

CRS Report for Congress

Intelligent Transportation Systems Program: Importance, Status, and Options for Reauthorization

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June 27, 1997



Congressional Research Service • The Library of Congress



INTELLIGENT TRANSPORTATION SYSTEMS PROGRAM: IMPORTANCE, STATUS, AND OPTIONS FOR REAUTHORIZATION

SUMMARY

Intelligent Transportation Systems (ITS) are computer networks, communications systems, and related advanced technologies that work together to improve surface transportation infrastructure and safety. More than 200 companies, many state and local governments, and the U.S. Department of Transportation (DOT) have participated in over 240 ITS projects. These activities are collectively referred to as the National ITS Program. This initiative is providing the technologies, institutional framework, and experience needed to make the nation's surface infrastructure easier to use and more efficient. Evaluations of many projects indicate that ITS locations reduce traffic congestion, improve transit services, decrease the number of traffic crashes, or reduce emissions and fuel use. Despite more than 5 years of effort, however, many institutional and financial challenges continue to constrain the widespread deployment of current ITS. Other more advanced ITS require 10-15 years of work to overcome technical problems as well as other challenges.

The legislative basis for this program is Title VI(B) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). This Act and annual appropriation laws have provided more than \$1.27 billion between fiscal years 1991 and 1997 for this initiative. Federal funds have been used to support: more than 75 ITS research and development projects; 83 operational tests; 90 early deployment projects, and 11 model deployment projects now underway. Despite these investments, which have leveraged state and often private monies, only modest progress towards achieving the ITS-related goals of ISTEA, such as widespread implementation of ITS and reduced costs of traffic congestion, has been made.

Hundreds of millions of additional federal dollars and tens of billions of additional state, local, and private monies will be needed if the nation's highways, vehicles, and transit systems are going to be equipped with ITS on a widespread basis during the next five to ten years. The federal investment serves as the catalyst to: leverage extensive use of highway trust fund monies for ITS projects, develop necessary standards to ensure ITS interoperability, provide data on costs and benefits of ITS deployment used in planning future transportation projects, and promote deployment that considers regional factors and integration. But even with a sustained federal investment, progress towards deployment will continue to be gradual and often difficult. The need to fund the traditional operating and maintenance costs of the existing highway infrastructure will substantially reduce the total amount of funds available for ITS.

If direct federal investment were terminated, states and industry would continue only portions of the National ITS Program. With continued federal investments, the time required to deploy ITS widely and to make substantial progress towards ISTEA goals for ITS would be expedited. The federal share to sustain a vigorous ITS program could easily total \$250 million each year, in addition to the \$1 billion or so that states now invest. This report considers 13 different options regarding the possible future federal role in the ITS program.

ACRONYMS USED

AHS	Automated Highway Systems
AVC	Advanced Vehicle Control Systems
APTS	Advanced Public Transportation Systems
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
DOT	Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ICC	Intelligent Cruise Control
IT1	Intelligent Transportation Infrastructure
ITS	Intelligent Transportation Systems
IVHS	Intelligent Vehicle Highway Systems
JPO	Joint Programs Office
LGOE	Limitation on General Operating Expenses
MCSAP	Motor Carrier Safety Assistance Program
MPO	Metropolitan Planning Organizations
NEXTEA	National Economic Crossroads Transportation Efficiency Act
NHTSA	National Highway Traffic Safety Administration
R&D	Research and Development
SDO	Standards Developing Organizations
USC	United States Code

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INTELLIGENT TRANSPORTATION SYSTEMS PROGRAM: IMPORTANCE, STATUS, AND OPTIONS FOR REAUTHORIZATION

INTRODUCTION

Intelligent Transportation Systems (ITS) are groups of technologies that use sensors, computers, and related information/communications systems to improve the management and control of roadways, vehicles, and driving capabilities.

ITS are in different stages of development and use. For example, some ITS, such as traffic management systems (using video cameras and sensors in the road to feed information to a traffic management center), are deployed in numerous metropolitan areas. These ITS supply information on congestion and crash locations and facilitate informed choices on travel modes and time efficient routes. To a large extent, these technologies work well with few technical problems, provided that the systems are well maintained. Other ITS, e.g., automated highways which would take control of some or all driver functions, would likely require 10 to 15 years or more to be deployed commercially and face major institutional and technical challenges.'

ITS is now primarily an approach to traffic management that uses communication and information technologies designed to improve the operating efficiency of roads and their users. One strategy that is used adjusts traffic control signal timing to traffic conditions, thus allowing for longer signals to maximize traffic flow. Another strategy is to inform motorists of congested traffic conditions, thus offering information that is hopefully accurate and timely to improve routing and travel plans away from congested routes. Such approaches may seek to increase the number of vehicles driving by a specific location per unit of time. ITS may also one day significantly improve traffic safety by using technologies designed to improve the capabilities of drivers, e.g., by providing information needed to reduce human error, e.g., advanced warning of possible crash situations.

More than 200 companies, many state governments and metropolitan areas, universities, and the US. Department of Transportation (DOT) have participated in over 240 projects and partnerships to advance and deploy ITS.' These activities can

¹U.S. DOT. The National ITS Program: Where We've Been and Where We're Going. 1997. 13 p; and personal communication with FHWA officials, 1997.

²For the last few years, DOT has prepared each January a compendium of these projects. For example, see: U.S. DOT. Intelligent Transportation Systems (ITS) Projects Book. Jan. 1997. 397 p.

collectively be referred to as the National ITS Program. This program was initiated during the early 1990's, and began as a research, development, and testing program with some deployment activities. As the program evolved, the DOT participated in partnerships with state and local governments and the private sector to advance the state of technology, share experiences gained, and to test ITS. The results of these projects helped the National ITS Program to evolve into a more comprehensive effort, including research, development, but with more focus on deployment activities. As discussed later in this report, this initiative is gradually providing the technologies, institutional framework, and experience needed to convert the nation's surface transportation infrastructure into an "intelligent" system and to convert future cars, trucks, and buses into safer and more "intelligent" vehicles.

This report provides an overview of the National ITS Program and analyzes a broad array of options regarding the future federal role in this initiative. First, a brief introduction to the major categories of ITS technologies and a discussion of the status of the program are presented. Then, DOT's role in this public/private partnership is analyzed, as are the scope of federal activities, funding levels, and the process the Department uses to promote the innovation of ITS. Some of the challenges associated with this program are then listed. The question of whether the Department has accomplished its objective in the National ITS Program as set forth in federal law is also addressed. Finally, this report analyzes 13 different options regarding DOT's future involvement in the National ITS Program. Some of these options are now being considered as the Administration's proposed National Economic Crossroads Transportation Efficiency Act of 1997 (NEXTEA) is debated. NEXTEA seeks to reauthorize the federal surface transportation programs and polices, including the National ITS Program.

This report is primarily based on an extensive review of the literature; attendance at numerous meetings held by the ITS Joint Program Office of the U.S. Department of Transportation and the Federal Highway Administration, and various subcommittees of ITS AMERICA dealing with ITS; as well as visits to ITS facilities in Maryland, Virginia, and California.

KEY ITS TECHNOLOGIES AND SELECTED COST-BENEFIT ANALYSES

The key ITS technologies can be grouped into several broad categories according to intended functions: Advanced Traveler Information Systems (ATIS) help travelers by providing real-time routing, scheduling and congestion information relevant to transportation systems; Advanced Traffic Management Systems (ATMS) help highway departments manage surface transportation systems through surveillance, signal coordination, ramp metering, and incident response; Advanced Public Transportation Systems (APTS) improve the scheduling and transfers as well as on-time performance of transit systems and provide improved schedule information to users; Commercial Vehicle Operations (CVO) help safety inspectors and economic regulators efficiently conduct their responsibilities pertaining to commercial buses and trucks; Advanced Vehicle Control Systems (AVCS) seek to improve driver information and functions or facilitate emergency response of drivers; and Automated Highway Systems (AHS) intend to increase the operating efficiency or

throughput of highways by automating cars, allowing them to be driven in closely spaced platoons under roadway controlled and safe conditions).'

ITS technologies also can be grouped according to types of user services. For example, in-vehicle navigational systems, information kiosks, traffic management centers, surveillance cameras, incident management systems, radio/telephone traffic advisories, and traffic condition displays constitute a group of related technologies that when coupled together provide useful traveler information. There are many different ways that ITS can be bundled together into various user services. Examples are presented in table 1.

³A presentation on actual uses of and benefits derived from ITS is found in: Public Technology, Inc. *Traveling with Success: How Local Governments Use Intelligent Transportation Systems*, Washington, D.C., 1995. 55 p.

Table 1. User Service Bundles

1. Travel and Transportation Management	A.Enroute Driver Information B.Route Guidance C.Traveler Services Information D.Traffic Control E-Incident Management F.Emissions Testing and Mitigation
2. Travel Demand Management	A.Pre-trip Travel Information B.Ride Matching and Reservations C.Demand Management and Operations
3. Public Transportation Operations	A.Public Transportation Management B.Enroute Transit Information C.Personalized Public Transit D.Public Travel Security
4. Electronic Payment	A.Electronic Payment Services
5. Commercial Vehicle Operations	A.Commercial Vehicle Electronic Clearance B.Automated Roadside Safety Inspections C.Onboard Safety Monitoring D.Commercial Vehicle Administrative Processes E.Hazardous Material Incident Response F.Commercial Fleet Management
6. Emergency Management	A.Emergency Notifications and Personal Security B.Emergency Vehicle Management
7. Advanced Vehicle Control and Safety Systems	A.Longitudinal Collision Avoidance B.Lateral Collision Avoidance C.Intersection Collision Avoidance D.Vision Enhancement for Crash Avoidance E Safety Readiness F.Pre-Crash Restraint Deployment G.Automated Highway Systems

Source: U.S. Dept. of Transportation and ITS AMERICA. Draft National Program Plan for ITS. November 1994.

Most of the systems listed in table 1 (primarily bundles 1-6) are deployed on a limited scale in various states and are beginning to demonstrate many positive or cost-beneficial impacts. Selected examples and locations where ITS are now installed are presented below and in Appendix I.

1. Travel and Transportation Management - Many studies supported by DOT or state governments indicate that ITS projects aimed at improving travel and highway management have exhibited a favorable cost-benefit ratio. DOT cites, for example, the Maryland CHART program, an advanced traffic management system consisting of automated surveillance with lane sensors and video cameras,

which is estimated to show a benefit/cost ratio of 5.6 to 1, based on a 5% reduction in travel time. An evaluation of a computerized signal system installed in Abilene, Texas, indicates -an overall decrease in travel time of 14% a decrease in delay of 37%, and an increase in travel speed of 22%. The results of an operational test using in-vehicle navigational devices in the Orlando, Florida area indicate that travel time decreased by 20% relative to using paper maps and that travel planning time decreased by 80%. In Minneapolis, Minnesota, ramp metering (which limits the number of vehicles that can enter the highway at a particular time and location) has increased freeway speeds by 35%, freeway capacity by 22% and reduced accidents by 25%. On some of Seattle's interstate highways, advanced freeway management systems have reportedly reduced crash rates by more then 38% over a 6-year period despite an increase in traffic.⁴

2. Public Transportation Operations - The Kansas City Area Transportation Authority estimates that automatic vehicle location systems (which often use satellite systems to pinpoint with a fair degree of accuracy the location of a vehicle) have precluded the need for spending \$1.5 million on new buses and reduced operating costs. DOT predicts that ITS deployments in the transit area nationwide will yield a cost savings over the next decade of \$3.8-\$7.4 billion.⁵
3. Electronic Payment/Automated Toll Collection - The Tappan Zee Bridge in New York has five electronic lanes and a moveable barrier procedure that have replaced eight toll booths, causing traffic speed to increase from a crawl to 25 mph. These electronic lanes are equipped to read information contained on transponders carried on vehicles. The information read reveals the account balances of the toll patrons who have prepaid fees. DOT reports data from the Tappan Zee bridge toll plaza demonstrating that the operating efficiency of an electronic toll collection lane can exceed that of a conventional lane by 250 to 285%. Data from the Oklahoma Turnpike's Electronic automated toll collection system indicate a reduction in operating costs of 91% per toll lane as compared to an attended lane.⁶
4. Commercial Vehicle Operations (CVO) - Private companies using computing and communications technology for their truck fleets are realizing productivity gains, e.g., increasing the number of pickups

⁴U.S. Moves Towards a National ITS. ITS International Issue. No. 4, Mar. 1996, p. 33; FHWA responses to FY 1998 budget justification questions submitted by the House Appropriations Committee, 1997; and briefing materials prepared by U.S. DOT Joint Program Office, 1997.

⁵*Ibid.*

⁶*Ibid.*

and deliveries per truck per day.' Cost savings have also been predicted for states using CVO at weigh stations. Furthermore, the ATA Foundation, Inc. has completed an assessment of the costs and benefits of ITS/CVO user services. Although many CVO activities are not currently operational, the Foundation found that ITS holds promise for improving the efficiency of regulatory and enforcement agencies. The Foundation calculated the range of benefit/cost ratios for electronic clearances for those carriers that pay their drivers based on time worked to be from 2:1 to 7:1, depending on the size of the carrier.'

Although many of the cost-benefit studies completed to date are based on ITS projects that have operated for less than 10 years, these studies generally indicate substantial positive benefits over costs for installation of ITS. Benefits are often attributable to improved safety and reduced congestion. Estimates are often made of the benefits of avoided crashes and congestion delays. Costs may include capital construction costs of ITS and other factors. Costs and benefits analyses may vary from study to study. A few of the studies reported in the literature do show some potential negative impacts, such as diverting travel to lower quality secondary roads off of the higher quality interstates, and some studies do show increases in speeds but often with fewer crashes, reportedly as a result of the installation of ITS.

The following list provides an indication of the number of U.S. locations now operating each of the indicated types of ITS:

Freeway Management Centers: 41

Advanced Public Transit Systems: 39

Centralized Traffic Signal Control Systems: 57

Incident Management Programs: 39

Electronic Toll Collection Systems: 28

Electronic Fare Collection Systems: 18⁹

Other examples of ITS deployment are presented in Appendix I and II. The number of ITS facilities will increase steadily during the next few years because

⁷ibid.

⁸The ATA Foundation, Inc. ITS/CVO User Services Benefit/Cost Analysis-Final Report. Alexandria, Va., 1996.

⁹FHWA response to questions posed by the Senate Appropriations Committee on the FY 1997 budget request, 1996.

states are now using roughly \$1 billion or more of their apportioned Federal Highway Trust Fund monies each year to deploy various ITS.¹⁰

Many other ITS technologies are just emerging from the laboratory or completing prototype or initial tests and are not likely to be commercialized in the immediate future. For example, several companies and universities are testing a variety of Advanced Vehicle Control Systems (AVCS), such as first generation Intelligent Cruise Control (ICC) systems which seek to maintain the headway or distance between vehicles by either increasing or decreasing speeds. It appears that some AVCS may not be introduced into the U.S. marketplace for several years, but will be first tested in Europe and Japan.”

The ITS program primarily involves highway and transit operations. Intermodal transfer activities-efforts to improve the linking of highway operations to transit, rail, maritime or aviation centers-are evolving, but considerably more intermodal links facilitated by ITS could be pursued.

NATIONAL ITS PROGRAM AND ITS PURPOSES

The federal government has invested over \$1.270 billion in the National ITS Program. One of the original driving forces that stimulated this investment was frustration over the increase in traffic congestion. DOT estimates that traffic has increased 30% during the past 10 years and that the number of cars will increase 50% during the next decade.¹² Americans now lose an estimated two billion hours each year in gridlock.¹³ Various studies estimate the cost of congestion at over \$50 billion per year.

As indicated by the examples presented in the previous section, deployment of ITS is a strategy to address congestion problems, to increase the efficiency of existing surface transportation infrastructure, and to provide transportation planners and managers with alternatives to new highway construction. The National ITS Program is implemented primarily at the state and local levels where congestion occurs and where safety problems must be addressed. The “national” focus is one of funding, coordination, planning, and overall program management.

The ITS construction and operational activities which are intended to improve the efficiency of the nation’s highway system are especially timely because personal and freight transport demands are at an all time high, while the ability of our

¹⁰Personal communication with FHWA, 1997.

¹¹At least one company is offering ICC in Japan today.

¹²FHWA. Joint Program Office (JPO). ITS At a Glance. Apr. 1996, p. 2.

¹³Secretary of Transportation remarks before the Transportation Research Board. January 10, 1996.

highway systems to handle these demands is declining.¹⁴ Many state and local governments, even when supplemented with monies from the Federal Highway Trust Fund, do not have sufficient funds to build enough new infrastructure to accommodate traffic demands nor to maintain existing bridges and roads at acceptable performance levels.

By testing and deploying technologies which increase the operational efficiency of the existing surface transportation infrastructure, the National ITS Program seeks to demonstrate cost-effective alternatives to building new highway capacity, especially in urban areas. The DOT estimates that in order to achieve a desired increase in highway throughput capacity by 30% in the largest 50 metropolitan areas during the next 10 years, deployment of ITS must occur in conjunction with adding highway lanes. DOT estimates that by deploying ITS along with additional highway lanes, a cost savings of 35% would be achieved.¹⁵

There are other reasons why the federal government partners with state and local governments and the private sector to advance ITS. Increasing the efficiency of the surface transportation systems through ITS contributes to the nation's economic productivity. Real-time travel and congestion data provided by ITS facilitate route planning and promote "just in time" deliveries and reduce time wasted in traffic. Commercial companies that have invested in various ITS technologies report substantial benefits, especially in urban areas.¹⁶

The National ITS Program is stimulating new markets for U.S. industries, and the potential for future growth is large. A recent study sponsored by the DOT forecasted that the ITS market could generate \$420 billion of sales over the next 10 years.¹⁷ Companies in the United States that are producing ITS products and services are competing internationally for new ITS markets. Products of U.S. subsidiaries of foreign-based corporations in Germany and Japan, for example, compete or will soon compete for a share of the U.S. ITS market. Federal financial participation in the National ITS program helps some components of the emerging U.S. ITS industry by creating more market demand for ITS products.

¹⁴U.S. Department of Transportation. 1995. Status of the Nation's Surface Transportation System: Condition and Performance.

¹⁵JP0. Research note entitled "Estimate of Savings Through Intelligent Transportation Infrastructure (ITS)". In this analysis, ITS is found to contribute 20 percent of the needed 30 percent increase in effective capacity. This cost comparison is for unit of effective highway capacity, i.e., the same number of vehicles per unit of time.

¹⁶Documentation of selected benefits and advances from the ITS program are elaborated on in: U.S. DOT. FHWA. Key Findings from the Intelligent Transportation Systems (ITS) Program. Sept. 1996. 35 p. and U.S. DOT. FHWA. Review of ITS Benefits: Emerging Successes. Sept. 1996. 40 p.

¹⁷Apogee Research, Inc. National ITS Investment and Market Analysis. 1997.

KEY CHALLENGES AND CONSTRAINTS TO NATIONWIDE DEPLOYMENT OF ITS

The challenges and constraints encountered in accelerating the deployment of ITS nationwide are substantial. Even with a well funded federal ITS program supporting state and local governmental and industry efforts, combined legal, financial, institutional, infrastructure, and technical challenges necessitate a gradual ITS deployment schedule, at least for the next five or so years. A recent DOT study concluded that institutional issues, not technical obstacles, are the main barriers to implementing ITS.” More than five years of experience in the National ITS Program shows cooperative and successful federal, state, and private sector partnerships are likely to help overcome these constraints in most cases. There have been some ITS projects, (primarily operational tests), that required cost adjustments among partners, that were delayed because of renegotiations of agreements among partners, or that needed to be reconfigured from their original proposals.¹⁹

During the next five or so years, federal and state governments, industry, Metropolitan Planning Organizations (MPOs), universities, and national laboratories will continue to address many of the challenges and constraints to ITS deployment. These include:

Systems Architecture. The DOT has completed and issued the first edition of the National Systems Architecture, which provides the framework or guidelines used in designing and integrating the various components of ITS.²⁰ The challenge now is to ensure the acceptance of the architecture by the diverse segments of the transportation community and to update and revise the architecture as needed. The DOT plans to continue pursuing these objectives during the next few years. About \$5 million was spent during FY1996 on systems architecture work, and about \$5.4 million is allocated for FY1997 and \$2.8 million is planned for FY1998.²¹

Standards. Standards can facilitate innovation and promote interoperability among ITS. Some of the interfaces where standards are needed include transmission of information between the highway and vehicles as well as between different traffic management or emergency centers. The total number of new or modified standards necessary to ensure interoperability has not yet been determined, but substantial and considerable work will be required to reach agreement on these.” Standards developing organizations (SDOs) are gradually issuing the standards needed to achieve interoperability.

¹⁸US DOT. FHWA. Key Findings from the Intelligent Transportation Systems (ITS) Program. p. iv.

¹⁹FHWA responses to questions posed by the House Appropriations Committee, 1997.

²⁰U.S. DOT. FHWA. ITS Architecture: Executive Summary. Jan. 1997. 22 p.

²¹Personal communication with FHWA, 1996.

²²ibid.

The DOT has signed cooperative agreements with five organizations to promote and accelerate the standards-setting process. The DOT expects the entire standards process to cost roughly \$43 million between FY1996 and FY2000. The Department spent about \$5 million on standards work during FY1996.²³ A substantial amount of work towards developing standards remains, and must be completed if successful interoperability of ITS across the United States is to be achieved.

Testing and Evaluation. The several billions of federal, state, and private sector dollars invested in various ITS projects, have paid for some 83 different ITS operational tests, four priority corridors, and the "ITS Showcase" in Atlanta.²⁴ These have contributed to a strong technical foundation and diverse institutional experience upon which to base future ITS deployments. As the National ITS Program proceeds during the next few years, the technical and institutional advances resulting from these projects will continue to be analyzed and incorporated into new projects. In addition, laboratory research conducted during the last few years has yielded several promising ITS technologies that will need to be tested in the field to continue technological progress.

Non-Technical Constraints. Partnership arrangements and other institutional matters, questions of public acceptance, and financing and procurement factors will likely continue to constrain the operational testing and deployment of ITS. Substantial lead times are required to establish the partnerships that form the basis of ITS project implementation. Assignment of the associated risks, responsibilities, and rewards can be difficult. The deployment of ITS typically requires an increase in cooperation among diverse institutions, e.g., state highway departments may need to cooperate with local fire and police services to provide priority handling for emergency vehicles. Cooperation among various jurisdictions, other agencies and the public/private interests greatly facilitates deployment of ITS. Institutional problems and long lead times remain, but no problem has been identified which is insurmountable, in fact, challenges are generally location specific.²⁵

States and MPOs face difficult financial choices in deciding whether to invest the hundreds of millions of dollars that are required to deploy ITS in specific areas. Competition for limited transportation dollars is intense given alternative uses of these monies, e.g., to repair aged infrastructure, to replace older transit vehicles, to build new transportation infrastructure such as bicycle and walking paths for sustainable communities, and to pay for numerous transportation safety programs

²³ibid, and review of FHWA responses to questions posed by House Appropriations Committee, 1997.

²⁴The priority corridors were areas or regions that received designated funds in ISTEA to advance ITS project development and deployment. The 1996 Olympics in Atlanta and the surrounding regions were used as a "showcase" to display the deployment and integration of ITS.

²⁵For additional information on ITS challenges and constraints see U.S. Library of Congress, Congressional Research Service. Intelligent Vehicle Highway Systems (IVHS): Challenges, Constraints, and Federal Programs. Report No. 92-189 SPR, by Paul Rothberg, Feb. 18, 1992. Washington, 1992.

(such as the Motor Carrier Safety Assistance Program, the State and Community Traffic Safety Program, the Hazard Elimination Program, and the Highway/Rail Grade Crossing Program). Each of these activities is supported with funds from the Federal Highway Trust Fund and from other state highway monies. The demand for these monies to meet conventional transportation needs, not to say anything about ITS needs, substantially exceeds the availability of funds.

DOT AGENCIES INVOLVED IN ITS AND THEIR ACTIVITIES TO PROMOTE THE INNOVATION OF ITS

The DOT serves as a major funding source and stimulus for the National ITS Program. (Funding amounts for specific program activities are presented in table 2 on page CRS-15.) The Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), the Federal Transit Administration (FTA), and the ITS Joint Program Office (which coordinates and leads the overall federal effort) are the primary DOT participants.²⁶ These entities, working with the highway and transit communities, elected officials, academics, major corporations, and small businesses are seeking to advance the state of ITS technologies and are working to accelerate the deployment of ITS.

The DOT is financing a wide diversity of ITS activities, including research and development, operational testing, and deployment related or large scale implementation initiatives. As part of the National ITS Program, federal funds have been used to support more than 75 research and development projects that seek to advance new technologies and develop basic tools and knowledge bases. Additionally, beyond the R&D, there have been more than 83 operational tests of new combinations of technologies and institutional arrangements conducted in a real world environment, as well as more than 90 early deployment projects that help state and local officials plan for future ITS projects.²⁷ DOT also supports training, standards development, and systems architecture work. The Department also is working with the private sector to advance numerous safety technologies that will be integrated into "intelligent vehicles."²⁸

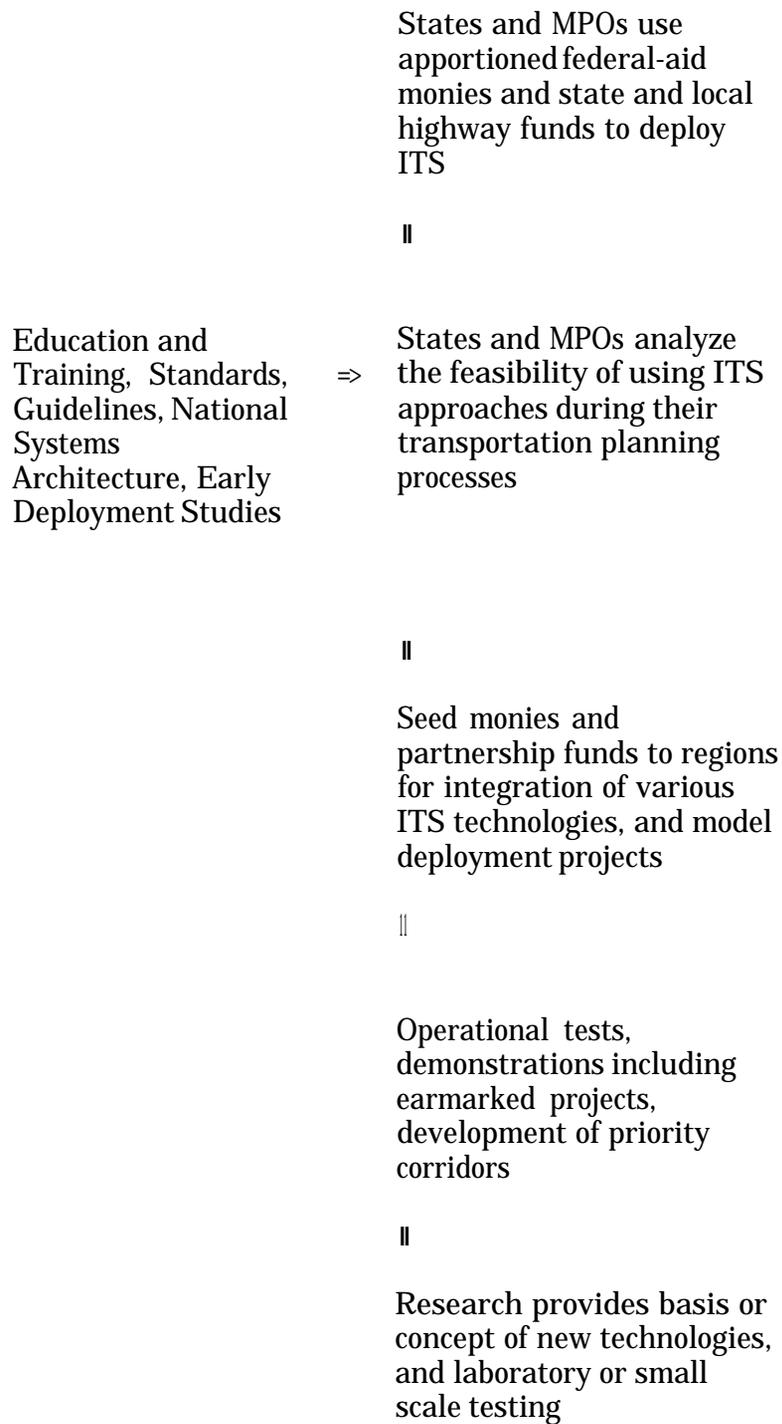
Figure 1 below presents a conceptual diagram of the ITS innovation process that illustrates the key strategies which DOT is using to promote the innovation of ITS.

²⁶The Federal Railroad Administration, Maritime Administration, the Research and Special Programs Administration, and the Office of Intermodalism are also involved, but to a lesser extent.

²⁷U.S. Dept. of Transportation. Intelligent Transportation Systems (ITS) Projects. Jan. 1995, and U.S. Dept. of Transportation. Intelligent Transportation Systems (ITS) Projects Book. Jan. 1997.

²⁸An intelligent vehicle might be equipped with intelligent cruise control, internal crash warning systems, radar systems for backing control, and night-time vision systems, in addition to various navigational and advanced diagnostic systems.

FIGURE 1. THE PATHWAY FOR ITS INNOVATION



As shown in figure 1, one of the primary goals of DOT's involvement in the ITS innovation process is to convince state, local, and regional governmental entities to use their own funds to deploy ITS. The DOT does not have enough money to underwrite this deployment. State and local governments invest more in highway infrastructure each year than does the federal government. Also, by investing in ITS deployment projects, DOT helps states link information systems that pertain to commercial vehicle operations; document the benefits and costs of integrated ITS technologies working synergistically in metropolitan areas; and stimulate investment in large scale or deployment projects that approach ITS from a regional point of view.²⁹ Because of the importance of deployment to the current debate on reauthorization of the federal surface transportation programs and policies (including investment in ITS), this activity is discussed further in the next section.

DEPLOYMENT AND INTEGRATION OF ITS

The DOT is promoting the deployment of integrated ITS projects through an initiative called "Operation Timesaver". As part of this effort, the Department has set a national goal to reduce by 15% the travel time for nearly half of all Americans. The DOT hopes to achieve this goal primarily by encouraging state and local governments to deploy integrated ITS technologies in 75 of the largest metropolitan areas within the next 10 years. Several of these integrated technologies that DOT wants to have deployed into integrated systems include: "smart" traffic signal controls that sense traffic volume and adjust timing as needed, freeway management systems such as ramp metering, transit management systems that provide the location of buses, incident management programs that are able to respond rapidly to various congestion-causing problems, automated or electronic toll collection on roads and bridges, electronic transit and parking fee collection systems, "smart" railroad grade crossing systems that allow communications between the highway and the train, emergency response technologies that improve response times, and traveler information systems that provide up to date information."

To encourage state transportation departments and Metropolitan Planning Organizations (MPOs) to invest in integrated ITS, DOT is partnering with numerous government and industry entities in four model deployment projects in metropolitan areas. The DOT's initiative is funded at a total of \$50 million for FY1996 and FY1997 (see later section), and seeks to promote and foster local integration strategies and agreements, maximize private sector involvement, build on existing

²⁹When various ITS technologies are coupled or integrated into a system, synergistic benefits are likely to be realized. When a regional traffic management center links freeway, transit, and incident management systems together with traffic signalization systems, the quality and quantity of information and communications should be increased. A group of ITS technologies working in combination to provide information to travelers, highway operators, and transit managers is expected to be more cost-beneficial and effective than a number of technologies working independently. Ongoing tests of ITS are being conducted to provide quantitative evidence of the potential synergistic benefits of integration.

³⁰Secretary of Transportation. Remarks before Transportation Research Board. Jan. 1996. These technologies are collectively referred to as the Intelligent Transportation Infrastructure or the ITI.

ITS, and promote interoperability.” DOT requires that federal funds for these projects must at least be matched on a 50/50 basis. These initiatives, if successful, will allow transportation planners and officials to observe the performance of deployment projects and to obtain information on costs and benefits of integration. Also, if successful, these cutting edge projects could convince other MPOs and states to use their own highway funds or their apportioned federal aid funds to construct similar projects.

The Department’s goal for “Operation Timesaver” is rather ambitious given the current state of deployment and integration of ITS and expected increases in traffic congestion. Many regional areas that have invested in ITS are still building the basic infrastructure for ITS. Few metropolitan areas have yet to integrate their various ITS components. It is questionable whether successful operation of four model deployment projects would be sufficient to convince each of the 75 largest metropolitan areas to deploy integrated regional ITS projects using their federal aid apportionment and other highway funds. Some state DOTs are rather conservative organizations that prefer not to take risks and may not want to spend dollars for regional ITS objectives or to integrate diverse ITS projects. To further catalyze such investments, DOT, as part of its reauthorization proposal, is requesting additional incentive funds for integration of ITS projects. (See last section of this report.) Also, to further catalyze investment in ITS that pertains to commercial vehicle operations and international border crossing improvement, the reauthorization proposal sets aside \$25 million per year. To lay the foundation for this effort, the FHWA is helping to finance Commercial Vehicle Operations (CVO) deployment projects and several operational tests at the US. border. There are also seven CVO model deployment projects which are partially financed with DOT monies.

AMOUNT OF FEDERAL FUNDS BEING SPENT ON ITS

Funding for DOT’s role in the National ITS Program is primarily derived from two sources: contract funds authorized under Title VI(B) of the ISTEA of 1991 and funds appropriated to the Secretary of Transportation in DOT’s annual appropriation acts.

The ISTEA, as modified by subsequent legislation, authorizes a total of \$644.8 million contract funds out of the Federal Highway Trust Fund from FY1992 through FY1997 for the ITS Program. In addition to these monies which were allowed to be transferred out of the Trust Fund, subsequent appropriations acts have added roughly \$581.3 million for conducting this program from FY1991 through FY1997. Historical funding data of appropriations and past contract funds provided under the ISTEA are shown in table 2. Most of the appropriated funds were provided under the Limitation on General Operating Expenses (LGOE) “portion” of the FHWA appropriations account. Also as shown in table 2, a total of about \$45 million of additional appropriations went to the NHTSA (\$31.5 million), and to the FTA (\$13.5 million) during FY1991 through FY1995 for various ITS projects.³²

³¹Interoperability is the concept used to describe the ability of an ITS technology to be used anywhere in the country.

³²Dollar amounts were supplied by FHWA, 1996.

**Table 2. DOT Funding for the ITS Program
(\$millions)**

	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997
ISTEA FHWA	\$94	\$113	\$113	\$113	\$99	\$113
LGOE	\$140	\$30	\$90	\$74	\$105	\$120
NHTSA	\$8	\$7	\$8	\$7	\$0	\$0
FTA	\$4	\$3	\$3	\$3	\$0	\$0
TOTAL	\$246	\$153	\$214	\$197	\$204	\$233

Source: U.S. Dept. Of Transportation.

For FY1997, the annual appropriation under LGOE was roughly \$120.4 million. These funds were allocated as follows:

- research and development: \$29 million
- automated highway system: \$22 million
- architecture and standards: \$5 million
- operational tests: \$56 million
- program support: \$8 million

These monies are commingled by the DOT with the \$113 million of contract funds authorized under the ISTEA for FY1997. Together, these sums constitute essentially all of the funding used by the DOT to participate in the National ITS Program during FY1997.

Using both contract and appropriated monies, the DOT leverages substantial funds from the private sector and from the states. At a minimum, the Department obtains cost shared funds of 20% from non-federal sources, and often about 50%, of the total costs of the various operational tests. At least a 20% total match is obtained for activities pursued under the Automated Highway Systems Program. Model deployment activities are funded at least with a 50% non-federal contribution. Much of the applied research and early developmental work is funded with 100% federal monies, because risks are substantial and return on investment is highly uncertain.³³

Each year a substantial portion—typically between 40 and 60% — of the ISTEA contract funds are earmarked for special projects by the DOT and Related Agencies Appropriations Conference Committee. Of the \$1.270 billion of federal funds made available for ITS from all sources from FY1992 through FY1997, \$473.6 million or about 37% have been earmarked for specific ITS projects and studies in various appropriation acts, and \$4 million of these earmarked monies have not yet been

³³This analysis is based on a review of numerous cooperative agreements and ITS solicitations issued during the last five years.

unobligated.³⁴ Some of the earmarked projects would probably not have received DOT funding in the absence of congressional direction; other earmarked projects might have received DOT funding but perhaps not at the same amount specified by Congress.³⁵

The federal cost of participating in the National ITS Program is much less than state and local costs. In addition to participating in model deployments and operational tests with U.S. DOT, state and local governments also pay the majority of the cost of deployment, operations, and maintenance of other ITS projects, not originated by the U.S. DOT. Often, the states use apportioned monies from the Highway Trust Fund to pay for ITS projects. DOT does not have absolute control over the use of these monies because they are really state monies once they leave the trust fund. As previously stated, FHWA estimates that about \$1 billion of apportioned monies are used each year by the states on ITS projects.

PROGRESS MADE TOWARDS ACCOMPLISHING THE ITS GOALS STATED IN ISTEA

Title VI(B) of the ISTEA specifies that the federal component of the National ITS Program should contribute to a broad array of national goals. Arguably, the overarching goal of Title VI(B) was to promote the widespread implementation of ITS.³⁶ Other goals were to help the states improve air quality and highway safety and contribute to economic competitiveness.³⁷ To achieve these goals, Congress directed the U.S. DOT to conduct a comprehensive program of ITS research, development, operational testing, and priority corridor development.

As a result of the nearly \$1.3 billion investment made by the DOT, and billions of dollars invested by the private sector and state and local governments since enactment of ISTEA, there is substantial evidence (see below) that modest progress has been made towards achieving several of the goals set forth in ISTEA. The National ITS Program, which primarily started in 1992, has laid a solid foundation that could be used to continue progress towards achieving the goals articulated in the ISTEA. More progress has been made on some goals than on others. The following briefly assesses the progress made on each of the major ITS-related goals as articulated in the ISTEA.

³⁴As of March 1997.

³⁵Personal communication with DOT officials, 1995 and 1996. In order to meet other goals and objectives, the Department would have likely funded a wider array of projects.

³⁶One of the driving forces that led to this section of law was a desire shared by many Members to do more to reduce traffic congestion. ITS is a means to accomplish this objective.

³⁷See Title VI(B) of ISTEA.

GOAL in ISTEA	PROGRESS TO DATE
promote widespread implementation of ITS	beginning
reduce costs of traffic congestion	achieved in some localized areas
improve air quality	ITS benefits hard to measure, probably minimal in terms of national impact
increased safety	emerging, especially in CVO area, some local safety benefits in instrumented areas
establish ITS technology base	definitive advances, US presence in ITS is substantial, and evolving

Widespread implementation-Title VI(B) of the ISTEA states that a goal of the National ITS Program is widespread implementation of ITS to enhance the efficiency, capacity, and safety of the highway system. During the last few years, state and local governments have invested several billion dollars in various travel management and traveler information components of ITS, including: improved traffic signal controls, transit management and information systems, freeway surveillance systems, and traffic management centers.³⁸ As a result of this investment, many major metropolitan areas have installed parts of the basic ITS infrastructure in some portions of their highways or on transit systems. Despite these investments, only small segments of the nation's transit systems, highways, and arterials have been instrumented with ITS. Furthermore, much of the ITS that have been implemented are stand alone components and have not been integrated with other ITS components, especially on a regional basis. There are roughly between 6 to 12 metropolitan areas that have begun to integrate or combine regionally some form of transit, freeway, or traffic signal information with traveler information.³⁹

It is not surprising that only limited progress towards widespread implementation of ITS has been made during the course of ISTEA.⁴⁰ The major thrust of the program and funding has been towards research, development, operational testing, and pre-deployment activities. The funding that has been provided has helped develop the industrial, technical, and institutional frameworks

³⁸Precise data on the amount of this investment are unavailable. The amount specified is based on FHWA data and discussions with others.

³⁹Based on discussions with various FHWA and industry experts, 1997. The different definitions or degrees of the term "integration" explain why a range of metropolitan areas is cited.

⁴⁰Earmarking concentrated a substantial portion of the funds available in specific regions of the country.

needed for deployment to mature. Only during the last two or so years has the focus begun to shift towards deployment. Billions of additional dollars would need to be invested if the goal of widespread ITS implementation is to be reached, given the current state of deployment. New cost-benefit analyses are now underway to analyze the impacts of large-scale, regional ITS deployment projects. Independent evaluators working with the partners in the model deployment projects and under DOT's guidance are performing these studies.

Reduced costs of traffic congestion-According to ISTEA, the National ITS Program is to reduce the societal, economic, and environmental costs associated with traffic congestion. Documentation of specific time savings resulting from advanced traffic management systems, advanced public transit systems, and from commercial vehicle operations is reported in the literature.⁴¹ The program has contributed to improved traffic flow only in some areas of the country, e.g., along the I-95 corridor particularly in the New York/New Jersey areas, and in the ITS showpieces in Atlanta and Los Angeles. Hundreds of thousands of commuters have saved substantial time by using electronic payment transponders which have accelerated their passage through toll booths. Commuters also are benefitting because of ITS instrumentation along major traffic corridors such as those in Long Island, New York, and along various interstates in Maryland. Other areas of the country where substantial ITS infrastructure has been deployed include: Seattle, Washington; Chicago, Illinois; Detroit, Michigan; Houston and San Antonio, Texas; and Phoenix, Arizona.

Non-recurring incidents due to traffic crashes are a major cause of traffic congestion. More rapid identification of a congestion-causing problem typically expedites incident response, thus reducing the costs of congestion. Video surveillance cameras, improved radar and infrared detectors and loops, as well as traffic counters imbedded in highway systems, are all illustrative of ITS technologies that improve traffic monitoring and detection of incidents and provide accurate, real-time information on traffic conditions. In those areas of the country that have installed these or similar technologies, delays due to traffic congestion are generally reduced and the costs of traffic congestion also are reduced.⁴² But, many metropolitan areas of the country have not comprehensively instrumented their infrastructure and thus the potential beneficial impacts of ITS on traffic congestion remain largely unrealized.

Identifying sources of traffic congestion and facilitating incident response and routing alternatives will likely help to further reduce the costs of traffic congestion. Various ITS projects that are deployed as part of the National ITS Program are **slowly** beginning to improve the performance of portions of the nation's surface transportation infrastructure. Providing real-time information about travel routes and schedules helps travelers make more informed choices about transportation

⁴¹U.S. DOT. FHWA. Review of ITS Benefits: Emerging Successes. p. 5-11.

⁴²U.S. DOT. Intelligent Transportation Infrastructure Benefits: Expected and Experienced. Jan. 1996. 17 p. In the report, DOT summarizes the benefits of freeway management systems in terms of the decreases in travel time (20-48 percent) and accident rates (15-50 percent) and fuel used in congestion (41 percent). Similar types of results, but of a smaller magnitude, are reported for traffic signal systems.

alternatives, and may possibly encourage travelers to delay trips or use less congested modes. ITS projects that improve bus systems through the use of more flexible routing and time schedules are expected to promote increased use of mass transit, thus reducing congestion on existing surface transportation systems and the costs of traffic congestion. Illustrative ITS benefits for transit operations have been reported in the literature: The Maryland Mass Transit Administration claims a 23% improvement in on-time performance of its buses equipped with advanced vehicle location devices that specify where a vehicle is; reductions in emergency response time of up to 40% have been documented with the implementation of ITS which are intended to improve transit safety and security; and reductions in fleet requirements ranging from 2-5% are cited as a result of efficiencies in fleet utilization.⁴³

Improving air quality--ISTEA also sets the ITS program goal of enhancing, through more efficient use of the highway system, the efforts of the states to attain air quality goals established by the Clean Air Act.

There is evidence that the National ITS Program helps reduce congestion and improve traffic flow, resulting in decreases in emissions in localized areas. ITS provide real-time traffic information which identifies bottlenecks. By informing travelers of these choke points, traffic congestion, emissions, and fuel use can be reduced if different routes are chosen or if trips are delayed. Computer-based traffic signal systems seek to ensure that the signal green time is consistent with traffic and transit flow demands, resulting in fewer stops and a reduction in emissions.⁴⁴ There is also the countervailing factor that ITS could increase travel demand by making traveling easier, thus potentially adversely affecting air quality. This tradeoff has not been fully quantified or substantiated.

Although there is potential, the ITS program does not yet appear to have contributed much to achieving the goal of improving air quality, except perhaps, in a few localized areas. There are two facts that support this conclusion. First, few regions have been instrumented with ITS on a sufficiently large scale that would result in measurable benefits. Second, the impact on air quality resulting from deployment of ITS is difficult to measure. There are many variables, such as economic growth, increases in traffic volume, and changes in industrial base, that also affect air quality.

Increased safety--ISTEA also sets forth the ITS program goal of enhancing the safe operation of the nation's highway systems. There are several major ways that the deployment of ITS is beginning to promote or could result in safety benefits. These include: through crash avoidance technologies, improved traffic flow and mitigated (stop and go) traffic congestion, and electronic recognition and clearance of safe commercial vehicle operations thus allowing for increased targeting of unsafe ones.

⁴³U.S. DOT. Benefits Assessment of Advanced Public Transportation Systems. 1966. p. 8-9.

⁴⁴U.S. DOT. FHWA. Review of ITS Benefits: Emerging Successes. Sept. 1996. p. 32-34.

ITS crash avoidance technologies promise to reduce the number of traffic fatalities and the frequency of traffic crashes. NHTSA estimates that 1.1 million out of the 6.4 million crashes (or about 17%) that occur each year could be prevented annually if all vehicles were equipped with three types of ITS technologies: driver warning systems to reduce the frequency of rear-end crashes, roadway departure countermeasure systems, and lane change/merge crash avoidance systems.⁴⁵ Large scale market penetration of ITS crash avoidance technologies in the United States has not occurred, and it remains unclear when or if this will happen. NHTSA has entered into a variety of partnerships with industry sponsors to accelerate this process, but there remain many challenges such as costs, liability issues, and public acceptance. Thus, the potential to save lives and prevent injuries with crash avoidance technologies is substantial, but mostly theoretical at this time.

Improving the flow of traffic by reducing stop and go congestion reduces the frequency of traffic crashes. Although there are studies that document that ITS systems have improved traffic flow and have resulted in reduced crash frequency in specific corridors or projects, the impact of ITS on national crash statistics is difficult to ascertain.⁴⁶

Various CVO technologies are beginning to contribute to highway safety. Electronic clearance of safe carriers, vehicles, and drivers should allow more time for truck and bus inspectors to focus on higher risk operations. Inspectors working under the Motor Carrier Safety Assistance Program (which provides grants to the states to supplement their enforcement activities) at roughly 1,000 sites use CVO technologies to identify high risk carriers for roadside safety inspections. These technologies have helped inspectors identify critical safety violations with greater frequency than is achieved using conventional inspection means.⁴⁷

In terms of reducing the nation's traffic fatality rate or improving highway safety, the ITS program does not appear to have contributed much to date. But, the potential for major safety benefits may increase rapidly, depending on the success of these technologies and the extent of their deployment. Illustrative potential and realized ITS safety impacts are presented in Appendix III.

Development of ITS technology and domestic ITS industry.-Title VI(B) also sets the development of an ITS technology base and industry in the United States as a national goal. The investment of several billion dollars into ITS projects during the last five years has yielded much technological progress. The conceptualization, development or evaluation of new ITS technologies and the operational testing of such systems have been accelerated as a result of the federal investment. Real-time adaptive traffic control systems, the results of some 83 operational tests, the emerging conceptualization of the Automated Highway System, and the initial integration of various ITS technologies in several areas and showpiece

⁴⁵FHWA. JPO. ITS At a Glance. July 1996.4 p.

⁴⁶U.S. DOT. FHWA. Review of ITS Benefits: Emerging Successes. p. 14-16.

⁴⁷Inspection data supplied by FHWA, 1996.

demonstrations of ITS, such as in Atlanta at the 1996 Olympics, are illustrative examples of technological accomplishments, some more important than others.

The marketing of new ITS technologies and services has led to an emerging American ITS industry. Database vendors, auto companies selling "May Day" emergency notification systems, and companies selling or operating toll, traffic management, and electronic clearance systems are illustrative of this emerging industry. The various advances resulting from the investment in ITS R&D represent the underpinnings for the future growth of this industry.

Overall assessment.-The partnerships formed to conduct the National ITS program are gradually beginning to achieve the goals articulated in Title VI(B) of the ISTEA. The federal investment has ensured that extensive evaluations have been conducted, has provided valuable lessons from various operational tests, and has accelerated the initial deployment of ITS. Numerous benefits from ITS have been documented; cost data are now available on some ITS impacts. The costs of some ITS technologies are being reduced, while experience is gained and new approaches are tested. State DOTs and some metropolitan areas are beginning to learn how to integrate these systems to realize synergistic benefits of many different technologies working together.

These investments also have identified and begun to address many of the key challenges that constrain ITS deployment. Based on the status of ITS today, at least another 6 or so years of strong federal involvement would be necessary if substantial progress in realizing the goals articulated in Title VI(B) of ISTEA were to be accomplished.⁴⁸ To realize major impacts on air quality, safety statistics, and traffic congestion, substantial deployment will be necessary. Strong federal, state, and non-governmental partnerships are likely to be needed to accomplish widespread deployment of ITS. The widespread and timely transformation from the existing highway and transit systems to a coordinated intelligent infrastructure and the widespread use of intelligent vehicles would likely require hundreds of millions of additional federal dollars and tens of billions of additional state, local, and private monies. The federal investment serves as the catalyst to leverage extensive use of highway trust fund monies which are apportioned to the states. In the near term, ITS deployment is likely to continue to be difficult and gradual. Furthermore, the need to fund the traditional operating and maintenance costs of our existing highway infrastructure, much of which is in poor condition, will substantially reduce the total amount of funds available for ITS.⁴⁹

⁴⁸Based on the amount of progress made in the National ITS Program during the last six years, which is more or less the typical period for reauthorization of the highway bill in recent years.

⁴⁹As rehabilitation and repavement of infrastructure occurs, it is sometime possible to incorporate ITS improvements simultaneously.

OPTIONS FOR REAUTHORIZATION OF THE FEDERAL ROLE IN THE NATIONAL ITS PROGRAM

The ISTEA authorizes a federal role in the National ITS Program that will expire at the end of FY1997. Both the nature and level of funding to support DOT's involvement may be changed as a result of the upcoming surface transportation or ISTEA reauthorization process. There are numerous policy issues that are likely to be addressed as part of this debate. The central issue is: What should be the role of the U.S. DOT in National ITS Program?

Secondary questions that stem from this issue include: Should the federal investment be focused on research, development, operational tests, or deployment initiatives, or a combination of these? What amount of federal funds should be allocated and for which purposes? Should DOT's deployment incentive program be continued or expanded? At what level of funding should FHWA be authorized to continue funding the research and prototype engineering of the Automated Highway System? These policy questions assume continuation of some federal role. Some policymakers, however, would terminate all federal investments in the National ITS Program. They maintain that the private sector could continue the deployment of ITS without any federal subsidies or encouragement.

Once a fundamental decision is made on the appropriate role of the U.S. DOT in the National ITS Program, then legislative strategies can be designed to implement this decision. In addition to presenting the Administration's option for reauthorizing the ITS Program (see last section), this report considers 12 other options. These options are not mutually exclusive and can be combined. For ease of presentation, these options are divided into two groups: those that require contract monies from the Federal Highway **Trust** Fund (Options 1-5) and those that require minimal or no trust funds (Options 6-12).

- 1. Status Quo**-Continue to fund the federal component of the National ITS Program at roughly the same level
- 2. Increase Federal Investment**-Continue the current program, but explicitly provide the Secretary of Transportation with additional funds to accelerate the deployment of integrated ITS projects
- 3. Promote Safety Components**-Provide separate contract authority to ensure advancement and deployment of the Commercial Vehicle Operations (CVO) component of ITS and to encourage the development and deployment of Advanced Vehicle Control Systems (AVCS)
- 4. Reduce Federal Investment to Minimal Level**-Provide funding only to those areas of critical importance to the National ITS program which the private sector is unlikely to pursue either on its own or in a timely manner to maximize public benefits
- 5. Limit Funds for the Automated Highway Systems Program (AHS)**-Set a definitive limit on the amount of federal dollars allocated each year for the AHS Program, thus extending the time horizon envisioned for this program.

- 6. Standards Conformation**--Require that any ITS project using federal funds (LGOE, contract or federal aid monies) conform with the National Systems Architecture and existing consensus standards
- 7. Standards Issuance**--Require the Secretary of Transportation to specify standards used in ITS projects funded with any federal monies if such standards are not reached voluntarily within a time period necessary to ensure interoperability
- 8. Improve Transportation Planning**--Encourage state and local governments as part of their transportation planning process to evaluate more carefully the feasibility of deploying ITS
- 9. Increase Flexibility for States**--Specify that ITS operation and maintenance costs are eligible expenses under the Federal Aid Highway Programs
- 10. Refocus Priorities**--Update and revise the stated goals of the federal role in the National ITS program
- 11. Improve Incident Management**--Authorize some funds (roughly \$3 million to \$5 million per year) to accelerate incident management initiatives, improved technologies, and training
- 12. Eliminate Federal Investment**--Discontinue direct federal funding for the National ITS Program

These options were selected for discussion because of their relevance to the current debate regarding reauthorization of the surface transportation programs and because they represent a wide spectrum of choices. These options also entail a range of potential costs, with Option #1 assuming level funding, Option #2 resulting in an increased draw on the Federal Highway Trust Fund compared with current federal outlays for ITS, and Options #3, 5, and 12 reducing future federal outlays for ITS. Some of the options would affect both funding and policy considerations; others pertain to policy issues only. For example, Options #7-11 would change current federal law, but would have little impact on the amount of funding provided to DOT to conduct its portion of the National ITS Program.

The discussion below analyzes each of these options and considers the advantages and disadvantages of each. Table 3 below presents a broad overview of these options.

Table 3. Selected ITS Reauthorization Options

	Likely Cost per Year (\$ millions)	Purpose	Major Disadvantage
1. statusquo program	\$225-250	Continue federal role	Limited deployment funds
2. Expand program with increased deployment funds	\$250-325	Sufficient funds to accelerate deployment	Additional cost
3. CVO and AVCS programs	\$50-75	Ensure continuation of ITS activities	Restrictive in scope, would not support comprehensive program
4. Low level maintenance of standards architecture and other public functions	\$10-15	Minimal federal involvement in the National ITS Program	Essentially would end momentum contributed by DOT
5. Reduce AI-IS funding	\$10-21	Reduce immediate AHS federal outlays	AHS consortium could disband
6. conform to existing standards	Minimal	Promote interoperability	Could limit new innovations
7. Standards issuance	Minimal	Ensure interoperability	Some private sector segments could resist
a. Stimulate ITS planning	No cost	ITS must at least be considered in the planning process	Possible DOT micro-managing
9. Ensure operational/maintenance costs are eligible for federal aid funding	No cost	Encourage use of trust fund monies for ITS	Would reduce funds for other transportation priorities
10. Update and revise goal	No cost	New direction for the program	Existing goals not yet achieved
11. Incident management	\$3-5	Cost-effective strategy to reduce congestion	States can conduct such activities using existing funds
12. No federal funding	No cost	Terminate direct financial involvement in the program	Could prove more costly than any of the funding choices

OPTIONS THAT REQUIRE MONIES FROM THE FEDERAL HIGHWAY TRUST FUND

Option:

1. Continue to fund the federal component of the National ITS Program at roughly the same level

Implementation of Option #1 would require a draw on the Federal Highway Trust Fund of about \$225 to \$250 million per year.⁵⁰ Maintaining the current federal program would allow the U.S. DOT to continue partnering with the ITS R&D community, MPOs, and other regional entities and states to help these entities acquire operational experience with ITS or construct and operate ITS integrated deployment projects or components of these projects.

Given the current state of technology and assuming continuation of the progress made to date, it is reasonable to expect that several key milestones would likely be achieved if the current federal role were continued during the next six years at roughly the FY1997 funding level. These include:

- Adoption of most of the critical standards needed for widespread deployment and interoperability;
- Implementation of major portions of the Commercial Vehicle Information Systems and Networks (CVISN) by most of the states;⁵¹
- Widespread integration of ITS into transportation planning, transit operations and highway systems;
- Deployment of integrated ITS in an additional 15 to 30 metropolitan areas;
- Gradual integration of a few crash avoidance ITS systems into passenger cars.

Those seeking a reduced federal investment in ITS could argue that substantial progress has been made in the National ITS Program. They could point out that the states can use their regular federal aid funds to invest in ITS. Those favoring this option could argue that given the nature and difficulty of the remaining major challenges facing the deployment of ITS, a reduced federal role would delay the realization of economic, safety and environmental benefits of widespread ITS deployment.

2. Continue the current program, but explicitly provide the Secretary with additional contract funds to accelerate the deployment of integrated ITS projects.

⁵⁰Based on amount provided during the last five years and continuation of current program activities.

⁵¹CVISN is the information system needed to link all of the states to facilitate an effective and comprehensive CVO program.

DOT currently supports many different ITS program components with a wide variety of objectives. The current funding level severely constrains DOT's ability to expand its deployment efforts, unless allocations to other program objectives or areas, such as research, development, and operational testing, are diminished.

At this early stage in the ITS program, there are many states and MPOs that are hesitant to invest heavily in ITS. Investments in integrated deployment projects provide quantitative data on costs and benefits which are important in assessing the value and feasibility of ITS in the transportation planning and investment process.⁵² Additional funds spent on research and development, smaller operational tests, or the AHS will not easily convince states to use a substantial amount of their federal aid monies on integrated ITS projects.

Under Option #2, the Secretary of Transportation would be provided with new contract authority to accelerate the deployment of integrated ITS projects. Funds could be used to link components of ITS projects that serve regional needs, to link information sources that might serve multiple purposes, or to couple public and private interests in jointly-sponsored systems. These projects, if successful, may help convince additional states and metropolitan areas to deploy such projects. Deployment funds could be allocated to projects which provide congestion mitigation in urban areas, to smaller deployment projects of benefit to rural areas, or for CVO projects.

Option #2 would require an increase in federal outlays of roughly \$25 million to \$75 million each year above current levels, and would considerably expand DOT's role in deployment projects.⁵³

3. Provide separate contract authority, i.e., a specific amount of funds, to ensure advancement and deployment of the Commercial Vehicle Operations (CVO) component of ITS and to encourage the development and deployment of Advanced Vehicle Control Systems (AVCS).

If Congress decided to reduce the total amount of funds available for the ITS program, an option would be to provide separate contract authority for the CVO and the AVCS components of the ITS program. Both CVO and AVCS offer significant safety benefits that could reduce death and injury on the nation's highways. Many believe that this potential is unlikely to be realized in a timely manner without strong federal involvement.⁵⁴

The CVO component also promises significant financial benefits to the states by reducing administrative processing charges associated with fuel taxes and commercial

⁵²This is the strategy that DOT is currently using in its model deployment program.

⁵³The amount needed would vary on the size of the model deployment program desired. Based on the current program, a typical metropolitan project can require about \$10 million of seed money.

⁵⁴DOT's involvement facilitates CVO interoperability and reduces the costs to individual states.

vehicle registration. On the other hand, if contract funds were legislatively designated for these two components of the program, the total amount available for other ITS program elements would be reduced. Under this option, the Director of the JPO would have less flexibility in managing the overall program.

4. Provide funding only to those areas of critical importance to the National ITS program which the private sector is unlikely to pursue either on its own or in a timely manner to maximize public benefits.

If Congress were to restrict ITS contract funds to a minimal level, perhaps in the range of \$10 to \$15 million per year, difficult choices would need to be made. Federal ITS funding could be restricted to only those areas of critical importance which the private sector would be unlikely to pursue on its own in a timely manner. In addition to the safety-oriented technologies mentioned in option #3, there are other “public interest” concerns. For example, the private sector may not finance timely updates or improvements to the National Systems Architecture because such an investment offers little or no chance of return.⁵⁵ In addition, the private sector may not develop and agree to all of the standards necessary to ensure interoperability in a timely manner. Maintenance of the systems architecture and facilitating the development and implementation of applicable standards are critical to conducting a successful ITS program.

Those in favor of this option could argue that a sufficient amount of federal resources has already been invested in the National ITS Program and that considerable progress in deployment could be made now without a large federal role. On the other hand, many ITS supporters would argue that since restricting funds only for essential “public needs” would severely curtail the technical progress and institutional experience that has been gained as a result of the federal role in the ITS program, this option would delay the realization of potential returns from the ITS program.

5. Set a definitive limit on the amount of federal dollars allocated each year for the Automated Highway System (AHS) Program, thus extending the time horizon envisioned for this program

The AHS Program is conducted through a partnership financed about 80% by U.S. DOT and about 20% by a consortium of industry, academic, and other participants. The AHS would be designed to integrate numerous technologies that collectively allow driving functions to be partially or fully controlled or automated. These technologies may be imbedded in the highway or incorporated into a vehicle or a combination of both. AHS would allow specially equipped vehicles to be driven much closer together than is safe during conventional highway driving, thus increasing throughput, e.g., number of vehicles passing a point per unit of time. Substantial improvements in throughput are promised, but remain theoretical until large-scale deployment occurs perhaps in 10 to 15 years, depending on the

⁵⁵During the last few years, the DOT spent more than \$20 million in developing the National Systems Architecture. This initiative yielded a set of specifications forming the framework within which ITS deployment will occur in the United States. The Department intends to update this document and distribute it widely in a variety of useable forms.

availability of funds and progress made. Spinoffs of new or improved safety technologies resulting from the investment in AHS may be realized sooner.

Of all of the major components of the ITS program, commercial deployment of the AHS is furthest from realization. Given its current status and the numerous uncertainties remaining, the demonstration of an automated highway engineering prototype system around 2002 or later could easily require an additional \$100-\$120 million of federal funds beyond the amount appropriated to date.⁵⁶ Beyond this stage of the AHS, tens of millions of additional federal dollars would most likely be required to conduct a large scale operational test of AI-IS, which would be needed before commercial deployment could reasonably be expected to proceed.

The AHS program element of the National ITS Program could be separated out from other elements. Although there may be some spinoffs of improved safety-oriented technologies from the program, the significant prospects for immediate payoff remain uncertain. The AHS program, as originally conceived in the existing cooperative agreement, could therefore be reconfigured, delayed, or conducted over a longer period than now envisioned without adversely affecting most of the other components of the ITS program.

There is a risk associated with implementation of this option. The consortium of public and private sector groups which has formed to support and help fund the development of AHS could collapse. Costs for the AHS program could escalate if the project were substantially delayed. There are, however, some who argue for termination of the AHS program in its current form, because they judge the costs are high and the likelihood of commercial success is uncertain.

OPTIONS THAT REQUIRE MINIMAL OR NO FUNDS FROM THE FEDERAL HIGHWAY TRUST FUND

6. Require that any ITS project using federal funds (LGOE, contract or federal aid monies) conform with the National Systems Architecture and existing consensus standards

The National Systems Architecture is the broad framework that is intended to help engineers design and deploy interoperable ITS technologies across the Nation. Standards are the implementing specifications that must be complied with to ensure interoperability. If interoperability is to be promoted, federal funds to further deployment would need to be spent only on ITS projects that conform with the National Systems Architecture and with consensus standards in effect at the time of funds allocation. There are few, if any, in the ITS community that would oppose such a requirement. In fact, DOT administratively requires that ITS projects funded with federal program funds must conform with the National Systems Architecture and existing consensus standards. The Department, however, does not now have a requirement that the apportioned Federal Aid to Highway Program monies must be

⁵⁶The original cooperative agreement for the AHS called for a federal expenditure in the range of \$160 million. About \$60 million has already been appropriated.

used in this manner.⁵⁷ DOT's reauthorization proposal (Appendix V) also addresses this concern.

7. Require the Secretary of Transportation to specify standards used in ITS projects funded with any federal monies if such standards are not reached voluntarily within a time period necessary to ensure interoperability

Option #6 pertains to those areas of ITS technology for which voluntary, consensus standards exist. There are, however, many areas for which standards do not yet exist. DOT is working with the major standards setting organizations and with ITS AMERICA to promote the development and acceptance of all key voluntary consensus standards needed to ensure interoperability of ITS across the country. The Department is facilitating the adoption process and is trying to avoid mandating specific standards.

If this process fails in some technical areas and if interoperability is to be ensured, then DOT may need to take a more definitive role by issuing those standards needed to ensure that Federal Highway Trust Funds or federal funds are invested only in projects which will be interoperable. The time period for the issuance of such standards could be left to the discretion of the Secretary. Alternatively, Congress could set a date after which the Secretary would be required to set any standard needed to ensure interoperability. Any federally set standards could be replaced with voluntary standards once these were agreed to by the responsible parties. Some companies might object to this option, but others would favor such federal action, especially if it promoted the marketability of their products. Some would consider it risky for the DOT to set standards.

8. Encourage state and local governments to evaluate as part of the transportation planning process the feasibility of installing ITS

As part of the transportation planning process now specified under ISTEA, states and MPOs evaluate their transportation needs and determine their highest priorities for funding. Some governmental entities will consider the benefits and costs of installing ITS into existing infrastructure and compare this investment with alternative uses of limited funds, such as repairing existing roads or expanding highway capacity. Others will not. Under the ISTEA, which was enacted before the feasibility of ITS deployment was well established, there is no formal requirement that ITS be given explicit consideration as part of the transportation planning process.⁵⁸

As part of the reauthorization process, current law could be modified to ensure that the option of installing ITS is considered as part of the transportation planning process. If the process demonstrated that ITS were a cost-effective means to meet

⁵⁷Personal communication with FHWA, 1997.

⁵⁸ISTEA provides for formal processes to develop transportation plans which integrate roadways, transit and multi-modal facilities into a comprehensive transportation system. In non-attainment areas (as defined in the Clean Air Act Amendments (CAAA) of 1990), these plans must be consistent with State Implementation Plans required by the CAM.

transportation needs, states would likely spend a portion of their federal aid highway monies and local funds pursuing this option.

To encourage ITS to be considered in the planning process, Congress could consider amending

A. Section 134 of Title 23, United States Code, (g,2,A), which is designed to provide a planning process which views different modes of transportation as an integrated whole. This section could be amended to require states to: identify transportation facilities (including but not limited to major roadways, transit, multimodal and intermodal facilities **and intelligent transportation systems and low cost operational improvements**) and

B. Section 134 of Title 23, United States Code, (g,2,C) which is designed to ensure the preservation of the transportation system and the most efficient use of the system. This section could be amended to require states to **assess capital investment, low cost operational improvements including ITS and other measures necessary to...**

These changes would likely encourage states and MPOs and perhaps local governmental entities, to consider ITS as one of several measures necessary to ensure the efficiency of the transportation system.

Some states, however, may object to expanding the complexity of the planning process or to adding requirements to be imposed by the Secretary of Transportation as a condition of receiving Federal Aid Highway monies. (Other options regarding changes in the planning process are discussed in appendix V.)

9. Specify that ITS operational and maintenance costs are eligible expenses under the Federal Aid Highways Program

Many in the ITS community would like all operation and maintenance costs for ITS systems to be an eligible expense for reimbursement under any of the categories of the Federal Aid Highways Program. Questions remain regarding whether various categorical funds from the Federal Highway Trust Fund can now be used to pay for the long-term operation and maintenance of ITS. Legislative language to clarify this situation is sought by many in the ITS community. In support of this option, it can be argued that considerable expenses are incurred to ensure that ITS operate and are maintained over the long-term at a high level to achieve maximum efficiency. Costs to maintain on-line ITS technologies cannot be deferred if high operational efficiency is to be maintained.

Implementation of this option would allow ITS operational and maintenance costs to be eligible expenses under the Federal Aid Highways Program, thus providing the states with additional flexibility on how they can use apportioned federal aid monies. Additional dollars would not be required. Some highway and transit groups which regard ITS as competition for these funding sources might oppose this option.

10. Update and revise the stated goals of the National ITS Program

As part of the reauthorization process, Congress could consider revising or updating the goals of the program now specified in Title VI(B) of ISTEA. Congress might consider whether goals recently set by either ITS AMERICA or the DOT should be incorporated into federal statute. (An example of an ITS AMERICA goal is presented in appendix IV and the DOT's goals for deployment are summarized in an earlier section.) Alternatively, because the goals of Title VI(B) of ISTEA have not yet been fully realized, the current goals are still valuable guides for the program.

11. Authorize funds (roughly \$3 million to \$5 million per year) to promote incident management initiatives, improved technologies and training

As a result of investing tens of millions of dollars in applied research and various operational tests, the DOT and its partners have advanced technologies that are effective in determining where unusually high traffic congestion is occurring. The cause of much of this non-recurring congestion is traffic crashes. Effective detection of such incidents is only part of the challenge to reduce congestion: incident management and response also are of fundamental importance. Emergency response operators typically need to remove a vehicle or a victim or both in order for normal traffic flow to resume. Some communities have developed coordinated plans for incident response and management and have equipped their response vehicles with the latest technology to facilitate this process. Many communities have not implemented effective incident response systems which minimize the economic costs of congestion.

The DOT spends relatively little money-less than \$2 million each year-on improving the actual response capabilities of state and local governments and private entities. DOT uses these funds to facilitate partnerships by promoting improved incident management, to advance relevant technologies, and to provide training.⁵⁹

Investment in improved incident management, especially as part of an integrated approach to traffic management based on ITS, is a relatively high payoff area.⁶⁰ Reduced traffic congestion results from more efficient responses to incidents. Additional federal assistance could encourage many more metropolitan areas to establish incident management systems equipped with the latest technology and techniques. But, it can be argued that states and MPOs can pursue this option without additional federal involvement.

12. Discontinue Direct Federal Funding for the National ITS Program

Eliminating federal funds for the National ITS Program is an option that would "save" approximately \$1,300,000,000 of contract and appropriated funds over the next

⁵⁹Personal communication with FHWA, 1996.

⁶⁰For example, DOT reports in its responses to questions posed by the House Appropriations Committee, 1997, that the Minnesota Highway Helper Program, which costs about \$600,000 per year to operate, reportedly yields annual benefits through reduced delays of \$1.4 million.

six years at roughly current funding levels. Implementation of this option would likely result in numerous consequences to the National ITS Program:

- development of standards needed to obtain interoperability would slow,
- the National Systems Architecture would probably not be maintained or updated properly,
- technology transfer from state and local governments that have successfully tested ITS to other governmental entities would be more difficult,
- higher risk research on ITS technologies would be substantially reduced,
- the AHS Program (as now implemented with more than 80 different entities participating) would most likely end, and
- NHTSA as well as consumers would have less information on which to base decisions regarding the reliability, costs, benefits, and safety of new crash avoidance technologies.

Most importantly, DOT's ability to partner with various non-federal entities to accelerate the introduction and deployment of ITS would be severely constrained.

DOT's REAUTHORIZATION PROPOSAL FOR ITS⁶¹

The Administration's reauthorization proposal is a multi-faceted approach that extends its basic authorities under ISTEA and shifts emphasis towards deployment, while still maintaining a research and development program. The DOT maintains that with enactment of this proposal, it is poised to launch the deployment of a national intelligent transportation infrastructure, and the development of a fully integrated intelligent vehicle. The three basic components of DOT's proposal are:

- (1) **Research** programs-Research efforts would continue as would support of ITS deployment efforts with standards development, training, and technology transfer. The funding proposal specifies contract authority of \$96 million for FY1998 through FY2000, and \$130 million for FY2001 to FY2003. There does not appear to be any empirical basis to justify the amounts specified in the out years.
- (2) **Incentive** programs-These programs are designed to launch widespread deployment of several proven technologies that DOT claims are both feasible and highly cost-effective. For this initiative, DOT proposes an annual authorization of \$100 million, which requires matching funds.
- (3) **Legislative** changes-The DOT is proposing a variety of amendments to the ISTEA that would promote widespread deployment of ITS infrastructure using existing Federal-aid programs.

⁶¹FHWA; ITS Fact Sheet. Mar. 18, 1997.

(A more detailed explanation on each of these three initiatives is provided in Appendix V of this Report)

Portions of the Administration's proposal are similar to some of the options presented in this report, especially Options #2, #6, #8, #9, and #10. The Administration's proposal would increase contract funding for ITS, expand the National ITS program, tie it more closely into the federal aid funding process, and redirect some activities. The CVO program and international border components would receive special attention with 25% of proposed deployment funds, or \$25 million per year. It remains unclear how much money would be allocated for NHTSA's AVCS program.

CONCLUSION

The National ITS Program has been partly financed with some \$1.270 billion of funds provided to the Secretary of Transportation, by perhaps several billion dollars in federal aid highway monies apportioned to the states, and by perhaps hundreds of millions of dollars derived from the private sector. The resulting partnerships financed by these monies have helped to advance new technologies, stimulate investment in an emerging ITS industry, and laid the foundation for ITS integration, deployment, and interoperability. The nation now has the capability to convert the existing surface transportation system to a more intelligent system, one that may prove to be safer, more efficient, and more productive. This path is not without cost and difficulty.

If the direct federal investment were terminated, states and industry would continue portions of the National ITS Program. But, with continued DOT investments in the program, it is reasonable to expect that:

- the time required to convert to an intelligent system would be expedited and the costs would be reduced because of federal support of standards, architecture, and technology transfer; and
- hundreds of billions of dollars in economic savings from reduced congestion and productivity gains and safety benefits are likely to result from deployment of ITS over the next twenty years. These benefits are likely to be realized sooner rather than later due to sustained federal support of the ITS innovative process.

The costs of continuing a strong federal role in the National ITS Program are substantial. Appropriated and contract federal funds could easily total \$250 million or so each year. Absent a strong federal role, costs to society could be much greater: ITS that are not interoperable with each other would likely be deployed; deployment would likely occur, but at a much slower pace.

APPENDIX I. ITS AROUND THE NATION: EXAMPLES

The Salt Lake Area is in the process of designing and implementing an integrated, multi-agency, multi-modal traffic management system which facilitates the safe and timely movement of people and goods in the Region through the coordinated management of recurring congestion, traffic associated with incidents and planned special events.

The State of Arkansas has recognized the importance of truck safety and productivity by participating with two other states in the “Southwest States Electronic One-Stop Shopping” operational test. This test will analyze how to make sure regulatory paperwork is in order; allows motor carriers to pre-screen and electronically file credential applications with state agencies; and more.

The City of Las Vegas is a key player in the Las Vegas Area Computer Traffic System (LVACTS) — a model for regional cooperation between Las Vegas, Clark County, the City of North Las Vegas, the City of Henderson, the Nevada DOT, and the Regional Transportation Commission.

Advantage I-75 — The longest ITS deployment in the world. Allows trucks to travel non-stop from Florida to Canada.

In Kansas City, with the Transit Management System implementation, transit officials reduced operating costs by \$400,000, avoided \$1.5 million in new bus purchases, and cut the response time to emergencies from 4 minutes to 1 minute.

In Lexington, KY coordinated computerized traffic signals reduced “stop and go” traffic delay by 40% and reduced accidents by 31% between 1985 and 1994.

In Seattle, ramp metering kept traffic moving and cut accident rates by more than 60%, despite a 10% to 100% increase in traffic levels.

In Washington, DC., the regional traveler information system being developed will provide citizens traffic information in real-time.

In Cincinnati, Ohio, the ARTIMIS System allows citizens to dial “311” for travel information.

TransGuide, the Transportation Guidance System in San Antonio, Texas, can detect any freeway incident within two minutes. Assistance is dispatched immediately. Freeway message signs take only 15 seconds to inform drivers.

The SMART corridor is located along 12.3 miles of pure congestion in the Santa Monica freeway corridor west of downtown Los Angeles. The Automated Traffic Surveillance and Control (ATSAC) system, has reported impressive benefits, including a 13% reduction in travel time, 35% reduction in vehicle stops, 14% increase in average speed, 20% decrease in intersection delay, 12.5% decrease in fuel consumption, and a 10% decrease in harmful emissions.

The City of Providence, RI, has a three year area wide early deployment planning study underway for ITS. They are looking at ITS in terms of congestion management.

The Minnesota Highway Helper Program reduces the duration of a stall (the most frequent type of incident, representing 84% of service calls) by 8 minutes. Using representative numbers, annual benefits through reduced delay total \$1.4 million for a program that costs \$600,000 to operate.

In Maryland, Montgomery County cable stations reach 180,000 homes to show traffic conditions on major highways – giving commuters mode of travel options.

In Boston, SmarTraveler, a powerful tool to make decisions about altering their routes, adjusting departure times, and changing modes of travel. In a survey of 2,000 Boston SmarTraveler users, nearly 50% reported that the information had a direct influence on travel decision making.

In New Jersey, electronic payment saved an estimated \$2.7 million through labor costs.

In Oklahoma, the turnpike electronic toll collection has resulted in a savings in annual cost per land of more than 90%.

Source: Prepared by the United States Department of Transportation, 1997.

APPENDIX II. RURAL ITS ACROSS THE NATION

Road Weather Information Services – While the use of weather sensing has become relatively well known, we are experimenting with linking it to forecasting capability to get square mile by square mile forecasts, linking that to communication channels such as cable TV and the Internet to get the same information to farmers. That work is going on in Nebraska. We are beginning to look at Automatic Vehicle Location on Snow Plows for better management of resources.

NOTE: *Each year weather causes or contributes to 6,000 fatalities on U. S. Highways. A FHWA report (1995) states that between 25 and 35% of all intercity road accidents occur during adverse weather, with the risk of accidents increasing during bad weather by a factor of from 2 to 5. And highway agencies spend an estimated 1/2 billion dollars a year preparing for snowstorms that are predicted but never occur.*

The Nevada DOT and CALTRANS are working jointly on State Road 431 in the Lake Tahoe Basin to provide a Road Weather Information System. The purpose is to help maintenance forces better respond to winter storms and to inform motorists of road conditions. The system uses several remote weather stations to monitor the weather. Roadway information is transmitted to the motorist with VMS and HAR.

NOTE: *Accurate short term predictions of snowfall and icing on a very small scale could greatly reduce the costs of snow and ice control perhaps by 10% or more (Boselly, 1992) Given statistics showing such costs exceeding \$2 billion a year in the U. S. and Canada, total savings could be as high as \$200 million annually.*

An Advanced Transportation Weather Information System for Rural Interstate Highways is being developed at the University of North Dakota. The project will focus on weather information processing and the generation of site-specific weather forecast, and the effective information distribution for general, commercial, and government transportation utilization.

Idaho Storm Warning – This project is testing various sensing equipment for use to determine hazardous visibility conditions on a section of I-84 in SE Idaho prone to blowing snow and dust. The early detection information will then be used to provide general warnings, speed advisories and possible road closure information to approaching motorists. Test sites were established and preliminary testing begun in 1994 of sensing and communications equipment. Delays in construction of variable message signs and a lack of visibility incidents in 1995 and 1996 has resulted in an extension of the test, Completion is now scheduled for 1998.

Wyoming: Visibility Project to Detect Blowing Snow – Now in the study phase (may be implemented in about 2 years), it will analyze modern visibility sensors are located at two locations: 1) southeast of Riverside, WY at the Skyline site (1 monitor) and 2) south of Laramie, WY, on Route 287 at the Pumpkin Vine site (3 monitors). Two studies are underway to determine how the monitoring system should be developed and where monitors should be added.

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Remote Sensing of Rural Road and Travel Conditions (I-80 from Cheyenne to Laramie, WY) A report is available on this study which data collected by the remote weather information station with actual weather conditions.

Tourism Information Services – particularly at our national parks. For example in Yosemite we have kiosks that communicate to tourists the availability of camping and other facilities as well as whether the park can accept more visitors – well before the traveler gets to the park.

Yosemite Area Traveler Information System (YATI) – This program is a traveler information system for Yosemite National Park and the surrounding area, including five county agencies. The project objective is to provide real time travel information on road and traffic conditions, transit alternatives, tourist activities, parking information, and lodging and camping information. This information will be provided to travelers through VMS, HAR, and a multimedia database accessible through information kiosks, bulletin boards, and touch-tone telephones.

Mayday Services – (Automatic or semi automatic notification of an accident along with geographic coordinates) attacks the “golden hour” that separates injury from fatality in rural areas – where the time from accident to notification and response can often exceed an hour. In Germany such systems have shown a decrease in time for response from 14 minutes to 8 which has corresponded to a 12% increase in the chance of survival.

The PUSHME MayDay Operational Test in Washington State tests two different cellular based systems. One system being tested uses cellular packet data network (CPDN) using two way pagers to transmit data packets with information about the emergency. Verification between the emergency response center and the distressed vehicle is accomplished through a Yes\No push button response with a digital read out. The second system is a voice communication system. This will allow interactive voice between the distressed vehicle and the emergency response center. This test also examines the issues of protocol between the public and private sectors.

Sweetwater County Wyoming. Use of sophisticated computer aided dispatch, smart cards and GPS to cut costs and extend the service areas of rural transit systems. In Sweetwater County Wyoming the use of computer aided dispatch alone allowed the integration of the various HEW services and the extension of service to twice the number of clients without increasing dispatch staff.

Dynamic Truck Speed Warning For Downgrade – In Colorado, this project is a partnership between FHWA and CDOT, the Colorado Motor Carriers Association, and International Road Dynamics, Inc. Located on I-70 West of Denver, the project uses weigh-in-motion technology to determine the safe decent speed based on predetermined algorithms. This safe speed is then posted to the trucks via VMS signs. Sensors are in place to assure that a partial weight for a truck is not calculated, and that vehicles under 30,000 pounds are not taken into account. Downstream speed sensors are used to evaluate the effectiveness of the system.

An Out-of-Service Verification Operational Test is currently underway that will utilize technologies that will provide automatic, real-time out-of-service verification

at the roadside. The project will utilize AVI tags, video imaging analysis and an inspection site alarm that would be activated when an out-of-service vehicle attempts to leave.

The **ARCTIC Operational Test** in Minnesota will use available technologies to increase fleet efficiency and transit ridership. Through this test, the elderly, handicapped, and those without a vehicle at their disposal, will be given the mobility that is necessary to their existence. The test will coordinate the communication systems of several public agencies to improve response times to accident and road condition emergencies, eliminate redundant communications systems, provide real-time vehicle status and schedule information, and improve transit service. The test site is the 18.223 square mile Arrowhead Region of northeastern Minnesota.

The Green Light Project in Salem, Oregon will develop and deploy advanced technology to automate truck operations in three areas: mainline pre-clearance, enforcement and safety. Mainline pre-clearance systems will be implemented at 15 sites on Oregon's major highways. These systems will allow compliant trucks to completely by-pass port-of-entry and weigh stations. Enforcement sites, located at key by-pass routes will be equipped with weigh-in-motion and advanced vehicle identification technology to assist in identifying vehicle attempting to evade weigh stations. About 35 potential sites have been identified for construction as part of Phase II of the project. Safety enhancements will be installed at four locations and will consist of downhill speed information systems, road and weather information systems, and will link existing real-time safety inspection database to all weigh stations.

Primary In-Vehicle Navigation Market — In 1994 six states were chosen by General Motors Corporation in which to market the Oldsmobile/Zexel in-vehicle navigation system. Plans are underway to introduce the system in Rhode Island and five additional states within the year.

Source: Prepared by the United States Department of Transportation, 1997.

APPENDIX III. SELECTED SAFETY ASPECTS OF ITS**Advanced Traffic Management Systems**

Washington, Illinois, New York, Virginia, Minnesota, and California: Collisions on freeway systems under freeway management have been reduced between 15% and 50%, with ramp metering being a significant positive factor. While some other freeway improvements were implemented during the study periods, the combination of geometric, vehicle, and operational procedures showed significant reductions in collision rate.

Maryland: Recent evaluations of freeway management systems without ramp meters also yielded crash reductions. The CHART system in Maryland reported a 5% reduction in secondary crashes.

Texas: The TRANSGUIDE system in San Antonio, Texas, another freeway management system that does not use ramp meters, reported a 30% reduction in secondary crashes and a 35% reduction in total crashes.

Los Angeles: Initial tests of photo enforcement at highway-railroad intersections in Los Angeles have yielded positive results, with a 92% decrease in violation rate (Dana Ring, U. S. Public Technologies Inc., personal interview, January 1996).

Japan: Two types of speed-sensitive traffic signal control devices recently installed in Japan have reduced crashes at equipped intersections by 25% - 30% and pedestrian involvement by 85%.

London: Although controversial, video enforcement for speed and red-light violation are effective. Installations in London have reduced crashes 20% - 80% and serious injuries and fatalities by about 50%.

Commercial Vehicle Operations (CVO)

Oregon: An early information network in Oregon enabled an increase of 90% in number of weighings and 428% in number of safety inspections between 1980 and 1989 while staff increased by only 23%. While these measures are not directly of desired outcomes, the link between inspections and reductions in crashes is intuitive.

National: ITS implementation is expected to improve the safety record of motor carriers. Evidence of future success is indicated by ongoing motor carrier safety programs including the Motor Carrier Safety Assistance Program (MCSAP) and safety audits. The benefit/cost ratio of these programs has been estimated as 2.5 while yielding a reduction of 2,500-3,500 collisions annually.

Advanced Traveler Information System (ATIS)

Colorado: The Dynamic Truck Speed Warning System for Long Downgrades, installed on I-70 near of the Eisenhower Tunnel West of Denver, warns drivers of safe truck speed at the start of the downgrade based on the, truck's measured

weight. Observers report that trucks being instructed to slow frequently apply their brakes immediately. (Greg Fulton, Colorado DOT, telephone interview, January 1995).

Florida: The TravTek project examined the safety aspects of an in-vehicle navigation device that used a moving map display as well as voice directions. Compared to control conditions of paper maps and road signs, use of both visual and voice displays yielded lower driver workloads in each category of stress including time stress, visual effort, and psychological stress. TravTek users also perceived that they were safer.

Florida: The TravTek project used a simulation approach to estimate safety impact. Results indicated an overall reduction in crash risk of up to 4% for motorists using navigation devices, due to improved wrong turn performance and the tendency of the navigation system to route travelers to higher class (normally safer) facilities.

Florida: TravTek simulation studies also indicated a slight network safety improvement when diversion from congested roadways reduced the level of congestion for the remaining equipped and non-equipped vehicles and helped to smooth traffic flows on those roads.

Reduction in the number of fatalities using the following ITS systems:

Advanced Traffic Management System (ATMS)

National: According to statistical analysis based on data from the Fatal Accident Reporting System, reduction of incident notification times on rural highways from the current average of 9.6 minutes to 4.4 minutes, corresponding to MayDay devices working properly in 60% of rural crashes, would result in a reduction in fatalities of 7% annually, or a national total of 1727.

National: According to statistical analysis based on data from the Fatal Accident Reporting System, reduction of incident notification times on urban interstates from the current average of 5.2 minutes to 2 minutes would result in a reduction in fatalities of 15%, or a national total of 356 lives annually if all urban interstates nationwide were under such a program.

Germany: In field tests of an on-board crash notification system, calls generated to simulate emergency situations have shown a decrease in time for medical help to arrive from 14 minutes to 8 minutes for urban crashes and from 21 minutes for out-of-town crashes. The 43% drop in response time corresponds to a 12% increase in the chance of survival for an occupant involved in the crash.

Commercial Vehicle Operations (CVO)

National: Analysis using empirical data to estimate the impact of CVO implementation on fatal involvements found a potential reduction of 14% to 32%. The analysis considered experience reported relating total miles traveled, percentage of rural travel, and inspection practices to fatality rate.

Advanced Traveler Information System (ATIS)

Oklahoma: Automatic vehicle location (AVL) in conjunction with computer-aided dispatching (CAD) and navigation systems are being installed in fire, police, and emergency vehicles. A crash in Muskogee County, Oklahoma, involving a car and a school bus, resulted in the need for medical attention. The fog that contributed to the collision would have also delayed an ambulance and made location of the collision difficult from a helicopter. However, the helicopter, equipped with a Global Positioning System (GPS) receiver, located the crash scene using location information provided by a Highway Patrol officer on the scene using a handheld GPS. The helicopter was then able to complete the rescue.

Illinois: In Schaumburg, Illinois, the AVL system installed by the police department has been reported to enable dispatch of backup to officers who failed to report location information and dispatch of assistance to an incapacitated officer.

Integrated Systems:

Texas: The San Antonio TransGuide facility opened in the summer of 1995. The value of an integrated facility was demonstrated in the week before the center opened when an industrial plant fire erupted within view of freeway video surveillance. Based on the visibility afforded at TransGuide, the fire was accessed and fought more effectively, possibly saving the lives of several firefighters.

Source: Prepared by the United States Department of Transportation, 1997.

APPENDIX IV. A GOAL SET BY ITS AMERICA

The Board of Directors of ITS America, a public-private consortium dedicated to the development and deployment of ITS systems, adopted the following goal on December 6, 1995:

To complete deployment of basic ITS services for consumers of passenger and freight transportation across the nation by 2001:

- The private sector will lead in the development and bringing to market of reliable and affordable intelligent transportation systems;
- The public sector will lead in the deployment of core intelligent transportation systems to meet essential public needs, forming innovative partnerships with the private sector where appropriate; and
- The intelligent transportation systems developed and deployed will be integrated, interoperable and intermodal.⁶²

⁶²Deployment; it's time for results. James Constantino, ITS America. Issue 4, Mar. 1996; p. 37-38.

APPENDIX V. DOT's PROPOSAL FOR NEXT EA REAUTHORIZATION⁶³

Research, Testing, and Technology Transfer Component

This component will provide support for the development of the intelligent vehicle which includes the short range work that NHTSA has launched as well as the short-term vehicle/highway research that has been carried out under the Automated Highway Systems (AHS) Program. This component will also support standards development, testing, and training efforts, as well as continuing several on-going investigations.

For this program, the DOT proposes an annual authorization of \$96 million thru FY 2000 and \$130 million for each fiscal year thereafter. Federal share funding would continue at 80%, which could be waived for states offering innovative research activities. It is expected that research on the intelligent vehicle will be carried out collaboratively with industry on a 50/50 basis.

Infrastructure Deployment Incentives Program

This approach would provide small discretionary incentive awards for public sector state and local applicants to support Metropolitan Planning Organizations with the integration of intelligent infrastructure, and the deployment of CVO, as well as rural area intelligent infrastructure. The Administration's proposal includes specific criteria that applicants must meet for eligibility.

The DOT proposes an annual authorization of \$100 million for this program. This approach would require, according to DOT, a non-ITS funding match of 50% for each project, where the remaining 30% may be derived from other federal aid highway programs and transit apportionments. Thus the federal share of total project cost is limited to 80%. This approach would also establish annual award funding limitations as follows:

- (1) \$15 million per metropolitan area;
- (2) \$2 million per rural project;
- (3) \$5 million per Commercial Vehicle Information Systems and Networks (CVISN) project, and
- (4) \$35 million within any state.

Funding priorities would be established as follows:

- (1) At least 25% for implementation of commercial vehicle information systems and international border crossing improvements, and
- (2) At least 10% for other intelligent transportation infrastructure deployment outside metropolitan areas.

⁶³FHWA ITS Fact Sheet. March 18, 1997. This Appendix is based, almost verbatim, on the FHWA fact sheet.

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Additionally, the Administration's proposal **would provide funding to state and** local applicants as support for integration of metropolitan area travel management intelligent infrastructure, intelligent infrastructure elements in rural areas, and CVISN deployment within states and at border crossings. In metropolitan areas, the funds would be used primarily for integration of existing intelligent transportation infrastructure elements, but rural and commercial vehicle projects could include installation as well as integration. These funds are a sweetener to encourage integrated deployment, as well as innovative finance and public/private partnerships. This initiative replaces the IVHS Corridors Program, and currently designated Priority Corridors are eligible for funding.

The criteria for funding eligibility include:

- (1) Contributions to national ITS goals
- (2) Demonstration via written agreements, a commitment of cooperation among public entities, multiple jurisdictions and the private sector;
- (3) Demonstration of a commitment towards a comprehensive plan of fully integrated ITS deployment in accordance with national architecture and established ITS standards and protocols.
- (4) Participation in approved state and metropolitan area plans for transportation and air quality;
- (5) Catalyzation of private investment with minimized federal contributions
- (6) Having a sound financial plan for continued long-term operations and maintenance, without continued reliance on federal ITS funds
- (7) Demonstration of the capability to effectively operate and maintain the systems.

Legislative Provisions:

Requires the Secretary to develop a National Architecture and supporting standards and protocols to promote interoperability among ITS technologies implemented throughout the states; use of approved standards and protocols established as prerequisite for use of federal-aid funds on ITS projects; it is anticipated that the Secretary will establish on an annual basis which standards and protocols are required to be used.

Requires the Secretary to take necessary actions to secure a permanent spectrum allocation for Dedicated Short Range Communications, recognizing the importance of ensuring availability of a common vehicle-to-wayside wireless communications capability for ITS applications.

Makes explicit the authority of states and local entities to use specified federal-aid and transit funds for ITS and intelligent transportation infrastructure implementation, modernization, and operational activities as mainstream program activities.

Emphasizes importance of involving Historically Black Colleges and Universities and other Minority Institutions of Higher Education.

Directs the Secretary to provide independent and objective evaluation of field and related operational tests.

Requires life-cycle cost analyses when federal funds are to be used to reimburse operations and maintenance costs and the estimated initial cost of the project to public authorities exceeds \$3,000,000.

Directs the Secretary to develop guidance and technical assistance on procurement for ITS projects, including innovative and non-traditional methods.

Mandates updating the ITS National Program Plan on an as-needed basis; implementation report must be made to Congress within one year, then biennially thereafter.

Expands type of technical assistance to be provided to state and local governments to include training and building of professional capabilities.

Authorizes the Secretary to provide financial assistance and technical support for ITS planning, and ties operational testing to specific national research objectives.