

1. Report No. TX-00/1985-5		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle HOUSTON <i>SMART COMMUTER</i> ITS OPERATIONAL TEST: FY 99 STATUS REPORT				5. Report Date October 1999	
				6. Performing Organization Code	
7. Author(s) Katherine F. Turnbull, Stephen P. Farnsworth, and Darryl D. Puckett				8. Performing Organization Report No. Report 1985-5	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No Project No. 7-1985	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Research: September 1997 - August 1999	
				14. Sponsoring Agency Code	
15. Supplementary Notes Research performed in cooperation with the Texas Department of Transportation. Research Project Title: Houston <i>Smart Commuter</i> ITS Operational Test: Project Management Assistance and Study Design, Data Collection, Monitoring, and Local Evaluation Program					
16. Abstract  This report documents the Houston <i>Smart Commuter</i> ITS Operational Test. The project examined the influence of providing real-time traffic and current bus information to commuters in the I-45 North Freeway corridor. The project was one of the federally sponsored ITS Operational Tests. It was jointly funded by the Metropolitan Transit Authority of Harris County (METRO), the Texas Department of Transportation (TxDOT), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). Planning for the project was initiated in 1990, and the actual test of the hand-held information devices occurred over a two-year period from the fall of 1997 to late 1998. This report summarizes the development of the <i>Smart Commuter</i> project in the I-45 North Freeway corridor, the technology used to provide real-time traffic and current transit information to selected commuters, and the results of the surveys and travel diaries of test participants and individuals in the control group.					
17. Key Words Intelligent Transportation Systems, ITS, Smart Commuter, Transit, Instant Carpooling, Real-Time Ridematching			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 82	22. Price



**HOUSTON *SMART COMMUTER* ITS OPERATIONAL TEST:  
FY 99 STATUS REPORT**

by

Katherine F. Turnbull  
Research Scientist  
Texas Transportation Institute

Stephen P. Farnsworth  
Assistant Research Scientist  
Texas Transportation Institute

and

Darryl D. Puckett  
Associate Research Scientist  
Texas Transportation Institute

Report 1985-5

Project Number 7-1985

Research Project Title: Houston *Smart Commuter* ITS Operational Test:  
Project Management Assistance and Study Design, Data Collection,  
Monitoring, and Local Evaluation Program

Sponsored by the  
Texas Department of Transportation

October 1999

TEXAS TRANSPORTATION INSTITUTE  
The Texas A&M University System  
College Station, Texas 77843-3135



## **DISCLAIMER**

---

The contents of this report reflect the views of the authors, who are responsible for the findings and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation, and is not intended for construction, bidding, or permit purposes.

## **ACKNOWLEDGMENTS**

---

The authors would like to recognize a number of individuals who contributed to and assisted with this research study and the preparation of this report. First, the research team would like to acknowledge the assistance of John Gaynor, the Texas Department of Transportation (TxDOT) project director. Mr. Gaynor provided guidance and assistance throughout the study, and his involvement greatly enhanced the research effort. Second, the authors would like to recognize the contributions of Gloria Stoppenhagen and Susan Beaty, METRO. Bonnie Duke, Toni Monroe Eaton, David Schrank, and Dena Jackson, TTI, assisted with the word processing, survey coding and data reduction, and graphics. The help and contributions of these individuals are both acknowledged and greatly appreciated.

## TABLE OF CONTENTS

---

LIST OF FIGURES . . . . .	viii
LIST OF TABLES . . . . .	ix
CHAPTER ONE—INTRODUCTION . . . . .	1
Background . . . . .	1
Houston <i>Smart Commuter</i> Concepts . . . . .	2
Report Organization . . . . .	2
CHAPTER TWO—DEVELOPMENT AND OPERATION OF THE HOUSTON <i>SMART COMMUTER</i> OPERATIONAL TEST . . . . .	5
Organization of the Houston <i>Smart Commuter</i> ITS Operational Test . . . . .	5
I-45 North Real-Time Information System and Technology . . . . .	6
Recruiting and Training the <i>Smart Commuter</i> Participants . . . . .	15
CHAPTER THREE—ASSESSMENT OF THE <i>SMART COMMUTER</i> OPERATIONAL TEST . . . . .	17
Methodology . . . . .	17
Before Travel Surveys . . . . .	20
Use of Magic Link™ Devices . . . . .	22
Use and Rating of Traffic Information Delivery Methods . . . . .	24
Changes in Travel Behavior . . . . .	32
Discussion Group Summary . . . . .	36
E-mails and Exit Interviews . . . . .	39
CHAPTER FOUR—CONCLUSIONS . . . . .	41
Assessment . . . . .	41
Further Tests . . . . .	43
REFERENCES . . . . .	45
APPENDIX A—Before Travel Survey — Test Participants and Control Group Members . .	47
APPENDIX B—After Travel Survey — Test Participants . . . . .	51
APPENDIX C—After Travel Survey — Control Group Members . . . . .	57
APPENDIX D—Daily Travel Diary . . . . .	61
APPENDIX E—Letter to Motorists in I-45 North Corridor . . . . .	63
APPENDIX F—Detailed Socio-Economic and Trip Characteristics . . . . .	65

## LIST OF FIGURES

---

Figure	Page
1. I-45 North Corridor Test Area . . . . .	7
2. I-45 North Corridor Freeway and Toll Facilities . . . . .	8
3. Magic Link™ Handheld Personal Information Device . . . . .	9
4. Example of Transit Information . . . . .	9
5. Example of Transit Schedule Information . . . . .	10
6. Example of Map with Downtown Bus Stop Locations . . . . .	10
7. Freeway, HOV, and Toll Road Segments . . . . .	11
8. Magic Link™ Components . . . . .	12
9. I-45 North Default Map . . . . .	13
10. Example of Detailed Corridor View . . . . .	13
11. Example of Graphic Icons . . . . .	14



## LIST OF TABLES

---

Table	Page
1. Travel Survey and Travel Diary Schedule . . . . .	17
2. Number of Completed Travel Surveys and Diaries . . . . .	18
3. Reported Frequency of Magic Link™ Use . . . . .	23
4. Sources of Traffic and Transit Information: Before and After Survey Responses . . . . .	25
5. Importance of Availability of Traffic Information . . . . .	25
6. Changes in Obtaining Traffic Information over the Past Year . . . . .	26
7. Participant Rating of Different Traffic Information Sources . . . . .	27
8. Control Group Rating of Different Traffic Information Sources . . . . .	29
9. Other Methods to Obtain Traffic Information . . . . .	31
10. Interest in Subscribing to Service and Payment for Transportation Information . . . . .	31
11. Reported Changes in Commuter Behavior During Project by Participants . . . . .	33
12. Reported Changes in Commuter Behavior During Project by Control Control Group Members . . . . .	35



## CHAPTER ONE—INTRODUCTION

---

The Houston *Smart Commuter* Intelligent Transportation Systems (ITS) Operational Test was a federally sponsored advanced technology project. The Operational Test was funded, implemented, and evaluated through the joint efforts of the Metropolitan Transit Authority of Harris County (METRO), the Texas Department of Transportation (TxDOT), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). The Texas Transportation Institute (TTI), a part of the Texas A&M University System, assisted with the development of the operational test concept design and conducted the local evaluation. This chapter summarizes the background to the operational test, the project objectives, and the organization of this report.

### Background

As in many other major metropolitan areas, traffic congestion continues to be a significant problem in the Houston area, especially during the morning and afternoon peak periods. Although recent improvements in the transportation system have reduced congestion levels in some corridors, Houston ranks as one of the top 15 most congested cities in the country. The annual cost of this congestion, based on the costs associated with time delay and fuel, is estimated to be approximately \$2 billion (1). Air quality and environmental issues are also major concerns. Houston is currently in severe violation of the Environmental Protection Agency (EPA) standards for ozone emissions. In order to meet the requirements of the 1990 Clean Air Act Amendments, the area must develop measures to control growth in vehicle miles of travel and initiate other programs.

In response to the combination of increasing demands on the system and limited resources, the agencies responsible for transportation in the Houston area have often utilized innovative approaches to address mobility and congestion problems. Examples of these elements include:

- The regular development and publication of a multimodal Regional Mobility Plan.
- The extensive system of high-occupancy vehicle (HOV) lanes, park-and-ride lots, transit centers, express bus services
- The expansion of the freeway and toll road system.
- The development of TranStar, the Greater Houston Transportation and Emergency Management Center

The development of these projects has occurred through the coordinated and cooperative efforts of TxDOT, METRO, the city of Houston, Harris County, the Houston-Galveston Area Council (HGAC), and others. TTI has provided technical assistance on many of these projects.

In preparing to move Houston forward into the 21st century, these agencies continue to work together to ensure that the transportation system will meet the needs of future generations. Incorporating advances in technology, such as those offered through the application of Intelligent Transportation Systems (ITS), is an important part of this overall approach.

The Houston *Smart Commuter* ITS Operational Test is a further example of this multi-agency approach. The development of the Houston *Smart Commuter* ITS Operational Test began in 1990. A planning and feasibility study funded by FTA, METRO, and TxDOT was conducted by TTI in 1990 and 1991. This study examined the concepts behind the project, analyzed available literature on commuting behavior and mode choice selection, and examined the market potential for real-time traffic, transit, and rideshare information through the use of focus groups and surveys. Also assessed were potential technologies for providing the real-time traffic and transit information to individuals in their homes and work places (2, 3, 4, 5, 6). A multi-year project funded by METRO, TxDOT, FHWA, and FTA followed this preliminary study.

### **Houston *Smart Commuter* Objectives**

The Houston *Smart Commuter* Operational Test examined the influence of providing real-time traffic information and current bus information to commuters in the I-45 North Freeway corridor. The test focused on the traditional suburb-to-downtown travel market in the I-45 North corridor. A group of individuals living in the Spring and Kuykendahl park-and-ride lot market areas, and working in downtown Houston or other areas served by regular route buses, were recruited to participate in the test. These individuals were provided with access to current traffic and transit information through a hand-held device and a telephone system. Researchers monitored the use of these methods and evaluated changes in travel behavior. The travel behavior of a control group, comprised of commuters in the corridor not participating in the project, was also monitored.

A second component was originally planned for the Operational Test. Researchers anticipated that this phase would focus on real-time ride matching in the I-10 West Freeway corridor. Due to other activities in the corridor, including the *QuickRide* Value Pricing Demonstration on the I-10 West HOV lane, testing the use of pagers to provide real-time traffic information to commuters was considered. Both METRO and TxDOT decided not to pursue a second phase, however, due to the Priority Corridor projects and other activities underway in the region.

### **Report Organization**

The remainder of the report is divided into three chapters. Chapter Two summarizes the development and operation of the Houston *Smart Commuter* Test. The organizational structure for the operational test, the development of the hand-held and telephone information systems, and the recruitment of participants are summarized. Chapter Three examines the results of the travel

surveys and travel diaries completed by participants in the test and control groups over the course of the project. Chapter Four summarizes the major findings from the project and identifies potential areas for further testing and research. Copies of the surveys and travel diaries are provided in the appendices, along with more detailed survey results.



## **CHAPTER TWO—DEVELOPMENT AND OPERATION OF THE HOUSTON *SMART COMMUTER* OPERATIONAL TEST**

---

This chapter provides an overview of the development of the Houston *Smart Commuter* ITS Operational Test. The organizational structure for the operational test and the roles and responsibilities of the different agencies are outlined. The development and operation of the technology used to provide real-time information to the test participants in the I-45 North corridor is described. The methods used to recruit and train the project participants are also highlighted.

### **Organization of the Houston *Smart Commuter* ITS Operational Test**

The development, operation, and evaluation of the Houston *Smart Commuter* ITS Operational Test was accomplished through the joint efforts of METRO, TxDOT, FHWA, FTA, and TTI. METRO provided the overall project management responsibility for the operational test, in ongoing coordination with TxDOT. FTA and FHWA provided federal oversight. TTI was responsible for the local evaluation and ongoing technical assistance. The roles of each agency are highlighted next.

**METRO.** Houston METRO was responsible for the overall management of the operational test. METRO appointed a project manager and provided other support functions for the project. METRO received funding from FTA for a portion of the project and executed an agreement with TxDOT for reimbursement of funding from FHWA.

**TxDOT.** TxDOT was involved in all aspects of the operational test. TxDOT received funding from FHWA for a portion of the project and executed an agreement with METRO for use of these funds. TxDOT was also responsible for developing the real-time traffic information system that formed a major part of the I-45 North component.

**U.S. DOT—FHWA and FTA.** FHWA and FTA representatives provided federal oversight and guidance throughout the operational test and participated in periodic meetings as appropriate. Although FTA had the overall federal monitoring responsibilities for this operational test, these responsibilities were shared and coordinated with FHWA, especially the FHWA Austin office.

**TTI.** TTI was responsible for conducting the local evaluation of the operational test under contract to METRO and TxDOT. TTI helped coordinate the local evaluation, with the national evaluation being sponsored by FTA and administered by the Volpe National Transportation Systems Center. The Volpe Center is using the consulting firm, Multisystems, Inc., to conduct the national evaluation. The Institute also provided ongoing technical assistance for the project.

## I-45 North Real-Time Information System and Technology

As noted previously, METRO had overall project management responsibilities on the Houston *Smart Commuter* Operational Test. Thus, the procurement of the information delivery system followed METRO policies and procedures. A joint working group of METRO, TxDOT, and TTI representatives developed an initial draft Request for Technical Proposal (RFTP) in 1993 and 1994. This document was modified to meet the METRO procurement requirements and to provide more flexibility on potential technologies.

METRO used a two-step procurement process to select the contractor to develop the information delivery system. Under this procurement method, the first step involves the request, submission, and evaluation of technical proposals to determine if the proposer meets the minimum requirements outlined in the RFTP and if the proposer is qualified to perform the work. In the second step, METRO issues formal invitations to bid only to those firms that successfully completed the first step and that are, in METRO's opinion, technically and financially capable of performing the required work.

METRO issued the RFTP for the information delivery system in March 1995. The RFTP was advertised in local and national trade publications, magazines, and newspapers. In addition, a variety of mailing lists were used to notify potential bidders of the project. A pre-proposal meeting was held in March 1995 for interested vendors. METRO staff reviewed the RFTP, and potential bidders had the opportunity to ask questions concerning the project. A period for written questions provided additional opportunities for vendors to clarify specific issues. A letter to all vendors attending the pre-proposal conference provided answers to these questions.

METRO received four proposals in response to the RFTP. One of these was determined not to meet all of the specifications outlined in the RFTP and was eliminated from further consideration. The three remaining teams made formal presentations to METRO and TxDOT staff. The three teams were then invited to submit formal bids on the information service delivery system. METRO and TxDOT staff evaluated the final bids, and a recommendation was made to the METRO Board of Directors in the fall 1995.

The Board approved the selection of the TRW team at its November 1995 meeting. A notice to proceed was authorized by METRO, and a kick-off meeting with representatives from the TRW team, METRO, TxDOT, and TTI was held in December. The TRW team was comprised of the following firms:

TRW — Principal,  
S&B Infrastructures, Houston,  
Fastline Traffic, San Francisco,  
Celebration Computer Systems, Houston,  
Software Decisions, Inc., Houston,  
A&W Couriers, Houston, and  
CUE Networks Corporation, Houston.

---



Figure 1 illustrates the geographical area included in the I-45 North corridor component. A group of participants living in this area and working in downtown Houston, or another transit-accessible location, received real-time traffic and static transit information through an enhanced Sony Magic Link™ Personal Intelligent Communication (PIC)-1000 and an interactive touch-tone telephone system developed by the TRW team. As shown in Figure 2, real-time traffic information for the I-45 North Freeway and HOV lane, and the Hardy Toll Road was available to participants. Information on construction activities and transit services in the corridor and in downtown Houston was also available.

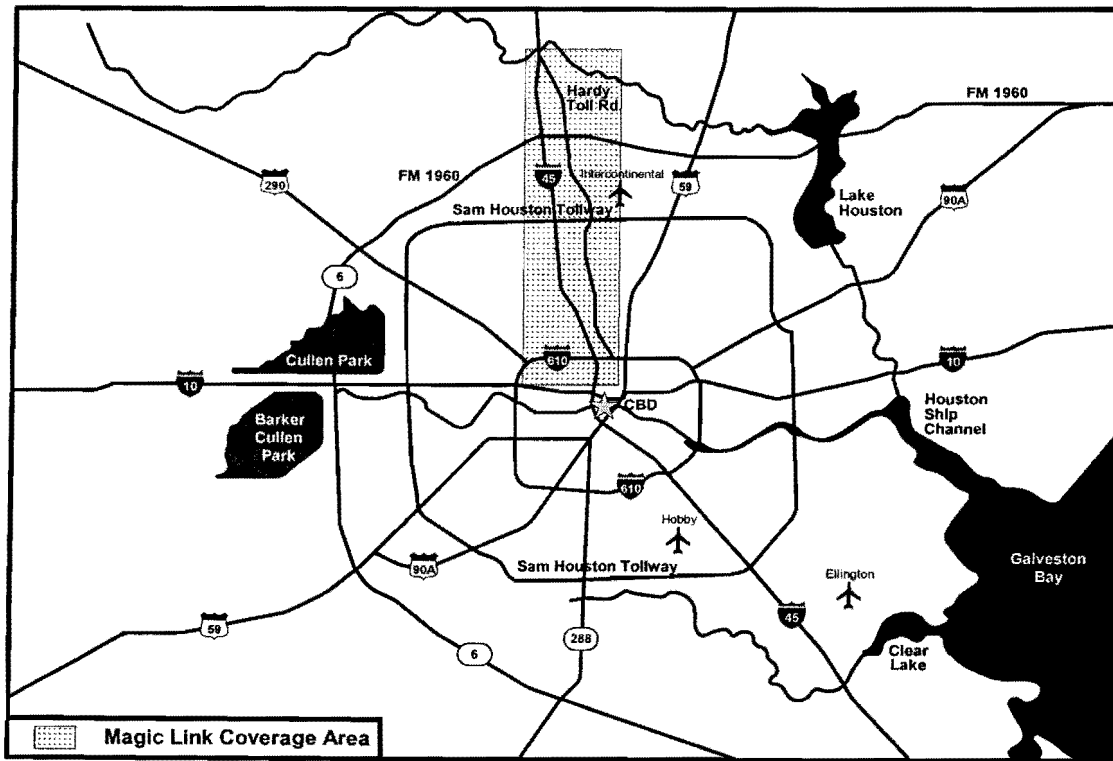


Figure 1. I-45 North Corridor Test Area.

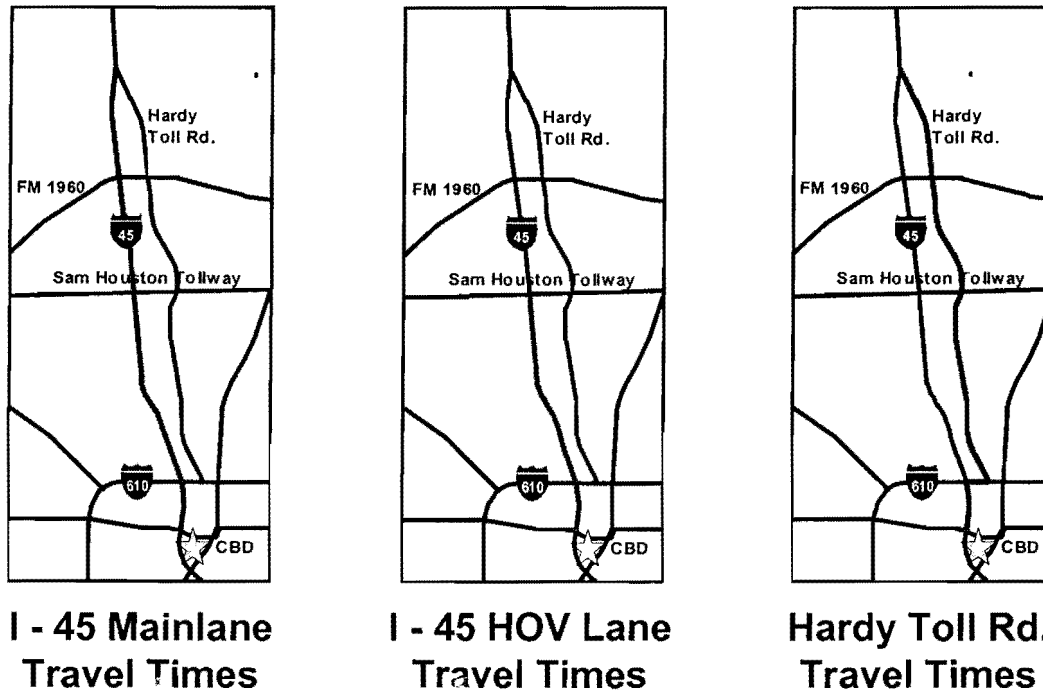


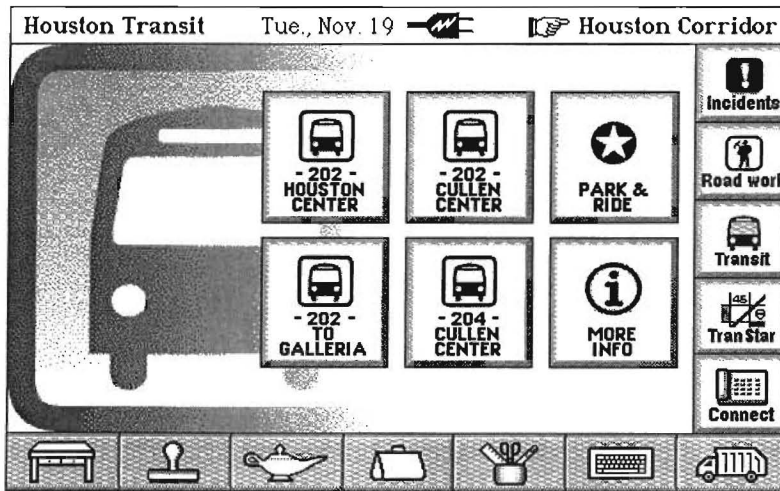
Figure 2. I-45 North Corridor Freeway and Toll Facilities.

The Magic Link™, shown in Figure 3, is a commercially available battery-operated handheld personal information device. Participants were able to access a wide range of programs and information on the Magic Link™ through the LCD touch screen. The basic Magic Link™ unit includes functions such as a datebook, a notebook, a calculator, a spreadsheet, a dictionary, games, and a communication platform allowing users to access telephone, e-mail, fax, pager, and other devices.

The TRW team used the Magic Link™ as a basic platform and added a number of enhancements for the project. First, as illustrated in Figures 4 and 5, information on METRO services was added, including bus routes, schedules, and fares. Maps showing the locations of the park-and-ride lots in the I-45 North corridor, as well as in the downtown area, were developed and incorporated into the Magic Link™. Figure 6 shows the location of bus stops in the downtown area.



Figure 3. Magic Link™ Handheld Personal Information Device.



- Route 202 serves the Kuykendahl Park-and-Ride (with midday service to Spring Park-and-Ride) and has three possible destinations
- Route 204 serves only the Spring Park-and-Ride and Cullen Center (Downtown)
- **More Info** will link you to information on HOV lane policies, bus fares, transfers, etc.

Figure 4. Example of Transit Information.

Touch to change direction of schedule information

Touch to show the downtown bus stops for this route

Houston Transit Details 12:76 Houston Transit

**202 Inbound Cullen Center** *display stops*

Spring Park & Ride	Kuykendahl Park & Ride	Milam / Congress	Calhoun / Smith	Jefferson / Smith
900a	910a	934a	943a	-
935a	945a	1009a	1018a	-
1010a	1020a	1044a	1053a	-
1045a	1055a	1119a	1128a	-
1120a	1130a	1154a	1203p	-
1155a	1205p	1229p	1238p	-
1230p	1240p	104p	113p	-
105p	115p	139p	148p	-
140p	150p	214p	223p	-
215p	225p	249p	258p	-
250p	300p	324p	333p	-
325p	335p	359p	408p	-

Incidents  
Road work  
Transit  
Transit  
Connect

Touch to scroll for viewing the entire schedule

Figure 5. Example of Transit Schedule Information.

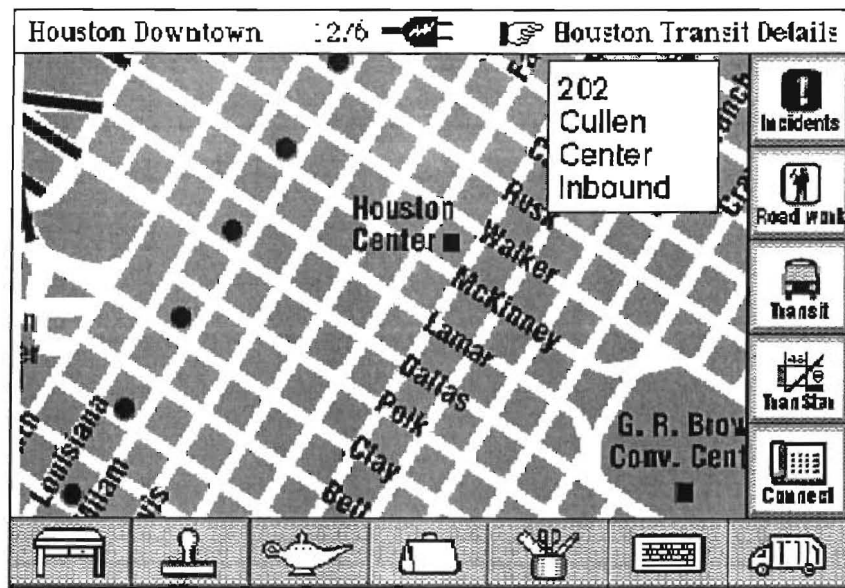
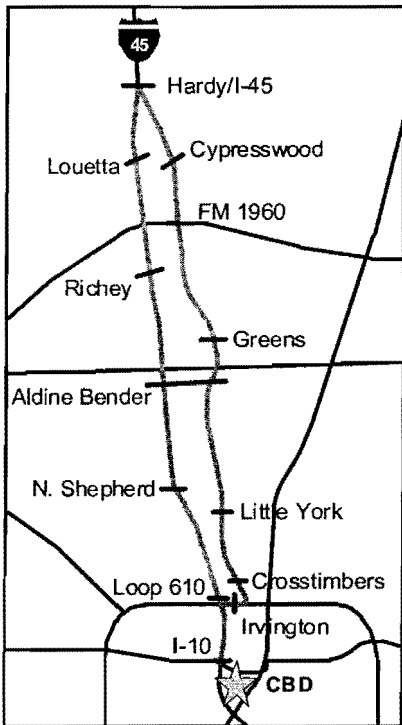


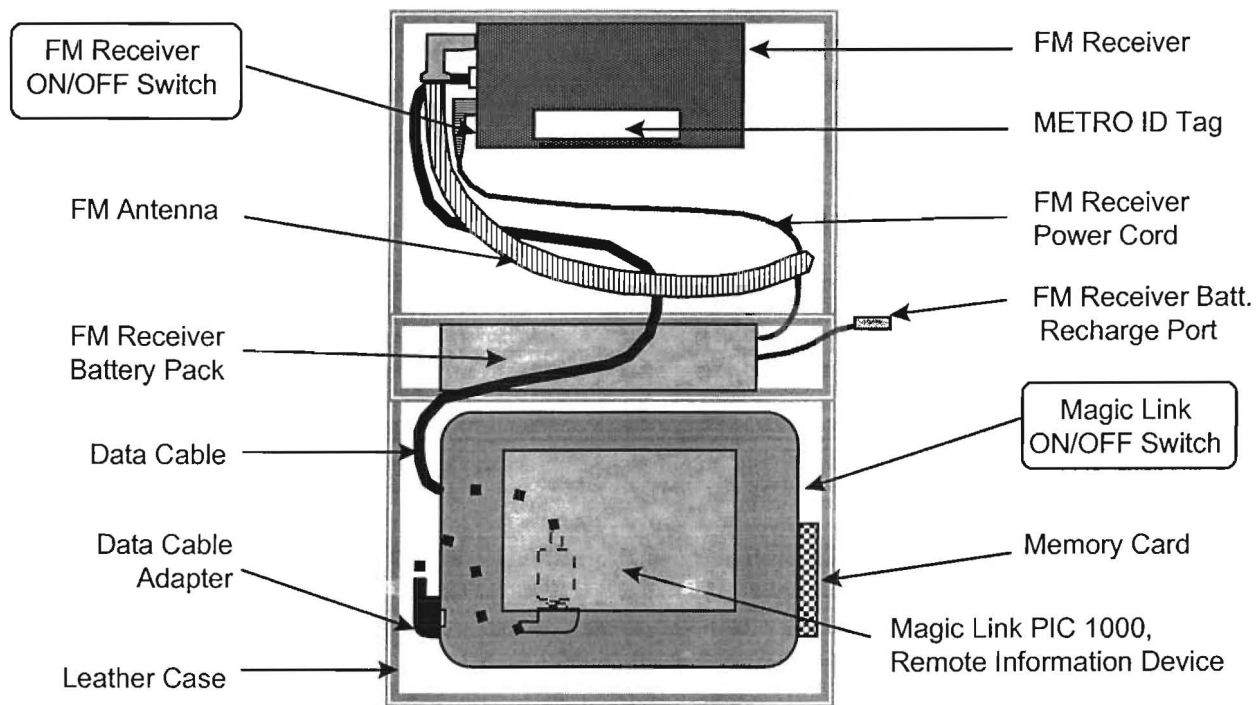
Figure 6. Example of Map with Downtown Bus Stop Locations.

Participants were also able to access real-time traffic information on the I-45 North HOV lane and Freeway, as well as the Hardy Toll Road. Figure 7 highlights the freeway, HOV lane, and toll road sections covered by the Automated Vehicle Identification (AVI) real-time traffic system. The real-time traffic information from the TranStar facility was sent through an FM subcarrier subsystem. A participant activated power to the receiver and turned on the Magic Link™ device. The components of the Magic Link™ system are shown in Figure 8.

✱ Travel times and average travel speeds are provided on the freeway segments indicated on this map.



**Figure 7. Freeway, HOV, and Toll Road Segments.**



**Figure 8. Magic Link™ Components.**

As illustrated in Figure 9, the Magic Link™ screen automatically defaulted to a map of the I-45 North corridor, which highlighted the current total travel times for the I-45 North Freeway lanes, I-45 North HOV lane, and the Hardy Toll Road. Known incidents were also shown. A user could then access more detailed screens with specific information on segment travel speeds, travel times, accidents, and construction activities. Icons highlight the travel speeds and the travel times for the I-45 North HOV lane, the general purpose freeway lanes, and the Hardy Toll Road. Figures 10 and 11 provide examples of these screens. Other screens were accessed by simply touching the face of the Magic Link™. In addition, participants were able to complete periodic travel diaries using the Magic Link™.

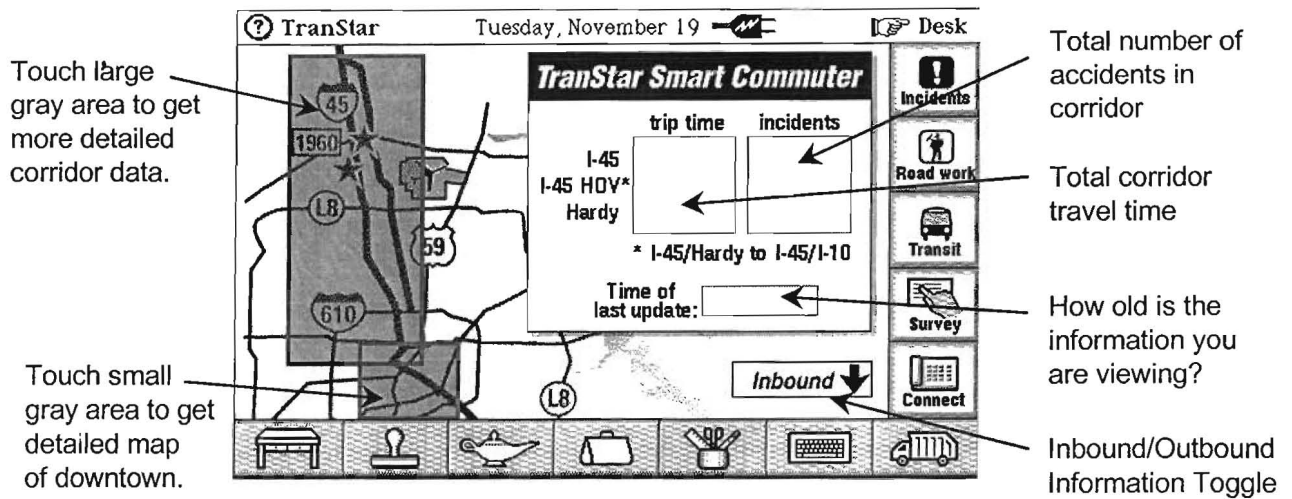


Figure 9. I-45 North Default Map.

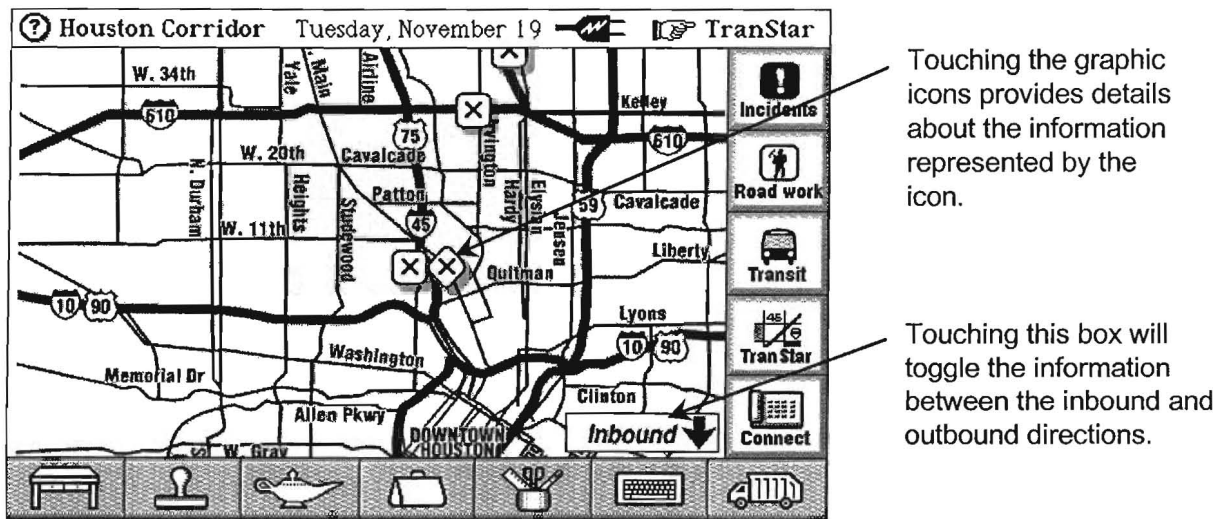


Figure 10. Example of Detailed Corridor View.

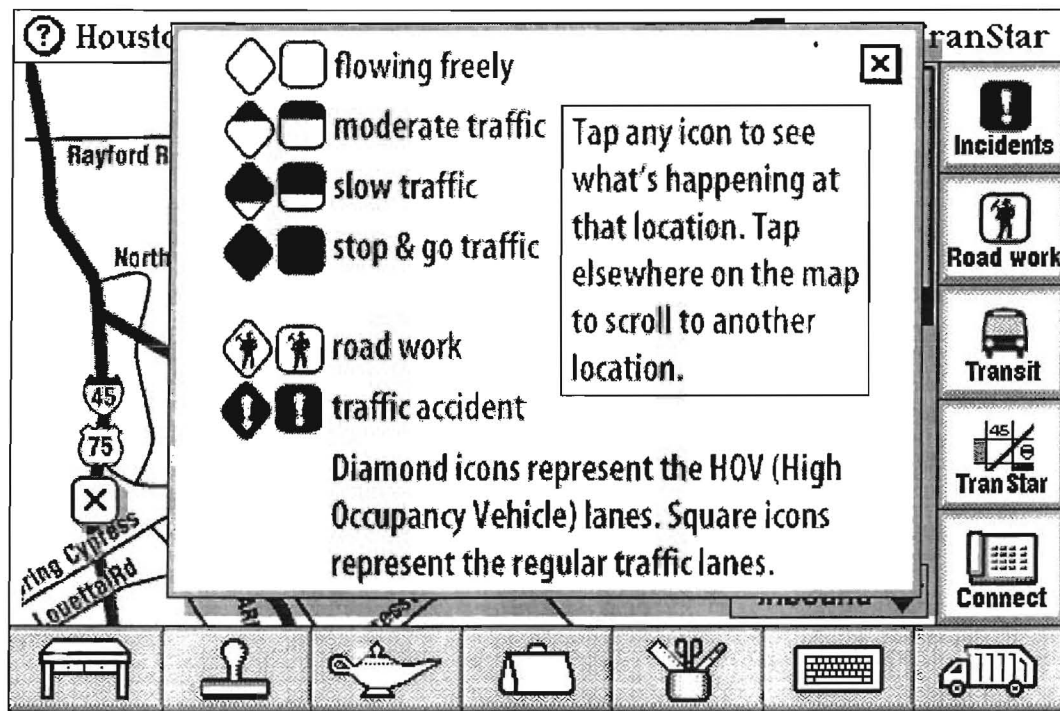


Figure 11. Example of Graphic Icons.

As noted, the various components included in the Magic Link™ were developed by the TRW team, METRO staff, and TxDOT personnel. The specific components unique to the *Smart Commuter* Operational Test included the system interface to the TranStar real-time traffic database provided by TxDOT, which followed the Interface Control Document prepared by TxDOT; the link through the FM subcarrier; the design of the maps and icons for the traffic and transit information; the METRO route, schedule and fare information; and user surveys and travel diaries.

The interactive telephone system represented the second information delivery method. The system utilized pre-recorded speech files which were produced and stored digitally. *Smart Commuter* participants accessed the system by calling a local telephone number. After a welcome message, participants were asked to enter their personal identification number (PIN). Participants were automatically provided with the current total travel time on the three facilities. They were also able to obtain information on segment travel times, bus routes and schedules, and construction activities for the I-45 North HOV lane, the freeway lanes, and the Hardy Toll Road. The system automatically provided inbound information in the morning and outbound information in the afternoon. A caller was able to either step through the various messages or to go directly to specific information.



## Recruiting and Training the *Smart Commuter* Participants

An initial group of approximately 275 individuals registered as *Smart Commuter* participants in the fall of 1996. These individuals met the criteria of residing in zip code zones in the Kuykendahl and Spring park-and-ride lot market areas, working in downtown Houston or other transit-accessible locations, and driving alone to work most of the time. These individuals completed travel diaries and travel surveys before they received a Magic Link™ in December 1996. Due to the technical problems encountered with the FM subcarrier transmission to the Magic Link™ devices during the first six months of operation, which are documented in the FY 97 report (8), a number of individuals dropped out of the test. As a result, additional commuters were recruited in the fall of 1997 to participate in the project.

A number of techniques were used to identify potential volunteers living in the Kuykendahl and Spring park-and-ride lot market areas. Initial techniques included direct contact with major employers in the downtown area and other transit-accessible activity centers, the METRO Web Site on the Internet, changeable message signs on the I-45 North Freeway, press releases, and information booths at the Woodlands Mall and the Park Mall.

To help recruit the second group of participants, METRO contracted with a private mailing service to obtain the names and addresses of approximately 80,000 individuals residing in the general area. The initial list was narrowed to some 44,000 individuals living in the appropriate zip code zones, who were sent a copy of the *Smart Commuter* brochure. Approximately 1,000 people responded indicating an interest in participating in the project. Most of these individuals did not meet the criteria for the test. After screening out those who were not employed, those who worked outside the target area, and those who did not use the I-45N corridor on a regular basis, 226 individuals registered to participate in the test.

Representatives from TRW, METRO, and TTI conducted the training session for the initial test participants in the fall of 1996, and METRO and TTI staff provided training for the new participants in October, November, and December 1997. Each session started with an overview of the project, including the objectives of the operational test and the various components. Hands-on instruction was provided on the use of the Magic Link™ and the telephone system. Individuals were shown how to operate the unit, how to access the normal Magic Link™ features, and how to use the *Smart Commuter* functions. The use of the interactive telephone system was also described and demonstrated.

Participants were required to bring their completed travel survey and travel diary with them to the training session. These surveys had been mailed previously to each participant. During the training, participants were shown how to access, complete, and submit the periodic surveys using the Magic Link™, as well as how to upload usage statistics through the built-in telephone modem. The participants were also provided with information on what to do if they experienced any problems or difficulties with either of the information delivery systems.

A variety of techniques were used to communicate with the *Smart Commuter* participants throughout the test. These included newsletters, electronic mail (e-mail), and special help sessions. The newsletters provided information on the project, reminded the participants of the schedules for the surveys, and announced dates for help sessions. A *Smart Commuter* e-mail address was also given to participants. The e-mail came to TTI researchers, who were able to quickly respond to questions and problems. This approach proved to be a very successful method of communication with participants who had access to e-mail.

In addition, four workshops were held at METRO in January 1998. The workshops provided participants with the opportunity to obtain help directly from METRO staff and TTI researchers. Individuals wishing to discontinue their participation in the test were also able to return their Magic Link™ devices at the sessions.

## CHAPTER THREE—ASSESSMENT OF THE *SMART COMMUTER* OPERATIONAL TEST

---

Participants' use of the *Smart Commuter* information delivery system and other sources of traffic information was monitored during the test through travel surveys and trip diaries. Similar information was also obtained from control group members. Members of both groups completed surveys and travel diaries before the start of the test, travel diaries at six-month intervals, and surveys and travel diaries at the end of the project. The Magic Link™ devices also automatically recorded the time and the duration of use sessions. Additional feedback was obtained from participants through ongoing telephone calls and e-mails, a discussion group at the end of the project, and exit interviews. This chapter discusses the methodology used to conduct the travel surveys and the travel diaries, and presents the results from these surveys, the focus group with participants, and the comments received by e-mail and in the exit interviews.

### Methodology

As noted in Chapter Two, the two test groups started at different times. Table 1 highlights the travel survey and travel diary schedule for the various groups. Participants in the initial test group and the control group completed before travel surveys and diaries in November 1996, six-month diaries in June 1997, one-year travel diaries in January 1998, 18-month travel diaries in June 1998, and two-year surveys and diaries in December 1998. The second group of participants completed travel surveys and travel diaries before receiving the Magic Link™ devices in October 1997, travel diaries at six months in June 1998, and surveys and diaries after one year in December 1998.

**Table 1. Travel Survey and Travel Diary Schedule.**

Group	Before <sup>1</sup>	Six-Month <sup>2</sup>	One-Year <sup>1/2</sup>	18-Month <sup>2</sup>	Two-Year <sup>1</sup>
Control Group	Nov 1996	June 1997	Jan 1998	June 1998	Dec 1998
First Test Group	Nov 1996 <sup>3</sup>	June 1997	Jan 1998	June 1998	Dec 1998
Second Test Group	Oct/Nov 1997	June 1998	Dec 1998	—	—

<sup>1</sup> - Travel Surveys and Travel Diaries.

<sup>2</sup> - Travel Diaries.

<sup>3</sup> - 17 participants in the first test group completed the before surveys and diaries in February 1997.

A copy of the travel survey completed by participants and control group members before the start of the test is provided in Appendix A. A copy of the participant travel survey administered at the end of the project is contained in Appendix B, and the after control group travel survey is provided in Appendix C. The travel diary used throughout the test is contained in Appendix D. The surveys were developed through the coordinated efforts of TTI, METRO, and TxDOT personnel, with input from the national evaluation consultants. Table 2 highlights the number of completed travel surveys and diaries for each time period. The procedures used to conduct the surveys and diaries with the test and control groups are described next.

**Table 2. Number of Completed Travel Surveys and Diaries.**

Group	Number of Completed Surveys/Diaries				
	Before <sup>1</sup>	Six-Month <sup>2</sup>	One-Year <sup>1/2</sup>	18-Month <sup>2</sup>	Two-Year <sup>1</sup>
Control Group	466 <sup>3</sup>	110 <sup>3</sup>	74 <sup>3</sup>	76 <sup>3</sup>	61 <sup>3</sup>
First Test Group	290	42	69	43	39
Second Test Group	226	85	71	—	—

<sup>1</sup> - Travel Surveys and Travel Diaries.

<sup>2</sup> - Travel Diaries.

<sup>3</sup> - 251 of the 466 control group respondents indicated a willingness to complete future travel diaries. Only these individuals were sent travel diaries at six months, 12 months, 18 months, and one year.

Travel surveys and travel diaries were mailed to test group participants prior to the training sessions in the fall of 1996 and 1997. The participants were asked to complete the survey and to record their commute trips for a specific one-week period before the training session. The participants were required to bring the completed surveys to the training session in order to obtain a Magic Link™ information device. A total of 290 travel surveys and travel diaries were received prior to the start of the test from the initial group of *Smart Commuter* participants. The second test group was comprised of 226 individuals. Completed travel surveys and diaries were received from this group prior to the start of their participation in October and November 1997.

Members of the initial test group completed six-month travel diaries in June 1997. As noted previously, and documented in the FY 97 report (8), the response by the first group of participants to the six-month travel diaries was low. It appears that the small response was due to the problems encountered with the FM subcarrier, which hampered the transmission of the real-time information to the Magic Link™ devices. Individuals in the initial test group who continued to participate in the project were asked to complete travel diaries at one year in January 1998, at 18 months in June 1998, and at two years in December 1998.

Participants in the second test group completed before travel surveys and travel diaries in October 1997. A total of 226 individuals started in this group. Participants were asked to complete a one-month travel diary in January 1998 to coincide with the one-year diaries completed by the initial test group and the control group. A total of 153 one-month diaries was completed in January; 85 diaries were received at six months in June 1998, and 71 one-year diaries and surveys were completed in December 1998.

The control group for the project was comprised of commuters in the I-45 North Freeway corridor. The following procedure was used to obtain information from the control group. This technique has been used by TTI, METRO, and TxDOT on other surveys and projects.

First, TTI researchers videotaped the license plate numbers of vehicles traveling in the I-45 North Freeway general purpose lanes for 2.5 hours during the afternoon peak-period. The videotaping was conducted in September 1996. Of the 6,300 vehicles observed during the time period, the videotape produced 5,308 readable license plates. The license plate numbers were transcribed and sent to the Texas Department of Motor Vehicles (DMV).

The DMV provided TTI with a list of names and addresses for the owners of the videotaped vehicle license plates. The list was reviewed by TTI researchers, and vehicles belonging to commercial businesses, rental car companies, and individuals from out-of-state were deleted. A total of 3,754 useable names resulted from this process. These individuals were sent a letter explaining the *Smart Commuter* project and requesting assistance by completing and returning the travel survey and travel diary. A copy of this letter is provided in Appendix E. A total of 466 surveys were returned, accounting for a response rate of approximately 8 percent.

The last question on the survey asked if the individual would be willing to complete another travel diary in six months. A space was provided for their name and address. Over half the respondents, or 251 individuals, indicated a willingness to complete a second survey.

A second letter and travel diary, similar to the first, were sent to these individuals in June 1997 as part of the six-month evaluation of the initial test. A total of 110 completed surveys were returned. Five people responded that they were no longer using the I-45 North Freeway due to a change in either their home or work location, and three individuals indicated that they had retired. Three surveys were also returned as undeliverable.

Control members were asked to complete three more waves of travel diaries at one-year, 18-months, and two years. As highlighted in Table 2, 74 responses were received to the one-year survey, 76 diaries were completed at 18-months, and 61 surveys and diaries were received in December 1998.

## **Before Travel Surveys**

The results from the travel surveys conducted prior to the start of the operational test are documented in previous reports (8, 9). This section summarizes the employment, work hours, commute time, travel modes, factors influencing commute behavior, and socio-economic characteristics of the individuals in the test and control groups. Appendix F provides tables containing more detailed information.

### *Normal Commute Mode*

The vast majority, slightly under 90 percent, of individuals in both the test and the control groups normally drove alone to and from work. Carpooling was the next most reported regular commute mode, followed by riding the bus. These responses are not surprising given that the recruitment of volunteers focused on individuals who primarily drove alone to and from work, and the control group was intended to be regular automobile commuters.

### *Employment, Commute Length, and Commute Travel Time*

Most of the individuals in both the test and control groups were employed on a full-time basis. Slightly over 90 percent of the participants in both groups were full-time employees. Between 2 percent and 6 percent were employed on a part-time basis. The remaining individuals reported they were university students or seeking employment. The majority of individuals in both groups lived over 20 miles from their place of employment. Further, most had commute travel times of at least 30 minutes.

### *Knowledge of Transit*

Individuals were asked to respond to a series of questions relating to their knowledge of the transit system and bus services in their area. Participants in the test group expressed slightly higher levels of understanding related to the various transit system components than those in the control group. For example, 93 percent of participants in the test group indicated a knowledge of the park-and-ride lot nearest to their house, compared to 82 percent of the control group members. The test group participants also reported more familiarity with transit schedules, bus stop locations, and fares.

### *Factors Influencing Commuting Behavior*

The surveys included a series of questions relating to the factors influencing the use of different modes and commuting behavior. Individuals in the test and control groups were asked to identify the reasons they currently drove alone and the factors that may influence them to use a different mode. The responses by participants in the test and control groups were fairly similar, with work schedules that do not permit sharing a ride the most frequently noted reason, followed by the need for an automobile before and after work, and the need for a car during the work day.

Individuals were also asked about factors that may influence them to change their commuting behavior. Thirty percent of the test group participants and 44 percent of the control group respondents indicated that nothing would influence them to ride the bus. On the other hand, 28 percent of the test group and 22 percent of the control group responded that having their employer subsidize bus passes would influence them to use the bus. Late evening bus service and more information on existing bus routes were also noted as positive factors by respondents in the test and control groups.

Twenty percent of participants in the test group and 29 percent of the control group members responded that nothing would influence them to carpool or vanpool. Factors cited as possible inducements to sharing a ride included access to the HOV lanes, vehicles available for midday work trips, free ridematching services, employer vanpool subsidies, and preferential parking for rideshare vehicles.

The availability of a guaranteed ride home program would influence 37 percent of the test group and 43 percent of the control group respondents to consider using a high-occupancy commute mode. Variable or flexible work hours were noted as a positive influence by approximately 25 percent of the participants. Other factors receiving lower levels of interest included increased parking costs and midday shuttle services.

#### *Employer Provided Commute Benefits*

Individuals in both groups were asked about commute benefits provided by their employers. Free parking was the most frequently reported benefit, with slightly over half of the control group participants and 44 percent of the test group participants receiving free parking from their employer. Approximately 16 percent of individuals in both groups reported that their employer subsidized bus passes, and 11 to 16 percent indicated that on-site bus pass sales were provided. Less than 10 percent of the respondents reported employer-subsidized vanpools and guaranteed ride home programs.

#### *Socio-Economic Characteristics*

Males account for a slightly higher percentage of test group participants than the control group. Test Group participants are 72 percent and 80 percent male, while 59 percent of the control group are male.

All groups reflect fairly similar age distributions. Thirty-five to 44 percent of participants fall within the 35 to 44 age group, while 24 to 28 percent are 45 to 54 and 20 to 26 percent are 21 to 34 years of age.

Participants reflect fairly similar income levels, although more test group participants are in the higher income brackets than control group members. Seventy percent of the first test group

and 82 percent of the second reported incomes of \$50,000 or higher, compared to 63 percent of the control group.

The reported household size of participants in all groups was fairly similar. Two-person households were the most common, followed by three-person households.

Reported vehicle ownership per household is similar among participants. The majority of individuals in all groups have two or more vehicles available.

The ethnicity of individuals in both groups is similar. The majority, 83 to 89 percent of participants, are White, while 4 to 7 percent are Afro-American, 4 to 7 percent are Hispanic, and 2 to 4 percent are Asian.

### **Use of the Magic Link™ Devices**

Researchers employed four techniques to help determine actual use of the Magic Link™ devices by test group participants, changes in travel behavior, and general reactions to the demonstration. Three of these methods—the travel surveys, the travel diaries, and the discussion group—relied on information provided by the participants. The final technique—the Magic Link™ use logs—also required participants involvement. The Magic Link™ automatically recorded each time the device was turned on, the duration of the session, and the information requested. Participants were asked to download their use logs every two weeks through the telephone modem. The use logs were also sent automatically when a participant submitted their travel diary electronically.

The use of the Magic Link™ devices by participants is examined in this section. The responses to a question included in the December 1999 survey are discussed first, followed by a review of use levels reported in the periodic travel surveys, comments from the discussion group, and the Magic Link™ logs.

Table 3 indicates use of the Magic Link™ devices to obtain traffic and transit information as reported by participants in the December 1998 surveys. Participants fall into three general categories. These are regular (daily) users, periodic (once or twice a week to once or twice a month) users, and infrequent users (almost never). Twenty percent of the respondents reported daily use of the Magic Link™ devices; 25 percent reported periodic use, and 55 percent indicated they almost never used the system.

The general breakdown of use levels matches the information obtained from the travel diaries and the discussion group. Individuals were asked to identify all the sources used to obtain traffic information on the way to and from work in the travel diaries. Commercial radio was the most frequently reported source of traffic information during all travel diary periods. Approximately 60 percent of the participants indicated obtaining traffic information from commercial stations on their way to work on the various diaries. Television was the next most



frequently used source, followed by the Magic Link™ devices. The number of actual days of Magic Link™ use reported ranged from a high of 83 in June 1998 to 40 in December 1998.

It is interesting to compare the traffic information sources used at home and on the way to work with those accessed at work and on the trip home. As noted above, information sources used in the morning at home and on the way to work were radio, television, Magic Link™, Internet, and newspaper. As one might expect, television was not commonly used at work, but use of the Internet increased. The order of traffic information sources accessed at work, and on the trip home were radio, Magic Link™, Internet, television, and newspaper.

The comments from participants during the discussion group indicated that a small number of participants used the Magic Link™ on a daily basis, while others reported turning the device on only periodically, and most noted infrequent use. Three of the eight individuals participating in the discussion group indicated they used the Magic Link™ device on a daily basis, while two reported periodic use, and two noted they were infrequent users. One participant reported changing from using the Magic Link™ on a daily basis to only periodically checking it when he started riding the bus.

Only two participants reported using standard Magic Link™ features on a regular basis. Approximately 80 percent of the test group respondents indicated they almost never used these functions. The remaining 19 percent were evenly split between using other available features once or twice a week and once or twice a month. The most frequently reported programs used were games, calendar, address book, and modem. The results from the discussion group indicate that participants may have been hesitant to use many of the Magic Link™ standard features since they knew the devices would have to be returned.

**Table 3. Reported Frequency of Magic Link™ Use.**

Use Frequency	Participants	Use Logs
Daily	20%	18%
Once/Twice a Week	15%	20%
Once/Twice a Month	10%	
Almost Never	55%	62%

The Magic Link™ use logs were examined on a quarterly basis. In examining the logs, the periods when it appeared that an individual left the device on for a major portion of the day were discounted. A number of interesting trends were identified from this analysis. First, use of the Magic Link™, as measured by the number of sessions in a week, declined over time. The

average number of weekly sessions after participants received the devices was upwards of 400 for the first test group and around 200 for the second group. Use tapered off over time, however, averaging between 50 and 100 weekly sessions in the last six months. Second, the Magic Link™ logs reflect the same use patterns reported in the surveys, diaries, and discussion group. Approximately 18 percent of received logs indicated regular use, while 20 percent reflected periodic access, and 62 percent were used infrequently. Third, the real-time traffic information was the most frequently accessed screen by participants, followed by the incident/roadway screens, and transit schedules and routes. Finally, the session duration for those seeking traffic information was longer than those for transit information.

### **Use and Rating of Traffic Information and Delivery Methods**

The surveys conducted at the beginning and the end of the test included a series of questions relating to the use of commercially available information on traffic conditions. The survey completed before the start of the test asked participants and control group members what sources they used to obtain traffic information and if they ever changed their behavior based on this information. The final survey asked individuals in both groups to rate available information sources by a series of attributes. The results of these questions are summarized in this section. As highlighted in Table 4, radio traffic reports are the most common source of information used by individuals in all groups, followed by television. For the control group, the newspaper and Internet were the next most frequently noted source of information. Test group participants noted the Internet, Magic Link™, telephone system, and newspaper as the remaining sources for traffic information.

It is interesting to note the difference in the use of the Internet over time. The reported use of the Internet as a source of traffic information was higher in the before survey of the second test group in November 1997 than in the before surveys of the first test group and the control group in the fall of 1996. Use of the Internet among participants in all groups increased over time. The growth in the use of the Internet and the availability of the Houston AVI real-time traffic map Website probably accounts for this increase. Also, as noted previously, using the Internet to obtain traffic information is more common at work than at home.

As highlighted in Table 5, 92 percent of the test group participants indicated that the availability of traffic information was somewhat to very important to them in both surveys, while the control group response was slightly lower at 82 percent in the before survey and 86 percent in the after survey. As shown in Table 6, the majority of individuals in both the test and control groups reported no change in the way they seek traffic information over the past year. Thirty-seven percent of the test participants and 23 percent of the control group responded that they sought traffic information more over the past year.

**Table 4. Sources of Traffic and Transit Information:  
before and after Survey Responses.\***

Source/ Technology	First Test Group		Second Test Group		Control Group	
	Before	After	Before	After	Before	After
Radio	64%	46%	60%	45%	65%	48%
Television	25%	14%	26%	22%	26%	30%
Newspaper	3%	5%	1%	2%	3%	8%
Internet	6%	16%	11%	13%	1%	8%
Magic Link™		14%		12%		
Telephone System		5%		3%		
Other				3%		3%
Do not seek out traffic or transit information	2%		2%		5%	3%

\*Multiple responses possible. Survey questions varied slightly. On the before survey, the question was “How important is traffic information to you in selecting radio and television stations?” The question on the final survey was “How important is obtaining traffic information to you?”

**Table 5. Importance of Availability of Traffic Information.**

Importance Rating	Test Group		Control Group	
	Before	After	Before	After
Very Important	54%	52%	50%	43%
Somewhat Important	38%	40%	32%	43%
Somewhat Unimportant	4%	6%	7%	10%
Not Important At All	4%	2%	11%	4%

**Table 6. Changes in Obtaining Traffic Information over the Past Year.**

	<b>Test</b>	<b>Control</b>
Seek Traffic Information Less	7%	10%
Seek Traffic Information More	37%	23%
No Change	56%	67%
If seek more, which sources do you rely on?		
Radio	36%	50%
Television	11%	29%
Newspaper	1%	8%
Internet	20%	13%
Magic Link™	24%	—
Telephone System	8%	—

Participants were asked to rate the Magic Link™, telephone system, radio, television, newspaper, and Internet by five attributes. Members of the control group were asked the same questions for the non-test methods of obtaining traffic information—radio, television, newspaper, and the Internet. The attributes focused on the ease of use of the method and the reliability, accuracy, timeliness, and usefulness of the information provided. A five-point rating scale was used, with 1 being very good and 5 being very poor.

The ratings provided by the test group participants are provided in Table 7 and the control group's responses are highlighted in Table 8. Both tables show the percentage of individuals responding to each rating category—very good, good, unsure, poor, and very poor—and the overall numerical rating. Given the five-point scale, a lower overall rating indicates a more positive response, while a higher number corresponds to a poor response. The ratings of the various ways to obtain traffic information are highlighted next.

**Table 7. Participant Rating of Different Traffic Information Sources.**

Method/Feature	Rating					Overall Rating <sup>1</sup>
	Very Good (1)	Good (2)	Unsure (3)	Poor (4)	Very Poor (5)	
<b>Magic Link</b>						
Ease of Use	14%	54%	6%	16%	10%	2.5
Reliability of Information	7%	41%	25%	21%	6%	2.8
Accuracy of Information	10%	42%	28%	14%	6%	2.6
Timeliness of Information	7%	36%	22%	24%	11%	2.9
Usefulness of Information	6%	35%	24%	22%	13%	3.0
<b>Telephone System</b>						
Ease of Use	14%	31%	39%	12%	4%	2.6
Reliability of Information	7%	29%	55%	5%	4%	2.7
Accuracy of Information	6%	29%	55%	6%	4%	2.7
Timeliness of Information	4%	30%	55%	7%	4%	2.8
Usefulness of Information	4%	32%	50%	8%	6%	2.8
<b>Radio</b>						
Ease of Use	70%	29%	—	1%	—	1.3
Reliability of Information	24%	49%	14%	13%	—	2.2
Accuracy of Information	21%	50%	18%	10%	1%	2.2
Timeliness of Information	20%	40%	18%	17%	5%	2.5
Usefulness of Information	21%	60%	7%	10%	2%	2.1
<b>Television</b>						
Ease of Use	37%	30%	16%	13%	4%	2.2
Reliability of Information	12%	42%	33%	11%	2%	2.5
Accuracy of Information	13%	40%	31%	14%	2%	2.5
Timeliness of Information	10%	27%	32%	23%	8%	2.9
Usefulness of Information	12%	39%	29%	15%	5%	2.6

**Table 7. Participants Rating of Different Traffic Information Sources (continued).**

Method/Feature	Rating					Overall Rating <sup>1</sup>
	Very Good (1)	Good (2)	Unsure (3)	Poor (4)	Very Poor (5)	
<b>Newspaper</b>						
Ease of Use	12%	24%	36%	18%	10%	2.9
Reliability of Information	5%	26%	40%	18%	11%	3.0
Accuracy of Information	—	12%	36%	27%	25%	3.6
Timeliness of Information	1%	25%	48%	14%	12%	3.1
Usefulness of Information	—	20%	40%	21%	19%	3.4
<b>Internet</b>						
Ease of Use	21%	35%	28%	10%	6%	2.4
Reliability of Information	12%	41%	42%	2%	3%	2.4
Accuracy of Information	13%	36%	42%	6%	3%	2.5
Timeliness of Information	17%	30%	39%	8%	6%	2.6
Usefulness of Information	16%	34%	38%	7%	5%	2.5

<sup>1</sup>A 5 point rating scale was used on this question, with a 1= very good and 5= very poor.

**Table 8. Control Group Rating of Different Traffic Information Sources.**

Method/Feature	Rating					Overall Rating <sup>1</sup>
	Very Good (1)	Good (2)	Unsure (3)	Poor (4)	Very Poor (5)	
<b>Radio</b>						
Ease of Use	64%	28%	2%	6%	—	1.5
Reliability of Information	18%	66%	9%	7%	—	2.1
Accuracy of Information	14%	70%	7%	7%	2%	2.1
Timeliness of Information	14%	45%	22%	14%	5%	2.5
Usefulness of Information	25%	59%	9%	5%	2%	2.0
<b>Television</b>						
Ease of Use	32%	34%	18%	12%	4%	2.2
Reliability of Information	16%	45%	35%	4%	—	2.3
Accuracy of Information	14%	47%	37%	2%	—	2.3
Timeliness of Information	10%	33%	43%	12%	2%	2.6
Usefulness of Information	20%	33%	41%	4%	2%	2.3
<b>Newspaper</b>						
Ease of Use	12%	31%	19%	17%	21%	3.0
Reliability of Information	10%	22%	44%	12%	12%	3.0
Accuracy of Information	10%	22%	49%	7%	12%	2.9
Timeliness of Information	5%	15%	34%	24%	22%	3.4
Usefulness of Information	3%	23%	40%	17%	17%	3.3
<b>Internet</b>						
Ease of Use	12%	30%	46%	6%	6%	2.6
Reliability of Information	12%	22%	63%	—	3%	2.6
Accuracy of Information	12%	19%	63%	3%	3%	2.6
Timeliness of Information	3%	28%	63%	—	6%	2.8
Usefulness of Information	10%	25%	56%	3%	6%	2.7

<sup>1</sup>A 5 point rating scale was used on this question, with a 1= very good and 5= very poor.

**Magic Link™.** Test participants' overall rating of the Magic Link™ on all five attributes was close to the middle of the scale (good to unsure). Ease of use (2.5) was the highest rating. Accuracy of information (2.6) was the second highest rating. Many participants seem to have questions about the reliability, timeliness, and usefulness of the information provided, with ratings of these attributes ranging from 2.8 to 3.0.

**Telephone System.** The overall ratings for the telephone system on all five attributes ranged from 2.6 for ease of use to 2.8 for timeliness and usefulness of the information. These ratings are relatively similar to those for the Magic Link™ devices, indicating generally neutral responses.

**Radio.** Radio was rated the highest on all five attributes by both test and control group members. Seventy percent of the test group and 64 percent of the control group participants rated radio very good on ease of use, for an overall rating of 1.3 for participants and 1.5 for control group members. The reliability, accuracy, and usefulness of the information was also considered good by individuals in both groups, with ratings of 2.0 to 2.2. The timeliness of radio traffic information was slightly lower at 2.5.

**Television.** Television was rated between 2.2 and 2.9 on the five attributes by both groups. Ease of use received the highest rating (2.2), while timeliness of information received was the lowest (2.9).

**Newspaper.** The newspaper as a source of traffic information received the lowest ratings among the different methods. Average ratings for the five attributes were in the unsure to poor range (3 to 4).

**Internet.** The average ratings on the five attributes for the Internet were in the good to unsure range (2 to 3). Test group participants tended to rate the Internet slightly better than control group members.

Individuals in both the test and control groups were asked their interest in other potential methods to obtain traffic information. As noted in Table 9, hand-held/palmtop computers, cellular telephones, pagers, and e-mail all received some positive responses, but 49 percent of the control group members and 21 percent of the test participants indicated they were not interested in any additional methods.



**Table 9. Other Methods to Obtain Traffic Information.**

<b>Method</b>	<b>Participants</b>	<b>Control Group</b>
Cellular Telephone	18%	11%
Pager	10%	7%
E-mail	3%	11%
Handheld/Palmtop Computer	36%	15%
None	21%	49%
Other	12%	7%

Finally, both surveys contained questions on possible interest in subscribing to a service providing current traffic information at a reasonable cost, and willingness to pay for this type of service. As highlighted in Table 10, the majority of individuals in both groups were not interested in subscribing to a traffic information service. Of those who were interested, most favored a fixed monthly rate for the service, rather than a flat rate per call. In terms of willingness to pay, test group participants identified an the average monthly fee of \$9.48 and an average per call of \$.55, compared to \$7.14 and \$1.00 respectively, for control group members.

**Table 10. Interest in Subscribing to Service and Payment for Traffic Information.**

	<b>Participants</b>	<b>Control Group</b>
<b>Subscribe if Reasonable Cost</b>		
Yes	39%	24%
No	61%	76%
<b>Payment Preference</b>		
Fixed rate per month	74%	67%
Flat rate per call/page	26%	33%

## Changes in Travel Behavior

The travel diaries completed by test participants and control group members were examined to assess changes in travel behavior based on real-time traffic information obtained through the Magic Link™ devices and other methods. The final survey included questions relating to changes in commute behavior during the two-year period and changes made in response to real-time traffic information. Additional information on changes in travel behavior was obtained from participants during the discussion group and the exit interviews.

The survey completed by participants and control group members at the end of the project contained a series of questions related to changes in travel behavior based on traffic information obtained through the *Smart Commuter* devices and other sources. Tables 11 and 12 highlight the responses to these questions. Approximately 37 percent of the test participants reported their commute behavior had changed over the course of the project. Of those, 39 percent reported changing their travel route more frequently; 33 percent noted changing their travel mode more often, and 13 percent indicated changing their time of travel more frequently.

About half of those responding reported making infrequent changes based on the information obtained specifically from the *Smart Commuter* devices, while 15 percent noted frequent changes, and 36 percent did not make any changes. Using different travel routes was the most frequently reported alternative (73 percent), followed by changing time of travel (22 percent). Only three percent reported changing their mode of travel. Most respondents reported favorable experiences when a change was made. Forty-six percent noted less stressful trips; 34 percent reported time savings, and 14 percent indicated their trip was more comfortable. Only 3 percent reported more stressful travel. These generally positive experiences translated into 79 percent of the respondents indicating they would make the same change again. Finally, participants indicated they were most likely to change their travel behavior on commute trips to and from work, followed by related travel, errands/personal business, and recreation/social activities.

Similar responses were noted by individuals in the control group, as highlighted in Table 12. Fifty-eight percent reported they were likely to change travel behavior infrequently based on available traffic information, while 34 percent noted they were likely to change on a frequent basis. Both of these percentages are higher than those given by participants for changing behavior based on the *Smart Commuter* information. Altering travel routes was the most frequently cited change, followed by time of travel, with only a negligible amount (two percent) changing mode. Similar to participants, the control group reported positive experiences when making a change. Forty-two percent indicated a less stressful trip, and 30 percent reported saving time. A slightly higher majority, 85 percent, reported they would make the same change again based on their experience. Commute travel was identified as the most likely trip for changing behavior, followed by recreational/social.

The travel diaries reflect similar trends, with a few differences. The diaries indicate somewhat lower levels of changes in travel behavior on a daily basis than those reflected in the general question on the final survey. Over the course of the test, between 10 percent and 16 percent of the participants reported changing their travel behavior on the commute to work due to traffic information. Actual days with reported changes for individuals in the control group averaged between 5 percent and 15 percent. The travel behavior changes reported in the diaries by both groups are similar to those noted in the surveys. Altering travel routes was the most frequently cited changed, followed by changing the time of travel, using a different mode, and eliminating the trip.

**Table 11. Reported Changes in Commute Behavior During Project by Participants.**

	Percentage
Has commute behavior changed during participation of the project?	
Yes	37%
No	63%
If yes, how has your travel changed?	
Changed mode more frequently	33%
Changed route more frequently	39%
Changed time of travel more frequently	13%
Other	15%
Did you ever change your travel behavior as a result of <i>Smart Commuter</i> provided information?	
Yes, frequently	15%
Yes, infrequently	49%
No	36%
If yes, what change did you make?	
Mode	3%
Route	73%
Time of travel	22%
Did not make trip	2%

**Table 11. Reported Changes in Commute Behavior During Project by Participant (continued).**

	Percentage
What was your experience when you made a change?	
Save time	34%
More comfortable trip	14%
Less stressful trip	46%
More stressful trip	3%
Other	3%
Based on your experience, would you make the same change in the future?	
Yes	79%
No	6%
Undecided	15%
What types of trips are you most likely to change travel behavior based on traffic information?	
Commute to/from work	58%
Work related travel	16%
Errands/personal business	14%
Recreational/social activities	11%
Other	1%

**Table 12. Reported Changes in Commute Behavior During Project by Control Group Members.**

	<b>Percentage</b>
Did you ever change travel behavior based on specific traffic information?	
Yes, frequently	34%
Yes, infrequently	58%
No	8%
If yes, what change did you make?	
Mode	2%
Route	61%
Time of travel	30%
Did not make trip	5%
Other	2%
What was your experience when you made a change?	
Save time	30%
More comfortable trip	18%
Less stressful trip	42%
More stressful trip	2%
Other	8%
Based on your experience, would you make the same change in the future?	
Yes	85%
No	4%
Undecided	11%
What types of trips are you most likely to change travel behavior based on traffic information?	
Commute to/from work	54%
Work related travel	13%
Errands/personal business	9%
Recreational/social activities	22%
Other	2%

## Discussion Group Summary

A discussion group was held with *Smart Commuter* participants in January 1999. The objective of the discussion group was to obtain additional information from *Smart Commuter* participants on general travel patterns, the use of the Magic Link™ device, changes in travel behavior, likes/dislikes about the system, and general ideas on the provision of traffic and transit information. The discussion group added to the information obtained through the surveys and travel diaries by allowing more probing questions and interaction with participants.

All participants returning surveys in December 1998 were considered for the discussion group. The attempt was made in recruiting discussion group participants to obtain a mix of individuals, including old and new *Smart Commuter* participants, males and females, and ethnic backgrounds. METRO staff made contact with the individuals, and a follow-up call was made the day before the session to remind participants of the meeting. The discussion group was held at the METRO offices over the lunch hour. Sandwiches were provided for participants. TTI staff led the discussion group based on a series of questions developed, with input from METRO and TxDOT staff, and the national consultants.

Ten individuals were invited to the discussion group, and eight attended the session. These individuals provided a mix of test participants (3 old, 5 new), sex (6 males, 2 females), and ethnic diversity (1 minority). As highlighted next in the summary comments, they also provided a mix of modes (drive alone, bus) and heavy/light users of the Magic Link™ device.

### *General Work Trip Characteristics*

- Six drove alone on a regular basis.
- Two rode the bus on a regular basis. Since all of the original participants were screened to eliminate regular bus riders, these individuals switched from driving alone to riding the bus during the course of the demonstration.
- Work schedules varied from early (6:00/6:30 a.m. start) to more traditional (8:00 a.m. start).
- Downtown was the major work destination, but one individual reported traveling to different offices in the city throughout the day, and one indicated often working in an office to the south of downtown.

### *Use of the Magic Link™ Device and Likes/Dislikes*

- Three individuals characterized themselves as heavy users of the Magic Link™ device; two were moderate users; two were light users, and one noted that he changed from being a moderate/heavy user to a light user when he started riding the bus.
-

- The heavy users reported accessing the device on a daily basis to check on traffic conditions. In two cases, the individuals noted that they kept the device in their vehicles at all times and used it throughout the day as they traveled for work.
- The two bus riders indicated they used the Magic Link™ periodically to check on bus schedule changes and to check on traffic conditions for trips to the park-and-ride lot.
- The participants all indicated that the real-time traffic information provided through the device was valuable. Three participants questioned the construction information, as it did not always seem to be up-to-date. The two bus riders indicated that the updated bus schedule information was very helpful.
- Participants noted the information provided was especially of help during inclement weather, such as the flooding the past year.
- Some type of problem receiving information through the device was noted by six of the eight individuals. In some cases, this was a minor sporadic problem, while in other cases it occurred more frequently. Individuals living in the Woodlands seemed to experience the most problems with radio transmission.
- The need to activate the receiver and the bulkiness of the device was noted as cumbersome by some participants, and one indicated that the screen was hard to read in the late afternoon and evening.
- Four participants suggested a device mounted in the car would be very good.
- The periodic need to re-initialize the device and to upload survey data was noted as a problem by three participants.
- All of the individuals indicated that they had gotten quick answers to their questions and help when they needed it. Two noted that the e-mail system was especially easy to use to get help.
- All participants indicated they would like all of the freeway system covered by the device.

#### *Changes in Travel Behavior Based on Magic Link™ Information*

- The three heavy users indicated that they changed their travel behavior based on information obtained through the Magic Link™ devices on a regular basis. The most frequently noted change was using the toll road rather than I-45 North, but other alternative routes were noted, along with changes in time of travel.

- The infrequent users indicated that they had made similar changes in travel behavior, but less often.
- The bus riders noted that they used the information to check schedules and to take buses at times other than their normal trip.

#### *Importance of Traffic Information and Ways to Review It*

- All of the participants indicated that they value traffic information and use a variety of methods to obtain it. These included radio while driving, television reports, and the changeable message signs on the freeways.
- Suggestions for additional ways to obtain traffic information included a radio station dedicated to traffic information (like highway advisory radio—HAR—this idea was strongly supported by all participants), more information on freeway changeable message signs, such as travel times to various destinations, as well as more signs. An in-vehicle unit, voice or visual, was also suggested. Some participants indicated that they have pagers and would use that method, while others suggested the Internet (although none currently use the real-time traffic map).
- Participants noted that the information should be available for all freeways and some major streets. A comment was made supporting the value of flood information.
- Participants identified the following characteristics as crucial to any real-time traffic information system:
  - Fast
  - Real-Time Information
  - Dependable/Reliable
  - Low Cost
  - On all Freeways/Major Roads
  - Portable
  - In-Vehicle: Voice or Visual
- Participants did not express a willingness to pay for traffic information.

#### *Other Magic Link™ Features*

- All participants indicated they had tested/played with other features of the device, but no one indicated heavy use after an initial period.



- One individual commented that he did not use some of the features (like address book) because he would not be keeping the device and was concerned about privacy.

#### *Other Comments/Suggestions*

- There was a mix of reaction on use of electronic or paper surveys. Most liked completing the surveys electronically, while a few said they had problems and liked the paper forms better.
- All of the participants indicated they enjoyed being part of the test, found it a worthwhile use of their time, and would participate again in a future project.

#### **E-Mails and Exit Interviews**

The *Smart Commuter* e-mail address given to participants proved to be an effective method to answer questions and provide assistance to individuals with access to e-mail over the course of the project. In addition, informal interviews were conducted with 37 participants during the collection of the Magic Link™ devices in January 1999. The general issues and comments obtained through these e-mails and exit interviews are summarized in this section.

The e-mails from participants tended to focus on problems encountered with the Magic Link™ devices. The major issue was not being able to obtain the real-time traffic information due to the problems with the radio reception. Other concerns included not being able to initialize the devices, problems downloading the diaries, and dead batteries. Participants, especially those in the first group, also used e-mail to request dropping out of the project demonstration.

The general comments from participants in the exit interviews indicated that many found the Magic Link™ device too cumbersome to use on a regular basis. Activating the receiver, waiting for updated information to be transmitted, and scrolling through the various screens was too time consuming. In addition, many individuals reported reception problems and inability to obtain information. It appears that these two factors—the length of time involved to set up and use the devices and the frequent lack of information—caused many participants to not use the Magic Link™ on a regular basis.



## CHAPTER FOUR—CONCLUSIONS

---

This report documents the results from the Houston *Smart Commuter* ITS Operational Test. The project background and the development of the traffic and transit information delivery systems were summarized. The results from the surveys and travel diaries completed by test participants and control group members throughout the project were presented. Information from participants obtained through the e-mail system, the discussion group, and the informal exit interviews were highlighted.

This chapter provides an overall assessment of the *Smart Commuter* Operational Test. The contributions of the project to advancing the state-of-the-practice relating to providing real-time traffic and transit information are discussed. Areas where further research and testing may be beneficial are also identified.

### Assessment

The results from the Houston *Smart Commuter* project provide a wealth of information concerning commuters' travel behavior. These include travelers' interest in and use of current traffic and transit information, methods for obtaining this information, and changes in travel behavior resulting from the provision of this information. The project also provides additional insights into the difficulty of developing user-friendly and reliable systems, especially with the rapid evolution of technology. The major conclusions from the test related to these items are highlighted next.

- The project successfully developed and tested the provisions of real-time traffic and static transit information through a hand-held device and a telephone system. The Magic Link™ and the telephone system were tested over a two-year period with participants commuting in the I-45 North corridor. Technical problems with the FM radio subcarrier limited the reliability of the Magic Link™ system during portions of the test, however.
- The results from the travel surveys, trip diaries, and the discussion group all indicate that drivers do seek information on traffic conditions on a regular basis. Commercial radio stations are the primary sources of information for most drivers, followed by television, the newspaper, and the Internet. Radio is the most frequently used method on both trips to work in the morning and home in the afternoon. Television is used more in the morning, while Internet use is higher at work in preparation for the trip home.
- Frequency of use of the Magic Link™ varied among participants. Approximately 20 percent of the participants responding to the final survey reported daily use of the

devices; 25 percent indicated periodic use of once or twice a week to once or twice a month, and 55 percent were infrequent users.

- Factors that appeared to limit the use of the Magic Link™ devices included the time to set it up, the inability to obtain information due to the problems with the FM subcarrier, and the fact that it was not intended to be used in a moving vehicle.
- Factors that appear to be important to travelers in obtaining traffic information are ease of use, reliability, and accuracy. The Magic Link™ was rated by participants below other methods, except the newspaper, on most of these attributes. Commercial radio reports were rated the highest by both participants and control group members on the five attributes—ease of use, reliability, accuracy, timeliness, and usefulness of information.
- While the results indicate that people seek traffic information, most do not appear interested in paying for it. The majority of participants and control group members responding to this survey question were not interested in subscribing to a system requiring payment.
- Other potential methods for obtaining traffic information of interest to some members of the test and the control groups included cellular telephones, pagers, e-mail, and hand-held or laptop computers.
- Test and control group members reported changing their travel behavior based on traffic information. Most individuals appear to modify their behavior on an infrequent basis, although some reported making frequent changes. Altering their travel route is by far the most common type of change, followed by time of travel. Only a small percentage reported changing mode or not making the trip. Some participants did change from driving alone to taking the bus on a regular basis over the course of the project.
- Individuals in most groups reported mostly positive experiences when they did make a change. A less stressful trip was the most frequently cited benefit, followed by saving time, and a more comfortable trip. As a result, most individuals noted they would make the same change in the future.
- The survey results indicate that individuals are more likely to change their behavior on work commute trips, rather than work related, personal business, or social/recreational travel.

- The project points out the difficulty in developing projects given rapidly evolving technologies. At the time of the RFTP, the Magic Link™ and the use of the FM subcarrier represented state-of-the-art approaches. By the time the Magic Link™ system was deployed, however, other more advanced technologies were available.

### **Further Tests**

Initially, it was anticipated that the *Smart Commuter* project would include a second component. Testing real-time ridematching in the I-10 West (Katy) Freeway and using pagers to provide traffic information to a small group of commuters were both considered. Although it was decided not to move forward with a second phase, the following ideas may be considered for further tests or deployment efforts.

- Test providing real-time traffic information through the use of pagers. The system could notify commuters only in specific situations, such as when traffic reaches a certain congestion level, or at pre-determined times regardless of traffic conditions.
- Test providing real-time traffic information through e-mail messages.
- Test the use of Highway Advisory Radio (HAR) in a corridor or area.
- Test the use of numerous dynamic message signs (DMS) in a corridor or area.

These efforts could be developed, tested, monitored, and evaluated through public/private partnerships. A variety of technologies, approaches, and institutional arrangements could be used to conduct these tests. The results would help advance the state-of-the-practice related to providing real-time traffic and transit information to travelers.



## REFERENCES

---

1. Schrank, David L., and Timothy J. Lomax. *Urban Roadway Congestion 1982 to 1993, Volume 1: Annual Report*. College Station, Texas: Texas Transportation Institute, 1996.
2. Texas Transportation Institute. *Houston Smart Commuter IVHS Demonstration Project: Review of Existing Market Research Information*. College Station, Texas: Texas Transportation Institute, October 1990.
3. Texas Transportation Institute. *Houston Smart Commuter IVHS Demonstration Project: Bus and Carpool Concept Definition*. College Station, Texas: Texas Transportation Institute, February 1991.
4. Gelb Consulting Group, Inc. *Exploratory Research on the Smart Commuter Concept*. College Station, Texas: Texas Transportation Institute, March 1991.
5. Texas Transportation Institute. *Houston Intelligent Transportation Systems*. College Station, Texas: Texas Transportation Institute, April 1991.
6. Turnbull, Katherine F. *Houston Smart Commuter IVHS Demonstration Project: Concept Design and Implementation Program Outline*. College Station, Texas: Texas Transportation Institute, June 1991.
7. Turnbull, Katherine F., and Sarah M. Hubbard. *Houston Smart Commuter ITS Operational Test and Local Evaluation Program*. College Station, Texas: Texas Transportation Institute, 1994.
8. Turnbull, Katherine F., Stephen P. Farnsworth, and Darryl D. Puckett. *Houston Smart Commuter ITS Operational Test: Six-Month Evaluation and FY 1997 Status Report*. College Station, Texas: Texas Transportation Institute, 1998.
9. Turnbull, Katherine F., Stephen P. Farnsworth, and Darryl D. Puckett. *Houston Smart Commuter ITS Operational Test: FY 98 Status Report*. College Station, Texas: Texas Transportation Institute, 1999.





**APPENDIX A—BEFORE TRAVEL SURVEY—TEST PARTICIPANTS AND CONTROL GROUP MEMBERS**

---

**I-45 NORTH FREEWAY  
TRAFFIC INFORMATION SURVEY**

Thank you for participating in this very important study. As a traveler on the I-45 North Freeway, please complete this survey and the attached travel diaries for the week of **November 18-22, 1996**.

Home Zip Code \_\_\_\_\_

Work Zip Code \_\_\_\_\_

1. How often do you use the following modes of transportation for commuting to or from work?

	<u>Always or Almost Always</u>	<u>Occasionally</u>	<u>Never</u>
a. Drive alone .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
b. Carpool .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
c. Vanpool .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
d. Ride the bus .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
e. Other (Specify) _____	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>

2. Are you aware of a Park & Ride bus lot located near your home?      <sub>1</sub> Yes      <sub>2</sub> No

2.1 Which Park & Ride bus lot is nearest your home? \_\_\_\_\_

2.2 How familiar are you with the following features of Park & Ride bus service?

	<u>Very Familiar</u>	<u>Somewhat Familiar</u>	<u>Not At All Familiar</u>
a. Schedule .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
b. Bus stop locations .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>
c. Cost .....	<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>

3. What are your work hours and schedule? (Check all that apply, indicate hours, and circle a.m. or p.m.) If you work full-time or part-time, circle which days of the week you work.

HOURS	SCHEDULE (Circle all that apply)								
<input type="checkbox"/> <sub>1</sub> Full-time. Hours are from ___:___ a.m./p.m. to ___:___ a.m./p.m. <div style="text-align: center;">(Circle One)</div>	<table border="1"> <tr> <td>Mon.</td> <td>Tues.</td> <td>Wed.</td> <td>Thur.</td> </tr> <tr> <td>Fri.</td> <td>Sat.</td> <td>Sun.</td> <td></td> </tr> </table> <div style="text-align: center;">(Circle One)</div>	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.	
Mon.	Tues.	Wed.	Thur.						
Fri.	Sat.	Sun.							
<input type="checkbox"/> <sub>2</sub> Full-time. Hours are irregular.									
<input type="checkbox"/> <sub>3</sub> Part-time. Hours are from ___:___ a.m./p.m. to ___:___ a.m./p.m. <div style="text-align: center;">(Circle One)</div>	<table border="1"> <tr> <td>Mon.</td> <td>Tues.</td> <td>Wed.</td> <td>Thur.</td> </tr> <tr> <td>Fri.</td> <td>Sat.</td> <td>Sun.</td> <td></td> </tr> </table> <div style="text-align: center;">(Circle One)</div>	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.	
Mon.	Tues.	Wed.	Thur.						
Fri.	Sat.	Sun.							
<input type="checkbox"/> <sub>4</sub> Part-time. Hours are irregular.									
<input type="checkbox"/> <sub>5</sub> Student. Attend school ( <i>Circle One</i> ): Full-time or Part-time									
<input type="checkbox"/> <sub>6</sub> Other ( <i>Specify</i> ): _____									

4. On an average workday, how many minutes do you spend commuting one-way? \_\_\_\_\_

5. How many miles, one-way, is it from your home to work location? \_\_\_\_\_

6. Which of the following would influence your commuting habits? (*Check all that apply*)

**Bus Service**

- |   |   |
|---|---|
| <input type="checkbox"/> <sub>1</sub> More information regarding bus routes           | <input type="checkbox"/> <sub>4</sub> Your employer paying a portion of your bus pass |
| <input type="checkbox"/> <sub>2</sub> Late evening bus service                        | <input type="checkbox"/> <sub>5</sub> None, nothing would influence me to ride a bus  |
| <input type="checkbox"/> <sub>3</sub> None, I already ride the bus on a regular basis |   |

**Carpool-Vanpool**

- |  |   |
|--|---|
| <input type="checkbox"/> <sub>1</sub> Free matching with other convenient car/vanpoolers         | <input type="checkbox"/> <sub>5</sub> Preferential parking at work                    |
| <input type="checkbox"/> <sub>2</sub> Vehicles at work available for midday business trips       | <input type="checkbox"/> <sub>6</sub> Access to HOV Lanes                             |
| <input type="checkbox"/> <sub>3</sub> Employer paying a portion of your vanpool seat (vans only) | <input type="checkbox"/> <sub>7</sub> None, nothing would influence me to car/vanpool |
| <input type="checkbox"/> <sub>4</sub> None, I already car/vanpool on a regular basis             |   |

**General**

- |   |  |
|---|--|
| <input type="checkbox"/> <sub>1</sub> Guaranteed ride home for emergencies/overtime     | <input type="checkbox"/> <sub>4</sub> Midday shuttle service to restaurants/shopping |
| <input type="checkbox"/> <sub>2</sub> Increased parking costs which I would have to pay |  |
| <input type="checkbox"/> <sub>3</sub> Variable/flexible work hours                      | <input type="checkbox"/> <sub>5</sub> Other: _____                                   |

7. If you drive alone to work, what are the two most important reasons you do so? (Check 2)

- |   |  |
|---|--|
| <input type="checkbox"/> <sub>1</sub> Can't find anyone to ride with                | <input type="checkbox"/> <sub>5</sub> Need car to take/pickup child to/from child care |
| <input type="checkbox"/> <sub>2</sub> Need car for work during day                  | <input type="checkbox"/> <sub>6</sub> Work schedule doesn't permit sharing a ride      |
| <input type="checkbox"/> <sub>3</sub> Need car before/after work for errands        | <input type="checkbox"/> <sub>7</sub> Need car in case of emergencies                  |
| <input type="checkbox"/> <sub>4</sub> Enjoy my privacy, do not care to share a ride | <input type="checkbox"/> <sub>8</sub> Other: _____                                     |

8. How many passenger vehicles does your household own or have available for use? \_\_\_\_\_

9. How many individuals, including yourself, are 16 years old or older in your household? \_\_\_\_\_

10. For your trip to/from work, do you regularly seek out traffic or transit information from the following? (Check all that apply)

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> <sub>1</sub> Radio      | <input type="checkbox"/> <sub>3</sub> Newspaper | <input type="checkbox"/> <sub>5</sub> Do not seek out traffic or transit information |
| <input type="checkbox"/> <sub>2</sub> Television | <input type="checkbox"/> <sub>4</sub> Internet  |  |

10a. When do you normally seek out this information? (Check all that apply)

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> <sub>1</sub> Before leaving for work | <input type="checkbox"/> <sub>2</sub> On my way to work | <input type="checkbox"/> <sub>3</sub> At work before leaving to go home |
|---|---|---|

10b. How important is availability of traffic information in your choice of a radio station or television station?

- |  |  |
|--|--|
| <input type="checkbox"/> <sub>1</sub> Very Important     | <input type="checkbox"/> <sub>3</sub> Somewhat Unimportant |
| <input type="checkbox"/> <sub>2</sub> Somewhat Important | <input type="checkbox"/> <sub>4</sub> Not Important At All |

11. Does your employer provide any of the following commuting benefits? (Check all that apply)

- |  |  |
|--|--|
| <input type="checkbox"/> <sub>1</sub> Free parking                                 | <input type="checkbox"/> <sub>4</sub> On-site bus pass sales         |
| <input type="checkbox"/> <sub>2</sub> Subsidizes bus passes at \$_____ per month   | <input type="checkbox"/> <sub>5</sub> Guaranteed emergency ride home |
| <input type="checkbox"/> <sub>3</sub> Subsidizes vanpool seat at \$_____ per month | <input type="checkbox"/> <sub>6</sub> Other: _____                   |

**The last few questions are for statistical purposes only to ensure a representative sample of survey participants.**

12. What is the highest level of education that you have completed?

- <sub>1</sub> Some high school                      <sub>3</sub> Technical/Vocational school                      <sub>5</sub> College graduate  
<sub>2</sub> High school graduate                      <sub>4</sub> Some college                      <sub>6</sub> Post graduate studies

13. What is your total annual household income (*range*) before taxes?

- <sub>1</sub> Under \$20,000                      <sub>3</sub> \$35,000 to \$49,999                      <sub>5</sub> \$75,000 to \$99,999  
<sub>2</sub> \$20,000 to \$34,999                      <sub>4</sub> \$50,000 to \$74,999                      <sub>6</sub> \$100,000 or more

14. What is your gender?                      <sub>1</sub> Male                      <sub>2</sub> Female

15. Please check the appropriate age (*range*):

- <sub>1</sub> Under 21                      <sub>2</sub> 21-34                      <sub>3</sub> 35-44                      <sub>4</sub> 45-54                      <sub>5</sub> 55-64  
<sub>6</sub> 65 or older

16. What is your race/ethnicity?

- <sub>1</sub> White                      <sub>2</sub> African American                      <sub>3</sub> Hispanic                      <sub>4</sub> Asian  
<sub>5</sub> Other \_\_\_\_\_

If you would be willing to complete another survey in 1997, please provide your name and address below.

<b>Name</b>
<b>Home Address</b>
<b>City</b> <span style="float: right;"><b>Home Zip Code</b></span>

Thank you for your assistance in completing this survey. We would also like you to record your trips to and from work for the week of **Monday, November 18 thru Friday, November 22, 1996**. Please complete the attached travel diaries for this time period.

## APPENDIX B—AFTER TRAVEL SURVEY—TEST PARTICIPANTS

### HOUSTON SMART COMMUTER PARTICIPANT SURVEY

Thank you for participating in the Smart Commuter project. Your assistance is requested in completing this short questionnaire to help evaluate the project and plan future efforts.

1. In general, how frequently did you use the Magic Link™ device to obtain traffic and transit information?

- Daily (\_\_\_ morning \_\_\_ afternoon)       Once or twice a week  
 Once or twice a month                       Almost never

2. In general, how frequently did you use the other features of the Magic Link™ device?

- Daily (\_\_\_ morning \_\_\_ afternoon)       Once or twice a week  
 Once or twice a month                       Almost never

3. What other features did you use most often (check all that apply)?

- Address Book     Calendar     Games     Modem for e-mail  
 Other \_\_\_\_\_

4. In general, how frequently did you use the telephone system to obtain traffic information?

- Daily (\_\_\_ morning \_\_\_ afternoon)       One or twice a week  
 One or twice a month                       Almost never

5. Please rate the Magic Link™, telephone system, and other methods on the following criteria.

	<u>Very Good</u>	<u>Good</u>	<u>Unsure</u>	<u>Poor</u>	<u>Very Poor</u>
<b>Magic Link™</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	<u>Very Good</u>	<u>Good</u>	<u>Unsure</u>	<u>Poor</u>	<u>Very Poor</u>
<b>Telephone System</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Radio</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Television</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	<u>Very Good</u>	<u>Good</u>	<u>Unsure</u>	<u>Poor</u>	<u>Very Poor</u>
<b>Newspaper</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Internet**

Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. What methods do you currently use to obtain traffic information (check all that apply)?

- Radio   
 Television   
 Newspaper   
 Telephone System  
 Internet   
 Magic Link™   
 None   
 Other \_\_\_\_\_

7. How important is obtaining traffic information to you?

- Very important   
 Somewhat important   
 Somewhat unimportant  
 Not important

8. Over the past year have you changed the way you obtain traffic information?

- Seek traffic information less now   
 Seek traffic information more now   
 No Change

If you seek traffic information more now, which sources are you relying on?

- Radio   
  Television   
  Newspaper   
  Internet   
  Other \_\_\_\_\_  
 Magic Link™   
  Telephone System

9. What other methods would you like to use to obtain traffic information?

- Cellular telephone   
  Pager   
  E-mail   
  Handheld/Palmtop Computer  
 None   
 Other \_\_\_\_\_

10. Would you consider subscribing to a service providing current traffic information at a reasonable cost?

- Yes   
 No

If yes, how would you prefer to pay?

- Fixed rate per month   
 Flat rate per call/page

How much would you be willing to pay for this service?

\$ \_\_\_\_\_ per month \$ \_\_\_\_\_ per call/page

11. How often do you use the following modes of transportation for commuting to or from work?

	<u>Always or Almost Always</u>	<u>Occasionally</u>	<u>Never</u>
Drive alone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carpool/Vanpool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ride the Bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Has your general commute behavior changed during your participation in this project?

- Yes   
 No

If yes, how has your travel changed?

- Change mode more frequently                     
  Change route more frequently  
   
 \_\_\_\_\_ Carpool more                                     
  Change time of travel more frequently  
   
 \_\_\_\_\_ Take bus more                                       
  Other \_\_\_\_\_



13. Did you ever change your travel behavior as a result of the specific information provided by the Magic Link™ or telephone system?

- Yes, frequently       Yes, infrequently       No

14. What change did you make based on this information (check all that apply)?

- Mode       Route       Time of travel       Did not make trip  
 Other \_\_\_\_\_

15. What has been your normal experience when you made a change (check all that apply)?

- Save \_\_\_\_ minutes in travel time       More comfortable trip       Less stressful trip  
 More stressful trip       Other \_\_\_\_\_

Based on your experience, would you make the same change in the future?

- Yes       No       Undecided

16. For what types of trips are you most likely to change your travel behavior based on traffic information?

- Commute to/from work       Work related travel       Errands/personal business  
 Recreation/Social activities       Other

17. Please provide any comments on the information devices or the project.

---

---

---

---

---

---

---

---

Thank you for your participation in the Smart Commuter project and your assistance completing this survey!



## APPENDIX C—AFTER TRAVEL SURVEY—CONTROL GROUP MEMBERS

---

### I-45 NORTH FREEWAY CORRIDOR COMMUTER SURVEY

Thank you for participating in the I-45 North Freeway Corridor travel survey over the past two years. Your assistance is greatly appreciated. Please complete this short questionnaire as part of the final survey period.

1. What methods do you currently use to obtain traffic information (check all that apply)?

- Radio   
  Television   
  Newspaper   
  Internet   
  None  
 Other \_\_\_\_\_

2. How would you rate the ease of use, reliability, and accuracy of these sources?

	<u>Very Good</u>	<u>Good</u>	<u>Unsure</u>	<u>Poor</u>	<u>Very Poor</u>
<b>Radio</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Television</b>					
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Very Good   Good   Unsure   Poor   Very Poor

**Newspaper**

Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Internet**

Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reliability of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accuracy of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timeliness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usefulness of Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. How important is obtaining traffic information to you?  
 Very important    Somewhat important    Somewhat unimportant    Not important

4. Over the past year, have you changed the way you obtain traffic information?  
 Seek traffic information less now    Seek traffic information more now    No change

If you seek traffic information more now, which sources are you relying on?

Radio    Television    Newspaper    Internet    Other \_\_\_\_\_

5. What other methods would you like to use to obtain traffic information?  
 Telephone    Cellular telephone    Pager    E-mail    Handheld/Palmtop Computer  
 None    Other \_\_\_\_\_

6. Would you consider subscribing to a service providing current traffic information at a reasonable cost?  
 Yes       No

If yes, how would you prefer to pay?

- Fixed rate per month       Flat rate per call/page

How much would you be willing to pay for this service?

\$\_\_\_\_\_ per month      \$\_\_\_\_\_ per call/page

7. How often do you use the following modes of transportation for commuting to and from work?

	<u>Always or Almost Always</u>	<u>Occasionally</u>	<u>Never</u>
Drive Alone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carpool/Vanpool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ride the Bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Do you ever change your travel behavior based on specific traffic information?

Yes, frequently       Yes, infrequently       No

9. What changes do you normally make based on this information (check all that apply)?

Mode     Route     Time of travel     Did not make trip     Other \_\_\_\_\_

10. What has been your normal experience when you made a change (check all that apply)?

Save \_\_\_\_\_ minutes in travel time     More comfortable trip     Less stressful trip

More stressful trip     Other \_\_\_\_\_

Based on your experience, would you make the same change in the future?

Yes     No     Undecided

11. For what types of trips are you most likely to change your travel behavior based on traffic information?

Commute to/from work     Work related travel     Errands/personal business

Recreation/Social activities     Other

12. Please provide any comments on other ways you may wish to receive traffic and transit information.

---

---

---

---

---

---

---

---

Thank you for your assistance in completing this survey!

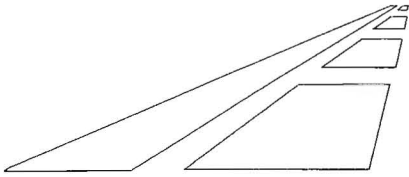
**APPENDIX D—DAILY TRAVEL DIARY**

---





## APPENDIX E — LETTER TO MOTORISTS IN I-45 NORTH CORRIDOR



---

TEXAS TRANSPORTATION INSTITUTE • The Texas A&M University System

SYSTEMS PLANNING DIVISION  
Telephone (409) 845-1535  
FAX (409) 845-6008

Dear I-45 North Freeway User:

Your vehicle was recently observed traveling from downtown Houston on the I-45 North Freeway. As a user of this facility, your help is needed on the *Smart Commuter* project being conducted by the Texas Department of Transportation (TxDOT) and Houston METRO. The *Smart Commuter* project focuses on travelers' use of traffic information. The study is examining the sources of traffic information commuters listen to, watch, or read, and if any changes are made in travel as a result of this information.

Your help is needed in this study. We would like to ask you, as a traveler on the I-45 North Freeway, to complete the enclosed survey and to record your commute trips for the week of **November 18-22, 1996**. Please return the survey and the travel diaries in the enclosed postage-paid envelope. The study is being conducted by the Texas Transportation Institute, a part of The Texas A&M University System, for TxDOT and METRO.

Your cooperation and timely return of the survey is greatly appreciated. Thank you in advance for your time and assistance in this important undertaking. If you have any questions on the survey or study, please feel free to call Mr. Darryl Puckett at (713) 686-2971.

Texas Transportation Institute

Enclosures



## APPENDIX F—DETAILED SOCIO-ECONOMIC AND TRIP CHARACTERISTICS

---

The detailed information on the socio-economic characteristics of individuals in the first test group, the second test group, and the control group are presented in this Appendix. The responses to questions on the before surveys relating to gender, age, income, household size, vehicles per household, and ethnicity of participants is provided in the following six tables.

### Normal Commute Mode

Mode/Frequency	First Test Group	Second Test Group	Control Group
Drive Alone			
Always	88%	72%	89%
Occasionally	11%	26%	9%
Never	1%	2%	2%
Carpool			
Always	5%	21%	9%
Occasionally	37%	33%	20%
Never	58%	46%	71%
Vanpool			
Always	0.5%	-	-
Occasionally	3.5%	0.5%	1%
Never	96%	99.5%	99%
Ride the Bus			
Always	2%	3%	3%
Occasionally	29%	30%	11%
Never	69%	67%	86%
Other			
Always	2%	-	5%
Occasionally	8%	3%	6%
Never	90%	97%	89%

### Employment Status of Test and Control Group Participants

Employment Status	First Test Group	Second Test Group	Control Group
Full-Time	94%	92%	91%
Part-Time	2%	5%	6%
Other	4%	2%	3%

### Home to Work Distance for Test and Control Group Participants

One-Way Miles from Home to Work	First Test Group	Second Test Group	Control Group
0-9 Miles	-	0.5%	1%
10-19 Miles	3%	3.5%	15%
20-29 Miles	44%	39%	44%
30-39 Miles	37%	45%	29%
40-49 Miles	10%	11%	6%
50+ Miles	6%	1%	5%
<b>Total</b>	100%	100%	100%

### Home to Work Travel Time for Test and Control Group Participants

One-Way Time from Home to Work	First Test Group	Second Test Group	Control Group
0-9 Minutes	-	0.5%	-
10-19 Minutes	-	-	1%
20-29 Minutes	1%	2.5%	7%
30-39 Minutes	9%	6%	9%
40-49 Minutes	33%	35%	34%
50+ Minutes	57%	56%	49%
<b>Total</b>	100%	100%	100%

### Knowledge of Bus Service

Question	First Test Group	Second Test Group	Control Group
Are you aware of a park-and-ride lot located near your house?			
Yes	93%	93%	82%
No	7%	7%	18%
Subtotal	100%	100%	100%
How familiar are you with the following features of park-and-ride bus service?			
Schedules			
Very Familiar	17%	23%	13%
Somewhat Familiar	37%	32%	28%
Not Familiar	46%	45%	59%
Subtotal	100%	100%	100%
Bus Stop Locations			
Very Familiar	21%	26%	17%
Somewhat Familiar	40%	38%	35%
Not Familiar	39%	36%	48%
Subtotal	100%	100%	100%
Cost			
Very Familiar	22%	27%	21%
Somewhat Familiar	35%	36%	28%
Not Familiar	43%	37%	51%
Subtotal	100%	100%	100%

### Reasons for Driving Alone\*

Reason	First Test Group	Second Test Group	Control Group
Cannot find anyone to ride with	8%	10%	9%
Need car for work during the day	18%	22%	15%
Need car before/after work for errands	19%	19%	18%
Enjoy privacy, do not care to share a ride	8%	7%	12%
Need car to take/pick up child at daycare	6%	4%	6%
Work schedule does not permit sharing a ride	21%	21%	20%
Need car in case of emergencies	11%	10%	11%
Other	9%	7%	9%

\*Respondents were asked to check no more than two.

### Factors Influencing Commuting Habits\*

Factors	First Test Group	Second Test Group	Control Group
<b>Bus Service</b>			
More information regarding bus routes	16%	18%	18%
Late evening bus service	20%	23%	14%
None, I ride bus regularly	2%	3%	2%
Employer pays portion of bus pass	28%	29%	22%
Nothing would influence me to ride a bus	34%	27%	44%
<b>Carpool and Vanpool</b>			
Free matching with other convenient carpoolers and vanpoolers	15%	12%	15%
Vehicles at work available for midday business trips	19%	20%	14%
Employer pays part of vanpool cost	13%	14%	14%
None, I carpool or vanpool now	3%	9%	4%
Preferential parking at work	10%	10%	8%
Access to HOV lanes	20%	15%	16%
Nothing would influence me to carpool or vanpool	20%	20%	29%
<b>General</b>			
Guaranteed ride home for emergencies and overtime	38%	43%	37%
Increased parking costs that I would have to pay	15%	10%	8%
Variable/flexible work hours	25%	23%	21%
Midday shuttle service to restaurants or shopping	10%	16%	13%
Other	12%	8%	21%

\*multiple responses possible

**Employer Provided Commute Benefits\***

<b>Type of Benefit</b>	<b>First Test Group</b>	<b>Second Test Group</b>	<b>Control Group</b>
Free Parking	42%	45%	55%
Bus Pass Subsidy	15%	19%	16%
Vanpool Subsidy	6%	4%	3%
On-Site Bus Pass Sales	16%	15%	11%
Guaranteed Ride Home Program	7%	8%	4%
Other	14%	9%	11%

\*multiple responses possible

**Gender of Test and Control Group Participants**

<b>Gender</b>	<b>First Test Group</b>	<b>Second Test Group</b>	<b>Control Group</b>
Male	72%	80%	59%
Female	28%	20%	41%
Total	100%	100%	100%



**Age of Test and Control Group Participants**

<b>Age Levels</b>	<b>Test Group</b>	<b>Second Test Group</b>	<b>Control Group</b>
Under 21	-	0.5%	2%
21-34	23%	20%	26%
35-44	38%	44.5%	35%
45-54	28%	26%	24%
55-64	10%	9%	12%
Over 65	1%	-	1%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Income of Test and Control Group Participants**

<b>Income Level</b>	<b>First Test Group</b>	<b>Second Test Group</b>	<b>Control Group</b>
Under \$20,000	1%	1%	4%
\$20,000 - \$35,000	8%	4%	16%
\$35,000 - \$50,000	13%	12%	17%
\$50,000 - \$75,000	26%	32%	28%
\$75,000 - \$100,000	25%	20%	18%
Over \$100,000	27%	31%	17%

### Household Size of Test and Control Group Participants

Number of Individuals in Household	First Test Group	Second Test Group	Control Group
1	8%	13%	15%
2	71%	65%	57%
3	13%	19%	17%
4	7%	2%	8%
5 or more	1%	1%	3%

### Number of Vehicles per Household of Test and Control Group Participants

Number of Vehicles in Household	First Test Group	Second Test Group	Control Group
1	11%	13%	19%
2	67%	63%	54%
3	17%	19%	17%
4 or more	5%	5%	10%

### Ethnicity of Test and Control Group Participants

Ethnicity	First Test Group	Second Test Group	Control Group
White	89%	84%	83%
Afro-American	4%	7%	5%
Hispanic	4%	4%	7%
Asian	2%	3%	4%
Other	1%	2%	1%