31,733	97, 20	27
OR	Northbend/Coos Bay	9927/15,448	101	10
OR	Florence/Reedsport/ Lakeside	6124/4891/1560	101	11
OR	Goldbeach	1555	101	6
OR	Brookings	5001	101	6
OR	Oakridge	3121	58	3
OR	Grants Pass	20,894	199	4
OR	Coquille	4063	42	5
OR	Winston	3894	42	4
OR	Klamath Falls	18,580	39	6

Road Closures

Road closures and multi-jurisdictional incidents that occur on the roadway may consist of slides, flooding, weather, vehicle accident, and object interference. For all types of road closures, the performance criteria for identifying the problem areas were 1) the number of closures, 2) their respective duration and 3) whether the closure was full or partial. District 1 in California provided all three of these data; Oregon only provided the number of road closures. Therefore, to make valid comparisons, the number of closures were weighted with respect to whether they were a full or partial closure and averaged into a per year number of closures. The weighted equations are:

$$C_w = 2C_f + C_p \qquad \text{Equation 2}$$

$$D_w = 2D_f + D_p \qquad \text{Equation 3}$$

where C_w is the weighted number of closures in District 1, California, C_f is the number of full closures, C_p is the number of partial closures, D_w is the weighted duration, D_f is the duration of full closures and D_p is the duration of partial closures. Since Oregon did not deliniate between partial and full closures, so it was assumed that they were all full closures and only one year of data. When more than one year of data was provided, it was normalized into one year.

Limiting values were assigned to eliminate road segments that were not experiencing recurring road closures or closures of significant duration from consideration. In addition, the limits varied by closure type, thereby more accurately representing the nature of the closure. Respective proposed limits for each road closure type is listed in Table 1.

Other Challenges

Many challenges were identified, but due to unavailability of data specific locations were only identified through stakeholder input or will be determined when a specific project is identified. These challenges include:

- Safety Challenges
  - Passing maneuvers
  - Construction zone
  - Poor alignment
  - Railroad grade crossings
- Lack of intermodal facilities
- Environmentally sensitive areas (HAZMAT)

TRAVELER SAFETY AND SECURITY

Dynamic Warning Variable Message Signing

Description:

Dynamic signing provides real-time, warning of potentially hazardous road conditions. Integration of these signs with environmental sensors, and vehicle speed and weight sensors can help to alert the driver to potentially hazardous situations and make recommendations regarding safe speed, etc.

Objectives:

- To provide safe travel speed advisory for given geometric and road conditions (e.g. steep downgrades, curves, entrance and exit ramps, etc.)
- Use of roadway sensors to collect vehicle characteristics (i.e. weight, type, speed, height) and road surface

Potential Locations:

- Roadway segments which experience accidents associated with speed too fast for conditions
- Roadway segments that have horizontal and vertical alignment challenges
- Areas with frequent ice build-up on roadway
- Areas with poor visibility due to fog, etc.

Intersection Advance Warning Signing

Description:

Intersection advance warning detects the presence and speed of vehicles approaching an intersection from a minor roadway and warns the traveler on the major roadway approach of a potential conflict through dynamic signing. This may be used in areas where speed zones decrease more than 20 mph or where rural conditions change to urban development.

Objectives:

- Provide advance information to travelers of approaching intersections
- Monitor location and speed of vehicles approaching intersection and provides dynamic warning when potential conflict exists

Potential Locations:

- Areas where there is a 20 mile/hour decrease in speed
- Rural conditions change to urban
- Areas meeting intersection conflict related safety performance criteria

Animal/Vehicle Collision Warning System

Description:

Animal/vehicle collision warning systems help to alert the driver of animal presence in the right-of-way, decreasing the driver's chance of animal/vehicle conflict. Systems will use an advanced technology to replicate an electronic fence that detects animal encroachments in areas of high migration routes and transmits signal to upstream dynamic signal/ signing. There are also on-board systems available that detect other objects, such as vehicles, in the roadway and alerts the motorist.

Objectives:

- Provide for increased safety in areas with known animal/vehicle collisions
- Reduce animal/vehicle conflicts

Potential Locations:

- Areas with existing high animal migration patterns
- Areas meeting animal collision related safety performance criteria

Mayday Systems

Description:

The Mayday system allows the user to initiate a request for emergency assistance from the vehicle. The request may be either manually or automatically initiated. A simple after-market device in the vehicle or cellular telephone with Global Positioning System (GPS)/Automatic Vehicle Location (AVL) would enable the traveler to access this service. This system requires vehicle location/tracking technology and wireless communications (e.g. cellular, satellite, microwave) to geographically locate and display vehicle at response center.

Objectives:

- Allow stranded motorist or motorists requiring aid to notify emergency managers of needed service (tow truck, medical assistance, police, etc.)
- Reduce notification time
- Reduce response time by providing more accurate location information to emergency response teams

Possible Locations:

- Vehicle fleets that commonly travel areas where good or excellent cellular communications coverage exists
- Areas meeting notification and response time related emergency service performance criteria

Lateral Safety Warning

Description:

A lateral safety warning system senses the center of the lane and provides either driver assistance or control to keep the vehicle in the center of the lane. The in-vehicle system would track the vehicle's lateral position, and warn the driver if they are leaving the travel lane, thus increasing the chances that the driver will be able to make an appropriate correction. Communication with highway infrastructure may be required, such as accurate lane markers, imbedded magnetic nails or radar-reflective pavement marking stripes.

Objectives:

- To give warning when vehicle leaves the travel lane
- Reduce the number of single vehicle "run off the road" accidents
- Reduce infrastructure damage to barrier rail and other roadside devices

Potential Locations:

- In conjunction with existing vehicle fleets (i.e. rental cars, snow plows, emergency service fleets, DOT vehicles, rural transit)
- Areas meeting narrow shoulder/clear zone related safety performance criteria

Automated Anti-Icing Dispenser for Roads and Bridges

Description:

An automated anti-icing dispenser is linked to a road surface sensor, which uses an algorithm dependent on the road surface temperature to automatically dispense anti-icing chemicals on the road or bridge. Another means of deicing bridges without the use of chemicals is to install bridge heaters that are automatically activated based on the same algorithm. These systems can also be used to automatically alert maintenance personnel for more prompt mitigation.

Objectives:

- Increase the efficiency of ice mitigation on roads and bridges
- Improve safety
- Minimize waste of anti-icing materials

Proposed Locations:

- Roads and bridges subject to regular icing
- Areas meeting speed and slippery surface related safety performance criteria

Driver Impairment Detection and Warning

Description:

Driver impairment and detection warning systems consist of a vehicle-based system that detects driver inattentiveness, an electronic device that monitors driving patterns and an alert system. The inattentive driver is alerted with an audible warning signal.

Objectives:

- To prevent accidents caused by driver fatigue
- Improve safety

Proposed Locations:

- Areas meeting the drowsy driver related safety performance criteria

Advance Warning Systems for Narrow Lane Widths

Description:

In various locations within the study area, stakeholders have identified narrow lane widths, limited buffer distance from obstacles (e.g. canyon walls) and limited sight distance. These characteristics cause greater concern to commercial vehicles and recreational vehicles because of their width. The system would identify the vehicle type and speed through weigh-in-motion, and provide upstream warning to other travelers through a flashing beacon.

Objectives:

- Reduce side-swipe or head-on accidents and speed in areas where narrow lanes have been identified
- Provide advance warning of conditions for classes of vehicles

Potential Locations:

- Areas meeting narrow shoulder/clear zone related safety performance criteria

Automated Flood Warning

Description:

Automated flood warning is a solar powered, cellular communication system to notify both maintenance personnel and motorists of "water on roadway" conditions. The system would be composed of a sensor connected to a cellular signal with a prerecorded message to notify maintenance crews when the water on the road reaches a significant level. Motorists would be notified by use of a warning sign with beacons triggered by the same sensor.

Objectives:

- Notify travelers of potentially adverse road conditions
- Notify maintenance crews of water levels on roadways in a more timely manner

Potential Locations:

- Routes not frequently surveyed by maintenance crews that are susceptible to high water levels
- Areas meeting flood related road closure performance criteria

Automated Visibility Warning

Description:

The automated visibility warning system would be composed of sensor, communication, and warning systems.

Objectives:

- Improve response time by maintenance
- Regulate the number of travelers on dangerous roads
- Increase awareness during poor visibility incidents to travelers, enforcement and road maintenance crews

Potential Locations:

- Roadways currently requiring manpowered observation to warn motorists and close roads
- Areas meeting visibility related safety performance criteria

Advanced Bicycle/Pedestrian Warning

Description:

An Advanced Bicycle/ Pedestrian Warning Systems would consist of a push-button actuated system that would communicate with a dynamic flashing beacon above a fixed sign which reads "BICYCLES (or PEDESTRIANS ON HIGHWAY". The sign would be located upstream of where the bicycle/ pedestrian is crossing and automatically shut-off after a period of time.

Objectives:

- Provide advance warning to motorist
- Increase safety and reduce exposure of crossing bicycle/ pedestrian

Potential Locations:

- Areas meeting bicycle/pedestrian related safety performance criteria

On-Board Transit Safety Systems

Description:

This system provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g. stops, park and ride lots, stations) are also monitored. Information is communicated to the transit managers using the existing or emerging wireless or wireline infrastructure. Security related information is also transmitted to the enforcement personnel when an emergency is identified that requires an external response. Incident information is communicated to either enforcement or DOT staff.

Objectives:

- Increase safety of transit patrons and driver
- Reduce detection and response time to emergency conditions or incidents

Potential Locations:

- Transit agencies that have safety concern for patrons
- Existing city and county transit services

It should be noted that transit safety and security data was not collected as part of the COATS project. As such we are assuming that potential locations for this ITS infrastructure are in areas with transit service.

Motorist-Aide Call Boxes

Description:

Motorist-aide call boxes provide transportation users with the ability to call for roadside assistance. Each call box location gives the motorists pertinent information, such as a call box telephone number, identification number, post-mile, county and highway information to help motorists identify their exact locations.

Objectives:

- Reduce emergency notification times
- Reduce traveler/pedestrian exposure to potentially hazardous situation
- Reduce traffic congestion created by a disabled vehicle

Potential Locations:

- Segments of roadways with minimal services between communities
- Areas meeting notification time related emergency service performance criteria

EMERGENCY SERVICES

Rural Coordinate Addressing System

Description:

This system will help locate rural residences and businesses through standardized addressing incorporated through location technologies such as a Global Positioning System (GPS). This system uses information from a truncated plane coordinate system and GPS as input into a Geographical Information System (GIS) to produce maps with accuracy of approximately 100 feet. In areas where rural addresses do not provide sufficiently detailed information as to its location, the rural coordinate addressing system can provide this detail to aid emergency response personnel in locating the incident and assist rural transit providers in locating the customers. This system would reduce response times for both emergency situations and service providers.

Objectives:

- Improve emergency services, transit services, and other service providers to more efficiently locate rural destinations
- Provide the ability to better geo-locate 911 telephone calls
- Add value to other industries such as delivery services, telephone companies, etc.

Potential Locations:

- Areas that are deemed necessary by enforcement and emergency management officials
- Areas meeting notification and response time related emergency service performance criteria

Regional Incident Management Plan

Description:

Development of a regional incident management plan to assist with detection, and verification, incident response, removal/mitigation, traffic handling and coordination of information dissemination between transportation, tourism, law enforcement and emergency management personnel. The plan will help transportation and management officials to make sound decisions regarding coordination of mitigation measures, resources and release/control of public information. There is no infrastructure associated with this system.

Objectives:

- Develop a set of predefined actions, roles, responsibilities that will assist with incident management activities and provide for coordination with other agencies
- Increase coordination in responding to incidents and road closures
- Provide real-time information to travelers

Potential Locations:

- Area-wide
- Areas meeting road closure performance criteria

Traffic Signal Priority for Emergency Vehicles

Description:

Traffic signal preemption for emergency vehicles involves prompting a traffic signal to change so emergency vehicles have safe passage through intersections. Emergency vehicles may be retrofitted with preemption systems to gain control of signals at intersections where delays are frequent or where there are frequent traffic conflicts between emergency vehicles and other vehicles.

Objectives:

- To reduce the probability of accidents during emergency response
- To reduce the response times of emergency vehicles to incidents
- To further ensure the safety of the general public in emergency situations

Potential Locations:

- Signalized intersections where there are frequent emergency response traffic delays
- Area-wide

It should be noted that data relating to emergency services delay due to traffic signals was not collected as part of the COATS project. As such we are relying on COATS project participants to locate potential locations for this ITS infrastructure.

TOURISM AND TRAVELER INFORMATION SERVICES

Touch Screen Interactive Kiosk

Description:

Interactive kiosks can provide users with real-time information via databases and touch-screen monitors. Kiosks allow the user to tailor the information presented to their needs and interests such as regional tourist attractions, available accommodations, or road conditions. Kiosks can potentially have Internet access for these types of information.

Objectives:

- Provide tourist information and services
- Provide weather and roadway information
- Provide incident and construction information
- Provide for traveler orientation
- Provide National Park and State Park information
- Promote California and Oregon commerce
- Provide ability for travelers to make reservations
- Provide for increased data collection and customer surveys

Potential Locations:

- All major rest areas, welcome centers and traveler/tourist information areas
- Truck stops at major ports of entry
- Major airports, hotels, transit and shopping centers
- Areas meeting tourism performance criteria

We are relying on COATS project participants to locate potential locations for this ITS infrastructure.

Variable Message Sign

Description:

Variable Message Signs (VMS) enable the communication of real-time traffic information by displaying a variety of messages. The advisories can be related to traffic incidents, current and forecasted weather conditions, road conditions, and construction activities. VMS may also be able to give tourist information.

Objectives:

- Supplement Highway Advisory Radios
- Provide current roadway conditions
- Suggest alternative routes and modes
- Notify travelers of maintenance and construction activities, and incident locations
- Notify travelers of potentially adverse weather conditions, road closures and chain requirements

Potential Locations:

- In conjunction with existing Highway Advisory Radio
- Major/critical highway and freeway route decision points
- Areas meeting safety and road closure performance criteria
- Areas meeting tourism performance criteria

Highway Advisory Radio

Description:

Highway Advisory Radio (HAR) provides valuable information to travelers through pre-recorded messages that contain traffic information, road conditions, chain requirements and road closures, etc. Transmission is generally accomplished through low-powered AM broadcast.

Objectives:

- Provide tourist information and services (e.g. National and State Park information)
- Provide real-time weather and roadway information
- Supplement Variable Message Signs
- Suggest alternative routes and modes
- Notify travelers of maintenance and construction activities, and incident locations
- Notify travelers of potentially adverse weather conditions, road closures and chain requirements

Potential Locations:

- In conjunction with existing Variable Message Signs
- In conjunction with work zone and travel time/delay advisory systems
- Near major highway interchanges and junctions
- Near rest areas
- Areas meeting road closure performance criteria
- Areas meeting tourism performance criteria

Advisory Television

Description:

Local and cable television channels can be used to communicate valuable road condition, weather, and traffic information to a large audience using regional interest and transportation-related programming during emergencies. These channels can also be used to disseminate tourist-related information. The emergency message would be transmitted using FM side-band and shown on the bottom of the television screen.

Objectives:

- Provide pre-trip information to travelers
- Provide weather and roadway information
- Provide incident and construction information

Potential Locations:

- Existing locations with cable television availability
- Hotels and motels that subscribe to programming
- Areas meeting road closure performance criteria

1-800 Travel Advisory Telephone Hotline

Description:

The 1-800 Travel Advisory Telephone Hotline will provide roadside information to travelers regarding current road conditions, travel advisories, and tourist information/services or enhance existing 1-800 travel advisory services. Travel advisory hotlines will be supported through shared resources and a common management center. If supported by state and local enforcement communities, a single number will be used throughout the State and is supported by signing and marketing.

Objectives:

- Provide real-time information on road and weather conditions
- Provide information regarding major tourist attractions
- Suggest alternative routes and modes
- Notify travelers of maintenance and construction activities, and incident locations
- Notify travelers of potentially adverse weather conditions, road closures and chain requirements

Potential Locations:

- Area-wide
- Areas where sufficient cellular communications coverage exists
- In conjunction with variable message signs
- Areas meeting slide and flood related road closure performance criteria
- Areas meeting tourism performance criteria

Internet

Description:

The Internet is a rapidly growing user-supported source for all types of information. However, its success is dependent on the quality and accuracy of information presented and possible even more important the "linking" of website to create synergistic benefits. The focus of this project is to provide the linking of existing and planned websites to provide for increased use and the appearance of seamless services. Internet sites that would be a targeted for linking include sites that provide for access information such as transit, weather conditions, hotel vacancy, admission prices, and other tourist information.

Objectives:

- Provide travelers with pre-trip information, such as road and weather conditions, tourist information, etc.
- Provide access to home pages of public sector agencies (transit agencies, State DOT, Department of Commerce/tourism, local Chambers of Commerce, National Parks, etc,) and private tourist businesses.

Potential Locations:

- Area-wide

It should be noted that Internet accessibility and performance data was not collected as part of the COATS project. As such we are relying on COATS project participants to locate potential locations for this ITS infrastructure.

Work Zone Delay Advisory System

Description:

The work zone delay advisory system provides the travelers with an active indication of the actual delays that exist at the work zone. The simplest system is a static sign with flashers that can be activated when there are delays. The second level system uses speed sensors to determine approximate delay through the work zone and changeable message signs to transmit information to the travelers. The third level system takes advantage of probe vehicle that more accurately determines delay at work zones.

Objectives:

- Provide traveler information
- Provide construction information
- Notify travelers of work zone delays
- Improve traveler approval of work zone activities

Proposed Locations:

- Planned construction zones

It should be noted that work zone delay data was not collected as part of the COATS project. As such we are relying on COATS project participants to locate potential locations for this ITS infrastructure.

In-vehicle Route Guidance Systems

Description:

In-vehicle route guidance relies on in-vehicle sensors, location determination equipment, a computational map database, and an interactive driver interface to enable route planning and detailed route guidance based on stored information. This system is offered commercially in some automobiles such as Cadillac, Ford and GMC.

Objectives:

- Provide real-time traveler information, services and route guidance

Potential Locations:

- Existing rental car vehicle fleets
- Areas meeting road closure performance criteria
- Areas meeting tourism performance criteria
- Near airports

PUBLIC TRAVELER/MOBILITY SERVICES

Automatic Vehicle Identification System

Description:

Automatic Vehicle Identification (AVI) can be used to allow subscribers to electronically bypass tourist attraction gates without stopping to pay fees. Subscribers would be given small transponders to place in their windshield that will be read by an antenna at the automated gate. Users could pay a one-time, annual, or pay per use fee for using this system. Initial users could include employees, concessionaires, and transit vehicles that pass these gates daily. This system could be expanded to other user groups such as annual pass holders of the destination attraction. By removing these vehicles from the queue, time savings will not only be realized by the AVI users but by other travelers passing through the gate.

Objectives:

- Provide time savings at related access gates for vehicles operated by transit, employees, concessionaires, and locals
- Manage gate congestion
- Provide for automated fare collection through the use of AVI
- Provide rewards to system users

Potential Locations:

- Participating tourist services
- Areas meeting tourism performance criteria

Smart Card System

Description:

Smart cards could be issued to transit patrons and tourists for common fare medium and reward. Much like a credit card system, smart cards consist of cards carried by travelers and readers located on transit vehicles, at National Park gates, and at local stores. Smart cards allow transactions and other data to be electronically stored on the card. This data can be used by transportation officials to predict transportation needs and commonly used routes. Typically, the smart card does not require contact with the reader, and must only be in close proximity to the reader for a transaction to be made. Smart cards can also act as a congestion management tool by providing incentives, such as merchant discounts for using transit rather than personal vehicles.

Objectives:

- Provides for ability to store transportation and economic activity data
- Attract transit patrons through time savings and convenience
- Provide for automated fare collection
- Provide reward incentives for use
- Increase the use of transit in congested areas

Potential Locations:

- Areas meeting tourism performance related criteria

Parking Management and Information System

Description:

Parking management systems are used to monitor the availability of parking use in near real-time, and inform and direct motorists to available parking through the use of variable message signs, highway advisory radio, phone service or the internet. The system cuts localized congestion due to traffic circling, seeking parking in crowded areas. The variable message signs can also be used to inform commercial vehicle operators of parking and unloading situations, inform motorist of traffic conditions ahead, or of public service or event information. This system could be expanded to commercial vehicle operations in the long term.

Objectives:

- Be utilized in conjunction with travel demand management alternatives in high visitation areas such as tourist destinations, special events (Shakespeare Festival), National Parks, or gateway communities
- Allow parking system management and operations
- Allow for parking availability and access control
- Sense and collects parking data
- Allow the sharing of information between traffic management subsystems and information providers

Potential Locations:

- Areas meeting tourism performance criteria

Recreational Vehicle Park & Ride Lots with Surveillance

Description:

Recreational vehicle, park and ride facilities will be located outside high tourist destinations and/or National Parks and provide shuttle services to the special events or other major attractions within the study area. The park and ride lots would have closed circuit television (CCTV) surveillance for security and to ensure patron satisfaction. CCTV images would be transmitted to the local enforcement agency. The CCTV installation would be the only cost to the project and not the shuttle service. Accessible existing parking lots (shopping plazas, etc.) facilities would be used where security can be provided.

Objectives:

- Reduce congestion to tourist destination
- Reduce number of heavy vehicle on the roadway
- Provide for increased customer satisfaction of RV market
- Increase number of parking spaces for RV's

Potential Locations:

- Shopping plaza (if agreeable), park and ride lots or other areas where shuttle services may be feasible
- Areas meeting tourism performance criteria

Dynamic Ridesharing/Paratransit Service

Description:

Dynamic ridesharing is a dial-in service that matches drivers and riders making the same trips. The system is designed for jitney (non-fixed route) services. It will help reduce person-trips through enabling effective carpooling, and will increase mobility options for the mobility impaired. In areas where there are a greater number of transit dependent residents, this service will provide the means to improve the efficiency transit services and promote carpooling.

Objectives:

- Enhance transit services
- Promote carpooling
- Reduce congestion
- Reduce person-trips
- Reduce air pollution
- Increase mobility
- Provide transportation to the mobility impaired

Potential Locations:

- Areas meeting mobility performance criteria

Automated Passenger Counting System

Description:

The automated passenger counting system allows for increased management of passenger counting and fare payment. The system may be used for obtaining more accurate ridership information. A database would be developed to facilitate more detailed planning to be made regarding transit needs and management. Automated passenger counting systems can be used in conjunction with the smart card system.

Objectives:

- To allow for the development of a more accurate database to be used for effective management of the transit services
- To assess the needs of the transit patrons
- To assess the demands that are placed on the transit system

Potential Locations:

- Areas meeting mobility performance criteria
- Existing city and county transit services

Transit Vehicle Routing/Scheduling Software and Vehicle Tracking

Description:

Transit vehicle tracking enables the tracking of vehicle locations, development and maintenance of deliver itineraries, and fuel usage monitoring. In-vehicle equipment allows for the measuring of distance traveled and fuel used and is coupled with map-matching techniques. This technology combined with routing and scheduling software would allow for multiple agencies to operate as one and increase the quality of service. The software technology would allow multi-service vehicle (e.g., transit and paratransit) fleets to improve operations and provide for economies of scale. If satellite technology is unavailable, beacon-based vehicle-to-roadside communication technologies can also be deployed to provide vehicle location to the fleet management center.

Objectives:

- Monitor on-time performance and track vehicle fleets
- Provide more accurate real-time information to managers and patrons
- Assist in routing of fleets to required services

Potential Locations:

- Areas meeting mobility performance criteria

Transit Traveler Information

Description:

This system 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.

Objectives:

- Provide accurate and timely information to transit patrons (elderly, mobility impaired, etc.)
- Increase the quality of the transit trip and ultimately ridership

Potential Locations:

- Areas of inconsistent transit arrival times as identified by stakeholders

It should be noted that on-time transit performance data was not collected as part of the COATS project. As such we are relying on COATS project participants to locate potential locations for this ITS infrastructure.

INFRASTRUCTURE OPERATIONS AND MAINTENANCE

Road Weather Information Systems

Description:

Road Weather Information Systems (RWIS) collect pavement temperature, visibility, wind speed and direction, and precipitation data. This information is then presented in a useable format to transportation system operators, and potentially the traveling public.

Objectives:

- Provide weather updates pertaining to state roadways
- Increase the effectiveness of chemical and mechanical de-icing
- Provide input to pre-trip information advisories
- Used to activate snow and ice control

Potential Locations:

- Areas meeting speed & slippery surface and visibility related safety performance criteria
- Areas meeting slide, flood and weather related road closure performance criteria

Weigh-in-Motion

Description:

Weigh-in-Motion (WIM) allows vehicle weight data to be collected remotely, without stopping the vehicle. In addition to collecting planning data, WIM is often a vital part of commercial-vehicle pre-clearance systems.

Objectives:

- Provide vehicle weight without stopping
- Provide data for pavement design, research and planning
- Provide data for Strategic Highway Research Program
- Provide data for DOT Structures' Sections
- Provide data for Transportation Planning Divisions
- Provide data for Motor Carrier Services
- Provide data for percent of overweight vehicles

Potential Locations:

- Near weigh stations
- Areas where weigh data would be beneficial to designers, researchers and planners

Closed-Circuit Television Camera

Description:

Closed-Circuit Television (CCTV) cameras allow remote verification of road and weather conditions, traffic conditions and incidents. The quality of the camera will determine the compatibility with other communication technologies, such as, cable TV, kiosks, and the Internet. Because response times to incidents in rural areas are often times long, CCTV would give emergency management personnel the opportunity to dispatch a more suitable emergency vehicle, based on a particular incident. It would also give emergency personnel the ability to verify the occurrence of an incident.

Objectives:

- To verify incidents and response actions
- To assist in incident/emergency response
- To assist in adjoining state response coordination
- To verify road weather information systems and weather conditions
- Provide added-value to pre-trip information

Potential Locations:

- In conjunction with RWIS technologies
- Areas meeting response time related emergency service performance criteria
- Areas meeting weather related road closure performance criteria

Automated Gate Closure System

Description:

Automated gate closure systems will enable the safe and efficient closure of highway segments that are frequently closed such as mountain passes and slide areas. Bridges and roads that are especially susceptible to seismic activity or washout can be fitted with this technology to not only prevent vehicles from crossing the bridge but will alert maintenance personnel to inspect the bridge. This technology can also be coupled with the Internet, kiosks or HAR to provide real-time information to travelers.

Objectives:

- Provide enforcement and DOT's the ability to automatically close
- Alert maintenance personnel for inspection purposes

Potential Locations:

- Near mountain passes
- Seismically active areas
- Areas meeting speed & slippery surface and visibility related safety performance criteria
- Areas meeting slide, flood and weather related road closure performance criteria

Regional Server/Coordination Software

Description:

This system could build upon existing hardware, connections and software to develop an integrated method for sharing information and management responsibilities for incidents among the various agencies and departments involved. The Highway Closure Information System in Arizona, for example, tracks each incident on the highway system in a user friendly format using GIS. These incidents can include inclement weather, road closures, construction and maintenance activities, and major events such as a state fair. These incidents are entered and updated by persons from several agencies who are given authority to do so. This improves the accuracy and timeliness of the road conditions information available to both decision making agencies and the traveling public.

Objectives:

- Increase coordination and data sharing between departments and agencies
- Provide ability to coordinate and disseminate real-time transportation information
- Provide central point for response coordination

Criteria:

- Physical location having 24 hour/day seven days/week operations

It should be noted that operational characteristics data was not collected to-date as part of the COATS project. As such we are relying on COATS project participants to locate potential locations for this ITS infrastructure.

Satellite Traffic Operations Center

Description:

The Satellite Traffic Operations Center (SOC) center will provide a centralized control center to effectively monitor, and manage traffic, analyze data from multiple sources, and operate other systems. The SOC will also assist with traffic and incident management coordination.

Objectives:

- Allow traffic managers the ability to monitor and manage traffic flows on major highways and intersections, and to identify incidents
- Allow traffic managers to analyze collected data and make available to private information providers and other public agencies
- Provide the ability to coordinate transportation decisions
- Increase coordination between DOT's emergency managers, enforcement staff, and tourist organization staff at state boundaries

Potential Locations:

- Facilities with 24-hour dispatch operations
- Cities near areas meeting notification and response time related emergency service performance criteria

FLEET OPERATIONS AND MAINTENANCE

Automatic Vehicle Location

Description:

Automatic Vehicle Location (AVL) technology allows vehicles within a fleet to be tracked and located with the aide of a computer. This system allows more effective coordination and dispatch of vehicles within that fleet. Fleets may include emergency services, DOT maintenance forces, transit services, fire, and enforcement vehicles.

Objectives:

- Provide vehicle location of DOT maintenance, and highway patrol vehicles to aid in dispatching
- Assist in transit vehicle routing and monitoring
- Reduce response times to incidents

Potential Locations:

- Existing vehicle fleets where resources and needs are unbalanced
- Cities near areas meeting response time related emergency service performance criteria

Probe Vehicle Instrumentation

Description:

Instrumented probe vehicles are utilized for detecting road and weather conditions in areas where chronically bad weather conditions occur. These vehicles are typically instrumented with a Global Positioning System (GPS) so that it can be tracked and a transponder so that its location can be mapped at all times. Vehicle may be part of a public sector fleet (maintenance, enforcement, etc.) or a private sector fleet (rental vehicles, transit providers, power companies). Vehicles could transmit stored data periodically or save data and upload later.

Objectives:

- Increase accuracy and timeliness of traffic and weather data
- Minimize data collection infrastructure cost

Potential Locations:

- Areas meeting slippery surface related safety performance criteria

Freight/Cargo Content Administration and Tracking

Description:

Cargo administration and tracking is an integrated hazardous material response system involving all vehicles carrying hazardous cargo. These vehicles would be tagged through an AVI system and the cargo content information would be electronically available to emergency response agencies. In addition, various roadways would have restricted access. These roadways have been identified through stakeholder input.

Objectives:

- Expedite handling of incidents involving hazardous materials
- Minimize the environmental impacts of hazardous incidents
- Minimize the safety hazards associated with hazardous material incidents

Potential Locations:

- Areas of major hazardous material spills

We are relying on COATS project participants to locate potential locations for this ITS infrastructure.

COMMERCIAL VEHICLE OPERATIONS

HAZMAT Management

Description:

Hazardous materials management (HAZMAT) focuses on providing incident response personnel with accurate information regarding hazardous materials involved in vehicle incidents. This can be accomplished by maintaining an updated national or regional database of current hazardous material shipments. Emergency management centers or dispatchers could be able to access this database when an incident involving hazardous materials occurs. Additional elements may include on-board cargo monitoring to determine the quantity of material spilled and an in-vehicle system that automatically informs emergency management centers when an incident occurs (similar to the Mayday system), updating the dispatcher with accurate HAZMAT information. Automatic Vehicle Location systems can also be used to map the locations of all vehicles hauling hazardous materials.

Objectives:

- Provide efficient and appropriate response to incidents involving hazardous materials
- Decrease the environmental impact of hazardous material spills
- Reduce health danger caused by hazardous material spills

Potential Locations:

- Areas near existing emergency services **AND**
- Corridors with greater than 4000 average daily truck traffic **AND**
- Areas with higher concentrations of hazardous material spills

Electronic AVI Preclearance

Description:

Electronic preclearance allows approved commercial vehicles to bypass weigh and inspection stations, increasing efficiency for the carriers, and helping enforcement personnel to effectively focus enforcement and compliance activities.

Objectives:

- Provide automated bypass of commercial vehicles meeting selected criteria
- Allow Port of Entry operators to focus increased attention on non-compliant operators
- Provide means of automatically verifying vehicle credentials
- Provide means of identifying vehicles/carriers with safe driving records, which do not require safety inspections

Potential Locations:

- Near weigh stations and ports of entry