U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration
Federal Railroad Administration
National Highway Traffic Safety Administration
Maritime Administration

Implementation of the

NATIONAL INTELLIGENT TRANSPORTATION SYSTEMS PROGRAM

1997 Report to Congress

Joint Program Office for
Intelligent Transportation Systems

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FOREWORD

The Secretary of Transportation has forwarded this report to Congress pursuant to Section 6054(c) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). This is the fifth and final report provided to fulfill the statutory requirement to periodically summarize the progress of the Intelligent Transportation Systems (ITS) program administered by the U.S. Department of Transportation (DOT).

ISTEA provided unprecedented authority and funding for DOT to research, develop, and test intelligent transportation systems and to promote their implementation as a component of the Nation's surface transportation system. The program was chartered as a joint undertaking among public-sector agencies, academia, and private industry, with provisions and incentives for cost sharing.

The four previous reports addressed the program's activities to fulfill congressional directives (see Appendix A for further detail on the history and accomplishments of the program). Most notably, the 1996 Report to Congress extensively documented the achievements of the program and described the lessons learned from research, development, testing, and real-world applications since 1991. The 1996 report serves as a comprehensive reference document on the ITS program. The report drew three conclusions:

- ITS will deliver significant public benefit;
- ITS infrastructure is ready for deployment; and
- We must invest in the next generation of ITS — particularly smart vehicles.

In the Transportation Equity Act for the 21st Century (TEA-21), Congress authorized the strategies needed to continue the momentum in the public and private sectors toward the successful deployment of ITS. Based on these strategies, the 1997 Report to Congress presents the future direction of the program, discusses the remaining challenges, and offers an update on program activities.

As the ISTEA era concludes, ITS is at the end of a great beginning. The challenge ahead is to continue to provide leadership toward the creation of a modern, intermodal transportation system for the 21st century.

Washington, D.C., 1998

EXECUTIVE SUMMARY

The 1997 Report to Congress is the fifth in a series of reports summarizing the progress of the national Intelligent Transportation Systems (ITS) program administered by the U.S. Department of Transportation. It updates the 1996 Report to Congress which provided a comprehensive review of the program's progress and status from its inception in 1991, including the overall benefits of ITS. This report for fiscal year 1997 focuses on the challenges ahead, and the programmatic strategies to overcome those challenges. It also highlights specific accomplishments from 1997.

Background

With the enactment of ISTEA in 1991, Congress charted a course toward achieving greater operational safety and efficiency improvements by infusing existing surface transportation systems with electronics, communications, computer, and sensing technologies, referred to as Intelligent Transportation Systems, or ITS. It was a far-sighted decision, reflecting a prevailing consensus among leading transportation researchers and experts that ITS innovations afforded new opportunities to save lives and ensure America's global competitiveness and national security without compromising its environment or communities.

ITS represents the coming era in the evolution of surface transportation; it has already begun to revolutionize transportation. Just as advanced information technologies continue to dramatically change our modern-day world, the trend toward ITS in surface transportation is inevitable. Yet to realize this future,unprecedented cooperation and long-term commitment of public agencies and private organizations will be required over the next several decades.

Benefits of the National ITS Program

Through ISTEA, the national ITS program focused primarily on research, technology development, and field testing. The program also promoted the nationwide deployment of operationally proven ITS applications. The initial exploratory activities authorized by ISTEA have been completed successfully. Previously reported results and findings indicate that the ITS program is fully capable and positioned to achieve the 20-year vision of ISTEA in a cost-effective manner.

As documented in 1996, the benefits of deploying basic ITS infrastructure in urbanized areas include an estimated 35 percent savings to taxpayers in future investment in urban highways.[1] Moreover, ITS has the potential to reduce transit operating costs by an estimated $3.8 to $7.4 billion over the next decade, as well as lowering the administrative burden of commercial vehicle regulatory compliance by 9 to 18 percent.[2]

In 1997, further research indicated that over the next 20 years, implementing metropolitan ITS infrastructure will create a $420 billion market opportunity, consisting of $340 billion in private sector expenditures for consumer and commercial ITS

ITS: An Olympic Winner

During the 1996 Olympic Games in Atlanta, GA, unprecedented interagency coordination of traffic management, public safety, emergency response, transit, and traveler information services was achieved using ITS technologies.

Transit usage was nearly doubled and gridlock on roadways, already operating at or near capacity, was avoided through ITS applications.

products and services.[3] Furthermore, the ITS market potential represents nearly 600,000 new jobs within the same time period.[4] Metropolitan ITS infrastructure investment has an overall benefit-to-cost ratio of 5.7 to 1 in the top 300 metropolitan areas, and an even greater projected return on investment of 8.8 to 1 in the 75 most congested metropolitan areas.[5]

The economic returns for public investment in basic ITS infrastructure are remarkable, yet they pale next to the potential for safety improvements. The National Highway Traffic Safety Administration (NHTSA) estimates that if all vehicles were equipped with three types of systems — rear-end, roadway departure, and lane-change/merge warning systems — 1.1 million crashes could be prevented. This represents 17 percent of 6.4 million crashes nationwide each year. These three crash avoidance technologies alone would reduce crash-related costs by $26 billion annually, as well as the cruel toll in human pain and suffering.[6] These benefits are especially significant for rural travelers given that nearly 60 percent of fatalities occur outside metropolitan areas.[7]

National ITS Program Direction

In 1997, the national ITS program was focused to support two objectives more directly: 1) widespread deployment of proven ITS technology and applications; and 2) ongoing research to advance and achieve the knowledge needed to reap ITS safety benefits. Over the next few years, deployment and research activities will support two primary fronts: intelligent infrastructure and intelligent vehicles (see Exhibit E-1).

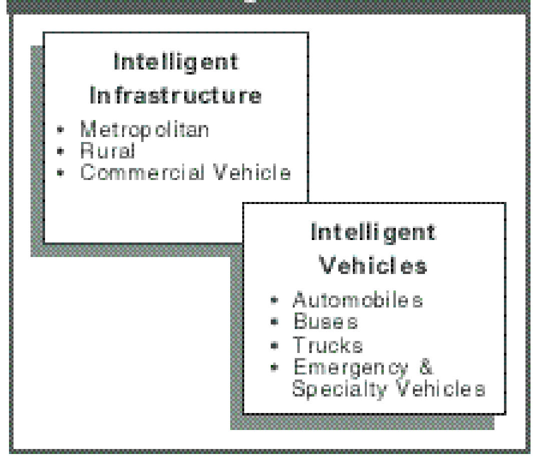
The intelligent infrastructure is the application of a unified set of electronics, communications, hardware and software technologies that address transportation needs of the traveling public in metropolitan and rural areas and ensure the safety of commercial carriers. Specific program activities for facilitating deployment of Metropolitan and Rural ITS infrastructure are underway. Intelligent infrastructure also includes a component to specifically address commercial vehicle user services. Known as the Commercial Vehicle Information Systems and Networks (CVISN), it is the application of technologies to improve commercial vehicle safety, streamline regulatory processes, and enhance the efficiency of the trucking industry.

Intelligent vehicles are the critical second half of the vision of an intelligent transportation system. They involve applying driver assistance and control intervention systems to reduce motor vehicle crashes. They also integrate driving assistance and motorist information functions to help drivers process information, make decisions, and operate vehicles more safely and effectively. They show great promise for dramatic safety improvements in the short-term as well as far greater operating efficiency and convenience benefits for motorists.

In addition to infrastructure deployment and vehicular research, the national ITS program recognizes new emerging program areas as they arise. In 1997, two new program areas, intermodalism and ITS data services, were identified. Each will require further attention as the ITS program progresses.

Through previous research and operational tests, the ITS program recognized numerous challenges to the widespread deployment of ITS infrastructure and the advancement of intelligent vehicles. In order to progress, the ITS program has recognized these challenges and developed strategies to overcome them.

Exhibit E-1: The ITS Program Structure



Challenges to Deployment

Challenges to widespread ITS infrastructure deployment and intelligent vehicle development include:

- The need for interoperability so that operational utility can be maximized from the infrastructure. Consumers will expect to purchase and use devices that can function in any state;
- The need to create a nation of experts to design, operate, and manage these systems;
- The critical need for technical guidance and assistance to “cutting-edge pioneers” who are moving forward with ITS deployment now;
- The need for greater awareness among elected officials and transportation decision-makers regarding the value and benefits of deploying integrated ITS;
- The need for regional ITS architectures to foster integration. This requires transportation professionals to incorporate ITS into the transportation planning process. It also requires a shift in focus to address ongoing regional operations and management from a systems perspective;
- The need to continue critical research and advance the “state-of-the-art.” Inherent in this is the need to engage private sector partners to leverage funding for ITS and to transfer research into the private sector marketplace; and
- The need to evaluate the ITS program in a way that clearly articulates the following:
  - The current status of ITS across the nation;
  - The progress in deploying and integrating ITS components;
  - The lessons learned and benefits derived from applying the program’s strategies; and
  - The program’s overall success.

Deployment Strategies

The following strategies are being pursued to overcome these challenges:

- **Establishing national ITS standards** to guide and enable systems interoperability across the Nation. TEA-21 requires conformance with national standards for all ITS projects that use Federal funds.
- **Building professional capacity** by providing training and education in the essential knowledge, skills, and abilities required to effectively plan, design, deploy, manage and operate ITS.
- **Providing technical guidance and assistance** to meet the immediate need for information and assistance to those who are implementing ITS, and to lay a foundation for mainstreaming ITS into existing processes.
- **Showcasing the benefits** of ITS through the DOT’s Model Deployment Initiative (MDI) site program. The MDIs will offer decision-makers a first-hand awareness of the benefits of deploying ITS infrastructure. The MDIs will also demonstrate successful inter-jurisdictional working relationships and document the interagency coordination required for the operations and management planning necessary to achieve integration.
- **Creating funding incentives** targeted at integrating ITS components. This also includes the development of regional architectures rooted in the National ITS Architecture. Funding incentives have proven to be extremely effective in leveraging other funding sources for integrating ITS.
- **Continuing research** that advances the state-of-the-art. The research program employs cooperative agreements, public-private partnerships and other resource-sharing agreements to engage the private sector and accelerate market availability for new intelligent infrastructure and intelligent vehicle systems.
- **Evaluating** the ITS program and tracking deployment progress. Tracking and evaluation are essential for understanding the value and effectiveness of ITS activities. This allows for the continual refinement of the ITS program, and is consistent with the Government Performance and Results Act (GPRA).

Notable 1997 Activities and Accomplishments

Funding for fiscal year 1997 totaled $232.5 million. To date,the ITS program has received over $1.2 billion in funding from both the Highway Trust Fund and general revenues, of which about 40 percent was for Congressionally directed projects.

ITS Program Funding ($ Million)

	ISTEA Authority	Annual DOT Appropriations	Total
FY 92-96	531.8	459.3	991.1
FY 97	**112.1**	**120.4**	**232.5**
Total	643.9	579.7	1,223.6

Source: ITS Joint Program Office Budget

Operational testing in priority corridors and other areas accounted for nearly 60 percent of the program funding, with the balance going toward enabling research and support activities. In many ways the program has impacted virtually every State in the Nation. The following presents a brief review of 1997 accomplishments by program area.

Metropolitan ITS Infrastructure

- The four MDI sites that were selected at the end of fiscal year 1996 (Phoenix, San Antonio, Seattle, and New York City metropolitan area) finalized their project objectives and detailed evaluation plans. Together, these sites will showcase the benefits of integrating existing ITS components, while validating the National ITS Architecture and associated standards and protocols.
- Operational tests continued delivering results, particularly in safety and cost reduction. For instance, the results of the Denver Smart Bus Operational Test,a fleet management and traveler information test, show:
  - Quicker emergency response time due to the automated vehicle location feature pinpointing the location of vehicles.
  - A 53 percent reduction in radio road calls by drivers.
  - A 32 percent reduction in customer complaints. (The new systems also allows for more detailed investigation of complaints.)
  - A reduction in supervisory staff and time transfer monitoring by streamlining functions with ITS technologies.
  - Ability to correct on-street service problems by utilizing automated vehicle location data.
- Four operational tests were begun on the Real-Time Traffic Adaptive Signal Control System (RT-TRACS). RT-TRACS is a new generation of control algorithms that allow real-time incremental improvements to traffic situations as they evolve. Four sites that present a wide spectrum of traffic conditions and roadway geometrics are being used to test the RT-TRACS suite of control algorithms.
- The ITS Professional Capacity Building Program was established to improve awareness of ITS among practitioners and to ensure that transportation professionals have the requisite knowledge, skills, and abilities to meet the challenges of deploying ITS. The Federal Transit Administration and Federal Highway Administration jointly conducted numerous seminars, workshops, and short courses. These increased the awareness and capacity of DOT field staff and their State and local partners to plan, deploy, operate, and maintain advanced technology systems. Nearly 2,000 people attended various training events throughout the Nation.
- The Peer-to-Peer Network program facilitated the sharing of information and technical assistance among State and local transportation professionals, policy-makers, and planners on issues related to ITS. A database of 106 peers was used to fill requests that resulted in at-desk reviews, telephone and documentation support, and, notably 17 site visits by peers to peers. In addition to the Network, Executive Scanning tours were conducted at 20 different sites this year to allow transportation officials to see first-hand how ITS technology can be applied in their jurisdictions.

Commercial Vehicle Infrastructure

- Prototype CVISN deployments in Maryland and Virginia reported on lessons learned which led to the piloting of CVISN in eight additional States across the country. The CVISN Model Deployment Initiative is deploying and integrating critical commercial-vehicle applications to ensure that consistency with the National ITS Architecture is feasible prior to widespread deployment.

- Several outreach activities were conducted including the development of a "Technology Truck." The truck operates as a traveling learning center and acquaints decision-makers, regulatory enforcement personnel, motor carriers, truck drivers, and others with ITS commercial-vehicle technology and opportunities.

- Operational tests of ITS for improving international border crossing operations were brought into operation at four sites: Nogales,AZ; Otay Mesa, CA; Buffalo, NY; and Detroit, MI.

- Two additional operational tests of the North American Trade Automation Prototype (NATAP) were brought into operation at Laredo and El Paso, TX, bringing the number of cooperative efforts with the U.S. Department of Treasury to a total of six.

Rural ITS Infrastructure

- Through a series of needs assessments and forums, the National ITS program came to better understand how to move forward with Rural ITS applications. A draft Advanced Rural Transportation System strategic plan, and a draft program plan of activities through 2001 were finalized and circulated among rural stakeholders for review and comment.

- Successful Rural ITS applications were documented as a resource for decision-makers in deploying ITS technologies in other rural jurisdictions. This includes an "on-line" compendium of some 200 ITS-related projects in rural settings,and a publication on low-cost,low-technology ITS success stories for rural areas, entitled *Technology in Rural Transportation: Simple Solutions*.

- Five new operational tests were funded that support three Rural ITS program areas. Rural public transportation tests will be conducted in Cape Cod, MA and Tallahassee, FL; Iowa DOT will develop an integrated weather information system; and tests of rural travel and tourism technologies will take place along I-40 in Arizona (including Grand Canyon National Park), and in Branson, MO.

Intelligent Vehicles

- A crowning ITS program achievement was the demonstration of automated highway system operations on a specially equipped freeway in San Diego, CA. Organized as a showcase by the National Automated Highway System Consortium, the demonstration met its goals in demonstrating fully automated operations of a variety of vehicles on public roadways in full view of the American public and the world media.

- Transit was a full player in the Automated Highway System demonstration. Two of Houston METRO's 40-foot, low-floor New Flyer buses successfully took part in the demonstration, utilizing full-scale, multi-vehicle automated transit technologies. The real-world application of these technologies is now under consideration in Houston and at other transit sites around the Nation.

- Operational testing of collision-avoidance technologies was advanced in 1997. Specifically, the data collection phase of the Intelligent Cruise Control operational test was completed; this phase was initiated for the Automated Collision Avoidance System.

- In 1997, the ITS program combined all ITS vehicle-related research into the Intelligent Vehicle Initiative. This overarching program brings together the various ITS research activities under the Advanced Vehicle Control and Safety Systems and the Automated Highway System programs to systematically and effectively invest in and plan for intelligent vehicles.

Enabling Research and Technology

- The Federal Communications Commission (FCC) was petitioned by ITS America to set aside spectrum at 5850-5925 megahertz (MHz) for ITS-related services, in particular, vehicle-to-roadside wireless communications. In the years it may take for the FCC to make a final decision, testing will be performed under a Certificate of Spectrum Support issued by the National Telecommunications and Information Administration to the FHWA.

- Training on the use of the National ITS Architecture was initiated. A companion series of technical guides is being prepared. *ITS Deployment Guidance for Transit Systems* has been completed and guides on other topics will be forthcoming during fiscal year 1998. Pioneering users attest that having the National ITS Architecture allows requirements to be determined and translated into system design concepts in one third to one half the time it would take to develop them from scratch.
- Accelerated development of 44 ITS technical standards sets continued. Eleven have been approved by standard development organizations and published for use. Another 20 are anticipated to be ready for formal balloting by the time this report is published. It is expected that over 100 standards will be needed to ensure interoperability among the various ITS functions.
- Research was completed on several human-factor issues. Significantly, results are available on Advanced Traveler Information Systems research, including the information needs and routing preferences of travelers, the structure of routing messages, and driver routing and rerouting decision sequences. A Traveler Information Effectiveness project was initiated to use the results of this and related research for assessing the effectiveness and improving the design of traveler information systems.

The Road Ahead

Having successfully completed the initial steps toward the 20-year vision articulated by Congress in ISTEA, the national ITS program is positioned to make even greater strides in the next several years. With a set of strategies developed to address the most immediate and significant challenges to deployment, targeted programs have been initiated and applied to greatly advance the state of the program. Throughout the Nation, the DOT has fostered ITS initiatives that are now at various stages of deployment — in metropolitan regions, major commercial-vehicle transportation corridors, and in rural America. State and local transportation officials are turning to ITS when the benefits are validated in field tests and showcased via model deployments. Highway and transit agencies are investing over $1 billion in regular federal-aid funds annually — four to five times the amount being expended by the national ITS program — to lay the technological and institutional foundations for long-term ITS deployment.[8]

While ITS can be counted among ISTEA success stories, the program is in mid-stream — important and substantive research, assessment, analysis, development, and testing have occurred, but the deployment phase has just begun. For the most part, ITS is being deployed in narrowly focused and modally fragmented “stove-piped” applications. ITS is happening without the planning and coordination among agencies necessary for fully integrated deployment and operations. And, few public agencies are able to plan,finance, deploy, operate,and maintain ITS technologies with the same ease as conventional solutions.

The challenges ahead are daunting but not insurmountable given a sustained national ITS program to meet them. In TEA-21, Congress authorized the following three-part legislative direction for the ITS program:

- A research and development program to advance the state-of-the-art and ITS deployment including:
  - Testing and evaluation of individual technologies, integration, and human factors associated with intelligent vehicles.
  - Testing of ITS standards.
  - Training, guidance, and technology transfer to facilitate infrastructure deployment.
  - Development of a Rural architecture, operational tests and, where appropriate, developmental research for Rural ITS applications.
- A deployment incentives program to encourage integration of legacy systems in Metropolitan areas and the deployment of CVISN and Rural ITS infrastructure.

- Language that will broaden eligibility of ITS for Federal-aid funding and require conformity with the National ITS Architecture and ITS standards.

The need to press ahead is clear. ITS deployment represents an important opportunity to enhance surface transportation safety and efficiency markedly in the 21st century. ITS will help secure economic benefits and improve the quality of life for all Americans — especially the traveling public.

End Notes to Executive Summary

1 McGurrin,M.F. and Shank, D.E. "ITS Versus New Roads: A Study of Cost-Effectiveness," *ITS World*, July 1, August 1997.

2 Volpe National Transportation Systems Center, *Benefits Assessment of Advanced Public Transportation Systems*, DOT-VNTSC-FTA-96-7, July 30, 1996, p.v.,and ATA/Foundation, *ITS/CVO User Services Benefit/Cost Analysis*, August 1996, p.xi.

3 Apogee Research, Inc.and Wilbur Smith Associates. *ITS National Investment and Market Analysis*, Washington D.C.:ITS America, May 1997, pp.ii-iii.

4 Apogee Research, Inc.and Wilbur Smith Associates. *ITS National Investment and Market Analysis*, Washington D.C.:ITS America, May 1997, pp.ii-iii.

5 Apogee Research, Inc.and Wilbur Smith Associates. *ITS National Investment and Market Analysis*, Washington D.C.:ITS America, May 1997, pp.ii-iii.

6 Recht,Philip R.,NHTSA Deputy Administrator. "*Realizing the Benefits*," Speech delivered at ITS America Annual Meeting, April 15, 1996.

7 U.S. DOT. *Rural Applications of Advanced Traveler Information Systems: Recommended Actions*, FHWA-RD-97-042, July 1997, p.1.

8 U.S. DOT. 1996 FHWA Estimate of Federal Aid funding ('92-95) spent on ITS infrastructure components: Response to Legislative Question #272,1996.

I. INTRODUCTION

The 1992 ITS Strategic Plan submitted to Congress reflected the collaborative vision of the U.S. Department of Transportation and the Intelligent Transportation Society of America (ITS America) for a safer, more responsive, and efficient national transportation system through the application of ITS technologies within 20 years.[1] Since 1991,the national ITS program has researched and developed nascent and unproven technologies, and has promoted deployment of first-generation ITS applications and services toward this vision.

Over the next 20 years, intelligent transportation systems are expected to become a routine part of new bus and rail systems, highways, streets, bridges, cars, trucks, buses, ferries, emergency response vehicles, and trains. In the future, public and private transportation managers will use ITS to better manage and operate the system to maximize capacity. The first steps have been taken to achieve that vision; however, many challenges remain.

A. Cornerstone Achievements Under ISTEA

The national ITS program has achieved the initial goals that Congress established under ISTEA, which expired in 1997:

- The program has shown that ITS technology can **enhance the safe and efficient operation of the Nation's highway systems** by improving traffic flow through advanced freeway, transit, and traffic management systems.
- The program has shown that ITS technology can **reduce traffic congestion and its societal, economic, and environmental costs** through field tests and feasibility studies.
- The program has shown that ITS technology **can enhance the safety and operations of our Nation's transit systems**, particularly by tracking buses and trains in real-time with Global Positioning System (GPS) technology that allows for more immediate identification of incidents and emergencies.
- **The program has advanced and promoted the ITS industry in the United States, and facilitated the transfer of transportation technology to the private sector** through field operational tests, priority corridors, research and development (R&D) partnerships, and deployment support.
- The program has **enhanced U.S. industrial and economic competitiveness and productivity**, primarily by improving transportation efficiency and applying ITS technology to commercial vehicle operations. A recent report comparing ITS across Japan, Europe and the U.S. asserts that the U.S. shows steady and promising market growth, especially in the areas of commercial vehicle and electronic toll collection applications.[2]
- **Institutional and nontechnical impediments to ITS deployment have been identified** and ways to overcome them determined as reported in the 1996 report to Congress.
- A **National ITS Architecture** was developed which depicts the many interrelated elements of ITS and identifies key standards for national interoperability and important markets.
- The program selected the National Automated Highway System Consortium to **develop a prototype automated highway and vehicle system**. In cooperation with the consortium, DOT successfully demonstrated prototype vehicles under fully automated control on a specially equipped section of I-15 near San Diego, CA.

These accomplishments have set the stage to deploy first-generation ITS,particularly an integrated public-sector infrastructure, and to advance the market-readiness of first-generation intelligent vehicle technologies.

B. 1996: A Year of Transition

By 1996, many first-generation ITS technologies — particularly advanced traffic management, traveler information, and public transit systems — were ready for market. The benefits and effectiveness of these technologies were affirmed by numerous field operational tests and feasibility studies. In 1996, the ITS program stepped up its plan to deploy market-ready ITS services and technologies:

- In January 1996, the DOT announced Operation TimeSaver, a broad ITS infrastructure deployment goal that will facilitate application of ITS products and services and advance intermodalism in the nation's metropolitan areas. DOT later announced parallel ITS infrastructure goals to support the distinct needs of commercial vehicle operations and rural communities.

- In June 1996, the National ITS Architecture was completed. The Architecture is a coherent framework for deploying various ITS infrastructure components. It shows how individual ITS services can be linked together to create intermodal and interoperable transportation systems that better serve travelers and system managers across all modes.

- Also in June 1996, the Federal Highway Administration,the Federal Transit Administration, Georgia Department of Transportation, and the Metropolitan Atlanta Rapid Transit Authority offered the first demonstration of the benefits of integrated ITS at the Atlanta Summer Olympics. This was the first attempt to integrate various ITS components into a seamless, intermodal transportation system. Notably, advanced public transportation technologies supported transit service that carried nearly 90 percent (23 million trips) of the entire Olympic Games attendance. This market share of travelers represented an unprecedented achievement for the U.S. public transit industry. Although integrating systems presents many challenges, the Olympics' success proved they are surmountable (see story box on the following page). Atlanta's experiences also provided the foundation for the ITS Model Deployment Initiative program currently underway.

C. Moving Forward: Reaping the Benefits of ITS

Initial research has demonstrated that current ITS technologies have great potential and can be applied cost effectively. These technologies have been used successfully to cross modal boundaries and realize the vision of an integrated system. The potential benefits from ITS include:

- An estimated 35 percent savings to taxpayers in required investment in urban highways.[3]

- The reduction of transit operating costs by an estimated $3.8 billion to $7.4 billion over the next decade.[4]

- A reduction in the administrative burden of ensuring commercial vehicle regulatory compliance by 9 to 18 percent.[5]

Additionally, public sector investment in metropolitan ITS infrastructure over the next 20 years is forecasted to generate a $340 billion market for consumer and commercial ITS products and services; and nearly 600,000 new jobs.[6]

The anticipated payoffs for public investment in basic ITS infrastructure pale next to potential safety improvements. The National Highway Traffic Safety Administration estimates that if all vehicles were equipped with just three crash avoidance technologies — rear-end, roadway departure, and lane change/merge warning capabilities — 1.1 million crashes could be prevented. This represents 17 percent of 6.4 million crashes nationwide each year and would avoid $26 billion annually in crash-related costs.[7]

D. 1997: Addressing the Challenges Ahead

In 1997, the Department moved forward on the basis of the goals set in 1996 and the potential benefits to be captured. Progress toward a national ITS system gained momentum, and the numerous program activities continued to focus on addressing the many challenges and barriers that remain:

- Standards are urgently needed to encourage interoperability, reduce public-agency risk, and encourage private-sector development of new ITS technologies and services.

Challenges of Integrated ITS Deployment: Lessons Learned from Atlanta

- Formal guidelines for deployment of ITS field devices and safety service patrols should be developed to assist local agencies in selecting systems and operating safe and efficient patrols.
- Extensive hands-on training is critical for realizing the full potential of ITS infrastructure components. Formal ITS training guidelines must be developed to maximize the effectiveness of ITS investments.
- ITS infrastructure component performance should be constantly monitored using proven methods — this is the key to assessing system functionality, quantifying benefits, and justifying additional investments for operational costs and upgrades.
- There should be a broad-based, interagency commitment to ITS deployment from the concept design stage to ensure that each agency's needs are accommodated — institutional problems are the "Achilles'heel"of ITS operations.
- Shared use of technologies and systems is a way of fostering cooperation and information sharing between highway and transit agencies, as well as making better use of existing transportation systems.
- ITS deployments, especially software components, require substantial shakedown periods before delivering full functionality — agencies with very short deadlines can expect hurdles along the way.
- Selection of an "optimal mix"of traditional traveler information systems (such as television and radio) with components of advanced traveler information systems and advanced public transportation systems, such as in-vehicle devices, is critical for balancing desired functionality and budgets.
- Problems with advanced traveler information systems hardware and/or software can adversely affect user market share and credibility, even if the information provided is accurate.
- Advanced traveler information systems components should carry information aimed at particular markets or groups of consumers to maximize benefits to users.
- Major special events like the Olympic Games offer an unparalleled opportunity to mobilize public cooperation for travel demand management measures; effective implementation of these measures will shift commuter travel patterns considerably.
- Travel demand management plans should reach both small and large employers alike — targeting just large employers will not yield the desired changes.
- During major special events, media expectations need special management — they serve as the "eyes and ears" for most of the local populace and the rest of the world.

Based upon: "Games Lessons Push ITS Forward," From ITS Intelligent Transport Systems, March/April 1997, p. 79.

- ITS deployment requires skills that go beyond the borders of the traditional civil engineering education of many of today's surface transportation professionals. The lack of requisite skills in systems engineering, communications technologies, and operations management in the transportation community could jeopardize rapid ITS deployment.
- Guidance and technical assistance are needed on an immediate, real-time basis to assist those who are moving forward now.
- Although ITS deployments are increasing, they are "stove-piped" — that is, narrowly focused and usually specific to one mode. Deployments need to be regionally integrated. Deploying agencies need to coordinate more closely, particularly at the regional level.
- The introduction of ITS expands the mission of many public-sector surface transportation agencies, from building infrastructure to operating and managing it. As a result, the transportation community will need to increase its emphasis on operations and management planning.
- The long-range potential of ITS cannot be fulfilled without continued research and development. In particular, "intelligent vehicles" could deliver significant safety break-throughs and efficiency to drivers and passengers, if properly developed to consider human factors and communications with an intelligent transportation infrastructure.

- A means for evaluating program progress and success is necessary to continually and effectively meet program goals.

These challenges emerged during the first five years of the program as the most immediate barriers to achieving an integrated, interoperable transportation system across the Nation. Other challenges continue to arise, such as the need to strengthen the program's focus on intermodalism and to devote attention to ITS data services. Intermodalism addresses the need to tie together all elements of infrastructure and transportation modes to achieve a "seamless" system for both passengers and freight. ITS data services are critical for long-term planning, evaluating effectiveness, and managing real-time transportation system operations.

Through the funding provided under ISTEA, program strategies have been developed to overcome these challenges, and specific goals for deployment and ongoing research have been set. The achievements of the past few years solidly position the ITS program to facilitate deployment of an integrated, nationwide ITS infrastructure, and to invest in the research and development of intelligent vehicle technology.

Based on the intermodal vision of ISTEA, the Department is moving forward with ITS as a means for improving customer service, efficiency, safety, and quality of life,and bolstering the competitiveness of U.S. industries.

E. Overview of the Report

The national ITS program is positioned to press ahead on two fronts: widespread ITS infrastructure deployment and advanced research, particularly on intelligent vehicle applications. The programmatic challenges, strategies, and activities are discussed in the following chapters.

Chapter II, Program Direction, describes the program's mission, vision, and programmatic areas, including newly emerging activities. It highlights significant challenges to ITS deployment and presents an overall program strategy designed to overcome barriers and realize the vision of a national,integrated intelligent transportation system.

Chapter III, Program Updates, presents the program's activities for 1997. These activities align with the program areas described in Chapter II. Specific achievements in research, testing, and strategic activities within each program area for 1997 are described.

Chapter IV provides a brief conclusion and is followed by a set of appendices. Appendix A is an historical perspective of the ITS program. Appendix B is a glossary of terms. Appendix C lists the reference materials used for this report.

End Notes to Chapter I

1 U.S. DOT. *ITS Strategic Plan in the United States*, FHWA-SA-93-009, December 1992.

2 Shibata, Jun and Robert L. French Associates. *A Comparison of Intelligent Transportation Systems: Progress Around the World Through 1996,* ITS America, June 1997. p. xvi.

3 McGurrin,M.F. and Shank, D.E. "ITS Versus New Roads: A Study of Cost-Effectiveness," *ITS World*, July 1, August 1997.

4 Volpe National Transportation Systems Center, *Benefits Assessment of Advanced Public Transportation Systems*, DOT-VNTSC-FTA-96-7, July 30,1996, p.v.

5 ATA/Foundation, *ITS/CVO User Services Benefit/Cost Analysis*, August 1996, p.xi.

6 Apogee Research, Inc.and Wilbur Smith Associates, *ITS National Investment and Market Analysis*, Washington D.C.:ITS America, May 1997, pp.ii-iii.

7 Recht,Philip R.,NHTSA Deputy Administrator. "*Realizing the Benefits,*" Speech delivered at ITS America Annual Meeting, April 15, 1996.

II. PROGRAM DIRECTION: THE ITS PROGRAM

This section begins with an overview of the ITS vision and mission, and introduces the four primary program areas — metropolitan, commercial vehicle, rural, and intelligent vehicles. It continues by highlighting current challenges, and outlining the Department's leadership strategies to facilitate an integrated, interoperable transportation system. The four program areas are then discussed in more detail, including a description of how the Department's strategies are being applied within each area. This section then poses new, emerging program areas that will likely require attention in the future.

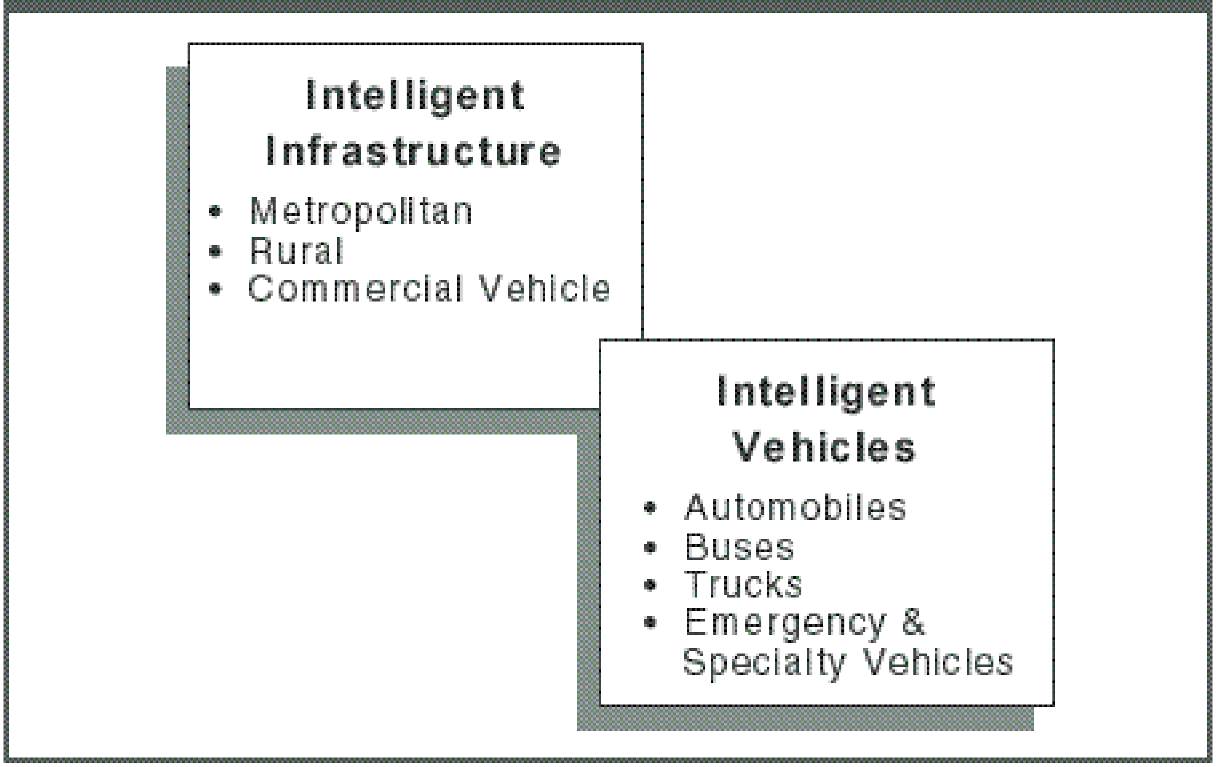
A. Vision of an Intelligent Transportation System

A national intelligent transportation system is a vision to be realized within 20 years. Ultimately, it is a vision of an intelligent infrastructure and intelligent vehicles working together to create an overall intelligent transportation system composed of multiple systems (see Exhibit II-1). ITS applications will gather and deliver real-time information to enable improved decision making and to create an intermodal system that is seamless from the customer's point of view. It is a vision in which transportation managers, across modes and in the public and private sectors, will be able to use information and communications services to better plan and manage operations. This will result in safer and more effective use of existing capacity.

B. ITS Program Mission

The ITS program mission is to provide leadership in the research, development, and deployment of ITS technologies. ITS technologies offer the promise of: a) improved highway safety, through services and technologies that aid in preventing crashes and

Exhibit II-1: The ITS Program Structure



provide more rapid emergency response; b) improved efficiency of the physical infrastructure; c) the ability to meet future transportation needs at a fraction of the cost of expansion or new construction; and, d) reduced transaction costs for governmental agencies and transportation users.

C. Introduction to the ITS Program Areas

Currently the ITS program is organized into two parallel efforts — intelligent infrastructure and intelligent vehicles. These two program efforts are broken down further into the four program areas shown previously in Exhibit II-1.

Research on the infrastructure components over the past six years has advanced significantly, and many are poised for deployment. In fact, a number of first-generation infrastructure technologies already have been deployed by States and localities under ISTEA.

The intelligent vehicle part of the program has evolved from a variety of research efforts pursued under ISTEA. Separate efforts addressing safety, automation, and human factors have been merged into one comprehensive program known as the Intelligent Vehicle Initiative (IVI). This program covers the research, testing, and evaluation of "intelligent vehicles" (automobiles, buses, trucks, and specialty vehicles) and their eventual interaction with intelligent infrastructure.

Intelligent Infrastructure

The term "ITS infrastructure" refers to the integrated electronics, communication, hardware and software elements that can support ITS services and products. The deployment of ITS technology to enhance the performance of the Nation's physical transportation system does not simply add a collection of components; instead, the technology creates a unified infrastructure that allows individual components to communicate with each other and work together. Adding this technological layer to the transportation system enables the most effective use of capacity and improves levels of safety so as to handle the expected growth in travel demand and the unprecedented levels of global commerce currently forecast. If widely accepted standards are used, the infrastructure can be designed to integrate with in-vehicle products and, eventually, provide intelligent vehicles with a new level of management capability, safety, and consumer convenience.

ITS infrastructure addresses the needs of metropolitan and rural areas, and streamlines regulatory processes associated with commercial carriers. The Department has established broad goals for infrastructure deployment:

Metropolitan ITS Infrastructure will integrate the various components of advanced traffic management, traveler information, and public transportation systems which will enable the management of these systems as a whole and allow for timely broadcast of information to customers. The goal set in 1996 by then-Secretary Federico Peña, and reaffirmed by Secretary Slater in 1997,is to deploy ITS infrastructure in 75 of the Nation's largest metropolitan areas within the next decade. The purpose is to save time and lives and improve the quality of life for all Americans.[1] This goal has been extended to include all aspects of ITS infrastructure. An additional metropolitan area, San Juan, Puerto Rico, has been added, bringing the total to 76.

Commercial Vehicle ITS Infrastructure will integrate the ITS user services for improving commercial vehicle safety, streamlining regulatory processes, and enhancing the efficiency of the trucking industry. An initiative known as the Commercial Vehicle Information Systems and Networks, or CVISN, provides the technical infrastructure link to these activities and information systems, including common standards for electronic communication among participating agencies and carriers.CVISN will eventually function nationally as the backbone for commercial vehicle regulation. The DOT's goal is to facilitate the deployment of safety credentialling and electronic screening nationwide and at borders for commercial vehicles.

Rural ITS Infrastructure has been characterized by several "functional clusters," which identify groups of potential services to be provided in rural areas and small towns, on rural roads, and in the National Highway System, as warranted. The logical architecture for these clusters has yet to be developed at a detailed level. It is expected that some rural systems will be extensions of metropolitan systems. Others will be independent site deployments, and others will be components of a larger state-wide information and communications backbone.

Intelligent Vehicles

The long-range safety potential of ITS cannot be fulfilled without smart vehicles — automobiles, buses, trucks, emergency vehicles, and specialty vehicles. These will combine advanced technological applications for safety, navigation, and communications in a safe, human-centered, and integrated fashion.

By the end of 1996, advanced systems such as automated collision notification and intelligent cruise control, were ready to move from the laboratory to field testing with the support of the ITS program. The program had also produced preliminary performance specifications for driver information and collision avoidance systems. These technology and human-factors breakthroughs allowed the ITS program to begin to focus on how individual vehicle information, safety, and automation technologies could be integrated to enhance the safety and performance of drivers.

Recognizing that these and other driver assistance systems potentially offer major benefits, the Department began to develop the Intelligent Vehicle Initiative. This initiative will cover applications for passenger cars, light trucks, vans, sport and utility vehicles, commercial trucks, transit and intercity buses, and specialized vehicles such as emergency and enforcement vehicles, highway maintenance, and snowplows on all types of roads. The program continues to be defined, but is focused on accelerating the commercial availability of advanced technology driver-assistance devices which improve safety.

D. Challenges

Complementary public-sector and private-industry research has resulted in ITS products, services, and technologies that are already being deployed in States, localities, and the private sector marketplace around the country. However, only pieces of the ITS infrastructure are being put in at any given time, and generally serve only a narrow need or function. These individual applications of ITS technologies, while useful, fall short of serving as a bridge to a new era of intermodalism. This current pattern of isolated deployments poses great long-term risk of electronic "hardening" of artificial agency and jurisdictional boundaries, which would take decades and billions of dollars to overcome.

ISTEA was passed with the recognition that a unified and intermodal transportation system requires cross-agency coordination and planning early in the life of transportation projects. It also recognized the efficiency and effectiveness of developing transportation strategies and solutions at a regional level. In requiring the development of an advanced electronics and communications infrastructure, the legislation recognized the importance of creating a seamless intermodal transportation system.

The following describes the broad challenges that must be addressed to move ITS from stove-piped, non-interoperable applications to an integrated, interoperable and intermodal system of systems.

1.)The Need for Interoperability

Interoperability is the key to designing, purchasing, and deploying ITS so they can easily be integrated. For travelers, interoperability means the ability to purchase a commercial ITS device, i.e.,a toll tag or an in-vehicle navigation unit, and be assured that it will operate nationwide. Without an eye toward interoperability, system managers risk deploying in a "stove-piped"manner, in which most agencies deploy systems with little consideration of regional implications beyond their own requirements. Stove-piped deployment actually risks raising modal boundaries rather than bridging them. ITS deployments that use the National ITS Architecture and technical standards are essential and a prerequisite to deployment of integrated, interoperable systems.

Use of the National ITS Architecture

Use of the National ITS Architecture is the first critical step toward facilitating interoperability nationwide. To a great extent, the National ITS Architecture provides choices that allow ITS deployments to be tailored to meet localized needs and preferences. This flexibility requires that public agencies and other stakeholders coordinate with one another to agree upon a regional ITS deployment framework within which individual agencies and private entities can approach deployment incrementally. This will allow systems deployed today to mesh with those that already exist, as well as with those installed in the future. Much of the current state-of-deployment relies upon traditional processes in which interagency interaction is not a vital component, resulting in "stove-piped" deployments and "hardening" of agency and jurisdictional boundaries.

Technical Standards

The foundation for intermodal, interoperable intelligent transportation systems is based on the fundamental need for, and compliance with, technical standards. Standards, then, are the second critical step to enabling system interoperability.

Without standards, ITS deployments that conform to the National ITS Architecture would have similar structure and perform similar functions, yet would not necessarily be able to readily exchange information.

Standards are also essential for reducing initial acquisition costs and reducing the risk of premature technological obsolescence. Standards allow multiple vendors to design compatible ITS components that can function together as an overall system. This enables competition among vendors to provide a wide range of equipment with differing levels of functionality, thereby affording transportation managers greater flexibility in choosing products that best suit their particular requirements. Standardized components result in significant cost savings for both upgrades (since one component can be replaced, rather than an entire system) and expansions of functionality. Standard human interfaces allow users to adapt to different products and services safely, reliably, and conveniently. Without ITS standards, State and local governments, as well as consumers, will face increased risk of buying products that do not necessarily work together or function consistently in various parts of the country.

2.) The Need for Training

The benefits of ITS cannot be realized without a work force that has the foundation of knowledge, skills, and abilities needed to effectively handle ITS services and their supporting communications and information infrastructure.

At present, this lack of sufficient ITS professional capacity within surface transportation agencies is one of the greatest nontechnical barriers to ITS deployment. Core competencies, particularly in the highway industry, are geared toward traditional capital expenditures and improvements. However, moving ITS deployment forward requires the training of present and future transportation professionals who can plan, design, procure, install, operate, and manage electronic and information systems as easily as traditional highway and transit improvements.

Prior studies have been conducted of training and education needs for adequately addressing ITS deployment. There is agreement among these studies that the following issues must be addressed:

- There is a lack of knowledge about ITS in general and about specific technical and institutional issues.
- There is a longer-term issue that ITS and the future of transportation will require multi-disciplinary skills, expanding the labor requirements from the more traditional engineering skills to such qualifications as systems planning and systems operations; policy, economics, and management; and electronics and communications.
- A sufficient labor pool does not currently exist across the Nation to satisfy the needs of ITS. One study estimated that the traffic operations field alone will require 550 new entrants annually, and that ITS may add 300-500 entrant requirements to that.[2]
- ITS will be in competition for this type of labor with other private-sector fields that are not bound by wage caps, hiring ceilings and other institutional constraints.[3]

3.) The Need for Guidance and Technical Assistance

Equally as urgent as the need to develop ITS professional capacity is the need to provide more immediate guidance and technical assistance to those on the cutting-edge, who are moving forward now with ITS deployment. These pioneers have a need to understand how other sites have been successful in developing technologies and institutional practices that work. They also have a need to receive the most up-to-date information on ITS, especially recent technical knowledge.

Providing this type of assistance can reduce the risk of failure or duplication of errors across sites. It is a way to provide answers to many of the most pressing challenges faced in the field, thereby facilitating deployment. Technical guidance and assistance also transfer knowledge about integration, help overcome stove-piped deployment and assist in mainstreaming ITS practices.

4.) The Need for Awareness

Despite the longstanding use of some advanced technologies, decision-makers continue to need information on the value and benefits associated with deploying integrated, interoperable ITS. For ITS to be widely deployed, State and local officials must come to regard it as a standard tool for addressing transportation needs. Once decision-makers understand the benefits of ITS, they must assess agency policies, procedures, and competencies to "mainstream" ITS.

5.) The Need for Systems Planning and Operations

Incorporating a new road or transit route as part of a regional transportation plan requires careful coordination with existing facilities so that the network functions as a unified system. Over the years, transportation planning processes have been geared solely to transportation capital improvement programs; however, the operations and management of regional highway and transit systems is most often undertaken agency by agency. This is the challenge of ITS.

The challenge is twofold. First, ITS faces the higher-level challenge of expanding the transportation planning process to include ongoing operations. Inherent within this challenge is the need to weigh ITS against traditional transportation improvement options. Comparisons are problematic because the more traditional planning tools and methods are poorly structured to compare operational options with capital options. Similarly, most transportation planning professionals are less familiar with ITS and its value in resolving regional operational improvements, or with combining ITS with traditional capital improvements. Also, it is State DOTs that historically tend to determine project funding. However, successful ITS deployments require the inclusion of stakeholders that are not traditional recipients of transportation improvement funds, such as police and other emergency workers, departments of motor vehicles, as well as city and county traffic and transit organizations.

The second challenge is a more basic need for a cultural shift in local thinking to occur — one toward operations and management planning from a systems perspective. This shift is required to develop regionally integrated operational concepts for ITS to facilitate and enable interoperability. Such a shift requires agency planners to incorporate ITS deployment opportunities into long-term planning in order to account for the needs of various stakeholders, and to coordinate communications infrastructure alternatives among stakeholders. A case in point, the State of Virginia is working hard to nurture a systems engineering perspective for its statewide transportation projects. In Northern Virginia alone, over 80 different stakeholder groups are being brought together to develop an integrated regional transportation system (see box on the following page).

6.) The Need for On-Going Research

Ongoing research is critical to creating and maintaining a "state-of-the-art" future in transportation. Current successful ITS deployments began as research concepts during the 1970s when prescient leaders developed systems and technologies now bearing fruit as ITS applications. It is this type of ongoing, foresighted research that is needed to ensure that successive generations of ITS are available to meet future transportation needs.

In support of ongoing research, it is critical to engage private-sector partners. Private-sector partners are key in promoting the transfer of technology to the market. In Washington State, for example, Microsoft Corporation is using public data, generated through the Seattle area's ITS infrastructure, to create a marketable traveler information service (see box on page 11). Another critical element in ongoing research is the Federal government's role in ensuring that systems are safe, interoperable, and take human factors into consideration. However, given this regulatory oversight role, the agendas of public- and private-sector transportation stakeholders are not completely aligned, and partnerships are not always viewed as advantageous. Recent endeavors have shown that synergies can occur when government and industry collaborate. One example is the August 1997 demonstration of the prototype automated highway system, developed through a public-private partnership known as the National Automated Highway System Consortium. While the consortium experienced the challenges of conflicting agendas among members, the demonstration was highly successful and illustrates the benefits of stakeholder cooperation.

7.)The Need to Evaluate the ITS Program

In order to understand the value and effectiveness of the ITS program,the Department needs to evaluate its program activities. Evaluation allows for an understanding of whether program progress is highly successful and produces benefits, and whether progress is occurring in the manner most suited to achieving program goals.

Evaluation efforts require that definitions of “deployment” and “integration” be developed and accepted by the various stakeholders involved in ITS. Once developed, these definitions will help establish the baseline of current ITS deployments. Tracking measures can then be instituted that clearly demonstrate progress. The use of tracking measures can reveal where the ITS program might need refinement and also help to ensure the effective allocation of ITS resources and priorities.

E. OVERALL PROGRAM STRATEGIES

To overcome the immediate and future challenges of ITS infrastructure deployment and development of intelligent vehicle technology, DOT has assumed a leadership role much like the one the Federal Highway Administration (FHWA) played in developing the Interstate Highway system. Back then, FHWA recognized a need to develop standards and to train a new breed of civil engineers to ensure the successful design and construction of the highway system. The ITS program is demonstrating similar leadership by facilitating intelligent infrastructure deployment, funding near-term critical research to overcome technical and institutional impediments,and focusing on research required to sustain future systems.

Specifically, DOT has designed a host of strategies that encourage the development of technically integrated and institutionally coordinated intelligent

Systems Engineering: One State’s Integration Efforts

ITS is not one technology or one project. Instead, it is a whole host of technologies and products, whose benefits and performance are maximized when combined with one another as an entire system.Systems engineering is the glue that makes these separate elements of ITS come together effectively. It is an approach to be used in designing, implementing, and managing large-scale projects by forcing officials to identify up front and in detail what results they want to achieve, the performance measures to be used, and the problems that they might encounter. By identifying goals from the outset, systems can be developed that minimize the construction of “closed” systems that are hard to upgrade as technology changes, as well as minimize cost overruns that regularly plague large projects.

In Virginia, where ITS-type technologies have been in use for 20 years, the Virginia Transportation Research Council is using systems engineering to conceptualize and implement a statewide system that links all ITS information components and users. As part of this effort, a research team is working to integrate transportation systems management in Northern Virginia by bringing together approximately 80 separate agencies, organizations, and associations that will be the users, developers, or supporters of the system.Currently little or no advanced automation for sharing information exists among municipalities in the region. By using a systems engineering approach, the group was able to set goals and design a system to meet their needs. Once complete, the integrated system will be a model for other regional systems and ultimately for the broader statewide ITS architecture.

Based upon “ITS in the Limelight” from ITS World May/June 1997 pp.28-33.

> **Public-Private Partnerships: Microsoft Corporation and the State of Washington**
>
> In Seattle, Microsoft Corporation and the Washington State Department of Transportation have formed an agreement to deliver personalized traffic information to the public using the Internet.The internet site is part of the Seattle area Model Deployment Initiative and was created by Microsoft Corporation using data supplied by the Washington State Department of Transportation.
>
> More than 1,000 people have signed up in the first month of operation to receive e-mail deliveries showing real-time traffic conditions on area freeways and within HOV lanes, as well as the best routes for specified travel plans. In addition, users can request that specific route information for a daily commute be sent to them via e-mail every day at a specific time. The system, called Trafficview, also offers links to other transportation sites on the Web that give local information for transit, ferry, and Amtrak rail schedules.
>
> This agreement illustrates a win/win situation for both the public and private sector, as private industry builds upon information generated by the public sector to enhance transportation service to the public.
>
> *Based on "Customized Traffic Info is Popular Feature on Microsoft's Seattle Site," From Inside ITS, June 2,1997, p. 8-9.*

transportation systems. The strategies respond directly to the challenges discussed in the preceding section.

1.)Enabling Interoperability through Technical Standards and the National ITS Architecture

To meet the challenge of systems interoperability across the Nation, DOT has established a program to develop over 100 technical standards defined by the National ITS Architecture. A policy for "architectural conformity" is also being developed for all projects that use Federal funds.

In July 1996, the ITS program achieved a major milestone with the completion of the National ITS Architecture. The Architecture provides a flexible framework to guide State and local governments considering ITS. It does not specify any particular technology solution thereby engendering an "open system." In addition, the Architecture defines ITS interfaces and identifies those which need to be standardized to create a unified national system.

Establishing technical standards in support of the National ITS Architecture is critical to achieving interoperability. As an "open system" ITS must be capable of evolving gracefully over time to accommodate additional functional requirements and to incorporate technological advances.

Based on these standards requirements and benefits, DOT initiated a program to accelerate the normally lengthy standards development process. The program provides funds to five Standards Development Organizations to perform technical work normally done by voluntary industry workers (see text box on next page for priorities in development). Numerous individual but related standards must be completed, verified, and disseminated for "mainstream" ITS deployment to become a reality. This process entails extensive efforts on the part of multiple public- and private-sector organizations over a substantial period of time. As part of the overall process, critical ITS standards are being coordinated with the International Standards Organization to ensure international compatibility.

Members of the National ITS Architecture development team are working with the standards organizations to assist them in understanding the interfaces and technical requirements. Additionally, the Department has produced 12 specific subvolumes to the National ITS Architecture that provide further definition for standards groups. As a result of this cooperation and accelerated effort, 20 standards will be at the mature draft stage and ready for use by the end of calendar year 1997.

2.)Building Professional Capacity

When the Interstate Highway construction program began,new skills in roadbuilding and civil engineering

DOT Priorities in ITS Standards

The Department has defined two "waves" of activities to complete the majority of the necessary standards. First-wave activities include the development of:

- Safety-related standards which establish human factor and operational guidelines to ensure that ITS products and services are utilized in a safe manner.
- Data dictionaries and other foundation standards, which support the general deployment of ITS and support multiple interfaces in the National ITS Architecture.
- Standards that promote national and regional interoperability and support the ITS metropolitan and rural infrastructure needs. This includes message set development and ITS specific communications standards supporting traffic management, public transit, and traveler information systems.
- Commercial vehicle operations standards that facilitate interstate commerce. Examples include Dedicated Short Range Communications standards and Electronic Data Interchange standards.

Second-wave activities include the development of:

- The remainder of requirements resulting from the National ITS Architecture. These include such areas as the highway-rail intersection service, ITS data user service, information-service-provider interfaces, financial transactions, or in-vehicle interfaces.
- Requirements identified by the ITS community that fall outside of the National ITS Architecture but still were essential.

In a similar fashion, ITS requires new skills in systems engineering, electronics, and communications to become a reality. To meet the challenges created by the scarcity in ITS expertise, DOT has established programs to train, educate, and build the essential knowledge, skills, and abilities to effectively deploy and manage ITS. This includes ITS services in addition to their supporting communications and information infrastructure.

In 1996, the ITS Professional Capacity Building program was established. The program is guided internally by DOT, as well as by an external steering committee made up of prominent transportation professionals from government agencies, academic institutions, and the private sector.

The large audience for training and education in ITS warrants a broad scope for the Professional Capacity Building program. The delivery framework for the program is divided into three audience tracks to better target needs.

Track 1: Train and retrain existing transportation professionals including academic and private-sector experts.

Track 2: Educate future transportation professionals and leaders, including students at universities, colleges and technical/vocational schools.

Track 3: Educate elected and appointed officials who have influence over transportation policies and funding. This track focuses on building greater awareness of ITS benefits among decision-makers; as such, it depends on the success of the strategy for showcasing and demonstrating the value of ITS.

Although the Professional Capacity Building program has been underway for little more than a year, it has made considerable progress. In 1997, Track 1 training and education activities for metropolitan and commercial vehicle operations were initiated. Audiences were identified, and courses were delivered. Federal and State transportation professionals attended many general awareness seminars throughout the ten FHWA and FTA regions and the majority of the State divisions. Seven additional technical seminars were offered on demand throughout the Nation on the following critical ITS topics:

- Deploying Integrated ITS,
- Use of the National ITS Architecture,
- ITS and the Planning Process,
- Public/Private Partnerships,
- Telecommunications Overview,
- Telecommunications Analysis, and
- Telecommunications Shared Resources

The number of professionals trained in ITS subjects throughout 1997 totaled over 2000.

The program has also established partnerships with the National Highway Institute, National Training

Center, and National Transit Institute. This will help mainstream ITS coursework within the DOT. Finally, a five-Year implementation/business plan known as the *Framework and Overview* was developed. It identifies the major activities and associated resource requirements needed from fiscal year 1997 through fiscal year 2002 to achieve the Department's professional capacity building goals for ITS.

3.) Providing Guidance and Technical Assistance

Recognizing that the Professional Capacity Building initiative involves a long-term strategy, DOT has instituted programs to deliver the technical assistance and documentation that are needed on a more immediate basis to assist those moving forward now.

Through the following programs, the Department is providing immediate guidance and technical assistance in the areas described below.

Clearinghouse of Information: ISTEA required DOT to establish a clearinghouse of information. The Department aims to make information available as widely as possible through its website and other Internet applications. In addition, ITS America has a library of ITS-related materials and makes them available to the public.

The Peer-to-Peer Network: The Peer-to-Peer Network offers short-term, no-cost, technical assistance on investigatory, implementation-oriented, and decision-oriented issues related to ITS. Telephone referrals, printed information, a speakers and facilitators bureau, at-desk reviews, and on-site consultations are all tools available to State and local transportation professionals, policy-makers, planners and others with questions about ITS. The network has been established for a little over a year and its use has increased as word of its existence spreads.

Executive Scanning Tours: Executive Scanning Tours are designed to bring decision-makers and high-level managers to ITS deployment sites. The hands-on experience allows for transportation officials to see first hand how ITS technology can be applied in their jurisdictions. In 1997, Executive Scanning Tours were conducted at 20 different sites.

Guidance Documentation: Guidance documents facilitate the spread of technical knowledge and provide specific assistance. Guidance gives policy-makers and transportation officials further information and recommendations on deploying ITS infrastructure and using the National ITS Architecture. Other technical subjects included, for example, using the National ITS Architecture, information security, telecommunications, and software procurement.

Many transportation-related organizations provide a conduit for disseminating this guidance. For example, the Department was instrumental in forming the National Associations Working Group for ITS. This group is a joint FHWA/FTA effort aimed at disseminating the ITS message and ITS materials to local elected officials and transportation service providers. The group represents a broad cross-section of the interests, and provides an opportunity for discussion and local input. Exhibit II-2 on the next page lists the members of the Group as of the end of fiscal year 1997.

As an example of why forming such a group aids in the success of mainstreaming ITS, four members of this group passed resolutions in 1997 in support of ITS (the U.S. Conference of Mayors, the National Conferences of State Legislators, the National League of Cities, and the American Association of State Highway and Transportation Officials). Also, the American Meteorological Society has formed an ITS subgroup to consider how weather information can be used to achieve greater transportation safety and efficiency, paving the way for the ITS program to obtain greater involvement and cooperation with weather information providers in the future.

4.) Showcasing the Benefits of ITS

The more exposure people have to useful products and services, the more likely they are to understand, plan, purchase, and use them. In meeting the challenge to provide greater awareness of ITS among elected officials and transportation decision-makers, the DOT has funded approximately one dozen Model Deployment Initiative sites around the Nation. These sites are designed to demonstrate the benefits of technically integrated ITS infrastructure, raise awareness of the capabilities of ITS technologies, and encourage public sector officials to embrace and build locally applied ITS infrastructure. The Model

Exhibit II-2: Members of National Associations Working Group for ITS (as of the end of FY 1997)

- American Association of State Highway and Transportation Officials
- American Highway Users Alliance
- American Legislative Exchange Council
- American Planning Association
- American Public Transit Association
- American Public Works Association
- Association for Commuter Transportation
- Association of American Railroads
- American Trucking Associations
- Automated Highway System Consortium
- Coalition of Northeastern Governors
- Community Transportation Association of America
- Friends of ITS
- Institute of Transportation Engineers
- International Bridge, Turnpike, and Tunnel Association
- International City/County Management Association
- ITS America
- National Association of Counties
- National Association of Regional Councils/American Metropolitan Planning Organizations
- National Association of Towns and Townships
- National Conference of State Legislatures
- National Governors' Association
- National League of Cities
- Public Technology, Inc.
- Roadway Safety Foundation
- Surface Transportation Policy Project
- U.S. Conference of Mayors

Deployment Initiatives exhibit ITS infrastructure applied to metropolitan areas and motor carrier operations,and showcase successful jurisdictional and organizational working relationships. The Federal role in these initiatives includes shepherding ITS infrastructure deployment, evaluating the effects and benefits of deployment, and providing guidance and technical assistance.

Specifically, four metropolitan sites (Seattle, Phoenix, San Antonio, and the New York City Tri-State Region) were selected to demonstrate the benefits of integrated advanced travel management services that feature a strong regional, multimodal traveler information component. In addition, seven states were selected to demonstrate CVISN: California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, and Washington/Oregon. The National ITS Architecture is serving as a framework for building ITS infrastructure at these sites.

Showcasing activities for metropolitan and CVISN ITS deployment also include executive scanning tours. Bringing transportation professionals to the ITS deployment sites allows them to see first-hand how ITS technology can be applied as a viable solution to transportation challenges in their jurisdictions.

5.) Creating Funding Incentives

DOT has proposed the Deployment Incentives Program to meet the challenges of coordinating regional and long-term planning, mainstreaming ITS into current processes, and effectively leveraging ITS funds. This program targets Federal funds to promote integration of legacy systems at Metropolitan and CVISN sites, and ITS deployment in Rural areas.

The Department also seeks to link these and other Federal funds used for ITS to conformance with the National ITS Architecture. The policy on conformance will be developed in early 1998 through a series of outreach forums designed to gather input and concerns from transportation professionals across the country who will be using this policy.

Temporary funding incentives have proven to be dramatically effective in halting fragmentation and fostering technical integration and institutional coordination. The power of small incentives was most clearly demonstrated in the 1996 Model Deployment Site solicitation. The solicitation catalyzed institutional collaboration, even among agencies at unselected sites.

In addition to targeted incentives,the Department has fostered new institutional models of doing business through public-private and public-public partnerships, cooperative agreements, and resource sharing. As documented in the 1996 Report to Congress, some partnerships have been highly successful. Forming partnerships with the private sector, for example, helps spread the costs of labor, materials, and system development while allowing for more efficient technology transfer and expertise sharing throughout the marketplace. The Department will continue to promote a variety of funding models in order to most effectively utilize all available resources in deploying ITS.

6.)Researching the Next-Generation of ITS

An aggressive Federal research, development, and testing program has helped move ITS technologies, largely unfamiliar to the transportation industry six short years ago, into "state-of-the-practice" use. The national ITS program has helped ITS evolve from relatively visionary concepts to viable and attractive solutions for transportation problems. While the national ITS program needs to continue the facilitation of integrated, interoperable deployment, research is still a critical component of the program strategy to move ITS toward the program's 20-year vision.

Research needs can be categorized in two ways: infrastructure research and vehicular research.

Infrastructure Research

Continued research and development is essential for advancing the real-time capabilities of ITS infrastructure components and for developing successive generations of ITS technologies. Specific program priorities target the following:

- Next-generation traffic and transit management centers that are designed to enhance human effectiveness and productivity through automation.
- ITS applications to make highway-rail crossings safer.
- Exploratory research into potential rural applications of ITS,including road hazards, weather advisories, automatic collision notification, and rural paratransit.
- Enhancement of evaluation and analysis tools and methods (such as simulation models) to enable transportation professionals to more accurately compare ITS services to traditional transportation alternatives.
- Deepening of the National ITS Architecture. Implementation of ITS by State and local jurisdictions is driving the need for further definition of the National ITS Architecture. Use of the Architecture at MDI sites around the country has revealed the need for a better understanding of the transportation community's information requirements to support weather communications, emergency and Mayday systems, and planning. The data flows and interfaces for each of these areas need to be better defined to allow for standards development and products that are interoperable.
- Research into emerging program areas, such as intermodalism and ITS data services.

In-Vehicle Research

To attain the 20-year vision of an integrated, intermodal transportation system, research is needed on intelligent vehicles, their implications for safety, and their ability to work cooperatively with the infrastructure. This research encompasses the following:

- Development of varying levels of vehicle technology for warning and information services, driver assistance, and automation.
- Application and testing of these technologies individually and in conjunction with one another to understand their impact on safety and driver ability.
- Building on the lessons learned from the Automated Highway System program's research on vehicle-to-infrastructure and vehicle-to-vehicle cooperation.

Of particular importance is the transfer of research results to the private sector to develop, introduce,and commercialize ITS technologies. To facilitate this transfer, many of DOT's technology-development research involves cooperative agreements with private industry and academia. For example, NHTSA has entered into nine cooperative agreements with industry to develop and test crash avoidance concepts and prototypes.

7.) Evaluating the Program

Program evaluation is critical to ensuring progress toward the vision of fully integrated intelligent transportation systems, and to meeting deployment goals. Evaluation is essential for understanding the value and effectiveness of ITS program activities. It also allows for the continual refinement of the program. The ITS program has undertaken assessment activities to meet these needs, and to use the Government Performance and Results Act to help ensure that the program effectively meets higher-level transportation and government goals. The following specific activities have been initiated:

- Tracking ITS infrastructure by establishing a baseline of ITS deployments currently in the field and updating this information annually.
- Evaluating the effectiveness and benefits versus costs of ITS infrastructure at the metropolitan and CVISN model deployment sites, and at field operational test sites.
- Using measurements from tracking and evaluation efforts to continually refine the program and ensure effective resource allocation. This includes developing goals and measures to track and evaluate the progress in professional capacity building and standards development.

Tracking ITS Infrastructure

To establish a baseline for the amount of ITS infrastructure currently deployed in the field, the ITS program has worked with transportation officials across the Nation to define and track infrastructure deployment and integration for measuring progress toward the Secretary's goals for deployment. To date, the program has defined metropolitan and CVISN tracking processes that will be updated periodically through fiscal year 2005.

A key component of this was to develop standard definitions of terms, such as "deployment" and "integration," so that progress toward these goals can be consistently measured across many sites. In 1997, the Department formulated a methodology to track the extent to which Metropolitan ITS infrastructure components have been deployed; enough information has been obtained to characterize levels of ITS deployment for 52 of the 76 metropolitan areas being tracked. In Exhibit II-3, summary indicators show the extent to which ITS components have been deployed.

Once this information is fully compiled, DOT will be able to establish an accurate view of the state of deployment and integration. This will provide the basis for program managers to apply deployment strategies in a way that is directly linked to national needs. As the program moves forward and more infrastructure is deployed, results of future tracking will provide insights into the program's progress.

Evaluating Effectiveness and Documenting Benefits

In addition to measuring the amount of infrastructure, there is also a need to measure its effectiveness and that of new ITS technologies and services. The ITS program has established categories of outcomes, termed "a few good measures," that will indicate whether deployment and integration are effective. These "few good measures" are:

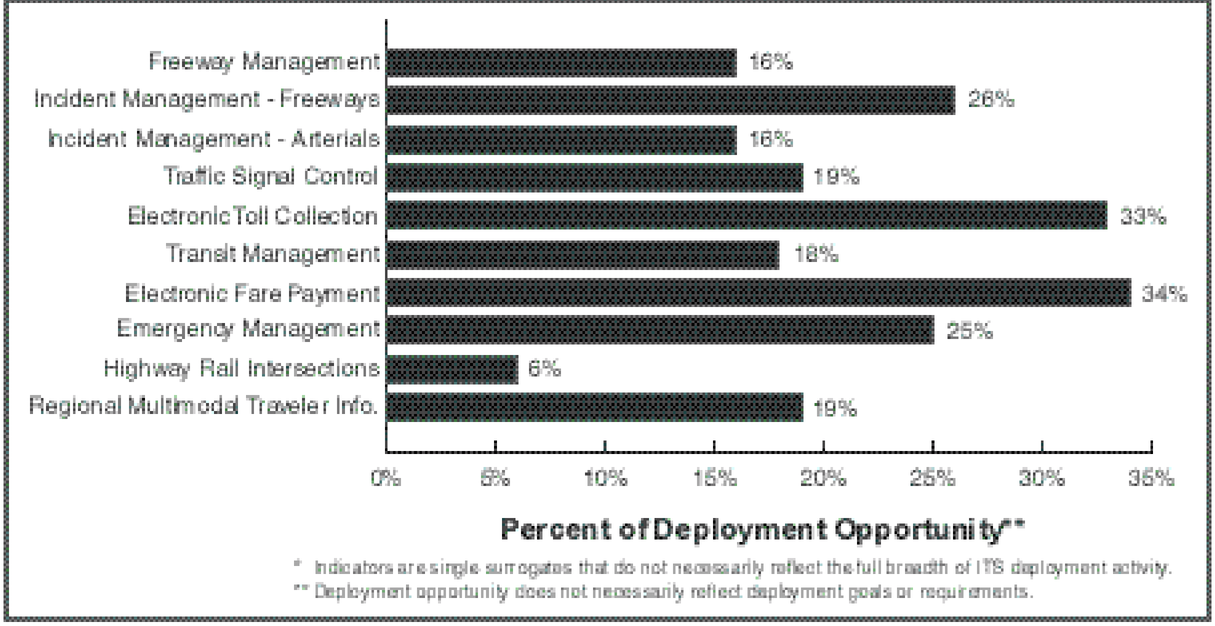
- Safety: this includes both lives saved and crashes avoided;
- Efficiency: travelers and goods moved per unit of time;
- Mobility: time saved in travel, as well as customer satisfaction;
- Productivity: cost savings to travelers, businesses, and commercial carriers; and
- Other important measures such as energy and emissions to ensure ITS deployments are not harmful to the environment.

Evaluation of deployment and integration activities at the model deployment sites across the Nation will test and confirm the viability of these "few good measures." This will provide an understanding of the effectiveness of certain types of ITS applications, and help other deployment sites make smarter choices for implementing similar systems.

Program Refinement and Optimal Resource Allocation

Consistent with the spirit behind the Government Performance and Results Act, another part of program assessment is to document lessons learned and deployment progress, and use this information to

Exhibit II-3: Summary Indicators*:
Total for 76 Largest Metropolitan Areas as of November 20, 1997
Response Rate of 65 Percent



refine the ITS program on an ongoing basis. This information will help refine the allocation of resources, assist in the planning process, and measure progress in achieving full deployment of ITS.

Tracking and evaluation also allow for the refinement of the "few good measures." By documenting the progress of deployment and any lessons learned, the Department can provide a better illustration of the benefits versus the costs of implementing ITS. This will serve to provide State and local agencies with credible evidence that ITS is a viable option to current transportation problems.

F. APPLYING PROGRAM STRATEGIES TO THE ITS PROGRAM AREAS

The strategies described above responded to challenges faced overall by the ITS program in its efforts to deploy integrated, interoperable systems. The challenges present direct and indirect barriers to implementing the various components of intelligent infrastructure and to facilitating the development of intelligent vehicle technologies.

This section provides a more detailed description of the four ITS program areas — Metropolitan ITS Infrastructure, Commercial Vehicle ITS Infrastructure, Rural ITS Infrastructure, and Intelligent Vehicles — and it describes how the ITS program strategies are being applied to advance each program area.

Metropolitan ITS Infrastructure

Metropolitan ITS infrastructure is comprised of several elements which constitute traffic management, traveler information, and public transportation systems. Each element describes a major ITS functional area and generally characterizes the technologies involved and stakeholders affected (see text box on next page). Additional elements may be defined as technologies advance. The main objective in implementing metropolitan ITS infrastructure is to enable the real-time operations and management of a metropolitan area's multi-modal transportation system, and to provide current status and schedule information to users.

The ITS technologies that create a metropolitan infrastructure have been greatly advanced under ISTEA. For the most part, this is due to the fact that research and testing under ISTEA focused on the issues of safety, congestion, and mobility — problems of growing magnitude within metropolitan areas.

Metropolitan ITS Infrastructure Elements

- Modernized **traffic signal control systems** that automatically adjust themselves to optimize traffic flow.
- The latest in **freeway management systems** that provide information to motorists and detect problems to increase capacity, and minimize congestion caused by crashes.
- Updated **transit management systems** that allow new ways of monitoring and maintaining our Nation's sizable transit fleets through advanced vehicle locating devices, equipment monitoring systems, and fleet management systems.
- Innovative **incident management programs** that enable communities to identify and respond to crashes or breakdowns with the best and quickest emergency services, thereby minimizing clean-up time.
- **Electronic toll collection** that provides drivers and transportation agencies with convenient and reliable automated transactions. This will dramatically improve traffic flow at toll plazas and increase the operational efficiency of toll collecting.
- New **electronic fare payment systems** that enable a person to pay for parking, bus and train fares, and tolls by using a single smart card.
- Advances in **railroad crossings** that are coordinated with traffic signals and train movements, and that notify drivers of approaching trains through in-vehicle warning systems.
- Coordinated **emergency response** that ensures that the closest available and most appropriate emergency response unit can respond to a crash.
- **Regional multimodal traveler information systems** that provide road and transit information to travelers, businesses and truckers, so they can more effectively plan their travel.

Many of the technologies and systems installed as operational tests produced real and measurable benefits. Furthermore, many sites have gone on to allocate their own funding to keep these legacy systems going.

Current tracking information indicates that many regions across the Nation have one or more of the metropolitan elements in place. However, it is the technical integration and institutional coordination of these elements that will provide an enabling platform for intermodal management, and provide the means for numerous other products and services. Given that Metropolitan ITS Infrastructure is more advanced and faces the more critical challenge of integration, it is not surprising that the ITS program strategies have been more focused on and have achieved more within the metropolitan program area.

Moving forward, the strategy for Metropolitan ITS Infrastructure is to focus the ITS program strategies on facilitating integration and interoperability. In support of this strategy, two critical standards — the National Transportation Communications for ITS Protocol (NTCIP) and the Transit Communications Interface Profiles (TCIP) — have significantly advanced in their definition. Both are currently in the final stages of draft and are being used as guides at deployment sites. These standards will allow data from many sources to be transformed into a common format and to be exchanged electronically among the various devices; this also allows for data to flow between external entities such as traffic and transit management centers, emergency management centers, and information service providers.

The Professional Capacity Building program was initially established to focus on the metropolitan aspects of transportation management and traveler information services. Although the PCB program has expanded to indude all aspects of ITS deployment,the initial suite of courses delivered to transportation professionals address some of the major concerns facing professionals involved in metropolitan deployment such as planning, partnerships,and use of the National ITS Architecture. The PCB program will continue to focus on the training and education required to overcome the impediments to deployment. It will develop a skills matrix to help professionals understand their roles and responsibilities in deploying, operating, and managing ITS.

Guidance and technical assistance programs have provided documentation to many professionals involved in metropolitan deployment. The Department carefully documented and distributed lessons learned from operational tests, partnerships, and studies on institutional issues. The *Deployment Guidance for Transit Systems* was the first in a series of guides to be completed. Others will be forthcoming in fiscal year 1998. One program developed through this strategy creates a network that links professionals together to share experiences. The Peer-to-Peer Network assisted seventeen State and local ITS deployment sites by sending peer practitioners for on-site assistance.

For showcasing, the Department is financing model deployment sites in four metropolitan areas around the country to provide real-life examples of technology potential and to demonstrate the benefits from integration. The sites are primarily engaged in deploying and integrating applications for managing traffic and transit,integrating emergency services,and providing real-time transportation information to travelers. For instance, Seattle is providing real-time bus location information over the Internet. These sites are scheduled to be operational in early 1998. The four Priority Corridors and the Atlanta Summer Olympics have also been useful in demonstrating the benefits of integration.

In order for ITS to be considered in longer term transportation planning, planners must have a way to understand the trade-offs between ITS options and more traditional capital improvements, as well as the value of combining ITS with capital improvements. To support this need, this year the Department completed development and released a package of traffic engineering and modeling applications, known as the TSIS Version 4.0. Importantly, this set of applications includes CORSIM, a modeling package that simulates corridor traffic integration. TSIS can be used to evaluate both the operational effects of ITS deployments as well as traditional traffic improvement programs.

Research continues to be a vital part of the strategy to integrate metropolitan ITS deployments. This year proved to be significant for the deployment of RT-TRACS, a critical tool that addresses the regional networking and control of surface street and freeway ramp signals under varying traffic demands. The move from laboratory to operational field testing means that a wide spectrum of traffic conditions and road geometrics throughout four regions will be tested in FY 1998.

As illustrated previously in Exhibit II-3, the Department was able to define summary indicators of deployed components for Metropolitan ITS infrastructure. The next step is to formulate the definition of "integration" and to evaluate the level of integration throughout the same metropolitan areas.

Commercial Vehicle ITS Infrastructure

The Commercial Vehicle ITS infrastructure is based on the linking of electronic systems and networks nationwide, to allow for simple, cost-effective, and seamless exchange of safety and administrative data, electronic business transactions, and information on commercial vehicle operations and processes.

Commercial Vehicle Information Systems and Networks Elements

- **Safety assurance** programs and services designed to assure the safety of commercial drivers, vehicles and cargo. These include automated roadside safety inspections and carrier reviews, safety information systems, and onboard safety monitoring.
- **Credentials administration** programs and services designed to improve the deskside procedures and systems for managing motor carrier regulation. These include electronic application, purchase and issuance of credentials, as well as automated tax reporting and filing.
- **Electronic screening** systems and services designed to facilitate the verification of size, weight and credential information. These include the automated screening of commercial vehicles at fixed weigh stations and international border crossings.
- **Carrier operations** activities and services designed to reduce congestion and manage the flow of commercial vehicle traffic, such as travel advisory and hazardous materials incident response services. The private sector is taking the lead in implementing fleet and vehicle management technologies and systems that improve motor carrier productivity.

This electronic framework is known as Commercial Vehicle Information Systems and Networks (CVISN) (see box below).

Like Metropolitan infrastructure, many of the first-generation CVISN components are ready to be deployed but need to be intergrated. However, unlike metropolitan deployment, CVISN is confronted with a unique challenge in achieving nationwide interoperability; that is, the need to automate and streamline administrative processes that vary widely across 50 States and the District of Columbia. Many of these states already have systems in place that are not mutually compatible. To overcome this challenge, the Department has set out a strategy for deployment that is based on networking existing systems and databases, recognizing the widely differing needs of each state.

Under ISTEA, the various commercial vehicle applications that comprise CVISN were extensively researched, developed, and tested. The success of this effort was documented in the 1996 Report to Congress. Recent program efforts have been focused on the gradual integration of these applications into CVISN, and their deployment at pilot and model deployment sites across the Nation.

The strategy for CVISN deployment is provided in the document entitled, *Intelligent Transportation Systems/Commercial Vehicle Operations Program Plan*, and illustrated in Exhibit II-4. This Plan sets out a program of incremental deployment of CVISN infrastructure. Part of this strategy has been for DOT to provide financial support to States for the development of business plans that identify how States will set out to develop integrated CVISN elements.

To encourage interoperability across state lines, the Department has divided the Nation into regional "truck“sheds" for commercial vehicle activity based on the economics of regional and national shipping patterns (see Exhibit II-5 on following page). There has been significant progress in developing standards

Exhibit II-4: CVISN Nationwide Deployment Strategy

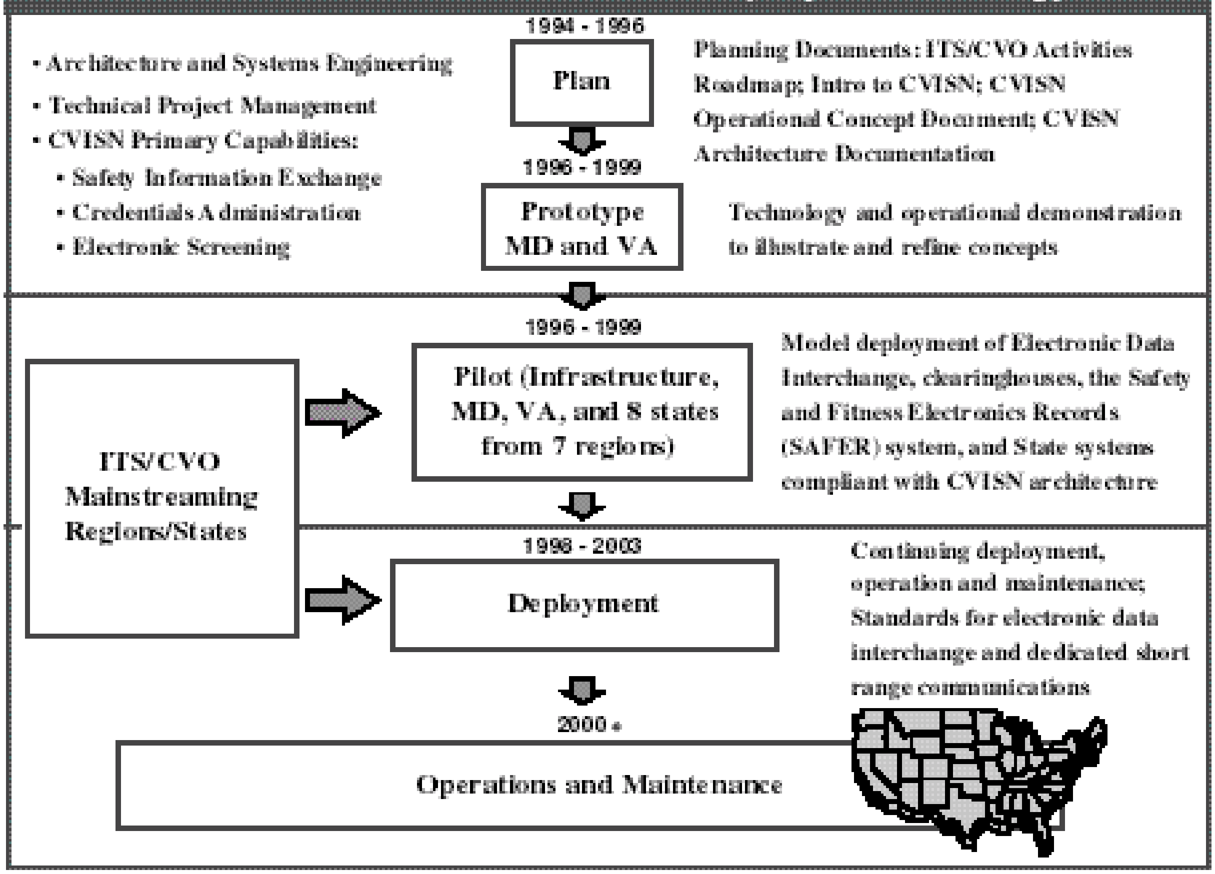
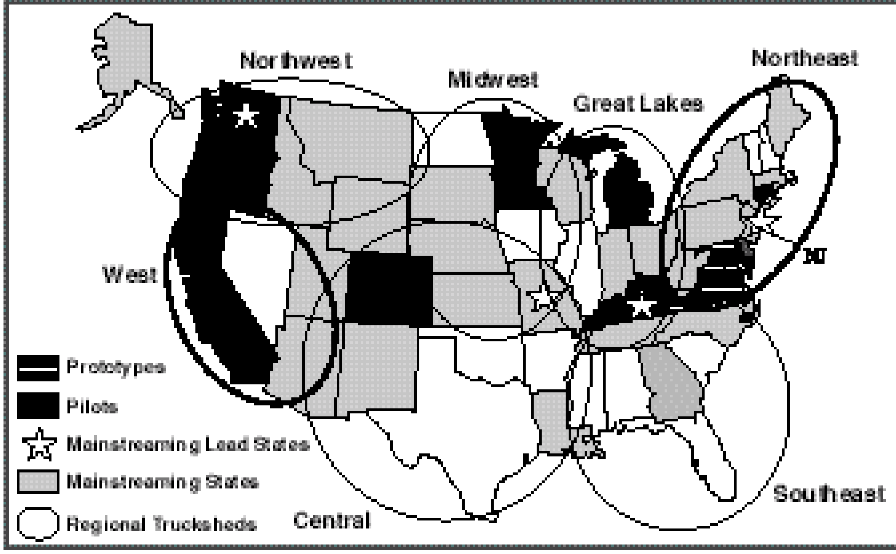


Exhibit II-5: Prototype, Pilot & Mainstreaming States



FHWA is sponsoring Regional champions to coordinate the development of policies, plans, agreements, and forums which will expedite regional deployment of CVISN.

critical to commercial vehicle operations. The development of a Dedicated Short Range Communications (DSRC) standard has been advanced to near final draft stage. This standard is fundamental to toll collection and electronic screening. The proposed standard is expected to be approved for provisional use by December 1998. Also, the CVISN architecture is being used as an essential part of planning at both State and regional levels to facilitate integrated and interoperable systems.

The ITS/CVO program office has developed an introductory course to ensure that professionals at Federal, State, and local areas gain the knowledge, skills, and abilities required to deploy and operate CVISN. Two other courses are proposed and will be available for delivery in 1998-1999. In addition, a comprehensive skills matrix is under development for commercial vehicle professionals.

Guidance documents that address management and applications will be distributed to States, vendors and the ITS/CVO Regional Champions to aid in deploying Commercial Vehicle infrastructure.

Ten CVISN model deployments sites have been established and are moving toward operational demonstration. These sites are meant to catalyze the decision making within bordering States to deploy CVISN. In addition, a "Technology Truck" was formally launched in 1997. The truck houses portable ITS technologies, classroom-type facilities, interactive kiosks, a graphic/video wall, and a driver simulation area. It is designed to educate legislators, key state, regulatory and enforcement agency representatives, and members of the motor carrier community on the technologies and benefits of ITS commercial vehicle applications. The truck will tour the country for approximately three years, accessing the public through professional conferences, state meetings, truck shows, ITS events, and other forums.

To expedite regional deployment of CVISN, the Department has facilitated the hiring of "Regional Champions" within each truckshed to coordinate the development of policies, plans, agreements, and forums. Regional planning forums are being sponsored by the Department to support the development of multi-state business plans that will incorporate common aspects of each State's own business plan.

Rural ITS Infrastructure

Rural America accounts for a small and dispersed portion of our Nation's population, yet it encompasses a significant portion of the transportation system. Rural areas account for 80 percent of the total U.S. road mileage, 40 percent of the vehicle miles traveled, and have relatively unique transportation characteristics in comparison with Metropolitan areas. Consequently, while rural travelers have ITS needs similar to those of their urban counterparts, the priority of these needs differs markedly. The conditions found in rural travel, the characteristics of the travelers, the geography, and the costs of maintaining a rural system all present different challenges and underscore the need for a focused rural ITS program.

Because of this distinction, the Rural ITS program has taken longer to develop than other infrastructure component programs. However, in 1997 the rural program "arrived." Through a series of needs assessments and forums, DOT has come to a clearer understanding of the components of a rural-based ITS program and identified several clusters of services that begin to characterize this infrastructure (see text box).

Many of these services derive from metropolitan and commercial-vehicle applications (such as transit and traveler information systems, fleet management, and vehicle safety). Because of the unique and varied challenges posed by rural travel and the rural environment, these technologies and services will need to be applied differently. As a result, some of these Rural ITS applications are still in the research stage and will require further operational tests. One example is ITS for emergency services, a critical application in rural areas where response times can be much higher than those in metropolitan areas. Work in this area is still needed to further advance these technologies and their applications. However, some technologies are well developed and are available for application in a rural setting, such as road weather information systems or expanded use of cellular telephone coverage for travelers.

The Rural ITS program has defined and adopted a "start-to-finish" deployment strategy involving three major steps. The first step is *development*, which includes research, operational tests, and examination of system integration issues, such as the application of the National ITS Architecture and standards.

The second step is to facilitate *deployment*. To do this, the Department is promoting a "think big, start small" approach that encourages rural areas to define the technologies they ultimately want to integrate into an advanced system, and at the same time begin with modest subsystem implementation. The deployment effort includes a Rural Deployment Incentives program of $10 million or more per year depending on need. The criteria for these deployment projects

Services that Characterize a Rural ITS Infrastructure

- **Traveler safety and security** technologies that alert drivers to hazardous conditions and dangers, and include wide-area information dissemination of site-specific safety advisories and warnings.
- **Emergency services** technologies that automatically mobilize the closest police, ambulances, or fire fighters in cases of collisions or other emergencies — even in the most remote locations.
- **Tourism and travel information** services that provide information to travelers who are unfamiliar with the local rural area. These services can be provided at specific locations, en route, or well in advance of the traveler's destination.
- **Public traveler and mobility** services that improve the efficiency of transit services and their accessibility to rural residents. Advanced vehicle locating devices and communications systems can help achieve better scheduling, improved dispatching, smart card payment transactions, and advanced ridesharing and ride-matching systems.
- **Roadway operations and maintenance** technologies that improve the ability of our highway workers to maintain and operate rural roads. These include severe weather information systems, early detection of pavement and bridge failures, and immediate detection of dangers to work zone crews.
- **Fleet operations and maintenance** systems that improve the efficiency of rural transit and other rural fleets, such as snowplows and even law enforcement vehicles, through advanced vehicle tracking and on-board equipment monitoring systems.
- **Commercial vehicle systems** that manage the movement and logistics of commercial vehicles in rural settings, and locate them during emergencies and breakdowns. These include applications to improve safety, such as warnings associated with slow-moving vehicles, and scheduling applications for harvest season when vast numbers of trucks are needed during a very small time window.

will be more flexible in comparison to Metropolitan or Commercial Vehicle deployments given the need to further development of technologies and the limited systems architecture and standards definitions for this area.

The third Rural ITS program step is *delivery* — getting the message out and promoting technical development and professional capacity building. Guidance on types of applications and their success have been documented in two major resources:

- **The ARTS Compendium** — This is an operational on-line information system that manages a comprehensive list of ARTS and ARTS-related rural projects (almost 200 so far) under and outside of the ITS umbrella. The compendium consists of a variety of project types from planning studies to Federally funded field operational tests. Not all of the projects listed are strictly rural in nature; some are vehicle-based and operate independently of the road, and others are urban with rural applications. The ARTS Compendium can be downloaded from the Rural ITS website (www.its.dot.gov/rural/arts.html).
- **The Simple Solutions project** — *Technology in Rural Transportation: Simple Solutions* is a report that resulted from a joint FHWA/ENTERPRISE project to identify low-cost/low-tech success stories that are precursors to more advanced ITS solutions. Referred to as "Simple Solutions," the report documents model solutions for rural areas by describing technologies, partnerships, and lessons learned. The State of Minnesota provides an example of how the application of a simple technology can become critical for saving lives (see text box).

These two resources, as well as products from the Metropolitan and Commercial Vehicle ITS programs, will form the basis for further development of Rural ITS infrastructure and strategy. Positive returns on investment in rural areas will depend on a well-reasoned implementation process that includes thorough evaluation to identify where and when integration works. Operational tests will further clarify some of these opportunities, but the timing and cost-effectiveness of rural ITS integration must still be determined. In addition, the ultimate success of rural ITS, as in all other parts of ITS deployment and development, requires institutional partnering in both the public and private sectors.

Intelligent Vehicles

Motor vehicle crashes create a significant burden in our society in terms of fatalities, injuries, and economic costs from resulting emergency and health care, property damage,and highway congestion. More than 40,000 motor vehicle fatalities result in related costs exceeding $150 billion per year.

Driver error is the predominant cause of highway crashes. New technologies are becoming available that can help drivers operate their vehicles more safely and efficiently. These technologies can provide collision avoidance capabilities as well as motorist-information and driving assistance.

This year, the DOT launched the Intelligent Vehicle

Minnesota's Rural Coordinate Addressing System

In some rural areas of the United States, streets are not named or identified, potentially creating delays for emergency or delivery services that must visit private residences. A low-cost, "simple solution" is to assign every residence to a coordinate mapping system, enabling more direct navigation to specific sites.

Blue Earth County, MN recently initiated a pilot project of this technology. Mapping coordinates were assigned to rural locations and entered into a geographical database. These addresses could be read using GPS receivers, a commercial off-the-shelf location technology used in many ITS applications. Each electronic address is also related to phone numbers so that when a 911 call comes in from a rural location, the site appears on a digital map that emergency workers can access to locate the residence. The database may also be used for locating postal addresses and providing coordinates to utilities and delivery companies to help them find rural addresses. Most importantly, this type of system is finding widespread use in rural counties to decrease emergency response times and improve critical services to rural constituents.

Based on "Technology in Rural Transportation: Simple Solutions," by the ENTERPRISE Consortium.

Initiative to research the ability of these technologies to solve highway safety problems. Previously, the DOT had established multiple programs for research and development efforts to improve driving safety and efficiency within the ITS program. These efforts include the Driver Vehicle Interface program, the Collision Avoidance program, and the Automated Highway System program. The Intelligent Vehicle Initiative is positioned to take advantage of these maturing programs and the synergies resulting from their close coordination. These programs will be united under the Intelligent Vehicle Initiative into a common framework leading to a multi-functional integration of proven systems with a strong emphasis on human-factors. Longer-term research and development will be linked to near-term deployability.

The Department intends to define and carry out the Intelligent Vehicle Initiative program plan in cooperation with the motor vehicle, trucking and bus industries, State and local governments, and other stakeholders. Through this program, the Department intends to facilitate the development, evaluation, and deployment of vehicle-related safety and mobility-enhancing products and systems in order to accelerate their market availability which will facilitate fewer crashes and greater efficiency. In particular, this involves research into the areas of crash avoidance and vehicle control.

The Department will work with industry to identify and develop voluntary architectures and standards, as well as a prototype integrated system. It will also focus on field test evaluations so that government-industry participants can assess benefits, define performance requirements, and accelerate deployment of incremental driver assistance products.

In 1997,the Department was able to define three levels of vehicle capability for testing and development (see text box).Each level integrates additional technologies that achieve an incremental evolution from autonomous safety and mobility devices to vehicle-infrastructure cooperative automation systems. Operational testing of the first testbed is expected to include both warning and information services and driver assistance.

While the Intelligent Vehicle Initiative is still primarily a research effort, it is expected that the first testbed from the various categories of vehicles could be available for operational testing within the next five years. The vehicles included in program planning are light vehicles such as passenger cars and minivans, commercial vehicles such as trucks, intercity buses and other transit vehicles, and emergency and specialty vehicles such as police cars and snowplows.

The Department has developed documents describing this initiative in order to stimulate discussion and to begin to set programmatic goals. This set of documents includes a draft business plan, a programmatic roadmap, and a definition of candidate Intelligent Vehicle Initiative user services that are based on the broader ITS user services. The Department will continue to solicit information from a wide audience of stakeholders in order to finalize the program's strategic direction.

Emerging Program Areas

While the ITS program has categorized the overall

Capability Levels in the Development of Intelligent Vehicles

- The first-level system will provide **warning and information services** that enhance the driver's ability to sense what is going on in the surrounding environment and expand the driver's knowledge of routes and locations. Technologies include collision notification systems, crash warning systems, in-vehicle signing, and navigational/route guidance systems.
- The second-level system will provide **driver assistance**, including limited control assistance and alternative technologies to reduce cost or improve performance. Technologies include rear-end collision avoidance possibly integrated with intelligent cruise control, steering assistance, and vehicle-infrastructure communications.
- The third level will provide **more sophisticated vehicle/infrastructure and vehicle/vehicle commands** to enhance driver performance. Technologies include lateral and longitudinal collision avoidance and fully cooperative real-time vehicle-to-vehicle and vehicle-to-infrastructure information and control systems.

national intelligent transportation system as being comprised of intelligent infrastructure and intelligent vehicles, the program also recognizes there are additional areas to be addressed. Over time, other new areas requiring specific attention will continue to emerge. Intermodalism and ITS data services are two such applications on the immediate horizon. They use information generated by ITS technology to create decision making options for: safer intermodal passenger and freight movement; real-time, optimal system utilization; program evaluation and refinement; and long-term planning improvements.

Intermodalism

In 1996 a study was conducted to explore the business perspectives, operations, and technologies used in the intermodal freight industry. The study also sought to suggest courses of Federal action that will improve communications with the commercial intermodal freight sector and enhance the interface between the ITS program and industry initiatives.

This study, the *Intelligent Transportation Systems Intermodal Freight Transportation* report, was made available in early 1997.

The study found the following related to ITS:

- To maximize capacity of the nation's transportation infrastructure, it is important to plan and manage transportation assets as a single intermodal system
- The current intermodal "system" is in fact not a system at all, but a collection of systems that have been variously linked together. Modes of transportation operate in parallel and sometimes cooperatively, but each largely retains its own distinct operating patterns. No one is responsible for integrating the overall system.
- Intermodal transportation depends upon both the transmittal of information and the transfer of cargo between modes.

Importantly, the findings reveal that:

- Advanced information and communications technologies applied across the intermodal system offer important opportunities to increase system capacity.
- Information and communication technologies have enormous potential to strengthen the links between the separate modal systems.
- Information technologies and telecommunications are being employed in innovative ways to improve customer service and achieve transport cost savings. In fact, private freight carriers and terminal operators have made substantial use of information technology to enhance the productivity of their own operations. These technological systems have initially developed as closed corporate systems; the question of system-wide data interchange remains problematic.

The report made the following recommendations relative to the ITS program:

- Public investment in ITS systems can further improve the productivity and safety of intermodal freight operations. This requires support and funding for federal programs that are essential to the information infrastructure, including weather information, the global positioning system, navigation information, and the full communication spectrum.
- The federal government is positioned to provide leadership to develop a shared vision of the capabilities of technology. This vision should apply to global transportation and its benefit to the nation, to the private sector, and to state and local governments. Further, it should incorporate knowledge derived by the Department of Defense (DOD) as a major user of the system. This requires the Office of Intermodalism to reach out to the ITS Joint Program office as a technical resource in addressing private sector ITS issues. It also requires that representatives of the intermodal freight industry provide input on the impact of the ITS program on the freight industry in order to address policy issues.

The current regulatory and reporting system for commercial transportation operators is complex and duplicative. ITS offers significant opportunities for single point electronic delivery of information to government agencies. This requires development of transportation technology policy initiatives,along the lines of the National Science and Technology Council's Transportation Committee. It also requires coordination among agencies, particularly at border crossings, continued and expanded use of interoperable transportation technologies such as tagging, and the use of technology to simplify the current regulatory and reporting system, thereby providing a single point of electronic information delivery to Federal and state agencies.

Going forward in this manner also requires a commitment to an open ITS Architecture. As with other areas of ITS, agencies and the private sector are reluctant to implement technologies if there is a fear that the technologies will become obsolete or incompatible. With intermodalism,this is a particular concern in the interface between private sector and government-operated systems; e.g., toll facilities and border crossings. This will require efforts to develop and adopt industry-wide standards and data protocols. It will require addressing the issues of data exchange and interoperability among commercial users and Federal agencies, in particular the primary players of the U.S. DOT, the Department of Defense and the U.S. Customs Service (for interchange at national borders).

In part, this can be realized through ITS/CVISN deployments already occurring. For instance, both rely upon Electronic Data Interchange (EDI) for transferring data between partners using specific industry standards, data sets, and protocols. Intermodal truck operations visibility could be improved at reasonable cost by piggybacking on the dedicated short range communication (DSRC) systems being installed on the regional highway network for toll collection and weigh station pre-clearance. These systems could help terminal operators to manage inbound traffic flows, and shippers and receivers to improve the visibility of the truck portion of intermodal shipments. However, much still needs to be done to identify the opportunities and problems at the interface between ITS and the existing intermodal freight systems.

Recognizing that information and communication technologies have enormous potential to strengthen the links between individual transportation modes, the ITS Joint Program Office and the Office of Intermodalism convened an interagency working group made up of representatives from each mode to oversee development of an ITS/Intermodal Freight Program during 1998.

The goal of the ITS intermodal freight program is to deploy ITS to provide a safe, reliable, and responsive intermodal freight system that contributes to the national goals of enhancing economic performance and ensuring national security.

The working group has approved a program that includes the following activities:

- A scan of the intermodal freight industry to identify current bottlenecks and best practices that can be replicated elsewhere. The scan will be based on recently completed work and interviews with industry and government leaders. It will include the following subactivities:
    - Examine CVISN application in Maryland and Virginia, both of which have major international ports of entry, to determine the potential for integrating the ITS CVISN activities with the current commercial technology applications at ports.
    - Examine the I-95 Corridor Coalition's FleetForward operations as a possible source of EDI information that could improve the operation of the regional intermodal system.
    - Assess opportunities to apply the North American Trade Automation Prototype electronic process currently being deployed at the Otay Mesa, California border crossing at seaports, airports, and border crossings.
    - Monitor progress in the I-10 New Orleans to San Antonio Early Deployment Planning Study that will develop a strategic plan for facilitating intermodal freight movements.
    - Co-sponsor (with DARPA, TRB, the Office of Intermodalism and others) a conference on the potential for cross-applications of EDI programs and practices.
- Assess the scope and impact of intermodal problems on international trade and national security, and the availability and appropriateness of ITS applications to address the problems.
- Define six to eight projects where ITS can be deployed or integrated to improve intermodal freight movement.

This 1998 activity will provide the basis for the deployment in FY 1999 of up to two ITS intermodal test projects in corridors of significance to international trade and the national defense.

ITS Data Services

ITS technologies provide up-to-the minute data on the traffic and transportation environment, allowing transportation managers to optimize the transportation system in real-time. ITS operations are based on the collection and use of data on transportation performance and user characteristics. Clearly, much of the data available from ITS can be of great value beyond their immediate use. These data can be gathered and stored for other purposes such as transportation planning. ITS offers planners the opportunity to sample and archive traffic and transit data — such as origin-destination patterns or number of trips made on transit links or specific road segments — for analyses of patterns and trends over the long-term. Certain types of data can also be used to evaluate the progress and success of ITS program activities and refine them to better meet the program goals.

The collection and use of system-wide data raises privacy issues. For example, people are concerned about an agency's ability to identify vehicle occupants and location by time of day and date. These concerns highlight the need for careful decision making regarding what data are captured and stored, who has access to it, and how the stored data is managed and analyzed. The definition of the ITS Data User Service will need to include a requirement for programs that capture specific data. However, the definition must recognize that data collection programs must be developed in a way that takes privacy issues into account.

G. Summary

Through ISTEA,the ITS program has had a great start toward developing the intelligent transportation system of the future. The challenges of enabling interoperability, building professional capacity and greater awareness of ITS benefits, mainstreaming the planning and operations of ITS, creating funding incentives that leverage existing resources and partnerships, pursuing critical future research, and showing progress toward stated goals are very real; however, success stories and lessons learned during the ISTEA years show that these challenges are surmountable. Through targeted strategies specific to Metropolitan, Commercial Vehicle and Rural ITS infrastructure deployment,as well as a strong research program, the ITS program can provide the leadership to successfully encourage the development of technically integrated and institutionally coordinated intelligent transportation systems while laying the foundation for future systems.

End Notes to Chapter II

1. Peña, Transportation Secretary Frederico. "Operation Time Saver Program," Remarks delivered January 1996.
2. Robinson, Carlton C. "Traffic Operations Manpower: A Scoping Study of Education Needs and Response," Paper prepared for the National Highway Institute,FHWA,October 15,1994.
3. Urban Institute, *IVHS Staffing and Education Needs*, U.S. DOT/Federal Highway Administration, September, 1993.

III. PROGRAM UPDATE

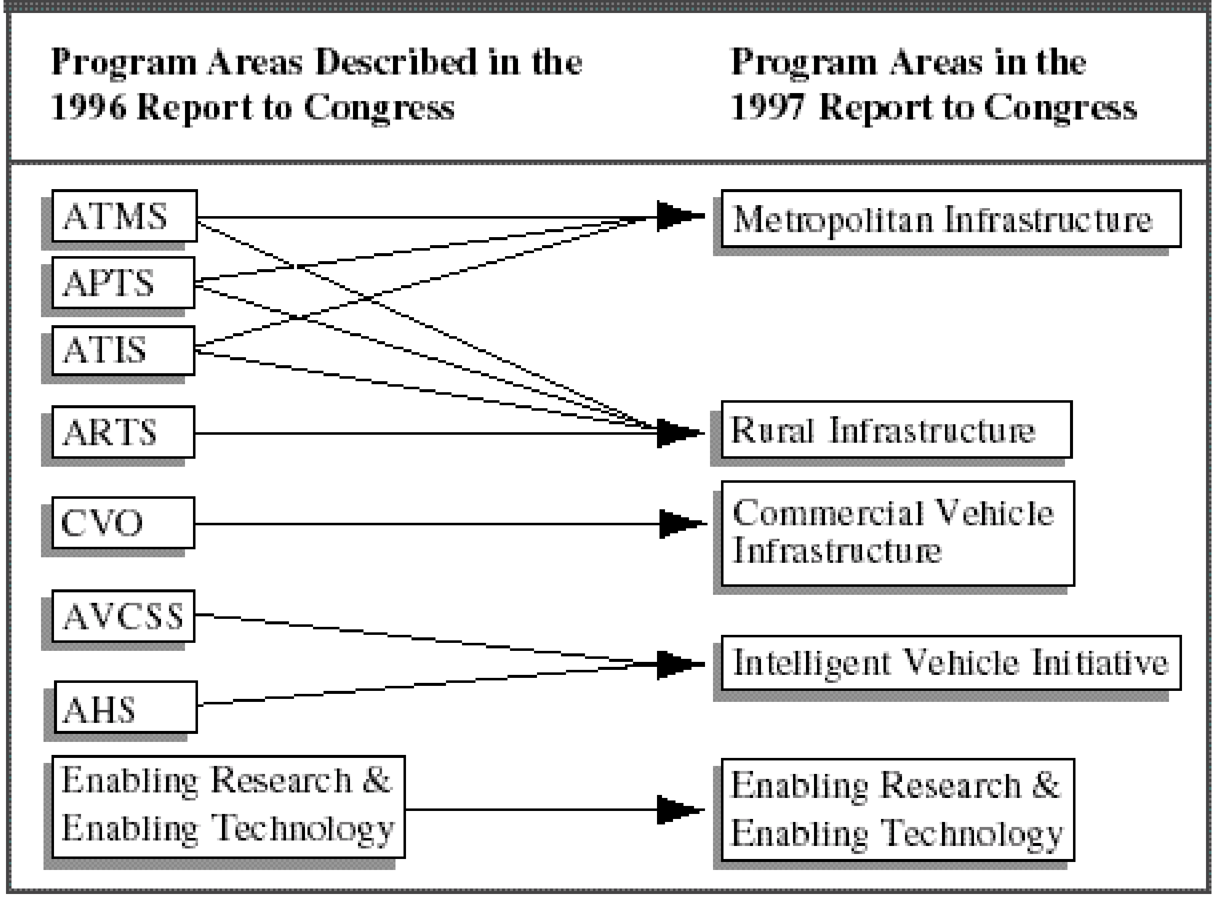
A. Overview

The 1996 Report to Congress presented a comprehensive review of the ITS Program from its inception, describing eight technical program areas. It provided a detailed description of the goals, activities, lessons learned, accomplishments, and future directions for each program area.

This year's report realigns the 1996 program areas into a format that reflects the Department's goals for facilitating deployment of intelligent infrastructure in three areas — metropolitan, commercial-vehicle, and rural — and facilitating the research, testing and evaluation of intelligent vehicle technology. Exhibit III-1 below illustrates the program reorientation.

Specifically, Metropolitan ITS infrastructure draws on research in Advanced Traffic Management Systems, Advanced Public Transportation Systems, and Advanced Traveler Information Systems. The Commercial Vehicle ITS infrastructure builds on the research activities of the Commercial Vehicle Operations program. This focuses primarily on the development and deployment of CVISN, but also addresses international border crossings and intermodal freight. The Rural ITS infrastructure is based on the activities of Advanced Rural Transportation Systems program, including application of many technologies being developed for Metropolitan and Commercial Vehicle infrastructure that can be tailored to meet the specific needs of rural communities.

Exhibit III-1: ITS Program Reorientation



The Intelligent Vehicle Initiative incorporates work done on various aspects of intelligent vehicles. This includes the Advanced Vehicle Control and Safety Systems program, in which research has concentrated on specific needs associated with vehicle-related issues (such as intelligent cruise control and automated braking applications for heavy commercial vehicles), and on broader issues such as the characteristics of collisions that help to identify the most useful applications of warning or notification systems to vehicles. The Intelligent Vehicle Initiative also draws on the Automated Highway System and its recent successful prototype and demonstration of platooning passenger, transit,and commercial vehicles using ITS technologies. DOT's National Highway Traffic Safety Administration is integrating its ongoing research into the use of ITS for vehicle safety into this area.

In bringing these programmatic areas together under one initiative, the Intelligent Vehicle Initiative rises to the challenge posed last year by the National Science and Technology Council, an executive office of the President, to develop "human-centered" transportation systems. In the spirit of this national effort, the initiative advocates incorporation of human-factors research into intelligent-vehicle development to bring about driver-centered design.

The Enabling Research and Technology program area continues to provide cross-cutting support to each of the four functional components that constitute the program's foundation. As shown in the graphic on the previous page, Enabling Research provides the foundational support for development and deployment of both intelligent infrastructure and intelligent vehicles.

The following section begins with a presentation of the program budget expenditures for fiscal year 1997. The program funding layout reflects program activities more than program focus. The section then describes the future directions and specific accomplishments for the ITS program in 1997 under the five categories of Enabling Research and Enabling Technology, Metropolitan ITS Infrastructure, Commercial Vehicle ITS Infrastructure, Rural ITS Infrastructure, and Intelligent Vehicles. The reporting of accomplishments among the four components is somewhat uneven because levels of programmatic definition, progress,and activities differ. Reporting on ITS program accomplishments under these new categories will become more meaningful as the Department moves forward under this reorientation.

B. ITS Program Expenditures

ISTEA authorized a net total of $643.9 million for the program from fiscal year 1992 to 1997. At the end of fiscal year 1997, all of these ISTEA funds had been authorized for expenditure. This amount was supplemented by $579.7 million in funds from the General Operating Expense budget (including $20 million in fiscal year 1991), for total funding of $1,223.6 million through fiscal year 1997. All but approximately $6.5 million of this total was obligated as of the end of fiscal year 1997. The following chart, Exhibit III-2 on page 33, breaks down overall ITS funding obligations. Roughly 40 percent of total program funding was directed by Congress.Fiscal year 1997 programmatic highlights for each of the major funding categories shown in Exhibit III-2 are outlined on the adjacent page.

Operational Tests/Priority Corridors

About 58 percent of obligated funds supported field testing and demonstration projects as part of operational tests or the ITS Priority Corridors Program; 68 percent of this amount was congressionally directed. These efforts provided a crucial bridge between laboratory and large-scale deployment. By the end of 1997, the Department had launched 88 field operational tests across the Nation, breaking new ground with Rural and Advanced Vehicle Control and Safety System tests. These tests are providing valuable information on the benefits of individual ITS services and on methods to overcome institutional barriers to deployment. In these tests,the Department is fostering the development of public-private partnerships, and forging new institutional arrangements between State and local agencies.

In addition, the Priority Corridors Program is well underway in four regions: I-95 (Virginia to Maine); Houston; Gary-Chicago-Milwaukee; and Southern California. A 1997 draft report entitled *Policy Review of ITS Priority Corridors* concluded that the program has helped to identify regional coordination and technical integration issues, and has helped to dismantle institutional barriers to ITS deployment in these four corridors.

Basic and Applied Research

Since 1991,about 20 percent of ITS program funding has supported R&D efforts to adapt existing and emerging information and control technologies to meet basic, everyday transportation needs for highway, transit, and commercial vehicle travel. Funding has also furthered the state-of-the-art in advanced collision avoidance and vehicle safety systems. In addition, the Department has developed and enhanced analysis tools and methods, such as simulation models, to allow transportation professionals to more accurately monitor and control traffic,and evaluate the impact of ITS.

Program Assessment and Deployment Support

Roughly 12 percent of the program's funding was spent to assist State and local governments in overcoming the complex challenges to adopting and deploying advanced technology. Support has been offered in program assessment and evaluation, deployment planning, showcasing and mainstreaming, and building professional capacity.

Program Assessment and Evaluation

As the effort to facilitate ITS deployment begins, the ITS program's progress and effectiveness need to be tracked. The ITS program has initiated a comprehensive program assessment effort to:

- Track deployment by establishing a baseline of ITS products currently in the field and annually update them;
- Evaluate the technical effectiveness and operational utility of new ITS technologies in rural and intelligent vehicle field test settings;
- Evaluate the effectiveness, and benefits versus costs of ITS infrastructure at model deployment sites; and
- Use measurements from tracking and evaluation efforts to continually refine the program and ensure effective resource allocation.

Deployment Planning

Funding of Early Deployment Plans has supported local and regional agencies in developing ways to apply ITS solutions to local problems. Ninety early deployment plans are serving as key mechanisms for incorporating ITS into the traditional transportation planning process, as well as requiring planning and deployment officials to work together to look for integrated and coordinated solutions to transportation problems.

Mainstreaming

The ITS Program has sought to facilitate deployment of ITS through a series of technical workshops that bring together elected officials, and transportation and planning professionals with training programs. In particular, DOT has developed a program plan to incorporate ITS more fully into State and metropolitan transportation planning activities, and to help coordinate these activities among local agencies and States.

Building Professional Capacity

The Department has established the Professional Capacity Building Program to ensure that public transit, highway agency, and motor vehicle regulatory professionals have the knowledge, skills, and abilities to meet the challenges of deploying ITS as part of the next century's transportation system. The program has identified those transportation professionals who need immediate training and education, and identified existing, relevant training offered by DOT sources. It has established partnerships with leading transportation professional and educational organizations and has initiated the development and delivery of ITS awareness and technical seminars. A Five-Year Professional Capacity Building Program Framework was developed and approved in 1997. It identifies major activities and associated resource requirements for fiscal year 1997 to fiscal year 2002. Over the next year, the Professional Capacity Building Program will continue to deliver courses, seminars, and workshops to professionals at the State, regional, and local levels to promote widespread understanding of ITS.

Automated Highway System

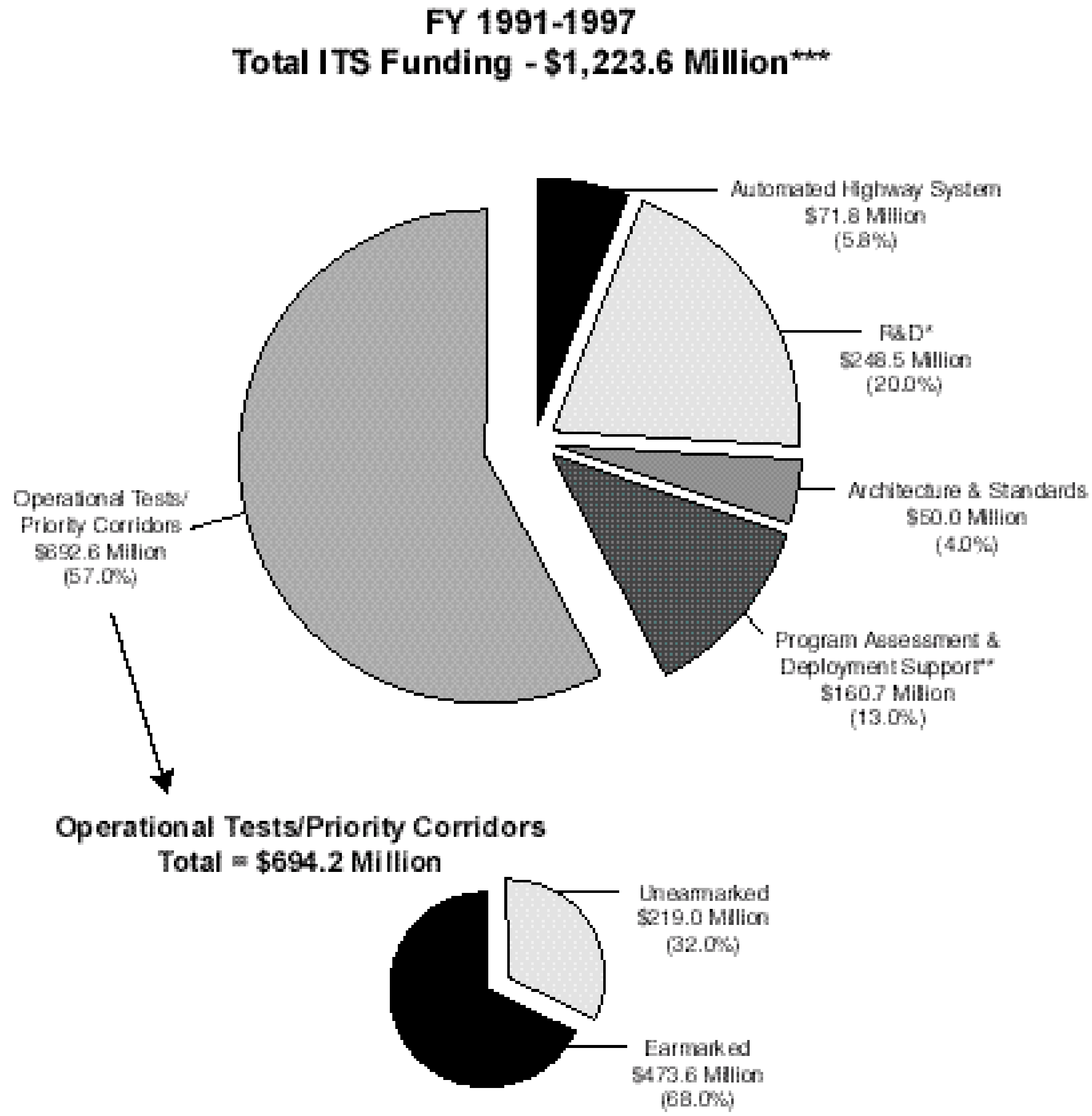
About 6 percent of ITS funding has been dedicated to the development of an Automated Highway System. In addition to development of concepts and technology, the program has pursued an extensive effort to involve stakeholders in reviewing the program and evaluating broader impacts to society. In 1997, DOT and its partners in the National Automated Highway System Consortium demonstrated the technical feasibility of automated highway technology by operating prototype vehicles under fully automated control on a specially equipped section of I-15 near San Diego, California. This dramatic and highly successful demonstration fulfilled the Congressional mandate as stated in ISTEA.

Architecture and Standards

About 4 percent of ITS funding has supported development of the National ITS Architecture and essential standards. The National ITS Architecture was completed in July 1996. Work in 1997 focused on developing criteria and guidelines for its adoption, and incorporating a thirtieth user service — highway-railroad intersection warning.

In addition, in 1996, the DOT signed cooperative agreements with five Standards Development Organizations to advance critical standards to support the building of ITS infrastructure and individual applications. Building upon the Architecture, development work for standards in all areas of ITS gained momentum in 1997. To date, thirteen standards have been formally adopted, six standards are at the mature draft stage and available for use, and forty-four standards are currently under development. With the current process for development in place, the Department estimates that roughly twenty draft standards per year will be developed.

Exhibit III-2: What has been funded?



* Commercial Vehicle Operations program funds are also included in R&D, Operational Tests, and Deployment Planning.

** $26.2 million for Deployment Planing, $22.3 million for Technology Transfer, $72.6 million for Program Support & Evaluation, $25.6 million for Mainstreaming, and $14.0 million for Driver Simulator.

*** $15.1 million was unavailable to the ITS Program due to a reduction associated with Section 1003 of Public Law 102-240.

Note: Of the $1,223.6 million made available to the FHWA for the ITS Program, $473.6 million (41.4%) has been earmarked by Congress, leaving $750.9 million (58.6%) to be expended at the discretion of the DOT. Also note that in addition to funding provided for FHWA, NHTSA, and FTA received $31.5 million and $13.2 million, respectively.

C. Enabling Research and Technology

Enabling research and technology form a foundation for deploying ITS in an integrated fashion. This program area provides the ITS program with research that facilitates technical integration and "openness," based on the National ITS Architecture and Standards development, and incorporates the behavior and reactions of operators and drivers to ITS technologies through human factors research. It also provides policy support on the communications that form the backbone for linking ITS applications together into a system. In order for the ITS program to continue to develop beyond ISTEA, work is still needed in each of the following areas of enabling research and enabling technology.

National ITS Architecture

One of the major accomplishments of the ITS program under ISTEA was the definition of the National ITS Architecture. This Architecture allows planners and deployers to see the need for and value in coordinated planning and integrated interoperable systems. It also helps identify where standards are required (see following text box for description of real-world benefits). In 1997, the need for maintenance of the National ITS Architecture became clear, including refinement and expansion where needed. Future program activities will focus on maintaining the currency of technical information and continuing to educate the ITS community on the use of the Architecture in deployment. Courses will be developed for transportation executives and engineers, and any new user services that are developed will be incorporated into the National ITS Architecture.

Standards

As noted in the program direction section, standards are the foundation for national compatibility and interoperability among all ITS components. With the National ITS Architecture defined, the coordinated development and dissemination of appropriate nonproprietary technical and operational standards has become more significant. Many of the communications standards and protocols that ITS will use already exist, but must be supplemented to support specific ITS-related applications such as communications between two traffic management centers. Working in partnership with localities and industry, DOT anticipates that ITS may require as many as 100 new standards to support U.S. ITS deployments.

Human Factors

Melding the results of human factors research into the design and manufacture of ITS systems can ensure safe and user-friendly services; help prevent crashes, fatalities, and injuries on the U.S. transportation system; and improve the performance of the overall network. In the near term, human factors research in

Southern California Applies the National ITS Architecture

The Southern California Priority Corridor Showcase Network is using the National ITS Architecture to integrate ITS throughout the corridor. The basic functional elements and related terminology have given the multiagency steering committee a common vocabulary that can be used throughout the corridor and during interactions with other transportation-related agencies across the Nation.The corridor team found significant value in the National ITS Architecture's interoperability analysis, framework, and standardization among individual subsystems within ITS. This contribution from the National ITS Architecture has been key in jumpstarting the corridor project to help achieve a seamless, "multi/intermodal," integrated ITS throughout Southern California.

A systems engineer on the Southern California Priority Corridor estimated that using the National ITS Architecture saved upwards of 33 to 50 percent of the time needed to define requirements for the new system.This anecdote echoes a similar perception by the Minnesota Guidestar team based on its use of the National ITS Architecture in establishing the vision of the State of Minnesota's future transportation system.

Based on the experiences of the Southern California Priority Corridor Showcase Network (G. Smith and M Nuaimi).

ITS will focus on improving the design and operations of traveler information and traffic management user services. The joint FHWA/NHTSA efforts in Crash Avoidance Display Research and In-Vehicle Information Systems will play a significant role in supporting the development of “human-centered” intelligent vehicles. This work will be further supported by the development of specifications and user documentation to cover areas such as driver-vehicle interface, risk-compensation driver behavior, and the impact of crash-avoidance systems on driver workload. Among the areas anticipated to receive increased emphasis in the future are factors related to inexperienced and aged drivers, commercial drivers, traffic management center operators,and automation of the highway infrastructure.

Enabling Technology

Nearly every ITS user service relies on communications technologies. Much of the ITS communications effort has sought to promote the best available and potential forms of wireless and wireline communications. The continued evolution of dedicated short-range communications capabilities, and the availability of radio frequency spectrum to support this service, have received particular attention, especially for vehicle-to-roadside communications requirements.

Specific accomplishments for 1997 under each area of this program are presented on the following pages.

1997 Accomplishments for National ITS Architecture

- Applications of the National ITS Architecture at Model Deployment Initiative sites have revealed that its use cuts development time by highlighting the issues agencies must agree on before developing their own architecture.
- A consistent approach to planning the Model Deployment Initiative sites facilitated interoperability so that the benefits of integration could emerge.
- Representatives from the ITS development and implementation communities were trained and briefed on how to use the National ITS Architecture as a tool during the design of ITS deployments. A three-day course on "Using the National ITS Architecture for Deployment," aimed primarily at developers/integrators of ITS systems, was developed and delivered twice in September 1997. Additional presentations are being scheduled for the remainder of 1997/1998 across the country. A half-day technical seminar was developed on the concept of the National ITS Architecture for the executive level.
- User documents were developed and distributed to guide ITS systems developers and implementers. To assist in standards development, 12 subvolumes of the National ITS Architecture were produced. Guidance documents were begun to provide technical assistance on how to use the National ITS Architecture to integrate specific systems:freeway management, incident and emergency management, transit management, traffic signal control systems, and traveler information systems. Guidance for transit management, entitled *ITS Deployment Guidance for Transit Systems*, was completed and distributed. Remaining documents will be available in early calendar year 1998.Guidance for software procurement is in development.

1997 Accomplishments for Standards Development

- Standards development organizations have either formally approved or brought to the mature draft stage 19 ITS standards that cover a variety of operational areas, including a dedicated short-range communications protocol; electronic data interchange standards for motor carrier roadside electronic verification and one-stop electronic purchase of credentials;spatial data location referencing;message set standards for such applications as vehicle navigation; and a National Transportation Communications for ITS Protocol.This protocol further consists of specific standards for various ITS-related communications requirements.
- The four metropolitan Model Deployment Initiatives – New York metropolitan area, San Antonio, Phoenix, and Seattle – will use the developing ITS standards to guide implementation.
- Another 44 standards are currently under way that, once approved, will support the application areas of traffic management, traveler information, transit, commercial vehicles, and safety and human factors. By the end of calendar year 1997, approximately 20 of these will be at the mature draft stage, ready for formal balloting and possibly available as early guidance to public procurement agencies.
- Plans have been formalized to develop training for ITS implementers and operators in the value and use of standards. Under the auspices of the Professional Capacity Building Program, the Institute of Traffic Engineers is developing a set of courses in conjunction with the standards development organizations to ensure adequate understanding by users when deploying standards-based systems.

Accomplishments in 1997 for Human Factors Research

- The second edition of the Human Factors Handbook for Advanced Traffic Management Systems Center Design is complete. The handbook addresses human error, the interface between user and computer in transportation settings, the use of display and input devices and controls, and workstation design and configuration.
- In a related activity, a prototype Traffic Management Center Computer-Aided Design Support System was developed and evaluated.
- Research was completed on several human-factor issues related to Advanced Transportation Information Systems, including the information needs and routing preferences of travelers, the structure of routing messages, and driver routing and rerouting decision sequences. The Traveler Information Effectiveness Project was initiated to use the results of this and related research for assessing the effectiveness and improving the design of traveler information systems.

Accomplishments in 1997 for Enabling Technologies

- In May 1997, ITS America filed a Petition for Rulemaking with the Federal Communications Commission to set aside a new spectrum bandwidth at 5850–5925 megahertz (MHz) for the numerous ITS user services that will depend on dedicated short-range communications for effective operation. Since the filing process typically lasts four to five years, formal allocation of this bandwidth to ITS is not expected immediately. However, the National Telecommunications and Information Administration of the Department of Commerce has granted bandwidth access to the Department through a Certificate of Spectrum Support for testing purposes. In June 1997, the Federal Register ran an FHWA notice to establish agreements with industry for testing dedicated short-range communications applications. Testing should begin in 1998, with results expected at the end of that year.
- The Department funded testing and evaluation of several commercial sources for communications and navigation services, including the FM Subcarrier Traffic Information Channel, short-range communication systems, and Differential Global Positioning System radio beacons, as well as guidelines for augmenting global positioning systems to benefit surface transportation users.
- The *Telecommunications Resource Guide* was issued in February 1997 that assembled the results of research, policy statements, and case studies on the relationship between implementing ITS user services and telecommunications resources, particularly in light of the significant changes in the industry caused by the Telecommunications Act of 1996. This publication will assist policy-makers in navigating the complexity of incorporating telecommunications into transportation systems. Workshops will be held in 1998 to disseminate the information in the guide.
- Several telecommunication studies were released that demonstrate cost-effective ways to implement ITS. For example, research on compressed video found that medium to be much less costly and just as effective as full-motion video. Another study showed that leasing infrastructure for ITS purposes can be two to four times less expensive than building it. Maryland saved $70 million this way; Pennsylvania, Chicago, and Houston will each save $40 million or more.
- DOT developed and distributed the ITS Procurement Resource Guide dealing with the Federal Aid System and the implementation of ITS.
- The Department assessed information security issues of ITS data flow, communications, and subsystems. In 1998, Maryland will be used as a case study to further assess the vulnerabilities of telecommunications data transfers.
- FHWA sponsored the development and delivery of telecommunications workshops and seminars for transportation professionals under the umbrella of the Professional Capacity Building Program, which will continue to offer training throughout fiscal year 1998 and beyond. Workshops and seminars range from one-half day to five days in duration and address the following topics: sharing right-of-way for telecommunications; cost analysis; overview of telecommunications; and short courses in telecommunications technology.

D. Metropolitan ITS Infrastructure

Moving beyond ISTEA, the next phase for Metropolitan ITS infrastructure is the pursuit of activities that further deployment and focus on integration. The Department recognized in 1996 that the success of the Metropolitan ITS infrastructure primarily relies on integrating traffic management systems, advanced public transportation systems, and advanced traveler information systems. Research under ISTEA promoted development, testing, and initial deployment of these technologies and produced insight into potential benefits as well as institutional barriers to deployment. Metropolitan ITS infrastructure has achieved significant gains in advancing toward deployment in terms of infrastructure definition, technological and institutional readiness and deployment of first-generation technologies and systems.

In 1997,using the ITS program strategies described in Section II, the Department focused on the following activities to facilitate deployment and the initial integration of Metropolitan infrastructure.

Standards

Critical standards necessary for enabling Metropolitan interoperability were advanced in 1997. Specifically, work on the National Transportation Communications for ITS Protocol (NTCIP) and the Transit Communications Interface Profiles (TCIP) furthered both of these standards to the mature draft stage. These standards are now available as guidance for use at Metropolitan deployment sites.

Metropolitan Model Deployment Initiative Sites

In 1996, Phoenix, San Antonio, Seattle, and the New York City metropolitan area were chosen to showcase the benefits of integrating existing, "stove-piped" ITS deployments. These sites provide real-life examples of technology potential in metropolitan areas across the Nation. Investments from public and private partners will integrate existing ITS elements in the four sites as part of a national showcase to reduce travel times, improve emergency response, and provide travel information to the public. Other metropolitan areas can use the lessons learned from this initiative to guide their efforts to integrate technology into their regional transportation systems (see text box).

"Smart" Roads Help Drivers Make Smart Choices

If Judy Bing's Seiko watch beeps eight times at 4:00 p.m., she knows there's trouble on Interstate 5 southbound, her main route home from her job in Seattle. By pressing a button on her wristwatch, she reads on the display exactly what the traffic problem is and where. Since January, Bing, a data-entry specialist for the University of Washington, has relied on her watch to help her avoid traffic congestion to and from work.It's programmed to beep between 6:00 and 7:30 a.m. if there are northbound tie-ups and between 3:30 and 5:00 p.m. if the problem is on southbound lanes. Bing can then choose an alternate route or wait for the problem to clear."It's pretty handy and it's very accurate," she says. It should be. The information is updated about once a minute and comes from county and State sources that monitor transit and freeway systems.

Bing is one of 500 people helping the Washington State Department of Transportation test how well the DickTracy-like technology works. Using technology to ease congestion is not a new idea for Washington's DOT. The State, like many others, started putting "intelligent" transportation features on its roadways some 30 years ago starting with such breakthroughs as closed-circuit television cameras on express lanes.

One of the key requirements for receiving Model Deployment Initiative, ITS Federal funding for installing advanced technologies is that State and local agencies and the private sector pull together so a whole region would work in sync. They also must guarantee that they run newly integrated systems for at least five years. The hope is that public and private partners will find ways to raise revenues so that the enhanced intelligent transportation systems can stay in place for the long haul.

Condensed from Ellen Perlman, Governing Staff Writer, Congressional Quarterly.

The Metropolitan Model Deployment Initiative sites provide the first examples of the benefits realized from integrating advanced traffic management and transit management with traveler information services. Such integration will move transportation operations closer to real-time, demand-responsive management that meets congestion-reduction goals and improves customer satisfaction. In 1997, the DOT actively supported these sites in helping them plan and install integrated systems and prepare for operations in early 1998.

The Professional Capacity Building Program

The ITS Professional Capacity Building program was established to improve awareness of ITS among practitioners and to ensure that transportation professionals have the requisite knowledge, skills, and abilities to meet the challenges of deploying ITS. While Professional Capacity Building activities apply to all areas of the ITS program, efforts in 1997 focused on transportation management and traveler information services in support of Metropolitan ITS deployment.

In 1997 a series of preliminary needs assessment activities were conducted to identify the training necessary to overcome impediments to deployment. Results are being used to develop a program roadmap and set long-term goals for the future.

A major accomplishment in 1997 was the joint FHWA/FTA development of a one-day ITS general awareness seminar. More than 2,000 Federal transit and highway professionals throughout the country attended. A three-day course on ITS integration was also developed, piloted, and presented in 1997, focusing on integrating the elements of Metropolitan ITS infrastructure. In addition,a suite of technical seminars was developed to transfer lessons learned and valuable technical assistance in deployment stages.

The Peer-to-Peer Network

The Peer-to-Peer Network is a critical tool in transferring experience and lessons learned among deployment sites around the Nation. Usage of the network was significantly advanced in 1997 through public outreach activities. A database of 106 peers was developed and used to address requests. Assistance was provided in many forms: at-desk reviews, telephone and documentation support, and site visits by peers to peers. In 1997, 38 requests for assistance were handled and seventeen site visits were conducted.

Scanning Reviews

Visiting ITS deployment sites allows transportation professionals to see first hand how ITS technology can be applied as a viable solution in their jurisdictions. With this in mind, the Department established executive-level scanning reviews to showcase the benefits and the operational concepts of ITS. These reviews were started in 1996,and have proven to be an effective means of transferring knowledge and technological concepts to new sites. Scanning reviews complement Professional Capacity Building courses with hands-on, peer-to-peer experience, and support the Department’s efforts to meet the Operation Timesaver goals.

Executive scanning reviews were conducted at 20 different sites in 1997. From preliminary data, more than 500 senior executives and public agency officials viewed ITS facilities. Atlanta, GA continues to be the most important site with nearly 200 visitors. Other major points of interest included Phoenix, AZ, the Yosemite Area Traveler Information Project, TRANSCAL in southern California, and Seattle, WA. Most useful to the participants were the examples of interagency coordination showcased at each site.

Development of Real-Time Adaptive Signal Control Systems

Research to advance ITS applications is critical to ensure that States and localities deploy state-of-the-art transportation systems. The development of Real-Time Adaptive Signal Control Systems (RT-TRACS) furthered the potential for operating Metropolitan ITS infrastructure as a system. RT-TRACS is a suite of control algorithms that allow real-time incremental improvements to traffic situations as they evolve. Four operational sites were established in 1997 that allow RT-TRACS to be tested under a wide spectrum of traffic conditions and roadway geometrics.

Understanding Consumer Decision-Making

With the establishment of public sector ITS infrastructure, travelers will gain choices and opportunities in their modes of travel, in navigating their routes, in improving the safety of their driving and their vehicles, and in accessing transportation information. Because these choices and the resulting travel decisions will have an impact on the transportation system, it is important to understand how consumers make decisions about transportation-related technologies and information. It is also important to understand consumer choice in order to successfully transfer ITS technologies to the market.

In 1997, research was conducted on user acceptance of advanced traveler information systems products and services. A report was issued that identifies consumer concerns and the attractive features of an advanced traveler information system. The report presents qualitative findings that set the foundation for more statistical research to be conducted.

Ongoing Research and Program Activities

In 1997, research efforts and activities in advanced traffic management systems, advanced public transportation systems, and advanced traveler information systems continued in support of Metropolitan ITS infrastructure deployment. These research efforts and activities are presented on the following pages.

1997 Accomplishments for Advanced Traffic Management Systems

ATMS Research & Development:

- Began field testing on the Real-Time Traffic Adaptive Signal Control System (RT-TRACS), a new generation control system that begins to allow real-time incremental improvements to traffic situations as they evolve. Four operational sites, presenting a large spectrum of traffic conditions and roadway geometrics, are being used to test the RT-TRACS suite of algorithms.
- Architected, engineered and built the Controller Interface Device, a revolutionary, integrated hardware/software component that allows extant and emerging traffic signal controller units to be incorporated as part of a real-time, hardware-in-the-loop simulation testbed. This device is being used to support the simulation-based, laboratory testing, and evaluation of candidate Real-Time Traffic-Adaptive Control System (RT-TRACS) control algorithms as well as the entire RT-TRACS system prior to field installation and live operational testing.
- Completed development and released the TSIS Version 4.0 package of traffic engineering applications. TSIS includes the CORSIM integrated corridor, microscopic traffic simulation; the TRAFVU output graphics processor; and the TSIS environment. Now available to users through the Center for Microcomputers in Transportation (McTrans), TSIS can be used to evaluate the operational effects of ITS deployments as well as traditional traffic improvement programs.
- Researched, developed, tested and validated novel Multi-Regime Traffic Models that greatly enhance the fidelity of many important microscopic traffic simulation processes such as lane changing and car following.
- Designed and initiated development of the ITS Deployment Analysis System (IDAS), a sketch planning tool to meet the short-term analysis needs of identifying and assessing ITS costs and benefits as compared with other conventional improvements. A method for demonstrating these benefits is needed to justify ITS as a feasible alternative in the development of regional transportation plans. A proof-of-concept IDAS will be completed in 1998.
- Work began on development and testing of real-time ramp metering control algorithms for improving the operational efficiency of a freeway corridor under recurrent as well as non-recurrent congestion conditions.
- Work was completed on development of two dynamic traffic assignment models. Testing is currently underway and demonstrations are planned during 1998.
- Work was completed on the development and testing of incident detection algorithms. This study used actual data obtained from freeway systems in Oakland and San Diego, CA, and the Twin Cities in Minnesota.
- Work was completed on the development of the National Transportation Communications for ITS Protocol exerciser. The exerciser is a software tool designed to test and debug the emerging standards.

ATMS Metropolitan Deployment

- The Department completed the *Intelligent Transportation Infrastructure Deployment Strategy*, a document to provide internal guidance to allocate resources toward reaching the Operation Timesaver goal. Work on supporting documents, including a business plan, is underway.
- The Metropolitan Model Deployment Initiative sites are all underway, with the Phoenix, AZ site operations expected to be ahead of schedule. These public/private partnerships are serving as models of fully integrated, multi-modal transportation management and traveler information systems.
- The Professional Capacity Building Program developed a one-day awareness seminar and delivered it to over 2000 Federal transportation employees around the Nation. Other course and seminar development was completed with Nation-wide delivery planned for FY 1998.
- More than 500 senior executive and public agency officials viewed ITS facilities at 20 different sites this year through the Executive Scanning Reviews program.

1997 Accomplishments for Advanced Public Transportation Systems

- Partnerships and contractual arrangements are in place for deployment and integration of advanced transit management technologies at Metropolitan Model Deployment Initiative sites.
- The Transit Communications Interface Profiles (TCIP) project is developing a family of standards for transit communications. The new standards will provide the interfaces among transit applications that will allow data to be shared among transit departments and other operating entities such as emergency response services and regional traffic management centers. The public review of the initial draft standard was completed in November 1997.
- Transit was a full player in the AHS demonstration in San Diego in August. Two of Houston METRO's 40-foot, low-floor New Flyer buses were part of the National Automated Highway System Consortium's Demonstration which featured full-scale, multi-vehicle presentation of automated transit technologies.
- Transit is a fully committed partner in the Intelligent Vehicle Initiative, and work has begun identifying the transit IVIplatform. As apart of the IVI, a committee of transit operators and suppliers has been established to advise the Federal Transit Administration on the specific activities that offer the greatest payoff in achieving the Departmental goal of improving safety and efficiency.
- The Denver Smart Bus Operational Test, one of the sites where fleet management and traveler information systems are almost fully operational, shows positive initial results:
    - 53 percent reduction in radio road calls by drivers.
    - 32 percent reduction in customer complaints. (New system also allows for investigation of complaints.)
    - Reduction in staff for supervision and time transfer monitoring due to streamlining of functions with ITS technology.
    - Quicker emergency response time because the automated vehicle location feature pinpoints the location of vehicles involved.
    - Automated vehicle location data was found useful for correcting on-street service problems.
- Evaluation of an additional 18 currently active operational tests continued;many will be completed in the near future. Evaluation reports on completed tests are expected in 1998.
- The Department completed the *Deployment Guidance for Transit Systems* Report. This report has received notification and distribution throughout all 10 FTA regions and to local transit agencies.
- FTA jointly developed and offered a one-day ITS general awareness seminar with FHWA. A two-day course was developed and offered in Fall 1997 dealing with ITS and transit specific issues.
- Six transit ITS workshops were held across the country in conjunction with annual meetings. FTA has an aggressive schedule of speaking engagements planned across the country on transit and ITS for 1998.
- A study was completed on the integration of transit rail and ITS, including bus/rail interface, aiding in development of intelligent trains for safety and productivity, and attention to rail-grade crossings.
- Work has begun on the development of guidance for multi-use electronic payment systems. A steering committee of industry representatives has been formed to guide the effort.The same committee will also provide guidance for the planned FY98 Electronic Payment Operational Test.

1997 Accomplishments for Advanced Traveler Information Systems

- Efforts are under way at Metropolitan Model Deployment Initiative sites to integrate traveler information systems with transit and traffic management and to determine whether traveler information can help increase the productivity of transit and traffic management systems.
- A report entitled *An Update of the Commercial ATIS Market:A Compilation of Consumer ITS Products and Services* catalogues the ATIS applications available to consumers in the United States including products for in-vehicle navigation, in-vehicle personal security and safety, navigation using personal computers, general travel products, and traveler information.
- Demonstration of several real-world applications of traveler information products that were originally developed for the Atlanta Traveler Information Showcase has continued. The first draft of a report highlighting the success of the demonstration and lessons learned was completed in 1997.
- Key findings from the Genesis Operational Test under the Minnesota Guidestar Program, which tested the feasibility of using personal communication devices to distribute real-time traffic information, confirm the expectation that travelers seek to avoid congestion and will change behavior as a result of receiving information.Sixty-five percent of respondents used the device/information daily and 42 percent reported taking alternate routes in response to information provided.The test also revealed that travelers place measurable value on access to real-time traffic information.
- DOT completed a report on the results of 12 focus groups on user acceptance of consumer products that provided traveler information.The study clarified the attributes of ATIS information that appear to be most important to people:accuracy, timeliness, reliability, costs (both one-time and recurrent), level and personalization of decision guidance, ease of access of specific information needed, and perceived safety implications. The qualitative study provides a basis for structuring a quantitative questionnaire, which is to be fielded during fiscal year 1998.

E. Commercial Vehicle ITS Infrastructure

At the center of Commercial Vehicle ITS infrastructure are Commercial Vehicle Information Systems and Networks (CVISN) which provide an information and communications infrastructure link to existing disparate and cumbersome information systems. These links facilitate the electronic exchange of information associated with the regulation of commercial vehicles. The development and application of new systems and networks to administrative processes aids in streamlining roadside inspections, State registration, compliance and regulations, and the movement of people and goods across international borders. This streamlining also eliminates some of the current labor-intensive processes that reduce the efficiency of goods movement and add to the cost of government services.

The Department is focusing on the following major commercial-vehicle initiatives to foster deployment of these integrated and interoperable systems and networks.

The International Border Clearance Program

The USDOT has been working together with the Departments of the U.S. Treasury and Justice to modernize the trade and transportation processes for clearance of commercial vehicles at border crossings with Canada and Mexico. The new methods use ITS to: 1) facilitate the safe and expeditious travel of commercial vehicles both entering and exiting the United States, and 2) to promote and expand trade and commercial activity between the three signatory nations of the North American Free Trade Agreement (NAFTA). All three U.S. federal agencies have been conducting tests with counterparts in Canada and Mexico on a prototype system known as the North American Trade Automation Prototype (NATAP). The tests are being conducted at six sites, and include processes to electronically check custom declarations to help Customs clear truck's cargo, and electronically access driver information to help Immigration and Naturalization Services clear the driver. The clearance processes are conducted through wireless data transmission, triggered by a transponder system installed in the commercial vehicle, and a reader system installed at roadside. The objective of these tests is to develop and test operational methods that will facilitate the transportation of motor carrier goods at the border, with assurance that safety, data quality, and reliability are maintained.

The six test sites include two on the northern border: 1) Detroit, Michigan/Windsor, Ontario; and 2) Buffalo, New York/Fort Erie Ontario. The other four sites on the southern border are: 1) Otay Mesa, California/Tijuana, Mexico; 2) Nogales, Arizona/Nogales-Sonnora, Mexico; 3) Laredo, Texas/Neuva Laredo, Mexico; and 4) El Paso, Texas/Juarez, Mexico. All six sites became operational in 1997, and are undergoing formal evaluation through May, 1998.

Under a continuing partnership with the U.S. Department of Treasury, DOT is also exploring the use of ITS for safety applications. The department will begin testing safety and registration verification on transponder and non-transponder equipped commercial vehicles in FY 1998-99 at three of the six test sites using the ITS infrastructure that was installed for the NATAP tests.A partnership agreement is being negotiated with the Treasury Department, and stakeholder meetings have been held to initiate the safety and credentials verification process.

Issues of Interoperability

In promoting interoperability within the commercial-vehicle sector, two standards are critical: Electronic Data Interchange (EDI) and Dedicated Short Range Communications (DSRC). Together, these technologies enable electronic identification interchanges between trucks and agencies, and checking safety and credentials at the roadside. EDI is already used for business transactions in a wide range of industries, including shipping, warehousing, manufacturing, and retailing. The CVISN pilot States will test and install software to support carrier-to-State and State-to-State credentialing using EDI technologies.

A DSRC standard is currently being developed by the American Society for Testing and Materials (ASTM). Both the manufacturers and users have joined together in a voluntary manner to adapt a standard that will have applicability throughout North America. The proposed standard is expected to be approved for provisional use by December 1998. The standard will ensure that a single,affordable electronic tag can support all applicable ITS user services in all North American jurisdictions. Without this standard, carriers would need multiple tags,and States multiple readers, which would be an expensive barrier to deployment.

The agencies using these technologies are often independent of one another. As such, interoperability problems can arise due to hardware (e.g., tags or scales) and software (e.g., various EDI systems in use) issues as well as business and institutional issues. The CVISN program is addressing these critical interoperability issues.

Building ITS Professional Capacity

In 1997, the Department sponsored a series of awareness seminars for public and private stakeholders to identify the knowledge, skills, and abilities needed by transportation professionals in deploying Commercial Vehicle ITS infrastructure. Based on this input, the Commercial Vehicle Operations program identified a series of courses to fill the identified needs. The FHWA began piloting an introductory course in October 1997. In 1998-99, the Department will have three CVO courses piloted, modified,and ready for delivery to Federal, State, and industry stakeholders.

CVISN Model Deployment Initiative

The CVO program has successfully developed the CVISN architecture and is installing it in two prototype states, Maryland and Virginia. In 1997, the initial lessons learned in these States led to the piloting of CVISN at seven additional sites to provide testing and evaluation in projects of more manageable size before infrastructure elements proceed to widespread deployment. The CVISN Model Deployment Initiative has partially funded the seven CVISN sites to deploy and integrate critical commercial vehicle applications and ensure that compliance with the National ITS Architecture is feasible.

Eventually, deployment will expand from pilot States to all interested States. As part of the ITS/CVO Mainstreaming program, regional planning forums and State business plans will be instrumental in distributing lessons learned and promoting benefits to ensure widespread deployment. There are currently 36 states engaged in ITS/CVO business planning activities.

Intelligent Vehicle Initiative

This year the CVO program became involved in the Intelligent Vehicle Initiative to study the ways in which on-board technology can be applied to the safe movement of commercial vehicles. The inclusion of commercial vehicle operations in the Intelligent Vehicle Initiative is aimed at accelerating the deployment of driving assistance and intervention systems to reduce motor vehicle crashes and enhance mobility and efficiency of our Nation's highways. This includes the FHWA's and NHTSA's work on drowsy-driver detection, on-board diagnostics, and brakes.

Ongoing Research Efforts and Program Activities

In 1997, research efforts and activities in CVO continued in support of Commercial Vehicle infrastructure deployment. These research efforts and activities are presented on the following page.

1997 Accomplishments for Commercial Vehicle Operations

- Installation of 100 automated Motor Carrier Safety Assistance Program (MCSAP) stations is complete. MCSAP uses the Safety and Fitness Electronic Records (SAFER) system to provide access from inspection sites to data residing within Federal and State motor carrier safety information systems. Efforts to equip an additional 100 sites have begun.
- Several tests and development projects are complete, including the Automated Safety Assessment Program (except that minor revisions will continue); the Interstate Fuel Tax Agreement (IFTA) system and International Registration Plan (IRP) clearinghouse development, testing, and model deployment projects; and testing visual imaging technology for automating brake safety inspection (with minor modifications possible in the future).
- National draft standards are now available for electronic credentialling for IRP and IFTA.
- Efforts to mainstream commercial-vehicle operations into routine transportation planning are underway in seven regions. Regional ITS/CVO Coordination Plans, which outline strategies for the deployment of ITS/CVO technologies by a group of States with common economic and transportation needs, are scheduled to be completed in CY 1998. Business Plans summarizing the current and planned commercial-vehicle products and services projects to be developed, tested, and deployed are to be completed by 36 States in 1998.
- A CVO World Wide Web site is now accessible on the Internet (http://www.avalon-ais.com/itscvo).
- A "Technology Truck," an over-the-road 48-ft trailer that houses interactive kiosks, a graphic/video wall, and a driver simulation area was developed to tour the Nation for the next three years. The Technology Truck is designed to educate legislators, regulatory/enforcement representatives, and the motor carrier community. Other mainstreaming efforts included recommendations for standards guiding procedures, training, data requirements, communications protocols, software, and hardware.
- The *ITS/CVO Regional Champion Toolbox* was introduced, containing recent information on ITS/CVO news, guidelines, and study results. Specifically, the Toolbox is aimed at promoting ITS/CVO deployment and includes a guide for governors, a qualitative cost/benefit analysis, and mainstreaming activity news.
- The CVO roadmap has been updated within the Department to reflect progress in deployment.

International Border Clearance Program

- Operational tests were brought into operation at sites in Laredo and El Paso, TX; Nogales, AZ; Otay Mesa, CA; Buffalo, NY; and Detroit, MI. Documentation of costs, benefits, a study of the institutional issues, and refinement of an international border clearance system design have begun.
- New international border clearance tests are also just beginning in Sweetgrass, MT, as well as Blaine, WA.
- The Treasury Department's involvement in the Department's North American Trade Automation Prototype (NATAP) program brings the number of cooperative efforts between these two Departments to six in ongoing International Border Clearance initiatives.
- The NATAP program is the first step in implementing an International Trade Data System (ITDS).The development of ITDS is called for in the Vice President's National Performance Review.

F. Rural ITS Infrastructure

1997 was a pivotal year in which the Department came to a clearer understanding of the components of a rural-based ITS program. A series of needs assessments and forums helped identify seven clusters of user services that characterize Rural ITS infrastructure. These seven clusters, listed below, are based on many of the ITS services in other categories that can be enhanced to address the unique safety and mobility problems of diverse rural communities:

- Traveler Safety and Security Services, including systems for hazard warning and in-vehicle crash avoidance;
- Emergency Services, including Mayday products and services, incident detection, location finding, and partnerships and coordination with police, fire,and emergency personnel;
- Tourism and Traveler Information;
- Public Transit/Mobility Services;
- Infrastructure Operations and Maintenance;
- Fleet Operations and Maintenance; and
- Commercial Vehicle Operations.

The delivery of these services will use some of the technologies and standards developed for Metropolitan ITS infrastructure,especially transit and traveler information systems, and for Commercial Vehicle ITS infrastructure, especially fleet management and vehicle safety systems. The way they will be used, however, varies according to the different requirements of rural geography and demography.

Program Development and Delivery

The Rural Program has adopted a "start-to-finish" philosophy in its program goals, defining three major steps: development, deployment, and delivery. The program is moving forward with development of technology for rural areas, and determining the best way to showcase rural projects. Technological, political/institutional, and planning issues all require further attention. Actions will have to be taken to overcome the barriers that hamper cost-effective implementation.

The Department has documented successful rural applications in two products:

- **The ARTS Compendium** — An operational on-line information system that manages a comprehensive list of ARTS and ARTS-related rural projects (almost 200 so far) within and outside of the ITS umbrella. The compendium consists of a variety of project types, from planning studies to Federally funded field operational tests. Not all of the projects listed are strictly rural in nature; some are vehicle-based, operating independently of the road type, and others are urban with rural applications. The ARTS Compendium is available for downloading on the Rural ITS website (www.its.dot.gov/rural/arts.html).

- **The Simple Solutions project** — A report entitled *Technology in Rural Transportation: Simple Solutions* is the result of a joint FHWA/ENTERPRISE project to identify low-cost/low-tech success stories that are precursors to more advanced solutions. Referred to as "Simple Solutions," the report documents technologies, partnerships, and lessons learned in such a way as to model solutions for other areas.

National ITS Architecture Applied to the Rural ITS Program

Work in the rural area has highlighted the need to deepen the National ITS Architecture for rural applications in at least two specific areas: Mayday systems and weather information systems for surface transportation.

It has been recognized that the National ITS Architecture lacks the level of detail needed to deploy Mayday systems. Specifically, information systems within the emergency response community need to be better integrated into the data and system flows. In response, the ENTERPRISE Consortium has established the Multi-Jurisdictional Mayday working group whose members include public and private agencies currently testing and evaluating Mayday systems.

This group has focused on coordination of Mayday projects in order to share information and review lessons learned. Discussions have focused on institutional barriers, concerns, and conflicting public and private opinions regarding Mayday standards, features, functional requirements, protocols, and architecture. This effort also moves Mayday products closer to the ultimate goal of a nationwide system that links communication and interaction among individual systems.

Like Mayday, weather is an important component of rural transportation management. The transportation and traveling communities can benefit from better and more timely weather information, but such information must be adapted to the specific needs of the various ITS services. To maximize the benefit of weather information use within ITS,it is important to incorporate plans for disseminating weather information into the National ITS Architecture. The importance of this information should also be accommodated in the planning stages for transportation management centers.

Leveraging Metropolitan ITS Applications

Building on the work accomplished for Metropolitan ITS infrastructure, the Rural program is developing ways to leverage advanced traveler information and advanced transit systems. For traveler information, the Rural program has developed six tasks for understanding how traveler information systems apply in rural settings: (1) comprehensive assessment of user needs; (2) review of existing and new relevant technology; (3) evaluation of rural transportation problems that can be addressed by ATIS;
(4) development of a range of rural ATIS concepts;
(5) selection of a range of promising concepts; and
(6) field-tests of selected concepts.

In 1997, the first five tasks were completed and documented in two reports — *Rural Applications of Advanced Traveler Information Systems: User Needs and Technology Assessment*, and *Rural Applications of Advanced Traveler Information Systems: Recommended Actions*.

The Department has developed operational tests to apply advanced traveler information systems to recreational areas. For instance, the TRANSCAL project, currently underway, addresses the need to provide information on road, traffic, transit, and weather to tourists and travelers along the I-80/US 50 corridor between San Francisco, California, and Lake Tahoe/Reno, Nevada. The test is demonstrating the ability to integrate information from multiple sources — urban, rural, rough terrain, severe weather, and so forth — and the ability to integrate traveler services and transit information with real-time regional congestion and incident content.

In 1997, research efforts and activities in ARTS, with integration of some APTS and ATIS, were initiated in support of Rural ITS infrastructure deployment. Most notably, five new operational tests were awarded and are listed in the following table on page 51.

Cooperative Agreements Awarded in September 1997

Rural Public Transportation

- **Florida Commission for the Transportation Disadvantaged** was awarded a cooperative agreement to provide regional, multi-agency application of ITS technologies to selected rural areas of Florida's coordinated transportation system, which provides transit service for people who need transportation for job training, employment, medical services, rehabilitation, and other basic necessities.
- **Cape Cod Regional Transit Authority** was awarded a cooperative agreement to develop an intermodal transportation network that incorporates ITS technologies to address the rural transportation needs of the region.In a joint effort with the Federal Transit Administration and local jurisdictions, the Cape Cod Regional Authority will deploy several advanced technology systems, such as an automated vehicle location system, a real-time customer information system, and a computer-aided dispatching system in order to provide transit service that is more efficient and reliable.

Weather Systems

- **Iowa Department of Transportation** was awarded a cooperative agreement to develop an integrated weather information system that improves and broadens the scope of atmospheric and road surface condition information available to highway users and operators in three midwestern states (Iowa, Wisconsin, and Missouri).The purpose of the project is to assess the benefits of integrating the information from Road Weather Information Systems (remote weather sensing systems currently being deployed by state highway agencies for winter maintenance purposes) and other weather information sources with transportation management and traveler information operations in rural areas.

Travel and Tourism

- **Arizona I-40/Grand Canyon National Park** was awarded a cooperative agreement to help improve mobility, increase access, stimulate economic development, and relieve traffic congestion caused by high travel demands and limited capacity of road and parking facilities. The project design includes commercial vehicle operations, transit, parking management, and information systems.
- **Branson, MO** was selected to evaluate the use of advanced technologies to collect and disseminate traveler information on such topics as weather, traffic and road conditions, and tourist attractions. This information will be provided through media such as the Internet, dial-in-telephone services, changeable message signs, commercial radio, kiosks, and cable television.

Also, work this past year has focused on developing an Environmental Sensor Station standard within the NTCIP family of standards, which has been formally approved. Such a standard will support technology applications for such uses as decreasing the amount of anti-icing and de-icing materials used, resulting in a reduction of chemical run-off into streams.

Work completed in 1997 also highlighted the importance of advanced public transportation systems in Rural ITS infrastructure. The existence of over 1,100 rural transit providers of widely varying sizes creates problems of efficiency in areas with small and fragmented services, especially areas that seek to serve the Nation's 30 million rural elderly, working poor, and people with disabilities. Advanced public transportation systems can improve the efficiency of rural transit operators by using automated vehicle locationing, fleet management systems for improved dispatching, and advanced ridesharing and ride-matching systems for more efficient scheduling. For example, in Sweetwater, Wyoming, vehicle location systems combined with a central dispatching center has allowed various transit agencies to coordinate with each other and provide improved services to the public (see text box on following page). Automated vehicle location rural applications also support other Federal requirements and initiatives such as welfare-to-work efforts. Advanced public transportation systems can improve accessibility to rural inhabitants and reduce the isolation of travelers.

In July 1997, the Department launched a study to understand the application of advanced public transportation systems technologies to rural needs. The study will use market research to determine

Multi-Service Provider Dynamic Dispatching System in Sweetwater County, WY

A large percentage of rural residents either do not drive or do not have access to vehicles, and therefore rely on the mobility services offered by transit operations. In Sweetwater, WY, transit organizations and the Sweetwater County Transit Authority worked together to find an effective solution.

- **Challenge:** To find a simple solution that combines and coordinates services of several transportation operators.To provide more efficient and effective public transit service.
- **Solution:** Various agencies, including a child development center, a counseling service, two senior centers, a youth home, and a nursing home came together to form a single transit organization. A central dispatching center was created to handle requests. Using an advanced dispatching system and AVL technology on some vehicles, fleets were combined to create the equivalent of a single transit operation, thus eliminating overlapping services.
- **Result:** The system has been operational for six years, and now provides dispatching for approximately 20 agencies. Ridership has doubled without increasing operational overhead.

information requirements, problems, interests, and concerns of operators and passengers. It will eventually document the state-of-the-art and practice in advanced public transportation technologies, specifically those related to traveler information services, and will assess their applicability in meeting the needs of rural transit users. Based on these activities, the Rural program will develop conceptual system designs and implementation strategies for rural transit applications.

Ongoing Research Efforts and Program Activities

The 1997 accomplishments for the Rural ITS program are presented on the following page.

1997 Accomplishments for Advanced Rural Transportation Systems

- In fiscal year 1997, the draft of the Advanced Rural Transportation Systems Strategic Plan was finalized and distributed for comment to rural stakeholders. Also, a draft of the Program Plan was finalized in August 1997 and presented for comments at the Rural ITS Conference. The program plan specifies candidate projects and activities from fiscal year 1997 through 2001 to advance the Rural ITS in partnership with other national, State, and local public agencies and the private sector, as well as to address the uncertainties and ultimately deploy Rural ITS infrastructure. It describes the user services, functional requirements, and knowledge gaps that apply to each cluster of rural ITS services.
- Five new operational tests were launched in three Rural program areas: rural public transportation systems, weather systems, and travel and tourism systems.
- Outreach to stakeholders continued for review and feedback on the National Rural ITS Program Plan. An open forum is planned for 1998.
- The ARTS Compendium was finalized and published on the Rural ITS web site.
- The report, *Technology in Rural Transportation: Simple Solutions*, was presented at the annual Rural conference in Montana in August 1997.
- Two Rural field projects were conducted — an evaluation of satellite communications systems for Mayday applications was completed, and an assessment of surveillance and delay advisory systems was conducted in rural New Jersey.
- General Motors and Ford introduced first generation Mayday products to market based on the success of operational tests. DOT is developing second generation concepts and technologies that provide greater linkage with public-sector emergency medical response and medical trauma services.
- The Environmental Sensor Station standard was formally approved for use.
- The Advanced Transportation Weather Information System was operational in North and South Dakota for the 1996-1997 winter season.
- A study was launched to identify how advanced public transportation systems technologies can be applied to meet rural needs. The information gathered will assist in developing a strategy for deploying advanced public transportation systems technologies in rural settings.

G. Intelligent Vehicles

Intelligent vehicles represent the second half of the vision for a national intelligent transportation system. The incorporation of intelligent applications into vehicles offers promise for major safety improvements as well as better mobility, enhanced productivity and greater customer convenience.

In recognizing the need to effectively invest in and plan for intelligent vehicles,this year the ITS Program combined its ITS vehicle-related research under one programmatic initiative, the Intelligent Vehicle Initiative (IVI). The Initiative is predominantly comprised of research into the science of crash avoidance and automated control. This research was previously conducted under two of the ITS program areas described in the 1996 Report to Congress — the Advanced Vehicle Control and Safety Systems (AVCSS) Program, led by the National Highway Transportation Safety Administration (NHTSA), and the Automated Highway System (AHS) Program, guided by the National Automated Highway System Consortium (NAHSC).

The IVI will continue activities from these programs as well as smaller efforts that had been underway in the Office of Motor Carriers and in FTA. The following describes the critical next steps on which the IVI will need to focus, then presents specific accomplishments of the AVCSS and AHS programs in 1997.

1997 Accomplishments for the Intelligent Vehicle Initiative

In addition to continuing ongoing high-priority safety-related work, this past year was a planning year for the new program. An initial draft of a Business Plan was developed and circulated for comment. Candidate user services that improve safety, impact safety, provide platform-specific functions, or provide supporting capabilities for other future services have been identified. The 26 candidate services include some existing or slightly modified ITS user services and are listed in the box below.

Candidate IVI User Services

Safety Services

- Rear End Collision Avoidance
- Road Departure Collision Avoidance
- Lane Change and Merge Collision Avoidance
- Intersection Collision Avoidance
- Vision Enhancement
- Location-Specific Alert and Warning
- Automatic Collision Notification
- Smart Restraints

Safety Impacting Services

- Navigation/Routing
- Real Time Traffic and Traveler Information
- Driver Comfort and Convenience

Platform Specific Services - Special Vehicle

- Fully Automated Control at Certain Facilities

Platform Specific Services - Commercial Vehicle

- Vehicle Stability Warning and Assistance
- Driver Condition Warning
- Vehicle Diagnostics
- Cargo Identification
- Automated Transactions
- Safety Event Recorder

Platform Specific Services - Transit Vehicles

- Obstacle/Pedestrian Detection
- Tight Manuever/Precision Docking
- Transit Passenger Monitoring
- Transit Passenger Information

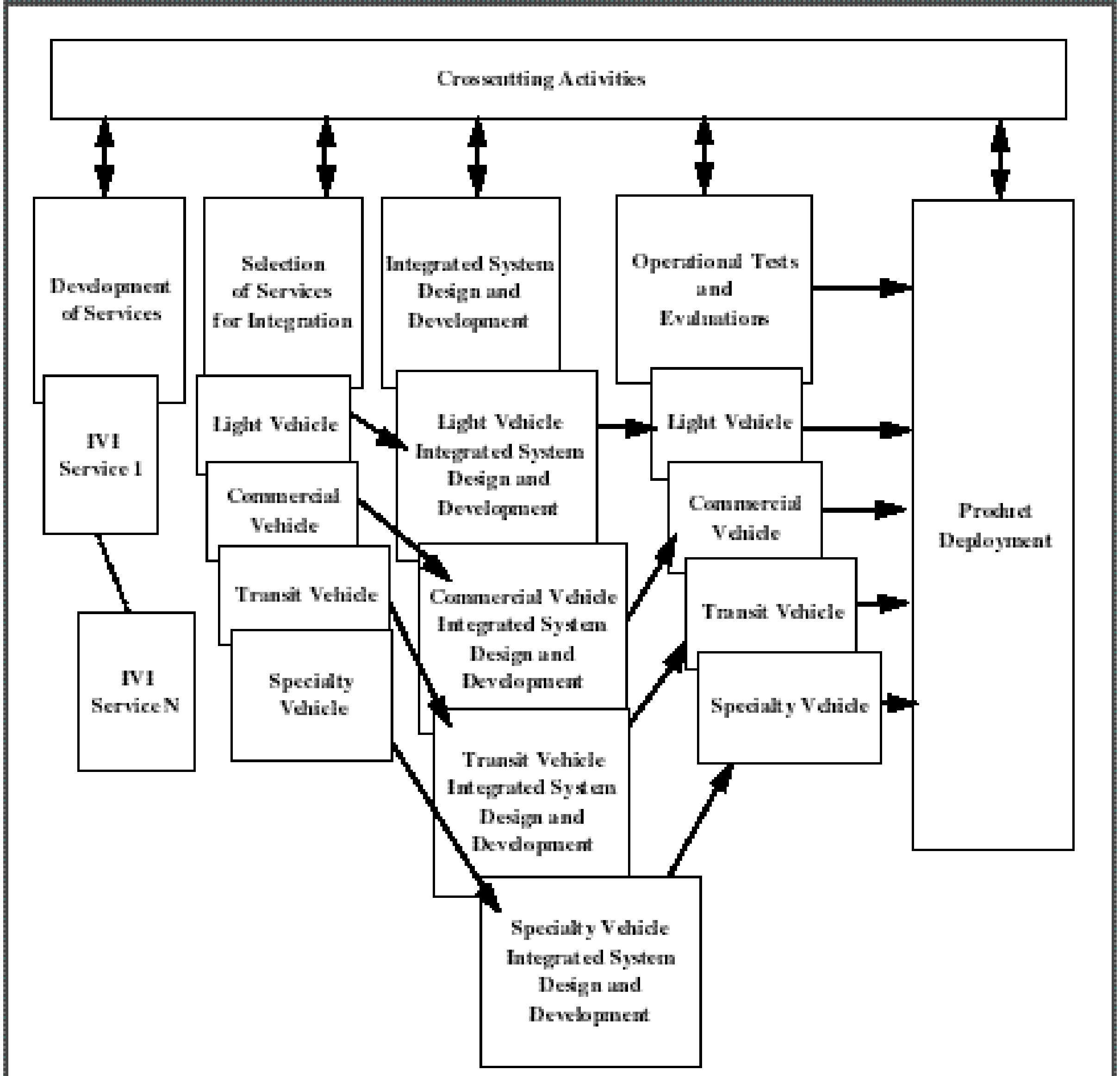
Supporting Services

- Low Friction Warning and Control Assist
- Longitudinal Control
- Lateral Control

The Intelligent Vehicle Initiative team also developed a preliminary program roadmap that incorporates the candidate services, illustrated in Exhibit III-3. The roadmap represents an attempt to illustrate the sequence in which broad program goals will be accomplished. The major elements are:

- Cross-cutting activities;
- The development of the IVI user services;
- The selection of services for integration;
- Integrated systems design and development;
- Operational tests and evaluation activities; and
- Product deployment, including transfer of research to the commercial market and actions by State, regional, and local governments to install infrastructure-based IVI system components on their highway systems.

Exhibit III-3: Preliminary IVI Roadmap



The driving force behind the Intelligent Vehicle Initiative is to seize the opportunities ITS offers for improved safety and efficiency and to avoid the potential risks of safety degradation. These opportunities are:

- Safety: A reduction in highway crashes and their resulting injuries and fatalities;
- Mobility: An improvement in public access to activities, goods, and services;
- Efficiency: An improvement in the utilization of existing highway systems and a reduction in travel time;
- Productivity: An improvement in the economic efficiency of the Nation's transportation system and a reduction in operating costs; and
- Environmental Quality: A reduction in motor vehicle fuel consumption and emissions.

A major consideration in the IVI program is that ITS solution to problems must be human-centered. This means that applications of ITS technologies must complement the perception, cognition, and behavior of drivers in everyday safety-critical functions. Despite many advancements over the past 100 years, no aspect of automotive technology has replaced what the human driver does with his or her eyes in terms of assessing the immediate need for speed and path control. Thus, it is a significant challenge to developers of advanced technology that applications effectively complement human perceptions and cognitive capability. This challenge becomes more complex when drivers are provided with additional in-vehicle information that might, unless carefully designed, compromise driver safety and efficiency. A related risk is that individual technologies, which on their own may provide positive benefits, may, when combined, demand excessive driver attention and potentially degrade driver performance.

The Intelligent Vehicle Initiative seeks to overcome these challenges by designing programs to test technologies individually and together, with a focus on human-centered design. Beyond this,the IVI team will work collaboratively with industry to explore issues of manufacturability, market-transfer, cost, and liability.

Partnerships and Technology Transfer

The emphasis of the future program will be on the steps necessary to make effective systems available to car, truck and bus buyers. This will include developing an enhanced understanding of the trade-offs between desirable and achievable system capability, developing a much greater understanding of user acceptance and expectations, and an extension of efforts to estimate benefits that will accrue to users of collision avoidance systems. The program has made, and will continue to make, a concerted effort to share research results and understanding of system performance with the automotive industry and with consumers. Through a proactive outreach process, the initiative will seek to work with product designers, automotive industry researchers, and the buying public. It will also be necessary for the initiative to be sensitive to industry's concerns regarding competitive advantage and the protection of proprietary information, as methods to overcome impediments are jointly sought.

In the past, both NHTSA and FHWA programs have actively solicited and supported industry initiatives to research and develop these technologies. This approach is considered key to the development and introduction of safe and effective products that address specific safety problems. Currently, NHTSA is actively preparing and updating functional performance specifications for specific collision avoidance focus areas, and working with industry to assess performance, reliability, maintainability, failure modes and consequences, driver acceptance potential, costs, and market readiness of promising systems. Collision avoidance system performance and testing guidelines, as well as an array of research tools, including simulators, data collection suites, test vehicles,and test beds are being developed to support the cooperative efforts in developing safety-enhancing products, and in evaluating their feasibility for introduction.

1997 Accomplishments for the Advanced Vehicle Control and Safety Systems Program

Significant progress has been made in the area of advanced vehicle control and safety systems. A field operational test of an adaptive cruise control system, consisting of 10 passenger cars equipped with a state-of-the-art adaptive cruise control system, was completed. These systems provide automatic speed control, which causes the vehicle to match the speed of a preceding vehicle and helps the driver maintain a safe headway between vehicles. These vehicles were loaned to volunteer drivers who were instructed to drive this test vehicle in the same way that they use their own personal vehicle. As these drivers used the vehicle, data were collected on driver actions, vehicle motions, and traffic conditions and events. Initial assessment of the results indicates that drivers found the system to be comfortable and stress-relieving, and that system-induced decelerations served as a vigilance-enhancing cue. Preliminary quantitative analysis of the data found that under virtually all conditions drivers chose headway distances when using the system that are greater than those seen when the same person drives manually. A complete evaluation of the results of this test will be completed during the next year.

In another project, the driving phase of a field operational test of an automatic collision notification system was initiated. In this project, 1000 privately owned vehicles were equipped with systems that will automatically place a cellular telephone call to the local emergency service dispatcher if a crash occurs. After the telephone connection is made the vehicle will automatically transmit its location and details of the type and severity of the crash. This information will assist the dispatcher in sending the most appropriate emergency equipment to the scene. Data will be collected on this fleet of vehicles for the next year, after which a full evaluation of results will be performed.

A major project, done in cooperation with the Defense Advanced Research Projects Agency and a consortium of motor vehicle industry partners, was also completed. This project produced significant reductions in manufacturing costs and in improving performance of key components of collision avoidance systems such as sensors (both radar and laser) and head-up displays. Three generations of forward-looking radar sensor were developed during this project. Major improvements were also made in manufacturing techniques and performance; e.g., brightness of reconfigurable head-up displays. These displays will provide a means of advising the driver of impending crash situations in a manner that does not require drivers to divert their attention from the road ahead. The project also demonstrated significant progress in understanding the nature of driver interactions with collision avoidance systems. Results of this project will be combined with results from other projects to form the basis for an operational test of a rear-end collision avoidance system. Lessons learned from the two other operational tests mentioned above will help make this a model for other IVI operational tests in the future.

The Data Acquisition System for Crash Avoidance Research (DASCAR) continues to gather data on how drivers interact with advanced technologies. During this year, the system was used to gather baseline driver data during lane change maneuvers. These data provided a basis for determining the best location for the driver interface of a lane-change collision avoidance system. That information is now being used to build a testbed vehicle that will be used to refine preliminary performance specifications for lane-change systems. Another ongoing project is using DASCAR to study the effects of new in-vehicle technologies on driver workload. The workload demands of several navigational aids are being compared to other in-vehicle tasks such as the use of a cellular telephone or tuning a stereo. The DASCAR is also being used to gather data on how drivers interact with anti-lock brake systems when confronted with an imminent collision. This information will provide a basis for understanding how the benefits of anti-lock brakes may be affected by actual driver reactions in real emergencies. During the next year, the DASCAR will be used to gather baseline driving data in rear-end collision and road-departure situations.

In the field of heavy truck safety, a major initiative is underway to develop and test a reliable drowsy driver detection system. A prototype system is currently being evaluated by a trucking company during overnight runs. In another heavy truck program, a government/industry team has developed several prototype approaches for enabling new technologies to be used for providing better and more reliable powering and communications between tractors and their trailer. Two tractor-trailer units, equipped with numerous ITS technologies, are now in the process of an 18-month test.

1997 Accomplishments for the Automated Highway System Program

One of the most visible successes of 1997 was the full-scale demonstration of automated highway operations, which occurred in August 1997 on San Diego's I-15 express lanes. Culminating years of work, the National Automated Highway System Consortium met its goals in demonstrating full automation of a variety of vehicles on a public roadway in the full view of the American public and the world media. The demonstration safely gave rides to 3,500 people, including national and State elected officials, heads of major corporations, transportation industry professionals, and international researchers. The vehicle operated successfully for over 10,000 vehicle-miles. The accompanying exhibition showcased current and emerging technology in vehicle control. A subsequent international workshop included over 100 leading researchers from North America, Europe, Asia, and Australia.

This demonstration, organized as a showcase by the National Automated Highway System Consortium to build public and industry awareness, was required by ISTEA and represents a milestone in ongoing automated highway system definition. The 7.6 miles of test roadway were equipped with magnets for lane guidance. Vehicle-mounted technologies were used to control speed and lane position in relation to other traffic in the roadway. Commercially available wireless local area network technology was used in vehicle-to-vehicle communication for "platooning." Passenger cars, heavy trucks, and transit buses were involved in the test. Specific capabilities demonstrated included the following:

- Vehicle following, lane changing, and obstacle avoidance by cars and buses both operating independently and in communication with each other;
- Closely-spaced "platoon" operation of cars in communication with each other, including a split-up and rejoin maneuver to allow others to enter the platoon; and
- Autonomous systems equipped only on the subject vehicle included collision warning, side-obstacle detection, and adaptive cruise control. All three technologies are soon to be offered commercially for passenger cars in the United States.

Concept development for the automated highway system reached several milestones during 1997. The execution of the demonstration required the development of products previously unavailable. Research into the state-of-the-art vehicle control led to the identification of vital technologies for an automated highway system, including rough specifications and availability requirements. Operational concepts were described for mixing automated and manually-driven vehicles on the same facility, and application of automation technology to the nearer term in partial automation scenarios was developed. Finally, program staff and regional planners jointly developed case studies to apply automated highway systems to several regions of the country.

As the Department brought the crash avoidance research and the short-term research underway in the Automated Highway System program into a consolidated Intelligent Vehicle Initiative, it made the decision to withdraw from its relationship with the National Automated Highway System Consortium. This withdrawal will level the playing field in engaging in a new round of cooperative relationships to pursue the research on intelligent vehicle technologies.

Ongoing Research Efforts and Program Activities

In 1997, research efforts and activities in the Advanced Vehicle Control and Safety Systems program and the Automated Highway System program continued in support of intelligent vehicle development. These research efforts and activities are presented on the following pages.

1997 Accomplishments for the Advanced Vehicle Control and Safety ITS Program

Advanced Vehicle Control and Safety Systems

- Initial application of the Data Acquisition System for Crash Avoidance Research (DASCAR) began in research areas such as gathering data on driver "point-of-regard" behavior prior to changing lanes.
- The data collection phase of the Intelligent Cruise Control Operational Test was completed.
- The data collection phase of the Automated Collision Avoidance System Operational Test was initiated.
- In the drowsy program, data collection on driver behavior using two instrumented trucks was begun. Seven drivers were observed during in-service operation.
- A Report on Preliminary Assessment of Crash Avoidance Systems Benefits was completed.
- A report was submitted to Congress which described progress of the NHTSA ITS program during 1992-1996 and provided a Strategic Plan for the NHTSA ITS program for the years 1997-2002.

1997 Accomplishments for the Automated Highway System Program*

Automated Highway System

- The analysis phase of the program was completed in which alternative approaches to highway automation were defined and analyzed. An overall broad concept for an automated highway system in the 21st century was defined as the system definition phase started. In this phase, remaining technical, social, and institutional issues are being addressed.
- As part of this effort, work began on defining the near-term systems that are expected to be introduced in the marketplace over the next five to ten years. These systems, which will provide warnings and partial vehicle control, will act as stepping stones to full automation. A broad array of these potential services were defined, including services that are vehicle-based and those that are supported by the infrastructure.
- Validation of the automated highway system concepts also began. The National Automated Highway System Consortium began teaming with several regional and local transportation agencies to conduct case studies for highway automation. In these efforts, automation solutions are postulated for local and regional problems, and the automated highway system is included in the locale's transportation planning process.
- In-vehicle technologies, such as driver warning systems, are being developed in close coordination with the NHTSA-administered Collision Avoidance Program. This represents the creation of "stepping stones" to the eventual goal of fully automating vehicle steering, acceleration, and braking as part of intelligent vehicle development.
- In conjunction with the NHTSA and FHWA, the National Automated Highway System Consortium began work on the Intelligent Vehicle Initiative program. This has involved assisting the Department in defining the program and in redirecting some of the National Automated Highway System Consortium work to concentrate on more near-term operational tests of the warning and partial automation systems.
- The program is identifying ways to integrate an automated highway system and collision avoidance research and development activity, and reviewing the role of the National Automated Highway System Consortium.

* The funding for the Automated Highway System Program has sinced ceased. All advanced vehicle control activities have been subsumed under the Intelligent Vehicle Innitiative.

IV. CONCLUSION

The national ITS program is based upon a strategic vision of how advanced information technologies can enhance the safety and efficiency of surface transportation systems and the American way of life. Under ISTEA, the Department conducted the first phase of a national program to create an innovative, more capable,and cost-effective generation of surface transportation systems. But the transformation of ITS into a mainstream element of surface transportation planning and infrastructure investment has only begun.TEA-21 presents the opportunity to realize the benefits of that initial research and extend its horizon.

To meet the challenges ahead, as outlined in this report, the ITS Program needs to provide leadership in two ways. First, the ITS program requires deployment funding incentives to support integration of the metropolitan ITS infrastructure, and deployment of both Commercial Vehicle Information Systems and Networks and rural ITS infrastructure. Second, it must support ongoing research. This includes the development of the next generation of ITS technologies, including a fully integrated intelligent vehicle, the development of standards, professional capacity building, rural research and field testing, and technology transfer.

In TEA-21, Congress presents an historic opportunity to dramatically improve the future of surface transportation and ensure meeting the transportation challenges of the 21st century. Tied to this opportunity is the prospect of improving the Nation's safety, productivity, and quality of life at a fraction of the cost of implementing traditional solutions to national transportation challenges. The ITS program is at an important juncture. Although the full potential of ITS has yet to be realized, enough has been learned under ISTEA to verify the wisdom of forging ahead and nurturing the ITS program to fulfill the vision of a national, safer, more efficient, and less costly intermodal transportation system.

APPENDIX A: A Brief Summary of the ITS Program

Pre-ISTEA

The establishment of the ITS program followed a congressional request for a formal DOT assessment of the desirability of developing and deploying surface transportation applications of advanced information, communications, navigation, and vehicle control systems technologies. The DOT assessment echoed two independent conclusions that a national ITS program was desirable; one by a National Academy of Sciences expert panel, and another by an ad hoc coalition of visionary public sector, private industry, and university transportation professionals known as Mobility 2000. Both stressed the importance of a domestic ITS program to counter rising congestion that stalls traffic — sapping the lifeblood of the Nation's economic vitality — and to ensure that U.S. industries are not overly disadvantaged by foreign government research and development (R&D) in the development of vehicles with sophisticated safety features and electronic devices that enable travelers to make well-informed choices about the most convenient or expeditious time, mode, and route of travel. Mobility 2000 concluded that "a national policy [on ITS] should be formed using input from Federal, State, and local levels; and, based on the policy, legislation, and funding programs, should be developed to guide needed research, conduct operational testing and evaluations, and deploy systems on a meaningful scale."

Research on applying computer, navigation, information, and communications technologies to improve the operational safety and efficiency of surface transportation systems dates back to the late 1960s and early 1970s. Although primitive and costly by today's standards, computerized traffic and transit management systems were deployed on an experimental basis and/or as cutting-edge applications. Remnants of Urban Traffic Control Systems (UTCS) pioneered and promoted by the Federal Highway Administration in the 1970s still operate today in some major U.S. cities, and the advanced traffic management system currently used by Minnesota DOT in the Twin Cities area, evolved from a Federally-funded demonstration project in the 1980s. Similarly, a crude information kiosk was evaluated in the 1970s as a means of informing arriving air passengers of the various transit operators, routes, transfer points,schedules, and fares associated with getting from National Airport to various points within the Washington, D.C. area. The Federal Transit Administration has been involved with a large number of activities related to ITS ever since the creation of the Urban Mass Transportation Administration (UMTA) in 1970. As a result, transit agencies have long been familiar with technologies for signal/bus priority systems, automated fare payment systems, automated traveler information systems, and automated vehicle control systems.

However, many pioneering efforts failed to gain widespread acceptance for a number of reasons. In particular, Federal R&D program cutbacks during the late 1970s and early 1980s led to a precipitous decline in advanced highway and transit system development and deployment. In the late 1980s, three factors combined to spur renewed interest in ITS research, testing and deployment. The first was dramatic performance/cost advances in computer, sensor, and communication technologies. The second factor included mounting traffic congestion, traffic safety, and air quality concerns, and a growing realization that simply adding conventional roadway capacity alone was not a viable long-term solution. And third, it was perceived that aggressive European and Japanese ITS R&D initiatives,if successful, could limit the future competitiveness of the U.S. motor vehicle and electronics industries such that national economic and defense interests would be adversely impacted.

The ISTEA Era

The passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 marked a shift in national surface transportation priorities. ISTEA initiated a transition from an era of major highway and transit system expansion to a new age of system management to more efficiently using the existing transportation infrastructure. In addition, ISTEA stressed intermodalism — the seamless integration of travel modes. Specifically, ISTEA called for the implementation of a "national system of travel support technology, smoothly coordinated among modes and jurisdictions to promote safe, expeditious, and economical movement of goods and people."

In this spirit, the Intelligent Vehicle-Highway Systems Act, a component of ISTEA, established the IVHS program (later renamed the Intelligent Transportation Systems Program) and authorized approximately $659 million[1] in funding from 1992 through 1997. Congress set ambitious goals for this program, which included:

- Enhancing safe and efficient operation of the Nation's highway and transit systems, focusing particularly on system aspects that will increase safety, and identifying those that may degrade safety.
- Reducing societal, economic, and environmental costs associated with traffic congestion.
- Developing and promoting intelligent transportation systems and an ITS industry in the United States.
- Enhancing U.S. industrial and economic competitiveness and productivity.
- Enhancing, through more efficient use of the Federal-aid highway system, the efforts of several States to attain air quality goals established by the Clean Air Act.
- Developing a technology base for ITS and establishing the capability to perform demonstration experiments, using existing national laboratory capabilities where appropriate.
- Facilitating the transfer of transportation technology from national laboratories to the private sector.

To meet these goals, ISTEA required DOT, with the assistance of State and local governments and private partners, to undertake the following objectives:

1. Promote widespread implementation of ITS to enhance the capacity, efficiency, and safety of the Federal-aid highway system, and to serve as an alternative to additional physical capacity of the Federal-aid highway system.
2. Enhance the safety and operations of our Nation's transit system.
3. Promote standards and protocols to facilitate the widespread, compatible use of ITS technologies.
4. Develop and evaluate ITS field operational tests.
5. Establish an information clearinghouse.
6. Establish an ITS Priority Corridors program to evaluate technologies under real-world conditions.
7. Develop a prototype of an automated highway and vehicle system.
8. Provide technical, planning, and operational test assistance to State and local governments to encourage widespread deployment of ITS.

Prior reports all reflect accomplishments to meet these goals.

End Notes to Appendix A

[1] $15.1 million became unavailable to the ITS Program due to a reduction associated with Section 1003 of Public Law 102-240.

Appendix B: Glossary of Related ITS Terms

AASHTO	American Association of State Highway and Transportation Officials.
ACN	Automated Collision Notification system.
AHS	Automated Highway System. The AHS is a highly advanced system that will redefine the current vehicle-highway relationship by shifting many tasks from the vehicle operator to the roadway itself. The first demonstration of the AHS concept was in San Diego in August 1997.
APTS	Advanced Public Transportation Systems. Collection of technologies to increase efficiency of public transportation systems and offer users greater access to information on system operation.
Architecture	An overarching framework that allows individual ITS services and technologies to work together, share information,and yield synergistic benefits. The National ITS Architecture was released as a final document in June 1996.
ARTS	Advanced Rural Transportation Systems.ITS technologies aimed at addressing the specific needs of rural communities, particularly the issues of mobility and road safety.
ATIS	Advanced Traveler Information Systems. ATIS technologies provide travelers, businesses, commercial carriers, and transportation professionals with the information they need to make decisions,from daily individual travel decisions to larger scale decisions that affect the entire system, such as those concerning incident management.
ATMS	Advanced Traffic Management Systems. ATMS technologies apply surveillance and control strategies to improve traffic flow on highways and streets.
AVI	Automatic Vehicle Identification. A system which combines an on-board tag or transponder with roadside receiver for the automated identification of vehicles. Used for electronic toll collection,stolen vehicle recovery, using vehicles as traffic probes, etc.
AVL	Automatic Vehicle Location system. Computerized system which tracks the current location of fleet vehicles, to assist dispatching, etc.
AVCSS	Advanced Vehicle Collision and Safety Systems. These systems employ mostly in-vehicle technologies to help drivers avoid collisions, monitor driver performance, and automatically signal for emergency aid immediately upon collision.
CVISN	Commercial Vehicle Information Systems and Networks. A network that connects existing Federal, State, and private-sector information systems to improve commercial-vehicle movement.
CVO	Commercial Vehicle Operations. ITS program to apply advanced technologies to commercial-vehicle operations, including commercial-vehicle electronic clearance; automated roadside safety inspection; electronic purchase of credentials; automated mileage and fuel reporting and auditing; safety status monitoring; communication between drivers,dispatchers, and intermodal transportation providers; and immediate notification of incidents and descriptions of hazardous materials involved.

DASCAR	Data Acquisition System for Crash Avoidance Research. A portable on-board vehicle data-gathering system that can monitor and record vehicle performance and the driver's physical reactions.
DGPS	Differential Global Positioning System. A technique that can be applied by civilian GPS users to improve GPS accuracy to 1-10 meters.
DOT	Department of Transportation. When used alone, indicated U.S. Department of Transportation. In conjunction with a place name, indicates State, city, or county transportation agency (e.g., Illinois DOT, Los Angeles DOT).
DSRC	Dedicated Short-Range Communications. Wireless, short-range digital communications. Uses electronic readers, tags, and software.
EDI	Electronic Data Interchange.
EDP	Early Deployment Plans.
EMS	Emergency Management Services. Services designed to optimize the response time to incidents.
Enabling Research	Applied research that advances existing technologies to enable them to support ITS applications. This research has refined technology for eventual field testing, developed evaluation methods to determine potential benefits and cost effectiveness, developed human factors guidelines, and established performance specifications and criteria.
ENTERPRISE	Program standing for Evaluating New Technologies for Roads Program Initiative in Safety and Efficiency. International public sector cooperative initiative to facilitate the rapid development and deployment of ITS technologies. Participants include Arizona DOT, Colorado DOT, the Dutch Ministry of Transport, FHWA, Iowa DOT, Maricopa County, AZ, Minnesota DOT, New York DOT, Ontario Ministry of Transportation, Transport Canada, Virginia DOT, and Washington State DOT.
FCC	Federal Communications Commission.
FHWA	Federal Highway Administration.
FMS	Freeway Management Systems. Network systems that allow transportation managers the capability to monitor highway and environmental conditions on the freeway system, identify recurring and non-recurring flow impediments, implement appropriate control and management strategies, and provide collection and dissemination of critical real-time information to travelers.
FOT	Federal Operational Test.
FRA	Federal Railroad Administration.
FTA	Federal Transit Administration.
GCM	Gary-Chicago-Milwaukee corridor. One of the ITS Priority Corridor projects as defined by ISTEA to receive funding for applying ITS to assist in reducing extreme or severe ozone. The initial GCM priority is real-time data acquisition and sharing of information across the corridor that is useful to both multi-modal system operators and travelers.

GIS	Geographic Information System. Computerized data management system designed to capture, store, retrieve,analyze, and report on geographic/demographic information.
GPRA	Government Performance and Results Act.
GPS	Global Positioning System. A method of determining the position of vehicles using communications with a satellite. Government-owned system of 24 Earth-orbiting satellites which transmit data to ground-based receivers. Provides extremely accurate latitude/longitude ground position.
HRI	Highway-Rail Intersection. User service that integrates ITS technology into already existing HRI warning systems to enhance their safety effectiveness and operational efficiency. At railroad grade crossings,HRI technologies located both in-vehicle and along the roadside ensure that train movements are coordinated with traffic signals and that drivers are alerted to approaching trains.
Human Factors	Research done to understand the impact of automated technology on human decision making and driving behavior. For instance, studies are being done to investigate whether the use of cellular phones while driving distracts drivers to the extent that more accidents occur with their use.
ICC	Intelligent Cruise Control. A crash avoidance technology that automatically adjusts vehicle cruise speed to maintain safe following distances.
IMS	Incident Management Systems. Monitoring and surveillance system that identifies incidents in real-time so that they can quickly be removed.
Intermodalism	Seamless integration of multiple travel modes.
Interoperability	The ability to integrate the operation of diverse networks and systems. The vision of the intelligent transportation infrastructure is a seamless interoperable network from coast-to-coast that allows drivers and information to flow through the system without barriers.
In-vehicle Navigation	Technology that allows drivers to access route guidance information while en-route. Includes location referencing technology, in-vehicle display units,map information, and audio/text delivery technology.
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991. Federal law providing primary Federal funding for highway and other surface transportation programs in the United States through 1997. ISTEA contains the Intelligent Vehicle-Highway System Act. Directs the establishment of a National ITS program that is to include: a strategic plan for ITS in the United States,implementation and evaluation of ITS technologies, development of standards protocols,an information clearinghouse, the use of advisory committees (one of which is ITS America), and funding for ITS research, development, and testing in such efforts as the corridors program.
ITS	Intelligent Transportation System(s). The application of advanced technologies to improve the efficiency and safety of transportation systems.
ITS America	Intelligent Transportation Society of America. A nonprofit, public/private scientific and educational corporation that works to advance a national program for safer, more economical, more energy efficient, and environmentally sound highway travel in the United States. Federal advisory committee used by U.S. Department of Transportation.

IVHS	Intelligent Vehicle-Highway Systems. Now known as intelligent transportation systems.
IVI	Intelligent Vehicle Initiative.
JPO	Joint Program Office for ITS.
Kiosk	An information center for traffic or travel data located in shopping malls,parking decks, hotels, airports, businesses, transit terminals, etc. usually with interactive computer capability.
LAN	Local Area Network. A method of connecting several computers together using either high or low bandwidth communication media.
Location Referencing	Technology that identifies locations of vehicles, incidents, and travelers. Used with GPS, AVL technologies. Supports user services such as Mayday, EMS,CVO, ATMS, ATIS, and AVCSS.
Mainstreaming	The act of bringing ITS technology into everyday use by travelers and transportation professionals.
Mayday	An ITS program designed to link travelers in trouble with transportation officials in real-time. Uses location-referencing technologies and communications systems.
MDI	Model Deployment Initiative.A program designed to develop model sites demonstrating integrated intelligent transportation infrastructure and successful jurisdictional and organizational working relationships. The program is also designed to demonstrate the benefits of integrated transportation management systems that feature strong regional, multimodal traveler information services.
MPO	Metropolitan Planning Organization. Regional policy body, designated by local officials and the governor of the State, that is responsible in cooperation with the State and other transportation providers for carrying out the metropolitan transportation planning requirements of Federal highway and transit legislation.
NAHSC	National Automated Highway Systems Consortium.
NHTSA	National Highway Traffic Safety Administration.
NTCIP	National Transportation Communications for ITS Protocol. Required for traffic management operations. Allows for wireline communications between traffic management centers and field equipment.
OCD	Operation Concept Development.
Operation Timesaver	Federal initiative aimed at reducing congestion by building an intelligent transportation infrastructure in 75 of the Nation's largest metropolitan areas within 10 years. The goal is to reduce travel times by 15 percent by the year 2005.
PCB	Professional Capacity Building program.
Priority Corridor	One of the first ITS programs established by ISTEA. Originally designed to showcase technology and hardware, it has created communication channels and organization frameworks among the numerous agencies that must coordinate to successfully implement ITS.
Protocol	"Envelopes" used to package data for interoperable flow of ITS information. Protocols can include information on addressing, security, priority, and other handling information.

Public-Private Partnerships	Agreements with private-sector companies to participate in the deployment of ITS through commitment of time, services, products, or capital investment. These partnerships are the foundation of the ITS strategic plan's financial strategy for ITS deployment.
R&D	Research and Development.
RF	Radio Frequency.
RFP	Request for Proposals.
RSPA	Research and Special Programs Administration.
RT-TRACS	Real-Time Traffic-Adaptive Control System. Next-generation traffic signal control management system. An advanced dynamic control strategy that uses state-of-the-art traffic signal control based on real-time demand.
SAFER	The Safety and Fitness Electronic Records System.
SAVME	System for Assessing the Vehicle Motion Environment. A roadside measurement system to quantify the movement of vehicles in real traffic.
SDO	Standards Development Organization.
Standard	Specifications that are established to address the need for various technologies, products, and components from different vendors to work together.
TMC	Traffic management center.
TMDD	Traffic Management Data Dictionary. A source of standardized information that defines how data is exchanged and how it flows between ITS devices and systems. The TMDD standardizes message sets for national interoperability.
TRB	Transportation Research Board. Part of the National Academy of Science, National Research Council. Serves to stimulate, correlate, and make known the findings of transportation research.
TSCS	Traffic Signal Control Systems. Advanced systems that adjust the amount of green time for each street and coordinate operation between each signal to maximize traffic flow and minimize delay based on real-time changes in demand.
UDOT	Utah Department of Transportation.
User Services	Services available to users of an ITS-equipped roadway, as set forth by ITS America. The 30 services are arranged in seven categories as follows: 1) Travel and Transportation Management 2) Travel Demand Management 3) Public Transportation Operations 4) Electronic Payment 5) Commercial Vehicle Operations 6) Emergency Management 7) Advanced Vehicle Control and Safety Systems
WAN	Wide Area Network.
WWW	World Wide Web.

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