Evaluation of Phase II of the *SmarTraveler* Advanced Traveler Information System Operational Test

Final Report

Submitted to:

Central Transportation Planning Staff

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BACKGROUND

SmarTraveler is an operational test of an Advanced Traveler Information System that offers free, real-time, route-specific, traffic and public transportation information to travelers in the Boston metropolitan area via telephones. The operational test is jointly funded by the Federal Highway Administration and the Massachusetts Highway Department and also receives monetary contributions and in-kind services from the private sector. The first phase of ***SmarTraveler,*** which is operated by SmartRoute Systems Limited Partnership, began on October 30, 1992 and provided a "scale-up" period. Phase II, the operational phase, began on January 13, 1993 and was extended beyond its original eleven and a half month operating schedule until March 3 1,1994; this evaluation covers Phase II of the operational test. A subsequent extension of the service until December 3 1,1994 has been designated Phase III.

PURPOSE OF THE STUDY

Under contract to the Massachusetts Highway Department, the Central Transportation Planning Staff (technical staff to the Boston MPO) chose Multisystems, Inc. of Cambridge, Massachusetts, to perform an evaluation of Phase II of ***the SmarTraveler*** project. (Under a separate procurement, Multisystems will also be evaluating Phase III of the project, from April 1994 through December 1994.) The Phase II evaluation is aimed at examining how well the project's objectives were achieved and assessing the desirability and feasibility of replicating such services in other areas of the country. Its specific objectives are

- to assess the quantity and quality of information provided to motorists by ***the SmarTraveler operational test;***
- to evaluate the public acceptance and utility of the travel information provided by ***SmarTraveler;***
- to determine the existing and potential impact of the project on managing traffic congestion; and
- to recommend improvements in collecting and disseminating traffic information.

To accomplish these objectives, the evaluation team undertook observation of ***SmarTraveler's operations,*** discussions with representatives of transportation organizations interacting ***with SmarTraveler,*** statistical analyses of the call data collected

by ***SmarTraveler*** and the implementation and analysis of both a user survey (completed by 2010 individuals) and a survey of service area travelers (completed by 762 members of the traveling public over the age of 16, most of whom were not ***SmarTraveler*** users) to learn how the system operates, who it serves, what its impacts are on roadway congestion, and what its potential may be.

SMARTRAVELER OPERATIONS

SmarTraveler's service area is the portion of Massachusetts east of Interstate Route 495, Boston's outer circumferential highway. Conventional phone users and Cellular One cellular phone subscribers access the system by dialing (617) 374-1234. They pay no fee for the information they receive, but are responsible for any applicable conventional telephone and/or cellular tariffs. Subscribers to the NYNEX cellular phone service, which has had an ongoing relationship with SmartRoute Systems that predates the operational test, simply dial *l and are not subject to charges of any kind.

One of the unique ***aspects*** of ***SmarTraveler*** is the synchronous audiotext system that was developed by SmartRoute Systems. This system is used to store, organize, and disseminate travel information. Its design allows the data (i.e., recorded human speech) to be added or modified while the system simultaneously provides callers uninterrupted access to the database. Callers can choose to hear a recorded report on one or more of 20 monitored highway segments and/or three public transportation services by entering a key code. The reports include conditions, travel times and anomalies like accidents, but in most instances do not give explicit alternative highway routes.

A variety of different data sources are used to compile the information and continuously update the audiotext system. These include views from strategically placed live and slow scan cameras; reports from the State Police *SP program (to which motorists call in accidents and other highway anomalies without being charged for the calls); approximately 200 mobile phone and two-way radio "probes"(i.e., travelers who report traffic conditions to SmarTraveler as they travel the local highways); surveillance data from up to three aircraft (depending on the time of day and the season); and travel information provided by the Massachusetts Bay Transportation Authority (MBTA), the Massachusetts Port Authority, the Massachusetts Highway Department, and other institutions involved in transportation.

To acquaint the public with this new service**,** ***SamrTraveler*** embarked on a multi-faceted marketing plan which included advertising spots on local radio and television stations, display of promotional messages on variable message signs, media stories and interviews concerning the service, inclusion of the logo and message on bus schedules and transit passes, and the distribution of flyers.

FINDINGS

The most important findings of the evaluation of Phase II of the ***SmarTraveler*** operational test are as follows:

- Awareness of ***SmarTraveler*** among the target population (i.e., adults in the service area who travel on highways and/or use public transportation) is limited. Only a third of these potential users reported they had heard of ***SmarTraveler*** and believed they knew what it was. Among these, two-thirds believed the information provided by ***SmarTraveler*** to be more accurate or up-to-date than that provided by broadcast media. However, in focus groups, participants could not identify why the information was more accurate (e.g., what ***SmarTraveler*** did in data collection that was different from other services). Furthermore, only 53% of land-line (i.e., conventional, non-cellular telephone) callers could correctly provide the ***SmarTraveler access*** number - 374-1234.

- ***SmarTraveler's*** data collection activities are extensive. The relative contributions from different data sources varies by time of day and weather conditions, but the information from probes, cameras, and the State Police (i.e., from the *SP incident reporting system) appears to be most prominent. ***SmarTraveler*** maintains relationships with many transportation institutions in the Boston metropolitan area which provide information such as hot-line notification of problems (e.g., from the MBTA and commuter rail services), access to camera feeds, and notification of construction schedules, shutdowns, etc.

- For the period from October 1, 1993 through March 3 1, 1994 (which included an exceptionally severe winter), the average weekday call count ***was 4,094; the*** estimated number of ***callers*** who use land-line phones in an average week (5820) is larger than the number who use cellular phones (4164), but a larger percentage of the ***calIs*** are made from cellular phones.

- The ***SmarTraveler*** user population includes a higher percentage of upper income individuals than does the target population, and users tend to use SmarTraveler for trips that are longer than the average trip made by those in the target population. Other factors which increase the likelihood of being a ***SmarTraveler*** user are access to a car phone (especially for males), being of prime working age (i.e., 25 to 55), and extensive use of highways monitored by ***SmarTraveler*** Travel to/from work was the purpose for 64% of the trips for which ***SmarTraveler was*** used.

- Among ***SmarTraveler*** users who request information about public transit, the percentage using commuter rail is much higher than among transit users in general. This likely reflects the more useful information reported for commuter rail services.

- Daily call counts are increasing at a steady rate, but not rapidly enough to have meaningful impacts on congestion in the near future, unless the rate of growth increases sharply.

- Severe weather conditions significantly influence daily call counts; calls (particularly those from land-line users) rise dramatically on snowy days.

- Callers are pleased with the information they receive, and rate the service highly. Only 3.1% of surveyed users indicated they were unlikely to use ***SmarTraveler again.***

- Callers often act on the information they receive: 29% of the callers surveyed reported altering their travel behavior in direct response to what they heard from ***SmarTraveler*** on a particular call; another 19% reported using the information to choose between alternate routes, but the percentage of these who took a different route than they would have without ***SmarTraveler*** is indeterminate. Nevertheless, utilization of the service by the public at this time is below the level required to make a measurable impact on traffic congestion.

- Regardless of how narrowly one defines the potential market for ***SmarTraveler's services,*** its present market penetration is very small; consequently its potential for growth is great, if the public accepts the "product" as superior. There are approximately two million potential ***SmarTraveler users in the*** target population, and about 43% of them at least occasionally use media traffic broadcasts. These "information seekers" appear to represent the most attractive market for ***SmarTraveler's*** services, but only 7% of them (about 52,000) indicated that they were dissatisfied with their current traffic reporting source.

CONCLUSIONS

The utilization of SmarTraveler's services by the public is clearly below the level required to make a measurable impact on traffic congestion, even if every single caller modified his or her travel behavior in response to the information received. From this perspective, the project has yet to achieve one of its most important objectives.

On the other hand, daily call counts are continuing to grow at a steady rate, and utilization during times of severe weather is much higher than on an average day, implying greater market penetration than average system usage would suggest. Furthermore, callers are fairly pleased with the information they receive; very few users indicated that it was unlikely they would call again.

SmarTraveler operations appear to be well organized and implemented, but the integration and processing of traffic information from the various sources can be very hectic at times, and is more art than science. Cooperative arrangements have been reached with other local public transportation institutions, but despite the government's financial involvement in the operational test, these organ&ions view ***SamarTraveler*** as simply another media outlet, rather than as an instrument of public policy deserving of special treatment; the extent to which ***this affects the flow*** of information to ***SmarTraveler*** is unclear, but it is certainly not advantageous.

One could postulate that, with continued operation (and aided by major increases in marketing), daily call counts will continue to rise and that eventually the number of people whose travel behavior is regularly affected by ***SmarTraveler*** information will be large enough to influence traffic congestion, particularly on those days when traffic conditions are worst. The extension of service and the emphasis on marketing during Phase III of the operational test should increase awareness among the traveling public and provide greater insight into how attractive ***SmarTraveler*** currently is to Boston area travelers.

Future success appears to be very dependent on marketing, but these activities to date have shown limited success. Only about a third of the target population actually know what ***SmarTraveler*** is, and very few know the telephone number. Perhaps most important is that the marketing campaign does not appear to have established why ***SmarTraveler*** is superior to other travel information sources.This seems to be critical because most "information seekers" in the target population do not appear to be very dissatisfied with their current source of information To increase its call counts and user population dramatically, ***SmarTraveler*** must either induce additional individuals to be information seekers and/or attract users of other services to ***SmarTraveler.*** To accomplish these objectives, ***SmarTraveler*** must be perceived as a better "product" by these consumers.

1. INTRODUCTION

SmarTraveler is an operational test of an Advanced Traveler Information System that offers free real-time, route-specific, traffic and transit information to travelers in the Boston metropolitan area via telephones. The operational test is jointly funded by the Federal Highway Administration and the Massachusetts Highway Department and also receives monetary contributions and in-kind services from the private sector. The first phase of ***SmarTraveler*** began on October 30, 1992 and provided a "scale-up" period. Phase II, the operational phase, began on January 13, 1993 and was extended beyond its original eleven and a half month operating schedule until March 31, 1994; this evaluation covers Phase II of the operational test. A subsequent extension of the service until December 3 1,1994 has been designated Phase III.

SmurTraveler is operated by SmartRoute Systems, Inc. (general partner of SmartRoute Systems Limited Partnership). This firm, headquartered in Cambridge, MA, specializes in the design, development and deployment of early-stage IVHS technologies, including advanced traveler information systems.

SmarTraveler's service area is the portion of Massachusetts east of Interstate Route 495, Boston's outer circumferential highway (see Exhibit 1). This 1,400 square mile area includes 122 cities and towns, and is home to more ***than two*** million licensed ***drivers.*** Callers to ***SmarTraveler*** can choose to hear a recorded report on one or more of twenty monitored highway segments and/or three public transportation services by entering a key code. Travel conditions are monitored and the information in the system is updated continuously from 5:30 AM to 7:00 PM Monday through Thursday and until 9:00 PM on Friday; and from 3:00 to 9:00 PM on Sunday. (Static data, such as announcements of scheduled construction activities, is provided at all other times; except when extended hours of operation are instituted for certain holiday weekends or for special weather emergencies.) The real-time reports include conditions, travel times and anomalies like accidents, but do not typically give explicit alternative highway routes.

Several different data sources are used to collect the information needed to continually update the synchronous audiotext system. This proprietary system, one of the unique aspects of ***SmarTraveler*** was developed by SmartRoute Systems and is used to store, organize, and disseminate travel information. Its design allows the data (i.e., recorded human speech) to be added or modified while the system simultaneously provides callers uninterrupted access to the database.

Under contract to the Massachusetts Highway Department, the Central Transportation Planning Staff(technical staff to the Boston MPO) chose Multisystems, Inc. of Cambridge, Massachusetts, to perform an evaluation of Phase II of the ***SmarTraveler*** project (i.e., the period from January 1994 through March 1994. (Under a separate procurement, Multisystems will also be evaluating Phase III of the project, from April 1994 through December 1994.) The Phase II evaluation is

aimed at examining how well the project's objectives were achieved and assessing the desirability and feasibility of replicating such services in other areas of the country. Its specific objectives are:

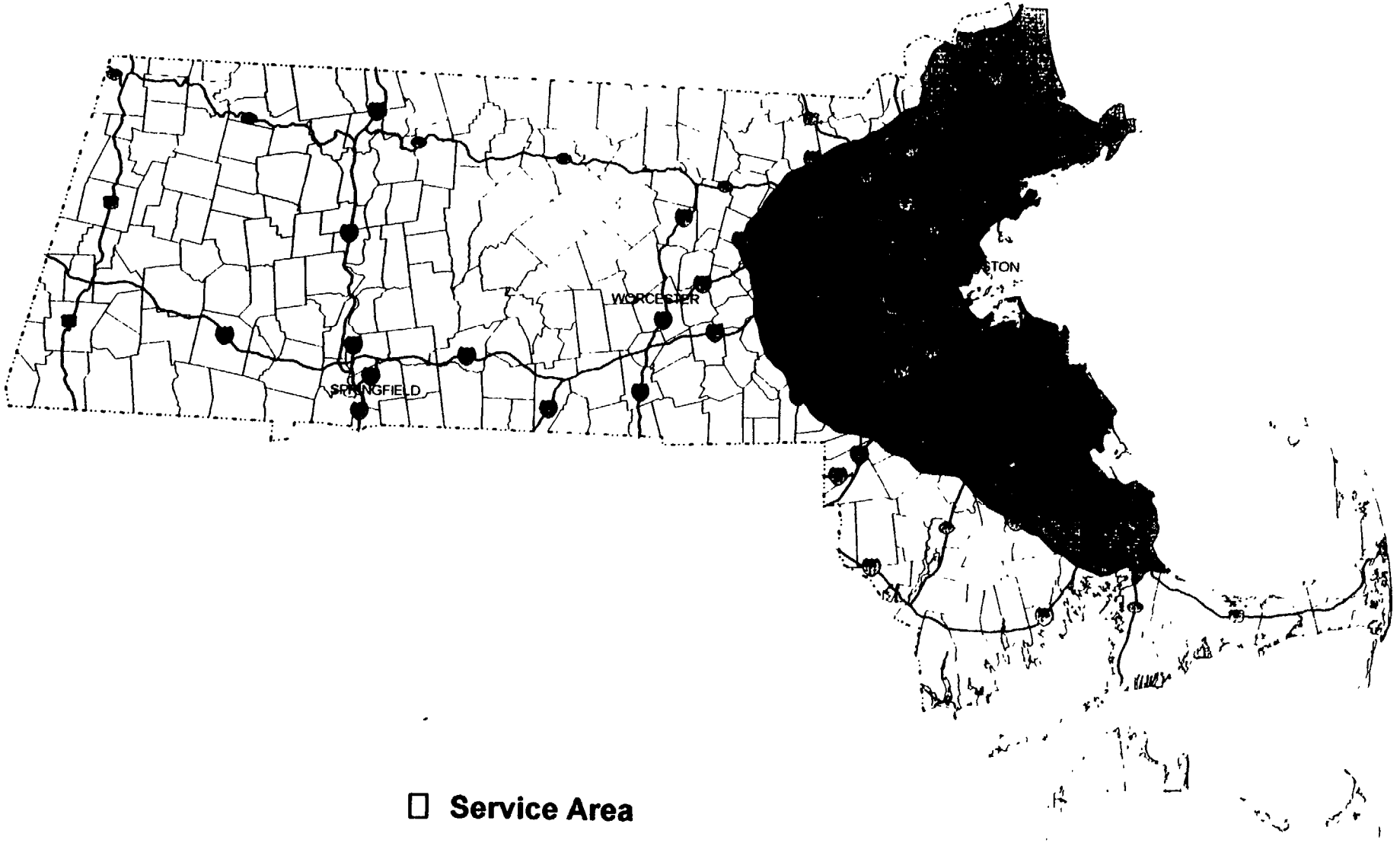
- to assess the quantity and quality of information provided to motorists by the ***SmarTraveler*** operational test;
- to evaluate the public acceptance and utility of the travel information provided by ***SmarTraveler;***
- to determine the existing and potential impact of the project on managing traffic congestion; and
- to recommend improvements in collecting and disseminating traffic information.

To address these objectives, the evaluation has focused on how the service was operated and how the public responded to the services that were provided. Major components of the evaluation effort include:

- profiling the service consumed, using count data captured by ***SmarTraveler's*** computer system;
- administering various telephone surveys, including interviews of both users and non-users;
- assessing the data sources to determine how well they functioned;
- assessing the institutional issues associated with the operational test; and
- assessing the privatization feasibility analysis performed by SmartRoute Systems (addressed in a separate technical memorandum)

This final report presents the results of these efforts.

Exhibit 1: *SmarTraveler* Service Area



2. *SMARTRAVELER* OPERATIONS

2.1. DESCRIPTION OF OPERATIONS

SmarTraveler is an operational test of both information capture and information dispersal strategies and technologies. Information capture for ***SmarTraveler*** involves:

- the use of as many as 200 "mobile probes" who relay information about traffic conditions directly to ***SmarTraveler's*** operations staff
- images from a variety of live and slow-scan cameras located at key locations around the service are, which allow ***SmarTraveler'*** staff to observe conditions first-hand, rather than relying on reports from others;
- traffic reports from up to three fixed wing aircraft which observe conditions over much of the service area, and can be directed to focus in on particular trouble spots, if needed; and
- incident and/or travel condition information reported ***to SmarTraveler*** by a variety of local institutions, including the State Police, the Massachusetts Bay Transportation Authority, the Massachusetts Port Authority, the Massachusetts Turnpike Authority, the Massachusetts Highway Department, and other transportation-related institutions.

All of this captured information is focused into ***SmarTraveler's*** operations center, which is located at the headquarters of SmartRoute Systems in Cambridge, MA. The entire facility, including SmartRoute's offices and meeting rooms, occupies about 2500 square feet of office space. The facilities dedicated to ***SmarTraveler*** operations include:

- the control room
- A recording studio
- a computer room, housing the audiotext computer system and telephone equipment

2.1.1. The *Control Room*

In the control room, one or two "traffic managers" are responsible for digesting the myriad threads of information about travel conditions from all sources and determining when a significant change in those conditions has occurred. During peak periods, the service area is divided into north and south "halves" by the Massachusetts Turnpike (Interstate-90), with one traffic manager specifically responsible for each half. In addition, when the flow of information

is heavy and conditions are hectic, a third staff member occupies what is known as the "overflow" station.

A major feature of the control room is a wall containing nine 19" and one 36" video monitors, which at any given time display the images from a selected subset of 51 different views from cameras used to monitor traffic. The choice of views displayed is controlled from the South traffic manager's station, which is the one used when only a single traffic manager is on duty. Otherwise, the two traffic manager stations are essentially identical, consisting of an L-shaped arrangement of two computers, one additional "feedback" monitor, and a collection of two-way radios, radio scanners, and a multi-line telephone.

One of the two computers provides access to an application (developed by SmartRoute Systems) called Commence which provides access to several databases of information which a trafiic manager may need to access. These include MapInfo (a product of MapInfo Corporation of Troy, NY), used for locating unfamiliar streets and addresses, a variety of on-line telephone directories (with lists of probes, etc.), a directory of construction activities on area roads, and a calendar of all local events which might impact traffic (such as concerts, sporting events, and parades). The system is programmed to automatically pop-up a reminder message two hours before a scheduled event, so that the traffic manager can insert appropriate reminders into travel messages.

The other computer at each traffic manager location is used to enter the travel condition information used to update the audiotext system. To do this, each manager continuously "monitors" the various scanners, radios, certain telephone lines, and the camera displays to identify travel conditions on the roadway segments and public transportation facilities in his area (i.e., north, south or both). This process is much more art than science, and while it seems like bedlam on occasion, it appears to work much better than one would expect, probably because of training and experience. In addition, there is much sharing of information among the traffic managers, both verbally and via a message passing facility in the computer system.

During the most hectic periods, the traffic managers are assisted by an "overflow manager" who handles communications with a variety of express buses and with the probes, to reduce the load on the two traffic managers. The overflow manager has a pair of monitors which show the travel condition updates entered by each traffic manager, but cannot enter such information himself. Instead he forwards information to the appropriate traffic manager, who actually enters the data into the system.

When a traffic manager identifies a change, he calls up a data input screen which asks him the following information:

- date and time for which the entry applies
- a message ID for unique identification

- up to two routes (from among the twenty which ***SmarTraveler*** monitors) to which the entry applies
- the priority of the message
- a shorthand description of the situation, which include references to direction, delays, lanes blocked, etc.

When this data is entered, it becomes the bottom set of lines on the regular display screen, which shows about ten such messages at any given time, depending on their length. These messages must be entered into the audiotext system by the announcer in the recording room, but as a check (to ensure that messages are not overlooked before they pass off the top of the screen), the traffic manager also monitors a "feedback" display which shows (via key data items) which audiotext messages the announcer has added to the system. The feedback display includes most of the same information entered by the traffic managers, plus the duration of the recorded message, the first recording for this roadway that day, and the time the latest update was made; the screen is part of a confirmation process, but also provides the traffic manager with a way to check on what the current message is in the system for a particular facility and when the last update was made. The entries on this screen are color coded to indicate their age. Green entries are less than 10 minutes old, blue entries are between 10 and 20 minutes old, and red entries are over 20 minutes old. ***SmarTraveler*** policy is to update the language in a message periodically even if traffic conditions have not materially changed, so that the system will not appear stagnant to callers. Therefore, the announcer and the traffic managers work together to redo "red" entries when time permits, even in the absence of new data.

2.1.2. Recording Studio

In the recording studio, a small room adjacent to the control room, an announcer monitors a pair of computer screens which display the traffic condition messages entered by the traffic managers. For each message on screen, the announcer decodes the shorthand entry and creates and records the kind of conversational language one typically hears on broadcast traffic reports. This is accomplished using proprietary software developed by SmarRoute Systems which allows the announcer to create a new message, edit an existing message, or review the messages in the system for a particular facility. Generally, the short text description associated with an audiotext message is sufficient to indicate what it says, but the system also allows the announcer to play the message back (which might be particularly useful after a shift change).

Due to SmartRoutes' unique system, when making an update, it is not necessary to replace the entire message associated with a facility if only a portion of the total message has to change. In fact, the "message" for a particular facility may consist of many component pieces of text, which can together extend for several minutes. One component might detail current conditions, another might mention a special event with potential traffic impacts, and a third might be a promotional message; in the downtown area, the current conditions on each of the several monitored facilities

would be entered as separate message components. The system allows the announcer to replace these components individually, and also to control the order in which they will play. The idea is to play back the most important information first.

Like the traffic managers, the announcer can review a "feedback monitor" with the color coded status of entries in the system. The announcer works with the traffic managers to "freshen" messages that are more than 20 minutes old, so that repeat callers do not get the impression that the data is not being updated.

2.1.3 The Audiotext System

The audiotext system used by ***SmarTraveler*** is a five chassis system produced by Brite Voice Systems, with proprietary software modifications by SmartRoutes and Micrologic, Inc. of Watertown, MA. The modifications are primarily associated with the way in which audiotext message components (i.e., partial messages) can be edited and then assembled and played in priority order, and the system's ability to update this information without closing the database or otherwise interrupting the flow of information to callers already connected.

As presently configured, the system is capable of servicing up to 6,000 calls per hour (assuming typical 60 to 90 second calls). This is almost three times the highest hourly call count recorded during the operational test; however, if necessary, capacity can be improved by increasing phone line capacity. Reliability of the hardware during the operational test was very good, but because the system configuration is not completely redundant; a component failure can halt operations (as it did for an hour in June 1993 when a power supply failed). In addition, there were six instances during which information provided by the traffic managers backed up in the system for a period of 5 to 10 minutes because the announcer could not load the stream of information into the Brite System quickly enough. SmartRoutes believes this constraint on capacity could be alleviated by upgrading the processor in the audiotext system from a 25 Mhz. 80386 to a 66 Mhz. 80486, and by adding a second announcer. These changes would effectively double current message creation capacity.

2.2. DATA COLLECTION SOURCES AND ACTIVITIES

In contrast to several current IVHS projects which involve expensive investments in infrastructure to monitor and collect travel condition information over a highway network, the ***SmarTraveler*** philosophy has been to collect information from all possible existing data sources, and to augment this information by judicious use of relatively low cost collection methodologies where required. The aim is to achieve results similar in accuracy to those promised by the more hardware-intensive approaches.

"Live" ***data sources*** used by ***SmarTraveler*** include strategically placed live and slow scan cameras; approximately 200 mobile-phone and two-way radio "probes," surveillance data from up to three aircraft; reports from the State Police *SP program (to which motorists call in

accidents and other highway anomalies without being charged for the calls); a variety of scanners and radios that keep traffic managers aware of local police, fire, and emergency vehicle activities; and travel information provided by the Massachusetts Bay Transportation Authority, the Massachusetts Port Authority, the Massachusetts Turnpike Authority, the Massachusetts Highway Department, and other transportation-related institutions. These sources are discussed below.

2.2.1. Camera Surveillance

Video camera installations provide the only truly objective information the traffic managers have with which to assess traffic conditions. Exhibit 2 provides a list of the locations and characteristics of the various camera installations as of July 1994.

The difference between the live and slow scan displays is actually not in the camera itself, but in the technology used to transmit the image back to ***SmarTraveler*** headquarters in Cambridge, MA. The cameras on the roof of SmartRoute's offices are directly wired into the system, and thus provide real-time live action images. The cameras at One Financial Center and at the Massachusetts General Hospital are linked to ***SmarTraveler*** by microwave equipment, which is expensive, but provides enough bandwidth to support live action images. In contrast, the remainder of the cameras transmit their data to SmartRoutes over conventional analog telephone lines, and it takes seconds to pass enough data over these lines to "paint" a single screen. (To create a "live" image one would need to paint the screen more than 20 times each second.) While the slow scan display does not convey as much information as the live action displays do, the slow scan images can clearly indicate when a roadway is congested, also, although they cannot actually show motion (like a live action display does), when traffic is very slow moving the experienced viewer can track a particular vehicle's movement from scan to scan to gauge how "fast" traffic is moving. Although not the equal of live-action images, slow scan displays offer a cost effective alternative for remote areas with relatively light volume most of the time.

The camera locations currently ***used*** by ***SmarTraveler*** generally appear to be well chosen. Some cameras can move about a little during windy periods, but the views generally provide an excellent indication of conditions at critical locations. The cameras are particularly useful in areas where aerial observation is prohibited by Logan Airport traffic control (i.e., close to Boston) and at traditional bottlenecks (like the Central Artery, the entrance to the Tunnel, the Tobin Bridge, and the Boume and Sagamore Bridges).

2.2.2. Probes

Probes are people traveling within the service area who have agreed to communicate traffic and incident information to ***SmarTraveler.*** About half of the 200 probe units in ***SmarTraveler's*** database communicate ***with SmarTraveler*** using two-way radios in their vehicles. These include members of the Metro Radio System (a non-profit association whose 400 participants share information about incidents affecting public safety) who often contribute information

Exhibit 2: Locations and Characteristics of Traffic Monitoring Cameras

Installation	Location	Principal Coverage	Views	Type
SmartRoutes Headqtrs	Cambridge	Route 1, Tobin Bridge, I-93. Turnpike. McGrath O'Brian Hwy.	1	Live action w/ pan/zoom/tilt
One Financial Center	Boston	Central Artery Callahan Tunnel. Southeast Expressway. Turnpike South Station. Downtown Boston	7	Live action
Logan Airport	East Boston	Sumner Tunnel & East Boston	3	Slow scan
Guest Quarters Hotel	Brighton	Turnpike & Soldiers Field Rd.	3	Slow scan
Sheraton Tara Hotel	Farmingham	Route 9	3	Slow scan
Fortress Building	Dorchester	Southeast Express	4	Slow scan
Sheraton Tara Hotel	Braintree	Route 128 & Southesat Expressway	2	Slow scan
Sheraton Tara Hotel	Newton	Turnpike	2	Slow scan
Mass General Hospital	Boston	Storrow & Memorial Drive, I-93, Central Artery, Tobin Bridge, Downtown Boston, Charlestown	8	Live action
Colonial Hilton Hotel	Wakefield	Route 128	2	Slow scan
Mass Highway Garage	Sagamore	South side Sagamore Bridge toward Route 3, Route 6A, south side of Sagamore rotary, Route 3 northbound lanes	4	Slow scan
State Police Barracks	Bourne	Bourne Bridge, Bourne rotary and Route 28	3	Slow scan
Tobin Bridge	Charlestown	Tobin Bridge toll plaza and bridge ramps	8	Slow scan
Summner Tunnel	East Boston	Approaches to tunnel	1	Slow scan

about driving times, delays and incidents to ***SmarTraveler '.s*** traffic managers over SmartRoutes two-way frequency. Similarly, through an agreement with Logan Express buses (which are operated under contract to the Massachusetts Port Authority), ***SmarTraveler*** receives traffic information from 168 daily bus trips between the airport and Wobum, Framingham and Braintree; since these trips follow specific routes on a fixed schedule, they are particularly useful. In addition, radio probes include members of SmartRoutes' operations staff and selected individuals whose jobs often place them on the road and/or at the scene of an accident (such as local reporters).

To augment the information received from the radio probes, ***SmarTraveler*** has enlisted a "fleet" of commuters to provide similar information using cellular telephones - typically for specific routes at specific times. As such a probe commutes, he or she reports travel times over specific segments of the trip, and characterizes traffic conditions; if the probe encounters an incident (such as an accident or breakdown) which might influence travel conditions or becomes trapped in unanticipated congestion, this will also generate a call to ***SmarTraveler.*** (Note that the functions performed by a probe are not predetermined by the type of communication media they use; some radio probes report on specific AM and PM commuting routes and provide travel time data to headquarters (like a typical phone probe) while some phone probes do not have route-specific reporting responsibilities and simply report on problems they encounter.)

New telephone probes are recruited on the basis of their travel times and patterns, in an effort to provide coverage when and where augmentation of the existing probe network is judged to be useful. Particular preference is given to travelers who make additional trips during late evenings and on Sundays during "live data" periods, in order to maximize the coverage generated by each probe. SmartRoutes trains the selected individuals to ensure that they provide the desired information, and evaluates their calls on a regular basis (both subjectively by the traffic managers and by checking the number of calls to ***SmarTraveler*** on their cellular phone bill) to ensure that they contribute appropriately.

The compensation that many telephone probes receive for their participation results from the fact that ***SmarTraveler*** supplies them with cellular telephones (which are provided at no charge by NYNEX Mobile Communications and Cellular One, the area's two service providers) and that ***SmarTraveler*** reimburses them for their monthly service charge plus all calls made to the telephone number to which the probes report travel data). *All* other charges are the responsibility of the probe, who submits a copy of each monthly bill to ***SmarTraveler*** for reimbursement for covered costs; the individual is responsible for payment of the monthly invoice to the service provider. Note that one byproduct of this agreement is that traffic managers never call probes for information, since this would result in an inbound call charge for which the probe would be personally responsible; however, if the probe is properly performing its function, such a call should not be necessary.

When they happen to be in the "right" place, probes can greatly enhance ***SmarTraveler's*** ability to determine traffic conditions and identify accidents and other problem situations. As a data collection methodology, they offer wide geographic coverage and offer the opportunity for two-way communication (for example to clarify a situation, if needed). However, probes are also subject to constraints which limit their utility, for example:

- a probe is typically completely unaware of a problem that occurs "behind" it. Probes report on what they see, and an accident that occurs after a probe passes an accident site may not be identified until a subsequent probe passes that point or the situation is identified by another methodology.
- a probe caught in a traffic jam can report that traffic is very slow, but cannot know how far traffic has backed up behind it, nor can it determine the source of the problem until it comes into view.

In the ***SmarTraveler*** operational test, the first limitation has been addressed by using probes in conjunction with a diverse range of data collection systems employing a variety of methodologies. The second limitation has been dealt with, when necessary, through the use of aerial surveillance (discussed below).

Obviously, the greater the number of probes in operation, the greater the number of reports one can receive and the higher the probability that a probe will sight a problem on the roadway system. Since traffic conditions can change rapidly in response to an accident or breakdown, in the absence of other data collection methodologies, one would expect to want a very large number of probes evenly distributed over the monitored roadway network and over time, In the real world, however, this is not an effective strategy for several reasons.

- Probes communicate their information by calling the traffic managers (by telephone or two-way radio). Consider a situation where there were sufficient probes to traverse and report on each of the 20 monitored highways every 5 minutes; this would imply 10 calls per minute for each of two traffic managers, or no more than 6 seconds per call. Obviously, this much reporting would immediately necessitate structural changes in the control room's operation. Even so, this level of monitoring would still imply that an incident could go unreported for 5 minutes.
- Probes are not the only data collection methodology in use. Consequently, one would prefer to employ them on facilities where alternative sources of live data are unavailable or insufficient to provide adequate coverage.

SmarTraveler actually utilizes a relatively small pool of probes, given the size of the service area. Exhibit 3 shows the number of probes reporting on each monitored highway during the AM and PM peak periods (i.e., from 5:30 AM to 9:00 AM andfrom 3:00 PM to 7:00 PM, respectively). (Note that most telephone probes follow a fixed route at a fixed time, sometimes

providing data on travel times between specific points as well as condition and incident data, whereas most radio probes travel more randomly and report in only when conditions warrant.) Clearly, if one were to rely solely on reports from probes for traffic condition information, problems could potentially go unreported for a long time on some roadways, while others are relatively well covered.

The most monitored roadway segment, Route 128-l (between the Massachusetts Turnpike and Beverly) is reported on by 37 probes. If one were to make the simplifying assumptions that each probe traveled the entire length of the segment in the same direction and if they were evenly distributed over the peak, one would expect a probe to pass a given point approximately every 7 minutes. In contrast, on the Massachusetts Turnpike (Route 90), there are only 4 probes reporting during the entire moming peak. Of course, on the Massachusetts Turnpike, there are a variety of other non-probe data sources (including express buses, state police vehicles, etc.) which make extensive coverage by telephone probes unnecessary.

AS part of this evaluation, an attempt was made to survey the entire population of probes to learn about their interactions with ***SmarTraveler*** (Despite repeated attempts to reach these people over a period of months, only 78 useful interviews were completed. For the remaining people, the interviewers encountered consistent use of answering machines, failure to answer, invalid telephone numbers, and a few people who wished to be called back at another time, but were subsequently unreachable.) Of the 78 people interviewed, 34 had specific AM peak and/or PM peak travel assignments on specific roadways. Twelve were phone probes and the remainder were radio probes. The average commute for these peak period probes is 30.2 miles each way.

Although peak period probes are expected to call in information at least daily, only 14 of the 32 who responded to the question indicated that they called at least once a day, although all but 4 said they called at least several times a week. Of those who called in information daily, only 3 stated that they reported travel times for their segments (information which ***SmarTraveler*** can only obtain from probes).

When asked about the call-in process, all of the phone probes reported that the procedures operated well, as did most of the radio probes. Only 4 radio probes mentioned problems, which included a lack of available channels, radio interference and a lack of courtesy when calling in information.

2.2.3. Aerial Surveillance

Depending on the time of day and the season, between one and three fixed-wing aircraft provide aerial surveillance within the entire Service area The single-engine propeller-driven planes, which fly at altitudes of 1000 to 1500 feet, operate under contract to SmartRoute Systems and communicate regularly with the traffic managers via two-way radios.Because of clearance issues, the planes cannot generally operate inside Route 128, and therefore focus primarily in the area between Routes 128 and 495.

Exhibit 3: Distribution of AM and PM Peak Period Probes

Number of Peak Probes by Route		
	AM	-PM
Route 1 between Topsfield and Charlestown	9	7
Route 1 between Dedham and Wrentham	6	5
Route 2	12	10
Route 3 between Lowell and Burlington	19	18
Route 3 between Boston and Plymouth	17	17
Route 5 (Logan Airport and Tunnels)	1	1
Route 6 (Downtown Boston and Cambridge	14	13
Route 7 (Cape Cod and the Islands)	6	6
Route 9	6	5
Route 24	3	2
Route 90 (Massachusetts Turnpike)	4	3
Route 93 between Boston and Andover	15	16
Route 93 between Boston and Canton	10	11
Route 95 between Salisbury and Peabody	8	7
Route 95-4 between Canton and Foxboro	7	6
Route 128 between the Turnpike and Beverly	37	34
Route 128 between the Turnpike and Braintree	23	18
Route 495 between the Turnpike and Salisbury	19	20
Route 495 between the Turnpike and Boume	10	10

Throughout the year, during peak periods, one plane covers the area north of the Massachusetts Turnpike and another covers the area to the south. Coverage during off-peak periods is more limited; a midday flight (with a two-hour itinerary) operated during a portion of the operational test. In addition, during ***the*** summer season when ***SmarTraveler*** provides coverage of Cape Cod traffic a third plane is assigned specifically to monitor traffic involving the Cape.

All the planes generally follow an established route designed to provide the best coverage of their area at any particular time. However, traffic managers can direct a plane to leave its regular route to investigate traffic conditions in another part of its observation area. This might be done in response to a problem reported by a probe; typically a probe cannot tell, for example, how far traffic has backed up behind it, nor the nature of an incident ahead which is tying up traffic. In these cases, if other sources do not provide the traffic managers with sufficient information, they may feel that the cost of dispatching a plane to investigate is warranted.

While aircraft surveillance is undoubtedly a valuable component of ***SmarTraveler 's*** data collection process, its usefulness is compromised under the conditions when it might be most useful - during periods of severe weather, when visibility is reduced and flying may be unsafe.

2.2.4.Scanners and Pagers

Each traffic manager listens to a collection of scanners tuned to intercept more than 300 channels of local police, fire, and emergency vehicle communications which might give an early indication of an accident or other incident which could affect traffic The result is a cacophony of squawking sounds which is difficult for the novice to interpret, but the traffic managers are explicitly listening for particular keywords or police status codes which will catch their attention. Once they are alert to a problem, they may dispatch one of the airplanes to examine the situation, and/or call the state or local police for status information.

SmarTraveler also subscribes to several pager services which can provide an early indication of a traffic related problem. For example, one service alerts subscribers about fires - which can clearly impact traffic A single monitor located between the two traffic manager stations displays short text message from these services. The information is used the same way the scanner information is, as an early indication which needs to be followed up.

2.2.5. Communications from Other Transportation Institutions

Incident and /or travel condition information is reported to ***SmarTraveler*** by a variety of local institutions, including the State Police, the Massachusetts Bay Transportation Authority, the Massachusetts Port Authority, the Massachusetts Turnpike Authority, the Massachusetts Highway Department, and other transportation-related institutions. Interviews with personnel at these institutions have provided an understanding of their relationships with ***SmarTraveler*** and the information reporting mechanisms currently in use.

2.2.5.1. Massachtsetts State Police

In 1993, a telephone hot-line was established between Massachusetts State Police Operations in Framingham and ***SmarTraveler*** to provide traffic and incident information during the morning and afternoon commuting periods. This telephone link is staffed from 7:00-9:30 AM and 3:00-6:00 PM by an off-duty State Police dispatcher who is paid directly by ***SmarTraveler*** at a rate of $20 per hour (which is $1.35 more than regular overtime shift work, to ensure interest). As a rule, this assignment is for Monday through Friday only, but may be instituted on holiday weekends when increased traffic is expected.

The work details with ***SmarTraveler*** are purely voluntary, and regularshift work takes precedent over detail work. Consequently, at times State Police Operations cannot find people to work the ***SmarTraveler*** details due to scheduling conflicts. It is estimated that l-2 shifts every 3-4 weeks ***are*** not covered for ***SmarTraveler.***

Although State Police Operations receives information from a variety of sources (including radio communication from State Police cruisers and various police and fire departments), the information from the State Police *SP Program (to which any motorist can call in accidents and other highway emergencies without being charged for the calls on their cellular phones) is of particular interest to ***SmarTraveler.***

*SP receives between 350 and 400 single-origin incident calls from motorists per day. This does not count multiple calls on the same particular incident (e.g., a car fire) where as many as 30 to 40 calls may be received on the same incident.

The State Police Operations dispatching center is typically staffed by a minimum of three dispatchers (up to a maximum of five) depending on the time of day. Incoming *SP calls are answered by any of the dispatchers and the details regarding the reported incident are entered into a computer-aided dispatch system, which provides an on-screen display of incidents. As soon as a new "traffic worthy" incident appears on screen, the dispatcher assigned to the ***SmarTraveler*** detail uses the hotline to call the ***SmarTraveler traffic*** managers; this occurs at the same time that two-way radio transmissions are made to State Police barracks for regional dispatching and response. During non-SmarTraveler shift hours, State Police Operations typically does not call ***SmarTraveler*** with information except in an emergency situation (e.g., if the Callahan Tunnel is closed due to an accident). During these non-coverage hours, ***SmarTraveler*** personnel initiate calls to confirm information which ***SmarTraveler*** has received from other sources. Concurrently, ***SmarTraveler*** provides the State Police with current traffic incident information (e.g., delays caused by accidents or construction crews).

As a general policy, State Police Operations initiates calls to major media outlets only during emergency situations. However, during commuting hours, two State Troopers have off-duty traffic reporting details with Boston-area radio stations, and as State Troopers, they have access to all State Police Operations information. Nonetheless, ***SmarTraveler*** ultimately receives more

information than the radio stations because State Police dispatchers do not forward all *SP incident reports to them ***as they*** do to ***SmarTraveler.***

SmarTraveler also maintains a direct link to the State Police radio system and can monitor radio communications for seven State Police Troops, including Troop E (Massachusetts Turnpike), Troop F (Logan Airport), and Troops A, C, D, H, and I, which serve the ***SmarTraveler*** information area. Upon hearing of incidents on these cruiser-to-barracks radio transmissions, ***SmarTraveler*** typically calls either the police barracks directly or State Police Operations to confirm the information. For this confirmation, the State Police prefer that ***SmarTraveler*** calls Operations rather than the particular barracks, which may be staffed by only a single dispatcher.

The State Police consider their relationship with ***SmarTraveler*** to be productive and successful. The cooperative give and take of information appears to benefit the endeavors of both organizations.

2.2.5.2. Massachusetts Bay Transportation Authority (MBTA)

In September 1992, the Massachusetts Highway Department approached the Massachusetts Bay Transportation Authority (MBTA) about the idea of installing telephone information hot-lines to connect the MBTA with ***SmarTraveler.*** The premise behind these hot-lines was that MBTA information would provide ***SmarTraveler*** with an important intermodal aspect to its Advanced Traveler Information System reports. Discussions between the two groups resulted in a proposal by ***SmarTraveler*** to install (at no cost to the MBTA) three separate hot-lines at strategic MBTA control center locations. In late December 1992, hot-lines were installed at the MBTA's 45 High Street Central Control Center, the South Station Dispatch Center, and the North Station Control Center. These hot-lines are tied to a dedicated button on ***SmarTraveler's*** 24-button Merlin System phones, so that the operator immediately knows that a call is coming in from the MBTA. In addition to the telephone hot-lines, ***SmarTraveler*** monitors four different MBTA radio scanners (one per rail line) for additional information.

As a matter of course, on Monday through Friday, MBTA staff call ***SmarTraveler (as*** well as six other media outlets) from the 45 High Street Control Center at 5:20 AM with a first report on operations. An additional round of calls is made around 6:45 AM, and then there typically will not be any more calls until afternoon, unless there is an incident.

However, the MBTA provides more information ***to SmarTraveler*** than it does to other broadcast media outlets. For example, the MBTA is generally reluctant to alert broadcast media about problems or delays which it expects to be cleared up quickly. Their claim is that it takes so long for a broadcaster to process the information and get it on the air, that the problem may very well be resolved; under such circumstances, the message going out to the public would alert them to a problem which no longer exists.

However, the MBTA recognizes that ***SmarTraveler's*** procedures for processing travel information allow it to provide new information to the public within minutes of the time the report is received at ***SmarTraveler.*** Consequently, current policy is to alert ***SmarTraveler*** whenever there is a delay of 10 or more minutes. In addition, while only two employees at the Control Center are authorized to talk about conditions with other media outlets, many are authorized to ***discuss status with SmarTraveler.*** As a result, during bad weather there may be as many as 30-40 calls back and forth between the MBTA's Control Center and ***SmartTraveler*** during the peak. Some of these calls may be ***SmarTraveler*** calling the Control Center to say that they heard something on a scanner which had not been reported to them. ***SmarTraveler*** would like the MBTA to call every 15 minutes with subway updates, but the MBTA feels this is simply unpractical. For one thing, the MBTA admits that it is very difficult to track every subway delay because of the number of trains and the interactions among them. However, it is important that ***SmarTraveler*** recognize that a subway delay is intrinsically very different than a traffic delay, especially with regard to their respective impacts on the traveling public. Unlike a traffic incident, which sometimes affects 'downstream" travelers for a relatively long time, a subway delay affects current passengers dramatically but typically has little or no impact on passengers boarding five minutes after a breakdown is cleared. Because the subways operate on short-headways, the reporting of subway delays requires careful thought; for example, reporting of incidents expected to be cleared in under 10 minutes is unlikely to be helpful to anyone calling ***SmarTraveler*** for advance information.

In contrast, commuter rail operations involve many fewer trams, and the implications of a late start by a single train are relatively simple to predict. ***SmarTraveler*** receives information about commuter rail status from the North Station and South Station Control Centers over hot-line telephones, and there appears to be an excellent rapport between ***SmarTraveler*** and these control centers. ***SmarTraveler*** provides a simple mechanism for them to tell their clients about delays; some of this results from the fact that the data is not all that dynamic: a relatively infrequent commuter rail tram that is late by 10 minutes at a particular station along the line will typically will be late by 10 minutes at all of the following station stops, and almost all commuter rail passengers "aims their commute for a single particular trip. Consequently, ***SmarTraveler's*** information for these travelers can be very helpful.

With over 750 buses on the road during the peaks, it is impractical for the MBTA to provide ***SmarTraveler*** with detailed real-time status information by route. However, advance changes in bus route information (due to public events such as funerals or parades) is relayed to ***SmarTraveler in*** advance. ***SmarTraveler*** also plays an important role in the winter, especially during snowstorms, when some buses operate on "snow routes" over different roads and/or different stops. ***SmarTraveler*** is particularly effective in getting out changes to routes quickly, and thus provides the MBTA with an effective way to alert travelers as to whether their bus is running and, if it is on a snow route, provide them with specific information about where the bus stops are located.

SmarTraveler has approached the MBTA about electronic access to the Control Center, for example to view the Passenger Waiting Time Monitor which shows subway delays of greater than two minutes, and flashes when delays are over 5 minutes. ***SmarTraveler*** has also requested that the MBTA transmit their public address announcements and its alphanumeric beeper page to ***SmarTraveler*** in real time. Thus far, the MBTA has been unwilling to accommodate these requests, but might consider them in conjunction with the introduction of a new MBTA Control Center in the future.

Overall, the relationship between ***the*** MBTA and ***SmarTraveler*** is mutually beneficial, but is not without admitted institutional barriers. There remain individuals in the MBTA Control Center who are reticent to provide information to ***SmarTraveler*** because they have not established a feeling of trust. For example, there is a perception by some that SmartRoutes' broadcasts on WCVB-N concerning MBTA service tend toward negative reporting (e.g., service problems) and under report positive things (such as the MBTA adding extra service during bad weather). (interestingly the concern was expressed only for SmartRoute's N broadcasts and specifically not for ***SmarTraveler*** reports.) Of course, one could argue that the nature of travel reporting ***is*** to highlight the problems; nevertheless, if this concern exists, it can hamper the free flow of information.

Because ***SmarTraveler*** monitors the MBTA scanners, they will call the Control Center if they hear of something that has not been reported to them. As a result, there is some resentment on the part of some of the Control Center staff because they feel ***SmarTraveler is*** looking over their shoulders. In a similar vein, the Control Center is reluctant to tell ***SmarTraveler*** about potential problems (such as a subway train running 3 minutes late), because they are concerned it will be reported on WCVB or on ***SmarTraveler,*** when in fact the problem will be quickly resolved.

There have been complaints by ***SmarTraveler*** that on occasion they are not told of a problem until it is a real emergency. For example, there was an instance where a person jumped in the subway pit in front of an oncoming tram and brought the subway to a standstill. No one contacted ***SmarTraveler*** about the incident for an extended period of time, presumably because they were so engrossed in trying to resolve the problem that they didn't stop to report it. Because of a few instances such as this, ***SmarTraveler's*** opinion of the MBTA's incident reporting has been clouded.

In an effort to increase trust between the two sides, a meeting is planned to discuss these and other issues regarding what information should be forwarded to ***SmarTraveler*** in the future. The nature of the MBTA's concerns are at least twofold: 1) the differences (compared to traffic incidents) in the impact and duration of delays involving short-headway subway service; and 2) ***SmarTraveler's*** perceived "connection" with WCVB-N (Channel 5) and other media outlets which in turn opens the MBTA staff to criticism of media "favoritism." Resolution of these issues is imperative so that ***SmarTraveler*** can continue to accurately inform the public transportation market.

2.2.5.3. Logan International Airport, Massachusetts Port Authority (Massport)

The Logan Massport Public Affairs office supplies information to ***SmarTraveler*** in a variety of ways. In addition to providing immediate updates through its 1-800-23LOGAN information line, which anyone can call, its Logan Express Buses have a formal arrangement with ***SmarTraveler*** to provide traffic information via two-way radio contact.

The Logan Express Buses transport the public from three satellite parking areas (in Framingham, Wobum, and Braintree) to Logan Airport. The service, which makes 168 trips daily, runs every half-hour starting at 5 AM, and its drivers provide ***SmarTraveler*** with up-to-the-minute information on traffic tie-ups, accidents, tunnel conditions, etc. while enroute. In turn, ***SmarTraveler*** personnel provide traffic information to these drivers to enable them to take the most expedient route.

The 1-800-23LOGAN hot-line provides complete Airport Ground Transportation Information (i.e., for Logan Express, Water Shuttle, Logan Subway Station, Airport Parking, Fort Devens Service, and Airport Bicycle Access information). This is continually updated throughout the day by the Airport Operations Center and is accessible to anybody. ***SmarTraveler*** also has telephone access to Logan Operations Center to enable them to check on current updates.

News (e.g., regarding airport closings, etc.) also is released from the Public Affairs office as it ***occurs.*** Massport officials typically call ***SmarTraveler*** and Metro Traffic first because of their coverage on radio and television. Other radio, television, and the print media receive information from Logan in that order because of the time-sensitivity of the information. In anticipation of heavy travel weeks (such as school breaks and major holiday periods), advance press releases are sent to all the media outlets.

In addition to the aforementioned information, ***SmarTraveler*** has tried to obtain direct access to the airport's monitoring cameras but, like all other media outlets, have been denied that access.

2.2.5.4. Tobin Bridge, Massachusetts Port Authority

The Tobin Bridge, a part of Massport, has no hot-line link with ***SmarTraveler*** but does provide ***SmarTraveler*** access to the bridge's cameras. ***SmarTraveler also*** monitors the bridge's radio frequency for information and, if the traffic managers see something on the cameras or hear something on the radio, they will call the bridge to find out what is happening.

Otherwise, ***SmarTraveler's*** relationship with the Bridge is similar to that of other "media outlets." Lane closures, ramp closures, or expected heavy traffic on the bridge are communicated to ***SmarTraveler*** via fax in the form of press releases out of the Massport headquarters office (at the State Transportation Building, Boston) as needed. These press releases are usually faxed l-2 days in advance. Short-term bridge conditions or emergencies are on occasion called into

SmarTraveler as they are to other media outlets. ***SmarTraveler*** also faxes information to the Tobin Bridge if they have information that might impact the Bridge.

2.2.5.5. Massachusetts Turnpike Authority

Working in conjunction with the Massachusetts State Police (Troop E), the Massachusetts Turnpike Authority's domain entails the Massachusetts Turnpike and the Callahan/Sumner Tunnels. Troop E (with barracks in Weston, Charlton, and Westfield) covers the entire 135~mile stretch of turnpike. The State Police are responsible for reporting any emergencies or incidents; if the emergency is storm-related, it is up to the State Police to announce that traffic speed has been reduced. This is communicated to the Turnpike Authority's Public Affairs Office, from which update advisories are faxed to the local media, including ***SmarTraveler.***

A special service which the Massachusetts Turnpike Authority Public Affairs office provides to ***SmarTraveler*** is a construction update, which is faxed on a weekly basis. The update lists bridge and tunnel closings due to construction, as well as holiday schedule updates. If a bridge is to be closed due to construction on a particular day, the information is typically faxed by 2:00 PM the previous day. In addition, on occasion the Massachusetts Turnpike has displayed the ***SmarTraveler*** message: "For Real-Time Info**,** call ***SmarTraveler,*** 374-1234" on its two variable message signs.

2.2.5.6 Callahan/Summer Tunnels, Massachusetts Turnpike Authority

The dynamic flow of traffic information to ***SmarTraveler*** from the Sumner Tunnel results primarily from ***SmarTraveler's*** ability to monitor a camera at its entrance. Discussions are currently underway with the Turnpike Authority to get similar access later this year to the existing camera at the entrance to the Callahan Tunnel. ***SmarTraveler*** has not been granted access to the Authority's monitors inside the Callahan (and similar monitors are to be installed in the Sumner Tunnel later this summer). ***SmarTraveler*** also monitors the radio communication between Tunnel personnel and truck drivers who are calling to get traffic information.

Most telephone communication with the tunnels is initiated by ***SmarTraveler*** to confirm information they have received from other sources (most notably the Logan Express Buses). ***SmarTraveler*** also sometimes calls the tunnels to alert them to problems they have identified in the Sumner Tunnel (where there currently are no monitors); the tunnels then dispatch tow trucks, if necessary.

2.2.5.7. Massachusetts Highway Department (MHD)

Massachusetts Highway Department (MHD) provides information to ***SmarTraveler*** on a daily basis for all state roads and highways within the greater Boston area (inside the Interstate 495 beltway). MHD's Public Affairs office (at the State Transportation Building, Boston) calls

SmarTraveler daily with construction updates it receives from on-site engineers, and faxes advance press releases to ***SmaTraveler*** (and other local media outlets) for upcoming state highway construction projects.

The MHD radio room (at Dewey Square, Boston) is also a source of information for ***SmarTraveler.*** In emergency situations (such as a road closure due to an overturned tractor trailer), the radio room will either call MHD Public Affairs (which in turn calls ***SmarTraveler).*** or call SmarTraveler directly, as soon as it has dispatched emergency vehicles. ***SmarTraveler*** often returns the favor by providing information to MHD.

2.2.5.8. Samaritania, Inc.

Samaritania, Inc. is a private organization which provides on-the-road traveler assistance programs for a variety of private and public entities throughout the U.S. For more than a decade, Samaritania has been the provider of CVS Pharmacy's CVS Samaritan Program, a program which now consists of three vans which travel throughout the greater Boston area to assist stranded motorists and motorists involved in accidents. Samaritania operates a similar one-van program for the Worcester County Institute for Savings (WCIS) in the Worcester area.

Prior to the introduction of ***SmarTraveler,*** Samaritania had established a relationship with Metro Traffic to supply (through its CVS Samaritan vans) information regarding traffic-related incidents. However, when accidents it has discovered are judged to be very significant, Samaritania has an informal policy of passing along the information to ***SmarTraveler,*** as well, but these calls have been sporadic at best and are not considered a priority by Samaritania drivers.

As part of a recent contract with the Massachusetts Highway Department, Samaritania was selected to provide a new Motorist Assistance Patrol Program which, by the end of September 1994, will consist of 16 Samaritan vans (including the existing CVS and WCIS vehicles) and four tow trucks designated to assist motorists on Massachusetts roadways. The tow trucks, will serve only roads where travel is permitted in breakdown lanes during commuter rush hours. As of July 15, 1994, 11 (of the total of 20) vehicles were on the road with 14 expected to be operational by the end of July.

With the advent of the new Motorist Assistance Patrol Program, a new Media Contact mechanism will be established which will see 10 of the 20 vehicles reporting incidents directly to ***SmarTraveler*** and the remaining 10 reporting directly to Metro Traffic. Coverage areas will be split as equally as is practical. Communication will take place either by two-way radios or cellular phones, depending on distance. This reporting system is scheduled to be in place later this summer.

2.2.5.9. Boston Police Department & Boston Emergency Medical System

Neither the Boston Police Department nor the Boston Emergency Medical System (the 911 operations center for the City of Boston) typically call ***SmarTraveler*** (or any other media outlets) to pass on traffic-related information. However, ***SmarTraveler*** does call the Boston Police Information Services desk on occasion to confirm information they have already received about a problem (e.g., a water main break or a fire) and check whether or not there are any street closings.

* * *

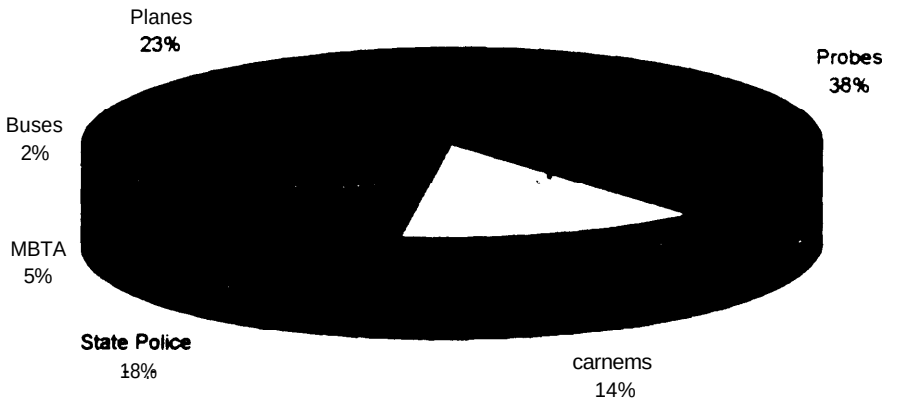
In summary, it is apparent that ***SmarTraveler*** receives significant information from outside institutions, and in many cases, it is more information than is provided to other local electronic and print media The relationships ***SmarTraveler*** has with these institutions varies significantly, and the quality of data provided appears to directly reflect the perceived value (or non-value) these agencies feel they receive in return. It is interesting that in almost all instances, ***SmarTraveler*** is thought of by these other institutions as "another media outlet" rather than as a state-sponsored mechanism for providing the public with travel information. It is unclear how much (if at all) SmartRoutes' relationship with WCVB and various local radio stations has affected its relationships with other institutions.

SmarTraveler's management would like it to be the designated recipient of all travel condition information from the area's transportation institutions, as well as to have access to every conceivable information source. In some cases the institutions have supportable reasons for not wanting to provide access to certain internal sources, whether to ***SmarTraveler*** or any other media outlet. However, ***as*** long ***as SmarTraveler*** is perceived of principally as just one of many local media outlets, it is less likely to obtain the level of cooperation from other public agencies that it might enjoy as a perceived instrument of public policy.

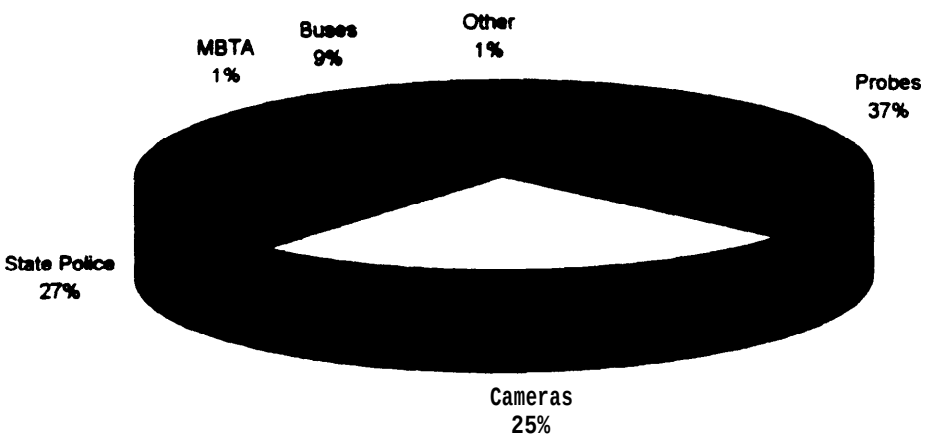
2.2.6.Assessment of Data Collection Activities

It is obviously inappropriate to assess the efficacy of ***SmarTraveler's*** data collection methodologies individually, since each is specifically designed to operate as one component of an integrated system. No single activity is expected to provide comprehensive information, except in a very limited geographical area (as the video cameras do). Exhibit 4 displays the distribution of the data sources which initially identified a travel condition change added to the audiotext system. (The data represents a total of 140 audiotext changes made during three different peak periods. A total of 96 changes were made when weather conditions precluded the use of aerial surveillance; the remaining 44 changes were made while the planes were in use.) Note that this exhibit displays aggregate data; for any particular route the distribution is likely to be different. Nevertheless, the contribution of information from probes is clearly significant.

Exhibit 4: Distribution of Data Sources Initially identifying a Condition Change



With Aerial Surveillance



Without Aerial Surveillance

The real measure of this system's utility is how long it takes to identify a problem or a change in traffic conditions (anywhere) in the system. Empirical testing to establish some measure of this response time would be informative, but extremely expensive to obtain and is well beyond the scope of this evaluation. One proxy for this information is user perceptions of the systems' accuracy and how up-to-date the data is, which one might argue is more important than actual measurements, since users' act on their perceptions rather than on scientific measurements. By this measure, the data collection activities are apparently successful, since the results of user surveys (discussed later) clearly indicate that satisfaction levels are high. However, personal experiences of the evaluation staff, while certainly anecdotal, suggest that significant problems can slip through the data collection system for surprisingly long periods of time. In one instance a staff member with a cellular phone was trapped in a traffic jam bebind a breakdown during the AM peak on a monitored roadway for more than twenty minutes without any mention of the problem appearing in the ***SmarTraveler*** message for that facility; an intriguing aspect of this incident is that it eventually became apparent that a State Police officer was at the scene, which one would have expected to result in notification of the incident to ***SmarTraveler*** by the *SP program.

In another instance, a member of the evaluation staff enroute to a major sporting event received information from ***SmarTraveler*** of a general nature warning travelers to avoid the area because of expectations of severe roadway congestion. At the same time, a major radio station was reporting that traffic was actually much lighter than had been expected and was relatively free flowing, which was actually the case.

These anecdotal incidents should not be misconstrued as an indictment of ***SmarTraveler's*** data collection activities. Although a detailed comparison between ***SmarTraveler*** and its broadcast media competition was not conducted as part of this evaluation, ***SmarTraveler*** utilizes a more intensive and broader range of data collection activities than its competition, and the information which it collects appears to be managed efficiently and provided rapidly to the public. Bather, these incidents point out the fact that despite the broad range of data collection methodologies employed, incidents can and do slip through the cracks. SmartRoutes' contention has been that its "low cost" data collection approach represents a viable alternative to the high-investment traffic monitoring approaches being pursued in other IVHS projects (such as the imbedded loop technology). One could argue that these two approaches represent extremes, and that the most cost effective approach for any given city may be a hybrid design which utilizes the costly, hardware-based approach in some locations and the ***SmarTraveler-type*** lower-cost approach in others. More research in this area may prove useful.

3. MARKETING ACTIVITIES AND AWARENESS

3.1. OVERVIEW OF MARKETING ACTIVITIES

At the time of its introduction in January 1993, ***SmarTraveler*** was a new organization offering a new service with which the public had no familiarity. Of course, commuters had for many years been exposed to traffic reports from broadcast media (via both radio and television), but these services were intrinsically different from ***SmarTraveler*** in a variety of ways. Aside from the differences in data collection (which ought to provide ***SmarTraveler*** with more accurate and up-to-date information), the new service offered information for ***particulur*** roadways and public transportation services on demand rather than on a preordained schedule, and the information could be considerably more detailed because long messages are easily accommodated. However to obtain this information, travelers had to telephone ***SmarTraveler,*** rather than simply listen or watch for information provided by a radio or television which might already be operating in the background for other purposes; this required new users to know how to contact ***SmarTraveler.*** Finally, although it is truly a very simple process, some users might find negotiating the audiotext system confusing or intimidating because it is automated.

As part of the operational test, SmartRoutes developed a marketing plan designed to educate the public about the new service, induce them to try it, and keep the service and its telephone number in the public eye. The campaign to accomplish these objectives were multi-faceted; a partial list of its components include:

- media coverage of a press conference on the day of introduction for the initial service and in conjunction with the addition of coverage for Cape Cod
- stories about the service and interviews with SmartRoutes' personnel in a variety of daily and weekly newspapers and in all the major trade publications and newsletters
- broadcasting of advertising spots on local radio and television stations (177 and 529 spots, respectively, in the first quarter of operation alone), and display of a modified version of the TV spot on the DiamondVision screen during Red Sox home baseball games and soccer games at Foxboro Stadium.
- specific mention of ***SmarTraveler*** and its phone number during SmartRoutes' trafiic reporting segments on WCVB-TV and WODS-FM, and the ***WNSH/SmarTraveler" reporting*** segment on WNSH-AM..
- display of a promotional message for ***SmarTraveler*** on the Massachusetts Turnpike Authority's variable message signs during the first week of operation, on a sign in front of Kappy's Liquors on Route 1 in Malden, and on the Boston Garden's variable message sign during 76 Bruins and Celtics games

- posting of cards promoting ***SmarTraveler*** in MBTA buses and subway cars
- printing of ***SmarTraveler's*** message and phone number on MBTA bus schedules
- inclusion of the ***SmarTraveler*** message and phone number on MBTA transit passes
- distribution of flyers in commuter rail trains on one day in March 1993
- distribution of over 400,000 ***SmarTraveler*** flyers during the first quarter of operation, including at toll booths on the Tobin Memorial Bridge and the Massachusetts Turnpike, at the Central parking facility at Boston's Logan Airport, and MBTA and commuter rail stations. During the second quarter another 100,000 flyers were distributed, including sizable quantities at the Steamship Authority and Hy-Line Cruise ticket booths and to MBTA users
- display of a promotional slide(s) at movie theaters run by General Cinema and Hoyts Cinema.
- speaking engagements concerning the project

An examination of the marketing materials indicates that they consistently emphasize the name and logo of the service, its telephone number, and the message of "Real time commuter information. Any route. Any time." However, conspicuous by its absence is any attempt to compare ***SmarTraveler*** to its natural competition, broadcast media traffic reports. For example, there might have been some focus on educating the public that ***SmarTraveler*** offered better information because of its "high-tech" control room (perhaps comparing it to air traffic control) and a variety of data collection methodologies which provide more up-to-date and more accurate information than is available elsewhere. SmartRoutes' staff believes that their information base is better than those available to others, but they chose not to promote the service on that basis. Instead, they concentrated on the "ondemand" and route-specific nature of the service, and used the term "real time" to indicate that the information was up to date. However, the public was never given a basis for believing that the information from ***SmarTraveler*** was superior to that available from other sources, and the participants of two focus groups conducted during the evaluation had no idea why ***SmarTraveler's*** database should be considered any better than that of other alternatives.

The impacts of these activities, in terms of public awareness and understanding of the service. and in terms of system usage, are discussed later.

33. AWARENESS OF SMARTRAVELER

ln order to evaluate the effectiveness of the marketing programs designed to raise awareness and promote use of ***SmarTraveler,*** a random digit dial telephone survey was conducted of several

hundred persons considered to be the target population of ***SmarTraveler*** (See Appendix B.) This target population is composed of all persons over the age of 17 living in the ***SmarTraveler*** service area of Eastern Massachusetts who travel on major highways or use public transportation. The 762 persons in the sample target population were asked questions about their level of awareness of ***SmarTraveler,*** their sensitivity to the price of using the service, and a variety of questions useful for comparison with the user population.

General Awareness of ***SmarTraveler:*** Less than half of the survey respondents had heard of ***SmarTraveler,*** and about one-third of those who had heard of ***SmarTraveler*** were unsure what it was. For subsequent analysis, the "target population" survey sample was divided into four awareness groups with the following sample sizes:

1. Persons unaware of ***SmarTraveler*** (403 respondents representing 53% of the sample)

2. Persons who have heard of ***SmarTraveler,*** but are unsure of what it is (118 respondents representing 16% of the sample)

3. Persons aware of ***SmarTraveler,*** but have not used it (169 respondents representing ***22%*** of the sample)

4. Persons who have used ***SmarTraveler*** (71 respondents representing 9% of the sample)

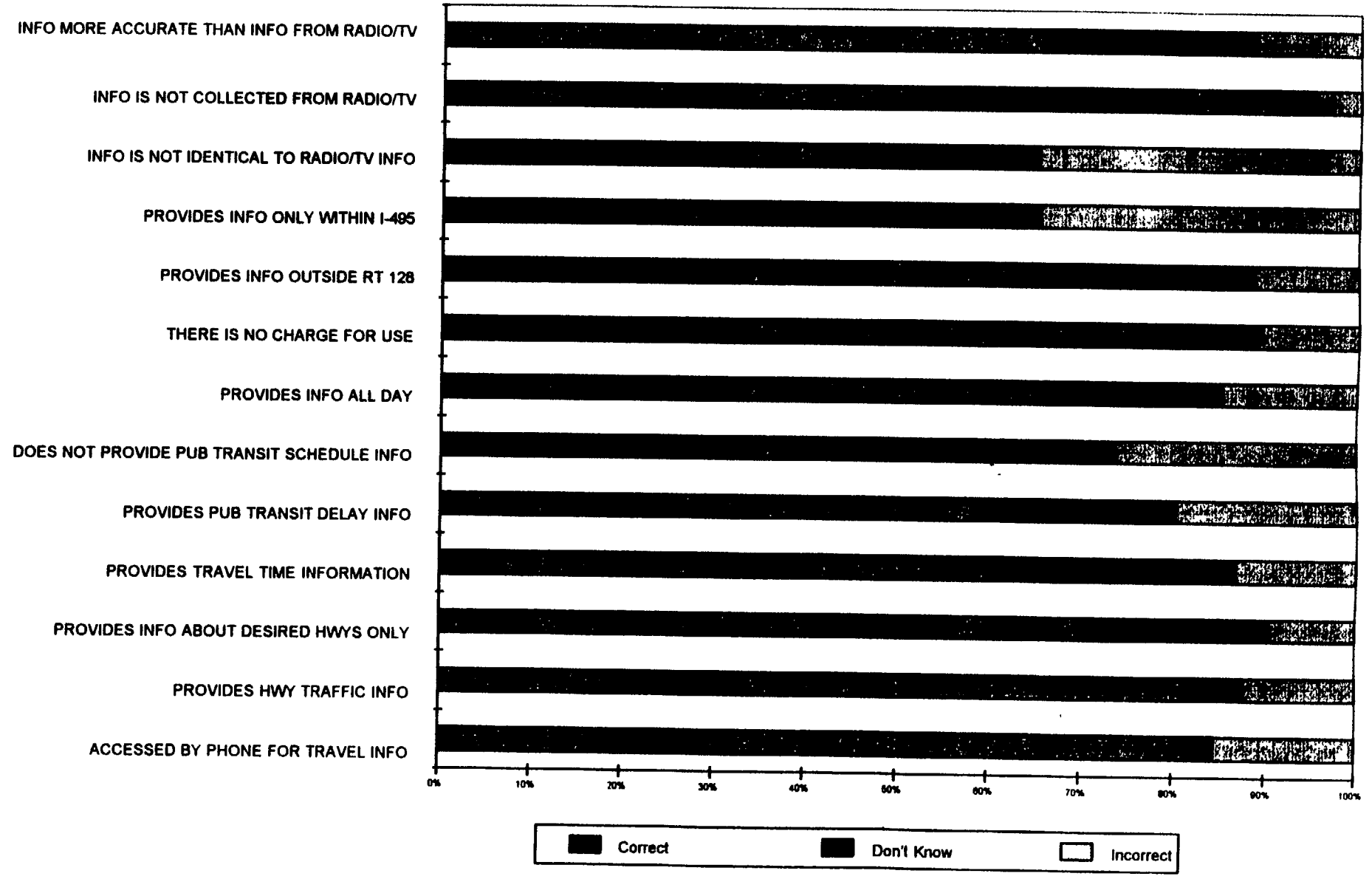
Only those persons who indicated an awareness of SmarTraveler (that is, groups 3 and 4 above) were asked specific questions about services provided/not provided by ***SmarTraveler*** In ***the*** discussion which follows, a distinction is made ***between those*** who have ***used SmarTraveler*** and those who have not among these "aware" respondents.

There was a general understanding of ***SmarTraveler*** 's characteristics among those who reported themselves aware of the service. Of 13 questions used to measure the target groups' knowledge, ***76*** percent answered at least 10 correctly and virtually all answered at least 7 of these questions correctly (see Exhibit 5).

The majority of persons indicating that they were aware of ***SmarTraveler*** knew how to access ***SmarTraveler*** information, and had at least a general understanding of the type of information provided by ***SmarTraveler.*** Nearly 82 percent of persons knew that one calls ***SmarTraveler*** by phone to get travel information, and nearly 84 percent knew that one calls ***SmarTraveler*** for highway traffic information. However, there were substantial gaps in knowledge. For example, of those persons who were aware but who had never called ***SmarTraveler,*** 24 percent did not know that one calls ***SmarTraveler*** by phone to get travel information, and 18 percent did not **know** that one calls ***SmarTraveler*** for highway traffic information. Specific awareness issues are investigated in the following several sections

SmarTraveler telephone number: ***There*** is a low level of awareness of the ***SmarTraveler*** telephone number. Nearly all persons responding to the target population survey who were

Exhibit 5: Understanding of *SmarTraveler* (Among Those Indicating Awareness)



aware of ***SmarTraveler*** but have not called did not think that they could correctly identify ***SmarTraveler***'s phone number without looking it up. Respondents to the ***SmarTraveler*** user survey (see Section 4.2) were asked if they hew the ***SmarTraveler*** number without looking it up. Eighty-eight percent (88%) of callers using NYNEX lines, 76% of the Cellular One callers, and only 59% of the land-line callers reported that they knew the number ; about 9% of these people did not correctly produce the number when questioned further. Thus only 53% of the land-line users could correctly identify the number is 374-1234 - a notable impediment to increased use.

Highway travel times: While 84 percent of the target population knew that ***SmarTraveler*** provided highway and traffic information, less than 70 percent knew that you could get specific information about only the highways you wanted. Those who had called ***SmarTraveler,*** not surprisingly, were twice as likely as those who have not called ***SmarTraveler*** to know that you could get information about only desired highways.

There was a lower level of awareness among the target population that ***SmarTraveler*** provides travel time information. Less than 62 percent of those aware of ***SmarTraveler knew*** that ***SmarTraveler*** reports travel times for key roadway segments.

SmarTraveler service area: Even among those members of the target population aware of the service, there appears to be a lack of knowledge about ***SmarTraveler's service*** area. Only 63 percent knew that ***SmarTraveler's*** coverage extends outside (i.e., to the west of) Route 128 and ***only 39*** percent thought that ***SmarTraveler's*** area of coverage was exclusively inside (i.e., to the east of') Interstate-495 Even among those who had called ***SmarTraveler,*** nearly 39 percent did not think that the service covers only travel east of I.nterstate-495. (It is possible that some individuals who were generally familiar with the service coverage found this question confusing. Although ***SmarTraveler's*** service primarily about conditions east of Interstate-495, the system sometimes provides information about conditions welI beyond the official service area In addition, for those who knew that ***SmarTraveler*** provides information about Cape Cod traffic, it may have been unclear whether the entire service area was east of Interstate-495. Consequently, it is possible that a higher percentage of the "aware" population understands the service's area of coverage than the survey results would indicate.)

Public transportation coverage: The target population is less aware of the public transit information provided by ***SmarTraveler*** than they are of the highway information provided. Among those who had called ***SmarTraveler,*** less than 60 percent of the target population knew that ***SmarTraveler*** reports public transit delay information. This is not surprising since most persons who call ***SmarTraveler*** do not seek information about public transit. Less than 47 percent of those persons in the target population knew that ***SmarTraveler*** does not report public transit schedule information.

Temporal coverage: The majority of respondents were aware that ***SmarTraveler*** provides up-to-date information throughout the day (over 65 percent knew that ***SmarTraveler*** is available at times other than the morning and evening rush hours).

Cost of calling SmarTraveler: A significant majority (76 percent) of respondents knew ***SmarTraveler*** is a free service. Only 1 percent of those who had called thought there was a charge, compared to 15 percent who had not called. Misinformation about the cost of using the service is important since those who were aware that ***SmarTraveler*** is a free service were more likely to call ***SmarTraveler than those*** who thought there is a charge.

Quality of information provided: While over 66 percent of respondents believe that ***SmarTraveler*** provides more accurate and more current information than that provided by radio and TV stations, more than 30 percent indicated that the information provided by ***SmarTraveler*** is identical to information on the TV or radio. This apparent inconsistency may result from some respondents having interpreted the second question to be whether the same type of information (i.e., accidents and traffic delays) was provided by both sources.

Sources of awateness of SmarTraveler: Based on the survey of ***SmarTraveler*** users (see Section 4.2), the single most important reported source of initial knowledge about the service ***was through*** appearances by ***SmarTraveler*** staff member Eli Sherer on television station WCVB (2 1%), where he regularly provided early morning traffic reports and mentioned ***SmarTraveler as*** a source of additional, route-specific information. NYNEX promotional material (16%), word-of-mouth (14%), television advertisements (13%) and radio-spots (7%) were other major sources of knowledge about the service. Among NYNEX callers, promotional material from the cellular provider was the single largest contributor.

For the target population, television ads were clearly the most important means for first becoming aware/heating of ***SmarTraveler.*** Among those persons who were aware of ***SmarTraveler,*** but had not used the service, 47 percent first became aware of ***SmarTraveler*** through TV ads, 18 percent through Eli Scherer or Jeff Larson on Channel 5, and 15 percent through radio ads. Among those who had heard of ***SmarTraveler,*** but were unsure of what 'it is, only 29 percent report they first became aware of ***SmarTraveler*** through TV ads, compared to 17 percent through radio ads. A high, but not surprising 22 percent of persons who had heard of ***SmarTraveler,*** but were unsure of what it was did not remember where they first heard of ***SmarTraveler.***

* * *

There is clearly much yet to be accomplished ***in making potential users*** aware of ***SmarTraveler*** and its primary service characteristics. First of all, barely half of those in the target population had ***any*** awareness of ***SmarTraveler,*** and one third of those who had heard of ***SmarTraveler were*** unsure of what it is. In all, less than one third of those in the target population were really "effectively" aware of ***SmarTraveler.*** Most of these individuals have a good idea of the services

offered, but there are still some important gaps in their knowledge. These include ***SmarTraveler's*** telephone number, the public transportation services it offers, and its actual service area. These gaps in the public's knowledge clearly work to reduce the number of people who actually use the service.

4. SYSTEM USAGE

4.1. USAGE STATISTICS

Exhibit 6 indicates the daily call count served by ***SmarTraveler*** from its introduction through March 31, 1994 (i.e., the complete evaluation period). The graph clearly depicts the large upward spikes in call counts that occur during holiday periods (such as Memorial Day) and severe weather conditions (such as the many snow storms of January and February, 1994). The exhibit also indicates the relative contribution to the call counts from land-line (e.g., non-cellular), NYNEX, and Cellular One callers over time. (The Cellular One count, which averaged only 118 calls per day overall, is generally too small to observe on the graph.)

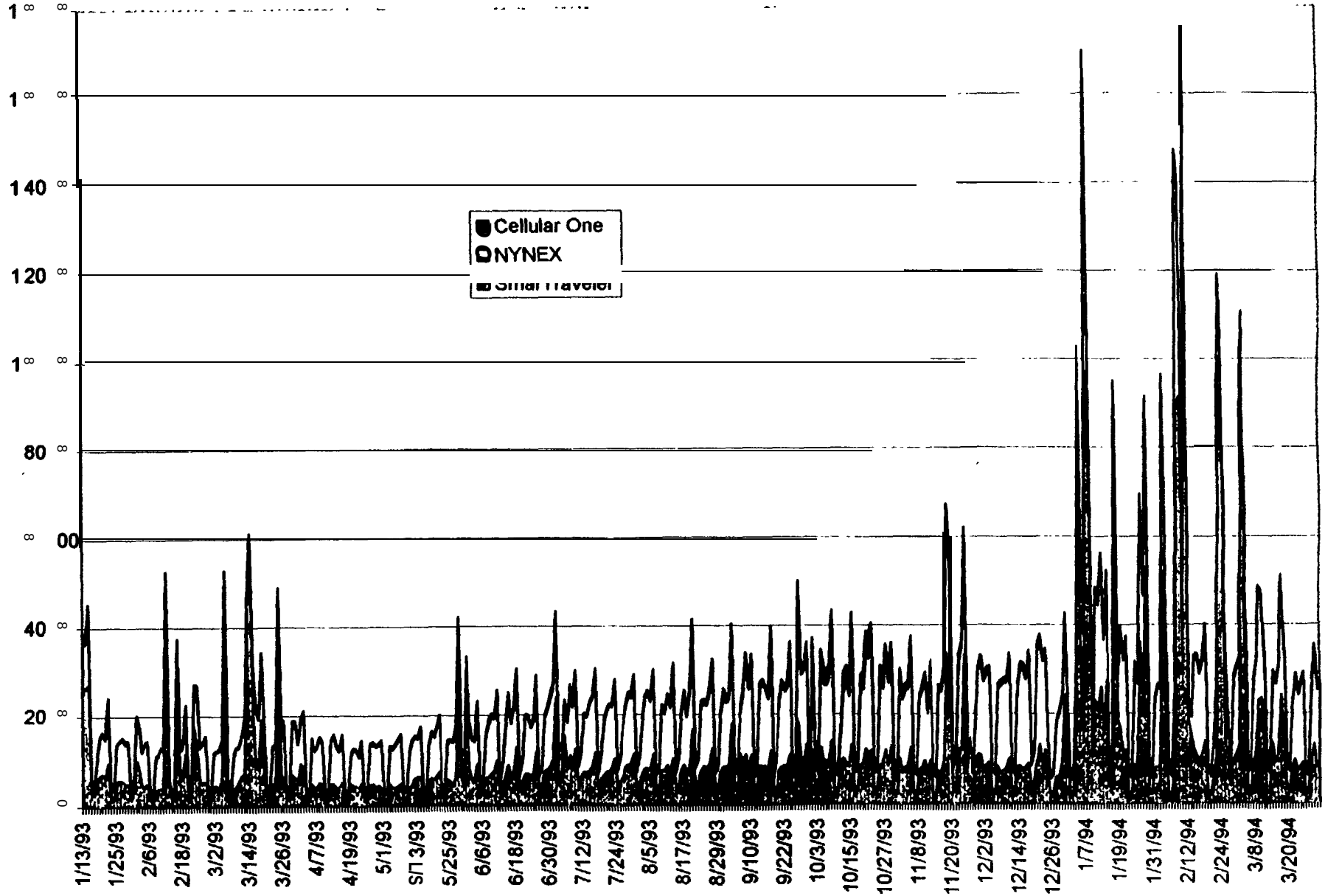
Since the daily call count is so strongly influenced by anomalies like holiday weekends and severe weather, the best measure of actual call growth (i.e., the underlying growth rate for the service) appears to be the increase in typical weekday (i.e., Monday through Thursday) calls on workdays without rain or snow. (Fridays are atypical both because of extended hours of service and because travel patterns are different from other weekdays.)

As Exhibit 5 indicates, while the total daily call count was relatively flat from project inception through the spring of 1993, there was clearly growth from that point on. It appears that the data from May 1, 1993 through March 31, 1994 represents the best predictor of future call growth. Linear regression analysis of this data indicates a growth rate of 5.4 1 calls per day, or an increase in calls of about 1,975 per day over a 12 month period. Based on this analysis, NYNEX calls are growing at the rate of 1,230 per day each year, versus only 679 for land-line calls and only 64 for Cellular One calls.

Utilization, as with most products, can be expected to vary with cost. Although the ***SmarTraveler*** information itself is provided free of charge, the caller is responsible for any telephone access charges. Thus land-line callers are charged for service units or can make the call for free depending on their particular telephone service plan. Unlike other groups, NYNEX cellular customers can access ***SmarTraveler*** free of any charges for the duration of the operational test, and also have the benefit of automatic two-digit speed dialing. In contrast, Cellular One calleers are charged normal rates for their calls (except for the month of October, 1993 when charges were waived during a promotional period). The actual cost of a one minute Cellular One call ranges from nothing (for callers with "free" monthly minutes remaining in their account) to $0.44 depending on the caller's service plan.

The impact of these differences in cost on relative usage by these various groups is difficult to assess. Approximately half of the land-line calls were made from the workplace, where the caller

Exhibit 6: Daily Count (All Days)



was unlikely to be charged personally, but may or may not have been reluctant to make a "personal" call. Similarly, the majority of cellular phone accounts are presumably maintained for business purposes, where bills are often paid directly by employers. However, the fact that Cellular One call activity fell back to pre-promotion levels after the call charge was re-imposed suggests that these new Cellular One callers were very sensitive to the cost of the call.

It is important to note that the discussion thus far has related to the number of calls made to ***SmarTraveler*** and not to the number of callers making these calls. Surveys of a sample of those using ***SmarTraveler*** provide estimates of the frequency with which people used the service. (Appendix A contains the user survey; however, the frequency of use data was obtained from a short intercept survey used to identify users for the full follow-up survey.) These surveys imply that for the period from October, 1993 through March, 1994 those using NYNEX cellular phones made an average of 3.1 calls per week, versus 2.6 calls per week by Cellular One callers and 1.7 calls per week by land-line callers. These rates are consistent with the fact that land-line callers are generally limited to calling before making any given trip, while NYNEX callers can call enroute (e.g., when approaching an important routing decision point), and can thus obtain more up-to-date information and call more than once per trip, if desired. Call rates of some Cellular One subscribers were presumably affected by the higher cost of calls compared to that of NYNEX subscribers.

Using the call counts recorded by ***SmarTraveler*** and the estimated call frequencies, one can estimate the number of people who call ***SmarTraveler*** in an average week. Based on the data collected from October, 1993 through March, 1994, the NYNEX caller population is estimated at 3,717; the Cellular One and land-line caller populations are similarly estimated at 447 and 5,820, respectively. (See Exhibit 7.) Obviously the number of people from each group who have ever called ***SmarTraveler*** is higher, and the caller population in any given week may vary significantly from these averages. Note that approximately two million commuters live or work within the service area.

In general, rainy weather caused call counts to rise only slightly above the norm, while significant snowstorms (of which there were many during Boston's record-breaking winter season) had a major impact on counts on the day of the storm and often on subsequent days because of residual storm effects. Over the time period from October, 1993 through March, 1994, typical weekday call counts (i.e., excluding Fridays, weekends, and holidays) for days on which it actually snowed averaged 8,650 versus 3,346 for rainy days and 3,119 for days with neither rain, snow, nor residual snowfall effects.

During the period from October, 1993 through March, 1994, NYNEX calls represented approximately half of all calls received. (See Exhibit 8.) However, this percentage varied significantly with weather. On days without snow, NYNEX calls averaged fully 58% of all calls, but on snowy days NYNEX calls did not rise nearly as much above average levels as did those

Exhibit 7: SmarTraveler User Populations (October 1993 - March 1994)

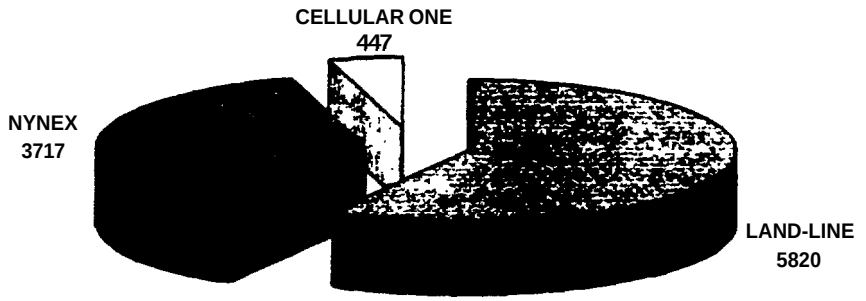
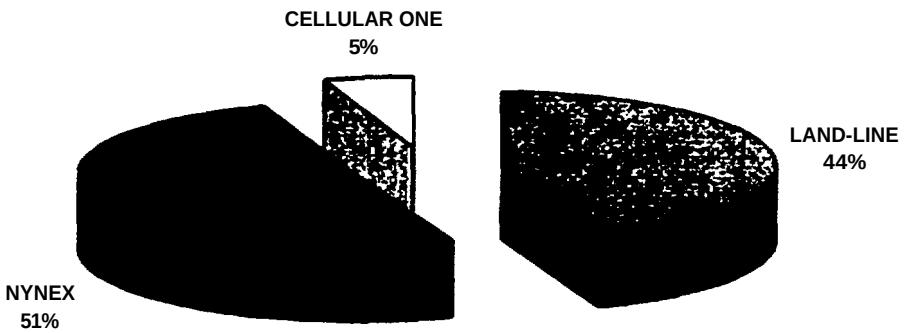


Exhibit 8: Percentage of Calls by Source (October 1993 -March 1994)



from land-line callers. Consequently, for snowy days, although NYNEX calls rose somewhat, they represented only 34% of all calls received. This difference may indicate that NYNEX callers who have the knowledge and inclination to use ***SmarTraveler*** do so on a fairly regular basis; in contrast, many land-line callers only call when they expect trafiic conditions to be dramaticalIy different from the norm.

Exhibit 9 indicates the distribution of calls by day of week over the course of the operational test. The relatively high Friday counts undoubtedly reflect the longer hours of live operation (until 9 PM instead of 7 PM) and increased post-work travel associated with weekend activities. ***SmarTraveler*** provides six hours of live service on Sunday (from 3 PM until 9 PM) but no live service at all on Saturday; therefore it is somewhat surprising that Saturday and Sunday call counts are so similar. Exhibit 10 indicates the distribution of call counts by hour of day for an "average" weekday (i.e., Monday through Thursday) over the duration of the operational test; the pattern is consistent with the typical rise and fall of traffic volume. Perhaps the most interesting aspect of Exhibits 8 and 9 is the portion of calls received during periods when ***SmarTraveler*** provides only pre-recorded messages (e.g., all day Saturday on Exhibit 8 and after 7 PM and before 5:30 am on Exhibit 9). It is unclear to what extent these calls represent people interested in the static (e.g., construction) information provided during "off" hours or people incorrectly seeking "real-time" information.

4.3. CHARACTERISTICS OF USERS AND TARGET MARKET TRAVELERS

To obtain information about user characteristics, a telephone survey was conducted which reached over 2000 ***SmarTraveler*** callers. (See Appendix A.) Users were selected through a random sampling of calls made to ***SmarTraveler,*** data from such sampling is appropriate for analyzing the characteristics of calls (i.e., for examining such trip-related data as routes used, travel times, and actions taken as a result of information received), but must be adjusted when analyzing the characteristics of callers (such as demographic characteristics). This is because random sampling of calls is more likely to select more frequent callers, who would therefore be over-represented. In the following section on user demographics, and where noted in subsequent sections, survey results have been statistically adjusted to correct for such "frequency bias."

As a point of comparison, and to determine the extent the public's awareness of ***SmarTraveler,*** a random survey of the general target population was also conducted. (See Appendix B). For this survey, the sampling approach screened respondents to find those making trips on major highways and public transportation in the service area; i.e., people whose travel behavior made them potential users of ***SmarTraveler.*** The results of this survey were also adjusted for frequency bias, but in the reverse manner from that used for the user survey, since the sampling methodology was different. In this case, the demographic characteristics required no adjustment (since the sample was already a random sample of travelers), but the trip characteristics had to be adjusted to represent frequent travelers appropriately.

Exhibit 9: Call Count Variation by Day of Week (All Days)

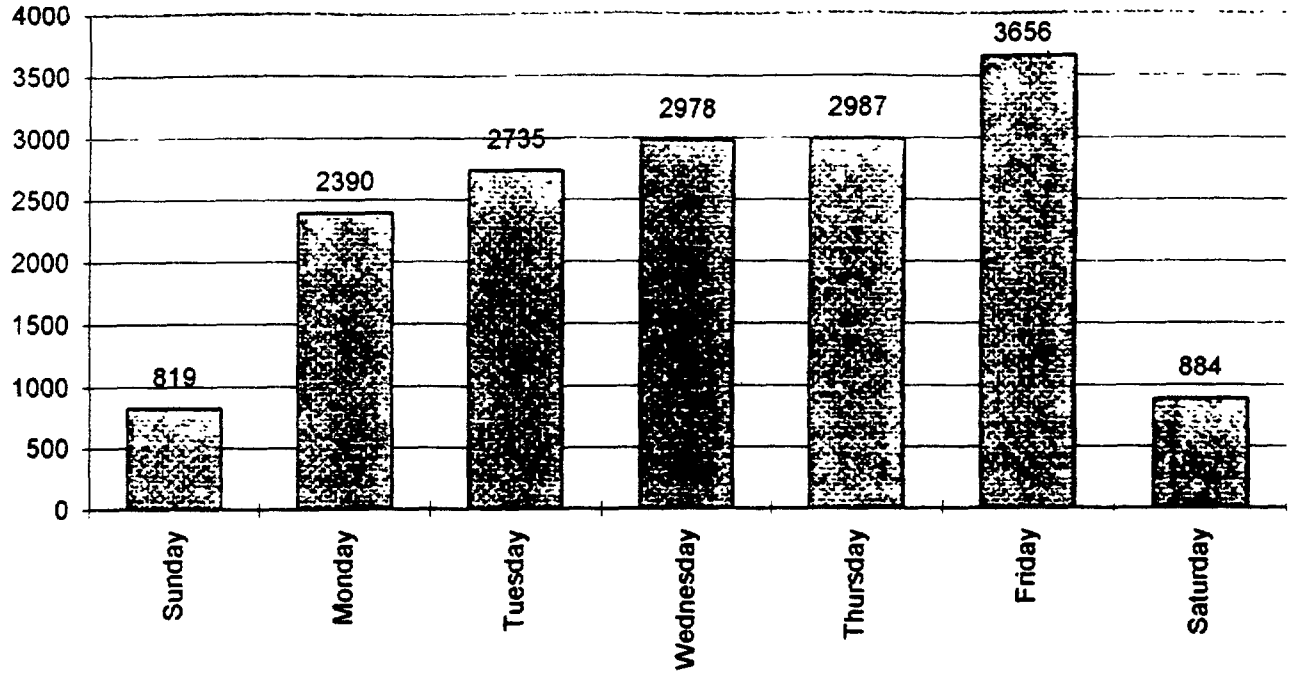
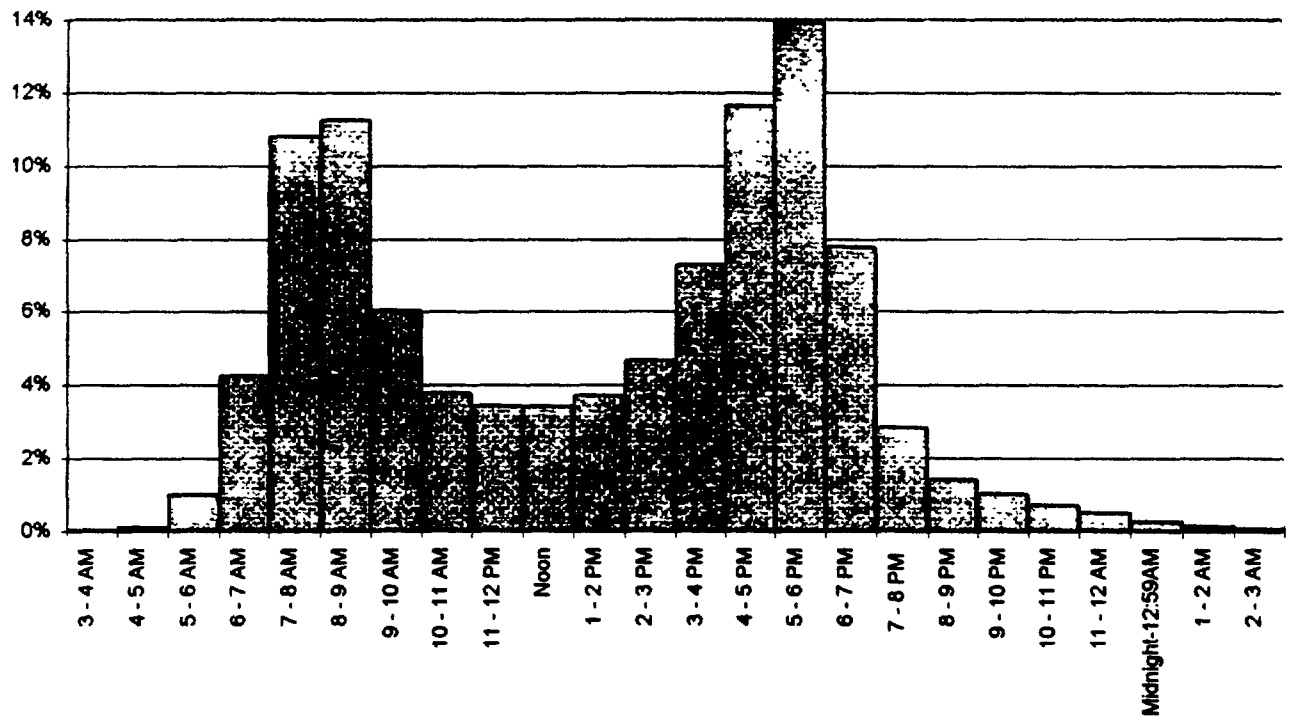


Exhibit 10: Percentage of Calls by Each Hour (Monday - Thursday)



4.2.1. Demographics

Exhibit 11 summarizes key demographic characteristics of the surveyed users and indicates that the cellular and land-line callers differed in several respects. Exhibit 12 shows that the users (as a group) had several demographic characteristics which distinguished them from the target population. Each characteristic is described below.

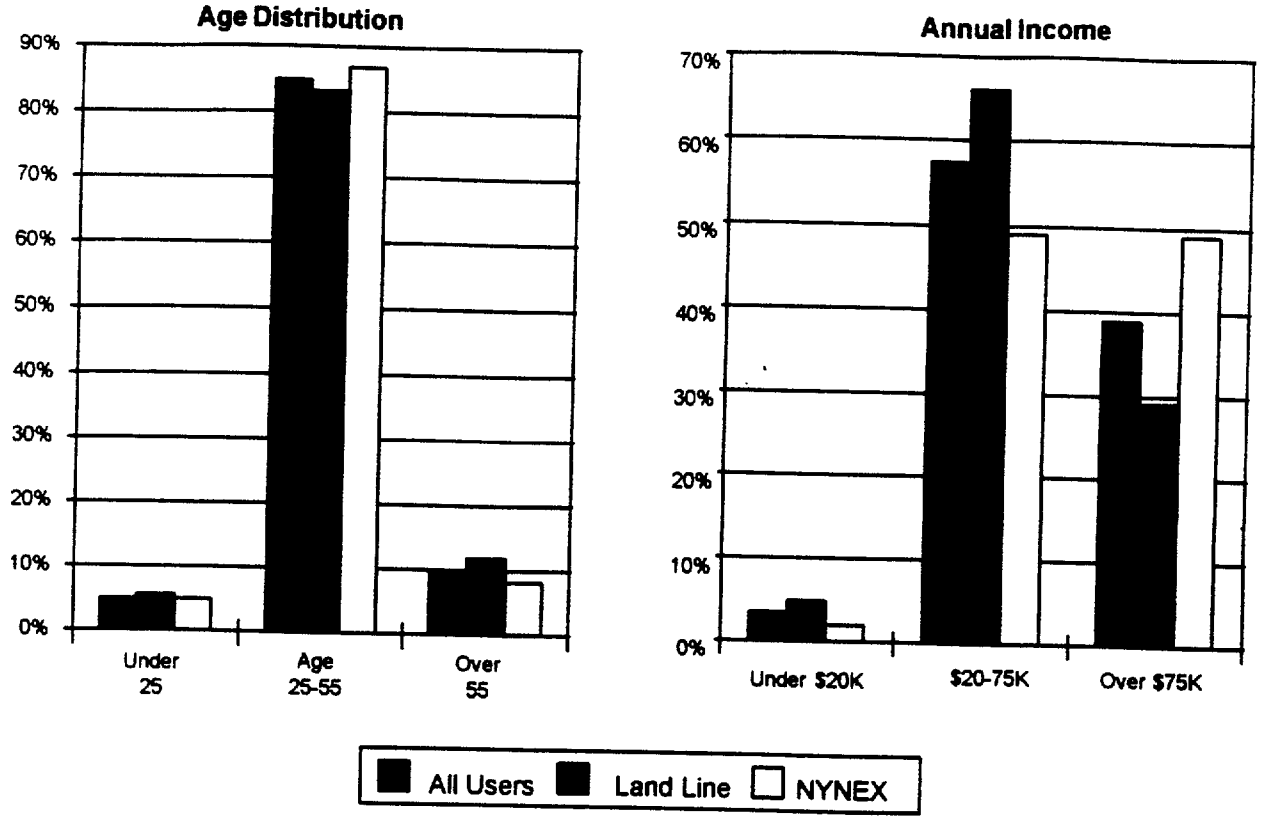
Cellular Phone: Cellular phone availability is an important user characteristic because cellular phones make ***SmarTraveler*** use both more convenient and more useful; multiple calls can be made while the user is in the vehicle, immediately before critical routing decisions. Also, taking the time to make the call does not delay the caller's departure, which can be the case for a land-line caller. Therefore it is understandable that a high proportion of calls to ***SmarTraveler*** were from cellular phones and those using cellular phones called ***SmarTraveler*** more frequently. Calls from cellular phones represent 56% of all calls to ***SmarTraveler*** and the survey analysis was adjusted to reflect this distribution. However, cellular users make more frequent calls to ***SmarTraveler*** and actually represent only 42% of the user population This proportion of the user population is higher than the percentage of the target population that had access to a cellular phone (28%). Thus, it appears that having a cellular phone makes one more likely to be a ***SmarTraveler*** user, and furthermore makes one more likely to ***call SmarTraveler*** more frequently .

During the operational test, NYNEX callers enjoyed free calls to ***SmarTraveler,*** while Cellular One customers faced regular cellular charges (except during a brief promotional period). One might therefore expect NYNEX users to ***be*** a higher proportion of ***the SmarTraveler users*** (and of the cellular users) than they are of the target population, which was true. While Cellular One customers were about twice as prevalent as NYNEX customers among the target population, the number of NYNEX customers was six times the number of Cellular One customers among the ***SmarTraveler users.***

Gender: Males constituted a higher percentage of ***SmarTraveler user***s (56%) than of the target population (46%). However, among ***SmarTraveler*** land-line users, the percentage of males (46%) was essentially identical to the percentage of males in the target population who did not have access to a cellular phone (45%). In contrast, cellular callers to ***SmarTraveler*** are predominantly male (69%) even though males represent only about half (49%) of the target population with access to a cellular phone. Apparently ***SmarTraveler*** is particularly attractive to males with cellular phones.

Income: The household income of ***SmarTraveler users*** is higher than that of the target population. This is most noticeable in the lowest and highest income groups – under $20,000 and over $75,000. For example, only 3.5% of ***SmarTraveler*** users have household incomes under $20,000, compared to 18% of those in the target population. As many as 39% of

Exhibit 11: Demographics of Surveyed Users



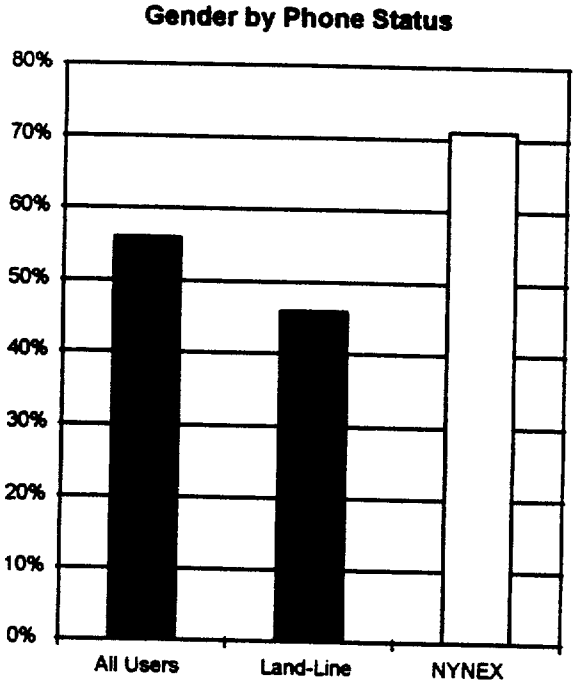
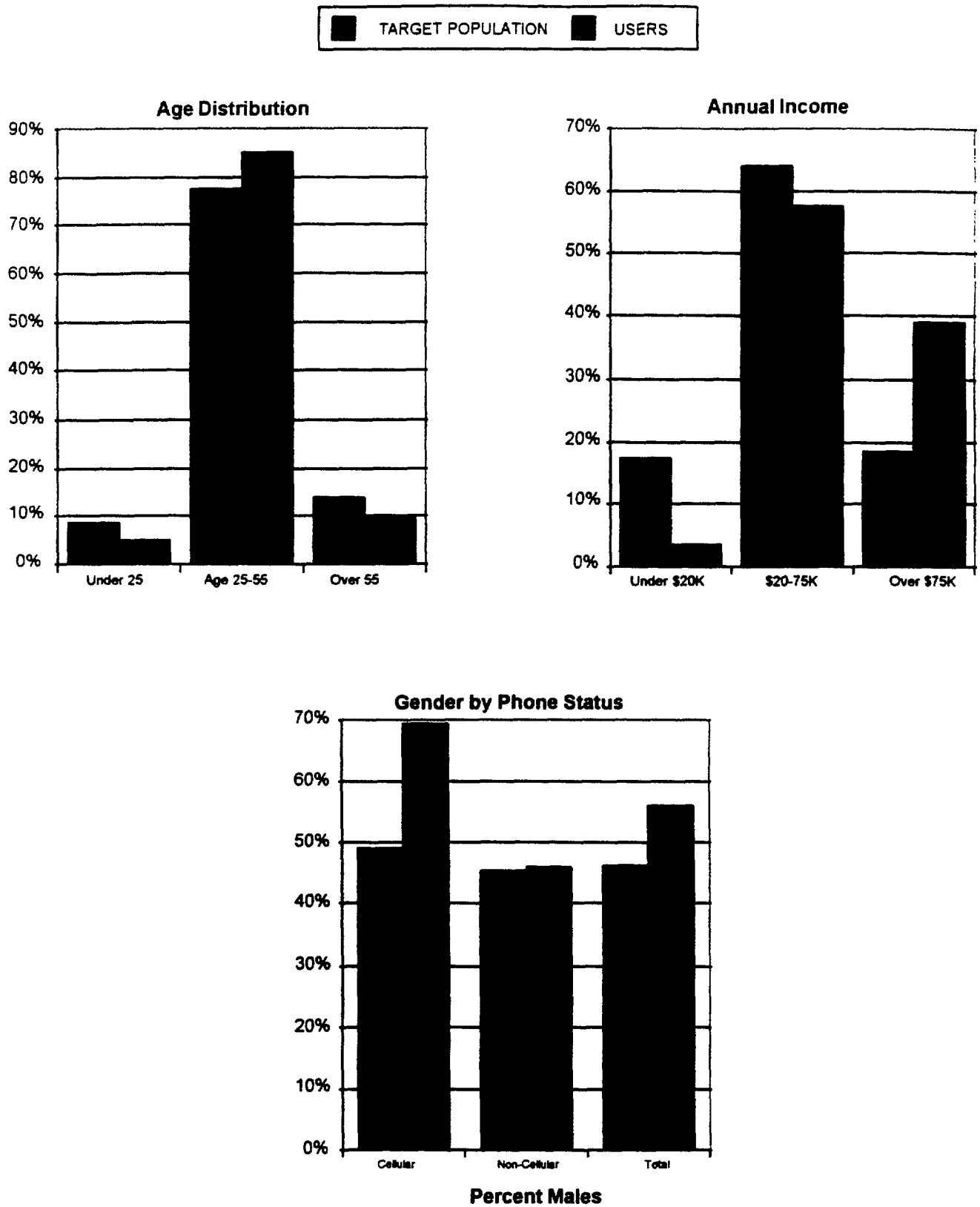


Exhibit 12: Demographics of Users and Target Population



SmarTraveler users have household income over $75,000, compared to only 19% of those in the target population.

Among ***SmarTraveler*** users, it is not surprising to find that the household income of cellular-based callers is significantly higher than that of land-line callers. For example, 51% of cellular callers have incomes over $75,000, compared to 29% of land-line callers. While the incomes of land-line users display less pronounced differences from the target population, they are also clearly higher. In fact, the percentage of ***SmarTraveler*** land-line users with income over $75,000 (29%) is almost twice that of respondents in the target population who do not have access to a cellular phone (15%). Similarly, the percentage of ***SmarTraveler*** callers with cellular phones having incomes over $75,000 (51%) is considerably. higher than the percentage of the target population with cellular phone access who have this level of income (29%). These results confirm that ***SmarTraveler*** has particular appeal to higher income individuals.

Age: Most ***SmarTraveler*** users (85%) are of "prime" working age (i.e., between 25 and 54), while only (76%) of the target population is in this group; the target group had a higher percentage in both the "under 25" group and the "55 and over" group than did the user population. Among the users, the use of a cellular phone is particularly unlikely for those in the 55 and over group (especially over age 65, although members of the target population over 65 are also less likely to have a cellular phone).

4.2.2. Trip and Callmaking Characteristic

This section describes the callmaking characteristics of ***SmarTraveler*** users and the trips for which these users called ***SmarTraveler.*** In addition, the characteristics of these trips are compared to a random sample of trips on major highways and public transportation made by respondents to the target population survey. Exhibit 13 contrasts the key trip characteristics of the users with that of the target population. Several trip characteristics distinguish the users, and these are described below. Exhibit 14 contrasts the trip characteristics of NYNEX cellular and land-line users of ***SmarTraveler.***

Trip Purpose: SmarTraveler callers were considerably more likely to be making work trips. Traveling to and from work was the purpose of ***64%*** of ***the*** trips for which ***SmarTraveler*** users were seeking information. This contrasts with 48% of the sample of trips of the target population. Business trips constituted similar percentages of trips by the user and target populations (17% versus 16%). The predominance of work trips among the users may be because of congestion during commuting hours and/or because work trips are the most time sensitive.

Travel Mode: ***SmarTraveler*** users are more likely to be using private vehicles as the usual mode for their trip than the average traveler in the target population. This is consistent with the fact that the vast majority of requests for facility information fiom ***SmarTraveler*** is for highway facilities. As many as 94% of ***SmarTraveler*** users surveyed indicated that they used a private

Exhibit 13: Characteristics of Sampled Trips
(Page 1 of 3)

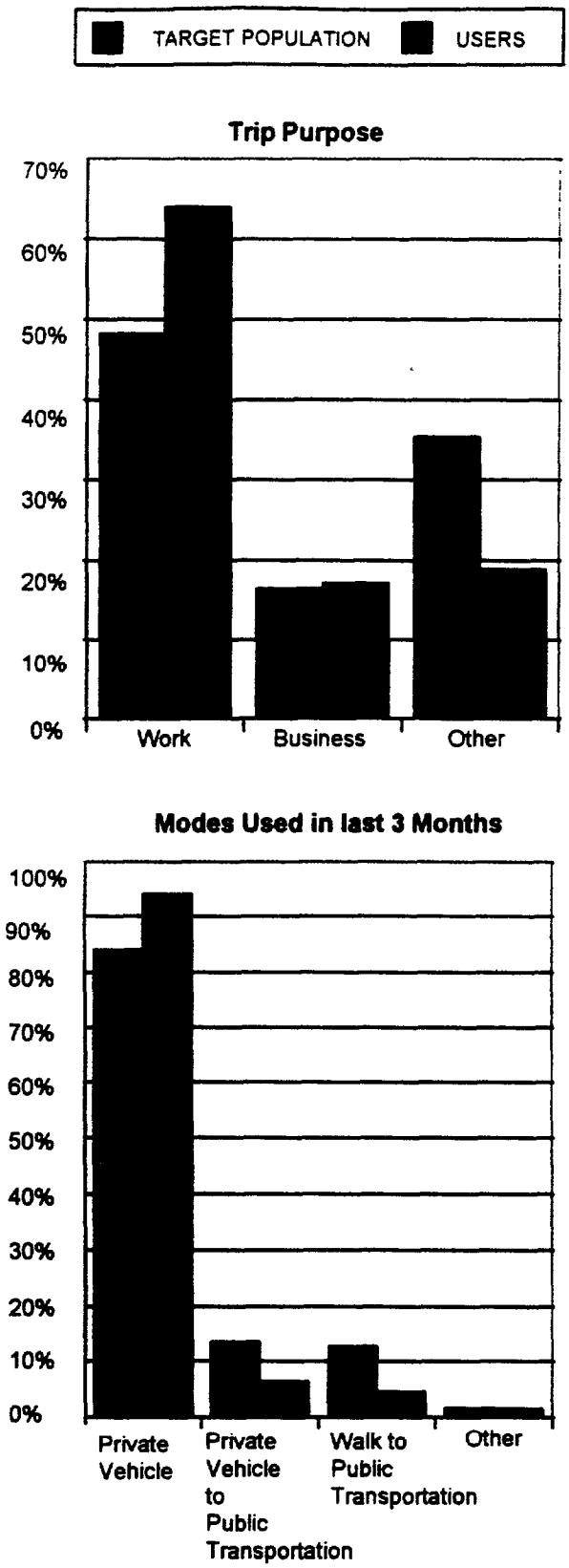


Exhibit 13: Characteristics of Sampled Trips
(Page 2 of 3)

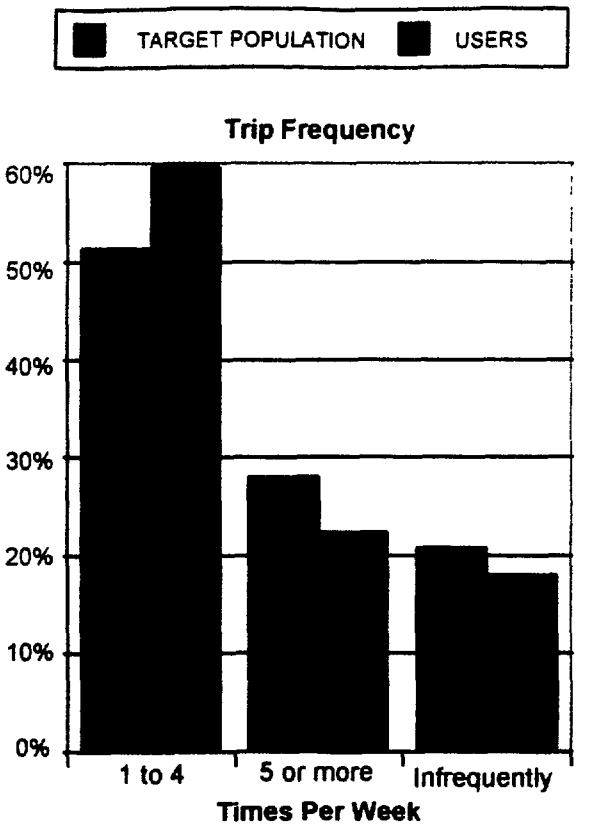
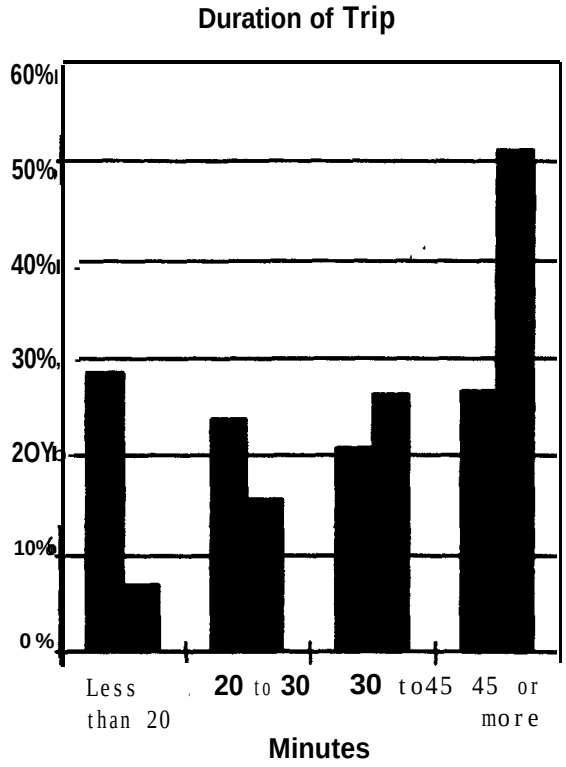


Exhibit 13: Characteristics of Sampled Trips
(Page 3 of 3)



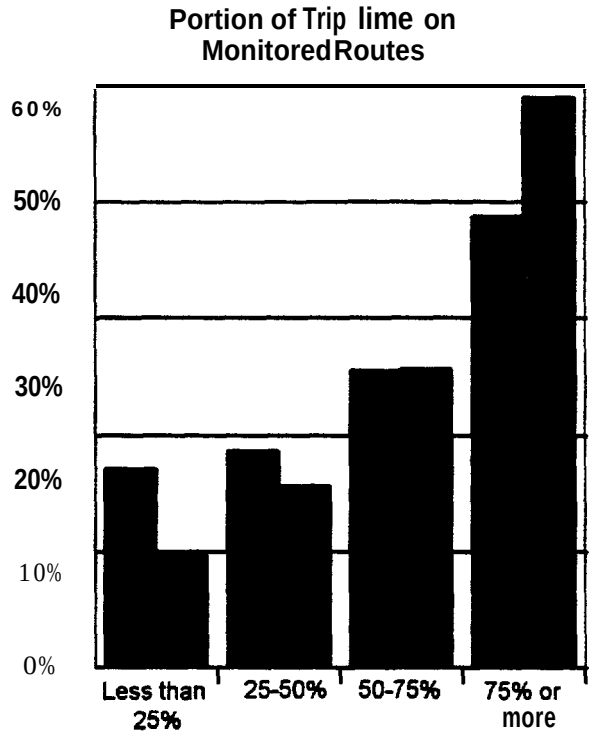
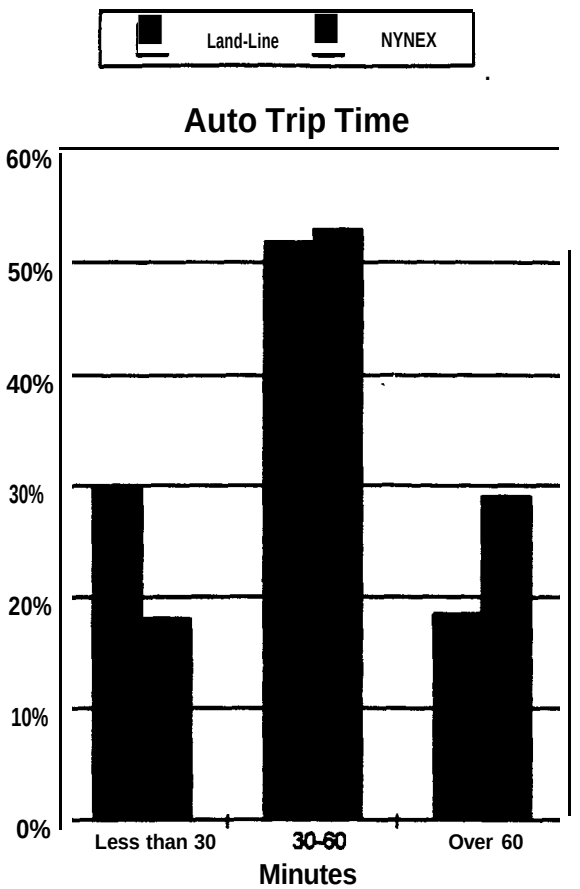


Exhibit 14: Characteristics of SmarTraveler Trips



vehicle at least on some days to make their trip. (Also, 94% of those users who reported that they always made this trip by the same mode did so entirely by private vehicle.) In contrast, among the target population, only 84% said that they used a private vehicle at least on some days. (Of those in the target population who always traveled by the same mode, only 83% did so entirely by private vehicle.)

Correspondingly, transit users are underrepresented in the ***SmarTraveler*** user population. Only 4.5% of users indicated walking to public transportation at least some of the time in the past 3 months for their trip, compared to 13% of the target population. The percentage of travelers who used private vehicles to access public transportation with private vehicle access was 6.5% for the user population versus 13% for the target population. Of course, fewer respondents to the surveys use public transportation all the time. Only 2.2% of ***SmarTraveler*** users who always made their trip by the same mode indicated walking to public transportation, and another 3.5% by driving or getting a ride to public transportation. In contrast, 7.7% of the target population respondents who use the same mode all the time indicated walking to public transportation and 8.3% using private vehicle access to public transportation.

Among ***SmarTraveler*** users, the type of public transportation used was about equally likely to be rapid transit (50%) or commuter rail (54%, multiple answers were possible), while among the target population, there was considerably less use of commuter rail (54% for rapid transit versus 19% for commuter rail). The relatively lower utilization of ***SmarTraveler*** by transit users may reflect the level of specificity and accuracy of transit information provided and/or the general perception that ***SmarTraveler*** is an automobile-oriented service. The greater relative share of commuter rail users among ***SmarTraveler*** users who use public transportation may be due to the greater usefulness of commuter rail delay information to riders who plan their arrival to meet scheduled trains rather than arrive randomly to use frequent rapid transit service.

Trip Frequency: SmarTraveler callers were asked how often they make the particular trip about which they were being interviewed. As many as 60% of the callers made the trip daily (i.e., five or more times per week), while only 18% said they made the tip infrequently. While the share of infrequent travelers was essentially the same for land-line and cellular calls, land-line calls were more likely to be made for daily trips than were NYNEX calls (65% versus 56%). Among the target population, 5 1% made the trip five or more times per week, while 21% made the trip infrequently. Thus, it appears that there is some greater tendency to use ***SmarTraveler*** for frequent trips, which is likely to correlate with trip purpose (specifically commuting trips in times when there is congestion).

Call Frequency: As stated previously, NYNEX callers use ***SmarTraveler*** more frequently than Cellular One or land-line callers (i.e., an average 3.1 calls per week for NYNEX callers versus 1.7 calls for land-line callers). A much higher percentage of NYNEX calls were for trips for which the respondent said they called ***SmarTraveler*** every time the trip was made. Those who

Exhibit 15; Reasons for Calling Sometimes But Not Others

	Land-Line (%)	NYNEX (%)
Bad Weather	58	54
When Anticipating Congestion	52	71
When Time is Critical	25	30
Particular Time of Day	22	34
When Running Late	20	25
When I have Access to a Phone	15	21
When I see Congestion	13	46
When Using the MBTA	5	3
Other	13	8

indicated they did not call every time were asked whether each of the reasons presented in Exhibit 15 influenced their decision whether to call.

The expectation of congestion seems to be a major determinant of both land-line and NYNEX calls. It is not clear on what these expectations are based, but weather seems to be a key factor. Information from radio and television reports may be another. Seeing congestion ahead appears to be a major factor for NYNEX callers since they have the opportunity to call enroute "When time is critical," "time of day," and "running late," seem to be important to some callers (slightly more for NYNEX callers). Access to a telephone did not seem an important factor for most users. The major "other" reasons consist of first time users who have not developed a regular usage pattern and land-line users who said that they don? always remember to call.

Since they have mobile phones, NYNEX callers can choose to obtain traffic information at any time. It appears that some NYNEX users call every time they make their trip, probably as they approach a key decision point, but a significant number wait and decide whether to call based on observed traffic conditions. Land-line callers must decide whether to call before their trip starts, and thus may be obtaining information that will no longer be current by the time it applies. Many land-line callers may decide whether to call ***SmarTraveler*** after other sources, such as weather reports and radio/TV traffic reports, lead them to believe they will face unusual traffic conditions; few of these callers seem to feel that they would benefit from calling every time.

Trip Length: The survey results indicate that ***SmarTraveler*** trips are typically long trips in terms of mileage and travel time. Overall, about 55% of calls were for trips over 25 miles in length. In terms of travel time, 5 1% of the ***SmarTraveler*** callers using private vehicles were making trips over 45 minutes long as were 56% of those ***SmarTraveler*** users using public transportation. These reported trip lengths are very long for the Boston metropolitan area, and appear to indicate that the typical ***SmarTraveler*** caller has an atypically long commute. For example, among the target population, only 30% of trips were over 25 miles, and only 27% of those using private vehicles and 30% of those using public transportation were over 45 minutes long . The fact that travelers making relatively long trips are most attracted to ***SmarTraveler*** has important implications for the size of its potential market

It is also interesting to note that the percentage of NYNEX calls for long trips was greater than the percentage of land-line calls for such trips (i.e., 65% of NYNEX calls were for trips over 25 miles versus 43% for land-line calls). This could be because people with longer trips are more likely to have car phones, or because people calling from land-line phones are not likely to be able to obtain information that will be useful for the latter part of a long trip. Automobile trip times showed the same tendency that was exhibited by trip lengths, with longer trips by NYNEX users.

Time on Monitored Routes: Nearly half (49%) of the ***SmarTraveler*** callers indicated that they spent at least 75% of their trip time on ***SmarTraveler-monitored*** routes, and three-quarters spent

at least 50% of their trip time on these routes. Thus, it appears that most calls are generated for trips that include a large percentage of their time (and most likely, au even larger percentage of their distance) on the monitored routes.

The target population was less likely to spend much of their travel time on monitored routes. Only 39% reported that they spend 75% or more of their travel time on monitored routes and only 64% spend 50% or more. Thus, there is a greater tendency to use ***SmarTraveler*** among those whose trip is primarily on a monitored route.

It is interesting that trips by NYNEX callers showed a slightly greater percentage of time spent on monitored facilities than trips by laud-line callers. It might be expected that NYNEX callers would spend a larger share of time on monitored facilities since their trips tend to be longer. However, the difference may also support the hypothesis that land-line callers do not use ***SmarTraveler*** for trips where only a small portion is on monitored routes, especially if that portion is at the end of the trip, when pre-trip travel information may no longer be valid.

Routes Used: Survey respondents who used private vehicles were asked which highways they used for their trip, and responses were recorded for 39 major highway facilities (including the 20 SmarTraveler-monitored highway facilities). The five facilities most commonly mentioned by the users are Route 128/I-95 (north side) at 35%, Route 128/I-95 (south side) at 24%, I-93 north of Boston at 23%, the Southeast Expressway/Route 3 at 21% and the Massachusetts Turnpike/I-90 at 12%.

Among the target population, the most commonly mentioned facilities are Route 1280-95 (north side) at 24%, Route 128/I-95 (south side) at 15%, I-93 north of Boston at 13%, Southeast Expressway/Route 3 at 13%, Route 9 at 11% and Route 495 (north side) at 11%. While the four most commonly mentioned routes are also the most likely to be used by ***SmarTraveler*** users, there are some routes that are over- or under-represented among the user group. It is not surprising that the largest differences between users and the target population were for the four routes most mentioned by both groups; about 5-10% more users mentioned these routes than the target population at large. The reverse effect was found for Route 9 which was mentioned by 6% fewer users than the target population at large.

Perhaps the best way to examine these differences is to focus on the ratio of the percentage of ***SmarTraveler*** users to the percentage of the target population that cite each route. This comparison indicates greater relative popularity of the Massachusetts Turnpike and I-93 north of Boston among ***SmarTraveler*** users. In analyzing the differences between the percentage of the users and the target population who cited specific routes, it is important to keep several factors in mind: Users may be most likely to use ***SmarTraveler*** on routes with more congestion, with more variable travel times and where an alternative route is practical. For example, the Southeast Expressway/Route 3 is one of the most congested roadways, while I-93 north of Boston and the Massachusetts Turnpike are congested routes that have alternatives (e.g., Route 9 and Route 28).

Since ***SmarTraveler*** users make longer trips and since some routes are more likely to be used for long trips while others are not, such routes are likely to be overrepresented in the user sample. For example, the Massachusetts Turnpike may be used for longer trips while Route 9 is not.

Other reasons for differences between users and the target population in citing particular routes include: 1) users cited a larger number of routes on average, which increases the percentage of users mentioning any given route relative to the target population, and 2) fewer users indicated that they use none of the listed routes.

Among users, the pattern for NYNEX cellular calls differed sligbtly from that of land-line calls. NYNEX callers were more likely to use highways to the south of Boston such as Routes 3 and 24 as well as the southern portions of I-95, I-495 and Route 128. Highway usage patterns to the north of Boston were similar for NYNEX and land-line callers, except on Route I-495, which showed greater usage by NYNEX callers.

These percentages are generally higher than one would have expected based on the facility requests made when the user called ***SmarTraveler*** and was intercepted, suggesting that callers may be requesting reports on only a subset of the facilities they actually use. Over half (54%) of the callers indicated that they used two or more of the 20 monitored facilities listed. Over 21% indicated use of three or more facilities, with an average of 1.8 facilities per respondent. This contrasts with the target population which averaged only 1.4 facilities per respondent.

The most mentioned unmonitored route among the ***SmarTraveler*** users was Route 3 between Cambridge and Burlington (3.8%), although some of Route 3 (Memorial Drive in Cambridge) is included in ***SmarTraveler's*** "'Downtown Routes" facility (Route 'a"). Next were Route 16 at 2.7% and Route 1A at 2.4% (although part of Route 1A is included in the Logan Airport monitored "facility"). As many as 3% of ***SmarTraveler*** callers named none of the 20 monitored routes.

Among the target population, the most mentioned unmonitored route was Route 20 (3.9%). This was followed by Routes 16, 1A and 3 between Cambridge and Burlington (all at 3.2%), and then by Route 3A (2.4%) and Route 28 (2.1%). Only 6.9% of those respondents who used major highways indicated that they used none of the 20 monitored routes.

Cost for Using SmarTraveler: User survey respondents were also asked whether they thought they were being charged for using the service. Nmety-one percent of NYNEX callers correctly answered that there was no charge; 6% did not know and 3% thought that there was a charge. Except during October 1993, Cellular One callers were charged for their calls, but only 29% of Cellular One callers said that there was a charge; 46% did not know and 25% said that there was no charge; this confusion may have been caused by the "'free" promotion or because these users' phones are provided by employers who also pay their cellular phone bills. Note that land-line callers arc charged their normal telephone charges for the call, which may be free or not,

depending on their telephone service plan. Of land-line callers, 70% said that there was no charge, 23% did not know, and only 7% thought that there was a charge.

4.2.3. Satisfaction with Travel Information

Perceived Benefits of SmarTraveler: When asked about the benefits they received on their particular trip ***as*** a result of calling ***SmarTraveler,*** 70% of the users reported reduced frustration, 64% reported the ability to avoid a traffic problem, 6 1% reported that they had saved time, and 52% reported that they were aided in arriving on time (multiple answers were possible), Those who made changes in time, route, or mode from their normal trip were more likely to say that they saved time or avoided a problem. The percentage who reported receiving each benefit was higher for NYNEX callers than for land-line callers, but differences between the two groups were not dramatic. However, while only 3% of the NYNEX callers reported not receiving any benefits, fully 7% of the land-line respondents said they had received no benefit on this particular call.

Importance of Service Characteristics: User survey respondents were asked to rate, on a scale of 1 to 10, the importance of several characteristics of a travel information service, and then were asked to rate their satisfaction with ***SmarTraveler*** on each of these characteristics. Those chosen as most important were that the service be accurate, free of charge, cover mjor roadways and be up-to-the-minute (in that order). These are the same characteristics rated as most important (in the same order) by the target population. However, users generally gave a higher importance rating in each case than those in the target population. For example, 82% of ***SmarTraveler*** users rated accuracy of information as very important compared to 64% of the target population. It is not surprising that the users of ***SmarTraveler*** are travelers who attribute greater importance to most characteristics of travel information.

Exhibit 16 compares the percentage of ***SmarTraveler*** users and of the target population who rated each characteristic "very important" (i.e., rated 10 out of a possible 10). It is evident that there is a fairly consistent relationship between the ***SmarTraveler*** user ratings and those of the target population, with the ***SmarTraveler*** users more concerned about every characteristic, but with the least emphasis on the coverage of public transportation and secondary routes. Among the characteristics, the greatest difference in the average ratings of the two groups was for availability of information on demand. The average rating for this characteristic (see Exhibit 17) also exhibits the largest difference between the two groups; availability on demand is one of the most important ways in which ***SmarTraveler*** differs from other available information sources. Other characteristics which exhibited large differences in importance ratings between the two groups were coverage of major routes and up to the minute information. The emphasis on coverage of major routes by the ***SmarTraveler*** users may be associated with the fact that users make longer trips and have a greater tendency to use the major routes now covered by ***SmarTraveler.*** Up to the minute information, like availability on demand, is one of the ways in which ***SmarTraveler*** differs from competing information sources.

Exhibit 16: Importance of Information System Characteristics Ratings of Survey Population

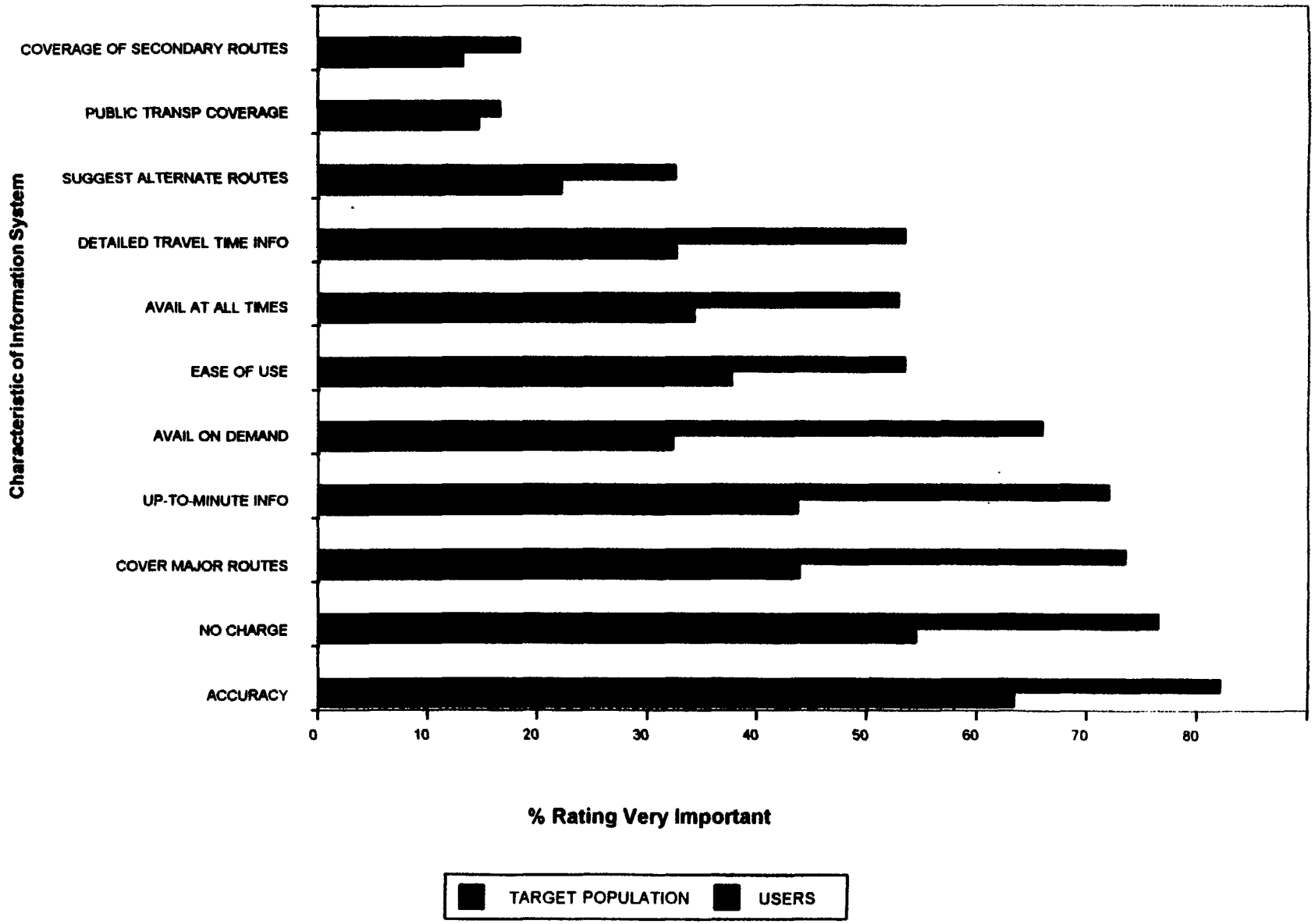
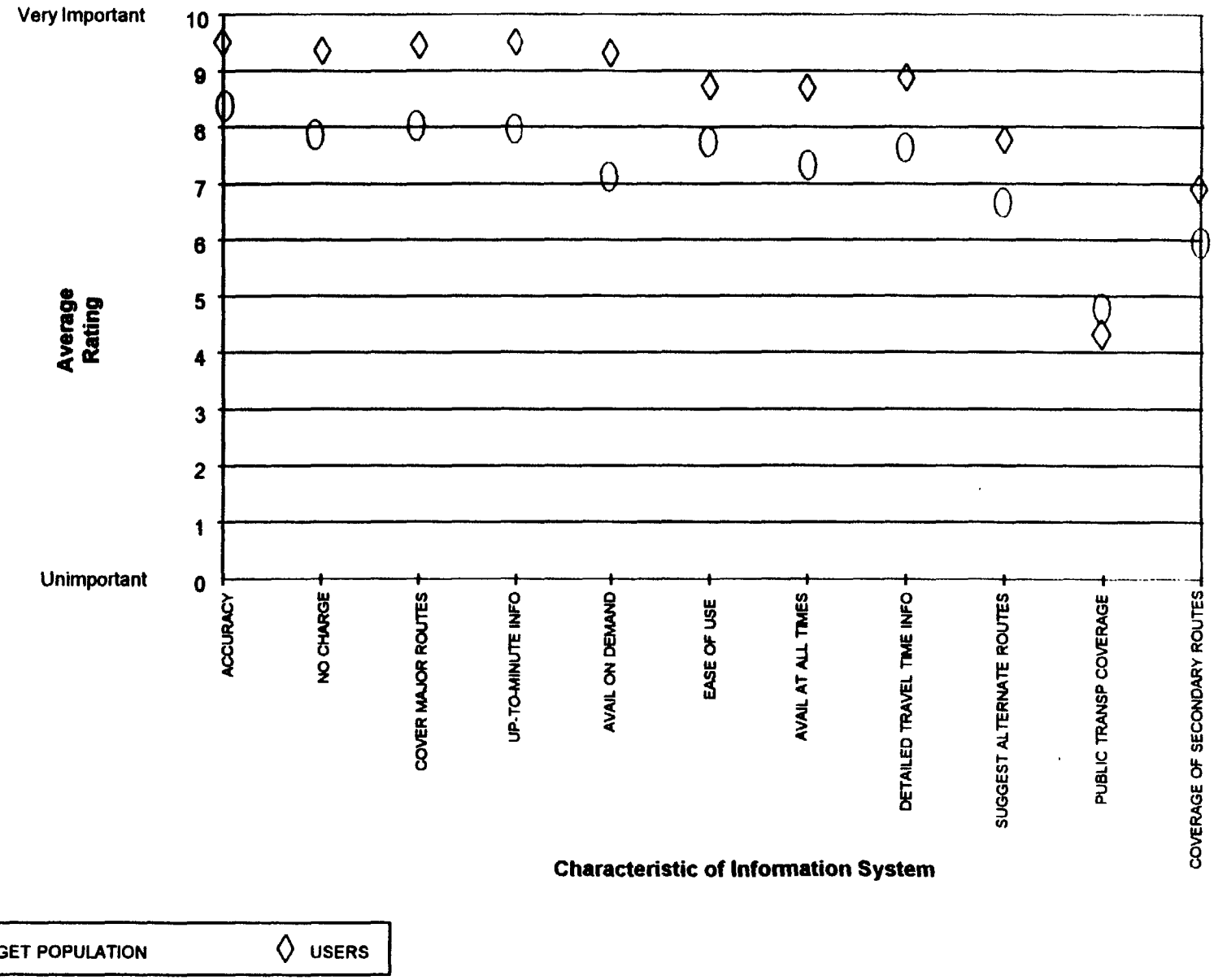


Exhibit 17: Importance of Travel Information System Characteristics



One characteristic that might have been expected to be less important to the users would be no cost to use ***SmarTraveler,*** since the users place a value on receiving this information, but this was not the case. Perhaps ***SmarTraveler*** users were more concerned that their answer would influence a change in ***SmarTraveler*** pricing policy that would directly impact them.

Satisfaction with Service Characteristics: Users' satisfaction with ***SmarTraveler's*** service characteristics was quite high. Exhibit 18 shows the average ratings for each characteristic and the percent rating the service below a "5" (indicating some degree of dissatisfaction). Considering the average rating, two characteristics -- not having a charge and providing information on demand -- were rated above "9" and both of these were rated over "9" in importance as well. In fact, of the eight characteristics rated above "8" in importance, all were rated above "8" in satisfaction. The lowest average satisfaction rating was for public transportation coverage, secondary route coverage and suggestions for alternative routes, in that order. Public transportation coverage, however, was the only characteristic rated under "5" in importance.

The percentage of users who rated ***SmarTraveler*** less than "5" (out of 10) was relatively small. The same three characteristics as above stand out as problems; public transportation coverage received the largest percentage under "5" (23%), followed by secondary route coverage (12%), and suggestions for alternative routes (10%) (see Exhibit 19).

Interestingly, there were differences in satisfaction between the cellular and land-line users. Land-line callers rated ***SmarTraveler*** higher than NYNEX callers in 9 of the 11 areas and 3 of the 4 most important areas mentioned above. The only two rated higher by NYNEX users were "no charge" and "ease of use," which may reflect the Wee" service and the two-digit speed dialing that NYNEX callers enjoy.

When asked whether ***SmarTraveler*** provided all the types of information they desired from a travel information service, about two-thirds (68%) of users indicated that it did. Similarly, more than half (60%) offered no suggestions about how the service might be improved. Consequently, it is not surprising that 83% of the land-line users and 86% of the NYNEX users rated the service an "8" or better. Fully 97% expected to call again; half of the 59 respondents who did not were land-line callers and half were Cellular One callers. (The above percentages have been adjusted for frequency bias.)

Exhibit 18: Satisfaction with Their Information System

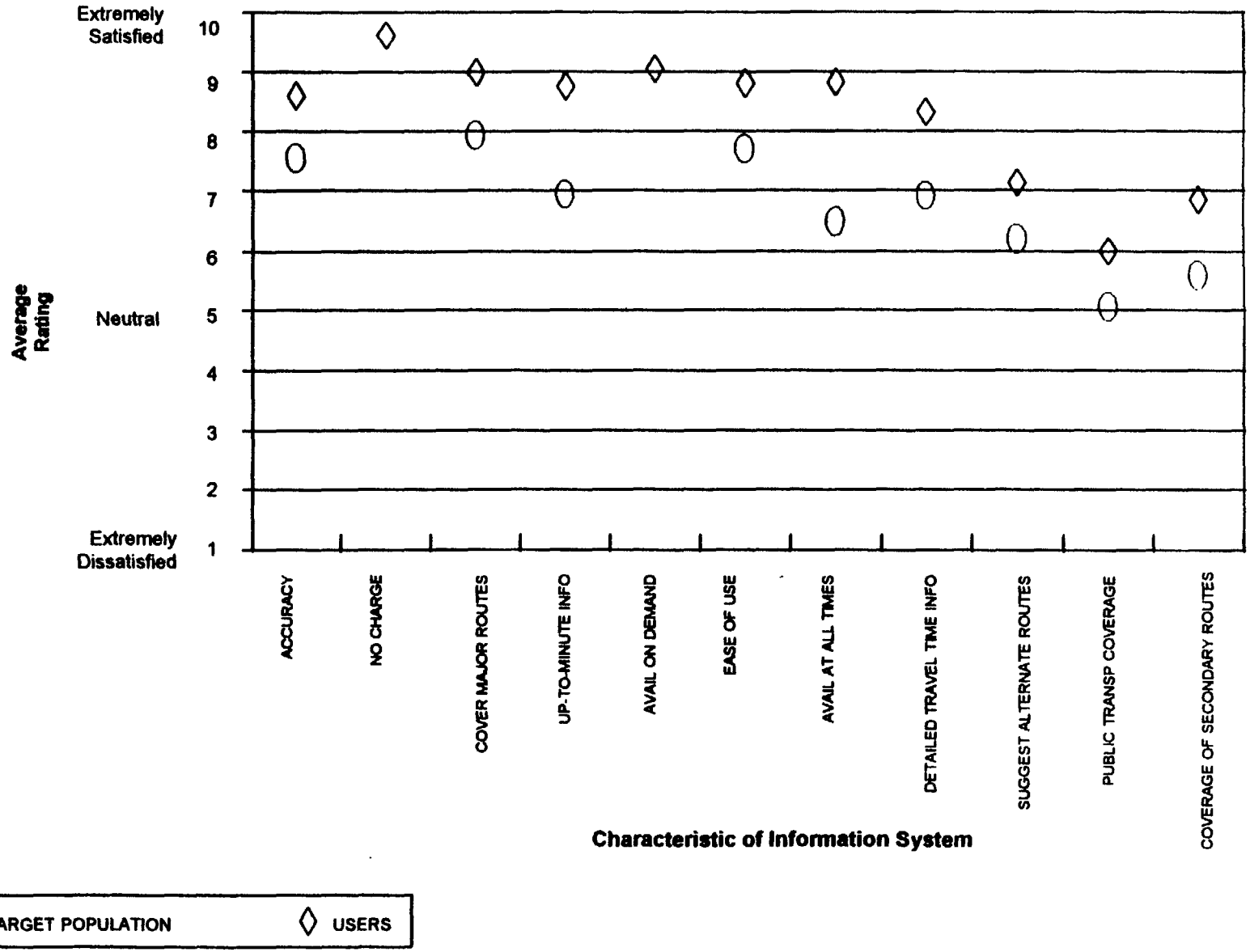
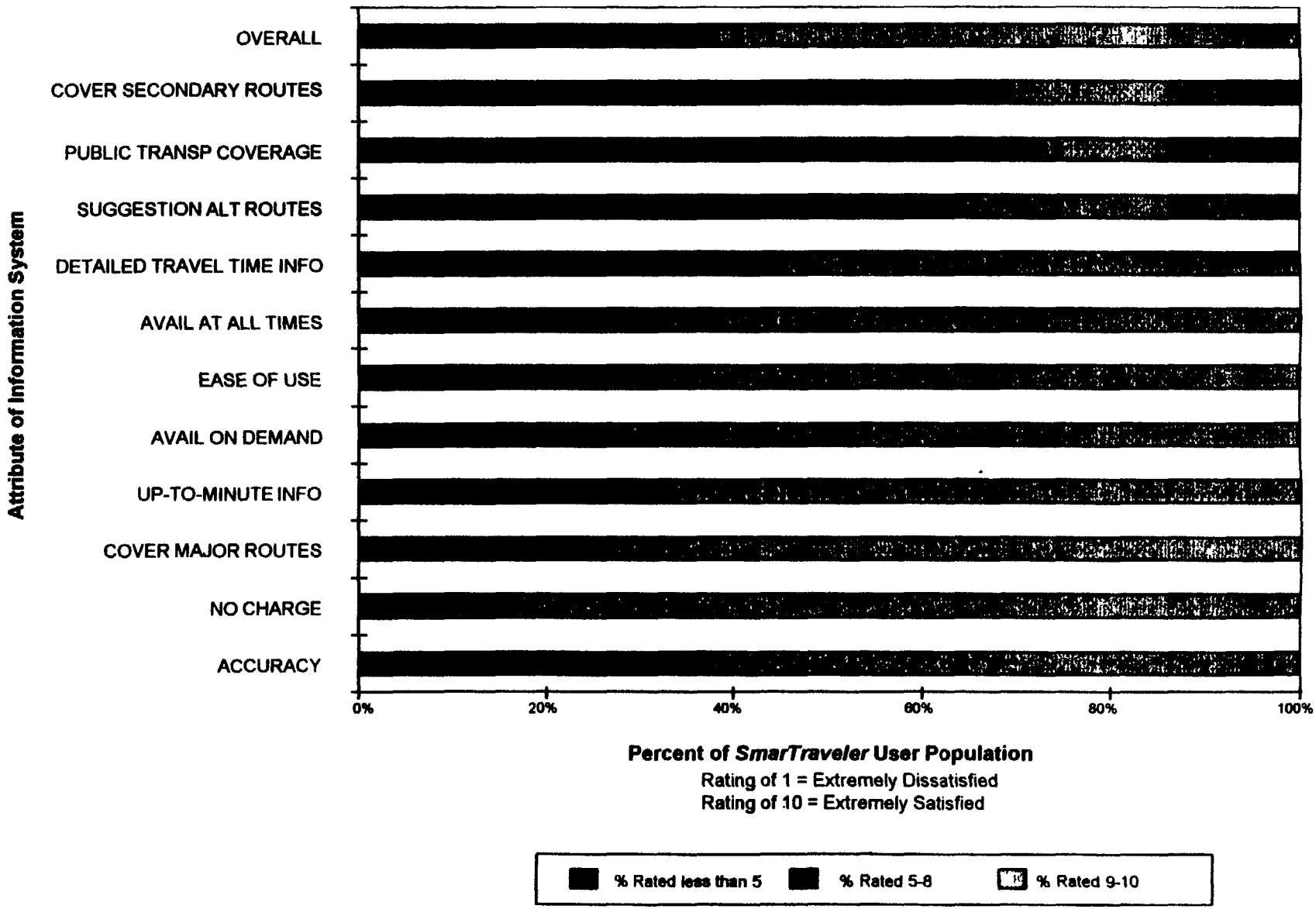


Exhibit 19: Satisfaction with *SmarTraveler*



5. ESTIMATED IMPACTS ON TRAFFIC CONGESTION

Based on the number of calls being processed by ***SmarTraveler*** each day and the fact that the calls cover virtually the entire metropolitan area, it is clear that any impacts of the service on traveler mode choice and traffic congestion 'to date are far too small to be measured directly. However, the responses of surveyed users provide an indication of how ***SmarTraveler*** information is being used, and by inference what its impacts are. In a survey where multiple uses could be reported for a given trip, 28.4% of the respondents reported making some kind of change in their travel behavior in response to the information they received during the particular call about which they were being questioned, and another 19.8% indicated that they used the information to choose between two or more relatively equal alternate routes (implying that some indeterminant percentage took a different route than they would have without ***SmarTrveler*** information and while others did not). The most frequent reported changes were "changing the time of departure" (13.6%), "using a different route" (10.8%), "canceling the trip" (2.0%), and "changing both route and time" (1.1%). Only 0.7% indicated they had switched from a private vehicle to transit in response to the information they received, and 0.2% indicated they switched from transit to a private vehicle. Most of the remaining callers in some way used the information they received to verify that their preferred route would be viable. About 7.5% indicated that they acted on the information they received by contacting others to indicate that they would be delayed.

6. POTENTIAL MARKET FOR *SMARTRAVELER* SERVICES

6.1. POTENTIAL MARKET FOR *SMARTRAVELER*

SmarTraveler can be used by anyone who makes a trip during its service hours by public transportation or by automobile on any one of the 20 monitored routes or the 3 reported public transportation services. Using this broad definition, the potential market for ***SmarTraveler*** is very large.

The target market survey (see Section 3.2) was designed to explore this potential further by interviewing people aged 17 and over who make trips on major highways or public transportation and live within or along I-495. This area contains 2.77 million people over the age of 17 and, according to data provided by the Central Transportation Planning Staff, about 2.59 million of these travel on any given weekday. While the target market population survey was completed only for those people making highway or public transportation trips on a specific day, the screening process (used to identify appropriate people to survey) indicated that 67% of those making trips on that day made at least one trip that involved either a major highway or public transportation. These numbers imply that on an average weekday, about 1.73 million people make at least one trip that could potentially make use of ***SmarTraveler*** information. The survey further indicated that those people make an average of 2.9 one-way highway or public transportation trips each day for a total of 4.96 million daily highway or public transportation trips in the ***SmarTraveler*** service area. Further questions about these trips determined that 93% of these, or 4.67 million, use either public transportation or one of the 20 ***SmarTraveler***-monitored highway facilities. Thus, if one assumes that on average ***SmarTraveler*** users call once per trip, the average 4000 daily calls ***SmarTraveler*** receives represent less than 0.1% of the potential market. Clearly, there has been very limited penetration of the target market if one uses this broad definition.

However, in reality, not all travelers in the target market could realistically receive benefits from using ***SmarTraveler*** for all "eligible" trips. Many trips are made along portions of the highway system or at times of day where congestion and delays are rare, or the individual traveler or type of trip may not be particularly sensitive to travel time variation and delays. Thus, the true market for the service is likely to be considerably smaller than the millions of daily trips indicated above. The service may only be beneficial for certain types of trips or be considered useful by only certain categories of travelers.

In an effort to identify more narrowly defined "core" market segments for the service, the target group survey and the ***SmarTraveler*** user survey results were compared to highlight both the types of trips and types of travelers that are most likely to use ***SmarTraveler. (SmarTraveler*** users were compared to the target population in Section 4.2 above. In the following two sections, several characteristics that appear to indicate trips or travelers with greater potential for

SmarTraveler use are identified and the size of each market segment is estimated. In subsequent sections, results from the target market suirvey are used to assess travelers' desire for travel information and their satisfaction with available radio and television traffic reports, to project use of ***SmarTraveler*** by travelers who were previously unaware of the service, and to estimate the impacts of charging a fee for the service.

6.2. POTENTIAL *SMARTRAVELER* CORE MARKET(TRAVELERS)

In the comparison between the market identified in the target group survey and the callers identified in the user survey, several characteristics stand out as indicative of a greater likelihood of being a ***SmarTraveler*** user. These characteriscs are: 1) having a car phone (particularly for men), 2) high income, and 3) being of prime working age (i.e., 25 to 55). Each of these characteristics are discussed below along with the estimated size of that market segment.

Having a Car Phone: SmarTraveler's cellular phone users tend to call more frequently, and having a cellular phone also appears to indicate a higher likelihood of being a ***SmarTraveler*** user. (While it is difficult to explain the survey results also show that men have a greater likelihood of being a ***SmarTraveler*** user if they have a cellular phone, while women have the opposite tendency.) Nevertheless, survey results indicate that 27% of the target population have access to a cellular phone, or about 470,000 of the 1.73 million in the target population.

Income: People in the highest income bracket (over $75,000 annually) were more likely to be ***SmarTraveler*** users, representing 40% of ***SmarTraveler users*** but only 19% of those in the target population. There are about 330,000 people in this key segment of the target population.

Working Age: People in the prime working age bracket of 25 to 55 were more likely to be ***SmarTraveler*** users; they represented 84% of all ***SmarTraveler*** users but only 76% of those in the target population. This may simply reflect a greater tendency to use the service for work trips. There are about 1.3 million people in this age bracket in the target population

In summary, while ***SmarTraveler*** holds some appeal for cellular phone owners, income level appears to be the most significant personal characteristic indicating the likelihood of being a ***SmarTraveler*** user.

6.3. POTENTIAL *SMARTRAVELER* CORE MARKET (TRIPS)

In the comparison of potential ***SmarTraveler*** trips identified in the target population survey to actual trips reported on in the ***SmarTraveler*** user survey, several characteristics stand out as indicative of trips for which a call to ***SmarTraveler*** is more likely. These characteristics are: 1) work trips, 2) trips made by automobile, 3) long trips, particularly greater than 25 miles in length, 4) trips where a majority of the time is spent on monitored highway routes, and 5) trips

using certain highway segments. Each of these characteristics are discussed below along with the estimated size of the associated market segment.

Work Trips: Work trips are much more likely to be ***SmarTraveler*** trips, representing 65% of ***SmarTraveler*** trips but only 48% of trips in the target market. This may indicate the time-sensitivity of work trips as well as the tendency of work trips to occur during congested periods. There are about 2.2 million work trips daily that could use the service.

Automobile Trips: Trips made only by public transportation were less than half as likely to be ***SmarTraveler*** trips. Trips made only by public transportation represent 16% of target population trips yet account for only 7% of ***SmarTraveler*** trips. This most likely reflects both the level of detail of public transit information and the perception that ***SmarTraveler*** is an automobile-oriented service. Automobile trips represent about 3.9 million daily trips in the potential market.

Long Distance Trips: The use of SmarTraveler was significantly greater for trips longer than 25 miles in length than for shorter trips. These trips represent 52% of ***SmarTraveler*** trips but only 30% of trips in the target market. ***SmarTraveler*** appears to be particularly attractive to travelers making relatively long trips. This key market segment represents about 1.4 million daily trips.

Trips Spent Primarily on Monitored Routes: - Trips with greater than 75% of the time spent on monitored routes were much more likely to use ***SmarTraveler*** than other trips. These trips represent 49% of ***SmarTraveler*** trips but only 39% of trips in the target population. ***SmarTraveler*** appears to be particularly attractive to travelers making trips that mostly involve travel on major highways. This key market segment represents about 1.9 million daily trips.

Trips Using Key Highways: While ***SmarTraveler*** reports on 20 different highway segments, several highway segments are used more heavily by ***SmarTraveler*** trips than by trips in the broader target market. While the share of ***SmarTraveler*** trips using a particular highway segment rarely exceeds twice the share of target group trips on the segment, I-93 North and the Massachusetts Turnpike have both higher usage by ***SmarTraveler*** users than the target population and have a relatively high level of usage overall. Travel on these two route segments represents about 600,000 daily trips, according to actual traffic counts.

In general, while the five key market segments identified above are smaller than the 4.67 million trips in the broadly-defined target market they still represent a large potential for ***SmarTraveler*** service. Although it is not clear from the user survey analysis to what extent it is the combination of these characteristics rather than individual characteristics that influence ***SmarTraveler*** usage, the target market survey indicates that the number of work trips, made by automobile, over 25 miles in length, and with more than 75% on monitored routes is still 15% of target trips. This would indicate a minimum of 690,000 daily potential ***SmarTraveler*** trips. Of course, other factors may also play a role in determining whether a traveler will use ***SmarTraveler*** and could reduce the size of the potential market even further. These factors could

include the extent to which travelers are truly time-sensitive and the degree to which they have alternative routes for their trips.

6.4. TRAVELERS SEEKING INFORMATION

Not all highway or transit travelers in the metropolitan area may make trips for which information about travel conditions and delays, such as that provided by ***SmarTraveler,*** may be judged beneficial. For those who seek travel information, it is already available, to some extent, through broadcast media (i.e., television and radio) traffic reports. The propensity to seek out information from ***SmarTraveler*** depends on a person's desire to obtain travel information and on that person's degree of satisfaction with the information they currently receive from radio and television travel reports.

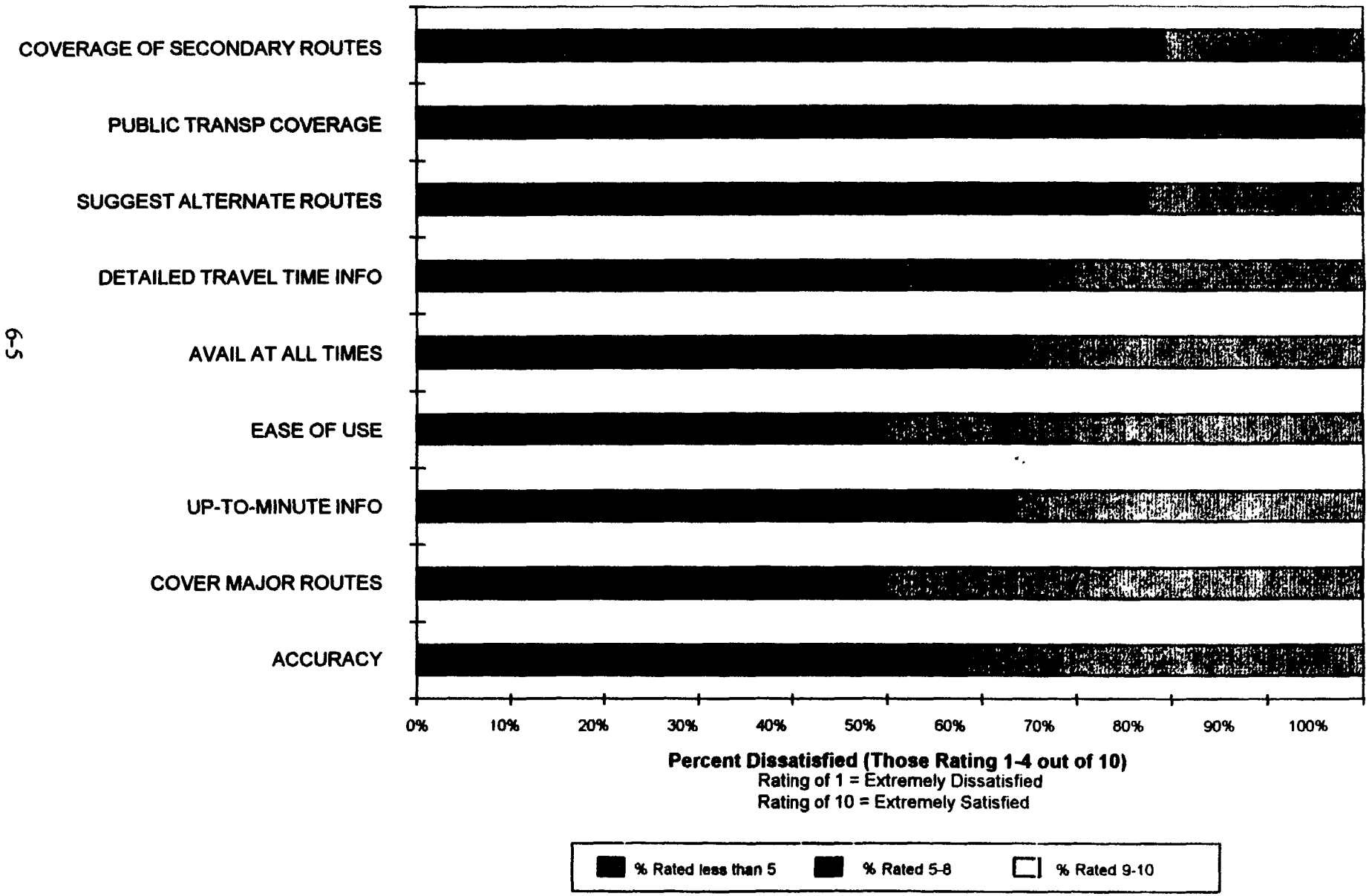
Use of radio and television reports was clearly evidenced by the target group survey results. When target group travelers were asked about their use of radio and television travel reports, 29% of trips were made by those who said that they watched television reports or listened to radio reports before the start of this trip every time the trip was made. On the other hand, 62% of trips were made by survey respondents who said that they never or hardly ever listened to television or radio reports before the start of their trip. Once travelers were in their cars, 30% of trips were made by travelers who listened to radio traffic reports every time the trip was made, while 45% of trips were made by travelers who never or hardly ever listened to traffic reports or listened only if the radio was already on. (Another 17% of trips were never made by automobile.)

A combination of responses to these two survey questions was used to define the portion of the target trips for which travel information was sought from radio and television reports, either prior to or during a trip, at least on an occasional basis. Possible survey responses such as "more than half the time" and "less than half to time" were converted to an estimated percentage of trips and the share of trips for which information was sought was estimated at 49% of the highway and transit trips, or about 2.3 million trips daily. The subset of the target population that are "information seekers" was also defined as those who use media broadcasts either at home or in their car at least "less than half the time" (i.e., not those who said "'hardly eve?' or "never"). This represents 43% of the target population (who account for 48% of target trips).

This is clearly a large market for travel information; however, many travelers may be quite satisfied with the information they currently obtain through radio and television reports. As reported previously in Section 4.2.3, when target group travelers rated the importance of travel information service characteristics, those rated most important were that the service be accurate, free of charge, cover major highways, and be up-to-the-minute, in that order. (See Exhibit 20).

On a ten-point satisfaction scale, three of the four most important characteristics were rated "9 or "10" by at least 37% of "information seekers." (Respondents were not asked to rate media

Exhibit 20: Satisfaction with Current Radio/TV Travel Information
Information Seekers in the Target Population



broadcasts in terms of the fourth characteristic, cost, since all are essentially free.) The accuracy of radio and television travel information broadcasts was rated "9" or "10" by 42% of "information seekers," coverage of major highways was rated "9" or "10" by 51% (the highest of any characteristic), and up-to-the-minute information was rated "9" or "10" by 37%. Overall, 36% of information seekers rated their most frequently used radio or television station's travel reports as a "9" or "10."

Among "information seekers" who were dissatisfied with media broadcasts, the accuracy of radio and television travel information was rated less than "5" by only 6%. This was the characteristic exhibiting the least dissatisfaction of any characteristic rated. Coverage of major highways and up-to-the-minute information were both rated less than "5" by only 13% of information seekers. Overall, only 7% of information seekers rated their most frequently used radio or television station's travel reports less than "5." These results suggest there is very little deep dissatisfaction with travel information, although most information seeking travelers are not completely satisfied with the information they receive.

6.5. EXPECTED USE OF *SMARTRAVELER*

As discussed above in Section 6.2, the majority of the target population is unfamiliar with ***SmarTraveler.*** After being asked about their knowledge of ***SmarTraveler,*** the 91% of survey respondents who had never used ***SmarTraveler*** were given a brief explanation of the service, including the fact that there is currently no charge. They were then asked if they expected to use the service, now that they knew what it offered and how to access it. Nearly half(47%) said that they were very unlikely to use the service, but 34% said that they were very likely or somewhat likely to use it. This represents about 540,000 individuals expressing a willingness to try the service (although market research experience indicates that respondents tend to overstate their willingness to try something new).

People with cellular phones were more likely to be willing to try the service; 41% said that they were very likely or somewhat likely to use it, while only 31% of those without cellular phones indicated they were likely to use it. This indicates that ownership of a cellular phone does appear to make people more willing to try the service, and is consistent with survey results indicating the percentage of cellular phone users in the ***SmarTraveler*** user population is greater than the percentage of cellular phone users in the target population.

6.6. USE OF *SMARTRAVELER* UNDER POTENTIAL PRICING PLANS

Both respondents in the target market survey and in the ***SmarTraveler*** user survey were asked about their expected usage of the service under various monthly and per call pricing plans. Respondents indicating that they were likely to use the service were asked how likely they would

be to use the service if it were available only for a monthly fee of $5, $ 10, $15, $20, or $25. They were also asked their likely number of calls per week if calls cost 10,25,35 or 50 cents.

Respondents to the ***SmarTraveler*** user survey were first asked about their expected future number of calls per week without reference to cost. They were then asked how often they would use it under the various per call pricing plans. When asked about their expected future use with a 10 cent cost per call, NYNEX users estimated an approximate 35% drop in the number of calls that would be made, while land-line users estimated an 18% drop. (These percentages have been adjusted for frequency bias.) With a 50 cent charge per call, NYNEX and land-line users estimated drops of 7 1% and 58%, respectively.

When asked about their willingness to pay a monthly fee, 37% of NYNEX users and 24% of land-line users indicated that they would be very likely or somewhat likely to purchase the service if it cost just $5. However, with a $25 monthly cost, only 4% of NYNEX and 3% land-line users indicated that they would be very likely or somewhat likely to purchase the service. While survey respondents in general tend to overstate their reaction to proposed changes, particularly increases in costs, ***SmarTraveler*** users clearly exhibit resistance to paying anything but a nominal charge for the service.

In the target market survey, travelers were not asked how frequently they might use the service under the current (i.e., free) pricing plan, and only those who indicated that they were likely to try ***SmarTraveler*** were asked their expected use under the various potential pricing plans. Their responses are shown in Exhibit 21. The responses of cellular phone owners averaged 3.6 calls per person per week at 10 cents per call, but only 1.8 calls per person per week at 50 cents per call. The average weekly projected calls per person for those without cellular phones ranged from 3.0 to 1.3 calls per week, under the same pricing plans. For both groups, a substantial number of people stated that they expected to make less than one call per week under all pricing plans, indicating that they could probably not be considered users. Therefore, the average number of calls per user would he even higher than the average per respondent. Thus, it appears that these respondents may have overstated their likely usage under all pricing scenarios, since currently NYNEX cellular phone users average only 3.1 calls per week (at no charge) and land-line users average 1.7 calls per week (at no charge). (Again, in market research studies consumers typically overstate their likelihood of using or purchasing a new product or service when interviewed.) The target population survey does show a difference in projected call rates for cellular and non-cellular phone users, but the stated difference is not as profound as has actually been found in analyses of ***SmarTraveler*** users.

Responses regarding the monthly plans for those in the target population likely to try the service are shown in Exhibit 22. Under the five different monthly pricing plans, the share expressing a willingness to subscribe to the service (either very likely or somewhat likely) ranged from 11% (at $5 per month) to only 1% (at $25 per month), which represents a market of between 18,000 and 180,000 potential subscribers who are not now users. (For those with cellular phones, the

Exhibit 21: Projected Use by Non-Users Likely to Try *SmarTraveler* Under Various Per Call Prices

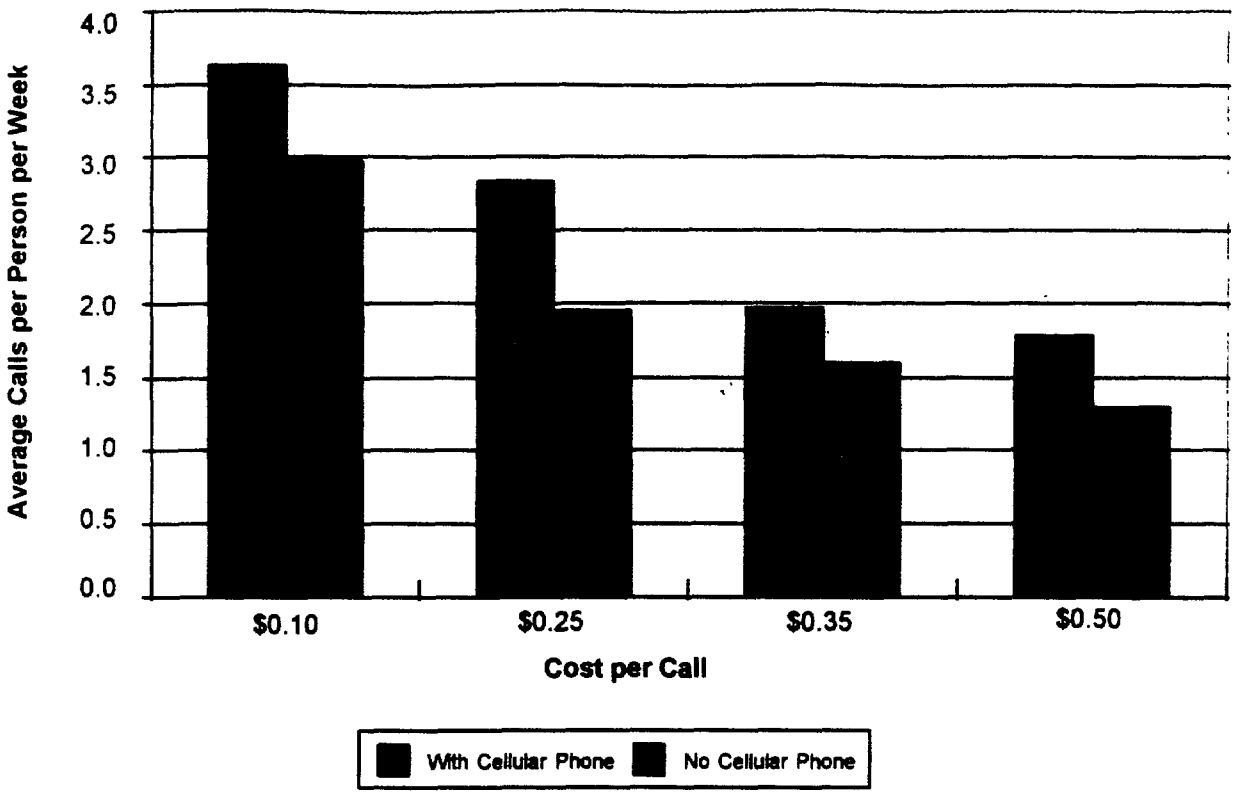
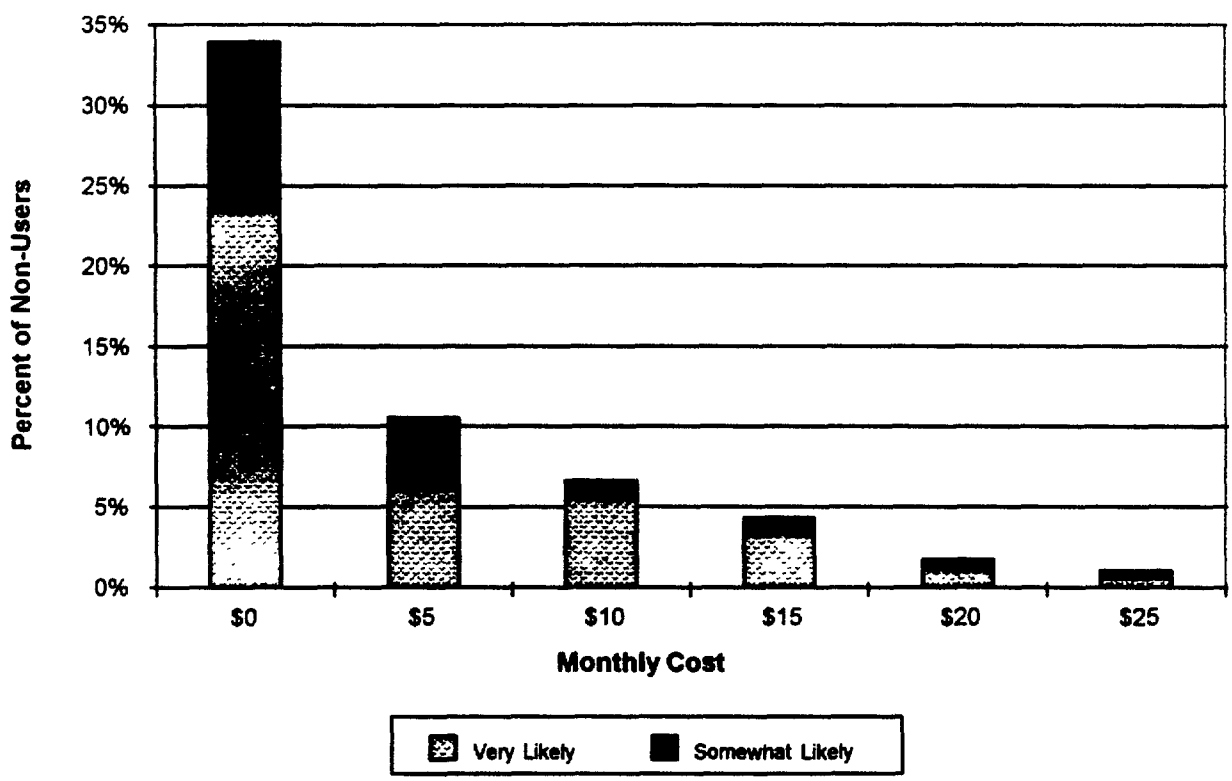


Exhibit 22: Projected Use by Non-Users Likely to Try *SmarTraveler* Under Monthly Pricing Scenarios



share expressing a willingness to subscribe ranged from 14% to only 2%, while for those without cellular phones the share ranged from 9% to less than l%.)

While cellular phone users in both the target and user populations showed more willingness to pay for the service than those without cellular phones, there is a clear resistance to paying a fee for the ***SmarTraveler*** service.

7. CONCLUSIONS FROM PHASE II

With an average weekday call count of 4,094 for the period from October 1, 1993 through March 3 1, 1994, (including the severe snow storms which generated the highest daily call counts of the entire operational test), and an estimated user population of about ten thousand, the utilization of ***SmarTraveler's*** services by the public is clearly below the level required to make a measurable impact on traffic congestion, even if every single caller modified his or her travel behavior in response to the information received. From this perspective, the project has yet to achieve one of its most important objectives.

On the other hand, daily call counts are continuing to grow at a steady rate, and utilization during times of severe weather is much higher than on an average day, implying greater market penetration than average system usage would suggest. From the survey it is clear that callers are fairly pleased with and act on the information they receive; 29% reported altering their travel behavior in direct response to what they heard from ***SmarTraveler*** on a particular call, and another 19% used the information to help choose between equally attractive alternative routes (although the percentage of these whose ultimate choice was different from what it would have been without ***SmarTraveler*** is indeterminate). Only 3.1% of the respondents indicated that it was unlikely they would call again, assuming it remains free of charge. (Willingness to pay more than a nominal charge for the service was limited.)

One could postulate that, with continued operation (and aided by major increases in marketing), daily call counts will continue to rise and that eventually the number of people whose travel behavior is regularly affected by ***SmarTraveler*** information will be large enough to influence traffic congestion, particularly on those days when traffic conditions are worst.

Depending on how broad a market definition one adopts, the potential for the service varies significantly. If one considers potential users to be all those who make a trip that could potentially be served by ***SmarTraveler,*** the number approaches 2 million. In contrast, if one were to focus exclusively on those potential users who are "information seekers" dissatisfied with the travel information they receive from TV and radio, the number is only 52 thousand. This might be reduced further if one were to exclude those without alternative routing possibilities and those with no sensitivity to time. Undoubtedly, the real market potential is in the vast range between these two extremes.

In order to generate measurable impacts on traffic, ***SmarTraveler's*** marketing efforts must convert potential users into actual users. However, marketing activities to date have shown limited success. Only about a third of the target population (i.e., a broadly drawn definition of potential users) actually know what ***SmarTraveler*** is, and very few know the telephone number if they want to call. Perhaps most important is that the marketing campaign does not appear to have established why ***SmarTraveler*** is superior to other travel information sources. This seems to be critical because most "information seekers" in the target population do not appear to be

very dissatisfied with their current source of information. To increase its call counts and user population dramatically, ***SmarTraveler*** must either induce additional individuals to be information seekers and/or convert users of other services to ***SmarTraveler.*** The likelihood of inducing new travelers to be information seekers is low, but the prospects for attracting broadcast media information seekers to ***SmarTraveler*** are significant, if ***SmarTraveler*** is perceived as a better "product" by these consumers.

Although on the surface ***Smartraveler*** and media broadcasts both provide traffic and public transportation information, they are intrinsically different products. ***SmarTraveler*** marketing focuses on the fact that the service provides route-specific information on demand, which is certainly true. However, since the information does not have to fit into a predetermined time spot, ***SmarTraveler*** messages can be as long as they need to be (for example to describe bus snow routes); this is very different from media broadcasts which try to provide the briefest snapshot of each major facility in a very short period of time. Another important difference is that ***SmarTraveler*** requires active involvement by the user, while media broadcasts are decidedly passive. This is a deterrent to its use, especially if people cannot remember the telephone number. Also, if one is in a hurry to leave for work, stopping to call ***SmarTraveler*** for information may or may not prove to have been time well spent.

By virtue of its state and federal funding, ***Smartraveler*** is also intrinsically different from other media outlets, but this distinction does not appear to be recognized by the many institutions which provide it with travel information. Instead they view ***SmarTraveler*** as just another media outlet - not as a state-sponsored instrument of public policy, deserving of special access to facilities and information.

For those potential users with cellular phones, ***Smartraveler*** offers a real advantage over broadcast reports, in that (presumably) up-to-the-minute information can be obtained at exactly the right time to make an informed route choice decision. Given that traffic problems can arise very quickly, especially during peak periods on congested roadways, the ability to get information that is not five minutes old can be crucial. Since the percentage of people with cellular phones continues to increase strongly, this market could represent a major area of growth for ***SmarTraveler*** services, assuming the public becomes aware of the system's benefits.

Assuming a traveler can be persuaded to try ***SmarTraveler,*** his/her ability to evaluate whether the information received was better than that provided by TV or radio is typically limited, since few travelers would make the effort to carefully evaluate the two for accuracy. Instead, their choice will be made on the perception of accuracy (as well as ease of use, ease of access, etc.) As indicated earlier, this is a topic on which ***SmarTraveler's*** marketing has thus far not focused. The breadth of ***SmarTraveler's*** data collection system and the speed with which information is made available to the user are different from competing services, and should be promoted as a major benefit to travelers.

On the other hand, despite the variety of data collection sources feeding information to the traffic managers in ***SmarTraveler's*** control center, and despite the sense that this system is superior to any other serving the Boston metropolitan area, traffic problems can and do slip through without being reported. When they do, the traveler who relies on the system thinking it is reliable and then gets let down may not return for another try. The cause of these omissions is undetermined, but one could speculate that some result directly from physical gaps in the data collection network (e.g., there are no probes on that facility at that time of day), some from the failure of a staff member at another organization to notify ***SmarTraveler,*** and some from simple human error in the ***SmarTraveler*** control room. However, it is not obvious how one might improve upon this operation in a meaningful way, except through the use of greater automation. The use of electronic roadway sensors, for example, could eliminate many of the possible "gaps" in the system, albeit at dramatically increased cost. However, one could also envision using modem technology to allow probe information to be transmitted and displayed automatically, thereby reducing the time traffic managers spend talking to probes; this might in turn allow the number of probes to be significantly increased without having to add traffic managers (which would produce more complicated dynamics in the control room).

Eventually, new technology is likely to make ***Smartraveler's*** telephone-accessed audiotext system for information dissemination obsolete. Automated electronic in-vehicle navigation/travel condition display systems are already being demonstrated, and the question is not whether they will find a market but when. As costs drop (as they certainly will continue to do), these systems are likely to become ubiquitous. However, that time is still years away, and in the interim ***SmarTraveler*** has the opportunity to serve au increasingly larger public.

APPENDIX A: THE USER SURVEY

The User Survey was designed to provide data about a random sample of users and user trips. Since users do not normally identify themselves to the system in any way, the sampling methodology required intercepting a subset of calls to ***SmarTraveler***; since callers could not be surveyed on the spot (due to the length of the user survey), only a quick screening survey was administered during the interception to identify those willing to participate in the subsequent survey, and to determine the caller's frequency of usage Any person previously agreeing to be surveyed was discarded. During the period from October 1993 through March 1994, the process yielded 364 1 completed intercepts of users willing to participate in the follow-up survey,

Generally within 48 hours of each interception the first attempt was made to reach that user at the telephone number and time of day each had specified. In many cases, multiple attempts were required before the caller could be reached and surveyed. A minimum of five attempts were made before a caller was removed from the active sample. In all, a total of 2010 user surveys were completed.

The survey was carried out using a Computer-Assisted Telephone Interview (CATI) System that allows complicated branching based on the respondent's answer to one or more previous questions. Interviewers worked from a computer screen which automatically brought up the correct question (based on earlier responses). This process also precluded the need for coding and data entry, since the interviewing process generated machine readable data already coded for analysis. The analysis of survey responses was performed using the Statistical Package for the Social Sciences (SPSS).

The User Survey was actually implemented as a stratified sample, based on the type of phone service used. The sampling was performed separately for calls by land-line telephones, NYNEX cellular telephones and Cellular One telephones, since each type of service entered the system through a different line. Analysis indicated that survey completion rates for these groups differed, so that the number of completed surveys for each type of phone service did not correspond to the distribution of callers by phone service derived from the intercept data Therefore, results were adjusted by weighting responses to reflect the "known" distribution of callers by phone service.

The survey methodology resulted in a sampling of ***SmarTraveler*** calls, which provides unbiased information about the trips made by users. However, since those who called ***SmarTraveler*** more frequently were more likely to be intercepted and surveyed, an adjustment was required for questions relating to characteristics of individuals. Without adjustment, these results would have been biased toward those who are frequent callers. To correct for this bias, responses to such questions were weighted by a correction factor based on the inverse of the number of times that users called ***SmarTraveler*** in the week during which they were intercepted (i.e., the inverse travel frequency). The factor was calculated for each survey respondent as the ratio of their inverse travel frequency to the average of the inverse travel frequencies for all survey respondents.

User Telephone Survey Date: _____ *Time:* _____

Name: _____ *Call Number:* _____

Telephone Number _____ *Survey Date:* _____

Call origin?: _____ *Survey Time:*

First call? _____ if not frequency-of calling? _____

Facility1: _____

Message: _____

_____

Facility2 _____

Message: _____

_____

Facility3 _____ Facility4 _____

[] Check here if the call was dropped.

Hello. My name is _____ calling from Bemett Research Services. May I speak with _____

Several days ago when you called SmarTraveler, your call was intercepted and you indicated that you'd be willing to answer some follow-up questions about your experience using the service. This shouldn't take longer than 10 minutes and your feedback would be very helpful. Is this a good time?

[] yes [PROCEED]

[] no [ATTEMPT TO GET ANOTHER TIME TO CALL: _____ 1

Just to refresh your memory, the call I am interested in was made at [time] last [day of week].

You requested information about [facilities 1.2.3.4).

il. Do you remember this call?

[] Yes Good. [PROCEED]

[] no

[IF NO, TRY *AGAIN* BY REPEATING INFORMATION AND INDICATING TEXT OF MESSAGEI

First, I'd like to ask some questions about this call to

i4. [IF CALLING FROM A CELLULAR PHONE]

Was the cellular phone service you used NYNEX or Cellular One?

[] NYNEX
[] Cellular One

15. Was the call made regarding a trip that you were making yourself or were you calling on behalf or another person or persons?

[] I was calling for a trip I was making.

[] I was calling for a trlp others would make without me.

PART A *Trip Characteristics*

Now I'd like to ask some questions about the trip you were making.

1. Which of the following best describes the purpose of this trip?

[] journey to/from work

[] business activity such as sales, delivery, traveling to/from a meeting

[] other travel such as recreation, shopping, medical or other personal trips

[IF BUSINESS AND QUESTlON Y IS "OTHERS" THEN GO TO PART G]

2 In which city or town did this trip originate? _____

3. In which city or town did the trip end? _____

4. In which of the following ways have you made this particular trip in the past three months?

[CHECK ALL THAT APPLY]

5. [IF A DRIVER OR PASSENGER IN PRIVATE VEHICLE ON QUESTION #4

When you travel as a driver or passenger in a car, motorcycle van or truck, which major streets or highways make up your route? Don t include minor local streets. [CHOOSE FROM LIST]

_____

_____

_____

_____

_____

_____

6. [IF RESPONDENT ANSWERED PUBLIC TRANSPORTATION ON QUESTION #4]

Which of the following means of public transportation have you used to make this trip in the past three months.?

[] commuter rail

[] subway

[] bus

[] commuter boat

[] other

6a. [IF *MORE* THAN ONE ANSWER CHECKED FOR #6]

Which means of public transportation do you use most often to make this trip?

[ASK ONLY MOSE CHOICES CHECKED IN QUESTION #6]

[] commuter rail

[] subway

[] bus

[] commuter boat

[] other

8a. Again, when you take this trip as a driver or passenger in a private vehicle using your usual route, what portion of your total travel time is on _____ , or _____

[BLANKS ARE SMARTRAVELER MONITORED ROUTES ON RESPONDENT'S ROUTE]

[] less than 25% of the trip

[] between 25% and 50% of the trip

[] more than 50% but less than 75% of the trip .

[] 75% or more of the trip

9. [IF A PUBLIC TRANSPORTATION USER IN #4]

About how long does this trip usually take, when you use [answer given to question 6a]?

[] less than 10 minutes

[] 10 to 20 minutes

[] 20 to 30 minutes

[] 30 to 45 minutes

[] 45 to 60 minutes

[] more than 60 minutes

10. How often do you make this particular trip, from the same origin to the same destination, by any means?

[] 5 or more times a week

[] 3 or 4 times a week

[] once or twicea week

[] infrequently

[IF NOT INFREQUENTLY, PROCEED TO #10A OTHERWISE GO TO #11]

PART 6 Use of Information

[IF THE CALL WAS A DROPPED CALL, CONTINUE; OTHERWISE GO TO #4]

1. Our records indicate that last [day of week], after talking to the interviewer and agreeing to be surveyed, your call was interrupted in some way and you did not actually obtain travel information from SmarTraveler during that call. Is that correct?

   [] yes [PROCEED TO #2]

   [] no Good. [PROCEED TO #4]

2. Can you tell me what happened to interrupt the call?
   [DO NOT READ.]

   [] respondent was disconnected by the system involuntarily
   [] respondent hung up accidentally
   [] respondent hung up deliberately (e.g., because in a hurry)
   [] respondent hung up deliberately due to frustration/loss of interest/etc.
   [] respondent was unsuccessful in obtaining information from the system
   [] respondent hung up because of a poor connection/unable to hear
   [] don't know/don't remember/not sure
   [] other [DESCRIBE]: _____

3. After your call was interrupted, did you call right back again?

   [] yes [PROCEED TO #3b]

   [] no [PROCEED TO #3a]

   3a. Why not?

   [DO NOT READ.]
   [] gave up out of frustration

   [] gave up out of lack of interest

   [] did not have time to call again

3b. Did you receive travel information when you called back?

[] yes Good. Then I'd like to ask you about the information you received when you called right back. [PROCEED TO #4a]

[] no [PROCEED TO #3c]

3c. Why not?

[DO NOT READ.]

[] was unsuccessful in obtaining information from the system

[] was disconnected by the system involuntarily
[] hung up accidentally
[] hung up deliberately (e.g., because in a hurry
[] hung up deliberately due to frustration/loss of interest/etc.
[] hung up because of a pcor connection/unable to hear
[] don't know/don't remember/not sure
[] other [DESCRIBE]:_____

I am sorry that you call was never completed. **[GO TO C1]**

4. Next, I would like to ask about how you used the information you received from SmarTraveler last [day of week].

4a. How, if at all, did the information you received from SmarTiaveler affect your travel decision making or behavior? [CHECK ALL THAT APPLY.]

[] It confirmed that my usual route would be the best route that day.
[] It resulted in a change in route from my usual route.
[] It helped me decide between alternative routes.
[] It resulted in a change in departure time.
[] It resulted in a decision to cancel the trip.
[] It resulted in a change from private vehicle to public transportation.
[] It resulted in a change from public transportation to private vehicle.
[] It caused me to notify others that I might be late.
[] it had no effect on my decision.
[] other [EXPLAIN]_____

PART C Service Awareness and *Characteristics*

1. How did you first become aware of SmarTraveler? [DO NOT READ; CHECK ONLY ONE.]

- [] Eli Scherer on Channel 5
- [] word of mouth
- [] newspaper articles
- [] TV ads
- [] radio ads
- [] MBTA pass or schedule
- [] fliers
- [] bill insert
- [] employer program
- [] don't remember
- [] other: [DESCRIBE:] _____

2. Can you tell me the SmarTraveler telephone number right now, without looking it up?

- [] no
- [] yes [INDICATE BELOW WHETHER RESPONDENT WAS CORRECT]
  - [] [ANSWER WAS CORRECT 3744234 or 1 if NYNEXI
  - [] [ANSWER WAS WRONG; RECORD IT: _____

3. Now I'm going to read a series of characteristics of a traffic and travel information service. On a scale of 1 to 10, please rate the importance of each of the following characteristics, where one is unimportant and ten is very important.

Ease of use _____

Up to the minute information _____

Available on demand _____

Accuracy of information _____

Detailed travel time, construction, & congestion information _____

Suggestion of alternative routes _____

4. On a scale of 1 to 10, please indicate how satisfied you are with *SmarTraveler* with respect to each of the following characteristics. One means extremely dissatisfied, while ten means extremely satisfied.

Ease of use _____

Up to the minute information _____

Available on demand _____

Accuracy of information _____

Detailed travel time, construction, & congestion information _____

Suggestion of alternative routes _____

Available at all times _____

Coverage of major routes _____

Coverage of secondary routes _____

Coverage of public transportation conditions _____

No charge for use _____

[ROTATE LIST]

5. Again on a scale of 1 to 10 where one means extremely dissatisfied and ten means extremely satisfied, how would you rate your overall level of satisfaction with the SmarTraveler service. _____

5a. Was there any information you wanted that wasn't provided?
[DO NOT READ]

[] alternate route suggestions

[] broader route coverage

[] extended hours of ● up to the minute' traffic information

[] access to a ***SmarTraveler*** staff member for questions

[] other [DESCRIBE]:_____

[] trips you make rarely or never have before

[] about the same for either type

7d. Again, for which of the following trips would you be more likely to use SmarTraveler?

[] trips you make by private vehicle

[] trips you make using public transportation

[] about the same for either type

PART D Cost Issues

At this point, I'd like to focus on the cost of using *SmarTraveler.*

1. For the trip.we have been discussing, how much, if anything, did it cost to call *SmarTraveler,* including any cost for the phone call?
[DO NOT READ RESPONSES]

[] donot know
[] there is no charge
[] there is a charge of _____

[IF THERE IS A CHARGEJ
Ia. Is this a charge you incur personally, or is it paid for by your employer or business?
[DO NOT READ RESPONSES]

[] I pay the charge personally.
[] Any charges are paid by my employer or another business.

[IF THE PERSON DOES NOT PAY THEIR OWN CHARGES, STATE THE FOLLOWING:]
For the next several questions about cost, I woukl like you to answer assuming that you would have to pay for any SmarTraveler charges personally.

- [] The information is not current.
- [] The information is not specific enough.
- [] The routes I need are not covered.
- [] I don't have to arrive at a particular time.
- [] I am leaving the area.
- [] I am no longer traveling (e.g., infirm).
- [] I simply don't need it.
- [] other

2. How many times would you estimate that you have called SmarTraveler?

- [] this was my first call
- [] less than 5 times
- [] 5 times or more

[] $40,000 to $49,000

[] $50,000 to $75,000

[] Over $75,000

Thank you very much for your coorperation. Goodbye.

PART G Commercial Use

This survey was designed specifically for non-commercial travel, and therefore is not appropriate for your use of the system. However, we are planning to hold a focus group session in late September exclusively for people who use SmarTraveler for commercial purposes. This would be an evening session of . . .

Would you be interested in being contacted about participating in this focus group. Your input would be greatly appreciated?

[] yes
[] no

Thank you and goodbye.

APPENDIX B: THE TARGET MARKET SURVEY

The Target Market Survey was designed to interview a random sample of the target population, which was defined as individuals aged 17 or more who use major highways or public transportation within the ***SmarTraveler*** service area. The sampling methodology involved a random digit dial telephone survey for telephone exchanges associated with the ZIP codes in the service area. Respondents were screened to meet the above "'target market" definition and a particular household member was requested to respond to the survey in accordance with a randomization procedure based on the number of male and female adults in the household. In addition, since the survey required recollection of detailed information about a specific trip, only respondents who indicated that they had traveled the previous day were included. A randomization procedure was used to select one trip from that day for further examination.

The survey was conducted during late June and early July, 1994. Over 4,000 individuals were contacted, but only just over 1,000 stated that they traveled inside I-495 and had made a trip the previous day. From this sample, the survey was conducted of the 685 individuals who had made highway or transit trips the previous day plus another 77 individuals who had made highway or transit trips in the past seven days. This resulted in a total of 762 completed interviews. As with the User Survey, actual implementation was computer assisted, to allow for complex branching based on answers to previous questions.

Unlike the User Survey, this sampling methodology resulted in a random sample of individuals directly. However since individuals make trips at different rates, the trips about which the individuals were surveyed does not constitute a random sample of trips, and results would therefore be biased against trips made by frequent travelers. To correct for this, the responses to each question involving trip characteristics were weighted by correction factor calculated as the ratio of the number of highway or public transportation trips made by that individual to the average number of highway or public transportation trips made by all respondents. Note that questions relating to the characteristics of individuals (such as demographic information) were not biased and did not have to be adjusted.

Target Market Telephone Survey *Date:* _____ *Time:* _____

Name: _____ Call Number _____
Telephone Number _____ Survey Date: _____
Survey Time: _____

Hello. My name is _____ calling from Bemett Research Services.
I am conducting a research study of people who travel by private vehicle or by public transportation anywhere in the Boston metropolitan area inside Interstate-495 I'd like to speak to {randomly chosen household member aged 17 or older}. [IF NOT IN, GET CALL BACK INFORMATION]

[IF A DIFFERENT PERSON THAN ANSWERED PHONE, REPEAT INTRO]

11. Do you travel by private vehicle or by public transportation anywhere in the Boston metropolitan area inside Interstate-495?

[] yes [GO TO #12]

[] no [THANK YOU AND TERMINATE]

12 Did you make any trips east of Interstate-495 in a private vehicle or on public transportation {yesterday/tast "xxxday"}?

[] yes [GOTO 13]

[] no [THANK YOU AND TERMINATE]

13. Good. I'd like you to think about those trips. Counting trips in each direction (for example, from your home and then back home) as separate trips, how many such trips dii you make that day which began between 5:30 AM and 9:00 AM? _____

13a. How many of these involved traveling on a major highway or using public transportation? ____

14. How many trips did you make which began between 9:00 AM and 3:00 PM? _____

l4a. How many of these involved traveling on a major highway or using public transportation? ____

15. How many trips did you make which began between 3:00 PM and 7:00 PM? _____

PART A *Trip Characteristics*

1. Which of the following best describes the purpose of this trip?

   [] going to work
   [] leaving work
   [] business activity such as sales, delivery, traveling .to/from a meeting
   [] other travel such as recreation, shopping, medical or other personal trips

2. In which city or town does this trip originate? _____

3. In which city or town does the trip end? _____

4. In which of the following ways have you made this particular trip in the past three months?
   [CHECK ALL THAT APPLY]

   [] drove or rode as a passenger in a private vehicle such as a car, van, truck, or motorcycle
   [] drove or rode in a private vehicle to public transportation
   [] walked to public transportation
   [] other [DESCRIBE]_____

   4a. [IF MORE THAN ONE ANSWER CHECKED FOR #4]
   In which way do you most often make this particular trip?
   [ASK ONLY THOSE CHOICES CHECKED IN QUESTION #4]

   [] driving or riding as a passenger in a private vehicle such as a car, van, truck, or motorcycle
   [] driving or riding in a private vehide to access public transportation
   [] walking to public transportation

6a. [IF MORE THAN ONE ANSWER CHECKED FOR #6]

Which means of public transportation do you use most often to make this trip?

[ASK ONLY THOSE CHOICES CHECKED IN QUESTION #6]

- [] commuter rail
- [] subway or street car
- [] bus
- [] commuter boat
- [] other

7. Approximately how many miles would you say this trip is, one way?

- [] less than 3 miles
- [] between 3 and 6 miles
- [] between 6 and 12 miles
- [] between 12 and 25 miles
- [] between 25 and 50 miles
- [] more than 50 miles

8. [IF A DRIVER OR PASSENGER IN PRIVATE VEHICLE IN #4]

About how long does this trip usually take, when you drive or ride in a private vehide?

- [] less than 10 minutes
- [] 10 to 20 minutes
- [] 20 to 30 minutes
- [] 30 to 45 minutes
- [] 45 to 60 minutes
- [] more than 60 minutes

10. How often do you make this particular trip, from the same origin to the same destination, by any means?

- [] 5 or more times a week
- [] 3 or 4 times a week
- [] once or twice a week
- [] infrequently

11. When you make this particular trip, how often do you listen to the radio or watch TV before leaving to find out about travel conditions or delays?

- [] every time the trip is made
- [] more than half the time
- [] about half the time
- [] less than half the time
- [] hardly ever
- [] never [SKIP TO #l2]

[IF EVERY TIME, SKIP TO #11 b, OTHERWISE GO TO #11a]

11a. I am interested in why you listen or watch some times but not others. Under which of the following circumstances do you listen or watch?

- [] when I anticipate congestion
- [] when weather is bad
- [] when my travel time is critical
- [] when I am running late
- [] at certain times of day
- [] if the TV or radio is on already
- [] when using public transportation
- [] other [DESCRIBE] _____

[IF MULTIPLE ANSWERS TO 11C.]

1 1d. To which one of these do you {listen/watch} most often? _____

12. [IF THE RESPONDENT NEVER MAKES THE TRIP BY PRIVATE VEHICLE, SKIP TO #13]

When you make this particular trip, how often do you listen to the radio IN YOUR CAR to find out about travel conditions or delays?

[] every time the trip is made

[] more than half the time

[] about half the time

[] less than half the time

[] hardly ever

[] only if the radio is on already

[] never [SKIP TO #13]

[IF EVERY TIME OR IF RADIO ON ALREADY, SKIP TO #l2b, OTHERWISE GO TO#12a]

12a. I am interested in why you listen some times but not others. Under which of the following circumstances do you listen?

[] when I anticipate congestion

[] when I see congestion on the road ahead

[] when weather is bad

[] when my travel time is critical

[] when I am funning late

[] at certain times of day

[] only if the radii is on already

[] when using public transportation

[] other (DESCRIBE):_____

Ease of use _____

Up to the minute information _____

Available on demand _____

Accuracy of information _____

Detailed travel time, construction, & congestion information _____

Suggestion of alternative routes _____

Available at all times _____

Coverage of major routes _____

Coverage of secondary routes _____

Coverage of public transportation conditions _____

No charge for use _____

[ROTATE LIST]

[ON QUESTIONS 2 TO 6, ALTERNATING RESPONDENTS USE EITHER ANSWER A#11d OR A#12c]

2. On a scale of 1 to 10, please indicate how satisfied you are with the station you use most often for travel information , {ANSWER A#11d or A#l2c} with respect to each of the following characteristics. One means extremely dissatisfied, while ten means extremely satisfied.

Ease of use _____

Up to the minute information _____

Accuracy of information _____

Detailed travel time, construction, & congestion information _____

Suggestion of alternative routes _____

Available at all times _____

Coverage of major routes _____

4. For which of the following types of trips would you be more likely to {listen/watch} to {ANSWER A# 11d or A# 12c}

[] trips that are longer than 20 minutes

[] trips that are 20 minutes long or less

[] about the same for either type

5. For which of the following types of trips would you be more likely to (listen/watch} to {ANSWER A# 11d or A#12c}?

[] trips you often make

[] trips you make rarely or never have before

[] about the same for either type

6. Again, for which of the following trips would you be more likely to {listen/watch} (ANSWER A# 11d or A# 12c}?

[] hips you make by private vehicle

[] trips you make using public transportation

[] about the same for either type

PART C ***SmarTraveler*** Awareness

1. Are you familiar with a service called *SmarTraveler*?

[] no [GO TO PART D]

[] I have heard of it but I am not sure what it is [GO TO #la]

[] Yes I know what it is. [GO TO #la]

[IF ANSWER TO #1 WAS "HEARD BUT NOT SURE" SKIP TO PART D]

1b. Can you tell me the *SmarTraveler* telephone number right now, without looking it up?

[] no
[] yes [INDICATE BELOW WHETHER RESPONDENT WAS CORRECT]
[] [ANSWER WAS CORRECT 3761234 or ● if NYNEX]
[] [ANSWER WAS WRONG; RECORD IT: J_____

1c. Which of the following statements about *SmarTraveler* do you believe are true? Please indicate "true" or "false" for each one: [MARK EACH ANSWER "T", "F", OR "D" FOR DON'T KNOW]

— You call SmarTraveler by phone to get travel information.
— You call SmarTraveler for highway traffic information.
— SmarTraveler covers only major highways.
— You can get information from SmarTraveler about just the highways you want.
— SmarTraveler reports highway travel times between major intersections.
— You call SmarTraveler for public transportation delay information.
— You call SmarTraveler for public transportation schedule information.
— SmarTraveler is onty available during the morning and evening rush hours
— SmarTraveler is free of charge
— SmarTraveler covers only travel inside of Route 128
— SmarTraveler covers only travel east of Interstate 495
— The information provided by SmarTraveler is identical to what you hear on the radio or TV
— SmarTraveler collects its information from radio and TV stations
— SmarTraveler provides mom accurate and more current information than radio stations do.
— SmarTraveler does not provide information about my travel route.

1d. Have you ever used the *SmarTraveler Service?*

[] yes [GO TO # 1f]
[] no [GO TO # 1e]

1. Now that you know what it is and what it provides, how likely are you to try it?

[] very likely

[] somewhat likely

[] somewhat unlikely

[] very unlikely

[IF ANSWER TO #1 IS "VERY LIKELY" OR "SOMEEHAT LIKELY" SKIP TO #2]

1 a. Which, if any, of the following things would make you more likely to use *SmarTraveler?*

[] If SmarTraveler provided travel information for all roadways, not just major highways
[] If SmarTraveler provided recommendations of the best alternate route when conditions are bad
[] If continually updated coverage were provided 24-hours a day
[] If I had a cellular phone in my car and were charged only the normal phone charge
[] If I had a cellular phone in my car and there was no charge
[] If I traveled on congested highways
[] If I had a longer commute than I do now
[] If I commuted to my job over major highways
[] If SmarTraveler provided more detailed public transportation travel time information
[] If the SmarTraveler phone number were easier to remember
[] If my commute were mostly in the SmarTraveler servtce area
[] other: [DESCRIBE:] _____

[SKIP TO PART F]

2. Although the service is currently free, it will eventually be partially supported by charges to callers. We are interested in teaming how likely people might be to use the service under various pricing plans.

[DO FOR xx = 10, 25 35, AND 50; ROTATE ORDER]

If the ***SmarTraveler*** service were only available for a service charge, in addition to the price of the phone call, how frequently do you think you would call if the charge were [xx] cents per call?

3. Do you have at least occasional use of a motor vehicle?

[] no [GOTO #4]

[] yes

6. Into which of the following categories does your total annual household income fall before taxes?

- [] Under $20,000
- [] $20,000 to $29,000
- [] $30,000 to $39,000
- [] $40,000 to $49,000
- [] $50,000 to $75,000
- [] Over $75,000

Thank you very much for your cooperation. Good-bye.