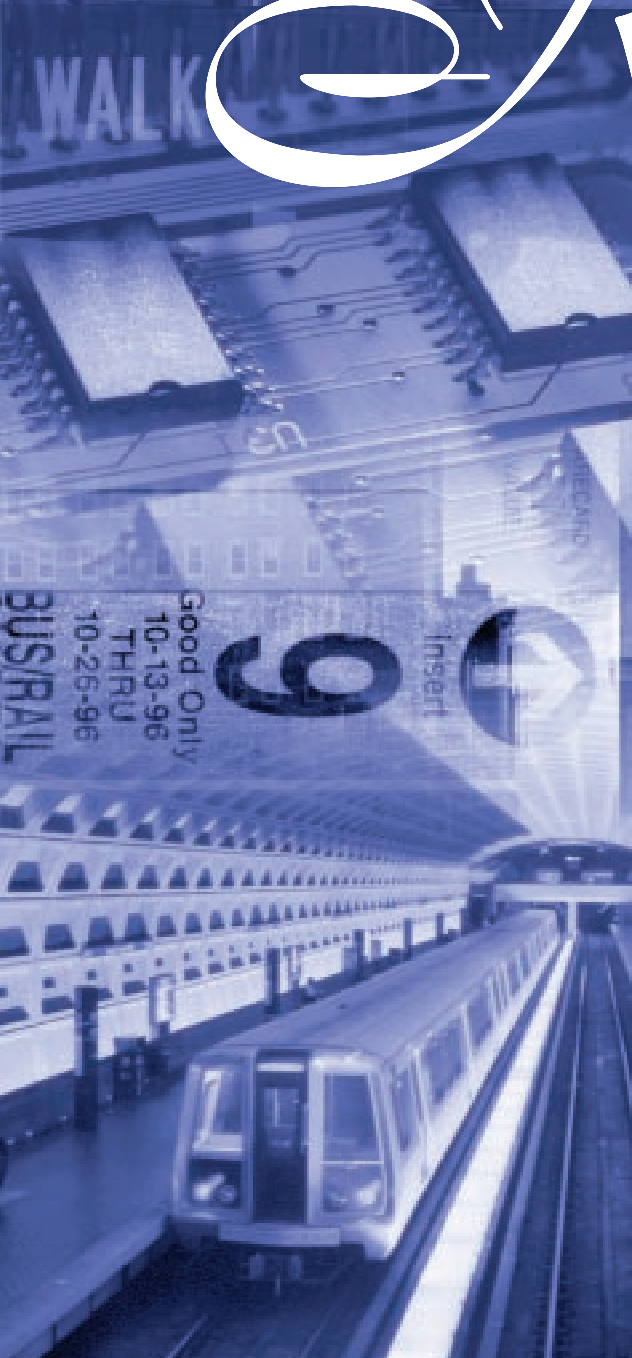

ROADS LESS TRAVELED

Intelligent Transportation Systems for Sustainable Communities

PUBLIC TECHNOLOGY, INC.

EPA's Transportation Partners

ROADS LESS TRAVELED

Intelligent Transportation Systems for Sustainable Communities

PUBLIC TECHNOLOGY, INC.
1301 Pennsylvania Ave. NW
Washington, DC 20004-1793
202.626.2400 ■ 800.852.4934
FAX: 202.626.2498
INTERNET: http://pti.nw.dc.us
PUBLICATIONS CENTER: pubs@pti.org

EPA's Transportation Partners

PTI PUBLIC TECHNOLOGY, INC.

Dear Official:

"Two roads diverged in a wood, and I—
I took the road less traveled by,
And that has made all the difference."

—Robert Frost

Choosing the right path for a sustainable transportation policy is a daunting responsibility. Local leaders nationwide seek ways to cut auto traffic, reduce pollution, boost safety, promote economic growth without encouraging sprawl, and offer better access to services and jobs for residents. Technological innovations are opening up new avenues for local governments and decision-makers, but on the road less traveled, pitfalls and potholes threaten those without direction.

One answer to these challenges has received significant federal and local investment since 1991: **INTELLIGENT TRANSPORTATION SYSTEMS (ITS),** information technology that can be used by transportation managers to automate and monitor transportation and inform travelers about their options. ITS promises to lighten auto traffic congestion and make public transit more convenient. But even as these approaches offer answers to some old problems of road use, they raise new questions for policy-makers: can these systems and technologies become part of the climate change solution by reducing greenhouse gas emissions?

Intelligent transportation systems within the sustainable community context such as signal prioritization for buses and light rail vehicles, variable message signing at park and ride lots to give motorists the alternative to use transit, environmental forecasting for traffic control, congestion pricing with electronic tolling, pre-trip information systems, automatic vehicle location systems, and other systems used as combined strategies and with transportation policy and pricing mechanisms can go a long way in helping communities get a handle on the rising percentage of vehicles miles traveled.

The communities highlighted in this booklet have chosen new paths through intelligent transportation systems. By harnessing existing resources with new technologies, ITS propels *sustainable local development* by enabling communities to use those resources now and in the future. **SUSTAINABLE DEVELOPMENT,** which the World Congress on Economic Development defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," emphasizes the important interdependency of environment, economy and social equity.

Five central objectives for sustainable transportation are discussed:

- **Options and Access for Citizens** (page 13);
- **Better Tools for Moving People** (page 19);
- **Fair Pricing for Transportation** (page 23);
- **Moving Goods** (page 29); and,
- **Shaping the City** (page 33).

Transportation Planning and Air Quality, page 39, briefly discusses the relationship between ITS and "conformity" requirements related to achieving clean air standards.

Getting ITS Off the Ground, page 41, gives an overview of financing and partnership arrangements necessary for successful intelligent transportation systems. Suggestions for meeting technical challenges also are offered. **Resources,** page 75, provides tips for further reading and Internet research. Terms and concepts featured in the Resources section appear in boldface throughout this guidebook. A **Glossary** at the back provides definitions of terms, which are highlighted in bold, all caps, throughout the book.

Success Stories, beginning on page 45, offer recent examples of communities that have put intelligent transportation systems to the test by delivering more efficient, accessible and sustainable services.

New technology is as exciting as it is risky: It can take us down roads we never imagined, leading to consequences we never anticipated. The aim of this booklet is to encourage local decision-makers to take control of the opportunities before them, to steer firmly down these virtual "roads less traveled" to reduce pressure on the real roads and routes in their communities.

ACKNOWLEDGMENTS

PTI URBAN CONSORTIUM TRANSPORTATION TASK FORCE

Douglas W. Wiersig, *Chair*
Director, Transportation Programs and Policy
City of Houston, TX

Albuquerque, NM
Atlanta, GA
Austin, TX
Baltimore, MD
Boston, MA
Chicago, IL
Clark County, NV
Columbus, OH
Delta County, MI
Denver, CO
Everett, WA
Fort Worth, TX
Hennepin County, MN
Houston, TX
Los Angeles County, CA
Metro-Dade County, FL
Milwaukee, WI
Monroe County, NY
Montgomery County, MD
New York, NY
Orange County, FL
Philadelphia, PA
Phoenix, AZ
Portland, OR
San Antonio, TX
San Diego, CA
San Francisco, CA
San Jose, CA
Scottsdale, AZ
Seattle, WA
Tucson, AZ
Washington, DC

Roads Less Traveled: Intelligent Transportation Systems for Sustainable Communities was produced by Public Technology, Inc. (PTI) with funding from the U.S. Environmental Protection Agency (EPA), through its Transportation Partners Program.

The development of this booklet has been the most challenging of any of the PTI transportation research publications to date: to help decision-makers in neighborhoods, local governments, metropolitan planning organizations and states understand the potential relationship between ITS, sustainable development and climate change, with the intent to chart a cleaner, more mobile, and prosperous future.

Thanks go to Gil Schamess and Lisa Wormser, of Two Heads Communications, who researched and authored the book; Kathleen Guzda and Kathy Springuel who edited it; and the Urban Consortium Transportation Task Force, David Van Hattum, Thomas Horan, Todd Litman, Michael Replogle, Ronald Boenau, Ralph Cipriani, Laurie Radow, Don Chen and others for their valuable critique of this book. Special thanks go to Paula Van Lare, EPA for her support and contributions to this book.

At PTI, Robert Hicks, business director for transportation programs, oversaw the project from concept to completion; Taly Walsh, director of communications, managed the book's writing, editing, design and production. Andrea Brown, communications specialist, assisted.

Washington, D.C.-based Lomangino Studio Inc., and Cesar Caminero, freelance graphics artist, designed the publication.

PTI is the non-profit technology R&D organization of the National League of Cities, the National Association of Counties, and the International City/County Management Association. Since 1971, PTI has tapped collective research by its member jurisdictions and partnerships with private industry to create and advance technology-based products, services, and enterprises in cities and counties nationwide.

PTI's membership includes the Urban Consortium (UC), a special network of the nation's largest cities and counties. Working in five task forces (Transportation, Environmental, Energy, Telecommunications/Information, and Public Safety), UC jurisdictions identify and test new solutions to common concerns and share their findings with a wide audience of local governments, large and small.

The UC Transportation Task Force guides PTI's Local Government Intelligent Transportation Systems (ITS) Program, which ties advanced transportation technology research, planning, and implementation activities to the needs of local government. Through this program, city and county officials work actively with federal agencies and private technology firms to develop a nationally compatible ITS architecture and to ensure that new ITS applications meet local requirements.

CONTENTS

WALK

INTRODUCTION

> *I see a community that looks a lot like it does now, but with kinder and gentler roads. A place where technology [and economic growth] will not radically change things, but will offer more choice and a lot more quality of life.*

—Local official at a 1995 PTI focus group defining his vision for transportation in his community.

While ITS has received significant federal and local investment since 1991, some local leaders, environmental advocates and research groups shunned this federal program because it originally focused on increasing roadway capacity. Those critics felt that adding more highway capacity was not the smart solution. But gradually, they began to see other ways to use the federal initiative, and opinions have changed as the program has matured. Today, intelligent transportation systems are applied intermodally to improve mass transit and ridesharing, as well as to enhance road capacity.

Roads Less Traveled seeks to encourage a positive view of intelligent transportation systems: That ITS technologies, selectively applied, can provide sustainable solutions for transportation problems in metropolitan areas, towns and rural communities. Many communities already are using these applications to contribute to a vision for "roads less traveled:" clear thoroughfares, few wasted trips, safe travel, more options and healthy neighborhoods.

ITS AT WORK

In Spokane, Washington, transit users can shop, grab a bite to eat, or simply people-watch—rather than stand uncomfortably at a gate—while awaiting their bus at the new Plaza transit hub. An **AUTOMATIC VEHICLE IDENTIFICATION SYSTEM (AVI)** pinpoints approaching buses as they come within a block of the terminal and posts announcements of impending arrivals, schedules and route designations. AVI doesn't just make travel by public transit more convenient for citizens, it makes the Plaza possible: Before the technology was put in place, Spokane couldn't manage the logistics of a central bus plaza, and buses clogged curbs at 20 different transfer locations throughout the city.

The new OmniLink transit-on-demand service in exurban Prince William County, Virginia, blends traditional fixed-route service for local residents with route deviation as needed. Using a **GEOGRAPHIC INFORMATION SYSTEM (GIS)** and **AUTOMATED VEHICLE LOCATION (AVL)**—both included under the designation ITS—OmniLink accurately pinpoints the address of users waiting for pickup and cuts advance notice needed for off-route trips from as much as two days to two hours.

THE ROOTS OF SUSTAINABLE ITS

In 1990, just as the interstate highway system was nearly complete, local decision-makers and citizen groups shifted national attention to the building blocks of the nation's transportation system: local infrastructure systems designed to satisfy diverse users. The *Intermodal Surface Transportation Efficiency Act of 1991* (ISTEA) officially recognized that transportation policy should be broadened to give equal consideration to all modes of transport, and that systems must address complex environmental, economic and social goals.

In 1992, a grassroots environmental movement that began in the 1970s achieved global impact when representatives of more than 150 nations gathered at the Earth Summit in Rio de Janeiro. Participants pledged to encourage ***sustainable development***, which the World Congress on Economic Development defined five years earlier as "***development that meets the needs of the present without compromising the ability of future generations to meet their own needs***." The concept emphasized the importance and interdependency of environment, economy and social equity.

Advocates of sustainable development called attention to one program authorized by ISTEA, the ***Intelligent Vehicle and Highway Systems*** (IVHS) program, which they believed was too narrow. Since their early warnings about the potential impacts of IVHS, the program has been expanded to include ***advanced public transportation systems*** (APTS). In 1994, IVHS was renamed the Intelligent Transportation Systems to reflect the change of policy, and now includes a $1.3 billion initiative to explore a spectrum of advanced information technologies that enhance transportation management and operations across modes.

In Phoenix, Arizona, the Bus Card Plus program is helping businesses meet annual goals for reducing auto trips by solitary drivers. These "smart" transit passes enable employers to track employee use of public transit and document trip-reduction efforts. The passes also reward frequent users of public transit with lower fares. Other ITS applications in Phoenix have streamlined ridesharing programs, helping 1,500 companies to reduce single-passenger automobile travel by 3.3 million miles per week.

Many more examples of successful applications of intelligent transportation systems are detailed in the final section of this booklet, beginning on page 45.

SUSTAINABILITY: A LOCAL SOLUTION

County, city and town governments manage infrastructure and natural resources and set policy for land use, transportation and economic development. For local decision-makers, sustainable development offers a new perspective of the tradeoffs, costs and benefits of decisions in these areas. Sustainable choices recognize the interdependence of three E's: Environment, Economy, and social Equity, key components in local efforts to improve quality of life.

Sustainable communities use essential resources wisely, protecting the air and drinking water and preserving the natural landscape. Maintaining and enhancing the built environment are also part of this approach, with priority given to the beauty and usefulness of buildings and public spaces, safety and cleanliness in commercial and residential neighborhoods, and the preservation of historic structures and sites. The commercial sector of a sustainable community relies on price signals that reflect the true costs and benefits of goods and services. Government decision-makers and business leaders support the interdependence of the economy and other local objectives, such as equal access to job opportunities for all residents and a high level of regional quality of life that is attractive to corporations seeking to expand or relocate.

The President's Council on Sustainable Development (PCSD) report, entitled "Sustainable America: A New Consensus for the Future," lays out a national strategy for an action plan for sustainable development. According to PCSD, in order for this progress to happen it will require reforming the current system of environmental management and building a new and efficient framework based on performance, flexibility linked to accountability, extended product responsibility, tax and subsidy reform, and market incentives.

Similarly, to ensure equal opportunity of the benefits of sustainable communities, governments must ensure that housing options, recreation and services are available to people of all incomes, ages and ethnic backgrounds.

FROM MOBILITY TO ACCESSIBILITY

For the past 50 years, the nation has invested in maximum mobility for individual motorists by building and expanding roads, highways, tunnels, bridges and parking facilities. That investment has continued by maintaining and operating this infrastructure. But as problems associated with our reliance on cars have become more and more apparent, the original goal of quality highways has given way to a larger vision of quality trips—by any mode within an integrated system. But functional efficiency is not enough: A system also must serve more ambitious community goals, such as preserving open space and trees; reducing noise, water and air pollution; protecting natural areas and agricultural land; and enhancing existing neighborhoods.

Myth

"Smart transportation" is for dreamers. It involves a lot of pie-in-the-sky, high-tech, high-maintenance equipment the average person wouldn't understand.

Truth

In fact, many "advanced" concepts have been used here and abroad for decades. Traffic control centers and emergency management systems are two examples. Intelligent transportation systems are simply the transportation-specific applications of many existing technologies. For example, some ITS applications use the Global Positioning System devised years ago by U.S. military; others use geographic information systems, which have been in development since 1964 and have been used by local governments, archaeologists on "digs" and environmentalists in the field since the mid-1980s.

> “With all our diversity, sometimes it is hard to see how each of the E’s [Environment, Economy, Equity] unites us: We all inhabit the same landscape, breathe the same air and drink the same water. However and wherever we earn our living, the economies of our cities and suburbs are interdependent, and they succeed or fail as one. Our lives are embedded in far-reaching networks of neighbors, family, friends and colleagues that stretch across racial, economic, physical and political boundaries.”
>
> —Robert D. Yaro and Tony Hiss, *A Region at Risk: The Third Regional Plan for the New York-New Jersey-Connecticut Metropolitan Area*, Island Press, Washington, D.C., 1996, p. 6.

Many of these goals are intrinsic to the term **ACCESSIBILITY**. Whereas **MOBILITY** refers to “the movement of people and goods to and from destinations as quickly as possible,”[1] accessibility may be defined as the ability of people to benefit from places and services. Maximum mobility is not always the best method for creating such opportunities, specially when the emphasis is on efficient travel over long distances.

Accessibility focuses on making destinations attractive and efficient, by locating services within walking or biking distance of homes and jobs; encouraging compact, mixed-use development around transit stops; and discouraging sprawl. Conventional and advanced information services, from phone information to the Internet to telecommuting programs, can help smooth local travel and eliminate trips.

Several basic steps are key to a sustainable transportation system:

- Maintenance of the existing system;
- Focus on improving linkages, accessibility and efficiency rather than on adding road capacity to address traffic congestion;
- Strategies to promote fair pricing of trips and identify their true costs to travelers;
- Commitment of revenues to transportation that will serve all citizens; and,
- Transportation decisions that incorporate the interdependent goals of a healthy environment, robust local economy, equity for all citizens, and high quality of life.

No single transportation strategy can address all facets of sustainability. But a combination of approaches—such as discounted parking for carpools, property-tax relief for businesses that locate near bus and rail routes, incentives for transit-oriented development that include affordable housing, and the “smart technologies” discussed throughout this booklet—can make a significant contribution.

ECONOMICS OF SUSTAINABLE TRANSPORTATION: UNRAVELING THE MATH

The economic benefits of minimizing travel time cannot be ignored: “Mobility…remains a critical concern among both transportation planners and the public, and the promise of facilitating economic growth remains a powerful justifica-

1 Horan, T., and D. Jordan. *Background Information on the Linkages Between Intelligent Transportation Systems and Sustainable Communities*. Paper presented at the Transportation Research Board 21st Century Transportation Infrastructure Symposium, Dec. 1996, p. 11.

tion for emphasizing mobility as the primary goal of transportation policy."[2] Sustainable transportation policy balances the promise of economic growth with economic realities and community goals, recognizing that prices for today's transportation services must be adjusted if they expect individuals to make economical choices. At the moment, too many factors affecting the costs of transportation are obscure to the average traveler: hidden subsidies such as tax-deductible employee parking; external costs such as congestion and pollution; and even public policies such as zoning requirements that make low-density development the most profitable kind.

Across the country, new local transportation policies are indeed encouraging links among economy, environment and equity.

- As the transit mission has evolved over the last quarter century in the budget processes of local and state governments, three transit policy functions have won enduring widespread public support. Nearly all urbanized areas subsidize transit services that provide a basic level of affordable regional mobility. In numerous severely congested urban travel corridors, the use of rapid transit to bypass congested highways has proven effective for keeping traffic congestion within tolerable limits. Finally, in many communities, high-quality transit services sustain mixed-use development patterns in which prosperous households and businesses achieve large efficiencies through the reduced cost of auto ownership and infrastructure.
- Cities and rural counties are factoring transportation into new welfare-to-work strategies.
- New methods are being sought to price transportation services more closely to their actual cost.

The private sector, too, is devising new shipping practices that complement sustainable transportation policies. Shipment tracking and rerouting methods avoid delays; production strategies reduce unnecessary trips. Partnership with local government is critical to these private efforts, yet little coordination has taken place across modes or jurisdictions.

WARNING: ROAD FORKS AHEAD

Much of the federal and private investment in development of advanced traveler information systems is devoted to route-guidance, parking availability and real-time traffic updates for automobile drivers. Although it appears this can reduce distance (lowering emissions for some individual trips) and ease congestion (also lowering emissions, as well

2 Horan, T., and D. Jordan. *Background Information on the Linkages Between Intelligent Transportation Systems and Sustainable Communities.* Paper presented at the Transportation Research Board 21st Century Transportation Infrastructure Symposium, Dec. 1996, p. 11.

Myth

Intelligent transportation systems only move traffic more quickly.

Truth

Smart systems can be used to gather data to improve system performance; aid in assessing through-travel, identify freight trends, and other local concerns; help planners to assess future land use and facility needs, (especially parking); educate citizens about their rights and responsibilities as transportation customers; and generate revenue for local governments through the sale of data. ITS also can improve safety and help law enforcement officials, provide new tools to enhance partnerships among local agencies, and strengthen regional and city-state cooperation.

> “Advanced public transportation management systems in 265 actual or planned deployments will save transit operators between $3.8 billion and $7.4 billion over the next 10 years (1996 dollars).”

—U.S. Department of Transportation. *Implementation of the National Intelligent Transportation Systems Program: 1996 Report to Congress.* John A. Volpe—National Transportation Systems Center, Cambridge, Mass., 1997, p.101

as the costs due to delay), the added convenience to car use could overshadow the use of public transit, bicycling and walking. Appropriate pricing strategies will be essential to avoid this.

ITS—INTELLIGENT TRANSPORTATION SUSTAINABILITY

A number of intelligent transportation applications can make transportation policies more compatible with sustainable development. By enhancing operations, providing personal access to information about travel choices, and making more sophisticated pricing mechanisms possible, these applications can help distribute travel throughout the intermodal transportation system to take advantage of overall system capacity.

Public Technology, Inc., has identified 14 advanced applications in five categories that can help to shape a sustainable transportation system:

TRANSIT OPERATION

Advanced public transportation systems (APTS) are designed to make transit service more reliable, reduce travel times, improve response time to accidents, and make paratransit services more flexible. Transit operators also benefit from enhanced cost-effectiveness, maintenance and planning through automatic data collection and improved real-time scheduling of vehicles.

- ***Automatic vehicle location systems*** use **GLOBAL POSITIONING SYSTEMS (GPS)** and computer systems to track the real-time location of mass transit vehicles, to assist in dispatching and other operations; automatic vehicle identification systems use a variety of methods to identify when mass transit by vehicles reach a specified point en route.
- ***Traffic-signal preemption for transit vehicles*** can change the timing of red lights, allowing buses and light rail transit vehicles to make up lost time, and giving emergency vehicles control over traffic flow. Systems are sometimes automatic, sometimes controlled by vehicle operators.
- ***Automated passenger counters*** record the number of passengers boarding and alighting at each transit stop, and can convey that information periodically or in **REAL TIME**, depending on the system. Smart paratransit systems use computerized dispatching with GIS to coordinate on-demand pick-up and drop-off of customers.

ENVIRONMENTAL MANAGEMENT SYSTEMS

These systems are being used extensively in Europe to demonstrate the usefulness of sustainable ITS solutions for protecting and improving the environment. They have been integrated with traffic management and control systems. Decisions about dramatic route guidance, public transit priority, road and parking pricing systems and the selection of transportation modes could be influenced by the information gathered from these systems.

- ***Environmental forecasting systems*** predict poor local air quality in real time and then initiate effective traffic demand management measures to reduce pollution levels in particular problem areas.
- ***Environmental monitoring systems*** produce data about air quality, vehicle emissions and traffic flow, which can be used to monitor and evaluate effects in order to assess the environmental impacts of installed systems on a broad basis.

ELECTRONIC FARE AND TOLL PAYMENT SYSTEMS

- ***Integrated smart cards*** offer several forms of "one-stop shopping" for transportation services through a single electronic debit card equipped with a readable computer chip. The **SMART CARD** can be debited by the trip—whether on a toll road, bus, train or some combination—and the system can alter the price of service by time of day and demand. Thus, the user can be rewarded with a rebate for using public transit during rush hour, or driving off peak hours. Some transit systems have explored integrating cards with other debit payment systems, such as automated teller machines and credit cards. And in large metropolitan areas, such as Chicago, where one transit trip can involve several transit operators, smart cards are being used to ensure seamless transfer from one system to the next.
- ***Electronic road and parking pricing systems*** apply charges electronically to allow variation based on time of use, class of vehicle, prevailing level of congestion, environmental factors, purpose of journey, high/low vehicle occupancy (HOV), and other access rights. (For example, a single-occupancy vehicle using an express lane during peak hours could pay a premium over a carpool using the lane). Smart cards are one kind of medium for this type of pricing, although radio-frequency **TOLLTAGS** and **TRANSPONDERS** (radio devices that respond to a designated incoming signal) have been the first choice on toll roads because they allow cars to pass through toll booths without stopping. Advance information via television and the Internet, combined with variable message signs on the roadway, can alert drivers about increased charges for road

BENEFITS OF SUSTAINABLE ITS

	Time Savings	Less Congestion	Local Cooperation	Operational Efficiency/Cost Savings	Safety	Potential Less Impact on Environment	Improved Access
Automated Vehicle Location **Benefits:** These systems increase transit system efficiency, often allowing fewer vehicles to meet the same level of service, and are necessary for real-time information systems. Smart paratransit technologies reduce the lead time needed for trip requests and enhance access for non-drivers, particularly important in low-density areas.	■	■	■	■	■	■	
Traffic Signal Preemption for Transit Vehicles **Benefits:** This approach to traffic management helps to keep buses on schedule and supports emergency vehicles trying to move through busy streets. When used for public transit, traffic signal preemption also puts bus riders, who cannot vary their route once they have boarded, on more equal footing with drivers when traffic is heavy.	■	■	■	■	■	■	■
Automated Passenger Counters **Benefits:** Detailed information on passenger use helps transit operators to schedule and route more efficiently, allowing fleet size and fuel use to be tailored more closely to the level of service needed.			■		■	■	
Environmental Forecasting Systems **Benefits:** Better information and knowledge of local air quality conditions. Provides capability for near real-time improvement of air quality in "hotspot" locations.	■	■	■	■		■	■
Environmental Monitoring Systems **Benefits:** Higher quality of life because of less pollution. Can be integrated with multimedia systems to disseminate information to the public. Supports development of demand management strategies. Provides detailed measurement of the environmental impact of transportation management policy.	■	■	■	■		■	■
Integrated Smart Cards **Benefits:** Smart cards simplify multimodal travel, allow governments to recapture the true costs of transportation, and identify all transportation costs for the traveler.	■	■	■	■		■	■
Electronic Road and Parking Pricing Systems **Benefits:** These technologies simplify variable pricing and allow local governments to charge in ways that reflects true costs, including environmental impacts.	■	■	■	■		■	■
Multimodal Traveler Information Systems **Benefits:** These systems allow travelers to design trips with maximum flexibility and to compare travel times and costs for all modes. Multimodal information systems also can educate travelers about mode choices.	■	■	■	■			■
Real-Time Transit Passenger Information Systems **Benefits:** Perceptions of waiting time and reliability are improved when travelers know what to expect. Transit customers can make free use of amenities and services near transit stops while keeping track of the arrival time for their routes.			■	■		■	■
Transit Park-Ride Information Systems **Benefits:** Transit use is encouraged when commuters can easily locate park-and-ride spaces. Transit park-and-ride information addresses the perception of parking "shortages," which often are an obstacle to consumers' confidence in the transit park-and-ride option.	■	■		■		■	■
Parking Availability Information Systems **Benefits:** Vehicle miles and congestion may be reduced when drivers no longer circle needlessly in parking lots and neighborhoods. However, roads and parking should be priced appropriately so that easier routing and more accessible parking do not encourage more driving.	■	■	■	■			■
Personal Advanced Traveler Information Systems (ATIS) **Benefits:** Personal ATIS may reduce car travel by assisting drivers in finding their way. Personal safety is also increased. These features are particularly beneficial in rural areas. However, roads and parking should be priced appropriately so that personal information systems do not encourage more driving.	■	■	■	■	■	■	
GIS-Enhanced Ridematching **Benefits:** New systems make ridematching easier and increase the attractiveness of ridesharing. Advanced mapping technologies allow more efficient route identification than with old ridematching methods.	■	■		■		■	■
Smart Goods–Movement Systems **Benefits:** "Smart freight" inspection systems make it easier to spot trucks carrying hazardous or overweight loads. Advanced inspection, permitting and vehicle-location systems reduce shipping delays, prevent bottlenecks and improve safety. These systems also promote interjurisdictional and public-private cooperation.	■	■	■	■		■	■

use at high-demand times. The sustainability benefits of ITS pricing systems depend on use strategies more than on operational advantages. Using advanced techniques to streamline payments for road use without reflecting true costs actually could make driving more attractive.

TRAVELER INFORMATION SYSTEMS

- ***Multimodal traveler information systems*** coordinate **REAL-TIME** information from numerous sources, both public and private, including automated vehicle location and vehicle identification systems, geographic information systems, and freeway and road management systems, to present travelers with route guidance, estimated travel times, transfer instructions, traffic conditions, parking availability, and travel costs for all modes. These systems can use a full range of customer interfaces, including the Internet, telephones, public kiosks and personal communications devices.
- ***Real-time transit passenger information systems*** use automated vehicle location and identification to pinpoint how far a transit vehicle is from its next stop and to relay an estimated arrival time to traveler information interfaces, usually variable message boards or television monitors.
- ***Transit park-ride information systems*** offer advance and en-route information through the use of variable messages signs (vms) and other means to help motorists find park-and-ride lots at transit stops, and to direct them to available spaces. Advance information can be accessed by telephone, via the Internet, or through public information kiosks. En-route information can provide updated details about available spaces using car-counting sensors that relay information to drivers through variable message signs. In-vehicle computers, which are being tested primarily for route-guidance, could also be adapted to parking guidance.
- ***Parking-availability information systems*** provide assistance similar to that of transit park-ride information systems, but on a wider scale to increase the efficiency of each driving trip. These applications contribute to sustainable transportation goals only if they complement incentives to drive less.
- ***Personal advanced traveler information systems***—multimodal traveler information system interfaces available for personal use—include in-vehicle route-guidance systems and mobile personal security and safety features (commonly referred to as "Mayday" features), that can broadcast an emergency message to the proper authorities and identify the user's location.
- ***GIS-enhanced ridematching*** provides extensive information useful to commuters in evaluating potential carpool and vanpool matches, including suggested routes, estimated

travel times and possible meeting places. When integrated with an interactive Internet site, it can be used to establish a dynamic ridesharing system, allowing users—offering and seeking rides—to arrange matches directly and immediately for regular or single trips. This can extend the usefulness of ridematching services beyond routine trips, such as commuting, to include errands and impulse trips.

FREIGHT OPERATION

- ***Smart goods-movement systems*** use AVL capabilities to track shipments, reroute operators from congestion or delays, and process shipments across state and international boundaries with minimal waiting. Transponders and computer data bases can speed routine transactions such as permitting and weighing. GIS and driver information systems can help van and truck drivers make local pick-ups and deliveries substantially faster. Advanced crash warning devices are being tested in commercial vehicles to save lives as well as dollars. Systems to monitor operator alertness, to warn truck drivers of drifting, and to apply brakes or correct steering, are only a few years away.

FIRST AND SECOND IMPRESSION OF ITS

What have local decision-makers and other leaders in the field of transportation said about ITS? A study of local government representatives was sponsored by PTI and the U.S. DOT in August 1995 and yielded these observations:

- "This is the same old stuff, DOT still wants to move people on the road."
- "If you say transit is better than highways, some interest group will say, 'Then don't build highways.' If you build ITS, are you giving people the opportunity to say, 'Then don't build transit'? That's politics."
- "This ITS system is freeway centered. The key is what happens off the freeway. These are palliative measures for the system we have. We need to think about land use and the longer term."

Participants said they wanted the impacts of transportation system on the quality of life within their communities to be addressed, including urban form, neighborhood safety and noise, and air quality. This concern was raised by officials regardless of their community growth. One participant suggested: "Show the general public how [ITS] can create jobs, deter crime, and then relate it to quality of life. Then you may have a winner."

A second series of focus groups—conducted by David Van Hattum of the Humphrey Institute of Public Affairs at the University of Minnesota between Feb. 28 and March 4, 1996—with professionals from a wide range of transportation-related fields resulted in similar findings, but also produced some principles for applying ITS technologies locally.

Participants emphasized that "ITS deployment should take place within the context of a comprehensive transportation system plan that reduces travel demand through creative land use patterns, and that better matches user costs with the costs to society as a whole. Participants felt that such a system would provide a greater degree of choice between automobile travel and alternatives such as public transit, telecommuting, biking and walking. "When educated about the wide range of applications for intelligent transportation systems, the groups' support for ITS increased: "A noted priority was for making transit and bicycle/pedestrian travel more convenient, understandable, attractive and safe rather than shifting traffic to presently less congested routes. In order to overcome the perception that ITS is strictly car-oriented, participants recommended that reduction in vehicle miles traveled per capita be made an explicit goal of ITS. They also recommended that the advancement of ITS be closely linked with promoting telecommuting substitutes for travel."[3]

3 *Transportation and Information Technologies for Sustainable Communities*. Draft. Humphrey Institute of Public Affairs, University of Minnesota; Claremont Graduate School, Claremont, California; and Surface Transportation Policy Project, Washington, D.C., Mar. 1997.

WALK

The "transportation mono-culture" that can be observed in many areas where housing, jobs, shopping, and schools are accessible only by car—is proving to be unsustainable because of congestion, infrastructure costs, air pollution, and other factors. Maintaining access in these places and sustaining their economic development means creating more choices for getting to them and getting around them. Over the long run, a range of transportation options—private auto, public transit, biking, and walking, are essential to access.

SUSTAINABLE SOLUTIONS

A more balanced, sustainable transportation network must offer more choices, better choices, and more customer-driven choices. ITS has several roles to play:

- ITS makes van-based, flexible suburban transit services more technically and economically feasible;
- ITS can reduce the operating cost and increase the on-time performance of traditional transit services;
- ITS can give travelers up-to-the-minute information to help them make choices and to feel more confident that they will reach their destinations on time.

More transit choices, in particular, are important for those struggling to get or keep low-wage jobs and for the local governments encouraging the move from welfare to work. The dispersion of jobs in suburban locations and the high cost of owning a car makes getting to many entry-level jobs a huge challenge for many. Howard Jennings, observing the situation in Richmond, Va., has concluded: "We need a new transportation product—something to offer them in-between the informality of carpools but without the rigidity and high cost of fixed-route bus service." The Job Express service of southeastern Michigan's SMART system (p. 66) connects the users of urban Detroit's transit system with 800 suburban employers and 16,000 jobs. The Winston-Salem Mobility Management System (p. 64), which uses intelligent transportation systems to increase the scope of transit-on-demand for the region, has expanded the transit service area well beyond city limits and doubled its client list.

Transit is not just for the disadvantaged or for non-drivers. Many of the same ITS applications can be used to improve transit services to capture more of the "choice" riders.

Like any other service, people with a choice will use a quality service if offered and ITS offers transit systems opportunities to improve quality through better on-time performance, more convenient and flexible routing, and safety. In recent years, upgraded transit service has begun to attract “choice” riders in Portland, Ore., St. Louis, Dallas, and New Orleans. In St. Louis, more than 80 percent of MetroLink riders come from households with at least one car, and more than 50 percent have two cars or more. According to the National Personal Transportation Survey, 60 percent of trips on transit were made by people whose household income was more than $20,000 and 29 percent were made by people with household incomes of $40,000 or more.

Surveys in Boston and Seattle indicate that up to 40 percent of travelers will adjust travel patterns based on detailed information.[4] Communities as diverse as Atlanta, San Francisco, and rural Blacksburg, Virginia, already have opted to make transportation information as widely available to their residents as telephone service, water, and electricity. San Diego’s interactive voice-response system has increased the productivity of information agents by 21 percent and the New Jersey Transit automated telephone-information system has reduced caller waiting time by two-thirds, with hang-ups dropping to 3 percent from 10 percent.[5] In Los Angeles, more than 85 percent of the people who tried Smart Traveler kiosks during operational tests said they planned to continue to use them.[6]

Just as important as the success of information systems themselves is their effect on customers’ satisfaction with all transportation services. Some early operational tests have shown that when travelers know what to expect, they believe their trips are less stressful and less time-consuming than before, even when actual time savings are insignificant.[7]

GOVERNMENT-CITIZEN GATEWAY

Traveler information systems that collect as well as disseminate information can help decision-makers gain insights—person by person, place by place—into individual travel preferences, public opinion on policy decisions, and the cumulative impact of travel choices on communities. For example, the Maryland Electronic Capital is an Internet “gathering” of the state’s public agencies, including the Department of Transportation. Maryland DOT has provided ITS services through its Web site for several years, includ-

4 U.S. DOT, Federal Highway Administration. *Review of ITS Benefits: Emerging Successes.* Washington, D.C. September 1996, p. 7.

5 U.S. DOT, *Intelligent Transportation Infrastructure Benefits: Expected and Experienced.* Washington, D.C., January 1996, p. 9.

6 U.S. DOT, *Implementation of the National Intelligence Transportation Systems Program: 1996 Report to Congress.* John A. Volpe National Transportation Systems Center, Cambridge, Mass., 1997, p. 94.

7 U.S. DOT, FHWA. *Review of ITS Benefits: Emerging Successes.* Washington, D.C., 1996, p. 28.

ing up-to-the-minute traffic information and transit connections. Now DOT is adding a public forum area for Maryland citizens.

Concerns about the quality and confidentiality of electronic data are growing. The use of traveler information systems for data collection needs to be perfected and monitored to fulfill the promise of better information, not just "more information." Individual privacy can be protected with options that allow anonymous responses, including public venues such as kiosks.

IMPROVED RIDEMATCHING

When public transit isn't the best option, many traveler information systems also can promote another convenient option to driving alone: ridesharing. Systems available through interactive Internet sites or telephone can help drivers and passengers find matches quickly and easily for regular or one-time trips. Use of GIS-enhanced matching data bases gives travelers all the information they need, making ridesharing more convenient. Many transportation demand management associations are using advanced ridematching applications to good effect, giving more commuters the opportunity to use HOV (high occupancy vehicle) lanes and save both money and time. In Denver, Colorado, even schoolchildren benefit: the Denver Regional Council of Governments has started using GIS-enhanced ridematching for its SchoolPool program, which arranges matches for parents whose children are not served by the public school buses. For more information on GIS-enhanced ridematching, see the Houston success story on page 48.

SUMMARY OF ITS BENEFITS

Sustainable communities are strengthened when traveler information systems and GIS-enhanced ridematching accomplish any or all of the following:

- Enhance accessibility by presenting all options for travel and providing route guidance;
- Distribute travel more evenly throughout the intermodal system;
- Assist travelers with disabilities by providing updated, comprehensive information in spoken and written formats;
- Improve travelers' perceptions of transit services;

Fact

Some Americans have fewer transportation options than others. The 1990 Nationwide Personal Transportation Survey reported that 6.4 percent of people lived in households without vehicles.[8] Millions of Americans belong to groups unable or unlikely to drive, regardless of whether they live in households with vehicles:

- Of the 32 million senior citizens in our country, many can no longer drive.
- Many of the 24 million people with disabilities rely on transit to maintain their independence.
- 37 million people live below the poverty line; those who can't afford a car rely on transit;
- Many of the 56 million children under driving age travel to school on their own, as well as to parks, theaters, shopping centers and the homes of family and friends.[9]

8 *Nationwide Personal Transportation Survey: Travel Mode Special Reports.* Federal Highway Administration, U.S. DOT, Washington, D.C., 1990, p. 1–7.

9 U.S. DOT, FTA. *Federal Transit Administration 1996 Report.* Washington, D.C., 1996, p. 6.

- Contribute to the success of transit-oriented development;
- Gather data on trip characteristics for planners;
- Connect the public with local decision-makers; and,
- Increase the frequency of transit use and ridesharing.

Traveler information systems that make driving more convenient are unlikely to strengthen sustainable communities unless they are balanced by highly effective strategies to encourage travel by high-occupancy modes, bicycling, and walking.

2569
WALK

WALK

We all know that traffic congestion is getting worse. From 1982 to 1993 the number of hours we've spent delayed in traffic has increased 95 percent in the largest 50 metropolitan areas. Some regions were much worse: the hours spent in congestion in Salt Lake City increased 320% over that period. In Los Angeles, congestion imposed an average annual per capita cost of $710. In Houston, congestion cost $680/capita; in Seattle, $720; in Miami, $560; and in Boston $520.

ITS offers applications that can increase road capacity at a fraction of the cost—and aggravation—of constructing new lanes. But, as we've all seen, that capacity is usually filled up sooner rather than later and once again we find ourselves looking for better ways of moving people.

Transportation operators need the best technology available to make services more convenient, efficient and inexpensive. Public transportation improvements are especially important for sustainability. Many of the newer concepts in transit operations can locate public transit vehicles in service, predict and address delays, count passengers, and adapt traffic signals to accommodate carpools, emergency services and mass transit vehicles.

Intelligent transportation systems offer new tools for upgrading transportation and providing better accessibility, but also fuel debate over the best methods for getting communities and individuals where they need to go. If we use these new systems to squeeze more cars on the road and move them faster, we address our mobility problem traditionally: Keep the automobile, and—theoretically—people will have the freedom and ease of movement they want. What they won't have are solutions to air pollution, sprawl, noise, deteriorating neighborhoods and limited access for those who don't drive.

Orion, Minnesota's model deployment of intelligent transportation infrastructure, "is advocated as a pivotal force for implementing the region's adopted transportation policy…namely, that better regional transportation management, and not expanded capacity, is the solution to many of our transportation problems." By using transit fleet management, a regional traveler information center, "silent alert" safety features on buses, transit priority at signals and ramps, and a World Wide Web site with traffic and transit information, among other strategies, the plan will "permit the region to further advance public transit as a key component of the region's transportation management strategy. All agencies are committed to making transit competitive, indeed to providing an advantage to transit."[10]

10 Orion: Minnesota's Model Deployment of Intelligent Transportation Infrastructure. Minnesota Department of Transportation—Minnesota Guidestar and Lockheed Martin Federal Systems, Saint Paul, Minnesota, 1996, p. 3.

History shows that any increase in road capacity is matched and eventually exceeded by new demand (a phenomenon often called "generated" or "induced" travel), sooner or later bringing us full circle.

Fact

Just how close are we as a nation to facing immobility within our existing transportation system? Annual delays in travel time are predicted to increase by 5.6 billion hours over the next two decades. The resultant annual waste in fuel adds up to 7.3 billion gallons and 73 million tons of carbon dioxide emissions. Annual increase in travelers' costs: $41 billion.

—*Managing Mobility: A New Generation of National Policies for the 21st Century.* Report of the American Public Transit Association 2000 Task Force, Washington, D.C., p. 7.

SUSTAINABLE SOLUTIONS

Advanced mass transit systems address every aspect of transit management, from passenger information and safety to vehicle tracking and traffic operations. Automated vehicle location and identification systems are the most widely used applications, operating or scheduled for installation on more than 28,000 vehicles within 59 transit systems.[11] These systems help transit managers keep buses and trains on schedule and deliver better service to riders. The Maryland Mass Transit Administration recently tested an AVL system that increased on-time performance by 23 percent. The Winston-Salem Transit Authority's AVL dispatch system added 17.5 percent more users to its paratransit service, decreased passenger waiting times by 50 percent, and cut operating expenses by 2 percent per passenger and 9 percent per vehicle-mile (see page 64). These systems also offer safer transportation by improving managers' ability to locate and respond to accidents and breakdowns.

Passenger-counting systems have been in use since the 1970s, aiding managers in long-term tracking and demand analysis. Advanced capabilities now make immediate data transmission possible, so information can be used to improve the accuracy of dispatching during peak use and help reallocate vehicles from low- to high-demand routes. Concerns about cost and radio capacity have so far prevented wide use, although many transit systems have some form of passenger-counting system. Among the most advanced is the system operated by the Metropolitan Atlanta Rapid Transit Authority (MARTA), which installed 15 infrared-beam systems,[12] linked with MARTA's AVL system, to relay passenger counts once a day via radio and to relay vehicle location information in real time.

Advanced public transportation systems (and intelligent transportation in general) work best when they integrate diverse management functions. They also need common standards by which to work—for example, computer operating platforms in

11 U.S. DOT, FTA. *Advanced Public Transportation Systems: The State of the Art: Update '96.* Washington, D.C., 1996, pp. 14–19.

12 U.S. DOT, FTA. *Advanced Public Transportation Systems: The State of the Art: Update '96.* Washington, D.C., 1996, p. 31.

different departments need to be compatible. Departments and agencies can use these characteristics to promote cooperation:

- The Suburban Mobility Authority for Regional Transportation (SMART) in Detroit, Michigan, uses advanced applications to coordinate paratransit service among 200 affiliated providers, improving services while cutting the costs of operation (see page 66).
- Montgomery County, Maryland, has linked its Ride-On suburban bus service with local traffic control. When Ride-On buses fall behind schedule because of traffic congestion, operators can communicate with traffic personnel via radio. Traffic managers use computers to change the timing of selected traffic signals and facilitate faster bus trips.[13]
- The Bay Area Rapid Transit System (BART) has invested $2.9 million in a "nerve center" that eventually will have a single state-of-the-art system to manage fare collection, train control and station message signs. New display boards already have been installed that centralize access to information on operations, electrification and safety. The BART police station is next door to the new control center, with a direct view of the display boards so that safety and train-control personnel can coordinate in emergencies.[14]

SUMMARY OF ITS BENEFITS

Advanced public transportation systems make transit services easier to negotiate, safer and swifter, and strengthen the accuracy and efficiency of paratransit. Among the benefits of advanced transit systems are:

- Ability to move more people more freely throughout their communities, taking them to jobs, shopping and recreational areas.
- Lower operating costs that free resources for service expansion and improvement without increasing the burden on tightly stretched city and county budgets.
- Safety improvements that, while not directly improving mobility, can make buses and trains more attractive to travelers.
- Cooperation among the different departments responsible for system deployment.

Appropriate pricing is another important strategy that can encourage travelers to choose among multiple modes. This is discussed in the following section.

Myth

Only transit riders benefit from transit service.

Truth

The majority of the benefits of transit accrue to motorists, businesses and society at large. If transit users traveled by car, they would add five million cars to city streets, highways, and parking spaces. Without transit, the cost of congestion in lost time and wasted gasoline would increase by $15 billion nationwide. Transit also saves us two to five billion dollars per year in accident-related costs because transit is 20 times safer auto travel per mile.

13 U.S. DOT, FTA. *Advanced Public Transportation Systems: The State of the Art: Update '96.* Washington, D.C., 1996, p. 40.

14 U.S. DOT, FTA. *Advanced Public Transportation Systems: The State of the Art: Update '96.* Washington, D.C., 1996, pp. 43–44.

WALK

Currently, the way we pay for transportation—roads, transit and other facilities—is both inefficient and inequitable. Transportation systems cost communities much more than land acquisition, ground breaking, construction, and ongoing maintenance and operation. Since the 1970s, communities have struggled to track the subtler costs of transportation: environmental and community impacts, additional safety and medical personnel, sprawl, and the value of land devoted to roads, parking lots and other transportation infrastructure. Beyond the local level, there are uncalculated costs associated with depletion of the ozone layer, global warming caused by motor vehicle emissions, and Federal defense spending to protect global oil supplies. While ITS alone cannot resolve the complex political disputes over transportation financing, it offers new mechanisms for implementing better alternatives.

The financial cost of building and maintaining roads is heavily subsidized by general tax revenues. Gasoline taxes, registration fees, tolls, and other user fees pay only about 44 percent of the cost of roads, with general taxes paying the rest—more than $60 billion nationwide. By comparison, the total public subsidy to transit is only $15.4 billion/year (1995).

Both roads and transit are likely to continue to need direct financial subsidies from government, but the economic efficiency of the public's investment in transportation could be significantly increased by linking government spending with the social costs and benefits of

DRIVING HOME THE FULL COST

A number of efforts have been made to determine the full costs of automobile use. One of the earliest and best known, The Going Rate: What It Really Costs To Drive, concluded that the cost of driving not recovered from user charges to drivers (gas tax and tolls) amounts to almost $300 billion per year, more than 5 percent of the country's Gross Domestic Product (1992 figures). The authors considered costs of government spending on road infrastructure and support services as well as costs more difficult to quantify, such as those associated with pollution, congestion and sprawl. They accepted many other costs—those associated with global warming, for instance—as incalculable, and did not include estimates of them in their final figure.[15] A more recent study conducted by the Natural Resources Defense Council estimates that the average full cost per mile of travel by automobile, bus and rail are very similar, but that the division of payments among individuals, governments and society for each mode is very different—automobile use carries the smallest proportion of governmental subsidy and the largest proportion of societal subsidy.[16]

15 Mackenzie, J.J. et al. *The Going Rate: What It Really Costs To Drive.* World Resources Institute, Washington, D.C., June 1992.

16 The Center for Renewable Energy and Sustainable Technology, Natural Resources Defense Council. Internet document: http://solstice,crest.org/policy-and-econ/nrdc/mobility/conclusn.html.

> "The financial cost of building and maintaining roads is heavily subsidized by general tax revenues. Gasoline taxes, registration fees, tolls, and other user fees pay less than half of the cost of roads, with general taxes paying the rest—more than $60 billion nationwide. By comparison, the total public subsidy to transit is only $15.4 billion/year (1995)."
>
> —1997 National Transportation Statistics, Bureau of Transportation Statistics. U.S. Department of Transportation Table 2-26.

different transportation modes. By creating congestion, pollution, and increased dependence on foreign energy sources, motorists impose costs on others. Subsidies that encourage more car use thus cost society and taxpayers twice. Subsidies to transit users impose significantly fewer external costs.

The market for transportation is skewed not only by subsidies: Roads, unlike airplanes or phone services, cost the same to the driver whether they are used at rush hour or 2 a.m. Road users therefore have no incentive to change their time of travel even when they could do so.

SUSTAINABLE SOLUTIONS

Advanced technologies allow governments to price transportation services to recover variable economic, environmental, and societal costs, thereby encouraging more economically efficient and environmentally sensible transportation behavior. Options go well beyond simply charging more for a toll road at rush hour—it's possible to exempt carpoolers from tolls; give discounts to citizens who contribute to system sustainability, such as frequent ridesharers, transit users and off-peak drivers; and provide convenient monthly payment plans for transportation services. On state Route 91 in southern California, motorists pay tolls ranging from 25 cents at night to $2.50 at rush hour, using an automated system that exempts cars with more than three passengers. In Aspen, Colorado, where a $1 downtown parking charge supports local transit, many motorists use an electronic in-vehicle device called an "electronic purse" to debit transactions automatically.[17]

Transportation services at full cost, or subsidized for the common good, can level the playing field to give everyone choices that combine efficiency and affordability. And they can have significant impacts on air quality. Pricing strategies could reduce emissions by four to eight times more than traditional traffic control measures.[18]

The seamlessness of pricing technologies allows communities to collect revenue more efficiently while handling far less cash. The potential revenue increases due to this efficiency depend on the type and scope of system used. Electronic fare payment systems for transit can increase revenues by at least 3 percent and up to 30 percent. The New Jersey

17 Surface Transportation Policy Project. Innovative Pricing Programs. In *Progress*, November 1996.

18 Burbank, C., Big Green Challenges Ahead. *Intelligent Highway Systems: A Supplement to ENR.* McGraw Hill, New York, March 1995.).

Transit System estimated in 1996 that its automated fare collection system saved $2.7 million in fare-handling costs and increased revenues by 12 percent.[19]

For transportation users, it's the integrated "smart card" that simplifies paying for services. Switching from mode to mode is easy because a single card is good for all fares and tolls within a system. With proper institutional cooperation, a traveler could use a single smart card for a cross-country trip, switching from train to car to public transit dozens of times. To draw a comparison with the private sector, ATM machines worldwide allow travelers to draw money from their accounts in any currency. The future may erase the differences between smart cards and other debit cards: Atlanta, Phoenix and Chicago are among the metropolitan areas experimenting with ATM cards that interface with transit fare machines, as well as public-private partnerships with credit card companies to combine services.

Ultimately, as with traveler information systems and APTS, the goal of using electronic fare and toll payment systems is to distribute travel more evenly throughout the intermodal system. Accurate price signals for consumers, and monthly smart-card account summaries that itemize travelers' costs, put more control in the hands of users. Once the demand for transportation services begins to react to true market conditions, governments can adjust their investment strategies to target consumers with more attractive and cost-effective services.

Myth

ITS will require significant investment without real paybacks.

Truth

The U.S. Department of Transportation estimates that infrastructure improvements to enable intelligent transportation systems in 50 of the nation's largest cities will cost taxpayers 35 percent less than comparable conventional improvements.[20] In addition, many ITS concepts, such as electronic road pricing systems, are aimed specifically at recapturing the costs of transportation use. Not only will this help assure an ongoing revenue stream for new infrastructure, it also represents a vast improvement over today's "shot-in-the-dark" approach to financing transportation through annual gas tax revenues and bonds.

FAIR PRICING AND ACCESSIBILITY

In the past, traveling through congested toll booths has been as much an annoyance as an expense to drivers. Today's electronic road pricing systems can eliminate the need to stop to pay tolls, but they can also enable variable tools that give drivers an incentive to travel at non-peak hour times. "Value pricing" of roads would guarantee drivers a higher level of service and predicable travel times in exchange for higher tolls during peak hours.

Concerns have been raised about the impacts of innovative pricing mechanisms such as variable tolls on lower income travelers. Studies of the distribution of transportation benefits in Southern California in 1994 and 1997 have confirmed that disadvantaged citizens, who own fewer and less reliable cars, receive a much smaller fraction of the region's transportation benefits than do the more affluent.[21] According to a report prepared by Michael Cameron, Environmental Defense Fund, if a region spends a portion of tolls on

19 U.S. DOT, *Implementation of the National Intelligent Transportation Systems Program: 1996 Report to Congress.* John A. Volpe National Transportation Systems Center, Cambridge, Mass., 1997, p. 100.

20 U.S. DOT, *Implementation of the National Intelligent Transportation Systems Program: 1996 Report to Congress.* John A. Volpe National Transportation Systems Center, Cambridge, Mass., 1997, p. 27.

21 U.S. Congress, Office of Technology Assessment. *The Technological Reshaping of Metropolitan America.* OTA-ETI-643, U.S. Government Printing Office, Washington, D.C., Sep. 1995, p. 181.

improved transit options for those who may be priced off roads, all income groups can benefit from value pricing. However, if toll revenue is spent only on roads, these disadvantaged citizens will lose even more mobility.

SUMMARY OF ITS BENEFITS

Advanced pricing and payment systems offer the following benefits:

- Flexibility to price services by time of day, demand, class of vehicle, environmental factors, purpose of journey, other access rights, mode and individual (e.g., student, senior, carpooler).
- Increased revenue and lower operating costs.
- User convenience and seamless transportation services.
- Possibilities for public-private partnerships and coordination with other payment media such as credit cards and ATM cards.

PROS AND CONS OF CONGESTION PRICING

According to the U.S. Congress Office of Technology Assessment, the costs of automobile use ''could be fully recovered and/or more fairly allocated among users.

If subsidies were withdrawn, externalities 'internalized,' and hidden costs brought out into the open and directly charged to motor vehicle users, the perceived price of motor vehicle use would increase and people would drive less. Consequently, infrastructure cost pricing would encourage more concentrated development and in-fill, favoring locations with established transit systems and road networks. Expansion at metropolitan peripheries would be more market driven, as is the case for the few private toll roads currently planned or under construction in the United States."

However, the Office warned that in very dense urban cores, congestion pricing, a potential method for allocating costs more fairly among users, could "encourage dispersion of wealthier workers, business suppliers, and anyone willing to pay for the privilege of traveling on otherwise congested roads. In the short run, those whose time is less valuable (e.g., the poor) would shift their travel time or mode in response to the extra costs. Over longer periods, congestion pricing would lead to more concentrated residential development for those with lower incomes, while higher-income residents would be dispersed. Moreover, congestion pricing could lead to a movement of activities, such as retail, away from congested areas because the cost of doing business may be too high."[22] Care must be taken to make sure that pricing policies do not aggravate income inequities.

22 Cameron, Michael. "Efficiency and Fairness on the Road." Oakland, CA: Environmental Defense Fund, 1994 and Southern California Association of Governments, "Preliminary Draft 1997 Regional Transportation Plan" SCAG: Los Angeles, 1997.

WALK

The United States relies increasingly on international trade, which comprises 20 percent of the nation's gross domestic product. Our local economies have changed in response. No longer dominated by manufacturing centers in the Northeast and the nation's heartland, the United States now boasts 20 major exporting areas. The emphasis on quick, diverse services has rapidly decentralized production and made city-to-city connections more important than ever. Communities are under pressure to compete and collaborate.

Diversified and intermodal it may be, but the nation's freight transportation system does not serve the needs of the marketplace in an integrated fashion, much less a sustainable one. Freight movement is a private concern, and its varied modes—by water, air, highway and rail—have developed independently of one another. Intermodal transfer is a relatively recent priority for freight companies.

However, private shippers interact with local governments at several key points, providing the opportunity for coordination if information is integrated and readily available. At ports and terminals, ease of access and transfer are paramount concerns. Across state and international borders, streamlined processing and inspection are crucial. Within metropolitan areas, strategies to relieve traffic congestion are crucial. The Greater Washington Board of Trade recently estimated that congestion in the Washington, D.C., region increases shipping costs by 350 percent each year.[23]

Smart goods movement offers ways to promote local economic competitiveness and boost regional clout. The private sector has taken the lead in developing and using advanced freight technologies, with efficiency and a lower bottom line the goals. If these efforts are to be truly beneficial to communities, local governments must become partners in promoting intermodal solutions to coordinate advanced applications.

The primary advanced methods used or being developed to support intermodal transfer, accelerate corridor movement and ease traffic congestion, are vehicle tracking and routing systems, electronic permitting and border clearance, in-motion inspection, and advanced monitoring of vehicle and driver safety.

New technologies have improved the tracking of freight from port to port, by any mode and across jurisdictions. New computer programming enables formerly unlinked databases to join forces through advanced information systems. This allows companies, state commerce departments and law enforcement agencies to work better and quicker when issuing permits and making inspections. Mapping and geographic positioning devices

23 Greater Washington Board of Trade. *Transportation Study, 1997.* Internet document, http://washingtonpost.com/wp-srv/local/daily/april/23/bot.htm.

smooth the way for freight travel in urban areas or remote locations. Safety concepts are being developed—primarily for freight but possibly in the future for private vehicles—to monitor driver alertness, to automatically correct or brake in an emergency, and to alert emergency personnel in case of an accident.

SUSTAINABLE SOLUTIONS

Local governments are under pressure to process incoming shipments more efficiently and to promote transfer from one mode to another. Several initiatives throughout the country have brought governments and private companies together to solve the challenges of freight flow. For example, the North Carolina Global TransPark Authority is a planning effort funded in part by the Federal Aviation Administration and the state of North Carolina. The goal of the authority is to create an air cargo port within an advanced, intermodal environment that supports better logistics and links the port with the Research Triangle Park region.[24] The success of advanced commercial technologies depends on the commitment of decision-makers to similar efforts in their own regions, across jurisdictions and traditional boundaries. These efforts should extend not only to intermodal operations, but to information gathering and distribution, taking into account the concern for confidentiality.

Transportation companies have used **TRANSPONDERS** (radio devices that respond to a designated incoming signal) since the mid-1980s to track their fleets and railcars. Commercial rail shippers have equipped 97 percent of their rolling stock with these devices, at a cost of $250 million.[25] Long-haul truckers have used several types of satellite systems to provide similar locational information.[26] These applications are largely proprietary, although clearinghouses exist for some information. If coordinated with geographic information and global positioning systems, private vehicle-location technologies could provide valuable detail on the physical network that helps get goods to market—and on the traffic snarls and accidents that slow movement.

Advanced systems make rerouting and freight planning more time-sensitive, eliminate the need for some trips through urban areas, make "just-in-time" delivery more viable,

24 U.S. DOT. *Intelligent Transportation Systems and Intermodal Freight Transportation.* DOT-FHWA-JPO-97-008, Dec. 1996, p. 26.

25 U.S. DOT. *Intelligent Transportation Systems and Intermodal Freight Transportation.* DOT-FHWA-JPO-97-008, Dec. 1996, p. 23.

26 U.S. DOT. *Intelligent Transportation Systems and Intermodal Freight Transportation.* DOT-FHWA-JPO-97-008, Dec. 1996, p. 25.

and reduce pressure on local systems. These capabilities can complement other sustainable economic strategies such as increased reliance on locally produced goods and promotion of opportunities for small businesses. In this way, intelligent commercial systems restore market balances within and between communities, make central cities more viable locations for new business and investment, and enable easier exchange of commodities and goods between rural and urban areas.

Permitting and inspection are central concerns for long-distance travel. The 14-state Pre-Pass consortium is among those testing a vision for paperless, secure movement of freight across state and international borders. In addition, 33 states in seven populous “trucksheds” have convened forums to promote advanced technologies that ensure uniform exchange of goods among regions with the highest trucking volume.[27] **COMMERCIAL VEHICLE INFORMATION SYSTEMS** allow inspectors to spot unsafe or overweight vehicles without stopping safe ones. Inspectors now have instantaneous access to permit information and operating credentials as trucks pass through checkpoints, instead of weeks or months after the fact. Local emergency-services personnel have ready access to information on hazardous-materials carriers in the region, including the nature of the materials in transit. Carriers also can use these systems to streamline their operations: to obtain state permits on demand or pay taxes as they travel; to pass through inspection stations without stopping if their paperwork is in order and their weight under state limits; and to communicate with their dispatchers in case of a problem.

Staff efficiencies also are greatly improved: Oregon instituted an early version of advanced vehicle inspection in 1980, which by 1989 had helped increase vehicle weigh-ins by 90 percent and safety inspections by nearly five-fold, with only a 23 percent increase in staff.

A crucial component of commercial vehicle information systems, still under development, is on-board monitoring to notify the driver or dispatcher of potential problems with brakes or other vital systems, driver drowsiness, shifting cargo or dangerous road conditions.

27 U.S. DOT. *Implementation of the National Intelligent Transportation Systems Program:* 1996 Report to Congress. John A. Volpe National Transportation Systems Center, Cambridge, Mass., 1997, p. 117.

SUMMARY OF ITS BENEFITS

Advanced commercial operations:

- Are tools that jurisdictions and private partners can use to integrate functions and create intermodal transfer centers.
- Integrate private and public data in ways that respect corporate confidentiality while providing freight managers in the public sector with valuable information.
- Eliminate unnecessary trips in urban areas, reroute traffic to avoid congestion, relieve pressure on local systems, and support sustainable local economic policies.
- Simplify long-distance intermodal shipping, reduce administrative burdens for governments and carriers, move vehicles at more energy-efficient speeds, lower vehicle miles traveled by keeping routing efficient, and reduce wear and tear on pavement from overweight and unsafe vehicles.
- Include on-board safety systems that can save lives as well as money.

Growth creates jobs, generates tax revenue, and expands the services available to citizens. Urban form, shaped in large part by growth, in turn shapes how we live: in compact communities or surrounded by open space, within reach of the natural landscape or in the heart of the downtown. The ingredients for a high quality of life are numerous, but how do we predict and shape growth so that our metropolitan areas offer citizens desirable options without adverse effects on less populous areas?

In 1995, the Office of Technology Assessment evaluated how the emerging model of growth, the result of technology-driven information-based commerce, is affecting the shape of our metropolitan areas—our environment and our access. The conclusion: It is pushing us further down the road we've been traveling for the past several decades, "creating an ever more spatially dispersed and footloose economy, which in turn is causing metropolitan areas to be larger, more dispersed and less densely populated."[28]

Although we may have identified a new reason for sprawl, its effects are largely unchanging: inadequate transportation in many places, loss of green space and increased greenhouse gas emissions, job loss and disinvestment in the urban core, and the isolation of our citizens who rely most on transit, especially the poor. To combat these effects, OTA recommends a four-point urban economic development policy:

- Revitalize urban core areas;
- Create public/private partnerships involving the urban core;
- Facilitate better access to jobs in the suburbs for residents of the urban core; and,
- Reduce or eliminate price subsidies that encourage sprawl.

ITS technologies can contribute to some strategies for achieving the first two goals, and play a more direct role in achieving the second two.

"OTA concludes that a new and reinvented federal urban economic policy is needed to respond to the fundamental changes that America's metropolitan areas are undergoing. The new policy would work to build up the productive capacity of distressed places, in partnership with state and local governments and the private sector. It embraces three kinds of policies: First, economic development policies that focus on economic revitalization of urban core areas (including central cities and urban suburbs); second, policies to create partnerships between urban cores and industry, state governments, and suburban jurisdictions, including facilitating the mobility of urban core workers into suburban labor markets; and third, policies to move toward full pricing development and infrastructure, to reduce or eliminate price subsidies now encouraging urban sprawl development."

—U.S. Congress, Office of Technology Assessment. *The Technological Reshaping of Metropolitan Areas,* OTA-ETI-643, U.S. Government Printing Office, Washington, D.C., Sept. 1995, p. 2.

28 U.S. Congress, Office of Technology Assessment. *The Technological Reshaping of Metropolitan Areas,* OTA-ETI-643, U.S. Government Printing Office, Washington, D.C., Sep. 1995, p. 1.

> “Transit-oriented design would be more feasible if combined with publicly accessible real-time traffic and transit information.”
>
> —Sperling, D. *Future Drive.* Island Press, Washington, D.C., 1995.

SUSTAINABLE SOLUTIONS

- ***Revitalize the urban core:*** For decades, decision-makers have tried to decipher how transportation investments can accommodate growth where it is needed without sapping the energy from downtown areas. Answering this question requires, among other things, detailed information on the daily activities and travel needs of individuals. Intelligent transportation systems can provide a new and valuable data source for this information, not only on trips by automobiles and transit, but also on trips by foot and bicycle. Used as input to travel models, such data can help to more accurately forecast the travel patterns that would result from possible transportation investments, and can help decision-makers head off unwanted consequences for downtown areas.

  One reliable strategy for bringing development and a high quality of life back to urban cores is investment in transit and transit-oriented design.

  Convenient access to detailed information gives people unprecedented power to plan their activities and get where they want to go by a variety of modes. Transportation centers like the Plaza in Spokane (see page 50), which make transit services more attractive by using traveler information systems, can also use transportation information as catalysts of neighborhood-appropriate development. Such centers are examples of transit-oriented design (see box), which strives to locate transportation options within convenient walking distance in a neighborhood or commercial district. Public kiosks that dispense transportation information also can promote neighborhood features and provide tips on surrounding places of interest, shopping, community services and local history. They can help visitors become better oriented and help residents discover new aspects of their communities.

- ***Create public/private partnerships involving the urban core:*** The traditional role for transportation planners has been to respond to demand. With a new awareness that those responses often create demand in themselves, and with increasing pressure to restrain spending, local decision-makers are seeking to pool resources and ideas. Intelligent transportation systems can be valuable catalysts for developing partnerships with private groups and other public agencies, because their deployment requires focus and cooperation across city and county boundaries; it promotes city-state collaboration to develop statewide standards and integrate the goals of new systems with other state goals; and it has invoked great interest among private companies in a position to benefit from its deployment, which gives local governments a powerful playing card in negotiating new programs.

Not forgetting another vital aspect of public-private partnership, citizen groups are a knowledgeable and vocal component of transportation decision-making. Such groups have demonstrated their staying power as stewards of the public interest and have responded with creative ideas to address the very real dilemmas decision-makers face. Intelligent transportation systems will require a great deal of public support, and citizen groups should be brought to the table as a community's planning for deployment begins. New technologies are a handy tool for bringing the public into planning, through interactive Web sites, teleconferences, and public information kiosks that can also accept confidential information from individuals about their choice of mode, time of day or travel, and other important elements of trip choices.

"...a transit station may have abundant uses, including jobs, housing, retail, restaurants, daycare centers, services, athletic facilities, pedestrian plazas with fountains and furniture, bicycle parking and lockers, news stands and, of course, tall double skinny lattes. Whatever is offered around the transit station, access to the light rail is an easy walk, bus ride or bicycle trip from people's single family neighborhood or just a simple walk across the street from a mixed-use building next to the station. Many activities are under way to encourage transit stations to become more than just a place to park the car."

—*Citizen's Workbook for the Annual Regional Rail Summit.* City of Portland, Oregon.

ABOUT TRANSIT-ORIENTED DESIGN

Facilities that follow transit-oriented design include these characteristics, among others:

- Readily available customer information;
- Attention to customer safety;
- Sufficient pedestrian and bicycle access;
- Carefully managed parking;
- Nearby or on-site customer services; and,
- Architecture that reflects the values of the surrounding community.[29]

Goals for such development include the following:

- Improve air quality by reducing the number of vehicle trips. If the design of the area surrounding a transit station promotes bicycling and walking, more people will use transit and alternative modes for their travel needs;
- Promote economic development by attracting consumers, businesses and social services to the area surrounding the transit station; and,
- Increase housing options by encouraging mixed-use development that incorporates commercial, social service and residential structures.[30]

29 U.S. DOT, Federal Transit Administration. *Planning, Developing, and Implementing Community-Sensitive Transit.* FTA Office of Planning, Washington, D.C., May 1996, pp. 3–4.

30 Olsen, L. What Is Transit-Oriented Design? An Internet document: *Access: Communities and Transit-Oriented Design.* Transportation Partners. Bureau of Transportation Statistics National Transportation Library Web site, http://www.bts.gov/smart/cat/271.html, June 1997, pp. 9–11.

“A study by the Metropolitan Area Planning Council for the Boston metropolitan region on the impact of infrastructure investments, including capital-intensive investments in water, sewer, highway and mass transportation systems, as well as open space set-asides, reports that “professional transportation analysts and planners in Santa Clara County, California…found that transportation development around rail improvements and high density zoning near stations would stimulate the economy more than two other programs examined: highway system improvements and bus system improvements with incentives for car and vanpooling.” Additionally, “evidence suggests that a single type of infrastructure is unlikely to induce widespread private investment without the others.”

—*Landau,* S.R. Infrastructure and Economic Development (MetroPlan 2000)—A Summary of a Literature Search. Metropolitan Area Planning Commission, Boston, Mass., 1991.

- ***Facilitate better access to jobs in the suburbs for residents of the urban core:*** Real-time ridesharing and enhanced ridematching can reduce the cost of reaching jobs in the suburbs, an important service for lower-income residents of urban cores—especially if sophisticated pricing strategies made possible by electronic fare and toll payment systems raise the cost of driving alone. Real-time ridesharing can also assist core residents searching for jobs in the suburbs. Traveler information systems can reduce confusion about the multiple bus transfers often necessary for longer trips by transit.
- ***Reduce or eliminate price subsidies that encourage sprawl:*** Intelligent transportation systems present the best method for instituting full pricing of transportation services, which will help cities to implement development strategies that balance a variety of densities. For more information, see page 23.

SUMMARY OF ITS BENEFITS

- Intelligent transportation systems can support land-use policies in the following ways:
- Data collected through intelligent transportation systems can help guide planning for transportation investments.
- Traveler information systems can enhance the success of transit-oriented design and development.
- The public and private support necessary to successful deployment of intelligent transportation systems encourages partnerships, which can be valuable tools in urban-core revitalization efforts.
- Advanced ridesharing and information applications can improve access to suburban job markets for residents of the urban core.
- Full pricing of transportation services, made feasible by electronic fare and toll payments systems, can help cities implement development strategies that balance a variety of densities.

2569
WALK

WALK

TRANSPORTATION PLANNING AND AIR QUALITY

An area's transportation system has a major impact on its air quality. Since 1992, local transportation decision-makers in "non-attainment areas"—areas that do not meet the national standards for healthy air—have been required to demonstrate that their transportation plans will promote, not undermine, plans for achieving clean air. These "conformity" requirements have been difficult to meet and will continue to pose a challenge, particularly for growing regions. The way an area chooses to use ITS technologies in meeting transportation needs can either improve air quality or hurt it.

In the short run, using ITS technologies to increase speeds and capacity on severely congested highways can reduce emissions of some pollutants because engines operate more efficiently at steady speeds than at variable and low speeds (as occur in stop-and-go traffic). However, there is a point at which higher speeds cause pollutant emissions to increase again. Moreover, as the increased capacity encourages more driving, the impact on air quality is clearly negative.

Sustainable uses of ITS technologies can reduce congestion without encouraging more traffic by distributing travel throughout intermodal systems, taking advantage of overall system capacity to meet current and increased demand. Implementing sustainable ITS strategies now can give a locality a head start in achieving and maintaining healthy air. Localities, regions and states that implement aspects of sustainable ITS may find it easier to get credit for demonstrating conformity in their air quality plans. Choosing "win-win" ITS measures that both improve transportation system efficiency and air quality can maximize return on transportation investments.

However, it is important to note that these technologies will have the most impact on reducing emissions when they are implemented as combined strategies along with specific transportation policy and pricing mechanisms such as parking or congestion pricing.

WALK

We no longer live in the days of heavily subsidized transportation projects. Fortunately, we have also witnessed the end of rigid and restrictive federal formulas for funding surface transportation programs. The passage of ISTEA and subsequent federal legislation gave local governments new flexibility in financing such programs. Local agencies that use intelligent transportation have most often sought federal Surface Transportation Program (STP) and Congestion Management and Air Quality (CMAQ) funds through their metropolitan planning organizations (MPO). States and MPOs distribute these funds to local jurisdictions in a variety of ways.

Funds also are available directly through U.S. DOT's ITS Program, allocated for early deployment studies, priority corridors, operational tests and model deployment activities.

Two steps can help define the appropriate level and source of funding for a local advanced transportation program: assessing technical challenges and responses, and identifying partners for projects.

A very helpful resource for information on funding options and their initial implementation strategies for Intelligent Transportation Systems is Public Technology, Inc.'s *Smart Moves: A Decision-Maker's Guide to the Intelligent Transportation Infrastructure.*

RESPONDING TO TECHNICAL CHALLENGES

Changes in telecommunications will have a direct effect on the feasibility of advanced transportation systems for local governments. The primary issue on the table is increased demand for radio bandwidth. The Federal Communications Commission is examining ways to reallocate current bandwidths. This will make new channels available, but many transportation agencies may have to replace existing systems or find alternative ways to supplement bandwidth.

One possibility is partnership with local commercial FM stations, which usually have more audio capacity than they need to transmit their signals. Advanced Highway Advisory Radio, used for traveler and parking advisories such as those at most airports, is an example of this application. Wider use of bandwidth sharing is operational in Europe, but is only in the testing stages in the United States, and deserves more attention.[31]

31 U.S. DOT, FTA. *Advanced Public Transportation Systems: The State of the Art: Update '96.* Washington, D.C., 1996, pp. 4,7.

Fact

VMT (vehicle miles traveled) per household increases by 25 percent to 30 percent when residential density is cut in half.

—The Gas Guzzler Campaign. *Getting There: Strategic Facts for the Transportation Advocate.* The Advocacy Institute, Washington, D.C., 1996.

Fact

The Pathways for People Poll, conducted by Louis Harris & Associates for Rodale Press in 1991, found that 72 percent of American adults surveyed wanted their town or locale to adopt an overall transportation planning structure "that would make walking, running and bicycling a safe and integral part of the area's transportation system."

To be fully effective, advanced systems must be compatible within and between communities, yet flexible enough to encourage ongoing local innovation. The development of standards for commercial telephone lines presents a good analogy: New standards for faster transmission over phone lines are constantly emerging, but only newly installed lines meet the newest standards. Modems and other devices that use the telephone system to transmit information are designed to work with several generations of standards, a capability sometimes called "backward compatibility." Because many advanced transportation applications have their roots in the telecommunications and computer industries, national standards for these applications may not have to be developed from scratch, but they will need input from local users, just as the shift from mainframe to personal computers in the 1980s required private consumers to test products and offer feedback in focus groups.

DEVELOPING PARTNERSHIPS

Early and ongoing dialog among local and state governments and private partners will ensure regional compatibility and reduce duplication. When advanced transportation initiatives are piggybacked with other initiatives that address growth, environmental protection and quality of life, they can promote even greater local cooperation. The Minnesota Department of Transportation is working closely with state and local groups to develop performance measures that reflect its achievement of goals for sustainability as well as accessible transportation services. The state reached out to community leaders and local transportation officials to help integrate social and environmental objectives into its intelligent transportation systems program.[32]

Minnesota also demonstrates the value of early teamwork with the private entities that provide much of the research and development for intelligent transportation systems. The state worked with Loral Federal Systems, now Lockheed-Martin, to conduct extensive market research into state needs for new transportation technologies, including discussions with local agencies, focus groups with citizens, and surveys to gauge public opinion and preferences. The model program that emerged attracted strong private-sector support. Minnesota is now involved in a $26-million public-private deployment effort, Orion, to implement advanced transportation statewide.

32 *Transportation and Information Technologies for Sustainable Communities.* Draft. Humphrey Institute of Public Affairs, University of Minnesota; Claremont Graduate School, Claremont, California; and Surface Transportation Policy Project, Washington, D.C., Mar. 1997, pp. 23, 33.

Public-private financing is useful in deploying intelligent transportation system applications. For example, the barter value inherent in jurisdictions' control of certain rights-of-way, such as road medians and utility poles, can be helpful in deploying the telecommunications network necessary to operate many ITS applications.

WHERE NEXT?

Information systems can transform local transportation options, but the vision for sustainable communities is the real guiding force behind how and where these systems are used. The power of new technologies—or, conversely, the daunting challenges they pose—should not obscure their proper role in decision-making as tools for realizing local goals efficiently and cost-effectively.

Success Stories

EPA's Transportation Partners

PUBLIC TECHNOLOGY, INC.

SMART BUSES IMPROVE ROCKY MOUNTAIN SKIES

CURBING POLLUTION LEVELS WITH TRANSIT

Located at the foot of the Rocky Mountains, Denver, Colorado's urban growth has spawned pollution problems caused by commuters' automobiles. The challenge for Denver's Regional Transportation District (RTD) is to make transit a convenient and appealing alternative to driving. RTD serves the entire Denver metropolitan area and uses intelligent transportation system (ITS) technology to keep the system running smoothly for approximately 70 million riders a year across six counties.

EQUIPPED FOR EFFICIENCY AND SAFETY

Denver's transit system was one of the first to use Global Positioning System (GPS) technology in transit. Today, it is one of a few transit fleets in the country fully operational with GPS. All 800 buses, plus some of the 150 support vehicles used for maintenance and supervisory personnel, are equipped with automatic vehicle-location (AVL) equipment.

The in-vehicle AVL package includes an on-board processor, a driver interface, a GPS antenna and a mobile radio. The vehicle's odometer is also connected to the on-board processor, which makes it possible to supplement satellite information if reception is impeded by mountainous terrain or man-made structures.

At RTD's Dispatching and Operations Center, transit vehicles appear as icons on the five computer consoles equipped with AVL and interfaced with maps of the area. The location of each vehicle is updated every two minutes. This system vastly improves dispatchers' ability to adjust on-street operations and keep buses running on time. Modifications to routes or schedules can be communicated to drivers over radio or through data terminals. Various preset messages can be sent by the driver to the dispatcher.

For safety purposes, emergency calls are distinguished from others and given priority. In threatening situations, a bus driver can alert the operations center by activating a silent alarm. The location of the bus is automatically reported. Data giving its whereabouts is then transmitted every 30 seconds. Dispatchers can activate a covert microphone on the bus to monitor the situation and help police assess the emergency.

IMPROVED EFFICIENCY ATTRACTS RIDERS

Through improved service, RTD has added more trips on certain routes. Overall transit ridership is up. The AVL system is credited with schedule improvements and efficient performance throughout the fleet.

Integration of real-time information throughout the system is a top priority. For example, once real-time information is made directly available to RTD's phone operators, the public will be able to access the most accurate schedule information without delay. Improvements are also planned for the passenger information display system in express bus terminals. By interfacing with AVL, real-time status and conditions could be communicated to riders.

The public has responded to RTD's improved performance, better service and enhanced safety by putting money in the fare box. Area employers are also encouraging transit use by distributing ECO Pass ID cards, which offer discounted transit fares. By decreasing reliance on the automobile, Denver's RTD brings a breath of fresh air to an area that has been plagued by congestion and vehicle emissions.

FOR MORE INFORMATION

Lou Ha
Manager of Technical Support
Denver Regional Transportation District
Phone: 303/299-6265
Fax: 303/299-6060

TECHNOLOGY MAKES BUSES AND CARPOOLS SMART TRAVEL

TEXAS GROWTH MEANS MORE TRAVEL

The city of Houston, Texas, and surrounding Harris County have enjoyed rapid growth in population and economic development. Yet, this brings with it the negative by-products of congestion, strained infrastructure and air-quality impairment. To minimize these drawbacks and make transit more appealing, Houston's Metropolitan Transit Authority is using technology to increase the efficiency of its 1,600 revenue vehicles and to make ridesharing more convenient.

MANAGING TRANSPORTATION WITH SMART BUSES

With the implementation of automatic vehicle-location (AVL) technology, transit dispatchers will be able to identify the exact location (within feet) of buses in the city or county. Dispatching software will keep track of every vehicle on the road, making adjustments to allow buses to stay on schedule despite traffic congestion or incidents.

Houston's "smart" buses also will be equipped with passenger counters that use sensors to track boarding and disembarking. Information recorded includes the number of persons getting on or off at each stop, the time, and whether wheel chair assistance was needed. This data will be valuable in evaluating ridership needs, the route's effectiveness and monitoring schedule compliance. Other smart features will include a silent alarm and electronic fare boxes.

Houston selected ITS America Communications Standards for component parts in its smart bus system. In addition to installing computers in all city vehicles, almost 300 buses have been retrofitted with headsigns supporting the ITSA Transit Standard SAE-J-1708 for Vehicle Area Networks, (VAN) the first such standard accepted by ITS America. This eliminates interfacing problems with headsigns, and makes it possible for all parts of the system to communicate through a common protocol. All of Houston's Registering Fareboxes also support the VAN standard. All future buses and equipment will be required to support this open-architecture standard.

GOOD FLEET MAINTENANCE REDUCES EMISSIONS

Houston's comprehensive approach also includes management of the fleet when off the road. Fleet management software helps keep track of multiple maintenance considerations, including parts inventory, scheduled lubrication and checking vehicle fluids. This will help keep the fleet running smoothly, reduce fuel consumption, and avoid problems with aging vehicles that may generate excessive emissions.

ELECTRONIC GIS SIMPLIFIES RIDESHARING

Houston's Rideshare is another innovative program making a big impact. Unlike most programs that are text-based and rely on zip codes and a "best guess," this one uses a geographic information system (GIS)—a detailed electronic map that includes every street name and address.

The system electronically "drives" the proposed route, taking into account travel elements needed to match riders. It can also match nonsmokers or those who work at the same location. Information provided to rideshare users includes ride matches, suggested routes, estimated travel times and possible meeting places. The use of carpools increased more than 9 percent during the program's first year.

ENVIRONMENTAL BENEFITS IN THE FAST LANE

Greater use of transit and ridesharing translates into a significant reduction in vehicle miles traveled. It also means getting there faster when buses and carpools are granted access to faster traffic lanes. With more than 100 miles of high-occupancy vehicle (HOV) lanes, Houston has the most extensive system in the United States, carrying more people with fewer automobile emissions.

FOR MORE INFORMATION

Bill Kronenberger
Manager of Advanced Technology Program
Metropolitan Transit Authority
Phone: 713/881-3030
Fax: 713/881-3028

ALL ROUTES LEAD TO THE TRANSIT HUB

ENCOURAGING TRANSIT USE

Located in a river valley, Spokane, Washington, has its share of difficulties with automobiles emissions. To encourage transit use, the Spokane Transit Authority instituted park-and-ride lots, put bike racks on buses, and offered express bus service into the city. The result: Passenger ridership exceeded 7.7 million in 1995. The next step was constructing a new transit terminal and transportation hub known as the Plaza, equipped with technology to improve service and customer information.

CENTRALIZING TRANSIT SERVICES AT THE PLAZA

After years of planning, the Plaza opened in summer 1995. Before its creation, there were more than 20 locations throughout the city where passengers transferred. Buses queued up at busy corners while passengers boarded, causing traffic delays and emission pollution. Now all routes converge at the Plaza.

The Plaza is connected to office buildings and retail stores through an elaborate system of skywalks. It features an atrium, a food court and shops. The Plaza's glass and brick construction contributes to its pleasant environment. Most importantly, it serves as the main transit station and transportation hub. However, this presented some logistical and informational challenges.

The automatic vehicle-identification (AVI) system is key to managing the bus fleet and informing passengers about the status of their bus. The system uses tags bolted atop buses and special tag-reading equipment that can identify vehicles using radio frequencies. Each bus in the fleet of 144 is equipped with an 8-by-2 inch tag. Special reading equipment located downtown identifies the tag using a radio link. The signal is transmitted to a database that matches the bus to its assigned route and scheduled bus bay zone location. This information is then updated on monitors and electronic zone signs in the Plaza.

An electronic information system provides waiting passengers with bus arrival and departure times for each of the bay zones located around the Plaza. Display signs give the route name, number and scheduled departure time for the bus parked in that bay zone. Signs also indicate the next bus assigned to the zone.

Throughout the public areas inside the Plaza, banks of large TV monitors (similar to those in airport terminals) display arrival and departure information. For each bay zone, monitors show the bus occupying the zone, the previous bus (now departed), and the next scheduled bus. Indicators similar to traffic signals direct buses to one of 10 zones used for boarding and departing passengers.

BRINGING PASSENGERS INSIDE TO A SAFE, PLEASANT PLACE

The AVI system is limited to recognizing buses approximately one block from the Plaza. This means passengers will know when their bus is right around the corner and which bus bay it will use. In the meantime, passengers can shop, eat or relax as they wait in an attractive customer-friendly environment. To further enhance the alternatives to single-occupant vehicles, parking is available in the Plaza basement for carpools, vanpools, bicycles and paratransit vehicles.

FOR MORE INFORMATION

Don Coon
Project Coordinator
Spokane Transit Authority
Phone: 509/325-6080
Fax: 509/325-6033

BETTER INFORMATION FOR BETTER TRAVEL CHOICES

TRACKING TRANSIT INFORMATION POSES CHALLENGES

With more than 6 million residents, the San Francisco Bay area is the nation's fifth largest metropolitan area, covering nine counties and 100 cities. Disseminating information about travel options and traffic conditions in the crowded Bay Area is a big task, especially since the region has roughly 1,400 miles of state highways, 18,000 miles of streets and roads, and 27 transit providers.

TravInfo is an advanced traveler information system designed to integrate multiple sources of transit and traffic information in the Bay Area and foster the dissemination of this data through various delivery mechanisms. The project represents a public-private partnership of several entities coordinated by the Metropolitan Transit Commission (MTC).

Information from the TravInfo database is accessible to the general public through a Traveler Advisory Telephone System. Data also is available to registered participants, who are Information Service Providers. They can further develop and repackage the information into products tailored for specific markets, using a variety of delivery technologies.

INTEGRATED DATA FROM MULTIPLE SOURCES

The database at the heart of the TravInfo system is compiled from several sources, many of them using intelligent transportation system (ITS) technology. One source is the California Department of Transportation (Caltrans), which has installed more than 200 sensor stations to assess congestion and speed on approximately 70 miles of freeway. When complete, sensors will cover 250 miles of freeway.

Roving Freeway Service Patrol trucks, each installed with automatic vehicle locators, also feed data into the system. The speed and location of each truck is transmitted every mile or every three minutes, providing a barometer of road conditions. Additional data is compiled from the California Highway Patrol computer-aided dispatch system and other sources.

MTC is also developing a regional public transportation database in connection with TravInfo. The database will include route and schedule information from Bay Area transit operators.

DIALING FOR TRAVEL INFORMATION

TravInfo's special regional phone system offers the general public touch-tone access to transit information and traffic advisories. Although the Bay Area covers six area codes, the "universal" phone number is a local call from all locations. Using an automated, menu-driven system, callers can be connected with transit operators for assistance in trip planning or arranging carpools and ridesharing.

By keying in a specific highway number, callers can receive information about incidents and backups, enabling them to select an alternate route or mode of transportation if necessary.

VENDORS ADD VALUE TO TRAVINFO DATA

TravInfo will rely largely on the private sector to develop and market other innovative applications for the information collected. Vendors must register and are then allowed to access the database via modem. Vendors may choose to develop specialized or convenient user interfaces and may repackage data in a format tailored to certain users such as commuters, truckers or tourists.

The major data collection sources have been operating since April 1996 and are working well. The project is being evaluated by a team at the University of California, Berkeley. The objective is to alter travel behavior and, thus, decrease congestion and emissions in the beautiful Bay Area.

FOR MORE INFORMATION

Michael Berman
Assistant Project Manager, TravInfo
Metropolitan Transportation Commission
Phone: 510/464-7717
Fax: 510/464-7848
email: mberma@mtc.dst.ca.us
Internet: http://www.travinfo.org

SURFING FOR TRANSPORTATION ALTERNATIVES

REACHING THE PUBLIC THROUGH NEW OUTLETS

Ventura County, California, covers more than 1,800 square miles of sprawling suburbs and small towns about 60 miles north of Los Angeles. For years, the primary means of getting information about the area's multiple transit systems has been an 800 phone number, which receives approximately 4,000 calls per month.

When Ventura County officials considered the possibility of using the Internet to provide transit information, research showed that 54 percent of the county's households had a personal computer, one of the highest levels in the nation. Putting transit information on the Internet seemed like a wise move. In early 1996, the Ventura County Transportation Commission entered the World-Wide Web.

MAKING TRANSIT PLANNING A SNAP

The Transportation Commission's Web site enables the public to access a variety of categories, including services for senior citizens and the handicapped, online bicycle maps, the location of free park-and-ride lots, and meeting agendas. Real-time traffic reports from the California Department of Transportation are also available for part of Ventura County.

Yet, the most popular feature by far is the online transit planner category, called "Getting there by bus or train." The planning system allows users to tap into an existing database used by phone operators when giving route information to callers. The database, which has been converted for Internet use, covers most of Southern California. A mapping capability is also being developed.

To use the Web site's planner, transit passengers must provide street addresses or cross streets for their starting point and destination. The system generates a step-by-step itinerary that takes passengers to their destination using the most convenient modes of travel—bus or train. Ridesharing options are also covered by the transit-routing database. In addition to planning the best route, the system calculates the total fare.

In Ventura County, paying for the ride is simplified by carrying a universal "Smart Passport." This prepaid card, which is read by radio frequency, allows seamless travel and payment across any transit system within the county.

RIDING ON SUCCESS

The county's Web site transit planner has been a phenomenal success. System reports reveal a pattern of steady use by transit riders. Grateful commuters have responded with very positive e-mail messages relaying their appreciation of the new service and offering suggestions. In addition to high marks from users, this unique Web site has gained national attention.

Making transit planning easy and accessible is key to getting people out of their cars and onto transit. For Ventura County residents and others in Southern California, the Internet has proved to be one of the best outreach vehicles yet.

FOR MORE INFORMATION

Steven DeGeorge
Transportation Planner/Manager, Bicycle Programs, Technology, Modeling
Ventura County Transportation Commission
Phone: 805/642-1591
Fax: 805/642-4860
Internet: http://www.goventura.org

GETTING AROUND WITH REAL-TIME INFORMATION

SHOWCASING INNOVATIVE TECHNOLOGY

Atlanta's state-of-the-art Traveler Information Showcase was created to provide real-time information on transit options, traffic and parking. As the Showcase got under way in summer 1996, many visitors who came to Atlanta for the Olympics witnessed not only the best in athletic excellence, but also several technologies designed to enhance transportation efficiency and help individuals make smart travel choices.

The Showcase featured several intelligent transportation system (ITS) technologies, including personal communications devices (PCDs), information kiosks, interactive television and an Internet site. The project involves transportation agencies at all levels of government and private-sector companies. Volunteer participants included residents and visitors.

PUTTING INFORMATION IN TRAVELERS' HANDS

Two different hand-held PCDs were part of the demonstration. One uses a keyboard and folds like a laptop computer. The other works with touch-screen technology. PCDs offer ready access to information about traffic routes and conditions, bus and rail routes, the location of transit stops and park-and-ride lots and transit fares.

The system also has customized routing capability. When using this feature, the traveler identifies the start and end points of the proposed trip. The system then analyzes the best route. However, the computation is not done by the PCD. Information is sent by radio signal to a computer, and the recommendation is communicated back to the PCD.

In addition to PCDs, information kiosks provide another means to assess travel options. There are about 130 traveler information kiosks in Georgia, most of them in Atlanta. Using touch-screen technology, kiosks provide real-time traffic and transit schedule information. Recommended travel route itineraries can be printed out for convenience. The kiosks also offer information about special events, weather, tourist attractions and airline flights. Other traveler information technologies in the Showcase include interactive television, cable TV, in-vehicle display devices, and an Internet site (www.georgia-traveler.com).

ITS IMPROVES RAPID TRANSIT ALTERNATIVE

ITS technologies have enabled the Metropolitan Atlanta Rapid Transit Authority (MARTA), one of the Showcase partners, to improve its traditional methods of providing consumer information. In the past, operators answering phone inquiries about routes and schedules manually referenced 30 different notebooks. Now, operators tap into the ITS MARTA system to provide customized transit routing, schedule information, and forecasts of anticipated arrival and departure times.

New ITS technologies are incorporated throughout MARTA's operations. Approximately 250 out of 800 buses are equipped with automatic vehicle-location (AVL) transmitters. Using its advanced system, MARTA can interface vehicle-location data with real-time information on traffic conditions to improve efficiency. At about 15 bus stops, changeable message signs display the anticipated arrival time of the next bus.

CHOOSING THE BEST WAY TO GET AROUND

Intelligent Transportation Systems in Atlanta are helping to move people and traffic more effectively. Accurate real-time information helps travelers make informed choices. ITS technologies have improved MARTA's bus schedule performance and overall customer satisfaction, both of which make major inroads to encouraging transit use and benefiting the environment.

FOR MORE INFORMATION

Katie Wyrosdick
ITS Engineer
Federal Highway Administration
Phone: 404/562-3638
Fax: 404/562-3703

TRANSIT COOPERATION MAKES EVERYTHING CLEARER

SAVING A NATIONAL TREASURE

A clear, blue, mountain lake, spectacular ski slopes and the crisp scent of…money draw tourists in droves to Lake Tahoe. A permanent population of 30,000 swells to 200,000 on a holiday weekend, with some visitors drawn by nature and some by four area casinos. The commerce is welcome, but with it comes pollution that has clouded one of the nation's prettiest resort areas. Ten years ago, you could see 17 feet farther into the clear blue water than you can today.

MERGING PUBLIC AND PRIVATE

Enter the **South Shore Transportation Management Association** (SS/TMA), a non-profit group seeking ways to provide efficient transportation and visitor mobility with less harmful impact on air and water quality. Partnering with local jurisdictions, casinos and the Heavenly Ski Resort, (the region's largest), SS/TMA's strategy was to create a Coordinated Transit System (CTS) to merge existing public and private transit services into a bi-state (California and Nevada), centrally-operated and dispatched, user-friendly system that is tightly focused on efficient passenger movement.

Building new roads was not an option. But reducing dependency on the automobile couldn't be done until a viable alternative was found.

Intelligent Transportation System (ITS) technology will be deployed to corral nearly 50 private vans and minibuses that ferry visitors from the California side of the lake to the casino area in adjacent Nevada or anywhere on the South Shore.

The marriage of these vans and public transit "provided a unique set of discussions," officials said. But ITS convinced them. Future use of Automatic Vehicle Location (AVL), Computer-Aided Demand Response Dispatching (CAD) and Advanced Traveler Information (ATI) strategies have reassured the casinos that they will get their fair share of gaming enthusiasts and be able to track their movements to and from casino doors.

Passengers will access the system via touchscreen kiosks (ATI) in retail shopping areas, casinos and hotel lobbies, or a voice-mail based telephone system accessible from bus stops or private residences. Following a series of prompts including desired destination, number of passengers, and requested time of departure, the computerized system (AVL and CAD) will dispatch a roving fleet vehicle and notify passengers exactly when they will be picked up.

Given an efficient system that makes them feel chauffeured, visitors should be glad to use mass transit. With fewer single vehicles on the roads and fewer trips taken by the roving vans, emission pollution should be reduced.

STAKEHOLDERS BECOME PROJECT PARTNERS

Funding for the $3.7 million project has come from public and private sources: Local cash contributions exceeded $1.1 million; Congress allocated nearly $2.6 million.

The various public and private transit providers have agreed to cooperate in working toward the CTS objective. An implementation plan has been developed, and the stakeholders—including participating casinos—will sign a legal document of cooperation. Once a system integrator is hired, SS/TMA hopes the program will be up and running within a year.

FOR MORE INFORMATION

Dick Powers
Executive Director
South Shore Transportation Management Association
Phone: 530/542-6076
Fax: 530/544-0278

HITCHING A RIDE THROUGH THE INTERNET

ENCOURAGING IMPROMPTU RIDESHARING

Efforts to reduce traffic congestion and emission problems are taken seriously in Seattle, Washington. In addition to a state law, there is a local ordinance dealing with trip reduction.

Ridesharing is one way to reduce single-passenger trips. However, most ridesharing programs are geared to daily commuters and pre-established schedules. In contrast, dynamic ridesharing involves arranging a one-way ride to an arbitrary destination, almost like using a taxi service. Yet, it can also be used to meet traditional commuting needs.

THE CAMPUS AS A TEST ENVIRONMENT

When researchers set out to test a dynamic ridesharing concept using the Internet, they decided that a university setting would be ideal. The University of Washington offered several benefits. Located on the edge of downtown Seattle, the university is the city's largest employer. Parking is limited and relatively expensive. All students and faculty have e-mail addresses and accounts for Internet access. With about 40,000 students, faculty and staff, and an abundance of computer facilities, the university offered a good location for the field demonstration.

FIND A RIDE ACROSS TOWN OR ACROSS THE COUNTRY

To request a ride or offer space to a rider through the Seattle Smart Traveler program, users enter information on the Internet site (http://www.sst.its.washington.edu/sst). Riders may specify certain locations listed in the system, such as other area colleges and universities, health facilities, park-and-ride lots and shopping centers. Or they may indicate their desire to travel to another city.

Whether it is a ride to a shopping mall one afternoon or a ride to Chicago for Thanksgiving, an instant match might be made. A list of one-way matches is shown on the system. By punching in a few commands, a user may send an automatic e-mail message to as many of the listed names as desired. During the field test, only members of the university community may use the system, both for security reasons and because it is easier to track the demonstration's results in a closed environment. Interested "surfers" outside of the university can, however, view a demonstration model.

GOT A MATCH? CHECK YOUR E-MAIL OR MESSAGE WATCH

Participants will usually be notified of matches via e-mail or by phone. In addition to Internet communication, a new test device—Seiko Message Watches—will be distributed to 100 participants. The watches receive data via an FM subcarrier system and are part of another project called Seattle Wide-Area Information for Travelers (SWIFT).

Once the system identifies a match, riders and drivers must contact each other and work out logistical details. Although the number of actual rides shared is not tracked, the system achieved a 35 percent match rate in its first few months of operation. This figure is expected to rise as the project continues.

The cornerstone for dynamic ride sharing is flexibility, speed and communication. With the Seattle Smart Traveler, the odds of catching a ride are greatly improved, making it more convenient to leave the car behind.

FOR MORE INFORMATION

Daniel J. Dailey
Assistant Professor of Electrical Engineering
Adjunct Professor of Civil Engineering and Technical Communication
University of Washington
Phone: 206/543-2493
Fax: 206/616-1763
email: dailey@ee.washington.edu

PUBLIC TRANSIT AT YOUR SERVICE

FILLING A TRANSPORTATION VOID

Virginia's Prince William County is a suburban-to-rural area about 25 miles south of Washington, D.C. With its low-density population, a traditional fixed-route system would have been inefficient. Yet, there was a real need for local transit service in this community.

To address this need, the Potomac and Rappahannock Transportation Commission (PRTC) developed a transit system called OmniLink to serve the general population and those with physical challenges. With its fleet of 24 passenger-lift-equipped vehicles, the system offers an innovative route-deviation service. OmniLink also offers nearly real-time response to riders' custom requests using the Smart Flex-Route Integrated Real-Time Enhancement System (SaFIRES).

SCHEDULE AN OFF-ROUTE PICKUP IF NEEDED

OmniLink's fixed routes have an average of 20 official stops, where riders can board or disembark during regularly scheduled stops without prior reservations. While a vehicle must stop at each of its fixed locations, it may also deviate up to three-quarters of a mile from its established route, while still adhering to its schedule. Reservations for off-route stops require 24 to 48 hours advance notice and are made by manually mapping the route.

With the new features available through SaFIRES, a host of intelligent transportation system (ITS) technologies will make the system even more flexible. Requests for route deviations will be handled within two hours, with a goal of one hour. Technologies such as Global Positioning Satellite tracking, automated vehicle location, and geographic information system mapping will enable dispatchers to pinpoint the location of each vehicle as it travels on or off its fixed route.

Real-time scheduling software will be used to compute the effects of a specific route deviation, and propose several choices for meeting the off-route request. Changes to a driver's route can be relayed quickly to the vehicle's data screen by digital transmission through mobile data terminals. The software will be capable of integrating flexible, fixed and paratransit modes.

FLEXIBILITY SERVES THE ENTIRE COMMUNITY

Route-deviation capability greatly expands OmniLink's service area without adding wasted miles to offer fixed routes for low-demand locations. This feature, coupled with the ability to respond on demand to special transportation requests, eliminates the need for a separate paratransit service to complement the traditional fixed-route system. Integrated dispatching software also simplifies reporting and provides a wealth of data for historical analysis and service modification.

Starting from scratch with no transit service, PRTC has built a steadily growing ridership since it began in early 1995. With its modest cost of 75¢ for a one-way ride and 25¢ for transfers, OmniLink is a very affordable and convenient transportation choice. Further enhancements made possible with the SaFIRES technologies will enable OmniLink to respond to users' needs on a real-time basis.

FOR YOUR INFORMATION

Eric Marx
Director of Planning
Potomac and Rappahannock Transportation Commission
Phone: 703/490-4811, ext. 117
Fax: 703/490-5254

TRANSIT ON DEMAND: SCHEDULING FOR SUCCESS

NEED FOR MORE SERVICE

Residents of Winston-Salem, North Carolina, who are unable to use fixed-route public transportation, are making increased use of paratransit services offered by the Winston-Salem Transit Authority (WSTA). TransAID, as it is known, offers demand-responsive and shared-ride services for the young, elderly and disabled.

WSTA's staff had previously developed an in-house software program to track TransAID rides and clients. However, as the demand for service grew, requests exceeded the capability of dispatchers and available vehicles. To maximize its strained resources, WSTA launched an effort called the Winston-Salem Mobility Management System.

A MATCH MADE BY COMPUTERS

One component of the project was implementation of a new Computer-Aided Dispatch and Scheduling (CADS) program to match ride requests with one of TransAID's 19 vehicles. Dispatchers enter trip request information directly into the computer. Most of the rides can be categorized as fixed-subscription trips, which are known in advance, scheduled for certain days, and are generally constant. For example, a wheelchair user may require transportation to a physical therapist every Monday and Wednesday at 10 a.m.

If the ride is needed immediately, the computer software checks certain criteria, such as the proximity of a vehicle to the passenger and whether special equipment is required. Adjustments to schedules and routes can be made in real time. Dispatchers can communicate alternate routing directly to the driver of the vehicle through mobile data terminals (MDTs) or radios.

"SMART" VEHICLES SIMPLIFY SYSTEM OPERATIONS

Some of TransAID's vehicles are already equipped with automatic vehicle locators (AVLs), MDTs and "smart-card" readers. Ultimately, all 19 vehicles will be so equipped. With AVL technology, knowing the location of these vehicles at all times enhances the ability to route them efficiently and add passengers as needed.

No fares are charged to individuals for TransAID service. Costs are billed to and paid by the appropriate human service agency. The use of smart-card readers simplifies this process.

Approximately 1,200 to 1,500 smart cards have been issued to eligible clients. For now, these cards may only be used on vehicles with reader equipment. On the other vehicles, drivers must still use a paper manifest to record passengers, mileage and time. The planned installation of smart-card readers on those vehicles will eliminate much driver paperwork and reduce data entry at WSTA headquarters.

INCREASED RIDERSHIP AND DECREASED UNIT COSTS

Using intelligent transportation system technology in Winston-Salem has shown impressive benefits within a short time. The service area, which had been limited primarily to the city, has now been extended to encompass rural areas. The client list has grown from about 1,000 to approximately 2,000 people eligible to use the service.

Although the number of vehicles has remained constant during the project, vehicle use has increased 32 percent, ridership has grown 18 percent, unit costs have decreased 13 percent, and passenger waiting time has decreased more than 50 percent. Efficiency improvements of this nature are a good way to persuade riders to continue using public transit.

FOR MORE INFORMATION

John R. Stone, Ph.D.
Associate Professor, Civil Engineering
Institute for Transportation Research and Education
North Carolina State University
Phone: 919/515-7732
Fax: 919/515-7908
email: stone@eos.ncsu.edu

Suzanne Tellechea
Transportation Planner
Winston-Salem Transit Authority
Phone: 910/727-2648
Fax: 910/727-8104

ONE ADVANCED SYSTEM HELPS MANY CUSTOM SERVICES

SHARING ITS BENEFITS

Small communities and human services agencies that provide paratransit services often find that it takes significant resources just to maintain operations, let alone pay for the intelligent transportation system (ITS) technology that can help schedule riders more efficiently. While many communities cannot afford this, they benefit when a regional coordinating entity takes the lead in implementing new ITS features, as in the tri-county area surrounding Detroit, Michigan.

The Suburban Mobility Authority for Regional Transportation (SMART) is using several ITS technologies to enhance its ability to meet the diverse needs of the communities it serves. In addition to providing fixed-route and paratransit services, SMART works with more than 200 affiliated service providers, which may range from communities that own paratransit vehicles to human service agencies that use vans to transport clients. Improvements being integrated into SMART's system include new reservations and dispatching software and automatic vehicle-location (AVL) technology.

USING TECHNOLOGY TO IMPROVE SERVICE EFFICIENCY

With more than 200 affiliates, SMART had a tremendous need to upgrade its reservations capacity. The new dispatching system recognizes street addresses and can calculate distance and estimate travel time between two points. With SMART's integrated software, paratransit trips can be arranged by clients six days in advance. Unlike most systems that take requests and call back later, SMART schedules clients' reservations during the initial phone call. For the general public, rides can be requested two days in advance, or less if space is available.

During the first phase of SMART's enhancements, paratransit vehicles will be equipped with AVL devices and new radios. In the second phase, the technology will be installed on the fixed-route fleet.

With the AVL system, dispatchers will be able to pinpoint the location of vehicles within 15 meters. Vehicle information can be accessed by type of service or by location. To accommodate the centralized dispatch system, the control room will double in size and feature four displays for paratransit operations and two for fixed-route buses.

A new regional telephone system is another element that will improve coordination. The integrated system, which will replace two incompatible phone systems in separate locations, will ensure uniformity and enable the exchange of computer data.

In all paratransit systems, clients who do not show up for reserved trips are a problem. "No-shows" waste as much as 20 percent of riding capacity. ITS technology can easily track habitual no-shows and generate warnings that continual abuse may result in loss of privileges to use the system. Reducing no-shows will allow the system to accommodate more riders without more vehicles.

RESPONDING TO REGIONAL NEEDS

Many communities want more customized service. With ITS technology, SMART has the flexibility to provide specialized services. It can act as a broker of transit services with a central dispatch. Or, it can provide the means for communities to enhance their own services by connecting via remote access to SMART's system—a system that most communities could not afford on their own.

FOR MORE INFORMATION

Steve Fern
Manager of Electronics and Communications
Suburban Mobility Authority for Regional Transportation
Phone: 248/362-4633
Fax: 248/362-0889

Doreen Tyrrell
Suburban Mobility Authority for Regional Transportation
Phone: 313/223-2121
Fax: 313/223-2390

CHARGING THROUGH TRANSIT WITH A SMART CARD

CREATING AN INTEGRATED EASY-PAY SYSTEM

The Washington Metropolitan Area Transit Authority (WMATA) provides transportation services throughout the District of Columbia and parts of Maryland and Virginia. Passengers make an average of 500,000 trips daily on WMATA's Metrorail (subway) and Metrobus routes.

Many passengers rely on a combination of transportation services for their daily commute. Yet, the system uses different payment arrangements for each mode of travel. Metrorail riders use magnetic fare cards, while bus riders pay with cash, tokens or a pass, and parking lots collect cash only.

To cut across these differences, WMATA tested an integrated fare-collection system using advanced technologies. Integrating the fare-collection system by allowing passengers to use one device to pay for Metrorail, Metrobus and parking would increase customer convenience.

FLASH THE GO-CARD AND GO

During this one-year demonstration project, WMATA tested a proximity reader/encoder card. Known as the Go-Card, it is about the size of a credit card, but thicker. When a passenger holds the card within inches of the fare gate, the reader is activated using a radio frequency. The card also can be briefly inserted into a reader mechanism. Much like the magnetic card currently used by the Metrorail system, money can be added to the Go-Card when needed, and the cost of the fare is debited after each trip.

The innovative fare-collection equipment was installed in both directions (inbound and outbound) of at least two fare gates at 29 Metrorail stations. Mechanisms were also installed on 21 out of 1,600 buses and at five parking lots. Approximately 2,500 regular commuters participated in the project. During the demonstration, the Go-Card system worked in addition to the regular collection system and did not reduce the capabilities of existing equipment.

BENEFITS ADD UP FOR TRANSIT SYSTEM AND CUSTOMERS

For the transit authority, standardized, integrated fare collection increases efficiency and security. An electronic fare medium would be a great help to bus drivers who now must verify the amount of money placed in fare boxes and confront those who do not deposit the proper fare. Electronic readers also diminish mechanical wear on existing collection systems, which would still be needed to some extent for occasional riders and those without a Go-Card. In addition to fare payments, electronic cards could be used to collect data on ridership usage and habits.

While parking lots that accept only cash must be staffed throughout their hours of operation, an electronic payment system would allow use of those lots around the clock. This would offer added convenience to commuters, while also reducing staffing needs and curtailing the possible theft of cash.

The idea of establishing a common fare medium across WMATA's bus, rail and parking services was welcomed by the demonstration participants. Some commuters suggested that a thinner and smaller card might be preferable. But they generally agreed that eliminating the need to scramble for different cards, tokens or cash would make using transit more convenient for commuters.

FOR MORE INFORMATION

Ramon Abramovich
Supervisory Fare Collection Engineer
Washington Metropolitan Area Transit Authority
Phone: 202/962-5274
Fax: 202/962-2155

LOOKING FOR PARKING IN ALL THE RIGHT PLACES

CONFRONTING PROBLEMS WITH URBAN PARKING

Concerts, theater performances, special events and conventions attract many people to downtown St. Paul, Minnesota. Yet, residents who live in the outlying area may only visit St. Paul on occasion and are not accustomed to finding their way in the city. Searching for parking increases driving time. During large events, congestion created by cars trying to find available parking causes excess emissions. To alleviate these problems, St. Paul needed a method to lead visitors to available parking.

GUIDING CARS TO AVAILABLE LOTS

The solution was an Advanced Parking Information System, implemented by St. Paul in early 1996. The system is the first of its kind in the United States, although similar systems have been used in Europe for the past decade.

The new system uses a series of signs strategically placed throughout the city to show motorists the way to available parking. The main destination targeted by the signs is the southeast quadrant of the city, which features the civic center and other major event locations. A total of 56 signs—10 electronic and 46 static—are used.

Static signs may contain a generic parking symbol with a directional arrow. Electronic signs give information about the number of spaces available at specific parking lots. Using sensors at each of 10 participating parking facilities, vehicle counts and available spaces are calculated and communicated automatically to the information system. Every two minutes, electronic read-outs show the updated counts at each location.

Signs guide visitors entering the city from all directions. For example, upon exiting the freeway, a sign displays the 10 participating parking facilities. Subsequent signs lead drivers closer to available parking. Given real-time information, motorists select a preferred parking facility and follow the signs to the specific lot. The 10 participating facilities—amounting to more than 4,500 parking spaces—represent a mix of public and private ownership.

The parking information system is operated only for special events. It is preprogrammed to begin about two hours before an event and run one hour after the start time (to accommodate late arrivals).

FILLING PARKING SPACES AND DOWNTOWN BUSINESSES

Combining Minnesota Guidestar's progressive approach to technology and St. Paul's commitment as a user-friendly city demonstrates a clear path to success. To fully assess the system's impact, traffic data was collected during select events before the new method was operational. This data will be used to conduct an independent evaluation of the parking information system's effect on traffic volume, congestion and occupancy levels at participating parking lots.

Another important element of the project is user satisfaction. Local media outlets have been very cooperative in informing the public about the signs and how they work. The evaluation and operations test of the project is complete. St. Paul is looking into deploying such systems elsewhere in the city. So far, there has been a resoundingly positive response from visitors and the business community alike.

The design and evaluation report is available on the Guidestar Website at http://www.dot.state.mn.us/guidestar/oats.

FOR MORE INFORMATION

Benjamin Osemenam
ITS Control Engineer
Advanced Transportation Systems
Minnesota Department of Transportation
Phone: 612/279-5651
Fax: 612/215-0409
email: ben.osemenam@dot.state.mn.us

MULTIPLE STRATEGIES FOSTER CLEANER AIR

GROWING POPULATION, GROWING POLLUTION

Phoenix, Arizona, is a hot spot in terms of weather and extraordinary growth. The metropolitan area encompasses an estimated 450 square miles and is growing at a rate of approximately one acre per hour. As expansion continues, many residents have to travel farther to their jobs. This means more vehicle emissions. In an effort to abate air-quality problems, Phoenix encourages a combination of ridesharing, telecommuting and trip-reduction planning, in addition to other measures, to reduce the number of cars on the road.

NEW RIDESHARING SOFTWARE

Although Phoenix's ridesharing program has been operational since the mid-1980s, technological advances will improve the system. New software using GeoMatch will provide color maps showing riders' proximity to each other. This will make it possible to match riders faster and more precisely. Program participants will receive a list of potential matches, which they can use to follow up with personal contacts and arrangements. Valley Metro also offers a van pool program.

Information about the ridesharing program and how to participate is being made available via the Internet (http://www.maricopa.gov/rpta/rpta.html). On-line transit schedules and route information also are accessible on the Web page.

TEACHING TOP MANAGEMENT ABOUT TELECOMMUTING

Phoenix also has taken an innovative approach to encouraging telecommuting as an alternative to driving. Recognizing that the attitude of a company's management plays a significant role in the acceptance and approval of telecommuting, Valley Metro launched a promotional effort targeted to businesses.

CEOs and human resource managers from more than 100 area companies attended a special breakfast briefing on telecommuting. Invitations were issued by the governor to demonstrate the importance of this issue, and attendance was high. The CEO gathering was followed by workshops for company staff to explain how telecommuting could work for them. Other avenues used to promote the campaign included billboards, brochures, media interviews and advertisements. In a two-year period, the number of companies using telecommuting rose from 57 to 261.

REDUCING EMPLOYEE TRAVEL IS THE LAW

Arizona's state-mandated travel-reduction program requires companies with 50 or more employees to develop plans to reduce workers' single-passenger commutes by 10 percent annually. This mandate now affects more than 1,200 employers and 500,000 employees and students.

To help employers carry out the trip-reduction requirements, the Valley Metro/Regional Public Transportation Authority offers training for the transportation coordinators, who must be appointed within each company. Employers are also offered assistance in developing trip-reduction plans required under the program.

One popular trip-reduction initiative is the Bus Card Plus, a pass issued by employers. This magnetic card tracks transit usage and rewards frequent users with reduced fares. In addition to providing a benefit for workers, the card offers employers a built-in method of documenting their efforts. About 400 employers distribute 45,000 Bus Card Plus passes.

Whether it's ridesharing, telecommuting or using transit, employers can help workers make transportation choices that benefit the environment. At the end of 1996, almost 1,200 companies employing more than 500,000 workers had reduced single-passenger travel by a total of 3.3 million miles per week. That makes everyone breathe easier.

FOR MORE INFORMATION

Valley Metro/Regional Public Transportation Authority
Phone: 602/262-7433
Fax: 602/534-1939
Internet: http://www.maricopa.gov/rpta/rpta.html
Maricopa County Trip Reduction
Phone: 602/506-6750

RESOURCES

PRINT RESOURCES

GENERAL REFERENCE

Managing Mobility: A New Generation of National Policies for the 21st Century. American Public Transit Association 2000 Task Force, Washington, D.C., 1989.

Nationwide Personal Transportation Survey: Travel Mode Special Reports. FHWA-PL-94-019. Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 1990.

Gas Guzzler Campaign. *Getting There: Strategic Facts for the Transportation Advocate.* The Advocacy Institute, Washington, D.C., 1996.

Landau, S.R. *Infrastructure and Economic Development (MetroPlan 2000)—A Summary of a Literature Search.* Metropolitan Area Planning Commission, Boston, Mass., 1991.

Sperling, D. *Future Drive.* Island Press, Washington, D.C., 1995.

The *Technological Reshaping of Metropolitan America.* OTA-ETI-643. U.S. Congress, Office of Technology Assessment, Washington, D.C., 1995.

INTELLIGENT TRANSPORTATION SYSTEMS

Burbank, C. *Big Green Challenges Ahead in Intelligent Highway Systems: A Supplement to ENR,* McGraw Hill, New York, March 1995.

Review of ITS Benefits: Emerging Successes. FHWA-JPO-97-001. FHWA, U.S. Department of Transportation, Washington, D.C., 1996.

Hicks, R. *ITS, the Environment and Global Climate Change: Can Information Technology Support Sustainable Transportation Policy?* Public Technology, Inc., German Marshall Fund of the United States, Washington, D.C., 1998.

Horan, T., and D. Jordan. *Background Information on the Linkages Between Intelligent Transportation Systems and Sustainable Communities.* Presented at the Transportation Research Board 21st Century Transportation Infrastructure Symposium, Washington, D.C., Dec. 1996.

Orion: Minnesota's Model Deployment of Intelligent Transportation Infrastructure. Minnesota Department of Transportation Minnesota Guidestar and Lockheed Martin Federal Systems, St. Paul, Minnesota, 1996.

Royer, C. *Intelligent Transportation Systems: Focus Group Report.* Public Technology, Inc., Washington, D.C., 1995.

Smart Moves: A Decision-Makers Guide to the Intelligent Transportation Infrastructure. PTI, Washington, D.C., 1996.

Technology: A Bridge to the States. Public Technology, Inc. The American Association of State Highway and Transportation Officials and the National Association of City Transportation Officials, Washington, D.C., 1997.

Transportation and Information Technologies for Sustainable Communities. Draft report. Humphrey Institute of Public Affairs at the University of Minnesota, Claremont Graduate School, Claremont, Calif.; and Surface Transportation Policy Project, Washington, D.C., March 1997.

Traveling with Success: How Local Governments Use Intelligent Transportation Systems. Public Technology, Inc., Washington, DC, 1995.

Intelligent Transportation Infrastructure Benefits: Expected and Experienced. FHWA-JPO-96-008. FHWA, U.S. Department of Transportation, Washington, D.C., 1996.

Implementation of the National Intelligent Transportation Systems Program: 1996 Report to Congress. HVH-1/6-97(70)E. John A. Volpe National Transportation Systems Center, U.S. Department of Transportation, Cambridge, Mass., 1997.

Advanced Public Transportation Systems: The State of the Art: Update 96. FTA-MA-26-7007-96-1. Federal Transit Administration, U.S. Department of Transportation, Washington, D.C., 1996.

Intelligent Transportation Systems and Intermodal Freight Transportation. DOT-FHWA-JPO-97-008. FHWA, U.S. Department of Transportation, Washington, D.C., 1996.

PRICING

Local Government Guide: Uncovering Auto Subsidies. In *Cities for Climate Protection* series. International Council for Local Environmental Initiatives, Berkeley, Calif., no date available.

Mackenzie, J.J. et al. *The Going Rate: What It Really Costs To Drive.* World Resources Institute, Washington, D.C., 1992.

Innovative Pricing Programs. Progress. Surface Transportation Policy Project, Washington, D.C., Nov. 1996.

SUSTAINABLE DEVELOPMENT

Yaro, R.D., and T. Hiss. *A Region at Risk: The Third Regional Plan for the New York-New Jersey-Connecticut Metropolitan Area.* Island Press, Washington, D.C., 1996.

TRANSIT AND TRANSIT-ORIENTED DESIGN

Citizens Workbook for the Annual Regional Rail Summit. City of Portland, Ore., no year available.

Federal Transit Administration 1996 Report. FTA, U.S. Department of Transportation, Washington, D.C., 1996.

Planning, Developing, and Implementing Community-Sensitive Transit. FTA Office of Planning, U.S. Department of Transportation, Washington, D.C., 1996.

Building Livable Communities Through Transportation. FTA, U.S. Department of Transportation, Washington, D.C., 1996.

Hickling Lewis Brod, Inc. *The Benefits of Modern Transit.* FTA, U.S. Department of Transportation, Washington, D.C., Jan. 9, 1997.

WEB SITES OF INTEREST

ITS AND TRANSPORTATION

Public Technology, Inc.
http://pti.nw.dc.us
Includes information that ties advanced transportation technology research, planning and implementation activities to the needs of local government.

American Public Transit Association (APTA)
http://www.apta.com
Link to international association of mass transit interest, which promotes the use of public transportation.

Bureau of Transportation Statistics
http://www.bts.gov
Includes the National Transportation Library, which provides information on a variety of transportation topics. Also provides many links to organizations involved in transportation.

California Partners for Advanced Transit and Highways (PATH)
http://www-path.eecs.berkeley.edu
Provides information on California's efforts to implement intelligent transportation systems. Also provides links to related sites around the world.

ITS America
http://www.itsa.org
ITS America is the congressionally mandated repository for the latest and historical smart car, smart highway and smart transit information.

ITS Online
http://www.itsonline.com
Link to the independent forum for discussions of ITS, including updates, links to recent media coverage, requests for proposals and industry news.

Office of Technology Assessment Archives
http://www.ota.nap.edu
http://www.access.gpo.gov/ota
Repository of all OTA research, including several reports relevant to sustainable development and transportation.

University of California at Berkeley Institute for Transportation Studies
http://www.its.berkeley.edu
Offers extensive links and information on research and conferences on intelligent transportation systems.

University of Minnesota Center for Transportation Studies
http://www.umn.edu/cts/
Provides information on University of Minnesota's activities to advance the state of the art in transportation research.

SUSTAINABLE DEVELOPMENT

The Center for Renewable Energy and Sustainable Technology, Natural Resources Defense Council.
http://solstice.crest.org
Focuses on energy, the environment, and full-cost accounting of transportation and other activities with an impact on sustainability.

President's Council on Sustainable Development
http://www.whitehouse.gov/PCSD
Offers updates on the White House's work to combat global warming and promote sustainable policies.

TRANSIT AND TRANSIT-ORIENTED DESIGN

Surface Transportation Policy Project—Environmental Protection Agency Transportation Partners Program
http://www.transact.org
Jointly sponsored site offering information on current federal transportation law, its relevance for sustainability, and related topics, including but not limited to transit and transit-oriented design.

SELECTED WEB SITES FOR COMMUNITIES AND PROJECTS

Aspen, Colorado
http://www.aspen.com/aspenonline/dir/gov/ sponsors/aspen/dir/transport.html

Atlanta, Georgia
http://www.georgia-traveler.com

Blacksburg, Virginia
http://www.blacksburg.va.us/trans.html

Boston, Massachusetts
http://www.smartraveler.com

Chicago, Illinois
http://www.yourcta.com

Denver, Colorado
http://www.rtd-denver.com

Houston, Texas
http://www.hou-metro.harris.tx.us

Los Angeles, California
http://www.smart-traveler.com

Maryland Electronic Capital
http://www.mec.state.md.us

Maryland Mass Transit System AVL Project
http://www.mdta.state.md.us/

Montgomery County, Maryland
http://www.co.mo.md.us

Phoenix, Arizona
http://www.valleymetro.maricopa.gov

Prince William County, Virginia
http://www.OmniRide.com

San Francisco, California
http://www.erg.sri.com/travinfo/travinfo.html

Seattle, Washington
http://www.sst.its.washington.edu/sst

Ventura County, California
http://www.goventura.org

GLOSSARY

ACCESSIBILITY

The ability of people to benefit from places and services, whether or not they drive. This concept includes access by electronic means and telephone, walking, bicycling and transit.

AUTOMATIC VEHICLE IDENTIFICATION SYSTEM (AVI)

A system that uses an electronic or radio signal, transmitted by a vehicle to a central information center, to identify the vehicle and provide information about its operations or mechanical condition.

AUTOMATIC VEHICLE LOCATION SYSTEM (AVL)

A system, similar to AVI, that determines the location of vehicles at intervals.

COMMERCIAL VEHICLE INFORMATION SYSTEM

A system using AVI technologies to enable freight inspectors to spot unsafe or overweight vehicles, vehicles lacking proper permits, or operators with unsafe driving records as they pass through freight checkpoints.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

A system of hardware, software, and data for collecting, storing, analyzing, and disseminating information about areas of the Earth. GIS can graphically represent a transportation system and cross-reference it with a variety of databases showing road, bridge, or transit system conditions; location of environmental resources such as wetlands; and land use maps.

GLOBAL POSITIONING SYSTEM (GPS)

A space-based radio positioning, navigational, and time transfer system developed by the Department of Defense and now available for civilian use. GPS uses space satellites to determine with a high degree of accuracy, and without being affected by weather conditions, the location of objects on earth, including moving vehicles.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

A wide array of advanced information technologies, adapted or designed to improve the efficiency and accessibility of transportation services.

MOBILITY

Traditional goal for transportation decision-making, which places priority on moving vehicles, especially cars and trucks, quickly and efficiently.

REAL TIME

Describes information that is transmitted as or very soon after it is gathered, as well as capabilities that allow immediate response to information and events.

SMART CARD

Electronic debit card equipped with a readable computer chip. The smart card can be debited by the trip—whether on a toll road, bus, train, or some combination—and can differentiate the price of service by time of day and demand.

SUSTAINABLE DEVELOPMENT

Development that meets present needs without compromising the ability of future generations to meet their own needs.

TOLLTAG

Electronic tag with unique identification code that is affixed to a car's windshield, enabling the driver to pass through a toll booth at normal speed but still be charged a toll. An electronic eye scans the code and records a debit on a pre-paid or monthly account.

TRANSPONDER

A piece of equipment that, when set on a special radio frequency, emits a directional signal that allows a vehicle to be tracked.

Roads Less Traveled **was produced with funding from the Transportation Partners program of the U.S. Environmental Protection Agency (EPA). This unique alliance between Public Technology, Inc. (PTI), and EPA offers communities information and technical assistance to help them with their sustainable mobility initiatives. If your community, agency or regional or metropolitan planning organization is interested in joining, please call Mary Key, PTI at 202/626-2445 (email: key@pti.nw.dc.us) or Catherine Preston, EPA at 202/260-6830 (email: preston.catherine@epamail.epa.gov).**

PUBLIC TECHNOLOGY, INC.

1301 Pennsylvania Ave. NW
Washington, DC 20004-1793
202.626.2400 ■ 800.852.4934
FAX: 202.626.2498
INTERNET: http://pti.nw.dc.us/trans.htm
PUBLICATIONS CENTER: pubs@pti.org