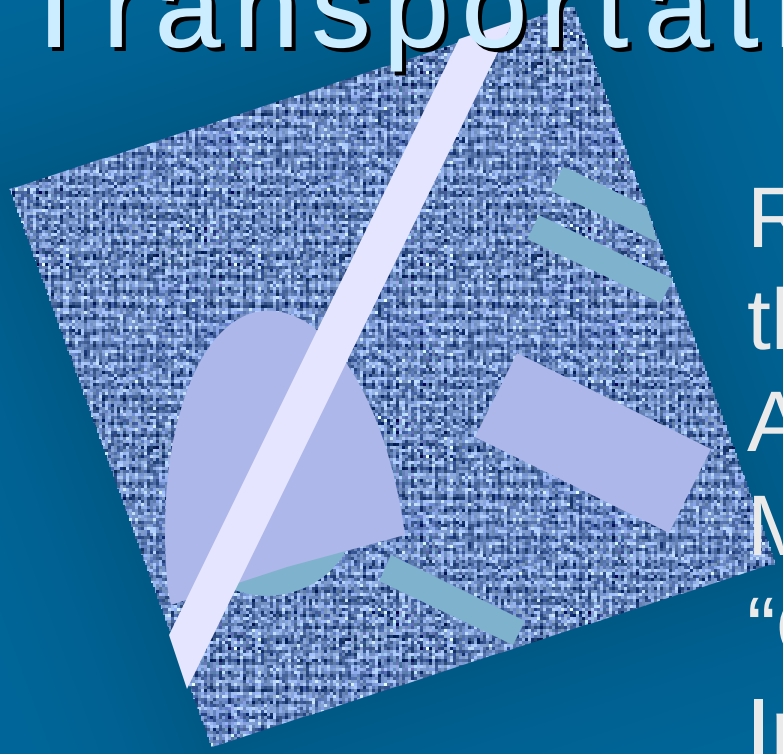
Advanced Rural Transportation Systems



Rural Challenges and the Application of Advanced Technology Must Be a "Community" Investment

Overview of Presentation

Modules

①Introduction

②Technology Focus Areas and User Needs

③Crash Prevention & Security

④Emergency Services

⑤Traffic Management

Overview of Presentation

Modules (Cont.)

⑥Transit & Mobility

⑦Operations & Maintenance

⑧Travel & Tourism

⑨Surface Transportation Weather

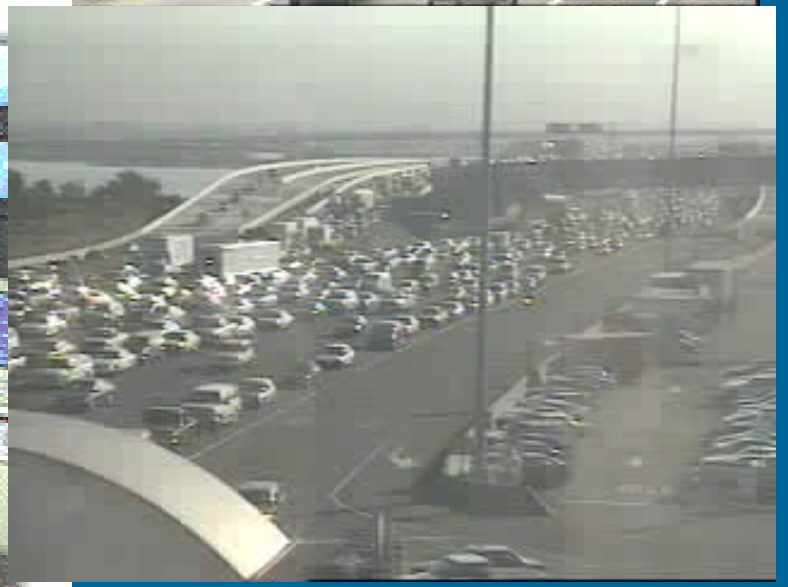
⑩Benefits of Advanced Technologies, How to Get Involved & Funding Opportunities

Module Format

- User Needs
- Stakeholders
- Applicable Technologies
- Projects
- Resources


I-5
220TH ST SW


I-405
SR 169



Rural Situations

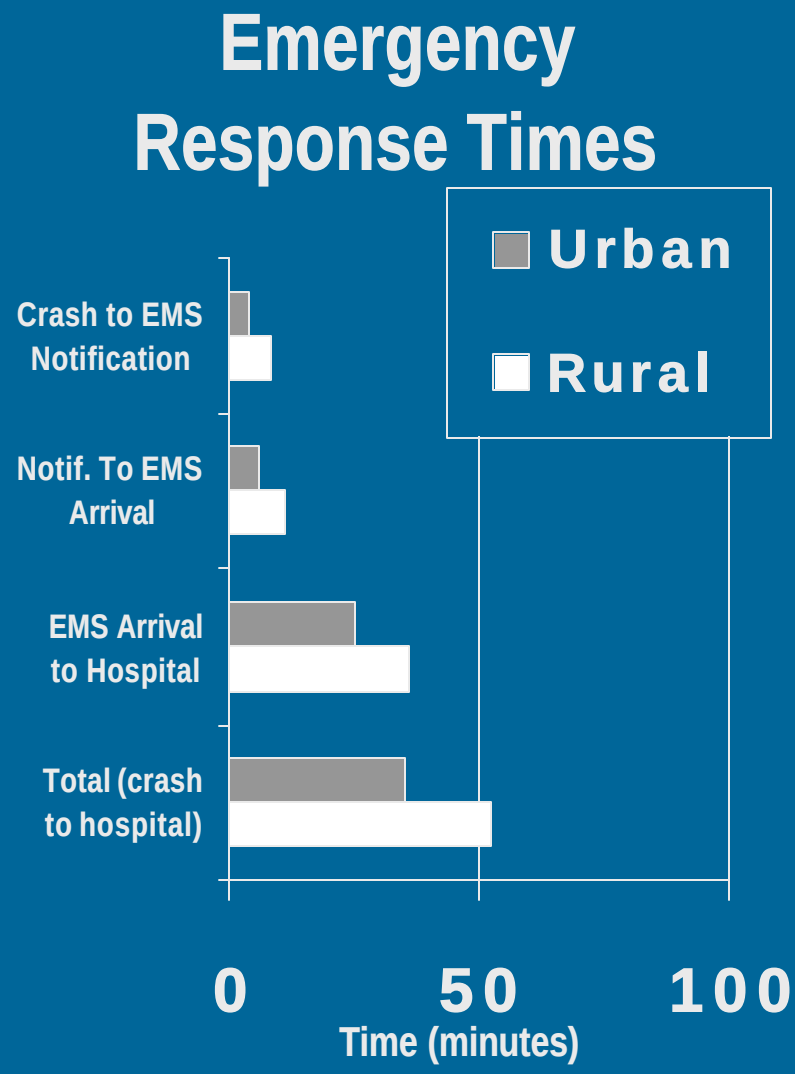
- Challenging geography, weather events, and road conditions
- A sparse telecom infrastructure
- Limited public transportation
- NOT one size fits all

Context

- Limited services between communities
- 78.5% of mileage traveled is rural
- 39.4% of vehicle miles traveled is in rural areas
- 68.4% of crash fatalities occur on rural highways

Source: FHWA Highway Statistics, 1998, Rural Versus Urban Highway Statistics

Crashes


Emergency Response Times
Urban
Rural
Crash to EMS Notification
Notif. To EMS Arrival
EMS Arrival to Hospital
Total (crash to hospital)
0
50
100
Time (minutes)

Emergency Response

In Urban and Rural United States

- Nearly 20,000 people die each year before receiving hospital care
- Another 22,000 people die after reaching the hospital too late to be saved

Source: http://www.nhtsa.dot.gov/cars/problems/studies/acns/champion.htm

Communications/Power

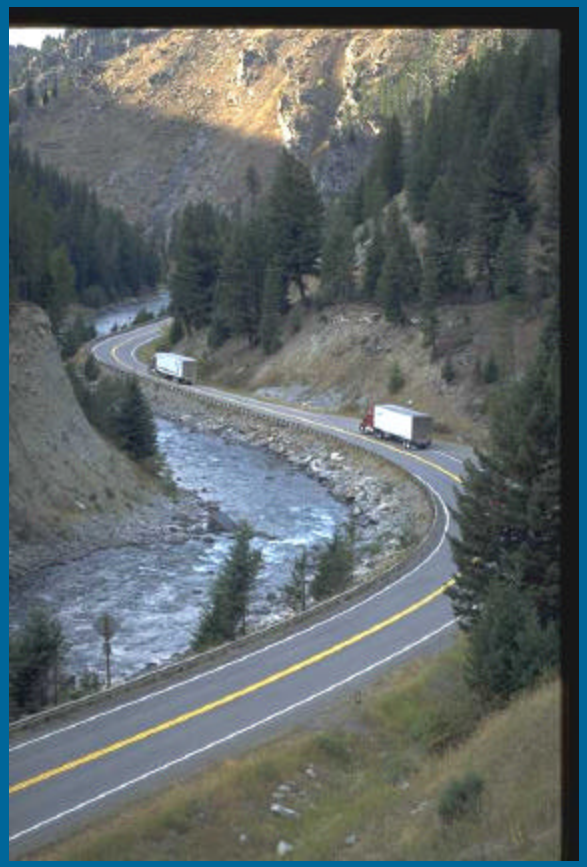
- Limited cellular communication coverage
- Limited power availability
- Limited E911 service
- Response services potentially volunteer

Weather

- 7,000 fatalities annually
- 450,000 persons injured
- $2 billion spent on snow and ice control

Source: Road Weather Road Show Presentation Paper

Commercial Vehicle Traffic



In 1998:

- 420,000 large trucks were involved in crashes
- 5,302 people died in crashes involving heavy trucks
- 13% of all traffic fatalities reported involved heavy trucks

Source: International Road Dynamics Inc

Commercial Vehicle Rollovers

- 10,000 per year
- 80 deaths
- 3,000 injuries
- Physical damage
- Property loss
- Traffic delays
- Environmental damage

Source: International Road Dynamics Inc

Maintenance

- City and County Responsibility -- 95% unpaved & 55% paved roads
- 95% of rural residents depend on personal vehicles
- Most rural lanes are less than 10 ft in width
- Limited budget and resources

Source: ARTS Strategic Plan

Animal Conflicts

- ~726,000 animal/vehicle crashes each year
- PDO estimates ~$2000/vehicle, $1.0 billion each year

Source: Conover, M.R. Wildlife Society Bulletin, 1997

High Recreational Traffic

- Major Route Congestion
- Seasonal Demand
- High Crash Locations
- Limited Visitor Information
- Limited Transit Alternatives
- Limited Infrastructure/Funding
- High Parking Demand/Turn-over

Transit

- 38% of the rural population has no access to public transportation
- 28% have little access
- 45% of rural elderly have no vehicle
- 57% of rural poor have no vehicle
- 1 in 14 households are without a private vehicle

Source: TCRP A - 21, 1999

Economic Viability

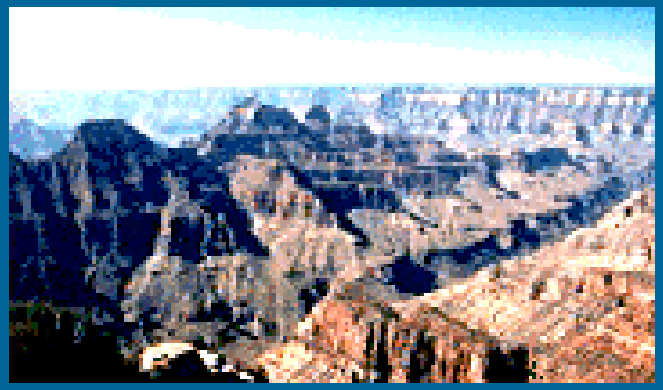
- 1998 Travel expenditures -- $515.2 billion, resulting in 7.6 million jobs
- Domestic travel -- 1.3 billion person trips in 1998
- In 1998, an estimated 46.4 million international visitors spent $91.3 billion on travel in or to the U.S.

Source: Travel Industry Association of America

State Statistics

1998 Traveler Spending, in billions

- California - $62.6
- Florida - $48.1
- New York - $31.3
- Texas - $27.6
- Illinois - $18.4
- Nevada - $17.6
- Hawaii - $14.0
- New Jersey - $13.2
- Pennsylvania - $13.1
- Georgia - $12.05



Source: Travel Industry Association of America

Stakeholders

Who are they?

Technology Focus Areas

Source: Rural ITS User Needs, 1999

Crash Prevention & Security

User Needs

- Collision Avoidance
- Roadway Geometrics
- Roadway Weather Information Systems
- Work Zone Control/Advisory System

Source: Rural ITS User Needs, 1999

Crash Prevention & Security (Cont)

More User Needs

- Highway-Rail Intersection Crossings
- Vehicle Pre-Emption
- Security
- Data Sharing

Source: Rural ITS User Needs, 1999

Emergency Services

User Needs

- Response Information
- En-Route Services Information
- Emergency Assistance
- System Operational Effectiveness

Source: Rural ITS User Needs, 1999

Traffic Management

User Needs

- Advisory Information
- Traffic Control

Source: Rural ITS User Needs, 1999

Traffic Management (Cont)

More User Needs

- Enforcement
- Economic Development/Environmental Protection
- Data Sharing

Source: Rural ITS User Needs, 1999

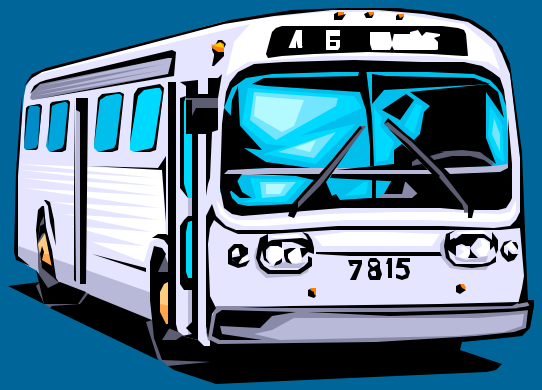
Transit & Mobility

User Needs

- Transit Management
- Traveler Information

Source: Rural ITS User Needs, 1999

Transit & Mobility (Cont)



More User Needs

- Electronic Fare Payment
- Data Sharing
- System Operational Effectiveness

Source: Rural ITS User Needs, 1999

Operations & Maintenance

User Needs

- Infrastructure Management
- Roadway Condition Monitoring
- Safety Management
- System Maintenance Effectiveness

Source: Rural ITS User Needs, 1999

Operations & Maintenance (Cont)

More User Needs

- System Operations Effectiveness
- Security
- Public Fleet Management
- Data Collection & Sharing

Source: Rural ITS User Needs, 1999

Travel & Tourism

User Needs

- Advisory Information
- En-Route Services Information
- Emergency Assistance

Source: Rural ITS User Needs, 1999

Tourism & Travel (Cont)

More User Needs

- Transit Information
- Economic Development
- Data Sharing

Source: Rural ITS User Needs, 1999

Surface Transportation Weather

User Needs

- Advisory Information
- System Operational Effectiveness
- En-Route Services Information
- Leveraging Weather Information to Cost Containment, Profitability & Safe Operations/Travel
- Data Sharing

Source: Rural ITS User Needs, 1999

Crash Prevention & Security

User Needs

- Collision Avoidance
- Roadway Geometrics
- Highway-Rail Intersection Crossings
- Vehicle Preemption
- Roadway Weather Information Systems
- Work Zone Control/Advisory System
- Security
- Data Sharing

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?

Applicable Technologies

- Mayday
- Roadway Weather Information Systems
- Dynamic Warning Variable Message Signs
- Highway Advisory Radio
- Emergency Vehicle Preemption
- Animal Detection/Deterrence

Projects

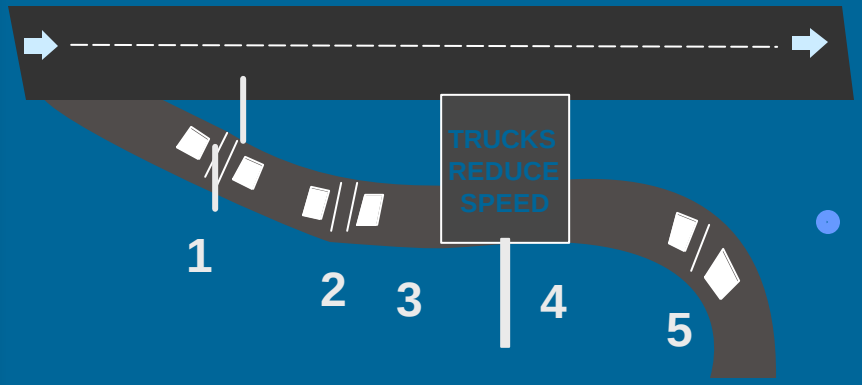
- California Dynamic Speed Warning
- Automated Truck Rollover Warning System
- Dynamic Downhill Speed Warning System
- North Dakota State University ATWIS -- #SAFE
- URGENCY
- Intersection Collision Avoidance
- Animal Vehicle Crash Mitigation Using Advanced Technologies

California Dynamic Speed Warning

- 10’ X 7’ full LED matrix
- Radar Unit
  - 18 Degrees
  - 15-120 mph and 2500 feet away
- 2 Fixed Closed Circuit Television Cameras
- Video Vehicle Detection System
- Controller and Phone Line

Source: http://www.coe.montana.edu/wti/wti.htm

Automated Truck Rollover Warning System

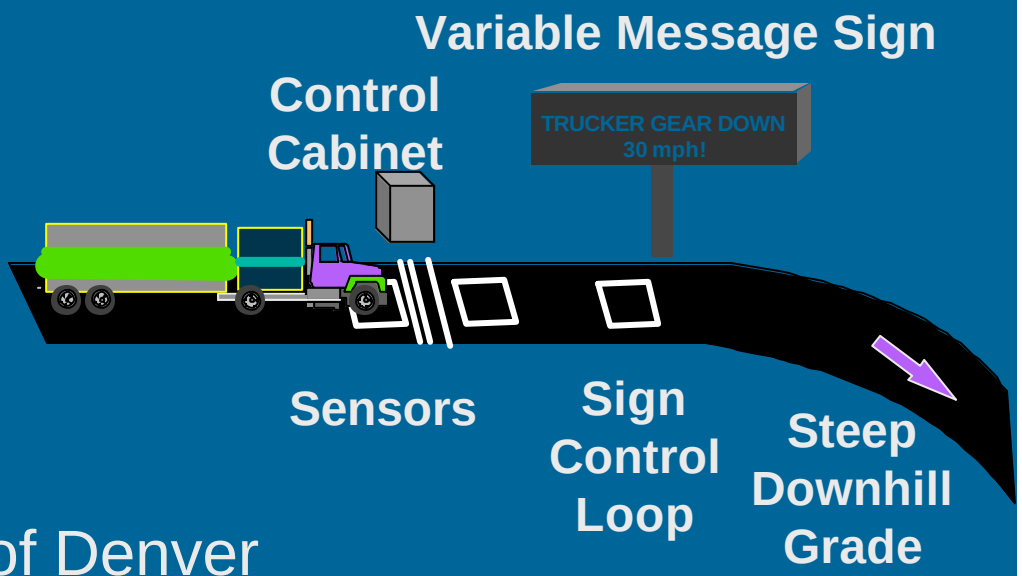


1. **Advance WIM**
2. **Tracking WIM**
3. **Calculations**
4. **Sign activation (if required)**
5. **Monitoring WIM (optional)**

- Based on real information:
  - vehicle
  - road
  - driver
- Roadside warning signs illuminate for specific trucks

Source: http://www.ird.ca/english/html/highway/system/sys_safe.htm

Dynamic Downhill Speed Warning System



- I-70 Westbound, west of Denver
  - Eisenhower tunnel leads into Straight Canyon
  - 10 miles at 7% grade
- Annual traffic count approaching 5 million
- About 20 runaways & 15 truck related crashes per year

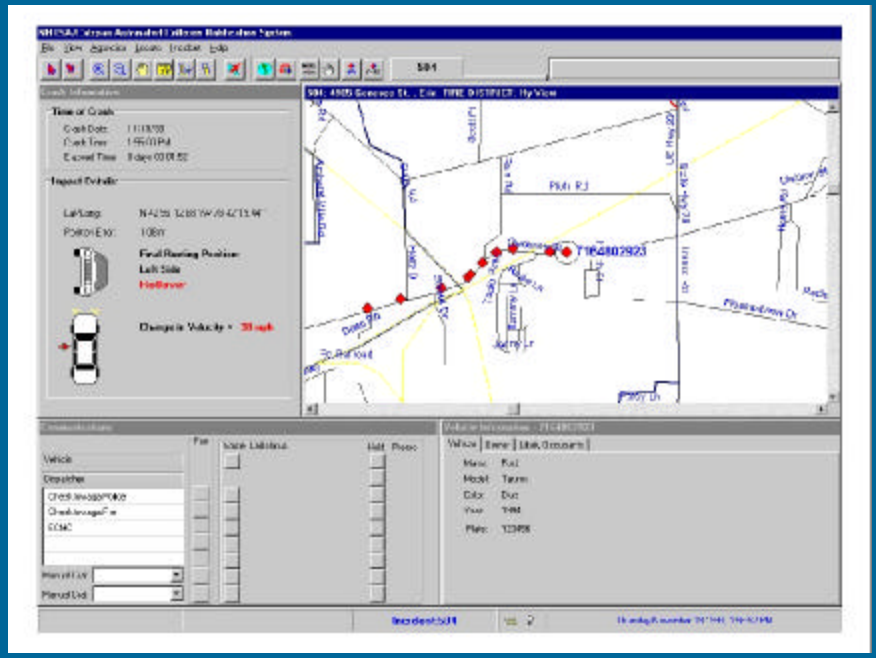
Source: http://www.ird.ca/english/html/highway/system/sys_safe.htm

University of North Dakota ATWIS -- #SAFE

- Forecasts weather for six hours into the future
- Forecasts weather for 60 miles in direction traveling
- 94.3% believe that they will benefit from #SAFE in the future

Source: Mark Owens, Regional Weather Information Center

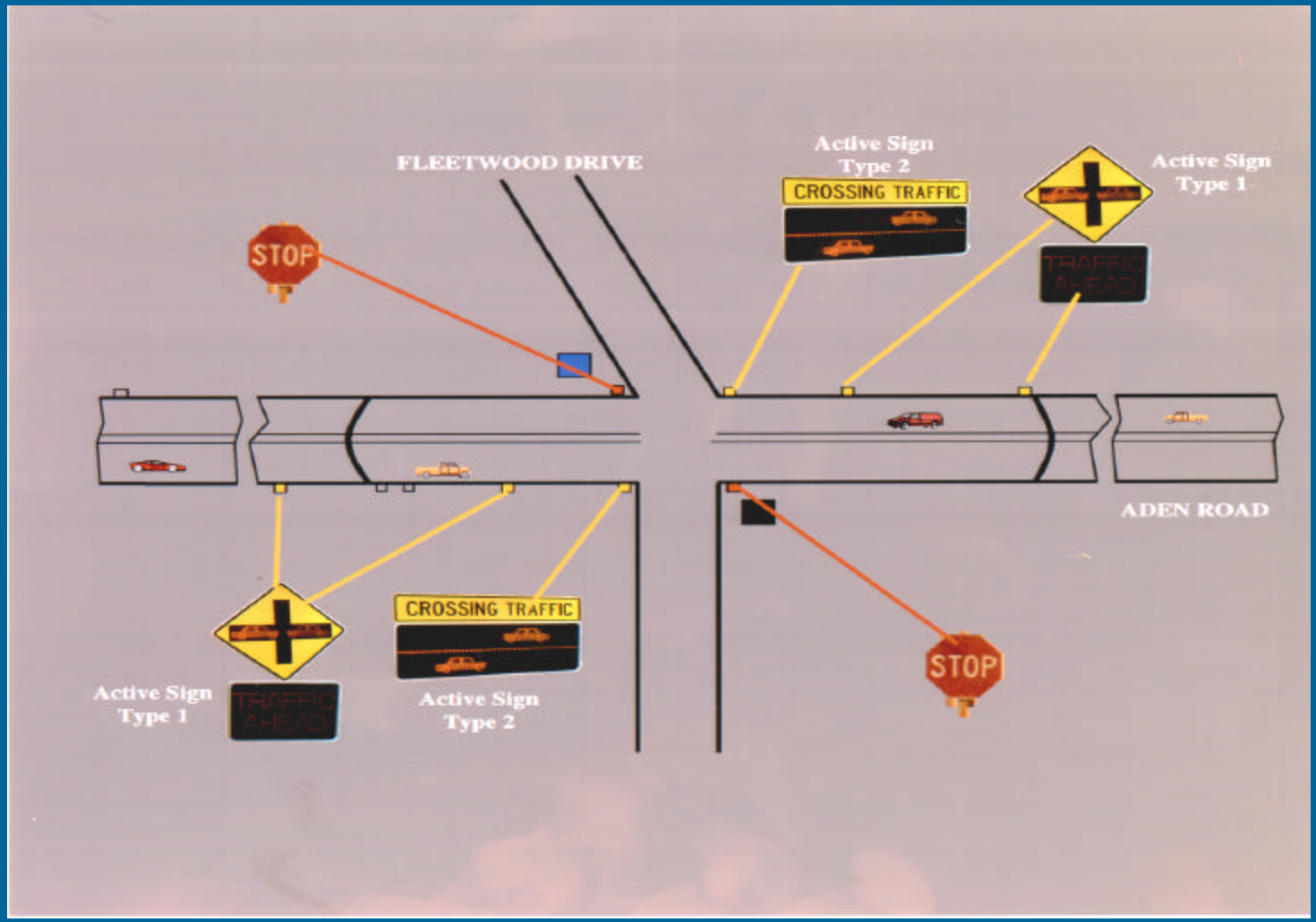
URGENCY



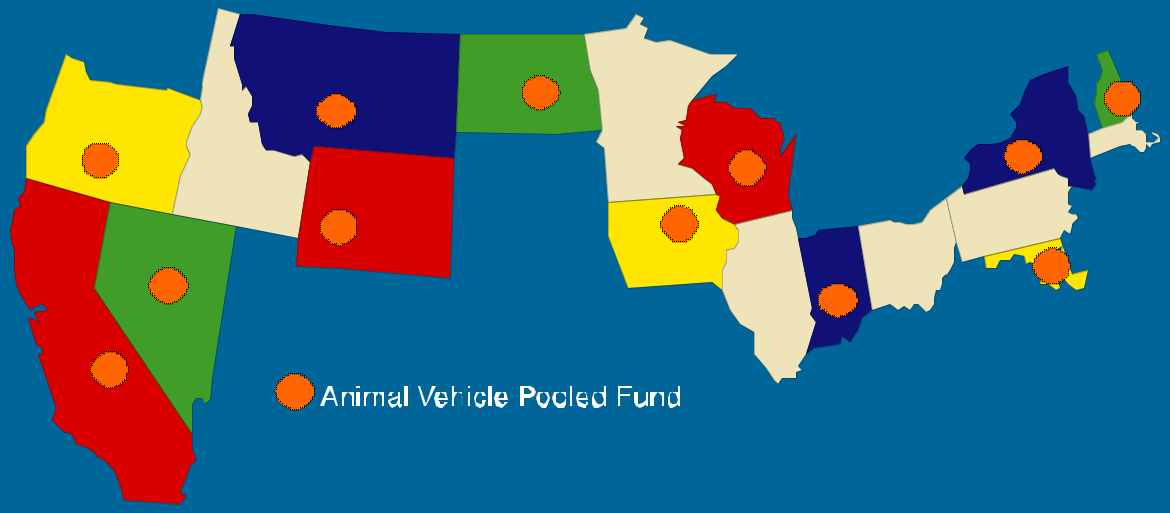
- Sensor shows
  - Location
  - Final Resting Position
  - Change in Velocity
  - Car Model
- Identifies the 250,000 crash vehicles with serious injuries from 27 million vehicles crashes each year.
- Crash sensor measurements are translated into a rating of urgency from 0 to 100%

Source: http://www.nhtsa.dot.gov/cars/problems/studies/acns/champion.htm

Intersection Collision Avoidance



Animal Vehicle Crash Mitigation Using Advanced Technologies



- System will
  - detect animal presence
  - alert driver through dynamic signing
- Demonstrate 2-4 sites
- 12 state pooled fund study
- 3 year project starting FY99-00

Source: http://www.coe.montana.edu/wti/wti.htm

Emergency Services

User Needs

- Response Information
- En-Route Services Information
- Emergency Assistance
- System Operational Effectiveness

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?

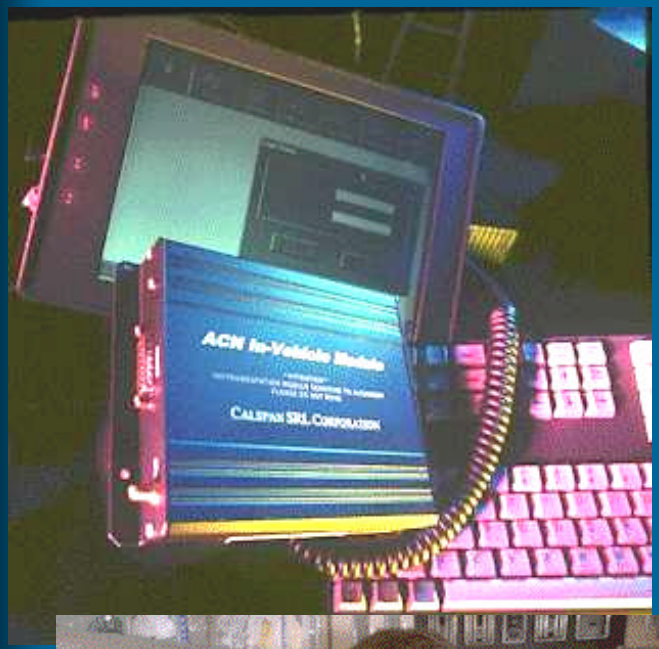
Applicable Technologies

- Rural Addressing
- In-Vehicle Route Guidance
- Automated Vehicle Location
- Automatic Collision Notification/Mayday
- Response Plans

Projects

- Crash Response
- Rural Addressing Scheme
- Wire 9-1-1 Phone Network
- Wireless E9-1-1
- LifeLink
- Emergency Vehicle Traffic Signal Pre-emption

Mayday Plus

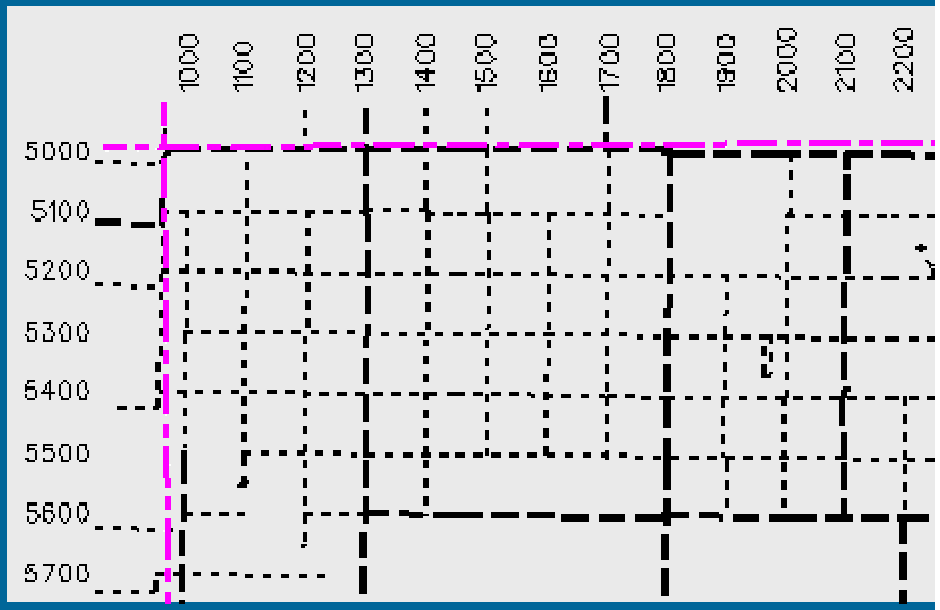


- Demonstrate public infrastructures (e.g., trauma centers) effectiveness with automated crash detection.
- Demonstrate how Automated Collision Notification system can reduce the time for personnel to reach crash victims.

Source: http://www.datumtech.com/Proj-Desc.htm

Rural Addressing Scheme

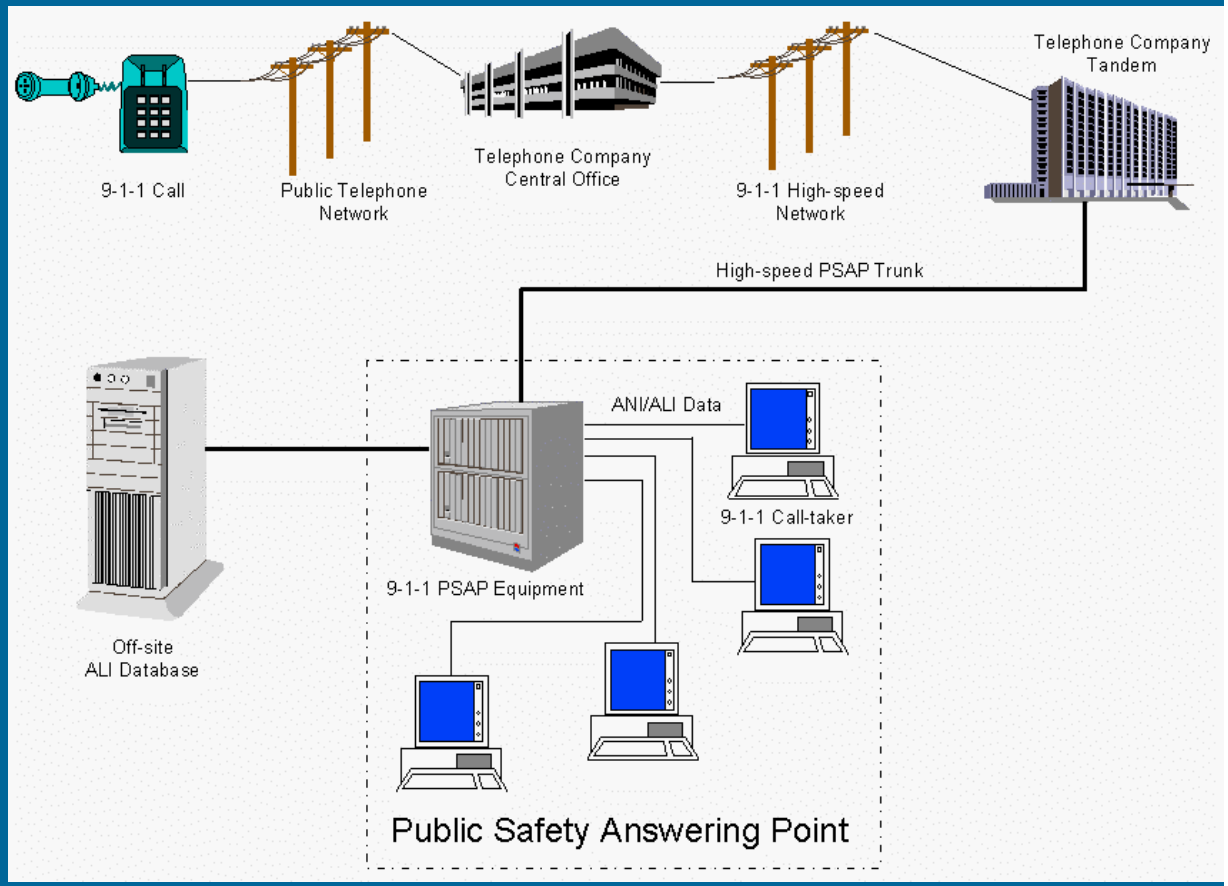
- Components of Physical Address
  - House number
  - Directional
  - Street name
- Designations for roads
  - A road at 1/8 mile = 10
  - A road at 1/4 mile = 20
  - A road at 1/2 mile = 40
  - A road at 7/8 mile = 70
- Exceptions
  - State highways
  - Farm-to-market roads



Source: http://www.911.lubbock.tx.us/address.html

Wire 9-1-1 Phone Network

- Features
  - Automatic Number Information
  - Automatic Location Information
  - Selective Routing



Source: http://www.911.lubbock.tx.us/e9-1-1.html

Wireless E9-1-1

1. RadioCamera collects the caller's signal

2. Location Fingerprint (LF) is generated

3. fingerprint is compared to a database

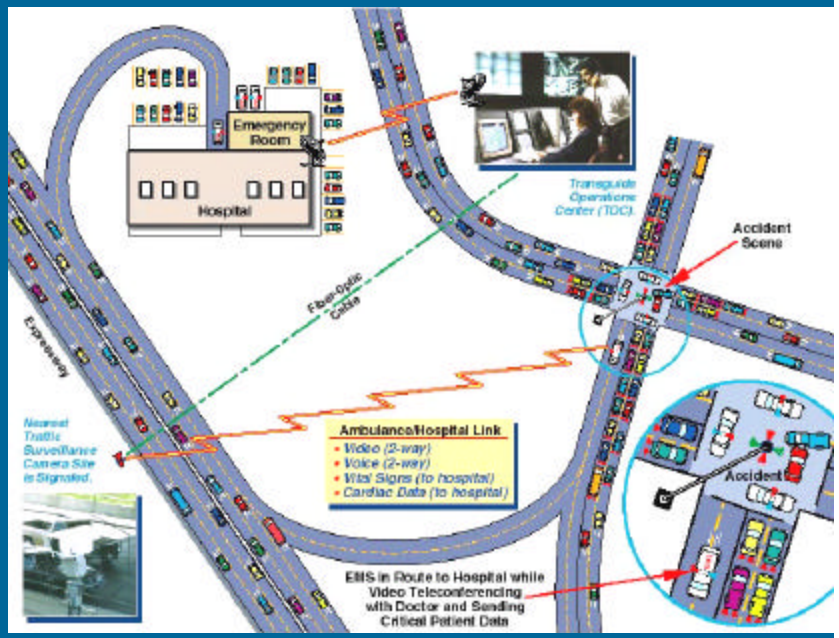
4. "tracking" refines the location estimate

5. the caller's location is established

Source: Mark Kahn, US Wireless Corporation

LifeLink

- Links ambulances with a hospital
- Each ambulance has videoconferencing hardware and software
  - 2-way video
  - 2-way voice
  - vital signs to hospital
  - cardiac data to hospital



Source: http://www.transguide.dot.state.tx.us/

Emergency Vehicle Traffic Signal Pre-emption

- Gives a green light to emergency vehicles for up to 45 seconds
- Requires minimal additional equipment

Source: Technology for Rural Transportation “Simple Solution” #11

Traffic Management

User Needs

- Advisory Information
- Enforcement
- Economic Development/Environmental Protection
- Data Sharing
- Traffic Control
- Detection and Verification

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?

Applicable Technologies

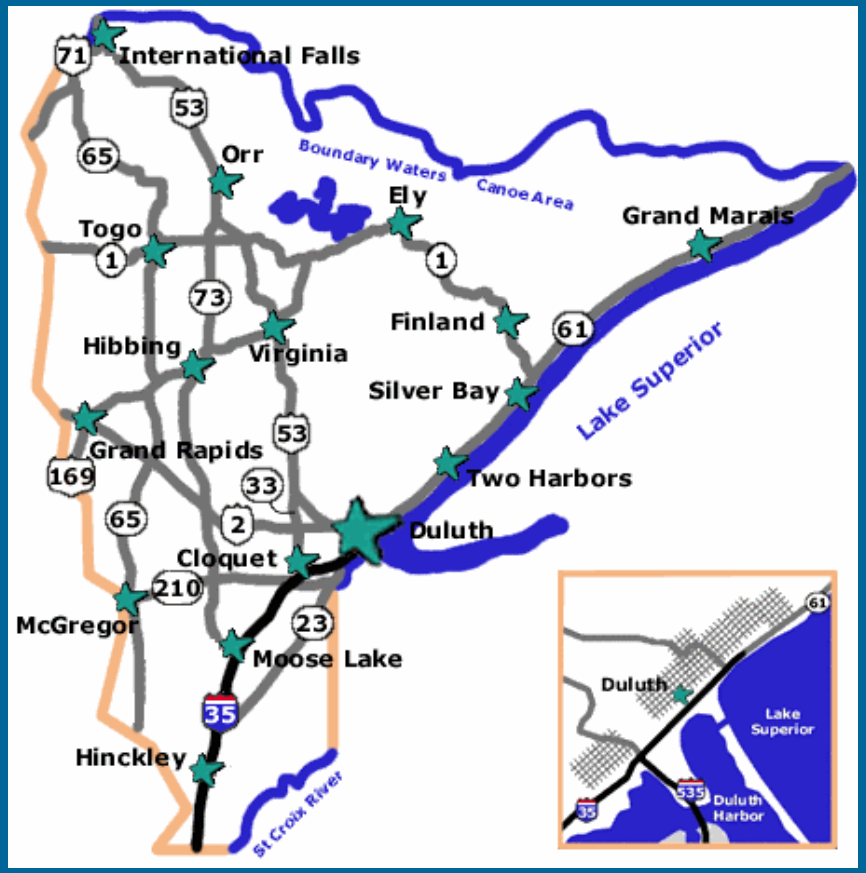
- Internet
- In-Vehicle Route Guidance
- Highway Advisory Radio
- Variable Message Signs
- Road Weather Information Systems
- Traffic Operations Center

Projects

- Duluth Transportation Operations Center
- ADOT Trailmaster
- Oregon TripCheck

Duluth Transportation Operations Center

- Goals for the Traffic Management Center
  - expandable traffic management system
  - real-time traveler/weather information
  - interagency cooperation for incident response
  - transit operation



Source: http://www.dot.state.mn.us/guidestar

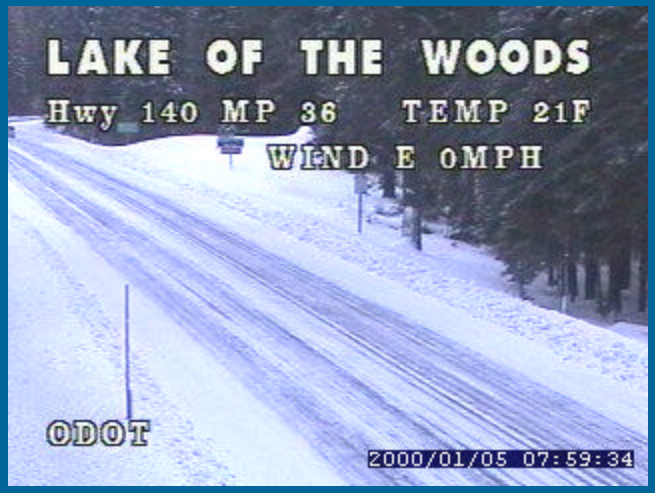
ADOT Trailmaster

- Highway Closure and Restriction System
- Red dots indicate entered events

Source: http://www.azfms.com/HCRS/hcrs.html

Oregon TripCheck

- Incident Maps
- Mileage Calculator
- Road Cameras
- ODOT/OSP Road Conditions Report
- Roadwork Schedule



Source: http://www.tripcheck.com/tripcheck/index.htm

Transit & Mobility

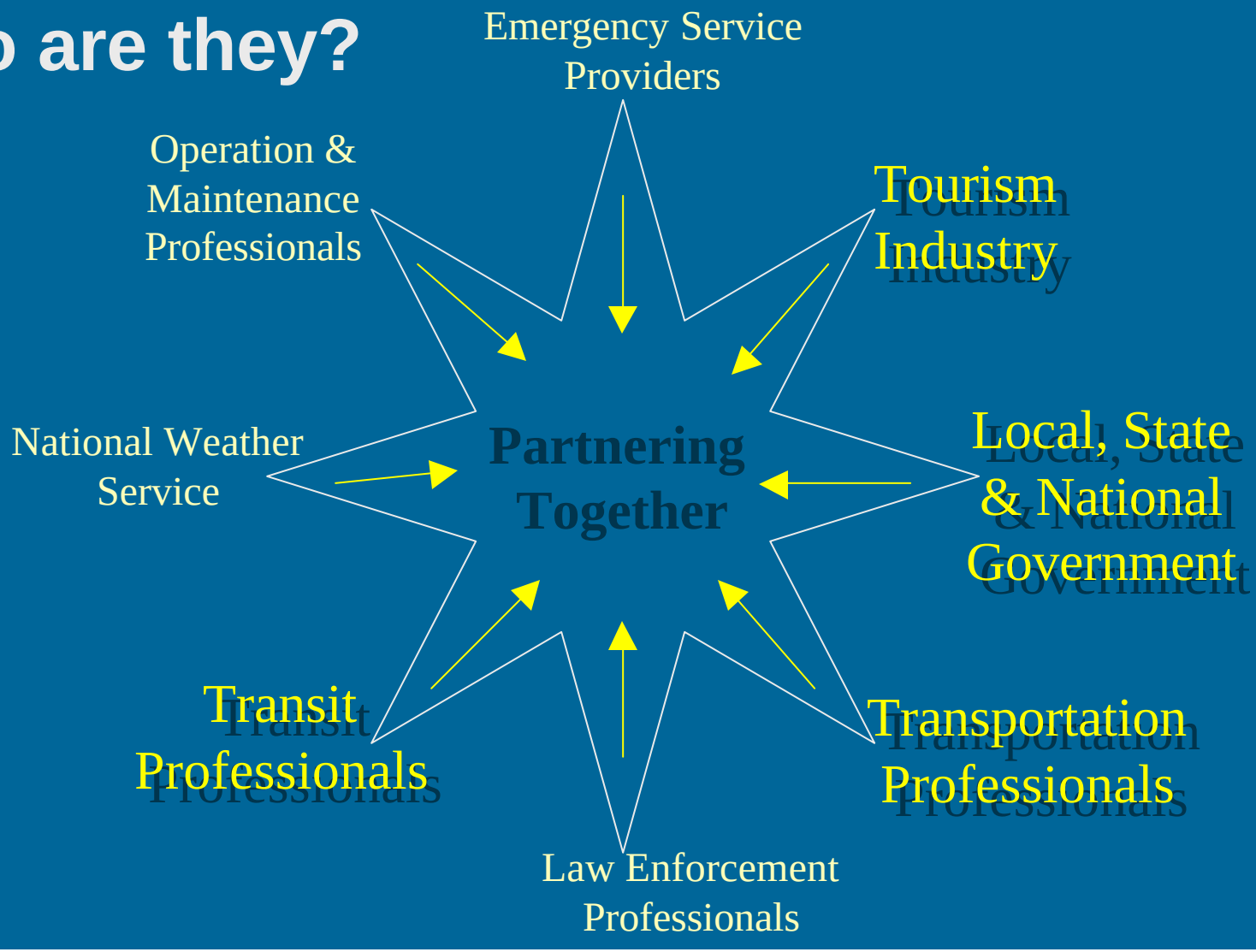
User Needs

- Transit Management and Coordination
- Electronic Fare Payment
- Data Sharing
- System Operational Effectiveness
- Real Time Traveler Information

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?



Applicable Technologies

- Automated Vehicle Location
- Automated Scheduling
- Computer Aided Dispatch
- In-Vehicle Route Guidance
- Electronic Fare Payment
- Rural Addressing
- Enhanced Communication
- Financial Management

Projects

- STAR Transit in Sweetwater, WY
- Arrowhead, MN Advanced Rural Transit Information & Coordination
- Cape Cod Rural Advanced Intermodal Transportation System

STAR Transit in Sweetwater County, WY

- Working in cooperation with local human service and coordinating agencies
- Installed a semi-automated dispatching system
- Dispatching system tracks demographic and trip information for every passenger trip

Source: TCRP A - 21, 1999

Arrowhead Region, MN Advanced Rural Transit Information & Coordination

- Coordinates communication between transit vehicles and the central dispatch facility
- Includes automatic vehicle locator system and scheduling system

Source: TCRP A - 21, 1999

Cape Cod Rural Advanced Intermodal Transportation System

- Development of
  - computer aided dispatching system
  - automated vehicle location system
  - SmartCard & mobile data terminal system
- Evaluation on
  - fixed route,
  - shuttle,
  - paratransit, and
  - Council of Aging transit vehicles.

Source: TCRP A - 21, 1999

Operations & Maintenance

User Needs

- Infrastructure Management
- Roadway Condition Monitoring
- Safety Management
- Resource Management
- Security
- Public Fleet Management
- Data Collection & Sharing

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?

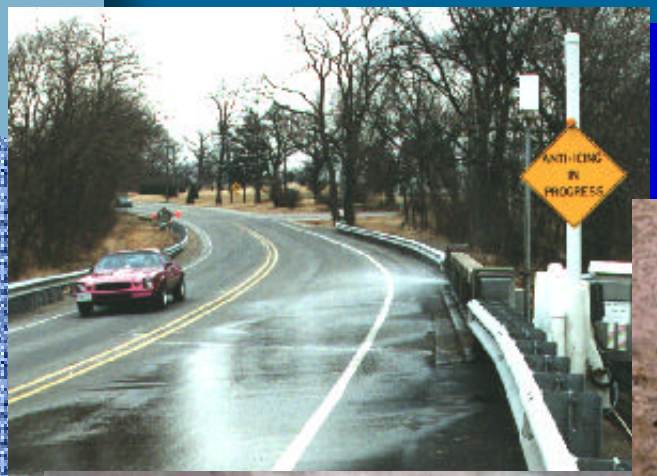
Applicable Technologies

- Road Weather Information System
- Inter-Agency Coordination
- Automated Vehicle Location
- Computer Aided Dispatch
- Collision Warning Devices
- Lane Positioning Devices
- Automated Deicing System

Projects

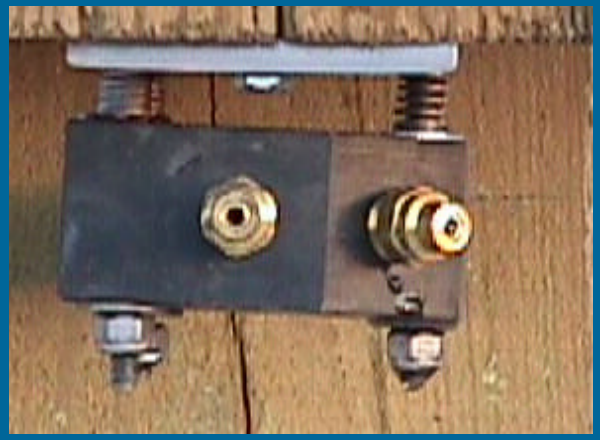
- Bridge Deicing
- Advanced Snowplow
- Advanced Rotary Blower
- Telerobotic Trash Collector
- Automated Litter Bag/Debris Collector
- Highway Cone Placement & Retrieval Vehicle
- Teleoperated Maintenance
- Frontier Lighting Monitoring System

Bridge Deicing



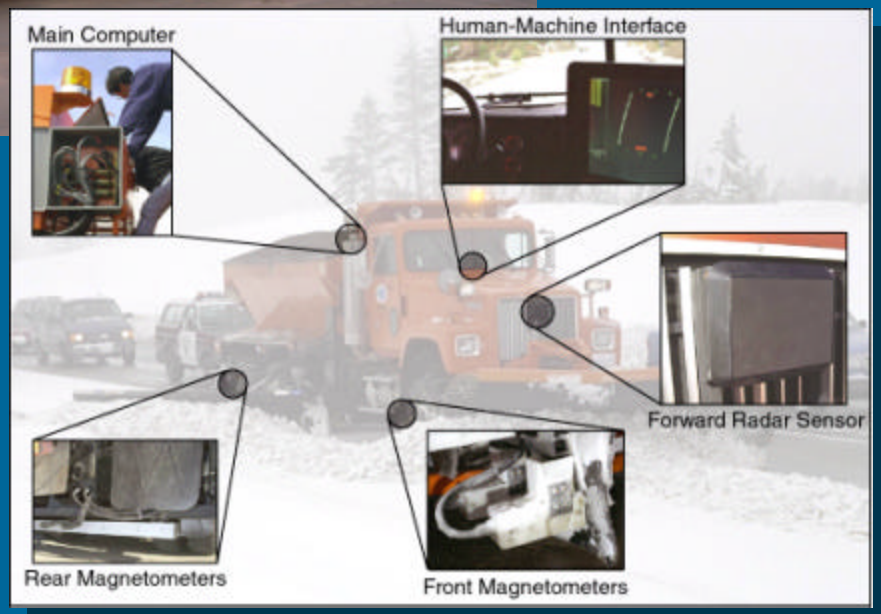
Curb & Wall

Flush in Pavement



Guard Rail

Advanced Snowplow



- Lane Positioning
  - Tolerance Edge
  - Current lateral position
  - Prediction marker
- Collision Warning
  - Forward
- Partners
  - Caltrans
  - ADOT
  - UC - Berkeley
  - UC - Davis
  - WTI/MSU

Source: http://www.coe.montana.edu/wti/wti.htm

Advanced Rotary Blower

- Full Automation
  - Steering
  - Throttle
  - Brake
- Forward Collision Warning
- Current Partners
  - Caltrans
  - AHMCT, UC - Davis
  - PATH, UC - Berkeley

Source: http://www.ahmct.ucdavis.edu

Telerobotic Trash Collection

Courtesy of MadVac

- Collect trash telerobotically using vacuum nozzle system
- Advanced human interface
- High-capacity trash collector
- Customizable for commercially available machines
- Rural/freeway/urban capabilities

Source: http://www.ahmct.ucdavis.edu

Automated Litter Bag/Debris Collector

- Pickup litter bags and large debris, such as tires, from roadside.
- Hydraulic clam shell operated with joy stick using preset locations and automatic return.

Source: http://www.ahmct.ucdavis.edu

Highway Cone Placement and Retrieval Vehicle

- One person, in-vehicle, totally automated placement and retrieval of highway cones
- Multiple stacking system extends range up to five miles

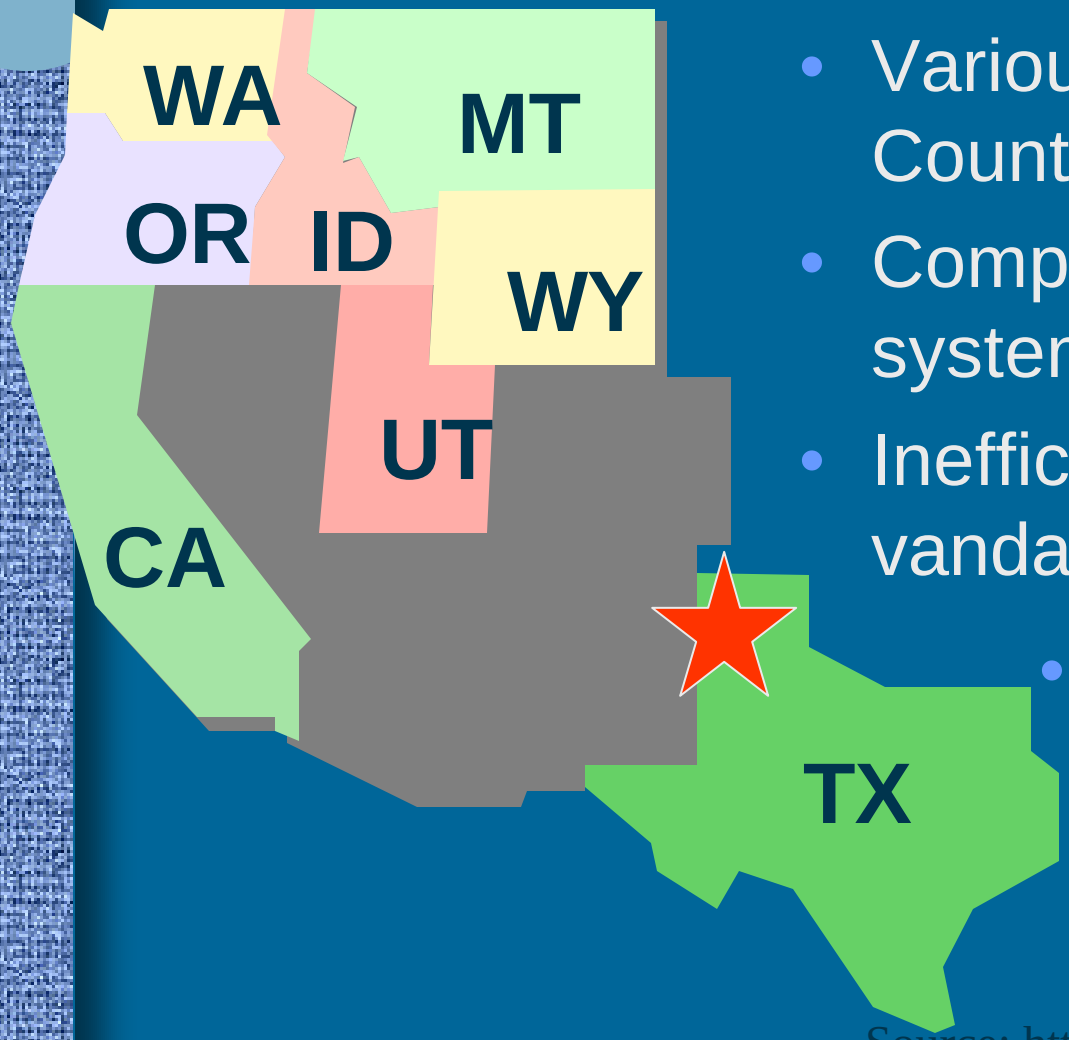
Source: http://www.ahmct.ucdavis.edu

Teleoperated Maintenance

- Normal or remote operation of maintenance equipment of all types.
- Uses either backpack or truck-mounted control system.
- Suitable for dangerous situations, such as mudslides and hazardous material spills.

Source: http://www.ahmct.ucdavis.edu

Frontier Lighting Monitoring System



- Various sites, Oldham County
- Component failure causes system failure
- Inefficiency, safety, vandalism
- Intelligent Outdoor Lighting Control System

Source: http://www.coe.montana.edu/wti/wti.htm

Travel & Tourism

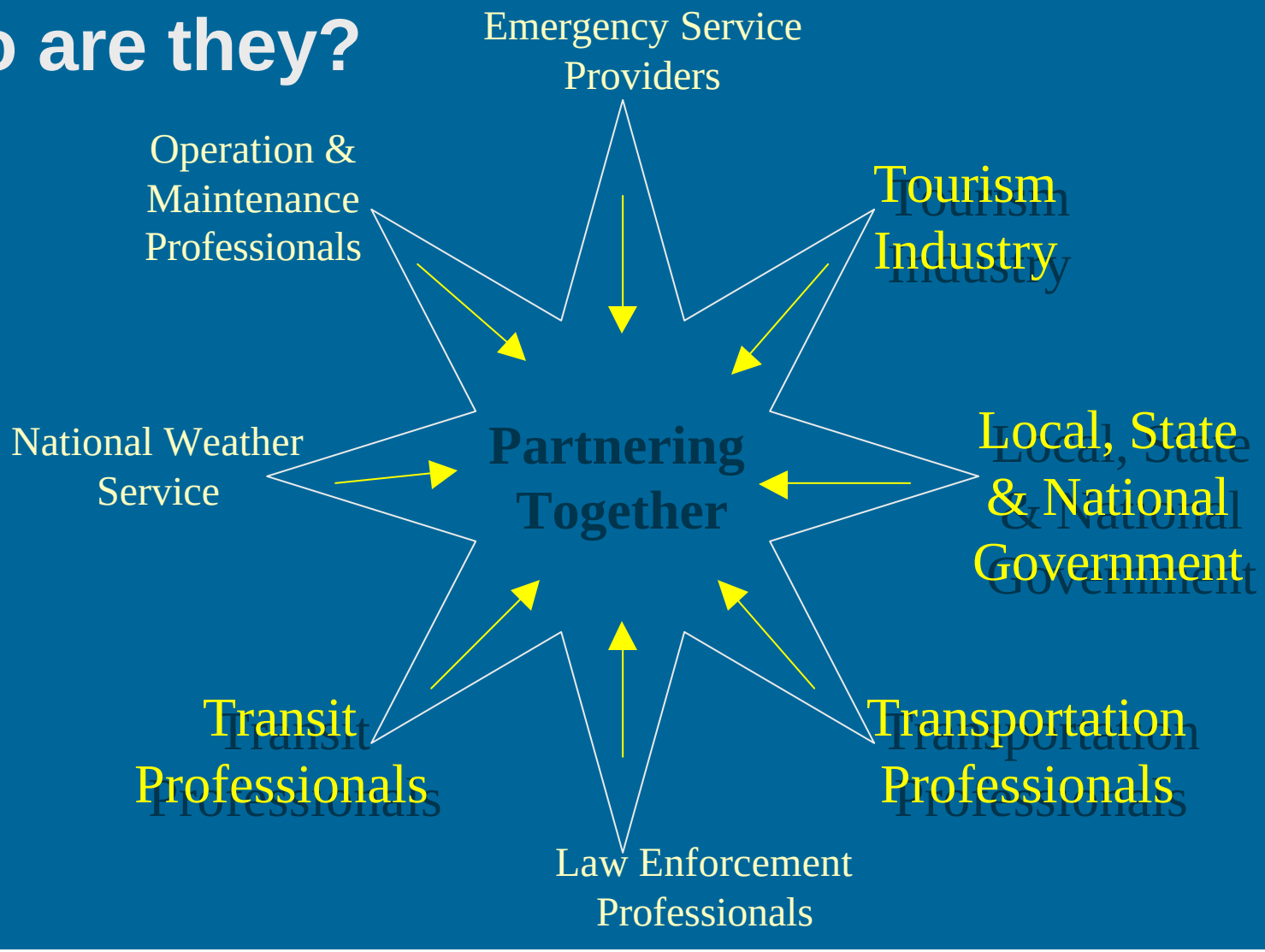
User Needs

- Advisory Information
- En-Route Services Information
- Emergency Assistance
- Transit Information
- Economic Development
- Data Sharing

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?



Applicable Technologies

- Internet
- Highway Advisory Radio
- In-Vehicle Route Guidance
- Real-Time Transit Schedules
- Smart Card Payment System
- Variable Message Signs

Projects

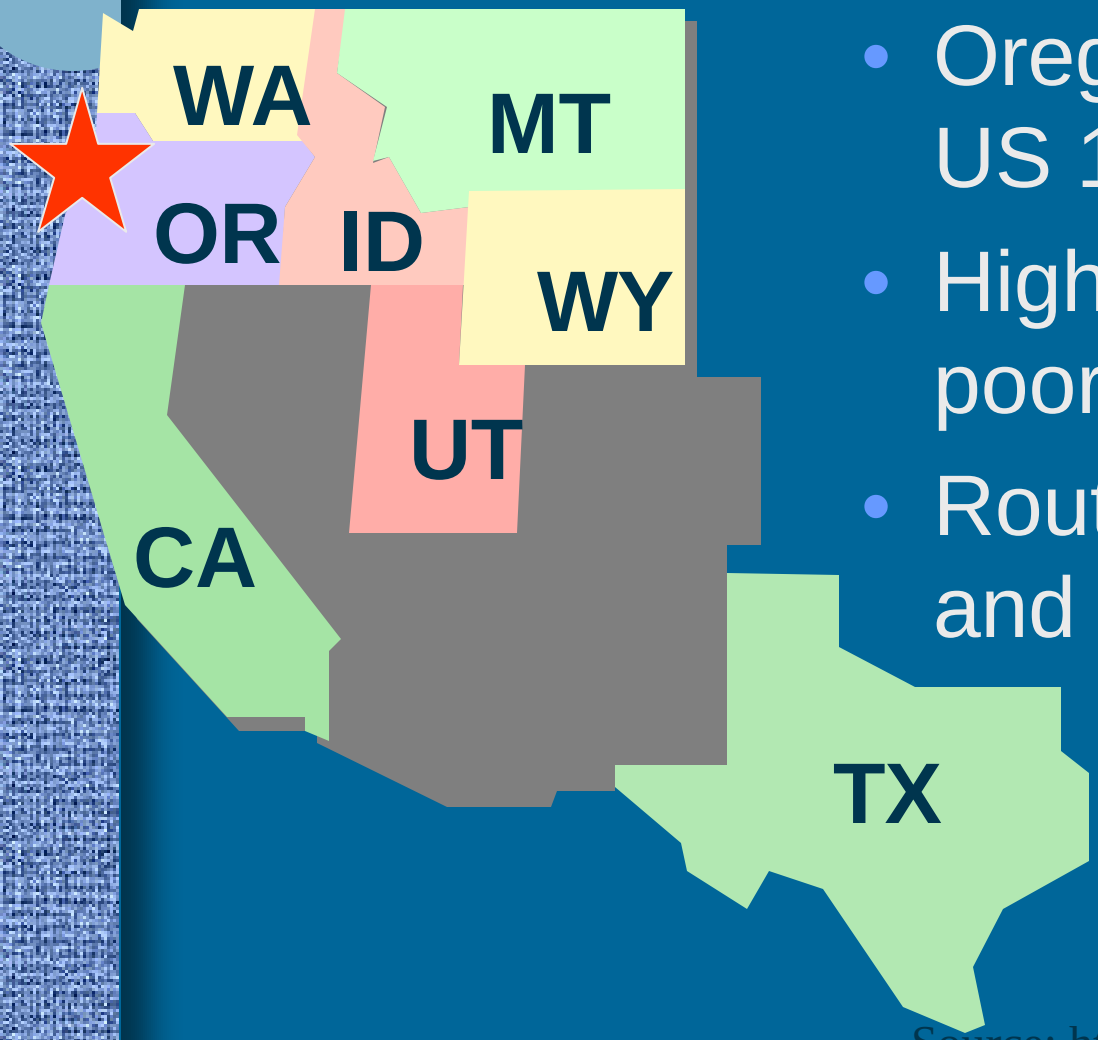
- Safe Passage -- Traveler Information
- Frontier Rural Travel Time Estimation
- Arizona I-40 Traveler & Tourist Information System
- Branson, Missouri Travel & Recreational Information Project
- Greater Yellowstone Rural ITS

Safe Passage -- Traveler Information

- Mountainous region near Bozeman, MT
- System for conveyance of roadway information while en-route
  - Variable Message Signs
  - Highway Advisory Radio
  - Cellular Phone (800 #)

Source: http://www.coe.montana.edu/wti/wti.htm

Frontier Rural Travel Time Estimation

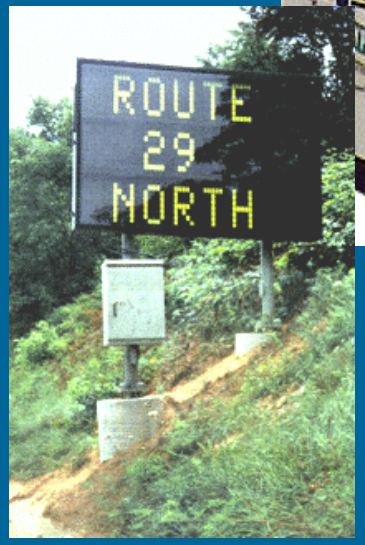


- Oregon Highway 39/ US 101
- High traffic volumes/ poor geometrics
- Routine congestion and incidents
- License plate recognition technology

Source: http://www.coe.montana.edu/wti/wti.htm

Arizona I-40 Traveler & Tourist Information System

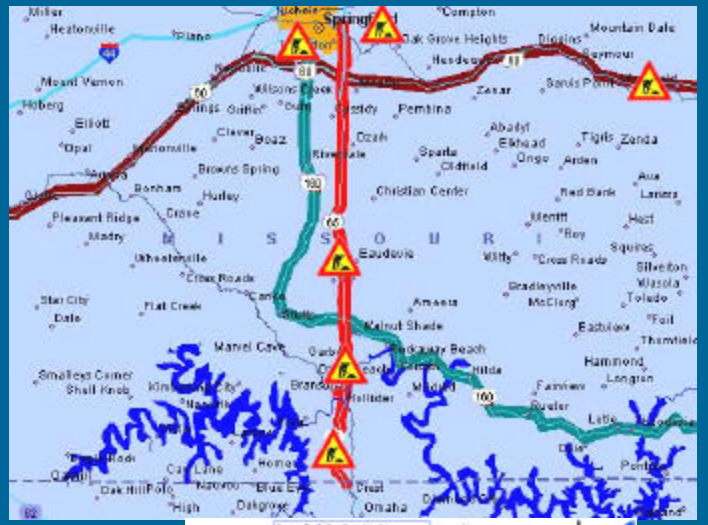
- Providing travelers with information about the area
- Includes
  - nearby National Parks,
  - welcome/tourist information centers,
  - a truck stop in Flagstaff, AZ,
  - the Kingman port-of-entry, and
  - 25 other recreation areas



Source: ITS Project Book January 1999

Branson, Missouri Travel & Recreational Information Project

- Provides information on
  - tourist attractions,
  - weather,
  - traffic, and
  - road construction information
- Information is provided through
  - internet,
  - dial-in telephone services,
  - changeable message signs,
  - highway advisory and commercial radio,
  - kiosks, and
  - cable TV



Source: Advanced Rural Transportation Systems Committee Meeting, 1998

Greater Yellowstone Rural ITS

- Strategic Plan with limited deployment
- Current projects
  - information kiosks
  - VMS and dynamic warning VMS
  - automated toll collection
  - incident management coordination

Source: http://www.coe.montana.edu/wti/wti.htm

Surface Transportation Weather

User Needs

- Advisory Information
- System Operational Effectiveness
- En-Route Services Information
- Leveraging Weather Information to Cost Containment, Profitability & Safe Operations/Travel
- Data Sharing
- Roadway Condition Monitoring

Source: Rural ITS User Needs, 1999

Stakeholder Partners

Who are they?

Applicable Technologies

- Road Weather Information Systems
- Variable Message Signs
- Internet
- Highway Advisory Radio
- Visibility Sensors
- Automated Deicing System

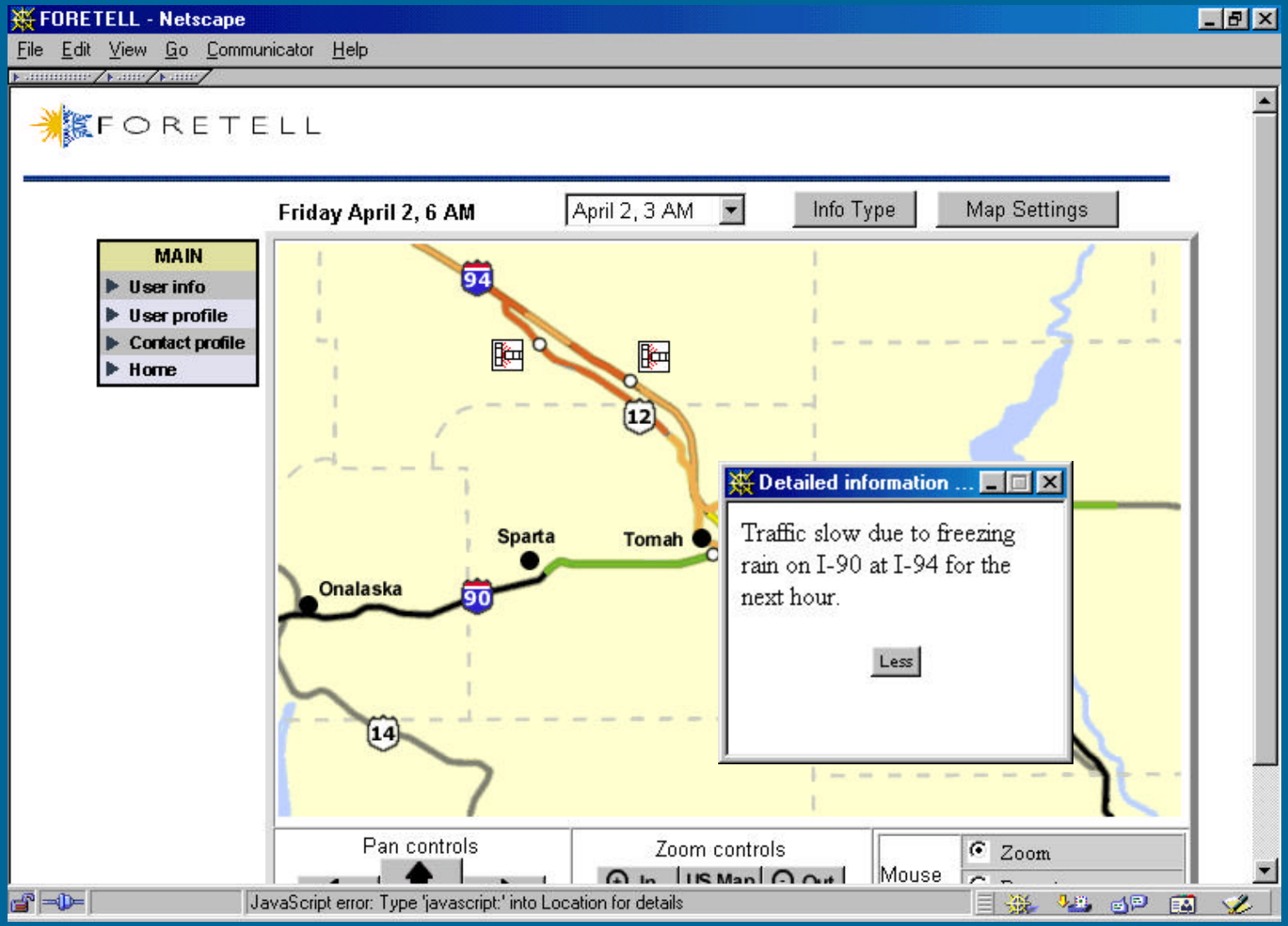
Projects

- Nevada Wind Warning System
- FORETELL
- Safe Passage -- Weather
- Frontier Fog Detection System
- Frontier High Water Level Sensors
- Traveler Warnings for Spot Hazardous Conditions
- Mobile Weather Sensors

Nevada Wind Warning System

- RWIS monitors sustained wind and wind gusts
- Sign information is tied to the Road Conditions Report
- Truck are prohibited with wind gusts of 30 mph

FORETELL


FORETELL - Netscape
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Friday April 2, 6 AM
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Contact profile
Home
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Traffic slow due to freezing rain on I-90 at I-94 for the next hour.
Less
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Mouse
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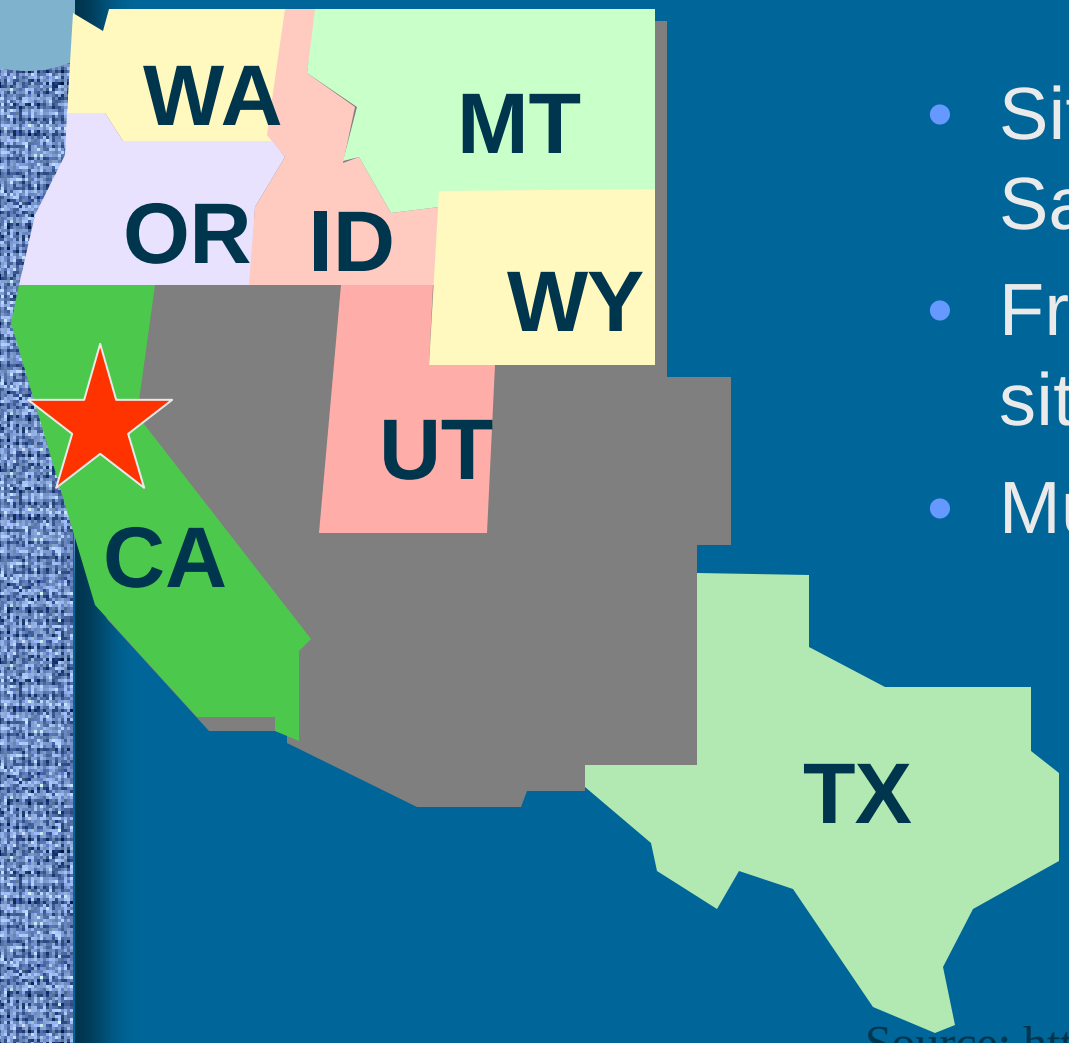
Safe Passage -- Weather

- Extrapolates pavement temperatures over entire roadway sections
- Considers sunlight, shadowing, radiant heat
- Graphically displays temperature changes
- Predictive
- Mountainous Region

Source: http://www.coe.montana.edu/wti/wti.htm

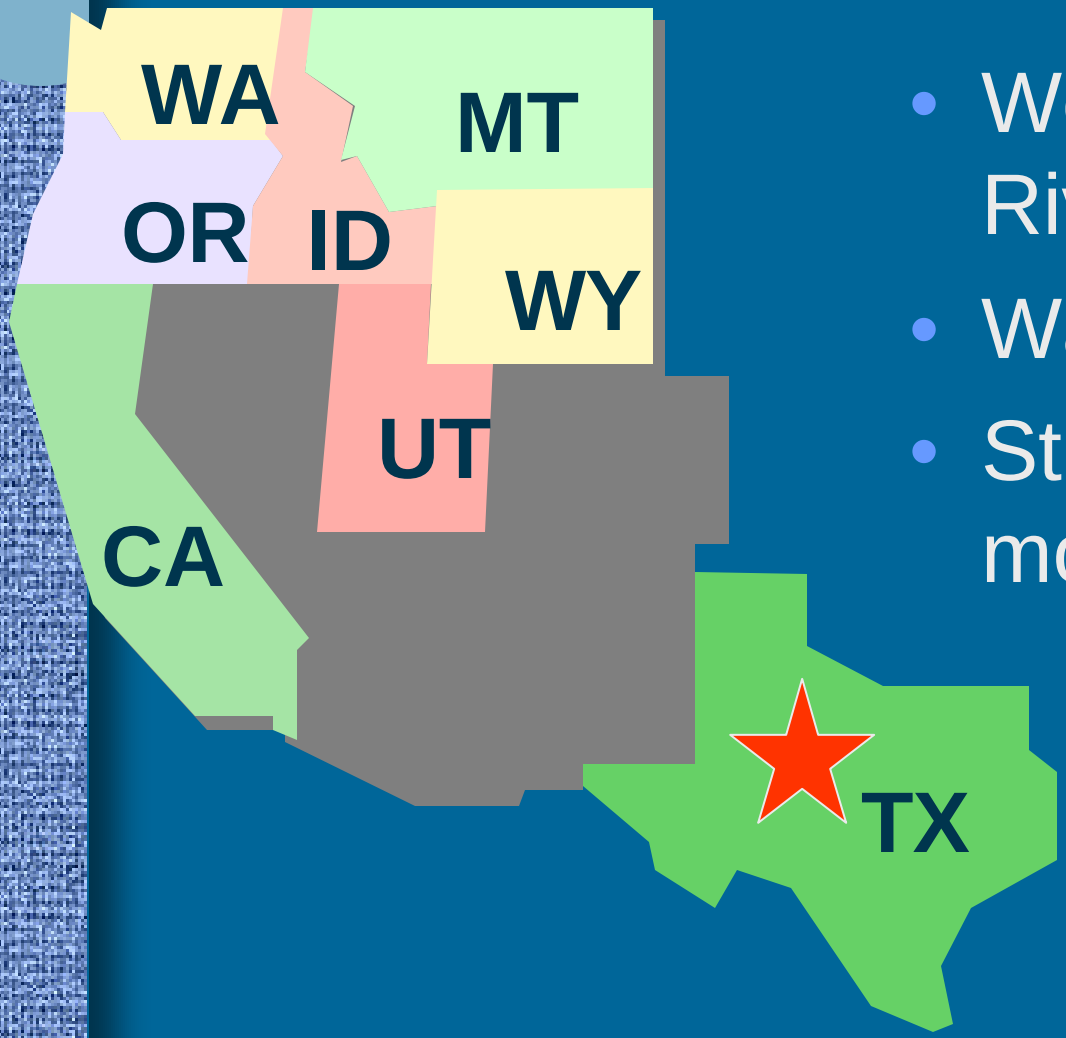
Frontier Fog Detection System



- Site TBD, near Sacramento
- Frequent and sudden situations of dense fog
- Multiple vehicle crashes
  - Intelligent Road Stud technology

Source: http://www.coe.montana.edu/wti/wti.htm

Frontier High Water Level Sensors



- West Fork, Trinity River near Fort Worth
- Water over roadway
- Stranded/endangered motorists
- Infrared water level sensors

Source: http://www.coe.montana.edu/wti/wti.htm

Traveler Warnings for Spot Hazardous Conditions

- Equips bridges and overpasses with ice detectors.
- Warns drivers to slow down on icy surface.

Source: Technology for Rural Transportation “Simple Solutions” #1

Mobile Weather Sensors

- Monitors the weather and road conditions on-site with maintenance vehicles.
- Increases efficiency and cost-effectiveness of anti- and de-icing materials.

Source: Technology for Rural Transportation “Simple Solutions” #8

Benefits of Advanced Technologies

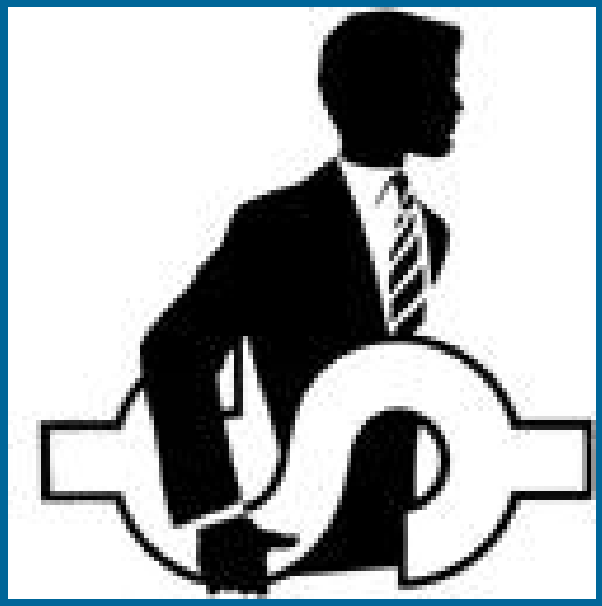
Benefit Measures

- Cost Savings
- Safety
- Delay/Time
- Energy & Environment
- Quality of Life

Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

STAR Transit Benefits

- An increase in ridership from 5,000 to 9,000 passengers per month
- No increase in dispatch staff
- A reduction of operational expense of 50% over a 5-year period.



Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

Benefits of the Advanced Rural Transit Information & Coordination System

- Safety of drivers and passengers increased
  - constant communication
  - vehicle tracking
- Allows more potential passengers
  - reservations made in real-time

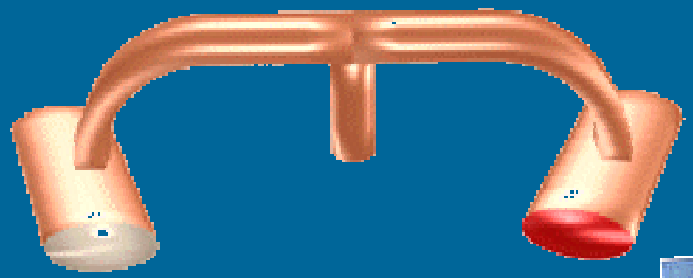
Benefits of Gate Operations

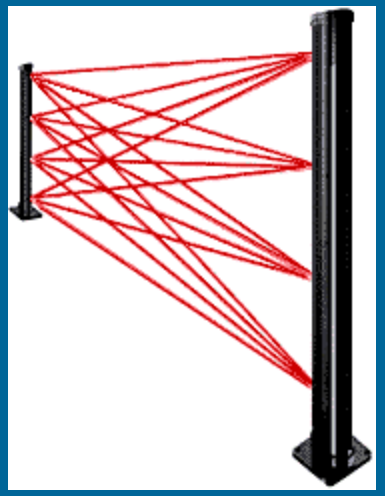
- Snowplows make up to 60% less passes for the road to be 95% clear
- Reduction in delays for both passenger vehicles and heavy trucks
- Reduction in snow and ice related crashes

Source: www.dot.state.mn.us/guidestar/pdf/gatereport.pdf

Automatic Fog-Signaling System

- 8 to 10 kph decrease in speed.
- 15% reduction in the number of crashes.





Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

Rural Transit

- Use of a coordinated paratransit with a dispatch system has the potential to reduce fraud in Medicaid by $11 million annually.

Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

Computer Aided System for Planning Efficient Routes

- Equipment and operating cost for winter maintenance has been reduced by $11 to $14 million.
- 8 - 10% reduction in the number of routes needed to service the network.

Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

Winter Weather System

- Consists of ice detection systems and a snow forecasting model.
- $75,000 in reduced salt per storm.
- For 15 storms or approximately a season the reductions would be 37,500 tons of salt or $1,125,000.

Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

Intelligent Vehicle & Highway Systems Technologies w/Commercial Vehicle Operations

- A 65 mph weigh-in-motion mainline by-pass saves $267.8 million.
- AVI saves $17.7 to 53 million for motor carriers.
- $22.1 million saved annually from better enforcement.

Source: idf.mitretek.org/its/benicost.nsf/frm/entrance

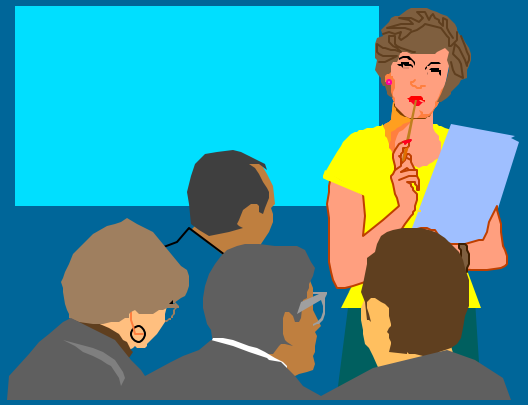
How To Get Involved

Contact your…

- State Department of Transportation
- FHWA Division Office
- US Department of Transportation

and your local...

- Emergency Service Providers
- Transportation Professionals
- Law Enforcement Professionals
- Transit Professionals
- Operations & Maintenance Professionals



Resources

Transit

- Community Transportation Association of America (http://www.ctaa.org/)
- Transit Cooperation Research Program (http://www.apta.com/tcrp)
- Advanced Rural Transit Systems
- Rural Transit Assistance Program (http://www.ctaa.org/ntrc/rtap/home.shtml)

Resources

National Organizations

- US Department of Transportation (http://www.dot.gov/)
- Federal Highway Administration (http://www.fhwa.dot.gov)
- Transportation Research Board (http://www4.nationalacademies.org/trb/homepage.nsf)

Resources

National Organizations

- ITS America (http://www.itsa.org/home.nsf)
- National Highway Traffic Safety Administration (http://nhtsa.dot.gov)
- State Departments of Transportation (http://www.fhwa.dot.gov/webstate.htm)

Resources

Universities

- Western Transportation Institute, Montana State U. (http://www.coe.montana.edu/wti/default.htm)
- Partners for Advanced Transit & Highways (PATH), UC - Berkeley (http://www.path.berkeley.edu)
- Advanced Highway Maintenance & Construction Technology Research Center (AHMCT), UC - Davis (http://www-ahmct.engr.ucdavis.edu/)

Resources

Consultants

- Castle Rock Consultants (http://www.crc-corp.com/)
- Science Applications International Corporation (http://www.saic.com/)

Resources

Pooled Fund Studies

- Frontier (http://www.coe.montana.edu/wti/default.htm)
- ENTERPRISE (http://enterprise.prog.org)
- AURORA (http://www.aurora-program.org)
- Animal Vehicle Crash Mitigation (http://www.coe.montana.edu/wti/default.htm)

Funding Opportunities

- Federal, State, County, or City Transportation Funding
- Organizations and Programs -- State Police, Media, Traveler Services, etc.
- User Fees and Advertising
- Vendors -- Selling Data Rights

Old URLs for Modules included in “Advanced Rural Transportation Systems: Rural Challenges and the Application of Advanced Technology Must Be a 'Community' Investment” Presentation:

Module 1: Advanced Rural Transportation Systems: Rural Challenges And The Application Of Advanced Technology Must Be A 'Community' Investment -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13383.pdf

Module 2: Technology Focus Areas and Users Needs -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13384.pdf

Module 3: Crash Prevention & Security -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13385.pdf

Module 4: Emergency Services -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13386.pdf

Module 5: Traffic Management -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13387.pdf

Module 6: Transit & Mobility -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13388.pdf

Module 7: Operations & Maintenance -
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13390.pdf

Module 8: Travel & Tourism:
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13391.pdf

Module 9: Surface Transportation Weather
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13392.pdf

Module 10: Benefits of Advanced Technologies, How to Get Involved & Funding Opportunities
https://ntlrepository.blob.core.windows.net/lib/jpodocs/briefing/13393.pdf