APTS Advanced Public Transportation Systems PROGRAM

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TECHNICAL ASSISTANCE BRIEF

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What is APTS?

Advanced Public Transportation Systems, or APTS, are advanced navigation and communication technologies applied to all aspects of public transportation system operations. APTS provides the technology for transportation agencies to make timely transit information available to the passenger and to improve the convenience, reliability and safety of public transportation service. For example, smart cards, telecommunications, and other electronic technologies that have the potential to improve the efficiency andappeal ofpublictmnsportation are being tested at various locations throughout the U.S.

The Federal Transit Administration (PTA) created the Advanced Public Transportation Systems (APTS) Program as part of the U.S. DOT initiative in Intelligent Vehicle Highway Systems (IVHS). IVHS is a tool to enhance transportation mobility, energy efficiency, environmental protection and safety. Most IVHS systems are designed for the automobile driver and not the transit rider. The APTS program addresses this imbalance by developing IVHS -systems that will improve the public transit option.

The importance of IVHS as a potential solution to transportation problems has grown in recent years, primarily because of the coordinated support from representatives ofbusiness, industry, and govemment. Recent Federal and state legislation tbat encourages a strong local approach to local transportation issues has also sewed to promote the multimodal, integrated approach of IVHS options.

Most of the technologies needed to implement Advanced Public Transportation Systems already exist. One exciting aspect of the APTS program is the interest shown by U.S. manufacturers. They view the application of IVHS technologies to transit as a new market in the transition of existing technology from defense to the domestic side of the economy. These commercial technologies are becoming the force for change in how transit manages its operations and improves service to the customer.

The challenge is to develop appropriate system applications in transit for thesetechnologies. The APTS program is developing an information base on the national applications of advanced technologies in public transportation and is testing these technologies in operating models. The operational tests serve as the transition between research and development and full-scale deployment of IVHS technologies. Tests are conducted in a "real world' operational environment under "live" transportation conditions. A typical APTS operational test

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DOT/FHWA

Funding for APTS Programs

The Federal Transit Administration's commitment to initiate a revitalized and expanded Transit Planning and Research Program resulted in the largest investment in these activities in the last 10 years. A total of $60 million was made available in FY '92 to provide new emphasis to a host of initiatives, including the Advanced Public Transportation Systems Program.

In 1993 limited FTA discretionary funds under Sections 6 and 26, of the Federal Transit Act, as amended, are available to support the implementation and evaluation of APTS operational tests. currently, funds from the FHWA/IVHS Corridors program and funds from FTA Sections 3 and 9 are being used to cover capital costs. However, the availability of all of the funds appropriated under ISTEA has been dramatically reduced, thereby hampering some of the progress made in 1992. In addition, budgetary pressures and congressional earmarking has put constraints on the overall APTS progam.

"The APTS program represents a critical opportunity to test the flexibility provisions of ISTEA"

The APTS program represents a critical opportunity to test the dynamic flexibility provisions of ISTEA because transportation decisions are now made based on local needs, rather than because of Federal requirements dictating how and where money must be spent. Flexibility offers Metropolitan Planning Organizations (MPOs), transit operators, and state highway agencies the financial resources necessary to develop the most appropriate transportation systems to maintain mobility, ease congestion, and improve air quality.

Future funding for APTS initiatives will come from both Federal sources and existing local financial resources as MPO's, State DOT's, and local transit operators work together to meet existing and future travel needs.

"Local TIP's, SIP's, and Long Range Plans should include APTS initiatives"

It is critical that technical information on the costs and benefits of Advanced Public Transportation Systems be aggressively promoted to state and local decisionmakers to ensure that multimodal Long Range Plans identify potential facilities and services to address future needs. Local Transportation Improvement Plans (TIPs), which represent the major planning document for securing Fedemlfinancialassistance, should include APTS initiatives. State Implementation Plans (SIPS), required by the Clean Air Act to serve as a state's commitment to actions which will lead to the attainment of National Ambient. Air Quality Standards, should also include APTS initiatives.

ISTEA gives local transportation authorities the financial capacity and programming flexibility to develop efficient transportation improvements. It establishes' a new multimodal Surface Transportation Program which allows flexible use of selected FTA and FHWA grant programs so that one program can augment the other. The best way to access Federal and non-federal funds for APTS related projects is through full and active participation in project planning, programming, and selection at the local level.

What is APTS?

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integrates existing technology, R&D products, institutional arrangements, public acceptance, and market readiness in a real world test bed,

Various technologies are being examined in the APTS program, and many projects and operational tests involve the integration of several different systems. For example, to help the traveler make immediate decisions about his/her travel mode or route, a series of Smart Traveler technologies are being explored. To improve vehicle and fleet planning, scheduling, and operations, a number of transit operators are testing Smart Vehicle technologies, which represent new methods of increasing reliability, efficiency, and safety. Smart Intemodal System3 involve the integration of APTS technologies into traffic management and other non-transit applications of IVHS.

Smart Traveler technologies, Smart Vehicle technologies, and Smart Intermodal Systems represent the transfer of technological innovations into the U.S. transportation systems of the 21st century.

DOT Identifies New Projects for IVHS Operational Tests

U.S. DOT has identified 16 operational tests to advance the IVHS program The IVHS Operational Test Program is designed to evaluate system concepts, technologies, institutional, and financial arrangements that hold the promise of improving mobility and transportation productivity, enhancing safety, and reducing congestion on the nation s highways.

The Federal Transit Administration, the Federal Highway Administration, and the national Highway Traffic Safety Administration will jointly administer this program.

All of the projects listed below were selected; projects that include APTS operational technologies are described:

- **Bus Transit Travel Time Information System Test** (Colorado) will evaluate the impact of real-time information presented through video-display terminals, etc. at key high-use locations;
- **Advanced Traveler Information System/Automatic Vehicle Location in the I-394 Corridor, "Travlink" (Minnesota) will** evaluate real-time transit schedule and traffic information provided through a combination of kiosks and audiotext/videotext at work, home, shopping, and transit stations;
- **Minneapolis/St. Paul** Personal **Communication Device Test,** "Genesis" (Minnesota) will evaluate a portable digital personal communications device (PCD) designed to receive various real-time and transit information;
- **SMART Card** Bus **Fare Collection Test, "Smart DART"** (Delaware) will evaluate the use of "smart cards" for fare collection on Wilmington's entire transit system;
- **San Francisco Bay Area Inter-modal Traveler Information System Test, "TravInfo" (California) will evaluate** a comprehensive, multi-modal, region-wide traveler information system which collects, integrates, and disseminates transportation information;
- New York **City Metropolitan Transportation Authority Travel Information System Test** (New York) will evaluate the effectiveness of various methods of providing comprehensive transit information at bus stops and on-boardbuses;
- **Spread Spectrum Radio Traffic Signal Interconnect Test (California);**
- **San Antonio Advanced Traffic Management System Test (Texas);**
- **Dynamic Truck Speed Warning for Long Downgrades** (Colorado);
- **On-Board Automated Mileage/ Stateline Crossing Test (Iowa, Minnesota, Wisconsin);**
- **Washington, D.C. Surveillance Test** (D.C., Virginia, Maryland);
- **Integrated Freeway Damp Metering and Adaptive Arterial Signal Control Test** (Califomia);
- **Mobile Surveillance System Test** (California);
- **Adaptive Traffic Signal Control System Test** (California);
- **Smart Call Box Test** (California);
- **Storm Warning System Test** (Idaho).

IVHS-IDEA Program

The Transportation Research Board (TRB) has announced an IVHS-IDEA* programto investigate the feasibility of new technological concepts and to examine potential application of cross cutting technological advances to IVHS.

IDEA innovations should match the needs of the IVHS program in key functional technology areas such as:

- Advanced Traffic Management Systems (ATMS)
- Advanced Traveler Information Systems (ATIS)
- Advanced Vehicle Control Systems (AVCS)
- Commercial Vehicle Operations (CVO)
- Advanced Public Transportation Systems (APTS).

TRB will release a detailed IVHS-IDEA project announcement by April 1993.

Proposals may be submitted anytime during the year. Each IDEA project will be a fixed price and cost effective contract below $100,000 and should be completed within one year.

Individuals interested in IVHS-IDEA may send their recommendations on IDEA projects or request copies of the program announcement by writing to Dr. K. Thirumalai; TRB-IDEA Program; National Research Council, 2 10 1 Constitution Avenue NW; Washington, D.C. 20418.

* *Innovations Deserving Explort rly* ***Analysis*** *(IDEA)*

Smart Traveler Technology

Smart Traveler technology focuses on providing basic travel information to transit users before they make personal decisions on how to travel. The goal of Smart Traveler programs is to provide real-time transportation information to the public through advanced computer and communications technology.

Providing real-time information to travelers at home, in the work-place, or through roadside or transit center monitors using IVHS communication technologies can help travelers choose their mode of travel or alter their route in response to a delay. Several methods for gathering and providing real-time information are being researched and tested for public transportation use. A basic starting point is to ensure that automated information on all public transportation services in a given area is available at a single source. No longer will someone considering the transit option be required to check with every transit service or rideshare program to get information.

Examples of Smart Traveler technologies include interactive displays on personal computers or cable TVs that provide graphic views of public transportation services. The traveler indicates the origin and destination of the trip using a touchscreen that maps out the best route on a graphic display and shows bus numbers, bus stop locations, arrival and travel times. Real-time information can also be provided to travelers on-board a bus or other vehicle, thereby giving him or her the opportunity to complete an efficient journey. Such information can be communicated visually (via vidiotext) or by voice (via audiotext) to aid passengers with disabilities.

The Los Angeles County Transportation Commission is testing the use of a system which would electronically integrate and coordinate regional paratransit services provided by several public and private, providers throughout the county and make the information available to potential users.

Houston METRO is demonstrating a traveler information service using IVHS technology. The project calculates,displays, and prints out the best possible travel itinerary on transit to specific destinations.

"Smart Cards provide a secure, flexible method of payment"

A number of convenient fare payment options are being tested that may move transit towards a "cashless" operation. These options include the use of deposit cards, credit cards, debit cards, and other so-called "smartcards". Smart cards provide a secure, flexible method of payment, and a single card can be used for a variety of uses, such as paying transit fares or parking fees, and ATM transactions.

Ann Arbor Transportation Authority is developing a mobility pass which uses advanced card technology for either parking or transit use. Wilmington, Delaware plans to evaluate the use of smart cards for fare collection on their entire transit system Instead of dropping coins or tokens into a fare box, passengers will swipe their pre-paid, smart card though electronic readers mounted beside the drivers, and the electronic reader will automatically debit the correct transit fare from the card.

Smart Vehicle Technology

Smart Vehicle technology frequently integrates vehicle-based APTS technologies into a single system that is designed to improve vehicle and fleet planning, scheduling, and operations. The smart vehicle implements many advanced communication and vehicle location applications that are adapted from military, aerospace, industrial, and highway use to transit use.

"The Smart Vehicle adapts many technologies from military, industrial, and highway use to transit use"

Some of the technologies that am being used by transit are Automatic Vehicle Location; automatic passenger counters; on-board passenger information (both voice and visual); vehicle diagnostics; smart card readers; traffic signal preemption; automated demand-responsive dispatching systems (on board equipment); transponders for automatic toll collection and HOV verification; on-board automatic guidance equipment; and global positioning systems.

The common element linking all of these technologies is communication To be effective, data must be transferred between the vehicle and the home base, with computational processing either on the vehicle, at the user location, or at a central computer.

On board sensors automatically monitor such elements as passenger loading location of the vehicle, fare box revenue, operating condition of the engine and other equipment. This information is transmitted to a central control

center and is compared with the predetermined operating schedule. Deviations are noted and displayed to both the driver and the dispatcher. Corrective instructions are automatically issued to the driver to restore service or schedule adherence. Of course, if the situation persists, the human dispatcher initiates corrective action. Data on the vehicle's status are stored in the computer so that schedules, analyses, and plans can be revised using actual data.

The FTA has sponsored the development of a standardized Vehicle Area Network (VAN) that permits inputs from various on-board electronic sensors such as AVL, fare boxes, and passenger counters, that can be transmitted through a common cable in the vehicle. Previously, different cables were wired separately at the factory or during installation, thereby increasing the number of wires in the bus, the bus weight, and maintenance complexity. The new standard ties these systems together through a common wiring harness, or Vehicle Area Network

There are a number of smart vehicle tests being initiated around the U.S. For example Norfolk's Tidewater Transit has implemented an Automatic Vehicle Location (AVL) system to assure the reliability of its timed transfers and improve customer service. In Chicago, AVL is being combined with bus traffic signal preemption technology to examine innovative bus service improvements, including computer-driven dispatching techniques. In Baltimore, after equipping and operationally testing 50 vehicles using a LORAN "C" based system, the MTA is now equipping its entire fleet using Global Positioning Systems (GPS) technology.

There are also a number of innovative public-private arrangements underway that integrate state-of-the-art technology with transit use. For example, in Denver the RTD has contracted with a private consortium for an automated, fully integrated mass transit communications system for its fleet The Dallas System Consortium is also an AVL system using GPS technology. The Milwaukee County Transit System has contracted with a private consortium to provide an integrated positioning and communications system for its fleet.

The Federal Transit Administration is evaluating the cooperative efforts of these cities in order to monitor the actual improvements of system performance to cost savings and expanded ridership.

Smart Intermodal Systems

Smart Intermodal Systems involve the integration of Advanced Public Transportation Systems (APTS) technologies into traffic management and other non-transit applications of Intelligent Vehicle Highway Systems (IVHS).

"Smart Intermodal Systems provide the link between APTS and non-transit IVHS"

Smart intermodal systems focus on building a multi-modal transportation network that ensures the adaptation of technologies that optimize the transportation system as a whole. Recognizing that transit systems operate in intermodal transportation environments, smart intermodal systems provide the link between APTS and non-transit IVHS.

A variety of technologies are involved in the design of smart intermodal systems, ranging from simple to complex. A simple version of a smart intermodal system can involve the exchange of information between transit dispatch centers and traffic control centers on traffic flow. A more complex version can involve a coordinated traffic signal preemption system that closely monitors traffic flow while favoring buses that are behind schedule. This requires the integration and coordination of information between the transit dispatch and control center and the traffic management center.

Current traffic management systems are designed to optimize the flow of vehicles. Using smart intermodal systems, 'traffic management' will evolve into 'transportation management' whereby systems are designed to optimize the flow of people and goods.

Another example of smart intermodal systems involves integrated electronic payment systems for transit, highway tolls, and parking so that one payment medium is used to pay for a range of intermodal transportation services.

A number of smart intermodal systems tests are being initiated around the U.S. In Dallas, the Texas DOT is using imaging technology and Automatic Vehicle Identification technology to monitor and enforce HOV lanes. Imaging technology involves the use of Department of Defense target identification and tracking systems and AVI technology involves the use of electronic tags to identify individual vehicles.

The Ann Arbor Transportation Authority is considering expanding the use of "smart cards" to include the activation of an alarm at bus stops to alert the driver or as a personal security device. The Chicago Transit Authority is including an Automatic Vehicle Location system, a traffic signature preemption system., a computer-assisted dispatch and control system, and real-time passenger information signs as part of their Bus Service Management (BBMS).

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APTS Evaluation Guidelines

The Advanced Public Transportation Systems (ARTS) Program was established by the Federal Transit Administration (FTA) as part of the overall U.S. Department of Transportation Intelligent Vehicle Highway Systems (IVHS) initiative. (For a description of the APTS Program, see APTS Technical Assistance Brief 1, Spring 1993.)

Many innovative applications of APTS technology are being implemented at sites throughout the U.S. in the primary focus areas of Smart Traveler technologies, Smart Vehicle technologies, and Smart Intermodal Systems. Real world testing is being conducted in urban and rural areas using technologies such as automated vehicle location systems, smart card systems, dynamic ride sharing systems, passenger information systems, high occupancy vehicle systems, and vehicle component monitoring systems.

Most of the activity is being sponsored by the APTS Program as operational tests; however, there are-also some local initiatives to innovate that will provide valuable information for the APTS Program. Both the local initiatives and ARTS sponsored operational tests will be documented through evaluation plans developed from comprehensive national guidelines to assure compatible data sets.

The various operational tests are meant to serve as learning tools and as models for other locales throughout the country. For these tests to have value and broad application, a consistent, carefully structured approach to project evaluation will be undertaken.

The purpose of the ARTS project evaluations is to examine the effectiveness of APTS applications in real-world environments in terms of factors such as costs, benefits, and market response. Projects will be assessed on the success in meeting basic objectives such as enhancing the quality of transit service to customers, improving system productivity, and meeting community goals.

The Volpe National Transportation Systems Center has been charged with the task of developing a set of APTS Evaluation Guidelines that provide a common framework and methodology for evaluating individual operational tests.

While all sites will be evaluated using the common guidelines, the guidelines are not intended to be all inclusive – that is, they do not offer a suggested or preferred course of action for every conceivable situation that might arise. Since each operational site is unique, each site will require a tailor made evaluation plan based on the model Evaluation Guidelines. ❑

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