Interim Analysis Report
Model Deployment of a Regional, Multi-Modal 511 Traveler Information System

Prepared for:

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by:

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This report presents the analysis of the existing, pre-enhanced 511 traveler information system operated by the Arizona Department of Transportation (ADOT) since 1998. The three digit 511 number was implemented in March 2002. The national 511 Model Deployment, sponsored by the Federal Highway Administration and Federal Transit Administration, consists of numerous significant enhancements to the existing ADOT 511 system, including adding several new types of information, modifying the menu structure, implementing voice recognition, and enhancing marketing activities. The purpose of the model deployment is to "push the envelope" in 511 operations. The purpose of the national evaluation of the deployment is to quantify costs, benefits and lessons learned that will inform the national 511 program and that will be of use to state and local agencies planning, implementing and operating 511 systems.

The model deployment was initiated in August 2002. Since that time, ADOT and the other 511 partners, which include transit agencies, municipal traffic agencies, airports and Metropolitan Planning Organizations, have designed and begun to implement the model deployment enhancements. Over this same period, the national evaluation team has prepared evaluation planning documents and collected and analyzed data describing the existing, pre-enhanced ADOT 511 system. This information provides context and a point of comparison to post-enhancement data, which will be collected over a period of one full year, starting in December 2003 when ADOT expects the bulk of enhancements to become operational. Analysis of existing operations will aid in the interpretation of post-enhancement findings, such as the planned user survey, and allow the various benefits of the model deployment to be gauged.

Baseline Data Collection and Analysis Activities

Baseline data have been collected and analyzed in the following areas:

- **Information Content** – the content of the information available in the existing 511 system is examined in terms of the type, volume, source and coverage of information travelers are able to access.
- **System Availability** – the availability of the system is examined in terms of system down-time and phone line availability.
- **Usage** – usage of the existing 511 system by travelers is examined from a number of perspectives, including: call volumes, call durations, time-of-day and day-of-week, wireless vs. wireline phone access, frequency of use (repeat users), geographic location of call origin, and menu selections (information requested by travelers).
- **User Satisfaction** – the results of focus groups conducted by ADOT as part of the model deployment design process are examined.
- **Costs** – cost estimates for the existing 511 system are presented and discussed.

Summary of Findings

Characteristics of the Existing 511 System

The ADOT 511 system is a mature system, having operated since 1998. The statewide data fusion system that supports 511, the Highway Condition and Reporting System (HCRS), was originally developed as a means for ADOT to coordinate highway construction and maintenance activities (the system was originally called the Highway Closures and Restrictions System) and the use of the system to provide information to travelers was seen as a beneficial byproduct.

The current ADOT 511 system provides information on Interstates, US Highways and State Routes throughout the state at the route level, that is, when a route number is entered, all advisories pertaining to the entire length of the route are provided, sequentially. The existing menu system includes Phoenix and Tucson transit options, which transfer callers to the transit agencies. The current system retains the original emphasis on construction and maintenance, which traces back to the origin of HCRS as an ADOT tool. Nearly all of the information available through the existing 511 system is manually input by ADOT staff located at offices throughout the state. Although weather and incident information does appear, the most common type of information pertains to construction and maintenance, road closures and restrictions.

A great deal of information is entered into HCRS and in terms of sheer volume of information, the existing system is relatively data rich. It is estimated that an average of between 29 and 43 HCRS entries are made per day (more entries are made in the winter) and it is estimated that on any given day, multiple advisories are present for the most heavily-traveled routes. This is consistent with the personal experience of the two national evaluation team members who reside in the Phoenix region. As evidenced by the focus group results discussed later in this section, merely having a lot of information does not necessarily make the system highly useful to travelers.

The ADOT 511 system is highly automated. Once information is input to HCRS using an on-screen entry form, information from key fields in the form are automatically converted to synthesized speech messages, through a text-to-speech process, which are then available through the 511 system.

System Availability

Overall, the pre-enhanced 511 system appears to be very accessible to users and therefore it seems unlikely that inability to access the system has significantly impacted either customer satisfaction or call volumes. System outages are rare, accounting for about 4% of total system time. Existing phone line capacity appears quite adequate. It is estimated that in only one instance in the past year has the volume of incoming calls exceeded half (24 lines) of the total system phone line capacity.

Usage

Comprehensive data on awareness of the system is not available, although focus groups conducted by ADOT in support of the model deployment design effort do provide some indication of awareness levels, and suggest that awareness is probably low. Of the 67 participants in the March 2002 ADOT focus groups, only five had heard of the system and only three had used the 511 system in the past. The two Phoenix-based members of the national evaluation team note that the 511 system seems "low profile" based on the very limited media attention it receives and low levels of awareness among friends, neighbors and even colleagues. Low awareness of the 511 system would be consistent with ADOT's low level of marketing of 511 to date. Aside from some publicity associated with the conversion to the 511 number in March 2002 and promotion of the system during wildfires in 2002, no other marketing has been done.

Consistent with the low profile of the current 511 system, usage is low, at least in proportion to the number of travelers in the state. On a typical day, about 1,000 calls are made to the system. System usage does spike dramatically, to between 10,000 and 14,000 calls per day, during winter storms and wildfires. This suggests that the typical daily usage does not reflect all who are "aware" of the system and who will use it under special conditions. Yet, these spikes suggest that most of those who are aware of the system don't use it on a frequent basis, a pattern consistent with the intercity and construction-maintenance orientation of the current system. Indeed, ADOT acknowledges that the existing system is not geared toward commuters. Data on repeat users confirms that frequency of use is low. 71% of callers use the system only once in three months. The existing 511 system is clearly not viewed as a resource for daily commuting. Rather, it appears to be used by a limited number of travelers during exceptional circumstances, or, as it can by hypothesized, for relatively infrequent intercity trips (which would be consistent with the type of information that is most common on the system).

A very high percentage of calls to the current 511 system are very short. About half of all calls to the system last no more than 20 seconds. For almost all of these calls, no menu items are selected. This could suggest that many callers are disoriented by the system; it's not what they expected, or were just calling to experiment. Disorientation or confusion on the part of first-time callers would be consistent with the lack of marketing of the 511 system. The fact that only 29% of callers are repeat users supports such an interpretation. Most of the calls that last long enough to make it past the introductory message, which is about 20 seconds long, last over 2 minutes. Some of these calls are much longer.

Most calls to the 511 system, about 80%, are made from wireline phones. The percentage of wireless calls may not reflect the actual demand for wireless calling, given that one major wireless provider (Verizon) was not supporting 511 service yet. This indicates that most users call before starting their trip. Such behavior could reflect the fact that the system does not include much urban commuter-relevant information, such as information on incidents and alternate routes, which a commuter might seek out while on the road, as they encounter unexpected congestion.

Most travelers who call 511 are interested in information on a single highway route; less than 2% of callers request transit information. The most commonly requested routes are I-40 and I-17, which account for about 25% of the total requests. Both routes include extensive segments through high-altitude areas where adverse winter driving conditions are common. Far fewer callers request information on the major Phoenix area urban routes, like US 60, I-10, SR 101 and SR 51, which together account for less than 10% of total requests.

The highest percentage of calls to 511 are made during AM and PM peak traffic hours (e.g., 6-9AM and 3-7 PM), and during the typical mid-day traffic peak that corresponds to lunchtime trip making. Since 511 appears to be used for intercity trips rather than for daily commuting trips, the peaking of calls during these traffic hours is probably more a reflection of higher traffic volumes during these times of the day, rather than specific information needs during morning or evening commuting. On Fridays and Sundays, call volumes are especially high in the late afternoons. This could reflect weekend intercity travel, of which there is a great deal in Arizona. Weekend trips from Phoenix to "up north" are very common—in the summer to escape the heat and in the winter for skiing and other outdoor recreation.

Overall, the usage findings point toward a conception of the existing 511 system as primarily a resource to a relatively small number of travelers, who use the system largely for relatively infrequent, intercity trip making, especially in areas where adverse weather is common.

User Satisfaction

The only baseline information available regarding user satisfaction is from six focus group sessions conducted by ADOT in March 2002 as input to the model deployment design process. Two sessions each were held in Phoenix, Flagstaff and Tucson. Each session was attended by 10-12 people for a total of 67 participants. Participants were recruited via the ADOT traveler information website, telemarketing and through the newspaper. The focus groups were administered by a professional market research firm.

Only three of the focus group participants had used 511 prior to being recruited and only five of the participant had heard of the system. The participants felt that existing marketing efforts are insufficient and emphasized the importance of enhanced marketing, through a wide variety of mechanisms, including road signs, buses, rest stops, gas stations, through the Department of Motor Vehicles, radio, television, and freeway dynamic message signs.

Most of the focus group participants were not very satisfied with the existing 511 system. (They were asked during recruitment to familiarize themselves with the system and the system was utilized during the focus groups). The overall average rating of the existing system was 4.7 out of 10. The rankings in Flagstaff were slightly higher, perhaps due to the reliance on the system for winter weather information. (Phoenix and Tucson do not experience adverse winter driving conditions.) Participants rated an enhanced 511 system, incorporating improvements that they identified, much higher: 8.8 out of 10.

Specific concerns and recommended improvements to the 511 system covered essentially the entire spectrum of system characteristics, including information content, user interface, and information format. Participants feel that the coverage of the 511 system should be expanded, especially to include major arterial streets in the urban areas. In general, more information relevant to urban area commuting is desired, especially among Phoenix residents. This includes more information on accidents (the existing system was not perceived as having much information on accidents) and overall traffic flow conditions. Phoenix participants felt that the system was over-populated with information on long-term construction and maintenance, especially in intercity areas, and did not have enough concise information to support commuters.

In the area of user interface, focus group participants feel that voice-recognition is a critical improvement. Most of the participants seemed quite familiar and comfortable with voice-recognition systems, but they did indicate that it is important to have a good quality system, one that is easy to understand and one that understands user inputs. Participants felt strongly that the information on 511 should be brief and succinct, and they desire the ability to move quickly to the information they're interested in. They felt the existing system was too plodding. They expressed interest in being able to screen out or move quickly past information that did not impact their current trip (e.g., intercity construction and maintenance in the case of a commute trip).

Overall, despite low satisfaction with the existing 511 system, focus group participants demonstrated support and enthusiasm for the concept of the 511 service, indicating that they felt a high-quality service would significantly enhance the public's perception of ADOT. They also expressed support for a nationwide network of 511 systems that was similarly designed.

Costs

ADOT estimates the cost to implement the pre-enhanced 511 system at approximately $355,000. That figure does not include the cost to develop HCRS, the data engine that feeds the 511 system, but does include the $270,000 cost to develop the original Interactive Voice Response (IVR) phone system, "VRAS" (Voice Response Activated System), original IVR hardware and engineering ($62,520), and the cost to convert the VRAS system from the original ten-digit number to 511 ($22,500).

ADOT estimates the annual cost to operate the 511 system at approximately $137,000, the majority of which ($102,000) is for phone charges (toll free, call transfers, etc.). In identifying some 511 budgeting "rules of thumb," the National 511 Coalition's January 2002 Deployment Assistance Report #1 describes the least expensive to implement and operate 511 systems as "highly automated, limited or no human involvement in operation," and identifies the ADOT system as an example. This is certainly the case, as the 511 portion of the overall ADOT traveler information system is essentially automatic. Once information is entered into HCRS (an activity not included in ADOT's 511 system cost accounting), the process is automated, with HCRS events automatically converted to synthesized speech 511 messages.

1.0 Introduction

1.1 Purpose of this Document

This document presents the results of the analysis of baseline, or "pre-enhancement," data describing the operation of the existing 511 telephone traveler information system operated by the Arizona Department of Transportation (ADOT). The United States Department of Transportation (U.S. DOT) National 511 Model Deployment is supporting a wide range of enhancements to the existing ADOT 511 system, including the addition of several new types of information and significant redesign of the user interface.

On July 21, 2000, the Federal Communications Commission assigned 511 as the nationwide traveler information telephone number and granted responsibility for it to government transportation agencies. Since that time, approximately 20 statewide and regional 511 systems have become operational throughout the United States, including the current Arizona statewide 511 system.

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) are jointly sponsoring the Arizona 511 Model Deployment. The model deployment seeks to demonstrate the potential of 511 services to bring together data from various sources, and provide useful information to travelers through a state-of-the-art telephone interface. The national evaluation will assess the extent to which the Arizona 511 project satisfies the objectives of the model deployment, which include:[1]

- Illustrate how the innovative application of technologies can create a highly effective 511 service that sets a standard for high quality telephone traveler information; "push the envelope" of traveler information quality production and dissemination.

- Utilize an innovative user interface that promotes ease of use without compromising the user's expectation for personalized information and allows callers to locate the content they desire quickly and efficiently. The user interface must take advantage of proven voice-recognition, voice response, and synthesized speech technologies.

- Provide information to callers automatically on a route segment or corridor basis, with no direct contact necessary between callers and human operators

- At a minimum, the information content on the 511 system shall include:
    - current traffic conditions;
    - major service disruptions for public transportation properties;
    - current information on active construction and maintenance projects along route segments that may affect traffic flow or restrict lanes;
    - unplanned events, major incidents, or congestion that shut down or significantly restrict traffic for an extended period;

[1] 511 Model Deployment Solicitation, Federal Register: January 16, 2002 (Volume 67, Number 11), Federal Highway Administration, Federal Transit Administration.

- transportation-related information associated with significant special events (fairs, sporting events, etc.); and
- abnormal weather or road surface conditions that could affect travel along the route segment.

The national evaluation of the 511 Model Deployment is intended to generate findings that will help shape U.S. DOT approaches to 511 and that will be of use to others implementing and operating 511 systems. The national evaluation is the primary mechanism for documenting the performance of the model deployment and the lessons learned. Analysis of the existing 511 system, the subject of this report, provides a context for the evaluation overall and provides specific points of comparison for those portions of the evaluation that include analysis of "system impacts," that is, before-after comparisons.

1.2 Overview of the Model Deployment

The Arizona Department of Transportation (ADOT) is leading the 511 Model Deployment in partnership with other transportation agencies in the Phoenix and Tucson regions. The 511 Model Deployment implements a number of key enhancements to the existing statewide 511 system that became operational in March 2002, when ADOT converted their ten-digit system that had been operational for several years to 511. The planned enhancements to the system include:

- new content on arterial streets, airports, neighboring states (Utah), transit (major service disruptions and estimated arrival times), weather, and downtown Phoenix special events and parking;
- a complete redesign of the menu system, conversion from a keypad system to voice recognition, conversion from a highway route-based reporting to segment-based reporting;
- enhanced 511 marketing; and
- partnership with a private, for fee, premium service information provider (ADOT was unable to reach agreement with the selected partner and this enhancement is not expected to occur.)

ADOT received the award of the model deployment in July 2002 and immediately began the planning and design process. Starting in August of that year, 511 Task Force meetings have been held once a month. A Program Management Plan document was completed in November 2002 that includes an overall schedule and high-level scopes of work for the various enhancements. At that same time, a System Requirements Document was completed that identifies the requirements for the various enhancements. Implementation of the system began in early 2003. Operation of the enhanced 511 system is scheduled to occur in a phased manner beginning in December 2003 with most of the enhancements in place and operational by mid-2004.

Battelle Memorial Institute is conducting the national model deployment evaluation. Battelle was given notice to proceed in September 2002. A kick-off meeting with the local evaluator, Dr. Mark Hickman, Assistant Professor at the University of Arizona, was held in October 2002. Since that time, Battelle and Dr. Hickman have been working

closely, monitoring the status of the model deployment planning, design and implementation, and developing plans for the evaluation.

1.3 Overview of the Evaluation

1.3.1 Evaluation Objectives

Nationally, implementation of 511 is in its early stages. Many more agencies are considering or planning 511 deployments than have implemented systems to date. Clear "best practices" have yet to emerge in a number of technical and institutional areas and key questions remain, including how much transit information should be made available directly on 511 versus transferring callers to existing transit agency customer information systems; how to interface with other state's 511 systems in border regions; the cost of 511 for public agencies and what sorts of private sector partnerships may be possible; and how to accommodate additional information while keeping menu systems easy to use. The model deployment and this evaluation are intended to address these questions.

Specific objectives of the U.S. DOT evaluation of the 511 Model Deployment are to:

- Provide an independent review of the performance of the model deployment, including the extent to which it accomplishes the national objectives (which is summarized in Section 1.1).
- Document how the model deployment was implemented, including system costs and how technical and institutional issues (especially cross-modal and interstate) issues were resolved.
- Provide ADOT and the other partners with feedback that will allow them to improve the effectiveness of the system.
- Deliver lessons learned that will inform the U.S. DOT 511 effort and that will be of use to agencies operating and planning to implement 511 systems.

1.3.2 Evaluation Phasing

The evaluation consists of three phases. The first phase consists of developing the evaluation plan and analyzing baseline data. Phase I essentially ends with the completion of the enhancements to the 511 system, which the 511 partners have scheduled for December 2003, and the completion of this document, which is the last of the Phase I deliverables. Phase II consists of the analysis of the enhancement process—the process of implementing the upgrades to the 511 system. Phase II concludes within two months following the completion of the enhancements and is documented in a briefing to U.S. DOT. Phase III consists of the analysis of one full year of post-enhancement data, including comparisons to pre-enhancement data. Assuming the enhanced 511 system becomes operational as planned in December 2003, the year of post-enhancement operation will conclude in December 2004 and the evaluation will conclude with the publication of Model Deployment Evaluation Final Report in approximately May 2005.

1.3.3 Evaluation Activities

In addition to capturing information on deployment and management issues, lessons learned, and costs, the evaluation will attempt to test the following hypotheses:

- The addition of a number of types of new data to the 511 system will contribute to increased usage.
- The addition of a number of types of new data to the 511 system will contribute to high levels of customer satisfaction.
- Users will view the information available on the 511 system as comprehensive and multi-modal.
- Usage of the 511 system will increase as a result of enhanced marketing.
- Enhancements to the user interface, including voice recognition, segment-based reporting, and "Quick Reports" will contribute to improved customer satisfaction.
- The addition of transit information, downtown Phoenix information, and a top level menu selection for the Grand Canyon will promote mobility and access.
- Providing users with arterial street travel times will allow them to avoid congestion and reduce travel time and travel time variability.
- System efficiency will be improved by increasing the number of phone lines, implementing new arterial street data capture methods, and enhanced data entry training and quality control.

These hypotheses were developed based on the objectives of the 511 Model Deployment implementers. The Evaluation Plan document presents a detailed listing of the data that will be used to investigate each of these hypotheses.

Evaluation analyses have been organized into individual "tests," with each test focusing on particular types of data. The tests and their relationship to the major focal points of national Intelligent Transportation System (of which 511 systems are an example) evaluations are shown in Table 1. In addition to these formal tests, a cost analysis will be performed and various other types of supporting data will be collected and utilized to aid in the interpretation of test results and to identify management and deployment issues and lessons learned.

Table 1
Evaluation Tests

Analysis Area	Tests		
	Usage Logs[(1)]	**User Survey**	**Key Informant Interviews**
Customer Satisfaction	**X**	**X**	
Mobility	**X**	**X**	
Efficiency	**X**	**X**	**X**
Management and Deployment Issues			**X**

[(1)] The analysis of system usage will include consideration of system data content (inputs from the various agencies that supply data to the system) and the reliability (e.g., system downtime) and availability (phone line utilization) of the system.

Table 2 identifies the general division of responsibilities for the evaluation activities between Battelle and the Local Evaluator, Dr. Mark Hickman of the University of Arizona. Designation of Dr. Hickman as the lead in certain areas is based on his interests and availability of lower cost student researchers who can assist with data reduction. For each test, activities will be very closely coordinated between Battelle and Dr. Hickman to ensure that all evaluation needs are met.

Table 2
Evaluation Lead and Support Roles by Evaluation Activity

Evaluation Team	Usage Logs Test	User Survey Test	Key Informant Interviews Test	Cost Analysis
Battelle	Support	**Lead**	**Lead**	**Lead**
University of Arizona	**Lead**	Support	Support	Support

The Usage analysis consists of three main components. The primary component of the test consists of the analysis of 511 system usage data itself, which consist of VRAS server log files, and in the case of the baseline analysis, electronic phone bill records. The two secondary components of the Usage test focus on data and issues that provide context to the interpretation of the usage data. Those secondary, supporting components include an analysis of agency data inputs to the 511 system, and the performance of the 511 system itself, in terms of system downtime and phone line availability/utilization.

The User Survey features a post-enhancement survey of 511 users. A percentage of calls into the 511 system will be intercepted and callers recruited to participate in a brief survey, which will be administered later in a separate call to users agreeing to be surveyed. It is expected that the minimal sample size of the survey will be 400 to 500. The survey is scheduled to be conducted in late summer/early-fall 2004, after the 511

system has been operational for several months and after users have had a chance to become familiar with the system. The survey will include questions focusing on users' utilization of the system (frequency of use, what sorts of trips, at what stage in the trip, cell phone versus landline, etc.), their satisfaction with the system (ratings of information types, ratings of accuracy/timeliness, ratings of overall satisfaction, perception of benefits, favorite and least favorite aspects, etc.), and recommended improvements. Evaluation resources do not support a pre-enhancement survey and ADOT has not conducted surveys of existing users. Therefore the user survey analysis does not include before-after comparisons. The model deployment partners did, however, conduct focus groups with 511 users as part of the development of the enhancements and this information will be used to provide context for the survey analysis.

The Key Informant Interviews will be conducted in two rounds, the first occurring shortly after completion of the enhancements and the second near the end of the first year of operation. The interviews will be used in the testing of efficiency-related hypotheses and to support the analysis of costs and management and deployment issues. Within the efficiency area, interviews with ADOT technical staff responsible for overseeing the operation of the HCRS and VRAS servers will complement the system data in the assessment of system availability. Interviews with ADOT Traffic Operations Center (Phoenix headquarters) HCRS operators and supervisors will complement the system input data in the assessment of improvements in the capture of arterial street data. Interviews with HCRS operators and supervisors at Tucson area agencies (ADOT District Offices, City of Tucson traffic, airport and transit) will help assess the extent to which the model deployment is successful in making available more information on Tucson. Interviews with HCRS operators and supervisors will also help assess the effectiveness of increased training and changes in data entry and verification procedures. Finally, interviews with various model deployment partners will be used to collect cost information (ADOT, primarily) and lessons learned, including challenges encountered and their resolution.

1.4 Scope and Organization of the Interim Analysis Report

Section 2.0 of this report describes the context for the 511 Model Deployment, in terms of the general transportation system and availability of traveler information, and describes the existing and enhanced 511 system.

Section 3.0 presents the baseline data analysis, including the following:

- **Information Content and Quality** – this information provides context for interpreting results of the usage analysis and pre-enhancement focus group results.
- **System Availability** – documenting system down-time and phone line availability, this information provides context for interpreting the results of the usage analysis and pre-enhancement focus group results.
- **Usage**
- **User Satisfaction** – results of the 511 partners' pre-enhancement focus groups.
- **Costs**

2.0 MODEL DEPLOYMENT CONTEXT AND SYSTEM DESCRIPTION

2.1 Project Context

The population of Arizona at the time of the 2000 Census was approximately 5.1 million. Geographically, the vast majority of the state is rural, although 88 percent of the population resides in urban areas.[2] Over two-thirds of the state's population is concentrated in Maricopa County (3.1 million), located in central Arizona and which includes the City of Phoenix and most of the greater Phoenix Metropolitan Area; and Pima County (843,000), located in southern Arizona and which includes the greater Tucson Metropolitan Area. Both the Cities of Tucson and Phoenix are partners in the 511 Model Deployment. The overall population density of the state is about 45 persons per square mile (ranked 36 in the US) compared to the overall average for the United States of 80 persons per square mile. Arizona has grown quickly over the last several decades. The population increased 40 percent between 1990 and 2000. Figure 1 identifies major cities and highways in Arizona.

Arizona is a major destination for US and international tourists. Arizona ranked 13th among US states with approximately 550,000 international visitors in 2002.[3] Major attractions include the Grand Canyon and over 30 other national parks and monuments, vacation resorts in Phoenix and Tucson, old west towns like Tombstone, Bisbee and Jerome scattered throughout the state, and the "red rock country" surrounding Sedona. The Grand Canyon National Park alone had over 4 million visitors in 2002.[4]

Arizona's highway system includes three major east-west interstates: I-8 in the southern portion of the state that serves as one of the major routes between Phoenix and San Diego; I-10 in the central portion of the state that links Phoenix with the Los Angeles area to the west and to southern New Mexico to the east; and I-40 in the north. Both I-10 and I-40 are major international trade corridors. Arizona includes two major north-south interstates: I-17, which links Tucson, Phoenix and Northern Arizona, and I-19 which links Tucson with Nogales, located on the international border with Mexico. Arizona includes several major international border crossings with Mexico, including San Luis Rio Colorado (in the west), Nogales (central), and Douglas (east).

[2] Bureau of Transportation Statistics, 1990 Census figures; July 2003, www.bts.gov/publications/transportation .
[3] United States International Trade Administration, Office of Travel and Tourism Industries web site (http://tinet.ita.doc.gov), July 2003.
[4] National Park Service web site, http://www2.nature.nps.gov/stats/, 2003.

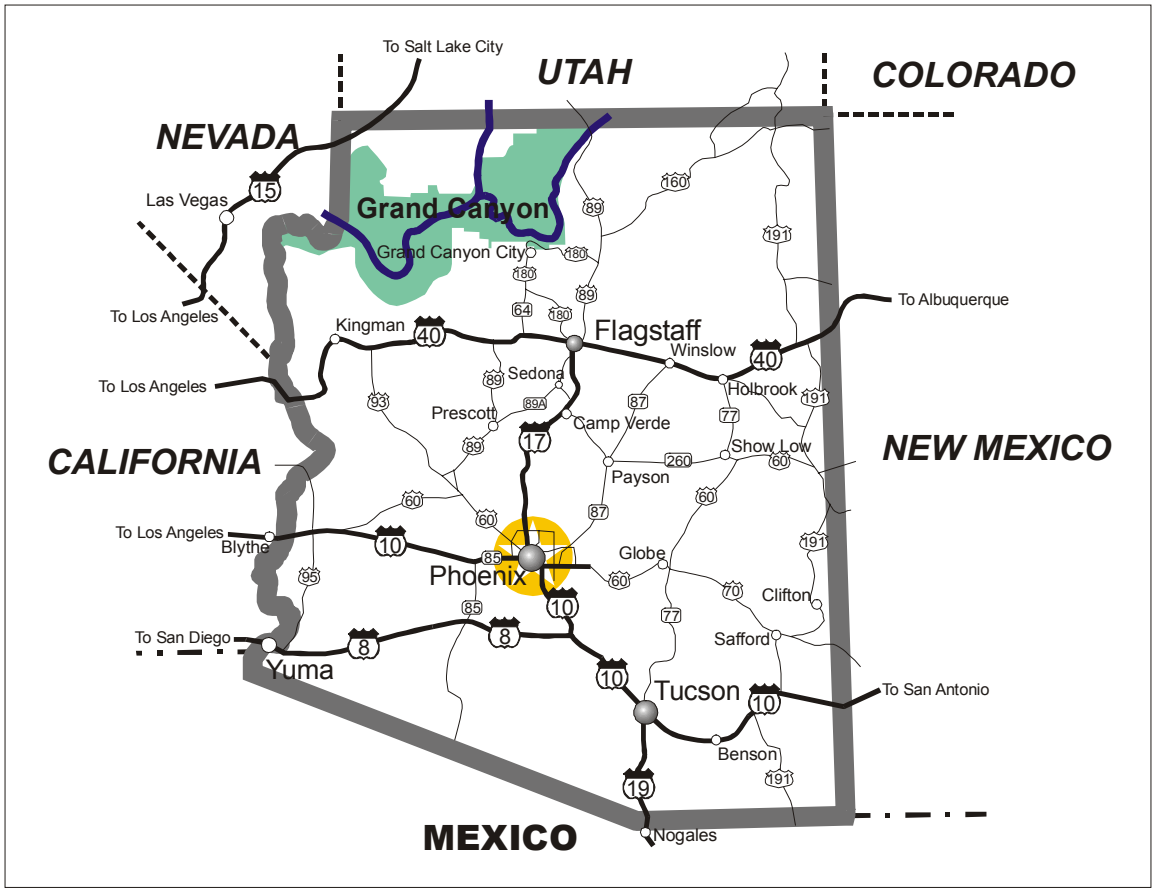

Figure 1. Location Map

Both the Tucson and Phoenix regions are characterized by low-density development and heavy reliance on the personal vehicle for transportation. Traffic congestion is significant in Phoenix, but below the levels of the handful of most congested urban areas in the United States, such as Los Angeles, San Francisco, Chicago and Washington, D.C. According to the 2000 Urban Mobility Study conducted by the Texas Transportation Institute (TTI), which studied 75 urban areas in the United States, Phoenix ranked 11th based on the "travel time index". The travel time index measures the amount of additional time needed to make a trip during a typical peak travel period in comparison to free-flow speeds. The average travel time index for all 75 urban areas is 1.39. Phoenix's travel time index of 1.40 is just above that average and indicates that a trip that would take 20 minutes at free-flow speed takes about 28 minutes (20 x 1.40 = 28). For comparison, the most congested urban area—based on the travel time index—is Los Angeles with 1.90. Of the ten urban areas that have travel time index values higher than Phoenix, eight of them are between 1.41 and 1.47, indicating that relatively little separates Phoenix from most of the more congested locations.

Tucson, which is much smaller than Phoenix, is far less congested, ranking 40th among the 75 urban areas studied by TTI with a travel time index of 1.20. Although below the average for all 75 urban areas (1.39), the Tucson travel time index is just above the average for urban areas of similar size (1.18).

Both Tucson and Phoenix have well-developed grid networks of major arterial streets at one-mile spacing and therefore there are a number of alternative routes for the portion of trips using local streets. However, both areas were relatively late in beginning to develop their urban freeway systems and there are very few viable alternate freeway routes in these areas.

Many miles of Interstate, State and US Highway routes in Arizona are located in high-altitude areas that receive considerable snow and ice, thus making winter-weather traveler information important. These high-altitude areas encompass most of Northern Arizona, including the Grand Canyon area; I-40, which traverses east-west across Arizona and is a major national freight corridor; Flagstaff; and large portions of Eastern Arizona.

2.2 Existing Traveler Information Systems

2.2.1 ADOT 511 System

ADOT converted their ten-digit statewide road conditions telephone information system, or "Voice Response Activated System" (VRAS), which utilized a toll free ten-digit phone number (888-411-ROAD) to 511 in March 2002 (the ten-digit number also remained operational). The current 511 system allows users to obtain either highway (state highways and interstates) or transit information (via routing to transit agencies customer information systems) using touchtone (keypad) menu selections. Information in the existing system is updated every 5 minutes. Figure 2 illustrates the current system menu structure.

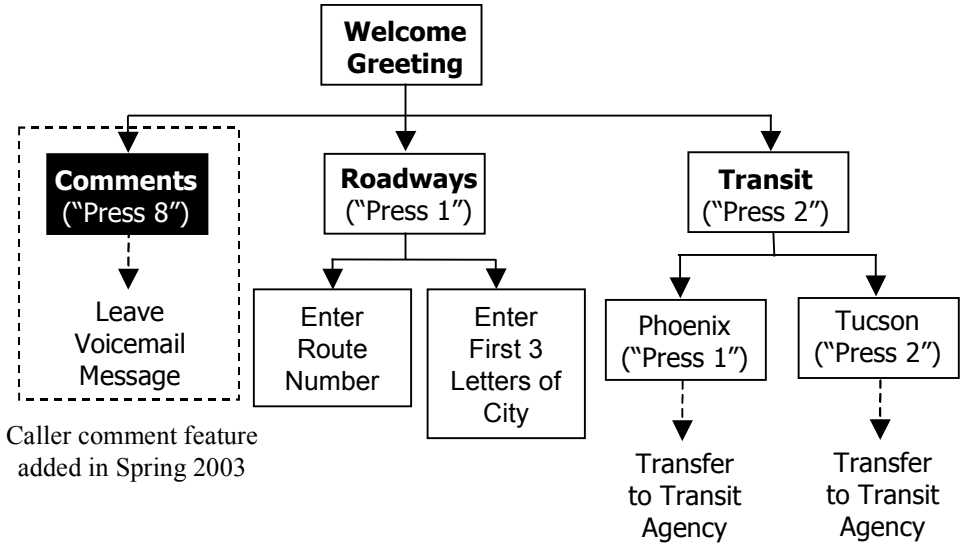

Figure 2. Current ADOT 511 System Menu Structure

All transit information requests are call-forwarded to the transit agencies where they are handled by the agencies' existing system; no transit information is provided directly through the 511 system. For highway information, users enter the route number of the highway and are provided recorded messages describing various "events," including roadway construction, closures, incident reports, weather updates, etc. Information is not available by roadway segment. Rather, once a given road is selected, all events pertaining to locations along the entire length of the route are described, in sequence. Events are not prioritized, that is, all incident-related events are not reported first. The user cannot request information for only a portion of a given highway. Users may also receive reports on local arterial streets in Maricopa County by entering the first three digits of the city in which they want information. Historically this feature has very seldom had information available, since the local agencies who are the source of this information have not regularly entered data into the system.

Figure 3 illustrates the major components of the existing 511 system. The ADOT Highway Condition and Reporting System (HCRS), located in the lower right portion of the diagram, is the database that feeds information to the 511 system as well as the ADOT traveler information website (not shown). HCRS was developed in the mid-1990's by ADOT principally as a means of coordinating the construction and maintenance activities among various ADOT jurisdictions statewide (originally, the "C" and "R" stood for "Closures" and "Restrictions.") However, the potential benefits of providing this information to the public were soon realized and HCRS was linked to both a website, where a statewide traffic map with various traveler information icons was made available, and a ten-digit statewide telephone traveler information system. That ten-digit phone system and website were co-branded as the "Trailmaster" system.

Information is entered into HCRS via the Internet from HCRS workstations located at ADOT facilities statewide, including in each of the nine ADOT District Offices and field offices within each District. As indicated in the upper right portion of Figure 3, several other organizations can also input information to HCRS, including the local traffic jurisdictions and Department of Public Safety in the Phoenix region that compose the regional AZTech ITS consortium. AZTech was created as part of the Phoenix Region Metropolitan Model Deployment Initiative (MMDI) in the late 1990's. In years past, as part of the I-40 Traveler and Tourism Information System (TTIS) deployment, approximately 20 additional organizations in the I-40 (Northern Arizona) Corridor also had the ability to enter information into HCRS. These agencies included Chambers of Commerce, a private tour operator, Arizona Department of Emergency Management, Grand Canyon National Park, and 911.

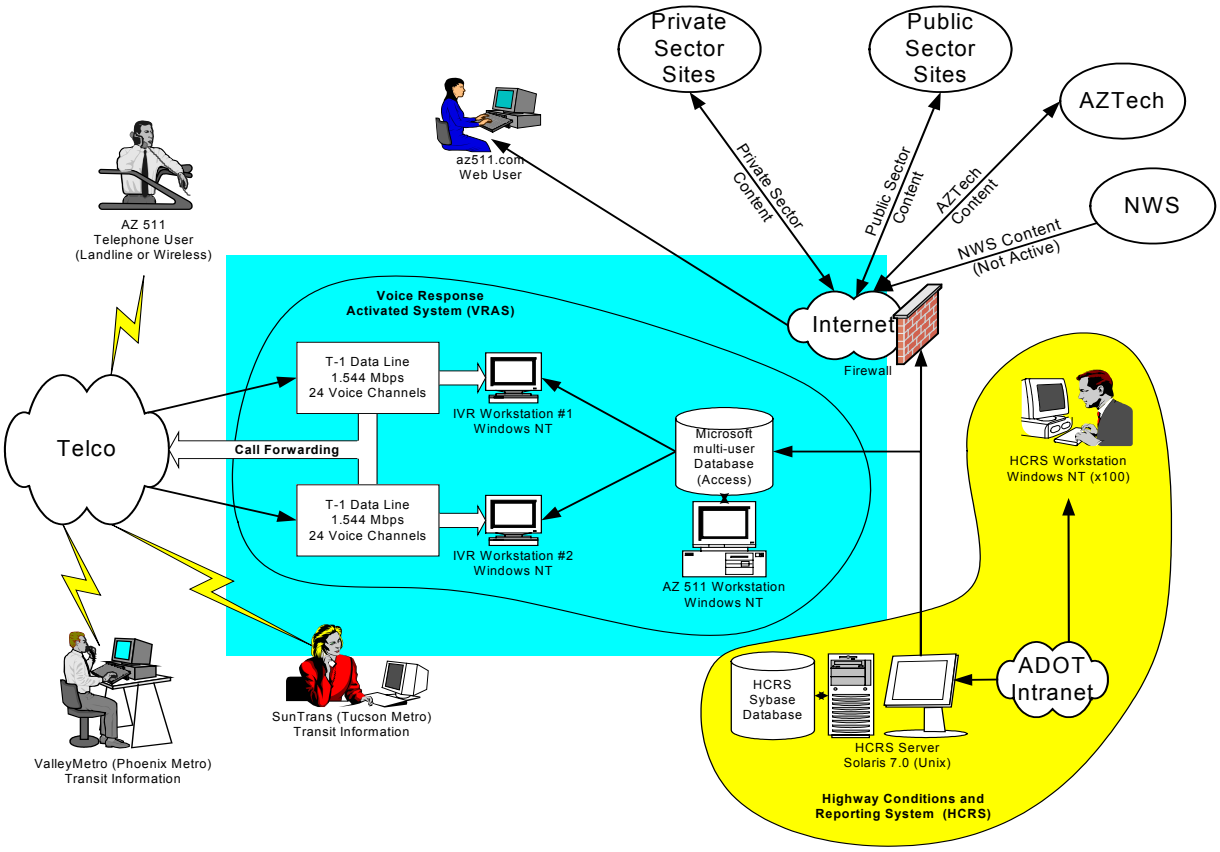

Figure 3 : Existing ADOT 511 System Diagram

HCRS events are entered via an on-screen event form, which includes a number of different fields. HCRS event entries are translated to roadway advisory messages "automatically". That is, the information in key fields, including location (type of route, such as "interstate" or "state route;" route number and direction, such as "eastbound") and the subject matter of the event, expressed using International Traveler Information Interchange Standard (ITIS) "category" and "description" information, is pulled from HCRS and converted to a synthesized speech message. The message is then pushed from the HCRS server to the VRAS server that powers the 511 service.

VRAS includes a server and two T-1 phone line "processors", or "boxes" as ADOT refers to them. Each T-1 unit includes 24 voice channels, or phone lines, and so the existing 511 system can accommodate up to 48 incoming calls simultaneously.

2.2.2 Other Traveler Information Systems

Aside from the 511 telephone system and the customer service telephone lines at the major transit operators, the other major public traveler information dissemination tool in Arizona is the ADOT traveler information web site, as indicated in the upper center portion of Figure 3. At about the same time that ADOT converted their ten-digit telephone information number to 511 in March 2002, they co-branded their existing traveler information web site, adding the 511 logo and making the site reachable via either http://az511.com or the previous address of http://azfms.com. The ADOT traveler information web site draws information from the same data engine as the 511 system, the statewide Highway Condition and Reporting System. The web site contains three types

of information, as shown at the top of Figure 4, the main page: still images and live views from closed-circuit television cameras located on freeways throughout the Phoenix area; a color-coded freeway congestion map of the Phoenix area; and a statewide map with clickable icons showing highway closures, restrictions, accidents and weather information. Figure 5 shows the Phoenix area color-coded freeway conditions map. Figure 6 shows the statewide roadway conditions map.

Figure 4. ADOT Traveler Information Web Site Main Page

Figure 5. ADOT Web Site Freeway Conditions Map

Figure 6. ADOT Web Site Statewide Traveler Information

Other sources of traveler information in Arizona include traditional commercial broadcast radio and television, which feature peak hour traffic condition reports oriented toward urban area commuters. As part of the AZTech MMDI, cable TV traffic information was established in four jurisdictions in the greater Phoenix area. Traveler information is also provided on websites operated by a number of Independent Service Providers in the Phoenix area, including the Travel Advisory News Network (http://traffic.tann.net/) and Tele Atlas/Metro Networks (http://www.aztech.org/traffic2.htm). Both of these services were initiated as AZTech partnerships and both provide regional traffic maps containing information provided by ADOT, and are similar in format to the ADOT Phoenix region traffic map that is available on the ADOT AZ511 website. Figures 7 and 8 present the Phoenix region traffic maps from the Tele Atlas and Travel Advisory News Network websites.

Figure 7. Tele Atlas/Metro Networks Phoenix Region Traveler Information Map

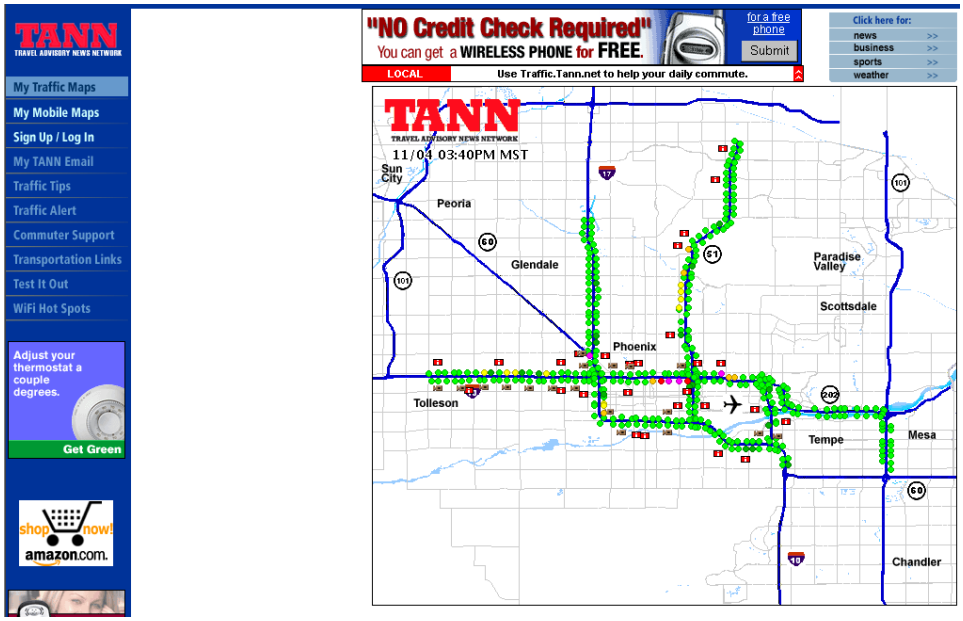

Figure 8. Travel Advisory News Network Phoenix Region Traveler Information Map

2.3 511 Model Deployment Enhancements

The model deployment consists of a number of enhancements to the existing ADOT 511 system. The project partners have categorized these enhancements into two types: information content enhancements and telephone system interface enhancements.

Information content improvements include a wide range of new types of information, including information on arterial streets; downtown Phoenix events and parking; airport information; additional weather information (including information from the state's Road Weather Information System); information from Utah; and a reporting scheme based on roadway segments rather than entire routes. System interface improvements include moving to a voice recognition system and a complete redesign of the menu system. Table 3 lists the various information content and telephone system interface improvements.

Table 3
Arizona 511 Model Deployment Enhancements

Type of Enhancement	Enhancement
Information Content Improvements	Add data from Tucson and Phoenix local streets.
	Implement standards upgrades (e.g., use of XML).
	Incorporate data from neighboring states.
	Improve data quality through further refinement of landmarks and terminology used in HCRS, operator training, and establishment of a data quality monitoring process.
	Incorporate travel time data for selected Phoenix region arterial streets and freeways.
	Incorporate some transit data, such as major service disruptions, directly into the 511 system.
	Incorporate estimated bus arrival times for selected Phoenix region routes and stops.
	Incorporate selected airport information for the Phoenix and Tucson airports.
	Incorporate information pertaining to Grand Canyon National Park.
	Incorporate additional weather information, including data from the ADOT Road Weather Information System (RWIS).
	Incorporate downtown Phoenix special event information, such as parking information.
	Provide highway reports at the segment rather than route level and provide regional traffic condition summary reports (i.e., Quick Reports).
Telephone System Interface Improvements	Implement voice-recognition and modify menu structure based on user focus group input.
	Improve methods for tracking, reporting and assessing performance of the system.

In addition to the information content and telephone system interface improvements identified in Table 3, the model deployment also includes enhanced 511 marketing activities. Currently, the 511 system is not marketed. The only exposure the system has received occurred during the period of major wildfires in June and July 2002 when ADOT and Department of Public Safety personnel directed the media and the public to the system, and in March 2002 when the conversion to the 511 number was announced.

ADOT has prepared a draft marketing strategy to support the enhanced 511 service. The marketing plan identifies strategies in four areas:

- Media Relations (media kit, media contact list, press releases)
- Branding and Cross-Promotion (use of 511 logo, ADOT web sites, other agency web sites)
- Public Information and Outreach (highway signs, variable message signs, public service announcements, special event booth, user group communications)
- Collateral Materials (511 rack card, bumper sticker, promotional items)

Plans for highway signs consist of the deployment of 50 static signs on highways throughout the state. Location criteria include: approaches to metropolitan areas with populations greater than 50,000, average 50 mile spacing, roads approaching snow routes, locations of frequent storms and routes heavily used by tourists. Plans to use variable message signs call for advertising 511 on signs located on highways throughout the state. The posting of messages on various signs will be staggered in order to allow usage statistics to be gathered for each posting. The extent to which the 511 marketing will target transit users is not yet clear.

Plans for a final model deployment enhancement, a partnership with a private traveler information provider who would provide some sort of premium 511 service, have been tabled. ADOT chose to withdraw from negotiations with the selected partner due to concerns about the partner's financial stability.

3.0 BASELINE DATA ANALYSIS

This section contains baseline analysis in the following areas:

- Information content and quality (establishes context for interpretation of other results)
- Usage
- User satisfaction (pre-enhancement focus groups)
- Costs

3.1 Information Content and Quality

This section examines the content of information in the 511 system in terms of the type, volume, source and coverage of information travelers were able to access. Also discussed is the quality of data within the system.

3.1.1 Information Content

Understanding the data content of the current 511 system is important both for establishing a baseline against which to compare post-enhancement data content, and for establishing a context in which to interpret customer satisfaction and other findings. This section describes the existing information content of the 511 system by examining HCRS entries. Any information available on the pre-enhanced 511 system, which includes only roadway information, is entered through HCRS by an agency staff person. (See Appendix 1 for details on HCRS.) Each HCRS data entry translates into a single 511 message, such as this message from October 29, 2003:

> "Height limit 16 feet 5 inches, width limit 24 feet, east and westbound from 22nd Street to 6th Avenue. Roadway reduced to two lanes. Expect slow traffic. Until July 31, 2004."

Although no record of actual 511 messages is preserved by ADOT, the content of the 511 system can be effectively gauged by examining the HCRS data entry records. Discussed below are the magnitude and pattern of existing HCRS entries, including monthly variations, entries by organization, and entries by subject matter.

Overall Magnitude, Seasonality and Distribution of Information by Route

A large number of event entries are made to HCRS. Figure 9 presents total HCRS entries for each of the last three full years (2000-2002). The total number of annual entries ranges from about 11,500 to 13,900. The average number of entries per year is 12,453. ADOT has indicated that one possible reason for the reduction in entries over the last couple of years is that the Phoenix Traffic Operations Center HCRS operators were instructed to discontinue making multiple event entries for updates to traffic incidents. Up until that time, each time that status of an incident was changed, a new event was being entered. Now those updates are made within the initial event.

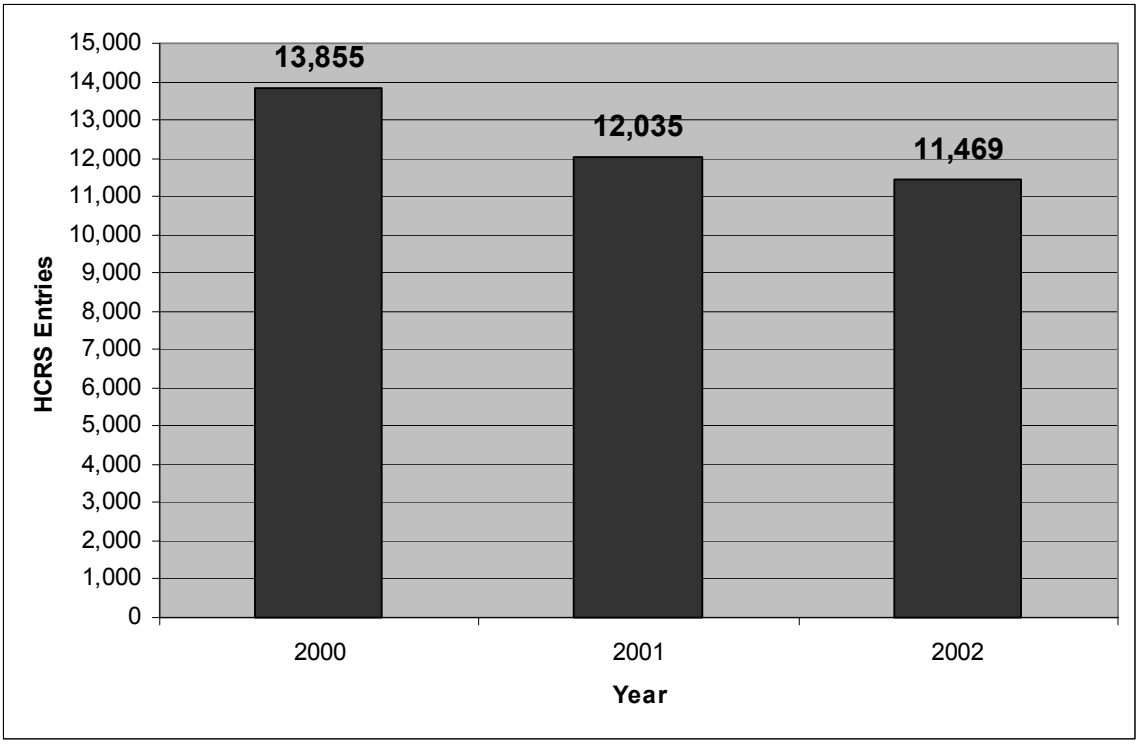

Figure 9: Annual HCRS Entries

Figure 10 presents HCRS entries by month for 2000, 2001 and 2003. During this latest three year period, the number of entries per month ranged from about 650 entries to about 2,050 entries, with the average number of entries being about 1,026 per month.

Figure 10 generally indicates that more HCRS entries are made in the winter months than in the summer months. Table 4 supports that observation, which shows the relationship between the average number of HCRS entries during winter months and summer months with the overall annual monthly average number of entries. In Table 4 the overall annual monthly average for HCRS entries is set to an index of 1.0. The number of HCRS entries during winter months (January – March) over the last three years has index values of between 1.1 and 1.4, that is, between 10 and 40 percent higher than the annual average. Summer months (June – September) have been about the same or a little lower than the annual average (index values of between 0.7 and 1.0).

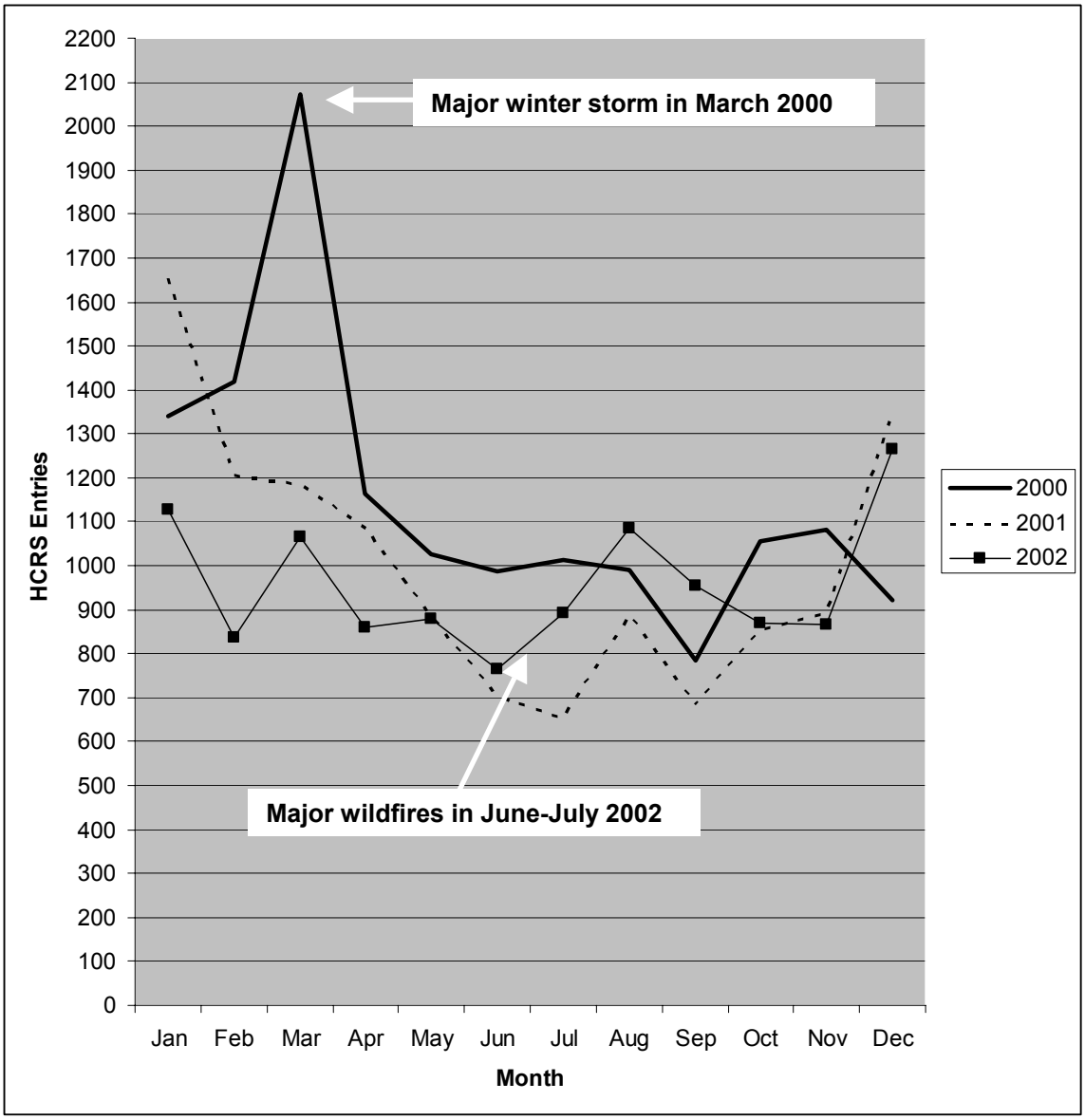

Figure 10: HCRS Entries by Month

Table 4
Seasonal Variability in HCRS Entries, 2000-2003

Monthly HCRS Entries Index	2000	2001	2002
Overall Monthly Average	1.0	1.0	1.0
Winter Months (Jan-Mar)	1.4	1.3	1.1
Summer Months (Jun-Sep)	0.8	0.7	1.0

The ADOT 511 system reports highway information at the route-level rather than route segment-level, and therefore it is not possible to determine which portions of which routes, such as urban versus rural/inter-city, are most often the subject of HCRS entries. However, since some routes are predominately rural/inter-city and some predominately urban, HCRS entries by route do allow some inference about the distribution of information in the 511 system. Consideration of HCRS entries by organization, that is, the ADOT Districts around the state, also provides perspective on the urban vs. rural nature of the information on the 511 system and is discussed further in this section.

Figure 11 presents the number of HCRS entries by route for the year 2002, along with the associated percentage of total entries. HCRS entries were recorded for a total of 90 different routes, although the 11 specific routes in Figure 11 account for about 70% of the total entries. The 79 other state and U.S. routes in the "others" category account for the remaining 30%. None of the individual routes in "others" routes was the subject of more than 2% of the total HCRS entries.

Clearly, in 2002, the majority of HCRS entries focused on a handful of routes. Predictably, these tend to be routes which may be theorized to have a greater incidence of traffic accidents and/or require more maintenance: high traffic volume routes (e.g., those through Phoenix and Interstates) and routes through high-altitude areas with considerable snowfall. The routes notated with a star are those that are either located entirely within the Phoenix urban area or pass through the Phoenix area. The other routes are largely rural/intercity. It is likely that the large proportion of HCRS messages dealing with US 60, a heavily traveled route in the eastern Phoenix urbanized area, pertain to the extensive roadway widening that occurred on that route during 2002. It is likely that during other years US 60 would be one of the most frequently referenced routes but the total percentage would be lower.

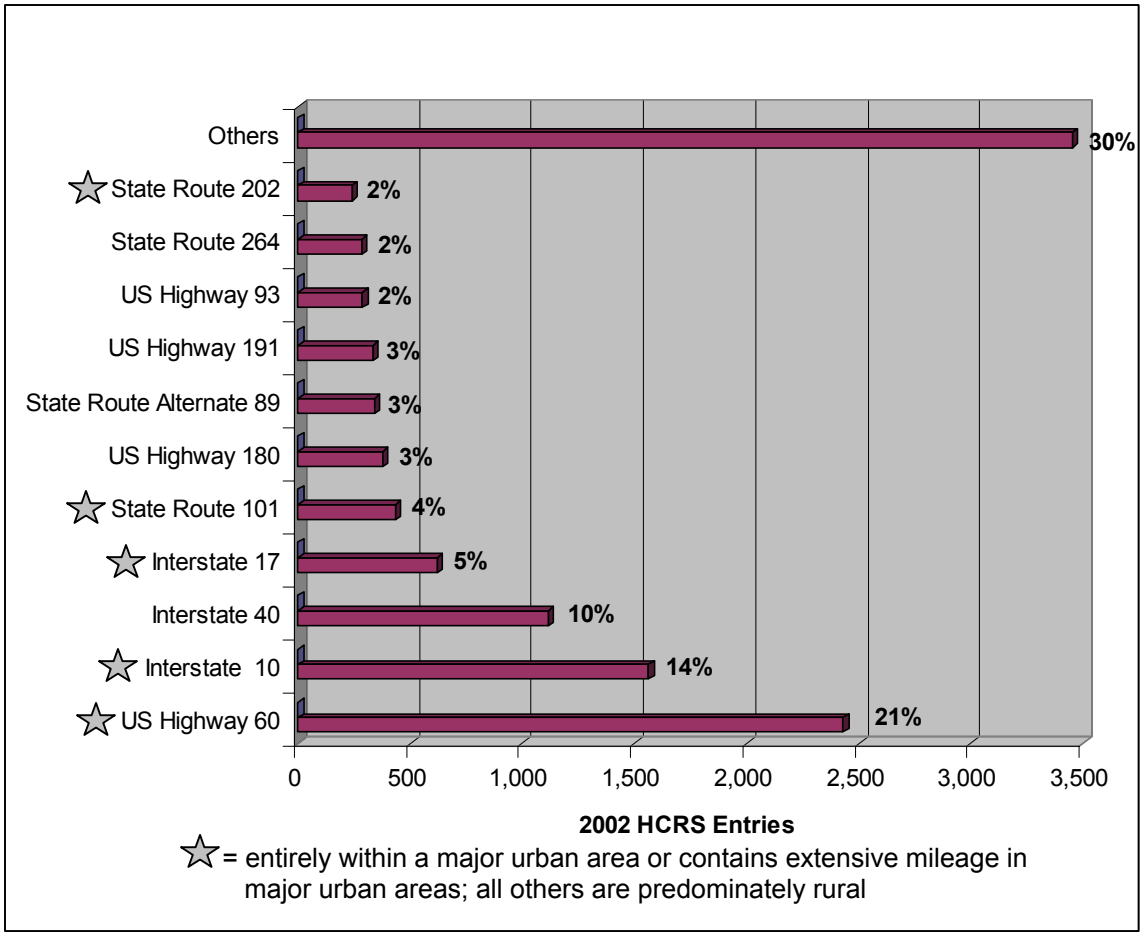

Figure 11: 2002 HCRS Entries by Route

In regard to the data content of the existing 511 system, the volume and pattern (i.e., month and route) of data inputs alone cannot provide a meaningful picture of information density. It is also necessary to compare information content against total system coverage. Even a large number of inputs, if spread out among a system of vast coverage, could yield a low information density.

The information density of the existing 511 system can be gauged using the data presented in the previous charts and tables, along with a few assumptions, as follows:

- The average number of HCRS entries per day = 12,453 (average entries per year) / 365 days = 34. Given the observed seasonal variations (see Table 4) the average number of daily entries can be estimated at 43 during the winter months and 29 during the summer months.

- No data is available describing how long the average HCRS entry remains in the system, but for the purposes of this estimate, the figure of 3 days is assumed. In reality, major construction-related events will stay on the system much longer and short-term incidents like accidents and most weather will be much shorter.

- Given an average of between 29 and 43 entries per day, depending on the season, each of which remains on the 511 system for 3 days, it can be estimated that on any given winter day 511 will contain 129 roadway advisories (43 x 3) and 87 advisories (29 x 3) on a typical summer day.

The distribution of HCRS entries is not uniform across all of the routes covered in the system. Based on the information in Figure 11 it is clear that more entries are made for the most heavily traveled routes. Therefore it can be theorized that on a typical day, multiple advisories are available for the most heavily traveled routes. Of course, as revealed in the discussion of focus group results (Section 3.4) just having a lot of information is not necessarily enough to satisfy users. They are interested in specific types of information and want to be able to access it quickly and easily.

HCRS Inputs by Organization

As indicated in Figure 12, during the three-year period 2000-2002, the vast majority of all HCRS inputs—81% on average—are made by the ADOT statewide Traffic Operations Center located in Phoenix. That percentage equates to about 10,000 entries per year. The only other organizations/offices responsible for entering more than 1% of the total entries are other ADOT offices in the Phoenix area, and ADOT offices in the Flagstaff, Holbrook, Kingman, and Globe Districts, which together account for about 16% of the total average annual HCRS entries, which equates to about 1,430 entries per year. Note that non-ADOT Phoenix organizations, which consist of the regional AZTech participants (local traffic jurisdictions and the Department of Public Safety), account for about one tenth of one percent of average total annual HCRS entries, which equates to only about 15 entries per year.

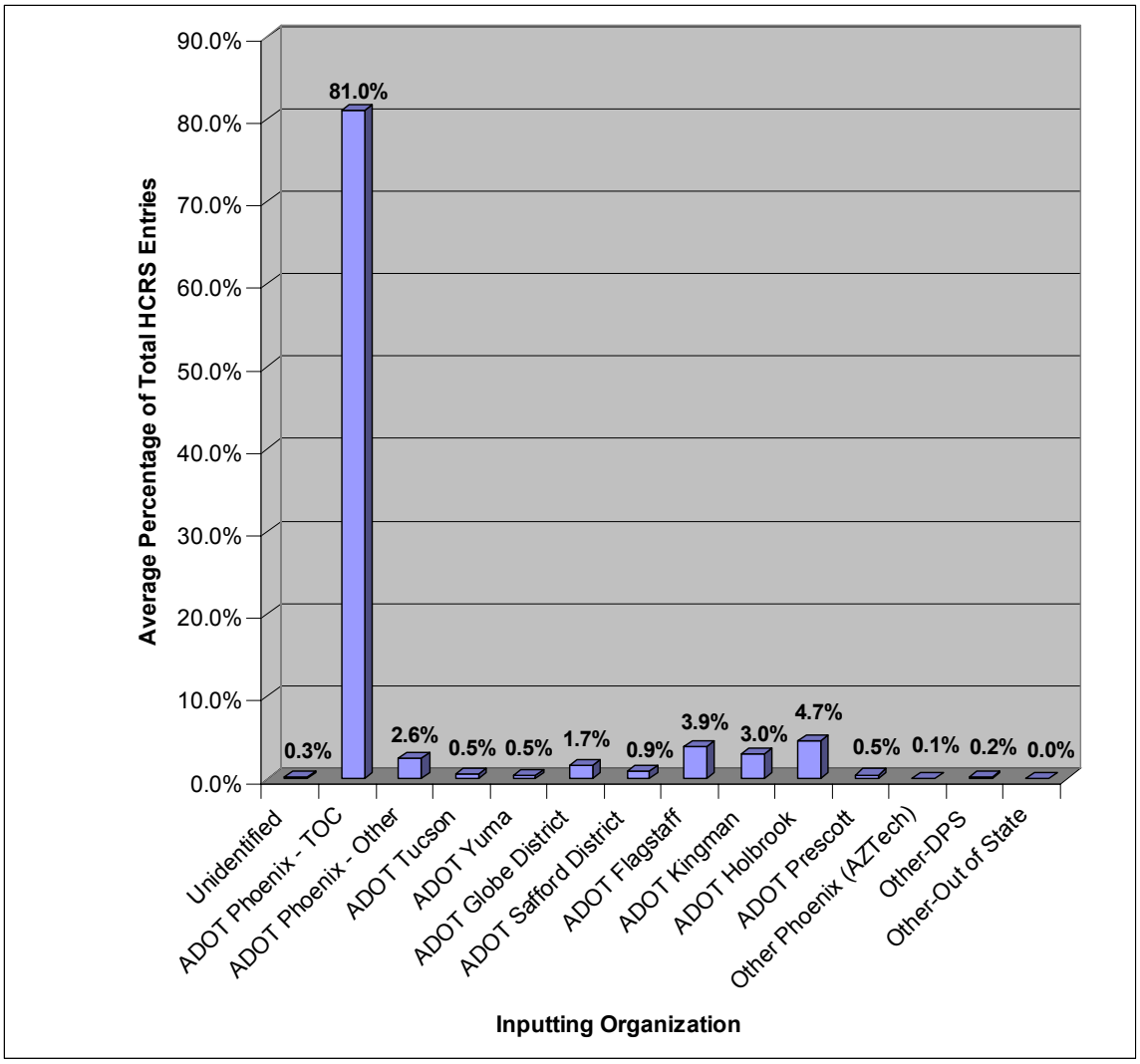

Figure 12: Average Percentage of Annual HCRS Entries by Organization

HCRS Inputs by Subject Matter

Figure 13 presents the percentage of HCRS entries by subject (based on ITIS categories in Appendix 1) over the period April 1998-January 2003. Six categories account for approximately 85% of all HCRS entries, with lane restrictions being the most common. The lane restriction category contains 170 separate "descriptions," or pre-coded specific messages covering all manner of lane closures, including those associated with both incidents and construction. (The incidents/accidents and road maintenance categories do not include messages referencing lane restrictions).

Currently, in the Phoenix region, ADOT only includes reports on "significant" traffic incidents, those for which ADOT is called out to assist the Department of Public Safety. ADOT has made a policy decision not to report what they consider smaller, shorter-duration incidents.

The large percentage of 511 information that is related to roadway construction, which likely includes most of the lane restrictions, road maintenance and closure HCRS entries (about 54% of all entries) may help explain one of the major findings of the 511 user focus groups (discussed in Section 3.3.2.1). A number of focus group participants felt strongly that the 511 system only seemed to contain information on roadway construction, and that incidents were not usually reported.

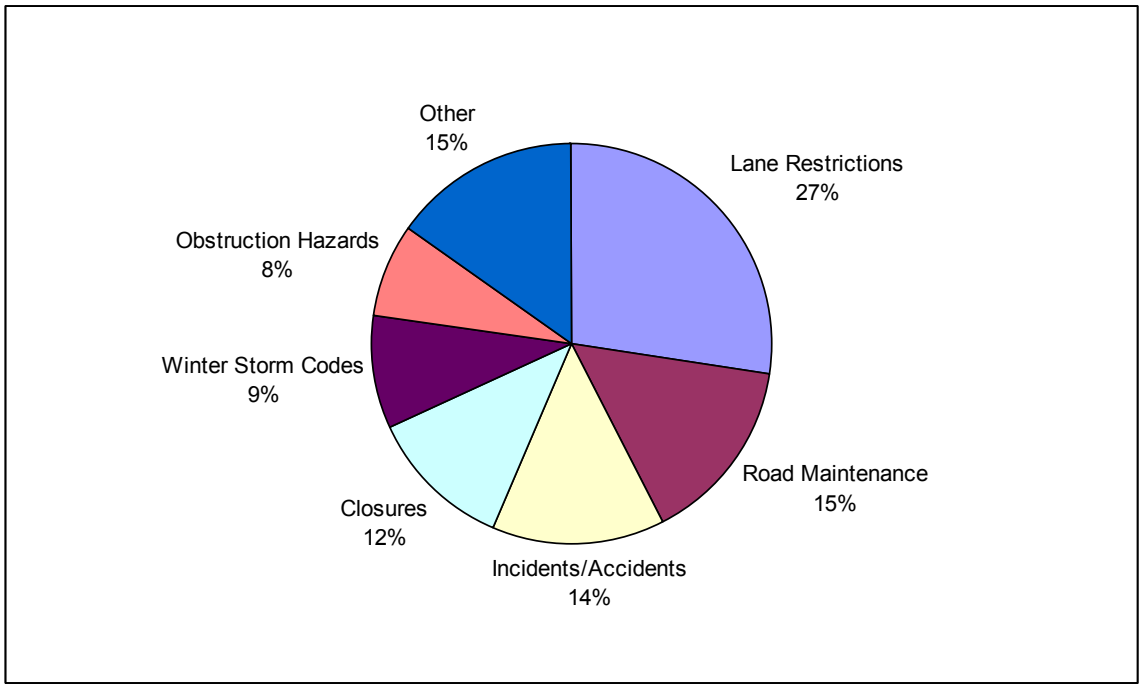

Figure 13: 1998-2002 HCRS Entries by Subject

3.1.2 Information Quality

One of the enhancements to the existing 511 system consists of the "Data Quality Initiative". That initiative includes several quality assurance improvements relative to HCRS data input, including additional HCRS operator training, increased supervisory oversight of HCRS, refinements of landmarks and terminology used in HCRS, and a feature that will allow HCRS operators to view a text message showing how the event information they have entered will be reported through 511. Currently, HCRS operators do not compose the text message that will be reported. Rather, they input event information using an on-screen data entry menu. This information is then automatically converted to a 511 message, without the opportunity for operators to view or revise their entries. In addition to being able to view the text output corresponding to specific event entries, plans call for HCRS operators or supervisors to call into 511 to hear the spoken version of the information.

These data quality enhancements have been motivated by ADOT's realization that the accuracy of information in the 511 system can be improved, and from the fact that there is currently no systematic quality control process or tools. No formal analysis of existing data quality has been performed, but ADOT staff have become aware through first-hand

observation that HCRS entries sometimes contain incorrect and even contradictory information, and that 511 messages sometimes do not capture the meaning that the HCRS operator was attempting to reflect through the HCRS entry.

3.1.3 Summary Observations

- System is relatively dense with information. In terms of the sheer number of advisories for the most traveled highways, statewide, the existing 511 system is relatively dense with information. Based on yearly totals, it can be estimated that between 29 and 43 HCRS entries are made each day, depending on the season (more entries are made during winter months.). It is likely that for those users interested in the most heavily traveled roadways, they would find a least one advisory for any given route, anytime they called the 511 system. This is not to suggest, however, that the system is dense with information on urban area roadways.

- Construction and maintenance information is most common. It is likely that as much as 50% or more of the advisories on the 511 system pertain to road construction or maintenance activity. That finding would be consistent with the fact that HCRS was originally designed primarily to provide this type of information, originally primarily to ADOT users, and later to the traveling public. That finding is also consistent with ADOT's perspective that the existing system is oriented more to intercity highway travelers (where congestion and accidents are relatively infrequent) than to urban area commuters.

- More information is available during the winter. Typically, between 10 and 40 percent more HCRS entries are made during the winter months than the average month. This is logical given the incidence of winter weather conditions in the extensive high-altitude portions of the state, despite the fact that "winter storm codes" do not constitute a high percentage of HCRS entries. ADOT states that many of the District offices enter a great deal of HCRS entries pertaining to snow plow activity under the "road maintenance" category.

- Nearly all information is entered by ADOT, and mostly by ADOT Phoenix. ADOT offices enter 99% of the information available on the current 511 system. Of that information, most of it, about 85%, is entered by ADOT Phoenix operations. Much of that information probably pertains to the Phoenix urban area, but since the Phoenix Traffic Operations Center (TOC) has evening and weekend responsibility for the ADOT District offices statewide, some percentage of the ADOT Phoenix entries pertain to non-Phoenix area locations.

3.2 System Availability

The 511 partners have not identified system performance as a problem and none of the model deployment enhancements are geared toward trying to improve system performance. However, understanding the performance of the system, in terms of its availability to users, provides context for the interpretation of other evaluation results, including user perceptions and usage. For example, knowing whether the system is often inaccessible, either because it is "down" or because all of the phone lines are utilized, allows for the objective assessment of the validity of any user complaints in that area.

System availability is considered here as a function of two factors: the 511 system being operational (i.e., system outages), and the phone lines being available (i.e., phone line utilization). Both measures have been observed over the last 12 months of operation, from September 2002 to August 2003.

3.2.1 System Outages

System outages are by nature a reflection of the reliability of the system. To date, there have been a number of occasions where the second VRAS "box" (each box contains 24 phone lines) has been down or a record of its operation (log) has not been preserved. Since call volumes almost never exceed the capacity of the first VRAS box, this has had minimal effect on the 511 system operations. As such, the current level of system reliability, in respect to effectively serving customer demand, is generally satisfactory.

In the daily VRAS call volumes, ADOT keeps records of VRAS computer down times. In the last year between September 2002 and August 2003, one of the two VRAS servers (VRAS #1) was recorded as being down during the periods from December 24-26 and again from July 27-August 4. In the December case, this was likely to have caused dropped calls, since line volumes in this time period (shown below) indicate that one whole set of lines (24 lines) in one box were in use during these days. In the July-August case, there is no evidence that calls were dropped, given that the line volumes were all under 24 lines in this period and could be handled by a single box.

Based on ADOT records of VRAS system performance, there is no significant evidence of major outages that were not corrected within a few hours. The reporting of this measure, however, is a bit problematic in that the system outages for the VRAS system are logged in terms of minutes of outage for each day, regardless of the time of day at which the outage occurs. Nonetheless, minutes of uptime are generally around 96% (e.g., August 2003) to 100% (numerous occurrences) of all minutes in a month, even when these are spread among multiple events in a single month.

3.2.2 Line Utilization

The use of lines into VRAS was investigated using the VRAS log files from September 2002 through August 2003 (1 year). As used in this analysis, these log files record the time of each call and the line allocated to the call. In total, two digital connections (VRAS boxes) of 24 lines each were in operation during this time, for a total of 48 lines. As noted in the introduction to this section, the VRAS log files only record line usage for

the first 24 lines (the first box). Whether this is a function of the VRAS software, or simply due to the lack of volumes on the second box, is not known. Based on anecdotal information provided by ADOT, although some outages of the second VRAS box have been experienced, the complete lack of log files for the second VRAS box do not signify that it was down for the entire time. That is, there were times when the box was operational but not creating logs.

Over the last year, 209 days in this one-year period had formal logs of the line use, and a total of 187,259 calls were recorded.The percentage of calls taken by each line is shown in Figure 14, with only the first 24 lines being recorded. As might be expected, line 1 handles much of the call volume, with 42.7% of the calls. Line 2 handles 16.3% of the call volume, and the remainder of the lines receive much lower percentages. Interpreting these values, this means that during times when there is at least one person on the 511 system, 42.7% of the time there is only a single caller, and the remaining 57.3% of the time there is more than one caller on the line. In comparison, line 24 only handled 561 calls in this year, or about 0.3% of the calls. This number suggests that the capacity of a single connection (24 lines) was probably exceeded on some days in the year. These additional calls would have been picked up by the second set of lines. This would likely have been during the week of December 17-26, 2002, when 511 usage was extremely high. Indeed, December is the primary month in which the 24th line shows use (541 of the 561 uses); in addition, February 25 and 27, 2003 and March 2 and 17, 2003 show a few uses of the 24th line. Nonetheless, in the last year, it is unlikely that the second set of lines was ever completely used, although we lack the data to verify this.

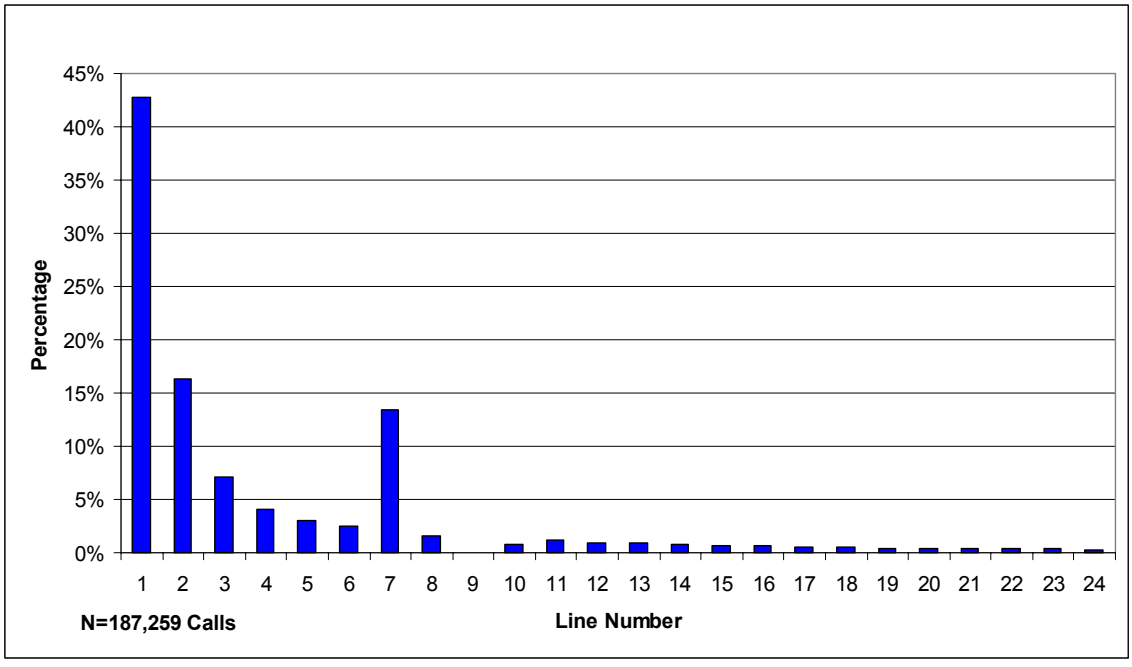

Figure 14: Calls by Line

Stating the obvious from Figure 14, line 9 never records any traffic. The spike for line 7 is also curious; call volumes on this line are consistently higher than lines 3-6 throughout the year. Whether these are due to some specific line allocation logic in VRAS is unknown.

3.2.3 Summary Observations

To users of the system, the 511 system is likely to appear very reliable. During all but a couple of days a year, during winter storms or wildfire, call volumes do not exceed half of the available phone line capacity. As a result, the outages in the second VRAS box (phone lines 25-48) that have been observed have impacted few callers. However, it is true that even a very small amount of unavailability, when it comes during critical periods like winter storms or during the rare times when a user may access the system, can leave a strong negative impression.

3.3 Usage

The primary source of data for the usage summary is the VRAS log files from September 2002 through August 2003. In this one-year period, there were 209 days of 511 use that were recorded in the log files, and a total of 187,259 calls. This compares with approximately 382,900 calls that were noted by VRAS (via a separate recording mechanism) in the daily call volumes (see next point), indicating that the VRAS log files are picking up approximately one-half of the total calls made in the year. When the results from the log files are described later, this must be kept in mind – the actual annual volumes in various classes are probably close to double the values shown in this analysis. While the sample of days is not a random sample, the size of the sample is sufficiently large that the results here would seem to provide a reasonable picture of "typical" 511 usage.

3.3.1 Call Volumes

In contrast to the VRAS log files, ADOT receives a report showing total daily call volumes from VRAS. These reports are more reliable than the daily log files mentioned above. The daily call volumes over the period from September 2002 to August 2003 are shown in Figure 15 below. On average, daily call volumes are approximately 1055 calls, although this varies significantly during certain times of the year. In December 2002, call volumes spiked to nearly 14,000 per day during the latter half of the month (17-31), most likely due to heavy holiday travel and snowy weather in northern Arizona . Volumes also rose during some weekends in February and early March (February 8-9, 13-14, February 25-March 2, and March 17-18). Each of these four time periods in February and March correspond to snow events in northern Arizona.

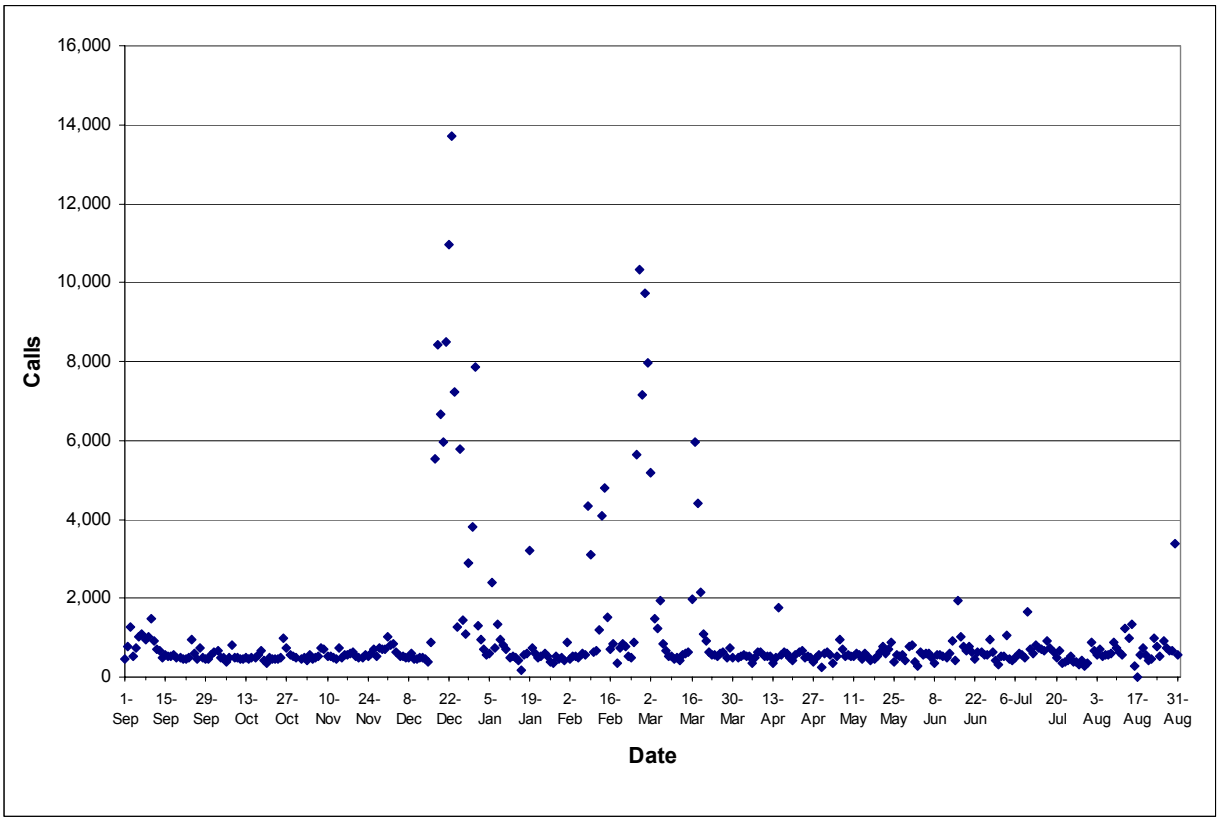

Figure 15: Daily Call Volumes, September 2002 – August 2003

Figure 16 presents monthly 511 call volumes for the period July 2001-October 2003. Prior to converting to the 511 number in March 2002, the usage of the ADOT traveler information telephone system ranged from about 4,000 calls per month upwards to about 20,000 calls during winter storms or during unusual events like major forest fires. After the conversion to 511, usage spiked from around 7,000 calls in January and February to about 20,000 calls per month in March. Since that time, usage has remained at that level or higher, ranging up to as high as 100,000 calls per month (in December 2002). As indicated in Figure 15, monthly call volume spikes reflect call volume spikes that typically span only a few days.

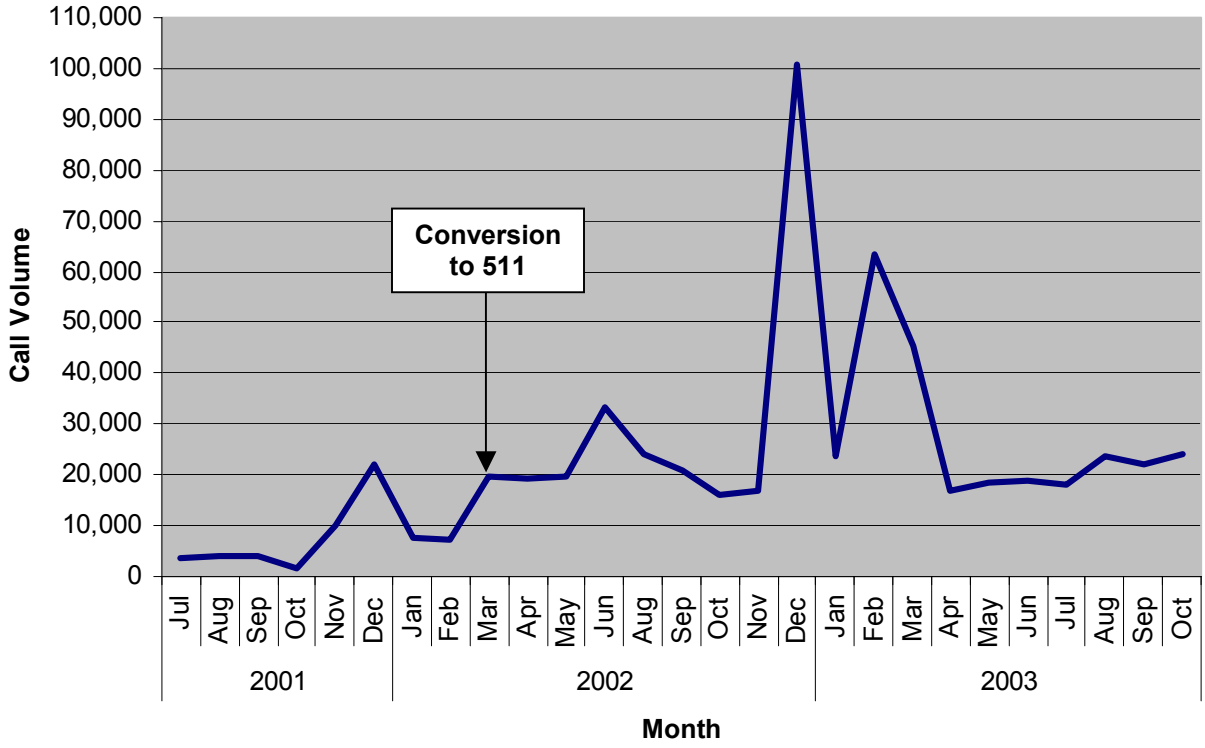

Figure 16: Monthly Call Volumes

3.3.2 Calls by Time of Day and Day of Week

In the VRAS log files, the time at which a call to 511 was made is recorded. These data were used to analyze calling patterns by time of day and day of week. For the purposes of the time of day analysis, the days of the week were divided into four categories: weekdays (Monday through Thursday), Friday, Saturday, and Sunday. The following figures (Figures 17 through 20) show the distribution of calls by hour of the day for these four categories.

The four different day categories have significantly different calling patterns. The typical weekday shows some peaks in the morning and evening rush hours, with a significant spike at the noon hour. These would be consistent with the common traffic patterns in the day. It is curious to note, however, that the tail of the distribution in the evening is fairly strong, even through 9 pm (hour 21). In sharp contrast, calls on Fridays seem to show very strong peaking in the late afternoon, with an extended peak between 2 pm and 8 pm. Saturdays show a more uniform pattern over the day, with some slight peaking around the noon hour. Finally, Sundays show strong peaking again in the late afternoon, beginning around 3 pm and continuing well into the evening until 10 pm. The Friday through Sunday pattern may reflect more of the inter-city travel on weekends in Arizona, with travelers departing on Friday evening and returning Sunday evening.

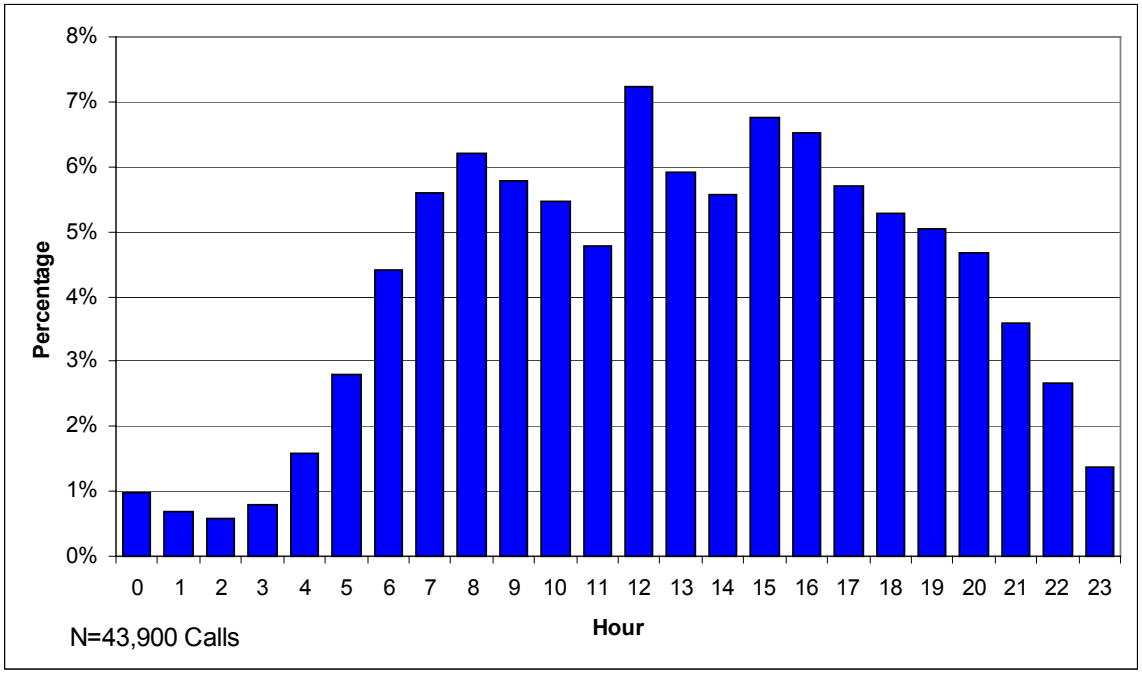

Figure 17: Calls by Time of Day for Weekdays (Mon-Thu)

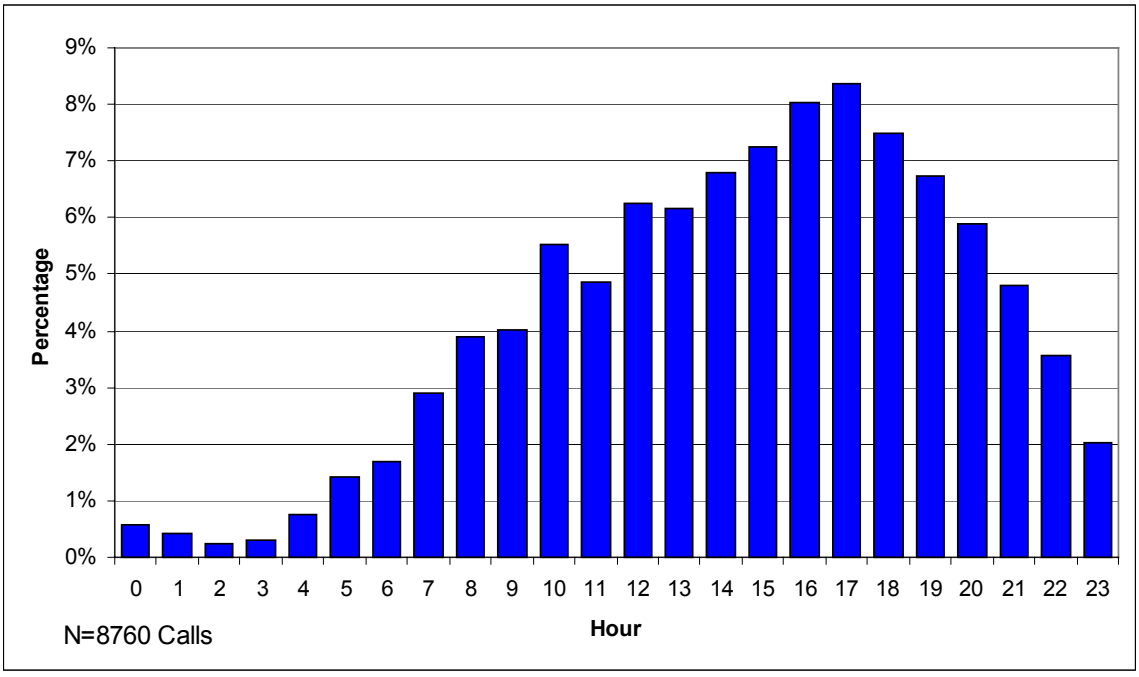

Figure 18: Calls by Time of Day for Fridays

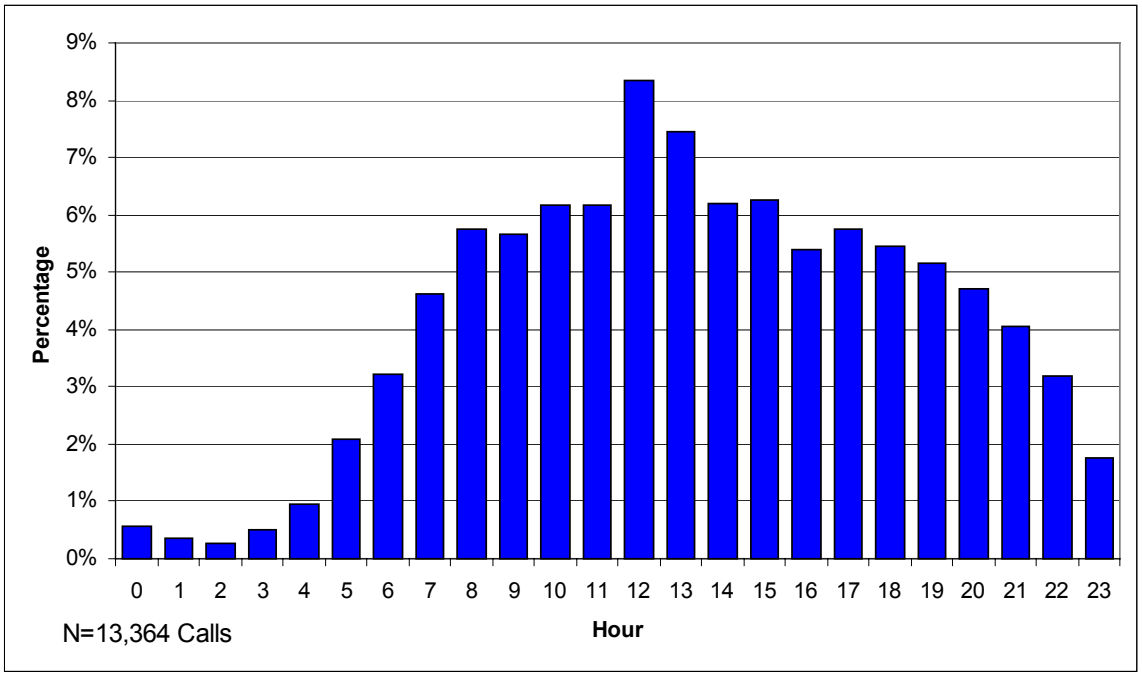

Figure 19: Calls by Time of Day for Saturdays

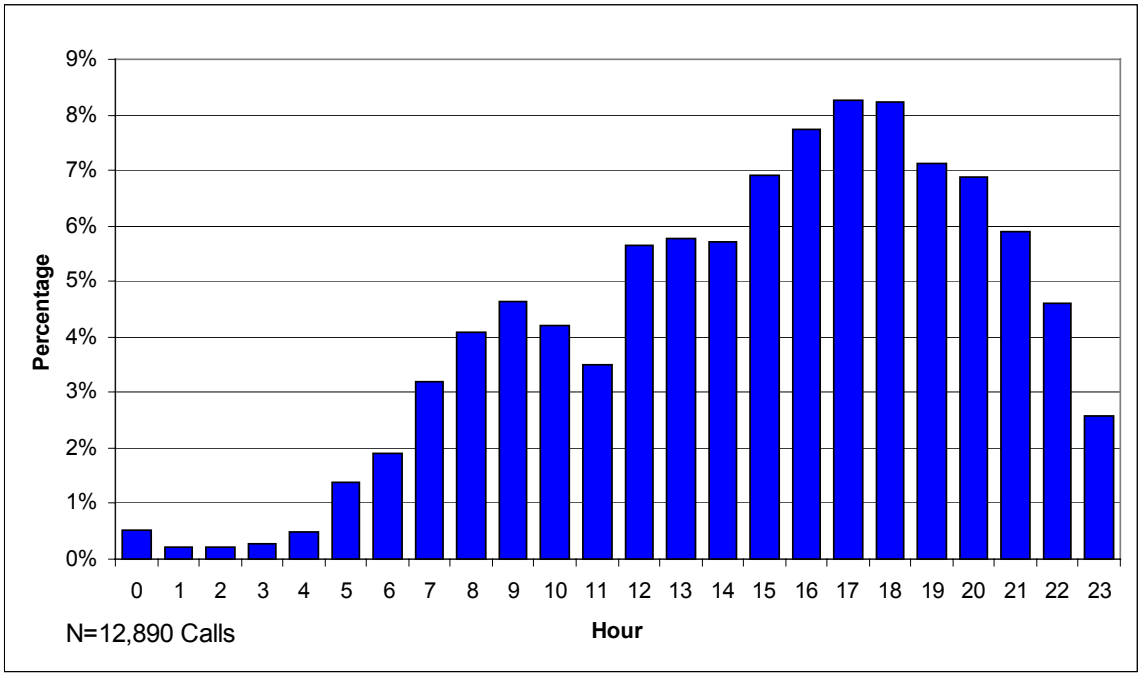

Figure 20: Calls by Time of Day for Sundays

Calls by day of the week were also examined and the results are shown in Figure 21. Overall, call volumes are nearly equally distributed over the week, between 12% and 16% daily. This supports the theory that the system is relatively heavily utilized for weekend travel. If the system was dominated by commuter users Saturdays and Sundays would tend to show lower use than weekdays.

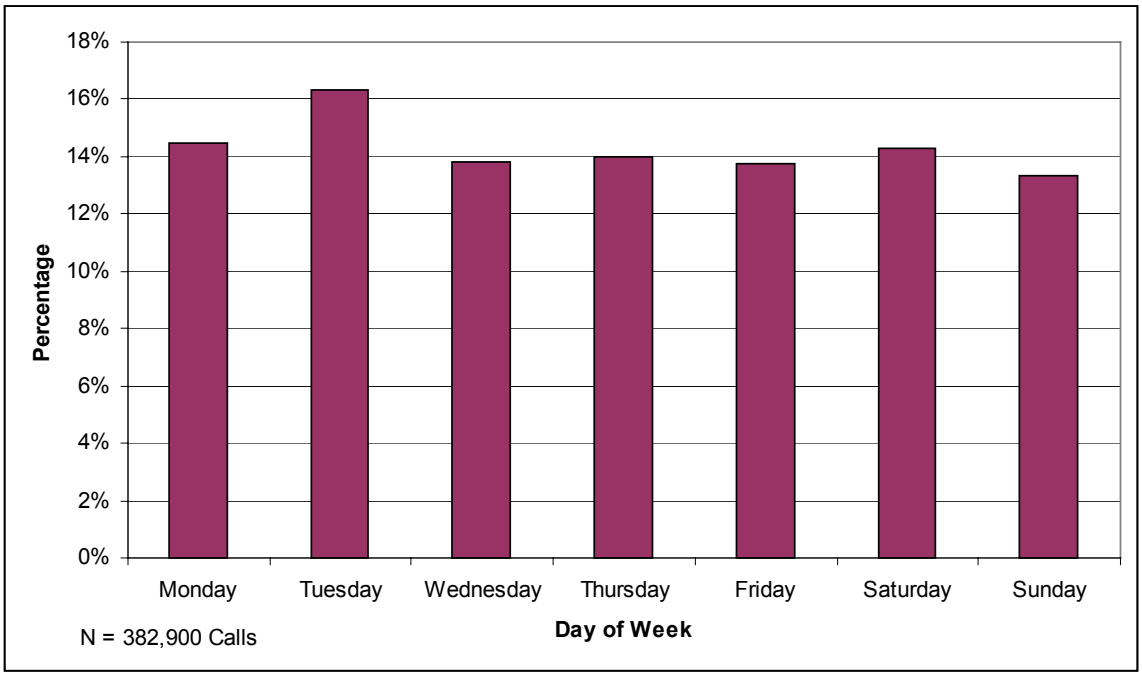

Figure 21: Calls by Day of Week

3.3.3 Call Durations

The second analysis of calling patterns more specifically concerns call durations. This is the most basic question of how long people are staying on the line to gather information. Using the 209 days of VRAS logs from September 2002 to August 2003, all 187,259 calls were analyzed for their call duration. The resulting distribution of call durations is shown in Figure 22. The largest proportions of calls are for 0-10 seconds (19% of calls) and for 10-20 seconds (32%). A further analysis indicates that about 97.8% of these calls (under 20 seconds) make no request and likely do not stay on the line past the introductory message, since the introductory message lasts for over 20 seconds. The remaining calls (2.2%) under 20 seconds have some interaction with the system, but only about 1.0% of the calls under 20 seconds are actually using shortcuts to get information by bypassing the introductory message. If all these calls under 20 seconds are included in the total, then the average call duration is over one minute (approximately 66 seconds).

Of the 187,259 calls in the VRAS logs, only 92,162 (49%) lasted more than 20 seconds. The distribution of call durations for these calls can be seen in Figure 23. The highest proportion here is for the 20-30 second time interval, at about 20% of the remaining calls. It is possible that this still includes some callers who only listen to the introductory message. Nonetheless, after this interval, the call durations are only slightly peaked, with

many calls (about 18%) lasting 200 or more seconds. There is also a peak around 40-50 and 50-60 seconds; this represents people who have made a single request and then hang up or are transferred within the system. In total, the average call duration among calls lasting at least 20 seconds is just over two minutes (approximately 124 seconds).

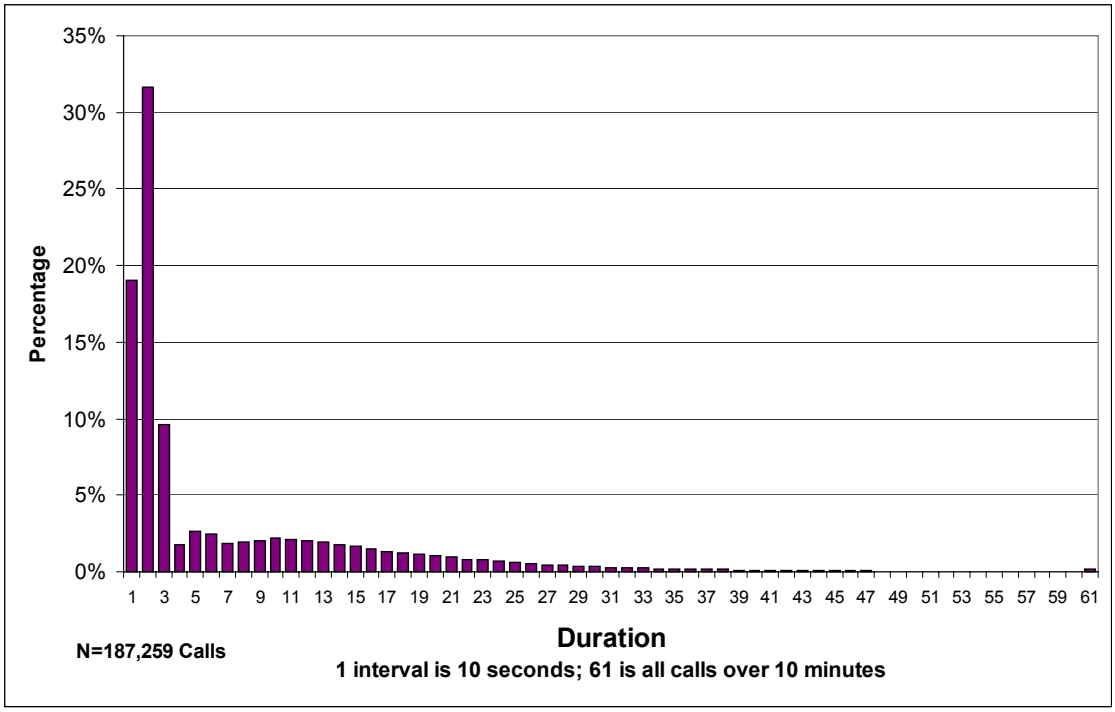

Figure 22: Duration of Calls

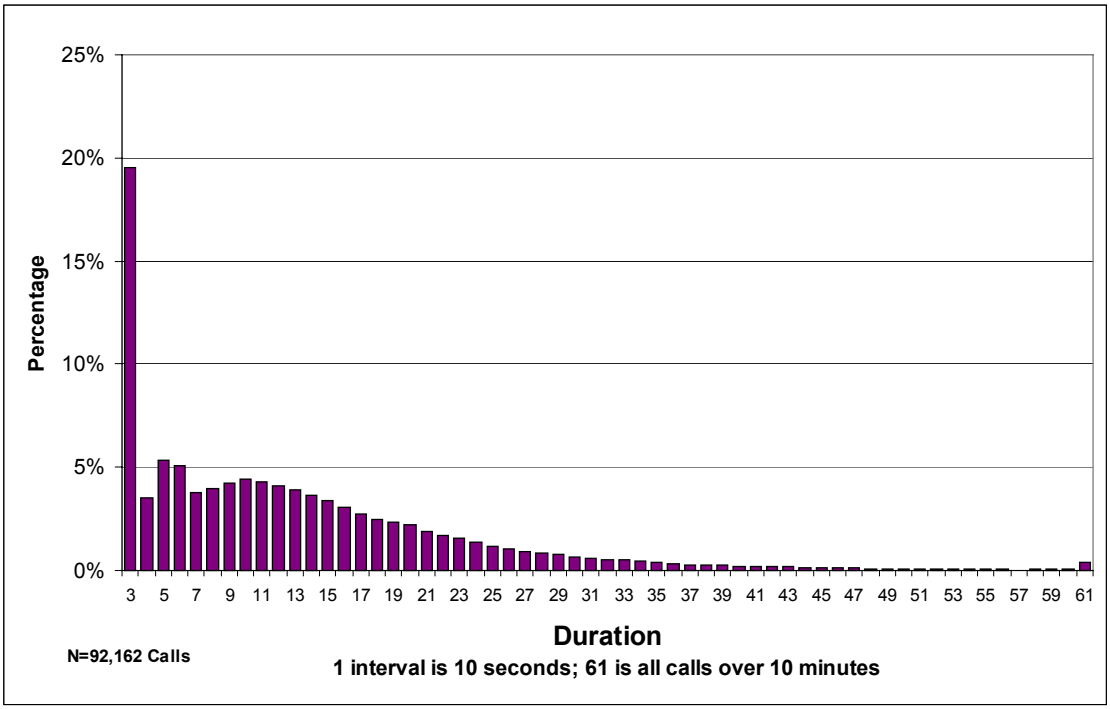

Figure 23: Duration of Calls over 20 Seconds

3.3.4 Wireless vs. Wireline Telephone Use

Electronic telephone bills from Qwest were provided for the months of July, August and September, 2003. These telephone bills represent calls to 511 and to 1-888-411-ROAD during this time period. It is important to caveat that these data come from the Qwest local service area in the Phoenix metropolitan area and from some other areas in the state where Qwest provides long-distance service, primarily Flagstaff and other parts of northern Arizona. This provides some limitations on the geographic areas that are covered (see Section 3.3.6). In the three-month period, 16,337 calls appeared on the Qwest bills, although only 14,682 were deemed to be valid telephone calls to 511.

With the electronic phone bills, the calling phone number was compared with an index of phone "blocks," listing area code, exchange, and the "category" of service allocated to each block. For this analysis, the categories and the percentages of total calls by category are shown in Table 5.

Table 5
Percentage of Calls by Type of Carrier

Category	Percentage of Calls
Wireline	
Regional Bell Operating Company	64.3%
Independent Telephone Company	9.5%
Competitive Local Exchange Company	7.6%
General (considered wireline)	1.4%
Competitive Access Provider (wireline)	0.0%
Wireless	
Cellular and paging services	15.1%
PCS	2.1%

Note that the largest percentage (a majority) of the calls is made from a regional Bell operating company (Qwest), with about 15% of the calls from wireless cellular and paging services. Aggregating by wireless versus wireline, almost 83% of the calls were from wireline phones and only about 17% from wireless phones (Figure 24).). The percentage of wireless calls may not reflect the actual demand for wireless calling, given that one wireless provider (Verizon) was not supporting 511 service.

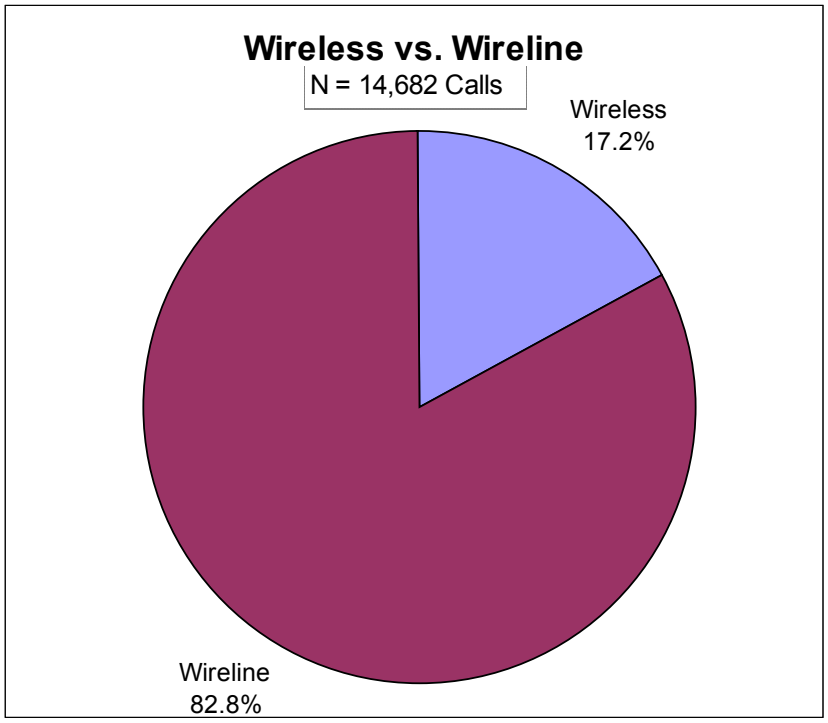

Figure 24: Wireline vs. Wireless Calls

3.3.5 Frequency of Use

The same three months of telephone bills from Qwest were used to analyze the frequency of calling from different telephone numbers. This is intended to serve as a proxy measure for how frequently a person or a household uses the 511 service. One potential source of distortion in this analysis is the use of trunk lines or Private Branch Exchange (PBX) numbers used by companies or other organizations where calls originate. In these cases, calls made by different individuals could be ascribed to the same incoming phone number, thus appearing to be the same caller in this analysis. To the extent this distortion exists, it would overstate the number of repeat callers.

In this analysis, of the 14,682 valid calls, a total of 6,764 different telephone numbers were recorded. That is, each caller has called 511 on average about 2.2 times. Naturally, these numbers represent only a very small number of the potential 511 market, in relation to the population.

The histogram in Figure 25 shows the percentage of recorded calling numbers that called once, twice, etc. during the 3-month period. Table 6 gives the raw numbers used in creating the graph, showing both the actual percentage and the cumulative frequency. 71% of the calling telephones used 511 only once in the 3-month period, but 29% were repeat callers. Within the 29%, 17% used it twice, 6% three times, 3% four times; the remaining 3% use it more frequently. In total, this implies that about 97% of callers

used it five times or less over the 3-month period. In addition, although not directly shown in Table 6, there are a few users (12, or about 0.2%) who are clearly very regular users, with over 100 uses in 3 months.

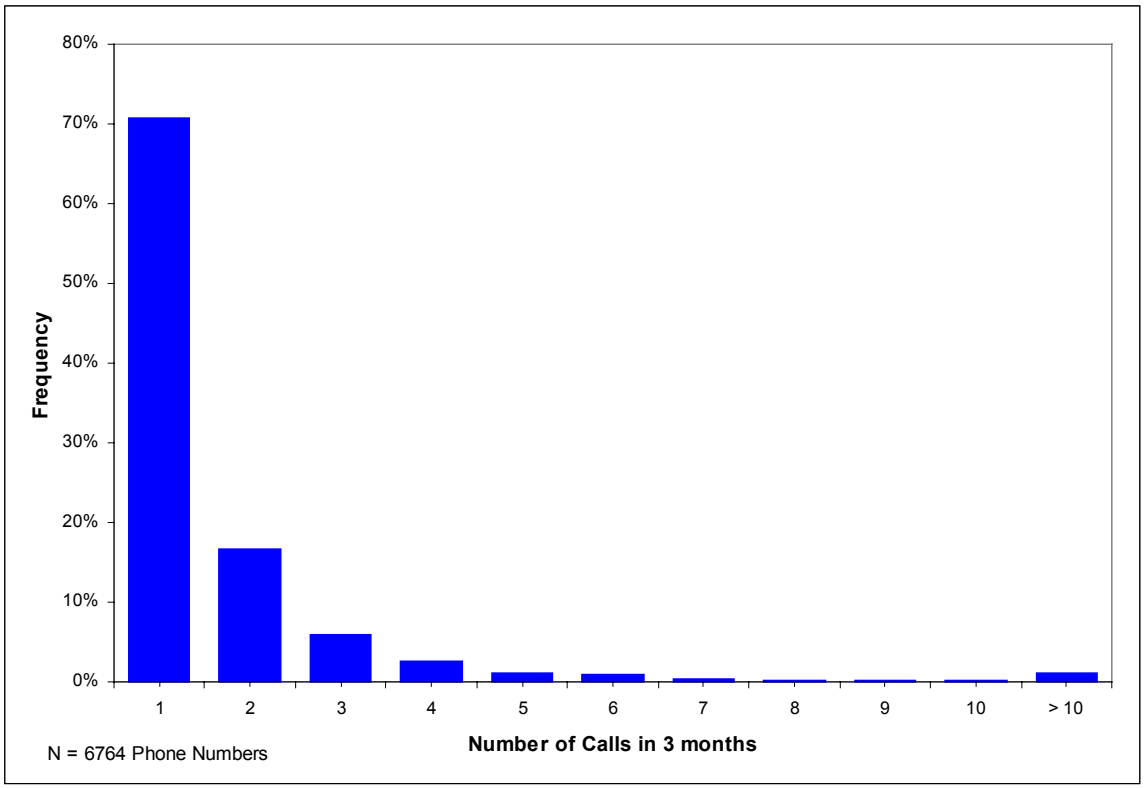

Figure 25: Frequency of Use

Table 6
Frequency of Use for 3-month Period

Number of Calls	Number of Phones	Percentage	Cumulative Percentage
1	4789	70.8%	70.8%
2	1123	16.6%	87.4%
3	395	5.8%	93.2%
4	179	2.6%	95.9%
5	77	1.1%	97.0%
6	57	0.8%	97.9%
7	29	0.4%	98.3%
8	18	0.3%	98.6%
9	16	0.2%	98.8%
10	7	0.1%	98.9%
> 10	75	1.1%	100.0%

3.3.6 Geographic Location of Phone Registration

With the limitations of the Qwest calling area, one can also examine the geographic dispersion of locations where the phone is registered. This is also a good proxy for the caller's location, given the predominance of wireline calling. The three months of phone bills (July through September 2003) give an interesting view of calling patterns. Figure 26 gives the major sources of calls; "others" represents all locations with less than 1% of the total call volume. Without much surprise, the metropolitan Phoenix area generates a large number of calls (5289, or 36%), when adding the call volumes from North Phoenix, Mesa, Scottsdale, Tempe, Glendale, Chandler and Peoria. Significant fractions of calls are also recorded for Flagstaff, Prescott, and Yuma, followed by Casa Grande and some other smaller towns in rural areas in the state.

Of the total calls handled by Qwest in this 3-month period, 122 (0.8% of all calls) were from a payphone. While this percentage is small, it still indicates that there is some usage of 511 from payphones in Arizona.

Finally, the use of Qwest phone bills limits the geographic coverage. For examples, the cities and towns of Tucson, Nogales, Willcox, Safford, Globe, Kingman, Bullhead City, Quartzite (among many others) are not included in the Qwest coverage area.

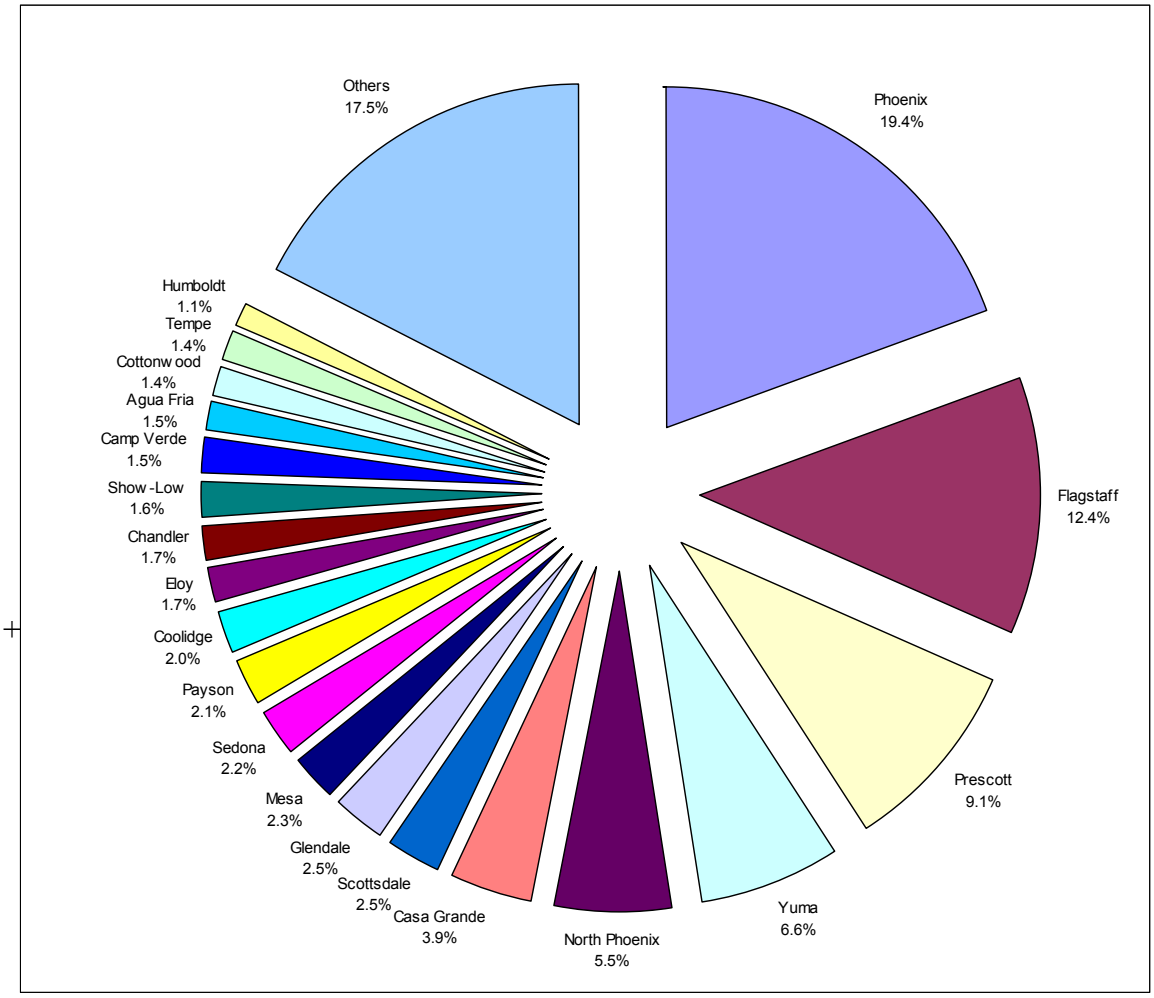

Figure 26: Registered Phone Origin

3.3.7 Call Menu Selections

In the year from September 2002 through August 2003, the VRAS log files were analyzed to examine what information was requested. In the course of the year, 209 calling days were observed in the VRAS log files, and 187,259 total calls, and a total of 272,761 total menu selections. Of these selections, 74,507 were actually "null" selections, in which no keys were punched in by the caller. This leaves a total of 198,254 actual menu selections, and a resulting average number of selections per call of just over one (1.06 menu selections/call).

In this one-year period, the top menu selections are given in Figure 27. The figure includes all menu items that received at least 1,000 selections during the year (i.e., about 5 per day, given the 209 calling days recorded in the VRAS logs). In normal operation, highway requests are input as the highway number followed by the pound (#) key, and area reports are given by the first three letters of the area followed by the asterisk (*) key.

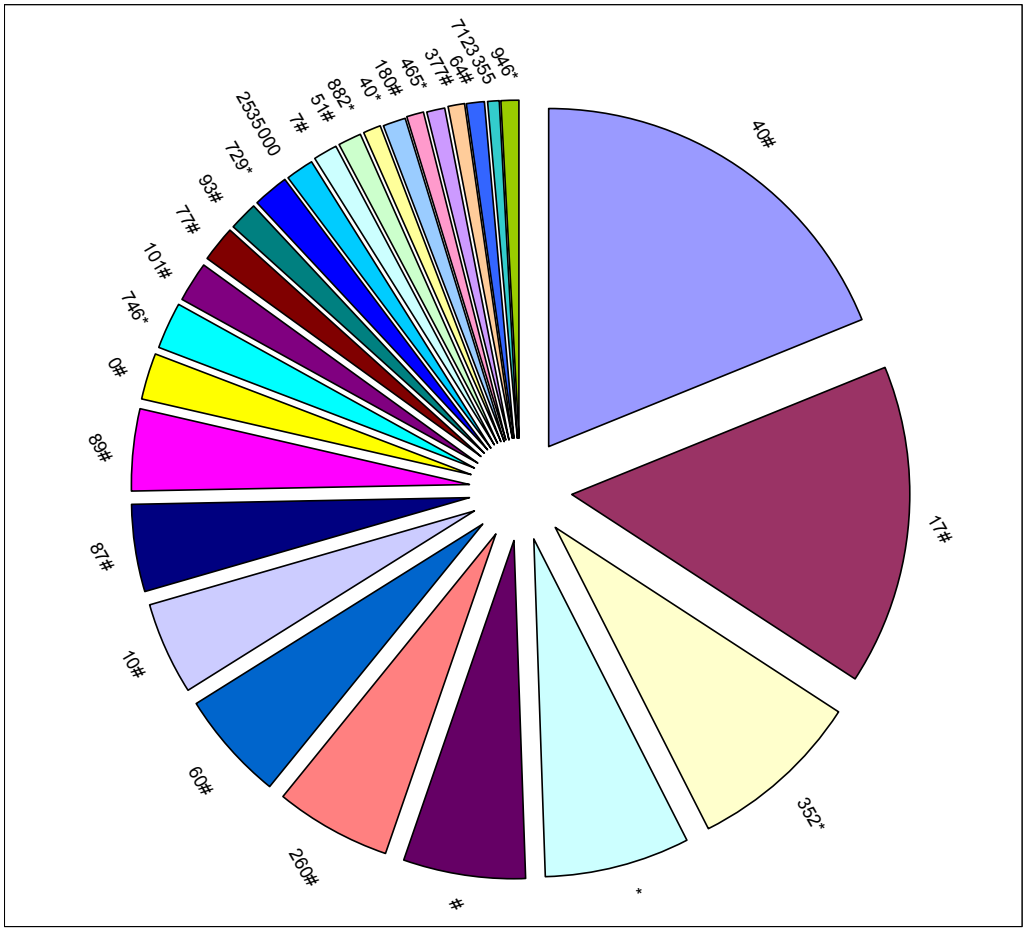

Figure 27: Call Menu Selections with Over 1000 Requests

Popular Menu Selections

The menu items that were selected at least 1,000 times in the past year are listed in Table 7. Perhaps not surprisingly given the peak usage during the winter season, the most common menu selections were for traffic conditions on I-40, I-17, and activities around Flagstaff (352*). This reflects the construction activities and winter weather in and around northern Arizona. One may also note that one of the other major requests is an erroneous call for I-40 (40*), which received 1260 requests during the one-year period. At the same time, the focus on northern Arizona implies that a smaller proportion of travelers are using the service for daily commute information in a major metropolitan area: only about 1.5% of calls are for information for the "Phoenix Region" (746*) and the total requests for Phoenix area freeways (e.g., I-10, US 60, SR 101, and SR 51) amount to less than 10% of the total.

It is also curious to note the large percentage of calls without numbers (the * and # keys without any numbers), totaling over 9% of the requests. In these cases, either no selection was made by the user, or the digits were not interpreted by VRAS.

Table 7
Popular Menu Selections

Input	Request	Number	Percent
40#	I-40	26,560	13.4%
17#	I-17	21,499	10.8%
352*	Flagstaff	11,571	5.8%
*		9,807	4.9%
#		8,232	4.2%
260#	SR 260	7,851	4.0%
60#	US 60	7,312	3.7%
10#	I-10	6,068	3.1%
87#	SR 87	5,911	3.0%
89#	SR 89	5,650	2.8%
0#	Help	3,172	1.6%
746*	Phoenix	3,008	1.5%
101#	Loop 101	2,744	1.4%
77#	SR 77	2,252	1.1%
93#	SR 93	2,085	1.1%
729*	Payson	2,028	1.0%
2535000	Phoenix Transit	1,966	1.0%
7#	SR 7	1,884	1.0%
51#	SR 51	1,442	0.7%
882*	Tucson	1,298	0.7%
40*	I-40 (incorrect)	1,260	0.6%
180#	SR 180	1,239	0.6%
465*	Holbrook	1,172	0.6%
377#	SR 377	1,123	0.6%
64#	SR 64	1,108	0.6%
7123355	Comment	1,095	0.6%
946*	Winslow	1,006	0.5%

N = 198,254 requests

Handoffs

One may also note some phone numbers and categories in Figure 27 for "handoffs," that is, transfers out of the 511 system to transit agencies or to the 511 comment line voicemail box. Phoenix Transit (253-5000) received 1,966 handoffs (about 1% of all calls to 511) in the 1-year period, and the comment line (712-3355) received 1,095 handoffs (about 0.55% of all calls) in the year. Sun Tran, Tucson's transit service, received 627 successful handoffs in the 1-year period, but also experienced 301 *failed* handoffs, which occurred during the months of May, June and August 2003. These failed handoffs occurred because the transfer number appears not to have been recognized by VRAS ("Invalid extension number passed"). Even so, in total, about 0.5% of all calls (928 calls) tried to reach Sun Tran in the 1-year period. These results are summarized in Table 8.

Table 8
Call Handoffs

Call Handoffs	Number of Calls	Percent
Phoenix Transit	1966	0.99%
Comment Line	1095	0.55%
Tucson Transit (Sun Tran)	627	0.32%
Failed Handoffs (Sun Tran)	301	0.15%
Failed Handoff (Phoenix Transit)	1	0.00%

3.3.8 Summary Observations

The usage results can be summarized in the following observations:

- Call volumes are currently averaging just over 1,000 calls per day. This has been observed to fluctuate considerably during special time periods (the December holidays) and/or weather events, logging 10,000 or more calls on three occasions during the past year.

- Call patterns by time of day show significant variation by type of day. Typical weekdays (Monday through Thursday) show slight peaking during the peak travel periods--in the morning, over the lunch hour, and throughout the evening. Since 511 appears to be used for intercity trips rather than for normal commuting trips, the peaking of calls during these traffic hours is probably more a reflection of higher traffic volumes during these times of the day, rather than specific information needs during morning or evening commuting. Fridays and Sundays show very strong demand during the afternoon and evening hours, perhaps due to the beginning or end of weekend travel activities. Saturdays show a relatively uniform pattern throughout the day.

- Call patterns by day of week support the theory that the 511 system is relatively heavily utilized by weekend travelers: volumes on Saturday and Sunday are about the same as those on weekdays.

- About half of the calls to the system in the past year have been simply to check out the system, with no formal information transaction in the menu structure. Nonetheless, once people pass the introductory message, the call durations last over 2 minutes, and some calls are much longer.

- In recent months (July through September 2003), over 82% of the calls have been from wireline sources. This suggests that people are using the system before beginning their travel, which seems consistent with weekend travel and winter storm condition travel. This finding seems to be contrary to other 511 systems in the US, where higher wireless call volumes have been noted. However, the percentage of wireless calls may not reflect the actual demand for wireless calling, given that Verizon was not supporting 511 service.

- Most of the callers use the 511 service on a relatively infrequent basis: about 71% were found to have used it once in a 3-month period. Nonetheless, close to 29% of the callers in the same period are repeat callers.

- The most common types of information requested in the 511 system include routes in northern Arizona (I-40, I-17 and Flagstaff), with a large number of requests for other major interstates and state routes. Both I-40 and I-17 include extensive mileage through high altitude areas where adverse winter driving conditions are common. Handoffs have been a smaller part of the total call volume (about 2%), with half of these going to Phoenix transit and the remainder split between the comment line and Tucson transit.

- Analysis of the geographic locations of callers has been performed, but there are significant caveats with the data source that prevent more general conclusions from this analysis.

3.4 User Satisfaction (Focus Groups)

No baseline user survey data are available and, therefore, the post-enhancement user survey will be analyzed in a stand-alone manner. However, as part of the development of the 511 Model Deployment design, ADOT conducted several focus groups with 511 users and the results of those sessions do provide some perspective on user perceptions of the existing 511 system.

3.4.1 Methodology

Focus groups were held in Phoenix, Flagstaff and Tucson in late April and early May 2003. Two approximately 2-hour long sessions were held in each city. Each session included about a dozen participants.

Three weeks prior to the scheduled start of the focus group, a professional market research firm began identifying panelists through the most appropriate method in each market, including telemarketing (Tucson), the ADOT Website (Phoenix) and advertising in the local newspaper (Flagstaff). Once a prospective panel was identified, each panelist was qualified over the telephone to ensure that they met specific participant criteria.

Criteria were developed to ensure that a representative sample of Arizona drivers participated. Criteria that were determined to be significant included a range of ages, gender, education and driving distances. Those who met the criteria were scheduled for a session. Participants were scheduled in specific groups to provide a balanced mix of age, gender and driving patterns per group. Each participant was asked to try the 511 service prior to the session.

Fourteen participants were selected and confirmed for each session. A participant incentive of $75 was provided for those in Phoenix and Tucson and an incentive of $50 was paid in Flagstaff. Each of the participants received a confirmation card, with a map, directions and information along with a reminder phone call the day before the scheduled session.

A survey instrument was developed in collaboration with the market research firm, ADOT, and ADOT's 511 support consultant, PBS&J, to be used as a moderator's guide. Each of the six focus group sessions were audio taped, transcribed and observed by PBS&J staff and ADOT 511 project staff (Phoenix and Tucson). A member of the national evaluation observed the two Phoenix focus groups.

3.4.2 Findings

The information presented in this section is based on the first-hand observations by the evaluation team at the Phoenix focus group and the report *"Summary of Findings for the ADOT Market Research on Model Deployment of 511 Travel Information Service in Arizona"* prepared by PBS&J for ADOT.

In total, 67 participants attended the six focus group sessions. There were 37 men and 30 women. The majority of participants had attended or graduated from college. With the exception of one individual, all participants drive frequently or commute to work or school a minimum of 4 days per week.

Participant's Travel Behavior

Driving patterns vary based on the geography, climate and population dynamics of each market. Tucson is a mid-sized metropolitan market with a large state university and one major north-south interstate (I-10). Flagstaff is a small market, with a large proportion of seasonal visitation, a state university and a major east-west interstate (I-40). Phoenix is a very large, sprawling urban area with a well-developed freeway system. Most focus group participants take trips of 50 miles or more weekly and take out-of-state trips once or twice each year. As indicated in Figure 28, Phoenix focus group participants average the most miles driven weekly.

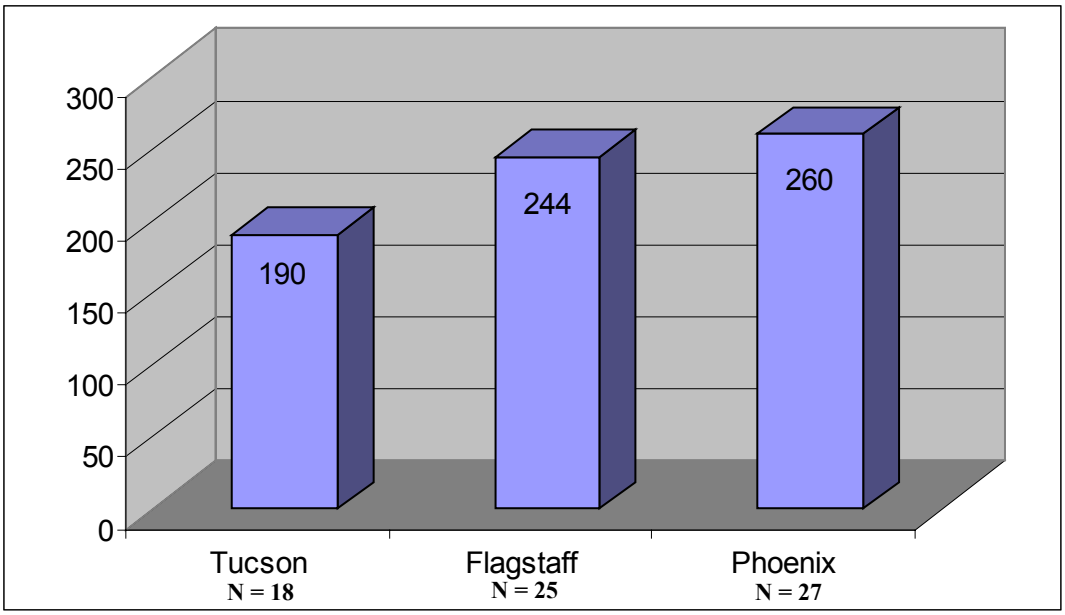

Figure 28: Average Miles Driven Weekly

Travel in Tucson is heavily impacted by weather disturbances (wind and dust storms) and freeway construction. Located in a high-altitude area, Flagstaff travel is most impacted by winter weather and related accident or road hazard delays. Phoenix has significant freeway traffic, which is most significantly impacted by accidents and road construction.

Branding/Marketing

Most of the focus group participants were not aware of the 511 service prior to focus group recruitment. Only five out of the 41 participants had heard of the 511 service prior to being contacted to participate in the focus group. All of the focus groups agreed that 511 needs to be heavily marketed. They provided a multitude of branding and marketing suggestions, including modification of the 511 logo to be more intuitive and inclusion of the URL. Several of the most common marketing suggestions included:

- Highway signs
- Variable message signs
- Billboards
- Back of buses
- AAA partnership
- Rest stops
- Gas stations
- Signs at freeway entrance
- Motor Vehicle Division
- TV
- Radio
- Telephone directories

Overall Customer Satisfaction

Only three of the focus group participants, all from Flagstaff, had used 511 in the past. However, each focus group participant was asked to call 511 in advance of the sessions to familiarize themselves somewhat with the system. About 85% of the participants indicated that they had tried the service prior to the sessions.

Focus group participants were asked to rate the current 511 service on a scale of 1 to 10, with 1 being poor and 10 being excellent. Participants were not very satisfied with the current system. The average ranking was 4.7. As indicated in Figure 29, rankings fluctuated only slightly among the three cities. The slightly higher ratings in Flagstaff could be due to the fact that the three participants who are existing users of the system are all from Flagstaff, which would imply some satisfaction with the system or perception of value. It could also relate to the fact that of the three cities, only Flagstaff experiences severe winter weather, and the ability to get that information from the 511 system, regardless of perceived short-comings in the system, may be more highly valued.

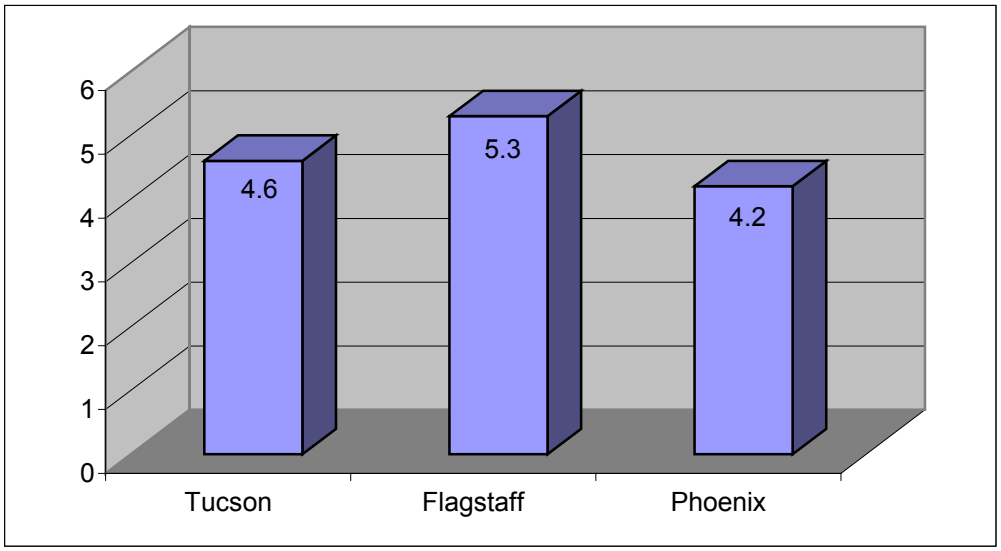

Figure 29: Average Ratings of Current 511 Service

Although they were not satisfied with the existing 511 system, focus group participants felt that an enhanced system, incorporating improvements that they identified, would be very useful. The average rating for an enhanced version of the system was 8.8. Figure 30 shows average ratings by city. Again, the ratings did not differ significantly by city, and Flagstaff participants again averaged the highest rating.

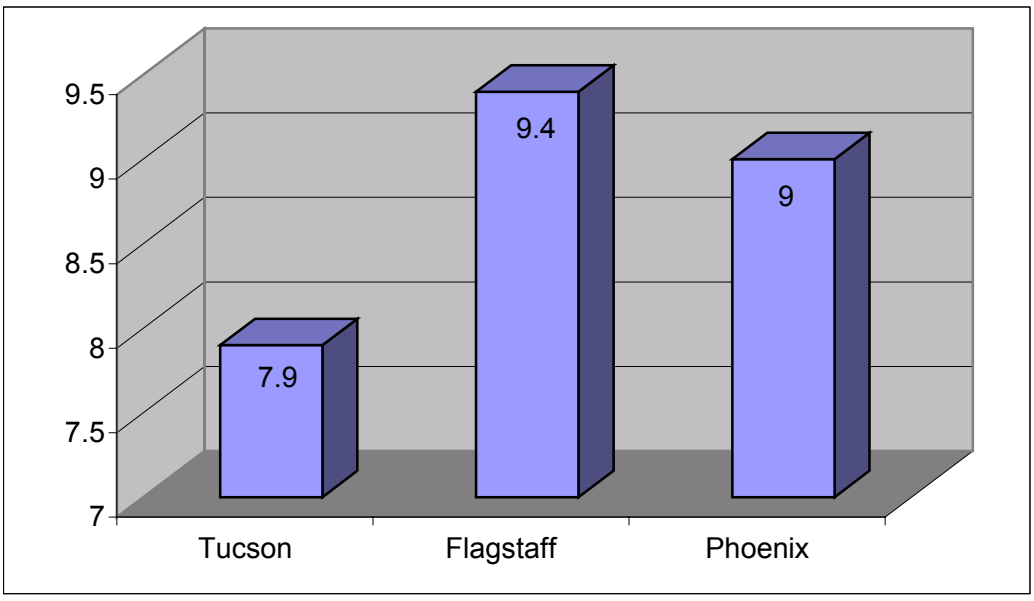

Figure 30: Average Ratings of an Enhanced 511 Service

Specific Concerns and Recommended Enhancements

Focus group participants identified a number of specific concerns with the existing system and recommended enhancements in both information content and user interface/information format.

In terms of content, the major complaints or suggestions fell into the following two general categories:

- **Increase coverage**. Coverage on more roadways; major urban arterial streets in particular, should be provided. Contributing to the perception that the system does not contain enough information is the apparent misconception on the part of many Phoenix participants that the "no information available" message means "we don't know," rather than "nothing unusual to report," as ADOT intends. Several participants expressed frustration with the existing "city" option for highway information, noting that every time they had tried the option no information was available.

- **Provide more information of interest to urban area commuters.** This sentiment was found principally among Phoenix area participants, who would like the system to provide more information on accidents and overall traffic flow. Phoenix participants felt that the 511 system did not include enough accident information, citing examples of when they had observed an accident that was not included on the 511 system. Phoenix participants also expressed a strong interest in relatively short, overall traffic flow summaries, similar to the reports heard on commercial radio and television. ADOT has acknowledged the validity of participants' perceptions that the existing 511 system is more oriented toward intercity travelers than urban commuters, in that it provides a great deal of information on roadway construction and maintenance in intercity areas. This is consistent with the genesis of the HCRS system, which was originally intended primarily as a tool for ADOT to coordinate construction and maintenance information and activities among various ADOT Districts and offices.

In terms of user interface and information content, a number of complaints/suggestions were made. They can be summarized as follows:

- **Provide for voice recognition.** Five of the six focus groups identified the need to provide for voice recognition, prior to being prompted, and the sixth group identified this need when asked. The participants seemed familiar and comfortable with voice recognition systems but did cite negative experiences and emphasized the need a high quality voice recognition system. All of the focus groups noted problems with the quality and clarity of the 511 voice. They indicated that the volume fluctuated among messages and that some words were hard to understand.

- **Be brief and succinct and allow users to quickly move to the specific information they want.** Participants were extremely interested in the ability to get information quickly and felt that the existing system was too plodding and that it was not easy to bypass unwanted information. Participants desire a means to rapidly obtain the specific information they want by requesting information for a region or roadway

segment, rather than having to listen to all events on a specific roadway as is the case with the existing system. Participants also desire a means to screen out or easily bypass intercity construction and maintenance information, a suggestion closely tied with their perception that the system contained too much advance notice of intercity roadway construction and maintenance activities and not enough accident and traffic flow information of immediate consequence to commuters. Participants characterized such a capability as "prioritization" of information.

3.4.3 Summary Observations

The focus groups results support the general perception among both ADOT and the evaluation team members who reside in Phoenix that few people are aware of or use the existing 511 system. Of the 67 participants, only 3 had used the system prior to being recruited for the focus groups.

The sessions also indicated that the users perceive a number of serious problems with the existing system that significantly constrain its usefulness. These concerns cover essentially the entire spectrum of system characteristics, including information content, user interface and information format. Although certainly less than fully satisfied with the existing 511 system, focus group participants did however, feel strongly that an enhanced system would be of great value and they seemed to support the concept of the 511 public service in principle. Participants felt that a high-quality 511 service would significantly enhance the public's perception of ADOT.

Participants generally agreed that the existing 511 system is not visible and noted the importance of enhanced marketing of the 511 system in concert with system improvements. Finally, many participants noted that they would appreciate a national 511 system that was similarly designed, so that they did not have to consider different user requirements when crossing state lines.

3.5 Costs

ADOT has provided estimates of the cost to implement and operate the existing 511 system. The costs reported here do not include the cost to develop the data gathering and fusion component of the overall ATIS, which consists of the Highway Condition and Reporting System (HCRS), or the costs to operate and maintain HCRS. As such, the starting point that ADOT has chosen in documenting the cost of their 511 system corresponds to the "Stage 3" level of 511 deployment as described in the "Deployment Assistance Report #1: Business Models and Cost Considerations for 511 Deployment," developed by the National 511 Coalition in January 2002. That document identifies the following five stages of 511 implementation:

- Stage 1 – Implementer has no data gathering, data fusion engine or telephonic dissemination platform.
- Stage 2 – Implementer has data gathering, but no fusion or processing engine or telephonic dissemination platform.
- Stage 3 – Implementer has data gathering and fusion, but no telephonic dissemination platform.
- Stage 4 – Implementer has data gathering, fusion and telephonic dissemination platform, and would like to implement the 511 code for the latter.
- Stage 5 – Implementer MUST enter into a continuing marketing campaign for the 511 service.

The cost information provided by ADOT takes their system from Stage 3 (HCRS was implemented but the telephonic platform was not) through conversion to 511 and 511-era operations.

Table 9 presents a high-level summary of the costs for the existing 511 system, which include implementation of the telephonic platform for the initial ten-digit number system and then conversion to the 511 number. The total estimated cost to develop, design and implement the ADOT telephone traveler information system is about $355,000. Of that total, an estimated $270,000 was required to develop the original phone system software that links HCRS with the telephonic platform. All of the other hardware and software and engineering costs shown in Table 9 were associated with implementing the telephonic platform itself. The only cost associated with the March 2002 conversion to 511 is the $22,500 one-time phone company charge for reprogramming switches.

The estimated annual cost to operate and maintain the system is approximately $137,000. Monthly phone charges over the period January 2002 through October 2003 range from about $4,300 to $36,000. As expected, phone charges vary almost directly with call volumes.

In identifying some 511 budgeting "rules of thumb," the National 511 Coalition's January 2002 Deployment Assistance Report #1 describes the least expensive to implement and operate 511 systems as "highly automated, limited or no human involvement in operation," and identifies the ADOT system as an example. This is certainly the case, as the 511 portion of the overall ADOT traveler information system is essentially automatic. Once information is entered into HCRS (an activity not included in ADOT's 511 system cost accounting), the process is automated, with HCRS events automatically converted to synthesized speech 511 messages. The report notes that annual operations of human operated systems, or automated systems that utilize human recorded messages, can range from $1 million to $4 million.

Table 9
Existing 511 System Cost Estimate

Project Phase	Component	Cost
Design and Development	Original Voice-Response Activated System software development costs (including linkage to HCRS)	**$270,000**
Implementation		
Hardware	PathFinder IVR Advanced Configuration at 8 Voice Ports	$15,320
	Teleprompt IVR Module	$7,500
	Speech Recognition Package	$17,550
	Text-to-Speech – 8 Channels	$8,000
	Subtotal	$48,370
Software & Engineering	Telelink (database interface)	$7,500
	Custom Development (12 hours)	$1,800
	Installation and Training (3 days)	$4,250
	ADOT Staff (40 hours)	$600
	Subtotal	$14,150
	Reprogramming of phone company switches to 511	$22,500
Subtotal		**$85,020**
Operation (Annual)	Phone Charges (toll free, call transfers, etc.)	$102,464
	T-1 Line Rental (2 T-1's, totaling 48 phone lines)	$27,600
	IVR System Support (contracted)	$6,400
	ADOT Staff (system administration, reporting, etc.)	$270
	Subtotal	**$136,734**

Note: Annual phone charges are for 2002. Based on charges through October, it appears that total charges for 2003 are likely to be in the area of $123,000.

APPENDIX 1

BACKGROUND ON THE HIGHWAY CONDITION AND REPORTING SYSTEM

The subject matter of HCRS event entries is characterized using International Traveler Information Interchange Standard (ITIS) "category" and "description" information. There are a total of 22 different ITIS categories. Each ITIS category includes anywhere from a few to several hundred specific messages, or "descriptions". There are a total of 1,374 ITIS descriptions. The table below lists the ITIS categories and a couple of ITIS description examples from each category.

ITIS Categories Used in HCRS Event Entries and Example ITIS Descriptions

ITIS Categories	Examples of Associated ITIS Descriptions
Level of Service	Stop and go traffic for 3 miles
	Expect Traffic Congestion
Incidents/Accidents	Disabled vehicle. Delays
	Overturned vehicle
Closures	Road blocked ahead. Long delays
	On- and off-ramps blocked
Lane Restrictions	Narrow lanes. Expect slow traffic
	Right lane closed
Road Maintenance	Road marking operations. Two lanes closed
	Road construction. Heavy traffic.
Obstruction Hazards	Object on roadway
	Flooding. Expect heavy traffic.
Road Conditions	Fuel on roadway
	Loose gravel. Caution
Weather	Rain. Visibility reduced.
	Partly cloudy weather
Winds	Tornado watch
	Strong winds
Environment	Sandstorms
	Patchy fog
Activities	Sports event. Traffic building up
	Closed due to parade
Delays/Cancellations	Delays for buses. Irregular service
	Delays up to 20 minutes
Dangerous Vehicles	Objects falling from moving vehicle
	High-speed chase
Exceptional Loads	Wide load
	Military convoy
Traffic Equipment Status	Traffic lights working incorrectly. Delays
	Railroad crossing failure. Slow traffic
Traffic Regulations	Police directing traffic
	Temporary axle load limit
Headways	30 minute headway
	5 minute headway

ITIS Categories Used in HCRS Event Entries and Example ITIS Descriptions

ITIS Categories	Examples of Associated ITIS Descriptions
Travel Times	5 minute travel time
	20 minute travel time
Parking	No parking
	Parking garage full
Information	Gas station closed
	Rest area closed
Winter Storm Codes	Ice
	Winter storm advisory

As an example, the following message was the sixth of eight messages for I-10, at 2:00 PM on Wednesday, October 29, 2003:

> "Height limit 16 feet 5 inches, width limit 24 feet, east and westbound from 22nd Street to 6th Avenue. Roadway reduced to two lanes. Expect slow traffic. Until July 31, 2004."

This message was generated by an event entry that utilized the "Lane Restriction" ITIS category, description #561: "Roadway reduced to two lanes. Expect slow traffic." The height and width limit and schedule information were pulled from other parts of the HCRS event entry form (in addition to specifying ITIS categories and descriptions other information, including restrictions, can be added to each event).