

# Module 10: Rural and Regional ITS Applications

Authored by **Steve Albert**, Director, Western Transportation Institute (WTI), Montana State University, Bozeman, MT, USA

## Purpose

The purpose of this module is to introduce the reader to the unique needs and challenges of deploying intelligent transportation systems (ITS) in rural and regional settings and to offer examples of how these deployments have been accomplished.

## Objectives

This module has the following objectives:

- Identify the unique transportation needs in rural areas, as well as the specific challenges of deploying ITS in a rural setting.
- Identify and select ITS initiatives that can be integrated and applied at the regional and multistate levels.
- Apply lessons from the examples of successful ITS deployment in rural, regional, and multistate settings, for use in other locations.
- Articulate the value of addressing rural and regional needs, and apply this knowledge to support rural and regional transportation initiatives.

## Introduction

### *Background*

Rural America is home to large and important segments of the national transportation infrastructure. Rural areas contain over three-fourths of the nation's surface roads, or roughly 3 million miles of roadway.<sup>1</sup> In addition, roads in rural and small urban areas possess unique features that can have an adverse effect on both traveler safety and economic issues. Transportation officials, therefore, have an interest in applying the potential benefits of ITS to the rural environment. For many years, the evolution and development of advanced transportation technologies focused on urban area deployments that addressed issues such as congestion management, highway capacity, and increased throughput of vehicles. It became apparent to many transportation professionals, however, that there are different yet significant rural transportation needs or problems that could be addressed using ITS technologies.

For decades discussions and debates have failed to agree on what is rural. While some define rural as less than 50,000 in population, there are many places in the United States where this

threshold would apply to a major regional population center. Because rural is more of a context, it may be easier for this module to consider rural as nonmetropolitan, and beyond the hinterlands and suburbs. In regard to ITS deployment, rural settings can take a number of shapes, including a mega region (multistate corridor), a region (a corridor or Statewide area), a rural area (a location that might lie between two small towns), or a hot spot (an isolated problem such as a curve in the road with run-off-the-road fatalities). Therefore this module discusses and gives examples of ITS deployments in corridor and regional settings.

In recognition of the rural issues in need of attention, the United States Department of Transportation's (USDOT) Joint Program Office (JPO) established the Advanced Rural Transportation Systems (ARTS) Program in 1997, the Rural Safety Initiative in 2008, and the Multi-State Corridor Management and Operation initiative in 2013. Over the past decade, these programs have helped establish rural ITS as a nationally relevant issue, as well as provided support for rural ITS research and deployment projects throughout the country. As a result, this module draws on an expanding foundation of knowledge on rural ITS technologies and a growing number of project examples.

### ***Module Organization***

This module focuses on the unique issues, user needs, and advanced technology applications that are associated principally with the rural environment. As a secondary focus, it addresses regional ITS planning and multistate corridor initiatives. In this module a discussion of the following topics is included:

- Rural transportation needs and issues
- Advanced rural transportation systems
- Examples of existing rural ITS applications
- Regional management and coordination
- Multistate coordination initiatives
- A vision for the future

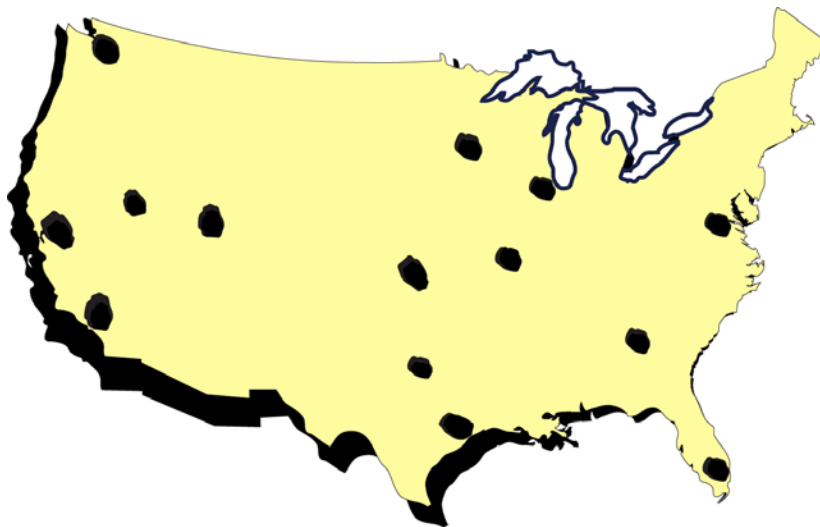
## **Rural Transportation Needs and Issues**

### ***Overview***

The nation's transportation network is an integrated system with each segment, rural and urban, necessary to the whole. People, goods, and services cannot reach every corner of the country unless they can travel safely and efficiently to and through cities, towns, and regions of all sizes. To create a truly national transportation system, transportation services and facilities in these areas should be maintained and enhanced at a level equivalent to their urban and suburban counterparts. However, improving rural transportation is not as simple as transferring urban policies and solutions to a less populous environment. Rural areas have different technological infrastructure, fiscal resources, infrastructure usage, and travel patterns relative to urban areas. Creating and implementing viable and effective initiatives require understanding and expertise in the unique needs, conditions, and constraints of travel in rural areas.

To understand the scope and impact of traditional transportation policy on rural America, one can visualize a slice of Swiss cheese. Urban areas are the random holes across the landscape that attract most of the attention. Rural areas are the large tracts of solid mass in between that do not stand out but are essential to holding the cheese together. In this analogy, addressing rural transportation needs helps to enhance the whole transportation system, rather than just the holes. This approach would support the development of a complete, integrated, and seamless transportation infrastructure that would allow people, goods, and services to move safely and efficiently across and throughout every region of the country.

**Figure 1. America’s “Swiss Cheese” Approach to Developing a National Transportation Network**



Note: The black “holes” represent urban areas where most transportation initiatives and funding are focused. Source: Western Transportation Institute.

Specific issues that have a significant impact on the rural transportation network include the following:

- Safety and operations
- Public transportation and mobility
- Infrastructure
- Global connectivity and production
- Travel and tourism
- Federal and public lands and tribal lands
- Environmental stewardship and sustainability
- Demographic and population trends

These issues are described in more detail in the following subsections. Understanding these challenges provides a context for the ITS program areas and opportunities, which are presented later in this module.

## ***Safety and Operations***

According to the Federal Highway Administration,<sup>2</sup> rural roads account for 80 percent of the national road network and carry about 40 percent of vehicle miles traveled. These corridors serve more than rural residents; they are used by a large percentage of all Americans on a daily basis. Thus they must be available to provide safe and expeditious travel and transport at all times for commuter, personal, and commercial travel. Despite this need, rural areas face numerous and unique challenges that significantly compromise safety and increase risk for travelers.

Rural roadways often have more severe alignment features than their urban counterparts as a result of varied terrain; in addition, slow-moving vehicles (e.g., farm equipment) and truck traffic are frequently encountered in the traffic stream. Unexpected obstacles (e.g., animals) and poor weather and visibility combine with excessive speeds to compromise safety. Motorists include tourists unfamiliar with rural driving conditions, as well as a rapidly growing and disproportionately high population of aging residents. Furthermore, gaps in the country's technology infrastructure can inhibit communication (e.g., gaps in cell phone coverage). Should emergency response be necessary, long distances and lack of communication coverage result in longer response times. As a result of the combined impact of these factors, traveling in rural areas presents a disproportionate risk of severe injuries and fatalities:

- 57 percent of roadway fatalities occur in rural areas, whereas only 40 percent of vehicle miles traveled are on rural highways.<sup>3</sup>
- Emergency response times are approximately 50 percent longer in rural areas relative to urban areas.<sup>4</sup>
- 57 percent of all alcohol-impaired driving fatalities occur in rural areas.<sup>5</sup>
- A majority of rural crashes occur on two-lane rural roads.<sup>6</sup>
- Long distances between towns and cities make it expensive to deploy and monitor infrastructure enhancements for safety.
- Many rural areas are subject to severe weather conditions, which can have a great impact on safety by creating dangerous driving conditions.
- An estimated 1 to 2 million collisions between cars and large animal occur every year in the United States, with 89 percent of wildlife-vehicle collisions occurring on two-lane roads.<sup>7</sup>

Rural America for the most part does not have mobility issues and recurring congestion, as one would expect in major metropolitan areas. Rural areas do, however, have nonrecurring congestion and mobility issues as a result of weather, construction, incidents, and special events. The nonrecurring issues are safety and operational challenges, which can be addressed using ITS applications, as discussed later in this module.

A 2004 General Accounting Office report found that human behavior, roadway environment, vehicles, and medical care after a crash were the key factors that contributed to rural roadway fatalities.<sup>8</sup> The report identified nearly 30 specific factors that contribute to fatal crashes. A

number of crash factors that demonstrate a greater probability for causing fatalities can be grouped into the following categories:

- Driver behavior (e.g., drowsy driving)
- Passing or lane departure (e.g., overcorrecting)
- Speed
- Animals on roadway
- Roadway environment design features and weather conditions

These factors suggest aspects of safety that should be addressed on a priority basis in order to reduce the risk of serious injury or fatality for society at large. Many of these factors correspond to rural driving and travel challenges; therefore, initiatives to address these issues could have a significant impact on enhancing safety on rural roadways.

### ***Public Transportation and Mobility***

In urban areas, public transportation service is often viewed as a means of reducing congestion. In rural areas, public transportation service, or the lack thereof, has a direct impact on the quality of life of many rural residents. Rural public transportation is often viewed as a lifeline providing access to jobs, grocery stores, and medical services that are not available in many rural and frontier communities. However, approximately 38 percent of the rural population has no access to public transportation.<sup>9</sup> Even when public transportation exists, little or no information is readily available about the services. Furthermore, service is sometimes restricted to weekdays, with service often operating from 8 a.m. to 4 p.m., or even fewer hours per day. Low population density in rural service areas makes it difficult at best to deliver public transit services, and the cost per ride is significantly higher than the cost in more urbanized areas. In a setting where people often live miles apart, trip distances are long, and travel routes with common origins and destinations are infrequent, public transportation providers find it difficult to identify and implement economically viable systems and services.

Rural transit agencies typically operate small fleets (two or three vehicles) that provide service to these sparsely settled areas. In fact, many recipients of Federal Transit Administration (FTA) Section 5311 funds serve areas with fewer than 20 persons per square mile using 13- to 15-passenger body-on-chassis vehicles. The passenger capacity of the vehicles is low so drivers are not required to hold a CDL (commercial driver's license). With the low demand, rural transit services operate less frequently, which increases the wait time for people needing service. In addition to service limitations associated with the size of the fleets and how often they operate, rural transportation also must meet the diverse needs of a broad range of users, including elderly, disabled, and financially disadvantaged individuals. Public transportation providers often find it necessary to pool resources and coordinate services with multiple local agencies to develop an economically sustainable system that serves the unique needs of rural residents. Priority mobility issues include expanding access to traveler information about schedules and alternative routes, raising public awareness of existing transit services, and coordinating services among multiple agencies.

## ***Infrastructure***

As the managers of 80 percent of the national road network, rural transportation agencies have a disproportionate responsibility for keeping roads, bridges, and other key infrastructure open and in a state of good repair. They also face unique operational and maintenance challenges related to infrastructure management on those corridors:

- Smaller populations limit local resources available for construction, operation, and maintenance of facilities. According to the Rural Policy Research Institute, 40 percent of county roads are insufficiently maintained.<sup>10</sup>
- Long distances between towns and cities make it expensive to deploy and monitor infrastructure enhancements, as well as to conduct timely operations and maintenance.
- Many rural areas are subject to severe weather conditions, which decrease longevity of facilities and limit mobility. The United States spends more than \$2 billion per year to keep roads clear of snow and ice, and another \$5 billion for corrosion mitigation on structures.<sup>11</sup>
- Road closures during severe weather can have a great impact on travel within as well as through rural areas, as there are few, if any, alternative routes. Thus, such closures can have a significant impact on both rural and urban residents.

Priority infrastructure issues include infrastructure longevity, cost-effective infrastructure monitoring and maintenance practices, mobility and maintenance during severe weather, and work zone management.

## ***Global Connectivity and Production***

The movement of goods is critical to the economy of the United States, and the rural interstate system is an essential component of the process. Rural interstates are, in essence, the arteries over which flow the goods to be distributed to citizens throughout the country. On many rural highways, 30 percent of traffic is commercial vehicles, and their numbers continue to grow. This increase is a result of many closures of rail lines that served rural communities and freight centers, such as grain elevators. In many instances rural America is inheriting the traffic from urban areas that moves within and between its communities.

Commercial vehicle operators, who often operate on strict deadlines, can be severely affected by mobility issues discussed in previous sections, such as delays caused by severe weather or the absence of alternative routes. The severe alignment of roadways and varied terrain that increase safety risks in rural areas can also have a disproportionate impact on commercial vehicle operators, who are often driving much larger, high-profile vehicles.

Commercial vehicle operators have identified several transportation needs associated with rural travel, such as the frequency with which they must stop at weigh stations for verification of permits, load limitation checks, and safety inspections. Every time a commercial vehicle stops at a weigh station or a border crossing, it costs the carrier money. Therefore, measures to increase the operational efficiency of the system or reduce travel delays for the commercial

vehicle operators are considered of primary importance. Road weather systems that can enhance the availability of real-time road conditions are also a critical issue for commercial vehicle operators.

### ***Travel and Tourism***

Tourism is a critical concern to the economic viability of numerous rural communities. In 2011, travel and tourism in the United States was among the top 10 industries in terms of employment in 48 States. It is the largest export industry and second largest employer, accounting for more than \$1.9 trillion in economic output generated by domestic and international visitors (including \$813 billion in direct travel expenditures that spurred an additional \$11 trillion in other industries). One out of eight U.S. jobs depends on this industry, and travel and tourism accounts for 2 billion trips annually for business and leisure purposes.<sup>12</sup>

Tourism initiatives are a common component of rural economic development plans. Rural areas depend on an effective transportation network to transport visitors to their communities as well as to specific tourist sites and recreational opportunities. If public transportation options are limited, tourist travel is often predominately by automobile, which may result in seasonal or location-specific congestion. The Western Transportation Institute, in partnership with FHWA and the travel and tourism community, conducted rural ITS outreach workshops in 15 States to identify priority transportation issues affecting tourism, including directional signing, timely and accurate information, coordination of traffic management alternatives, seasonal and special event traffic management, parking information, regional sharing of information and services, and funding.

In many rural areas, travel and tourism is focused around national parks and other public lands, which is explored in greater detail in the next section.

### ***Federal and Public Lands and Tribal Lands***

One issue that highlights the unique nature of rural transportation is the challenge of providing effective and appropriate transportation for Federal and other public lands. Many public land units (national parks, forests, and recreation areas) and tribal lands are located in rural areas. Gateway communities and the units themselves have an economic interest in encouraging visitation and expanding transportation services to facilitate increased visitation. At the same time, public land managers must balance those responsibilities with their role as the stewards to protect the resources that visitors come to see.

For example, consider these statistics that describe the impact of the National Park Service (NPS) on regional economies and their transportation systems:<sup>13</sup>

- Scale—374 parks in 49 States, covering 18 million acres
- Employees—19,200
- Economic activity—\$14 billion, supporting 309,000 jobs
- Visitation—266 million visitors, with demand increasing 500 percent over the next 40 years

With a broad impact and visitation on the increase, the NPS is under extreme pressure to provide increased services with fewer fiscal resources, while simultaneously trying to provide stewardship for an environment they are entrusted to protect for future generations. As our national parks become increasingly “loved to death,” it is apparent that respective transportation systems and associated services are a critical issue.

Priority transportation issues for public lands and gateway communities include congestion management, traveler information, parking management, integration and coordination with regional transportation networks, and multimodal transportation development (including bicycle and pedestrian facilities).

Another unique challenge in rural areas pertains to Native American lands, where safety, economic viability, and transportation are key issues. Research has shown that Native Americans die in motor vehicle crashes at rates six times that of the rest of the nation; in addition, three-fourths of Native American traffic fatalities involve alcohol. Unemployment rates on reservations often exceed 70 percent, over 10 times the national rate. Furthermore, only 29 percent of tribes have any form of transit system. The issue of economic viability was the most important issue identified by 300 Native American tribes in a recently completed survey to assess tribal and transportation needs. Safety needs were the second priority, followed by tourism and traveler information.<sup>14</sup> Here again, ITS deployment will have a positive impact by providing enhanced safety and traveler information.

### ***Environmental Stewardship and Sustainability***

In urban areas, environmental sustainability issues related to transportation often focus on the protection of air and water resources, congestion management, growth management, and related concerns. Rural areas face some of these issues, plus additional challenges related to preserving the character, resources and wildlife populations present in these settings.

For example, wildlife-vehicle collisions have a significant impact on human safety, property, and wildlife. Researchers at the Western Transportation Institute estimate that 1 to 2 million collisions occur between large mammals and vehicles each year in the United States, and an additional 45,000 occur in Canada. These numbers have increased substantially over the past decade. These collisions cause an estimated 211 human fatalities, 29,000 human injuries, and over \$1 billion in property damage annually in the United States alone.<sup>15</sup> These collisions affect rural areas more directly, as 89 percent of wildlife-vehicle collisions occur on two-lane roads.<sup>16</sup>

In summary, priority transportation issues related to environmental sustainability include mitigation methods for wildlife-vehicle collisions, context-sensitive transportation planning, and use of environmentally safe products in construction and maintenance of roadways.

### ***Demographics and Population Trends***

The population trends and demographic changes in rural America have a complex history. During much of the 20th century, rural population growth rates were low, as residents moved out of rural areas to suburban and urban areas. However, in the 1970s and the 1990s, the trend



reversed, with large migration rates to rural areas contributing to rapid population growth. A recent study by the University of New Hampshire shows that in the past 10 years, growth rates have slowed again, with the total rural population in the United States growing by only 2.2 million people from 2000 to 2010. The same study also shows that the patterns of population growth vary considerably based on location and other factors. Rural counties in the West and Southwest have the largest population gains, along with counties that border urban areas in the Midwest and Northeast. By contrast, other rural areas had net population losses, particularly in the Great Plains, Corn Belt, and Mississippi Delta. Rural areas that are close to recreational areas or have other amenities continue to grow, because they attract retirees. Population diversity in rural America, particularly among children, has shown a considerable increase in the past 10 years, with minorities accounting for more than 80 percent of rural population growth. Interestingly, the minority population in each rural area tends to come from only one or two ethnic or minority groups; in other words, there are very few multiethnic counties in rural America.<sup>17</sup>

These trends suggest that not only do population and demographic trends differ in rural areas versus urban areas, the trends vary considerably *among* rural areas. In terms of transportation, the needs of rural areas will differ accordingly, and solutions will have to be tailored to the local population. However, emerging needs that are common in many rural areas include the following:

- Services for older residents. Many rural counties have a growing percentage of older residents, either because of outmigration of young people or because the area attracts retirees. This presents a growing need for transportation facilities and services that serve the needs of the elderly, mobility-impaired, and otherwise transportation-disadvantaged groups.
- Ethnically and culturally specific transportation needs. The growing population diversity of rural counties may affect planning and development of services, as well as how public information and traveler information are disseminated.

## **Advanced Rural Transportation Systems**

### ***Introduction and National System***

As discussed in the previous section, rural areas have unique and critical transportation needs. Rural transportation improvements not only improve the quality of life for residents, they can support important national priorities, such as the following:

- Reducing the number of accidents resulting in injuries or fatalities that occur as Americans drive throughout the country for business and recreational purposes.
- Incorporating protection of wildlife habitats and natural resources into the transportation development process.
- Managing growth in a coordinated, regional manner.
- Ensuring seamless and expedited transport of freight throughout the country to support business growth and development.

- Facilitating access to national parks, tourist attractions, and recreational areas, which nurture economic development in the gateway communities.
- Enhancing emergency preparedness and public safety resources, so that Americans have access to emergency response services and safe evacuation routes wherever they live or travel.
- Addressing mobility and transportation needs of a rapidly aging population.

Rural transportation issues are multifaceted and generally cannot be solved by a single strategy. The Federal Highway Administration has identified critical program areas (CPAs) that categorize principal rural transportation challenges and describe ITS technologies that may be applicable and beneficial in the development of solutions.

### ***Critical Program Areas***

FHWA defines the rural environment to include both rural areas and small urban centers (defined as having populations less than 50,000 people). To develop the CPAs for rural transportation, the agency developed characteristics that distinguish the rural traveler and rural setting from their urban counterparts.<sup>18</sup>

- Trip lengths are greater than in urban areas and often include unfamiliar roadways.
- Alternative routes may not be available or are few in number.
- Tourists and other unfamiliar travelers represent a large proportion of rural road users.
- Many of the roadway miles are owned and operated by city and county governments.
- Rural roadways are more difficult to maintain, which means that severe and rapidly changing weather conditions are more problematic.
- Remote regions and rugged terrain present additional challenges.

Rural transportation needs and issues cover a wide range of topics, but this section will limit discussion to issues covered by the following CPAs. Development of these categories evolved through rural outreach sessions and focus groups conducted in numerous rural communities.<sup>19</sup>

### **Traveler Safety and Security**

This CPA addresses the need for improving a driver's ability to operate his vehicle in a safe and responsible way and for improving driver notification of potentially hazardous driving conditions (e.g., poor road conditions, reduced visibility, obstructions, or animals).

Examples of projects in this CPA may include dynamic speed warning message signs, intersection advance warning signing, and animal-vehicle hazard warning systems, to alert the unfamiliar drivers to safety hazards. Other ITS technologies that could enhance safety include applications that address human factors, such as lane departure alerts or road sensors that trigger warning signs based on driver behavior (e.g., speeding).

## **Tourism and Travel Information Services**

This program area includes methods to provide traveler information and mobility services to travelers unfamiliar with the rural area through which they are traveling.

Examples of projects in this CPA may include, but are not limited to, areawide dissemination of information regarding weather and road conditions via radio, computers, television, or cell phone applications. In addition, ITS technologies could be used to provide real-time information to tourists about road conditions, parking availability, or construction projects in order to reduce congestion and enhance visitor experience. To support tourism development, regional servers could be used to consolidate tourism service information such as lodging and special events and disseminate it to the traveling public using highway advisory radio systems, kiosks, or other communication technologies.

Many States are integrating travel information from throughout the State and disseminating it through a Statewide 511 system, as shown in the following video from the Virginia Department of Transportation: <https://www.youtube.com/watch?v=mPJhyfoMHcw>.

## **Infrastructure Operations and Maintenance**

Included in this CPA are measures to address the efficient and effective maintenance and operation of rural roadways and infrastructure to respond to changes in weather conditions, coordinate response activities, manage construction and work zones, and automate maintenance activities.

Examples of projects in this CPA may include road weather information systems, weigh-in-motion sensors, closed-circuit television cameras, and automated gate closure systems. ITS technologies can be used to enhance safety in work zone areas, and in-vehicle technologies can facilitate snow plow operations.

## **Emergency Services**

This program area focuses on providing improved notification and emergency response when an incident occurs, including reducing the time to notify the appropriate emergency service providers), as well as providing additional crash details to enable appropriate, efficient responses.

Examples of projects in this CPA may include mayday systems, hotline call-in programs, and emergency fleet management tracking systems. Emerging technologies include custom applications that facilitate collection and dissemination of data from remote locations, such as the Redding Responder System developed by the California Department of Transportation and the Western Transportation Institute at Montana State University, as described in the following video: [www.westernstates.org/projects/Responder/History/default.html](http://www.westernstates.org/projects/Responder/History/default.html)

## **Public Traveler Services or Public Mobility Services**

This CPA addresses the accessibility and coordination of public transportation services to rural residents or travelers. Also within this program area are operational improvements that would

allow transit vehicles to be pre-cleared through congested areas or the use of electronic fare payment systems for easy boarding. Other examples within this CPA may include automatic vehicle location systems, computer-assisted scheduling and dispatching, automatic telephone information systems, enunciator systems, advanced fare collection systems, automatic vehicle identification systems, dynamic on-demand transit dispatching, and automated ridesharing services.

### **Fleet Management**

This CPA provides for the efficient scheduling, billing, routing, locating, and maintaining of rural fleets. Also included in this area is the use of designated fleets or probes to collect, process, and transfer field data to operations managers for response.

Examples of projects in this CPA may include automatic vehicle location systems, and vehicle and engine monitoring systems. Connected vehicle technologies could be applied to probe data collection projects.

### **Commercial Vehicle Operations**

This CPA addresses the regulation, management, and logistics of commercial fleet operations. Included in this program area would be projects designed to meet the needs of rural commercial vehicle operators, such as hazardous material identification, driver monitoring, rural addressing, and enforcement and management efforts.

### ***ITS Case Studies***

This section provides examples of existing CPA applications with the Advanced Rural Transportation Systems Program. A brief description of each project, including the project background, the ITS system and technologies, and the benefits and lessons learned (if available). It should be noted that some of these projects are in the early stages of implementation, so benefits attributable to the respective ITS application have yet to be determined, so not all case studies will have benefits or lessons learned included in the description. More information about ITS success stories can be accessed through a variety of resources, including the following:

- USDOT Research and Innovation Technology Administration ITS Joint Program Office Knowledge Resources website  
[www.itslessons.its.dot.gov/its/itsbcllwebpage.nsf/krhomepage](http://www.itslessons.its.dot.gov/its/itsbcllwebpage.nsf/krhomepage)
- FHWA Pooled Fund Projects [www.pooledfund.org/](http://www.pooledfund.org/)
- Western Transportation Institute, Montana State University  
[www.westerntransportationinstitute.org/research/home](http://www.westerntransportationinstitute.org/research/home)
- University of Minnesota Center for Rural Safety [www.ruralsafety.umn.edu/](http://www.ruralsafety.umn.edu/)

### **Traveler Safety and Security**

As stated earlier, this CPA addresses the need for improving drivers' ability to operate their vehicle in a safe and responsible way and for improving driver notification of potentially

hazardous driving conditions (e.g., poor road conditions, reduced visibility, obstructions, or animals). Many countermeasures are focused on speed, intersection (two-lane or multilane roadways), road departure, obstacles, or wildlife. Examples of projects in this CPA may include variable or dynamic speed warning message signs, intersection advance warning signs, and animal detection and motorist warning systems, among others. A number of initiatives and FHWA Pooled Fund efforts provide good reference materials, including the following:

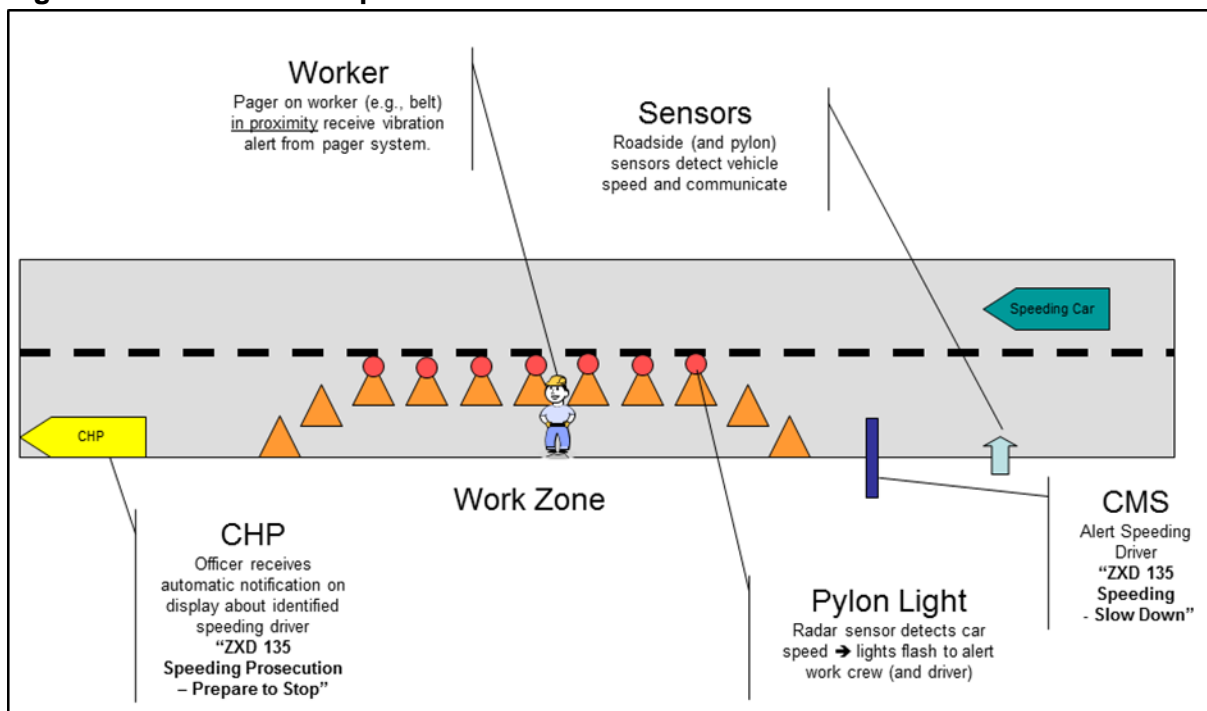
- FHWA Rural Safety Innovation Program (RSIP) [www.its.dot.gov/rural/index.htm](http://www.its.dot.gov/rural/index.htm)
- Enterprise Pooled Fund Project <http://enterprise.prog.org/>

## CALIFORNIA: Augmented Speed Enforcement

### Project Background

The California Department of Transportation (Caltrans) and the Western Transportation Institute (WTI) at Montana State University are researching whether the deployment of an augmented speed enforcement (aSE) system on State Route 12 (SR 12) in San Joaquin County, CA, will help to change driver behavior and reduce crash rates in work zones. The primary function of this system is to communicate relevant speed, violation, and hazard information to the stakeholders in this work zone context. Stakeholders include the driver, California Highway Patrol (CHP) officers, and the highway workers. The prototype system was developed in 2011, with testing and initial deployment in 2012.

**Figure 2. Functional Components of aSE**



### ITS System Overview

The aSE includes the following functional components that are shown in Figure 2:

- Portable radar stations (sensors) track the speed of vehicles exceeding the speed posted by the advanced work zone speed limit sign.
- Violators identified by their license plate will receive a speed warning on a dynamic message sign (DMS), shown as a changeable message sign (CMS) in the figure, at the entrance to the work zone.
- As cars enter the work zone, a series of “smart cones,” each fitted with a light display (beacon) and with nonradar sensors (e.g., sonar, light), track the individual vehicle speed and synchronize the cone and light display to highlight and follow any violating vehicle. These lights automatically cancel when the violation is corrected by reducing speed. The display is intended to provide a visual warning to drivers that they are violating the speed limit.
- A local pager network will be configured to automatically alert (vibration mode) only those workers in direct proximity to the detected hazard. This pager system will also incorporate a panic mode that any worker can trigger in the case of an injury to automatically contact the site supervisor who can request public safety assistance to the work zone. This panic mode may also trigger a unique and conspicuous sequence of cone lights to alert all workers to the potential injury event.
- Those vehicles that do not adhere or adjust to the posted speed limit for the work zone will be notified by an additional DMS that they may be subject to a speed citation, shown as a CMS in the figure, at the exit of the work zone.
- Relevant information about the violating vehicle (e.g., duration of violation, maximum speed, average speed, license plate, and vehicle photograph) will be communicated and displayed to downstream CHP officers, who can then use their judgment to locate the vehicle and cite the driver based on the information documented by the aSE.

### ***Road Weather Management***

Adverse weather conditions have a major impact on the safety and operation of U.S. roads, from signalized arterials to interstate highways. Weather affects driver behavior, vehicle performance, pavement friction, and roadway infrastructure. Weather events and their impacts on roads can be viewed as predictable, nonrecurring incidents that affect safety, mobility, and productivity. Weather affects roadway safety through exposure to weather-related hazards and increased crash risk. Weather affects roadway mobility by increasing travel time, reducing traffic volumes and speeds, increasing speed variance (i.e., a measure of speed uniformity), and decreasing roadway capacity (i.e., maximum rate at which vehicles can travel). Weather events influence productivity by disrupting access to road networks and increasing road operation and maintenance costs.

The FHWA Road Weather Program has done excellent work to address these challenges. It has produced a report that contains 27 case studies of systems in 22 States that have improved roadway operations under inclement weather conditions. Each case study has six sections, including a general description of the system, system components, operational procedures, resulting transportation outcomes, implementation issues, and contact information and references ([http://ops.fhwa.dot.gov/weather/mitigating\\_impacts/best\\_practices.htm](http://ops.fhwa.dot.gov/weather/mitigating_impacts/best_practices.htm)).

## OREGON: Automated Wind Warning System

### *Project Background*

The Oregon Department of Transportation (ODOT) conducted evaluations of automated wind warning systems (AWWS) at the following two sites: between Port Orford and Gold Beach, OR, on US Route 101 between mileposts (MP) 300 and 327 (South Coast system); and on the Yaquina Bay Bridge (US Route 101) between MP 141 (southbound) and 142 (northbound) in Oregon. The evaluation was completed in 2006.

**Figure 3. Wind Warning Sign with Flashing Beacons**



Source: Western Transportation Institute

### *ITS System Overview*

The system was designed to warn drivers to pull over (stop) and wait until conditions improved or to take an alternate route. The two systems had similar components. Wind gauges (anemometers) were connected to roadside static message signs, and flashers were activated when average wind speeds reached predetermined threshold levels. The system automatically recorded the severity of the cross winds and notified traffic operators of system status. Once wind conditions were verified by the traffic operations center, additional warnings were posted on the Oregon DOT TripChek website. The warning messages were deactivated when wind speeds dropped below threshold levels.

### ***Results and Lessons Learned***

Accounting for the benefits of reducing motorist delays, as well as other benefits, such as improving safety for motorists and maintenance personnel during high wind events, the benefit-to-cost ratios for the South Coast system and Yaquina Bay Bridge system were 4.13:1 and 22.80:1, respectively. The Yaquina Bay Bridge system had a higher benefit-to-cost ratio, reflecting the higher frequency of cross winds in the area and heavier traffic volumes compared to the South Coast system. The analyses assumed the system would reduce delays by approximately 20 percent as a result of prompt deactivation of wind warnings.

### **Tourism and Traveler Information Systems**

Traveler information systems that provide information on traffic congestion, incidents, multimodal alternatives, and weather have been implemented in tourist areas, such as national parks and recreational sites. In many tourist destinations where congestion is an issue during peak seasons, traveler information helps to promote mode shift, which can enhance visitors' experience and protect natural resources. The following example addresses those issues.

### **ARIZONA: Grand Canyon National Park Traveler Information System**

#### ***Project Background***

In the summer of 2008, the Grand Canyon National Park conducted a shuttle bus pilot program that offered visitors the option of car-free travel from Tusayan, AZ, to the Canyon View Information Plaza. The pilot program was funded by the FTA, through the Alternative Transportation for Parks and Public Lands (ATPPL) Program, with an award of \$193,000. A key component of the pilot program was the deployment of a traveler information system to provide information needed by visitors to use the shuttle (such as shuttle location and availability and where entrance passes could be purchased).

#### ***ITS System Overview***

The information system was deployed in the cities of Valle and Tusayan. It consisted of one portable dynamic message sign (PDMS), two highway advisory radio (HAR) signs, and two HAR static signs.



**Figure 4. Traveler Information System DMS near Grand Canyon National Park**



Source: Western Transportation Institute.

### ***Results and Lessons Learned***

The results of the pilot suggested that the presence of the PDMS and HAR strongly increased visitor ridership, with the traveler information system having the effect of adding 368 shuttle passengers per day, an increase of 45.7 percent in shuttle ridership over that without the PDMS and HAR. The evaluation also determined that the pilot shuttle program provided a 250,000 vehicle-mile reduction and a 10,000 gallon fuel savings. Therefore, the presence of the PDMS and HAR signs resulted in a reduction of between 66,000 and 99,000 vehicle-miles driven and a fuel savings of between 2,600 and 2,800 gallons. In summary, the pilot test demonstrated that the traveler information system significantly supported the goals of the shuttle program in alleviating traffic and parking congestion at Grand Canyon National Park during the summer peak season.

### **Infrastructure Operations and Maintenance**

This CPA addresses the efficient and effective maintenance and operation of rural roadways and infrastructure to respond to changes in weather conditions, coordinate response activities, manage construction and work zones, and automate maintenance activities. Examples of projects in this CPA may include road weather information systems, weigh-in-motion sensors, closed-circuit television cameras, and automated gate closure systems.

## **WASHINGTON: I-90 Automated Anti-icing System**

### ***Project Background***

To address weather-related crashes on a section of I-90 near Vantage, WA, the Washington State Department of Transportation assessed the benefits and costs of deploying an automated

anti-icing system to prevent the formation of pavement frost and black ice and to reduce the impact of freezing rain. Poor road surface conditions contributed to 42 percent of total crashes and 70 percent of winter crashes. The high crash corridor extends from MP 137.67 (the Columbia River bridge approach) to MP 138.49 on I-90, near the State Route 26 interchange. This corridor includes a 955-foot-radius horizontal curve and a vertical alignment transition from 3 to 5 percent within the limits of the curve. The average daily traffic volume on this road section is 10,000 vehicles per day, of which 26 percent are trucks. The system was installed in 1999 and evaluated in 2001.

### ***ITS System Overview***

The system design included a liquid chemical storage tank, a pump, a 3,100-foot dispensing system with barrier-mounted and pavement-embedded spray nozzles, an environmental sensor station (ESS), a computerized control system, and a closed-circuit television (CCTV) camera for remote viewing. The control system monitors weather and road condition data from the ESS and automatically activates the dispensing system when predetermined conditions exist. The system also alerts dispatchers and the North Central Region maintenance supervisor when the anti-icing system is activated.

### ***Results and Lessons Learned***

The automated anti-icing system installed on I-90 had a benefit-to-cost ratio of 2.36:1, with benefits including fewer winter weather-related crashes and more efficient use of abrasives.

### **Emergency services**

ITS applications such as variable message signs, highway advisory radio, 511 telephone systems (for traveler information), video surveillance cameras, Motorist Assistance patrols, websites with traveler information, and transportation management centers (TMCs) all have applications in emergency response and recovery. However, due to limited geographic deployment and lack of redundancy in the communications linkages for the ITS equipment, their application in emergency response and recovery remains limited in rural areas. An automated collision notification system is one example of a technology that can improve coordination of agencies, services, functions, or modes, which may result in greater efficiency and service delivery improvements in emergencies.

## **NEW YORK: Automated Collision Notification Systems**

### ***Project Background***

Between July 1997 and August 2000 this study evaluated the benefits of an automatic collision notification (ACN) system for reducing incident notification and response times for vehicular accidents in rural and suburban areas of Erie County, NY. To evaluate the impact of ACN, incident notification and emergency response times were tracked for vehicles with and without ACN systems. Collision event timers were installed on about 2,600 vehicles to collect baseline data. If participants were involved in a collision, these devices recorded the elapsed time

starting at the moment an incident occurred. The data was then later compared to dispatcher and emergency responder records to determine actual notification and response times.

### ***ITS System Overview***

ACN crash detection modules and wireless communications equipment were installed on about 700 vehicles. These systems used accelerometers to detect crashes, global positioning system (GPS) equipment to identify vehicle location, and mobile wireless communications to automatically transmit data regarding incident severity, location, and vehicle orientation (car overturned, resting on side, etc.) to emergency dispatchers in the Erie County Sheriff's Office. Dispatchers confirmed incident data by activating a hands-free, in-vehicle communication system to question passengers about the nature of their accident, their location, and the number of people injured.

### ***Results and Lessons Learned***

During the evaluation, 15 of 21 ACN crashes generated data to evaluate notification times; however, very little data was available to study response times for emergency medical services. The average incident notification time for vehicles equipped with ACN systems was less than 1 minute, and in some cases it was as long as 2 minutes. The average incident notification time for vehicles without an ACN system was approximately 3 minutes, and in some cases it was as long as 9, 12, 30, and 46 minutes.

In situations where ACN did not function properly, the following problems were noted: cellular phone coverage was insufficient, ACN equipment was damaged during vehicle impact, the vehicle battery was low, and telephone equipment at the dispatch center was temporarily disconnected. In addition, there were 31 false notifications for noncrash events during the testing period. The false alarms were attributed to faulty accelerometer mount installations or to intermittent vehicle power supply failures.

### **Public Travelers and Public Mobility Services**

ITS applications can help regional travel agencies, public transportation agencies, rural residents, and travelers to access real-time traveler information and coordination of public transportation services. For information dissemination and coordination in rural contexts, several systems are used, including ITS applications such as automatic vehicle location systems, computer-assisted scheduling and dispatching, automatic telephone information systems, enunciator systems, advanced fare collection systems, and automatic vehicle identification.

## **MAINE: Island Explorer Transit ITS Enhancements in Acadia National Park**

### ***Project Background***

Acadia National Park (ANP) welcomes more than 2 million visitors each year. The park comprises 40,000 acres of island land and coastal land. During the peak visitation months of June, July, and August, the area faces traffic congestion and parking shortages in the recreation areas as well as the island communities.

In 1999, ANP and partners created the Island Explorer System to provide transit routes that link hotels and businesses with destinations in the park. The system consists of the Island Explorer with eight shuttle routes, the Bicycle Express (passenger vans with bicycle trailers), and two other express routes. ANP continues to develop and improve the system; in 2002, many ITS technologies were implemented to facilitate operations and enhance visitors' experience.

### ***ITS System Overview***

In 2002, ANP implemented many ITS technologies to enhance the transit system, including the following:

- Two-way communication
- Automatic vehicle location for the Island Explorer buses
- An automated annunciator for on-board audio messages
- Electric sign within the bus, displaying the next bus stop
- Real-time departure times on electronic message signs at select bus stops
- Automated passenger counters for buses
- Real-time parking conditions
- Park entrance traffic volume recorders

### ***Results and Lessons Learned***

Personnel who operate the transit system have cited the following operational benefits:

- Improving communication
- Facilitating scheduling
- Monitoring vehicle locations
- Tracking system usage
- According to surveys, 80 percent of visitors said that upgrades like electronic arrival and departure signs made the bus system easier to use.<sup>20</sup>

**Figure 5. Island Explorer Bus Stop Sign**



Source: John Daigle, University of Maine.

## **Fleet Management**

Fleet (vehicle) management can include a range of functions, such as vehicle financing, vehicle maintenance, vehicle telematics (tracking and diagnostics), driver management, speed management, fuel management, and health and safety management. Fleet management is a function that allows public transportation agencies, railroads, and commercial companies that rely on transportation in their business to remove or minimize the risks associated with vehicle investment. It has many benefits, including improving efficiency, effectiveness, and productivity; reducing overall transportation and staff costs; and facilitating compliance with government legislation (duty of care). There are numerous computer-aided fleet management applications and GIS-based applications that are used for fleet management, as shown in the following example.

### **FLORIDA: Deployment of Scheduling Software and Automatic Vehicle Location and Mobile Data Terminals**

#### ***Project Background***

The Central Florida Regional Transportation Authority (LYNX) and the Polk County Transit System (PCTS) serve the rural community of Poinciana, FL, with fixed-route and paratransit services. LYNX and PCTS were awarded a grant from the FTA for an operational test in 2002 with the purpose of evaluating the benefits of applying ITS technologies to reduce costs and the number of duplicate trips in the area. The ITS technologies implemented were mobile data terminals (MDTs) and automatic vehicle location (AVL) system devices on 10 paratransit vehicles for each agency. In addition, the use of common automated scheduling, reservation, and dispatch software by both agencies allowed for interoperability between the two systems.

### ***ITS System Overview***

Data was collected from both LYNX and PCTS for the period prior to the FTA operational test. The project was evaluated from April 2007 to January 2008. Furthermore, post-project data was collected to test system benefits that were not immediately accrued. Data related to passengers per trip, trip times, trip distances, and trip cost was collected for each of the study periods. Interviews were also conducted with staff at the offices of the two paratransit services, as well as with the drivers, during the post-project period to see if any changes in workload, efficiency, and customer satisfaction had occurred as a result of the changes.

### ***Results and Lessons Learned***

During the project period, the demand for paratransit services increased for both agencies, up more than 25 percent for both LYNX and PCTS, with more than 12,000 additional reserved trips in the post-project period than in the pre-project period. Ninety-five percent of paratransit users surveyed said they used the same amount of service that they had a year ago, with 5 percent increasing their use of the service. This finding indicates that much of the growth in the demand for paratransit reserved trips was the result of new customers. Even with the increased number of trips, both agencies were able to maintain an on-time performance level for 90 percent of trips. AVL technology allowed customer relations representatives to give potential riders current vehicle location information and allowed them to check the validity of complaints by using historical data.

During the post project period, service opportunities for the residents of the Poinciana, FL, area increased as LYNX added four additional paratransit vehicles because of increased ridership. During the project period, LYNX also implemented a flex-route service, the Pick Up Line, which serves as a feeder service to the Route 26 fixed-route service. The Pick Up Line saw ridership continue to increase in the post project period. Overall, the project area saw an increase in transit use per capita by nearly 2 to 8.5 percent. Mixed results were seen in the area of cost reduction, with only the larger LYNX system seeing cost reductions. The PCTS saw cost increases, both at the per passenger and per vehicle hour levels.

### **Commercial Vehicle Operations**

Commercial vehicle operations is an application of ITS generally used for large freight trucks. ITS applications such as global positioning systems (GPS), dedicated short-range communications (DSRC), license plate recognition (LPR), weigh-in-motion (WIM), road weather information systems (RWIS), and downhill speed information systems (DSIS) help commercial companies that use fleet and freight administration, electronic clearance, commercial vehicle administrative processes, international border crossing clearance, weigh-in-motion, roadside safety, on-board safety monitoring, fleet maintenance, hazardous material planning and incident response, freight in-transit monitoring, and freight terminal management. The following illustrates a successful ITS application in Australia.

## **AUSTRALIA: Evaluation of an Automated Commercial Vehicle Safety Enforcement System**

### ***Project Background***

The Roads and Traffic Authority of New South Wales, Australia, uses a system of remote automated cameras linked to a central processing center to monitor commercial vehicle operations and enforce safety regulations. A cost-benefit evaluation was conducted in 1999.

### ***ITS System Overview***

Cameras are located along interstate highways in New South Wales, along with processors that allow the remote sites to photograph a vehicle and perform vehicle detection and classification and license plate recognition. The processors then forward the information to the central processing site over an Integrated Services Digital Network (ISDN)-based communications network that can simultaneously transmit video, data, and other network services over traditional switched circuits

The central site processes the information received to determine average vehicle speeds over highway segments, identify registration infractions or license plate alerts, and determine if there is a need for driver fatigue notification. The central location also issues any necessary citations for recorded infractions.

### ***Results and Lessons Learned***

An evaluation of the system, considering the reduction in lives lost and the time lost during unnecessary vehicle stops and inspections, found a benefit-to-cost ratio of 2.5 to 1.

## **Regional Management and Coordination**

This section includes discussions of the following: (1) the larger framework of regional ITS planning, (2) rural ITS architecture, (3) the role that stakeholders can play in planning and implementing ITS applications, (4) the need for coordination and exchange of information among participating agencies or groups, and (5) the role of multistate corridor coalitions.

### ***Regional ITS Planning***

Rapid advances in information processing and communications technology have created new opportunities for transportation professionals to deliver safer and more efficient transportation services and to respond proactively to increasing demand for transportation services and mounting customer expectations. However, many of these new opportunities are predicated on effective coordination between organizations—at both an institutional and a technical level. To encourage and enable this coordination, USDOT has developed the National ITS Architecture and related tools to help identify and leverage these opportunities for cost-effective cooperation.<sup>21</sup>

In 1997, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) to address the need to begin to work toward regionally integrated transportation systems. In

January 2001, FHWA published a rule (ITS Architecture and Standards) and FTA published a companion policy (Policy on ITS Architecture and Standards Conformity) to implement section 5206(e) of TEA-21. The rule and policy seek to foster regional integration by requiring that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and officially adopted standards. “Conformance with the National ITS Architecture” is defined in the final rule and policy as using the National ITS Architecture to develop a regional ITS architecture that would be tailored to address the local situation and ITS investment needs, and the subsequent adherence of ITS projects to the regional ITS architecture.<sup>22</sup>

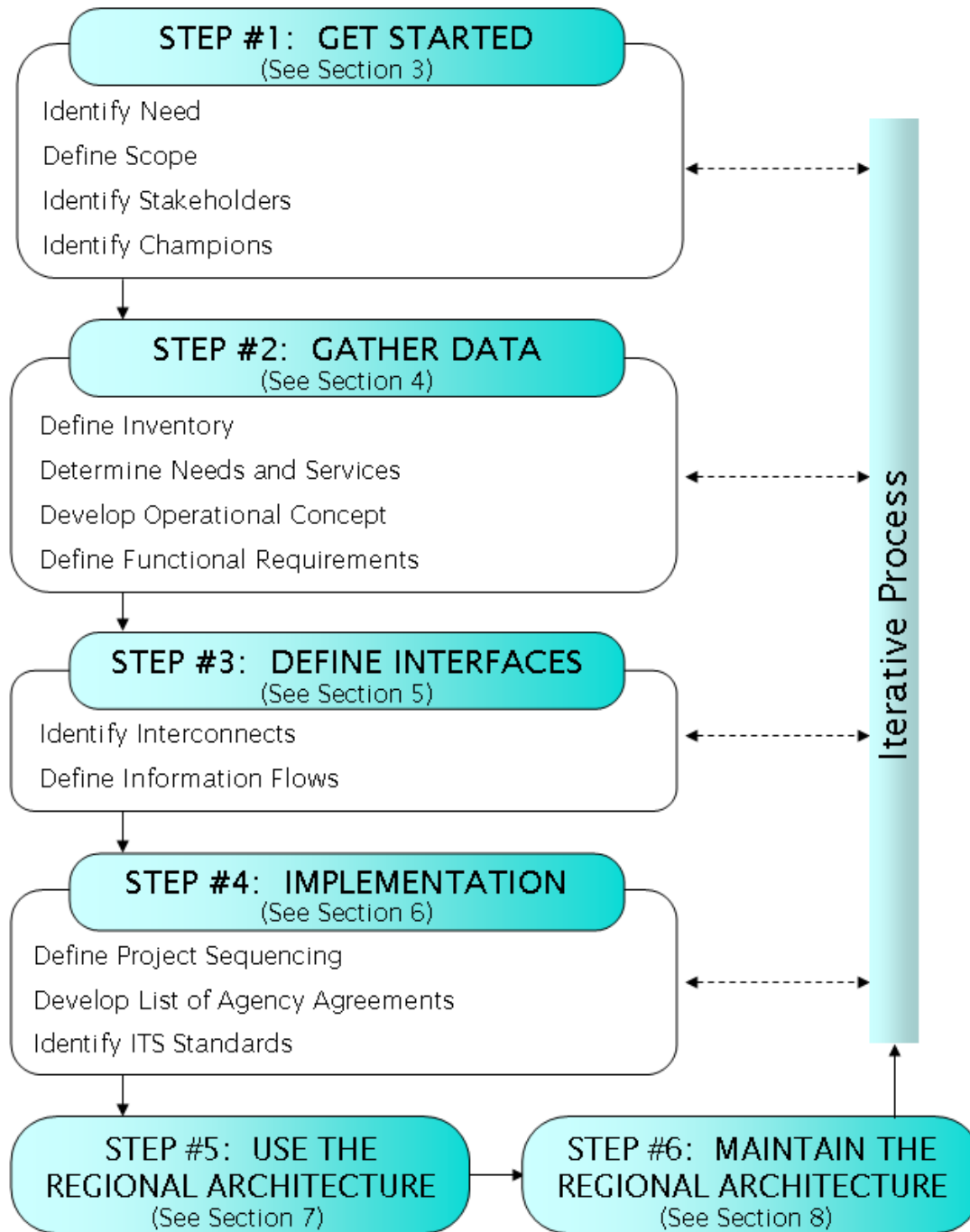
This ITS Architecture and Standards Rule and Policy continue today and have been updated in subsequent Federal transportation bills (SAFETEA-LU in 2005, and MAP-21 in 2012). Current legislation and policy emphasize, among other things, congestion mitigation, real-time system management information systems, and a regional approach to planning and transportation operations. State and local governments are required to address information needs and data exchange associated with highway and transit information and monitoring systems when developing or updating their regional ITS architectures.

FHWA has produced an excellent reference document as a guide for transportation professionals who are involved in the development, use, or maintenance of regional ITS architectures, titled “Regional ITS Architecture Guidance: developing, using, and maintaining an ITS Architecture for your region.”<sup>23</sup>

The document describes a process for creating a regional ITS architecture with supporting examples of each architecture product. In its discussion of how to use the regional ITS architecture, it presents an approach for mainstreaming ITS into the transportation planning and project development processes. Maintenance of the architecture is also discussed. The guidance is structured on the process shown in Figure 6.



**Figure 6. “Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region”**



Source: Report No. FHWA-HOP-06-112.

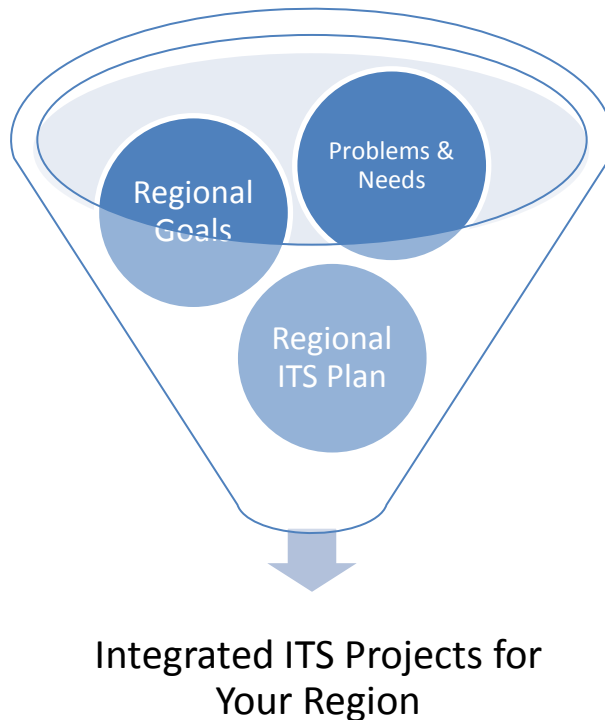
[www.ops.fhwa.dot.gov/publications/regitsarchguide/index.htm](http://www.ops.fhwa.dot.gov/publications/regitsarchguide/index.htm)

References in this chart to specific sections refer to the source document (available at

[www.ops.fhwa.dot.gov/publications/regitsarchguide/index.htm](http://www.ops.fhwa.dot.gov/publications/regitsarchguide/index.htm)).

With a regional architecture in place, transportation professionals can use it to guide project planning and selection. One approach to developing a set of integrated ITS projects is to examine specific transportation problems, map them to regional goals and objects, and identify a set of short-, medium-, and long-term projects (as illustrated in Figure 7).

**Figure 7. Project Identification Process**



### ***Rural ITS Architecture***

Regional ITS planning may encompass cities and counties within a geographic area, the gateway communities surrounding a national park, or the jurisdictions that border a transportation corridor. Within the regional planning context, there may be one or more rural ITS architectures. A rural ITS architecture can serve as a framework for the development of multimodal integrated transportation systems to address the unique issues and needs of the rural transportation environment. When the National ITS Architecture was originally developed, some transportation professionals asserted that rural ITS should have its own architecture for the purpose of organizing rural functional requirements and systems interfaces.<sup>24</sup> However, over the past few years, USDOT has reviewed user services and market packages to incorporate rural applications.

Typically, ITS applications in a rural setting have been selected and designed to solve an individual problem at a single hot spot location (e.g., a blind curve with a high incidence of

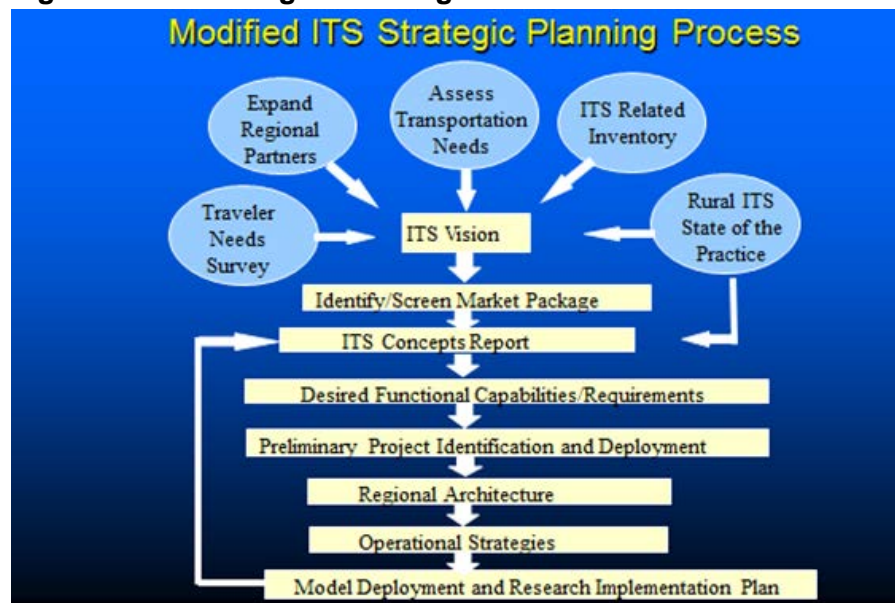
crashes). ITS technologies have been applied to a variety of complicated issues, such as safety, freight movement, incident response, mobility, congestion and delay, environmental impacts, and deteriorating pavement (Table 1).

**Table 1. Sample Challenges to Be Mapped to ITS Applications**

Program Area	Identified Challenges
Safety	Poor alignment Railroad grade crossing Speed on ice and snow Poor visibility Intersections Narrow clear zone Animal conflicts Slow farm vehicles Passing maneuvers Construction zones Alcohol use and driver fatigue Seatbelt use
Freight Movement	Intermodal issues High truck traffic
Incident Response	Multijurisdictional incidents Notification and response time
Mobility	Congestion and delays Bike and pedestrian issues Transit availability
Tourism	High recreational travel Traveler information Economic development
Environmental Impacts	Resource mapping and monitoring Wildlife conflicts
Infrastructure	Deteriorating pavements or structures Weather and road condition monitoring Safety applications

To develop a rural ITS architecture and a strategic plan that represents the more comprehensive needs of a rural region, local leaders and transportation professionals should begin with a strategic planning process that quantifies the multimodal needs of the traveling public, leverages regional partnerships, and builds on the success of legacy projects and systems (Figure 8). This process is a key component in selecting and prioritizing effective and sustainable projects.

**Figure 8. ITS Strategic Planning Process**



### **Stakeholders**

In rural areas, stakeholders can provide valuable input regarding local challenges, user needs, and available resources. However, some may not immediately recognize the importance of transportation in efforts to address community or regional challenges related to public safety, economic sustainability, or interagency cooperation and coordination. Therefore, transportation leaders may have to take the lead in identifying and inviting representatives from a broad range of organizations to participate in the planning and development of a rural ITS program. An effective stakeholder outreach component can broaden the impact of transportation enhancement initiatives.

Rural stakeholders represent a variety of public and private entities, all with their own interest in how transportation supports their needs. Stakeholders may also bring specialized expertise or resources to the table that may assist with ITS development and deployment. Stakeholders may represent law enforcement, tourism, chambers of commerce, agriculture, tribal nations, councils of government, commercial vehicle operators, emergency managers, and State and local transportation agencies (Table 2).

However, rural stakeholders may have less experience with advanced transportation technologies or regional coordination initiatives than stakeholders in urban areas. The following are some of the planning challenges to be found in working with diverse stakeholders:

- Limited multiagency/State experience
- Limited funding and extreme competition
- Familiarity with traditional transportation projects; a low-tech perspective
- Need for a different hook to bring stakeholders to the table (not transportation versus jobs, for example)

**Table 2. Potential Stakeholders**

<b>Category</b>	<b>Potential Partners</b>
Federal Agencies	USDOT (FHWA, FTA) Resource agencies (NPS, U.S. Forest Service) National Weather Service
State Agencies	Department of Transportation Department of Commerce or Economic Development State Police or Highway Patrol Department of Tourism
Local or Regional Agencies	Regional planning organizations or councils Chambers of commerce Emergency response providers
Tribal Organizations	Native American organizations Individual tribes
Private Sector	Transit operators Fleet operators Concessionaires National tour organizations

A successful stakeholder meeting or ongoing programs typically include the following objectives and tasks:

- Identify potential partners and develop outreach efforts
- Identify and prioritize regional problems
- Identify multimodal traveler needs
- Improve ITS understanding
- Achieve consensus on long-term deployment
- Facilitate public and private sector cooperation
- Update participants on project status and next steps

Although many benefits have come from developing regional architectures with stakeholders, there are challenges to achieving ongoing and committed participation. Not all stakeholders want to be involved in the process or believe that their involvement is necessary. If partnerships require multijurisdictional coordination or shared responsibility for services, additional challenges may arise related to communicating across State boundaries or allocating responsibilities among stakeholders. Recommendations for addressing these challenges include the following:<sup>25</sup>

- Involve a wide range of stakeholders in the process and get them interested early on in the process. Constant communication is necessary.

- Teach stakeholders (in simple terms) why ITS technologies are important and why ITS architecture is an important step in the process of operations and maintenance of the technology.
- Consult State and/or Federal DOT for help throughout the process. Several types of Federal funds are eligible for regional architecture development and maintenance.
- Create a website to house the architecture information so that people can use it. It can also help in the updating of architecture.
- Conduct regular outreach to the community, especially local elected officials.
- Maintain architecture on a regular basis or when regionally significant projects are identified.

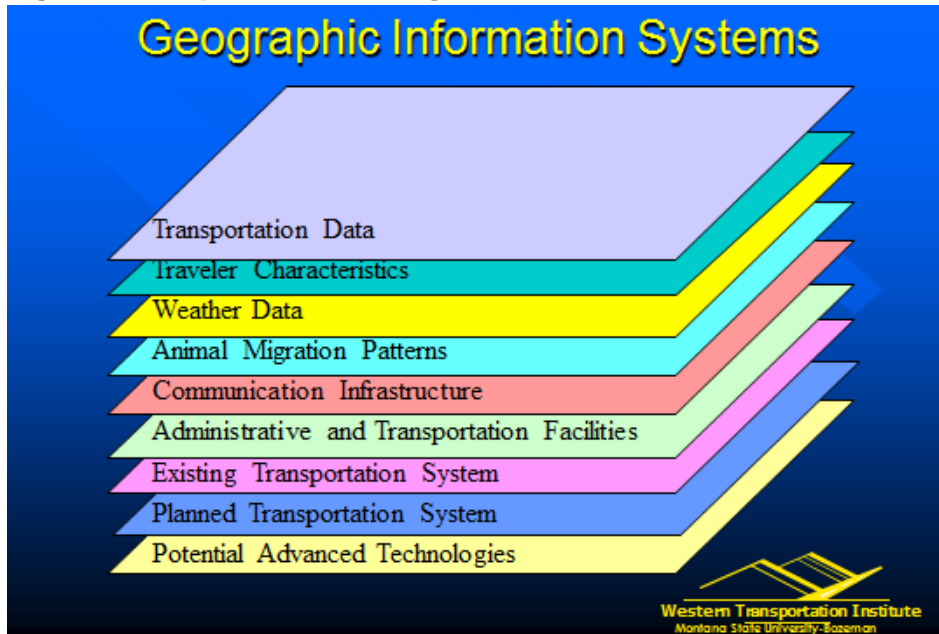
A critical need in every ITS project, architecture, or deployment is to have a champion that can move forward with a specific, Statewide or regional ITS initiative. The champion can come from any stakeholder group; however, without a committed and enthusiastic champion, ideas and initiatives stall or never reach completion.

### ***Coordination and Data Exchange***

The most common issues faced by rural communities are not technological, but institutional. Similar to their urban counterparts, rural communities are challenged by the issues of communication, cooperation, and coordination. The situation is, perhaps, more serious in rural areas because these locations typically do not have a metropolitan planning organization or a regional transit agency to facilitate or oversee cooperative efforts.

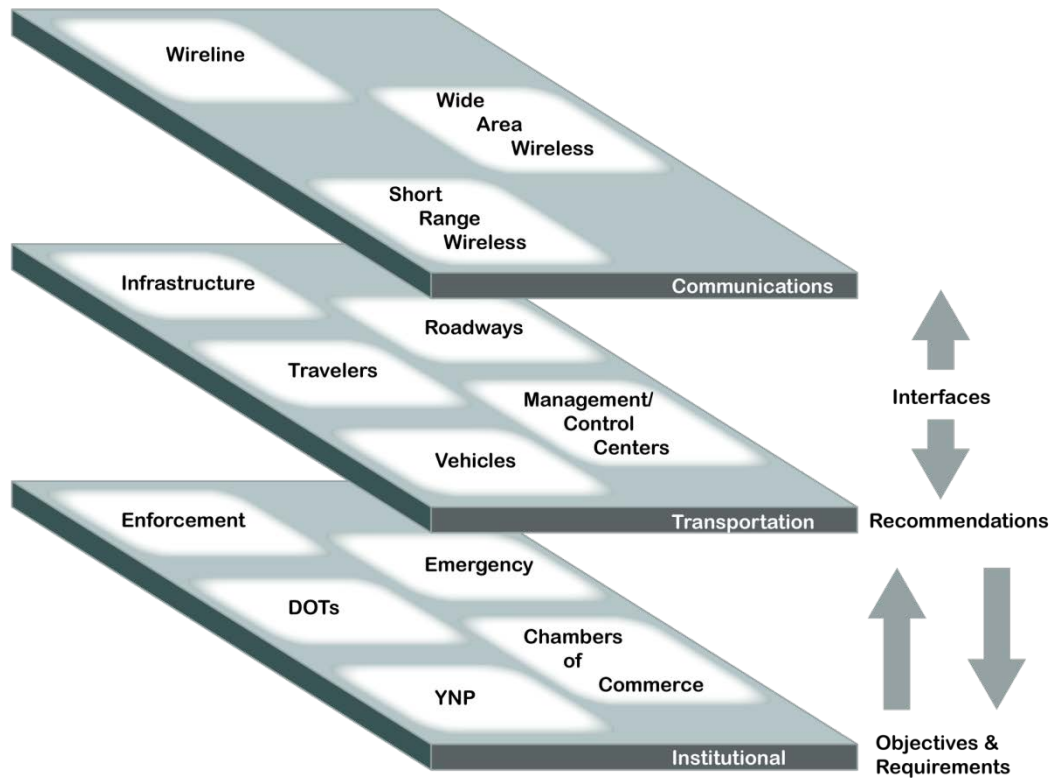
In regional or rural ITS planning, a variety of data will be collected; in addition, any deployed ITS systems will collect data and disseminate information (Figure 9 and Figure 10). The most essential element of effective advanced transportation technology applications appears to be the ability to provide for regional data collection and information sharing. In many States and multistate coalitions, regional servers are being created to house and synthesize data. As connected vehicle efforts mature, the availability of data from roadside units and from vehicles will become an important aspect of data collection and information dissemination.

Figure 9. Sample Data Exchange Model



Source: Western Transportation Institute.

Figure 10. Data and Communication Exchange Modes



Source: Western Transportation Institute.

A robust data collection and dissemination process facilitates multijurisdictional and multimodal coordination in several ways:

- Increases awareness among partners of current conditions, available resources, and other key information
- Facilitates timely alerts and updates
- Facilitates coordination of responsibilities and activities across organizations and locations

### ***Multistate Corridor Coalitions***

Twenty years ago, the preliminary concepts for ITS envisioned a national system resembling the air traffic control model, including a big board where transportation managers would access surveillance, communication, and control capabilities. In the absence of a national system, stakeholders began to form corridor coalitions to address the common challenges on the roadways and in the adjacent market sheds. These corridor coalitions were in urban and rural areas and brought together multimodal partners; over time these corridors are forming the foundation for a patchwork national system. Funding for the creation, management, operation, and deployment came from a variety of sources, ranging from State planning and research, non-Federal or local funding, earmarks, and other sources. Many of these multistate corridor coalitions had a rural-specific focus. Examples of these coalitions, including their partners, vision, and focus, are shown in Table 3.

Corridor coalition initiatives address the following common themes:

- Integrated traveler information systems
- Enhanced freight and passenger movement
- Coordinated safety and traffic management
- Economic development of communities adjacent to corridors



**Table 3. ITS Corridor Coalitions**

Interstate Highway	Name	Vision	Hyperlink	State DOTs
<b>I-95</b>	I-95 Corridor Coalition	A partnership of transportation agencies and related organizations, from Maine to Florida and in Canada, is working together to accelerate improvements in transportation across multiple jurisdictions and throughout all modes.	<a href="http://www.i95coalition.org/i95/Default.aspx">www.i95coalition.org/i95/Default.aspx</a>	Maryland DOT (Lead State) (Connecticut; Delaware; Washington, DC; Florida; Georgia; Maine; Maryland; Massachusetts; New Hampshire; New Jersey; New York City and State; North Carolina; Pennsylvania; Rhode Island; South Carolina; Vermont; and Virginia)
<b>I-81</b>	I-81 Coalition	The I-81 Corridor Transportation Network, supporting both freight and passenger movement, will be safe, efficient, environmentally sensitive, seamless, and intermodal. The network will support economic development and encourage coordinated land use policy.	<a href="http://www.i-81coalition.org/">www.i-81coalition.org/</a>	Virginia DOT (Lead State) (Tennessee, West Virginia, Maryland, Pennsylvania, and New York State)
<b>I-90/94</b>	North/West Passage Corridor Coalition	The Northwest Passage extends from Wisconsin to Washington. The vision of the North/West Passage Corridor is to focus on developing effective methods for sharing, coordinating, and integrating traveler information and operational activities across State and provincial borders. The vision provides a framework to guide the States' future projects in the corridor.	<a href="http://www.nwpassage.info/">www.nwpassage.info/</a>	Montana DOT (Lead State) (Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota, Minnesota, and Wisconsin)
<b>I-15</b>	I-15 Corridor	The I-15 Corridor System Master Plan is a summary document of a series of technical studies conducted by the I-15 Mobility Alliance. The plan includes a long-range multimodal plan and a vision for development of facilities along the corridor.	<a href="http://www.i15alliance.org/">www.i15alliance.org/</a>	Nevada DOT (Lead State) (California, Nevada, and Utah)

Interstate Highway	Name	Vision	Hyperlink	State DOTs
<b>I-94</b>	Great Lakes Regional Transportation Operations Coalition	The Great Lakes Regional Transportation Operations Coalition (GLRTOC) is a partnership of Great Lakes agencies that collaborates on initiatives that improve cross-regional transportation operations in support of regional economic competitiveness and improved quality of life.	<a href="http://www.glrto.org/index.html">www.glrto.org/index.html</a>	Wisconsin DOT (Lead State) (Illinois; Indiana; Michigan; Ontario, Canada; Minnesota; and Wisconsin)
<b>Rural areas throughout California and Oregon</b>	California–Oregon Advanced Transportation System (COATS) Western States Rural Transportation Consortium	The Western States Rural Transportation Consortium (WSRTC) is a product of the California–Oregon Advanced Transportation System (COATS), which comprises California, Oregon, Washington, and Nevada. The consortium has been established to facilitate and enhance safe, seamless travel throughout the western United States.	<a href="http://www.westernstates.org/default.html">www.westernstates.org/default.html</a>	California DOT (Lead State) (Oregon, Washington, and Nevada)
<b>I-80</b>	I-80 Corridor Coalition	The goal of the coalition is (1) to provide better and more comprehensive information on I-80 corridor conditions to both transportation agencies and to travelers; (2) build on existing multistate coordination efforts on I-80 and expand to include general road conditions information, consistent corridor wide traveler information, proactive traffic management strategies, coordinated maintenance operations, and potentially shared use of infrastructure near State boundaries; and (3) leverage State resources and tools to implement innovative solutions for winter operations as well as day-to-day corridor management.	<a href="http://www.i80coalition.com/">www.i80coalition.com/</a>	Nevada DOT (Lead State) (Utah, California, and Wyoming)
<b>I-15</b>	West Coast Corridor Truck Freight ITS and	This research tests the viability of using commercially available GPS-based data to track truck performance within the central Puget	<a href="http://www.westcoastcorridors.org/library/BestPractices%20Manual.pdf">www.westcoastcorridors.org/library/BestPractices%20Manual.pdf</a>	Washington State DOT (Lead State)

<b>Interstate Highway</b>	<b>Name</b>	<b>Vision</b>	<b>Hyperlink</b>	<b>State DOTs</b>
	Operations Program	Sound region. The data is used to monitor truck speeds and system reliability as performance measures that can be applied to guide freight investment decisions and track project effectiveness.		

In 2012 and 2013, FHWA launched the Multistate Corridor Operations and Management Program grant. The purpose of this program is to promote regional cooperation, planning, and shared project implementation for programs and projects to improve multimodal transportation system management and operations. In addition, the projects supported by this grant program should advance the goals of improving corridor safety and operational performance; enhancing economic competitiveness; improving sustainability; and enhancing livability (all of which are consistent with USDOT strategic goals). In the absence of a national rural ITS program, the MCOM program offers significant opportunities for rural challenges to be addressed at a Statewide level.

## **Vision**

The challenges faced by rural travelers and the agencies responsible for rural transportation networks are largely the same as they were 50 years ago:

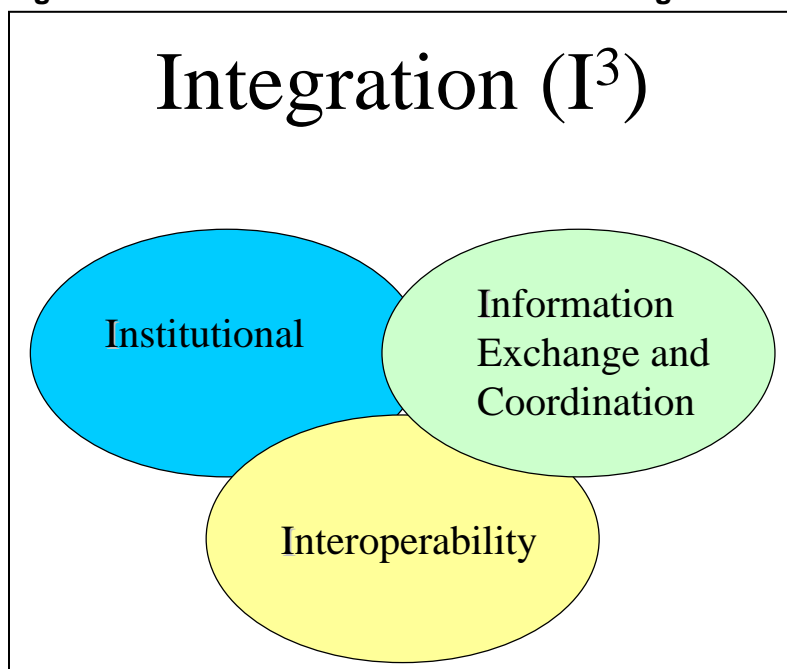
- Dynamic weather conditions
- Long distances between services
- Organizations operating independently or with minimal coordination between States
- Limited traveler information
- Long notification and response times to emergencies

In the past 10 to 15 years, transportation researchers and practitioners have effectively deployed ITS systems to address targeted and location-specific challenges. In addition, regional and corridor initiatives have laid the foundation for strategic ITS deployments and integrated systems.

As rural ITS moves from hot spot applications to corridor and regional solutions, the corresponding vision for rural ITS will be more integrated and interoperable. In other words, rural ITS can play a larger role in facilitating overall transportation agency planning and operations in rural areas. As rural agencies and residents become familiar with the potential or realized benefits of these technologies, ITS can begin to change the following:

- How familiar and unfamiliar travelers view transportation in rural settings
- The ability of agencies to communicate and coordinate
- The logical inter-relationships of institutions, information, and interoperability (Figure 11)

Figure 11. Framework for Future Rural ITS Integration



To achieve this vision, rural ITS initiatives will need to target three areas:

- **Institutional Cohesiveness:** Technology (in particular, integrated technology) cannot be implemented without cohesive institutional support. State and local departments of transportation must work with other public agencies (law enforcement, tourism boards) as well as private sector partners (service providers, chambers of commerce) to build and maintain a foundation for working together on transportation enhancements that support the missions and objectives of all the individual agencies. Rural ITS can support planning and deployment with technologies and systems that facilitate or add value to these transportation initiatives.
- **Information Dissemination, Exchange, and Coordination:** Information is useful only when it reaches the agencies and travelers who need it or can use it. If ITS deployments are planned and integrated, there will be more opportunities to incorporate and maximize information exchange and dissemination. Information exchange among departments of transportation, law enforcement, and tourism agencies can help these entities act locally but think regionally when managing their relative responsibilities. For traveler information projects, rural ITS improvements should strive to make that information accessible and seamless to both the operating agencies and the traveler. Ideally, travelers will have access to pre-trip and en route information of changing road weather conditions, services (available and unavailable), and attractions that may enhance their trip. Institutional cohesiveness and coordination will facilitate expanded information exchange and produce greater synergistic benefits among agencies.
- **Interoperability and Scalability:** This vision for rural ITS includes improving the use and interoperability of legacy (existing and planned) infrastructure and integrating those systems to meet current and future needs. This vision can be achieved through the

development of a bi-state architecture that will support current statewide architecture efforts. One approach would be to make all systems scalable, to add value to those legacy systems. Scalability can be achieved by providing increased detail to the ongoing high-level architecture development to understand both functional requirements and long-term interoperability needs.

Developing a shared vision among stakeholders will require ongoing identification and recognition of shared needs. Transportation professionals must work in partnership with the traveling public and other stakeholder groups, rather than in isolation. By keeping the customer at the forefront, transportation leaders can identify user needs through surveys and other tools, and document key guidance information such as the following:

- *What* information the rural traveler needs and wants
- *How* information should be presented to the traveler
- *Where* the traveler would want this information
- *How much* the travelers are *willing to pay* for the solutions

Using this approach, transportation leaders can carry out the vision with projects that address existing issues and reflect user needs. In the long term, the projects will also support goals to enhance safety, improve operational efficiency, and create sustainable communities by providing technologies that save lives, time, and money.

## Summary

This module provided an overview of the unique transportation needs of rural areas and the challenges of deploying ITS in a rural setting. Like urban areas, rural areas face critical safety, mobility, infrastructure, economic development, and sustainability issues, but the specific issues in each category are shaped and characterized by the rural setting. In other words, travelers can face long delays on both urban and rural roadways, but in urban areas they are more likely to be caused by congestion, and in rural areas they are more likely to be caused by severe weather or the absence of alternate routes. Similarly, potential solutions must work within the significant constraints of rural areas, which include limited fiscal resources, remote locations, long distances between cities and towns, and limited communications and technological infrastructure.

Rural ITS technologies have been deployed and evaluated to address all of the critical program areas identified by USDOT, as presented by the ITS project success stories. Initially, most systems were deployed to address a single challenge or specific location. However, there is movement toward integrated systems and regional coordination, particularly at the corridor level. The corridor coalitions provide a foundation of integrated systems and a framework for the development of a national ITS network.

Current research and emerging technologies support increased information sharing and regional coordination. Connected vehicle technologies show potential for monitoring road conditions, weather conditions, vehicle locations, and driver actions, and disseminating the

information to or among vehicles, roadside infrastructure, or traffic management centers. This capability has enormous implications for enhancing regional traffic management, disseminating real-time safety alerts, expediting emergency response, and using other applications that support a vision for rural ITS that promotes integration, coordination, and interoperability.

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