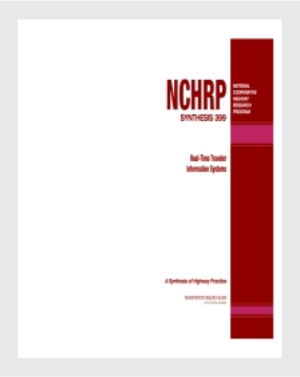

# Real-Time Traveler Information Systems

**DETAILS**

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

# NCHRP SYNTHESIS 399

# Real-Time Traveler Information Systems

## *A Synthesis of Highway Practice*

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West Linn, Oregon

**SUBJECT AREAS**
Highway Operation, Capacity, and Traffic Control, and Safety and Human Performance

Research Sponsored by the American Association of State Highway and Transportation Officials
in Cooperation with the Federal Highway Administration

**TRANSPORTATION RESEARCH BOARD**

WASHINGTON, D.C.
2009
www.TRB.org

**NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM**

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**Cover Figure:** Travel time sign (Brian Kary, Minnesota Department of Transportation).

## FOREWORD

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, *Synthesis of Highway Practice*.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

## PREFACE

*By Donna Vlasak*
*Senior Program Officer*
*Transportation*
*Research Board*

This synthesis reports on the state of the practice in real-time traveler information systems. Emphasis is placed on the needs and expectations of travelers, the current status of a variety of traveler information systems in the United States, available and emerging data sources, and business models for sustaining traveler information. This synthesis will benefit state DOT transportation managers and others that provide or seek to provide affordable, accurate, timely, and effective information in a format that travelers can use.

Four major activities were undertaken in this synthesis effort. A literature review of previous studies, evaluations, and research activities was conducted. In addition, a survey was distributed to 51 unique public agencies operating traveler information systems that achieved a 65% (33/51) response rate. A third major activity performed was to observe and test as many statewide, regional, and local traveler information systems as possible. Observing content and presentation of traveler information systems allowed the consultant to avoid asking extra survey questions and allowed for map presentations to describe types of content nationwide. A fourth major activity involved a number of in-person meetings and telephone discussions with a variety of transportation professionals representing both public and private sector industries with experience in either research, operating, or evaluating traveler information systems.

Dean Deeter, Athey Creek Consultants, West Linn, Oregon, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

# CONTENTS

# REAL-TIME TRAVELER INFORMATION SYSTEMS


## SUMMARY

Travelers who are informed about weather and driving conditions, delays and detours, and other situations that may affect their travel can use the information to make decisions and increase the mobility, safety, and satisfaction of their trip. From the moment travelers wake up and view the weather conditions outside their window until they complete their trip, they are receiving information that will benefit the many decisions they must make regarding mode choice, route choice, destination choice, and departure time. Real-time traveler information systems, operated by either public or private sector service providers, have proven to be effective at informing travelers about the circumstances affecting their trips and empowering travelers to reach informed decisions.

A variety of traveler information systems exist, including telephone support phone numbers, Internet dissemination sites, in-vehicle or handheld devices able to receive notices and alerts, and field devices informing travelers while en route. Operations of these traveler information dissemination systems may be performed by either public or private agencies.

Given this background, the primary purpose of this synthesis is to gather and report on the state of the practice for real-time traveler information delivery, with an emphasis on the following:

- The needs and expectations of travelers
- The current status of traveler information systems in the United States
- Available and emerging data sources
- Business models for sustaining traveler information systems.

The study conducted within this synthesis project involved four key data collection processes:

- An online survey of agencies currently operating traveler information systems
- Observations and testing of existing traveler information systems
- A literature review of documented surveys, evaluations, and benefit-cost analyses of traveler information systems
- Interviews and discussions with industry experts from public and private agencies.

The results and conclusions of this synthesis project were influenced in part by each of the 50 U.S. states because each state operates some form of traveler information system that was able to be observed and studied during the project. During the survey, 34 public sector agencies (of the 51 contacted) completed the survey and shared their views on the topics. The report was not limited to any one form of traveler information delivery, but rather it documented the best practices for various traveler information mechanisms. Currently, travelers have a variety of sources from which they can receive traveler information, including the following:

- Public-operated 511 phone systems are available free of charge to callers; 42 public-operated 511 phone systems in 33 states offer coverage to 128 million Americans (47% of the population). Public 511 phone systems are available to anyone with access to a telephone.
- Public-operated traveler information websites are available free of charge to users. Each of the 50 states offers some form of traveler information website.
- Field devices such as Dynamic Message Signs (DMS)—visible to drivers through the windshield and dashboard (which can be considered to include the line of sight visible out the front windshield) at no cost to drivers and without any need for devices. Highway advisory radio is another example of a field device that allows travelers to hear reports from standard AM or FM radios.
- Private sector traveler information providers offer web, phone, or special devices (e.g., navigation system or handheld devices) primarily in metropolitan areas; some products are now expanded to include rural areas.
- Private-operated news and media outlets disseminate traffic, weather, and event information over radio and television broadcasts with the majority of traffic and event information describing metropolitan areas.

Travelers (as consumers) have certain levels of expectations for traveler information. Simply put, they need quick, simple, safe access to accurate, timely, reliable, route-specific information. The agencies providing traveler information face challenges of their own in attempting to meet the needs of travelers while operating within limited budgets and with available resources. This project identified the following three key challenges that traveler information providers face:

- *Challenge 1*: The use of some aspects of the traveler information that is being delivered is limited.
- *Challenge 2*: A gap exists between what is possible in the state of the art in data collection, information generation, and delivery and what occurs in today's state of practice.
- *Challenge 3*: Both public and private traveler information providers face funding and budget challenges.

As a result of this synthesis, six suggestions are presented (in no specific order) to the traveler information industry:

The first suggestion is that more formal discussions occur between experts in information accessibility and the traveler information system operators and developers to increase awareness and understanding of best practices and approaches. The results of this projects' survey showed that many public agencies either have been successful at making their traveler information systems accessible to all travelers, including those with disabilities, or are working diligently to do so. However, based on feedback and input, it appears that most agencies are unclear about the steps to achieve an accessible system and also have received little feedback from the traveling public.

The second suggestion is that a nationwide effort be considered to achieve consistency in the use of icons on traveler information system websites. The results of this projects' observations and surveys showed that there is little consistency in the use of icons and nomenclature of event descriptions among traveler information websites.

The third suggestion is that the performance measures for 511 phone systems be reconsidered to include consideration of the information content delivered per call, the information missing per call, and the travelers' reactions based on the 511 call. Traditionally, call volume statistics have been a major performance measure used to assess the success of 511 phone

systems. However, the study suggests that volume of use tells only a small portion about the success and value of the system.

The fourth suggestion is that more detailed and focused user feedback surveys be conducted to understand the true reactions of travelers. Feedback suggests there are three related and somewhat conflicting issues regarding 511 phone system feedback:

- Feedback from transportation professionals who have tested 511 phone systems typically cite many frustrations with the systems and describe both the need for improvements and the technical ability to accomplish such improvements.
- Contradicting the negative feedback from transportation professionals, the feedback obtained from surveys of 511 users expresses satisfaction with 511 systems and often describes how useful and beneficial the systems are.
- With very few exceptions, the usage statistics for 511 do not reinforce the positive feedback expressed by surveyed users; instead, usage spikes at certain times during major events and is very low at other times, suggesting that the value of the system varies greatly depending on the situations facing travelers.

The fifth suggestion is that public agencies consider VoIP (Voice over Internet Protocol) technologies to reduce "per minute" phone costs, and that the 511 industry research the feasibility of centralizing (either regionally or nationally) portions of the call-handling processes (while leaving content development and call dialogs to continue to be locally controlled). Such an approach might better meet the peaks in demand, while reducing overall operations costs.

The sixth suggestion is to research the apparent "gap" between the availability and use of weather information. Although a great deal of weather information is offered by traveler information systems, the weather reports often are general and do not represent the highly detailed and accurate capabilities of the weather forecasting industries.

CHAPTER ONE

# INTRODUCTION

## PROJECT BACKGROUND AND OBJECTIVES

Public and private sector agencies strive to deliver accurate, reliable, and timely information to travelers to empower them to make informed decisions about their daily trips. Because of limited budgets, ever-changing technologies, and an escalating level of expectation from travelers, the agencies performing traveler information delivery face many challenges. Success stories, lessons learned, and best practices that work for one or more agencies can often benefit several other agencies with similar problems.

This synthesis report documents the state of practice in real-time traveler information delivery.

## STUDY METHODOLOGY

This synthesis project was conducted in five major steps.

The first major activity in this synthesis project was the creation, execution, and analysis of an online survey of public agencies operating traveler information systems. The results of this survey are presented throughout the report whenever appropriate.

The survey was created to allow responders to complete the questions in 10–20 minutes. The survey was administered using an online web survey tool and the link to the survey was distributed individually to contacts in each state or public agency. Recipients of the survey link were asked to either complete the survey or forward the link to the most appropriate individual within the agency to provide answers to the questions. The survey either was sent to only one individual from each agency, or if sent to multiple individuals, each individual was informed of the other recipients. The goal of the survey was to receive feedback from as many agencies as possible while only receiving one response per agency.

The authors of this project recognized that transportation professionals receive multiple requests to complete surveys. Given time limitations that everyone encounters, the approach to this survey was to focus the questions on topics that could not be studied and documented online. Therefore, responders were not asked to describe the content of their websites or 511 phone systems, because descriptions of these systems were documented in the observations of existing systems (described in the following subsection).

The survey was sent to 51 unique agencies believed to be operating some form of traveler information system. The survey received a total of 34 unique responses, resulting in a 67% response rate. Although the number of responders initially appears low, it is important to remember that each responder to the survey was asked to answer questions on behalf of their agency and their traveler information system.

The second major activity performed within this synthesis was to observe and test as many statewide, regional, and local traveler information systems as possible. The intent of observing the content and presentation of traveler information systems allowed the authors to avoid asking questions about content in the online survey, and allowed them to create map displays in this document to describe the various types of content offered nationwide. Although efforts were taken to accurately observe traveler information systems and document the content and presentation styles, the authors recognize that it is inevitable that some data or information may have been missed in the observations.

The third major activity was a literature review of previous studies, evaluations, and research activities. Traveler information systems have been evaluated by a number of federal, state, and locally funded formal evaluations. In addition, user benefit analyses and development of intelligent transportation system (ITS) architectures have reviewed traveler information systems. A large portion of this synthesis project was a review of these assessments. In examining published reports on such things as traveler information needs, user feedback, and documented benefits, considerable information was found, much of which dates back to the early 1990s. The authors attempted to synthesize the most relevant and pertinent results of the literature review and have cited the results throughout this report at the most appropriate locations.

The fourth major activity was a number of in-person meetings and telephone discussions with a variety of transportation professionals representing both the public and private sector industries with experience in one of the following

areas: researching, operating, or evaluating traveler information systems. The experts contacted were:

- Dr. Leon Osborne, Regional Weather Information Center, Director, University of North Dakota
- Bill Legg, State ITS Operations Engineer, Washington State Department of Transportation (DOT)
- Ryan Peterson, founder and CEO of TrafficGauge, a traffic flow aggregator with consumer products and services
- Terry Haukom, Traffic Management System Design and Integration Supervisor, Minnesota DOT
- Doug Finlay, founder and CEO of SpeedInfo, a provider of solar-powered radar traffic speed sensors

The feedback and insight offered by the industry experts is presented throughout the report, whenever appropriate.

The final major activity was the assembly of the information, analyses of all results, and the development of the synthesis report through interactions with the project panel.

## ORGANIZATION OF SYNTHESIS

Following this introductory chapter, this synthesis report is organized as follows:

Chapter two provides a brief summary of the history of traveler information, including a description of early traveler information approaches. Chapter two also presents a summary of the impact of the introduction of the Internet and the Federal Communications Commission (FCC) designation of the three-digit-dial recognition of 511 for traveler information.

Chapter three presents the topic of traveler information user needs and expectations to build a successful system. A synthesis of a literature review, an online survey, and agency interviews conducted as part of this project are presented in this section.

Chapter four presents a synopsis of current traveler information delivery throughout the United States. The primary emphasis is on 511 phone systems and traveler information websites; however, field devices, in-vehicle devices, and personal mobile devices are also referenced.

Chapter five describes the feedback from the survey of traveler information providers on their use and needs for data sources, then also describes feedback and insight gained from discussions with traveler information industry experts and through reviews of existing systems.

Chapter six presents a synthesis of the business plan challenges that public agencies face operating a traveler information system, together with a summary of several example business plan approaches in use by agencies throughout the United States.

Chapter seven provides a summary of conclusions reached from completing the syntheses. The conclusion addresses the following six topic areas:

- Accessibility of Traveler Information
- Display Consistencies
- Performance Measures and the Role of 511
- The Correlation between System Use, User Satisfaction, and Industry Feedback
- Ongoing Costs and Business Models
- The Gap between Weather Information Availability and Delivery

The results of the survey, the literature review, the website and phone system testing, and the personal interviews are not presented separately in individual chapters, but rather are synthesized throughout this report. The report is arranged to present topic areas together.

CHAPTER TWO

# THE HISTORY OF TRAVELER INFORMATION

This section provides a brief summary of the history of traveler information and sets the stage for the remainder of this report. Following this brief introduction, the remainder of the section describes early traveler information approaches. The section then presents a summary of the impact of the introduction of the Internet and the FCC designation of the three-digit-dial recognition of 511 for traveler information.

## EARLY REAL-TIME TRAVELER INFORMATION APPROACHES

Before the 1990s, traveler information dissemination was typically limited to existing media outlets, such as television, radio, and newspaper; and field devices, such as changeable message signs, message boards, highway advisory radio (HAR), and commercial radio broadcasts. As the ITS industry developed, both pre-trip and en route traveler information were recognized as effective tools for reaching travelers in both metropolitan and rural areas. However, although early attempts to communicate with travelers proved beneficial and successful, limited off-the-shelf products or systems were available to travelers. In several European countries, digital data sent in the subcarrier (a separate analog, or digital signal carried on main radio broadcasts used to carry additional voice or data content) of radio broadcasts emerged as an effective mechanism to reach in-vehicle receivers with real-time information for display on in-vehicle devices. Similar technologies were tested in the United States and proved to be effective; however, commercial products never reached the market. An assortment of telephone systems existed to provide regional or local travel information. Although the capabilities existed to disseminate travel information using telephone systems, wide-scale branding of a common phone number was lacking, and only a limited set of the population knew of the systems.

The ITS industry recognized and demonstrated the value of reaching travelers in their homes or work places and in their vehicles with information about current and impending conditions, but the lack of an efficient, nationally reproducible, and market-priced solution prevented personal traveler information systems from reaching the market, with few exceptions. Therefore, from the 1950s to the early 1990s, the majority of travel information dissemination occurred by way of commercial television and radio broadcasts, augmented by a number of changeable message signs and HARs.

## THE INTERNET'S IMPACT ON TRAVELER INFORMATION

The introduction of the World Wide Web to the general population in the early to mid-1990s created what could be considered the first paradigm shift in the field of traveler information. The industry recognized that the number of computers and offices connected to the Internet would continue to increase, and the Internet allowed users to create cost-effective websites to disseminate information and that (once created) could be viewed by anyone with Internet access. The Internet affected the traveler information industry in two distinct ways:

- It allowed public agencies to create traveler information websites that contained large amounts of information relevant to travel throughout the state, and that could be viewed by anyone at any Internet accessible location, therefore creating an opportunity to assemble information at one location with the understanding that it would be viewed by many travelers.
- It allowed private sector information service providers to create local, regional, or nationwide traveler information systems and to reach travelers nationwide.

Public transportation agencies have had experience with static traffic signs for many years. However, when Internet use grew tremendously in the 1990s, it represented a technology arena with a tremendous learning curve. The ubiquitous nature of the Internet and the standardization of technologies and approaches have allowed the transportation industry's use and understanding of the Internet to mature quickly for the purposes of traveler information dissemination.

Television and radio media outlets now actively disseminate traveler information and are consumers of traveler information provided by the public transportation agencies. In addition, the Internet has been the primary driving factor at accomplishing the amount of "on-demand" information now offered to travelers.

## THE IMPACT OF 511 ON TRAVELER INFORMATION

When the FCC designated the three-digit dialing code of 511 as the national traveler information phone number and commented that a review of progress would be conducted after 5 years to determine whether a national traveler information service was achievable, it began the second largest paradigm shift in the traveler information industry. In addition, shortly after the FCC designation of the 511 dialing code, the U.S.DOT began a program where initial "seed" money was provided to each state DOT to plan 511 deployment. The combination of these two activities prompted a rapid development of 511 phone systems for traveler information dissemination throughout the United States.

Much like the Internet, public agencies had a learning curve with regard to the technologies, institutional issues, legal issues, and cost issues that surround a 511 phone system. AASHTO, in cooperation with APTA, the U.S.DOT, and ITS America created the 511 Deployment Coalition to facilitate 511 deployment and allow public agencies to benefit from an open exchange of each others' experiences (U.S. Department of Transportation 2001).

The combination of the designation of a three-digit number that can be marketed nationwide, the federal seed money, and a national coalition to unite agencies in a common goal has been successful in launching 511 phone systems across the United States. Eight years after the designation, 511 is now available to roughly half of the population (and coverage includes the majority of the land mass of the United States).

CHAPTER THREE

# TRAVELER INFORMATION—NEEDS AND EXPECTATIONS OF TRAVELERS

Understanding the needs of users is a critical initial step in building a successful traveler information system. This chapter presents the topic of traveler information user needs and expectations. A synthesis of a literature review, an online survey, and agency interviews conducted as part of this project are combined in this chapter.

The agencies operating traveler information systems surveyed as part of this project were asked how they determined their user needs as they developed their traveler information systems. The results of this question are summarized in Figure 1.

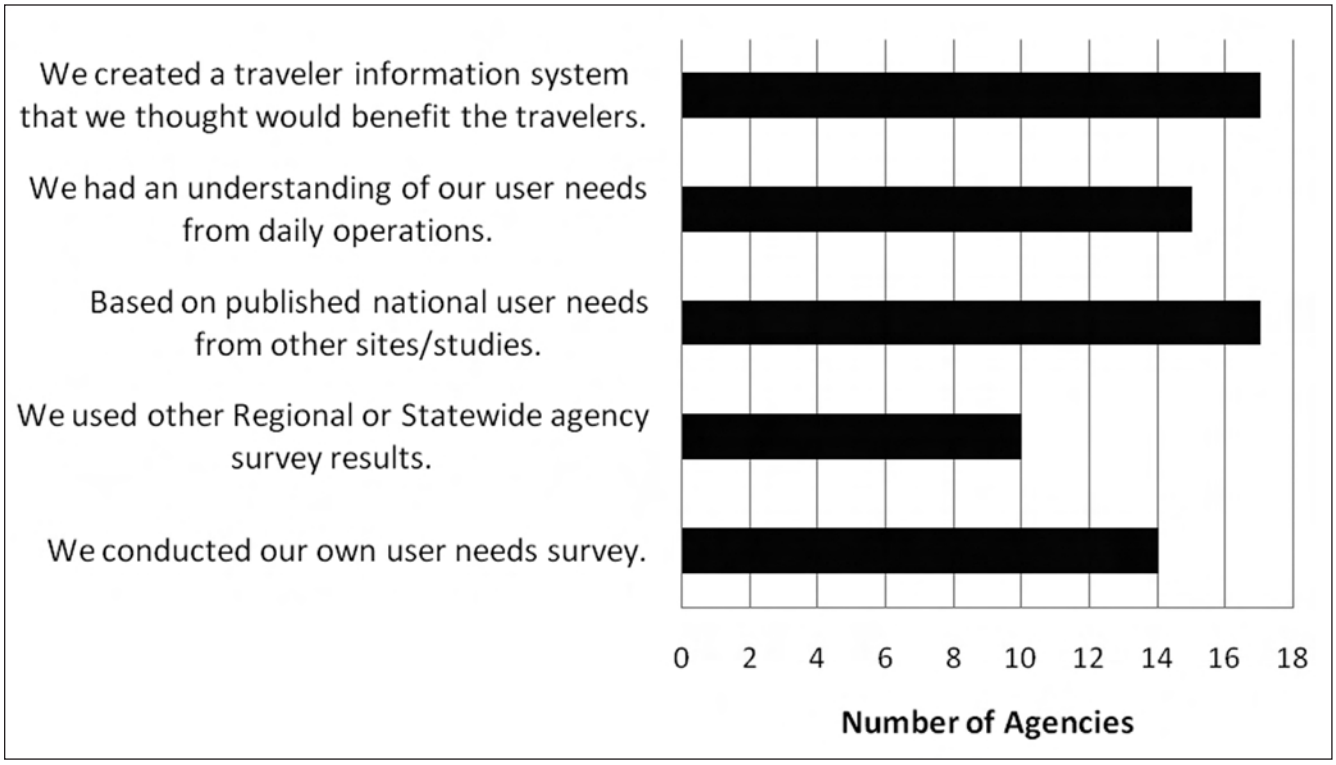


FIGURE 1 Agency feedback on how user needs were assessed.

## TRAVELER INFORMATION NEEDS

A large number of formal and informal studies have assessed travelers' needs for pre-trip and en route traveler information over the past 15 years. Travelers need quick, simple, safe access to accurate, timely, reliable, route-specific information so that they may save time, improve safety, avoid traffic congestion, and reduce stress. From May 11 through June 8, 1999, a banner on the Wisconsin DOT traffic website invited users to respond to an online survey to help improve the website. A total of 608 users completed the questionnaire.

When inclement weather or unplanned incidents or congestion occur, virtually every traveler (regardless of their mode or length of trip) benefits from traveler information. The definition of travelers' needs for information is closely tied to the travelers' use of the information. Most often, travelers use pre-trip and en route information for one or more of the following uses:

- Time management—for example, changing a departure time to avoid or accommodate delays or inclement weather
- Trip modifications—changing the route of travel, the destination, or the mode of travel based on conditions or situations

- Reduction in stress—a well-documented use of traveler information is to understand the cause of a delay or the upcoming road conditions and an estimate of the impact to reduce driver stress.

In addition to this summary of the needs of travelers, the literature review of needs assessments and user benefit studies identified three distinct classifications of users with specific traveler information needs, summarized as follows:

- Employed commuters performing local commute trips
- Interregional travelers through both rural and urban areas
- Rural drivers (commercial or recreational)

#### Employed Commuters Performing Local Trips

Typically, employed commuters access traffic reports (Internet, television, or radio) before departing in the morning. Certain circumstances such as incidents, unusual congestion, or reported delays of transit vehicles may cause commuters to adjust their departure time, change their route, or change modes. Each commuter is unique in the elasticity of their travel-time restrictions. Some commuters have fixed work shift start times and are heavily penalized if they are late by even a few minutes, whereas other commuters have more flexibility in their arrival patterns. However, even commuters with flexible start times have some days where critical meetings, airport departures, or other events mandate strict adherence to a schedule. Therefore, commuters need traveler information systems to provide them with the information required to make these decisions, either pre-trip or en route. Commuters are typically knowledgeable about their routes and available alternates.

The Wisconsin DOT conducted a survey of commuters' use of travel information. The survey results identified the following five uses (listed in prioritized order):

- To assess traffic congestion on their routes
- To judge the effects of incidents on trips
- To decide among alternate routes
- To estimate their trip duration
- To time their trip departures

Commuters who use transit (either regularly or occasionally) have a different set of needs for traveler information. Real-time transit information is needed to understand delays in transit routes that might require commuters to select an alternate route and therefore change their departure time. In addition, real-time departure information can aid flexibility and inform riders of their need to leave work at a certain time or to stay at the office if routes are running late. Finally, commuters need access to information about exceptions to transit service (e.g., bus stop closures owing to roadwork or transit schedule changes).

In summary, commuters' traveler information needs are summarized as follows:

- Route-specific information describing the current travel time or speed of travel
- Information about specific circumstances affecting travel (e.g., incidents, closures, major congestion)
- Current alerts of transit delays or service interruptions

#### Interregional Travelers

Interregional travelers often travel from one metropolitan region to another. They may pass through rural or suburban areas; however, their needs are not as extreme as those encountered by travelers in remote rural areas. Interregional travelers may need to understand travel conditions in both the originating region and the destination region. Many times, these regions may be located in separate states and therefore may require travelers to access multiple travel information systems operated by different agencies.

*Continuity of Traveler Information*

Travelers who pass from one metropolitan area into another do not recognize jurisdictional borders. To the traveler, he or she is experiencing one trip and prefers continuous and consistent travel information. One challenge to continuity in traveler information delivery is connectivity. If a traveler needs to access two separate phone systems or two independent traveler information websites, this increases the effort and time required to obtain the useful information. Many 511 phone systems avoid this problem by offering call-forwarding capabilities on phone systems to link callers directly to the 511 phone system in an adjacent state or agency. Traveler information websites often allow users to click on an arrow or graphic that enables them to connect to the traveler information system operated by the adjoining state or agency.

One example of a more sophisticated and user-friendly example of connectivity between jurisdictions is an automated exchange of event and incident data between agencies. This allows one traveler information system to offer information to travelers that describe the conditions reported by adjoining agencies. As an example, the North Dakota and Minnesota 511 phone systems and supporting databases are linked together so that callers dialing 511 from within North Dakota can request information for I-94 and receive reports of incidents and events throughout Minnesota and North Dakota. This enables a traveler who is about to embark on a trip through North Dakota and Minnesota—and who may be familiar with the North Dakota 511 phone system menu options—to make one phone call and receive a report for their entire trip.

In 2007, the eight state DOT agencies from Washington State to Wisconsin (commonly referred to as the North/

West Passage Pooled Fund) recognized the value of interagency information sharing to promote continuity of interregional travel. In addition to the physical data exchanges needed, however, they recognized the need for each agency to use consistent phrases with uniform definitions. Using the example of a traveler taking a trip through North Dakota and Minnesota, assume that one snow storm were to blanket both states with consistent snowfall across the region. If the conditions in Minnesota were manually entered as "blizzard conditions," whereas the conditions in North Dakota were manually entered as "snow" (describing the same event), travelers might falsely be led to believe that conditions were worse in Minnesota, when actually they were the same.

Travelers expect uniform descriptions of their entire route of travel from origin to destination. Interregional travel involving multiple jurisdictions and potentially long travel times presents a complicated challenge.

#### Rural Travelers (Commercial or Recreational)

Rural travel differs from urban and interregional travel in several ways:

- Although nonrecurring incidents (such as crashes) may be less frequent, the response and clearance time is often much greater. Because there are typically fewer known route options, a crash on a rural route can cause extremely long backups until clearance is completed.
- The limited services (e.g., food, lodging, emergency response) combined with inclement weather creates a more dangerous situation when weather events occur. Unlike metropolitan areas where shelter and services are nearby, rural travelers can remain stranded for days in extreme conditions that pose serious health risks.
- The long range of travel means that travelers often are not able to observe the conditions for their entire trip. It is not uncommon for rural travelers to begin trips in clear conditions and encounter snow or ice within hours of departing.

In summary, traveler information needs of rural travelers are summarized as follows:

- Information about current and short-term future weather and road conditions and information about accidents and other incidents are consistently highest in priority for rural travelers.
- The second highest priority is information about planned or unplanned events (incidents or roadwork) that cause lengthy delays.
- Travelers have stated a need for directions to their destination.
- Travelers have noted the need for travel times and tourism information.
- Travelers have expressed interest in gas and rest stops, distances to destinations, tourism information, and food locations.

### EXPECTATIONS OF TRAVELERS

In 1997, a set of 12 focus groups in six jurisdictions (New York City, Washington, D.C., Boston, Philadelphia, Los Angeles, and Orange County, California) conducted by Charles River Associates captured the opinions of drivers about user expectations of critical components of a traveler information system (Charles River Associates Inc. 1997). The opinions of travelers were based on current traveler information practices at the time, which primarily included television and radio. A number of additional surveys since 1997 have confirmed these opinions. Traveler expectations for traveler information systems include the following:

- Accuracy
- Timeliness
- Reliability
- Convenience (ease of access and speed)
- Safety (of operation)

Through research conducted by the John A. Volpe Transportation Center, researchers assessed the expectations of drivers with experience using traveler information systems to understand a more detailed set of requirements and expectations. This research found that experienced travelers seek the following (Lappin 2000):

- Camera views that portray road conditions
- Detailed information on incidents
- Direct measures of speed for each highway segment
- Travel time between user-selected origins and destinations
- Coverage of all major freeways and arterials
- En route access to good traffic information

Transit riders and travelers who are seeking information to support their choice of mode, have a separate set of needs for traveler information. These needs include various types of static information (such as bus schedule information, fare information, security information, safety information, accessibility information, and overall summaries of services offered). In addition, transit travelers have a set of needs for real-time transit information such as updated real-time bus arrival and departure information and service changes or outages (e.g., related to a crash or weather event). Finally, regular transit riders seeking information to help reach an unfamiliar area, or occasional transit users who are searching for transit options have a need for transit trip planning services. Transit trip planning services are most often interactive systems on the Internet that allow users to enter origin and destination addresses and receive step-by-step direc-

tions for using transit to reach the destination (Burks and Waddell 2001).

### Current Traveler Information Systems Ability to Meet Travelers' Expectations

In the survey of agencies operating traveler information systems conducted within this project, agencies were asked to rank how well their individual systems (511 and Web) meet the expectations of travelers in both rural and metro areas. The agencies' replies are presented in Figures 2 and 3.

### Travelers' Satisfaction with the Current Systems

In the survey of agencies currently operating traveler information systems, agencies were asked whether they believed that travelers were satisfied with the coverage and delivery methods of their traveler information systems (based on feedback received from travelers). The results are presented in Figures 4 and 5.

In summary, the majority of negative feedback received about traveler information systems has related to the

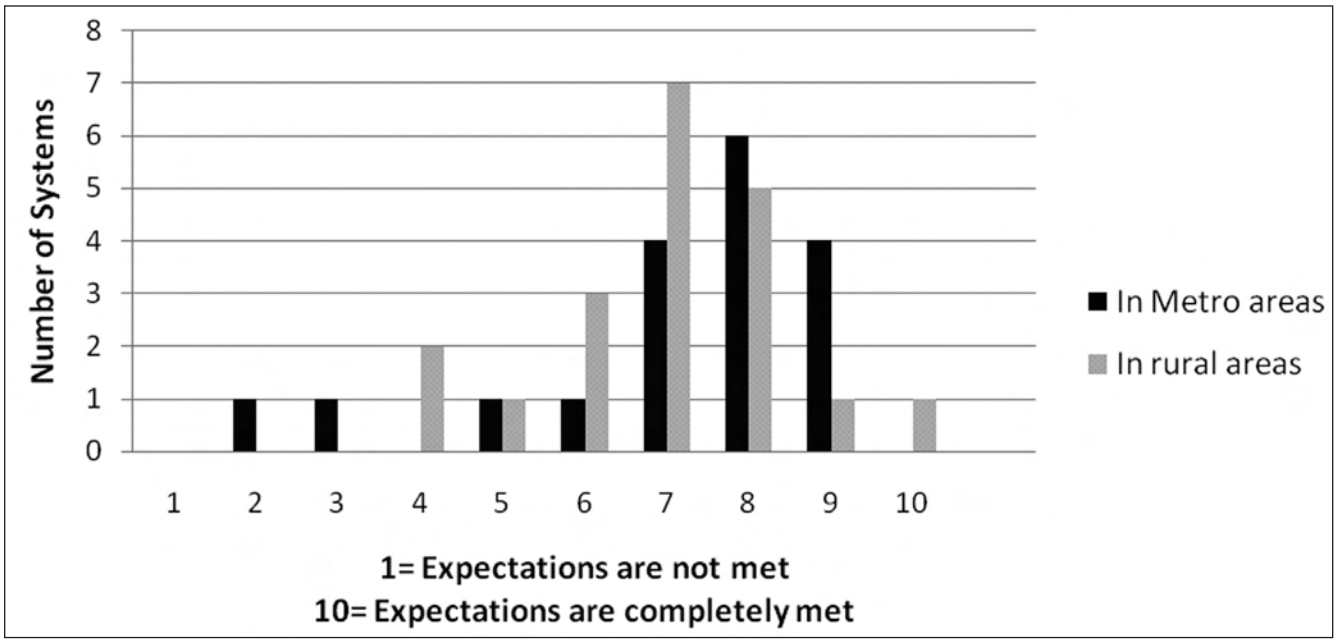


FIGURE 2 Assessment of how well current 511 systems meet expectations on a scale of 1 to 10.

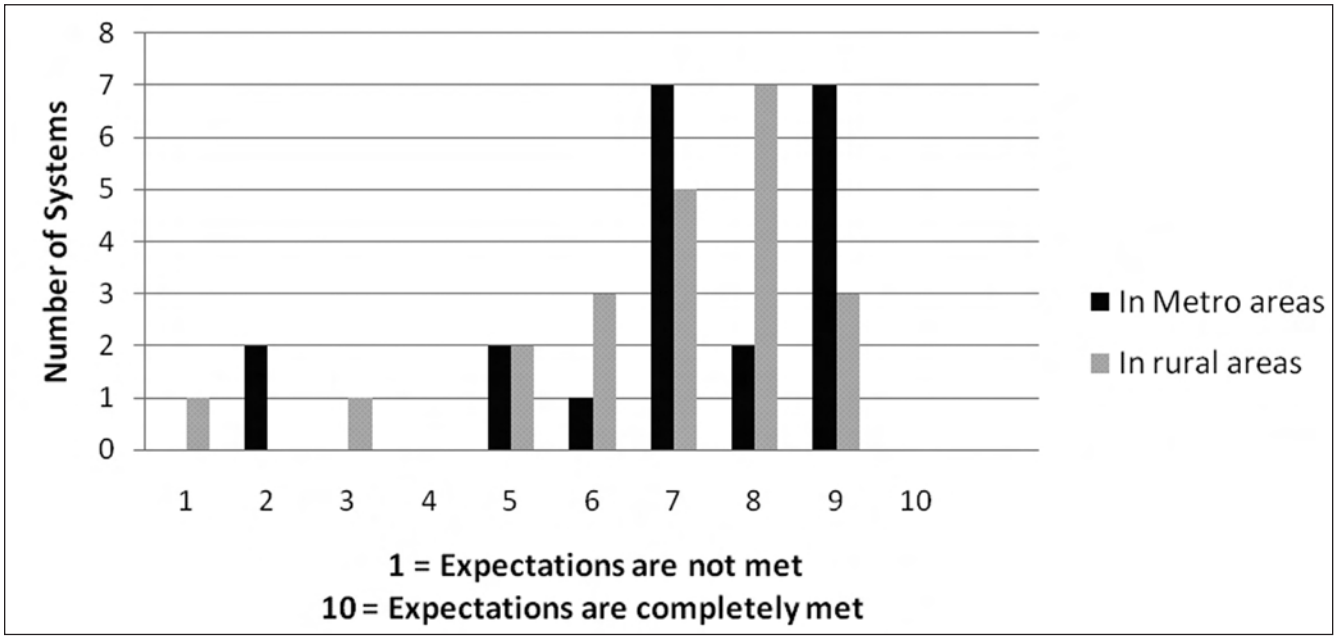


FIGURE 3 Assessment of how well current traveler information websites meet expectations on a scale of 1 to 10.

delivery methods. Users have requested additional information delivery methods, such as text messaging or push systems, and have cited examples of such technologies as voice recognition performing poorly.

## SPECIAL CONSIDERATIONS FOR TRAVELERS

Travelers seeking information about their trip may have special conditions related to permanent disabilities; temporary

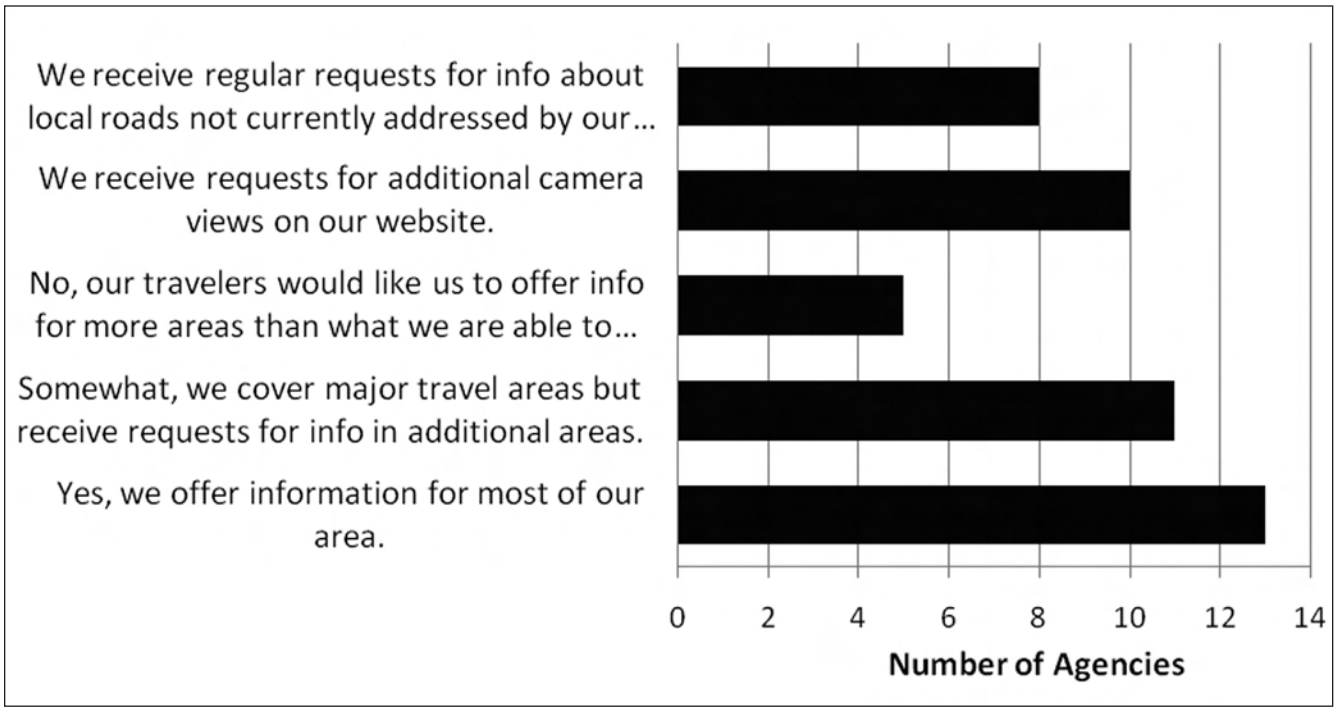


FIGURE 4 User satisfaction with coverage of information delivery.

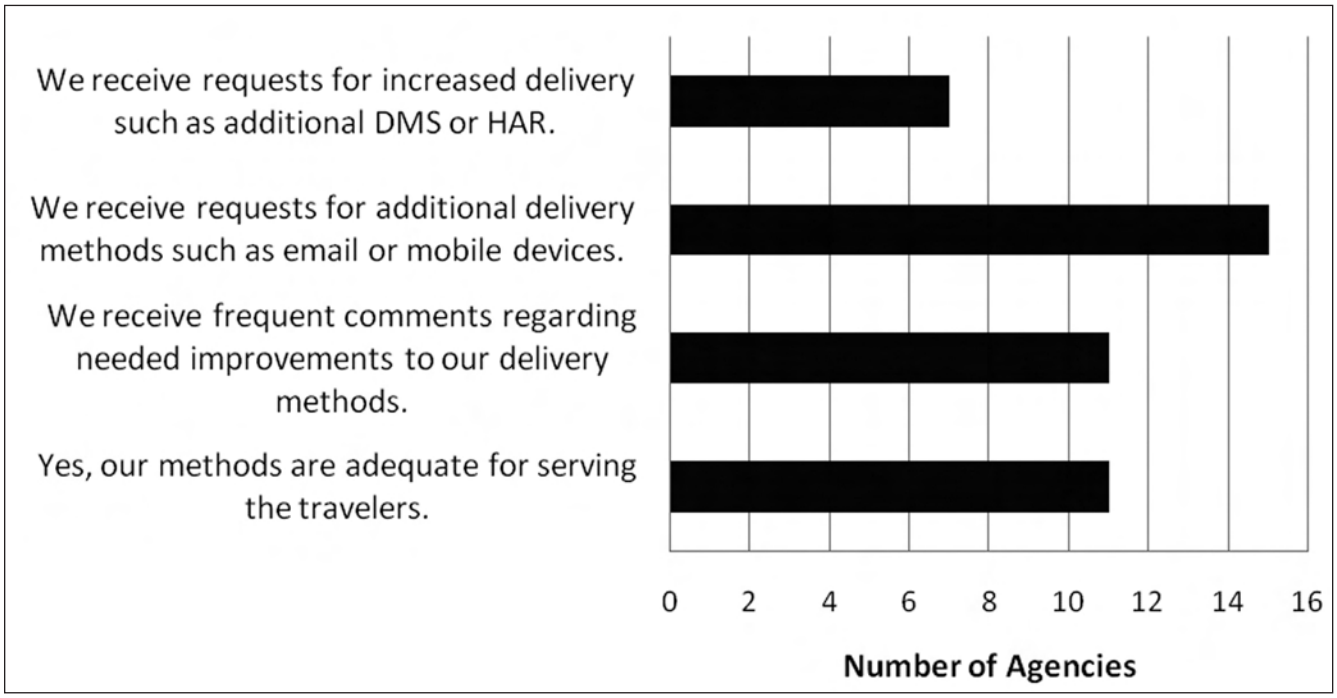


FIGURE 5 Traveler satisfaction with current information delivery methods.

disabilities that remain for days, weeks, or months; or disabilities that occur gradually over time, such as those that result from aging. Some of the types of disabilities that most often prevent travelers from successfully receiving information are summarized as follows:

- Visual impairments (e.g., blindness, near-sighted, far-sighted, and color blindness) can prevent a traveler from accessing travel information when visual displays are used exclusively.
- Hearing or speech impairments (including deafness, partial hearing loss, and various speech impairments) can prevent a traveler from successfully accessing travel information when audible announcements or voice prompts are used to disseminate travel information.
- Language barriers (e.g., not speaking or reading the English language) can prevent travelers from successfully accessing written or audible traveler information presentations.

The World Health Organization (WHO) estimates that, worldwide, approximately 750 million people have disabilities or special needs. According to the latest U.S. Census, approximately 54 million persons with disabilities live in the United States (Hunter-Zaworski and Stewart 1999).

The U.S. Access Board is an independent federal agency devoted to accessibility for people with disabilities. The Access Board operates a website with a large collection of information and many resources to serve travelers and agencies wishing to build accessible information systems. The Access Board's website is http://www.access-board.gov/.

## SUMMARY OF CHALLENGES FACING ACCESSIBILITY TO TRAVELER INFORMATION

The accessibility of traveler information systems to persons with disabilities refers both to the individuals' ability to access the information, as well as the need for the information to be presented in a manner that is easily understood.

This section summarizes the challenges related to Internet systems, telephone systems, and personal communication devices. Descriptions about additional challenges and resources available to meet these challenges are available at the Access Board's website.

### Accessibility Challenges Related to Internet-Based Traveler Information Systems

The primary challenge facing persons with disabilities when accessing Internet websites is for visually impaired users to access the information presented visually on the website. One solution to this challenge is the use of screen readers. Screen readers are software applications that attempt to identify and interpret what is being displayed on the computer screen. The interpretation is then presented to the user with text-to-speech, sound icons, or Braille output. One challenge that is specific to traveler information system websites is that the use of graphics, maps, pictures, movable text, and other similar features is often used on traveler information websites. For example, maps are often displayed with colored segments of roads to indicate whether traffic is moving freely, slowly, or is congested. The display of images such as maps may not be interpreted properly by screen readers. For example, in many circumstances, a map displaying traffic speeds or transit routes would not be relayed in its entirety by a screen reader. Therefore, if the map is the only source of information dissemination, a user with impaired vision would not have access to the information.

A number of solutions are possible to achieve accessibility in traveler information websites:

- An optional page with an all-text feature in which the text descriptions of the conditions are provided to website visitors in a useful manner would allow the screen reader to announce the information to the user.
- Similarly, tags can be appended to graphic images describing the content of the graphic and allowing screen readers to read the information.
- Some sites avoid graphic use altogether or provide mirror pages with all text descriptions.

An all-text display does not necessarily solve the entire problem for visually impaired users. The information may be accessible (in that the screen reader can interpret the information to the user), but the written reports may be difficult to understand unless the text is descriptive and thorough. For example, a report of a crash may be shown on a map such that a visual user of the website sees the location; however, the text description may not describe the location in a useful manner. Guidelines exist for universally designed websites to meet the accessibility and usability needs of persons with disabilities, and they are available on the Access Board's website.

### Accessibility Challenges Related to Traveler Information 511 Phone Systems

Accessibility to traveler information 511 phone systems by persons with either speech or hearing disabilities is an additional challenge. A TTY (teletypewriter or text telephone) device is a text communication terminal that allows people with hearing or speech disabilities to use the telephone. One challenge to using TTY devices to access traveler information phone systems is that typically a delay occurs while the TTY device displays text to the user or interprets what the user has typed in to the device. Often, automated phone systems do not work well with delays, and may interpret the pause as a hang-up or as a failure to select a menu option.

One approach to achieve accessibility of 511 phone systems (and the ability to support delays inherent to TTY devices) is to use menu options at the onset of the call inviting callers to select an option that indicates they are using a TTY device, therefore activating a menu tree that includes pauses and delays to wait for the TTY responses. In many instances, ordinary instant messages are a convenient substitute for TTY communication.

#### Accessibility Challenges Related to Handheld Devices

Several states now disseminate traveler information in formats that are compatible to mobile handheld web devices [including smart phones, cellular phones, and personal digital assistants (PDAs)]. The sizes of both the keys and the visual displays offer unique challenges to persons with a variety of disabilities. Selecting and pushing small keys is a challenge for users with any form of visual impairment, as well as for users who lack dexterity in their fingers as a result of such things as injuries or arthritis.

#### Other Accessibility Challenges

Additional accessibility challenges exist beyond those specifically defined as disabilities. These challenges and a synthesis of options are summarized as follows:

- Persons who are color-blind may not be able to interpret colored maps or icons with similar colors.
  - Some traveler information websites avoid color (or use drastic color contrasts) by using patterns to distinguish roads or regions.
- Persons with strong accents may encounter difficulties interacting with 511 phone systems.
  - Many 511 phone systems offer touch-tone options and do not rely on voice recognition.
- Persons who do not speak English may have difficulties reading websites or interacting with phone systems.
  - Multilingual traveler information systems are beginning to develop. Currently, a few sites offer traveler information in English and French, and several systems offer information in both English and Spanish. Agencies surveyed were asked whether either their 511 phone system or traveler information website offered information in multiple languages, the results are summarized in Figure 6.

#### Current Accessibility of Existing Systems

Accessibility to information by individuals with disabilities is covered in Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794d). Section 508 requires that individuals with disabilities, who are members of the public seeking information or services from a federal agency, have access to and use of information and data that is comparable to that provided to the public who are not individuals with disabilities, unless an undue burden would be imposed on the agency.

As part of the survey conducted for this project, survey responders were asked whether their systems were compliant with Section 508 (and were provided a brief explanation of Section 508 of the Rehabilitation Act of 1973). The responders' answers to these questions are summarized in Figures 7 and 8.

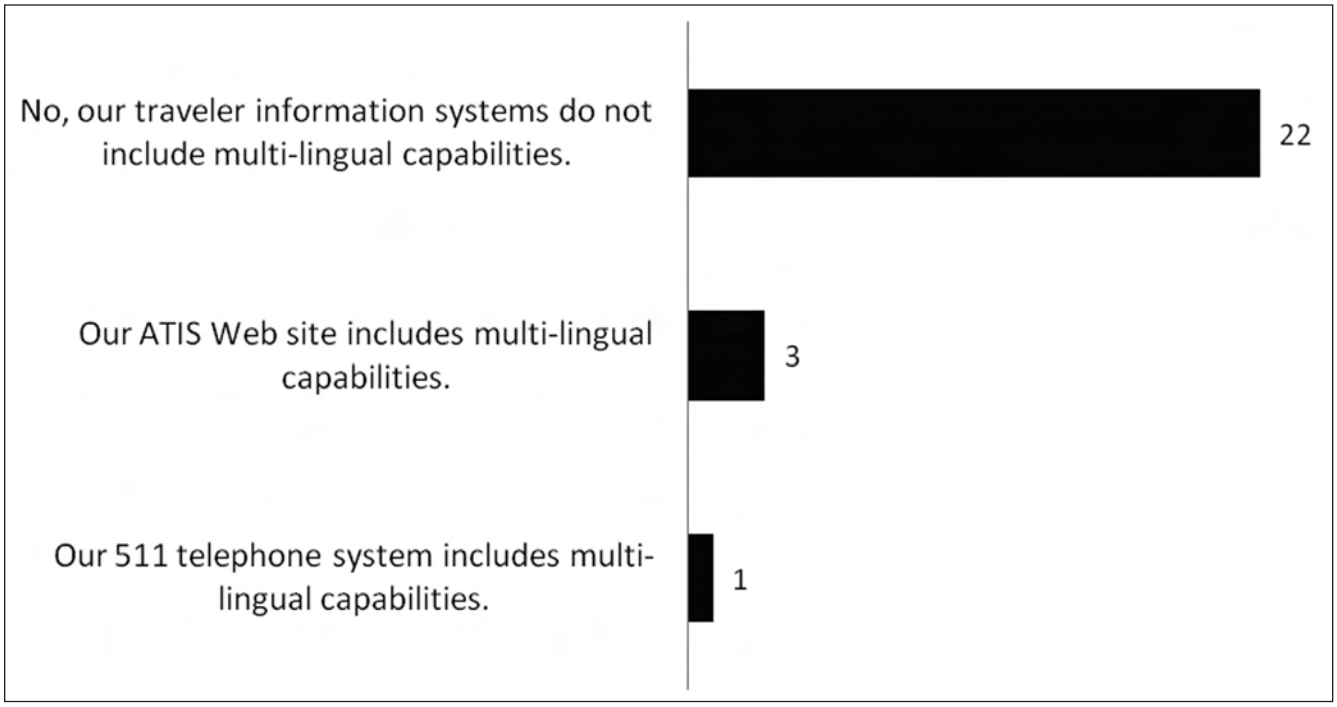


FIGURE 6 Availability of traveler information in multiple languages.

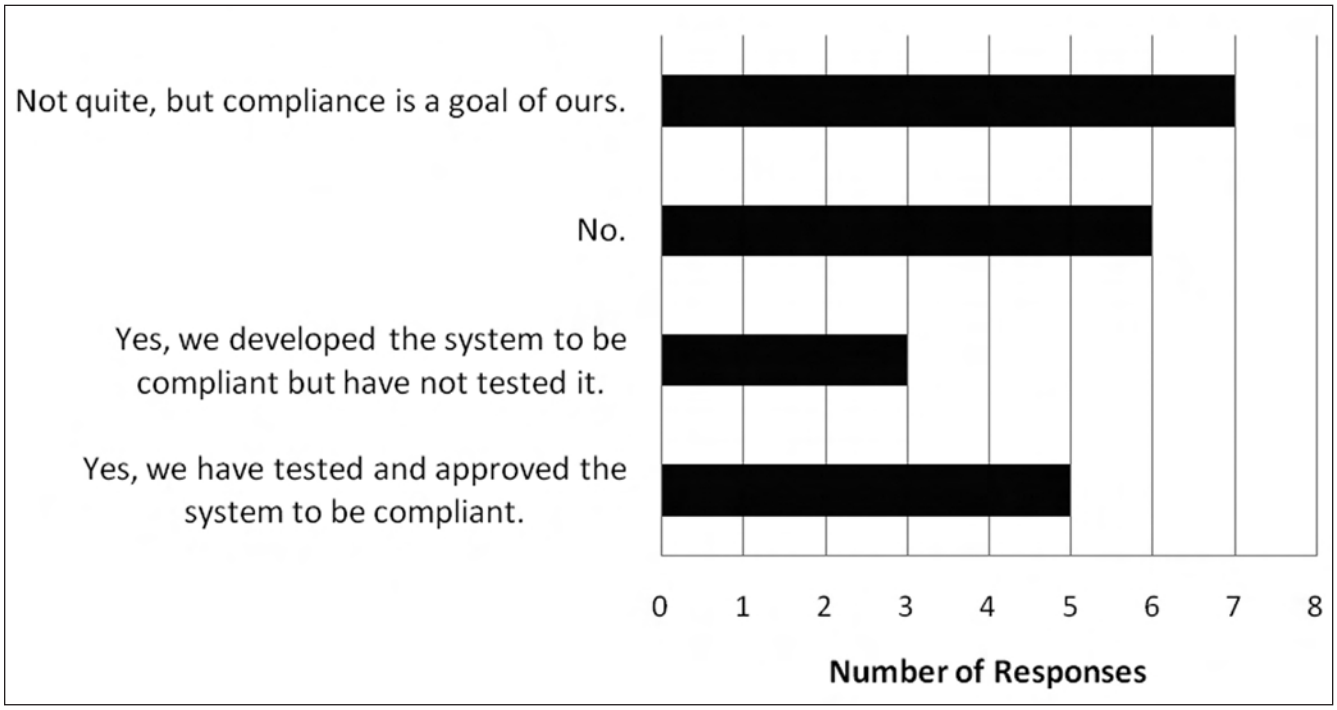


FIGURE 7 511 phone systems compliance with Section 508.

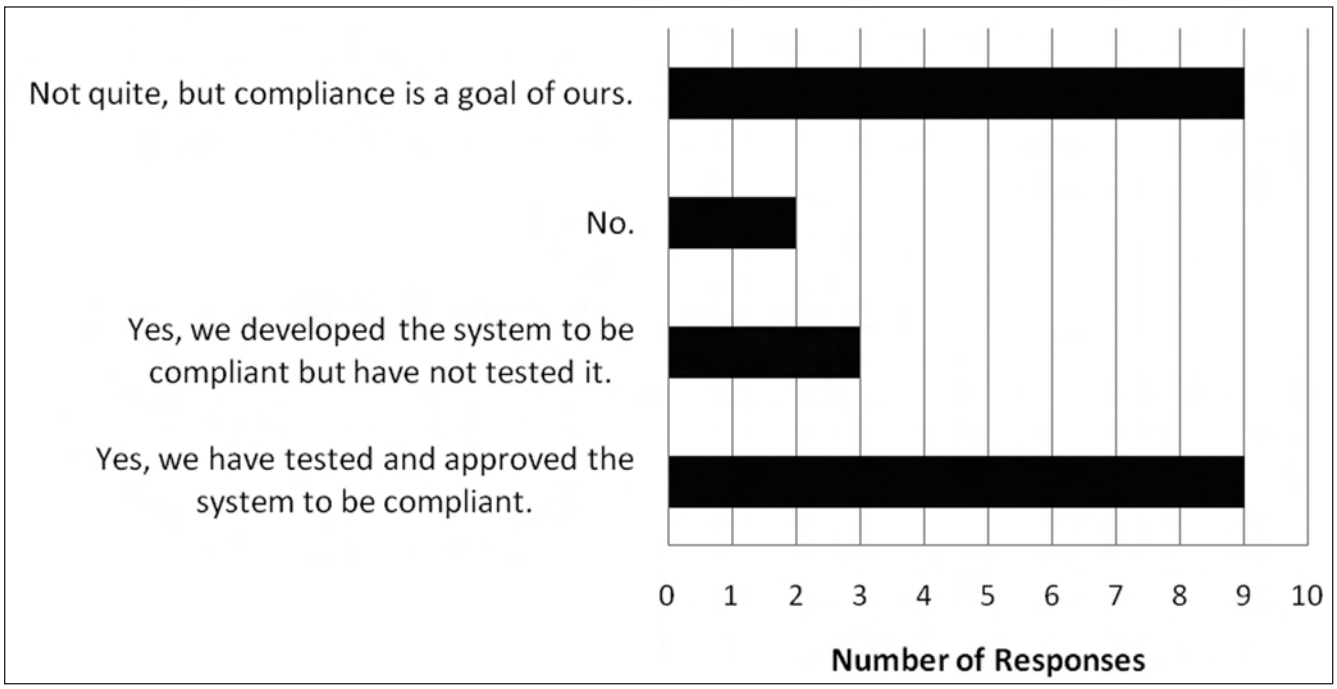


FIGURE 8 Traveler information websites compliance with Section 508.

*Feedback from Users Regarding Accessibility*

Responders to the survey were asked to describe any feedback they have received regarding the accessibility of their 511 phone and Internet dissemination systems. The responders' reactions are summarized in Figure 9.

*Guidelines for Accessibility of Traveler Information Systems*

Research conducted at Oregon State University (OSU) regarding ergonomic designs for Internet sites that disseminate information is presented as part of a research project

titled "Next Frontier in Accessible Traveler Information Systems" (Hunter-Zaworski and Stewart 1999). The results of the OSU research documented 12 guidelines for Internet traveler information systems to maintain accessibility for persons with disabilities. These guidelines are reproduced here, as follows:

- Guideline 1: Every graphic image must have a text descriptor.
- Guideline 2: If "image maps" are used, then an alternative method of selecting the embedded links must be provided. Only use client-side image maps.
- Guideline 3: Include a detailed text description for all complex images, such as photographs.
- Guideline 4: Avoid the use of nonstandard text formatting and layout.
- Guideline 5: Avoid moving or changing text.
- Guideline 6: Provide a text transcription or description for all embedded audio.
- Guideline 7: Make text links descriptive but not overly wordy.
- Guideline 8: Use non-HTML formats only as alternatives to HTML files and not as replacements.
- Guideline 9: Provide an alternative to online forms, such as a printable form or an e-text version of the form. If a form is used, then ensure that it can be navigated using the Tab key.
- Guideline 10: Test pages in a variety of browsers and on different operating systems.
- Guideline 11: Avoid the use of proprietary HTML.
- Guideline 12: Avoid the use of Java or Active X in all World Wide Web pages.

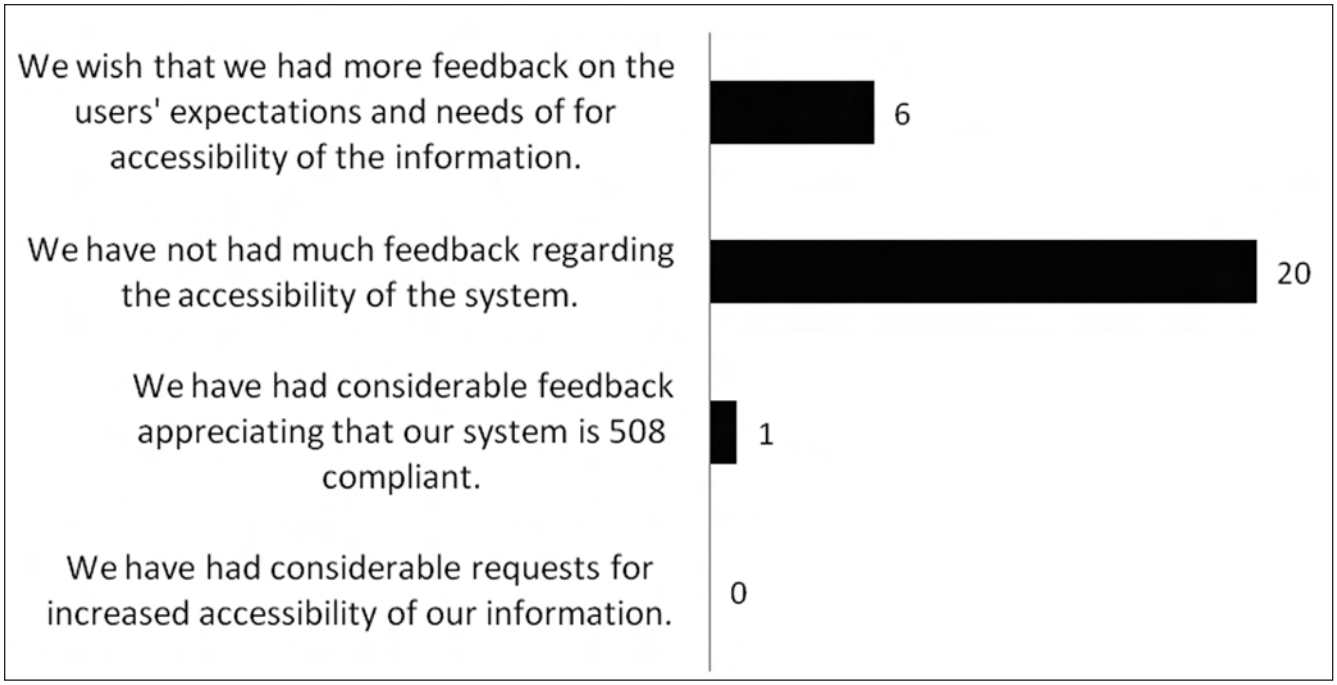


FIGURE 9 Feedback on accessibilty of traveler information system from individuals with disabilities.

CHAPTER FOUR

# CURRENT STATUS OF TRAVELER INFORMATION

This section presents a synopsis of current traveler information delivery throughout the United States. The primary emphasis is on 511 phone systems and traveler information websites; however, field devices, in-vehicle devices, and personal mobile devices are also referenced.

## SUMMARY OF THE CURRENT STATUS OF TRAVELER INFORMATION

In 2009, travelers have a variety of sources for traveler information.

*Public-operated 511 phone systems* are available free of charge to callers. Forty-two public-operated 511 phone systems in 33 states offer coverage to 128 million Americans (47% of the population). Public 511 phone systems are available to anyone with access to a telephone. Based on the findings of this synopsis:

- User feedback continues to be positive toward 511 phone systems, and call volumes for the majority of systems continue to increase each year.
- Incident and event reports (including roadwork, crashes, and road closures) are common among 511 phone systems. However, few systems present daily details about the impacts of roadwork activities.
- Although weather and road condition reports are common to many 511 phone systems, only a limited number of systems present detailed route-specific weather forecasts that are available with today's technologies.

*Public-operated traveler information system websites* are also available free of charge to users. Each of the 50 states offers some form of traveler information website. Based on the findings of this synopsis:

- Many public agencies first deployed traveler information websites when the majority of Internet users did not have high-speed connections. Therefore, initial mapping technologies often included static map views that lacked sophisticated zoom capabilities. Many agencies are now operating (or in the process of building) second- or third-generation Internet display systems with increased performance.
- Often, common elements of traveler information websites delivering information for metropolitan areas include the availability of real-time traffic condition reports offered as travel-time reports, traffic speed reports, crash notifications, and views of camera images along heavily traveled highways. Common elements of traveler information websites delivering rural information include weather, driving conditions, and roadwork, incident, or closure reports.

*Dynamic Message Signs* (*DMS*) are visible to drivers through the windshield or dashboard (the dashboard can be considered to include the line of sight visible out the front windshield) at no cost to drivers and without any need for devices. Currently, dissemination occurs predominantly on freeways. Industry experts believe that DMS use on high speed arterials will expand over the coming 10 years.

*Private sector traveler information providers* offer web, phone, or special devices (e.g., navigation system or handheld devices) primarily in metropolitan areas; however, some products are now expanded to include rural areas.

*Private-operated news and media* outlets disseminate traffic, weather, and event information over radio and television broadcasts. The majority of traffic and event information describes metropolitan areas.

*Transit-specific traveler information systems* are operated by a variety of public and private service providers. Transit traveler information systems range from human-operated phone systems to complex vehicle tracking systems tied to automated phone and Internet delivery systems. One example of a geographic area with a comprehensive transit traveler information system is the Tri-County Metropolitan Transportation District of Oregon (Tri-Met). Tri-Met operates a real-time traveler information system for transit riders. The Tri-Met system includes an online transit trip planner offering statewide transit trip planning services. Tri-Met tracks transit vehicles using Automated Vehicle Location (AVL) and offers updated arrival and departure times on both the website and traveler information phone system. These updates allow riders to call a phone number or visit the website to view the real-time arrival of their bus. An example of a private-operated transit trip planning system is operated

by Google. Google offers transit trip planning services in a large number of cities and metropolitan areas throughout the United States (e.g., the Portland, Oregon, metropolitan area), offering travelers both public and private information dissemination outlets for transit information.

A more detailed description of the needs of transit users and the real-time information delivery offered by transit agencies is available through the results of the *TCRP Synthesis 68: Methods of Rider Communication* (Schweiger 2006).

The use of traveler information systems varies and includes peaks of heavy use and times when use is low. Discussions with the industry have revealed examples of success stories in which travelers were able to access information during major storms to maintain safe and efficient travel, as well as stories about times when traveler information systems fell short of travelers' expectations.

Many times more traveler information is available to U.S. travelers in 2008 than was available in the early 1990s. Nonetheless, the technologies available today still present many options for major improvements to traveler information.

## SUMMARY OF TRAVELER INFORMATION USE

The nature of Internet websites and 511 phone systems allow for tracking statistics to report system use. Often, agencies can track use patterns to understand when the system is being used, and what information travelers are seeking from the system. The 511 Deployment Coalition tracks national call volumes from all active 511 phone systems. When tracking website use, there is less consistency throughout the industry. Some systems track hits, but hits are not always an accurate reference tool. Depending on the structure of the website, one page view may generate multiple hits. Additionally, websites may track page views, which also may not be an accurate representation of use. If a site requires users to click several options to reach the on-screen map, the tracking would count each page viewed. Yet another web-tracking statistic is a "visit" or "user session." This is most closely related to a number of phone calls. Each time a user visits a traveler information website (and views one or more pages of information), it would be treated as a "visit."

The National 511 Deployment Coalition is advancing toward consistent tracking of the use of 511 cobranded websites; however, consistent statistics are not available for all states at this time. To introduce this section and give readers some perspective of the ratio of 511 phone use compared with traveler information websites use, statistics were tracked by Oregon DOT (ODOT) for the use of both the 511 phone system and the website (branded as Tripcheck.com). Figure 10 illustrates annual call volume and website visits from 2004–2007.

## 511 TELEPHONE TRAVELER INFORMATION SYSTEMS

On July 21, 2000, the FCC approved the three-digit 511 number for traveler information. At that time, a number of state and regional telephone-based traveler information delivery systems were in operation. Since the designation of 511, deployment of new telephone traveler information systems has accelerated, and the conversion of existing systems to work using the 511 dialing code has expanded as well. As of June 2008, 42 public-operated 511 phone systems in 33 states offered coverage to 128 million Americans (47% of the population).

Figure 11 illustrates the current deployment status of 511 phone systems throughout the United States.

### Summary of 511 Call Volumes

In the spring of 2008, the total comprehensive number of 511 calls placed to all operational 511 systems in the United States exceeded the 100-million-call threshold for the first time. The call volumes received by the 42 operational systems vary tremendously. Of the 100 million calls received, more than 20 million were received by the 511 system serving the approximately 7 million residents in the San Francisco, California, area.

When the volume of 511 calls is compared with the 128 million residents who have access to 511 throughout the United States, or compared with an estimated 51 million households (47% of an estimated 110 million households nationwide), the 511 call volume statistics appear low in proportion to the number of annual trips (planning processes often estimate five trips per household per day). A review of user feedback and case studies, however, suggests that 511 systems play a critical role in travel information and that travelers find the information useful. Therefore, perhaps this role cannot be adequately defined simply by call volumes. An analogy can be drawn to a city park. Local cities spend considerable money on the upkeep and maintenance of city parks and take considerable pride in their parks. Although parks play a specific role in the community, they are not used by everyone. Families with young children (as an example) may use the park weekly, although other residents may go years without using the park. Also, many parks are not used regularly during winter months. This does not suggest that the parks have a lack of value, but rather that city parks play one or several roles in the community, serving each resident differently. The 511 call volume statistics suggests that 511 plays a role in traveler information and that this role cannot solely be evaluated based on call volume statistics. Instead, other performance measures are needed.

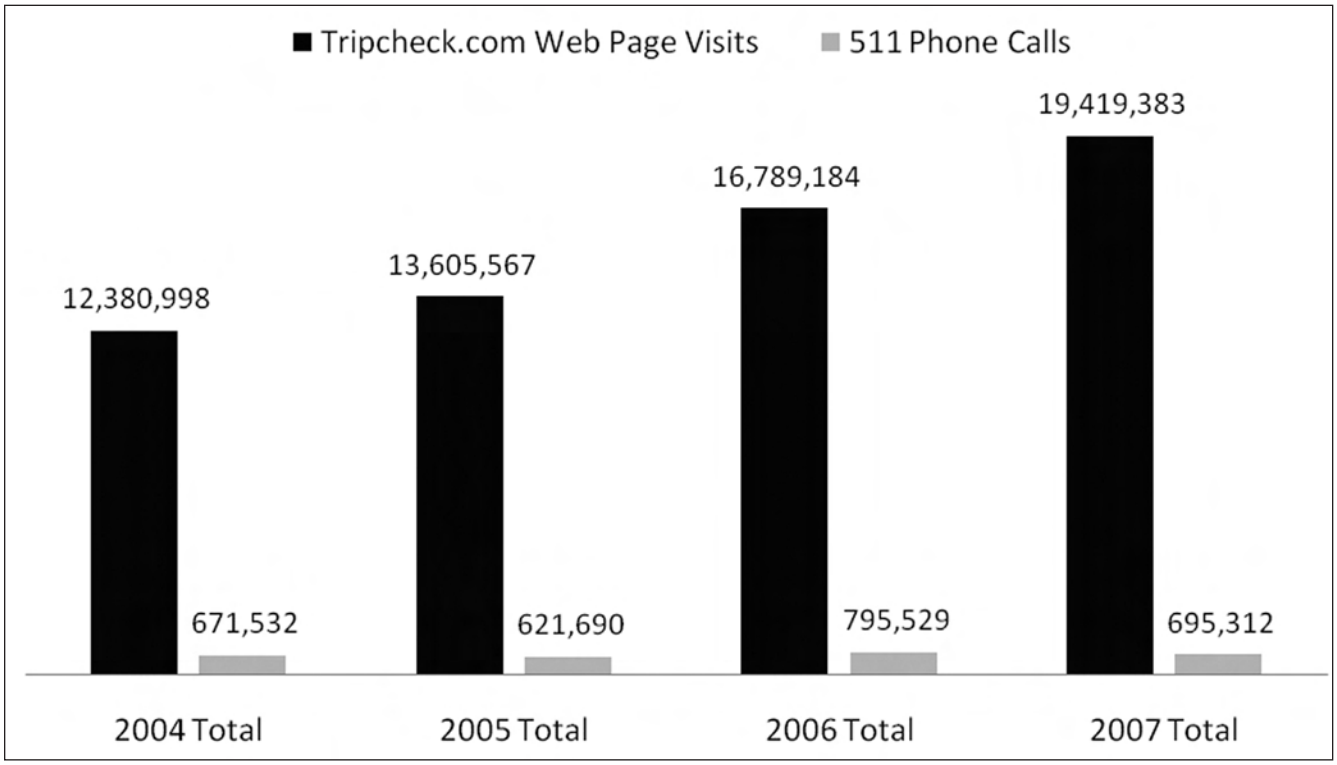


FIGURE 10 Oregon DOT 511 phone and website use statistics (2004–2007).

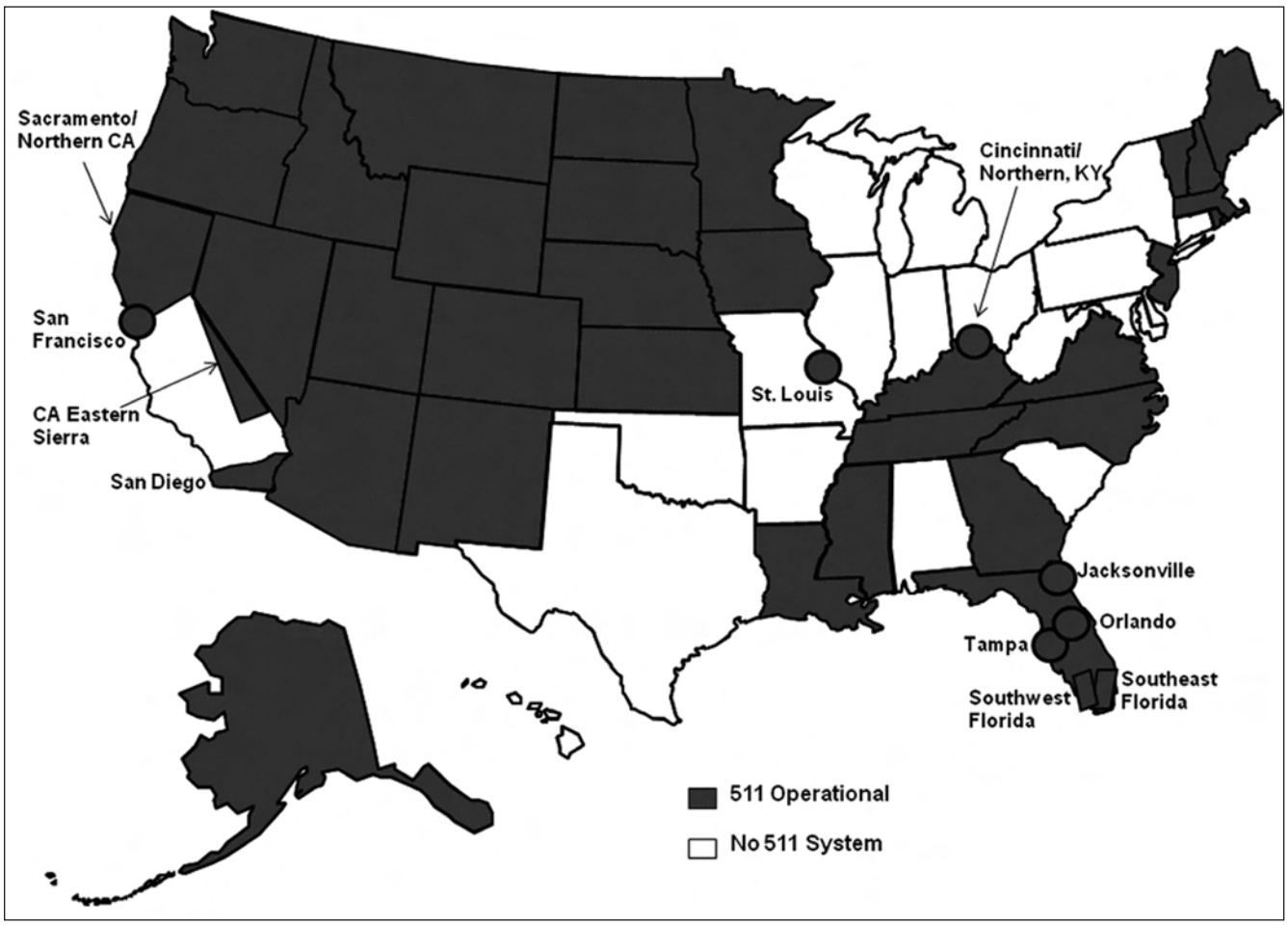


FIGURE 11 Current 511 phone system deployment status (as of February 21, 2008).

### Geographic Spread of 511 Call Volumes

To present a summary of the volume of calls received to individual 511 phone systems and illustrate the variations in call volumes, Figure 12 presents the total call volumes in the 12 months from April 2007 to March 2008. Systems that were not operational for those 12 months or for which statistics are not available are shown as blanks on the map.

Based on the 12-month call volumes shown in Figure 12, several observations appear as follows:

- The 511 systems disseminating content needed on a daily basis receive the highest call volumes. The San Francisco system contains real-time traffic reports (travel times) and links to real-time transit information, as well as detailed reports of daily construction activities (all items described in chapter five as lacking in many other 511 systems).
- Typically, the states with larger populations, instances of inclement winter weather, and mountain passes receive larger call volumes.
- A correlation exists between congestion and call volumes. San Francisco, Miami, and Seattle typically rank in the 15 most congested cities referenced in the "Annual Urban Mobility Report" published by the Texas Transportation Institute, and the Texas A&M University System (http://mobility.tamu.edu/).

### Factors Influencing Call Volumes

In general, the degree to which consumers use a technology application is a combination of the need for the application and the level at which the application satisfies that need. It appears that 511 use follows this pattern:

- San Francisco's 511 system receives far more calls than any other 511 system. The San Francisco system offers a combination of real-time traffic and event information as well as detailed transit information. The majority of phone requests are for traffic information and the majority of website requests are for transit information (Kuester 2006). The large population base, strong tourism market, and geographic limitations on access points to the city (i.e., the San Francisco Bay) create a definite need for traveler information during each commute period. The San Francisco 511 telephone system is marketed throughout the area, including marketing to promote users dialing 511 to access transit information.
- The Washington State 511 system received more than 2 million calls from April, 2007 to April, 2008. Approximately 462,000 calls (22% of the annual calls) were received in December 2007, a month when considerable flooding and winter storms occurred throughout Washington State (National 511 Deployment Coalition 2008).

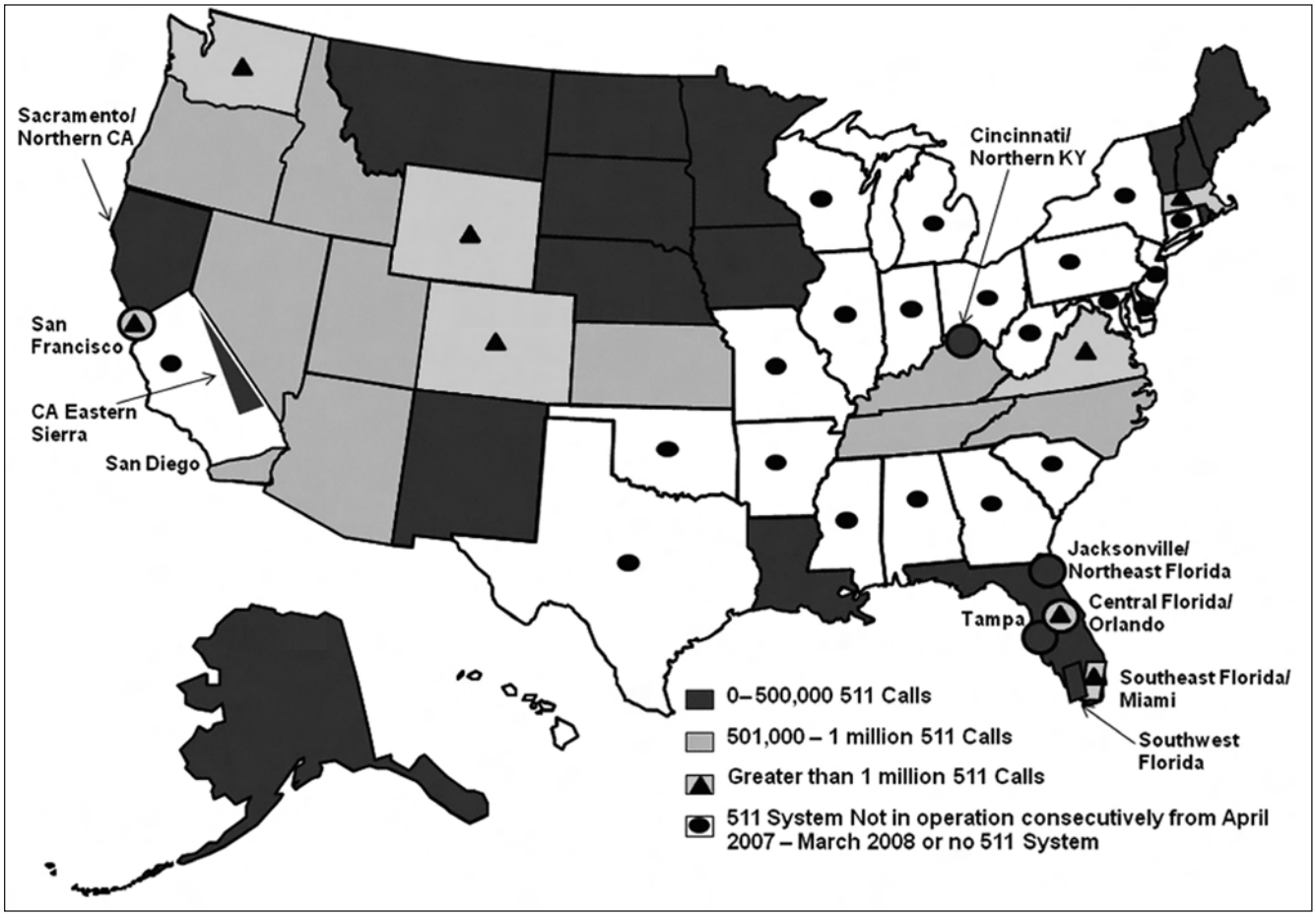


FIGURE 12 Total 511 call volumes from April 2007–March 2008.

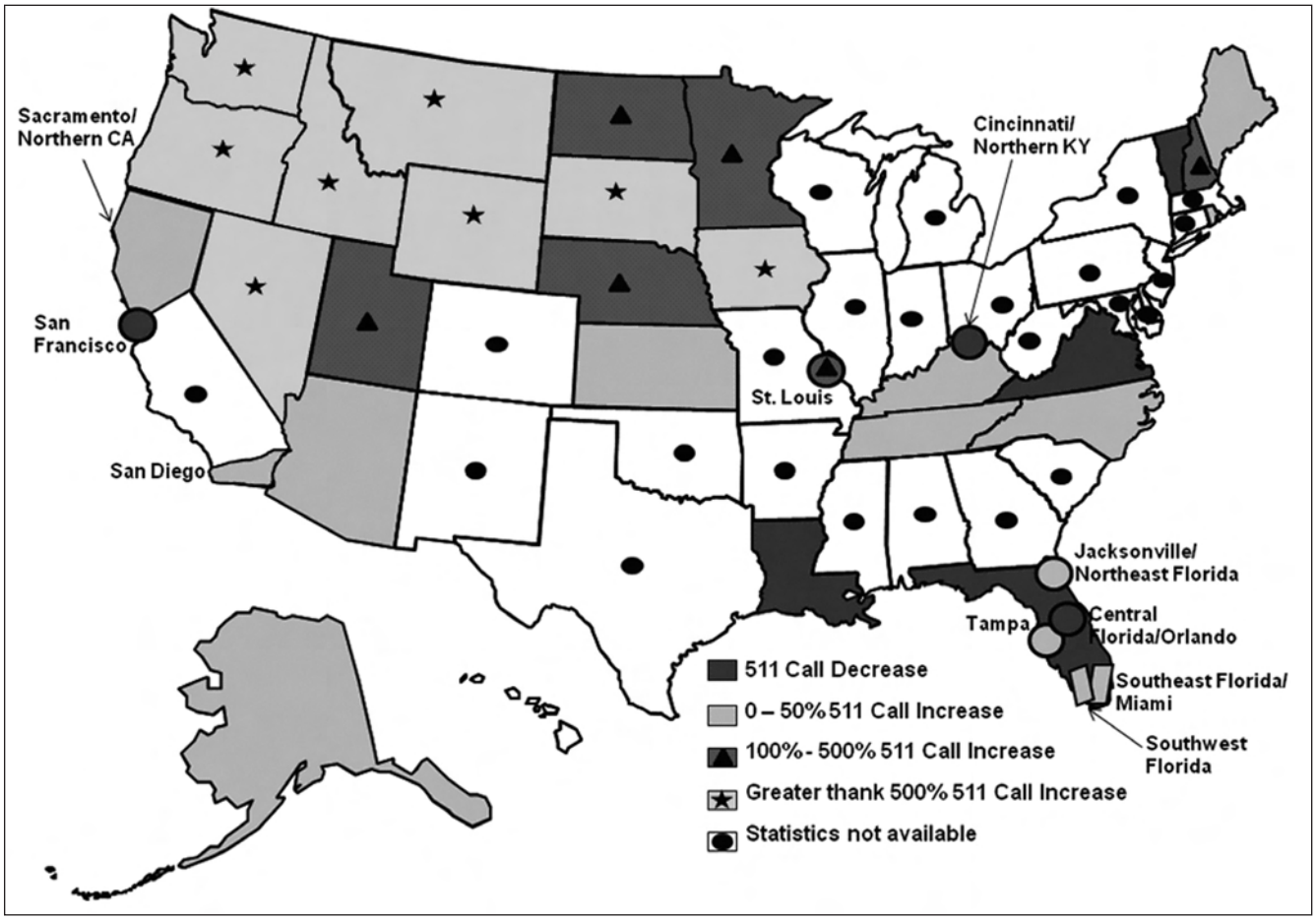


FIGURE 13 Percent increase in call volumes from Summer 2007 to Winter 2008.

- The Massachusetts 511 system operated by MassHighways is another large call volume system. MassHighways has been operating a real-time traveler information phone number as part of the SmartTraveler network since 1993. The MassHighway phone system has received a total of 62 million calls, with recent averages near 575,000 calls per month. The MassHighways system uses several sources for traffic information and offers links to transit information. The detailed content, large population base of the Boston area and limited options for routes to key destinations such as the airport and downtown area appear to be contributors to the large call volumes (MassHighway 2007).
- The Colorado 511 phone system offers weather and driving condition information statewide, including numerous mountain passes, accessing key mountain destinations. Of the nearly 2 million calls received from the April, 2007 to April, 2008, 1,450,000 were received in the four months of December through March (National 511 Deployment Coalition 2008).

Seasonal variations in 511 call volumes occur throughout the United States. Based on the data, it appears that primarily rural areas or mountainous areas receive considerably more 511 calls during the winter season than they do in the summer season. Major metropolitan areas remain relatively unchanged between seasons, although popular tourist areas or areas where summer weather patterns pose more challenges than winter risks (e.g., flooding, thunderstorms, hurricanes) experience more calls in the summer months. *This pattern of call volumes is best summarized by the statement that while the data assembly and information creation is constant, the demand for real-time traveler information is event (or crisis) driven.*

Figure 13 illustrates the percent increase in call volumes from summer months to winter months. For this illustration, call volumes were summed for the months of June and July to compute typical summer volumes, and for the months of January and February to compute typical winter values.

The results presented in Figure 13 are not surprising. The northern states and mountainous states show the largest increase in call volumes between summer and winter seasons.

#### Synthesis of How 511 Phone Systems Are Used

In addition to purely examining the call volumes, this study examined available information about the actual use of 511 phone systems.

In a survey of Montana 511 users (Western Transportation Institute 2004), survey participants were asked when they called the 511 phone system. The survey response showed the following:

- 68% of responders called 511 before the start of the trip
- 7% called 511 during the trip
- 25% called 511 both before and during the trip

This suggests that 511 is most often thought of as a source for pre-trip information, and that 511 is less likely to influence trips already under way.

The same Montana survey asked responders how they are most likely to respond if the 511 system informs them of poor travel conditions. The responders indicated they were most likely to change the departure times. Responders also indicated, however, they were likely to alter their route or cancel their trip based on the information.

In 2005, 21% of the participants in a Washington State survey noted that they modified their trip based on information received from 511 *the last time they called the 511 phone system*. Although 21% may not seem like a large value, it represents a considerable change in travel patterns, especially considering that the question specifically asked about the last time the responder called 511 (as opposed to asking whether they have ever modified their trip based on 511 information) (Washington State Department of Transportation 2005).

In the same Washington State 511 survey, 87% of responders indicated that they are likely or very likely to use 511 again. Washington State Department of Transportation (WSDOT) tracks the caller identification (ID) of incoming 511 calls. Roughly 50% of incoming calls include a caller ID value and can be used to measure whether callers are repeat callers. WSDOT has found that typically 55% to 60% of the calls with caller ID are callers who make at least two calls per month to 511. Some rural cellular providers deliver a caller ID related to a cell tower and therefore the number of repeat callers may appear to be higher than the actual number. A caller, however, also may call from his home phone, work phone, or cell phone, and therefore the use of caller ID may underestimate repeat calls. Repeat caller use of the 511 system indicates satisfaction and regular use of the system, rather than spontaneously experimenting with the system.

Surveys of users of the San Francisco Bay Area 511 (Travel Info) system show that callers are frequently repeat callers to the system (Metropolitan Transportation Commission 2004). About 55% of callers indicated that they altered their trip in some way based on information received from the 511 system.

#### Synthesis of 511 System User Feedback and Experiences

A number of agencies have conducted formal or informal surveys of users' perceptions and experiences with 511 phone systems. The results of these analyses are summarized as follows:

- In 2004, callers to the San Francisco Bay Area 511 system rated the overall satisfaction to be an average of 92.3%.
- In a 2003 survey, Montana 511 callers identified satisfaction with the 511 system to be 90.3%.
- In a 2003 survey, 99% of callers to the Virginia 511 service in the I-81 Corridor indicated they would call the system again.
- In 2005, Arizona 511 customer satisfaction was identified as 71%.
- In 2005, Washington 511 customer satisfaction was 68%.

#### Comparison of User Satisfaction and Frequency of Use

In the Montana detailed 511 customer survey conducted in 2003, survey responders were asked to rank their satisfaction with several components of the 511 system on a scale of 1 to 5 (1—not satisfied, 5—very satisfied). The average of all responses ranked all components of the 511 system at 4 or above (either satisfied or very satisfied). The highest ranking component of the 511 system was the "Usefulness of the Service," which received an average score of 4.45. However, the same survey asked those responders who had used 511 how many times they used the system in the past 6 months (from January 2003 through June 2003). The number of times each caller used 511 are summarized in Figure 14.

#### Summary of 511 System Content

When callers use 511 phone systems, they receive audio messages or are linked to additional services such as transit or tourism call centers. Therefore, the type of information and level of detail that can be relayed to a caller is limited by what a caller can understand without any illustrative references (as opposed to Internet sites that may convey images, maps, or other visual displays) and can retain in memory.

Based on a review of the content of operational 511 phone systems, the content of 511 systems typically fits into one of the following categories (this categorization of content does not imply menu options; for example, one menu tree in a 511 system may disseminate traffic and road conditions):

- Reports of events and alerts causing some impact to the road
- Reports of existing current traffic situations
- Reports of weather or road conditions
- Transit information

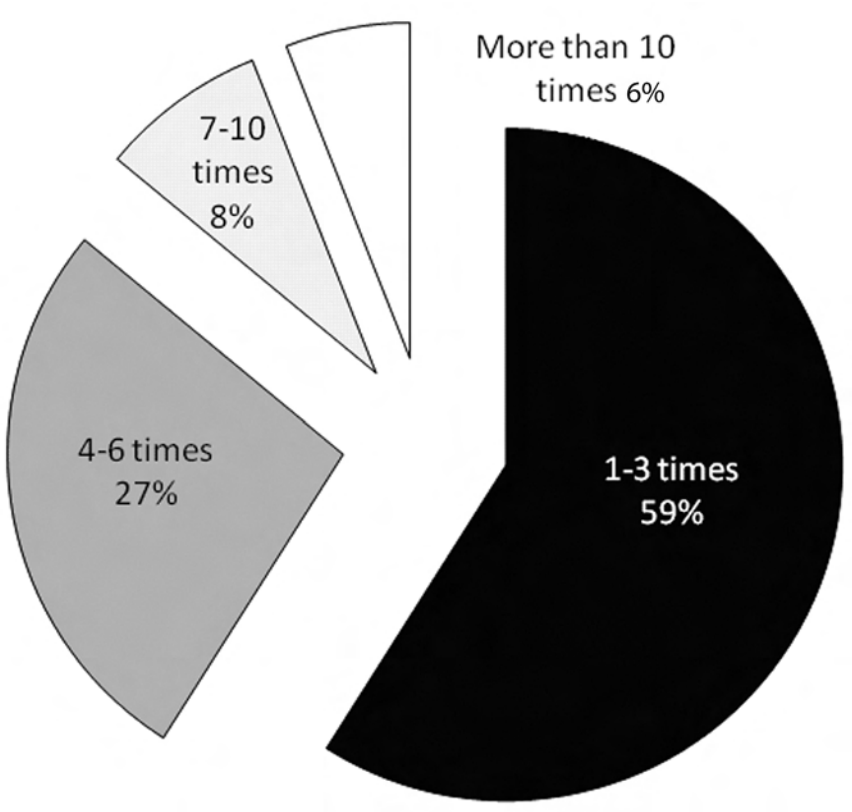


FIGURE 14 Montana survey results on the number of times callers used 511. (January 2003–Summer 2003).

#### 511 Reports of Events and Alerts

The most common information that is disseminated over 511 phone systems includes notification of construction, crashes, closures, or other events. 511 phone systems work well to describe the route, starting point, and ending point of the event.

Although construction and maintenance activities are offered on every 511 system, only a few 511 phone systems tested appeared to have detailed construction and maintenance activities with daily impacts reported (e.g., most report general summaries such as "intermittent lane closures from June 1–August 15").

#### 511 Reports of Existing Traffic Situations

A few 511 phone systems disseminate current traffic conditions in the form of travel times, speeds, or a qualitative description of the speed of flow (e.g., "slow traffic" or "free flowing traffic"). However, the nature of the 511 call creates challenges for dissemination of traffic reports (unlike Internet websites that are conducive to colored maps to illustrate speeds and travel times). An example of a 511 phone system operating traffic reports is the San Francisco Bay Area 511. Callers to the system may select origin and destination locations and hear travel times. Another example is the Minnesota 511 phone system that presents qualitative descriptions of the flow along segments of road (e.g., stop-and-go traffic, slow traffic, or free-flowing traffic). Also, the Florida DOT (FDOT) operates the My Florida 511 system, which allows users to establish an account and predefine up to 10 different routes (profiles). These profiles can be accessed when the user dials 511 to receive real-time traffic information.

Outside of these and a few other example systems, little information has been disseminated on 511 phone systems about the current traffic flow situation.

#### 511 Reports of Weather or Road Conditions

Reports of weather and road conditions are common on 511 phone systems, particularly in states where severe weather events occur frequently. The road condition reports are typically either manual entries describing the pavement conditions reported by the DOT, or detailed forecasts of conditions based on atmospheric and pavement models. Based on survey results, only a few 511 phone systems disseminate detailed route-specific forecasts of weather conditions.

#### 511 Reports of Transit Information

Most often, 511 phone systems link to existing transit phone numbers that offer either live operators or recorded

messages describing transit services. Some 511 phone systems present limited transit updates of departure times or route exceptions. For example, the Miami, Florida, 511 phone system (http://511southflorida.com) provides schedule and route information to 511 callers, as well as ridesharing information. In Portland, Oregon, the Tri-Met public transit system (http://www.trimet.org) operates a telephone system that allows users to enter a transit stop ID and hear the next planned arrivals at the bus stop. This system serves the same purpose as reader boards or on-screen displays at the transit stop, but it is operated at a much lower cost than would be involved to equip each transit stop with reader boards. Additionally, callers may call the system before leaving their home or office.

A number of current initiatives are developing real-time transit arrival and departure information as well as transit park-and-ride space availability information. Two federal initiatives, the Urban Partnership Agreement and the Integrated Corridor Management (ICM), are advancing increased transit information.

## PUBLIC-OPERATED TRAVELER INFORMATION WEBSITES

According to the most recent Nielsen Report, more than 75% of Americans have access to the Internet (more than 200 million people) (Nielsen 2007). In a survey conducted by the Pew Internet and American Life Project, 64% of Americans with Internet access have used it to access travel information. In addition, 62% of Americans have accessed weather information on the Internet. The impact of the Internet can be seen in homes and offices every day. Simply stated, the Internet allows safe, anonymous, on-demand access to information from a variety of locations.

Unlike 511 phone systems that typically carry a cost per call (or per minute), Internet sites can support millions of visits with only marginal cost impacts as the number of visits increase. The Internet is a primary player in the dissemination of traveler information, with some form of travel information offered in every state, although the level of detail and type of information varies.

This section summarizes the current status of Internet traveler information dissemination.

### Summary of Traveler Information Website Content

Traveler information websites disseminate a variety of types of traveler information. For this synthesis, the information content on traveler information websites is classified into four types of content:

- Reports of current traffic conditions
- Reports of weather or driving conditions
- Reports of current or planned events and incidents (including construction, crashes, and special events)
- Reports of multimodal options

*Reports of Current Traffic Conditions*

Through a review of existing online traveler information websites, the most common methods for relaying current traffic conditions in metropolitan areas to visitors were found to be as follows:

- Still or full motion camera images offering views of enough of the metropolitan areas to allow travelers to understand traffic along key routes
- Maps or tabular displays of current conditions, travel speeds, congestion levels, or travel times.

To illustrate the coverage of traveler information websites displaying current traffic conditions, Figure 15 shows the statewide and regional traveler information systems that utilize camera images and display traffic or travel-time information. As illustrated in Figure 15, the availability of traffic condition information is extensive.

*Reports of Weather or Driving Conditions*

Through a review of traveler information websites, Internet displays of weather and driving condition reports were found to include the following features:

- Displays (map or textual) of current and forecasted atmospheric weather reports generated by regional weather tools (e.g., National Weather Service)
- Displays (map or textual) of detailed weather conditions and forecasts often tied to pavement conditions generated by detailed models and or measurements from weather monitoring stations
- Camera images (static or full-motion video) that allow visitors to view the conditions of the road and observe ambient conditions at key locations throughout the state.

This synthesis project reviewed existing traveler information websites to identify the level at which the country is covered by weather and driving condition reports. Figure 16 illustrates those states currently reporting general weather reports (typically reported as countywide conditions), as compared with detailed route specific reports.

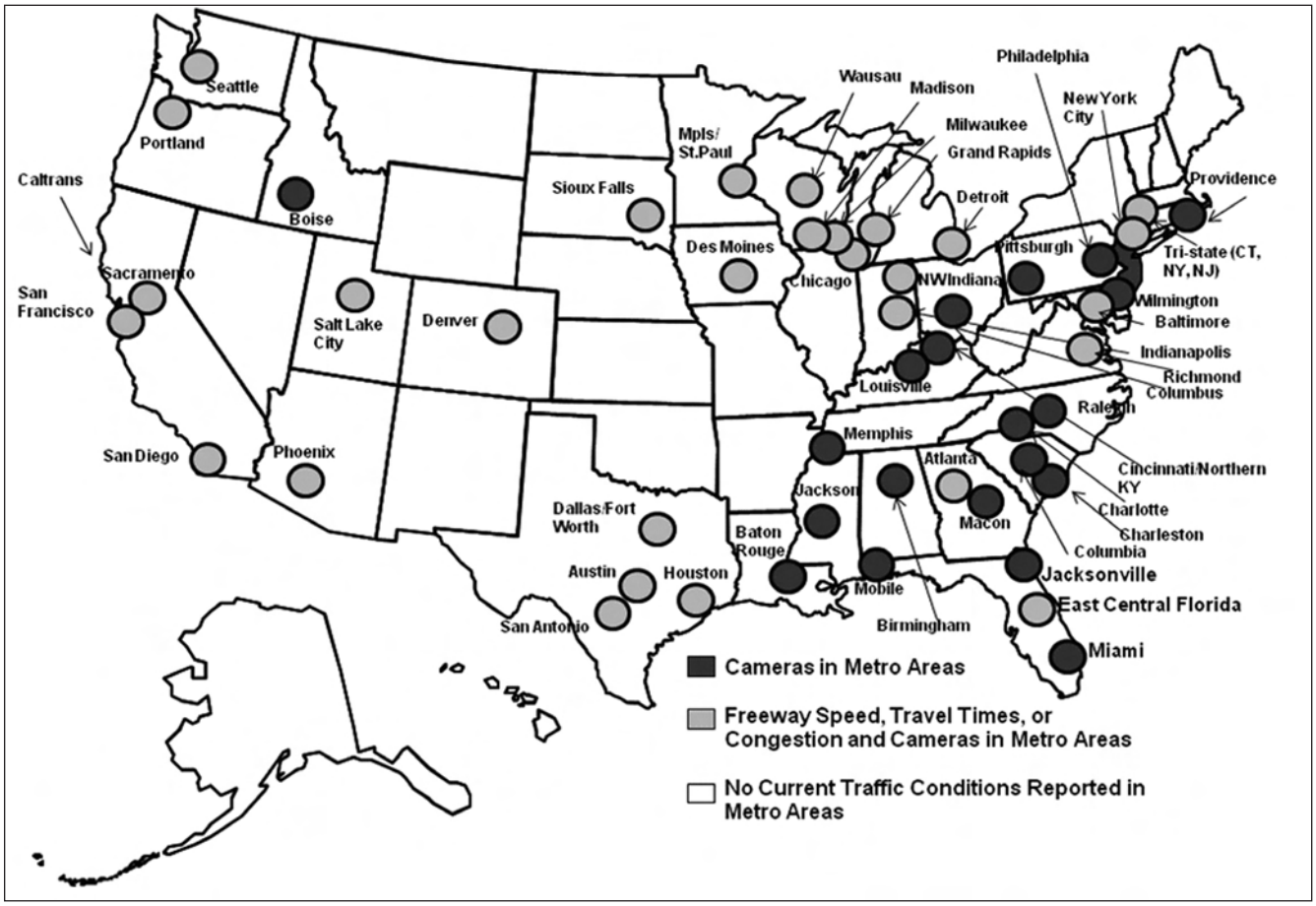


FIGURE 15 Illustration of traveler information websites providing traffic condition reports.

*Reports of Events and Incidents*

Accurate and up-to-date reports describing the impacts of construction, crashes, closures, and other events are most likely the most requested information on traveler information websites. Although every state includes some form of construction and event reports on public websites, the quality and standardization of these reports varies tremendously. Some states operate a network of data entry personnel who are tasked with entering events and situations that impact travelers. These data entry personnel may enter events during business hours or 24/7 depending on the reporting philosophy of the agency.

*Reports of Multimodal Options*

Traveler information website displays of multimodal options typically present transit route and schedule information, offer transit trip planners, and present real-time information describing next bus arrivals and departures. *TCRP Synthesis 68: Methods of Rider Communication* (Schweiger 2006) summarizes methods that transit agencies use to communicate with riders, including websites and traveler information systems.

**Summary of Traveler Information Website Display Approaches**

*Use of On-Screen Map Displays*

Traveler information Internet sites most typically display information through on-screen map displays, and less frequently through tabular displays. At the time that public agencies first began deploying Internet sites for traveler information, many users were still accessing the Internet over dial-up connections. Therefore, maps requiring the download of large data files took too long to load. For this and other reasons, most public agencies originally deployed simple map displays. In 2008, services such as Google Maps began to mainstream the use of zoom-able maps to the point at which users now are demanding high-quality maps. Figure 17 illustrates those states where public-operated traveler information websites currently operate zoom-able maps, fixed maps (statewide only), and a set of predefined maps offering different views of the state.

*Use of Icons to Describe Events and Incidents*

Many traveler information websites display icons over map images to represent the locations of incidents, construction,

closures, or other events. The ITS industry has defined ITS standards for the nomenclature of event descriptions; however, accepted standards have not been established for icon displays on traveler information websites. Therefore, the icons displayed by states vary across the country. Some states use icons that closely mirror the sign designations in the *Manual on Uniform Traffic Control Devices* (*MUTCD*) (FHWA 2003b), whereas other states have created local icons for on-screen display.

This synthesis project reviewed traveler information websites throughout the United States to document the use of icons. The results showed little consistency among icon use. Although traveler information websites typically include a legend describing the icons and therefore visitors to the site are able to understand the images, consistency among icons (and therefore the nomenclature of descriptions) would assist in universal understanding of the information.

In addition to the variations in icons, some states vary in the phrases used to describe conditions. For example, some states use the phrase "construction" or "road construction," whereas other states use the phrase "roadwork." Similarly, some states use the phrase "accident," whereas others use "crash." The North/West Passage Pooled Fund program conducted a study that documented the phrases used by the eight member states (Washington State, Idaho, Montana, Wyoming, North Dakota, South Dakota, Minnesota, and Wisconsin) and attempted to define an acceptable set of phrases that could be used to consistently describe events throughout each state in the program. The results of this project are available on the North/West Passage Pooled Fund website at http://www.nwpassage.info.

Figure 18 illustrates an example of the issues surrounding icon consistency. In addition to the inconsistent use of icons used by states to depict roadwork or construction activities, nomenclature also varies. The color coding of the states illus-

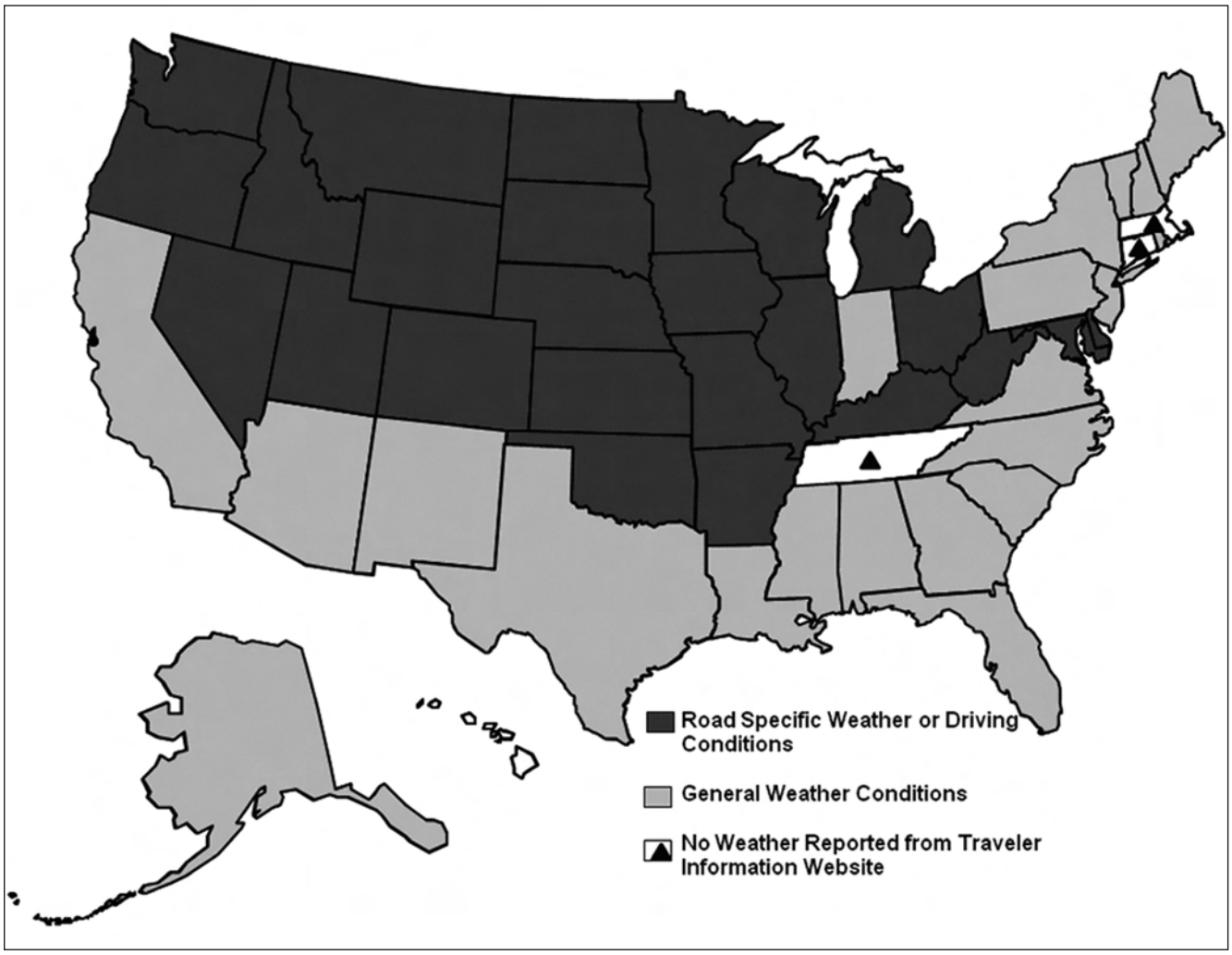


FIGURE 16 Traveler information website weather coverage.

trates that some states use "roadwork" whereas others use "construction" to describe the activity.

*Summary of Traveler Information Websites Use and User Feedback*

Travelers frequently have continuous connection to the Internet while at work, therefore allowing them to acquire pre-trip travel information. Given that approximately 50% of Americans have access to high-speed Internet in the home, travelers frequently have the opportunity to quickly sit at a computer and view Internet sites before departing on trips.

In a survey of general (noncommercial) travelers in rural portions of Washington State, 94% agreed or strongly agreed that the website displaying road weather information better prepared travelers for their trips. Furthermore, more than 50% agreed the information helped them avoid travel delays (FHWA 2004).

Volumes of statistics can be generated to describe traveler information website use. Consistency, however, is a challenge to ensure that the statistics of one site are presenting comparable statistics to another. For this reason, nationwide statistics of traveler information websites are not commonly found or presented in this report. To highlight the large volume of use that occurs during winter storms, Figure 19 illustrates the number of website visits (one visit is recorded regardless of the number of pages or views the visit involves) recorded by the WSDOT website during the January 27–31, 2008, winter storm. WSDOT does not include camera views as part of its current traveler information website tracking.

One study used an Internet survey to evaluate customer satisfaction with web-based real-time traffic information in Pittsburgh and Philadelphia. Results showed the following:

- In Pittsburgh, 68% of users changed their original travel routes and 47% changed their original time of travel as a result of traveler information received online.

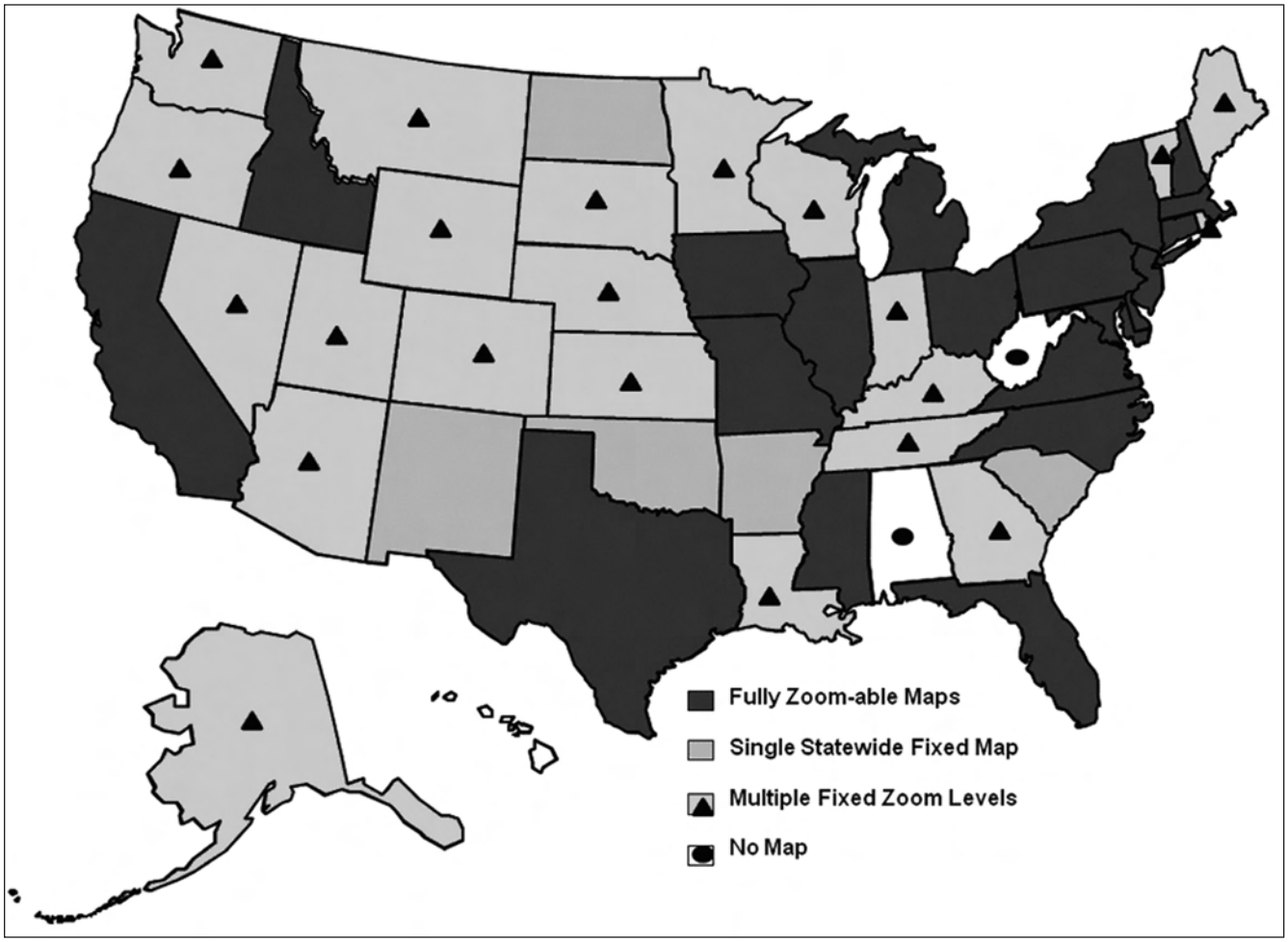


FIGURE 17 Summary of zoom capabilities of traveler information website maps.

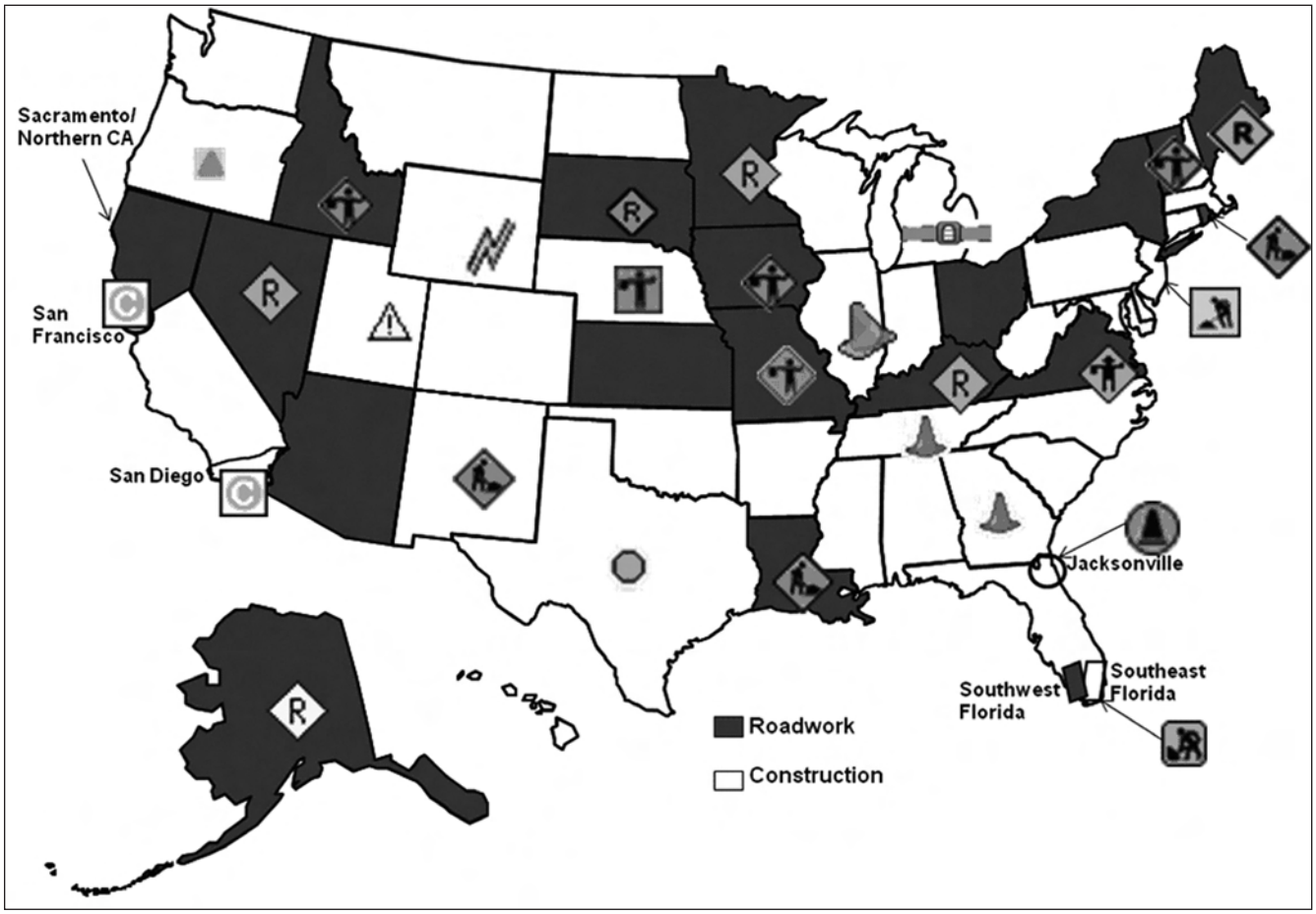


FIGURE 18 Summary of various icons used to report roadwork and construction.

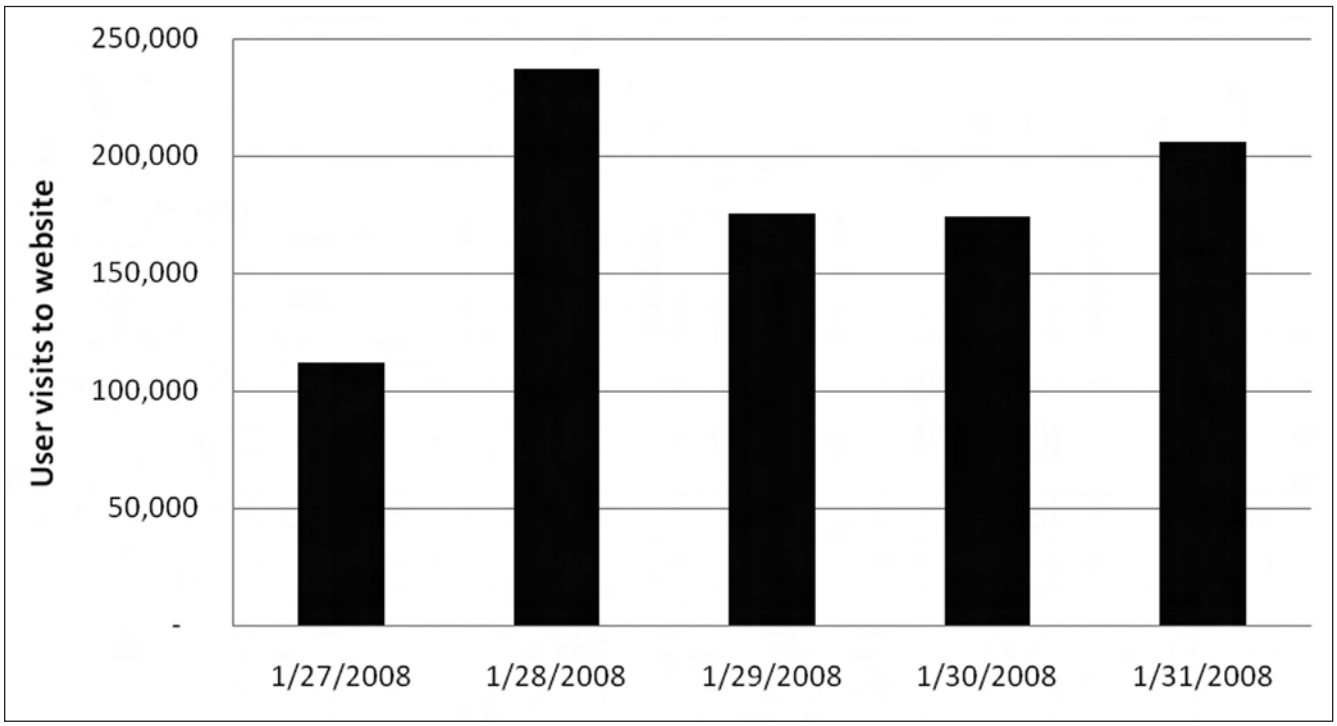


FIGURE 19 WSDOT traveler information website daily visits during January 2008 storm.

- In Philadelphia, 86% of users changed their original travel routes and 66% changed their original time of travel as a result of the traffic information (FHWA 2003a).

*Ideas for Traveler Information Website Improvements*

As part of this synthesis project, public agencies operating traveler information Internet websites were asked what they are doing (or could do) to improve them. Several written comments were received to the online survey. The following written comments illustrate the types of improvements planned or being performed to update Internet traveler information systems:

- Accident reports are not reported in a timely manner to the website.
- First-generation map system is outdated. Next-generation map using Google Map base will greatly improve user understanding of event locations.
- We need to revamp our website. It's very out of date … especially the map capabilities.
- The system does report closures and incidents but we also have committed to improving the system by upgrading the mapping software to Google Maps–based system.
- Timeliness (particularly with driving conditions) must be improved.
- For the content, format, and coverage that we currently have, we are definitely meeting the needs of our customers. With the webpage, the one thing that could enhance our product delivery is to provide it in a GIS (geographic information system) map format as well as the current textual format rather than just the textual format.
- We hope to integrate various data feeds into an easy-to-use, comprehensive Internet map (with a text option for disabled users).

### Traveler Information Dissemination Using Field Devices

The images that travelers view most often are those they see on their own dashboard. The dashboard typically consists of a speedometer, gas gauge, various engine monitoring and vehicle control devices, gauges, and a radio or entertainment console. In addition, the dashboard can be considered to include the line of sight visible out the front windshield, therefore including static and dynamic signs visible through the windshield.

If you consider a busy urban freeway that experiences up to 250,000 vehicles per day, that is 250,000 exposures to travelers of information on a dynamic sign that could be used to relay pertinent details about conditions downstream. For a state or metropolitan area with tens of signs in use, the ability to reach travelers far exceeds the exposures achieved through a 511 phone system, particularly when you consider that many states average 1,000–2,000 calls per day.

Highway advisory radio (HAR) is another field device used to reach large volumes of drivers. HAR broadcasts typically are received on either AM or FM radios, and travelers need only tune to the station to receive the messages.

*Benefits and Drawbacks of Field Devices*

Several benefits of field devices are identified as follows:

- Every driver passing a sign can view the information posted (no need for any device, service, or to tune the radio).
- Signs can offer information that is geographically specific to a location. Unlike 511 phone or web systems, the information providers know where the travelers are when they view these signs and thus can use such messages as "1 mile ahead" and can disseminate alternate route information.
- Sign technology is increasing and these signs now often offer color and graphics, and therefore can be used to convey messages in user-friendly formats.

Some potential drawbacks to field devices are as follows:

- Signs and HAR do not support pre-trip travel information, and therefore travelers are en route when they read the message and are limited in their response possibilities (i.e., they cannot alter departure time and have limited route diversion options).
- Signs and HAR incur installation and operational costs for each deployment, therefore preventing statewide operation as is possible with Internet and 511 phone systems.
- Signs are limited in the length (and complexity) of the message displayed, given the limited time drivers will see the sign. HAR broadcasts are limited as well but offer a longer period for playing a message.
- HAR broadcasts are often thought of as difficult to understand and lack presentation quality. In addition, they require the driver or passenger to tune the radio when information is desired and available.

In a WSDOT-sponsored survey of commercial vehicle operation companies, 57% of respondents said the availability of the new HAR system made them somewhat or a lot safer. Of those interviewed during the postdeployment period, 56% indicated they tuned in to one or both of the HAR stations while traveling in the area, and 51% found the HAR messages useful (FHWA 2004).

*Industry Perspective on Use and Future of Field Devices*

Through discussions with transportation professionals operating field devices, the following perspectives are offered about the future of field device use:

- DMS deployments will continue to expand. In Minnesota, there are currently often 4–6 mile gaps between DMS signs, and a possibility was identified to increase the density of DMS signs to locate signs every 2 miles.
- The use of dynamic lane management signs (where overhead lane-specific signs are located as close as 0.25 mile apart to advise travelers about the use and status of each lane) is being developed in a number of Urban Partnership Agreements beginning in 2008.
- Currently, DMS signs are most often used for travel-time message dissemination, notices of lane closures or crashes ahead, weather and road condition reports in rural areas, Amber Alerts, and construction reports. Industry professionals indicated that they expect to see an increase in the use of DMS for purposes such as weather reporting in metro areas, parking, transit, High Occupancy Toll availability and prices, and air quality reports. The Traffic Management Center (TMC) Pooled Fund Study completed a project to establish guidelines for the policies, procedures, and practices of operating DMSs. This report is available on the TMC Pooled Fund website at http://tmcpfs.ops.fhwa.dot.gov.
- DMS or other field device use is limited along arterials. The majority of the use is either—
  - High-speed arterials (especially to advise travelers about conditions on connecting freeways)
  - High-density metropolitan areas with considerable tourism traffic or unfamiliar drivers (e.g., the Anaheim, California, area has operated arterial DMS for approximately 20 years because of the large traffic volumes in and around the Disneyland areas).

In the Los Angeles County and Orange County areas of Southern California, the Regional Integration of Intelligent Transportation Systems has developed a regional architecture to support an information exchange in real time between freeway, traffic, transit, and emergency service agencies, including agencies that operate arterial networks. The U.S.DOT supports the ICM program. The concept behind ICM is that freeway networks, arterial networks, and transit networks all have mature technology deployments (including real-time traveler information). However, the technologies deployed on the three networks are rarely integrated. The ICM initiative is developing and modeling concepts that include the display of information on arterial streets that describe the following:

- Arterial travel time and comparison freeway travel times of parallel routes
- Incident information provided either ahead on the arterial or on parallel freeways to give travelers information needed to decide whether to remain on the arterial or deviate to the freeway
- Other closure or detour information that is needed en route.

Detailed information about the ICM initiative and concepts for arterial street real-time traveler information delivery can be found at http://www.its.dot.gov/icms/index.htm.

*Digital Billboards*

Since the creation of roadways, billboards along the side of the road informing travelers of businesses or services ahead have existed in some fashion. Typically used for advertising, billboards are most often located "on-premise" in that they are located on private property adjacent to the right-of-way of a highway. The influence of billboards on the traffic flow and the safety of travelers have been controversial over the years. In recent years, digital billboards have been introduced to the marketplace. Digital billboards utilize a combination of dynamic message displays and real-time communications to display messages and graphics that change every 4 to 10 seconds. In addition, the digital billboards typically use light-emitting diode (LED) displays and therefore may appear brighter than traditional illuminated billboards. However, digital billboard operators are able to turn down the brightness at night, reducing the impacts on travelers. The billboards can receive real-time messages sent by the advertising agency operating the billboard and therefore have the potential to display notices of Amber Alerts, weather conditions, or traffic messages, and could become effective traveler information dissemination devices if public–private partnerships are formed.

According to the Outdoor Advertising Association of America, digital billboards account for approximately 700 of the roughly 450,000 billboards across the United States. Digital billboards are considerably more expensive than traditional billboards, costing approximately $250,000 (Stateline.org 2007). TRB started a subcommittee on digital signage during 2008. This subcommittee and the participating partners are exploring the legal, safety, and human factor issues surrounding digital billboards.

#### In-Vehicle and Personal Devices

During the 1990s, a number of public-funded operational tests were conducted of in-vehicle devices. Some examples include the Trilogy project in Minnesota that disseminated data displayed on in-vehicle maps showing traffic speeds on the metropolitan freeways, locations of incidents, and whether freeway on-ramps were metered. In a similar Minnesota effort, the Genesis project deployed handheld devices to receive messages sent by the Mn/DOT TMC.

A similar project in Seattle, Washington, called the Seattle Wide-area Information for Travelers (SWIFT) disseminated traveler information to three devices:

- Watches equipped to receive and display the information (pager technology)

- Portable computers
- In-vehicle navigation devices

Although these and other projects (including the TravTek project in Orlando, Florida) were successful and user feedback was positive, the business model of disseminating a data stream and consumer devices tied to subscription services receiving the information did not explode as quickly as was predicted in the early 1990s.

With the introduction of the Internet, digital cellular phones, and smart phones, the concept of personal traveler information devices no longer mandates dedicated devices. Today, many public agencies operate web-enabled cell phone–specific traffic flow maps that are legible on web-enabled cellular phones.

ODOT developed information dissemination specifically for mobile phones. The service (called TripCheck Mobile) allows users with web-based phones to request information for specific routes and view camera images. TripCheck Mobile has been in service for 9 months and averages approximately 40,000 visits per month (with winter months averaging about 70,000 visits).

#### Privately Operated Information Dissemination Services

Radio and television media have disseminated traveler information for decades. In the early days, media outlets used aerial surveillance to gather traffic information and presented information using voice and personality talents. Today, automated data collected by state DOTs feed media outlets with data, to complement their own data collection practices.

Since the introduction of the ITS industry, private sector information service providers have explored business models for traveler information dissemination. The most common revenue sources explored have been advertising revenues and subscription fees.

Private sector information service providers compete with public traveler information systems, free sources of weather information, and existing television and radio broadcasts. Therefore, private information service providers typically offer value added services in the form of increased detail (often gained through the collection of additional data using privately owned sensors) or expanded delivery options.

The following summaries of a number of private sector information service providers illustrate the types of services offered. The selection of service providers does not represent any priority or distinction among providers. This is not an exhaustive list of all providers, but rather a sample of the providers currently operating at the time of this report.

*Traffic.com*

Traffic.com provides real-time traffic information for 51 cities across the United States. Real-time information may include construction, incidents, events, transit, or roadwork. Traffic.com has teamed up with trafficland.com to provide video images for 16 cities across the United States.

Traffic.com includes personalized drive times. Users are provided with the option to enter a starting address and ending address to calculate drive time. The calculation produces two options, the fastest drive time, and the drive time for a direct route. The calculation displays the average speed as well as indicates any delay in minutes. In addition to personalized drive times, Traffic.com identifies traffic hotspots for each city. The hotspots have a predetermined starting and ending point on major roadways. The hotspots provide a jam factor from 0 (clear) to 10 (jammed) to indicate the worst traffic conditions for the section of road selected.

*BeatTheTraffic.com*

BeatTheTraffic.com is a nationwide service that processes and integrates real-time traveler and weather information from public and private sources. Traveler and weather information is provided online, through three-dimensional television newscasts, and with e-mail and cell phone alerts. Currently, BeatTheTraffic.com provides traveler and weather information to more than 70 cities. Each of the 70 cities includes a separate web page that identifies information available for that city such as travel times, forecasts, incidents, or cameras.

*TrafficLand.com*

TrafficLand.com provides live video from thousands of cameras worldwide from partnering with local, state, and federal government agencies. The website is intended to assist the driving public, first responders, DOTs, media, commercial enterprises, and emergency management by providing real-time information nationwide.

*TrafficGauge.com*

TrafficGauge.com provides real-time information from handheld devices, cell phone maps, and online maps. Users can purchase a handheld device that provides real-time information for four cities. Information includes congestion reports for the selected city, such as light, medium, or heavy traffic. Users can access color traffic maps on a cell phone, which provides areas of heavy, medium, and light congestion. TrafficGauge.com also provides congestion information online for 20 cities across the United States.

*SigAlert.com*

SigAlert.com provides personalized traffic reports throughout all of California, including speed maps in major cities. SigAlert offers speed maps and traffic incident summaries over the Internet and cellular phones, and sends personalized traffic reports to various devices, including cellular phones, pagers, and PDAs.

## EMERGING TECHNOLOGIES AND DEVICES

Each month, new and innovative technologies reach the marketplaces that change user behavior. One example was the affordable introduction of cellular telephones in the late 1980s and early 1990s. The use of the cellular telephone increased connectivity and communication of individuals tremendously. Less than 20 years later, basic cell phones now are considered outdated and users demand additional handheld services such as e mail, Internet, and text messaging. The potential for technologies 20 years from now is endless.

The rapid, creative, and commercially lucrative industry of emerging technologies offers many options for traveler information providers and also several challenges. As an example, the use of e-mail and text-messaging delivery allows traveler information systems to reach many travelers using inexpensive devices (saving considerable costs when compared with the costs of long-distance minutes on a landline phone system). Similarly, the penetration of the Internet offers another low-cost option to reach large numbers of travelers. Furthermore, the Internet allows travelers to view graphics, such as camera images, providing a view of conditions that simply could not be described on a phone system.

From the opposite perspective, rapidly evolving emerging technologies often create expectations from travelers that public agencies will deliver information to a brand-new device. As a result, DOTs may be pressured to deploy additional services and bear the costs of such services to respond to the volumes of requests.

Travelers interact daily with a number of end-user applications that take the form of vendor-specific products and services. Before describing a sample of the emerging products and services, this section describes three enablers that have been instrumental in supporting recent emerging technologies and that will continue to be instrumental in the future.

### Internet as an Enabler

The Internet and the ability to create web software that can be accessed instantly by anyone with an Internet connection have changed the software industry. Early traveler information systems (both operational tests and deployments) often required software and hardware to be physically connected by direct communication such as dedicated phone lines or coaxial cable. As a result, development and operational costs were high, economies of scale were limited in software development, and the industry saw a limited reuse of source code. The introduction of the Internet and the ubiquitous nature of Internet connectivity have created an environment in which technology applications can rapidly develop and evolve. Therefore, many emerging technologies have been made possible because of the Internet, including such things as e-mail messages, mobile access to the Internet, Internet accessible event entry systems, and an assortment of traveler information websites offering various options of services.

Although the rapid increase in Internet use from the time it was introduced to the general public in the early 1990s has been rapid, Internet connectivity is still a relatively new service. Also, over this time, access to the Internet has changed from being primarily low bandwidth in the early years to more recent high-bandwidth connections. It is likely that the general population's use of the Internet will continue to fluctuate until finally settling into a stable and predictable pattern. Indications also suggest that the target market and user expectations will vary by region throughout the world [e.g., rural versus urban; northern (winter weather) states versus southern].

### Digital Cellular Phones as an Enabler

A second technology advancement that has been responsible for enabling many emerging products and services is the coverage of digital cellular phone service throughout the United States. The digital backbone of communications has enabled the use of text messaging, mobile Internet access, and cell phones as probes, and essentially has introduced an affordable method for delivering mobile traveler information. The end products that can be developed are nearly endless. En route traveler information delivery can now be accomplished by creating an e-mail push application that delivers text and e-mail messages to cellular phones. As recent as 15 years ago, options for en route information delivery were limited and expensive.

### Accurate and Comprehensive Mapping Databases as Enablers

The third enabler to emerging technologies covered in this report is the existence of detailed maps and map attributes for the United States. By 2008, travelers were regularly using online products such as Google Maps or Mapquest to view turn-by-turn directions to their final destination. Although the applications that deliver these services to the traveling public are impressive, the real enabler to all forms of online directions, in-vehicle navigation systems, and personal navigation systems is accurate maps and associated attributes. The existence of these maps has enabled many technologies and will continue to do so in the future.

**Emerging Products and Services**

*In-Vehicle Navigation Systems with Traffic Information*

In-vehicle navigation systems offer travelers on-screen map displays identifying the position of the vehicle, offer point-to-point driving directions, and estimate arrival times. Many navigation systems report the vehicle speed [calculated from a global positioning system (GPS)], altitude, and direction of travel. In addition, the navigation systems available today offer wireless (e.g., Bluetooth) communication capabilities that allow drivers and passengers to use the navigation system, speakers, and microphone to talk on their Bluetooth-equipped cellular telephone. In addition, if text messages are received to the phone while the phone is connected to the navigation system, the text messages can scroll across the bottom of the navigation screen. Therefore, in-vehicle navigation systems offer a tremendous assistance to travelers. If travelers receive text messages of incidents or alerts from traveler information systems, the in-vehicle navigation system is part of the information delivery process. Perhaps the largest impact of navigation systems on the traveler information industry centers on the integration with real-time traffic reports. In-vehicle navigation systems typically can be upgraded or configured to receive real-time notifications of traffic, speeds, and incidents and to display these events on the navigation map. The data are typically received by wireless FM radio, cellular phone, or Sirius/XM satellite broadcasts. Typically, a monthly service charge applies and the real-time traffic reports are available only in a limited number of cities.

Navigation systems are no longer limited to in-vehicle devices. Portable navigation systems may be used outside vehicles. Most recently, many cellular phones now offer GPS location services and a navigation feature, allowing a cellular phone to perform the services of an in-vehicle navigation device.

*Travel Time Detection Using Wireless Devices*

Transportation agencies often calculate travel times in metro areas where speed, volume, or occupancy sensors exist at a density that will support accurate calculations. In areas lacking sensors, however, public agencies are challenged to produce accurate travel-time estimates. A number of approaches have been conceived, tested, and implemented to detect travel times using wireless devices. For example, cellular phones that are continuously transmitting signals that identify the telephone offer an opportunity to track the progression of phones and estimate a travel time. Electronic toll tags that communicate (actively or passively) with toll readers offer another option for estimating travel times. Most recently, new technologies and approaches to track Bluetooth devices in vehicles are emerging that can estimate travel times. Early deployments and demonstrations occurred in 2008.

The advantages of these and other wireless devices that assist in the reporting of travel times is that the number of these devices is always increasing, and therefore the accuracy and geographic coverage of quality reports is increasing as well.

Even with the emerging travel-time approaches and strategies, a considerable gap still exists between the need for travel times nationwide and the emergence of a clear plan of action that would deliver nationwide travel-time information.

*Personalized Text Message and Support Tools*

It is estimated that 255 million people subscribe to handheld devices such as cell phones, smart phones, pagers, and PDAs. Each device offers different applications allowing users to send or receive information. Devices with web browsers provide users with the capability of viewing real-time traveler information websites. Washington State, Oregon, and Idaho represent examples of three states with websites dedicated solely to the mobile web browsers that are found on cellular phones. Also, handheld devices now exist that display full Internet sites, allowing travelers access to any traveler information website while mobile.

Most digital cellular phones allow text messaging. Monthly rate plans offer competitive pricing and, as a result, text messaging is commonplace among travelers ranging in age from elementary school children to the elderly. It is estimated that in the United States 48 billion text messages are sent monthly, compared with an estimated monthly total of 9.8 billion monthly text messages 2 years ago. The benefits of text messaging are that it is low cost, portable, nonintrusive (messages can be sent and responded to when convenient), and quick to perform. Some push systems are capable of sending traffic and travel messages using text messaging. In addition, some private sector services offer automated text-messaging replies (e.g., Google). Anyone can send a text message to Google with the flight number of any flight on any airline. The Google automated system will automatically and immediately reply with the most recent available information describing the arrival and departure status of the flight and the gate at which the flight will arrive or depart. A similar system is possible for traveler information systems. Travelers could text an automated service and specify the route and segment they are planning to travel, and receive a text reply summarizing the conditions. Text messaging is a major means of communicating. It offers a quick, low-cost option for reaching travelers; however, it has the potential to create information overload in that travelers already receive a large number of text messages.

CHAPTER FIVE

# AVAILABLE AND EMERGING DATA SOURCES

Previous sections of this report have summarized traveler information dissemination approaches. However, traveler information dissemination is only possible because of data collection and information creation to supply the information. Adequate data sources are critical to deliver accurate and timely traveler information.

This section describes the feedback from the survey of traveler information providers on their use and needs for data sources, and then describes feedback and insight gained from discussions with traveler information industry experts and through reviews of existing systems.

## CURRENT USE OF DATA SOURCES AND ADDITIONAL DATA NEEDS

### Accuracy and Timeliness of Information Dissemination

The quality and availability of data sources directly impacts the accuracy and timeliness of the information presented to travelers. Responders to this survey were asked whether they believed customers were satisfied with the accuracy of the information disseminated (based on feedback received from customers). Figure 20 presents the agencies' understanding of customer satisfaction.

### Current Sources for Traveler Information

In this study's survey of public agencies operating traveler information systems, responders were asked to describe their sources for traveler information data:

- Twenty-four of 26 agencies indicated that data sources are primarily owned and operated by the DOT (e.g., loop detectors, weather stations, manual entry by personnel).
- Ten of 26 agencies indicated that they have some no-cost data feeds from external sources outside the DOT, including National Weather Service weather reports.
- Four of 26 agencies indicated they use outside "priced" data sources that may include a fee for service or barter arrangements.

### Interest in Additional Data Sources

Twenty-six agencies responded to the question about their interest in additional data sources as follows:

- Nine agencies indicated they would be open to outside data sources if the data were provided free of charge.
- Nine agencies indicated they would be open to outside data sources and may consider paying a fee for the data.
- Eight agencies indicated they are not seeking or open to the concept of outside data sources because their current data sources meet their needs.

### Factors Contributing to Use of Outside Data Sources

Responders to this study's survey were asked to identify the determining factors in selecting an outside data source (and were allowed to select as many factors as they wished). The responders indicated that the following factors would determine their acceptance of an outside data source:

- Cost (23 of 27 responders)
- Reliability of data (21 of 27 responders)
- Quality assurance (19 of 27 responders)
- An ongoing commitment that the data will always be available (13 of 27 responders)

### Comments from Survey Responders on Additional Data Source Needs

Survey responders were asked to comment on additional data sources they wish they had:

- Responder from Mississippi indicated an interest in law enforcement and emergency services (field information).
- Responder from Montana indicated an interest in an information feed from the State Patrol.
- Responder from North Carolina indicated that they are considering purchasing congestion and flow data from a third party and will be assessing the cost to purchase the data compared with installing, owning, operating, and maintaining the infrastructure, as well as the accuracy, reliability, and timeliness of the data when reaching the decision.

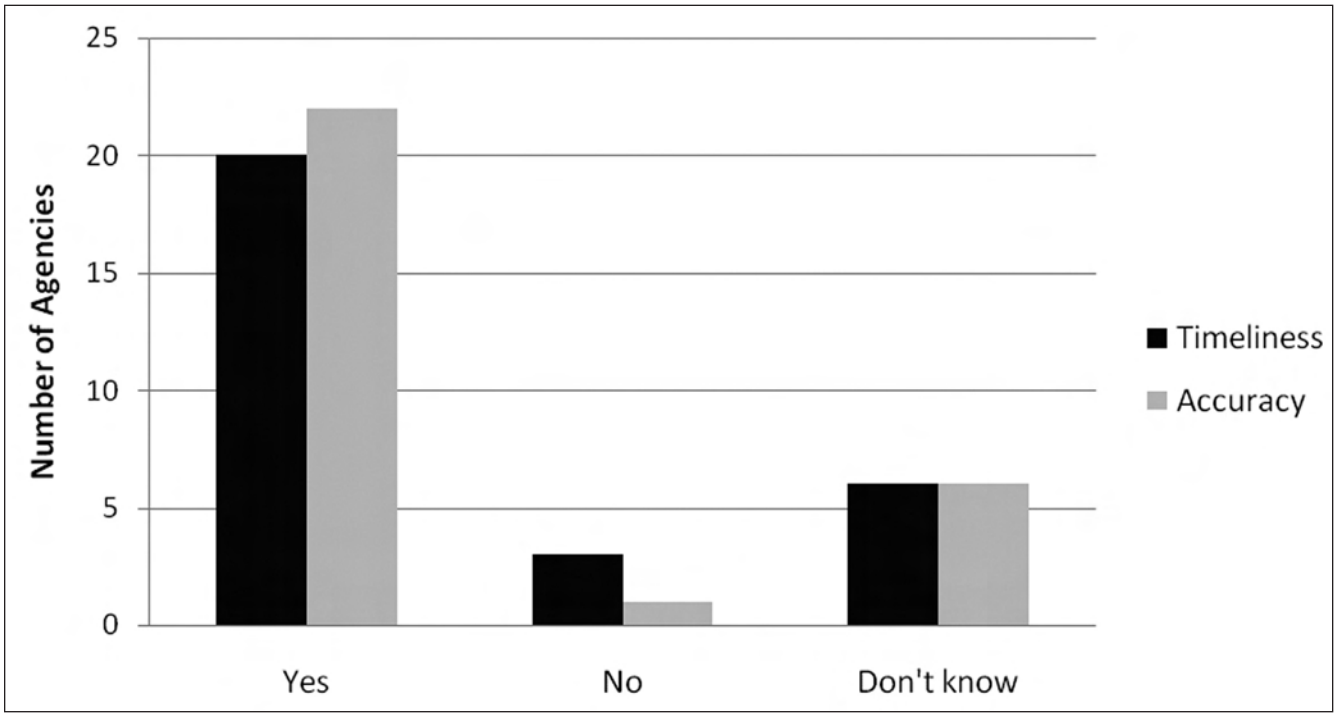


FIGURE 20 User satisfaction with accuracy and timeliness of information delivery systems.

- Responder from the San Francisco Bay Area expressed an interest in sensors that collect volume and occupancy in addition to travel-time data.
- Responders from California indicated an interest in more flow data, more cameras, more weather stations, and statewide databases shared among the TMCs; as well as additional data along arterial routes and transit data.
- Responder from the Eastern Sierra area of California (a rural area) expressed an interest in more cameras, more HARs, and more vehicle and speed detection.
- Responders from California also indicated they may be pursuing outside sources for cellular phone and GPS roadway traffic data to augment performance monitoring and therefore improve traveler information.
- Responder from Chicago indicated an interest in probe data for arterial street travel times.

### SUMMARY OF CURRENT AND FUTURE WEATHER DATA SOURCES

In describing weather sources, it is important to note the difference between data and information:

- Data typically refers to numerical or graphical descriptions of weather or road conditions.
- Information refers to messages or descriptions that describe the data in a format that is understandable and useful to the recipient.

Many state DOTs own and operate Road/Weather Information Systems (RWIS). RWIS are field-automated weather and pavement condition observations points. Typically, however, RWIS observations are used by the maintenance operators and often are not displayed on traveler information maps.

The U.S.DOT Clarus Initiative is actively developing a central database of weather data to be available to public and private information providers. The Clarus initiative will make great strides toward having a universal, quality-controlled source of weather data throughout the United States.

Detailed route-specific weather and pavement condition models have been developed and are offered to public agencies. Many states, however, have not yet purchased these detailed weather reports for traveler information dissemination systems.

Therefore, even when Clarus is completed and detailed weather data are available, it is unclear whether state DOTs operating traveler information Internet and 511 phone systems will invest in harvesting the detailed weather reports (either from Clarus or from a private sector value-added service provider).

One possible explanation is the availability of National Weather Service regional weather reports (most often at a county level). The availability of this free source of weather information has made it easy for traveler information systems to link to the data or incorporate it into their dissemination

system. Therefore, the existence of this high-level weather data source may be preventing state DOTs from investing in the purchase of detailed weather and road condition data that are now offered.

Based on interviews with weather industry experts, the following observations and insights were offered:

- The accuracy and quality control of real-time weather data sources will continue to improve gradually.
- Federal initiatives, such as Clarus, will advance the state of the art and increase the availability of weather data.
- A disconnect exists between the detailed weather forecasts that are available and the information disseminated by most state DOT Internet and 511 phone systems.
- Although the weather data sources from observations and forecasting models deliver quality data, it is still a challenge to present these data to travelers as useful information, packaged appropriately for the dissemination medium.

## TRAFFIC DATA AVAILABILITY

Traffic data refers to speed and volume or occupancy data or to travel-time data. Generally, the two categories of sources for traffic data are as follows:

- Public traffic data collection and assembly by DOTs
- Private sector traffic data collection

### Public Sector Traffic Data Collection

*Intrusive Detectors*

Loop detectors were one of the first approaches used for traffic data collection, and they still offer a highly accurate and effective source for traffic data when they function properly and are properly placed and located.

- Many metropolitan areas operating ramp meters have placed loop detectors at 0.5-mile frequency (some even every 0.25 mile). A network of closely spaced loop detectors provides a solid source of reporting traffic conditions and travel times.
- The largest challenge with loop detectors is the cost of deployment and maintenance, especially when considering the need to close a freeway or arterial to replace or repair a loop detector.
- Based on the costs of maintenance, existing loop detectors may be left inoperable if broken and state DOTs are increasingly less likely to install as dense a network of loop detectors as they have in the past.
- State DOT representatives interviewed recognize that, when loop detectors and communication equipment are functioning properly, they offer accurate representations of traffic volume and occupancy and also can be used to calculate speeds. At any given time, however, data may be missing for locations where detectors or communications are inoperable.

*Nonintrusive Detectors*

Several approaches to nonintrusive traffic data collection do not require the installation of data collection equipment in the roadway. Some examples of nonintrusive detectors include wireless radar, Doppler radar technologies, toll tag readers, and license plate readers.

- Nonintrusive traffic data collection offers lower cost deployment and operation of data collection, and therefore some state DOTs have been able to cover expanded areas for their same budget. As an example, a deployment of Doppler radar–based devices in North Carolina combined with wireless communications and solar power provided coverage of many more miles than the budget would have allowed with loop detectors.
- A challenge with some radar-based traffic detectors is that some only detect the speed of vehicles and not vehicle traffic counts, which are often needed by state DOTs for other purposes. In the North Carolina example, only speed is measured and not traffic volumes.
- Toll tag readers provide accurate readings in location where a large number of electronic toll tags are located on vehicles. However, the inherent delay caused by the approach of tracking a vehicle as it crosses two locations often causes a delay in readings and can negatively affect the accuracy of real-time data.

*Private Sector Traffic Data Sources*

A number of private sector companies offer traffic data to public agencies. The traffic data offered may consist of real-time travel time, speed, or volume data, or historic data to be used by DOTs for planning and mobility assessments. The sources of traffic data and algorithms for computing travel times and speeds vary and are specific to each product and provider. However, based on feedback and input from industry experts, the private sector data collection typically involves a combination of feeds from public agencies and data from some form of vehicle-based probes (e.g., long-haul commercial vehicles, local delivery vehicles, or cellular phones).

A number of state agencies are either testing or using private sector traffic data sources, and over the next few years, evaluation reports will summarize the accuracy, costs, and ultimately business models of public agencies that purchase data from private providers.

The potential benefits of private sector traffic data, and that mobile probes are used to gather the data, offers tremendous opportunities for much wider spread data coverage than what is possible with the current infrastructure of sensors. In addition, many public agencies are challenged by the costs of maintaining and repairing intrusive and nonintrusive traffic detectors, and private traffic data collection could supply this data, if accuracy is proven to be adequate.

In summary, for reasons of reducing traffic data collection costs and increasing geographic coverage of traffic reports, many public agencies are either testing or using private sector traffic data. Examples were cited of tests of services from Inrix and AirSage; however, additional companies and ventures may also develop and offer traffic data.

## EVENT AND INCIDENT DATA AVAILABILITY

Descriptions of current and planned event and incident data describes such things as road construction or maintenance activities, crashes or other incidents, road or lane closures, and special events (e.g., parades, running/bicycling events) that will affect travel and parking. These events may describe either currently active situations or planned events for future dates and times. These descriptions are critical to complement current traffic reports and to give travelers an understanding of the cause and expected duration of traffic slowdowns. The sources for event and incident data are typically from one of two categories:

- Manual entry into a statewide or regional condition/event reporting system; or
- Automated system to system data exchange.

The following sections provide a synthesis of the findings related to these two categories.

### Manual Event and Incident Entry

Manual entry is often performed by selecting predesignated phrases and location points to ensure standardized descriptions of events. The entry of event and incident descriptions is often performed in a traffic management center or by operators statewide using a distributed network of system interfaces. Accuracy and timeliness are challenges with manual entry of events. During peak periods, operations staff are busy and are challenged to find time to enter even quick entry of event and incident reports.

One pressing challenge to event and incident entry is gathering the knowledge about the event or incident. For example, road construction and maintenance activities are an information source that is difficult to maintain accuracy. Often, road construction activities last for long durations and general messages such as "intermittent lane closures from June to August" are common. Travelers want details about daily activities, and condition reporting systems allow the entry of this information; however, operators who perform the entry often do not know the daily plans for specific closures. This is just one example of a challenge with keeping

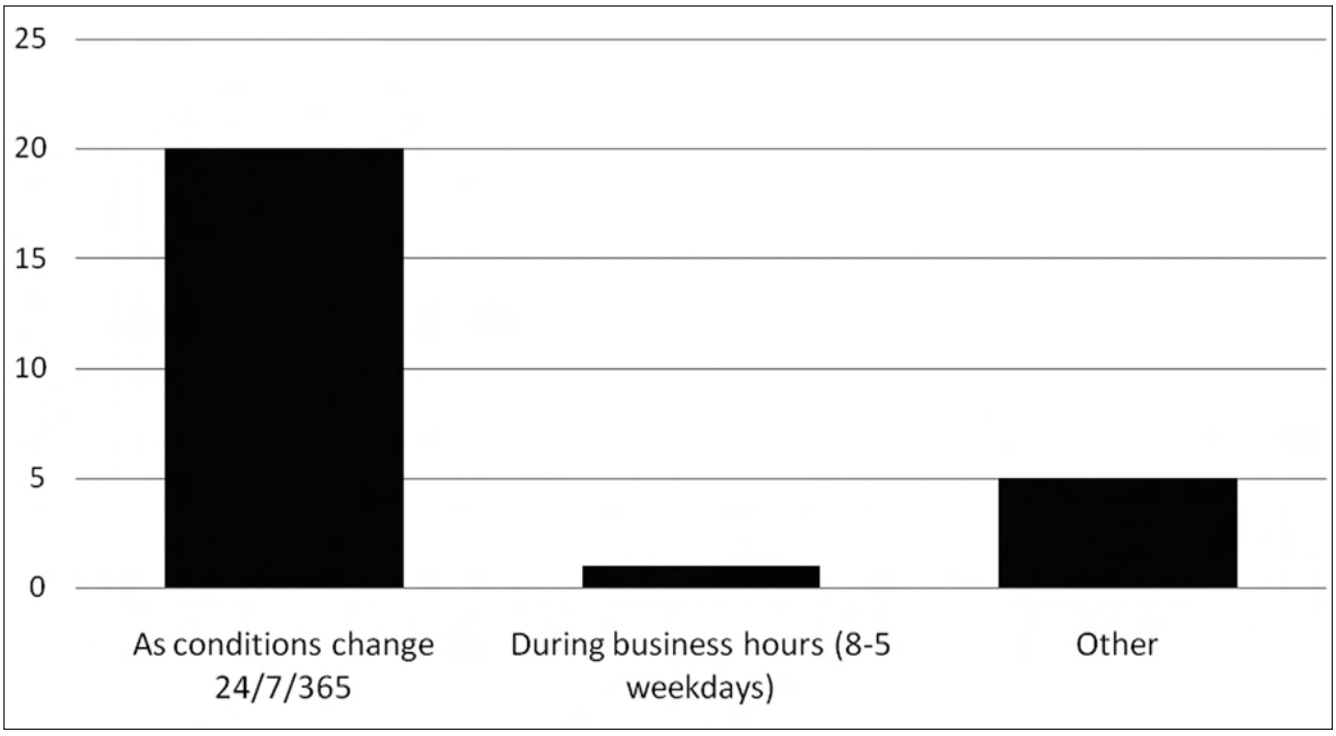


FIGURE 21 Reporting frequency of events and incidents.

manual entry of events updated and detailed enough to benefit travelers.

In the survey conducted within this project, every respondent indicated they had a manual system for entering conditions and event information. Responders were asked how often events and conditions are entered, and the results are summarized in Figure 21.

Responders who entered "Other" to the question presented in Figure 21 were asked to comment. The comments received are summarized here:

- Varies by season (winter is reported as conditions change and are reported from the field personnel and summer is updated weekly or as project info changes).
- Varies; we try for two to three times daily but often outstate staff fail to do it.
- 24/7/365 in Northern Nevada. So NV calls in to ops center in Reno to update major/critical events only.
- Several times per day from 4 a.m. to 9 p.m. (October–April).
- October through May: M–F early a.m. Sometimes updated in the afternoon and provided on weekends. June through September: only report if adverse weather conditions exist.

#### Automated System to System Data Exchanges

*Automated Exchanges of Incident Data*

Another popular approach to assemble event and incident information is through automated data exchanges with other systems. Recently, several federally funded projects have deployed automated systems to exchange incident information that is stored in emergency response or law enforcement computer-aided dispatch (CAD) systems with transportation information dissemination systems. These systems help to avoid the need for duplicate entry of events and are based on the understanding that the law enforcement or emergency response agencies enter descriptions of crashes and incidents into CAD systems to facilitate response. Rather than ask these dispatchers to reenter incident descriptions, automated data exchanges have been developed. Systems that include this automated data exchange have been developed (and are operational) in Salt Lake City, Utah, and Washington State.

Another successful example of automated data exchanges is a relationship established with the OnStar services. Today, a number of states receive automatic reports from the OnStar service center any time a vehicle has an air-bag deployed and emergency services are notified. The way the system works is that active OnStar-equipped vehicles that are involved in a collision that deploys the airbag send a notification to the OnStar operations center (together with the vehicle location and in many instances a description of the crash characteristics). A voice connection is automatically established to the vehicle and the OnStar operator speaks with the passengers. If the OnStar dispatcher determines that emergency services are required, they are able to push a button to automatically establish a three-way communication with the local Public Safety Answering Point. At the time this three-way phone connection is established, the data describing the vehicle location, description, and any available crash statistics is transmitted to a national data router. These data are received and used by a number of states, both to support emergency response (as the vehicle location can be plotted on an on-screen map) and to include in traveler information dissemination.

Some of the technical challenges to automated system-to-system data exchanges are summarized as follows:

- **Data consistency.** Often, the entry of incidents is done using free text entry into CAD systems, and therefore can be a challenge to extract, format, and insert into a condition reporting system that supplies data to traveler information systems.
- **Institutional.** Institutional challenges associated with sharing incident data may cause some emergency providers to not share their data. Often, the removal of any personal information and simply reporting the traffic impacts can reduce these institutional challenges.
- **Need for verification.** As an example, WSDOT has a policy that they disseminate information only about events that are verified by DOT staff. Some incident reports received from emergency response CAD systems may not have been verified (e.g., a cellular 911 caller may report seeing a vehicle stalled and blocking a lane and this may be entered into the CAD system; however, when a responder arrives on the scene, the vehicle has cleared). Because CAD events are not always verified, WSDOT performs some form of a manual review of the incidents received from external CAD systems, and therefore requires operator input.
- **Data Sharing.** Beyond the institutional issues mentioned in the second bullet, data sharing challenges may include legal challenges that prevent data sharing or technical challenges such as firewall barriers.

#### Automated Exchanges of Construction Data

Another example of possible automated data exchanges is construction and maintenance reports. Maintaining current and useful construction information with daily updates is a challenge. With increasing numbers of electronic construction and maintenance planning tools, interfaces can be developed to share planned activities with traveler information systems.

### Survey Input on Automated Data Collection

Responders to this project's survey were asked to describe any automated data sources for crash and incident data. The comments received are summarized as follows:

1. CAD systems or automated systems are not employed at this time.
2. OnStar feed provided by the Condition Acquisition and Reporting System consortium.
3. None.
4. No automation but are working with developer for automated CAD entries.
5. CAD is used. Also, the freeway flow map is an indicator of possible trouble when a segment turns red or black when normally at that time it is green or yellow. So if the colors change then the TMC operators can use the cameras to figure out the cause of the nonstandard congestion.
6. Currently, NC receives data from our State Highway Patrol.
7. Our operators MANUALLY enter incident information from the California Highway Patrol (CHP) CAD.
8. CHP CAD. We are seeking to build a "TMC Activity Log" and to gain statewide use of "lane closure reporting system."
9. CHP CAD incidents are fed automatically to the Advanced Transportation Management System.

### Coordinating Information from Several Sources

As described in this chapter, traveler information systems often disseminate information obtained from multiple sources. This information may describe either different topics (e.g., weather information from one source and travel-time information from another source) or the same topic (e.g., travel-time information from internal to the DOT and travel-time information from an outside service provider). Based on the survey of operational traveler information websites, the most common approach is to present data obtained from several sources together, taking steps to normalize the data as much as possible and present a universal picture of the travel situation. Simply put, travelers are not going to understand the various sources of the data, and the industry-wide approach appears to be to amalgamate the data.

The coordination of information topics does raise another issue regarding the normalization of data. As public agencies move from first- or second-generation traveler information systems to later-generation systems, consideration should be given to a more formal data and information normalization process that begins at the data collection phase. The accuracy, precision, recording procedures, and time frame for which the data are valid can all be normalized. The result will be a situation that more accurately compares "apples to apples" and presents more unified information to the travelers.

CHAPTER SIX

# STRATEGIES AND BUSINESS MODELS FOR INFORMATION DELIVERY

Beginning with the ITS Traveler Information Operational Tests in the early 1990s, there have been attempts to generate self-sustaining traveler information systems that would either generate enough revenue to cover the public sector operating costs or allow private companies to recoup costs through advertising and subscription services to relieve the financial burden on the public sector. Projects such as Trilogy, Genesis, and SWIFT all involved private sector partners seeking to establish a role in ongoing operations.

In summary, any effective business model needs adequate funding to perform the needed operations, and to perform system enhancements and modifications as needed to continue to serve the users' needs. This section presents a synthesis of the business plan challenges that public agencies face operating a traveler information system, together with a summary of business plan approaches.

## CHALLENGES FACING PUBLIC-OPERATED TRAVELER INFORMATION SYSTEMS

Responders to this study's survey were asked to identify challenges they face in maintaining and delivering traveler information (and were allowed to select as many as appropriate). Figure 22 illustrates the responders' input on challenges faced.

In addition to selecting the survey options, the responders added the following comments further describing their challenges:

- One responder noted the challenges of keeping up with technology changes (and costs involved to continuously update systems); and
- Another responder noted a shortage of in-house staff as required to continue to add components to the system.

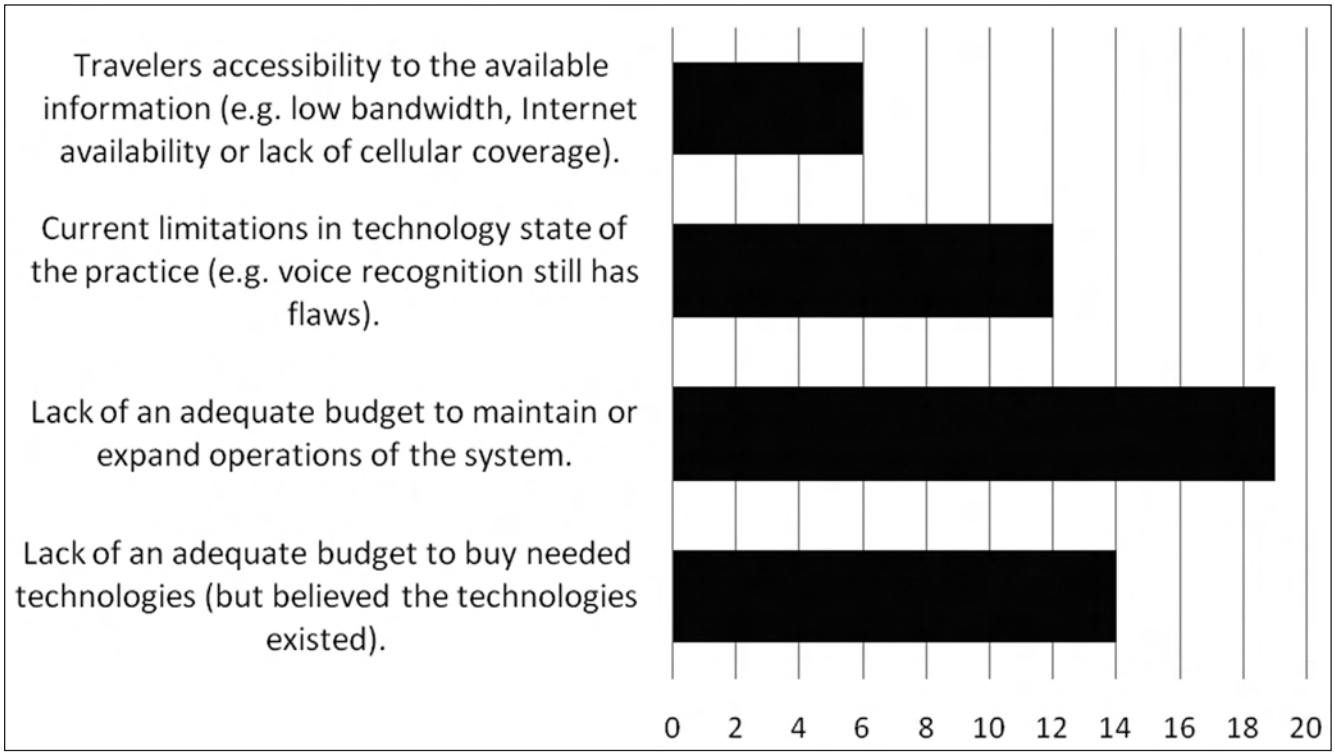


FIGURE 22 Challenges facing traveler information operations.

### Access to Information Challenges Facing Traveler Information Service Providers

A large portion of the population now regularly uses the Internet and cellular phones. However, the accessibility and quality of connections still varies, particularly from rural to urban areas. Based on feedback from surveyed agencies and industry participants, the following are examples of the accessibility challenges to both the phone and web information dissemination:

- Cell phone coverage and quality of service. Traveler information phone systems offering voice recognition services can function only as well as the phone connection. The potential for cellular phone access to traveler information systems to gain information about conditions in rural areas will be challenged by the rural cellular phone coverage for some time.
- Internet speed and mapping functions. Internet users have become accustomed to high-quality, online mapping products because of the free access offered by mapping systems such as Google Maps and Mapquest. However, without high-bandwidth Internet connections, the sophisticated maps can be slow to load. This presents a dilemma to agencies operating traveler information systems. If they solely offer a service that requires high bandwidth access, it is not available to all travelers. One approach used by some agencies is to offer both a high-bandwidth and a low-bandwidth site; however, this requires multiple systems and forces travelers to select an approach.

### Reliability Challenges Facing Traveler Information Service Providers

For purposes of this report, the reliability of a system refers to the frequency of which the system is operational and available. Reliability failures would include times when a website cannot be accessed by travelers and/or portions of the website or links from the site are not available, as well as times when the phone system either is not operational or provides callers with busy signals.

The survey conducted in this study showed that agencies operating traveler information systems were as concerned about reliability as they were with the timeliness and accuracy of the data, and were more concerned about reliability than the ease of use of the systems.

Specific feedback from the ODOT suggests that reliability and operational "up-time" of the traveler information website is a critical requirement of their system. Any upgrades to servers or software related to the traveler information websites is performed during overnight hours when no inclement weather is planned. Also, redundancy is built into the website. During the very rare outages of the traveler information website, feedback from travelers is almost immediate and therefore suggests that travelers' expectation of website availability is as high as their use of the site.

The reliability of the 511 phone system is critical and redundancies are built into the ODOT 511 phone system to ensure continuous operation. However, even when inclement weather has caused the maximum number of phone ports to be in use and additional callers receive busy signals (which happens only rarely), travelers have not provided considerable negative feedback. This suggests that travelers can understand phone lines being busy and are more accepting of it than they would be of malfunctioning websites, as long as receiving a busy signal is an infrequent occurrence. ODOT further clarified that they believe that, if travelers received busy signals more often, they would not be as accepting. ODOT is taking steps in their next-generation system to reduce or possibly eliminate busy signals.

Reliability (accuracy) of the information presented to travelers is another related challenge. This issue is further complicated by the interpretation of information. For example, a snow-plow driver may report a road as having "patches of ice," the information delivery system could accurately report this manual description of the conditions, and travelers still may understand "patches of ice" to mean something different than an experienced plow operator. The detailed review and discussion about data accuracy and precision was not included in this study.

### Budget Challenges Facing Traveler Information Service Providers

Defining the budget and costs to operate a traveler information delivery system can be interpreted many different ways. For example, the data collection typically involves a number of field devices (such as loop detectors) used for other purposes. In addition, operations staff time is often used to enter incident or event descriptions and typically internal staff time is shared among many activities. Therefore, capturing the true costs of information dissemination is open to interpretation.

However, responders to this study's survey were asked to select the category that best describes their annual budget for the operations of traveler information delivery. As Figure 23 suggests, the majority of agencies responding to this survey operate with a budget of $250,000 or less, and only a small number of systems have budgets that exceed $500,000.

#### *Trends in Operations Budgets*

Another critical consideration to a business plan is the budgetary trends. Each year, new technologies emerge and coverage of traveler information systems increases. This study believed it was necessary to understand the trend in operations budgets each year. Responders to this study's survey

were asked to describe the trend in their annual operations budget for delivering traveler information. As Figure 24 indicates, the majority of agencies' budgets either remains the same or decreases each year, with only 4 of the 25 agencies indicating their budget increases each year.

### Technology Challenges and Opportunities Facing Public Agencies

As indicated in Figure 24, public agencies believe that challenges remain in the sophisticated technologies used

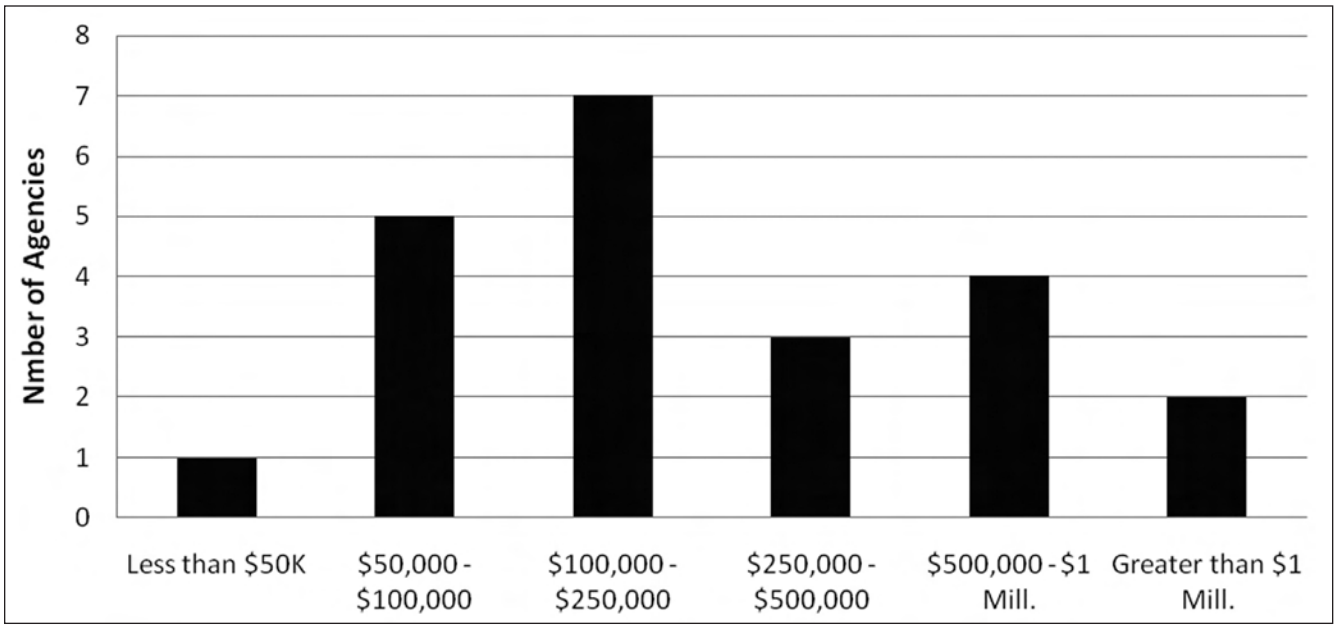


FIGURE 23 Summary of annual operations budget for traveler information delivery (Sample size = 22).

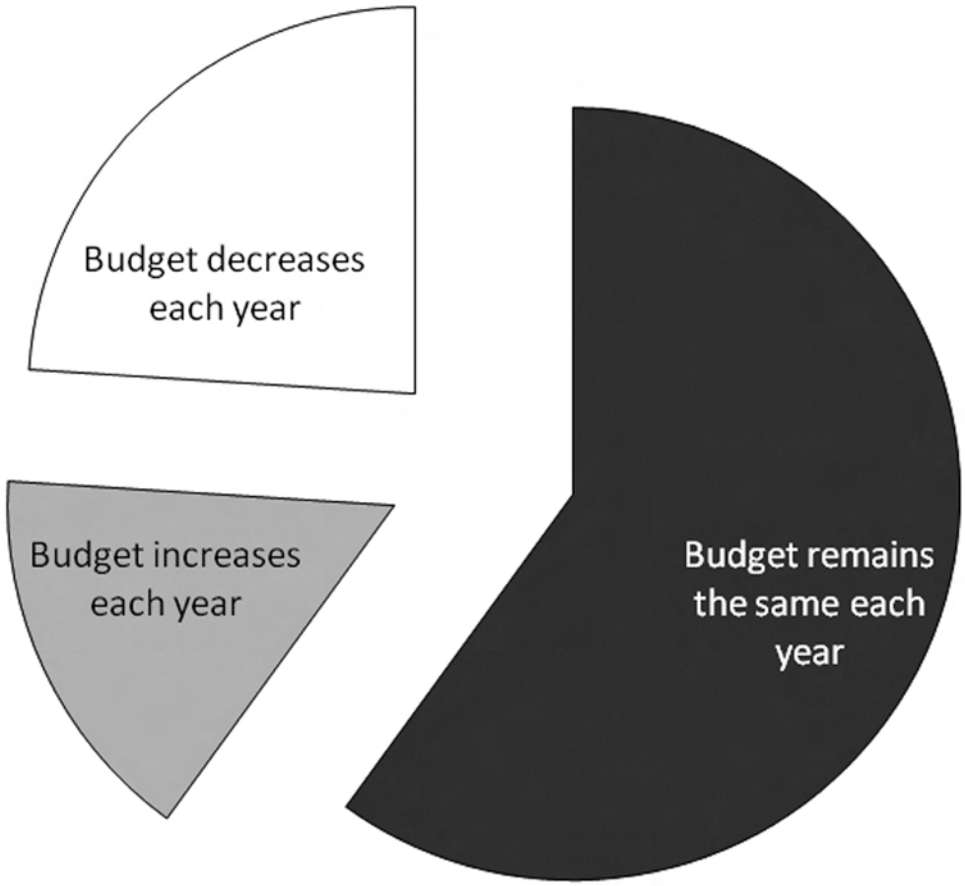


FIGURE 24 Survey results describing trends in operating budget (Sample size = 25).

to deliver traveler information. However, responders indicated that a larger challenge is funding to purchase or deploy existing technologies. Also, based on the comments added by responders, public agencies are challenged by rapidly changing technologies and the need to "keep up" with new trends.

Technologies used for 511 phone systems to answer calls automatically, support voice recognition, and deliver information using a quality voice product require considerable costs, in addition to the telecommunications charges of long distance and phone port use.

Part of the problem posed by technology changes is the traveling public's interest and demand for services that match their latest technologies. According to the Pew Internet and American Life Project (2008):

- 58% of adult Americans have used a cell phone or PDA to do at least one of ten mobile nonvoice data activities, such as texting, e-mailing, taking a picture, looking for maps or directions, or recording video.
- 41% of adult Americans have logged onto the Internet as they travel—that is, while away from home or work with either a wireless laptop connection or a handheld device.

With a population that is increasingly comfortable with accessing data "on the go," it is not surprising that the demand for mobile and personalized access to traveler information is increasing.

With advances in technology, there are also benefits to public agencies operating traveler information systems. In recent years, a number of systems have migrated to the use of Voice over Internet Protocol (VoIP) technologies for handling 511 phone costs. Feedback from systems administrators in California alone has suggested annual savings of 511 call costs of several hundred thousand dollars each year.

In addition, information dissemination (both Internet and 511 phone delivery) reduce the manual operations that previously were required to answer and respond to calls from travelers.

#### System Maintenance Challenges Facing Public Agencies

The maintenance and upkeep of traveler information systems is another challenge facing information providers. Maintenance of traveler information systems can be categorized as follows:

- **Maintenance of field devices (e.g., data collection devices)**. Maintenance of any device in the field is a challenge, especially considering inclement weather. However, because field devices are often used for other purposes beyond traveler information (e.g., loop detectors are also used for ramp meter control and long-term data collection for planning purposes), the maintenance costs are often shared or deferred by other projects.
- **Maintenance of the traveler information system hardware and software.** This includes the hardware and software that collectively operate the information assembly and dissemination portions of the system. Warranties on hardware and "off-the-shelf" products often help defer these costs. However, regular maintenance and replacement of equipment is necessary. One challenge is the availability of funding to build systems compared with the common lack of funding for ongoing maintenance. Some agencies find it is easier to acquire funds during the design and build phase of the project (e.g., more sources of funding can be used for building systems than for maintaining systems).
- **Maintaining the systems at the current state of the art.** One aspect regarding traveler information maintenance is the need for periodic updates to the systems as travelers' expectations change based on the state-of-the-art practices. For example, as travelers have grown accustomed to high-quality full-zoom maps, they now expect such enhancements on traveler information system map displays. Similarly, as the number of web-enabled mobile devices has increased, travelers now demand access from mobile devices. Another form of maintenance is the need to maintain compatibility with current Internet browsers and related Internet software. For example, a new version of Java software may cause older web systems to malfunction with newer versions of browsers. Therefore, even the most well-designed traveler information system should plan for periodic upgrades and enhancements as part of the maintenance of the system.
- **Maintenance of manual data entry and reporting.** Finally, maintenance of traveler information systems must include regular maintenance of the reporting procedures and training aspects that result in the data being entered properly into the entry systems. Without regular review of these agreements, even properly functioning hardware and software will no longer produce quality information delivery, if the manual data entry is no longer adequate.

### EXAMPLES OF COST-SHARING BUSINESS MODELS

This study has identified several examples of business models that either are being attempted or are successfully in operation. These examples were selected to present some examples of different business model approaches and are not an exhaustive list of business models.

### Jacksonville, Florida, Traveler Information Business Model

FDOT operates a traveler information system in and around the Jacksonville, Florida, area. The business model for the traveler information system is based on a public coalition of local agencies that includes FDOT, the local law enforcement, the Florida Highway Patrol, the Jacksonville Metropolitan Planning Organization, and the local city traffic engineer's office. Currently, the systems interconnect to the extent possible; therefore, all agencies are aware of the activities and operations of the other agencies. The coalition is in the process of designing a new facility that will house law enforcement, transit, the city of Jacksonville traffic office, and emergency (fire and rescue) response, and that will be interconnected with the Jacksonville airport authority.

The business model for traveler information is based on assembly of all information to one location and the operation of one central traveler information system. Traveler information 511 systems (phone and web) are used to disseminate information such as traffic speeds, incidents, airport information, transit information, construction, and congestion. At this time, the coalition is not seeking any form of revenue generation for traveler information services; however, the economies of scale of centralizing all information has allowed them to operate a successful traveler information system. The variety of information has helped them establish a good relationship with the media, including considerable airtime announcing the 511 phone system.

### Oregon Department of Transportation/Travel Information Council Business Model

ODOT operates the statewide traveler information system (commonly branded as TripCheck). In Oregon, another public agency called the Oregon Travel Information Council (TIC) is responsible for maintaining highway traveler information signs (e.g., Interstate logo signs describing services at the exits), rest areas, and welcome centers. Beginning in 2000, ODOT and the Oregon TIC began to cooperate and have since developed a partnership in which customers of the Oregon TIC can advertise their hotel, restaurant, or gas station on a special travel services portion of the ODOT TripCheck website.

The advantage to this business model is that the Oregon TIC has a network of sales staff selling Interstate logo signs placements to the businesses and has an established relationship with businesses throughout the state. Therefore, businesses are offered the option to be promoted on TripCheck for a marginal increase in costs (reported as $150 per year). ODOT receives a portion of the revenue generated by the Oregon TIC each year by the TripCheck option.

Based on discussions with ODOT, the relationship is beneficial. The system generates approximately $15,000 per year in revenue to ODOT (approximately 20% to 25% of the gross revenue generated by advertising sales for TripCheck spots) to help offset some portion of the TripCheck operating costs. The placement of the traveler services is on a portion of the TripCheck site called Travel Services. Users who select Travel Services view a map with icons allowing them to click metropolitan areas and view details of services offered by paying supporters. Therefore, it is not banner advertising, but rather geographic representations of services for travelers, who may then access details about the hotel, restaurant, or gas station.

ODOT estimates that the number of website visitors accessing the Travel Services averages about 14,400 visits per month, with the maximum monthly visits being in January (43,000 visits in January 2008) and the minimum monthly visits being in April (7,000 visits in April 2008) (McGill 2008).

A challenge to this business model is that the information available in the Travel Services portion of TripCheck is limited to the number of businesses who are paying customers. Therefore, the site does not offer as comprehensive a set of travel services as other private sites would offer. The benefits of this business model is that ODOT does not have to perform any advertising sales or customer relations and account collections, because all account relations are performed by the Oregon TIC in a role they were already performing for the Interstate logo sign sales.

### St. Louis, Missouri, Example of Privately Operated Traveler Information System

Another example of a unique and successful business model for traveler information operations is the Missouri DOT (MoDOT) approach to traveler information. MoDOT has partnered with a private sector company (Traffic.com) to provide traveler information services. Under this arrangement, Traffic.com operates the 511 phone system as well as a traveler information website branded as the Gateway Guide website used by MoDOT. Traffic.com operates this service without any operating costs to MoDOT. The services offered by Traffic.com are similar to traveler information services operated in other cities throughout the United States (and include personalized information delivery and alerts and notices of incidents); however, in St. Louis, callers dialing the three-digit 511 number are connected directly to the Traffic.com operated system. Unlike other 511 phone systems, callers to the St. Louis system may hear advertisements or sponsorship messages, because these announcements generate the revenue that allows Traffic.com to sustain the service. The St. Louis operation is an example of minimizing direct costs to government agencies and benefiting from the successful technical and marketing services of the private sector.

### Other Examples of Revenue Generating Business Models

Each year, the use of traveler information websites and 511 phone systems increases. Therefore, business models that attempted revenue generation a few years ago now have the advantage of a larger user base and more familiarity with the product. Recently, two initiatives in California have begun revenue-generating business models:

- In San Diego, California, video feeds from cameras are available and the project team is seeking to establish relationships with one or more partners to disseminate the video to travelers while recovering costs through revenue generation. The project is attempting to find partners who will disseminate the video access without paying the partners, and hopes to recover a portion of the revenue that is generated by the partners.
- In Los Angeles County, the Motorist Assist Traveler Information System will provide a comprehensive traveler information system, including an automated phone system, an operator answered phone system, and traveler information websites. The current initiative will attempt to recover portions of the operations' costs through advertising sales on the phone system, websites, and transit and transportation infrastructure (e.g., signs on buses and trains).

Although the amount of revenue generated by these two examples of business models will be understood over the coming years, these examples illustrate that agencies are still attempting to find business models that benefit from revenue generation and attempt to offset operations costs.

## SYNTHESIS OF REAL-TIME TRAVELER INFORMATION DELIVERY BUSINESS MODEL BEST PRACTICES

Based on the literature review and personal interviews with industry experts, the following best practices have been identified for business models for the operation of traveler information delivery systems:

- Try to minimize public sector operations costs as much as possible
  - Few examples of public sector information delivery systems have generated any revenue (and the net revenue generated has been minimal), therefore suggesting that operations budgets will most likely always be limited to public set-aside funds, which are limited and tend not to increase.
- Avoid technology changes without a clearly defined need for the change
  - Technology upgrades almost seem like a race at times, where new technologies replace old technologies regularly and considerable costs can be required for each technology upgrade.
- Take advantage of technology changes that introduce large cost savings
  - VoIP is an example of a technology that may be appropriate for many agencies and can deliver substantial cost savings.
  - Other examples of cost-saving technologies are consolidated systems where operators enter event or incident summaries one time and the information is disseminated through several mechanisms.
- Seek committed annual operations budgets
  - Many successful public traveler information systems have committed annual budgets for traveler information that allow the agency to negotiate long-term agreements for such things as voice hosting and information data collection.
  - Committed long-term budgets also allow agencies to strategically plan a sequential deployment or expansion of services.
- Choose services offered by public agencies wisely and seek private partners for the remainder of services
  - Although public agencies may always deliver statewide traveler information over the Internet and 511 phone, new demands from travelers for information delivery options (e.g., push technologies that deliver information to travelers based on profiles, interfaces with in-vehicle navigation systems, and handheld devices) may be best delivered by private information service providers either on a fee-per-use basis or through advertising support.
  - Information service providers most definitely have a role to tailor information delivery according to a private business models.
- Make as much information available to private sector information providers as possible
  - Many states now post traffic data, incident and construction event information, camera images, and weather information for easy access by information service providers. In some areas, large numbers of information service providers are accessing the data, repackaging it, and delivering it to customers. Each time this happens, more travelers are receiving information without added expense to the public agencies.

CHAPTER SEVEN

# CONCLUSIONS

## SUMMARY OF CHALLENGES

Based on the findings of this synthesis project, the traveler information delivery industry faces three key challenges:

First, the traveler information that is being delivered receives limited use. When it is considered that the Internet is still a relatively new tool (with widespread use beginning less than 15 years ago), it is remarkable that traveler information is available in every state (with more than half of the public agencies surveyed in this project operating a second generation or later version of their website). Similarly, with the designation of the 511 phone number happening in 2000, that 511 traveler information systems are available to 47% of travelers is another noteworthy accomplishment. However—

- Although the 511 phone system is available to 47% of the population, the statistics estimate that travelers call 511 during 4 of every 10,000 trips made in the United States.
- Telephone calls to 511 information systems during winter seasons increase drastically compared with calls during the summer seasons, and call volumes spike during inclement weather. This demonstrates that travelers are receiving information during inclement weather, but also demonstrates that many systems are underutilized (and perhaps not needed) for large portions of the year.
- Although more than 100 million 511 calls have been made to date, more than 30% of these calls were placed in either the San Francisco Bay area or the state of Florida.
- The results of one survey presented in this synthesis describes how the majority of travelers surveyed in Montana called 511 fewer than three times in 6 months, whereas in a Nielsen survey, 77% of Americans indicated they watch local television news broadcasts either daily or several times a week and 54% said they listen to radio news broadcasts daily or several times per week. Currently, most travelers do not use 511 as a daily activity, except in rare locations.

The second challenge is that a gap exists between what is possible in the state of the art in data collection, information generation, and delivery, and what occurs in today's state of practice.

- In the weather industry, detailed weather forecasting and reporting is possible through public and private service providers. However, many traveler information systems disseminate information based on no-fee regional or county-based weather reports. In some ways, the availability of no-cost weather sources has prevented the use of more detailed services.
- Through an online observation of traveler information websites and 511 phone systems, it was observed that typically road construction and maintenance event reports are generic, with such phrases as "Intermittent lane closures from June through August." Although the daily construction and maintenance activities are known by the crews and supervisors in the field, information describing daily updates rarely reaches travelers through information dissemination systems.

The third challenge is that both public and private traveler information providers face funding and budget challenges.

- Information delivery traditionally has been seen as a "free" service and therefore the only business models in which end users are paying for services are in limited areas with the most critical conditions.
- Public sector agencies face unique challenges with restrictions on the use of funds only for deployment or construction, and often encounter a lack of budget for operations.

## SUGGESTIONS FOR FUTURE RESEARCH

Based on the results of this synthesis, several suggestions are presented to individual agencies and the traveler information industry in general.

### Accessibility of Traveler Information

The results of this projects' survey showed that many public agencies either have been successful at making their systems accessible or are working diligently to do so. However, based on feedback and input, it appears that some agencies are unclear about the steps required to achieve an accessible system and also have received little feedback from the traveling public.

These findings suggest that more formal discussions occur between experts in information accessibility and the traveler information system operators and developers to increase awareness and understanding of best practices and approaches.

#### Display Consistencies

The results of this projects' study and surveys show that there is little consistency in the use of icons and nomenclature of event descriptions among traveler information websites. The 511 Deployment Coalition is actively pursuing consistency and interoperability among 511 phone systems; however, a coordinated effort was not found related to traveler information websites.

These findings suggest that a nationwide effort be considered to achieve consistency in the use of icons on traveler information websites, beginning with consideration of the static signs designated in the *Manual on Uniform Traffic Control Devices* as a starting point on which to base website standards.

#### Performance Measures and the Role of 511

Traditionally, call volume statistics have been a major performance measure used to assess the success of 511 phone systems. For the following reasons, however, research suggests that volume of use tells only a small portion about the success and value of the system:

- Even during periods of large call volumes, the information delivered may be inaccurate, ineffective, and unavailable, or the users may not react based on the information.
- The role that 511 plays in the industry may be a specialized role in which information is requested and received at times when television, radio, or Internet information is not available. This role that 511 plays may contribute as much toward improving safety and mobility as other (more widely used) dissemination mediums do, but it may not post the annual statistics of other systems.

These findings suggest that the performance measures for 511 phone calls be reconsidered to include consideration of the information content delivered per call, the information missing per call, and the travelers' reactions (or changes in action) based on the 511 call. Industry consideration and definition of the role of 511 in the larger traveler information industry picture should reflect accurate expectations.

#### Correlations Among System Use, User Satisfaction, and Industry Feedback

Survey feedback suggests the following three related and somewhat conflicting issues related to 511 phone systems:

- Feedback from transportation professionals who have tested 511 phone systems typically cite many frustrations with the systems and detail both the need for improvements and the technical ability to accomplish such improvements.
- Contradicting the negative feedback, feedback obtained from surveys of 511 users indicates satisfaction with 511 systems and often describes how useful and beneficial the systems are.
- With few exceptions, the use statistics for 511 do not reinforce the positive feedback expressed by surveyed users. For example, nationwide, it is estimated that on average travelers who live where 511 is available call 511 for roughly 4 in every 10,000 trips performed. (This estimate is based on an assumption of 110 million households, and 511 availability to 47% of those households—approximately 50 million households. An estimate of five trips per household per day is used to estimate 91.25 billion trips per year performed by travelers with access to 511. Using the last 12 months of call statistics, roughly 30 million 511 calls were placed per year.) That 511 is called infrequently when compared with the number of trips may reflect the role 511 phone systems play (i.e., travelers only need 511 at specific times and 511 is not a service travelers expect to call for their regular trips).

User surveys in California suggest that greater than 80% of callers to a traveler information phone system call because they suspect they might encounter a closure or major delay (as opposed to routinely calling about their route). Roughly 50% of the times, these callers are correct and they receive a report of a closure or a delay. Furthermore, seven out of ten of these callers alter either their route or their departure times. This suggests that the value of 511 phone systems is in responding accurately when adverse conditions exist (including weather, construction, disasters, and crashes).

The findings of this report suggest that more detailed and focused user feedback surveys be conducted to understand the true reactions of travelers, and that 511 and other information dissemination systems be evaluated against their objectives and customer or marketplace focus. For example, detailed focus groups with travelers who have used 511 phone systems could discover their true reactions and answer the question of why call volumes are not higher. The findings also suggest that call volumes should be compared against the conditions or situations travelers are facing and therefore compared against a perceived need for 511. For example, very low call volumes on a snowy busy day may reflect poor customer support for the service; however, very low call volumes on a typical sunny summer day are probably normal.

#### Ongoing Costs and Business Models

Experiences to date suggest that the majority of public sector traveler information systems are not going to benefit enough

from private revenues to support ongoing operations. The business model most agencies have adopted as a result is to operate systems with the lowest ongoing operations costs as possible. Although the operations budget for traveler information websites vary little according to use, typically 511 phone systems carry an ongoing cost per use and represent a technology area (phone hosting) that involves rapid technology turnover.

These findings suggest that public agencies should consider Voice over Internet Protocol technologies to reduce "per minute" phone costs, and that the 511 industry research the feasibility of centralizing (either regionally or nationally) portions of the call-handling processes (while leaving content development and call dialogs to continue to be locally controlled). Such an approach might better meet the peaks in demand.

#### The Gap Between Weather Information Availability and Delivery

Nationally, a great deal of weather information is offered on traveler information websites and 511 phone systems. The current state of the art in weather monitoring and forecasting is able to describe detailed and route-specific, current, and forecasted conditions. However, there are many locations in which general weather reports are presented, often using free weather content in lieu of executing in-house or outsourced weather forecasting products. As a result, a considerable amount of weather data and information is available that is not presented to travelers.

This gap between the availability and use of weather information should be researched at a national level to help state departments of transportation confirm whether they wish to continue using existing "no cost" weather sources or if the benefits justify a transition to the use of more sophisticated weather information.

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# APPENDIX A

# SURVEY FORM

## NCHRP Real-Time Traveler Information for the Public Survey

Thank you for participating in this survey to support the "NCHRP Real-time Traveler Information for the Public" Research Project. The results of this survey will be available in late 2008. By providing your email address we will notify you when the study is completed.

This survey has been designed such that completion should take less than 15 minutes. Also, most questions are multiple choice, asking either that you select the most appropriate response or to select all responses that apply.

Please try to answer all questions in the survey. However, if the answer to any question is unknown, you may skip it and continue with the survey.

Your progress in completing the survey is shown across the top of the page.

Also, please note that many questions ask you to describe your traveler information system. For the purposes of this survey, traveler information system is defined as all of the components that comprise your information dissemination systems (e.g., data collection, information assembly, and information dissemination).

We appreciate your time and look forward to your responses.

### CONTACT INFORMATION

**1. Your Name**_____

**2. Agency**_____

**3. E-mail Address**_____

**4. Phone Number**_____

## TRAVELER INFORMATION DISSEMINATION SYSTEMS

**5. What comprises the information dissemination portion of your traveler information system? (Select all that apply.)**

- ☐ 511 Phone
- ☐ Internet/Web Traveler Information
- ☐ Highway Advisory Radio (HAR)
- ☐ Dynamic Message Signs (DMS) in Metro Areas
- ☐ DMS in Rural Areas
- ☐ E-mail, text message or other individual messaging technique
- ☐ Other (please specify): _____

**1. What version is your 511 phone traveler information system? (Select one.)**

- ☐ This is our first-generation 511 phone traveler information system
- ☐ We have upgraded our initial 511 phone traveler information system and are now operating version 2 or higher
- ☐ We are not currently operating a 511 phone system
- ☐ We are not currently operating a 511 phone system, but are in the planning process or considering a 511 phone system
- ☐ Other (please specify): _____

**2. What version is your Internet traveler information system? (Select one.)**

- ☐ This is our first-generation Internet/Web traveler information system
- ☐ We have upgraded our initial Internet/Web traveler information system and are now operating version 2 or higher
- ☐ We are not currently operating an Internet/Web system
- ☐ We are not currently operating a Internet/Web system, but are in the planning process or considering an Internet/Web system
- ☐ Other (please specify): _____

**8. How would you describe your traveler information operations? (Select one.)**

- ☐ In-house data entry, collection, and hosting of systems (limited or no contracted services)
- ☐ A combination of in-house operations and contracted services (e.g., we host some of the system and contractors host or supply some data)
- ☐ Almost entirely outsourced operations
- ☐ Other (please specify): _____

**9. Do you receive any revenues from your traveler information system (e.g., sponsorship, advertising, data sales)?**

- ☐ Yes
- ☐ No

**ESTIMATED REVENUE**

**1. Please estimate the annual revenue generated from your traveler information system. (Select one.)**

- ☐ Less than $50,000
- ☐ $50,000–$100,000
- ☐ $100,000–$200,000
- ☐ $200,000–$300,000
- ☐ $300,000–$400,000
- ☐ $400,000–$500,000
- ☐ More than $500,000
- ☐ Other (please specify): _____

## NEEDS AND EXPECTATIONS OF TRAVELERS

**11. How did you determine the travelers' needs for information when designing your traveler information system? (Select all that apply.)**

- ☐ We conducted our own user needs survey
- ☐ We used other Regional or Statewide agency survey results
- ☐ Based on published national user needs results from other sites/studies
- ☐ We had an understanding of our user needs from daily operations
- ☐ We created a traveler information system that we thought would benefit the travelers
- ☐ Other (please specify): _____

**12. Based on feedback of travelers, are travelers satisfied with the ACCURACY of the information provided through your traveler information system?**

- ☐ Yes
- ☐ No
- ☐ Don't know

Comment: _____

**13. Based on feedback of travelers, are travelers satisfied with TIMELINESS of the data provided by your traveler information system?**

- ☐ Yes
- ☐ No
- ☐ Don't know

Comment: _____

**14. Based on feedback of travelers, are travelers satisfied with COVERAGE of your traveler information system? (Select all that apply.)**

- ☐ Yes, we offer information for most of our area
- ☐ Somewhat, we cover the major travel areas adequately but still receive requests for information in additional areas
- ☐ No, our travelers would like us to offer information for more areas than what we are able to cover
- ☐ We receive regular requests for additional camera views on our website
- ☐ We receive regular requests for information about local roads (county and city roads) not currently addressed by our system

**15. Based on feedback of travelers, are travelers satisfied with the DELIVERY METHODS of your traveler information system? (Select all that apply.)**

- ☐ Yes, our methods are adequate for serving the travelers
- ☐ We receive frequent comments regarding improvements to our delivery methods (e.g., better DMS messages, more responsive Website, …)
- ☐ We receive requests for additional delivery methods such as e-mail or mobile devices
- ☐ We receive requests for increased delivery such as additional DMS or HAR

**16. Please identify the most often requested features or functions that you don't currently offer on your traveler information system?**

_____

_____

**USER NEEDS**

**17. Based on travelers feedback, on a scale of 1 to 10 is your traveler information system meeting the expectations of travelers in METRO areas? (1 = not met, 10 = meeting all expectations, N/A = system does not include metro areas.)**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | N/A |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Traveler Information Phone System | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Traveler Information Website Traveler | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**18. Based on travelers feedback, on a scale of 1 to 10 is your traveler information system meeting the expectation of RURAL travelers? (1 = not met, 10 = meeting all expectations, N/A = system does not include rural areas.)**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | N/A |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Traveler Information Phone System | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Traveler Information Website Traveler | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**19. What is your traveler information system's highest priority performance target?**

| | Ease-of-use | Timeliness of information | Reliability |
|---|---|---|---|
| Traveler Information Phone System | ☐ | ☐ | ☐ |
| Traveler Information Website Traveler | ☐ | ☐ | ☐ |

Comment: _____

**20. Does your traveler information system include multi-lingual capabilities? (Select all that apply.)**

- ☐ Our telephone system includes multi-lingual capabilities
- ☐ Our Internet/Web system includes multi-lingual capabilities
- ☐ No, our traveler information system does not include multi-lingual capabilities

**21. How are you meeting or not meeting travelers' 511 phone system expectations?**

_____
_____

**22. How are you meeting or not meeting travelers' website expectations?**

_____
_____

**DATA SOURCES**

**23. How would you describe your data sources to your traveler information systems? (Select all that apply.)**

- ☐ Data Sources are primarily owned and operated by the DOT (e.g., DOT loop detectors, R/WIS stations, manual entry by field personnel)
- ☐ We have feeds from outside 'no cost' sources (e.g., national weather service, other public agencies such as Department of Natural Resources, police or other first responder agencies)
- ☐ We have feeds from outside 'priced' sources (e.g., data vendors, barters with news companies etc.)
- ☐ Other (please specify): _____

**24. Is your agency actively searching for (or open to the idea of) additional data sources to improve your information?**

- ☐ Yes, if the data source was free
- ☐ Yes, we may be willing to compensate depending on the data source
- ☐ No, our data sources meet our current needs

**25. Please describe other data sources you wish you had.**

_____

_____

**26. What would be a determining factor to adding more data sources? (Select all that apply.)**

- ☐ Cost
- ☐ Quality assurance
- ☐ If our travelers demanded more (current demands are being met)
- ☐ If the data was reliable
- ☐ Ongoing commitment that the data source will always be there
- ☐ Other (please specify): _____

**27. What kind of system is used currently for entering/managing repots of roadway conditions, construction activities, and other events?**

- ☐ Statewide
- ☐ Regional
- ☐ None at this time

**28. What frequency are road/driving condition reports updated on your traveler information system? (Select one.)**

- ☐ As conditions change 24/7/365
- ☐ At least 3 times daily
- ☐ At least once daily
- ☐ During business hours (8 a.m. to 5 p.m. weekdays)
- ☐ Beginning of shift change
- ☐ Other (please specify): _____

**29. Please describe any automated data sources for incident/crash events (e.g., from public safety Computer Aided Dispatch (CAD) systems).**

_____

_____

**30. Are you actively seeking to provide commercial travel services information (e.g., lodging, dining, tourist attractions)?**

☐ Yes, we would if we have a reliable source and/or link to a reliable system

☐ No, we feel that is outside the role of our traveler information system

☐ We currently offer information on commercial travel services

**BUDGETS—TRAVELER INFORMATION SYSTEMS**

**31. What has been the trend of your traveler information system's operation budget over the past couple years? (Select one.)**

☐ Our budget INCREASES each year

☐ Our budget DECREASES each year

☐ Our budget REMAINS THE SAME each year

**32. What is your estimated annual budget for operation of your traveler information system? (Select one.)**

☐ Less than $50,000

☐ $50,000–$100,000

☐ $100,000–$250,000

☐ $250,000–$500,000

☐ $500,000–$1,000,000

☐ More than $1,000,000

☐ Other (please specify): _____

**33. Which of the following are challenges for your agency? (Select all that apply.)**

- ☐ Lack of an adequate budget to buy technologies (but we believe they exist)
- ☐ Lack of an adequate budget to maintain or expand operations of the system
- ☐ Current limitations in technology state of the practice (e.g., voice recognition still has flaws)
- ☐ Travelers accessibility to the information delivery (consumers with low bandwidth Internet, lack of cellular phone service etc.)
- ☐ Other (please specify): _____

## INFORMATION ACCESSIBILITY TO INDIVIDUALS WITH DISABILITIES

**34. Are your traveler information dissemination systems compliant with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794d)? ("…Section 508 requires that individuals with disabilities, who are members of the public seeking information or services from a Federal agency, have access to and use of information and data that is comparable to that provided to the public who are not individuals with disabilities, unless an undue burden would be imposed on the agency").**

| | Yes and tested | Yes, but not tested | No | Not completely |
|---|---|---|---|---|
| Traveler Information Phone System | ☐ | ☐ | ☐ | ☐ |
| Traveler Information Website Traveler | ☐ | ☐ | ☐ | ☐ |

**35. How would you describe user feedback regarding the accessibility of your system to individuals with disabilities? (Select all that apply.)**

- ☐ We have had considerable requests for increased accessibility of our information
- ☐ We have had considerable feedback appreciating that our system is 508 compliant
- ☐ We have not had much feedback regarding the accessibility of the system
- ☐ We wish we had more feedback on the users expectation and needs of the accessibility of the system

**36. Please select each of the following that best describe the experiences of achieving 508 compliance.**

- ☐ Any modifications we had to perform were minor and deployment was achieved with low cost impact
- ☐ We experienced significant cost impacts in achieving 508 compliance
- ☐ We were not able to achieve 508 compliance in all the features and functions we wanted to offer
- ☐ Please describe any information regarding the attempt

_____

**COMMENTS**

**37. May we contact you for addition information regarding your traveler information system?**

☐ Yes

☐ No

**38. Do you have any comments on the overall survey?**

_____

Thank you for taking the time to complete this survey!

If you should have any questions regarding the NCHRP Real-time Traveler Information for the Public Research Project, please contact Dean Deeter at deeter@acconsultants.org or at 503.343.9602.

**38. Do you have any comments on the overall survey?**

# APPENDIX B

# AGENCIES RESPONDING TO SURVEY

Alaska Department of Transportation & Public Facilities
Arizona Department of Transportation
California Department of Transportation (five different districts each completed survey)
City of Chicago, Illinois
Colorado Department of Transportation
Georgia Department of Transportation
Kentucky Transportation Cabinet
Louisiana Department of Transportation and Development
Maine Department of Transportation
Michigan Department of Transportation
Minnesota Department of Transportation
Mississippi Department of Transportation
Montana Department of Transportation
Nevada Department of Transportation
New Hampshire Department of Transportation
North Carolina Department of Transportation
North Dakota Department of Transportation
Ohio Department of Transportation
Oregon Department of Transportation
Rhode Island Department of Transportation
San Diego Associations of Governments
San Francisco Bay Area Metropolitan Transportation Council
South Carolina Department of Transportation
Tennessee Department of Transportation
Texas Department of Transportation
University of Wisconsin–Madison/Wisconsin Department of Transportation
Washington State Department of Transportation

Abbreviations used without definition in TRB Publications:

| | |
|---|---|
| AAAE | American Association of Airport Executives |
| AASHO | American Association of State Highway Officials |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI–NA | Airports Council International–North America |
| ACRP | Airport Cooperative Research Program |
| ADA | Americans with Disabilities Act |
| APTA | American Public Transportation Association |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| ATA | Air Transport Association |
| ATA | American Trucking Associations |
| CTAA | Community Transportation Association of America |
| CTBSSP | Commercial Truck and Bus Safety Synthesis Program |
| DHS | Department of Homeland Security |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| FMCSA | Federal Motor Carrier Safety Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISTEA | Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | Institute of Transportation Engineers |
| NASA | National Aeronautics and Space Administration |
| NASAO | National Association of State Aviation Officials |
| NCFRP | National Cooperative Freight Research Program |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| NTSB | National Transportation Safety Board |
| SAE | Society of Automotive Engineers |
| SAFETY-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005) |
| TCRP | Transit Cooperative Research Program |
| TEA-21 | Transportation Equity Act for the 21st Century (1998) |
| TRB | Transportation Research Board |
| TSA | Transportation Security Administration |
| U.S.DOT | United States Department of Transportation |

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