CORRIDOR PLANNING AND FEASIBILITY ANALYSIS

EARLY ACTION PROJECTS

APPENDIX

NOTE TO READER:

THIS IS A LARGE DOCUMENT

Due to its large size, this document has been segmented into multiple files. All files separate from this main document file are accessible from links (blue type) in the table of contents or the body of the document.

I-70 RURAL IVHS

CORRIDOR PLANNING
AND FEASIBILITY ANALYSIS

EARLY ACTION PROJECTS
APPENDIX

COLORADO DEPARTMENT OF TRANSPORTATION

Colorado Department of Transportation

DE LEUW, CATHER & COMPANY

Engineers and Planners • Denver

in association with
Kaman Sciences Corporation . Coley/Forrest, Inc.
University of Colorado at Denver

660205-01330

May 1994
Revised: October 1995

DOT/FHWA
101568

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SECTION I INTRODUCTION

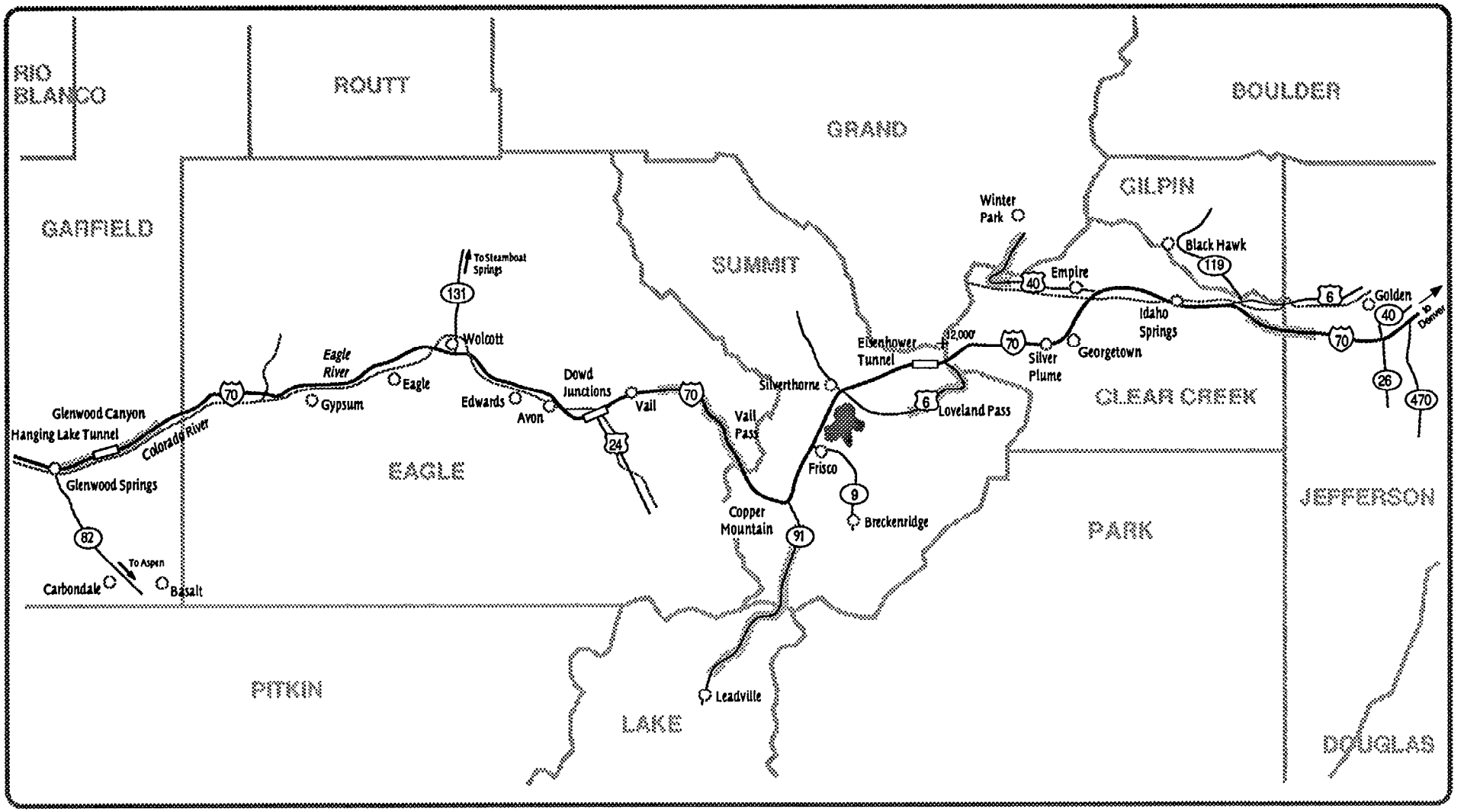
BACKGROUND

Study Objective. Because of the physical, environmental, and travel characteristics of I-70 from Denver to Glenwood Springs, the Colorado Department of Transportation (CDOT) identified it as a prime corridor for implementing Intelligent Transportation Systems (ITS) technologies (previously referred to as Intelligent Vehicle/Highway Systems [IVHS]). The *I-70 Rural IVHS Corridor Planning and Feasibility Analysis* study was initiated to address multi-jurisdictional problems and needs associated with the facility and to develop near-, medium-, and long-term strategies, beyond traditional capacity improvements, to enhance mobility, improve safety, protect the environment, stimulate economic development, increase efficiency, and encourage multi-modal transportation alternatives.

Physical Characteristics. The Interstate 70 (I-70) West Corridor, from Denver to Glenwood Springs (Figure I-l, Study Area), provides east/west vehicular access across the State of Colorado and to numerous communities and recreational areas throughout the northwest region. This heavily-traveled transportation corridor is classified as a rural, mountainous freeway facility, characterized by steep grades and sharp curves.

Many governmental jurisdictions and special interest groups are stakeholders in the ability of the I-70 facility to carry large volumes of traffic with minimal negative impact to the surrounding areas. From the C-470/1-70 interchange west of Denver in Jefferson County, at an elevation of 6,000 feet, I-70 enters Mount Vernon Canyon as a six-lane facility, traversing 6 to 8 percent grades as it heads west into the Rocky Mountains. The Hogback, a geologic formation along the Front Range, establishes the demarcation of the foothills from the Denver metropolitan area valley. Residential communities, scenic overlooks, historical, paleontological, and archaeological sites, and business/commercial activities attract commuters and travelers to this 12.5 mile segment of the corridor. Access to the towns of Golden, Evergreen, Morrison, Black Hawk, and Central City, and other northern Front Range communities intersect I-70 in this area via US 6, SH 40, SH 26, and C-470.

Entering Clear Creek County at 7,500 feet, I-70 narrows to a four-lane facility, dropping toward the canyon between Smith and Floyd Hills and Santa Fe and Saddleback Mountains in the Arapaho National Forest. At the bottom of the grade, US 6 interchanges with I-70, providing alternate access to Black Hawk and Central City via SH 119. Idaho Springs, an historic mining town nestled in Flirtation Peak canyon, lies approximately 8 miles from the Clear Creek/Jefferson County line. I-70 winds through the canyon approach and cuts through the mountainside via the l/4 mile long Twin Tunnels.



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I-70 RURAL IVHS

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Study Area

Figure I-1

Climbing out of the Idaho Springs canyon, I-70 begins a steep and twisting 15 mile ascent toward Georgetown and Silver Plume, passing the towns of Dumont, Downieville, and Lawson, reaching 8,500 feet at the US 40 interchange. US 40 continues west to Empire and toward its climb to Berthoud Pass on the Continental Divide, provides access to Winter Park, Steamboat Springs, and other recreational areas in northwest Colorado. I-70 turns south through Empire Pass toward Georgetown, at 9000 feet. At Georgetown, I-70 turns east, climbing toward the 10,000 foot elevation and Silver Plume.

I-70 continues the 12 mile westward climb toward the Continental Divide and 11,000 feet, serving the towns of Graymont and Bakerville before intersecting with US 6. US 6 heads south over Loveland Pass, providing an alternate route over the Divide for over-height and hazardous cargo-carrying commercial vehicles.

I-70 travels through the Eisenhower/Johnson Memorial Tunnel, an approximate 2 mile passage through the Continental Divide, delineating Clear Creek and Summit Counties. Exiting the west tunnel portal and turning southwest, a six-lane I-70 bends and descends for 10 miles, along 6 to 8 percent grades, into the Dillon Reservoir valley, serving the towns of Dillon, Silverthorne, and Frisco in Summit County. The valley flourishes with summer and winter recreational activities. Access to Keystone and the ski slopes via US 6; south to Breckenridge and Leadville via SH 9; and north to Kremmling and Steamboat Springs via SH 9 make this activity center an important travel hub.

I-70, a four-lane divided freeway, begins another 11.5 mile ascent into the White River National Forest and the Eagles Nest Wilderness, continuing south through Officer's Gulch, before turning west at the junction of SH 91, providing access to Fremont Pass and Leadville. I-70 veers west then north to Vail Pass at 10,666 feet and enters Eagle County. West of Vail Pass, I-70 continues a 13 mile up and down, winding travel path, generally northwest, then west into the Vail Valley at 8,200 feet. About 3 miles southwest of Vail, I-70 intersects with US 24 (heading southeast to Leadville) at Dowd Junction, where it turns easterly parallel to the Eagle River and the Southern Pacific (formerly Denver & Rio Grande Western)/AMTRAK train route. The I-70 descent into the Eagle River Valley, at approximately 7500 feet, serves the towns of Avon, Edwards, Wimor, and Wolcott.

Local routes intersect this 15 mile stretch of I-70, providing access north to Steamboat Springs via SH 131 and south along county roads into the White River National Forest. West of Wolcott, I-70 enters the Red Canyon, a generally straight and flat 15 mile passage through the town of Eagle to Gypsum. US 6 parallels I-70 throughout this stretch. I-70 continues west for 9 miles, at an approximate elevation of 6200 feet, toward Dotsero and the confluence of the Eagle and Colorado Rivers before entering Garfield County and Glenwood Canyon.

Entering Glenwood Canyon and Garfield County, I-70 winds sharply along a new four-lane elevated and cantilevered structure for 13 miles. It passes through the Hanging Lake Tunnel and provides access to numerous recreational and rest area facilities along the Colorado River.

Exiting the canyon to the west, I-70 enters the City of Glenwood Springs, at about 6,000 feet, famous for many summer recreational activities. It intersects with SH 82, which provides access to the towns and recreational areas of Carbondale, Basalt, Snowmass, and Aspen.

Environmental Characteristics. The I-70 West Corridor, from west Denver to Glenwood Springs traverses mountains and forest lands. From the Hogback at the foothills of the Rocky Mountains, I-70 passes through Mount Vernon Canyon along the north fork of Bear Creek, surrounded by woodland on the north and south. It crosses Soda Creek and Beaver Brook before leaving Jefferson County.

I-70 crosses rugged, mountainous terrain throughout Clear Creek County between the Roosevelt National Forest on the north and the Arapaho National Forest on the south. It enters the Arapaho National Forest at Graymont, west of Georgetown and Silver Plume.

I-70 parallels Clear Creek from the US 6 junction, three miles inside the eastern county border, to the Eisenhower Tunnel east portal. Numerous creeks and streams feed into Clear Creek from their headwaters on the north and south. Fishing in these waterways is a popular summer recreation.

The towns along I-70 are the surviving vestiges of the gold and silver mining days of the late 1800s. Many mine portals are still evident, with tailings scarring the hillsides. Some of the mines are still operating and gold-panning in Clear Creek is a popular summer activity.

I-70 descends into the Dillon Reservoir Valley in Summit County, within the Arapaho National Forest and skirts the southern tip of the Eagles Nest Wilderness. I-70 parallels Straight Creek upon its exit from the west portal of Eisenhower Tunnel in Summit County until the creek converges with the Blue River at Silverthorne. It then parallels Tenmile Creek from Frisco to Vail Pass. Again, numerous streams feed into Straight and Tenmile Creeks from their headwaters in the surrounding mountains.

Summit County is a popular year round vacation and recreational getaway, offering fishing, camping, hiking, and special events during the spring, summer, and fall, and downhill and cross country skiing, ice fishing, and special events during the winter.

I-70 enters Eagle County at Vail Pass, crossing the Gore Range and traversing the Arapaho and White River National Forests. It parallels Gore Creek and is surrounded by woodlands until its juncture with US 24 at Dowd Junction. Here, I-70 enters the Eagle valley, paralleling the Eagle River until its confluence with the Colorado River near the western county line. I-70 traverses the White River National Forest to Wilmor, where it follows the southern boundary of BLM Public Lands.

Western Eagle County is nationally known for its winter recreational activities at the Vail and Beaver Creek ski resorts. Much of the County is a haven for summer hiking, biking, fishing, and off-road vehicle activities. Many of the Colorado mountain resort area workers live in Eagle County.

I-70 re-enters the White River National Forest in Glenwood Canyon in Garfield County. It parallels the Colorado River through Glenwood Springs. Designated as a scenic byway throughout the Canyon, I-70 passes through wild vegetation and steep, craggy rock walls. The Canyon offers numerous mild weather outdoor recreation activities, including hiking, biking, river rafting, and picnicking.

Deer, elk, and Big-Horn sheep are common throughout the I-70 West Corridor. These animals cross and graze within the I-70 rights-of-way during the Spring and Fall. Animal/vehicular conflicts are frequent, causing personal property damage, injury, and clean-up and removal costs.

Generally, the climate throughout the I-70 West Corridor, from west Denver to Glenwood Springs, is characterized by 18 to 43 annual temperature days above 90 degrees Fahrenheit and 196 to 237 annual temperature days below freezing. High temperatures, from 99 to 104 degrees Fahrenheit, are usually recorded in June and July. Lows, around 3 to 10 degrees Fahrenheit, usually occur in January.

Pressure altitude variations range from a low in December between 5,300 and 6,300 to highs between 5,600 and 6,600 in June. Annual precipitation is approximately 11 inches per year. Thunderstorms occur about 34 days per year, peaking in July. Average snowfall is about 52 inches per year. About 11 days out of every year, record snowfall is greater than 1.5 inches. Winds peak in April with 4.7 percent stronger than 17 kts.

Weather extremes exacerbate travel along I-70. Preferential roadway icing, blizzards, avalanche, and high winds are characteristic during the winter months, creating visibility, traction, and stop/start driving hazards. Rock and mud slides, gusty winds, and rain storms are common during the spring thaw. The summer months are generally mild, however, snowstorms and their associated travel hazards do occur. The fall season inaugurates the onset of winter with sporadic snowstorms and gusty winds.

Travel Characteristics. The I-70 West Corridor supports east/west interstate, regional, and local vehicular travel. It serves as a major interstate trucking route between Denver and Salt Lake City. Commercial vehicle use of the corridor makes up approximately 20 percent of the year round vehicular traffic. Commercial vehicles also provide the necessary goods to support the communities along I-70.

I-70 serves as the primary access to the numerous winter and summer recreational areas in the northwest region of Colorado. In the winter, destination-oriented trips, from the Denver metropolitan area to ski resorts in Summit, Eagle, Garfield, and Routt Counties, comprise over

50 percent of the weekend vehicular travel. Peak westbound travel times occur on Friday evenings and Saturday mornings; peak eastbound travel follows on the return trips on Sunday evenings. These trips, particularly when adverse weather creates driving hazards, cause urban-like traffic congestion, travel delays, and accidents.

Spring, summer, and fall recreational trips can be destination-oriented, however, many are not associated with a particular destination, but are for sight-seeing and "Sunday drives." These tourist trips, again, make up more than 50 percent of the seasonal trips, with the same peak day and hour travel patterns and resulting effects.

Limited-stakes gambling in Gilpin County has created an additional demand on I-70 between Denver and Idaho Springs. Although gaming trips do not normally peak at the same time as recreational trips, safety and mobility become large issues on the US 6 and SH 119 routes to Black Hawk and Central City that access I-70.

I-70 serves many communities and is often the only thoroughfare for those towns adjacent to it. It is therefore the major facility for local citizens to make their daily home-based work and non-work trips. Many recreational area workers live in the smaller communities within a 50 mile radius of the resort towns to take advantage of more affordable living. Approximately 70 percent of the work trips are made using single occupancy vehicles (SOVs), and occur on weekdays between 7:00 and 9:00 am and 4:00 and 6:00 pm daily. Much of the work related travel uses segments of I-70, creating traffic operational problems at interchanges of the state highway and county route access points.

There are numerous public and private transit service providers that operate within the I-70 West Corridor. The Regional Transportation District (RTD) provides public fixed route and demand responsive services for the Denver metropolitan area, including those communities in Jefferson County west of C-470 served by I-70. Private transit operators provide fixed shuttle service, for tourists and commuters, from the Denver area, along I-70, to the recreational areas.

Summit County operates the Summit Stage, a "free" fixed route hub-and-spoke transfer system serving the communities of Copper Mountain, Frisco, Breckenridge, Keystone, Dillon, and Silverthome. The Stage also offers demand-responsive special services and a Winter Service Express. The Breckenridge In-Town Shuttle and Trolley and the Keystone Express provide local service for their respective resort areas. Summit County School District RE-1 provides transportation for students residing in the County.

Eagle County supports two public transit providers: the Avon/Beaver Creek Transit Service and the Vail Transit System. Eagle County School District RE-50 serves Eagle County students as well as those in southern Routt County and eastern portions of Garfield County.

Garfield County relies on the Pitkin County Roaring Fork Transit Agency to provide public transit service to Carbondale and Glenwood Springs. Students residing in these communities are provided school transportation through the Roaring Fork RE-1 district.

Aviation facilities within the I-70 Corridor study area, in addition to Denver International Airport (DIA) and other commercial/commuter facilities in the Denver area, include the Eagle County Regional Airport, the Glenwood Springs Municipal Airport, and the Aspen/Pitkin County Airport (Sardy Field). Airports in Hayden and Steamboat Springs (Routt County) and in Lake County provide alternative travel means to other communities to the north and south served by I-70.

The Southern Pacific (SP) railroad offers commodity transport in the Denver metropolitan area and through portions of Eagle, Garfield, and Pitkin Counties. AMTRAK provides passenger rail service on the SP tracks between Denver and Salt Lake City. The Denver Post sponsors a Rio Grande passenger service on the SP tracks between Denver and Winter Park. This service, called the "Ski Train" operates daily between mid-December and April. The Leadville Colorado and Southern Railroad Company operates summertime daily passenger rail service in Lake and Eagle Counties, which has high tourist use. There is no rail service in Summit and Clear Creek Counties.

The State Trails Program, established in 1971 by the Colorado Division of Parks and Outdoor Recreation, has funded the development of numerous bicycle and recreational trails. The Colorado Greenway Project, funded by Colorado Lottery proceeds, also provides trail funding. The United States Forest Service and the Bureau of Land Management maintain numerous hiking, biking, and off-road vehicle trails throughout their respective jurisdictions.

Summit County has 44 miles of asphalt-surfaced bicycle/pedestrian trails, including the Blue River Bikeway, the Tenmile Canyon Trail (Vail Pass), the Dillon-Frisco Trail, and the Dillon-Keystone Trail. The Colorado Trail, an unpaved path from Denver to Durango, passes through Surnmit County, benefitting hikers, horseback riders, and cross-country skiers.

Most of the bicycle/pedestrian trails in Eagle County are located in the Vail area. The Vail Bike Trails system provides paved facilities from East Vail to West Vail along Gore Creek. On- and off-street feeders and the extensive Vail Mountain hiking and biking trail network connect to the Vail Bike Paths.

The Horseshoe Bend Trail, Scout Trail, and Red Mountain Trail begin in the town of Glenwood Springs in Garfield County. The Horseshoe Bend Trail is a paved bicycle/pedestrian path running into Glenwood Canyon and connecting to the I-70 trail system in the canyon along the Colorado River. Scout Trail is an unpaved mountain bike path leading to Lookout Mountain. Red Mountain Trail climbs south along the Roaring Fork River and serves mountain bike and horseback riders, hikers, and cross-country skiers.

PURPOSE

Objectives. The development of a set of Early Action Projects has three major purposes:

1) To identify proven advanced technology applications that can be implemented along the I-70 West Corridor within the next two to five years, and that address current transportation problems and user needs.

2) To provide guidance for Colorado DOT Regions to plan for corridor-specific projects that can be included in their capital improvement budgets, as a part of the Statewide Transportation Improvement Program (STIP).

3) To set the stage for generating the IVHS Corridor Master Plan, and associated Business (Financing) and Marketing Plans that describe the vision and process to plan, design, and deploy ITS' within the I-70 West Corridor in the future.

Process. Early Action Projects are the result of input from many organizations and their representatives throughout the I-70 West Corridor, as well as from other local and state parties interested in transportation in Colorado. To identify all the problems associated with travel along I-70, an intensive agency outreach program is being conducted. The program includes one-on-one and telephone discussions, written surveys and questionnaires, and informational open houses and formal presentations to describe the potential benefits of ITS, and to solicit information on problem areas and needs, ideas, and concerns.

From this information, as well as an inventory of the physical and organizational structures affecting I-70 management and operations, the I-70 Rural IVHS Steering Committee developed a set of Early Action Projects to meet the three purposes described above.

Project Description Organization. Early Action Projects have been categorized into 12 functional areas that identify various system operations and functions, such as communications, data processing, and public transportation. This functional area classification also serves as an organizational tool for the numerous responsible agency representatives and other interested parties to participate in the planning process in their particular area of interest or specialty. The 12 Action Team Review Groups correspond to the 12 functional areas.

For each project, the following information has been provided:

The *Project Identification* uses an acronym for the functional area/review group category followed by an ordered number representing the total number of projects in that group. There is no significance to the order or ranking of projects by number.

The *Project Name* identifies the early action application by an abbreviated descriptive title so that project intent can be readily recognized for its function.

The *Project Description* provides a brief discussion of location, advanced technologies to be used, and the overall structure of the proposed system.

Problem Resolution defines the transportation problem or need that the project can alleviate or solve.

User *Benefit* identifies the potential benefits of the proposed project and who the benefactors are.

The *Approximate Cost* provides an estimate or a very broad range of the conceptual cost associated with planning, designing, constructing, operating, and maintaining the specific project. These costs are only rough estimates since the exact scope of each project is not specifically detailed.

Participating Agencies are listed to identify those organizations that will need to cooperate in the deployment of the project.

I-70 RURAL IVHS

EARLY ACTION PROJECTS
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SECTION II
PROJECT PRIORITIES

SECTION II PROJECT PRIORITIES

IMPLEMENTATION GOALS

Implementation goals were developed based on the goals and objectives established for the study. Early Action Projects have been evaluated for the ability to meet the goals and objectives through the following criteria:

- **ENHANCE TRAVELER MOBILITY**
- **INCREASE SAFETY**
- **IMPROVE ENVIRONMENTAL QUALITY**
- **AUGMENT COMMUNICATIONS/USER INTERFACE**
- **HIGH PUBLIC/POLITICAL ACCEPTANCE**
- **PROMOTE TRANSIT USAGE/IMPROVE TRANSIT SERVICE**
- **ENCOURAGE PUBLIC/PRIVATE SECTOR INVESTMENT**
- **INNOVATIVE USE OF ADVANCED TECHNOLOGIES**
- **REINFORCE ECONOMIC BENEFITS**

Table II-l, Early Action Project/Implementation Goals Matrix, identifies which goals each proposed Early Action Project satisfies.

MEASURES OF EFFECTIVENESS

Measures of effectiveness (MOEs) have been established to gauge the ability of each potential Early Action Project to satisfy the identified implementation goals (Table H-2). The MOEs will be used to evaluate each Early Action Project as they are deployed.

PROJECT RANKINGS

Table II-3 lists the Early Action Projects, identified in Section III, in an approximate order of importance, based on input received from all the stakeholders during the outreach process. This list was compiled to identify a number of Early Action Projects that will be recommended for implementation within the I-70 West Corridor within the next five years. Final Early Action Project recommendations, evaluated and recognized in the Early Action Projects Executive Summary, will arise out of review and comment of this document by Action Team Review Group representatives.

TABLE II-I: EARLY ACTION PROJECT/IMPLEMENTATION GOALS MATRIX

EARLY ACTION PROJECT	IMPLEMENTATION GOALS								
	MOBILITY	SAFETY	ENVIRONMENTAL QUALITY	COMMUNICATIONS/ USER INTERFACE	PUBLIC/ POLITICAL ACCEPTANCE	TRANSIT SERVICE/ USAGE	PUBLIC/ PRIVATE INVEST	ADVANCED TECHNOLOGIES	ECONOMIC BENEFIT
COMMERCIAL VEHICLE OPERATIONS									
CVO-1 Elecrronic Tag Hazardous Materials Monitoring	X	X	X				X	X	X
CVO-2 Dumont/Downieville Automated Port of Entry	X	X	X	X	X			X	X
CVO-3 Dynanic Truck Warning Operations		X						X	X
CVO-4 Eisenhower Tunnel Over-Height Vehicle Detectors		X					X	X	X
COMMUNICATION SYSTEMS									
cs-1 Regional Traffic Operarions Cenrers (TOC)	X	X		X			X	X	X
cs-2 High-Capacity Data Transmission Links				X			X	X	X
cs-3 Real-Tittre Road/Weather Infortnation Electronic Relay	X			X	X	X	X	X	X
cs-4 Voice/Data Communications Upgrades				X					X
cs-5 Weather Station Centralized Communications Links			X	X				X	
cs-6 Corridor-Wide Cellular Telephone Coverage		X			X		X		
cs-7 HAR Broadcast Messaging System	X			X	X		X		X
cs-8 Mobile Two- Way Information Communications				X		X	X		X
CS-9 Hanging Lake TOC Upgrades				X				X	
DATA COLLECTION/AGGREGATION									
DCA-1 Vehicular Probe Data Collection/TOC Aggregation	X			X		X	X	X	X
DCA-2 Weather/Ice Sensor Data Collection/TOC Aggregation	X		X	X					X
DCA-3 Video Surveillance Data Collection/TOC Aggregation	X			X			X		X
DCA-4 Avalanche Detection Research	X	X			X		X	X	
DCA-5 Eisenhower Tunnel Approach Vehicle Detectors	X			X					X
DCA-6 Basic Data Fusion				X		X			X
DCA-7 Advanced Ice Detection Warning System	X	X	X		X			X	

TABLE II-1: EARLY ACTION PROJECT/IMPLEMENTATION GOALS MATRIX

EARLY ACTION PROJECT		IMPLEMENTATION GOALS								
		MOBILITY	SAFETY	ENVIRONMENTAL QUALITY	COMMUNICATIONS/ USER INTERFACE	PUBLIC/ POLITICAL ACCEPTANCE	TRANSIT SERVICE/ USAGE	PUBLIC/ PRIVATE INVEST	ADVANCED TECHNOLOGIES	ECONOMIC BENEFIT
EDUCATION/TRAINING										
ET-1	*Trained Caller Program*	X	X			X		X		X
ET-2	*I-70 West Corridor Road Show*					X				X
ET-3	*Smart Driver/Vehicle Program*		X			X		X	X	X
ET-4	*Traveler Information Community Service Program*	X	X			X		X		X
ET-5	*Public Acceptance Program*					X		X		X
EMERGENCY RESPONSE										
ER-1	*Hot Spot Courtesy Patrols*	X	X	X	X	X		X		X
ER-2	*Good Samaritan Reporting System*	X	X		X		X	X		X
ER-3	*Corridor-Wide Call Box System*		X			X		X		X
ER-4	*MAYDAY Operations*	X	X			X	X		X	
ER-5	*Emergency Services District Program*		X		X					X
ENVIRONMENTAL/ECONOMIC IMPACTS										
EEI-1	*Alternate Fueled Vehicles Program*			X		X	X	X		X
EEI-2	*Sensor/Chemical De-Icing Program*	X	X	X	X	X				X
EEI-3	*Sanding/Storm Water Runoff Program*					X				X
EEI-4	*Economic Development Partnership Program*					X		X		X
EEI-5	*Mobile Emissions Testing Stations*			X		X	X	X		X
INSTITUTIONAL ISSUES										
II-1	*Proactive Legislative Change Campaign*				X	X		X		X
II-2	*FCC Rule-Making Permit Process*	X			X					X
II-3	*MOVE-IT/REMOVE-IT Campaign*	X	X			X				X
II-4	*Public Information Officer Training Program*		X		X			X		X
II-5	*Corridor Incident Management Plan*	X	X	X	X		X	X		X

TABLE II-1: EARLY ACTION PROJECT/IMPLEMENTATION GOALS MATRIX

EARLY ACTION PROJECT		IMPLEMENTATION GOALS								
		MOBILITY	SAFETY	ENVIRONMENTAL QUALITY	COMMUNICATIONS/ USER INTERFACE	PUBLIC/ POLITICAL ACCEPTANCE	TRANSIT SERVICE/ USAGE	PUBLIC/ PRIVATE INVEST	ADVANCED TECHNOLOGIES	ECONOMIC BENEFIT
II-6	*I-70 West Corridor ITS Coalition*					X				X
II-7	*ITS Implementation Team Regional Task Force*					X				X
PUBLIC/PRIVATE PARTNERSHIPS										
PPP-1	*Metro Traffic Control/ TOC Real-Time Information Relay*	X			X		X	X	X	
PPP-2	*Television Station Video Surveillance*	X	X		X	X		X		
PPP-3	*Communications Links*				X			X		X
PPP-4	*Traveler Information Systems*				X	X		X		X
PPP-5	*Adopt-a-VMS Program*				X	X		X		X
PPP-6	*Colorado Ski Country USA/ Tourism Region ITS Task Forces*				X	X		X		
PPP-7	*City and County of Denver/DIA/TOC Information Links*	X			X	X		X	X	X
PUBLIC TRANSPORTATION/Alternative Modes										
PTAM-1	*Summit Stage Transfer Center APTS/ ATIS Operational Test*	X	X	X	X	X	X	X	X	X
PTAM-2	*Transit Incentives Promotional Program*	X		X		X	X	X		X
PTAM-3	*Hogback Multi-Modal Transfer Center Phase II*	X	X	X	X	X	X	X	X	X
PTAM-4	*Vail/Gypsum Multi-Modal Transit Center*	X	X	X	X	X	X	X	X	X
PTAM-5	*Public Transit System Cooperative Management Program*	X			X	X	X	X		X
PTAM-6	*Intelligent Bicycle System*	X	X	X	X	X		X	X	
PTAM-7	*Transit Referral Service*	X	X		X	X	X	X		X
SAFETY/WARNING										
SW-1	*Incident Investigation Sites*	X	X		X	X				X
SW-2	*Excessive Speed Warning System*	X	X						X	X
SW-3	*Avalanche Detection and Warning System*	X	X		X	X		X	X	X

TABLE II-1: EARLY ACTION PROJECT/IMPLEMENTATION GOALS MATRIX

EARLY ACTION PROJECT	IMPLEMENTATION GOALS								
	MOBILITY	SAFETY	ENVIRONMENTAL QUALITY	COMMUNICATIONS/ USER INTERFACE	PUBLIC/ POLITICAL ACCEPTANCE	TRANSIT SERVICE/ USAGE	PUBLIC/ PRIVATE INVEST	ADVANCED TECHNOLOGIES	ECONOMIC BENEFIT
SW-4 Advanced Technology Roadway Delineation		X			X			X	X
SW-5 Regional Incident Control Centers		X		X		X	X		X
SW-6 Animal Alert Warning System	X	X		X	X		X	X	X
SW-7 Tunnel Video Surveillance Systems	X	X	X	X					X
SW-8 Emergency Response Information System		X			X			X	
TRAFFIC MANAGEMENT/OPERATIONS									
TMO-1 Peak Period Congestion Pricing	X		X			X		X	X
TMO-2 Bus/HOV Lanes	X		X			X			X
TMO-3 Automated Reversible Lane Program	X			X	X				X
TMO-4 Recreational Area Peak Return Trip Incentive Progratti	X				X		X		X
TRAVELER INFORMATION SYSTEMS									
TIS-1 Georgetown Gusty Wind Sensor/VMS System		X		X	X			X	X
TIS- 2 Tenmile Canyon Vail Pass/ Vail Icy Road Sensor/VMS Systems		X		X	X				X
TIS-3 Information Kiosk Program	X			X		X	X	X	X
TIS-4 573-ROAD Information Service		X		X	X		X		X
TIS-5 Vail Super-HARNMS Program	X	X		X	X	X	X	X	X
TIS-6 In-Vehicle Travel Advisory Demonstration Project				X			X	X	X
TIS- 7 Road/Weather Map Broadcast Information System	X	X		X	X		X	X	
TIS-8 Idaho Springs Intelligent Rest Area				X	X	X	X	X	X
TIS-9 Regional Portable VMS Acquisition		X		X					X
TIS-10 Recreational Area Live Video Broadcast System	X	X		X	X		X	X	X
TIS-II Link Travel Time HARNMS System	X			X	X			X	
TIS-12 Eisenhower Tunnel Motorist Information System		X		X	X		X		X

TABLE II-2
MEASURES OF EFFECTIVENESS

EVALUATION CRITERION	MEASURE OF EFFECTIVENESS
Enhance Traveler Mobility	• Traffic Counts/Forecasts · Travel Times · Stops/Delays · Number of Accidents
Increase Safety	· Accident Types/Severity · Incident Detection/Response Time
Improve Environmental Quality	· VMT · Pollution Levels · Environmental Enhancements
Augment Communications/ User Interface	• Quality of Service · Personnel Response/Reaction Times · Operator Efficiency · Inter-/Intra-Agency Cooperation
High Public/ Political Acceptance	· Public Opinion Surveys · Media Reports
Promote Transit Usage/ Improve Transit Service	· New Services · Schedule Reliability · Ridership · Operating Costs
Encourage Public/Private Sector Investment	· Interest Level · Implementation Dollars · In-Kind Services
Innovative Use of Advanced Technologies	· New Applications · Existing System Improvements
Reinforce Economic Benefit	· Commercial Vehicle Throughput · Local Economic Stimulation · Traveling Public Usage · Operations/Maintenance Savings · Low Cost Implementation - Benefit/Cost knalyses

TABLE II-3
EARLY ACTION PROJECT RANKING

ID NUMBER	NAME	REVIEW GROUP
cs-4	*Voice/Data Communications Upgrades*	Communications Systems
TIS-5	*Vail Super-HAR /VMS Program*	Traveler Information Systems
CVO-2	*Dumont/Downieville Automated Port of Entry*	Commercial Vehicle Operations
ER-1	*Hot Spot Courtesy Patrols*	Emergency Response
cs-2	*High-Capacity Data Transmission Links*	Communications Systems
PTAM-1	*Summit Stage Transfer Center APTS/ ATIS Operational Test*	Public Transportation/Alternative Modes
SW-1	*Incident Investigation Sites*	Safety/Warning
TMO-3	*Automated Reversible Lane Program*	Traffic Management/Operations
ER-3	*Corridor-Wide Call Box System*	Emergency Response
EEI-5	*Mobile Emissions Testing Stations*	Environmental/Economic Impact
SW-4	*Advanced Technology Roadway Delineation*	Safety/Warning
cs-9	*Hanging Lake TOC Upgrades*	Traffic Management/Operations
SW-8	*Emergency Response Information System*	Traffic Management/Operations
DCA-7	*Advanced ice Detection Warning System*	Safety/Warning
TIS-1	*Georgetown Gusty Wind Sensor/VMS System*	Traveler Information Systems
PTAM-4	*Vail/Gypsum Multi-Modal Transit Center*	Public Transportation/Alternative Modes
PPP-7	*City and County of Denver/DIA/ TOC Information*	Public/Private Partnerships
II-1	*Proactive Legislative Change Campaign*	Public/Private Partnerships
ET-2	*I-70 West Corridor Road Show*	Education/Training
PTAM-3	*Hogback Multi-Modal Transfer Center Phase II*	Public Transportation/Alternative Modes
ET-5	*Public Acceptance Program*	Education/Training
II-6	*I-70 West Corridor ITS Coalition*	Institutional Issues

TABLE II-3
EARLY ACTION PROJECT RANKING

ID NUMBER	NAME	REVIEW GROUP
cs-3	Real-Time Road/ Weather Information Electronic Relay	Communications Systems
SW-7	Tunnel Video Surveillance Systems	Safety/Warning
cs-8	Mobile Two-Way Information Communications	Communications Systems
TIS-2	Tenmile Canyon/Vail Pass/ Vail Icy Road Sensor/VMS Systems	Traveler Information Systems
TIS-12	Eisenhower Tunnel Motorist Information System	Traveler Information Systems
cs-6	Corridor- Wide Cellular Telephone Coverage	Communications Systems
TIS-8	Idaho Springs Intelligent Rest Area	Traveler Information Systems
EEI-2	Sensor/Chemical De-Icing Program	Environmental/Economic Impacts
SW-2	Excessive Speed Warning System	Safety/Warning
PTAM-2	Transit Incentives Promotional Program	Public Transportation/Alternative Modes
DCA-4	Avalanche Detection Research	Data Collection/Aggregation
TIS4	573-ROAD Information Service	Traveler Information Systems
PTAM-7	Transit Referral Service	Public Transportation/Alternative Modes
SW-6	Animal Alert Warning System	Safety/Warning
PPP-3	Communications Links	Public/Private Partnerships
ER-4	MAYDAY Operations	Emergency Response
cs-7	HAR Broadcast Messaging System	Communications Systems
CVO-4	Eisenhower Tunnel Over-Height Vehicle Detectors	Commercial Vehicle Operations
DCA-6	Basic Data Fusion	Data Collection/Aggregation
EEI-4	Economic Development Partnership Program	Environmental/Economic Impacts
PPP-6	Colorado Ski Country USA/ Tourism Region ITS Task Forces	Public/Private Partnerships

TABLE II-3
EARLY ACTION PROJECT RANKING

ID NUMBER	NAME.	REVIEW GROUP
TIS-3	***Information Kiosk Program***	Traveler Information Systems
CVO-1	***Electronic Tag Hazardous Materials Monitoring***	Commercial Vehicle Operations
II-7	***ITS Implementation Team Regional Task Force***	Institutional Issues
cs-1	***Regional Traffic Operations Centers (TOCs)***	Communications Systems
DCA-1	Vehicular ***Probe Data Collection/ TOC Aggregation***	Data Collection/Aggregation
DCA-2	***Weather/Ice*** Sensor ***Data Collection/ TOC Aggregation***	Data Collection/Aggregation
DCA3	***Video Surveillance Data Collection/ TOC Aggregation***	Data Collection/Aggregation
ET-4	***Traveler Information Community Service Program***	Education/Training
PPP- 1	***Metro Trffic Control/ TOC Real-Time Information Relay***	Public/Private Partnerships
TMO-2	***Bus/HOV Lanes***	Traffic Management/Operations
DCA-5	***Eisenhower Tunnel Approach Vehicle Detectors***	Data Collection/Aggregation
ER-2	***Good Samaritan Reporting System***	Emergency Response
ET-l	***Trained Caller Program***	Education/Training
PPP-4	***Traveler Information Systems***	Public/Private Partnerships
II-5	***Corridor Incident Management Plan***	Institutional Issues
TIS-7	***Road/Weather Map Broadcast Information System***	Traveler Information Systems
TIS-9	***Regional Portable VMS Acquisition***	Traveler Information Systems
SW-5	***Regional Incident Control Centers***	Safety/Warning
CVO-3	***Dynamic Truck Warning Operations***	Commercial Vehicle Operations
PPP-2	***Television Station Video Surveillance***	Public/Private Partnerships

I-70 RURAL IVHS

EARLY ACTION PROJECTS
APPENDIX

SECTION III
PROJECT DESCRIPTIONS

SECTION III EARLY ACTION PROJECTS

FUNCTIONAL AREAS

Early Action Projects are described within the following functional area categories, corresponding to the Action Team Review Groups organized for the I-70 Rural IVHS study. The Action Team is comprised of members of the coalition for the I-70 West Corridor study area, including transportation agency representatives, business leaders, special interest groups, and local policy makers. The Review Groups within the Action Team organizational structure provide a forum for Action Team members to concentrate on a particular area of interest or specialty.

Commercial Vehicle Operations. Commercial vehicles make up a large portion of the traffic that uses the I-70 corridor. Commercial Vehicle Operations (CVO) include large vehicles that transport goods using the nation's surface transportation system. CVO represent a vital link in the nation's commerce: its safety, cost, and efficiency ensure the nation's competitiveness in the world marketplace. Services that increase productivity; reduce risk of commercial vehicle crashes; reduce costs; and ease restrictions in compliance with safety regulations will help create safer travel corridors; lower shipping costs; and better efficiency of CVO.

ITS and advanced technology applications can contribute to seamless border crossings, safe transport of hazardous materials, vehicle tracking, and information dissemination to the driver, as well as regulatory agencies, regarding size, weight, and vehicle condition. ITS applications to CVO include:

- Automated Roadside Safety Inspection
- Electronic Purchase of Credentials
- Automated Mileage and Fuel Reporting and Auditing
- On-Board Safety Monitoring
- Real-Time Communications
- Electronic Payment Services

Communications Systems. Collection and dissemination of information relies on communications systems to send raw data for processing and transmit reliable information to the end user. Several technologies for sending and receiving data include:

- AM and FM Subcarriers
- Cable Television
- Cellular
- Microwave
- Land Lines (fiber, coax, TWP)
- Local Area Broadcast
- Infrared
- Spread Spectrum
- Satellite
- Commercial Radio/Television

Communications systems are the vital link to implementing ITS technologies. The ability to provide real-time information to and from the roadway, vehicle, and infrastructure is reliant on the ability of the various equipment, hardware, and software to send its information.

Data Collection/Aggregation. Data collection includes the hardware and software necessary to gather information. Data collection methods and technologies include vehicle location systems (sign post, LORAN, GPS) that use GPS receivers, differential transmitters, and radio voice and data communication technologies. Roadway and weather condition information can be collected through Traffic Operations Centers (TOCs) using inductive loops, closed-circuit television, image processing, and weather sensors. Data collection sources can include:

- Sensors
- Video Surveillance
- Traffic Probes
- Emergency Reporting Systems
- Information Centers

Aggregation of data needs to be accomplished at a central facility so that appropriate information can be disseminated to travelers via kiosks, signs, and in-vehicle systems as well as to operating agencies and service providers. Data aggregation includes software and hardware to collect, categorize, and separate data from sources for processing and distribution to information centers, roadside systems, and in-vehicle systems.

Education/Training. Many state and local agency representatives are either unfamiliar with, uninformed, or close-minded about the use of advanced technologies and ITS applications to provide solutions for their transportation problems. Rural agency staff members, in particular, are skeptical that high technology solutions can serve their constituencies.

Traditional, routine procedures internal to public agencies are often ingrained in the way management and staff members perform their jobs and manage their operations. Implementation of ITS applications and advanced technologies requires changes (paradigm shifts) in planning for future transportation needs.

An educational program needs to foster interest in and promotion of ITS within each agency from planning through design and construction to operations and maintenance. Program guidelines, for such techniques as team-building and partnering, need to be established so that each agency can continue to build internal acceptance of ITS applications throughout their organization.

As advanced technology applications are implemented, public agency staff members will need training to understand, operate, and maintain new systems. Training program guidelines will outline how staff members can be retrained, how that training will proceed, and how the learning curve will affect when a particular system can become fully operational.

Emergency Response. Incident management and response is crucial within rural areas due to long travel distances, isolation, inadequate communications, and understaffing. Thousands of travel incidents occur every day on the nation's transportation system. Delays or errors in notification of the nature and location of an incident often exacerbate safety and mobility of other travelers and induces environmental impacts.

ITS technologies can provide solutions to increase the safety and efficiency of incident management and response systems. Applications include:

- Driver and Personal Security Systems
- Automated Collision Notification
- Hazardous Materials Incident Notification

Coordination between the Colorado State Patrol, CDOT maintenance crews, local police and fire districts, emergency medical teams, hospitals, and other response teams, to assist travelers with breakdowns, provide emergency medical services, and clear accidents, will be paramount.

Environmental/Economic Impacts. Many believe that ITS, in its ability to increase capacity on existing roadways, will encourage more single occupancy vehicle use. Proponents of ITS believe that advanced technologies will improve existing roadway systems to the benefit of the environment by improving air quality (less idling and stop/start conditions) and avoiding capacity improvements (such as roadway widening) that cause direct environmental impacts.

ITS applications such as real-time information dissemination and intermodal facilities can encourage travellers to delay trips during heavily-congested periods and encourage carpool, rideshare, and mass transit use.

Economic development in rural counties and communities is vital for their survival. Transportation facilities, developed to accommodate the regional traveler, can usurp valuable land that could otherwise be used for commercial and/or industrial development that supports a local tax base. Transportation facilities can also attract traffic that results in negative environmental impacts (such as noise and air pollution) that reduce the quality of the rural life style. Local and regional travelers, sharing the same transportation facility, can create conflicts regarding expected use and efficiency of the facility.

ITS applications, such as intelligent rest areas, information centers, and multi-modal transit/transfer facilities, can precipitate regional travelers into rural communities to use local services. Local involvement can create economic development opportunities. High-occupancy vehicle lanes, ramp metering, and advanced communications systems can contribute to the flow and distribution of travelers to help support local policies and activities.

Institutional Issues. Institutional issues are those administrative and organizational rules, regulations, and procedures that affect how public agencies can conduct business. Existing legislation and policy may prevent certain ITS activities and/or programs from being realized.

Some examples of institutional issues that can affect ITS deployment include:

- Use of public right-of-way by the private sector
- Sole-source working relationships between a public agency and a for-profit organization
- The competitive bid process
- Intra- and inter-agency cooperative programs
- Intra- and inter-agency communications

Public/Private Partnerships. Public/private partnerships are those potential associations where private sector businesses join forces with the Colorado Department of Transportation and/or other local transportation agencies to help design, finance, implement, construct, operate, and/or maintain the infrastructure that supports proposed ITS applications. Generally, the private sector partner will provide a service or financial backing in exchange for some future profit.

Some examples of public/private partnerships include:

- Installation of hardware to collect and use information that can be sold to the public
- Financial support to construct/equip infrastructure in return for advertising of a product or service
- Joint use of rights-of-way

Public Transportation/Alternative Modes. Encouraging use of public transportation and travel modes other than the single-occupancy vehicle can reduce traffic congestion and environmental impacts. ITS applications can support transit, carpool, and rideshare services. These can include:

- Transit vehicles as probes
- Information centers at transit pick-up/drop-off facilities
- In-vehicle real-time road advisory systems
- "Super" buses
- High speed mass transit
- Rideshare management through real-time matching
- Automated fare payments
- Intermodal facilities

ITS technologies have application for modes other than the motorized, rubber-tired vehicle. As more people take advantage of mass transit systems (such as commuter rail and light rail transit) and bicycle and pedestrian facilities to accomplish their daily trip making, advanced technologies will be incorporated into other modal infrastructure and vehicles to improve traveler efficiency and mobility. Examples of ITS for other transportation modes include:

- In-vehicle traveler information systems
- Integrated automated vehicle location systems for scheduling management
- Intelligent bicycle/recreational trails
- Advanced intersection traffic control systems

Safety/Warning. Safety and warning systems can provide critical information in reducing the number and severity of collisions caused by impaired drivers, vehicle component failures, and degraded infrastructure conditions. Advanced technology systems can provide warning about driver, vehicle, infrastructure, and environment by monitoring conditions and transmitting appropriate information.

Some ITS applications include:

- Impaired Driver Warning and Control Override
- Vehicle Condition Warning
- In-Vehicle Infrastructure Condition Warning
- Vision Enhancement for Crash Avoidance
- Longitudinal/Lateral Collision Avoidance
- Automated Pre-Crash Restraints (belts, air bags, rollbars)

Traffic Management/Operations. Traffic management and operations applications are those systems that reduce congestion, improve mobility, and increase safety by incorporating changes to the roadway infrastructure and/or operational characteristics.

Some examples of traffic management and operations include:

- Transportation Demand Management to encourage non-peak period travel (demand reduction through congestion pricing)
- Identifying and improving alternative routes
- Creating reversible lane configurations during peak periods
- Incorporating HOV/Bus lanes into roadway cross-section
- Adding new facilities
- Improved methods and algorithms for signal, ramp metering, and sign control

Traveler Information. Traveler interfaces and services are those technologies and applications that provide information to the traveling public to help them make informed decisions regarding their trips. Infrastructure, roadside, and vehicle applications can include:

- Roadside kiosks
- Intelligent rest areas
- Highway advisory radio
- Variable message signs
- In-vehicle navigation and route guidance systems
- Road/vehicle communications
- Electronic "yellow pages"
- Links with tourist/recreation facilities

Information on road and weather conditions; heavy traffic volumes and roadway incidents; and skiing, gaming, and tourist information can be disseminated to the traveling public via television, personal computer, telephone, and radio receiver to information centers, signs, and in-vehicle communication devices.

The kinds, extent, and quality of information that is given to the traveler is important. A marketing program to attract travelers to use roadside kiosks and intelligent rest areas will be required.

EARLY ACTION PROJECT LIST

Commercial Vehicle Operations:

cvo-1	Electronic Tag Hazardous Materials Monitoring
cvo-2	Dumont/Downieville Automated Port of Entry
cvo-3	Dynamic Truck Warning Operations
cvo-4	Eisenhower Tunnel Over-Height Vehicle Detectors

Communications Systems:

cs-1	Regional Traffic Operations Centers (TOCs)
cs-2	High-Capacity Data Transmission Links
cs-3	Real-Time Road/Weather Information Electronic Relay
cs-4	Voice/Data Communications Upgrades
cs-5	Weather Station Centralized Communications Links
cs-6	Corridor-Wide Cellular Telephone Coverage
cs-7	HAR Broadcast Messaging System
cs-8	Mobile Two-Way Information Communications
cs-9	Hanging Lake TOC Upgrades

Data Collection/Aggregation :

DCA-1	Vehicular Probe Data Collection/TOC Aggregation
DCA-2	Weather/Ice Sensor Data Collection/TOC Aggregation
DCA-3	Video Surveillance Data Collection/TOC Aggregation
DCA-4	Avalanche Detection Research
DCA-5	Eisenhower Tunnel Approach Vehicle Detectors
DCA-6	Basic Data Fusion
DCA-7	Advanced Ice Detection/Warning System

Education/Training:

ET-l	Trained Caller Program
ET-2	I-70 West Corridor Road Show
ET-3	Smart Driver/Vehicle Program
ET-4	Traveler Information Community Service Program
ET-5	Public Acceptance Program

Emergency Response :

ER-1	Hot Spot Courtesy Patrols
ER-2	Good Samaritan Reporting System
ER-3	Corridor-Wide Call Box System
ER-4	MAYDAY Operations
ER-5	Emergency Services District Program

Environmental/Economic Impacts:

EEI- 1	Alternate Fueled Vehicles Program
EEI-2	Sensor/Chemical De-Icing Program
EEI-3	Sanding/Storm Water Runoff Program
EEI-4	Economic Development Partnership Program
EEI-5	Mobile Emissions Testing Stations

Institutional Issues:

II-1	Proactive Legislative Change Campaign
II-2	FCC Rule-Making Permit Process
II-3	MOVE-IT/REMOVE-IT Campaign
II-4	Public Information Officer Training Program
II-5	Corridor Incident Management Plan
II-6	I-70 West Corridor ITS Coalition
II-7	ITS Implementation Team Regional Task Force

Public/Private Partnerships:

PPP- 1	Metro Traffic Control/TOC Real-Time Information Relay
PPP-2	Television Station Video Surveillance
PPP-3	Communications Links
PPP-4	Traveler Information Systems
PPP-5	Adopt-a-VMS Program
PPP-6	Colorado Ski Country USA/Tourism Region ITS Task Forces
PPP-7	City and County of Denver/DIA/TOC Information Links

Public Transportation/Alternative Modes:

PTAM-1	Summit Stage Transfer Center APTS/ATIS Operational Test
PTAM-2	Transit Incentives Promotional Program
PTAM-3	Hogback Multi-Modal Transfer Center Phase II
PTAM-4	Vail/Gypsum Multi-Modal Transit Center
PTAM-5	Public Transit System Cooperative Management Program
PTAM-6	Intelligent Bicycle System
PTAM-7	Transit Referral Service

Safety/Warning:

SW-1	Incident Investigation Sites
SW-2	Excessive Speed Warning System
SW-3	Avalanche Detection and Warning System
SW-4	Advanced Technology Roadway Delineation
SW-5	Regional Incident Control Centers
SW-6	Animal Alert Warning System
SW-7	Tunnel Video Surveillance Systems
SW-8	Emergency Response Information System

Traffic Management/Operations:

TMO-1	Peak Period Congestion Pricing
TMO-2	Bus/HOV Lanes
TMO-3	Automated Reversible Lane Program
TMO-4	Recreational Area Peak Return Trip Incentive Program

Traveler Information Systems :

TIS-1	Georgetown Gusty Wind Sensor/VMS System
TIS-2	Tenmile Canyon/Vail Pass/Vail Icy Road Sensor/VMS Systems
TIS-3	Information Kiosk Program
TIS-4	573-ROAD Information Service
TIS-5	Vail Super-HAR/VMS Program
TIS-6	In-Vehicle Travel Advisory Demonstration Project
TIS-7	Road/Weather Map Broadcast Information System
TIS-8	Idaho Springs Intelligent Rest Area
TIS-9	Regional Portable VMS Acquisition
TIS-10	Recreational Area Live Video Broadcast System
TIS-11	Link Travel Time HAR/VMS System
TIS-12	Eisenhower Tunnel Motorist Information System

Commercial Vehicle Operations

PROJECT IDENTIFICATION: cvo-1

PROJECT NAME: Electronic Tag Hazardous Materials Monitoring

PROJECT DESCRIPTION:

Commercial vehicle operators transport materials across Colorado that may be toxic or contaminating to the environment if leakages or spills occur during conveyance. Vehicles carrying hazardous materials are restricted from passage through the Eisenhower/Johnson Memorial Tunnel due to potential fire, toxic fume, and/or removal difficulties in the 2-mile bore. Utilizing AVI technologies, commercial vehicles would be equipped with electronic tags coded with cargo type, volume, specifications, and restrictions, and vehicle identification, description, and driver identification. Computerized monitoring systems, installed at ports of entry and weigh/check stations along the I-70 route, and the Hanging Lake, Eisenhower, and Denver Metro TOCs, would receive signals from the electronic tag transmitter as the vehicle enters the station's jurisdictional area. Automatic checking and processing of vehicle and cargo information would allow passage of the vehicle if all specifications are matched. Alarms would sound if discrepancies occurred, allowing system operator intervention and stopping of the vehicle for inspection.

A site specific application for this technology would include westbound I-70 control prior to the Loveland Pass (US 6) turn off to stop hazardous materials shipments before they enter Eisenhower Tunnel. This project is also recommended (and noted) in the Dumont/Downieville POE Early Action Project to pick up eastbound hazardous materials carriers before they enter the Eisenhower Tunnel.

AVL technologies, such as GPS, would allow tracking of commercial vehicles throughout the I-70 Corridor. Receivers, installed on the vehicles, would send continuous signals to the TOC computer systems on the exact location of the vehicle. If a spill occurs, the TOC operators would pinpoint the spill site and dispatch the appropriate emergency response teams to the scene.

PROBLEM RESOLUTION:

- Monitoring/route control of hazardous cargo shipments.
- Emergency response and removal of toxic spills.

USER BENEFIT:

- Controlled collection of taxes and fees associated with hazardous materials shipments.
- Advance identification of hazardous cargo approach for alternate route guidance.
- Immediate and effective hazardous materials clean-up.

APPROXIMATE COST:

AVI Sites: $10,000 - $20,000 Each
GPS Receivers: $500 - $5,000 Each
Computer/Communications Systems: $10,000 · $50,000

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Department of Public Safety
Colorado Department of Revenue

PROJECT IDENTIFICATION: **cvo-2**

PROJECT NAME: Dumont/Downieville Automated Port of Entry

PROJECT DESCRIPTION:

Utilizing AVI technologies, commercial vehicles would be equipped with electronic tags carrying cargo and vehicle identification information. Computerized monitoring systems, located in the Dumont/Downieville weigh/check station facility, would receive signals from the electronic tag transmitter as the vehicle enters the station's jurisdictional area. Automatic checking and processing of vehicle and cargo information would allow passage of the vehicle if all specifications are satisfactory. Alarms would sound if discrepancies occurred, allowing system operator intervention and stopping of the vehicle for inspection.

Weigh-in-motion (WIM) detectors would be installed in the I-70 mainline pavements preceding the station facility to measure the weight of the vehicle. This information would be electronically transmitted to the station's computer for comparison to the previously recorded weight. If weight measurements agree, the vehicle would continue without stopping. If inconsistencies are detected, alarms would sound to allow station operators to intervene.

PROBLEM RESOLUTION:

- Commercial vehicle queuing onto local access roads and interchange ramps.
- Commercial vehicle delays during peak check/weigh periods.
- Environmental and socio-economic impacts associated with processing and storage of large volumes of vehicles.
- Inefficient processing of check/weigh operations.

USER BENEFIT:

- Improved local traffic access and circulation.
- Weigh/check station operations time and cost savings.
- Improved quality of life for the affected communities.
- Seamless movement for commercial vehicles.
- Reduced air and noise pollution.
- Controlled collection of taxes and fees associated with commercial vehicle weight and cargo regulations.

APPROXIMATE COST: **$750,000** to **$900,000**

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Revenue

PROJECT IDENTIFICATION: cvo-3

PROJECT NAME: Dynamic Truck Warning Operations

PROJECT DESCRIPTION:

Following successful implementation and evaluation of the Dynamic Truck Speed Warning Operational Test, located on the steep grade between the west portal of Eisenhower Tunnel and Silverthorne (Summit County), installation of the system at other high-accident locations would be warranted. Those locations can include the Glenwood Canyon area in Garfield County; the Dowd Junction Area west of Vail in Eagle County; the Vail Pass area in Summit County; the eastern approach to the Eisenhower Tunnel west of Georgetown; the Floyd Hill area in Clear Creek County; and the Genesee Park and Mount Vernon Canyon steep grade areas in Jefferson County.

Using weigh-in-motion (WIM) and automatic vehicle classification (AVC) technologies, a series of detectors, installed in the pavement, would measure vehicle weights. This information would be electronically transmitted to a computerized data bank system containing vehicle classification specifications. The system uses algorithms to calculate recommended safe speeds for particular vehicles under current conditions. The safe speed for a specific vehicle would be transmitted to a variable message sign (VMS) to advise the driver of the recommended speed.

PROBLEM RESOLUTION:

- Run-off road and jack-knifing incidents on downhill grades.
- Runaway trucks.

USER BENEFIT:

- Advance warning of potential steep grade or curve hazards for unaware commercial vehicle operators.
- Prevention of serious accidents and resulting traffic delays, removal and emergency response efforts.
- Safe speed information.

APPROXIMATE COST: $500,000 Per Site

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: cvo-4

PROJECT NAME: Eisenhower Tunnel Over-Height Vehicle Detectors

PROJECT DESCRIPTION:

Along the westbound lanes at the east Eisenhower tunnel approach and the eastbound lanes at the west approach, two sets of over-height vehicle detection systems at each approach monitor the advance of vehicles over 13'-7" in height. New detectors, mounted on overhead mast arms, would be located at 3000 feet from tunnel portal and at 1200 feet from portal. The existing system uses infrared technology to detect over-height vehicles. Replacement technologies could use infrared, radar, microwave, optical (OVMD), or ultrasonic transmitter/receiver technology. The existing system sends a signal to the tunnel control center monitoring system and the attendant shack. The signal also sets off an outdoor siren and trips a traffic signal to sequence from green to yellow to red. This part of the system is adequate.

New variable speed and message signs, located 5000 feet from the portal along the approach lanes, would be installed to provide advance warning to approaching motorists that a stop control has been initiated and a delay may occur. New color video surveillance cameras would be mounted on the overhead sign structures to visually monitor the system, allowing remote vehicle identification and progress and providing additional security for pullout areas. The cameras can be tied into the rest of the surveillance system for additional coverage. Electronic guidance signs would be activated to advise the driver that the vehicle is over-height and where to pull off.

This project would involve replacement of the existing equipment and associated infrastructure for over-height vehicle detection at both tunnel portals.

PROBLEM RESOLUTION:

- Outdated equipment with high maintenance costs.
- Manually operated subsystems.

USER BENEFIT:

- Automated monitoring/control to increase system/operator efficiency.
- Improved traffic control to clear travel lanes.
- Reduction in commercial vehicle delays.

APPROXIMATE COST: $200,000

PARTICIPATING AGENCIES: Colorado Department of Transportation

Communications Systems

PROJECT IDENTIFICATION: cs-1

PROJECT NAME: Regional Traffic Operations Centers (TOCs)

PROJECT DESCRIPTION:

Establishing the Hanging Lake and Eisenhower traffic control centers as Regional TOCs provides the most cost-effective strategy to integrate existing and future advanced transportation systems implemented within the northwest and inter-mountain regions of the state. The TOCs would provide a centralized location for collection of all weather, traffic, roadway, and environmental data for aggregations, processing and disseminating to other information-providing systems (VMS, information kiosks). In addition, the TOCs would provide a center of operation for dispatch of maintenance and emergency response services.

The TOCs would be linked to each other, as well as to the Denver Metro TOC, so that data and information can be shared. Regional TOCs would process and distribute local information. That information would be transmitted to the Denver TOC for central storage and dissemination of information of interest in the Denver area. Modifications to insufficient and incompatible communications links pose the largest impediment to establishing the Regional TOCs At this time, fiber optic cabling offers the best solution for transmitting large quantities of data between centers. Interim links could include cellular telephones, leased lines, and RF radio and be a part of an incremental solution.

The Hanging Lake center has limited site space for accommodating TOC employees. Currently, CDOT operations staff are shuttled from Glenwood Springs to the tunnel control center facility. As the Hanging Lake center is established as a Regional TOC, strategies will need to be developed to address this problem.

PROBLEM RESOLUTION:

- Decentralized control leads to ineffective communications.
- No central location to collect, process, and disseminate data and information.
- Existing communications systems are not interfaced.

USER BENEFIT:

- Collocation of shared facilities to influence manpower/equipment savings.
- Regionalized data collection, processing, and dissemination.
- Coordinated police, fire, and emergency response dispatch.

APPROXIMATE COST: **$200,000** to **$800,000** Per Site

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Division of Telecommunications
Colorado State Patrol
Local/Regional Fire/Police/Emergency Response Districts

PROJECT IDENTIFICATION: **cs-2**

PROJECT NAME: High-Capacity Data Transmission Links

PROJECT DESCRIPTION:

Fiber optic cable has been identified as the most reliable bounded media technology to provide the most appropriate communications links between roadside infrastructure, TOCs, and the various agencies that support transportation operations/maintenance; traffic enforcement/regulation; and fire/emergency response. The existing state-owned microwave system (unbounded media) uses wireless transmission technology that is subject to atmospheric and terrain disturbances and currently does not support adequate line-of-site equipment to provide complete communications coverage.

Fiber optic technology is expensive to install and maintain, compared to other communication technologies. Funding related issues that need to be resolved before installation include:

- Solicitation of private institutions willing to install fiber optic cable.
- Enabling legislation to allow private use of public rights-of-way.
- Installation and maintenance responsibilities.
- Redundant systems in case of cable damage.

PROBLEM RESOLUTION:

- Unreliable, poor-quality, and incomplete communications links.

USER BENEFIT:

- Reliable high-capacity data transmission.
- Connectivity for future systems.
- Better use of resources.
- Digital and analog data conveyance.

APPROXIMATE COST: $10 - $50 Per Foot

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Division of Telecommunications
Private Communication Company Partners

PROJECT IDENTIFICATION: CS-3

PROJECT NAME: Real-Time Road/Weather Information Electronic Relay

PROJECT DESCRIPTION:

Relay of real-time road and weather information, in the long-term, is dependent on installation of high-capacity data transmission links and information facilities to disseminate that information to the traveler. In the interim, CDOT has established a semi-real-time data collection/information dissemination system operating out of the IVHS Operations Division. Regional and local maintenance and operations divisions send hourly reports on area road and weather conditions to the Denver Metro Interim TOC. This data is processed by Public Information Officers (PIOs) onto a computerized form. The PIOs, then transmit the information back to regional and local control centers via modem and/or facsimile.

As traveler information centers are installed, modules within the software would include updatable databases to accept transmission of hourly road/traffic/weather condition information via modem. The information is transmitted to the Eisenhower and Hanging Lake tunnel operations centers. It can be integrated into the software operating the area variable message signs so that information can be disseminated to the traveling public via this equipment. The information would also be relayed to local and regional television and radio stations for timely broadcast and to kiosks as they are installed.

PROBLEM RESOLUTION:

- Inaccurate and time-delayed information dissemination.

USER BENEFIT:

- Access to actual and immediate remote travel information.

APPROXIMATE COST: $20,000 Per Installation

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Division of Telecommunications
Colorado Division of Public Safety
National Weather Bureau

PROJECT IDENTIFICATION: cs-4

PROJECT NAME: Voice/Data Communications Upgrades

PROJECT DESCRIPTION:

The telephone equipment and land line technology utilized for voice and data communications to many remote locations is obsolete. The bandwidth limitations of copper twisted pair (TWP) communications media make transmission unstable, time consuming, and many times, inaccessible. Reliable links to the Eisenhower TOC, the CSP communications centers, the remote Road Control/County Engineer offices, and the manned rest area facilities (particularly at the Vail Pass Rest Area) need to be established by replacement of the communications media and/or telephone transmission equipment. Ideally, a fiber optic network, or other high capacity media, wilI eventually be installed to handle all I-70 West Corridor needs. As an interim architecture for voice/data transmission, copper TWP can be used as a distribution cable to connect field data devices (modems, facsimiles) and voice circuits with remote nodes. Most new devices come with an inexpensive modem to communicate over TWP. As a backup system, where a hard-wired upgrade cannot be accomplished, the state's microwave radio system can transmit voice and data to remote sites if point-to-point line of site can be achieved.

At each location, equipment for data and voice transmission should include, as a minimurn, a telephone, a 14.4 kbps modem, and a plain paper facsimile.

PROBLEM RESOLUTION:

- Existing voice/data communications are unreliable and inadequate.
- Existing land lines/equipment are old and dysfunctional.

USER BENEFIT:

- Reliable voice/data communications.
- Enhanced data sharing.
- Labor savings through increased efficiency.
- Reduced personnel stress levels and improved attitude.

APPROXIMATE COST: $10,000 - $50,000 Per Site

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Division of Telecommunications
Colorado Division of Public Safety

PROJECT IDENTIFICATION: **cs-5**

PROJECT NAME: Weather Station Centralized Communications Links

PROJECT DESCRIPTION:

Weather monitoring and sensor stations collect atmospheric and road surface condition data that is transmitted to a computer for processing using basic data fusion algorithms. Many of the currently functioning systems operate independently, controlled by the region within which they exist. Collection of all regional weather-related data at one centralized processor will allow comprehensive accumulation of road/weather condition information that can be processed and disseminated to the various traveler information sites and broadcasts.

The Eisenhower and Hanging Lake TOCs should be established as the regional weather data collection sites for processing and distribution. An independent CPU at each TOC, dedicated to weather data collection, processing, and dissemination, would provide the eastern and western regions of the I-70 West Corridor with centralized weather information centers. Communication links from existing weather stations and for all future installations would be established to these central processors. Those links would use the immediate area's available communications media, whether that is TWP, coax, fiber, RF, or microwave.

PROBLEM RESOLUTION:

- Remote collection of weather-related information.

USER BENEFIT:

- All data collected at a centralized location.
- Ease of processing.
- Thorough and complete coverage of information for dissemination.

APPROXIMATE COST: $10,000 Per Site

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Division of Telecommunications

PROJECT IDENTIFICATION: cs-6

PROJECT NAME: Corridor-Wide Cellular Telephone Coverage

PROJECT DESCRIPTION:

Cellular telephone systems use analog and digital transmission and enhanced network controls to distribute voice/data over VHF or UHF radio frequencies. A mobile telephone, when connected, requests a frequency via the control channel. The cellular control system assigns a channel to that unit. Regional areas are divided into "cells" that are 2 to 20 miles (3 to 30 kilometers) in diameter. At the center of each cell, a cellular control system radio bundles the network management functions and assigns the frequency sub-channels. Cellular systems provide full-duplex, two-way communications.

The I-70 West Corridor has been divided into cells. Because the terrain and vegetation block the transmission of the radio signals, communication via cellular telephones can break-up and disconnect. The segment of I-70, between Eisenhower Tunnel and Vail, is particularly troublesome. Additional cells would be located at high points, that complete line-of-sight links, to provide complete and continuous coverage.

Because the cellular network is a public network, driven by consumer demand and dollars, CDOT will need to rely on the private sector to add more cells within the corridor.

PROBLEM RESOLUTION:

- Sporadic and/or unstable corridor-wide coverage.

USER BENEFIT:

- Alternate communications links if other systems are inoperable.
- Emergency call, good Samaritan, traveler connectivity, and peace of mind.
- Communications links for other advanced technology systems.

APPROXIMATE COST: $250,000 - $500,000 Per Cell

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Division of Telecommunications
Colorado Division of Public Safety
Private Communications Companies

PROJECT IDENTIFICATION: cs-7

PROJECT NAME: HAR Broadcast Messaging System

PROJECT DESCRIPTION:

A software database and algorithms would be developed to provide standard and customized messages for broadcast over the AM 530 radio frequency channel. Standard messages would be selected from a menu by the broadcast operator. Customized messages, which would follow specified type and length requirements, would be created by the operator for unusual or special events or conditions. A dedicated telephone number and access code would allow an operator to transmit a message to the HAR controller/base station. Broadcast times and locations would also be specified by the operator. When the message is transmitted to the HAR, it may be an actual broadcast or a message code, depending on whether it is customized or canned. Canned messages would be sent as a number that broadcasts a standard voice-synthesized message. Static and variable message signs would be used to advise motorists to tune to AM 530 for broadcast messaging.

This project may be based on expanding the existing HAR stations or implementing new HAR stations or sites. If new HAR is implemented, it would not be limited to 530 AM per FCC regulations.

Types of information to be broadcast over this system could include road/weather condition, traffic, special events, and ski/recreation area information, as well as other public service announcements. Private participation in the information dissemination could allay some of the maintenance and operational costs in return for some form of advertising, such as "This message brought to you by . . . Advertising would be dependent on FCC requirements and rule-making permit process (Early Action Project 11-2).

PROBLEM RESOLUTION:

- Providing more information to the traveling public via existing broadcast systems.
- Streamlining process to disseminate information over the HAR broadcast system.

USER BENEFIT:

- Up-to-date traveler information/advanced warnings.
- Efficient dissemination of information.
- Labor savings in providing information.
- Increased use of under-utilized equipment.

APPROXIMATE COST: $50,000 Start-Up/$5,000 Per Annum Operational

PARTICIPATING AGENCIES:
Colorado Department of Transportation
Colorado Department of Public Safety, Division of State Patrol
County/Municipal Agencies
Chambers of Commerce
Private Businesses/Organizations

PROJECT IDENTIFICATION: cs-8

PROJECT NAME: Mobile Two-Way Information Communications

PROJECT DESCRIPTION:

Participating private transit agencies, that regularly travel the I-70 West Corridor, would be used as probes to advise Eisenhower and Hanging Lake TOCs of approaching traffic volumes so Transportation Systems Management (TSM) and other operational measures could be implemented before the platoons arrive. Transit vehicle drivers would be equipped with two-way radios or cellular telephones to report, at preset intervals, the volume of traffic encountered along a fixed route. In turn, the TOC operators, outfitted with compatible equipment, would provide weather/road condition information to the transit vehicle driver that he/she would relay back to their dispatch center and other corridor drivers.

PROBLEM RESOLUTION:

- Unknown traffic volumes approaching TOCs, particularly the Eisenhower Tunnel, do not allow sufficient time to implement traffic control measures that increase operational efficiency.

USER BENEFIT:

- Up-to-date collection of traffic information.
- More accurate and reliable information dissemination.
- Advance knowledge of traffic volumes anticipated to accumulate in localized areas.

APPROXIMATE COST: $50,000 Start-Up/$l0,000 Per Annum Operational

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Division of Telecommunications
Private Transit Companies

PROJECT IDENTIFICATION: cs-9

PROJECT NAME: Hanging Lake TOC Upgrades

PROJECT DESCRIPTION:

This project would provide the Hanging Lake TOC with upgrades to 3 of its major components: communications, video surveillance and call boxes.

Communications will be improved with the installation of 17 miles of fiber optic cable between the Hanging Lake TOC and Glenwood Springs. The fiber optic communications is the most reliable high-transmission form of bounded communications today. This fiber optic backbone would serve as the communications link for the VMS located in Glenwood Springs, as well as the video system along this stretch. With a large bandwidth, the fiber optic backbone would be able to provide reliable communication links for all ITS additions to the corridor. Early Action Project CS-2, High-Capacity Data Transmission Links, expands this 17 mile fiber optic communications link to the entire I-70 West Corridor.

Fiber optic cable is expensive to install and maintain, compared to other communicating technologies. CDOT is faced with 2 feasibility alternatives to confront these costs. The first is to rely on private industry to install the cable and lease the necessary bandwidth from them. The second is to install the cable absorbing the high initial cost but with excess bandwidth than anticipated under full ITS deployment, done at a minimal additional cost, and lease the additional bandwidth to other users. This would provide additional income to fund future ITS projects in the corridor. Either way an installation cost of $45 per linear foot can not be met by this budget. Further discussion of fiber optic communications is discussed in Early Action Project CS-2, High-Capacity Data Transmission Links.

Color cameras with zoom capability would be installed in place/to supplement existing cameras. The color cameras would be connected to the Hanging Lake TOC via the new fiber optic cable, when applicable and via leased lines when fiber is not available. The cameras would be able to perform traffic counting and monitor traffic patterns for possible automatic incident detection. Color cameras would also allow for the identification of hazardous material vehicles. These vehicles would be monitored, by consecutive camera locations, as they traveled through Glenwood Canyon and through the Hanging Lake Tunnel.

Call boxes would be installed at regular intervals (every l/2 mile in high-incident locations; every mile elsewhere) throughout the I-70 West Corridor between Glenwood Springs and the Garfield/Eagle County line, These call boxes would consist of 2 way solar powered cellular phones. The call boxes would allow motorists involved in an accident or experiencing vehicular failure to contact the Hanging Lake TOC. In turn the Hanging Lake TOC would dispatch the proper emergency vehicles to the scene. This project would be enhanced by Early Action Project ER-3, Corridor-Wide Call Box System, in expanding the location of road-side call boxes to the entire I-70 West Corridor.

PROBLEM RESOLUTION:

- Communications between Hanging Lake TOC and Glenwood Springs is insufficient for future ITS needs.
- Existing black/white cameras can not identify hazardous material vehicles.

PROJECT IDENTIFICATION: cs-9 (continued)

PROJECT NAME: Hanging Lake TOC Upgrades

- Inadequate and inaccurate knowledge of incidents as they occur.
  Inability of traveling motorists to get help or communicate problems.

USER BENEFIT:

- Reliable high-capacity data transmission between the Hanging Lake TOC and Glenwood Springs.
- Connectivity for future systems.
- Digital and analog data conveyance.
- Incident confirmation through video surveillance and call box responses.
- Faster clearing of travel lanes to reduce congestion impacts by incidents.
- Positive ID of Hazardous material vehicles.
- Traveler security.
- Technologically updated TOC .

APPROXIMATE COST: $4,300,000: installation/$30,000: Maintenance

PARTICIPATING AGENCIES: Colorado Department of Transportation
Other

Data Collection/Aggregation

PROJECT IDENTIFICATION: DCA-1

PROJECT NAME: Vehicular Probe Data Collection/TOC Aggregation

PROJECT DESCRIPTION:

Building on Early Action Project CS-8, Two-Way Data Communications, public and private transit operation vehicles, as probes, would collect real-time road and weather condition information via in-vehicle sensors. The probe vehicles would be equipped with transponders that would transmit the information collected to roadside readers located at known "hot spots" along the corridor. The roadside readers would be linked to the Eisenhower and Hanging Lake TOCs, where the data would be collected, aggregated, and processed. The processed information would be used for road/maintenance crews to mobilize for sanding/deicing and other traffic management operations. It could also be disseminated through PIOs, television/radio, and information kiosks to the travelling public.

Hot spot areas include locations where traffic bottlenecks during peak travel periods (Idaho Springs/Twin Tunnels; Vail area) and where preferential icing typically occurs during adverse weather (bottom of Floyd Hill; Vail Pass; Dowd Junction; other steep grade locations). In-vehicle sensors would include those that measure the vehicle's speed and collect atmospheric moisture/pressure information. Roadside readers would provide the locational data that can be used to calculate travel time information (from vehicular speeds) and weather data (moisture content).

PROBLEM RESOLUTION:

- Lack of exact road/weather condition information to respond to potential problems.
- Dissemination of exact road/weather condition information to the travelling public.

USER BENEFIT:

- Increased efficiency by maintenance crews to respond to problem-areas.
- Additional real-time weather and travel information for dissemination to the travelling public.

APPROXIMATE COST:

$20,000 Per Vehicle for Sensors
$20,000 Per Roadside Reader
$50,000 Algorithm Development/System Integration

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Public/Private Transit Companies

PROJECT IDENTIFICATION: DCA-2

PROJECT NAME: Weather/Ice Sensor Data Collection/TOC Aggregation

PROJECT DESCRIPTION:

Adding to Early Action Project CS-5, Weather Station Centralized Communications Links, additional pavement sensors and weather stations would be installed in other known "hot spot" locations to provide up-to-date information on localized conditions. Data collected from the sensors and stations would be transmitted to the Eisenhower and Hanging Lake TOCs for aggregation and processing through the centralized road/weather information systems.

Known "hot spots" include the Denver metropolitan area (possibly DIA and the I-70/1-25 interchange complex); the Hogback area; the Genessee/Lookout Mountain areas; Floyd Hill; the Twin Tunnels/Idaho Springs area; the Georgetown area; both portal areas of the Eisenhower Tunnel; the I-70/SH 9 interchanges (Dillon/Frisco/Silverthorne area); Tenmile Canyon (Vail Pass); the Vail area; Dowd Junction; the Eagle area; the Glenwood Springs area; and the Grand Junction area. These locations would provide corridor-wide coverage. (The existing weather station/pavement sensor systems in Glenwood Canyon would be connected to this system when EAP CS-5 is implemented.)

PROBLEM RESOLUTION:

- Incomplete timely knowledge of corridor-wide road/weather conditions.

USER BENEFIT:

- Improved and automated maintenance crew response to localized problem areas.
- Corridor-wide collection and processing of road/weather-related information.
- Additional dissemination of real-time information to travelling public.

APPROXIMATE COST: $50,000 to $100,000 Per Site

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: DCA-3

PROJECT NAME: Video Surveillance Data Collection/TOC Aggregation

PROJECT DESCRIPTION:

CCTV color cameras would be installed at regular intervals and/or at "hot spot" locations to monitor traffic conditions along I-70 from the Denver metropolitan area to the Eisenhower Tunnel. Monitors for each camera would be situated in the Eisenhower Tunnel and Denver Metro TOCs for continual monitoring of roadway segments. TOC operators would analyze the nature and impact of incidents as they occur and dispatch the appropriate incident response personnel to the scene. Location, type, and severity of incidents would be conveyed to the communications companies for broadcast, as deemed appropriate by those companies. Live footage of the incident would be provided to the communications companies for their respective news reports.

The Denver Metro and Eisenhower TOCs would be established as regional incident management/data collection centers for processing and distribution of information. An independent CPU/monitor system at the TOCs, dedicated to video surveillance, would provide the eastern region of the I-70 West Corridor with centralized incident detection systems. Communication links from the video surveillance system installations would be established to these central processors. Those links would use the immediate area's available communications media.

Television communications companies have expressed an interest in installing and maintaining video surveillance along the I-70 West Corridor from the Denver metropolitan area to the Eisenhower Tunnel in exchange for use of the resulting information for broadcasting to the general public during weather/traffic report updates. They require broadcast-quality video, which is bandwidth intensive. This may not be achievable on the state microwave system. If a public/private partnership is initiated between CDOT and the TV companies, it will be dependent on the implementation/success of Early Action Projects II-l, Proactive Legislative Change Campaign and PPP-2, Television Station Video Surveillance.

PROBLEM RESOLUTION:

- Inadequate and inaccurate knowledge of incidents as they occur.

USER BENEFIT:

- Improved emergency response to incidents.
- Accurate knowledge of the appropriate response teams to dispatch to incident locations.
- Faster clearing of travel lanes to reduce congestion impacts by incidents.

APPROXIMATE COST: $25,000 Per Installation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Communications Companies

PROJECT IDENTIFICATION: DCA-4

PROJECT NAME: Avalanche Detection Research

PROJECT DESCRIPTION:

The Colorado Department of Transportation, Region 1 Maintenance Division has initiated avalanche detection research through the installation of several types of motion sensors in high avalanche incident areas (Berthoud Pass). During the evaluation program, sensors should detect shifting/movement within the snowpack. Detection information will be compared to slide events to determine if the sensors have detected the slide occurrence and which sensor systems can detect an avalanche before it occurs. This research should be supported to the fullest extent possible so that successful warning systems can be installed in high-incident areas along the I-70 West Corridor (see SW-3, Avalanche Detection and Warning System).

PROBLEM RESOLUTION:

- Avalanche slides onto roadway facilities, creating traveler safety hazards, road closures, and snow removal/roadway repair reaction.

USER BENEFIT:

- Advance detection of potential slides.
- Early mobilization of maintenance crews to imminent slide sites.
- General public safety precautions through early evacuation of potential hazard site.

APPROXIMATE COST: $50,000 to $500,000

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Detection/Sensor Development Companies

PROJECT IDENTIFICATION: DCA-5

PROJECT NAME: Eisenhower Tunnel Approach Vehicle Detectors

PROJECT DESCRIPTION:

Loop detectors would be installed across the approach lanes to the east and west portals. Vehicular numbers, counted by the loops, would be continually transmitted to the Eisenhower TOC. As volumes increase during peak travel periods, operators could determine when traffic management procedures should be initiated.

Effective locations for loop detector installation might be:

- Westbound: I-70 Interchange Exit 228, between Georgetown and Silver Plume
- Eastbound: I-70 Interchange Exit 205, SH 9/US 6 access at Dillon/Silverthorne

Loop detector vehicle count/type data could also be aggregated and processed to provide real-time traffic congestion/speed/travel delay information to the general traveling public via broadcast and advanced traveler information centers.

An alternate solution might include installation of a video vehicle detection system, such as Autoscope. This would require a low.speed data communications link back to the TOC.

PROBLEM RESOLUTION:

- Inadequate intelligence regarding large traffic platoons approaching the tunnel.

USER BENEFIT:

- Advance implementation of traffic management procedures including set up for reversible lane operations.
- More effective traffic flow, during peak periods, through the tunnel.
- Additional information on vehicle location/type/volume approaching the tunnel.

APPROXIMATE COST: $75,000 Per Approach

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: DCA-6

PROJECT NAME: Basic Data Fusion

PROJECT DESCRIPTION:

The development of software algorithms is essential to the accurate and efficient aggregation and processing of data collected by remote sensing/detection sources to create usable traffic, weather, and road condition information. The multitude of sources provides raw data that must be merged and processed through computations to create useful information. Other computational processes determine how data is collected and disseminated. The basic data fusion will provide the foundation for enhanced systems that make use of artificial intelligence technologies, such as expert systems and neural networks.

PROBLEM RESOLUTION:

- Inadequate and incompatible software systems for aggregating and processing data received from sensor and detector systems,

USER BENEFIT:

- Efficient use of TOC operator/PI0 resources.
- Compatible processing systems so that information can be stored and used effectively.

APPROXIMATE COST: **$50,000 to $200,000**

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: DCA-7

PROJECT NAME: Advanced Ice Detection/Warning System

PROJECT DESCRIPTION:

Pavement sensors would be installed at several locations along the I-70 West Corridor. Mountain pass locations would include Eagle (1 sensor, EB lane only); DeBeque (2 sensors); McClure, Independence (5 sensors); Dowd (2 sensors); and Douglas in the canyon (8 sensors). Information from the sensors would be used to determine problem areas, as defined by lengths of roadway with existing or forming ice patches. These areas would be targeted by road crews for ice removal. This would allow for more efficient use of road crews, equipment and materials.

Real-time weather data, from the sensors, would be transmitted to a central processor at the Hanging Lake TOC. Information from Surface Solutions Incorporated (SSI), including temperature, would also be received at the central processor where it would be fused together with the pavement sensor data. Centralized aggregation and processing of information would allow for more comprehensive analysis of the data. Expert systems would be developed that would determine the most effective and efficient use of labor, equipment and materials.

The data, both input and output, at the central processor would be made available for dissemination to other corridor TOCs, kiosks and outside agencies, including, but not limited to, information services and local and regional television and radio channels. Real-time road/ice conditions would eventually be sent to existing VMS where they would advise motorists of hazardous road conditions.

Related projects include TIS-2, Tenmile Canyon/Vail Pass/Vail Icy Road Sensor/VMS System.

PROBLEM RESOLUTION:

- Icy road conditions create hazardous traveling conditions.
- Incomplete timely knowledge of road/ice conditions.

USER BENEFIT:

- Early detection of icy road conditions.
- Preventive ice clearing procedures.
- Improved and automated maintenance crew response to localized problem areas.
- Dissemination of real-time road/ice conditions to traveling public.
- Traveler security/safety.

APPROXIMATE COST: $540,000: Installation/$30,000 per annum: Maintenance

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Information Providers

PROJECT IDENTIFICATION: DCA-7

PROJECT NAME: Advanced Ice Detection/Warning System

PROJECT DESCRIPTION:

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Related projects include TIS-2, Tenmile Canyon/Vail Pass/Vail Icy Road Sensor/VMS System.

PROBLEM RESOLUTION:

- Icy road conditions create hazardous traveling conditions.
- Incomplete timely knowledge of road/ice conditions.

USER BENEFIT:

- Early detection of icy road conditions.
- Preventive ice clearing procedures.
- Improved and automated maintenance crew response to localized problem areas.
- Dissemination of real-time road/ice conditions to traveling public.
- Traveler security/safety.

APPROXIMATE COST: $540,000: installation/$30,000 per annum: Maintenance

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Information Providers

Education/Training

PROJECT IDENTIFICATION: ET-1

PROJECT NAME: Trained Caller Program

PROJECT DESCRIPTION:

A program to train volunteers on observation and reporting of travel information along the I-70 West Corridor would be developed and initiated. Training sessions for volunteers would teach participants about types of situations to watch for; how and when to report conditions and incidents; and when and how to log their reports. The initial classes would provide training for start-up volunteers and be conducted, at least annually, as new or replacement volunteers are recruited. Volunteers would be provided with communication devices and reporting logs. Program volunteers would include individuals from public/private transit operators and citizens who travel the corridor at least once daily; CDOT maintenance and rest area personnel; ski instructors and recreational area staff; and local Chamber of Commerce and information center employees.

A special reporting hotline and access codes would be established. Trained callers would access the system via cellular telephone or other suitable communications medium. PIOs would collect and transmit the information to the appropriate TOCs for inclusion in the data fusion process and for operator response and information dissemination.

PROBLEM RESOLUTION:

- Lack of localized real-time traffic, weather and road condition, and incident information.

USER BENEFIT:

- Public cooperation and participation.
- Efficient use of resources.
- Effective relay of local information.

APPROXIMATE COST: $75,000 Start-Up
$10,000 Per Annum Operation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Public Safety
Transit Agencies
Local Chambers of Commerce
Recreational Area Operators

PROJECT IDENTIFICATION: ET-2

PROJECT NAME: I-70 West Corridor Road Show

PROJECT DESCRIPTION:

A modular slide show/script would be developed for presentation on ITS applications throughout the I-70 West Corridor. The "Road Show" would include a brief introduction on what ITS is; the types of advanced technology applications that would improve travel in the Corridor; examples of existing systems and the benefit they have and are providing; and what benefits future systems can provide. The "Road Show" would be modular so that specific local-area ITS projects would be highlighted for a given presentation and updates on newly deployed projects and emerging technologies can be added.

Presentations would be conducted by ITS proponents throughout the corridor. This would include individuals from CDOT involved in developing and implementing advanced technology applications; Colorado State Patrol communications and police officers; and consultants to these agencies. A schedule for the "Road Show" would be developed for presentation at local civic organization, county commission and town council, and public information meetings.

PROBLEM RESOLUTION:

- Educating/selling ITS and its potential benefits to all users.

USER BENEFIT:

- Increased understanding of ITS.
- Developing public and private interest and cooperation in ITS deployment.
- Creating institutional action toward deploying Early Action and long-term ITS projects.

APPROXIMATE COST: $10,000 Start-Up
$5,000 Per Annum Update/Presentation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Public Safety
Local County/Municipal Agencies

PROJECT IDENTIFICATION: ET-3

PROJECT NAME: Smart Driver/Vehicle Program

PROJECT DESCRIPTION:

An in-vehicle communication system would be developed for installation on volunteer/privately-owned vehicles to test and evaluate the use of such systems for travel along the I-70 West Corridor. The system would contain a transceiver, a two-way communications device (cellular telephone or radio), and a mobile message monitor and alarm as components. The receiver would collect information from Denver Metro, Eisenhower, and Hanging Lake TOC, distributions and display advisories on the mobile messaging screen. Volunteer drivers would communicate localized information to the TOCs for aggregation with other data collection systems. The communications device would also be used for requesting motorist assistance for the volunteer or other travelers the volunteer encounters during trips through the corridor.

A media campaign and advertising program would identify volunteer participants, who frequently travel the I-70 West Corridor, to test an in-vehicle communications system. Volunteers would go through the Trained Caller Program (ET-1) and receive additional training on use of the devices and how to log their use of the system for program evaluation.

Manufacturers of receivers, communications devices, and messaging processors would donate that equipment for the testing and evaluation program. Automobile retailers would provide equipment installation services.

A testing period will be established and an evaluation program devised to determine program effectiveness and potential implementation in other travel corridors throughout Colorado.

PROBLEM RESOLUTION:

- Involving manufacturers/retailers in the outfitting of automobiles with advanced technology equipment.
- Gaining public acceptance, purchase, and use of automated safety and information devices.

USER BENEFIT:

- Enhanced driver awareness.
- Increased availability of advanced in-vehicle technology devices.
- Additional safety precautionary measures for travelers.
- Supplemental information sources (vehicles as probes).
- Further public acceptance of advanced technology applications.

APPROXIMATE COST: $500,000

PARTICIPATING AGENCIES: Colorado Department of Transportation
Local Automobile Retailers
High-Tech Equipment Manufacturers

PROJECT IDENTIFICATION: ET-4

PROJECT NAME: Traveler Information Community Service Program

PROJECT DESCRIPTION:

A seminar program would be designed and implemented throughout the I-70 West Corridor to educate the local communities about travel behavior and recurring problems to help them fully understand the entire range of responsibilities that CDOT must prepare for and react to. The seminar presentations would include examples of specific situations and projects to drive home the importance of and trade-offs associated with agency decisions. Community participants would be allowed to voice their concerns for the record and further investigation.

In addition, a weekly traveler information announcement program would be initiated to provide details of local events, expected weather and traffic patterns, anticipated roadway construction/maintenance operations, and other informative regional data that can affect travel conditions. Local county/municipal agencies, Chambers of Commerce/Visitor's Bureaus, and CDOT would assist in compiling the reports. CDOT PIOs would collect the information and distribute the report to the local media for broadcast and publication.

PROBLEM RESOLUTION:

- Inadequate information dissemination of travel conditions in the I-70 West Corridor.
- Public-wide disillusionment about public agency policies and decisions.

USER BENEFIT:

- Increased general public awareness regarding travel/driving.
- Improved CDOT image.
- Advanced advisories on travel conditions to allow trip makers to make informed decisions regarding their impending journey.

APPROXIMATE COST: $25,000 Start-Up
$10,000 Per Annum Operation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Local County/Municipal Agencies
Chambers of Commerce/Visitors Bureaus
Local Media

Emergency Response

PROJECT IDENTIFICATION: ER-1

PROJECT NAME: Hot Spot Courtesy Patrols

PROJECT DESCRIPTION:

Implementation of Courtesy Patrols at high-incident locations during peak travel periods (holiday weekends, ski weekends, spring/fall sight-seeing weekends), and during extreme inclement weather, would provide a highly beneficial service to the travelling public. Motorist assistance would include vehicle tows to safe refuge areas; gasoline; simple automobile breakdown diagnosis and repair; toll-free emergency calls; and lifts to nearest public outlet if the vehicle cannot be moved under its own power. Participating Courtesy Patrol providers would be outfitted with cellular telephones, provided by a sponsoring telephone communications company, that have special access codes for the motorist to make a toll-free emergency call for help.

High-incident locations may include Mount Vernon Canyon; the Floyd Hill/Idaho Springs/Twin Tunnels area; the Frisco/Dillon/Silverthorne area; Tenmile Canyon/Vail Pass; the Vail/Dowd Junction area; and Glenwood Canyon. The Courtesy Patrols can be called into action during extreme inclement weather periods when road conditions create additional travel problems.

This program will be dependent on the implementation and success of Early Action Projects II-l, Proactive Legislative Change Campaign; 11-3, MOVE-IT/REMOVE-IT Campaign; and PPP-3, Communications Links.

PROBLEM RESOLUTION:

- Vehicular breakdowns and/or incidents that obstruct traffic flow.

USER BENEFIT:

- Reliable motorist assistance.
- Traveler security and peace of mind.
- Faster obstruction removal from travel lanes, lessening traffic congestion potential.
- More effective use of maintenance/operations crews.

APPROXIMATE COST: $600,000 Per Annum

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Motorist Assistance Providers
Communications Companies

PROJECT IDENTIFICATION: ER-2

PROJECT NAME: Good Samaritan Reporting System

PROJECT DESCRIPTION:

This system would provide a *999 cellular access code for good Samaritans travelling through the I-70 West Corridor, to report incidents or problems as they witness their occurrence and report stranded motorist and other problems as they encounter them during their trip. The program would be broadly advertised through the CDOT Public Relations Division and the local media so that anyone with access to a cellular telephone while traveling the I-70 Corridor would be aware of the reporting system.

The sponsoring telephone communications company would provide the toll-free reporting link. The call would be placed to an automated recording system at the regional TOC that would provide the call-in reporter to identify the problem and its location. As calls are recorded, a signaling system would alert PIOs to an incoming call. They, in turn, would assess the problem and dispatch the appropriate authority (Courtesy Patrol, Emergency Response, Police/Fire District) to respond.

This project will be dependent on the implementation and success of EAPs II-4, Public Information Officer Training Program and PPP-3, Communications Links.

PROBLEM RESOLUTION:

- Inadequate reporting of incidents as they occur.
- Inability of stranded motorists to obtain assistance.

USER BENEFIT:

- Accurate reporting of travel-related problems as they occur.
- Traveler security.
- Good Samaritan personal esteem.
- Overall general public acceptance and appreciation.
- More positive regard for CDOT/participating sponsors.

APPROXIMATE COST: $10,000 Start-Up
$10,000 Per Annum Operation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Communications Companies
Local Media

PROJECT IDENTIFICATION: ER-3

PROJECT NAME: Corridor-Wide Call Box System

PROJECT DESCRIPTION:

Installation of cellular or land line telephone equipment at regular intervals throughout the I-70 West Corridor (every 1/2 mile in high-incident locations; every mile elsewhere) will provide travelling motorist with communications access to report problems or needs. Communications companies would install and maintain solar-powered call boxes with two-way communications capabilities for motorists to make an emergency call using the *999 system implemented as a part of EAP ER-2, Good Samaritan Reporting System. They could then make credit card or collect calls to describe their impending travel delays.

This project will dependent on the implementation and success of EAPs II-l, Proactive Legislative Change Campaign; 11-4, Public Information Officer Training Program; and PPP-3, Communications Links.

PROBLEM RESOLUTION:

- Inability of traveling motorists to get help or communicate problems.

USER BENEFIT:

- Traveler security.
- Improved public perception of CDOT/sponsoring organizations.

APPROXIMATE COST: $5,000 - $15,000 Per Site

PARTICIPATING AGENCIES: Colorado Department of Transportation
Private Communications Companies

PROJECT IDENTIFICATION: ER-4

PROJECT NAME: MAYDAY Operations

PROJECT DESCRIPTION:

ENTERPRISE has received a federal operational test grant to test and evaluate a GPS/MAYDAY system for motorists to call for help if stranded in remote areas. Two thousand test vehicles will be equipped with GPS locational tracking devices. They will also be equipped with two-way cellular telephone communications for reporting problems and the automatically-determined vehicle location. The test will be evaluated on rural corridors throughout the State of Colorado, with particular emphasis on travel through the I-70 West Corridor.

CDOT regional and local agency assistance will be needed to support the program operation and evaluation. Labor resources to assist in collecting and evaluating data and maintenance/operational crew response to assist motorists will support the program's success.

PROBLEM RESOLUTION:

- Inability of traveling motorists to obtain assistance.

USER BENEFIT:

- Traveler security.
- Improved public perception of CDOT Regions.

APPROXIMATE COST: $25,000 to $75,000

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: ER-5

PROJECT NAME: Emergency Services District Program

PROJECT DESCRIPTION:

Development and implementation of a program to coordinate all emergency response activities will increase efficiency of all responsible organizations. The program would include development of an organizational structure that identifies each agency's responsibility (information collection, dispatch, response). Staffing schedules would be devised so that overlap of resources would not occur. The incorporation of potential private partners to provide appropriate service and offset operational costs would be outlined. Each organization involved in the program would have communication links to each other for immediate relay of important data. A line of communications among staff within and between each agency would be established.

PROBLEM RESOLUTION:

- Lack of communications between emergency response jurisdictions.
- Inefficient use of labor/other resources in responding to incidents.

USER BENEFIT:

- Coordinated emergency/incident response between all responsible organizations.
- Faster response times.
- Productive/effective use of all agency resources.

APPROXIMATE COST: $25,000 Start-Up
$5,000 Per Annum Operation

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Public Safety
Local Police/Fire/Emergency Districts

Environmental/Economic Impacts

PROJECT IDENTIFICATION: EEI-1

PROJECT NAME: Alternate Fueled Vehicles Program

PROJECT DESCRIPTION:

The Public Service Company of Colorado (PSCo) has implemented a statewide alternate fueled vehicles program where many of their fleet vehicles have been retrofitted to bum less pollutant-emitted fuels. They have located refueling stations throughout the state with locations in the Denver metropolitan area and in Summit County. In partnership with PSCo, CDOT would retrofit a fleet of their maintenance/operations vehicles and have access to PSCo refueling stations.

PROBLEM RESOLUTION:

- CO, NO,, HC vehicle emission air pollutants.

USER BENEFIT:

- Improvement to air quality.

APPROXIMATE COST: $5,000 to $7,500 Per Vehicle

PARTICIPATING AGENCIES: Colorado Department of Transportation
Public Service Company of Colorado

PROJECT IDENTIFICATION: EEI-2

PROJECT NAME: Sensor/Chemical De-Icing Program

PROJECT DESCRIPTION:

Pavement sensors would be installed at known preferential icing/snow accumulation areas to detect when pavements are nearing freezing/icing conditions. This data would be relayed to the appropriate regional TOC for maintenance alerts and chemical compound mixture computation. Maintenance crews would be notified immediately to mobilize to the location and as to which de-icing mixtures to apply. Sensors would also measure presence of previous chemical applications, so that, if temperatures drop and the chemical composition is still adequate, crews would not needlessly re-apply chemicals.

PROBLEM RESOLUTION:

- Salt/sand/other chemical runoff into area streams, water supplies, and vegetation.
- Late mobilization of sanding crews during unpredictable snowstorms/freeze snaps.

USER BENEFIT:

- Reduced environmental contamination.
- Advanced de-icing of pavement surfaces.
- Safer vehicular travel.
- More efficient use of manpower/resources.
- Improved CDOT image.

APPROXIMATE COST: $40,000 Per Site Sensor Installation
$5,000 Program Development

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: EEI-3

PROJECT NAME: Sanding/Storm Water Runoff Program

PROJECT DESCRIPTION:

CDOT Region 1 has installed a series of check-dams along the downgrades on the north side of I-70, west of the Eisenhower Tunnel, to catch and divert roadway runoff into containment ponds at the bottom of the crevasse carved by Straight Creek, south of the roadway. The system requires periodic checks to determine when removal and disposal of collected materials should occur. This system would be sensored to detect runoff material composition and level of residue in the check-dams and catch basins. If hazardous material contents are detected or their pollutent levels near dangerous, appropriate hazardous materials teams would be dispatched to properly remove and dispose of the materials. As check-dam and catch basins approach fill levels, maintenance crews would be scheduled in advance to effectively control sediment removal.

Once this system has been implemented and evaluated at this site, if successful, it could be deployed to other roadway areas where similar conditions exist.

PROBLEM RESOLUTION:

- Roadway salt, sand, and hazardous material spill runoff collecting in mountain streams and lakes, and water supply reservoirs.

USER BENEFIT:

- Decreased environmental contamination.
- Significant local County official approval.
- Improved control and monitoring of current systems.
- Increased use of manpower/equipment for removing and disposing of materials.

APPROXIMATE COST: **$35,000** Per Structure

PARTICIPATING AGENCIES: Colorado Department of Transportation

PROJECT IDENTIFICATION: EEI-4

PROJECT NAME: Economic Development Partnership Program

PROJECT DESCRIPTION:

A partnership program, between local economic development officials within the I-70 West Corridor and responsible state transportation regions, would provide a forum for identifying problems and needs associated with transportation and economic issues. Team-building workshops would be implemented to develop relationships and gain an understanding, by each group's representatives, of the impacts of each system on the other. As specific projects are planned by each group that may have an impact on the other, team meetings would be scheduled to discuss and review impacts and devise appropriate mitigation measures.

PROBLEM RESOLUTION:

- Lack of understanding of and communication and coordination between transportation and economic development needs and impacts.

USER BENEFIT:

- Improved assessment of transportation/economic development requirements.
- Better coordination between involved jurisdictions.
- Enhanced relationships between local and state agencies.

APPROXIMATE COST: $20,000

PARTICIPATING AGENCIES: Colorado Department of Transportation
Local Economic Development Authorities

PROJECT IDENTIFICATION: EEI-5

PROJECT NAME: Mobile Emissions Testing Stations

PROJECT DESCRIPTION:

Upon successful evaluation of the recently funded CDOT emissions detection and reporting operational test, Mobile Emissions Testing Stations would be installed in potential high-pollution locations within the I-70 West Corridor. The emission detecting stations, set-up along the roadside, would ascertain which passing vehicles were emitting greater then acceptable levels of CO. Identified vehicle drivers would receive a warning, via a portable variable message sign, that they are in violation of emission standards. Daily logs of the number of suspect vehicles detected would be maintained.

Depending on legislative changes, the system could be upgraded in the future to include video surveillance systems that record vehicle identification (license plate number) so that fines for not meeting air pollution standards could be levied through the US Mail on the vehicle owner.

PROBLEM RESOLUTION:

- Vehicular CO emissions above acceptable levels traversing the I-70 West Corridor.

USER BENEFIT:

- Potential improvement to air quality.

APPROXIMATE COST: $260,000 - $520,000

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Regional Air Quality Commission
Colorado Department of Public Safety
Colorado Department of Revenue

Institutional Issues

PROJECT IDENTIFICATION: II-l

PROJECT NAME: Proactive Legislative Change Campaign

PROJECT DESCRIPTION:

CDOT would continue its initiation and promotion of changes to existing legislation to allow lease easement or dedication of public rights-of-way for private entities to install fiber optic communications media, roadside call boxes, and other infrastructure appurtenances that enable improvement for transportation systems.

As other legal barriers to implementing advanced technology systems are identified, legislative campaigns should be mounted to pass amendments to the State Constitution or to create new laws so that system improvements can progress.

State regulations regarding sole-source contracting and procurement procedures need to be examined and revised to allow partnerships with specific private entities. As projects are identified that rely on partnerships with specific private businesses, rules and procedures (that may create barriers to implementation) need to be resolved.

PROBLEM RESOLUTION:

- Several state statutes prohibit initiation and/or implementation of some IVHS applications.

USER BENEFIT:

- Positive changes to promote technological advances.
- Improved transportation system.

APPROXIMATE COST: **$20,000 to $40,000**

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Department of Public Safety
Colorado Department of Revenue
Attorney General's Office
Legislative Sponsors
Legislative Lobbyists
Private Business Concerns

PROJECT IDENTIFICATION: II-2

PROJECT NAME: FCC Rule-Making Permit Process

PROJECT DESCRIPTION:

Local area communication systems, such as Highway Advisory Radio (HAR), provide localized broadcast of information over AM radio frequencies. Ten-watt transmitters require FCC licensing, requiring a frequency/interference search to obtain a secondary (a commercial license can preempt the signal) license. HAR transmissions could be supported by private business to help develop and maintain broadcast information updates on a weekly basis in return for a method to advertise their sponsorship. An application for Rule-Making to permit semi-advertising announcements, such as "This information message brought to you by., . would need to be initiated, processed, approved before private support could be enlisted.

PROBLEM RESOLUTION:

- Current prohibition of advertising over FCC authorized radio frequencies.

USER BENEFIT:

- Potential private investors in deploying specific ITS projects.
- Additional travel information dissemination to the public.

APPROXIMATE COST: **$10,000**

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Division of Telecommunications

PROJECT IDENTIFICATION: II-3

PROJECT NAME: MOVE-IT/REMOVE-ITCampaign

PROJECT DESCRIPTION:

A legislative bill was introduced and passed to allow motorists, if involved in an accident, to move (if possible) their vehicles out of the travel lanes on the Interstates in the Denver metropolitan area to the roadway shoulder before law enforcement officials arrive on the scene (MOVE-IT). A second bill was introduced and passed, for the Interstates in the Denver metropolitan area, to allow state funded agencies (such as CDOT maintenance and courtesy patrols) to tow disabled vehicles from the travel lanes to the shoulder (REMOVE-IT). These legislative acts would be extended to include I-70 west from Denver to the Colorado/Utah border and east from Denver to the Colorado/Kansas border.

PROBLEM RESOLUTION:

- Vehicles obstructing travel lanes following incidents, creating traffic backups.

USER BENEFIT:

- Legal removal of vehicular obstructions from travelled ways.
- Lessened traffic delays due to accidents.

APPROXIMATE COST: **$5,000**

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Public Safety

PROJECT IDENTIFICATION: II-4

PROJECT NAME: Public Information Officer Training Program

PROJECT DESCRIPTION:

A training program would be developed to teach PIOs how to use specialized equipment; collect and disseminate information; dispatch emergency/incident response teams; and maintain automated system performance. Annual update training would be provided, as necessary. Additional training on new systems and/or equipment would be initiated, as required.

PROBLEM RESOLUTION:

- Lack of trained staff to operate new advanced technology information systems.

USER BENEFIT:

- Skilled and responsive work force.
- Specialized personnel at each TOC.
- Efficient and effective monitoring and reporting systems.

APPROXIMATE COST: $10,000 Start-Up
$5,000 Per Annum Update Training
(new position salaries not included)

PARTICIPATING AGENCIES: Colorado Department of Transportation
Colorado Department of Public Safety

PROJECT IDENTIFICATION: II-5

PROJECT NAME: Corridor Incident Management Plan

PROJECT DESCRIPTION:

Development and implementation of a corridor-wide incident management plan would create a satisfactory program for operating a strong and effective system. An I-70 West Corridor Incident Management Coalition would be established to develop and update the plan as conditions change and new technologies are implemented and to oversee the program. The I-70 West Corridor IMC would work with the Colorado IMC to develop the plan. The plan would detail organizational and management structure; agency and individual responsibilities; action plans for responding to all types of incidents and maintaining transportation system efficiency and effectiveness; lines of communication; contact lists for all involved individuals and organizations; provisions for dealing with potential impacts, impediments, or conflicts; and identification of annual funding sources.

The plan would include provisions established for the regional emergency services district developed from EAP ER-5, Emergency Services District Program. The plan would be reviewed and adopted by all participating organizations.

PROBLEM RESOLUTION:

- No coordinated corridor-wide program to coordinate incident response, operations, and maintenance activities.
- Current system promotes ineffective use of resources, problems among organizations, and "poorer than possible" incident management.

USER BENEFIT:

- Effective use of resources.
- Program adoption by all participating organizations.
- Open lines of communication.
- Improved incident management.

APPROXIMATE COST: $50,000

PARTICIPATING AGENCIES:

Colorado Department of Transportation
Colorado Department of Public Safety
Colorado Incident Management Coalition
Local Police/Fire/Emergency Response Teams

PROJECT IDENTIFICATION: II-6

PROJECT NAME: I-70 West Corridor ITS Coalition

PROJECT DESCRIPTION:

Members of the I-70 Rural IVHS Action Team would organize as a corridor-wide productive and sustaining association to promote, identify, and design advanced technology projects that would improve transportation system performance and enhance local quality of life. The group would define their organizational structure, mission statement, goals and objectives, meeting schedules, and action plan. Their "Board of Directors" would meet regularly with CDOT Regional management to discuss their plans, problems, and concerns. CDOT would make every effort to incorporate Coalition plans into State programs.

PROBLEM RESOLUTION:

- Advancement of I-70 IVHS Action Team to continue ITS project identification and implementation throughout the corridor in the future.

USER BENEFIT:

- Improved agency coordination and cooperation.
- Continued identification of potential advanced technology applications by local leaders.
- Identification of local ITS "champions.
- Established working relationships between local and state representatives.

APPROXIMATE COST: $5,000 to $10,000 Per Annum

PARTICIPATING AGENCIES:

Local Counties/Municipalities
Local Fire/Police/Emergency Districts
County Commissioners/Town Councils
Special Interest Groups
Civic Organizations

PROJECT IDENTIFICATION: II-7

PROJECT NAME: ITS Implementation Team Regional Task Force

PROJECT DESCRIPTION:

The Statewide ITS Implementation Team is composed of CDOT representatives from each of the 6 regions and headquarters divisions that have interest in promoting advanced technology applications for transportation systems within their respective regions and across the state. The Team is carrying out the ITS vision, originally developed as the C-Star Strategic Plan for IVHS in Colorado. They are developing statewide ITS implementation, business (financing), and marketing strategies to further deployment of ITS in the state.

An I-70 West Corridor Regional Task Force would be established to participate with and report to the Statewide ITS Implementation Team on local efforts and plans. This Task Force may be the "Steering Committee" or "Board of Directors" of the I-70 West Corridor Rural ITS Coalition. The Task Force and the Coalition should have some common representation so that efforts are not overlapping nor duplicated.

PROBLEM RESOLUTION:

- Continuation of coordination between I-70 West Corridor and Statewide ITS programs.

USER BENEFIT:

- Integrated statewide and corridor-specific ITS plans.
- Improved state/local agency relationships.

APPROXIMATE COST: $5,000 Start-Up
$1,000 Per Annum Sustainment

PARTICIPATING AGENCIES: Colorado Department of Transportation
Local Counties/Municipalities
Local Fire/Police/Emergency Districts
County Commissioners/Town Councils
Special Interest Groups
Civic Organizations