RURAL ITS USER NEEDS

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Prepared for Federal Highway Administration

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1. INTRODUCTION

1.1. Background

One of the goals of the U.S. Department of Transportation (DOT) is to complete the system definition and architecture integration of rural Intelligent Transportation System (ITS). The National ITS Architecture and accompanying Standards activities promote interoperability of transportation-related systems within diverse organizations that operate the surface transportation infrastructure. The National ITS Architecture and Standards will help to increase the level of reusability of systems and technologies (as well as increase market size with commensurate multi-vendor competition) and lead to a reduction in the deployment cost of ITS systems. It is crucial to ensure that the requirements of rural settings are included in the National ITS Architecture. To do this, U.S. DOT has recently initiated an effort to advance existing work on rural user needs assessment to the point where it can be used as input to the National ITS Architecture development process. The goal of this effort is to ensure that rural travel needs and conditions are represented in what will be an interoperable, national and international transportation system.

1.2. Purpose

The purpose of this effort is to develop and document a comprehensive list of rural ITS user needs. These needs could be used to identify rural travel requirements. Rural travel requirements will be identified to:

- define the Rural ITS Infrastructure;
- update the Rural ITS Program Plan; and
- provide input to the National ITS Architecture.

1.3. Document Organization

This document is organized into four main sections:

- **Section 1 – Introduction**: provides introductory remarks regarding the background and purpose of the document.
- **Section 2 - Rural User Needs Development Process**: discusses the process of developing a comprehensive list of rural user needs.
- **Section 3 - Rural ITS User Needs Workshop**: provides a detailed description of the U.S. DOT sponsored Rural ITS User Needs Workshop held on April 18, 1999.
- **Section 4 - Rural User Needs**: Present a complete list of rural ITS user needs based on the results of previous studies and the Rural ITS User Needs Workshop.

2. RURAL USER NEEDS DEVELOPMENT PROCESS

The rural user needs development process involved two major steps:

1. Comprehensive review of existing literature for user needs assessment
2. Stakeholders input

The first step involved a comprehensive review of existing literature and ongoing activaties which address the needs of transportation users in rural areas. This activity included review of the following user needs assessment initiatives:

- USDOT's Rural Application of Advanced Traveler Information Systems (ATIS)
- USDOT's Rural Transit Study
- Minnesota Rural Scoping Study
- User needs assessments conducted by the Western Transportation Institute
- USDOT's Rural ITS Team needs list

These initiatives represent a set of major efforts to compile the most comprehensive list of possible rural user needs. The Rural ATIS program, for example, involved:

- 31 focus groups
- 61 one-on-one interviews
- 1025 telephone interviews

Based on the results of this comprehensive review, a draft rural user needs document was prepared.

The second step involved obtaining stakeholder input and critique of the user needs defined in the draft user needs document developed in step one. As part of this process, a broad cross-section of stakeholders from 28 different states, representing a variety of state and local constituencies were brought together at the Rural ITS Workshop. Figure 2.1 shows the states represented at this workshop (states represented are shown in black). The draft user needs document was reviewed and critiqued by stakeholders during the workshop. A finalized list of user needs incorporating stakeholder comments received during the workshop was then prepared.

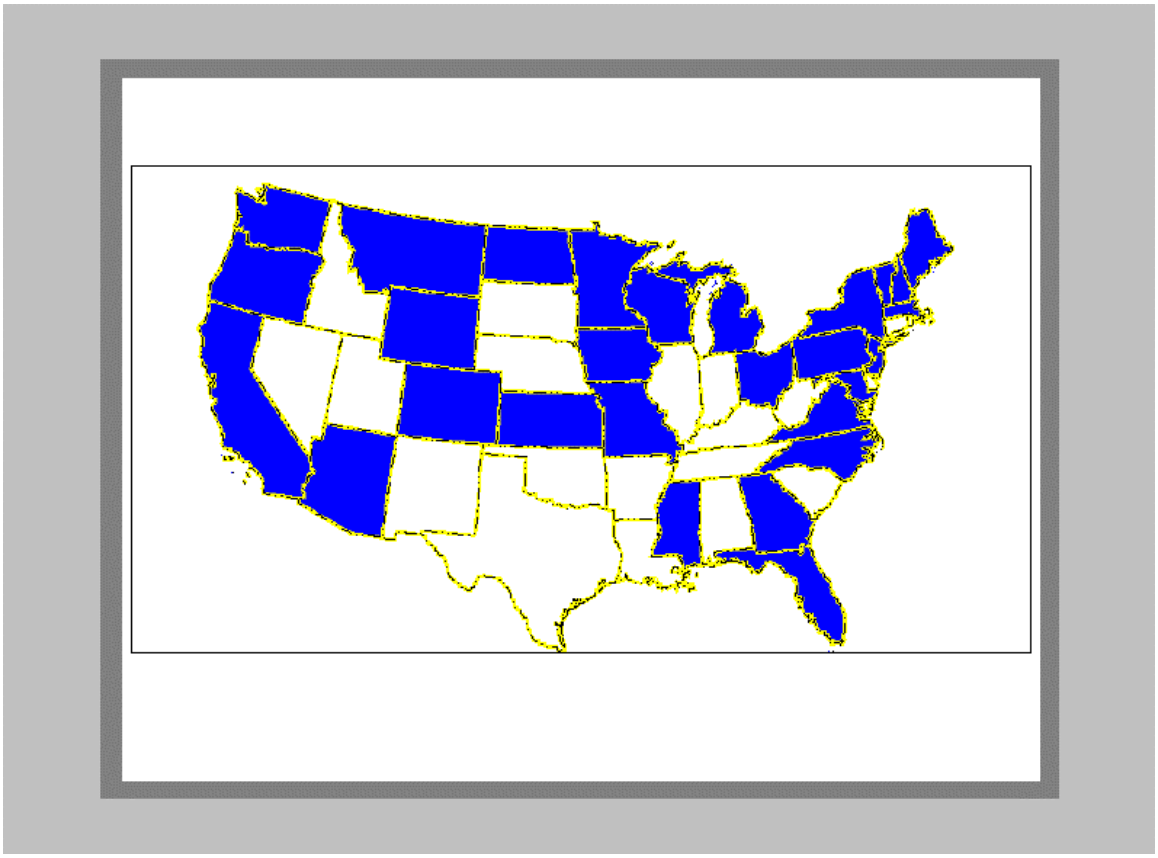

Figure 2.1 States Represented at April 18th Rural ITS Workshop

3. RURAL ITS WORKSHOP

The Rural ITS Workshop held on April 18th, in McLean, Virginia, served as a forum for discussing traveler needs in rural areas. Stakeholders representing a wide variety of interests were provided a draft list of rural user needs developed during previous efforts to review and critique.

3.1. Workshop Goals and Objectives

The rural ITS Workshop had two main goals. The primary goal of the workshop was to obtain stakeholder input on the draft list of user needs and to identify any necessary additions, modifications, or deletions to this list. A copy of the workshop agenda is included in Appendix A. Federal Highway Administration (FHWA) representatives provided workshop participants with a comprehensive overview of the Rural ITS program to establish workshop context. Other presentations covered workshop goals and objectives. Presentations addressing the Rural ITS program as well as workshop goals and objectives are included in Appendix B. A secondary goal of the workshop was to discuss how the user needs could be met and, if possible, identify for each need the following information relating to the deployment of various rural ITS technologies:

- Main consumers or recipients of each need
- Information/service provider
- Data collector/processor
- Main technologies involved or required

User needs were organized into seven major categories, with stakeholders representing specific categories to focus the discussions. Table 3-1 shows the number of stakeholders for each specific category.

Category	Number of Stakeholders
Emergency Services	**9**
Tourism and Traveler Information	**12**
Traffic Management	**12**
Transit and Mobility	**16**
Crash Prevention and Security	**10**
Operations and Maintenance	**13**
Surface Transportation Weather	**13**

Table 3.1 Number of Stakeholders for Each Category

Moderators with high levels of expertise in their assigned categories guided the stakeholder discussions. A list of moderators and stakeholders for each category is included in Appendix C. An alphabetized list of stakeholders participating in the workshop, as well as other attendees are included in Appendix D.

3.2. Workshop Details

The workshop was divided into two sessions, a morning session and an afternoon session.

The morning session included an overview of the Rural ITS Program by FHWA representatives as well as a discussion of workshop goals and objectives. Following the presentations and participant introductions, the stakeholders attended breakout sessions for the rest of the morning. Breakout groups were organized according to the seven categories listed in Table 3.1 above.

The focus of the morning breakout sessions was to review the draft user needs which were presented by the group moderator (participants were provided a complete listing of the draft user needs in a read-ahead package in the weeks prior to the workshop). Following lunch, participants reassembled in a plenary session. Each group moderator then gave a 10minute presentation summarizing the findings of the morning breakout session.

Breakout groups met once again during the afternoon following the conclusion of the presentations. Groups that did not complete their review of the user needs during the morning breakout session continued to review and discuss the draft user needs for their category. Groups that did complete their review of the user needs during the morning session discussed deployment issues associated with rural ITS.

3.3. Workshop Results

Workshop products fall into two general categories: results of the morning breakout sessions designed to produce a refined list of user needs and results of the afternoon breakout sessions. Development of the refined list of user needs was the primary objective of the workshop. Refined user needs are presented in Section 4. The results of the afternoon session are in various stages of completion depending on whether the group was able to complete its review of the user needs list during the morning session. This information will be useful for development and definition of rural infrastructure.

4. RURAL USER NEEDS

4.1. Background

This section presents rural ITS user needs identified to date. The user needs listed in this section have been reviewed and critiqued by stakeholders familiar with travel issues affecting rural areas.

The user needs presented herein are organized into the following seven categories:

1. Emergency Services
2. Tourism and Travel
3. Traffic Management
4. Rural Transit and Mobility
5. Crash Prevention and Security
6. Operations and Maintenance
7. Surface Transportation Weather

Each of the following seven sections provides an overview of each category followed by a listing of corresponding Rural ITS user needs identified to date. Each of the seven categories listed above were reviewed and critiqued independently of the other categories to facilitate the review process. In actual practice however, many of the user needs identified in this process are associated with more than one of the seven transportation categories discussed at the workshop. For this reason there is a degree of repetition or overlap of the needs listed in the following seven sections. In subsequent analyses user needs will be considered as they apply to transportation services in general.

4.2. Emergency Services

User needs in the area of Emergency Services address the response to an individual incident such as a traffic collision and to more widespread events such as natural disasters. Once an incident (accident or emergency situation) occurs, there is a need for emergency services. These services can be in the form of ambulances and medical care, police, fire, tow trucks, and other vehicle assistance, etc. The isolation of rural areas, extensive time from the incident to detection, and response once the incident is detected all contribute to notifications and response times much longer than found in urban areas. This may lead to more severe consequences than might occur with a more rapid response.

Many rural areas maintain evacuation and disaster response plans for dealing with events such as hurricanes and floods. Timely warning and evacuation are critical to successfully responding to these events.

Rural user needs in the area of Emergency Services focus on measures designed to improve the emergency response process, from reducing incident detection and verification times through the process of selecting the most appropriate response. Needs in this area also include the need for emergency notification or warning in the event of natural disasters. ITS rural user needs in the area of Emergency Management emphasize communications and emergency services fleet management.
Communication related needs include the need to facilitate the transmission of critical information to better prepare caregivers at the scene, en-route, and at medical facilities as well as to provide incident information and warning notices to emergency vehicle crews. Fleet management related needs include facilitating arrival of emergency vehicles at the scene through vehicle routing, identification, and in vehicle warning systems. User needs in this area also include the need for coordination of different services and the need to share critical and appropriate information on the emergency as rapidly as possible.

ITS user needs identified for Emergency Services in rural areas fall into the following four general categories:

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

4.2.1. Emergency Services User Needs

Response Information

Incident Notification – Should include information to assist emergency services personnel/agencies with operational responsibility for potentially large geographic areas and types of terrain (e.g., mountains). Information would include: when incident occurred, incident

location, incident type and classification, incident severity, information source, and confirmation of who is on-scene to establish protocols for appropriate response.

ResponseVehicle Location – Provide location of emergency vehicle to appropriate emergency management agency to facilitate dispatch and guidance of emergency vehicles to incident site over potentially large geographic areas and types of terrain (e.g., mountains). Location/routing system should include identification of all highway-rail intersections.

Rural Addressing – Determine location of destinations not available through existing/traditional sources and disseminates directions. Requires: uniform naming system and capability to cross reference latitude/longitude data with traditional local addresses. (Should follow/be consistent with FCC's work to locate cellular 911 calls.

Response Plans – Non-traditional response plans that promote multi-jurisdictional coordination of emergency response.

En-Route Services Information

The information/needs listed in this category should have the following characteristics:

- Information should be dynamic, with near real-time availability of resource inventory information.
- Information should be organized into two tiers for dissemination: call-in/general public and emergency services.
- Emergency vehicles should have priority treatment on toll roads and streets.

En-Route Directions – Provides emergency vehicle drivers (operating over potentially large geographic areas and types of terrain e.g., mountains) with information (e.g., congestion, travel time, incidents, etc.) and directions while en-route which will allow alternative routes to their destination to be chosen.

Emergency Centers/Medical – Provides location and availability of hospitals, clinics, emergency care centers, etc within a predefined range. Information also includes level of service of a facility (e.g., full trauma center or urgent care with no surgical services available).

Shelters/Red Cross (Weather) – Provides location and availability of sites designated as shelters during/following natural disasters and other emergency events within a predefined area or based on vehicle location.

Tow Services – Provides location and availability information for tow services in the area. Information would also include the type of tow services (e.g., industrial) available.

Trauma Systems Development Plan – Plans would include information on hospital communications protocols to include: how the hospitals communicate with each other, their dispatch process (what, when and how), and information sharing needs.

Emergency Assistance

Common requirements in this category include:

- Ability to relay information through multiple path communications
- Common data set format and terminology

Crash Information (Data, Voice) – Automatic or manual distress signal system to disseminate traveler vehicle location and crash characteristics needed by emergency services with operational responsibility for potentially large geographic areas and types of terrain (e.g., mountains). Required information includes: crash kinematics, delta-v, occupant information, if/when airbags deployed, vehicle characteristics (such as HAZMAT information), information on local weather conditions to determine wind direction/speed for HAZMAT information, such as provided by CAMEO model, and medical patient data in an encrypted or safeguarded format.

Emergency Notification/Response – Ability to automatically transmit information from traveler vehicle about occurrence of crash to include vehicle location and extent of crash damage from a variety of terrain environments to appropriate agency(s).

Vehicle Location – Provides location of vehicle involved in crash/incident over potentially large geographic areas and types of terrain (e.g., mountains) to appropriate emergency management agency.

System Operational Effectiveness

Inter-Agency Coordination (Emergency Services) – Systems designed to facilitate coordination of emergency response between traffic management and other agencies and emergency service providers in a wide range of geographic settings. Coordination should include:

- Data linkage to allow evaluation
- Standard format for data entry forms
- Uniform incident identification codes
- USDOT ID number for HAZMAT loads
- Private centers (ONSTAR)
- Process for verification information

Automatic Billing – Ability of emergency services to electronically process transactions with toll authorities, hospitals, and customers. Includes data linkage to facilitate evaluation, driver's license information, transmit a patient care report/registration from vehicle to hospital, and ability to safeguard information.

System Expansion – Ability to add new agencies/providers to the coordination system. Should include: services/systems such as ITS, Mayday, incorporate statewide planning prior to implementation, and identify process champion and all appropriate stakeholders.

4.3. Tourism and Travel

User needs in the Tourism and Travel area include the need to provide information and mobility services to tourists and destination locations, since many times visitors have little choice of mode (no auto) and require special services. Knowing where desired destinations are, how to get to them, and conditions along the way adds to the mobility and convenience of an area. Likewise, travelers must be aware of destinations before they can visit them.

Many rural areas are characterized by long distances between tourist destinations and diverse landforms including mountainous areas, forests and deserts, complicating information delivery to travelers in the region. Alternative modes of transportation such as shuttle buses may or may not be available from gateway communities further limiting information dissemination opportunities.

Providing services to tourists and others unfamiliar with the rural surroundings enhances the economic vitality of the area. In addition, once in a resort area, tourists often are hindered due to lack of a vehicle. As such, user needs in this area address aspects of both the "Mobility and Convenience" and "Economic Vitality and Productivity" goals for the Rural ITS program.

Tourism may also be a concern in any rural setting during major events and festivals. At these events the traffic, local population, and transportation problems of the participants, local residents, and emergency services swell to many times their average levels. Event logistics, traffic and parking management, provision of emergency communications, etc., are crucial to the success of these events and yet must be temporary in nature, and in most cases understandable to volunteers.

The main focus of user needs identified to date in this area is access to/dissemination of information. This includes information typically associated with electronic yellow pages, as well as weather and condition forecasting, route advisory information, information dissemination in hotels, roadside, wide band radio, etc. Tourism and travel needs also include the need for mobility through transit, paratransit, and Global Positioning Systems (for rental cars). User needs in the area of tourism and travel serve a variety of stakeholder to include: Tourism and Visitors Centers, Economic Development Bureaus, as well as the local service providers (transit authorities, State and Local Departments of Transportation, and Park Agencies).

ITS user needs identified for Tourism and Travel in rural areas are organized into the six general categories listed below. These categories are inter-related and are organized into these categories to facilitate subsequent analysis.

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

4.3.1. Tourism and Travel User Needs

Advisory Information

Pre-Trip Information – Provides route based information that focuses on destinations to include directions, estimated travel time and traffic conditions. Information would be tailored to include information of interests to hikers or bicyclists in areas such as national parks.

En-Route Directions – Provides travelers with information and directions (e.g., congestion, travel time, incidents, etc.) while en-route for route selection.

Roadway Traffic Conditions – Information to travelers describing effect of weather (e.g., visibility during snow storms), construction operations and other information (e.g., congestion near destination locations) affecting roadway operations.

Multimodal Route Information/Guidance – Disseminate information regarding routing and scheduling of various modes of transport in the area. Also includes location of system entry points (e.g., terminals).

Service Facility Availability – Disseminate information regarding the availability of traveler services or attractions such as those listed in a "Yellow Pages" traveler information service (e.g., hotel vacancies, 24 hour service stations, restaurants, etc.) within predefined area or range or based on vehicle location. Information would provide hours of operation.

Rural Addressing – Determine location of destinations not available through existing/traditional sources and disseminates directions.

Incident Warning - Provides notification and information concerning incidents to vehicle drivers, agencies, and information providers. Information would include incident severity and estimated duration.

En-Route Services Information

Yellow Pages – Information regarding traveler services in predefined area or based on vehicle location.

- Gas/Service Stations
- Lodging/Reservations
- Food/Restaurants
- Sites/Attractions
- Shopping Areas

- Historical Sites
- Rest Areas

Emergency Centers/Medical – Provides location and availability of hospitals, clinics, emergency care centers, etc within a predefined range. Information also includes level of service of a facility (e.g., full trauma center or urgent care with no surgical services available).

Shelters/Red Cross (Weather) – Provides location and availability of sites designated as shelters during/following natural disasters and other emergency events within a predefined area or based on vehicle location.

Emergency Assistance

Crash/Incident Information (Data, Voice) – Automatic or manual distress signal system disseminates vehicle location and crash/incident characteristics to appropriate management agency.

Transit Information

Transit Schedules – Disseminate information regarding scheduled transit services such as hours of operation, headways, fares, etc. Information should include specialized services such as shuttles serving major attractions in the area.

Public Transportation Routes/Services – Information regarding specific transit routes (to include transfer/connection information) and destinations as well as services (e.g., dial-a-ride) offered by area transportation providers.

Bus/Taxi Vehicle Location/Status – Information describing location of transit vehicles/taxis and anticipated arrival times.

Economic Development

Business Viability – Systems/practices designed to improve local transportation system operations, improved access to interstates, ports, dissemination of services to travelers, etc. Should also include customized information for business operators, CVO operators, and tourist travelers.

Trip Enhancement – Systems that allows travelers to access information through a variety of media regarding (fixed and mobile sources) regional tourist attractions and traveler services.

Electronic/Multiple-Use Payment Device – Card or other payment media that can be used to pay for transit and other services (e.g., retail).

Data Sharing

Market Data – Systems that collects information related to or which can be used to develop marketing strategies for regional business community.

4.4. Traffic Management

Travelers in rural areas are often faced with traffic congestion and excessive delays when traveling through construction areas or near seasonal or cyclical attraction areas such as ski areas, beaches, national parks, etc. Although congestion is less frequent than in urban areas, the lack of alternate routes in rural areas often results in traffic congestion as severe as that experienced in urban areas, creating costly and lengthy delays. Incident-related delay, exacerbated by the longer response times typical in rural areas and the high rate of fatal crashes (nearly twice that of urban areas) also contributes to traffic congestion and traveler delay along rural roadways. In addition, sudden, or unexpected areas of congestion may also contribute to secondary incidents and additional traveler delay.

Rural user needs in the area of Traffic Management focus on information requirements and management systems that can be adjusted or tailored to meet seasonal or periodic conditions. User needs include information regarding downstream traffic conditions, alternate routes around congested areas, road work requiring lane closure, changing or hazardous weather conditions, and adaptive traffic signal or traffic management systems for traffic control through small urban areas.

ITS user needs identified for Traffic Management in rural areas fall into the following five general categories:

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

4.4.1. Traffic Management User Needs

Advisory Information

Pre-trip and En-Route Directions – Provides information (e.g., congestion, travel time, etc.) and directions prior to a trip or while en-route for route selection. This information needs to be conveyed to vehicle drivers, commercial vehicle operators, tourists, emergency services, and transit users. Information may have to be provided across large geographic areas and types of terrain such as mountains.

Roadway Traffic Conditions – Information describing levels of congestion on area roadways such as volume and speed data. . Information may have to be provided across large geographic areas and types of terrain such as mountains.

Vehicle Location – Location of vehicles serving as mobile probes to provide data on travel times for congestion information. Vehicle location needs to specify a common mapping system

There is a need to have regional agreement on consistent naming and addressing. There is a need to automatically know the location of a vehicle calling in an incident as travelers/users don't always know where they are. A consistent means of showing rural addresses on electronic maps is needed. In addition, information may have to be provided across large geographic areas and types of terrain such as mountains.

Multimodal Route Information/Guidance – Disseminate information regarding routing and scheduling of various modes of transport in the area. Also includes location of system entry points (e.g., terminals).

Incident Information – There is a need to communicate among all agencies involved or potentially involved of the status of incidents. The information related to roadway closures and alternates needs to be communicated with drivers (pre-trip or en-route) in a variety of geographic settings.

Emergency Evacuation Routes — There is a need to maintain locations of emergency management/ evacuation routes, and staging areas for disaster recovery. There is also need to determine whether a HAZMAT incident is by rail or heavy truck and to correlate the rail/truck routes for short term and long term alternative routing and evacuation.

Construction Information -- Advisory Information needs to include road construction, schedule for construction, and whether construction is actually taking place or not. For the commercial vehicle and transit community, information needs to be provided in advance to make routing choices. Other information which needs to be provided to commercial vehicle and transit operators includes spring weight restrictions for vehicles, and overheight restrictions.

Natural Road Closures – There is a need to have a category of incident that covers natural road closures. This includes: heavy rains, slides (mud, rock, snow), weather (fog, sleet, etc.), earthquakes, wildfires, and road conditions (black ice, etc.).

Traffic Control

Road Surface-Dynamic Warning/VSL – Systems designed to monitor and detect changes in roadway surface conditions affecting drivability. These systems would alert drivers of driving conditions and reduce posted (electronic) speed limits to speed consistent with roadway conditions.

Work Zone Intrusion – Systems to monitor traffic activity on the vicinity of work zones and to provide advice and warnings to maintenance and construction crews. System to advise or warn drivers as they approach work zones.

Work zone management – There is a need to help engineers design work zones according to accepted industry practices. There is a need to implement lane closure management to more smoothly merge lanes.

Speed Warning – Need to notify users of their own speed using visual warning device such as a VMS.

Reduced Speed Ahead -- Need to notify users to reduce speed. The speed reduction may be to prevent rear-end collisions with slow moving vehicles such as farm vehicles.

Bridge Warning – There is a need to notify users of draw bridge up.

Signal Coordination – Systems which provide traffic management agencies with capability to adjust signal timing to efficiently manage periodic congestion. These types of systems include adaptive signal control systems and systems with self-timing capabilities for small communities.

Road Closure Management – Systems designed to enable remote closure of swing gates at road closure points and monitoring/signage on roads leading up to closure points so that remote closures can be done safely.

Seasonal Delays – Systems designed to manage delays associated with specific seasons such as flooding of certain areas in the spring or road and bridge icing during the winter (e.g. portable traffic management systems, weather information systems, etc.).

Seasonal Events – Systems designed to address conditions associated with seasonal/annual events such as higher than usual numbers of farm equipment on roads during harvest season or high levels of congestion due annual events such as rodeos, fairs ski season, hunting season (e.g., portable traffic management systems, etc.).

Incidents – Systems designed to provide a coordinated response to incidents in the area (which may cover a variety of landforms and significant distances). System capabilities would include ability to anticipate and plan, detect, verify, and assess incident/crash severity.

Incidents -- Multiple jurisdictions (over potentially large geographic areas with various types of terrain) need to know whether they are the only agency or one of many agencies responding.

Inter-Agency Coordination (O&M) – Systems designed to facilitate coordination of O&M activities with traffic management and other related agencies (e.g., maintenance vehicle tracking, shared operations, 24/7 operations, anticipated delays, roadways affected, etc.). In addition, not all rural areas have the resources to maintain or operate systems. Therefore, there is a need to share in O&M cost of utilities, and infrastructure. There is a need to leverage existing public-public partnerships to maintain ITS and other critical devices in rural areas.

Inter-Agency Coordination (Alternate Routes) – It is critical to determine alternative routes and information sharing needs between agencies and stakeholders. Stakeholders must include traditional public agencies, but also private sector such as restaurants, hotels, and gas stations.

Data Collection – System designed to facilitate collection of real-time traffic data. There is a need to collect historical traffic data for planning purposes. There is a need to be able to collect

information from the private sector without that information becoming part of the public domain.

Planning – There is a need to conduct more comprehensive planning of rural ITS systems than urban, especially when considering data collection systems and infrastructure.

Remote monitoring and maintenance – There is a need to monitor and have system malfunctions transmitted from remote location (over potentially large areas and terrain types). Systems need to track equipment malfunctions and failure from remote maintenance sites.

Statewide/Regional TOC – The need to coordinate and share information and operations. Sharing of control is also needed to allow functions of a TOC to take place across agencies when and where necessary.

Virtual TOC – Remote maintenance site could be used as a temporary TOC if needs warranted. This need also extends to the use of mobile command centers (i.e. van) .

Entrance Fee Collection – Systems to enable use of technologies such as toll tags for collecting entrance fees at national parks and other attractions generating large traffic volumes/queues.

Communications System Redundancy – A need exists that cell phones, and communications in general, have a backup capability, i.e. no single point of failure for communications (over potentially large areas and terrain types).

Enforcement

Speed Enforcement – Systems designed to enhance law enforcement's ability to effectively enforce speed limits in the area.

Unsafe Driving for Conditions – Systems designed to identify unsafe driving.

Remote Monitoring of Sites – Systems designed to provide video monitoring of key sites.

Economic Development/Environmental Protection

Reduce High Emission (Acceleration & Deceleration) – Systems designed to provide traffic conditions that reduce areas characterized by frequent acceleration and deceleration (e.g., bottlenecks, major arterials with poorly coordinated signal systems, etc.).

Reduce Vehicle Trips (Emissions) – Systems or practices designed to reduce SOV trips (e.g., ridesharing programs, multi-use zoning, transit promotions, etc.)

Reduce VMT (Emissions) – Systems or practices designed to reduce VMT (e.g., transit promotions, multi-use zoning, parks, etc.)

Data Sharing

Market Data – System that collects information related to or which can be used to assess effectiveness of traffic management strategies (e.g., traffic conditions, regional traveler information, planning information, other centers).

4.5. Rural Transit and Mobility

Isolation and accessibility to transportation services are critical concerns to many rural inhabitants. As the nation ages the need for accessible mobility services will become much more important. This is especially true for rural areas where neighbors are often miles apart, trip distances are long, and travel to common origins and destinations is infrequent. Key stakeholders in the area of rural transit needs include rural residents, visitors to tourist areas, rural transit agencies and human service providers.

Rural user needs in the area of rural transit focus on providing and having access to traditional fixed-route transit, flexibly-routed transit, demand-responsive paratransit, and other services associated with the ability to make a desired trip. Identifying those who need services, determining what types of services are needed; and determining how to provide the needed services in an efficient and effective manner, are key elements in defining rural transit user needs from the transit agency perspective. Further, there are additional factors that must be considered, including: the needs of agencies to identify special non-transit services (nursing, meals on wheels, hospital out patient, etc.); and the needs associated with coordination and communication between the many providers of services that may be involved (such as transit agencies and social service providers). From the customer's perspective, the needs include services that go where and when customers need to travel; access to accurate, real-time information regarding arrivals and departures; and better customer service.

ITS user needs identified for transit in rural areas fall into the following five general categories:

- Transit Management
- Traveler Information
- Electronic Fare Payment
- System Operational Effectiveness
- Data Sharing

4.5.1. Transit and Mobility User Needs

Transit Management

Vehicle Location – Determines location of vehicles and provides display in dispatch (or alternate locations) of appropriate agencies. Specific information needs/capabilities include:

- The display of real-time or near real-time vehicle location at a central management facility and for the general public should be considered
- Vehicle location should be linked to automated scheduling
- Vehicle location data can support safety-related decisions, such as those involving bad weather
- Vehicle location data can support recording revenue and non-revenue vehicle time and mileage, which is used to determine budget compliance

- Vehicle location data can assist in the preparation of the National Transit Database data (formerly Section 15 data)
- Vehicle location data can support the investigation of fraud issues, such as eligibility, safety and payroll
- Vehicle location technology can support a silent alarm feature, which can notify dispatch in the event of an incident on-board the vehicle
- Vehicle location technology will support using transit vehicles as "probes" to identify certain roadway conditions for transportation management centers and/or traffic operations centers

Automated Scheduling - Provides vehicle schedules for all transit services and provides input to dispatching. Specific information needs/capabilities include :

- Automated call taking and scheduling for demand-responsive service;
- Customer-generated ride request via a telephone and/or personal computer;
- Dynamic/adaptive scheduling, including feedback between vehicle location and scheduling functions.

Computer Aided Dispatch (CAD) - Provides schedule adherence; route adherence; communications among dispatch, vehicle operators, road supervisors and maintenance; and computer-aided service restoration. Specific information needs/capabilities include:

- This need should be fulfilled across all modes;
- CAD should support retaining the history of operations
- Access to a communication system is an absolute necessity for effective CAD
- CAD, along with two-way communication, should facilitate identifying no shows, and subsequently dispatching a vehicle for another piece of work
- CAD should assist in maintaining ridership
- CAD should provide a link between the transit agency and emergency services
- CAD should provide information to vehicle operators, such as wind speed, which is important when handling wheelchair passengers

Geographic Information - Computerized database management in which geographic databases are related to one another via a common set of location coordinates. Geographic information should be provided on-board vehicles for drivers and at all dispatch locations.

Advanced Communications - Communications systems (voice and data) that are capable of covering large rural areas and various types of terrain (e.g., mountains). Reliable and redundant communications for transit are a must. The communications infrastructure should be a common infrastructure, integrated with other transportation entities, such as a transportation management center (TMC), highway maintenance, emergency services, State highway patrol, etc.

En-Route Directions – Provides vehicle drivers with driving directions to destinations while en-route. This need will support determining the accessibility of particular addresses (e.g., house

has ramp for wheelchair), and will support transit maintenance (e.g., sending a maintenance vehicle to a particular location for a road call).

Roadway Conditions – Provides vehicle operators and dispatchers with information describing roadway conditions.

Rural Addressing – Provides location of destinations not available through existing/traditional sources including tribal lands.

Traveler Information

Pre-Trip Traveler Information - Information regarding transit routes, maps, schedules, fares, park-and-ride lot locations, points of interest, traffic conditions, weather, etc. provided through various media. Both real-time and static information are needed. Specific needs include: itinerary planning for regional tripmaking (using multiple modes/systems), information on intermodal connections; and notification of vehicle status and/or arrival time (e.g., beeping someone when the vehicle that is picking them up is five minutes from their home).

In-Terminal/Wayside Traveler Information - Similar to pre-trip information, but provided to traveler as he/she make their trip. Needs include en-route real-time information about connections/transfers (including intermodal connections); estimated time of arrival; and real-time arrivals and departures. Information needs would also include disability accessibility information, security information, language translation capabilities, and for transfer locations, information about services available within close proximity to these locations (e.g., local shopping, ATM machines, etc.)

In-Vehicle Traveler Information - Information on real-time arrivals and departures, and connections/transfers (including intermodal connections), stop announcements, security information; and language translation capabilities.

Vehicle Location and Estimated Time to Arrival– Provides location of vehicle and estimated arrival time to travelers.

Multimodal Traveler Information/Guidance – Information regarding routes, schedules and itineraries for various modes of transport in the region. Also includes location of stations and/or terminals

Automatic Callback – Notification from service provider to customer confirming trip and indicating when vehicle will arrive.

Emergency Trip Cancellation - Communication between the transit agency and the traveler in case of emergency. Intended for the traveler who experiences an emergency and is unable to communicate such to the vehicle operator before the operator arrives at the traveler's pick-up location (and would otherwise consider the traveler a no-show).

Emergency Driver Communication - Communication between dispatch and the vehicle operator in case of emergency.

Electronic Fare Payment

Electronic Fare Payment - Non-cash fare payment (e.g., using magnetic stripe card, contactless smart card, etc.). There should be a linkage between this need and automated billing.

Multiple-Use Payment Device - Card that could be used to pay for transit and other services (e.g., retail). There should be a linkage between this need and automated billing.

System Operational Effectiveness

Service Coordination – System to coordinate services among transit providers to enhance transit service (e.g., nearest vehicle to service)

Service Planning and Evaluation – Measures or systems designed to facilitate expansion of transit services in the region (e.g., customer needs, business development tracking, housing development tracking, demographic tracking, etc.), and system services/modes simulation capabilities. The simulation of new services/modes would be based on historical data about existing services, travel patterns, etc. (e.g., "SIMBUS")

Automated Billing – Ability of transit agencies to automatically generate third-party billing. Should have capability for linkage to Electronic Fare Payment and Multiple-Use Payment Device systems.

Trip Reliability - Systems designed to improve the schedule adherence of transit vehicles

Information for Traveler Requests - The use of real-time information to respond to traveler requests. For example, this need would support investigating a complaint that the transit vehicle never arrived at a traveler's home for pick-up, or would support a request for an estimated time to arrival for a pick-up. Further, the real-time information could be used as input to the planning and scheduling process to better serve customers' needs.

Transit Maintenance - Transit maintenance refers to those activities associated with scheduled, preventative and unscheduled/corrective maintenance of transit vehicles and associated equipment. Transit maintenance is linked to needs previously described in the Transit Management category, such as vehicle location, automated scheduling and computer-aided dispatch.

Training - Training is a need that becomes more significant as technology is added to various aspects of a transit agency's operations. Specific training is needed to describe current state-of-the-art technology that may help solve specific service, maintenance, and customer-related problems.

Data Sharing

Roadway Conditions - Two-way exchange of data, such as congestion levels and roadway travel times, between transit agency and traffic management center(s).

Regional Traveler Information - Exchange of data between transit agency, and regional traveler information providers and agencies.

Planning Information - Exchange of data between transit agency and local/regional planning organization to facilitate modifying, adding or deleting transit service. This exchange would include design elements of developments to facilitate transit-friendly design.

Other Data Exchanges - Other organizations that transit agencies would share data with include:

- State DOT
- State tourism bureau
- State department of health and human services and commission(s) on aging
- Economic development agency(ies) and chambers of commerce
- Emergency management
- Intercity transportation providers
- Other major transit providers
- "Main St. Network Groups" to promote appropriate development

4.6. Crash Prevention and Security

Within rural transportation settings, the type, rate, and severity of incidents/accidents have been repeatedly identified as one of the most serious problems that needs to be addressed. For example, accidents per-vehicle-mile-traveled are higher in rural settings than in urban areas and tend to be more severe due to higher vehicle operating speeds and longer travel times for emergency service response.

Rural ITS User Needs for Crash Prevention and Security focus on preventing crashes before they occur, reducing the severity of the crashes that do take place, and safeguarding other users of the transportation system (i.e., transit riders). These identified User Needs center around improving a driver's ability to operate a vehicle safely in rural settings. Therefore, they address the three (3) main components of vehicle crashes: the driver, the vehicle, and the roadway. These User Needs further attempt to reduce the factors that influence a crash: for example, diminishing driver alertness, roadway obstructions (e.g., animals, debris, etc.), poor roadway conditions (e.g., weather, visibility, roadway geometrics, etc.).

Other Rural ITS User Needs in this category involve increasing the security (both actual and perceived) of travelers during their trip. For example, a traveler may be injured even though he or she has not been involved in a vehicular accident (i.e., transit patron assaulted while waiting for a bus). Thus, providing a secure environment through remote monitoring of key transportation sites, the presence of silent alarms, and automated vehicle location (AVL) systems are also included.

Rural ITS User Needs identified for Crash Prevention and Security are broken-down into the following nine (9) categories:

- Collision Avoidance
- Roadway Geometrics
- Roadway/Weather Information Systems (RWIS)
- Work Zone Control/Advisory System
- Highway-Rail Intersection (HRI) Crossings
- Vehicle Pre-Emption
- Security
- Data Sharing

4.6.1. Crash Prevention and Security User Needs

Collision Avoidance

Collision Avoidance - systems designed to alert driver of impending situations that are inconsistent with safe vehicle movements and speeds on the roadway.

Foreign Objects/Obstructions in the Roadway – Systems designed to alert driver to impending situations that are inconsistent with safe headways or impending collisions with obstructions in the roadway (e.g., slow moving/stopped vehicles, large rocks/debris, pedestrians, animals, etc.).

Perimeter Detection – System designed to alert driver to presence of foreign objects (e.g., vehicles, pedestrians, etc.) in areas around car (i.e., blind spots).

Animal Deterrence – Systems designed to deter animals from entering roadway.

Terrain Hazard Advisory – Systems designed to detect inconsistencies in a driver's transient surroundings and provide static and dynamic information provided to travelers regarding hazards (e.g., falling rocks/rock slides, mud slides, floods, etc.).

Roadway Traffic Conditions – Information describing levels of congestion on area roadways.

Roadway Enhancement/Shoulder Detection – Systems designed to improve driving characteristics of roadway and alert driver when within defined distance of shoulder.

Driver Status – System designed to monitor status of driver's ability to operate vehicle within defined parameters (e.g., alcoholic consumption, etc.). Includes systems designed to monitor alertness of driver and provide warning if level of alertness falls outside defined parameters.

Driver Enhancement – Systems designed to augment vehicle operator's capabilities (e.g., vision enhancement to see pedestrians and hazardous situations during periods of poor driving visibility, steering enhancements, speed-control enhancements, etc.).

Roadway Geometrics

Roadway Geometrics refers to systems designed to alert driver of areas where roadway geometrics affect driver safety (e.g., area with reduced site distance, sharp bends, curves, steep downgrades, etc.).

Roadway/Weather Information Systems (RWIS)

Roadway/Weather Information Systems (RWIS) includes elements to monitor and detect weather conditions that affect driver safety [e.g., visibility (snow/fog/sand), slippery roadway conditions (ice/snow/water), etc.).

Road Surface Dynamic Warning [Variable Speed Limit (VSL)] – Systems designed to monitor and detect changes in roadway surface conditions affecting drivability. These systems would alert drivers of driving conditions and actuate system designed to reduce posted (electronic) speed limits to speed consistent with roadway condition.

Speed Enforcement of Unsafe Driving Conditions – System designed to enhance law enforcement's ability to effectively identify and enforce unsafe driving conditions and driver behavior (e.g., speeding, weaving, etc,) to facilitate enforcement activities.

Work Zone Control/Advisory System

Work Zone Control/Advisory Systems - Systems designed to inform drivers of upcoming work zones, anticipated travel delays, and provide physical barriers to prevent vehicles from entering.

Highway-Rail Intersection Crossings

Overall Category Definition – Systems designed to warn vehicle operators of train proximity and provide barrier to prevent vehicle from entering rail/roadway intersection (i.e., crash avoidance).

Rail/Vehicle Conflict Advisory & Control – Systems designed to alert approaching drivers of vehicle presence at a rail/roadway intersection.

Train Detection/Notification – Systems designed to detect approaching train and to alert drivers within defined distance of roadway/rail intersection of approaching train.

Rail Crossing - Provides traffic control of highway and rail traffic for at-grade highway-rail intersections.

Vehicle Pre-emption

Vehicle pre-emption systems designed to allow for safe passage of vehicles through signalized intersections:

- Emergency Vehicles
- Warnings to Non-Emergency Vehicles

Security

Overall Category Definition – Systems designed to provide remote monitoring (e.g., video, audio, vehicle presence, etc.) of an area or vehicle to a 3rd party in order to enhance site safety.

Remote Monitoring of Sites – System designed to provide monitoring at key locations (e.g., inside bus, rest area, bus stop, transit terminals, etc.).

Vehicle Location – Systems designed to provide location of vehicles to the driver and the appropriate management agency.

Individual Location – Systems designed to provide location of a particular individual (e.g., hiker/ranger in National Park, etc.) to the appropriate agency.

Silent Alarms – Systems designed to provide system users with access to silently activated alarms.

Roadway Throughput – Systems designed to track vehicle at specific roadway intervals in order to detect when a potential roadway hazard or event may have occurred (e.g., 100 vehicles pass Point A on mountain road but none pass Point B 5-miles down the road → possible avalanche, etc.).

Data Sharing

Data Sharing refers to sharing of appropriate information with other agencies that will assist in their mission/operations.

Shared with the appropriate regional traffic management agencies:

- Terrain Hazard Advisory
- Roadway Traffic Conditions
- Roadway/Weather Information System (RWIS)
- Road Surface Dynamic Warning [Variable Speed Limit (VSL)]
- Vehicle Presence at Intersection Notification
- En-Route Directions
- Train Detection/Notification
- Rail Crossing
- Remote Monitoring of Sites
- Vehicle Location
- Silent Alarms

Shared with the appropriate railway organizations:

- Train Detection/Notification
- Rail Crossing

Shared with the appropriate transit management centers:

- Remote Monitoring of Sites
- Vehicle Location
- Silent Alarms
- Terrain Hazard Advisory
- Roadway Traffic Conditions
- Roadway/Weather Information System (RWIS)
- Road Surface Dynamic Warning [Variable Speed Limit (VSL)]
- Vehicle Presence at Intersection Notification
- En-Route Directions
- Train Detection/Notification
- Rail Crossing

Shared with insurance carriers:
- Insurance-Actuarial Data (e.g., vehicle miles traveled (VMT), vehicle safety records, etc.)

Shared with safety planning agencies:
- All information collected to support every User Need (Archived Data)

Potential sharing with 3rd party enforcement agencies:

- Road Surface Dynamic Warning [Variable Speed Limit (VSL)]
- Driver Status
- Alertness

4.7. Operations and Maintenance

The isolation, distances involved, and the large number of rural roadway miles makes the operation and maintenance of the rural transportation infrastructure both challenging and costly. Low traffic volumes on these roads also makes the detection of problems and conditions a concern. Similarly, operations and maintenance activities are difficult for rural public transportation service providers, which are frequently small, dispersed, and which lack adequate human and financial resources.

Operations and maintenance of rural roads and their associated infrastructure is typically the responsibility of public agencies at the state, county or city and township level. Their responsibilities include monitoring, maintaining, and improving the physical condition of the infrastructure; maintaining the condition of public vehicle fleets; ensuring safe operation of the system, especially under adverse travel conditions, such as winter weather, or during construction and other work zone activities; and ensuring the efficient operation of the system, including the use and maintenance of various traffic management and traffic control devices.

In general, rural user needs in the operations and maintenance area focus on the issues of reducing costs, while maintaining or improving the efficiency and effectiveness of these activities.

ITS user needs for operations and maintenance in rural areas fall into the following categories:

- Infrastructure management
- Roadway condition monitoring
- Safety management
- System maintenance effectiveness
- System operations effectiveness
- Public fleet management
- Security
- Data collection and sharing

4.7.1. Operations and Maintenance User Needs

Infrastructure Management

Infrastructure Inventory and Condition Monitoring – Systems to collect, disseminate, and maintain information about the location, types, and condition/integrity of physical roadway infrastructure, including the pavement, bridges, materials, structures, signs, and other roadway devices, and the condition, and operations and maintenance needs of each, and about roadway closures and restrictions. Information should cover multiple agencies, and should support data sharing between agencies. Information should be accessible to field crews responsible for operations and maintenance. Consequently, the system should be appropriate for skill levels found in small maintenance sections many of which may be located in widely dispersed locations.

Work Zone Location Information – Systems designed to gather, store, and disseminate information about work zones and construction activities, such as locations, alternate routes, and anticipated delays, for short-term and long-term activities. These systems should support internal operations and maintenance needs, should be available to support commercial vehicle routing activities, and be suitable for providing information to traveler information systems and travel service organizations. Data should be collected in real-time and accessible information should be up-to-date. These systems should be capable of correlating planned activities with actual work in the field and they should support both pre-trip and at-site applications.

Portable System Resource Management – Systems to monitor the location and usage of portable assets (over widely separated locations and terrain types) such as portable traffic management and work zone management systems, and to manage the scheduling, delivery, set-up, operation, and return of such devices.

Roadway Condition Monitoring

Roadway Traffic Conditions – Systems to monitor traffic levels on roadways, and to provide information regarding the impacts that certain traffic levels would have on alternate roadways in the event of re-routing due to operations and maintenance activities.

Roadway Surface and Atmospheric Conditions – Systems to monitor and detect changes in roadway surface conditions and other weather and atmospheric conditions affecting drivability, and to alert agencies (potentially located in widely separated locations) of such changes. Conditions to be monitored would include ice, precipitation, fog, wind, blowing dust, and potentially air quality. Roadway surface condition information should also include a determination of coefficient of friction. Could also actuate systems to advise or warn drivers of these conditions as well as automatic de-icing systems.

Safety Management

Smart Work Zones – Systems to monitor, control, and direct traffic activity in the vicinity of work zones with the objective of enhancing the safety of maintenance and construction crews. These systems should be incorporated in work zone set-up procedures without increasing the burden on the crews. Ideally these systems would be accompanied by increased police enforcement in the work zone. Could also actuate systems to advise or warn drivers as they approach work zones.

System Maintenance Effectiveness

Winter Weather Maintenance – Systems to enhance the efficiency of pre-treatment and plowing operations, such as providing up-to-date information on weather and roadway surface conditions, location of nearest maintenance vehicle, time of last treatment or plowing per segment, or type of treatment or chemicals applied. Should also include systems on-board the maintenance vehicles that provide vehicle location, the ability for automated environmental recording, and automated recording of operational data (e.g., spreader on/off).

Winter Weather Maintenance Safety – Systems installed on-board snow plows and other winter maintenance vehicles to assist the operator in lane following and detecting obstructions.

Infrastructure Maintenance – Systems to facilitate efficient use and scheduling of resources to perform routine infrastructure maintenance, such as striping, patching, installation, and other repairs. Should also include systems on-board maintenance vehicles for automated logging of observed maintenance needs.

System Operations Effectiveness

Inter-Agency Coordination – Systems to facilitate coordination of operations and maintenance activities within and between agencies, such as sharing information about affected roadways and anticipated duration, or sharing resources.

Asset Management – Systems to facilitate management of operations and maintenance assets, such as the type, location, failure rates, and maintenance schedules of equipment, infrastructure, and the roadway. These systems should provide predication of when failures will occur so that preventative maintenance can be performed.

Natural Events Management – Systems to support enhanced allocation, dispatch and use of operations and maintenance resources during natural events or disasters, such as roadway icing, flooding, avalanches, and mud slides.

Seasonal and Planned Events Management – Systems to support operations and maintenance activities, such as dispatching and pre-positioning of equipment and resources during seasonal events, such as agricultural equipment movements during harvesting or traffic conditions during ski season, or during planned special events, such as traffic conditions around fairs or cultural events. Should include coordination with the private sector, such as event operators, where appropriate.

Incident Management – Systems to detect, verify and assess incident severity, and to provide a coordinated response to incidents. Approach should emphasize inter-agency coordination and communications and should consider emergency situations, such as hazardous material spills.

Public Fleet Management

Real-Time Information – Systems to provide vehicle operators and dispatchers with real-time routing information, for example, relating to congestion, incidents, or fixed and temporary roadway restrictions, and real-time information relating to predicted equipment failures. Could also support other traveler information systems.

Vehicle Location and Status – Systems to provide information on the location and status of vehicles in public fleets operating in various types of terrain such as mountains, including information about predicted failures of the vehicle or its on-board equipment.

Computer-Aided Dispatching – Systems to support route planning, scheduling and dispatching of vehicles in public fleets. Should include inter-agency communications (e.g., for a highway patrol officer responding to a crash and finding the roadway icy to request a gritting truck).

Rural Addressing – Information on destination locations, such as remote rural residences, that are not available through existing, traditional sources, used to support a variety of systems.

Security

Remote Monitoring of Sites – Systems to provide video monitoring of activities at remote sites (potentially located at widely dispersed areas), such as rest areas.

Silent Alarms – Systems to provide operators of vehicles with silently activated alarms to use in emergency situations.

Data Collection and Sharing

Performance and Planning Data – Systems to collect and store data on a variety of applications for subsequent analysis and distribution. Systems should be used as the basis of information dissemination applications

Infrastructure Information – Systems to provide access to databases necessary for assessing right-of-way, as-built drawings, and other CAD information. Should be updated regularly (e.g., to include information from recent bridge inspections).

4.8. Surface Transportation and Weather

Rural areas represent a diverse variety of terrain types ranging from mountainous areas to desert areas located below sea level. Weather conditions for rural travelers reflect this variety of characteristics. Some rural areas include such extreme differences in terrain and variability of weather within a single corridor, even within the same time frame. Weather-related crashes and delays represent a chronic problem for some rural areas prone to abrupt changes in conditions, terrain induced variability, and even seasonal occurrences such as spring and summer rainstorms creating flash flood conditions. Steep mountain grades combined with icy conditions present significant problems for commercial vehicle operators (as well as other travelers). Long response times of emergency services in these conditions delay vitally needed medical care, and further exacerbate travel delays due to secondary incidents.

Rural user needs in the area of Weather focus on support to decision making prior to trip initiation, monitoring roadway weather conditions for trips and operations that are underway, and communicating this information to system users. Rural user needs in this area also include providing service information to travelers who are not able to continue their trips due to hazardous conditions.

ITS user needs for Weather information in rural areas involve gathering, processing and dissemination and fall into the following five general categories:

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

There are also distinctly different domains of weather information, including: climatology, observations, and forecasts of the atmosphere, and of pavement/ground conditions.

Tailoring of weather information for specific users is at least regionalized or presented at local scales, which are defined climatologically. Successful use of weather information to optimize decision making depends on education of users relative to meteorology and diagnostic and forecasting capabilities, and of weather information providers relative to specific user requirements.

Evaluation of forecast accuracy, and conditioning of forecasts such as by assignment of probability, are complex issues that need attention in operational environments.

4.8.1. Surface Transportation and Weather User Needs

Advisory Information

Weather Warnings/Advisories:

_ Information regarding roadway and bridge surface conditions and timing that could affect travel conditions and operating speeds in the area (e.g., snow, icing, standing water, etc.)
_ Information regarding weather conditions and timing that could affect travel conditions in the area (e.g., fog, freezing precipitation, thunderstorms, snow, tornadoes, visibility, etc.)
_ Education of weather information users and providers re: the effects of weather on travel improve the outcome of decisions for weather-impacted activities.

Needs are addressed by need category (e.g., Traffic Management).

Some particular needs include:

Emergency Services

- Forecasts for short term planning and observations of current weather to determine the maximum safe speed and routing available to responders, duration of closures, and mode choice. Surface and air responses have differing requirements.
- All scales of information required, temporal and spatial—historical, prospective, short-term forecast, current conditions. There is a moving domain of interest, starting with large area during early planning, forecasts for each geographical and functional areas of interest, small areas for near-term and instant case. Weather information detail varies from synoptic (winter storm, for example) to mesoscale (thunderstorm).
- Customers include emergency response team and emergency operations centers, victims, responders, trauma centers, analysts.
- Decision making and weather information development and dissemination processes may be similar among users; but details of the information varies.

Tourism/Traveler

- Some parameters of interest, forecast and observed, include: road conditions, wind speed and direction, visibility, hazardous and severe weather.
- General weather conditions for tourist enjoyment, regional and national scale depending on trip length.
- Road conditions deriving from weather effects on terrain, such as falling rock, mud and rock slides, avalanches.
- Travelers advisory usually has a short horizon for trips. Combine weather, road, and traffic information to provide travel information. Formats should be simple for lay-travelers, and focussed on their route of travel. Weather information may be most useful when embedded in broader indicators such as Level of Service (LOS).
- There is a subtle conflict between the desire of recreation/destination operators to have weather portrayed in the most attractive light, and the need of tourists/travelers for targeted decision support.

Traffic Management

- Same as previous two tracks as well as the following:
- Weather effects on crew and staff scheduling is important.
- Forecast and observed weather impacts on traffic flow.
- Inputs to drafting of interagency agreements; e.g. permissible alternate routes necessitated by weather variations, and what, when, where and severity effects on traffic management actions.
- Duration and spatial extent of weather event; effect on designation of alternate routing.
- Weather observations and forecasts as input to traffic models.

Transit and Mobility

- Much like Traffic Management track, Also,
- Forecasts and observations focussed on routes of particular importance. Fixed route service removes alternate routing and schedule flexibility as options.
- Storm effects on roadway, rail, and pedestrian needs (passengers approaching, waiting, loading, unloading/departing).
- Thermal effects on trackage; icing on third-rail supplies.
- Snowfall rate, accumulation, drifting.
- Rain and hydrology, flash flooding and scouring.

Crash Prevention

- Road and bridge surface conditions, and their effects on speed.
- Visibility.
- Spot warning.
- Operator education regarding the effects of weather on crash occurrence.

Operations and Maintenance

- Forecasts of conditions likely to produce avalanches, mudslides.
- Weather to affect work zone scheduling, material and its delivery, constructability, equipment. Climatology for planning, forecasts for scheduling, observations for reactive changes.
- Effects on facilities: power supply (lightning), chemical storage, resource protection.

Terrain Hazard Advisory - Dynamic information for travelers regarding hazards such as falling rocks/rock slides, mud slides, avalanches, etc., pertains to all development tracks.

System Operational Effectiveness

Weather forecast and other systems providing appropriate information regarding weather conditions and timing which could potentially affect transportation system operations; and transportation user safety and efficiency.

Some particular needs include:

- Weather information requirements should be defined by each agency's (user) LOS standards. LOS usually depends on functional classification of roadways.
- Information gaps need to be filled to get sufficient observations both for diagnostic and forecast meteorology, and for operational use; and tailoring and synergistic (decision maker and meteorologist) integration are important.
- Cooperative agreements are needed to provide weather information for long and short range planning support resource management.
- Dissemination formats must have the user in mind.
- Forecast weather/solar effects on communications (e.g., microwave, high frequency).

En-Route Services Information

Shelters/Red Cross (Weather) – Determine location and availability of sites designated as shelters during/following natural disasters such as flooding and other emergency events within predefined area or based on vehicle location.

Some particular needs include:

- Very small scale weather impacts, spot conditions, affecting driving safety and travel time; for both "traveler's" intended route and alternates.
- Current and arrival time destination weather conditions.
- Observations and forecasts to support stop and restart "what if" evaluations.
- Lead time for determining when to activate shelters for emergencies.
- Current and forecast temperature and humidity for managing livestock stresses during travel.
- Consistency of language, format, and accessing of weather information across political boundaries.

Leveraging Weather Information to Cost containment, Profitability and Safe Operations/Travel

Weather Information Leveraging – Provide weather impact information on predetermined thresholds affecting cost and safety, with dissemination methods and formats tailored to various transportation users/stakeholders. Includes determining availability of suitable weather products and services, and/or taking actions to make them available.

Some particular needs include:

- Corridor orientation, especially for very long trips, to facilitate route selection/optimization.
- Climatology to minimize vulnerability to flooding, pavement deterioration, avalanche, etc. Also should optimize facilities placement.
- Weather forecasts for "just in time" and stocking logistical practices.
- Forecasts as the point of departure in anti-icing snow and ice control practices.
- Descriptive weather information to support economic development.

Data Sharing

Support to weather analysis and prediction for surface transportation:

- Systems to enhance and share weather and road surface condition historical records and current observations from multiple sources to support accurate and definitive weather forecasts for surface transportation.
- Identify any need to archive surface transportation generated weather data, and its value in the marketplace.

Appendix A
Workshop Agenda

Federal Highway Administration
Rural ITS User Needs Workshop
Agenda

AGENDA ITEMS	TIME
Registration/Continental Breakfast	8:00 AM – 8:30 AM
Rural ITS Program	8:30 AM – 9:00 AM
Workshop Goals and Objectives	9:00 AM – 9:15 AM
Participant Introductions	9:15 AM – 9:30 AM
Needs Development Process	9:30 AM – 9:45 AM
Overview of the Needs	9:45 AM – 10:00 AM
Break	10:00 AM – 10:15 AM
Group Breakout Session	
Presentation of Current User Needs	10:15 AM – 10:30 AM
User Needs/Issues Review	10:30 AM – 12:00 PM
Lunch	12:00 PM – 1:00 PM
Presentations by Group Leaders	1:00 PM – 2:30 PM
Participant Discussion	2:30 PM – 3:00 PM
Break	3:00 PM – 3:15 PM
Group Breakout Session Discussions of Rural Infrastructure/Technologies	3:15 PM – 4:30 PM
Next Steps/Closing Comments	4:30 PM – 5:00 PM
Adjourn	5:00 PM

Appendix B
Overview Presentations

Appendix C
Panel Moderators and Stakeholders

Rural ITS User Needs Workshop
Participants List

Crash Prevention and Security

Facilitator: **Chuck Dankocsik, Transcore** **Location:** **6th Floor**

Recorder: **Soumya Dey, SAIC**

Larry Brown
Federal Highway Administration

Thomas Bryer
Pennsylvania DOT

Major Larry Holestine
Colorado State Police

Ron Hughes
Human Factors & ITS Research
UNC Highway Safety Center

Warren Hughes
Bellomo-McGee Inc.

Richard Paddock
Traffic Safety Analysis Systems & Services, Inc.

Tim Peterson M.D.
Iowa Dept. of Public Health

Doug Siesel
Odetics ITS

Rural ITS User Needs Workshop
Participants List

Emergency Services

Facilitator: Steve Levine, Transcore **Location: 8th Floor**

Recorder: Dave Binkley, Lockheed Martin

Ginny Crowson
Minnesota DOT

Paul Einreinhofer
Bergen Co. Police Department

Mike Freitas
Federal Highway Department

Bob Glass
Jet Propulsion Laboratory

Gail Novak
Oakland County Emergency Mgmt.

Susan Schrage, RN
Mayo Clinic

John Tessandori
City of Piedmont Fire Department

Rural ITS User Needs Workshop
Participants List

Operations & Maintenance

Facilitator: Chris Hill, Castle Rock Consultants, Inc. Location: Conference Room A

Recorder: Russ Taylor, Lockheed Martin

Mike Bousliman
Montana DOT

Jeff Swan
Arizona DOT

Wayne Lupton
Colorado DOT

Gary Thompson
Minnesota DOT

Charles Neal
Odetics ITS

Ted Paselk
Oregon DOT

Tim Penney
Federal Highway Administration

Tom Ryan
Missouri DOT

Doug Schmitt
Pennsylvania DOT

Bayne Smith
Georgia DOT

Lee Smithson
Iowa DOT

Rural ITS User Needs Workshop
Participants List

Rural Transit & Mobility

Facilitator: Carol Schweiger, Multisystems Inc. **Location: Conference Room C**

Recorder: Karen Timpone, SAIC

Donna W. Allan
Minnesota DOT

Bill Cairns
Mitretek Transit

Michelle Cartwright
Kitsap Transit

Roger Dean
Intercity Transit Authority

Lawrence Harman
Lawrence J. Harman Consulting

Ron Ice
Odetics ITS

Cindy Johnson
Sweetwater Transit Authority

Russ Keeney
RCATS

Rose Lee
RIDES

Dwight Mengel
Tompkins Consolidated Area Transit System

Mary Jo Morandini
Beaver Co. Transit Authority

Boyd Thompson
ARC Transit

Paul Verchinski
US Department of Transportation

Karen Watkins
Lockheed Martin

Rural ITS User Needs Workshop
Participants List

Surface Transportation Weather

Facilitator: Doug Jonas, Matrix Management **Location: 5th Floor**

Recorder: Gary Nelson, Mitretek Transit

Michael Campbell
National Weather Service

Charnita Wilson
Lockheed Martin

Dean Deeter
Castle Rock Consultants

Dale Keep
Washington DOT

Steve Keppler
ITSA

Stephan Ketcham
USACRREL

Leon Osborne
University of North Dakota

Paul Pisano
Federal Highway Administration

John Quinlan
National Weather Service

Blaine Tsugawa
NOAA

John Whited
Iowa DOT

Rural ITS User Needs Workshop
Participants List
By Group

Traffic Management

Facilitator: **Manny Insignares, Transcore** **Location:** **Conference Room B**

Recorder: **Lee-Ann Seeling, Odetics ITS**

Jack Brown
Florida DOT

Allan Covlin
North Dakota DOT

Phil DeCabooter
ITS Program WI DOT

Leslie Jacobson
Washington DOT

Jim Nall
Colorado DOT

Marthand Nookala
Minnesota DOT

James Paral
New Jersey DOT

George Saylor
Ohio DOT

Matthew Volz
Kansas DOT

Tim Wolfe
Arizona DOT

Rural ITS User Needs Workshop
Participants List

Travel & Tourism

Facilitator: Steve Albert, Western Transportation Institute Location: 7th Floor

Recorder: Richard Hooper, Odetics ITS

Bruce Bender
Vermont AOT

Frank Cechini
Federal Highway Administration

Joe Coyne
Wyoming Business Council

Gregory Cross
Northern Shenandoah Valley Model
Rural ITS

Richard Foster
Vermont Information Center

Ann Hamilton
Franklin County Chamber of
Commerce

Joe Hunkins
Southern Oregon Visitors Assoc.

Steve Lyons
Maine Office of Tourism

Dale Thompson
Federal Highway Administration

Tom Van Hyning
Mississippi Dept. of Economic &
Community Development

Appendix D
Workshop Stakeholders

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RURAL ITS WORKSHOP

April 18, 1999

Workshop Agenda

Rural ITS Program	8:30 AM - 9:00 AM
Workshop Goals	9:00 AM - 9:05 AM
Participants' Introductions	9:05 AM - 9:30 AM
Overview of Needs	9:30 AM - 9:45 AM
Break	
Group Breakout Session	10:00 AM - 12:00 PM
Lunch	
Presentations by Group Leaders	1:00 PM - 2:30 PM
Participants Discussion	2:30 PM - 3:00 PM
Break	
Group Breakout Session	3:15 PM - 4:30 PM
Next Steps/Closing Comments	4:30 PM - 5:00 PM
Adjourn	5:00 PM

Rural ITS

Advanced Rural Transportation Systems

Paul Pisano
Federal Highway Administration

Four Program Areas

- Travel Management / Metropolitan
- Commercial Vehicle Operations
- Intelligent Vehicles
- Rural

So What is Rural ITS?

- That portion of the ITS Program that focuses on rural travelers' and operators' needs
- However, it is not limited to systems and services that only apply in rural areas
- Many if not all of the proposed systems and services have potential urban applications
- Emphasis on rural

What is the Scope of Rural ITS?

- Interurban / Interstate travel
- Small Communities
- Rural Counties
- Two-lane rural roads
- Statewide systems

Short-term goals

1-3 years

- Refine National ITS Architecture to include rural applications
- Define rural infrastructure
- Conduct operational tests
- Deliver information through:
  - Training,
  - Education, and
  - Technical Assistance

Development of Rural ITS

- Support contract for the Rural ITS program
- Defining and developing the rural ITS through systems engineering, integration, and deployment and planning guidance
- Contract team includes:
  - SAIC
  - Castle Rock Consultants
  - Western Transportation Institute
  - Multisystems

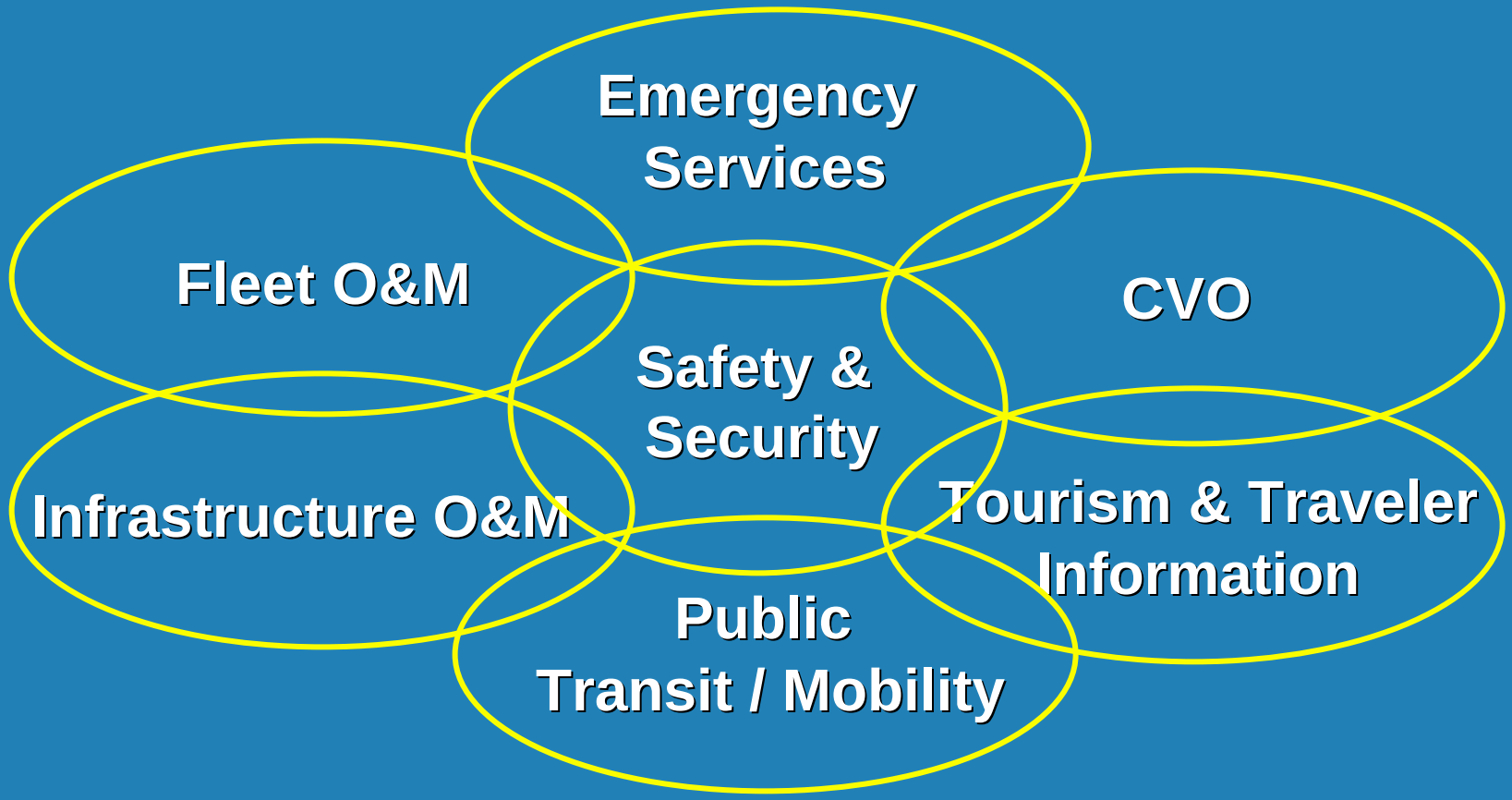
Rural ITS Vision

- An improved quality of life for rural residents and travelers because of safer, more secure, available and efficient movement of people and goods in Rural America, resulting in part from the judicious application of Intelligent Transportation Systems.

Critical Program Areas

- Critical Program Areas identify settings with similar attributes, needs and potential services. They provide a common basis for understanding, and enable clear communication about ARTS program development.

Critical Program Areas



Technology Focus Areas

- Emergency Services
- Tourism and Travel
- Traffic Management
- Transit and Mobility
- Crash Prevention and Security
- Operations and Maintenance
- Surface Transportation Weather

What's an architecture?

- An architecture is like a master plan that provides a common framework for planning, defining, and integrating technologies or systems.
- The National ITS Architecture is the framework that has been developed for the ITS program.

Why this Workshop?

- We must make sure the rural users and operators are appropriately represented in the ITS program.
- To do so, we are working with those on the front lines, the implementers, to make sure we've captured the needs.

RURAL ITS WORKSHOP

April 18, 1999

Moe Zarean Ph.D., P.E.

Overall Goals

- Develop a comprehensive list of rural ITS user needs
- Identify rural requirements to
  - define Rural Infrastructure
  - update Rural ITS Program Plan
  - provide input to the National ITS Architecture

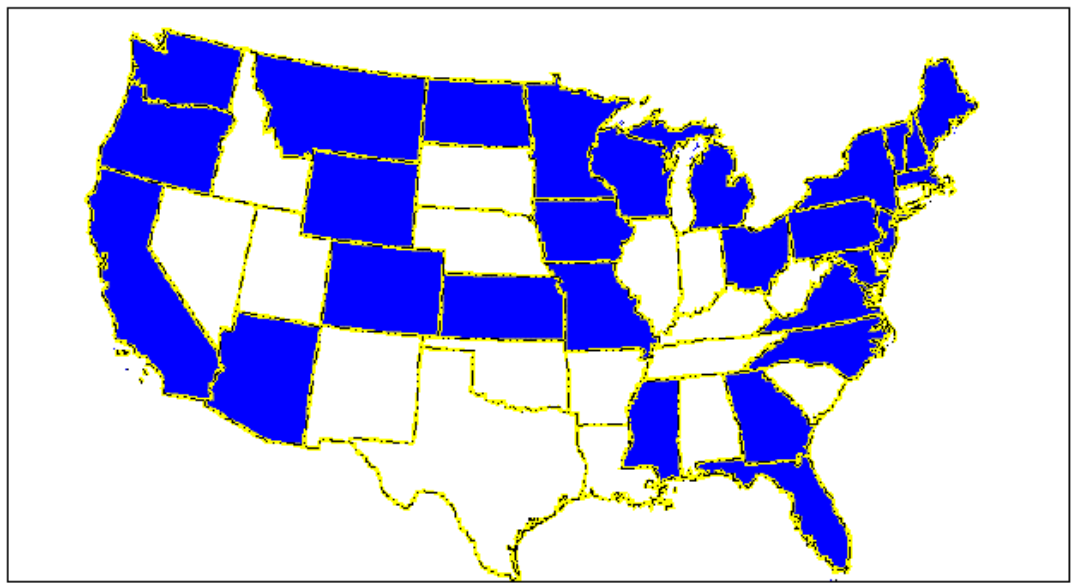
Workshop Goals

- Present existing rural user needs
- Obtain stakeholders input
- Identify any additions/modifications/deletions and
- Finalize rural user needs
- Discuss how these needs can be met

Participants' Introductions

- Name
- Agency
- Experience with Rural ITS (short statement)
  - Needs Study
  - Planning

States Represented at Rural ITS Workshop



Previous Rural User Needs Assessment Efforts

- **Rural Applications of Advanced Traveler Information Systems (ATIS)**
  - 31 focus Groups
  - 61 one-on-one interviews
  - 1025 telephone interviews
- **Rural Transit Study**
- **Minnesota Rural Scoping Study**
- **User needs assessments conducted by WTI**
- **Rural ITS Team needs list**

Rural ITS User Needs

- Emergency Services
- Tourism and Traveler Information
- Traffic Management
- Transit and Mobility
- Crash Prevention and Security
- Operations and Maintenance
- Surface Transportation Weather

Emergency Services

- **Advisory information:** en-route directions, vehicle location, rural addressing
- **En-route services information:** emergency centers/medical, shelters/Red Cross
- **Emergency assistance:** crash information, emergency notification/response, vehicle location
- **System operational effectiveness:** interagency coordination, automatic billing

Tourism and Traveler Information

- **Advisory Information:** en-route directions, traffic conditions, multimodal route information, service facility availability, rural addressing, incident warning
- **En-Route Services Information:**gas/service stations, lodging/reservations, food/restaurants, sites/attractions, emergency centers/medical, shelters/Red Cross
- **Emergency Assistance:** emergency notification and response
- **Transit Information:** transit schedules, public transportation routes/services, bus/taxi vehicle location/status
- **Economic Development:** business viability, enhance tourism, electronic/multiple-use payment devices

Traffic Management

- **Advisory Information:** en-route directions, traffic conditions, vehicle Location, multimodal route information/guidance
- **Signal Control:** signal coordination for small communities
- **System Operational Effectiveness:** traffic management, interagency coordination
- **Enforcement:** speed enforcement, unsafe driving for conditions

Transit and Mobility

- **Transit Management:** automatic vehicle location, computer aided dispatch(CAD)
- **Traveler Information:** pre-trip information, in-terminal/wayside information
- **Electronic Fare Payment**
- **Mobility:** welfare-to-work, elderly, commuters
- **System Operational Effectiveness:** service coordination, automatic billing

Crash Prevention and Security

- **Safety Information:** collision avoidance, slow moving vehicle warning, animal warning, hazards warning, work zone intrusion
- **Highway-Rail Intersection Crossing:** crash avoidance, train detection/notification
- **Security:** remote monitoring of sites, silent alarm

Operations and Maintenance

- **Infrastructure Management:** inventory and condition monitoring, work zone location information, roadway condition monitoring (traffic conditions, roadway surface conditions)
- **System Maintenance Effectiveness:** winter weather maintenance, infrastructure maintenance
- **System Operations Effectiveness:** inter-agency coordination, event management
- **Public Fleet Management:** vehicle location, CAD

Surface Transportation Weather

- **Advisory Information:** visibility conditions, roadway surface conditions, weather conditions
- **System Operational Effectiveness:** Weather conditions affecting transportation system operations
- **En-Route Services Information:** shelters/Red Cross
- **Data Sharing:** share weather data from and with multiple sources

Morning Breakout Sessions

- Review identified user needs
  - Identify additions/modifications/deletions
  - Completeness, level of detail
- Focus on the “type” of need to be addressed (the “WHAT”)
- Do not focus on institutional or technical issues (the “HOW”)

Afternoon Breakout Sessions

- Discuss “HOW” do you expect these needs to be addressed
  - Identify users (recipients)
  - Identify providers
  - Identify institutional and technical issues
  - Identify potential systems/technologies
- Develop a list of projects/contacts (re: “Lessons Learned”)

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Tourism & Traveler Info.	Steve Albert	7th Floor
Traffic Management	Manny Insignares	Conference Room B
Transit & Mobility	Carol Schweiger	Conference Room C
Crash Prevention & Security	Chuck Dankocsik	6th Floor
Operations & Maintenance	Chris Hill	Conference Room A
Weather	Doug Jonas	5TH Floor