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16. Abstract

The *Rural Public Transportation Technologies: User Needs and Applications* Study was conducted as part of the U.S. DOT's overall Rural Intelligent Transportation System (ITS) Program. The study examined the opportunities and challenges of planning and deploying advanced public transportation systems (APTS) technologies in rural and small urban areas.

The purpose of the study was to gain a better understanding of the state of the practice of rural APTS and to determine where the U.S. DOT could best direct its resources to close the gap between current practice and the state of the art.

User and operator surveys and site visits were conducted to determine information requirements, problems, interest, and concerns of both operators and passengers of transit systems in rural and small urban areas. A state-of-the-art technology assessment was also conducted to determine the potential for current and emerging technologies to satisfy the requirements of rural transit users and operators. The technology assessment focused on transit-related advanced traveler information systems for transit riders and applications of APTS technologies to improve financial accountability and data verification for rural transit operators.

Nine rural ITS action items are recommended to address the identified needs. Recommended actions could pertain to any part of the U.S. DOT's Rural ITS Program, including research and development, deployment, and delivery/outreach. However, the study's expert panel recommended that high priority be given to the delivery/outreach aspect of the Rural ITS Program.

An *Executive Summary*, which summarizes the findings of this study, was also prepared.

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TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION 1

REPORT OUTLINE 1

STUDY PURPOSE 1

THE STUDY TEAM 2

ITS APPLICATIONS IN RURAL TRANSIT 3

THE NATURE OF RURAL TRANSIT 3

RURAL AREAS 3

RURAL TRANSPORTATION SERVICES 3

IMPLICATIONS FOR APPLYING ADVANCED TECHNOLOGIES 7

TRANSIT MARKET SEGMENTS FOR RURAL AMERICA 7

STUDY APPROACH 9

SUMMARY OF FINDINGS AND RECOMMENDATIONS 11

OTHER RELATED REPORTS 12

CHAPTER 2: USER NEEDS ASSESSMENT 13

FOCUS GROUP 13

GENERAL NEEDS IDENTIFIED 13

AWARENESS OF ADVANCED PUBLIC TRANSPORTATION SYSTEMS 14

INSTITUTIONAL AND TECHNOLOGICAL BARRIERS 15

ONE-ON-ONE TELEPHONE INTERVIEWS 15

USER NEEDS 15

TECHNOLOGY APPLICATIONS 16

INSTITUTIONAL ISSUES 17

USER SURVEY 17

DEMOGRAPHICS AND SYSTEM USAGE 18

SERVICE CHARACTERISTICS 18

INFORMATION NEEDS 19

PERCEIVED PROBLEMS AND SOLUTIONS 19

RECOMMENDATIONS FOR FURTHER RESEARCH 22

CHAPTER 3: RURAL TRANSIT SITE VISITS 23

SELECTED SITES 23

GENERAL FINDINGS 24

ADMINISTRATIVE ISSUES 25

USER ISSUES 25

TABLE OF CONTENTS
(Continued)

OPERATIONAL ISSUES 25

ADVANCED TECHNOLOGIES 25

ANTICIPATED BENEFITS OF APTS 27

CHAPTER 4: TECHNOLOGY ASSESSMENT 28

TECHNOLOGY SURVEY 28

MAJOR FINDINGS AND CRITICAL ISSUES 28

LESSONS LEARNED 32

APPLICATIONS OF APTS TECHNOLOGIES TO FINANCIAL ACCOUNTABILITY AND DATA VERIFICATION ISSUES 36

ACCOUNTING AND BOOKKEEPING 38

DATA VERIFICATION 38

CURRENT EFFORTS BY STATE DEPARTMENTS OF TRANSPORTATION 39

THE PROBLEM OF AUTOMATING RURAL TRANSIT SYSTEMS – WHERE TO START? 41

SOFTWARE APPLICATIONS 42

SUMMARY 43

CHAPTER 5: ACTION CONCEPT DEVELOPMENT 45

BACKGROUND 45

ACTION CONCEPTS 45

DEVELOPMENT 45

DEPLOYMENT 46

DELIVERY 46

CHAPTER 6: ACTION CONCEPT DESCRIPTION AND IMPLEMENTATION PLAN 48

SHARED TECHNOLOGY INFRASTRUCTURE OPERATIONAL TEST 48

PROBLEM STATEMENT 48

CONCEPT DESCRIPTION 49

WORK PLAN 51

AUTOMATED TRIP STATUS OPERATIONAL TEST 52

PROBLEM STATEMENT 52

CONCEPT DESCRIPTION 52

WORK PLAN 53

TRIP VERIFICATION AND BILLING OPERATIONAL TEST 55

PROBLEM STATEMENT 55

CONCEPT DESCRIPTION 55

WORK PLAN 57

FLEET MANAGEMENT OPERATIONAL TEST 58

PROBLEM STATEMENT 58

CONCEPT DESCRIPTION 58

WORK PLAN 59

TABLE OF CONTENTS
(Continued)

BROADER MARKET RESEARCH STUDY 60
- PROBLEM STATEMENT 61
- CONCEPT DESCRIPTION 61
- WORK PLAN 61

DEMONSTRATION OF LOW-COST TECHNOLOGIES (SIMPLE SOLUTIONS) 63
- PROBLEM STATEMENT 63
- CONCEPT DESCRIPTION 63
- WORK PLAN 65

RURAL TRANSIT OPERATOR INFORMATION KIT 66
- PROBLEM STATEMENT 66
- CONCEPT DESCRIPTION 67
- REQUIRED WORK ACTIVITIES 70
- PROGRAM ALTERNATIVES 72
- WORK PLAN 73

RURAL APTS SUCCESS STORY BOOKLET 74
- PROBLEM STATEMENT 74
- CONCEPT DESCRIPTION 75
- REQUIRED WORK ACTIVITIES 77
- PROGRAM ALTERNATIVES 79
- WORK PLAN 80

TRAINING MATERIALS FOR RURAL APTS APPLICATIONS 81
- PROBLEM STATEMENT 81
- CONCEPT DESCRIPTION 81
- REQUIRED WORK ACTIVITIES 83
- PROGRAM ALTERNATIVES 85
- WORK PLAN 86

CHAPTER 7: EVALUATION AND RECOMMENDATIONS 88

EVALUATION AND PRIORITIZATION 88

RECOMMENDATIONS FOR NEXT STEPS 88

REFERENCES 90

OTHER REFERENCE MATERIALS 91

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LIST OF TABLES

Table 1. Expert Panel Members 2
Table 2. Transit Systems in Rural Communities 4
Table 3. Rural Transit Market Segments 9
Table 4. Market Segment Sites Visited 23
Table 5. Characteristics of the Visited Sites 24
Table 6. Rural APTS Applications and Future Deployment at Visited Sites 26
Table 7. Stage of Traveler Information System Development 29
Table 8. Type of Traveler Information System Planned or Operating 30
Table 9. List of Progress Toward Computerized Accounting and Data Verification Systems 37
Table 10. The Relationship Between User Needs/Issues and Candidate Action Concepts 47
Table 11. Potential Benefits of Joint Dispatching System 50
Table 12. Joint Dispatching Operational Test: Proposed Tasks, Schedule, and Cost Estimate 51
Table 13. Potential Benefits of Automated Trip Status 53
Table 14. Automated Trip Status Operational Test: Proposed Tasks, Duration, and Cost Estimate 54
Table 15. Potential Benefits of Trip Verification and Billing 56
Table 16. Trip Verification and Billing Operational Test: Proposed Tasks, Duration, and Cost Estimate 57
Table 17. Potential Benefits of Fleet Management Operational Test 59
Table 18. Fleet Management Operational Test: Proposed Tasks, Duration, and Cost Estimate 60
Table 19. Potential Benefits of a Broader Market Research Study 62
Table 20. Tasks, Duration, and Estimated Costs to Conduct a Broader Market Research Study for Rural APTS 62
Table 21. Potential Benefits of Bus Arrival Notification System 64
Table 22. Demonstration of Low-Cost Technologies: Proposed Tasks, Duration, and Cost Estimate 65
Table 23. Potential Benefits of the Information Kit 71
Table 24. Rural Transit Operator Information Kit: Proposed Tasks, Duration, and Cost Estimate 74
Table 25. Potential Benefits of the Booklet 77
Table 26. Rural APTS Success Story Booklet: Proposed Tasks, Duration, and Cost Estimate 80
Table 27. Potential Benefits of the Training Materials 84
Table 28. Training Materials for Rural APTS Applications: Proposed Tasks, Duration, and Cost Estimate 87
Table 29. Recommendations and Prioritization 89

LIST OF FIGURES

Figure 1. Type of Transit Services Available in Rural Areas 5
Figure 2. Rural Transit Passenger Trips by Type of Service 5
Figure 3. Type of Trips Made by Rural Transit Riders 6
Figure 4. Rural Transit Study Process 10
Figure 5. What Types of Information Do You Most Commonly Need For Your Trips? 20
Figure 6. How Do You Obtain Transit System Information? (Response by Market Segment) 20
Figure 7. How Do You Obtain Transit System Information? (Response by Fixed-Route and Paratransit Users) 21

CHAPTER 1: INTRODUCTION

This report describes the findings and recommendations of the rural public transportation user needs and applications study that was conducted for the United States Department of Transportation (U.S. DOT) and the transit industry. The study examined the opportunities and challenges of planning and deploying advanced public transportation system (APTS) technologies in rural and small urban areas. Nine action items are recommended to address the identified needs. This report is the outgrowth of a major national study entitled *Rural Applications of Advanced Traveler Information Systems* (ATIS).

REPORT OUTLINE

This report is organized into seven chapters.

- **CHAPTER 1** presents the purpose and background of the study. It provides information regarding Intelligent Transportation System (ITS) applications in rural areas, the nature of rural transit, rural transit market segments and rural transit services. This chapter also describes the study approach, and summarizes the study findings and recommendations.
- **CHAPTER 2** describes the methodology and findings of the user needs assessment. Findings are presented from a focus group discussion and telephone interviews with the operators of rural transit systems and from a survey of public transportation users in rural and small urban areas.
- **CHAPTER 3** presents the findings of a series of rural site visits conducted to identify technical, institutional, and funding issues of technology applications for transit systems in rural and small urban areas.
- **CHAPTER 4** examines the state of the art and the state of the practice for advanced public transportation systems and transit-related traveler information services. This chapter also includes a review of the state of the art in the application of APTS technologies to the issues of financial accountability and data verification.
- **CHAPTER 5** presents nine recommended actions for rural APTS identified in response to the needs and issues identified in the previous chapters.
- **CHAPTER 6** describes the need for and elements of each of the nine action items. This chapter also outlines an implementation plan, including suggested tasks, time duration, and preliminary cost estimates for each action.
- **CHAPTER 7** describes the process used by the study team to evaluate and prioritize the recommended actions and identifies the next steps for the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) to continue their support of rural APTS.

STUDY PURPOSE

ITS technologies are being effectively used by transportation agencies to provide more efficient and useful transportation services to the traveling public. A majority of ITS investments are concentrated in major urban areas, where congestion is most severe and population densities are highest. However, transportation agencies responsible for transportation systems in rural and small urban areas are beginning to realize potential benefits of ITS technologies and hence to

apply these technologies to improve transportation systems in these areas.

Rural transit systems are now able to change some of their practices through the application of advanced technologies. Rural transit systems are beginning to explore the use of computerized billing and accounting systems (which will substantially ease and improve record-keeping tasks for multi-funded agencies), computer-aided dispatching (which could lead to more cost-effective service scheduling in some communities), and traveler information systems (which are expected to be of particular use in rural tourist areas). Despite the potential for improved and more cost-effective operations, few rural transit operators know which advanced technologies to implement and how to do so in the most cost-effective manner.

The purpose of this study was to gain a better understanding of the state of the practice of rural APTS, and determine where the U.S. DOT could best direct its resources to close the gap between current practice and the state of the art. The objectives of this study were to:

- Conduct user and operator surveys and site visits to determine information requirements, problems, interest, and concerns of both operators and passengers of transit systems in rural and small urban areas.
- Conduct a comprehensive review of the state of the art and the state of the practice in APTS technologies, specifically those related to traveler information services.
- Identify and develop a series of APTS action items for rural applications on the basis of the study findings.

The actions could pertain to any part of the U.S. DOT's Rural ITS Program, including research/development, deployment, and delivery/outreach.

THE STUDY TEAM

As part of the *Rural Applications of ATIS* project, sponsored by FHWA and in association with the FTA, TransCore led a team to conduct the study of public transportation user needs and applications in rural and small urban areas. Other study team members were Virginia Polytechnic Institute and State University, Multisystems, Inc., and Ecosometrics, Inc. The study team was assisted by an expert panel consisting of government officials and rural transit experts. Table 1 shows the members of the expert panel.

Table 1. Expert Panel Members

Expert Panel Member	Organization
Bruce Ahern	Beaver County Transit Authority
Steve Andrle	Transportation Research Board
Mary Martha Churchman	Federal Transit Administration
Larry Harman	Moakley Center, Bridgewater State College
Charles Rutkowski	Community Transportation Association of America

ITS APPLICATIONS IN RURAL TRANSIT

Applications of ITS technologies are changing the way agencies deliver transportation services to their "customers," not only those who are traveling via private vehicles, but also those who travel via public transportation. For highway and transit travel, there are a variety of factors that determine the applicability of any particular ITS strategy or technology. Effective application of ITS for rural transit must be identified with an understanding of how rural transit agencies operate, the constituencies these systems tend to serve, the resource limitations, and other characteristics that tend to be unique to the industry.

U.S. DOT developed a Strategic Plan for the Rural ITS Program. The Strategic Plan focuses on the Federal government's role in development, implementation, and operation of emerging ITS technologies in rural areas of the United States. As part of this plan, an effort is currently under way to stimulate the application of ITS in achieving goals and objectives associated with rural transit. This report shows foci and approaches for the Strategic Plan to meet transit-related goals and objectives.

THE NATURE OF RURAL TRANSIT

In order to determine the potential of APTS applications within rural transit systems, it is critical to understand the nature of the country's rural transit systems, including the communities they serve, the type of services they provide, and the type of trips that are made.

RURAL AREAS

Rural communities can be defined in terms of their small population size and distance to metropolitan areas. These two characteristics are the factors of significance in determining what makes an area rural. One definition used within the ITS Community is that "rural areas are counties with populations of less than 50,000." The small population size and relative isolation of rural areas are sufficient in their own right to produce significant qualitative social and cultural differences from life in urban areas.

There is a wide diversity of rural areas. Of the nation's 3,141 counties and county equivalents, 2,288 (73 percent) were classified as non-metropolitan or rural according to the 1990 Census. Rural areas accounted for 83 percent of the nation's land, 21 percent of its population, 18 percent of its jobs, and 14 percent of its earnings. When compared with urban areas, rural areas contain greater percentages of males, the elderly, persons in poverty, households with income below the national median, homeowners, and car owners. [1]

Many rural parts of the United States had stable or declining populations and economic bases from the 1920s until the 1970s, when the economic revitalization of some rural areas began. Rural areas not touched by such revitalization are characterized by high proportions of dependent population groups and limited tax bases.

RURAL TRANSPORTATION SERVICES

The most prevalent mode used for transporting people in rural areas is the automobile. Most rural households own one or more cars and

NOTE: Urban areas consist of 1) both incorporated and unincorporated places of 2,500 people or more and 2) the urban fringe around cities of 50,000 or more. The remainder is classified as rural. Rural areas can be further classified as metropolitan or non-metropolitan. Metropolitan rural areas are rural areas in urbanized areas (counties with a city of 50,000 or more), or rural areas in counties that are adjacent to a county with a city of 50,000 or more and that are economically and socially integrated with the county containing the central city. For transportation purposes, non-metropolitan counties are generally classified as rural.

trucks, yet one of every 14 households in rural America has no car. Fifty-two percent of all rural households own one car. Thirty-eight percent of the people who are classified as transit dependent live in rural areas.

Despite these needs, 38 percent of the nation's rural residents live in areas without any public transit service and 28 percent live in areas in which the service level is negligible (less than 25 yearly trips for each household without a vehicle).[2] Therefore, public transit services are needed for a significant portion of the population who have trouble affording automotive transportation, do not have access to an auto, or have trouble driving.

SERVICE TYPES

Rural public transportation systems have developed in almost 1,200 rural localities since the 1970s, thanks in part to Federal funding efforts, such as the FTA's Section 5311 program. As shown in table 2, counties with small urban areas of 20,000 persons or more not adjacent to metropolitan areas most frequently have Federally funded rural transportation systems. About two-thirds of these counties have rural transit systems within their boundaries. The counties that are least likely to have rural public transportation systems are those that are the most rural, those that have no urban places with populations of more than 2,500 persons. Fifty-five percent of these counties have public transportation services. Nonetheless, 38 percent of the nation's rural residents live in areas without any public transit service whatsoever.

There are some other transportation resources. FTA's Section 5310 program provides funds for capital purchases for services operated by 3,673 private, not-for-profit, and public agencies providing transportation to the elderly and persons with disabilities in both rural and urban areas. The Section 5310-funded services are not often open to members of the general public but focus on human service agency clients or other persons with specific eligibility for service.

Figure 1 shows the type of transit services available in rural areas. Demand-responsive transit services are the predominant type of public transportation in rural areas.

Figure 2 shows rural transit passenger trips by type of service. Fixed-route service accounts for 55 percent of the rural transit passenger trips.

Table 2. Transit Systems in Rural Communities

Type of Rural Community	*% with Transit*
20,000 - 49,000 persons in urban areas, not adjacent to metropolitan area	66.4
2,500 - 19,999 persons in urban areas, adjacent to metropolitan area	60.3
2,500 - 19,999 persons in urban areas, not adjacent to metropolitan area	59.0
20,000 + 49,999 persons in urban areas, adjacent to metropolitan area	57.3
No urban places over 2,500 persons, adjacent to metropolitan area	56.7
No urban places over 2,500 persons, not adjacent to metropolitan area	55.2

Source: ***Assessment of the Economic Impacts of Rural Public Transportation***, prepared by Ecosometrics, Inc. for the Transit Cooperative Research Program, October 1997, p. 19.

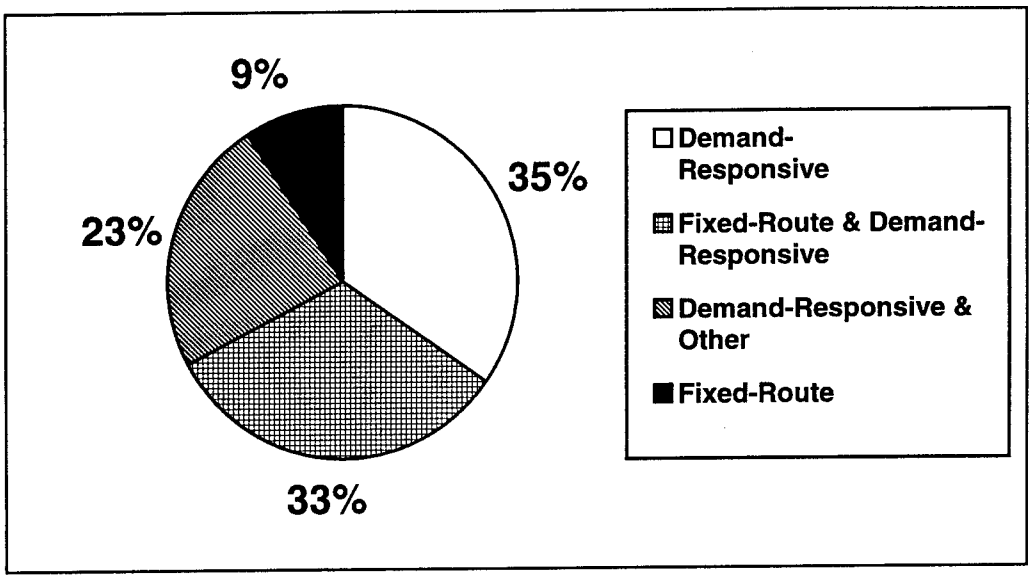

Figure 1. Type of Transit Services Available in Rural Areas

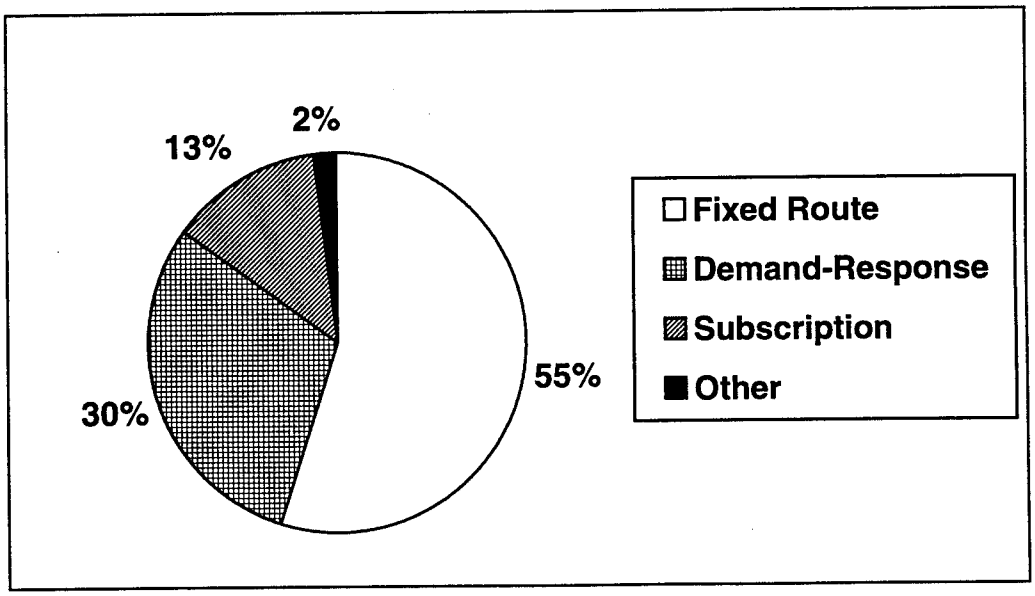

Figure 2. Rural Transit Passenger Trips by Type of Service

Source: ***Status Report on Public Transportation in Rural America***, prepared by the Community Transportation Association of America for the FTA, December 1994.

RIDERS

Sixty-two percent of rural transit riders are women, 36 percent are elderly, and 24 percent have a disability. Figure 3 shows various types or purposes of trips made by rural transit riders. Work-related trips account for only 20 percent of rural transit trips. Trips to human service agencies (e.g., nutrition and senior centers) represent 17 percent and health care trips total 14 percent.

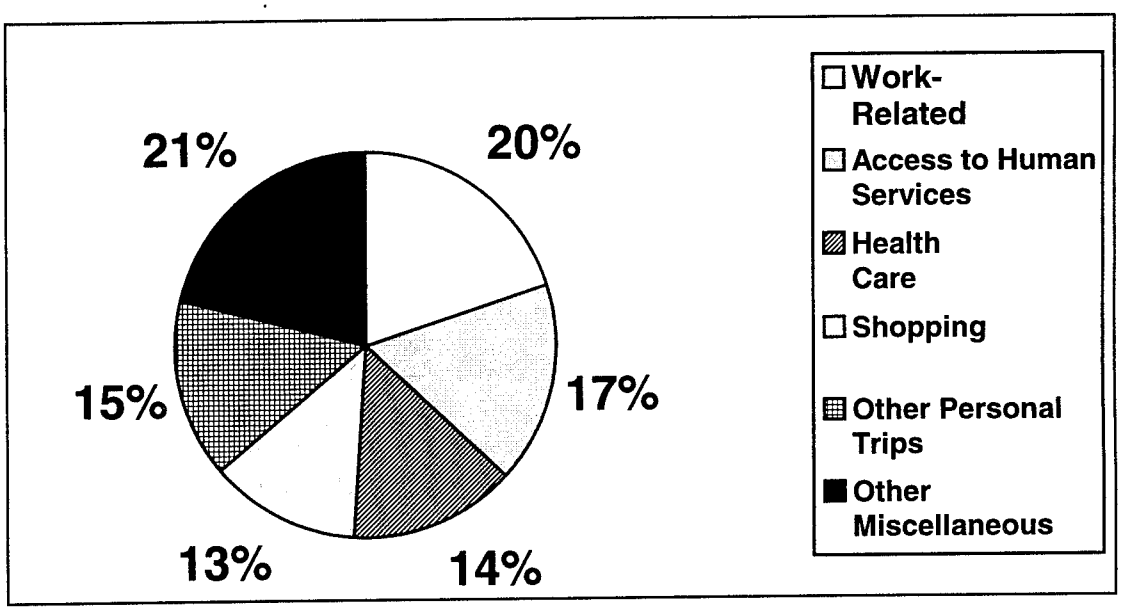

Figure 3. Type of Trips Made by Rural Transit Riders

SYSTEM SIZE

Numerous rural transit systems have only one vehicle and several systems have more than 50 vehicles. Those systems providing more than one type of service tend to have the most vehicles. The demand-responsive only services tend to have more vehicles than the fixed-route only services; the largest systems are those offering both fixed-route and demand-responsive services. The mean and median fleet size of 11 and 6 vehicles, respectively, indicate a very small base on which to apply advanced technologies. This size means that technological applications at the level of the individual system may have difficulties achieving appropriate levels of economies of scale. Of the largest systems, only one has more than 200 vehicles, and only four have more than 100 vehicles; the tenth largest system has less than 70 vehicles. (These figures are based on 1993 data, the last year that such information was collected.)

One system with mixed services reported total annual expenses of more than $8 million, while other systems reported less than $1,000 of annual expenses. The tenth largest system in 1993 had an annual budget of less than $2.5 million.[3] Rural transit systems in the top 20 percent of the budget ranges have average operational cost of greater than $1 million per year. However, smaller systems with operational costs of $20,000 to $75,000 per

year, could not be expected to have much money to spend on advanced technologies because of their limited services and expenditures.

IMPLICATIONS FOR APPLYING ADVANCED TECHNOLOGIES

Even the largest of these rural transit systems is relatively small in contrast to the overall level of operations of many urban public transit systems. This small size creates large challenges in terms of funding the technological improvements and then realizing their intended productivity and economic benefits at the level of the individual rural transit system.

Rural transit systems are widely diversified. Very different services are offered in different communities. Some of the systems are so small, and offer such infrequent service, that their chance of having any funds to devote to advanced technologies is slight. On the other hand, application of advanced technologies to some of the larger systems should indeed have noticeable effects on their operations.

Some technologies (e.g., automated accounting and billing systems, and communications and information gathering through the Internet) can help large and small rural transit systems. Other technologies (e.g., automated vehicle locations system and computer-aided dispatching systems) will probably be more beneficial to larger systems. More research and operational tests are needed to define the point between smaller and larger systems when the technology is cost effective, i.e., the minimum number of vehicles in the fleet, number of vehicle trips, or number of passengers.

TRANSIT MARKET SEGMENTS FOR RURAL AMERICA

For several years now, FTA has had an active interest in deploying ITS technologies in rural communities to increase the effectiveness and productivity of rural transit operations. In order to accomplish these objectives, it is necessary to understand the kinds of markets that exist for transit services in rural communities around the United States. A separate research effort identified transit market segments for rural America. The initial definition of these transit market segments contained five rural categories. The last two categories were recently added based on further research.

The initial five rural transit market segments are described as follows:

1. **Rural to Metropolitan Area Communities** are characterized as bedroom communities with strong metro links, with long travel distances, dispersed-to-concentrated trips, and high trip volumes. Examples of these areas can be found in Laredo, Texas (a growing city in a large county), and in Front Royal, Virginia (pastoral residence for Washington, D.C. area employees). Needs of these communities encompass connection to the urban transit system, utilization of vehicles during off-peak hours, high reliability of the transit system, and avoidance of traffic delays. Potential ITS applications for these communities include automated rideshare matching, pre-trip information systems, and dynamic vehicle routing.
2. **Large, Sparsely Populated Rural Areas** are characterized by low population density, low trip demand, and long trip distances. Examples of sites can be found in Sweetwater County, Wyoming, and in

Malheur County, Oregon. Needs for this segment include reliable communications links, coordination of distant service providers, and emergency notification and response. Potential ITS applications in this market segment include dynamic vehicle routing, automated vehicle location, mayday (position location for 911 cellular calls), and smart cards to aid in agency billing.

3. **Rural Tourist Areas** are characterized by large seasonal variations in demand, congestion during the peak tourist season, and numerous small service providers. Examples of this market segment can be found around popular national parks, such as Yosemite and Grand Canyon, and ski and sea resorts, such as Vail and North Carolina's Outer Banks. Needs for these areas include the utilization of capital equipment, accommodation of both tourists and service workers, and provision of information to customers unfamiliar with local transit services. Potential ITS applications for these regions include traveler information systems, dynamic routing, and automated public address systems.

4. **Slow/No Growth, Self-Contained Local Communities** are characterized by an aging population, declining population, stagnant economy, high unemployment, high demand for social services, few transportation options, and a high percentage of transit-dependent riders. Examples of this type of community can be found in the Appalachian region, Indian reservations, and the Great Plains and Deep South states. Many of these communities need coordination of social service providers, automation of scheduling and routing, improved efficiency of record keeping and billing, and encouragement of volunteerism. Potential ITS applications for this market segment include communications links to enhance service flexibility and computers to aid in agency billing and inter-agency cooperation

5. **High Growth, Self-Contained Local Communities** are defined as service areas and retirement communities, economically prosperous, with a higher percentage of work trips and competition with private automobiles for riders. Examples can be found in Flagler County, Florida; Blacksburg, Virginia; and Cherokee County, Georgia. Some of the needs consist of the coordination of transportation providers, accommodation of multiple trip purposes, and enhancements of service to attract discretionary trips. Potential ITS applications in these areas include computer-aided dispatch, automated passenger counting, and traveler information systems.

In addition to these five groups of rural counties, FTA added two more segments:

1. **Small, Poor, Growing Communities** are the smallest in terms of land area, among the most densely settled, average in terms of total population, and second highest in terms of population growth. The economic base is often manufacturing or non-specialized. This group contains high levels of counties in persistent poverty and those dependent on transfer payments. They are generally found in the central part of the United States, in places like southern Kentucky, northern Alabama, northern Arkansas, and southern Missouri. Counties in northern Michigan and southern Georgia also belong in this group.

2. **Small, Poor, Declining Communities** have small land areas, low population

densities, and negative rates of population growth. These are often farming communities, and this group contains high levels of counties in persistent poverty and those dependent on transfer payments. This group of counties has characteristics that are quite similar to the characteristics of the counties in the self-contained, low-growth category. They are most frequently found in the Appalachian region (West Virginia and eastern Kentucky) and in the central states, such as central Kansas, eastern and southern Nebraska, eastern South Dakota, southern Illinois, northern and southern Iowa, northeast Arkansas, southeast Missouri, and northwest Minnesota.

These seven transit market segments were defined with two hypotheses in mind: (1) There will be variations among different types of rural counties in terms of which ITS applications are most appropriate; and (2) Certain types of public transportation services work better in some rural communities than in other rural communities.

Table 3 summarizes the seven transit market segments and their characteristics.

STUDY APPROACH

To fulfill the objectives of this rural transit study, the study team conducted the following activities, also shown in Figure 4:

Table 3. Rural Transit Market Segments

Transit Market Type	*Percent of All 2,267 Rural Counties*	*Percent of Counties with Rural Transit*	*Distinguishing Characteristics*
Rural to urban commutes	49.0	57.6	Adjacent to metropolitan areas; more densely developed; often manufacturing or unspecified economic base; some persistent poverty counties
Large, sparsely populated areas	12.4	46.3	Primarily located in the West; often farming based; often Federal lands counties
Rural tourist areas	6.8	53.9	Emphasis on services industries; relatively high population growth; often Federal lands counties
Self-contained, low growth communities	6.8	67.3	Often farming based, characterized by persistent poverty and high transfer payments
Self-contained, high growth communities	2.6	57.6	Often nonspecialized or manufacturing based; relatively large counties
Small, poor, growing community*	5.9	58.7	Often manufacturing, retirement, or unspecified economic base; often smaller countries; characterized by persistent poverty and high transfer payments
Small, poor, declining communities*	6.6	66.5	Are often farming, smaller counties; characterized by persistent poverty and high transfer payments
*Recently added			

Source: ***Transit Market Segments in Rural America***, prepared by Ecosometrics, Inc. for the Volpe National Transportation Systems Center and the FTA, October 1997.

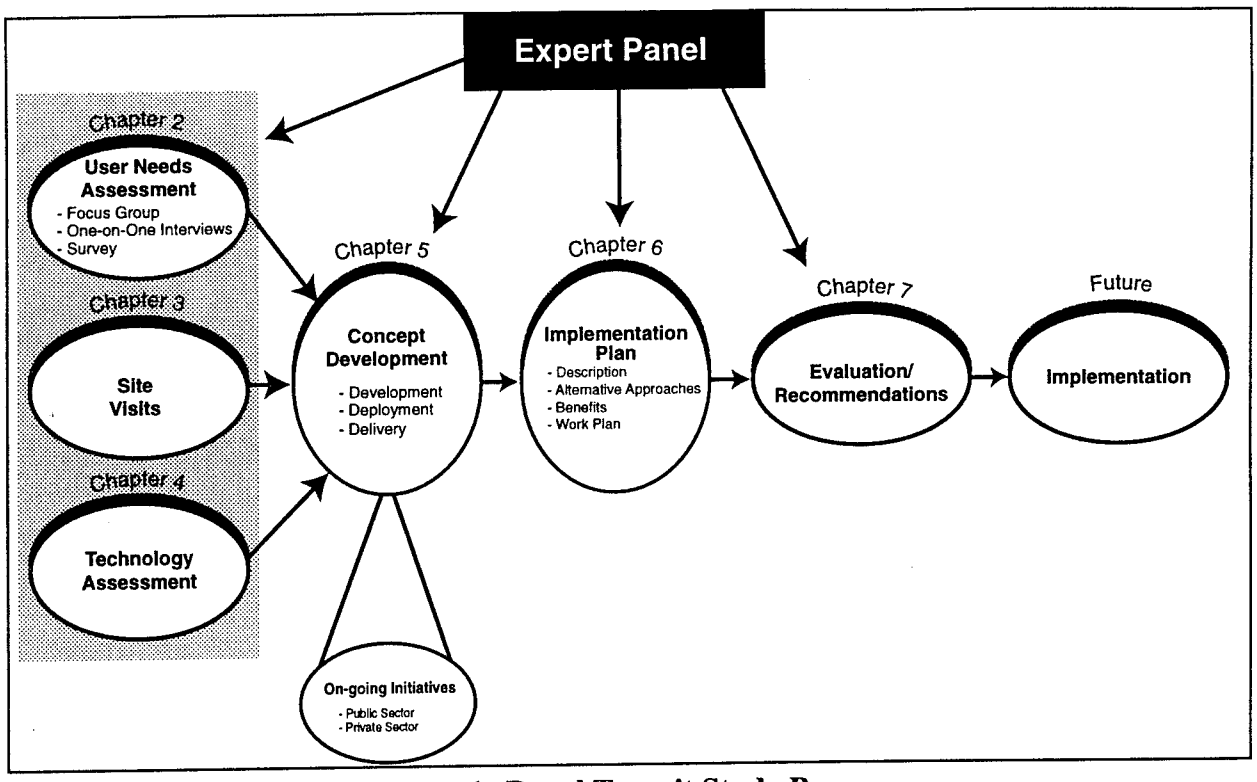

Figure 4. Rural Transit Study Process

- **User Needs Assessment.** The study team conducted a user needs assessment to determine information requirements, problems, and concerns of both operators and passengers of rural transit systems.
- **Site Visits.** Visits were made to several rural transit systems that have deployed or plan to deploy ITS technologies to identify potential technical, institutional, funding, and operational issues involved in designing, implementing, and operating rural transit systems.
- **Technology Assessment.** A comprehensive review of the state of the art and state of the practice was made. The purpose of this review was to assess the applicability of traveler information technologies in meeting the information needs of rural transit users and to assess the state of the art relative to the application of APTS technologies to solve financial accountability and data verification issues.
- **Action Concept Development.** A range of rural APTS actions was identified to address the rural transit needs and issues and take advantage of the emerging technologies.
- **Action Concept Description and Implementation Plan.** Detailed descriptions, potential benefits, a list of activities required for implementation, time requirement, and preliminary cost estimates were provided for each of the action items.
- **Evaluation and Recommendations.** The recommended actions were prioritized and the next steps toward development and

application of APTS technologies in rural and small urban areas were suggested.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The major findings from this study of rural transit user needs and applications include the following:

- Few rural transit systems have implemented advanced technologies as of 1997.
- Few rural transit operators know which ITS technologies are appropriate for rural transit needs, the benefits of these technologies, and how they should be implemented. Advanced technologies can offer benefits to rural transportation in terms of operations support (e.g., financial accountability and data verification) as well as for user support (e.g., traveler information).
- Rural transit operators understand that many of their problems do not have "high tech" solutions. Government and technology leaders should concentrate on solving the problems faced by rural transit agencies, not on applying particular technologies to rural transportation.
- Smaller transit systems need guidance to justify cost-effective technology applications. Identifying cost levels for implementation of specific technologies (e.g., automatic vehicle location, computer-aided dispatching) would be beneficial. Likewise, it would be helpful to identify logical building blocks to go from a "bare bones" systems to a more sophisticated system over time. To make intelligent implementation decisions, agencies need clear information on the costs associated with training, operations, and maintenance.
- Rural transit systems need information on partnering opportunities and barriers. Partnering can be with other public agencies and/or private organizations. Some of the increased efficiencies in rural transit services can come from appropriate partnering, especially with respect to non-transit agencies, such as a state DOT or law enforcement office. APTS can assist in making these partnerships work. Partnerships are useful for improved service coordination and also for more efficient operation and administration of public transportation systems. There is also the potential for consortium purchases, bringing down the unit cost of equipment and software purchases.
- The predefined rural transit market segments were not found to be powerful indicators of APTS needs or potentials. Rather, system size and service types are believed to be the best indicators of APTS needs or potentials.
- With respect to traveler information systems for rural transit, the needs for rural fixed-route systems are not greatly different from larger systems. The biggest benefits could be in the area of more exact pickup times, narrowing the pickup window, and translating vehicle location information into information that is usable by the customer.
- Future research is needed to determine how advanced technologies can help meet the demand for rural public transportation created by welfare reform.
- There is relatively little interest in automated fare collection among rural systems. On many systems, cash customers are a relatively small percentage, while agency-sponsored trips are a big part of the system (e.g., Medicaid and other government programs). Automation of trip verification, trip

eligibility, and agency billing could prove to be more significant payoff areas than converting cash customers to electronic fare payment.

The study team identified nine potential action items for rural APTS to address the needs, issues, and problems found by this study. The action items are compatible with the components of the U.S. DOT's Rural ITS Program plan: development, deployment, and delivery/outreach. The nine APTS activities for rural areas are listed below and detailed in chapters 5 and 6:

Development

- Plan and implement an operational test of shared technology infrastructure.
- Plan and implement an operational test of automated trip status information.
- Plan and implement an operational test of trip verification and billing.
- Plan and implement a fleet management operational test.
- Design and conduct a broader market research study of rural APTS needs and opportunities.

Deployment

- Plan and conduct demonstrations of low-cost technologies (simple solutions), e.g., bus arrival notification systems.

Delivery

- Develop a rural transit operator information kit.
- Prepare a rural APTS success story booklet.
- Develop specific training materials for rural APTS applications.

The findings and recommendations are described in detail in the rest of this report.

OTHER RELATED REPORTS

This report is one of a series of reports prepared for the *Rural Applications of ATIS* project. Two other published reports available through FHWA are:

- *Rural Application of Advanced Traveler Information Systems: User Needs and Technology Assessment*
- *Rural Application of Advanced Traveler Information Systems: Recommended Actions*

The following related study reports are available on U.S. DOT's ITS Web Page at (http://www.its.dot.gov)

- *Rural Public Transportation Technologies: User Needs and Applications, Executive Summary*, 1998
- *Evaluation of Satellite Communications Systems for Mayday Applications*
- *Surveillance and Delay Advisory System Initial Testing Report*
- *Rural Transit User Needs Assessment*, Draft, July 1997
- *Advanced Public Transportation Systems (APTS) Traveler Information Services: The State of the art*, Draft, August 1997

CHAPTER 2: USER NEEDS ASSESSMENT

This chapter describes the methodology and findings of the user needs assessment. With the growing Federal emphasis on intermodal Intelligent Transportation Systems (ITS), transit needs, including rural transit needs, must be given careful consideration. Rural transit systems can be made more intelligent to make the best use of available resources and to more efficiently meet the needs of transit users.

The identification and prioritization of rural transit user needs were accomplished from the standpoint of transit providers (via a focus group and one-on-one interviews) and from the users' perspectives (via a transit user survey). The focus group helped to identify issues of importance for the design of the questionnaires for the one-on-one interviews and the user survey. The eight one-on-one phone interviews elicited the transit providers' perspectives about traveler information requirements, provider needs, reaction to APTS technologies, implementation barriers and current problems, and institutional issues. The interviews facilitated in-depth investigation into the issues that face transit users and providers. The user needs survey was administered by the transit providers and elicited responses from 307 transit riders. The survey results give anecdotal or qualitative information about user needs and perceptions.

The three major elements of the user needs assessment and the findings from each are described below.

FOCUS GROUP

Focus group interviews helped to explore user needs from the perspective of the transit providers from each of the five market segments. Virginia Tech facilitated a focus group meeting held in conjunction with the Transportation Research Board (TRB) Annual Meeting in Washington, D.C., on January 12, 1997. A series of open-ended and probing questions were asked of the participants.

GENERAL NEEDS IDENTIFIED

The focus group participants identified numerous transit traveler user needs. These needs include:

- Eligibility - users want to know if they are eligible for subsidies and services and what types of services are available to them.
- Data management - users want a system that will allow them to register for services once.
- User-friendly systems - users want to be able to call one number and tap into a system that offers one-stop shopping.
- Dependability of services - users want services that are dependable and on-time.
- Extent of assistance - users want to know if the service is door-to-door or between bus stops, if there is assistance for the elderly, or if provisions have been made for language translation.
- Education about services - users want information about how to use public transportation, what to expect when using public transportation, etc.
- Consistency of service - users want to know how long they should have to wait for a bus if it is late, and users also want transit managers to set parameters for lateness.

- Assurance of safety - users want to know that the vehicle is safe, drivers are trained in emergency procedures, and that there is the ability to communicate with the base in the event of an emergency.
- Expanded availability - users want transit managers to provide services after hours, and on holidays and weekends.
- Continuity - users want to know that services will continue to be provided.

The focus group participants deemed vehicle safety, user friendliness, and access to informational and educational items as the most important user needs.

Safety issues encompass vehicle safety, assurance of safety in the event of an emergency, dependability of service, qualification of drivers, and maintenance of vehicles. The participants emphasized that it is especially important for users to feel comfortable in the event of an emergency.

User-friendliness issues include providing users with one-stop shopping, easy access to real-time information, and ease of requesting service. The participants maintained that being able to dial one number and talk to a living human being, rather than a voice response system, is a significant user need to easily obtain information about the system and to report problems.

Informational and educational issues encompass the provision of basic information to users about hours of operation, expectations when using public transportation, permissible travel, and the complaint process. The participants indicated that basic information and education about public transportation is important to increase ridership and keep current riders.

Awareness of Advanced Public Transportation Systems

A brief discussion about the focus group participants' awareness of Advanced Public Transportation Systems (APTS) technologies indicated that some participants were not aware of these technologies.

- Service Information
  - Real-time automated passenger information systems, Geographic Information System (GIS), automated telephone information systems
- Dynamic Ridesharing
  - Communications links, computer-aided scheduling and dispatching, automated vehicle location, automated rideshare matching
- Electronic Payment
  - Smart cards, advanced fare collection technologies, communications links
- Fleet Management Systems (fixed-route and demand response)
  - Computer-aided scheduling and dispatching, automated vehicle location, navigational aids for drivers, automated passenger counting linked to dispatch

A majority of the participants indicated that a passenger information system is useful to the passengers; however, it is difficult to implement. While dynamic ridesharing is advantageous for the providers because it is cost-effective, the participants indicated that it is not beneficial to users because it is not user-friendly.

Electronic payment methods also varied in terms of benefits to users and feasibility of implementation for providers. Participants indicated that electronic payment methods are too expensive to implement in some market segments because the riders may only use the system a couple of times during the course of a year. However, electronic payment methods are more efficient and cost-effective in some rural to metropolitan commute market segments because the users ride the system regularly.

Institutional And Technological Barriers

Focus group participants identified numerous institutional and technological barriers and organizational constraints that affect the operation of transit agencies. In particular, the discussion centered on attempts to identify the institutional and technological barriers and organizational constraints faced by transit managers and how these barriers affect services. The barriers include:

- Lack of financial resources
- Lack of public outreach programs
- Lack of standardization of driver/dispatcher training and lack of access to training programs
- Usefulness of many technologies not yet proven in rural areas
- Lack of advice about technology
- Complexity of technology

Institutional Barriers

The most prevalent barrier is the lack of financial resources to meet operating costs, undertake long-term planning, make capital investments, engage in entrepreneurialism and risk-taking, and justify the purchase of new technology. Lack of public relations/marketing programs is a barrier to attracting additional users. Lack of standardization in driver and dispatcher training is another barrier.

Technological Barriers

Lack of customized programs, simplicity in technology, and advice about new technologies are barriers to implementation.

ONE-ON-ONE TELEPHONE INTERVIEWS

Eight one-on-one telephone interviews were conducted with managers of transit agencies. The interviews allowed certain topics to be probed in-depth. These interviews also provided an opportunity to obtain the input and views of those who were not able to attend the focus group session. Virginia Tech's Center for Transportation Research (CTR) conducted the interviews with transit managers over a three-week period. CTR conducted the phone interviews to confirm the input garnered from the focus group and also to obtain more detail about user needs from the perspective of the transit providers. A summary of the results follows.

User Needs

The user needs identified by the agencies are:

- Friendly service
- Next-day service
- Safe service
- Prompt return time
- On-time service
- Expanded evening service hours
- Flexible fixed-routes
- More rural rideshares
- A larger service area
- Low-cost service

- Transportation to stores, employment, and medical appointments

The agencies maintained that the transit users are generally pleased with the safety of their transit services. Several common safety issues were identified by the agencies;

- Well-maintained vehicles
- Well-trained drivers
- Dangers of accessing a bus from the highway (individuals walking along the highway to catch a bus)
- Safe accommodation of disabled individuals
- The transportation of oxygen tanks, 3-wheel scooters, and non-standard wheel chairs

The most common types of information requested by transit users are schedules, prices, route information, eligibility for services, how to use the transit system, and how to carpool.

The transit agencies disseminate information in a variety of ways, including brochures, newspapers, presentations, billboards, word-of-mouth communication, TV, radio, civic events, public meetings and hearings, and the yellow pages.

Some of the barriers users face in obtaining information about services identified by the transit agencies include the fact that there is not single good way to reach people, and the agencies do not have automated phone systems or enough staff to answer calls.

The transit users most commonly contact the transit agencies by telephone (usually through a toll-free number) and by mail.

The most common problems that transit users face (from the providers' perspectives) when using these transit systems are:

- Inconvenient or insufficient schedules
- Access for persons with disabilities – getting to the bus
- Lack of door-to-door pickup
- Lack of good matches for carpools
- Outdated information about riders for carpooling
- Location of users off-route
- Snow-removal

Technology Applications

Most of those interviewed have implemented at least one of the following technologies: passenger information systems, dynamic ridesharing, electronic payment systems, and fleet management systems.

Some agencies do not view technology as a means to reduce their operating costs. However, they do see it as a mechanism for increasing their operational efficiency. Other agencies see little use in implementing new technologies if it is not accompanied by the resources needed to continually train personnel and maintain the technology. The agencies that have implemented technology maintain that several benefits have resulted, including a wealth of data generated about passengers, increased on-time performance, increased response to requests for services, and better information with which to make decisions. Providers are generally open to the implementation of new technologies, as long as they are cost-effective in the long term. Providers believe that users are also open to the implementation of new technologies, as long as they do not inconvenience the user.

INSTITUTIONAL ISSUES

Almost all of the agencies interviewed are partnering with other agencies or transit providers to meet transportation needs. Some of the barriers faced by agencies when attempting to coordinate efforts with other agencies or transit providers to meet transportation needs include liability issues, lack of understanding by users as to why the agency is working with others, philosophical differences, political and funding constraints, differences in operating areas, and a need to ensure the quality of personalized service.

The agencies identified several operational and capital needs, including the need for more funding, vehicles, facilities, staff training opportunities, drivers and administrative staff, and computers and printers.

Most of the agencies maintained that their training efforts are sufficient for their organization. However, the agencies maintained that they would like to offer more training opportunities for their employees, such as how to operate computer software and read maps.

Federal requirements with which the agencies must comply are the Americans with Disabilities Act and drug and alcohol testing. They deal with these by seeking money from state and local sources. Another concern of the providers is how to meet the demand created by welfare reform.

To manage change and plan for the future, the agencies state that they will seek more funding, continue to educate elected officials about their programs, identify other services that they can supply, cut back services or discontinue routes, and identify new ways to generate funding.

USER SURVEY

Using the results of the needs assessment gathered from the focus group, Virginia Tech designed a survey of rural transit users to verify the findings from the focus group and the one-on-one interviews and to determine needs from the perspective of the users. A total of 450 user needs surveys were distributed by mail, and 307 responses were returned.

The transit providers distributed the survey to their transit users, with one exception – Virginia Tech administered the survey to Blacksburg transit users. Due to limited resources, a full-fledged scientific survey could not be conducted. The survey results, therefore, are not necessarily statistically significant because the sample size was relatively small and the administration of the survey was not strictly controlled. The survey results are useful, however, in that they give some anecdotal or qualitative information about user needs and perceptions, but they should not be relied upon for quantitative analysis.

The user needs survey identified the demographics and the perceived needs of transit users. Informational needs delineated include the usage of information, the characteristics of information (e.g., frequency, timeliness), and the usefulness of the information. The survey also provides the demographics of transit users from the five market segments.

A total of 450 surveys were distributed to the five market segments (90 to each market segment). A total of 307 surveys were returned. The breakdown of those returned is as follows: 74 surveys from the high growth areas; 76 surveys from the slow/no growth areas; 76 surveys from the large, sparsely populated rural areas; 30 surveys from the

rural tourist areas; and 51 surveys from the rural to metro commutes.

The following sections summarize the key findings of the user survey.

DEMOGRAPHICS AND SYSTEM USAGE

- Of the 307 respondents, approximately 74 percent of the survey respondents were female, and 26 percent were male. Forty-one percent of the transit respondents were older than 65. Only 24 percent had access to a car all of the time, while 24 percent had access only some of the time, and 32 percent had no access to a car at all.
- Fifty-five percent of the respondents used the transit system daily. Seventy-seven percent of the commuter respondents used the transit system daily, whereas 21 percent used the system weekly. Respondents from the rural tourist market segment either used the transit system yearly (17 percent) or daily (73 percent), which corresponds with the seasonal fluctuation of tourists to these areas and a high rate of usage by service workers accessing jobs in these areas. Slow growth communities tended to use the system less often, with most users accessing the service monthly or weekly.
- Sixty percent of the survey respondents were fixed-route users and 40 percent were paratransit users.
- Slow/no growth respondents tended to use the transit system primarily for running errands (45 percent), while those in large, sparsely populated areas used it to commute to work and for other purposes (34 percent). Fixed-route users most often used the system to commute to work, while 70 percent of paratransit users either used the system to run errands or go to medical appointments.

SERVICE CHARACTERISTICS

- Of the fixed-route users, 85 percent indicated that the transit system is very easy to use, while 73 percent of paratransit users answered that the system is very easy for them to use.
- Seventy-seven percent of the respondents indicated that they are very satisfied with the transit systems' hours of operation. This result is interesting, because the data also indicate that users want more hours and days of operation in order to make the transit system more responsive to their needs. Evidently, the users were glad to have the transit service, but they also saw room for improvement. In terms of paratransit and fixed-route transit users, 48 percent of fixed-route users indicated that they are very satisfied with the hours of operation, while only 29 percent of the paratransit users indicated they are very satisfied with the hours of operation. Finally, 78 percent of the respondents indicated that the existing transit services are very adequate in meeting their needs. Overall, the results from these questions indicate that the respondents were pleased with the existing transit services.
- Sixty-seven percent of the respondents from the rural to metro commute market segment maintained that safety is the most important issue for them when using the transit system. Dependability and convenience were the dominant issues for the other market segment. This seems to indicate that the rural to metro commuters are more concerned with safety, possibly due to the longer drives and higher speeds.
- Seventy-seven percent of the respondents strongly agreed that the transit system is safe. In the commuter market segment, 92 percent said that they strongly agree that the transit system is safe; however, these same respondents indicated in the previous

question that safety is the most important issue to them when using the transit system. It can be inferred that the commuter respondents believed that the transit system is meeting their expectations with respect to safety. Overall, the perception of the transit system being safe was quite high across market segments.

- Sixty-two percent of the respondents strongly agreed that the vehicles are well-maintained. Overall, 96 percent of the respondents indicated that the transit service gets them to their destinations on time either all or most of the time. In terms of being on time all of the time, the fixed-route riders indicated a higher satisfaction than paratransit riders. Additionally, 82 percent of the respondents indicated that, based on the service they receive, the cost of the service is very reasonable.

Information Needs

- Across market segments, and in general, users said that information about the transit system is easy to obtain.
- As shown in figure 5, schedules are the primary type of information in all of the market segments. Commuters and rural transit users were the most interested in schedule information.
- Figures 6 and 7 illustrate the methods by which rural transit users obtain transit system information. Figure 6 indicates the responses by market segment, while figure 7 provides the response by service type.
- Users primarily phone the transit system to get information, with commuters overwhelmingly using the phone. Tourists do not use the phone very much, but rely on bus stops/buses, word-of-mouth, and brochures. This result is important because it illustrates the need for alternative information services for tourists. Other users also frequently obtain information at bus stops, from brochures, and by word-of-mouth. Paratransit users were more reliant on the telephone than were fixed-route users, while fixed-route users relied more heavily on brochures, buses, and bus stops.
- Seventy-six percent of users were very satisfied with the information they receive, while only 4 percent were somewhat or very dissatisfied.

Perceived Problems And Solutions

- Common problems faced when using the transit system included:
  - Waiting for the bus in inclement weather
  - Need to call ahead for service
  - Full buses/vans
  - Not enough service hours
  - Lateness of vans and changing schedule without notice
  - No AC/heat
  - Old vans/buses
- To solve the problems identified, the respondents indicated that the transit system could implement the following:
  - More, newer buses/vans
  - Call back passengers with confirmation
  - Extend service hours
  - Provide more and better bus stops
  - Provide more timely information

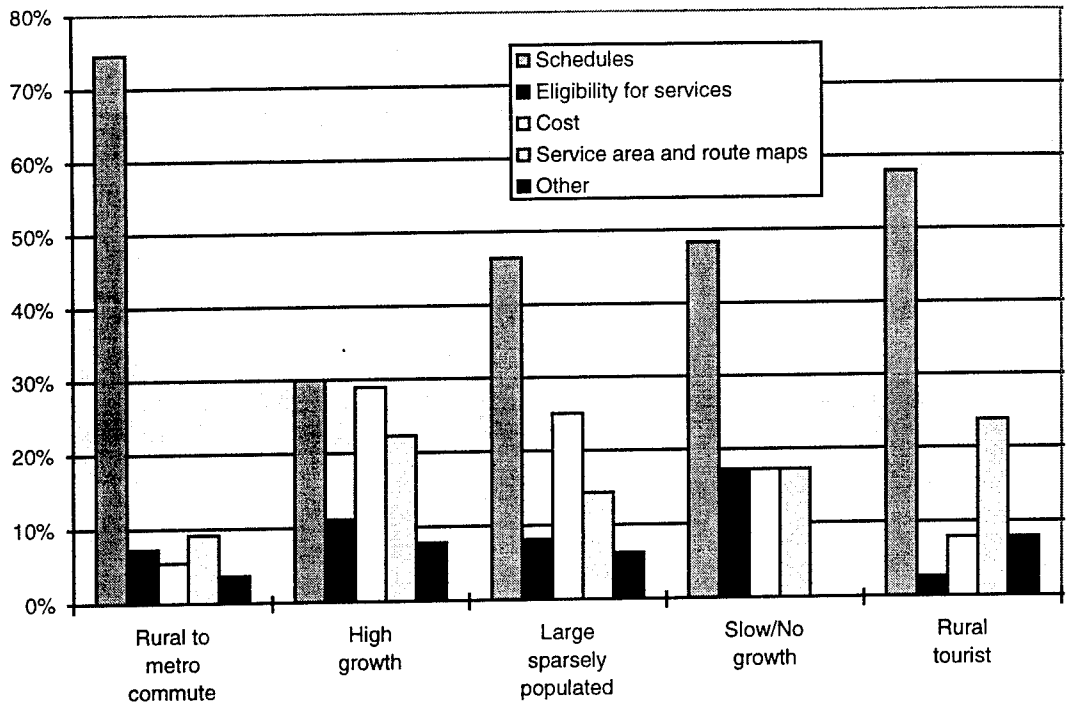

Figure 5. What Types of Information Do You Most Commonly Need For Your Trips? (Response by Market Segment)

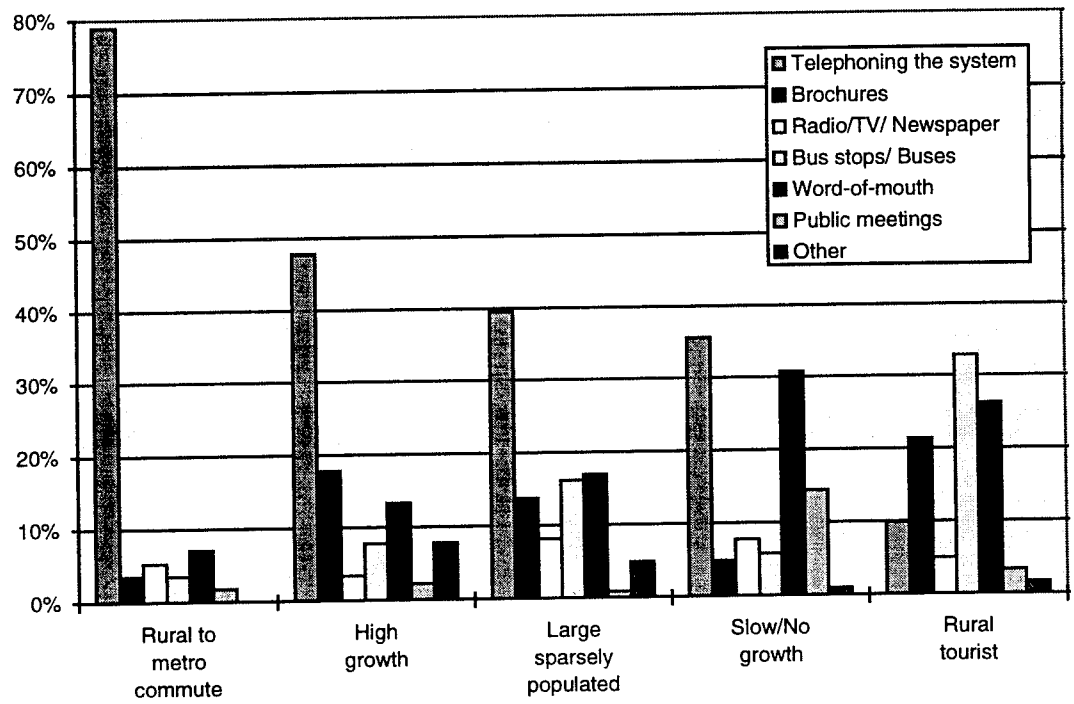

Figure 6. How Do You Obtain Transit System Information? (Response by Market Segment)

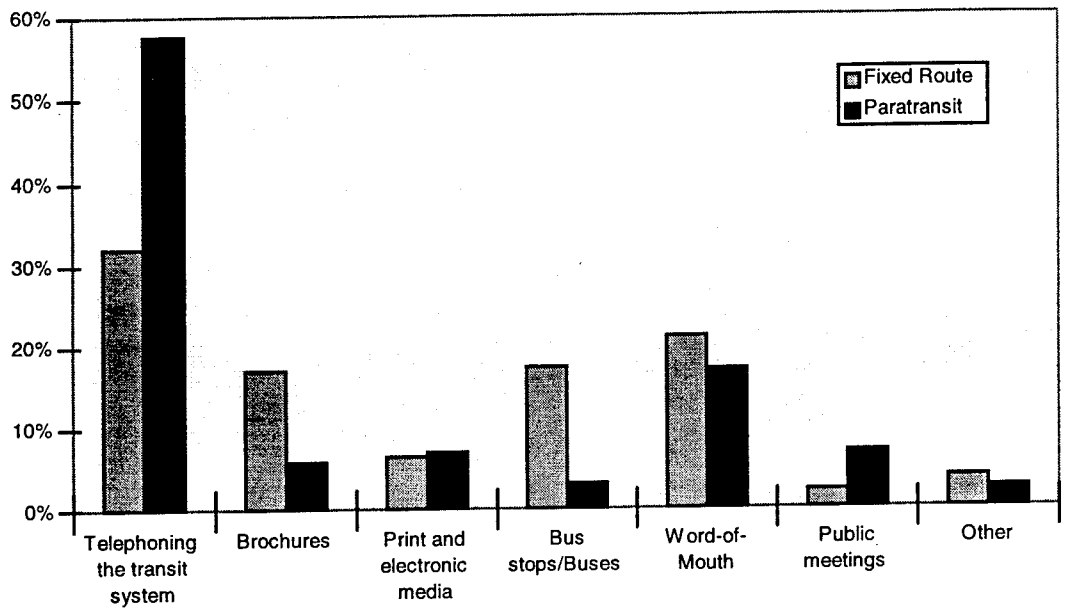

Figure 7. How Do You Obtain Transit System Information? (Response by Fixed-Route and Paratransit Users)

- When a user encounters a problem with the transit system, he or she is more likely to talk to the driver (52 percent) or call the transit system (33 percent). Respondents from the rural to metro commute market segment tend to call the transit system first when they experience a problem with the transit service (67 percent), whereas slow/no growth area respondents tend to talk to the driver first (81 percent).
- Overall, approximately 33 percent of the respondents indicated that offering more service hours and days of operation would be a potential solution to the transit problems they face. From the rural to metro commute market segment, 73 percent of the transit users indicated that offering more hours and days of operation would be a potential solution.
- Twenty-six percent of the respondents from rural tourist areas indicated that more timely information would improve the transit
- From the slow/no growth areas, 21 percent of the respondents indicated that more assistance getting on and off the vehicle would make the transit system easier for them to use, while 19 percent of the respondents from the high growth areas and 22 percent of the respondents from the large, sparsely populated rural areas indicated that more convenient payment methods would make the transit system easier for them to use.
- Both fixed-route and paratransit users said that more hours of operation are needed. More paratransit than fixed-route users indicated the need for assistance accessing the vehicle, a better telephone system, and faster service.

RECOMMENDATIONS FOR FURTHER RESEARCH

This study helped to identify several worthwhile areas for further research, which include the following topics.

- The present results were derived from transit users who seem to be relatively satisfied with the service. It would be worthwhile to conduct research from the perspective of non-users to assess the needs of potential rural transit users to ascertain the barriers and problems that discourage the rural populace from using the transit system. Survey research should include a thorough examination of the issues that may differ for potential users when compared with current users. Research will lead to the identification and implementation of appropriate APTS technologies.
- Because the sample size was small and the survey was generally distributed by the transit providers, future work should provide for a scientific survey with a much larger sample size.
- User surveys of areas that have deployed technology (kiosks, AVL, etc.) should be conducted to provide useful information about the impact of technology on user needs.
- Operational tests of low-cost technologies in response to rural needs could also be defined and deployed.

CHAPTER 3: RURAL TRANSIT SITE VISITS

This chapter summarizes the team's findings from the rural transit site visits. The study team conducted the market segment site visits to provide a better understanding of the operational and administrative problems and issues facing rural transit agencies. APTS technologies that the systems have deployed or plan to deploy were also identified.

SELECTED SITES

At least two transit systems were visited for each of the initial five market segments. Rural/small urban transit systems that had deployed or planned to deploy APTS technology were selected for site visits. Table 4 shows the rural transit systems visited. Table 5 shows detailed characteristics of the visited sites.

Table 4. Market Segment Sites Visited

MARKET SEGMENT	SITE
Slow/No Growth, Self-Contained Local Community	▪ Linn County, Iowa - Linn County Lifts ▪ Virginia, Minnesota - Arrowhead Transit, Virginia Dial-A-Ride
Large, Sparsely Populated Rural Area	▪ Sweetwater County, Wyoming - Sweetwater County Transit Authority ▪ Florence, South Carolina - Pee Dee Transit
Rural to Metropolitan Area Community	▪ Dakota County, Minnesota - Dakota Area Resources and Transportation for Seniors ▪ Front Royal, Virginia - Front Royal does not have a transit agency
High Growth, Self-Contained Local Community	▪ Blacksburg, Virginia - Blacksburg Transit ▪ Flagler County, Florida - Flagler County Transport
Rural Tourist Area	▪ Cape Cod, Massachusetts - Cape Cod Regional Transit Authority ▪ Park City, Utah - Park City Transit

Table 5. Characteristics of the Visited Sites

Site	Service Area Square Miles	Population	Vehicles	Service Provided	Annual Ridership
Sweetwater County, Wyoming	10,497	41,000	15	Demand-Responsive	89,800 (1995)
Park City, Utah	5	7,000	12	Fixed-route and Demand-Responsive	954,400 (1996)
Linn County, Iowa	780	170,000	12	Demand-Responsive	108,000 (1996)
Virginia, Minnesota	18,000	310,000	52	Fixed-route and Demand-Responsive	365,900 (1995)
Dakota County, Minnesota	571	300,000	25	Demand-Responsive	121,000 (1996)
Front Royal, Virginia	0	173,000	0	None	0
Florence, South Carolina	11,000	480,000	180	Fixed-route and Demand-Responsive	624,000 (1997)
Cape Cod, Massachusetts	400	200,000	75	Fixed-route and Demand-Responsive	500,000 (1996)
Flagler County, Florida	480	40,000	15	Demand-Responsive	75,000 (1996)
Blacksburg, Virginia	19	34,000	35	Fixed-route and Demand-Responsive	1,600,000 (1996)

GENERAL FINDINGS

General findings of the site visits are:

- Few rural transit systems have implemented advanced or automated technologies as of 1997.
- The systems that do have a formal ITS plan coordinate their efforts with external agencies. This provides the opportunity to consider regional issues and share resources.
- Large systems plan to deploy Automatic Vehicle Location to monitor vehicles and to increase system capacity. Knowing the location of all vehicles allows dispatchers to more efficiently dispatch vehicles, which can lead to an increase in system capacity.
- Most systems that have purchased an APTS application did not budget for an appropriate level of funding for training. Training is provided by the vendor but they typically do not provide additional training to fine-tune the technology to the transit system's needs.
- Most systems do not anticipate the learning curve required to understand how to operate their APTS application. Operators of the APTS application have to do their jobs as well as learn the technology.
- Rural systems have a general awareness of ITS, but they depend heavily on the vendor for specific information on APTS applications. Vendors have been aggressive in providing rural systems with information regarding their product, but in

many cases APTS has been oversold as a cure for all that ails transit.

- Implementation of APTS is done in phases. Most systems begin with computer-aided dispatch and scheduling technology. Operating costs of a transit system typically account for the largest percentage of its budget; therefore, improving schedule efficiency with computer-aided dispatch and scheduling is a logical first step.

ADMINISTRATIVE ISSUES

Administrative issues include report development, data accuracy and verification, service performance, monitoring and fare documentation. The following administrative problems were identified during the site visits:

- Inability to accurately record passenger fares reduces the system's ability to separate passengers into fare categories.
- Inability to separate passengers by contract, which is required by many clients.
- Inaccurate passenger and fare data do not allow systems to report accurate information to clients and funding agencies.

USER ISSUES

User issues were identified from passenger complaints received by the transit system. User issues include:

- Passengers do not like the pickup window (time frame when they will be picked up) because they prefer to have a specific pick-up time.
- Trips are missed because passenger information is misplaced.
- Return trip time is not guaranteed, therefore passengers cannot plan their day.
- Some passengers do not like to ride in group trips.
- Excessive travel time for many elderly and disabled passengers causes physical discomfort.

OPERATIONAL ISSUES

The operational issues that were identified focused on the problems transit systems have with delivering service:

- Poor emergency response time because the exact location of the vehicle is not known.
- Additional radio communication frequency is needed because of system growth.
- Lack of qualified drivers in labor pool.
- Problem with scheduling and rescheduling will call trips because vehicle location is not known.
- Cannot estimate the location of the vehicle due to traffic congestion.
- Poor on-time performance.
- Inability to monitor the location of the vehicle.
- Lack of information flow between passengers, dispatcher, and vehicle operator.
- Cannot fully coordinate services due to varying pickup times for multiple clients.

ADVANCED TECHNOLOGIES

The advanced technologies that these rural systems are using or considering include:

- Transportation Management Center (TMC) - a central facility for the coordination, monitoring, and management of the transit services and

traffic control systems within a jurisdiction.

- Computer-Aided Dispatch (CAD) - computer software and hardware that incorporates transit routes, schedules, and vehicle assignments and allows dispatchers to know where the vehicles are and to more efficiently schedule and dispatch transit service.
- Automatic Vehicle Location (AVL) - computer-based vehicle tracking system that allows a fleet manager to monitor vehicle location, conditions, and schedule. AVL is used to assist in dispatching.
- Geographic Information Systems (GIS) - combination of an electronic map and a relational database in a software package that allows the user to visualize and analyze data spatially. GIS is an automatic mapping tool used in combination with AVL and CAD.
- Mobile Data Terminals (MDTs) - small computer terminals in vehicles that allow drivers to receive and send text and numerical data by radio signals to the operations center and dispatchers. MDTs reduce the amount of air time that operators spend on the radio. MDTs allow vehicle, passenger, and other data to be transmitted in "real time," as events transpire, rather than waiting until the vehicle returns to the system's headquarters.
- Electronic fare payment systems, such as "Smart Cards" - automated fare payment systems that employ electronic communication, data processing and storage, and computer-based record keeping and funds transfer. Electronic media can store information in readable and writable form. They allow passengers to pay for their transit trips electronically.
- Advanced Traveler Information Systems (ATIS) - pre-trip, wayside or in-vehicle information that helps travelers make decisions before or during their trip, such as real-time passenger information at bus stops.

Table 6 shows APTS technologies presently deployed or that are planned for future deployment at the sites visited.

Table 6. Rural APTS Applications and Future Deployment at Visited Sites

System	APTS Deployed	Future APTS Deployments
Linn County Lifts	Computer Aided Dispatch (CAD)	Automatic Vehicle Location (AVL)
Arrowhead Transit, Virginia Dial-A-Ride	Transportation Management Center (TMC) & CAD	Mobile Data Terminals (MDTs), Geographic Information System (GIS)
Sweetwater County Transit Authority	CAD	GIS, MDTs & AVL
Front Royal, Virginia	None	GIS
Dakota Area Resources and Transportation for Seniors	CAD	AVL & MDTs
Pee Dee Transit	None	CAD & AVL
Blacksburg Transit	Internet, cable television, AVL, CAD, kiosks & real-time passenger information at bus stops	Electronic fare payment
Flagler County Transport	AVL	Electronic fare system, real-time passenger information at bus stops
Cape Cod Regional Transit Authority	None	AVL, TMS, cable television, Internet, variable message signs, highway advisory radio, information kiosks, MDTs, & CAD, real-time passenger information at bus stops
Park City Transit	None	AVL, Advance Traveler Information Systems (ATIS)

ANTICIPATED BENEFITS OF APTS

Many of the sites visited anticipate that APTS technologies will provide them a variety of benefits. The anticipated benefits are:

- AVL will allow transit managers/dispatchers to identify the location of their vehicles and thereby monitor/improve schedule adherence and ensure the safety and security of the drivers and riders.
- MDTs, which allow the dispatcher to send text messages and numerical data to transit vehicles, will improve the efficiency of the dispatching operation by reducing the amount of air time the dispatcher spends with the driver.
- AVL will improve emergency response time because the dispatcher will know the actual location of the vehicle better than by using a two-way radio system.
- CAD will enable operators to schedule more passenger trips and reduce the number of trip requests that are turned down because system efficiency will be improved, leading to increased system capacity.
- Some APTS technologies will help increase ridership due to an increase in the efficiency of the system.
- Some APTS technologies will improve passenger information because they work on a real-time basis.

For example, the bus system in Sweetwater County, Wyoming, doubled its monthly ridership using a computer-aided dispatch system. Five years after its installation, transit-operating costs have decreased 50 percent and ridership has increased by 5 times. The transit center now provides dispatching services for approximately 20 agencies in the region.[4]

CHAPTER 4: TECHNOLOGY ASSESSMENT

This chapter presents the results of two additional research efforts. One research effort covered the state of the art of technology for transit-related traveler information services. Another research effort looked at the applications of APTS technologies to accounting and data verification packages for rural transit services.

TECHNOLOGY SURVEY

As part of this study, the study team researched the types of ATIS technology currently being used or planned by transit agencies. The objectives of the technology assessment research were: 1) to determine and document the state of the art of ATIS in transit; and 2) to determine the potential for current and emerging technologies to satisfy the requirements of rural transit users and operators for ATIS systems. The research also identified the issues and a number of lessons learned related to procuring and implementing advanced technology. The research involved a survey of a variety of transit agencies in North America. Because few rural and small urban systems have deployed or plan to deploy ATIS technology, most of the systems that responded to the survey were urban and suburban transit agencies. Therefore, the research results are based on responses from 32 primarily urban and suburban transit agencies.

MAJOR FINDINGS AND CRITICAL ISSUES

The major findings of the ATIS technology survey were:

- 81 percent of the 32 respondents are or will be offering pre-trip planning information.
- More than half of the respondents are providing static arrival/departure information, information on routes and route details, and information on fares.
- More than half of the respondents expect to provide real-time arrival/departure information.
- 75 percent are using static data to drive their current ATIS.
- 50 percent are providing some ATIS functions on the Internet.
- 63 percent are providing customer service information using manual trip planning methods, rather than automated systems.
- 84 percent addressed consumer needs in their ATIS development; however, only 41 percent incorporated estimates of customer usage into their development process.
- More than half have information available on the current usage of their ATIS.
- 63 percent report that they are partnering with other local or regional agencies on their ATIS projects.

Tables 7 and 8 show the status of information technology of the 32 transit agencies that responded to the survey.

Table 7. Stage of Traveler Information System Development

Transit Agency	Location	Planning/ Definition	Development	Installation/ Testing	Full Operation/ Implementation	Expansion
Ann Arbor Transportation Authority	Ann Arbor, MI		✔	✔	✔	
Bay Area Rapid Transit	Oakland, CA	✔				
BC Transit	Vancouver, BC	✔				
Beaver County Transit Authority	Rochester, PA	✔	✔			
Broward County Division of Mass Transit	Pompano Beach, FL				✔	
Cape Cod Regional Transit Authority	Dennis, MA	✔				
Central Florida Regional Transportation Authority (LYNX)	Orlando, FL	✔	✔			
Chicago Transit Authority	Chicago, IL			✔		
Connecticut Transit	Hartford, CT		✔			
Corpus Christi Regional Transportation Authority	Corpus Christi, TX		✔			
County of Lackawanna Transit System	Scranton, PA				✔	
Houston Metro	Houston, TX		✔			✔
Kitsap Transit	Bremerton, WA	✔				
Mass Transit Administration of Maryland	Baltimore, MD		✔			
Merced County Association of Governments (Yosemite Area Traveler Information (YATI) System)	Merced, CA				✔	
Metro Transit	Halifax, NS				✔	✔
Metro-Dade Transit Agency	Miami, FL				✔	
Metropolitan Atlanta Rapid Transit Authority	Atlanta, GA			✔	✔	
Metropolitan Transportation Authority/New York City Transit	New York, NY		✔			
Metropolitan Transportation Commission	Oakland, CA				✔	
Milwaukee County Transit System	Milwaukee, WI	✔				
Minnesota Department of Transportation	Duluth, MN	✔				
Montreal Urban Community Transit Corporation	Montreal, ON				✔	
New Jersey Transit	Newark, NJ		✔			
Orange County Transportation Authority	Orange, CA			✔		
Ottawa-Carleton Regional Transit Commission	Ottawa, ON				✔	✔
Pace Suburban Bus Division	Arlington Heights, IL	✔	✔	✔		
Potomac and Rappahannock Transportation Commission	Woodbridge, VA				✔	
Ride-On	Montgomery Co., MD				✔	
Sun Tran	Tucson, AZ		✔			
Sweetwater County Transit Authority	Sweetwater County, WY	✔				
Toronto Transit Commission	Toronto, ON				✔	
Tri-County Metropolitan Transportation District of Oregon	Portland, OR	✔				

Source: 1997 Survey by Multisystems, Inc.

Table 8. Type of Traveler Information System Planned or Operating

Transit Agency	Location	Pre-Trip	In-terminal/ Wayside	In-vehicle
Ann Arbor Transportation Authority	Ann Arbor, MI	✔	✔	✔
Bay Area Rapid Transit	Oakland, CA	✔		
BC Transit	Vancouver, BC		✔	✔
Beaver County Transit Authority	Rochester, PA	✔	✔	✔
Broward County Division of Mass Transit	Pompano Beach, FL	✔	✔	
Cape Cod Regional Transit Authority	Dennis, MA	✔	✔	
Central Florida Regional Transportation Authority (LYNX)	Orlando, FL	✔	✔	
Chicago Transit Authority	Chicago, IL		✔	✔
Connecticut Transit	Hartford, CT	✔		
Corpus Christi Regional Transportation Authority	Corpus Christi, TX	✔	✔	✔
County of Lackawanna Transit System	Scranton, PA			✔
Houston Metro	Houston, TX	✔		
Kitsap Transit	Bremerton, WA			✔
Mass Transit Administration of Maryland	Baltimore, MD	✔	✔	
Merced County Association of Governments (Yosemite Area Traveler Information (YATI) System)	Merced, CA	✔	✔	
Metro Transit	Halifax, NS	✔	✔	
Metro-Dade Transit Agency	Miami, FL	✔		
Metropolitan Atlanta Rapid Transit Authority	Atlanta, GA	✔	✔	
Metropolitan Transportation Authority/New York City Transit	New York, NY	✔	✔	✔
Metropolitan Transportation Commission	Oakland, CA	✔	✔	✔
Milwaukee County Transit System	Milwaukee, WI			✔
Minnesota Department of Transportation	Duluth, MN	✔	✔	
Montreal Urban Community Transit Corporation	Montreal, ON	✔	✔	
New Jersey Transit	Newark, NJ	✔		
Orange County Transportation Authority	Orange, CA	✔		
Ottawa-Carleton Regional Transit Commission	Ottawa, ON	✔	✔	
Pace Suburban Bus Division	Arlington Heights, IL	✔	✔	✔
Potomac and Rappahannock Transportation Commission	Woodbridge, VA	✔		
Ride-On	Montgomery Co., MD		✔	✔
Sun Tran	Tucson, AZ	✔		
Sweetwater County Transit Authority	Sweetwater County, WY	✔		
Toronto Transit Commission	Toronto, ON	✔		
Tri-County Metropolitan Transportation District of Oregon	Portland, OR	✔	✔	

Source: 1997 Survey by Multisystems, Inc.

Even though ATIS systems are being widely implemented in North America by transit agencies, a majority of ATIS systems are based on static data, rather than real-time data. However, with the growing implementation of AVL systems and sophisticated techniques to collect data and distribute information, ATIS

systems based on-real-time data are just starting to be implemented.

The critical issue in using real-time information in an ATIS, expressed by several agencies interviewed for this study, is twofold. First, converting real-time data from an AVL system into useful, reliable, and accurate information for travelers is a considerable task. Second, extensive marketing is required to educate travelers, transit agency management, and other regional agencies as to how to use the information being provided by an ATIS. This is needed because there are different ways of providing and interpreting real-time information. For example, one way of providing real-time information on the arrival of buses is to "count down" the number of minutes until the bus will arrive. Another way is to display a range of time within which the bus will arrive. The latter approach was used in the Travlink system in Minneapolis, while the former approach is used in the COUNTDOWN system in London.

The information collected as part of the technology assessment indicates that the implementation of ATIS by transit agencies is relatively widespread among the larger agencies and is being considered by very few smaller agencies. The overwhelming reason given for this was lack of funding, with the secondary reason being lack of in-house technical expertise. However, the state of the art among the larger agencies shows that the technologies needed to support ATIS are readily available and can be successfully implemented. Further, the agencies that were interviewed expressed many "lessons learned" that can be used by smaller and rural transit agencies.

The following points summarize the results of the state-of-the-art technology assessment:

- A majority of transit agencies interviewed have or will be implementing a pre-trip planning system. This is evidenced by the number of agencies that provide pre-trip planning services either on the Internet or by telephone.
- In-vehicle information systems, consisting of automated annunciators, are being implemented primarily to comply with the ADA. Very few agencies are considering in-vehicle systems that provide additional information, such as information on transfers, connections, or other pertinent traveler information.
- A majority of transit agencies expect to provide real-time arrival and departure information as part of their ATIS in the future. Currently, a majority of systems provide static arrival and departure information from schedules.
- Besides the use of customer information operators to provide trip planning services, most agencies are or will be providing these services on the Internet.
- A majority of agencies addressed customer needs and potential reactions in the development of their ATIS systems. However, less than half of them incorporated potential customer usage estimates into their development.
- A majority of agencies are partnering with other regional transportation providers to coordinate the development and deployment of ATIS systems. In many cases, this may be one of the only ways that smaller and rural agencies can even consider implementing an ATIS.

On the basis of these results, the following conclusions can be drawn:

- While many ATIS systems are being developed, particularly by larger transit

agencies, smaller and rural agencies are not necessarily considering these systems.

- Often, APTS technologies that can improve operations are considered before those that can provide customers with better information.
- ATIS systems have the potential to attract new riders to transit, but actual experience is limited. The research lacks evidence on how much new ridership will be attracted to rural transit systems.
- While many agencies have these systems implemented or will be implementing a variety of APTS technologies, it does not minimize the effort and cost involved with implementing these technologies. The fact that a majority of agencies are partnering with other local and/or regional agencies may be part of the solution to the funding issue, which will be just as significant for rural agencies, if not even more critical.
- While there is great interest in providing real-time information to travelers through ATIS systems, very few agencies are actually providing it. This is due to the fact that information from AVL systems cannot be provided to the public directly – additional computations must be done in order to provide the information in a reliable, accurate, and usable format.
- Kiosks as media for ATIS systems are ranked relatively high in terms of current use and expected future implementation. While in urban and suburban areas, this medium may meet the needs of travelers, it may not meet the needs of rural travelers. Other media, such as Internet access, may be much more effective.
- Several European projects can provide useful information for rural and small urban transit agencies that may be considering the implementation of an ATIS. One such project is the Transportation Using Rehabilitation Technologies Leads to Economic Efficiencies (TURTLE), which is using advanced technologies as part of the European Commission's Technology Initiatives for Disabled and Elderly Persons Program in the United Kingdom, Germany, and Ireland. Several of these systems are fully operational and have been evaluated.

LESSONS LEARNED

The data collected as part of this state-of-the-art study yielded many lessons learned from the agencies that were interviewed. These lessons learned cover technical, organizational, institutional, procurement, marketing, and financial issues that were encountered as the ATIS systems were being developed and deployed. These lessons learned can be applied to rural transit systems as well as urban and suburban systems.

TECHNICAL ISSUES

Many technical issues were mentioned by the survey respondents. The most often-mentioned issue was the effort required to create, maintain, and update the databases needed to support ATIS systems. A related caution was to be realistic about the complexity of data required for the system.

Creating a database, such as a bus stop inventory, is a considerable effort, as is the effort required to maintain it. These efforts are sometimes overlooked in the planning process. Similarly, integrating data in different formats from multiple databases from multiple sources (even within the same agency) is required but often not considered in planning. This is a complex undertaking, particularly if multiple geographic information systems (GIS) data formats are in use.

Maintaining the independence, accuracy, and security of databases is yet another task that is difficult while ensuring open access by customers through an ATIS. Updating independent databases must be accounted for in the planning process as well. For example, when a bus stop is moved or eliminated, several independent databases must be updated. Likewise, maintaining printed and electronic schedule information separately can require resources that are not initially planned for.

The next major technical issue concerns communications interfaces and systems. Agencies may have to upgrade their communications interface to an APTS system in order to support additional components such as automated annunciators, and automatic passenger counters (APCs). This is particularly difficult when an agency is trying to integrate an APTS system with other regional agency systems that are proprietary (Proprietary System may not meet an interface standard such as Society of Automotive Engineers (SAE) J-1708).

Communications systems often have to be either upgraded or replaced to accommodate many APTS technologies, such as AVL. Communications system limitations will directly limit the capability of those technologies.

Following are other technical issues:

- Technical issues related to transit employees must be addressed very early in the development/design process. For example, drivers in one agency were allowed to turn down the volume of automated voice annunciators so far that customers could not hear. The agency had to place a limit on the lower end of the volume.
- Technical details, such as modeling certain transfer situations, must be handled accurately. For example, if the end of the route is not modeled properly, it can cause some itineraries to be sub-optimal. Similarly, it is difficult to provide automated real-time information without providing misinformation. For example, the system has to be sophisticated enough to account for layover time at the end of a route to put a late bus back on schedule.
- Systems that were originally created for single-purpose applications are difficult to integrate with one another.
- Applying new technology on top of an old system (e.g., ITS AVL on existing radio system) can be difficult.
- Maintaining a human-machine interface, that is, planning for personnel to screen information (since a complicated system cannot be completely automated) is very important.
- Writing specifications can be difficult considering that the J-1708 interface standard is becoming obsolete, especially since much of it rests on developments in the public sector and at the national level in terms of Transit Communications Interface Protocol (TCIP) specifications and development of open architecture.
- Customization of off-the-shelf components can be an issue.
- Agencies may want simple equipment, such as a Vehicle Logic Unit, but the industry only offers more advanced and costly models now. This may reduce the number of vehicles or facilities that can be outfitted.
- It may be difficult to implement a regional ATIS at a reasonable level of detail.
- Pilot tests are important, and system downtime should be limited for customers.

- The system should provide basic information early on, like route name, number and direction, and stop announcements.
- System components that are becoming obsolete, such as some GIS components, should be avoided.
- The GIS should be robust enough to handle processes, such as itinerary building.
- The underlying technologies, such as AVL, should be in place first, otherwise ATIS does not have a real-time basis.
- The ATIS should include multiple ways of trip planning, including intersections, addresses, and landmarks.
- Avoid proprietary systems.
- The number of types of data formats should be limited.

Organizational Issues

One of the most important organizational issues is obtaining "buy-in" from the key decision-makers in the agency that is considering any APTS technology. The buy-in can be facilitated by an honest cost-benefit analysis that is partially performed by each department involved in the project. The buy-in is critical to the success of deployment, and is instrumental in promoting departmental cooperation throughout the whole project, from planning through full deployment. It will also ensure that decisions are made jointly, by all involved. For example, through cooperation, the study team may find it easier to make a decision about who should be responsible for maintaining and updating the ATIS databases, hardware, and software.

Pursuant to one of the technical issues raised above about database maintenance, it is recommended that the maintenance and updating be done in-house to ensure quality. However, this is often difficult for small and rural agencies since they may not have the internal resources to support such an effort. One agency suggested that besides a lack of internal resources, other issues regarding in-house responsibility for a technology project include aversion to taking risks, lack of staff training, limited procurement processes, and unresponsive public processes.

Following are other organizational issues:

- The agency should look ahead in the deployment process by planning and budgeting for future system expansion and/or enhancements.
- A needs assessment should be included early in the deployment process to clearly identify needs of both the agency and its customers (and potential customers) in terms of the system(s) being developed.
- A key decision should be made in the agency to determine the right level of automation – that is, in what cases do staff still need to interpret real-time information?
- Staff turnover must be considered as APTS systems are deployed. In other words, reliance on a single individual for certain aspects of system operation should be avoided.
- Agencies may want to explore revenue opportunities from an ATIS, such as those available through the kiosks, including advertising, franchising, fee for itineraries, etc.
- Agency staff and project partners should be educated on the available technologies.
- On-going operations and maintenance should not be overlooked during the consideration, development, and deployment of an ATIS.

Institutional Issues

Perhaps the most important institutional issue raised was that some local governmental agencies, such as county commissions, question the need for advanced technology in a rural area. In other words, agencies should be prepared to address these concerns.

Another issue mentioned by several agencies was the challenge in working with other local or regional agencies. In one case, a transit agency had to work with the city on the traffic signal priority project and indicated that it was difficult. In another case, the transit agency had problems working with the county. Another agency warned of "turf" issues in pursuing the deployment and operation of an ATIS.

Following are various other institutional issues:

- Establishing public/private partnerships can facilitate project success and ensure adequate funding.
- If the consultant to assist the agency with APTS deployment is provided by another agency, it may be difficult to ensure the consultant is capable of performing the work.
- Institutional policies on information distribution should be considered.
- An agency may find it difficult for consultants to share information on a project, especially technical information, when they have competing interests.

Procurement Issues

The primary procurement issue is the need to use functional or performance specifications for procurement rather than technical specifications. Among other issues, technical specifications can be limiting in terms of using the latest available technology. It is a common practice for agencies to examine specifications from other agencies in order to assist in the specification development process. One agency suggested that specifications from other agencies should not be used because each system is unique and it could lead to a technically obsolete system. This is not a majority opinion.

Another major issue is related to source code access and ownership, data rights, and other intellectual property rights. Considering this is a very important issue before the vendor's contract is developed and negotiated. If ownership of the software and source code is not made clear enough during the contracting process, the agency may have to negotiate later with the vendor to obtain license and source code access, and may have to deal with disclosure agreements.

Yet another procurement issue concerns traditional procurement processes. These processes do not always accommodate a procurement of this type. Many agencies expressed concerns that their procurement processes make it difficult to deal with rapidly changing technology. Other agencies mentioned that their procurement processes were slow.

Other procurement recommendations concerned vendor selection. One agency suggested that caution should be exercised in vendor selection. The agency should make sure that the vendor has completed similar projects of similar scope on-time, within budget, and without change orders. Another agency said that it is difficult to determine the technical competence of the vendor in the procurement process. Yet another agency indicated that vendors can respond with a wide range of capabilities even if they do not have the appropriate expertise. Ensuring that technology in vendor bids is not heading toward obsolescence and balancing this

against low bid requirements was also mentioned as an issue.

MARKETING ISSUES

Marketing issues mostly concerned the need to provide the community with education on a variety of subjects related to the deployment of an ATIS. One recommendation was to provide community education about the planning and development process for APTS systems. Another respondent mentioned the importance of educating customers on how to use media, such as kiosks. Another discussed the importance of informing the public about what information is being provided through the ATIS – either static or real-time. If travelers think that the information is real-time when it is actually static, travelers may become disgruntled and, ultimately, decide not to ride transit.

Following are other marketing-related issues:

- Customer service surveys and focus group results should be incorporated into the planning process. Customer attrition should be quantified and estimates should be made of how ATIS can help stem that attrition.
- Kiosks should be focused on a targeted audience.
- Marketing to the private sector either for advertising and franchising or to provide other media for the information should be considered.
- The World Wide Web (WWW) might be a solution for ATIS, but it is unclear if computer users are really the target population for transit information.

FINANCIAL ISSUES

Financial issues are the most crucial issues in the consideration of ATIS systems. Agencies not only pursue Federal funding, but also State, regional, and local funding. Many agencies also pursue private contributions, through public/private partnerships. It may only be possible to secure funding for a demonstration, rather than full deployment. Besides funding, policy and/or regulatory issues can limit an agency's ability to deploy an ATIS. Also, matching budgets to technology to prevent obsolescence is very difficult. Funding should also be obtained for marketing and education

Performing cost/benefit analyses, including return-on-investment calculations, should be used to justify projects. However, this analysis is often difficult, since it is difficult to obtain sound costs and estimate potential benefits. There is great sensitivity to the cost of APTS technologies, particularly since costs may seem high to the uneducated who may not understand that APTS systems often involve multiple technologies. For example, one agency that is installing multiple technologies for an AVL system said that outside individuals thought that AVL only involved a new radio.

APPLICATIONS OF APTS TECHNOLOGIES TO FINANCIAL ACCOUNTABILITY AND DATA VERIFICATION ISSUES

The project team analyzed potential applications for APTS technologies to address financial accountability and data verification issues. This section discusses potential applications of emerging technology in addressing these issues.

Table 9 shows the current level of automation of various states and their rural transit operators. The figure indicates that, in 1997, there is still much progress to be made in automating the accounting and data verification practices of rural public transit

operations. Paper formats for reporting are still in widespread use. The most widespread use of technology at this time is computerization at the State DOT level. Forms-based and data-based software programs are beginning to be implemented, but are far from universally employed at rural transit operations. Electronic data transfer, a key component of the evaluation and monitoring practices of the future, is hardly in use at all, even by States whose DOTs have home pages on the Internet.

In reviewing how rural systems operate, financial accountability and data verification issues would appear to be a most fruitful area in which technological applications would make life easier and more productive for the operators of rural public transit systems.

As of 1997, most of the technological promises regarding financial accountability and data verification issues have yet to be fulfilled. Some progress is being made, and it is likely that the next few years could witness many more applications of advanced technologies for rural public transit systems interested in accounting and data verification.

What makes this area of technology particularly promising for rural transit applications is its relatively low cost and relative ease of implementation when compared with some of the other APTS technologies. All but the smallest of rural systems have the potential to implement and benefit from these particular applications. Reporting to a large number of funding sources is often one of the requirements of rural public transportation. Computerized programs make this accounting easier and more accurate.

Table 9. List of Progress Toward Computerized Accounting and Data Verification Systems

State	Computers at All Rural Operators	Computers at State DOT	Bulletin Board Data Exchange	Internet Data Exchange	Electronic Mail Communication	State Hosted Internet Home Page	DOT Internet Home Page	Forms-based Software	Data-based Software	Paper Forms Required
AZ	Yes	Yes	Yes	No	No	Yes	No	Yes	No	Yes
IN	No	Yes	No	No	No	Yes	No	Yes	No	Yes
MS	Yes	Yes	No	No	No	Yes	Yes	Yes	At State	Yes
NC	In Process	Yes	No	No	No	Yes	No	At Rural Sites	At State	Yes
NM	Yes	Yes	No	In Process	In Process	Yes	Yes	At Rural Sites	At State	No
NY	In Process	Yes	No	In Process	In Process	Yes	Yes	No	In Process	Yes
OH	Yes	Yes	Yes	No	No	Yes	No	No	Yes, both rural sites and state	Yes
OK	Yes	Yes	No	No	No	Yes	No	No	Yes, both rural sites and state	No
WV	No	In Process	No	No	No	Yes	No	Yes	No	Yes

Following is a summary of the findings of a variety of searches for applications of computerized accounting and data verification packages by rural transit operators. Local transit operators, State DOTs, national programs and associations, experts in the field, and vendors of technologies were contacted for information.

ACCOUNTING AND BOOKKEEPING

Rural public transit operations typically require substantial amounts of government funding to cover their operational and capital expenses. Federal funds from the Federal Transit Administration's Non-urbanized Area Formula Grant Program provide a core of support. They are apportioned to the States on the basis of the ratio of the non-urbanized population of each State to the non-urbanized population of all the States. State and local governments are also key sources of support for rural public transit operations. Therefore, a key responsibility for these rural transit operators is to account for the ways in which they have spent public funds.

Many rural public transit operations transport clients of public, non-profit, or private agencies, often under specific contractual arrangements. Each of these agencies will need some assurance that the transit system has in fact carried their clients to the required destinations when they said they would and expended funds on their behalf as specified in the contract.

While FTA does not have specific requirements for the precise forms of accounting required for rural transit operators, states and localities often have very distinct notions of the kinds of data to be collected and the forms in which they are to be presented. There have been several notable attempts to standardize reporting. While there seems to be some movement in the direction of more uniform reporting standards and requirements, there are still many different reporting procedures and formats in use in 1997 by rural public transit systems.

The best financial reporting systems will be closely tied with performance reporting systems so that their combined usage will enable transit system managers to make informed choices for the purpose of improving the cost-effectiveness of their operations. A comprehensive financial management accounting system will include at least the following components:

- Financial planning
- Cash management
- Monitoring and analysis

DATA VERIFICATION

Data verification is necessary at several levels to determine that the reports that are submitted accurately reflect actual patterns of expenditure and performance. Information needed for rural transit operations to be able to provide complete financial and performance reporting comes from a variety of sources: In most systems, drivers, dispatchers, supervisors, maintenance personnel, bookkeepers, passengers, and managers all have important data to contribute. Many data components need verification, including mileage, hours, numbers of passengers, types of trips, expenses, fares and other revenues collected, and other information.

Verification for many of these individual data items can begin by cross-checking the data for internal consistency, such as by constructing ratios among the various inputs. Besides the process of reasonableness checks, transit

systems will want to conduct their own internal reporting consistency checks.

Some of these review procedures should occur at the State level, probably within the DOT. DOT personnel should be sufficiently knowledgeable to spot "unusual" performance trends or reports, based either on tracking one system's reports over time or by comparing one system's reports with those of its peers. Performance that is substandard or dramatically changing should be a sign that someone needs to determine what is happening at that transit system. Used in this fashion, financial and performance reports can be useful tools in determining which transit systems need advice and technical assistance.

Current Efforts By State Departments Of Transportation

State DOTs collect financial and operating information from their local rural transit systems to monitor and verify the expenditure of public funds. This information is normally collected each month or each quarter. The standard operating procedure at this time is for the State to distribute report forms to each transit agency, which are then completed and mailed to the State DOT. A number of States compile the monthly or quarterly reports into annual reports.

The collection of data and preparation of reports is an arduous and time-consuming process, both for the individual transit agencies and for the State DOT. Certainly, an automated reporting process could save many hours and dollars each year, as well as providing a more accurate reporting procedure. In order to assess the possibilities of automating the accounting process for transit systems and State DOTs, it is first necessary to assess the current level of automation at the state level. The following is a brief sample of reporting processes in place in selected states.

Arizona. The Arizona DOT has installed an electronic bulletin board system (BBS), employing a 386-based computer as the host machine, running the standard Wildcat BBS software. Each of the State's seven agencies dials directly into the State DOT's host computer each month and enters their operating data into an on-line form. A monthly report is automatically generated for each agency. The transit agencies are also required to mail a paper report each month.

Indiana. The State of Indiana provides "boilerplate" forms to its 40 transit agencies each quarter, collecting data on each vehicle for hours, miles, passenger trips, fares collected, fuel-usage, and maintenance costs. The forms are then collected by the State, and entered into an Excel spreadsheet. This spreadsheet then becomes the database for the State's Annual Report. Currently, five of Indiana's 40 systems are entering the information electronically, scanning the boilerplate form into an application, and typing in the data. The form is then printed on paper and sent to the State.

Mississippi. The State of Mississippi is one of only two State agencies surveyed that provides an internally developed accounting and reporting program to its transit operators. Each month, when the 16 transit contractors with MDOT submit requests for payment, they must submit a progress report to the State. For administrative purposes, the State of Mississippi keeps track of the miles, hours, and trips logged by each vehicle at each of their 16 transit contractors. Each day, transit staff at each agency record the miles, hours, and trips logged by each vehicle. At the end of each month, the daily vehicle information is summarized and entered into a two-part computerized reporting form provided by the

Mississippi DOT. The first part deals with fleet operations costs, and summarizes the hours, miles, and trips provided by each vehicle. The second part of the form summarizes the trip purposes, revenues generated, and the funding source for the trip. The form is then sent to the State on diskette, where it is automatically entered into a stateside database. The program computes the performance measures, such as cost per mile and cost per trip, which can then be monitored by State officials.

NEW MEXICO. New Mexico is currently in the process of automating its accounting and reporting system. Currently, it provides electronic forms to transit agencies and receives reports on floppy disk via mail. The State is installing a distributed Windows for Workgroups network that will allow all of the State's 13 transit providers to communicate and exchange data via the Internet. This will allow the systems to share files and information directly with the State offices. Vehicle maintenance records, vehicle inventories, and quarterly and annual reports will be standardized for all systems. The State will also install a Teamlinks e-mail access program, which will simplify and expedite the dissemination of information from the State offices.

NEW YORK. The New York State DOT (NYSDOT) is in the process of developing an automated reporting and accounting system that will cover all 54 rural systems within the State. NYSDOT plans to provide an Internet connection for every rural system within the State. The completed e-mail system will be used for distributing Rural Transit Assistance Program (RTAP) information and receiving operating information. New York DOT chose the Internet-based e-mail system over a BBS system for several reasons. They felt that, in addition to serving the State DOT's purposes, the Internet connections would prove useful to their transit systems as a research tool and as a source of information. The Internet-based system was also thought to be more adaptive to future needs.

NORTH CAROLINA. The North Carolina DOT (NCDOT) requires each of its 99 transit systems to provide reports twice annually, one covering the first six months of the fiscal year and one covering the entire fiscal year. NCDOT provides paper report forms to the transit systems, filled out with the data from the prior year's equivalent report period. As the new data is entered, percentage changes are calculated. Changes from the previous year's report of 10 percent or greater require written explanations to the State. As the State receives the reports, the data is entered into a Microsoft Excel spreadsheet for the urban and regional systems and Microsoft Access for the rural and human service agency systems. State officials expressed interest in fully automating the accounting process, but with certain reservations. The system would have to be flexible enough to accommodate large urban systems with fleets of more than 130 vehicles while remaining cost-effective for small rural systems with only a few vans. The system would also need to be simple and intuitive, as providing training for the staff members at numerous transit systems could become prohibitively expensive.

OHIO. The State of Ohio's DOT (ODOT) requires quarterly invoices from each of its 32 rural transit systems. These invoices are entered into computers at the local agencies using ODOT's computerized Grants Management Accounting System (GMAS) and then transmitted to the State DOT via a dedicated modem. The automation process began three years ago with the purchase of the ACCPAC software, computers, and modems for the rural agencies. The software was chosen for its simplicity and because it did not require a dedicated ODOT employee for

technical support. ODOT is planning to complete e-mail installations for all the rural systems within the next year. Within the next two years, it will begin a full computer hardware upgrade in combination with a software upgrade.

OKLAHOMA. The Oklahoma DOT (ODOT) employs in-house developed software programs for collecting information from local transit agencies. ODOT has been working for the past 10 years with Oklahoma State University in developing the MYLE (Making Your Life Easier) computer program, which is in use at all 16 systems statewide. The program inputs trips, miles, hours, and costs, and generates the monthly bills to ODOT. Monthly reports are generated automatically by the MYLE program, and sent to ODOT on floppy disk. The data on the diskette are imported directly into a Visual D-Base program that automatically generates performance measures for comparison and processes claims. ODOT does use an electronic mail system for filing reports and claims. Its accounting department requires a hard copy of the standard claim form.

WEST VIRGINIA. The West Virginia DOT sends out a two-page form to each of its eight transit agencies each month. The rural transit systems then type their operating information (trips, miles, hours, costs) into the form, which is then mailed to the State DOT. The State DOT is hoping to implement an automated system in the near future. The West Virginia State DOT accounting department requires hard copies of all reports, so there would have to be a provision made to accommodate this requirement to make it possible to file reports electronically. Currently, the West Virginia DOT is exploring several options. Its primary interest in developing an automated system is to eliminate the monotonous task of entering the data from the monthly reports and to streamline the processes of verification and payment.

THE PROBLEM OF AUTOMATING RURAL TRANSIT SYSTEMS – WHERE TO START?

When looking at the prospect of applying technology to rural transit operations, contemplating the scope of the available technology can be daunting to transit operations that are not yet automated. Although the diverse technologies described above are indeed available, it is useful to begin the automation process at the "lowest common denominator" of options. For rural transportation operations, this is the purchase of proper hardware and the use of management software to enable financial planning, cash management, and financial and performance monitoring and analysis.

The declining prices of computer hardware make the purchase of a powerful computer possible. The computer that provides the required functionality today is a Windows 3.11 or Windows 95 compatible system, with an Intel Pentium microprocessor, at least eight megabytes of random access memory (RAM), a minimum of one gigabyte of hard disk storage, a VGA monitor, a CD-ROM drive, a floppy disk drive, and a high-speed internal modem.

Many computers today come equipped with a standard set of business software. These generally include a word processing program, a graphics program, and a spreadsheet program. Most Internet access companies will provide an Internet program free of charge. These programs will allow a transit operation to get up and running on the computer while the selection of proper management software is in progress.

Management software consists of any software application, either commercial or custom

written, that enables tracking and evaluating performance over time. By doing so, informed management decisions leading to greater productivity and cost-effectiveness are made possible. Financial management software automates both the budgeting process and the tracking of revenues and expenses. Management software provides the necessary tools for transit operators to internally monitor and evaluate their programs and report on their operations and expenditures to their local and State governments.

Communications technology ranges from personal computers equipped with modems that communicate data to one another over a telephone line, to wide area networks enabling many systems to be on-line in real time, to electronic data interchange over the Internet. Communications software can be part of the management software application, and thus enable operators to electronically file performance and financial reports. Electronic data interchange (EDI) is an important business methodology enabling computer-to-computer exchange of business transactions in electronic format. EDI information is generally structured so that both the sending and receiving computer can understand and act with little or no human intervention.

Although there are no commercially available software applications specifically for rural transportation operations, accounting software packages designed for small and medium-sized businesses offer a potential model of what is possible in terms of accounting and data verification for rural public transit operators. These applications allow users to maintain a general ledger and process transactions and reports while maintaining an audit trail. Although these programs vary widely in capabilities, they all provide the following functions necessary in any accounting system: general ledger, accounts receivable and payable, inventory, and payroll. A well-designed and easy-to-use interface incorporating on-line help is a necessary component of commercial software. In addition, these applications offer the user the ability to customize features and tailor reports. Most programs also offer user-defined fields for items that don't fit the standard transaction format.

Software Applications

It cannot be stressed too strongly that a successful software application must be designed to both take advantage of technological methodologies available and to make computer operations, including data input, as simple to use as possible. Good software design follows the optimal flow of the actual work process, rather than altering the work process to conform to arbitrary rules of software design. In most current programs, graphical interfaces based on a Windows-type environment are standard. Menus available to the operators for all task selections should be easily understandable. Toolbars and command features should be simple and consistent. On-line help should be available with the same keystroke throughout the application. Hard-copy forms and computer forms should be designed for consistency and easy input of information. The most technically sophisticated application available will not be used correctly if it is overly complicated or jargonized. This kind of flexible program design and concern for those maintaining key data results in making the application more "user friendly," less sensitive to either user or data errors, and maximizes the productive time spent at a computer.

The guidelines for successful software applications include:

Data-based, not forms-based software. Many States use electronic forms software, not database software. In forms software, data

exist only as typed numbers and cannot be manipulated electronically. This format precludes the analysis of data electronically. In data-based software, the information is dynamic and can be combined and calculated electronically in many ways, allowing for statistical analysis and aggregation or disaggregation.

A consistent interface. This includes the use of consistent menus, tool bars, and navigation keys.

Data validation. Data validation matters considerably to applications developers and software users. A date field is an example of an item that requires validation. Data integrity may require you to restrict the field to "no later than today" or "no earlier than six years ago." Another common example is a zip code field. Instead of letting the user type in any five (or 10) character zip code, a well-programmed database uses validation to immediately match any zip code input against a stored table, and immediately reject any invalid entries. When such validation is available, it simplifies the use of a database application.

Ability to query records. At a minimum, the user should have a query by example screen enabling him or her to find a record by typing values into a data-entry screen.

A helpful help system. Context-sensitive help, where the help content is linked to the operation the user is performing, is a real plus.

Calculations performed by the application, not the user. All mathematical, financial, and statistical calculations should be performed by the computer, rather than the user. Indeed, calculations performed by the computer should be used for audit-tracking and verification purposes.

Ability to maintain code databases. Most database programs use codes. In rural transit, codes could be used to indicate types of routes. Instead of these route types being written into a software program, users should have the ability to maintain their own code tables, and thus be able to add or delete codes as their operation requires.

Ability to define "rules." Users need to be able to define conditions that, if met, trigger a message or error condition in the software.

Standardized chart of accounts for rural transit. Using the standardized chart of financial accounts recommended for public transportation providers by the Transportation Accounting Consortium would maintain standard account titles and definitions across the industry. This would allow providers to share problems, solutions, and experiences with much more benefit. It would also allow industry averages to be calculated so that providers can compare their operation with historical records. If all providers use the same accounts, then the various funding agencies can design their reports to conform to the accounts being used.

Internet access. An Internet account is strongly recommended. Bulletin boards operated by Federal agencies have been replaced by the overwhelming use of "home pages" on the Internet. Bulletin boards operated by State governments are likely to become obsolete in the near feature. Internet accounts also enable access both to electronic mail and the great range of resources available on the Internet.

SUMMARY

The adoption of computerized accounting and data verification software for rural public transit operations would appear to be a sure bet in the very near future. On the basis of

contacts with rural transit operators, the rural transportation functions most often computerized to date have been those involving scheduling and dispatching rides, and it would appear that at least some operators are ready for another advanced technology, that of accounting for their expenditures and performance.

Computer-aided accounting programs are particularly applicable to reporting to the multiple funding sources that are often stitched together by entrepreneurial operators to obtain sufficient funds to make the entire operation viable. Possibilities for intelligent transit management at both the State and local levels will be greatly enhanced by software that can describe current performance in depth and compare it with previous operations of the same system and current operations of other systems. With this added level of detail, system managers can make better operational decisions, and State program managers can better decide how to distribute their funds and technical assistance.

CHAPTER 5: ACTION CONCEPT DEVELOPMENT

This chapter presents the development of nine rural APTS action concepts identified in response to the needs and issues identified in the previous chapters. A plan for implementing each action is presented in Chapter 6.

BACKGROUND

U.S. DOT developed a Strategic Plan for the Rural ITS Program. The Strategic Plan focuses on the Federal government's role in three specific areas:

- **Development.** Conduct research, operational testing and evaluation where necessary.
- **Deployment.** Promote applications through demonstrations and deployment incentives of cost-effective technologies ready for implementation.
- **Delivery.** Facilitate training, outreach, and technical assistance to transportation providers that are planning or implementing ITS technologies.

U.S. DOT has prepared a Rural ITS Program Plan, which sets the strategic priorities and lays out the future program projects. As part of the overall Rural ITS Program, efforts are being made to stimulate the application of ITS in achieving goals and objectives associated with rural transit.

ACTION CONCEPTS

Effective application of ITS for rural transit must be identified with an understanding of the transit rider needs, how rural transit operates, the constituencies these systems tend to serve, the resource limitations, and other characteristics unique to the industry. Preceding chapters of this report provided information on the needs of rural transit users and operators, identified key characteristics of rural transit systems, and described institutional and technical issues associated with these systems. In essence, previous chapters laid the groundwork for identification of several ITS concepts for application in rural transit.

The *Rural Public Transportation Technologies: User Needs and Applications* study identified a variety of needs requiring a range of potential actions for ITS applications in rural areas. In this chapter, nine action concepts are recommended to address rural transit needs. These action concepts were identified to be compatible with the three areas of the Rural ITS program as follows:

DEVELOPMENT

- **Shared Technology Infrastructure Operational Test.** This action involves identifying a number of agencies that would be interested in sharing the cost and use of advanced technologies, e.g., joint dispatching system, within their region, and conducting a field operational test.
- **Automated Trip Status Information Operational Test**. This operational test is oriented around evaluating various affordable systems for notifying riders of the status of their eventual pickup time.
- **Trip Verification and Billing Operational Test**. This operational test seeks to evaluate the application/integration of various automated accounting systems to verify trip eligibility and improve current billing operations.

- **Fleet Management Operational Test**. This operational test is oriented on optimizing the available vehicles and personnel for existing rural transit services through the application of various automated vehicle location (AVL) systems.
- **Broader Market Research Study**. This research study will help provide better information on non-riders, public agencies, and welfare reform regarding rural APTS needs and opportunities.

DEPLOYMENT

- **Demonstration of Low-Cost Technologies (Simple Solutions).** This action would involve identifying a number of low-cost technologies that could be used in providing simple solutions to specific rural transit problems (e.g., bus arrival notification system) and conducting field tests and evaluation of these technologies.

DELIVERY

- **Rural Transit Operator Information Kit**. This Information Kit is intended as a collection of materials that can provide information to rural operators regarding the nature of APTS and how to determine whether these systems are applicable to their situation.
- **Rural APTS Success Story Booklet**. This booklet will provide a series of case studies from rural systems (and possibly other small to mid-sized systems) that demonstrate how APTS has been successfully implemented and may be applicable to other rural transit services.
- **Training Materials for Rural APTS Application**. This action involves the development of a Rural Transit Short Course or Rural Transit Module for inclusion within selected existing training programs, particularly the ITS Professional Capacity Building (PCB) Program.

As mentioned earlier, these concepts have been developed in response to the rural transit needs and issues identified in previous chapters. Table 10 shows the needs and issues addressed by each concept.

All nine action concepts are recommended for further consideration.

The next chapter describes the above concepts in more detail so as to begin the development and eventual implementation of such products in the future.

Table 10. The Relationship Between User Needs/Issues and Candidate Action Concepts

User Needs/Issues		DEVELOPMENT					DEPLOYMENT	DELIVERY		
	Candidate Action Concepts	Shared Technology Infrastructure Operational Test	Automated Trip Status Information Operational Test	Trip Verification and Billing Operational Test	Fleet Management Operational Test	Broader Market Research Study	Demonstration of Low-Cost Technologies	Rural Transit Operator Information Kit	Rural APTS Success Story Booklet	Training Materials for Rural APTS Applications
OPERATORS	Information on Partnering Opportunities	✔				✔		✔	✔	✔
	Assistance in Quantifying Benefits	✔	✔	✔	✔		✔	✔	✔	✔
	Threshold Levels for Technology Application	✔	✔	✔	✔	✔	✔	✔	✔	
	Improved Vehicle Utilization	✔	✔	✔	✔				✔	
	Information on Technology Applications	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Information on Institutional and Procurement Issues					✔		✔	✔	✔
	Targeted Training							✔	✔	✔
	Improved Service Quality	✔	✔	✔	✔		✔		✔	
	Improved Operating Efficiency	✔	✔	✔	✔		✔		✔	
	Improved Billing and Accounting	✔	✔	✔					✔	✔
RIDERS	Bus Schedules, Service Area, and Routes		✔		✔		✔		✔	
	Eligibility for Services	✔		✔			✔			
	Fare Information			✔	✔					
	Improved Service Quality	✔	✔	✔	✔		✔			
STATE DOTs & LOCAL DECISION-MAKERS	Information on Partnering Opportunities	✔				✔		✔	✔	✔
	Assistance in Quantifying Benefits	✔	✔	✔	✔		✔	✔	✔	✔
	Threshold Levels for Technology Application	✔	✔	✔	✔	✔		✔	✔	
	Information on Technology Applications	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Information on Institutional and Procurement Issues					✔		✔	✔	✔
	Improved Service Coordination	✔	✔	✔	✔				✔	
HUMAN SERVICE AGENCIES	Information on Partnering Opportunities	✔				✔		✔	✔	✔
	Improved Vehicle Utilization	✔	✔	✔	✔				✔	
	Eligibility for Services	✔		✔			✔			
	Improved Billing and Accounting	✔	✔	✔	✔				✔	✔

CHAPTER 6: ACTION CONCEPT DESCRIPTION AND IMPLEMENTATION PLAN

This chapter provides a detailed description of each of the nine recommended action concepts and presents a work plan for implementing each action. Specifically, for each of the recommended concepts the following items are discussed:

- **Problem Statement**. This section identifies and illustrates the particular needs and opportunities that exist in rural settings for each identified action.
- **Concept Description**. Within this section, each concept is described in detail. In addition, other related efforts will be identified and useful characteristics directly related to each concept will be highlighted.
- **Required Work Activities**. This section identifies the required work activities needed to support the development of each action. This information is presented through a series of functional requirements and covers how pertinent information for inclusion will be obtained, analyzed, and presented.
- **Work Plan**. Within this section, a list of suggested tasks required for each concept is provided. The work plan also provides a task schedule or duration in months, preliminary cost estimate, and suggested time frame for implementing the action concept.

SHARED TECHNOLOGY INFRASTRUCTURE OPERATIONAL TEST

This section presents the proposed plan for a Shared Technology Infrastructure Operational Test in a rural or small urban setting.

PROBLEM STATEMENT

This field operational test involves identifying a number of agencies that would be interested in conducting an operational test that promotes the sharing of technology infrastructure within their region. Primary reasons why an operational test of this nature would be valuable to rural transit operators/services include the following:

- Resource-constrained rural transit agencies can partner with other agencies (both transit and non-transit agencies) to make the application of APTS more realistic.
- Actual costs, operating requirements, and benefits of shared technology can be documented.
- Resources are not readily available to implement advanced APTS technologies, which are often perceived as costly.

Potential benefits include:

- Operating efficiencies for all involved agencies.
- Better customer service and better on-time service.
- Decrease in operating and maintenance costs.
- Additional transportation services to meet demand created by welfare reform.

CONCEPT DESCRIPTION

One potentially viable option to resource-constrained rural transit agencies is to partner with other agencies (both transit and non-transit agencies) to make the application of APTS more realistic. Sharing in the procurement and use of technology infrastructure can reduce the costs for each participating agency. This approach will require the support of elected officials and agency policy boards.

One area where shared technology seems practical is that of joint dispatching system and operations. An operational test of an intermodal, joint dispatching system is needed to determine how it can work and whether it is beneficial to rural transit agencies. The field test should involve at least two fleet operators and be conducted on the entire fleet of each participating agency. The shared technology for joint dispatching would include AVL and CAD.

JOINT DISPATCHING APPROACH

The first step in developing a joint dispatching operational test is to identify agencies interested in participating. At this time, the possible candidates are:

- Rural transit operator.
- State DOTs (primarily maintenance vehicles).
- Emergency Medical Services (EMS).
- Police departments (e.g., State, county, city, local).
- Fire departments (e.g., city, local).
- Metropolitan transit authority, if one is located nearby.

The idea of joint dispatching operations can be a sensitive issue. However, the desire would be to promote joint dispatching operations that minimize interference with the "normal" operations of the involved agencies and eliminate concerns regarding security. Several options may be considered as follows:

- **Joint Dispatching with Shared Vehicle Operation**. The most comprehensive option would involve joint dispatching and shared use of vehicles for two or more transportation agencies/operators. In this option, dispatching responsibility would be allocated to an operations coordinator and vehicles would be available for multiple use. One operations coordinator would have the responsibility to dispatch for two or more agencies/systems. Vehicles from each agency/system would be used to satisfy a ride request from another agency.
- **Joint Dispatching with Separate Vehicle Operations**. Under this option, the dispatching function would be consolidated but vehicle operation and use would remain separate. The central dispatcher would use advanced technology to efficiently dispatch vehicles for two or more agencies/operators. However the use of the vehicle would not be shared for riders from more than one agency/system.
- **Shared Vehicle Location Technology but Separate Dispatching**. Another option would involve only the sharing of vehicle location technology, with the involved agencies still retaining control over their own dispatching functions. For example, if the State DOT had already implemented a system for monitoring its maintenance vehicles through the application of a Global Positioning System (GPS), then it seems like a good idea to also install the same type of GPS units on the demand-responsive transit vehicles. In this manner, the same type of GPS units, communications, and workstations (for control, monitoring, and display) can be

used by all. This situation has the potential for just adding an incremental cost adjustment to the price tag of also equipping rural transit, thereby making this option more affordable.

It is not expected that the joint dispatching operational test would be primarily directed toward trying to create all of the possible institutional arrangements. However, availability of APTS could potentially result in some consolidation of service when implemented in actual systems. It is recommended that FHWA/FTA determine the level of interest in this activity by distributing a formal "Solicitation of Interest" among rural transit operators, State DOTs, and other similar parties. From this solicitation process, a joint dispatching operational test can be identified in order to verify the feasibility, effectiveness, and impact of the selected option.

Joint Dispatching Potential Benefits

As shown in Table 11, rural transit operators, other fleet operators, and transit users will likely receive several benefits from the implementation of a shared dispatching system.

Table 11. Potential Benefits of Joint Dispatching System

Benefits to Transit Users	Benefits to Transit and Other Fleet Operators
▪ Improved reliability ▪ Improved safety ▪ Reduced travel time ▪ Additional resources to rely on ▪ Fewer trip restrictions	▪ Reduced costs ▪ Availability of additional resources ▪ Improved safety ▪ Improvement in management capability ▪ Improved understanding of the factors involved in making a joint dispatching/vehicle location system work in the field ▪ Improved/consolidated services ▪ Internal/external agency operating efficiencies ▪ Potential for actual cost savings ▪ Stimulation and refinement of ideas on joint dispatching options that can be tailored to the rural operator's available resources ▪ Better understanding of how joint dispatching can work successfully and how rural or perceived barriers can be overcome or eliminated ▪ Potential expanded applicability of APTS through appropriate partnering

WORK PLAN

This section presents a recommended work plan for a joint dispatching operational test. It present a series of short-, mid-, and long-term actions required for design, development, and evaluation.

SUGGESTED TASKS, DURATION, AND ESTIMATED COST

The development of a Federally sponsored field test of a complete and operational joint dispatching system will require a variety of public agency and private sector interests in order to complete. These groups will need to work together in order to develop functional and performance requirements, a detailed system design, a prototype system, and a fully operational joint dispatching system. In addition, these groups will be responsible for securing the funding necessary to complement the FHWA/FTA's investment to undertake this venture, developing a detailed and comprehensive evaluation plan, and for preparing a final report that will provide insight into the project's experiences as well as provide valuable lessons learned.

Table 12 shows the likely tasks, schedule, and cost estimates for this Operational Test if the FHWA/FTA were to sponsor a regional test.

Table 12. Joint Dispatching Operational Test: Proposed Tasks, Schedule, and Cost Estimate

TASKS	DURATION	COST
Phase I (Near-Term)		
Task 1 – Solicit Ideas and Sites	3 months	$10,000
Task 2 – Assemble Study Team	1 month	$15,000
Task 3 – Finalize Joint Dispatching Approach	2 months	$5,000
Task 4 – Define Test Area, Concept Plan, and Financial Plan	2 months	$10,000
Task 5 – Define/Assign Participant Responsibilities	1 month	$10,000
Task 6 – Secure Participation of Stakeholders (Funding)	2 months	$15,000
Task 7 – Develop Project Schedule and Deliverable Dates	1 month	$5,000
Task 8 – Develop Detailed Evaluation Plan	2 months	$20,000
Phase II (Short-Term)		
Task 9 – Develop Detailed Functional Requirements and Preliminary System Design	3 months	$30,000
Task 10 – Review and Refine System Design	1 month	$10,000
Task 11 – System Prototype Development and Installation	4 months	$100,000
Task 12 – System Acceptance Testing of Prototype	2 months	$25,000
Task 13 – Refine System Design and Revise Prototype (if necessary)	2 months	$40,000
Task 14 – Prepare User Documentation, Training Requirement, and Operating Requirement	3 months	$35,000

Table 12. Joint Dispatching Operational Test: Proposed Tasks, Schedule, and Cost Estimate (Continued)

TASKS	DURATION	COST
Phase III (Mid-Term)		
Task 15 – Agency-Wide Implementation and Evaluation	12 months	$500,000
Task 16 – Refine System Design and Revise System (if necessary)	3 months	$40,000
Task 17 – Develop Evaluation Report and Lessons Learned	4 months	$30,000
TOTAL	**40 Months**	**$800,000**

The estimated costs are based on the following assumptions:

- Combined fleet of 50 vehicles (all agencies)
- AVL technology
- One Computer-Aided Dispatching System

TIME FRAME

Medium term (3 to 5 years)

AUTOMATED TRIP STATUS OPERATIONAL TEST

This section presents the proposed action plan for an Automated Trip Status Operational Test.

PROBLEM STATEMENT

This operational test is oriented around evaluating various affordable systems for notifying riders of the status of their eventual pickup time. Primary reasons why an operational test of this nature would be valuable to rural transit operators/services include:

- Resource-constrained rural transit agencies could implement potentially low-cost gsystem(s).
- System(s) selected could be used at both the origin (e.g., telephone call, Internet access) or destination end (e.g., alpha-numeric pager displays, kiosks).
- Potential benefits include:
  - Internal operating efficiencies.
  - Better customer service and, hence, increased ridership.
  - Decreased operating and maintenance costs.

CONCEPT DESCRIPTION

This section presents a detailed description of the development of an Automated Trip Status Information Operational Test.

AUTOMATED TRIP STATUS APPROACH

This operational test is oriented around affordable systems for notifying riders of the status of their pickup time. This test would be focused on rural transit demand-responsive service. It is felt that the development of a central database system to maintain a record of vehicle locations and estimated time of arrivals (ETAs) at each pickup point would greatly facilitate this effort. At this time, the

following options appear as likely candidates for further investigation:

- **Trip Origin.** In this option, automated trip status information would be provided at the potential rider's origin end. For example, in order to reach as many riders as possible, it is felt that a telephone and/or Internet access system into the central database would allow potential riders to identify appropriate trip status information.
- **Destination End.** This option would involve the development of alpha-numeric pager displays and/or kiosks located at places frequented by transit riders (e.g., medical facilities, shopping centers). In this manner, potential riders could also gain access into the central database system.

In rural areas, most riders tend to be on the lower end of the economic spectrum. Therefore, it is important that this operational test involve low-cost technologies (to the greatest extent possible), thereby making it accessible/available to as many users as possible.

It is recommended that FHWA/FTA determine the level of interest in this activity by distributing a formal "Solicitation of Interest" among rural transit operators, State DOTs, and other similar parties. From this solicitation process, an Automated Trip Status Operational Test can be identified in order to verify the feasibility, effectiveness, and impact of the selected option.

Automated Trip Status Potential Benefits

Through the identification, selection, and testing of the identified Automated Trip Status Operational Test, it is anticipated that rural transit operators and transit customers will receive the benefits shown in Table 13.

Work Plan

This section presents a recommended work plan for an Automated Trip Status Operational Test. The work plan identifies the tasks, time frame, and cost estimates required for the operational test. This section presents a series of short-, mid-, and long-term actions required for design, development, and evaluation.

Suggested Tasks, Duration, and Estimated Cost

The tasks suggested to complete an operational test of an automated trip status system are similar to those suggested for the Shared Technology Infrastructure Operational Test. Table 14 shows the proposed tasks, duration, and estimated costs.

Table 13. Potential Benefits of Automated Trip Status

Benefits to Transit Users	Benefits to Transit Operators
▪ Reduced waiting time ▪ More reliability ▪ Greater security	▪ Reduction in number of canceled trips ▪ Improved vehicle productivity ▪ Better understanding of how low-cost trip status information could be provided to rural transit riders ▪ Potential operating efficiency for rural operators (by reducing the number of no shows and cancellation) ▪ Costs savings due to decreased operating costs (by reducing the number of calls to management)

Table 14. Automated Trip Status Operational Test: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Phase I (Near-Term)		
Task 1 – Solicit Ideas and Sites	3 months	$10,000
Task 2 – Assemble Study Team	1 month	$15,000
Task 3 – Finalize Automated Trip Status System Approach	1 month	$5,000
Task 4 – Define Test Area, Concept Plan, and Financial Plan	1 month	$10,000
Task 5 – Define/Assign Participant Responsibilities	2 months	$10,000
Task 6 – Secure Participation of Stakeholders (Funding)	2 months	$15,000
Task 7 – Develop Project Schedule and Deliverable Dates	1 month	$5,000
Task 8 – Develop Detailed Evaluation Plan	2 months	$20,000
Phase II (Short-Term)		
Task 9 – Develop Detailed Functional Requirements and Preliminary System Design	3 months	$30,000
Task 10 – Review and Refine System Design	1 month	$10,000
Task 11 – System Prototype Development and Installation	4 months	$50,000
Task 12 – System Acceptance Testing of Prototype	1 month	$20,000
Task 13 – Refine System Design and Revise Prototype (if necessary)	2 months	$40,000
Task 14 – Prepare User Documentation, Training Requirement, and Operating Requirement	3 months	$40,000
Phase III (Mid-Term)		
Task 15 – Agency-Wide Implementation and Evaluation	9 months	$300,000
Task 16 – Refine System Design and Revise System (if necessary)	3 months	$40,000
Task 17 – Develop Evaluation Report and Lessons Learned	3 months	$30,000
TOTAL	**36 Months**	**$650,000**

TIME FRAME

Medium term (3 to 5 years)

TRIP VERIFICATION AND BILLING OPERATIONAL TEST

This section presents the proposed action plan for a Trip Verification and Billing Operational Test in a rural/small urban area.

PROBLEM STATEMENT

This operational test seeks to evaluate the application/integration of various automated accounting systems to verify trip eligibility and improve current billing operations. Similar field operational tests have been conducted at urban transit systems, but not at a rural or small urban systems.

Primary reasons why an operational test of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Resource-constrained rural transit agencies could implement potentially low-cost system(s).
- Actual costs, operating requirements, and benefits of trip verification and billing can be documented.
- Reduction in the number of ineligible trips provided.
- More efficient management of agency billing information:
  - Internal operating efficiencies (e.g., elimination of outdated manual processes) can be achieved.
  - Better customer service.
  - Decrease in administrative work.
  - Cost reduction in billing for trips taken by recipient from other government aid.
- Improved accounting and revenue generation.

CONCEPT DESCRIPTION

The approach and benefits of conducting a Trip Verification and Billing Operational Test are described in this section.

TRIP VERIFICATION AND BILLING APPROACH

As indicated earlier, many trips on rural transit services do not involve cash payment. Rather, they are used to serve patrons of other agency programs such as Medicaid or Social Security. The system would likely include "Smart Card" technology that includes patron identification information that identifies both the individual and the particular trip. Information could then be verified in one of two ways:

- **Central System**. Patron information (e.g., personal ID, agency/program affiliation, trip eligibility) and transit information (e.g., bus/vehicle ID, route, time-of-day/TOD, fare amount) are obtained at/on the bus/vehicle, transmitted (via radio frequency communications), and processed at a central operating site. Processing will verify trip eligibility and determine fare amount.
- **In-Vehicle System**. Immediate check of patron and transit information will be processed by an in-vehicle system computer system. However, the inclusion of this element would be dependent on the willingness of the agencies to go to that level of sophistication.

Community Transit in Delaware County, Pennsylvania, is trying most of this concept. Their experience may be helpful in designing a new rural operational test.

Regardless of the processing method selected, there are potential operating efficiencies to be gained through the application of APTS to

verify trip eligibility and generate more accurate billing to the appropriate agencies. In effect, this operational test could make the rural transit operator's accounting more efficient. Or, it could promote the use of an accounting system that is tied into other agencies' accounting systems, perhaps on a statewide basis. This improvement in accounting does not necessarily mean that the operational test needs to be statewide. However, it does need to be over a sufficiently large geographic area in order to demonstrate that it would have some benefits to reduce agency paperwork. Because of their involvement in the funding of rural and small urban area transit systems, and because of their regulatory responsibilities in the area of Medicaid transportation, State agencies will need to be involved in the effort whether or not the actual test is conducted on a statewide basis.

It is recommended that FHWA/FTA and a local rural transit provider partner with Health and Human Service agencies at all applicable levels (e.g., Federal, State, region, county, city, local). These agencies are the ones that tend to be responsible for providing Medicaid and Social Security funding. More importantly, the trip verification and billing system needs to be coordinated with these agencies in order to serve as the channel for allocating those funds to recipients. Contacts with selected Health and Human Service organizations need to be made in order to identify the extent to which this operational test's services may be possible

Trip Verification and Billing Potential Benefits

Through the identification, selection, and eventual testing of the identified Trip Verification and Billing Operational Test, rural transit operators and transit users should receive benefits such as those shown in Table 15.

Table 15. Potential Benefits of Trip Verification and Billing

Benefits to Transit Users	Benefits to Transit Operators
▪ Greater convenience ▪ Enhanced security ▪ Time savings ▪ Ease of customer payment	▪ Enhanced security ▪ Improved cash flow ▪ Cost reduction in billing for trips taken by recipient from other government aid ▪ Reduction in ineligible trips provided ▪ More efficient management of agency billing information ▪ Better understanding of how "Smart Card" technology could be provided to rural transit riders ▪ Potential operating efficiency for rural operators ▪ Costs savings due to decreased operating costs (i.e., replace outdated manual paperwork processing)

WORK PLAN

This section presents a recommended work plan for a Trip Verification and Billing Operational Test.

SUGGESTED TASKS, DURATION, AND ESTIMATED COST

The tasks suggested to complete an operational test of trip verification and billing system are similar to those suggested for the Shared Technology Infrastructure Operational Test. The tasks, time duration, and estimated costs are listed in Table 16.

Table 16. Trip Verification and Billing Operational Test: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Phase I (Near-Term)		
Task 1 – Solicit Ideas and Sites	3 months	$10,000
Task 2 – Assemble Study Team	1 month	$15,000
Task 3 – Finalize Trip Verification and Billing Approach	2 months	$10,000
Task 4 – Define Test Area, Concept Plan, and Financial Plan	1 month	$10,000
Task 5 – Define/Assign Participant Responsibilities	2 months	$10,000
Task 6 – Secure Participation of Stakeholders (Funding)	2 months	$15,000
Task 7 – Develop Project Schedule and Deliverable Dates	1 month	$5,000
Task 8 – Develop Detailed Evaluation Plan	2 months	$20,000
Phase II (Short-Term)		
Task 9 – Develop Detailed Functional Requirements and Preliminary System Design	3 months	$30,000
Task 10 – Review and Refine System Design	2 month	$10,000
Task 11 – System Prototype Development and Installation	4 months	$150,000
Task 12 – System Acceptance Testing of Prototype	2 month	$35,000
Task 13 – Refine System Design and Revise Prototype (if necessary)	2 months	$50,000
Task 14 – Prepare User Documentation, Training Requirement, and Operating Requirement	3 months	$40,000
Phase III (Mid-Term)		
Task 15 – Agency-Wide Implementation and Evaluation	9 months	$300,000
Task 16 – Refine System Design and Revise System (if necessary)	3 months	$40,000
Task 17 – Develop Evaluation Report and Lessons Learned	3 months	$30,000
TOTAL	**36 Months**	**$780,000**

TIME FRAME

Long term (6 to 10 years)

FLEET MANAGEMENT OPERATIONAL TEST

This section presents the proposed action plan for a Fleet Management Operational Test.

PROBLEM STATEMENT

This operational test is oriented toward optimizing the available vehicles and personnel for existing rural transit services through the application of various automated vehicle location (AVL) systems.

Primary reasons why an operational test of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Resource-constrained rural transit agencies could implement potentially low-cost system(s).
- Actual costs, operating requirements, and benefits of fleet management can be documented.
- Potential reduction in the number of vehicles required to service the same number of trips.
- More efficient management of agency fleet/vehicles:
  - Internal operating efficiencies (e.g., improved trip scheduling, improved schedule adherence).
  - Better customer service.
  - Rural transit labor costs (operations and maintenance) may decrease.
  - Potential reduction in vehicle operating costs.

CONCEPT DESCRIPTION

This section describes the development of a Fleet Management Operational Test. Other related efforts are also discussed and useful characteristics directly related to this concept are highlighted.

FLEET MANAGEMENT APPROACH

At this time, a number of AVL-based fleet management systems are being used by transit agencies to monitor their vehicles. With these AVL systems, the real-time location of each vehicle is determined and transmitted to a dispatch operations center. This information may be used for a number of purposes, including taking corrective action to deviations in service, input to passenger information systems, and emergency location of vehicles in times of crises (e.g., crimes in progress, medical emergencies). In addition, data generated over time can be used for planning and management activities.

This Fleet Management Operational Test will be oriented toward optimizing a rural transit service's available vehicles and personnel. There is the potential that this test may piggyback with another operational test. If this were the case, the fleet management aspect would need to specifically focus on the ability to efficiently use an AVL system to improve vehicle scheduling and routing. Software would be developed that would assist dispatchers in matching rides, time periods, and available vehicles to generate trip matching patterns that may improve overall fleet effectiveness. It is possible that this operational test could be conducted for a small, non-rural transit operation as the problems are basically the same.

Fleet Management Potential Benefits

As shown in Table 17, through the identification, selection, and eventual testing of the identified Fleet Management Operational Test, it is anticipated that rural transit operators and transit users will receive several benefits.

Table 17. Potential Benefits of Fleet Management Operational Test

Benefits to Transit Users	Benefits to Transit Operators
▪ Improved information ▪ Greater reliability ▪ Reduced travel time ▪ Improved security ▪ Improved on-time performance	▪ Potential reduction in the number of vehicles required to service the same number of trips ▪ Potential reduction in labor costs ▪ Potential reduction in vehicle operating costs ▪ Increased overall dispatching and operator efficiency ▪ More efficient operations as schedules are improved ▪ More reliable service, promoting increased ridership ▪ Quicker and "better" response to service disruptions (e.g., disabled vehicle) ▪ Bus operator awareness of schedule adherence ▪ Improved driver safety and security ▪ Input into passenger information systems ▪ Input into bus priority systems ▪ Quicker notice of mechanical problems with the vehicles, reducing maintenance costs ▪ More extensive planning information collected at a lower cost than manual methods

Work Plan

This section presents a recommended work plan for a Fleet Management Operational Test. It will present a series of short-, mid-, and long-term actions required for design, development, and evaluation.

Suggested Tasks, Duration, and Estimated Cost

The tasks suggested to complete an operational test of the fleet management system are similar to those suggested for the Shared Technology Infrastructure Operational Test. The tasks, time frame, and estimated cost are listed by phase in Table 18.

Table 18. Fleet Management Operational Test: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Phase I (Near-Term)		
Task 1 – Solicit Ideas and Sites	3 months	$10,000
Task 2 – Assemble Study Team	1 month	$15,000
Task 3 – Finalize Fleet Management Approach	1 month	$5,000
Task 4 – Define Test Area, Concept Plan, and Financial Plan	1 month	$10,000
Task 5 – Define/Assign Participant Responsibilities	2 months	$10,000
Task 6 – Secure Participation of Stakeholders (Funding)	2 months	$15,000
Task 7 – Develop Project Schedule and Deliverable Dates	1 month	$5,000
Task 8 – Develop Detailed Evaluation Plan	1 month	$15,000
Phase II (Short-Term)		
Task 9 – Develop Detailed Functional Requirements and Preliminary System Design	3 months	$35,000
Task 10 – Review and Refine System Design	3 months	$10,000
Task 11 – System Prototype Development and Installation	4 months	$100,000
Task 12 – System Acceptance Testing of Prototype	2 months	$20,000
Task 13 – Refine System Design and Revise Prototype (if necessary)	3 months	$40,000
Task 14 – Prepare User Documentation, Training Requirement, and Operating Requirement	3 months	$40,000
Phase III (Mid-Term)		
Task 15 – Agency-Wide Implementation and Evaluation	10 months	$450,000
Task 16 – Refine System Design and Revise System (if necessary)	3 months	$40,000
Task 17 – Develop Evaluation Report and Lessons Learned	3 months	$30,000
TOTAL	**46 Months**	**$850,000**

TIME FRAME

Medium term (3 to 5 years)

BROADER MARKET RESEARCH STUDY

This candidate action is in response to the need for additional market research for rural APTS. The implementation plan for designing and conducting a broader market research study is described here.

PROBLEM STATEMENT

The purpose of this research is to identify the APTS needs and opportunities of a broader variety of rural markets. The research should focus on the general rural public, in order to understand non-users and identify potential users such as welfare-to-work clients. This additional research should also include a broader sample of transit users from different rural areas.

The user needs component of the *Rural Public Transportation Technologies: User Needs and Applications* concluded that additional research was needed particularly from the perspective of non-users. This additional research is important to assess the needs of potential rural transit users and to examine the barriers and problems that discourage the rural populace from using public transit. Further research will help continue the identification and implementation of APTS technologies that meet the needs and problems in rural areas. In the recent user survey, the sample size was small and the transit provider distributed the surveys. Future survey research should provide for a scientific survey with a much larger sample size.

CONCEPT DESCRIPTION

The market research should include both telephone surveys and focus group sessions. The purpose of the telephone survey is to obtain quantitative information on attitudes, perceptions, and preferences of a broader market(s). The telephone survey should be conducted of the general public in four to eight different rural areas. The sample size should be 500 completed telephone surveys in each area in order to provide an adequate number of responses for stratified analysis, especially the identification of elderly persons and welfare households. The sample selection should be based on random digit dialing for the telephone surveys.

The purpose of the focus groups is to qualitatively explore the subject of rural APTS in a structured, yet informal, discussion setting. The focus group sessions should take place in the same rural areas as the telephone surveys. The focus groups should involve two different groups in each of the selected rural areas: one session with non-users and one session with representatives from public agencies such as the labor department and human service agencies. Each group should have 12 to 14 participants.

The objective of both techniques is to identify needs and opportunities for transit service that could benefit by the application of advanced technologies.

Such a broad market research study will benefit transit users, non-users, operators, and public agencies. The main benefit is the identification and understanding of new market segments, such as the welfare-to-work clients. The potential benefits of completing this type of research are listed in Table 19.

WORK PLAN

A market research consultant should be selected to conduct this study under the direction of FTA and FHWA. The consultant should have experience in quantitative and qualitative market research for rural public transportation. As stated earlier, the research should include both telephone surveys and focus group sessions.

Table 19. Potential Benefits of a Broader Market Research Study

Benefits to Transit Users and Non-Users	Benefits to Transit Operators and Public Agencies
▪ Opportunity to express needs, perceptions, concerns, and suggestions ▪ Opportunity to help improve transit service	▪ Better understanding of different market segments and multiple needs, especially the welfare-to-work market ▪ Opportunity to get input from non-users as well as users ▪ Ideas on problems and needs that could have a technological solution ▪ New ideas for service design and delivery that could have a technological component

Suggested Tasks, Duration, and Estimated Cost

Table 20 lists the suggested tasks, duration, and estimated cost to design and conduct a broader market research study as described above. The cost assumes that the telephone survey is conducted in six rural areas and that two focus groups are held in each of the six rural areas. The consultant will likely have to design and administer multiple survey questionnaires to address the different market segments.

Table 20. Tasks, Duration, and Estimated Costs to Conduct a Broader Market Research Study for Rural APTS

TASK	DURATION	COST
Task 1 – Solicit proposals and select consultant	3 months	None
Task 2 – Finalize research methodology, develop survey instruments, develop focus group outlines, identify survey locations, and identify focus groups	1 month	$10,000
Task 3 – Conduct telephone survey in six rural areas (500 respondents in each area)	3 months	$180,000
Task 4 – Analyze and document telephone survey results	2 months	$30,000
Task 5 – Conduct two focus group sessions in each of six rural areas (12 focus groups)	3 months*	$42,000
Task 6 – Analyze and document focus group sessions	1 month*	$18,000
TOTAL	**12 months**	**$280,000**

* Could be done concurrently with the telephone survey.

Time Frame

Medium term (3 to 5 years)

DEMONSTRATION OF LOW-COST TECHNOLOGIES (SIMPLE SOLUTIONS)

This section describes the proposed action plan for demonstrating the applicability of low-cost technologies as simple solutions to address transit needs in rural and small urban areas. One specific low-cost technology, a bus arrival notification system, is identified as a candidate for such a demonstration.

PROBLEM STATEMENT

This field demonstration involves identifying "Simple Solutions" to specific rural transit problems and then conducting a field demonstration to evaluate the technology. One of the strong messages obtained from field interviews and contact with rural transit operators is that the solutions need to be relatively simple to be applicable in their settings.

The bus arrival notification system is a good example of this type of solution. This demonstration will evaluate the application of a low-cost system in which radio transmitters (located on buses) emit a signal that notifies the potential rider (who has a receiver) when the bus is nearing the pickup point.

Primary reasons why a field demonstration of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Resource-constrained rural transit agencies could implement potentially low-cost system(s).
- The technology required for this system is not complex and will not require experience in the planning and deployment of advanced technologies.
- Reduction in customer waiting time for bus, especially in unsafe or inclement weather conditions.
- Improved customer service/convenience for riders and family members.
- More efficient management of agency fleet/vehicles.
- Documentation of actual costs, operating characteristics, and benefits.
- Potential benefits (dependent upon overall fleet size):
  - Internal operating efficiencies (e.g., improved trip scheduling, improved schedule adherence).
  - Potential increase in ridership.

CONCEPT DESCRIPTION

Field demonstration of various Simple Solutions should be conducted to determine the actual benefits and costs. Some of these potential solutions may involve ideas that would not necessarily fall directly into the category of ITS/APTS. Although the focus of this effort is ITS/APTS, rural transit operators would be helped if they also understand some of the ideas that may solve their current problems. Eventually, these Simple Solutions, such as the bus arrival notification system could lead to a more technologically advanced ITS/APTS solution that is not practical now due to resource constraints.

The plan for a Bus Arrival Notification System Demonstration is described in detail below.

BUS ARRIVAL NOTIFICATION SYSTEM APPROACH

There are two primary approaches to conduct this demonstration:

- **School Bus System.** In this application, the bus arrival notification system would be applied to a rural school bus system. The technology would be located on

school buses. In this manner, the school bus could continuously emit a signal with a range of one to two miles. Riders could only receive the signal when the bus is within one to two miles of the pickup point. They would then have advance notification of the bus' impending arrival and not have to wait at the bus stop until it was known for certain that the bus was nearby. Then, school children could avoid having to stand in unsafe areas along the roadside for extended periods of time (e.g., when it is dark, inclement weather). If this direction were chosen, a partnership with a local Department of Education or School District would be in order. Then, a collaborative effort would be needed to select one or more school bus operators (either public operator or private contractor) willing to participate in the operational test.

- **Transit System**. The other application would be for either or both demand-responsive and fixed-route transit systems (where applicable). The same approach as for the school bus system would be followed. However, partners from a demand-responsive and/or fixed-route rural transit system would be solicited.

In either application, the receiver would be a pager-like device that could be purchased by parents or potential riders. The device would probably be more simple than an actual pager given the need to only receive a signal when the bus is nearing the pickup point. Therefore, alpha-numeric characters and/or voice-mail operations are not necessary for the most basic system but their inclusion in more advanced applications could be considered as applicable. This relatively low-cost technology is suggested for rural areas but it may also have applications in urban and suburban areas as well.

Regardless of which approach is undertaken, the demonstration of this technology should be conducted on the entire system to obtain a comprehensive test.

Bus Arrival Notification System Potential Benefits

Through the identification, selection, and eventual testing of the identified Bus Arrival Notification System Operational Test, transit operators and transit users could receive the benefits shown in Table 21.

Table 21. Potential Benefits of Bus Arrival Notification System

Benefits to Transit Users	Benefits to Transit Operators
▪ On-time operations as schedules are improved ▪ Reduction in waiting time in unsafe or inclement weather conditions ▪ Improved convenience for riders and family members ▪ More reliable service, promoting increased ridership	▪ Increased overall dispatching and operator efficiency ▪ More efficient operations as schedules are improved ▪ Input into passenger information systems

WORK PLAN

This section identifies a series of tasks required for design, development, and evaluation of the concept. It also present a preliminary cost estimate and project duration. The preliminary program schedule and cost estimates that follow anticipate what the development costs for this field demonstration might be if the FHWA/FTA were to sponsor a regional system. The work plan identifies the tasks, time frames, and estimated cost.

SUGGESTED TASKS, DURATION, AND ESTIMATED COST

The tasks suggested to complete an operational test of the bus arrival notification system are outlined in Table 22.

Table 22. Demonstration of Low-Cost Technologies: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Phase I (Near-Term)		
Task 1 – Solicit Ideas and Sites	2 months	$2,500
Task 2 – Assemble Study Team	1 month	$5,000
Task 3 – Finalize Bus Arrival Notification Approach	2 month	$5,000
Task 4 – Define Test Area, Concept Plan, and Financial Plan	1 month	$5,000
Task 5 – Define/Assign Participant Responsibilities	1 month	$2,500
Task 6 – Secure Participation of Stakeholders (Funding)	1 month	$10,000
Task 7 – Develop Project Schedule and Deliverable Dates	1 month	$2,500
Task 8 – Develop Detailed Evaluation Plan	1 month	$10,000
Phase II (Short-Term)		
Task 9 – Develop Detailed Functional Requirements and Preliminary System Design	2 months	$7,500
Task 10 – Review and Refine System Design	1 month	$5,000
Task 11 – System Prototype Development	2 months	$50,000
Task 12 – System Acceptance Testing of Prototype	1 month	$10,000
Task 13 – Refine System Design and Revise Prototype (if necessary)	1 month	$15,000
Phase III (Mid-Term)		
Task 14 – Implementation and Evaluation	6 months	$100,000
Task 15 – Refine System Design and Revise System (if necessary)	2 months	$15,000
Task 16 – Develop Evaluation Report and Lessons Learned	2 months	$20,000
TOTAL	**24 Months**	**$265,000**

The cost estimate assumes equipping 10 buses with transmitters and providing up to 50 riders with receivers. The cost for several of these tasks will not increase significantly if additional Simple Solution technologies are included in the test. However, the additional cost of hardware, prototyping, and evaluation of the other technologies will need to be added.

TIME FRAME

Medium term (3 to 5 years)

ADDITIONAL CONCEPTS

In addition to the bus arrival notification system, the Rural APTS User Needs Study identified some other initial ideas for potential

Simple Solutions. These solutions include better use of the following as a means to disseminate pre-trip and en-route transit information (e.g., schedules, routes, estimated time of arrival) and improve service operations:

- Cellular telephones
- Radio systems
- Internet
- Cable TV
- Pagers

However, U.S. DOT should undertake a broad solicitation process to stimulate ideas/ concepts from rural transit operators themselves. With all of the ideas in consideration, a set of selection criteria should be developed and used to choose from among the Simple Solution responses. Initial criteria will most likely include the following:

- Practicality of the problem being solved.
- Likelihood that the idea would be broadly applicable.
- Benefits expected to the operators.
- Benefits expected to the customers.
- Estimated cost.
- From this selection process, a collection of demonstration projects will be identified in order to verify the feasibility, effectiveness, and impact of the Simple Solution in question.

Any field tests of low-cost technologies should involve the entire transit service for the selected rural/small urban area.

RURAL TRANSIT OPERATOR INFORMATION KIT

This section presents the proposed action plan for a Rural Transit Operator Information Kit.

PROBLEM STATEMENT

An Information Kit on APTS that is specifically designed for rural transit operators would be useful because such a document does not exist. The Information Kit is intended as a collection of materials that can provide information to rural operators regarding the nature of APTS and how to determine whether these systems are applicable to their situation.

Primary reasons why an Information Kit of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Lack of knowledge of available options.
  - Need for realistic guidance on available options (i.e., justification of cost-effective technology applications).
  - Uncertainty over what conditions make certain opportunities appropriate.
  - Need to know how to take best advantage of those opportunities.
  - Need information on partnering opportunities and barriers to partnering.
  - Lack of knowledge of potential benefits of ITS/APTS (e.g., potential benefit of service coordination and trip optimization can be significant.
  - Need to identify logical building blocks to go from "bare bone" systems to a more sophisticated system over time.

- Resources available to those providers are relatively low:
  - Barely enough resources to keep their own service running.
  - Not enough resources to investigate opportunities that may be available (based on emerging technologies) for running services more efficiently.
- Lower density of potential riders:
  - Services tend to cover large land areas.
  - Services are more of the paratransit or on-demand type.
  - Potential for multiple providers with overlapping service areas that focus on different trip types.
- Various ridership "types" complicate discrete service provision:
  - Services are not heavily commuting-oriented, as in most metropolitan areas.
  - Focus on transit-dependent riders.

CONCEPT DESCRIPTION

The suggested contents of the Information Kit concept are described in detail. In addition, any other related efforts are investigated and useful characteristics directly related to this concept are highlighted. In short, the Information Kit is intended as a collection of materials that can provide information to rural operators regarding the nature of APTS and how to determine whether these systems are applicable to their situation. The information kit can include the following information:

- Information on the basics of ITS.
- Experience from other operators.
- Criteria for APTS applications.
- Lessons learned from other deployments.

The following sections provide more detailed information on each of the above topics.

INFORMATION ON THE BASICS OF ITS/APTS

Many operators are unlikely to be aware of even some of the most basic information on ITS and need to be provided this information in a readily understandable form. In order not to duplicate efforts, it is expected that existing information, such as the Rural APTS Study, will be used to the greatest extent possible. A brief, 10-page APTS for Rural Transit document will be developed for inclusion within the Information Kit that covers the following topics:

- User Needs (use existing information but may need to repeat user needs assessment if the results are more than two years old); reference the demand for rural public transportation created by welfare reform.
- Available Technologies/Solutions
  - Fleet Management
    - Communications Systems
    - Geographic Information Systems
    - Automatic Vehicle Location (AVL) Systems
    - Automatic Passenger Counters (APCs)
    - Transit Operations Software
  - Traveler Information
    - Pre-Trip Information
    - In-Terminal and Wayside Information Systems
    - In-Vehicle Information Systems
    - Multi-Modal Traveler Information Systems
  - Electronic Fare Payment
    - Automated Fare Payment Systems
    - Multi-Carrier Integration Systems
  - Transportation Demand Management Technologies
    - Real-Time Ridesharing
    - Mobility Manager
    - Transportation Management Centers (TMCs)

- High Occupancy Vehicle (HOV) Facility Monitoring

- Potential Benefits
- Estimated Costs
- Roles and Responsibilities

The above document will describe the basics of ITS and provide a lot of pointers on where rural transit operators should turn for more information. Since existing information on ITS (in general) and APTS (more specifically) have already been developed (or are being currently developed), it is anticipated that the following sources of information (at a minimum) will also be listed within the Information Kit:

- ITS Training Courses
  - Currently developed and being presented nationwide:
    - ITS Awareness Seminar
    - Deploying Integrated Intelligent Transportation Systems
    - Using the National ITS Architecture for Deployment
    - ITS related courses (5) by the National Transit Institute
  - Ideas currently under development/consideration:
    - ITS in Transit
    - ITS Public/Private Partnerships
    - Rural ITS Training Course
- ITS Literature
  - *APTS: The State of the Art – Update 1996 and 1998*
  - *APTS: Deployment in the United States*
  - *Benefits Assessment of APTS*
  - *ITS Technologies in Public Transit: Deployment & Benefits*
  - *Rural ITS Program Plan*
  - *Rural ITS Strategic Plan*
  - Rural ATIS Documents:
    - *User Needs Assessment Report*
    - *State of the art Technology Report*
    - *User Needs and Technology Assessment Report*
    - *Draft Action Plan*
    - *Recommended Actions Report*
- ITS on the Internet
  - http://www.fta.dot.gov
  - http://www.fhwa.dot.gov
  - http://www.its.dot.gov/rural
  - http://www.itsa.org

The Information Kit will also describe the best method by which a rural operator can sign up, obtain, or access the above information/resources.

EXPERIENCE FROM OTHER OPERATORS

The best way to learn about something is to experience it for yourself (both mistakes and successes). However, if you are resource-deficient and not able to pursue available options on your own, then it is time to seek out those agencies that have past and current experience. Within the APTS field, this usually means gleaning knowledge from those agencies that operate large transit systems (most likely in metropolitan areas) where resources are not as constrained. Though these agencies may be located in non-rural areas, their APTS applications may still be relevant to a rural operator.

The work just completed under the Rural Transit Study, presented to a limited degree some experience from operators of transit systems. The results of this work will be used to the extent possible. For additional information, telephone interviews or face-to-face discussions could be undertaken in order to extract first-hand knowledge and experiences from operators who have real-world APTS "been there, done that" experience/credentials. In this manner, invaluable APTS insights can be provided by word of mouth with little chance for confusing

the issues. This method should then provide an excellent way to give rural operators a sense of how the APTS system really works, what some of the potential problems and pitfalls are, and what benefits can be expected through its use.

In order to accomplish this broad, yet in-depth, real-world understanding, rural operators should be encouraged to contact other transit operators who have implemented various APTS systems/technologies within their own region. These discussions would provide a real-world understanding of both the pros and cons of implementing a specific APTS system/technology. In addition, these talks should also provide a broader sense of what is really out there and what to realistically expect from what you are getting (as opposed to what you think you are getting). In the end, rural operators would have talked to their peers, which in turn should enable them to better relate to their colleagues' experiences.

Therefore, this aspect of the Information Kit will just provide a listing of all of the agencies that are implementing APTS-type projects. The listing will include the following information at a minimum:

- Contact person (e.g., name, agency, telephone, fax, address, e-mail address).
- Brief project/concept description.
- Program status.
- Project schedule.
- Financial overview.

Some research/leg-work will need to be undertaken in order to develop this listing for the Information Kit, but a majority of the information can be extracted from the following publications:

- *ITS Projects Book: 1998*
- *ARTS Project Summaries*
- *Advanced Public Transportation Systems: The State of the art Updates 1996 and 1998*
- *Intelligent Transportation Systems - Real World Benefits*

Rural operators would then be responsible for contacting these individuals and discussing the various aspects of the APTS application(s) in which they are interested. In this manner, the rural operator is now an "informed consumer" of which is the best agency to contact.

Criteria for APTS Applications

One of the first questions that a rural transit operator probably asks is, "When should I consider pursuing an APTS application for my agency?" To help answer this question, a list of criteria of when to consider implementing an APTS application should be developed. These criteria would provide some general rules of thumb for when certain types of APTS systems/technologies are applicable. Although there would be a danger in making the criteria too rigid, this list would at least give operators a general indication of when they should begin to look at specific APTS systems/technologies that may be applicable to their agency/region.

The APTS Criteria List would involve classifying systems/technologies according to criteria to which rural operators could relate, and then identifying general applicability levels for each set of characteristics. Potentially, this list could be combined with a similar evaluation for larger systems, so that the generalized criteria would be somewhat consistent.

Potential APTS Application	Criteria	Applicability Level
Fleet Management	1. Density of potential riders 2. Geographic coverage zone 3. Type of transit service	1. Greater than X people/ square mile 2. Greater than Y square mile 3. Paratransit (call-in)

The brief example that follows provides a good indication of the level of detail to which the APTS Criteria List should be developed:

Within the Information Kit, the APTS Criteria List will be developed for all of the potential APTS Applications/Solutions that were identified for inclusion within the Basics of ITS/APTS document.

Lessons Learned from Other Deployments

This section is related to Experience from Other Operators. However, this Lessons Learned section would not be so tied to the other transit operators' experiences as to a systematic treatment of lessons learned in general. It is envisioned that such lessons learned and best practices would be categorized in the following manner:

- Technical
- Institutional/Organizational
- Operational
- Procurement
- Financial
- Marketing

The Lessons Learned section would be developed and provided as a way to give rural operators a sense of how the system really works, what some of the potential problems and pitfalls are, and what benefits can be expected through its use. Part of this could be done within the context of the Rural APTS Success Story Booklet. However, a real-world approach that blends both the pros and cons of implementing a specific APTS system/technology should be broached instead. This should be done because the provision of a broader sense of what is really out there and what to realistically expect from what you are getting (as opposed to what you think you are getting) would more likely provide rural operators with the experiences to which they can better relate. In addition, the Volpe Center is conducting a number of APTS Evaluations for the FTA from which numerous lessons learned can be extracted for inclusion within the Information Kit.

Potential Benefits of the Information Kit

The Information Kit will be an overall time-saving tool. As shown in Table 23, both users and operators of rural transit systems will likely receive several benefits from this APTS document.

Required Work Activities

This section presents a brief overview of the operating concepts that support the development of the Information Kit. This information is presented through a series of functional requirements and covers how pertinent information for inclusion will be obtained, analyzed, and presented.

Table 23. Potential Benefits of the Information Kit

Benefits to Transit Users	Benefits to Transit Operators
• System improvements to make it more responsive to user needs • Increased reliability • Increased safety/security • Improved access to information	• Improved understanding of ITS/APTS • Collection of resources from which to obtain invaluable ITS/APTS information, contacts, and direction • Assistance in identifying when/where APTS applications may be feasible and cost-effective • Avoidance of problems and mistakes in planning, design, and procurement of APTS systems/technologies

LITERATURE SEARCH

To the greatest extent possible, materials for the Information Kit will be compiled from previously developed work. Information will be gathered from the following sources:

- Federal Agencies (FHWA, FTA, Volpe Center, etc.)
  - Endorsed publications
  - Current consultant activities
  - Transit Cooperative Research Program (TCRP)
  - Rural Technical Assistance Program (RTAP)
- Other Agencies (State DOT, Regional Transit Authority, MPO, etc.)
  - Endorsed publications
  - Current consultant activities
- ITS America
- Community Transportation Association of America (CTAA)
- American Public Transit Association (APTA)
- National Transit Institute (NTI)
- National Technology Information Service (NTIS)
- Transportation Trade Journals
  - *ITE Journal*
  - *Inside ITS*
  - *Transportation Technology International*

DATA/INFORMATION ANALYSIS

Data/information to be included in the Information Kit should be of the highest quality possible. It will be assumed that previously published reports are accurate and need no further substantiation (because these agencies reputations and credibility will be on the line). Data/information obtained from interviews with knowledgeable experts in the transit field will similarly be expected to be accurate as personal reputations are at stake. In order for the Information Kit to be credible and acceptable, a detailed reference section and strict footnoting policy should be followed. In this manner, previously published information will be distinguished from recently developed material so that rural transit operators know the quality and source of the information that they are receiving.

Information Kit Publication

The Information Kit will be an attractive document as fits a Public Relations piece of this nature. Words, concepts, and descriptions will be simplified to the greatest extent possible to ensure a basic understanding of ITS/APTS across a range of operator knowledge/experience. Graphics, tables, and charts will also be used as appropriate to ensure that ITS/APTS concepts can be visualized along with their description. In addition, distribution of the Information Kit will be available from the FHWA and FTA to all interested parties.

Program Alternatives

This section presents a number of possible alternatives for advancing the Information Kit concept, discusses the pros and cons of each, and identifies a recommended approach. In addition, it relates the importance of the Information Kit to the future of ITS in rural transit applications and discusses anticipated FTA/FHWA, public agency, and private sector roles.

Alternative Approaches

Basically, there are two primary approaches to developing the Information Kit. The first would be for a joint FTA/FHWA in-house effort. The second calls for a consultant to undertake the development role with FTA/FHWA supervision. It is anticipated that activities included within the Information Kit development role would be the same for both approaches and that the same level of review would also be required. Therefore, the pros and cons for each alternative approach should also be the same. In this case, it is a very subjective matter to determine which approach should be undertaken. However, the consultant option may make better use of FTA/FHWA resources by freeing-up key individuals to concentrate on other important ITS/APTS concerns while a consultant prepares the necessary Information Kit materials.

Information Kit Importance

The Information Kit is extremely important to the future of ITS/APTS in rural transit. Since resources available to most rural operators are relatively scarce and they barely have enough to keep their own services running, the Information Kit would allow them to investigate available opportunities at low or no cost (i.e., only the time it would take to read the materials). In addition, most rural operators probably have little or no knowledge of available ITS/APTS options and probably also need realistic guidance on how to select the right solution(s) for their needs. The Information Kit would ease the uncertainty over what conditions make certain ITS/APTS opportunities appropriate for their agency and also how to take best advantage of those opportunities. Furthermore, the Information Kit would allow rural operators to become informed consumers of ITS/APTS on many fronts, including partnering opportunities, potential benefits, expected costs, and what they will need to do to make an ITS/APTS implementation successful in their region.

Suggested Roles

It is anticipated that both FHWA and FTA working in coordination with a consultant will be involved in the development and distribution of the Information Kit. The suggested roles and responsibilities are:

- Consultant
  - Develop Basics of ITS/APTS document
    - Synthesize existing ITS/APTS information into a 10-page Executive Summary type of report

    - Compile list of relevant ITS/APTS information sources
  - Develop ITS/APTS Contact List
    - Compile listing of all of the agencies (and personnel contacts) that are implementing APTS-type projects
  - Develop APTS Criteria List
    - Develop systematic approach that classifies APTS systems/technologies according to criteria to which rural operators could relate
    - Identify general applicability levels for each set of criteria/characteristics
  - Develop APTS Lessons Learned document
    - Compile other transit operators' experiences in a systematic treatment of general lessons learned and best practices
  - Develop/publish overall Information Kit
- FTA/FHWA
  - Review APTS for Rural Transit document
    - Provide Consultant access to all relevant ITS/APTS information sources at their disposal
  - Review ITS/APTS Contact List
    - Provide Consultant access to all relevant ITS/APTS information sources at their disposal
  - Review APTS Criteria List
    - Provide realistic guidance on criteria to which rural operators could relate
    - Ensure that general applicability levels for each set of criteria/characteristics are realistic
  - Review APTS Lessons Learned document
    - Provide Consultant access to all relevant ITS/APTS information sources at their disposal
  - Review overall Information Kit
  - Inform rural operators of the Information Kit's existence
  - Publish/distribute Information Kit

Work Plan

The suggested tasks for development of the Information Kit are presented below. Table 24 shows the proposed project duration and a cost estimate by task.

Suggested Tasks, Duration, and Estimated Cost

Four tasks are suggested to complete this action.

- Task 1 – Develop APTS for Rural Transit Document
  - Synthesize existing ITS/APTS information into a 10-page Executive Summary type of report (including revisions)
  - Compile list of relevant ITS/APTS information sources
- Task 2 – Develop ITS/APTS Contact List
- Task 3 – Develop APTS Criteria List
  - Develop systematic approach that classifies APTS systems/technologies according to criteria to which rural operators could relate
  - Identify general applicability levels for each set of criteria/characteristics
- Task 4 – APTS Lessons Learned Document
- Task 5 – Develop/Publish Information Kit

Table 24. Rural Transit Operator Information Kit: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Task 1 – Develop "APTS for Rural Transit" Document	2 months	$ 10,000
Task 2 – Develop ITS/APTS "Contact List"	.5 month	$ 1,500
Task 3 – Develop "APTS Criteria List"	1 month	$ 25,000
Task 4 – "APTS Lessons Learned" Document	1 month	$ 25,000
Task 5 – Develop/Publish Information Kit	1.5 months	$ 13,500
TOTAL	**6 Months**	**$75,000**

TIME FRAME

Near term (1 to 2 years)

RURAL APTS SUCCESS STORY BOOKLET

This section describes the action plan for preparing the Rural APTS Success Story Booklet. Such a booklet would highlight successful APTS case studies and lessons learned.

PROBLEM STATEMENT

Rural transit services and service needs are distinctively different than those in major metropolitan areas. Few rural transit systems have been able to plan and implement APTS technologies. Little information is oriented to the rural transit providers. The current literature is either highly technical or does not adequately focus on the rural needs and applications of APTS. Since only a few APTS are in operation in rural areas, highlighting the successes and lessons learned of each one can help foster more rural APTS. The objectives and results should be summarized in simple language and compiled in an easy-to-read booklet or notebook.

Primary reasons why a booklet of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Resources available to those providers are relatively scarce
  - Barely enough resources to keep their own service running
  - Not enough resources to investigate opportunities that may be available (based on emerging technologies) for running services more efficiently
- Lack of knowledge of available options
  - Need for realistic guidance on available options
  - Uncertainty over what conditions make certain opportunities appropriate
    - Problems that initiated the project
    - Problems that the agency was trying to solve
    - Justification of cost-effective technology applications
  - Need to know how to take best advantage of those opportunities
  - Need information on partnering opportunities and barriers to partnering
    - Description of the agencies involved
    - How the necessary partnerships developed
  - Lack of knowledge of potential benefits of ITS/APTS

- Internal and regional operating efficiencies
- Benefits to customers

- Need for political buy-in by elected officials
  - Understand what is involved
  - Understand why it works
  - Understand how it could benefit them
  - Identify potential pitfalls

CONCEPT DESCRIPTION

The booklet should describe successful case studies of the use of APTS technologies, including simple ones, by rural and small urban transit systems. The development of the Booklet should be an on-going activity similar to US DOT's technical briefs. New pages can be added to the booklet each time a new rural APTS is tested. The audience and contents of the Rural APTS Success Story Booklet are described below.

BOOKLET AUDIENCE

The intended audience for the Rural APTS Success Story Booklet is as follows:

- Rural transit service providers
  - Management/policy decision-makers
  - Technical staff
- State departments of transportation (DOTs)
  - Management/policy decision-makers
  - Mid-level technical staff/engineers
- Elected officials/policy decision-makers
- Interested private sector firms

BOOKLET CONTENTS (PER CASE STUDY)

This booklet would be modeled after similar materials produced through FHWA/FTA or ITS America. In addition, the booklet will include information on the following topics:

- Problems that initiated the project
  - User needs
  - Problems that the agencies were trying to solve
  - Problem description
  - Anticipated solution and performance expectations
  - Agency and/or consumer acceptance
- What made the project a success
- Description of the agencies involved
  - Public sector partners
  - Private sector partners
  - How the necessary partnership(s) developed
  - Roles/responsibilities & project management
  - Written agreements in-place (i.e., MOUs)
  - Institutional issues & organizational structure
  - Regional coordination
  - Project planning & development
- Complete, detailed description of the APTS systems/technologies involved
  - Functions performed
  - Involved operations
  - Hardware/equipment considerations
  - Software considerations
  - Communications used
- Procurement and development considerations
  - Systems requirements analysis
  - Systems design
  - Alternative approaches considered
  - Procurement
  - Deployment
  - Systems integration and testing
- Benefits achieved
  - Quantitative and qualitative
  - Customer-related
  - Operational efficiencies achieved
  - Operating costs reduced
- Project costs
  - Total capital costs

- Operations and maintenance (O&M) costs
- Project approval and funding

- Operations management
  - Staffing
  - Training
  - Funding
    - Cost-sharing arrangements
    - Revenue sources
- Lessons learned
  - Experience gained from implementation
  - Agency/operator insights
  - ITS/APTS project lessons
  - Evaluation results

BOOKLET APPROACH

The emphasis of the Rural APTS Success Story Booklet would be on identifying those factors that contribute to a successful application. It is not the intent of the booklet to be merely a "sales document" that presents an unrealistically optimistic picture of what "could" occur if a particular APTS application were implemented. Rather, the booklet is intended to be a true representation of what a rural transit service can expect if it chooses to implement a specific APTS application. Pros and cons of each case study will be presented in order to highlight "what went right" as well as "what went wrong." Then, invaluable lessons learned will be showcased so that project pitfalls are avoided and the right path to a successful implementation is followed.

The booklet should be relatively brief so that elected officials and rural transit service upper management personnel who have responsibility for making decisions on funding outlays for rural transit become "informed consumers." In this manner, they become aware of the following:

- What is really involved in forwarding a particular APTS application
- Why it should work as expected
- Applicability to their system and problem(s)
- How it could benefit them and their region
- Potential pitfalls to avoid

In order to present an accurate depiction of success within rural APTS, a diverse "cross-section" of APTS applications should be presented. Overall, the following APTS success stories from this Rural Transit Action Plan's proposed operational tests would be excellent candidates:

- APTS Simple Solutions
- Fleet Management
- Shared Technology Infrastructure
- Automated Trip Status Information
- Trip Verifications and Billing

In developing case study scenarios, multiple possibilities exist. One possibility is to develop and test at least one case study scenario presented from each of the above five categories. Another possibility is to test multiple solutions at one or more locations.

At this time potential case study locales/scenarios are as follows:

- Rural APTS Simple Solutions (focus on radio/communication systems and Internet web pages)
  - Radio Systems
    - Anchorage Public Transit (AK)
    - Boise Urban Stages (ID)
    - Madison County Transit District (Granite City, IL)
    - Laketran (Grand River, OH)
    - Clark County Public Transportation (Vancouver, WA)
    - City of Casper (WY)
    - The City of Cheyenne Transit Program (WY)

- Internet
  - King Co. Department of Metropolitan Services (Seattle, WA)
- Shared Technology Infrastructure
  - Advanced Rural Transportation Information and Coordination (ARTIC) in Minnesota
  - CAD system at Sweetwater County Transit Authority (WY)
- Automated Trip Status Information
  - Winston-Salem Transit Authority (NC)
  - Rochester-Genesee Regional Transportation Authority (NY)
- Trip Verifications and Billing
  - Community Transit (Delaware County, PA)
  - City of Torrance (CA)
  - Delaware Authority for Regional Transportation (DART)
- Fleet Management
  - Cape Cod Regional Transit Authority (MA)
  - Blacksburg Transit (VA)
  - The Vine (Napa, CA)
  - Arc Transit (Palatka, FL)
  - Ann Arbor Transportation Authority (MI)
  - Sun Tran (Albuquerque, NM)
  - Kitsap Transit (Bremerton, WA)

Further investigation needs to be undertaken in order to properly select the locale/scenario that best illustrates a rural APTS success story. This is especially true for those categories in which a locale/scenario was not identified at this time.

Potential Benefits of the Booklet

As shown in Table 25, through the development of the Rural APTS Success Story Booklet as an overall time-saving tool, both users and operators of rural transit systems will receive some benefits.

Required Work Activities

This section presents an overview of the likely activities needed to support the development of the Rural APTS Success Story Booklet. The activities are presented as a series of functional requirements and cover how pertinent information will be obtained, analyzed, and presented.

Table 25. Potential Benefits of the Booklet

Benefits to Transit Users	Benefits to Transit Operators
▪ Better customer service ▪ Improved system responsiveness to user needs	▪ Improved understanding of ITS/APTS ▪ Collection of resources from which to obtain invaluable ITS/APTS information, contacts, and direction ▪ Assistance in identifying when/where APTS applications may be feasible and cost-effective ▪ Avoidance of problems and mistakes in planning, design, and procurement of APTS systems/technologies ▪ Better understanding of the institutional arrangements that may be necessary to allow a particular APTS system/ technology to be most effective

INTERVIEW SESSIONS

The primary source of information for the Rural APTS Success Story Booklet will be the agency(s) involved in implementing the successful APTS system or technology. Senior agency representatives or the lead person(s) involved in managing the APTS implementation project will be interviewed. It is anticipated that these interview sessions will be in the form of telephone calls: either one-on-one sessions or multiple-party teleconferences. Agencies/firms to be contacted include the following categories as applicable:

- Local transit agency
- FHWA/FTA
- Equipment/hardware supplier
- Software supplier/developer
- Systems integrator
- Technical/operations support team
- Evaluator
- Other public and private sector partners

LITERATURE SEARCH

In order to prepare for the interview sessions (as well as provide supplemental information), materials published from previously developed work will be utilized. It is anticipated that this information will be gathered from the following sources:

- Federal Agencies (FHWA, FTA, Volpe Center, etc.)
  - Endorsed publications
  - Current consultant activities
  - Rural Technical Assistance Program (RTAP)
  - Transit Cooperative Research Program
  - National Transit Institute (NTI)
- Other Agencies (State DOT, Regional Transit Authority, MPO, etc.)
  - Endorsed publications
  - Current consultant activities
- Community Transportation Association of America (CTAA)
- American Public Transit Association (APTA)
- ITS America
- National Technology Information Service (NTIS)
- Transportation Trade Journals
  - *ITE Journal*
  - *Inside ITS*
  - *Transportation Technology International*
- Rural APTS Success Story Booklet developer inherent knowledge/contact base

DATA/INFORMATION ANALYSIS

Data/information for inclusion within the Rural APTS Success Story Booklet should be of the highest quality possible. Previously published reports and data/information obtained from the interview sessions should be carefully summarized. In order for the contents to be credible and acceptable, a detailed reference section and strict footnoting policy should be followed. In this manner, previously published information and newly developed material should be clearly identified so that rural transit operators and policy decision-makers know the quality and source of the information that they are receiving.

BOOKLET PUBLICATION

The Rural APTS Success Story Booklet should be designed as a notebook so that new pages can be inserted as they become available. Words, concepts, and descriptions should be simplified to the greatest extent possible to ensure a basic understanding of

each case study across a range of operator knowledge/experience. Graphics, tables, and charts should also be used as appropriate to ensure that the case study concepts can be visualized along with their description. FHWA and FTA should promote the booklet through CTAA, RTAP, and APTA. The Rural APTS Success Story Booklet can be used as a public relations document.

PROGRAM ALTERNATIVES

This section presents two possible alternatives for preparing the Rural APTS Success Story Booklet concept and discusses the pros and cons of each approach. In addition, it relates the importance of the booklet to the future of ITS in rural transit applications and discusses anticipated FTA/FHWA, public agency, and private sector roles.

ALTERNATIVE APPROACHES

Basically, there are two primary approaches to developing the Rural APTS Success Story Booklet. The first would be for a joint FTA/FHWA in-house effort. The second calls for a consultant to undertake the development role with FTA/FHWA supervision. Activities included within the booklet development role would be the same for both approaches and the same level of review would also be required. Therefore, the pros and cons for each alternative approach should also be the same. In this case, it is a very subjective matter to determine which approach should be undertaken. The consultant option may make better use of FTA/FHWA resources by freeing-up key individuals to concentrate on other important ITS/APTS concerns.

BOOKLET IMPORTANCE

The Rural APTS Success Story Booklet is extremely important to the future of ITS/APTS in rural transit. Since resources available to most rural operators are relatively scarce and they barely have enough to keep their own services running, the booklet would allow them and other policy decision-makers to investigate available opportunities at low or no cost (i.e., only the time it would take to read the materials). In addition, most rural operators probably have little or no knowledge of available ITS/APTS options and probably also need realistic guidance on how to select the right solution(s) for their needs. The booklet would ease the uncertainty over what conditions make certain ITS/APTS opportunities appropriate for their agency and also how to take best advantage of those opportunities. Furthermore, the booklet would allow rural operators to become "informed consumers" of ITS/APTS on many fronts, including partnering opportunities, potential benefits, expected costs, and what they will need to do to make an ITS/APTS implementation successful in their region.

SUGGESTED ROLES

The following agencies will be involved in the development and distribution of the Rural APTS Success Story Booklet and will undertake the following roles and responsibilities:

- Consultant
  - Identify/select case study categories
  - Identify/select case study locales/scenarios
  - Develop case study contact list
  - Develop Rural APTS Success Story Booklet
  - Compile case study materials in a systematic treatment of general lessons learned and best practices
  - Develop/publish overall Information Kit
- FTA/FHWA
  - Provide Consultant access to all relevant ITS/APTS information sources at their disposal

- Review/select case study categories
- Review/select case study locales/scenarios
- Review Rural APTS Success Story Booklet
- Inform rural operators of the booklet's existence
- Publish/distribute booklet

WORK PLAN

The various tasks required to develop the Rural APTS Success Story Booklet, project duration, and preliminary cost estimate are presented in Table 26. The schedule and cost information assumes development of six case studies. However, the booklet should be maintained and updated on an on-going basis after the initial publication. This action plan is assigned a medium-term time frame because time is needed to get several rural APTS fully tested.

SUGGESTED TASKS, DURATION, AND COST

- Task 1 – Identify/Select Case Study Categories
- Task 2 – Identify/Select Case Study Locales/Scenarios
  - Select case study locales/scenarios
  - Develop case study contact list
- Task 3 – Develop Rural APTS Success Story Booklet
  - Arrange/conduct telephone interview sessions
  - Compile case study materials in a systematic treatment of general lessons learned and best practices (assume a 5-10 page document)
- Task 4 – Format, Edit, and Publish the Booklet

Table 26. Rural APTS Success Story Booklet: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Task 1 – Identify/Select Case Study Categories	.5 month	$ 3,000
Task 2 – Identify/Select Case Study Locales/Scenarios	1 month	$ 4,000
Task 3 – Develop Rural APTS Success Story Booklet	3.5 months	$ 40,000
Task 4 – Format, Edit, and Publish the Booklet	2 months	$ 13,000
TOTAL	**7 Months**	**$ 60,000**

TIME FRAME

Medium term (3 to 5 years)

TRAINING MATERIALS FOR RURAL APTS APPLICATIONS

The proposed Action Plan for developing Training Materials for Rural APTS Applications is described in this section.

PROBLEM STATEMENT

These training materials will include development of a Rural Transit Short Course or a Rural Transit Module for existing ITS/APTS training programs, particularly the ITS Professional Capacity Building (PCB) Program and the National Transit Institute training courses.

Primary reasons why training materials of this nature would be valuable to rural transit operators/services include, but are not limited to, the following:

- Not enough resources to investigate opportunities that may be available for running services more efficiently
- Lack of information available that would be pertinent to rural transit operators
- Lack of knowledge of available options:
  - Need for realistic guidance on available options
  - Uncertainty over what conditions make certain opportunities appropriate
  - Need to know how best to take advantage of those opportunities
  - Need information on partnering opportunities and barriers to partnering
  - Lack of knowledge of potential benefits of ITS/APTS
- Need for better understanding of rural transit "focus areas"
  - Project planning
  - Project definition
  - Procurement
  - Operations and maintenance
  - Management
  - Funding
- Need for political buy-in by elected officials

These training materials need to supplement and be coordinated with other ITS/APTS training courses, e.g. the ITS Professional Capacity Building courses and the NTI APTS training courses. In addition, appropriate findings from the Rural APTS Needs Study will be assessed/applied.

CONCEPT DESCRIPTION

The development of training materials for Rural APTS is described in detail in this section. In addition, other ITS training efforts that are under way or planned will be investigated. In short, these training materials will enable the development of a Rural Transit Module for inclusion in selected, existing training programs, particularly the ITS Professional Capacity Building (PCB) Program.

INTENDED AUDIENCE

The intended audience for these training materials is as follows:

- FHWA and FTA Headquarters and Field Personnel
- Regional, State, and Local Personnel
- Transit Properties Staff
- Local and County Planners
- City/County Transportation Agencies
- Elected Officials/Policy Decision-Makers
- Interested Private Sector Firms
- Community Transportation Association of America (CTAA)
- American Public Transit Association (APTA)
- American Planning Association (APA)

- American Association of State Highway and Transportation Officials (AASHTO)
- Institute of Transportation Engineers (ITE)

Potential participants will be middle management and technical professionals who directly influence program decisions (e.g., planning, funding) within their agency/firm.

Training Material Contents

These training materials would be modeled after similar materials produced through the current FHWA/FTA ITS PCB Program. In addition, these training materials may include information on the following topics:

- Basic information on ITS and APTS
  - Available options
  - Hardware, software, and communication considerations
- Rural transit user needs, specifically needs created by welfare reform
- Project planning and development
- Institutional issues and organizational structure
  - Potential partner agencies/firms (public and private sector)
  - Roles/responsibilities
  - Regional coordination
- Development and deployment considerations
  - Systems requirements analysis
  - Systems design
  - Alternative approaches considered
  - Deployment
  - Systems integration and testing
- Procurement alternatives and contracting options
- Potential benefits
- Expected costs
  - Capital costs
  - Operations and maintenance (O&M) costs
  - Project approval and funding
  - Training costs
- Operations management
  - Staffing
  - Training
  - Funding
    - Cost-sharing arrangements
    - Revenue sources
- Lessons learned
  - Experience gained from implementation
  - Agency/operator insights
  - ITS/APTS project lessons
  - Evaluation results
- National ITS Architecture considerations
- Deploying integrated ITS/APTS systems within a region

Training Course Approach

At this time, there are a number of ITS training courses that have been developed and are being taught around the country. Unfortunately, there is currently little information that would be pertinent to rural transit operators. While this is not unexpected given that most of these courses are taught in major metropolitan areas, some information on rural transit needs to be conveyed to interested parties in order that they may successfully improve their operations and service. There are two primary recommendations for getting this information across, as follows:

- **Rural Transit Short Course**. The first approach is to develop a short course (probably a maximum of one day) specifically on rural APTS applications. This training material could then be targeted to specific areas that express an interest in receiving training. Then, these materials could be used at a gathering of

individuals who have responsibility for rural transit, or with a collection of operators who have an interest in the subject. Because it may not be economical to conduct the training in many areas due to smaller audience sizes, the training materials would also be designed to facilitate a "self-taught" approach. In this manner, the training materials can meet a two-fold purpose, both as a training guide and as self-instructional material.

- **Rural Transit Module**. The second approach for disseminating rural transit information would involve the development of a Rural Transit Module for incorporation into selected, existing training programs, particularly the ITS PCB Program. This module would be designed in such a way that it could be included or excluded, depending on the nature of the audience to which the class is being taught. In fact, multiple modules would likely be necessary. The first idea is to develop a module that focuses more on planning and project definition elements. The other is to develop a module that focuses on procurement and operations management issues. Discussions need to be held with responsible FHWA/FTA staff to specifically identify which rural transit modules may be appropriate for inclusion within existing training programs.

The developed materials for the Rural Transit Module will be included within the Rural APTS Short Course to the greatest extent possible.

DELIVERY APPROACH

A variety of delivery methods and formats should be pursued to better reach the diverse rural audiences. Methods of delivery include:

- Training workshops at annual and regional CTAA meetings
- Audio tapes with a manual/workbook
- Part of the ITS Professional Capacity Building (PCB) Program
- Part of the National Transit Institute's training curriculum
- Part of the Rural Technical Assistance Program
- Long distance, televised training sessions

POTENTIAL BENEFITS OF THE TRAINING MATERIALS

The expected benefits of these training materials to both users and operators of rural transit systems are shown in Table 27.

REQUIRED WORK ACTIVITIES

This section presents a brief overview of the operating concepts that support the development of the Rural APTS Training Materials. This information is presented through a series of functional requirements and covers how pertinent information for inclusion will be obtained, analyzed, and presented.

LITERATURE SEARCH

The primary source of information used to develop the Rural APTS Training Materials will be an in-depth literature search. This information will be gathered from the following sources:

- Federal Agencies (FHWA, FTA, Volpe Center, etc.)
  - Endorsed publications
  - Current consultant activities
  - Rural Technical Assistance Program (RTAP)

Table 27. Potential Benefits of the Training Materials

Benefits to Transit Users	Benefits to Transit Operators
• System improvements to make it more responsive to user needs • Increased reliability • Increased safety/security • Improved access to information	• More in-depth understanding of rural APTS applications by those who are interested • Broader understanding of potential rural transit ITS applications by those who are not necessarily involved in rural transit • Better understanding of how APTS can work successfully • Avoidance of problems and mistakes in planning, design, and procurement of APTS systems/technologies • Better understanding of the institutional arrangements that may be necessary to allow a particular APTS system/technology to be most effective

- Other Agencies (State DOT, Regional Transit Authority, MPO, etc.)
  - Endorsed publications
  - Current consultant activities
- ITS America
- Community Transportation Association of America (CTAA)
- American Public Transportation Association (APTA)
- National Transit Institute (NTI)
- Transit Cooperative Research Program (TCRP)
- National Technology Information Service (NTIS)
- Transportation Trade Journals
  - *ITE Journal*
  - *Inside ITS*
  - *Transportation Technology International*

Interview Sessions

If necessary, interview sessions will be conducted with rural APTS experts and those agencies/individuals who are involved with implementation efforts. Potential agencies/firms that may be contacted include the following:

- Local transit agency
- FHWA/FTA
- Consultants
- Equipment/hardware supplier

Data/Information Analysis

Data/information for the Rural APTS Training Materials should be of the highest quality possible. In order for the contents of the Training Materials to be credible and acceptable a detailed reference section will be included. In this manner, previously published information and newly developed materials will be noted so that rural transit operators and policy decision-makers know

the quality and source of the information that they are receiving.

Training Materials

Rural APTS Training Materials will include the following:

- **Slide Presentation**. A full-color slide presentation will be developed, most likely in a "Power Point" format.
- **Participant's Guide**. A bound, black-and-white document version of the slide presentation will be developed for the training course participants. This guide will most likely have two slides on one page, with the subsequent page left blank for note-taking. This guide is to be used in conjunction with the slide presentation and to be taken home by the participant.
- **Instructor's Guide**. This guide will be very similar to the Participant's Guide. However, this guide also includes the notes that the instructor will be presenting to the training class. It will follow a one slide per page format with the corresponding notes listed below each slide. This guide will also be used as self-instructional materials.
- **Video**. A full-color video will be prepared focusing on rural transit needs and opportunities for advanced technologies. Successful APTS of several rural transit systems should be showcased. The video should be about 12 to 15 minutes long. It should include scenes of real field applications and testimonies from transit operators and riders.

Words, concepts, and descriptions will be simplified to the greatest extent possible to ensure a basic understanding of rural APTS across a range of operator knowledge/ experience. Graphics, tables, and charts will also be used as appropriate to ensure that the rural APTS concepts can be visualized along with their descriptions. In addition, distribution of the training materials will be available from the FHWA and FTA to all interested parties.

Program Alternatives

This section presents two possible alternatives for advancing the Rural APTS Training Materials concept and discusses the pros and cons of each approach. In addition, it relates the importance of the training materials to the future of ITS in rural transit applications and discusses anticipated FTA/FHWA, public agency, and private sector roles.

Alternative Approaches

Basically, there are two primary approaches to developing the Rural APTS Training Materials. The first would be for a joint FTA/FHWA in-house effort. The second calls for a consultant to undertake the development role with FTA/FHWA supervision. It is anticipated that activities included within the training materials development role would be the same for both approaches and that the same level of review would also be required. Therefore, the pros and cons for each alternative approach should also be the same. In this case, it is a very subjective matter to determine which approach should be undertaken. However, the consultant option may make better use of FTA/FHWA resources by freeing-up key individuals to concentrate on other important ITS/APTS concerns.

Training Materials Importance

The Rural APTS Training Materials are extremely important to the future of ITS/APTS in rural transit, since resources available to most rural operators are relatively scarce and they barely have enough to keep their own services running. The training materials would allow them and other policy

decision-makers to investigate available opportunities at low or no cost (i.e., only the time it would take to read the materials or attend the course). In addition, most rural operators probably have little or no knowledge of available ITS/APTS options and probably also need realistic guidance on how to select the right solution(s) for their needs. The training materials would ease the uncertainty over what conditions make certain ITS/APTS opportunities appropriate for their agency and also how to take best advantage of those opportunities. Furthermore, the training materials would allow rural operators to become "informed consumers" of ITS/APTS on many fronts, including planning, project definition, procurement, operations management, partnering opportunities, potential benefits, expected costs, and what they will need to do to make an ITS/APTS implementation successful in their region.

SUGGESTED ROLES

It is anticipated that the FTA and FHWA will direct a consultant in the development and distribution of the Rural APTS Training Materials. The roles and responsibilities will be:

- Consultant
  - Develop learning objectives/establish intended audience
  - Develop module/course outline(s)
  - Develop module/course materials
  - Present module/course Walk-Thru
  - Revise module/course materials
  - Present module/course Pilot
  - Revise module/course materials
  - Develop video materials
  - Develop/publish final training materials
- FTA/FHWA
  - Provide Consultant access to all relevant ITS/APTS information sources at their disposal
  - Review learning objectives/establish intended audience
  - Review module/course outline(s)
  - Review module/course materials
  - Attend/review module/course Walk-Thru
  - Review revised module/course materials
  - Attend/review module/course Pilot
  - Review revised module/course materials
  - Inform rural operators of the training materials' existence
  - Publish/distribute/deliver final training materials

WORK PLAN

The tasks that will need to be accomplished for the development of the Rural APTS Training Materials, the anticipated project duration, and a preliminary cost estimate are presented in Table 28.

Table 28. Training Materials for Rural APTS Applications: Proposed Tasks, Duration, and Cost Estimate

TASKS	DURATION	COST
Task 1 – Develop Learning Objectives/Establish Intended Audience	.5 month	$1,500
Task 2 – Develop Module/Course Outline(s)	.5 month	$ 4,000
Task 3 – Develop Module/Course Materials	3 months	$ 50,000
Task 4 – Present Module/Course Walk-Thru	.5 month	$ 4,000
Task 5 – Revise Module/Course Materials	1 month	$ 10,000
Task 6 – Present Module/Course Pilot	.5 month	$ 7,000
Task 7 – Revise Module/Course Materials	.1 month	$ 10,000
Task 8 – Prepare Video Materials	2 months	$ 25,000
Task 9 – Develop/Publish Final Training Materials	1 month	$ 8,500
TOTAL	**8 Months**	**$ 120,000**

TIME FRAME

Near term (1 to 2 years)

CHAPTER 7: EVALUATION AND RECOMMENDATIONS

This chapter describes the process for evaluating and prioritizing the nine potential action items for rural APTS. The chapter concludes with the study team's recommendations for next steps.

EVALUATION AND PRIORITIZATION

To evaluate the actions, the study team agreed upon using the following criteria:

- FHWA/FTA priority, in terms of the ITS Goals as stated in the Rural ITS Strategic Plan
- Costs, both capital and operating costs
- Need, assessed in terms of the needs met and issues addressed by each action concept
- Operator benefits, such as reduced unproductive vehicle and driver time, improved supervision, improved record keeping, increased ridership, improved passenger and driver safety
- Rider benefits, such as improved quality of service, improved passenger safety, increased customer satisfaction
- Technical feasibility, in terms of ease of implementation
- Breadth, the ability of the application to be useful for different systems in different environments
- Potential to attract new riders, which is a goal of transit systems.

Using these evaluation criteria, study team and the expert panel members individually ranked each action item in relative priority from one (highest priority) to nine (lowest priority). The rankings were totaled to determine the criteria score for each action item. The lower the score meant the higher the priority.

Table 29 presents the results of the evaluation and prioritization process. This table shows the priority ranking of the action items. The table also summarizes information on when the action item should be addressed (near term, mid term, or long term), what it would cost, and how long the process of completing the action might take. These activities and their rankings do not necessarily reflect the opinions of the U. S. Department of Transportation or any other Federal agency.

Based on the evaluation process, the study team recommends that FHWA and FTA consider all nine actions and implement the actions according to their priority. The four action items with the highest relative priority are:

1. Develop a rural transit operator Information Kit
2. Prepare a Rural APTS Success Story Booklet
3. Plan and conduct demonstrations of low-cost technologies
4. Develop specific training materials for rural APTS applications

RECOMMENDATIONS FOR NEXT STEPS

As follow-up to the *Rural Public Transportation Technologies: User Needs and Applications* study, there are a number of suggested steps for FHWA and FTA to pursue. One of the next steps is to consider these action items in future updates of the U.S. DOT's Rural ITS Program Plan.

Table 29. Recommendations and Prioritization

Ranking	Action Item	Duration	Time Frame[1]	Estimated Cost	Criteria Score[2]
1	**Rural Transit Operator Information Kit**	6 Months	Near Term	$75,000	29
2	**Rural APTS Success Story Booklet**	7 Months (then on-going)	Near Term	$60,000	35
3	**Demonstration of Low-Cost Technologies, e.g., Bus Arrival Notification System**	24 Months	Medium Term	$265,000	38
4	**Training Materials for Rural APTS Applications**	8 Months	Near Term	$120,000	48
5	**Fleet Management Operational Test**	46 Months	Medium Term	$850,000	59
6	**Broader Market Research Study**	12 Months	Medium Term	$280,000	62
7	**Shared Technology Infra-structure Operational Test**	40 Months	Medium Term	$800,000	64
8	**Trip Verification and Billing Operational Test**	36 Months	Long Term	$780,000	79
9	**Automated Trip Status Operational Test**	36 Months	Medium Term	$650,000	82

[1] Time Frame:
Near Term = 1-2 years
Medium Term = 3-5 years
Long Term = 6-10 years

[2] Criteria Score: The lower the score the higher the priority ranking

The updates should include timetables for addressing the APTS priorities and identify potential sites for the demonstrations and operational tests.

Potential sites should be identified based on site characteristics, not by place.

In addition, the following action items are recommended as the next steps toward development and application of APTS technologies in rural and small urban areas:

- Allocate funding for near-term priority action items:
  - Rural transit operator Information Kit
  - Rural APTS Success Story Booklet
  - Training materials for rural APTS
- Design and conduct a broader market research study for rural APTS.
- Solicit proposals for demonstrations of simple technology solutions.
- Identify potential sites/problems for operational tests.

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