NATIONAL ITS PROGRAM PLAN
INTELLIGENT TRANSPORTATION SYSTEMS

SYNOPSIS

EDITED BY
GARY W. EULER
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FIRST EDITION
MARCH 1995

101523

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Abstract

The purpose of the ***National ITS Program Plan*** is to guide the development and deployment of Intelligent Transportation Systems (ITS) in the United States. This, the First Edition of the Plan was a joint effort of ITS America and the United States Department of Transportation. The plan was developed through a consensus building process which sought the involvement of the entire ITS community. The ***National ITS Program Plan*** consists of four documents: an Executive Summary, a Synopsis, and two Volumes. The Executive Summary provides a very brief overview of the goals, objectives, and recommendations presented in the ***National ITS Program Plan.*** The Synopsis provides a fifty page encapsulation of the major subject areas within the document, with special emphasis on the area of deployment. Volume I focuses on the issues of goals, compatibility, deployment, and program assessment, and Volume II contains detailed descriptions and plans for each of the twenty-nine user services.

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This document was produced, in part, with funding provided by the U.S. Department of Transportation, Contract Number DTFH61-94-R-00076.

PREFACE

This, the First Edition of the ***National ITS Program Plan*** was a joint effort of ITS America and the United States Department of Transportation. The plan was developed through a consensus building process which sought the involvement of the entire ITS community. Over 36 individuals participated actively as authors, and well over two hundred individuals from a wide range of organizations critiqued, commented, and otherwise contributed substantially to the material presented here.

The ***National ITS Program Plan*** consists of four documents: an Executive Summary, a Synopsis, and two Volumes. The Executive Summary provides a very brief overview of the goals, objectives, and recommendations presented in the ***National ITS Program Plan.*** The Synopsis provides a fifty page encapsulation of the major subject areas within the document, with special emphasis on the area of deployment. Volume I focuses on the goals of ITS, compatibility, deployment, and program assessment. Volume II contains detailed descriptions and plans for each of the twenty nine user services.

Work on the ***National ITS Program Plan*** formally commenced in June of 1993. The Second and Final Drafts of the Plan, completed in May 1994 and November 1994 respectively, incorporated the comments and contributions of a substantial number of individuals and organizations. In total, more than 4,000 draft copies of the plan were distributed to ITS America members, U.S. DOT staff, and the general public through the Federal Register process. Over 200 individuals and organizations commented and provided input for one or more of the drafts.

The process of developing the ***National ITS Program Plan*** was, in itself, a valuable exercise. The focus of the first draft was upon the creation of the user service development plans now contained in Volume II. The remainder of the draft consisted largely of annotated outlines. A Joint Writing Team (JWT) was formed and given the responsibility of developing the Plan. In the second draft, the deployment and deployment considerations chapters took shape, and with the third draft, deployment scenarios emerged. Each draft represented significant advances in our thinking about ITS technology, systems, deployments, and impacts.

Overall guidance to the JWT on the direction and structure of the Plan was provided by U.S. DOT officials and the ITS Planning Committee of ITS America. The Joint Writing Team, co-chaired by Doug Robertson (ITS America) and Gary Euler (US DOT ITS Joint Program Office), consisted of ITS America and U.S. DOT staff and ITS America members. The JWT members, acknowledged by name and organization below, worked extensively with ITS America members, U.S. DOT staff, and the general public with a goal of insuring balanced representation of the goals, objectives, concerns, and needs of a diverse ITS Community.

The field of ITS is advancing rapidly on many fronts; keeping abreast of it will require a continuing effort. This document will serve as the basis for periodic updates, which will provide information on current activities and projections for the future.

ACKNOWLEDGEMENTS

A substantial number of individuals contributed to the content of this document. The members of the ITS America Planning Committee, participating U.S. DOT officials, and the Joint Writing team are listed with their affiliations below. The names and organizations of over two hundred individuals who reviewed and commented on one or more drafts of the Plan are listed in Appendix A.

The ITS AMERICA Planning Committee

Members of the ITS America Planning Committee, chaired by Thomas Deen, TRB (retired), include*:

- Mike Bolton, Capital MTA, TX;
- Dick Braun, University of Minnesota;
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- Morgan Buchner, American Telephone and Telegraph;
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* The individuals listed served on the committee during the development of the plan.

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Gary Euler of the U.S. DOT ITS Joint Program Office and Doug Robertson of ITS America served as Co-chairs of the Joint Writing Team. The members of the team (in alphabetical order) include:

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I. INTRODUCTION

Surface transportation in the United States faces a number of challenges. Despite the fact that the United States has one of the best roadway systems in the world, mobility is declining and safety remains a serious problem. Inefficient movement of vehicles reduces productivity, wastes energy, increases emissions, and threatens the quality of life we enjoy. Safe, efficient, environmentally responsible transportation is vital to the social and economic health of the nation.

Intelligent Transportation Systems (ITS), formerly called Intelligent Vehicle-Highway Systems (IVHS), provide tools that can assist us in addressing current problems, as well as anticipate and address future demands through an intermodal, strategic approach to transportation. ITS applies advanced and emerging technologies in such fields as information processing, communications, control, and electronics to surface transportation needs. While ITS technologies alone cannot solve our transportation problems, they can enable us to re-think our approach to problem solutions, as well as to make current activities more efficient and cost effective. If ITS technologies are effectively integrated and deployed, there could be a number of benefits including more efficient use of our infrastructure and energy resources, and significant improvements in safety, mobility, accessibility, and productivity.

The National ITS Program Plan (NPP) provides a comprehensive planning reference for the application of intelligent transportation systems. It illustrates how the goals of private industry, transportation users, and federal, state, and local government can be addressed through the development and deployment of ITS. It provides guidance for those who are considering or have proceeded with the development and deployment of ITS by making them aware of the background, issues, considerations and requirements associated with a nationally compatible, intermodal ITS. The NPP, developed through an interactive, consensus building process, presents the views, activities, and needs of the broad range of ITS stakeholders. The audience for the NPP includes the private and public sector leaders, transportation users and operators, educators, transportation produce and service providers, and the general public.

STRATEGIC PLANNING FOR ITS

Congress asked the United States Department of Transportation (DOT) to prepare a strategic plan to guide implementation of IVHS. The U.S. DOT requested that ITS America, as a utilized Federal advisory committee, prepare a strategic plan to serve as a foundation for the Congressional Report. The “IVHS AMERICA Strategic Plan for Intelligent Vehicle-Highway Systems in the United States” was published in May, 1992, followed by the National Highway Traffic Safety Administration’s “IVHS Plan” in June, 1992. In December, 1992, DOT transmitted to Congress the “Intelligent Vehicle-Highway System (IVHS) Strategic Plan.”

These Strategic Plans built upon the foundation set forth in the Intermodal Surface Transportation Efficiency Act, enacted in December of 1991 (ISTEA). ISTEA established the principles for leadership in IVHS research and development, defined goals for a national IVHS program, and laid out key milestones for its achievement. Together these plans describe a long-range program for using modern communications, information processing, control, and electronics technologies to improve the operation of surface transportation systems across the nation. Many elements of the Strategic Plans provided guideposts for today's dynamic U.S. ITS program, but their most significant contribution was their collective depiction of a national vision for the emerging IVHS industry. This vision is summarized in the frame below.

"We envision, during the next 20 years, the implementation of a national IVHS program, comparable in scope to the Interstate Highway System, with major participation by the private and public sectors. The primary focus of such a program is the creation of a truly balanced transportation system that includes the following:

- *A national system **of** travel-support technology, smoothly coordinated among modes and jurisdictions to promote safe, expeditious, and economical movement **of** goods and people;*
- *A system that encompasses mobility and accessibility **for** urban, suburban, and rural transportation users;*
- *A new level of cooperation and commitment between the public and private sectors to deliver the systems and create the infrastructure that will implement a mobility revolution.*
- *A vigorous U.S. IVHS industry supplying both domestic and international needs.*
- *A safe, efficient surface transportation system that complements and interacts smoothly among air, transit, rail, maritime, and highway operations."*

*Adapted from: The U.S. Department **of** Transportation IVHS Strategic Plan and the IVHS AMERICA Strategic Plan for Intelligent Vehicle-Highway Systems in the United States.*

The Strategic Plans recognized that the United States and its major economic competitors worldwide have become information- and communications-intensive societies. The Plans predicted that travel in the U.S. could reach new levels of safety and efficiency by improving conventional transportation infrastructure with new information and communication capabilities.

The private sector is now poised to deliver a vast array of ITS products and services only imagined a few years ago. American communications, electronics, defense, and traditional transportation companies have invested in ITS to bring it to the commercial, consumer, and public marketplace. For much of the ITS vision, the technology has "arrived" and an ambitious program of testing ITS under operational conditions is in progress. Both public and private research efforts are underway to support the rollout of new products and services for several decades.

THE NATIONAL ITS PROGRAM PLAN

The IVHS Strategic Plan observed that deployment of ITS would not parallel the centralized, staged development of major national systems in the aviation, defense, and space programs. In contrast, ITS deployment and operation will unfold through a Federal, state, and local partnership for investment in ITS and the efforts of private companies to market ITS products and services. The Strategic Plans acknowledged the need to develop a specific framework for the deployment of ITS--a framework which addresses the role of the Federal government and public/private partnerships in facilitating deployment and identifies the important planning, marketing, education, and coordination tasks which must be undertaken nationwide.

The National ITS Program Plan provides that framework. A joint effort of the U.S. DOT and ITS AMERICA, the Plan attempts to reflect the views of a broad range of players with a stake in the development and deployment of ITS.[1]

The National ITS Program Plan will:

- ***Promote Shared ITS Goals***

  The Plan is unique in that it integrates activities that are public, private, and cooperative in nature. It reflects the input of many diverse interests, including the Federal government, state and local public agencies, private firms, and public interest organizations concerned about the environment and transportation safety. In the future it will provide a focus for public policy dialog.

- ***Guide ITS Investment Decisions***

  The Plan lays a foundation for both public and private strategic decision making. The Plan can help state and local governments, private businesses, and consumers determine

1 The Plan has been prepared through a participative process, reflecting the ideas and contributions of many different organizations and individuals. Public comments have been solicited by U.S. DOT through Federal Register notices and public meetings.

the availability of services that can address their travel and operational needs. It also provides information about market readiness to inform private sector investments in product development.

- ***Encourage Coordination***

  By providing a framework for planning, the Plan promotes coordination and integration of user service development activities.

- ***Maintain a Focus on Deployment***

  The Plan will reflect the order in which user services can, and likely will, be deployed and sharpen the focus on key forces affecting deployment decisions.

- ***Ensure ITS is Intermodal***

  The Plan outlines a deployment vision aimed at smoothing intermodal linkages and integrating a national transportation system.

The Program Plan is not a static document, but the beginning of a periodic planning process. As part of this process, ITS America will prepare a Program Advice Memorandum (PAM) conveying recommendations for Federal ITS program adjustments or other modifications for the next two fiscal years. Following submission of the PAM, updates to the Program Plan will be prepared by DOT and ITS America to reflect changes in program direction and priority. Every few years, a completely new edition of the Program Plan will be developed.

THE ITS OPPORTUNITY

Although the United States has one of the best surface transportation systems in the world, continued growth in travel is severely straining the system. The level of mobility on which we have come to depend can no longer be taken for granted. In many areas of the country we cannot financially or environmentally support the building of enough additional roads to solve the congestion problem.

Congestion on the Nation's highways continues to increase, particularly in urban areas and along heavily-traveled intercity corridors. The annual cost of congestion to the Nation in lost productivity alone is about $100 billion, exclusive of the costs of wasted fuel and environmental damage. In addition, more than 40,000 persons are killed and another 5 million injured each year in traffic accidents, at an additional cost of over $137 billion to the Nation's economy. Even though highway fatalities have been declining in recent years, the loss of so many human lives is unconscionable in an era when technology would permit us to save many of them.

We need a “smarter” surface transportation system that offers increased performance in many respects. While Intelligent Transportation Systems cannot solve every surface transportation problem, adoption of ITS user services does present the opportunity to make progress in relieving chronic national transportation problems and even help achieve broader social goals.

Improving Travel Without Harming the Environment

The benefits of ITS on overall transportation system efficiency will relieve some demand for new highway right-of-way and lane construction, with the effect that fewer wetlands, parklands, historical sites, and other sensitive areas will be adversely affected. For example, in Minneapolis, after 10 years of operation, evaluations of their freeway operations activities show that average peak period freeway speeds increased from 34 to 46 mph (35%) while peak period volume increased 32%.

Improving traffic flow through better traffic signalization, traffic management systems, and electronic toll collection has the potential to reduce harmful emissions associated with frequent vehicle acceleration and deceleration and to distribute traffic more evenly to eliminate hotspots. For example, reported benefits for the ATSAC computerized traffic signal control system in Los Angeles include reductions between 10% - 15% in fuel consumption and hydrocarbon and carbon monoxide emissions. Route guidance and other travel information services can prevent unnecessary mileage associated with inefficient routing or inadequate information about potential destinations. Good incident management systems can shorten periods of congestion, and resulting high emissions levels, caused by highway mishaps and special events.

Assuming local policy support, electronic payment services provide important enabling technologies for demand management strategies such as congestion pricing. For example, in Southern California, two new high-occupancy vehicle lanes will be built in the median of SR-91 and equipped with electronic toll collection capability. Vehicles with three or more people will be able to use the lanes for free, while vehicles with one or two people will pay charge that will vary according to the current level of congestion along the route.

ITS user services provide a variety of tools which can help States and metropolitan areas use their existing transportation resources more efficiently without exacerbating environmental and energy problems. Several ITS services provide better information about transit, ridesharing, and other alternatives to single occupant vehicle travel. For example, in the Smart Traveller system in Bellevue, Washington, 53 registered users divided into three ride groups (formed on the basis of common work trip origins and destinations), offered 496 rides over a four month initial operating period, and looked for rides 145 times over the same period. More accessible, complete information about transit schedules, routes and fares should also attract more riders, particularly if combined with demand management strategies. Other user services improve the safety and operation of transit systems, making them more attractive and dependable to riders.

Providing Convenient Travel for All Americans

Many Americans who now travel with difficulty may find transportation more accessible and reliable in the future with ITS. Information about travel options will be more widely and readily available, and it will be easier to plan travel that may involve more than one mode, such as bus and rail, or carpool to rail. Many young, rural and inner city residents will find public transportation more accessible as well. In fact, the application of information and communications technologies to transportation can make it easier to tailor services to individuals of many different backgrounds and needs, such as those facing literacy, language, and learning ability barriers.

More secure, affordable services will be more responsive to the needs of disabled and older Americans. Several ITS technologies will help disabled and older drivers with the driving task, including **head-up displays** to alleviate eye refocusing problems caused by repeated glances between an instrument panel (nearsighted) and the roadway (farsighted); **infrared imaging** to make it easier for drivers to navigate under reduced visibility conditions (nighttime, fog, etc.); **obstacle detection devices,** which will be of particular benefit to older drivers at intersections and during lane change maneuvers; **driver alertness warnings,** which will monitor deviations from normal steering and braking performance as an indicator of lapses of attention, perhaps caused by drowsiness; **automated braking and steering** to mitigate limited depth perception, reduced peripheral vision, and slower decisions and reaction times; and **MAYDAY systems** that will enable drivers to convey emergency messages and request assistance such as medical, police, fire, rescue, and vehicle services.

Increasing Transportation System Efficiency

One of the greatest advantages of ITS is its ability to help travelers make better use of the existing surface transportation system. ITS services can reduce routine congestion and smooth traffic flows through real-time traffic control, electronic toll collection, and pre-trip and en-route driver information. In a study of a corridor in Austin, Texas, for example, one set of researchers found that travel times may be reduced by 15% to 30% through route change, and 10% to 22% through departure time switching. Timely information can help some travelers avoid delays and disruptions caused by accidents and special events, and overall backups from incidents can be eased with better incident management systems. One study estimated that during off-peak hours, each additional minute taken to clear an incident extends the duration of congestion by four or five minutes. In peak periods, this factor often soars to fifty to one, or more. ITS also can facilitate special measures to reduce vehicle demand such as congestion pricing and high occupancy vehicle enforcement.

Wasted travel associated with navigational problems can be reduced or eliminated through the use of pre-trip and in-vehicle navigation services, as well as travel information services. FHWA research completed in 1985 showed that approximately 6% of all driving in the United States was due to incorrect choice of route. In the future, transportation system efficiency could be dramatically increased with implementation of special automated highway lanes. A simulation of the Long Island Expressway in New York showed that conversion of a single existing lane to an Automated Highway System (AHS) lane would cut congestion on both the AHS and non-AHS lanes and arteries to the point that average rush hour trip time would be cut by 50 percent.

Boosting Productivity

By reducing time and travel costs for individuals, commercial and public transportation fleets, and public regulatory agencies, ITS services can make a significant contribution to national productivity.

Commercial vehicle fleets and State regulatory agencies can achieve time and cost savings through electronic clearance for compliance with safety (e.g., carrier safety fitness rating, vehicle out-of service, driver license record), credentials (e.g., vehicle registration, fuel-use tax, operating authority, oversize/overweight payments), and size and weight (e.g., legal size and weight limits). According to a July, 1993, Oregon State ITS Strategic Plan, when 60% of trucks participate in an electronic clearance program, each dollar of cost is offset by $3.60 in benefits. Benefits of electronic clearance accrue to safe/legal carriers: time and fuel savings, greater ability to meet delivery schedules, fairer competition against illegal drivers and carriers. States will be able to streamline commercial vehicle regulatory processes and benefit through less need for new or expanded facilities; more efficient use of resources by concentrating enforcement activities on carriers with records of weight, registration or safety violations; increased revenue as a result of more effective enforcement; and preservation of pavements as a result of more efficient weight monitoring. The public will also benefit from safer roads and more effective use of tax dollars.
A host of other services designed to streamline administrative and regulatory processes and offer companies new management tools for effective operation can boost company productivity. For example, the availability of real-time traffic and vehicle location information for commercial vehicles would help dispatchers of demand responsive pickup-and-delivery operations optimize their fleet operations to avoid congested areas and improve the reliability of service.

Transit agencies can become more productive and customer responsive with adoption of ITS services that help keep systems operating on time and provide more information to the public about services offered, routes and schedule adherence.

Overall transportation system productivity will be improved with the use of ITS-generated data to inform transportation planning, operations management, systems maintenance, and user fee analysis.

Improving Safety on the Nation's Surface Transportation System

Deployment of many ITS user services can help reduce the number and severity of crashes and the resultant fatalities and injuries on our national transportation system. New products will ensure the driver's own state of fitness, enhance driver perception on a continuous basis, give warning of impending danger, intervene with emergency control if a crash is imminent, and eventually automate the driving process on specialized roadways. The next generation cruise-control system, for example, will automatically slow the vehicle to maintain a safe distance from vehicles ahead. With a lane tracking system, imminent departure from the roadway will be predicted by on-board electronics, and the driver will be alerted in time to recover. A cooperative intersection will communicate data on the state of the traffic signal and the presence of conflicting traffic so as to avoid intersection collisions. Nighttime vision will be enhanced by sensing images that the eye cannot readily perceive and converting them into visible form for viewing by the driver.

Enhanced emergency response services can ensure that help arrives more quickly to an accident scene. In 1991, the average elapsed time between a fatality crash and notification of the dispatcher was about 5 minutes in urban areas, and about 10 minutes in rural areas. The probability of a fatality or long-term injury increases with the delay in receiving medical attention. Personal security can be improved in private vehicles and public transportation facilities through greater use of existing technologies such as "MAYDAY" alarms and closed circuit television systems. Better incident management services will remove disabled vehicles from the roadway before they lead to secondary accidents. Studies have shown that 20% to 30% of freeway pedestrian facilities are associated with disabled vehicles. ITS can also provide timely information to individual travelers on traffic and weather conditions, allowing them to make better decisions about the safest mode and route for travel.

Even though the rate of fatal accidents involving medium and heavy vehicles has fallen from 4.1 per million miles in 1982 to 2.5 in 1992, this rate is still significantly higher than for all vehicles (1.6). These accidents cost carriers, drivers and the general public billions of dollars annually. Over 1.6 million State-conducted roadside safety inspections of commercial motor vehicles occur per year. However, these account for only a small percentage of the vehicles that pass inspection sites yearly. With the adoption of efficient and accurate automated safety inspection procedures, state enforcement personnel will be able to inspect more vehicles and target problem areas during inspections while reducing overall government costs. Between 10,000 and 20,000 incidents occur each year that involve release, or the threat of release of a hazardous material. In some cases, emergency responders were unable to obtain necessary information on the material, or experienced significant delay in obtaining it. Automated hazardous materials incident response systems will help emergency teams react to accidents more quickly with appropriate techniques to contain damage and protect the public.

II. ITS USER SERVICES

The national ITS program is focused on the development and deployment of a collection of inter-related user services. Twenty-nine user services have been defined to date as part of the national program planning process. This list of user services is neither exhaustive nor final. There are a wide array of transportation services that could develop that are not included in this list. Furthermore, the services here are expected to change over time. Some will develop largely as envisioned, new services will emerge, and others, for various reasons, may never be developed. This list of services, and the accompanying descriptions are expected to evolve through program plan updates and new editions.

The users of a particular service will vary and could include travelers of any mode, operators of transportation management centers, transit operators, Metropolitan Planning Organizations (MPOs), commercial vehicle owners and operators, state and local governments, and many others who ultimately may take advantage of ITS.

USER SERVICE DESCRIPTIONS

Although each user service is unique, they share several common characteristics. User services are:

- **Composed of Multiple Technological Elements**

  A single user service will usually depend upon several technologies such as advanced communications, mapping, and surveillance, and which may be shared with other services.

- **Building Blocks**

  Once the basic technological functions, such as communications or surveillance, have been deployed for one or more service, the additional functions needed by one or more related services may require only a small incremental cost, which producing additional benefits. User services can be combined for deployment in a variety of ways depending upon local priorities, needs, and market forces.

- **Adaptable to rural, urban, and suburban settings**

  ITS user services are not specific **to** a particular location. Rather, the function of the service can be adapted to meet local needs and conditions.

USER SERVICE BUNDLING

Although it may be possible to deploy a system that provides a single user service, in many cases, services are more likely to be deployed in combination with other services or *"bundle"* which share some commonality.

For purposes of discussion in the NPP, the twenty-nine user services have been sorted into categories termed "bundles." The services within these bundles, as shown in Table S-l, may be related in a number of ways. In some cases, the institutional perspectives of organizations that will deploy the services provided the rationale for the formation of a specific bundle. In other cases, bundles were organized around common technical functionalities. These services could have been bundled in any number of ways. Table S-l presents only one of a number of possibilities. When the services are actually deployed, it is likely that services will also be mixed and matched among the bundes, as well as within a bundle.

Travel and Transportation Management

- En-Route Driver Information

  Driver advisories and in-vehicle signing for convenience and safety during travel.

  Once travel begins, driver advisories convey real-time information about traffic conditions, incidents, construction, transit schedules, and weather conditions to drivers of personal, commercial and public transit vehicles. This information allows a driver to select the best route, or shift to another mode in mid-trip if desired.

  In-vehicle signing, the second component of en-route driver information, would provide the same types of information found on physical road signs today, directly in the vehicle.

- Route Guidance

  Provides travelers with simple instructions on how to best reach their destinations.

  The route guidance service provides a suggested route to reach a specific destination. Early route guidance systems will be based on static information about the roadway network, transit schedules, etc. When fully deployed, route guidance systems will provide travelers with directions to their destinations based on real-time information about the transportation system. The route guidance service will consider traffic conditions, status and schedule of transit systems, and road closures in developing the best route. Directions will generally consist of simple instructions on turns or other upcoming maneuvers. Users of the service include not only drivers of all types of vehicles, but also non-vehicular travelers, such as pedestrians or bicyclists, who could get specialized route guidance from a hand-held device.

Table S-l User Service Bundles

Bundle	User Services
1. Travel and Transportation Management	1. En-Route Driver Information 2. Route Guidance 3. Traveler Services Information 4. Traffic Control 5. Incident Management 6. Emissions Testing and Mitigation
2. Travel Demand Management	1. Demand Management and Operations 2. Pre-Trip Travel Information 3. Ride Matching and Reservation
3. Public Transportation Operations	1. Public Transportation Management 2. En-Route Transit Information 3. Personalized Public Transit 4. Public Travel Security
4. Electronic Payment	1. Electronic Payment Services
5. Commercial V ehicle Operations	1. Commercial Vehicle Electronic Clearance 2. Automated Roadside Safety Inspection 3. On-board Safety Monitoring 4. Commercial Vehicle Administrative Processes 5. Hazardous Materials Incident Response 6. Freight Mobility
6. Emergency Management	1. Emergency Notification and Personal Security 2. Emergency Vehicle Management
7. Advanced Vehicle Control and Safety Systems	1. Longitudinal Collision Avoidance 2. Lateral Collision Avoidance 3. Intersection Collision Avoidance 4. Vision Enhancement for Crash Avoidance 5. Safety Readiness 6. Pre-Crash Restraint Deployment 7. Automated Highway System

- Traveler Services Information

  Provides a business directory, or "yellow pages," of service information.

  Traveler services information provides quick access to travel related services and facilities. Examples of information that might be included are the location, operating hours, and availability of food, parking, auto repair, hospitals, and police facilities. Traveler services information would be accessible in the home, office or other public locations to help plan trips, and might also be available en-route.

- Traffic Control

  Manages the movement of traffic on streets and highways.

  This service will provide for the integration and adaptive control of the freeway and surface street systems to improve the flow of traffic, give preference to public safety, transit or other high occupancy vehicles, and minimize congestion while maximizing the movement of people and goods. Through appropriate traffic controls, the service will also promote the safety of non-vehicular travelers, such as pedestrians and bicyclists. This service requires advanced surveillance of traffic flows, analysis techniques for determining appropriate traffic signal and ramp metering controls, and communication of these controls to the roadside infrastructure. This service gathers data from the transportation system, organizes it into usable information, and uses it to determine the optimum assignment of right-of-way to vehicles and pedestrians. The real-time traffic information collected by the Traffic Control service also provides the foundation for many other user services.

- Incident Management

  Helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic.

  This service enhances existing capabilities for detecting and verifying incidents, in both urban and rural areas, and then taking the appropriate actions in response. The service would use advanced sensors, data processing, and communications to improve the incident management and response capabilities of transportation and public safety officials, the towing and recovery industry, and others involved in incident response.

- Emissions Testing and Mitigation

Provides infonnation for monitoring air quality and developing air quality improvement strategies.

This service uses advanced vehicle emissions testing systems to provide information to identify environmental "hot spots" and implement strategies to reroute traffic around sensitive air quality areas, or control access to such areas. Other technologies provide identification of vehicles that are emitting levels of pollutants that exceed state, local or regional standards, and provides information to drivers or fleet operators to enable them to take corrective action. The service also provides transportation planning and operating agencies with information that can be used to facilitate implementation and evaluation of various pollution control strategies.

Travel Demand Management

- Demand Management and Operations

Supports policies and regulations designed to mitigate the environmental and social impacts of traffic congestion.

This service generates and communicates management and control strategies that support the implementation of programs to reduce the number of individuals who choose to drive alone, especially to work; increase the use of high occupancy vehicles, transit, and commuter rail; and provide a variety of mobility options for those who wish to travel in a more efficient manner, for example in non-peak periods. Demand management strategies could ultimately be applied dynamically, when congestion or pollution conditions warrant. For example, disincentives such as increased tolls and parking fees could be applied during pollution alerts or peak travel periods, while transit fares would be lowered to accommodate the increased number of travelers changing modes from driving alone.

- Pre-Trip Travel Information

Provides information for selecting the best transportation mode, departure time, and route.

Pre-trip travel information allows travelers to access a complete range of intermodal transportation information at home, work, and other major sites where trips originate. Real-time information on transit and commuter rail routes, schedules, transfers and fares, and ride matching services are available to encourage the use of alternatives to the single occupancy vehicle. Information needed for long, inter-urban or vacation trips would also be available. Real-time information on accidents, road construction, alternate routes, traffic speeds along given routes, parking conditions, event schedules, and weather information is also included. Based on this information, the traveler can select the best route, modes of travel and departure time, or decide not to make the trip at all.

- Ride Matching and Reservation

Makes ride sharing easier and more convenient.

This service provides real-time ride matching information and reservations to users in their homes, offices or other locations, and assist transportation providers, as well as van/carpoolers, with vehicle assignments and scheduling. This will expand the market for ridesharing as an alternative to single occupant automobile travel.

Public Transportation Operations

- Public Transportation Management

Automates operations, planning, and management functions of public transit systems.

This service provides computer analysis of real-time vehicle and facility status to improve transit operations and maintenance. The analysis identifies deviations from schedule and provides potential solutions to dispatchers and drivers. Integrating this capability with traffic control services can help maintain transportation schedules and assure transfer connections in intermodal transportation. Information regarding passenger loading, bus running times, and mileage accumulated will help improve service and facilitate administrative reporting. Automatically recording and verifying performed tasks will also enhance transit personnel management.

- En-Route Transit Information

Provides information to travelers using public transportation after they begin their trips.

This service provides information to assist the traveler once public transportation travel begins. Real-time, accurate transit service information on board the vehicle helps travelers make effective transfer decisions and itinerary modifications as needed while a trip is underway.

- Personalized Public Transit

Flexibly routed transit vehicles offer more convenient service to customers.

Small publicly or privately operated vehicles provide on-demand routing to pick up passengers who have requested service and deliver them to their destinations. Route deviation schemes, where vehicles would leave a fixed route for a short distance to pick up or discharge passengers, is another way of improving service. Vehicles can include small buses, taxicabs, or other small, shared ride vehicles. This service can provide almost door-to-door service, expanding transit coverage to lesser populated locations and neighborhoods. This can potentially provide transportation at lower cost and with greater convenience that conventional fixed route transit.

- Public Travel Security

Creates a secure environment for public transportation patrons and operators.

This service provides systems that monitor the environment in transit stations, parking lots, bus stops, and on-board transit vehicles, and generate alarms, either automatically or manually, when necessary.

Electronic Payment

- Electronic Payment Services

Allows travelers to pay for transportation services electronically.

This service will foster intermodal travel by providing a common electronic payment medium for all transportation modes and functions, including tolls, transit fares, and parking. The service provides for a common service fee and payment structure using “smart cards” or other technologies. Such systems will be truly multi-use, allowing personal financial transactions on the same medium. The flexibility that electronic payment services offer will also facilitate travel demand management, if conditions warrant. They could, if local authorities so choose, enable application of road pricing policies which could influence departure times and mode selection.

Commercial Vehicle Operations

- Commercial Vehicle Electronic Clearance

Facilitates domestic and international border clearance, minimizing stops.

This service will enable transponder-equipped trucks and buses to have their safety status, credentials, and weight checked at mainline speeds. Vehicles that are safe and legal and have no outstanding out-of-service citations will be allowed to pass the inspection/weigh facility without delay.By working with Mexico and Canada, a more efficient traffic flow would be provided at border crossings and the deployment of technologies in these countries could ultimately prevent overweight, unsafe, or improperly registered vehicles from entering the United States.

- Automated Roadside Safety Inspection

  Facilitates roadside inspections.

  Automated roadside inspections would allow real-time access at the roadside to the safety performance record of carriers, vehicles, and drivers. Such access will help determine which vehicle or driver should be stopped for an inspection, as well as ensuring timely correction of previously identified problems.

  This service would also automate as many items as possible of the manual inspection process. It would, for example, allow for more rapid and accurate inspection of brake performance at the roadside. Through the use of sensors and diagnostics, it would efficiently check vehicle systems and driver requirements and ultimately driver alertness and fitness for duty.

- On-Board Safety Monitoring

  Senses the safety status of a commercial vehicle, cargo, and driver.

  On-board systems would monitor the safety status of a vehicle, cargo, and driver at mainline speeds. Vehicle monitoring would include sensing and collecting data on the condition of critical vehicle components such as brakes, tires, and lights, and determining thresholds for warnings and countermeasures. Cargo monitoring would involve sensing unsafe conditions relating to vehicle cargo, such as shifts in cargo while the vehicle is in operation. Driver monitoring is envisioned to include the monitoring of driving time and alertness using non-intrusive technology and the development of warning systems for the driver, the carrier, and the enforcement official.

- Commercial Vehicle Administrative Processes

  Provides electronic purchasing of credentials and automated mileage and fuel reporting and auditing.

  Electronically purchasing credentials would provide the carrier with the capability to electronically purchase annual and temporary credentials via computer link. It will reduce burdensome paperwork and processing time for both the States and the motor carriers. For automated mileage and fuel reporting and auditing, this service would enable participating interstate carriers to electronically capture mileage, fuel purchased, trip, and vehicle data by State. It would also automatically determine mileage traveled and fuel purchased in each State, for use by the carrier in preparing fuel tax and registration reports to the States.

- Hazardous Material Incident Response

  *Provides immediate description **of** hazardous materials to emergency responders.*

  This service would enhance the safety of shipments of hazardous materials by providing enforcement and response teams with timely, accurate information on cargo contents to enable them to react properly in emergency situations. When an incident involving a truck or railcar carrying hazardous material occurs, the material or combination of materials involved would be electronically provided to emergency responders and enforcement personnel at the scene so that the incident can be handled properly.

- Freight Mobility

  Provides communications between drivers, dispatchers, and inter-modal transportation providers.

  The availability of real-time traffic information and vehicle location for commercial vehicles would significantly enhance the management of fleet operations by helping drivers to avoid congested area and improving the reliability and efficiency of pickups and deliveries. These benefits would be particularly important for operators of intermodal and time-sensitive fleets who can use these ITS technologies to make their operations more efficient and reliable.

Emergency Management

- Emergency Notification and Personal Security

  *Provides immediate notification **of** an incident and an immediate request **for** assistance.*

  This service includes two capabilities: driver and personal security, and automatic collision notification. Driver and personal security capabilities provide for user initiated distress signals for incidents like mechanical breakdowns or car jackings. When activated by an incident, automatic collision notification transmits information regarding location, nature, and severity of the crash to emergency personnel.

- Emergency Vehicle Management

  Reduces the time it takes emergency vehicles to respond to an incident.

  This service provides public safety agencies with fleet management capabilities, route guidance, and signal priority and/or preemption for emergency vehicles. Fleet management will improve the display of emergency vehicle locations and help dispatchers send the units that can most quickly reach an incident site. Route guidance directs emergency vehicles to an incident location, while signal priority optimize the traffic signal timing in an emergency vehicle's route.

Advanced Vehicle Control and Safety Systems

- Longitudinal Collision Avoidance

Helps prevent head-on, rear-end or backing collisions between vehicles, or between vehicles and other objects or pedestrians.

This service helps reduce the number and severity of collisions. It includes the sensing of potential or impending collisions, prompting a driver's avoidance actions, and temporarily controlling the vehicle.

- Lateral Collision Avoidance

*Helps prevent collisions when vehicles leave their lane **of** travel.*

This service provides crash warnings and controls for lane changes and road departures. It will help reduce the number of lateral collisions involving two or more vehicles, or crashes involving a single vehicle leaving the roadway. For changing lanes, a situation display can continuously monitor the vehicle's blind spot, and drivers can be actively warned of an impending collision. If needed, automatic control can effectively respond to situations very rapidly. Warning systems can also alert a driver to an impending road departure, provide help in keeping the vehicle in the lane, and ultimately provide automatic control of steering and throttle in dangerous situations.

- Intersection Collision Avoidance

Helps prevent collisions at intersections.

This service warns drivers of imminent collisions when approaching or crossing an intersection or railroad grade crossing that has traffic control (e.g., stop signs or a signal). This service also alerts the driver when the proper right-of-way at the intersection or grade crossing is unclear or ambiguous.

- Vision Enhancement for Crash Avoidance

Improves the driver's ability to see the roadway and objects that are on or along the roadway.

Improved visibility will allow drivers to avoid potential collisions with other vehicles, obstacles in roadway, or parked or moving trains, as well as help the driver comply with traffic signs and signals. This service requires in-vehicle equipment for sensing potential hazards, processing this information, and displaying it in a way that is useful to a driver.

- Pre-Crash Restraint Deployment

Anticipates an imminent collision and activates passenger safety systems before the collision occurs, or much earlier in the crash event than is currently feasible.

This service identifies the velocity, mass, and direction of the vehicles or objects involved in a potential crash, and the number, location, and major physical characteristics of any occupants. Responses include tightening lap-shoulder belts, arming and deploying air bags at the optimal pressure, and deploying roll bars.

- Safety Readiness

*Provides warnings about the condition **of** the driver, the vehicle, and the roadway.*

In-vehicle equipment will unobtrusively monitor a driver's condition and provide a warning if he or she is becoming drowsy or otherwise impaired. This service could also internally monitor critical components of the automobile, and alert the driver to impending malfunctions. Equipment within the vehicle could also detect unsafe road conditions, such as bridge icing or standing water on the roadway, and provide a warning to the driver.

- Automated Highway Systems

Provides a fully automated, "hands-off," operating environment.

Automated highway systems are a long term goal of ITS which would provide vast improvements in safety by creating a nearly accident free driving environment. Drivers could buy vehicles with the necessary instrumentation or retrofit an existing vehicle. Vehicles that are incapable of automated operation, during some transition period, would drive in lanes without automation.

III. ITS NATIONAL COMPATIBILITY

ITS presents stakeholders with a variety of options to address their transportation needs. It is important that these products and services are interoperable and nationally compatible. Product providers, such as automobile manufacturers and software, map, sensor, and communications companies, want to be certain that their products will be technically compatible with related ITS products on a national basis. Traffic information services, phone and cable companies, and toll authorities want to invest in the development of services that they are certain cars, trucks and homes will be equipped to receive. State transportation departments, city and county authorities, and Metropolitan Planning Organizations want to invest public funds in systems which will function smoothly with systems used by other jurisdictions or agencies and be capable of expansion to future capabilities. Individual travelers and commercial users want assurance that their investments in ITS products have the maximum range, applicability, and interoperability.

Rather than leaving national compatibility to a random, evolutionary process with many risks, Congress, in ISTEA, directed the U.S. Department of Transportation to promote national ITS compatibility. The Department, with advice from ITS America, has responded by leading an effort to develop a national ITS architecture. In addition, ITS standards development is proceeding and new standards will be identified with the architecture development. Telecommunications systems are an important aspect of ITS and play a key role in the development of a national ITS architecture. Together, these activities represent the first steps toward a nationally compatible ITS.

THE NATIONAL ITS ARCHITECTURE

The development of a national ITS architecture will provide a framework that describes how ITS components interact and work together to achieve total system goals. It will be an open system architecture[1] that describes the system operation, what each component of the system does, and what information is exchanged among the components. It will be modular, allowing for and facilitating the introduction of new technologies and system capabilities over time. The architecture is different from a system design. Within the framework of the architecture, many different designs can be implemented. Using an analogy of the home stereo system, the architecture defines the functions of various components -- receivers, compact disk players, etc. -- and specifies how they will be interconnected. Consumers are able to put together their own system design with products of various capabilities and options with confidence that they will work together. Manufacturers adhering to architectural standards are assured that their products will be acceptable in the marketplace alongside other competing consumer products.

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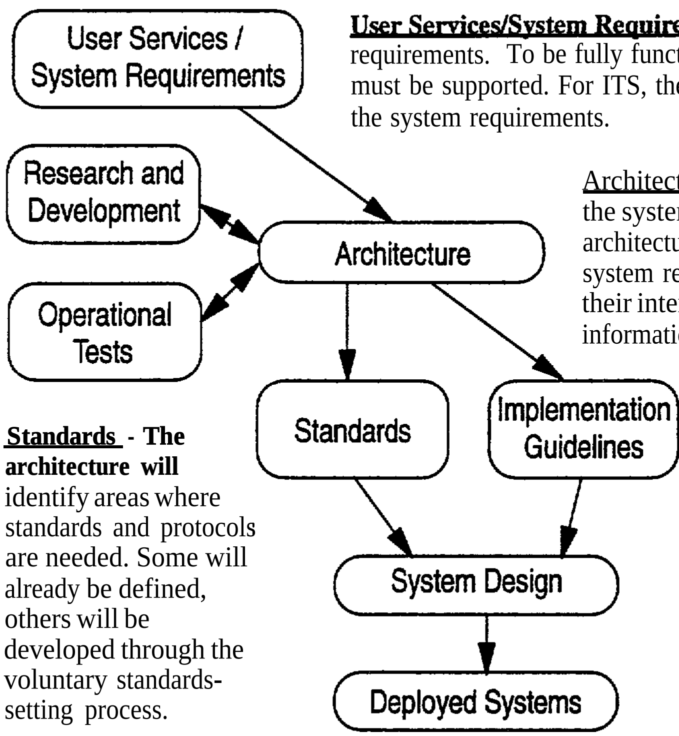
1 An architecture can be either "open" or "closed." An architecture is open if its documentation is in the public domain. An open architecture encourages competition among multiple vendors. with their success determined by capability, cost, and innovation. Supporting information in a "closed" architecture usually is proprietary and consequently does not encourage competition among suppliers.

The development of the national ITS architecture is a top-down, systematic process. It involves an understanding of system goals, the functions and functional requirements necessary to achieve those goals, and the different operational concepts and enabling technologies that can be used to build a system that meets those functional requirements. In ITS, the 29 user services are regarded as the functional requirements of the ITS architecture. The architecture is one step on the road to a nationally compatible ITS as illustrated in Figure S-l.



__User Services/System Requirements__ - A system is defined as a set of system requirements. To be fully functioning as a system, all system requirements must be supported. For ITS, the 29 user services serve as the foundation for the system requirements.

__Architecture__ - The framework that logically connects the system elements to meet requirements. For ITS. the architecture will integrate the user services, allocate their system requirements to physical elements, and define their interconnections. Early research and tests provide information necessary to develop an architecture.

__Standards__ - **The architecture will** identify areas where standards and protocols are needed. Some will already be defined, others will be developed through the voluntary standards-setting process.

__Jmplementation Guidelines__ - **The architecture** will set numerous performance characteristics. To deploy elements of the architecture, guidelines will be developed to illustrate things like minimum computer processing speeds or recommended communications data transmission rates. Guidelines are primarily targeted toward the public sector to aid in system design deploymentdecision.

Figure S-l National ITS Architecture and ITS Deployment

THE NATIONAL ITS ARCHITECTURE DEVELOPMENT PROGRAM

Initiated in September, 1993, the U.S. DOT is leading a 34-month, two-phase program to define a national ITS architecture. The first phase of the program, completed in January 1995, involved the development of four architectures developed in parallel by consortia teams led by Hughes, Loral, Rockwell International, and Westinghouse. These architectures were developed in a competitive environment and were evaluated for technical soundness and desirability to stakeholders. The most promising approaches were down-selected for continuation in Phase II, The teams selected to continue to Phase II were those led by Loral and Rockwell International. Phase II of the architecture development will involve the two downselected teams working together in a non-competitive environment to refine the Phase I architectures into a single national ITS architecture. This phase began in February 1995 and is scheduled for completion in July 1996.

Because ITS is a national, not a federal program, the U.S. DOT recognizes that it serves as a facilitator in the process of defining a national architecture, but will not be the "owner" of the architecture. An extensive effort is underway to outreach to, and get feedback from, those who will be affected by ITS. These "stakeholders" may be affected differently depending upon which architecture approach is implemented. This "consensus building" process being conducted jointly by U.S. DOT and ITS America has been designed to involve as many stakeholders as possible so that the architecture emerging from the national effort is both technically sound and responsive to the desires of the many stakeholders in ITS. Deployment of ITS will depend upon the decisions of stakeholders--consumers, public agencies, fleet operators, and others--that ITS is in their best interest.

THE BENEFITS OF A NATIONAL ITS ARCHITECTURE

There are many benefits to establishing a national ITS architecture. It will promote national *compatibility* allowing smooth operation of ITS devices throughout the country. It will also set the foundation for the development of national -- and possibly North American or international -- standards and protocols. A national ITS architecture will *facilitate user service integration* making system deployments more efficient and effective. It will *prerserve local agency and consumer choices* by stimulating the development of a broad array of products and services. The architecture will *accommodate new services and technologies* by providing a framework for integrating them with existing systems. *Market competitiveness will be encouraged* resulting in more product choices and lower prices to the consumer.

STANDARDS AND GUIDELINES

In addition to the national ITS architecture, development of ITS standards will accelerate ITS development and deployment. By ensuring that ITS components will operate in a consistent, predictable way, the establishment of standards will facilitate national, global, and cross-modal compatibility and interoperability, helping U.S. industries gain greater access to the international ITS marketplace, Standards development will improve overall product design and performance, safety, and ease of operation and maintenance. Industry standards will also boost consumer confidence, because new ITS products would be more likely to retain their value. Users would find it easier to upgrade their systems as new, add-on features become available.

In the long run, standards will reduce costs for manufacturers by eliminating much of the risk that new products would depend upon "orphan" technologies. National and international standards also would make it easier for ITS vendors to offer their products over wide geographic areas. Although standard setting activities are already underway, the adoption of the National ITS Architecture in 1996 will provide the framework for establishing many new ITS standards.

The U.S. DOT has a key role in ITS standards development and will use operational test results, deployment-related experience, and public safety responsibilities to contribute to the standard setting process.

ITS AMERICA's Standards and Protocols Committee, composed of government organizations, private sector stakeholders, and the academic community, is chartered to serve as an oversight and coordinating committee for all standards activities, including cross-modal applications, in the U.S. relating to ITS. The Committee identifies the need for specific standards and promotes effective communication among parties interested in standards. Once standards requirements are identified by the Committee, it looks to traditional standards developing organizations (SDO) for their development. The Committee would create standards only if there were no SDO available to do so.

SDOs establish standards through a consensus process among industry experts, user representatives, and general interest groups. ITS standards development activities are underway within the following organizations:

- The American Society for Testing and Materials is addressing vehicle-to-roadside communications, traffic characteristics, traffic and application device interconnection protocols, and smart materials and systems.

- The Institute for Electrical and Electronics Engineers is examining communications, electrical and software safety, and other topics within the field of electrotechnology.

- The Institute of Navigation is addressing topics in navigation, such as positioning performance.

- The Telecommunications Industry Association is pursuing standards in mobile communications systems.

- The Society of Automotive Engineers is identifying recommended practices and standards for vehicle components and/or systems interacting with a vehicle.

Other national and international standards activities have begun in important areas such as PM subcarrier broadcast traffic information; interface among traffic sensors, traffic controls, and traffic management systems; and wireline and wireless telecommunications standards for ITS applications.

TELECOMMUNICATIONS SYSTEMS

Telecommunications systems are a combination of facilities, stations, and electronic circuits that transfer information through wireless and wireline communications media. Telecommunications systems at the local, regional, state, national levels will provide the means for exchanging travel information to support ITS user services. For example, real-time traffic information may be exchanged through telecommunications between mobile users and the infrastructure to assist in route guidance. Commercial vehicles will use telecommunications to transmit safety, credential, and other data to the fleet management or state agency infrastructure for electronic clearance.

ITS telecommunications techniques include:

- Wireless broadcast, which transmits information one-way over large areas, without a physical connection;

- Cell-based communications, which divide a geographic area into cells, each of which employ a base station and a transmitter, and offer two-way information exchange;

- Beacons, which are short-range, two-way communication devices using infrared, millimeter wave, and microwave technologies; and

- Land-line communications, which pass information through a physical connection, such as cable or wire.

The U.S. DOT, ITS America, ITS industry organizations, standards developing organizations, and Spectrum Management Organizations currently are examining the telecommunications requirements necessary to develop and implement ITS. Efforts include telecommunications technologies assessment, standards development, and radio frequency spectrum requirements and allocation. These efforts must be coordinated among the various transportation modes, including transit, rail, and commercial vehicle, recognizing the interest that each has in the radio frequency spectrum and allocation.

The ITS AMERICA Telecommunications Committee works proactively with the Federal Communications Commission and the National Telecommunications and Information Administration on ITS radio frequency spectrum matters such as spectrum management and electromagnetic compatibility. Currently the Committee is assessing radio frequency spectrum resource requirements for ITS and mapping these requirements in a matrix with corresponding user services, current technologies, and future telecommunications services.

- ***Telecommunications Technology Selection Criteria***

  When choosing a particular telecommunications technology for ITS, organizations need to consider several factors. Reliability is essential to prevent loss of critical traffic and travel information, ensure the integrity of electronic toll collection systems, and ensure emergency notification functions operate smoothly. To improve reliability, systems should have continual monitoring, automatic outage detection, and automatic rerouting capabilities.

ITS telecommunications systems should be relatively easy and inexpensive to maintain, as well as secure to prevent eavesdropping, misuse of information, service theft, and malicious and inadvertent intrusion.

Because ITS may be deployed in several phases, resistance to obsolescence is an important element in selecting telecommunications technologies. Ideally, near-term hardware, software, and other network components would be compatible with equipment installed during later stages of deployment. ITS telecommunications systems should support both fixed and mobile applications, at both short and long ranges, and must permit both geographic and vendor interoperability. Systems should operate well in a variety of environments, ranging from urban population centers to rural areas.

- ***Telecommunications System Deployment Options***

When considering deployment of telecommunications systems to support ITS, State and local agencies, as well as private organizations, have three options: build and operate their own dedicated facilities, purchase facilities and services from private sector telecommunications providers, or enter into partnerships with telecommunications providers.

Each option has its own particular advantages and drawbacks. With dedicated systems, deploying agencies can rely upon known capacity and control of the system, and potential long-term cost benefits. However, dedicated systems require high initial capital investments and may involve long-term operations and maintenance costs and complexities. State and local agencies also risk system obsolescence and incompatibility with neighboring jurisdictions. In addition, a dedicated system may duplicate existing private sector infrastructure and place the government unfairly in competition with the private sector and present an issue concerning the government's role.

Purchased private sector telecommunication services require a smaller up-front investment, and costs of operation and maintenance will be included in usage fees. Periodic upgrades with new technologies may be made by the private operator, and geographic interoperability may be easily obtainable. However, the risks associated with using the existing private sector-owned systems include lack of infrastructure availability and capacity along some highways, and high costs due to regulatory policies and lack of competition at the local level.

A third alternative is a public/private partnership. Many partnership arrangements are possible. An example is one in which the public sector makes its right-of-way available to private sector providers. The availability of right-of-way should be done through a formal solicitation process so that all private sector providers are given equal opportunity to participate. The public sector may require a specific capacity, such as a specific number of fiber optic strands, be reserved for their dedicated use, as well as maintenance agreements. In return, the private sector participant would be able to lay land lines along the right-of-way and sell the remaining capacity to their customers.

To determine the optimum deployment scheme, state and local agencies need to perform both cost and capability assessments for the life of the telecommunications system.

IV. WHERE IS ITS TODAY?

In the information and electronics age, intelligent transportation services have gradually assumed an important role in improving the operation of the Nation's surface transportation system. Ramp meters, loop detectors, roadside cameras, and changeable message signs are common sights along the highway. Commercial and transit operators routinely use vehicle location systems and on-board computers to manage their fleets. Electronic toll collection systems are springing up around the country, and even in-vehicle route guidance systems are available to consumers. ITS can no longer be regarded as futuristic or even the technology of tomorrow.

Many ITS user services are now on the "ready rack," in use in some areas and available for mainstream deployment. Many others can be fully deployable within 3 to 5 years. At this time, however, there is no definitive, centralized scheme to deploy ITS throughout the nation. The National ITS Program is at important crossroads; key decisions can be made to stimulate and direct deployment of services now available, and break down barriers to deployment of those services that could become available in a matter of a few years.

A SNAPSHOT OF CURRENT DEPLOYMENT

An examination of the current state of deployment of ITS user services provides a useful starting point for determining the best path to mainstream deployment (See figure S-2).

Travel and Transportation Management

Many metropolitan and state transportation agencies are now deploying some form of advanced transportation management system. A recent tally of projects assembled by ITS AMERICA showed 12 freeway operation centers, 85 local traffic control centers, 31 freeway service patrols, and 47 incident management programs being established or in operation around the country.

Thirty-eight percent of state traffic engineers responding to an Institute of Transportation Engineers survey report that they are actually involved in advanced freeway traffic management system activities.

Using loop detectors, video cameras, and vehicle identification devices such as toll tags, traffic engineers are able to monitor current traffic conditions. Active control of traffic is achieved through use of signal timing, ramp meters, variable message signs, highway advisory radio, and commercial traffic information reporting services. Although substantial travel information is being collected by public agencies with transportation responsibilities, it is rare that this information is shared among local traffic control centers, freeway operations centers, transit management centers, and emergency management systems operators.

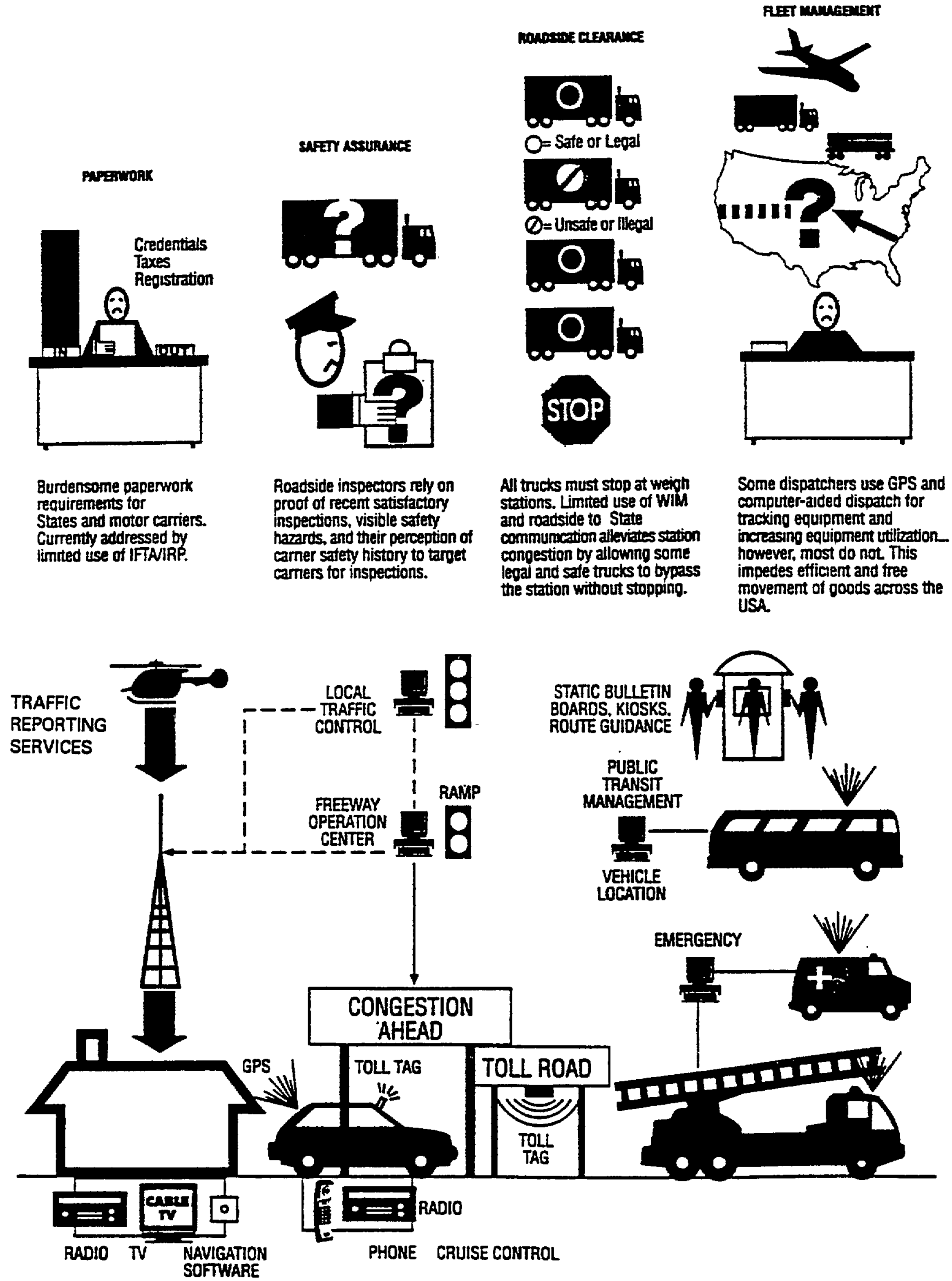


Figure S-2 ITS Deployment Today

Adaptive traffic control systems are now available, but most signal timing adjustments are still made through active human intervention. Some agencies are simply hesitant to adopt new technologies; others are limited by a shortage of employees with the technical skills to implement advanced systems, or by budgets too slim to support operations and maintenance on a long-term basis.

In the private sector, companies such as Metro Traffic and Shadow Traffic are collecting travel information from a variety of sources--aircraft, freeway operation centers, or car phones--and then packaging and selling the information. Through radio and television broadcasts of this information, travelers are often able to make better travel choices. However, the information available to individual travelers remains at a very general level. Information rarely can be obtained about specific roads or bridges, alternative travel modes, or better routes.

Personal devices to receive travel information are available to consumers using technologies such as digital cellular telephone and paging systems, portable digital personal communications devices, in-vehicle subcarrier radio, and palm top computers. However, their widespread implementation is hampered by uncertainty about marketability and a lack of specific, localized traveler information. Transit information, if included at all, is not real-time.

Static route guidance systems are now commercially available to consumers, either through products installed in vehicles or through personal computer software packages. Dynamic route guidance systems cannot be widely implemented until more real-time travel data is available and greater consistency can be achieved among jurisdictions.

Public Transportation Operations

Scheduling and run-cutting software are in use at most medium and large transit agencies. Computer-aided dispatch transit radio systems and automatic vehicle location systems are becoming more commonplace as agencies find they provide many unanticipated benefits. Fourteen transit properties currently have automated vehicle location capability. Location information is provided by GPS, signposts, or map matching applications. Despite the large amount of transit data being collected, sharing of data between transit and traffic management agencies, or with the traveling public, is rare.

Demand responsive trip scheduling software is in widespread use in specialized transportation systems for older and disabled travelers. Route deviation schemes are in use in a number of small systems. Advanced transit security devices, such as closed circuit TV in parking lots and stations, slow-scan recording cameras in vehicles, and emergency alarms in vehicle radios, have been in use for several years.

Electronic Payment

Electronic payment systems are planned or deployed at 20 toll facilities around the country, and a robust, competitive market has developed for these systems. In some regions efforts are underway to install compatible systems in adjacent states, but broad interoperability has not yet been achieved. Standards development to address interoperability is making headway, however.

Several public transit systems now are using magnetic stripe technology for collection of fares. Some systems are evaluating the use of "smart cards" for multiple transportation and non-transportation purposes, such as parking fees and telephone usage.

Commercial Vehicle Operations

Commercial fleet management systems have been deployed in over half the major U.S. trucking fleets. Private truck and bus companies are incorporating safety data from on-board devices, such as engine temperature and driver hours, in their routing and dispatching decisions. Automatic vehicle and container identification systems are expediting just-in-time deliveries and intermodal shipping operations.

Approximately 100 sites will be connected to the Motor Carrier Management Information System (MCMIS) in 1996, and in 1997 MCMIS will expand to include driver and vehicle data and 100 additional sites. MCMIS is a Federal database that contains motor carrier safety information which is used, for example, by states in roadside inspections.

Automatic vehicle identification and weigh-in-motion technologies are being applied to gather information on truck credentials and vehicle weight. Heavy Vehicle Electronic License Plate, Inc. (HELP, Inc.) and the Advantage I-75 operational test will soon use electronic clearance services to permit safe and legal trucks equipped with transponders to bypass weigh stations and state ports-of-entry at highway speeds.

Some states are already using pen-based data input devices to reduce the total time for routine roadside safety inspections of trucks and buses. These systems quickly upload inspection data electronically from the device to existing state and national safety databases for use by safety inspectors in other states. However, vehicle inspections still are conducted manually. Manual inspections are not particularly effective for assessing driver functions, a major safety concern, but advanced inspection procedures are still in the developmental stage.

Emergency Management

Nationwide, 24 emergency management systems are now equipped with automatic vehicle location (AVL) systems, and 104 others are planning to implement AVL. Enhanced 9-l-l deployment is bringing emergency services to accident scenes more quickly and efficiently.

Through automatic phone number and location identification, emergency service vehicles are assigned to respond and are quickly routed to the proper location.

Advanced Vehicle Contro1 and Safety Systems

The VORAD system, a longitudinal and lateral collision warning system, has been deployed by Greyhound on a portion of its interstate bus fleet. The system is expected to reduce accident rates and lower costs for operating and maintaining the fleet. All of the major automobile manufacuturers are currently working on intelligent cruise control systems, which are expected to be on the market within 3 to 5 years, perhaps in conjuction with rear end collision avoidance systems to reduce liability risks. Substantial research and testing, and institution issue resolution will have to be completed before other advanced vehicle control services reach the deployment stage.

V. HOW WILL ITS BE DEPLOYED IN THE FUTURE?

Many ITS stakeholders believe that if alliances can be forged to make public and private travel data available, future deployments can take place in the three stages described below.

1997-1999: THE ERA OF TRAVEL INFORMATION AND FLEET MANAGEMENT

The first wave of mainstream ITS deployment can begin in 1997 to 1999. Figure S-3 presents a schematic for how this might occur.

Private companies and public agencies at all levels, and in all modes, are now collecting travel data. However, no one has a broad enough information network to support real-time, detailed travel decision making. Building the relationships among public agencies and private companies to share data from all modes of surface transportation--and deliver that data to the public in a timely and effective way--is a crucial objective for ITS deployment in the next three to five years. With the development of rich, shared travel information bases, states and metropolitan areas could build the foundation to support and integrate many ITS traffic, transit, safety, and commercial vehicle services. State and local agencies would have the flexibility to find the cooperative model that will work for their own particular area and circumstances, while achieving the goal of increased data sharing. The resolution of institutional issues such as partnerships and cooperative arrangements are critical to ITS deployment.

Private sector companies will access public travel data, supplement it with data they collect using their own surveillance techniques, and distribute it to the general public, commercial fleet operators, and other transportation organizations. Over time, data bases will be expanded to provide more detailed and comprehensive transportation information. Cellular phone and automated vehicle identification networks will be extensive enough to provide wireless traffic surveillance. Data will become accessible through cable television, radio, telephone, on-line computer services in homes and offices, at interactive kiosks, and in private and commercial vehicles.

With the development of the National Information Infrastructure, a variety of new outlets for distributing travel information will emerge. The completion of the national ITS architecture and the emergence of more public infrastructure will provide private sector companies with greater confidence about entering the ITS market and supporting the communications required by transportation management systems.

Data sharing will be accelerating in commercial vehicle operations as well. State databases will be linked to exchange regulatory and safety information, boosting the use of advanced technologies to verify credentials and monitor fleet safety performance. Automated vehicle

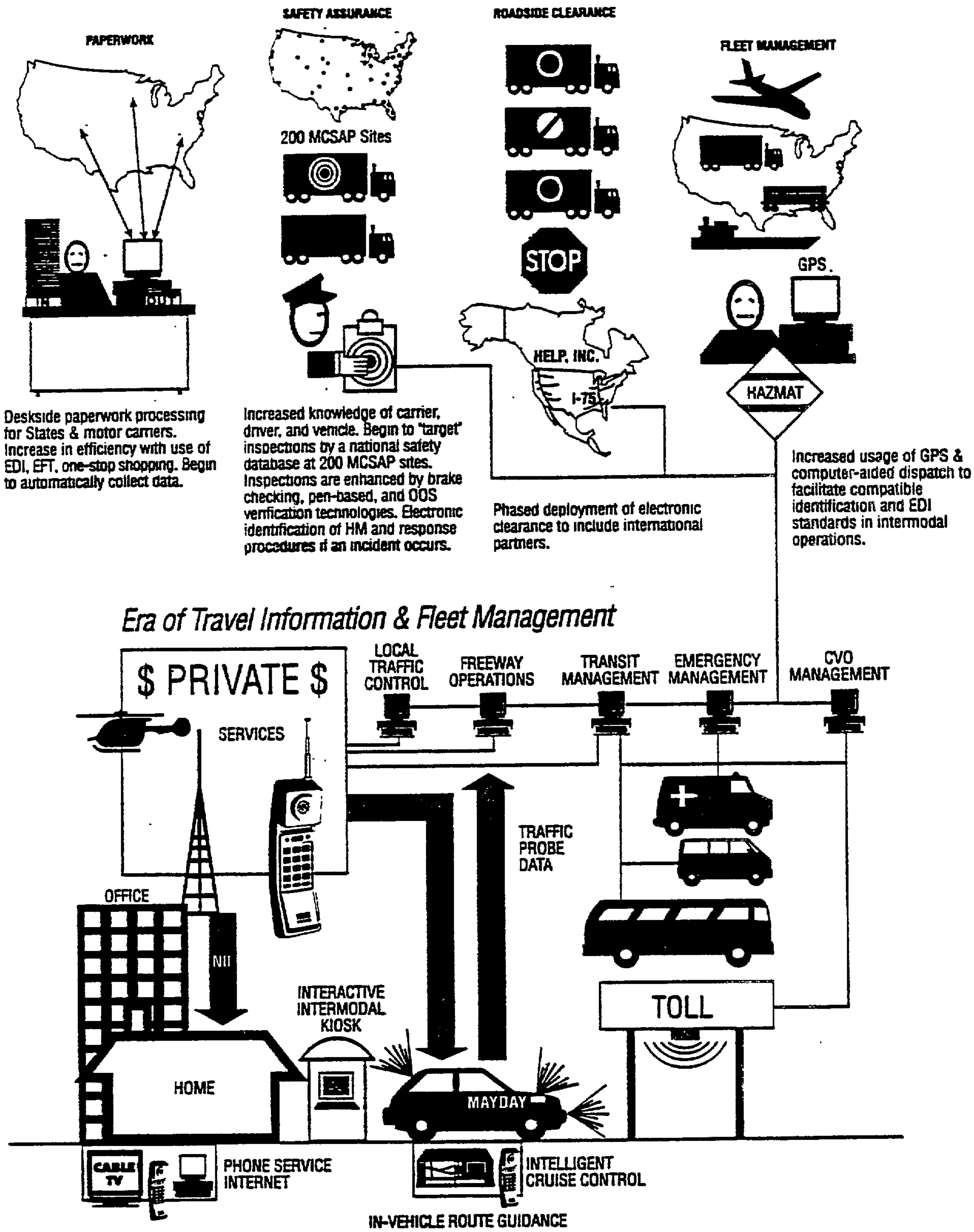


Figure S-3 5-Year Deployment Vision

identification and weigh-in-motion systems will be operational on most major trucking corridors and international border crossings. Navigation systems using GPS and satellite communications will become common in truck and bus fleets, enhancing the efficiency of freight distribution and fleet management systems.

Electronic toll collection systems will be deployed at an accelerated pace as their convenience is recognized by the general public and toll authorities begin to achieve cost savings. The technologies will be available to implement congestion pricing if local policy dictates. Revenues from congestion pricing applications and privatization activities might be seen as an appropriate resource for ITS operations and maintenance funding.

Automobile manufacturers will offer a variety of in-vehicle products, such as intelligent cruise control. Autonomous route guidance systems will be readily available to consumers, and as travel information bases mature, dynamic route guidance will become possible in some parts of the country. Mayday safety and security services will be deployed in both rural and urban areas.

By reaching this interim ITS deployment scenario, the stage will be set for achieving longer term transportation management objectives and establishing U.S. industries as strong players in the global market for ITS technologies and services.

2000-2005: THE ERA OF TRANSPORTATION MANAGEMENT

By the turn of the century the vision of the “smart traveler” can indeed become a reality (see Figure S-4). With the institutional mechanisms and transportation infrastructure in place to provide a steady stream of reliable travel information, effective personal and public transportation management can take place. State and local agencies will have established the alliances with the private sector for the travel information dissemination methods that work best in their own areas. More capable roadside-to-vehicle communications infrastructure will be deployed to provide richer data and real-time, adaptive traffic control over large areas will become a realistic goal.

Jurisdictions will cooperate to support real-time sharing of information and transportation management strategies by traffic, freeway, transit, and emergency services control centers. Integration and adaptive control of freeways and surface streets will improve the flow of traffic, give preference to public safety, transit, and other high occupancy vehicles, and minimize congestion. The public and private sectors will cooperate to share the up-to-the-minute information needed to support real-time, dynamic route guidance systems for private and commercial vehicles.

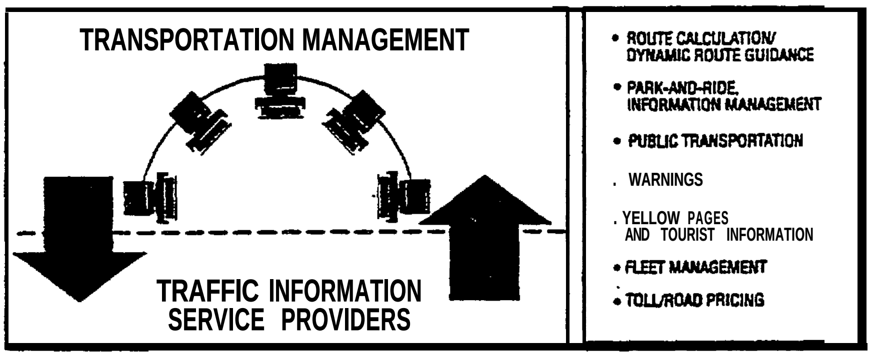
Deskside paperwork processing for States & motor carriers link ALL North America in a "paperless" environment with interactive automated data collection.

Smart trucks with vehicle-to-roadside communications, on-board diagnostics and on-board safely monitoring travel safely and freely throughout North America.

Effective targeting supported by automated roadside inspections using real-time access to interactive safety database, impedes only unsafe or illegal motor carriers at mobile or fixed stations.

Dispatcher utilizing an automated interactive system that communicates to All modes across Norm America--increasing SAFETY and PRODUCTIVITY.

Era of Transportation Management



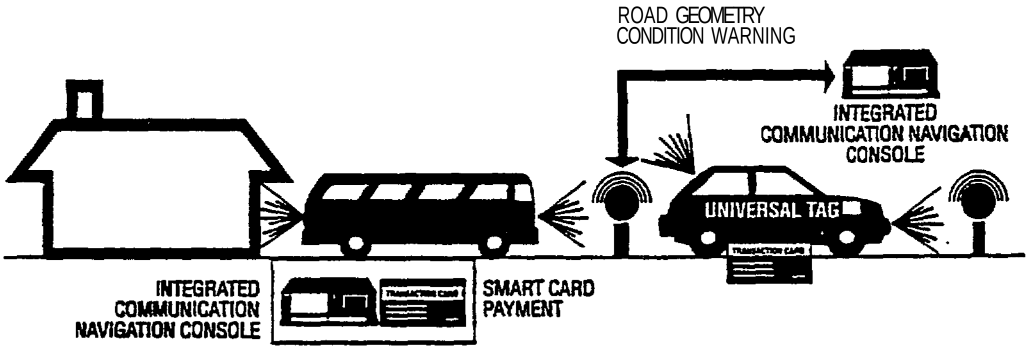


Figure S-4 IO-Year Deployment Vision

Universal electronic payment systems will be available for tolls, transit fares, parking, and other financial transactions. Communities wishing to implement congestion pricing strategies will have a ready infrastructure and may see this as a source for operations and maintenance support.

In this second wave of deployment, application of aerospace and defense technologies will provide dramatic advances to automotive systems to improve traveler safety and provide real-time navigation assistance. Enhanced vehicle control systems, such as lateral warning and early collision avoidance features, will begin to be marketed in private vehicles. Deployment of vehicle-to-vehicle communications systems may make preliminary intersection collision avoidance systems possible.

By the year 2000, electronic clearance for commercial vehicles may be operational nationwide. An integrated network and database of electronic clearance and safety information will be available to support North American uniformity and productivity for the nation's commercial fleets. Hazardous materials incident notification services will provide early, accurate information for emergency responders in some segments of the motor carrier industry.

2010: THE ERA OF THE ENHANCED VEHICLE

By the year 2010, research and testing will have brought ITS to a stage of reliability and accuracy that will support introduction of new, more sophisticated vehicle safety and control services, such as in-vehicle signing and more advanced collision avoidance systems. These advanced systems will include lateral and longitudinal space control, vision enhancement systems, and assisted braking and steering. The data collection, sharing, and dissemination systems established in preceding years will provide a foundation for the early stages of deployment of automated highway systems.

VI. SCENARIOS FOR ITS DEPLOYMENT

Two factors will have a profound effect upon how the ITS deployment visions in the previous chapter will unfold in the United States: private sector confidence in the market demand for ITS services, and the character of the Federal, state, and local government partnerships.

The Private Sector and the Market for ITS

While ITS is perceived to ultimately present a market opportunity for the private sector, there is not a consensus about which services and products will be most profitable for commercial development. Some private companies are reluctant to invest in product development in advance of defining the national ITS architecture and without the assurance that public infrastructure investments are forthcoming. However, if market research and other indicators should forecast a strong and fertile market opportunity in ITS, private companies may not wait for public infrastructure to develop and may move quickly to become independent leaders in ITS markets. Nevertheless, even under the most favorable conditions, some ITS services may not develop a strong market, including some of those which may be most desirable from a public service standpoint.

Federal. State, and Local Government Roles

The Federal role in ITS deployment currently is focused on research, development, testing, and support for early deployment planning. The U.S. Department of Transportation encourages deployment and innovative public/private partnership arrangements, but there is no centralized plan to actively stimulate deployment. In the future the Federal role could remain much the same as it is now, or become more aggressively focused on stimulating and guiding state and local deployment decisions.

Because state and local governments are directly responsible for construction, operation, and maintenance of the transportation systems in their jurisdictions, they have a major role in how ITS deployment will take shape. Although states receive substantial Federal funding and must comply with any attendant Federal requirements, their principal concern is meeting the transportation needs of their own jurisdictions. State perceptions of the appropriateness of ITS solutions in their areas will vary, and so will their willingness to create partnerships with private sector companies.

With many ITS products available for immediate deployment, and many others on a three to five year horizon, it is time for the ITS community and state, local, and Federal policy makers to examine the roles they will play in achieving the vision of ITS deployment. By making certain assumptions about private ITS market decisions and the public role in deployment, several scenarios for the direction and pace of ITS deployment can be developed. The analysis of these different assumptions can be useful in clarifying the options which face policymakers and private sector companies and helping to identify some implications for each option.

A FRAMEWORK FOR FOUR DEPLOYMENT SCENARIOS

Figure S-5 illustrates a concept of public and private sector roles in deployment. In this figure, the role of private sector follows the horizontal axis and the public role follows the vertical axis.[1]

The private sector role in deployment is influenced primarily by market forces.[2] If a Reactive Private Sector is cautious and offers services and products to meet well established consumer and commercial interest, the private sector role in deployment will be limited, at least in the near term.

On the other hand, if the private sector believes in the potential and opportunity in ITS, it will move quickly to invest in technology and market development. A Proactive Private Sector may see profit opportunity in private operation of services that fulfill traditionally public sector roles, such as turnkey travel information centers or commercial vehicle electronic clearance services. Substantial risks will be taken based on the belief that the market is solid and offers an enormous potential return on investment. If public infrastructure is not already in place, an aggressive private sector may shoulder the cost of installing its own infrastructure base for data collection and dissemination and recover costs through revenue from the sale of products and services.

A Non-Assertive Public Role in deployment would remain much as it is today. The Federal government would support ITS technology development through research and testing. State and local deployment would be encouraged to pursue ITS deployment through special funding for ITS planning, training, and outreach. Investments in ITS would remain discretionary for states and localities with funding provided through the regular Federal-aid process.

A more Assertive Public Role could include several strong steps on the part of Federal policy makers to promote state and local ITS deployment, including stimulation of regional public and private alliances to share travel information, providing national training programs, establishing special funding incentives, and developing a strategy for nationwide deployment.

1 The diagram is presented to stimulate discussion and is not intended represent the private and public roles with precision. For example, the public role and private sector activity cannot be regarded as truly independent because Federal, state, and local investments will have a strong effect upon private sector market development.

2 This discussion deals with private sector market development decisions in the abstract for the purpose of drawing general conclusions about roles in deployment. In reality, the private sector cannot easily be analyzed in the aggregate. Hundreds of private companies mvolved in ITS are making independent market-related decisions on a daily basis. In a similar fashion, state and local roles are generalized for the purposes of discussion although their decisions about ITS deployment depend upon many different factors.

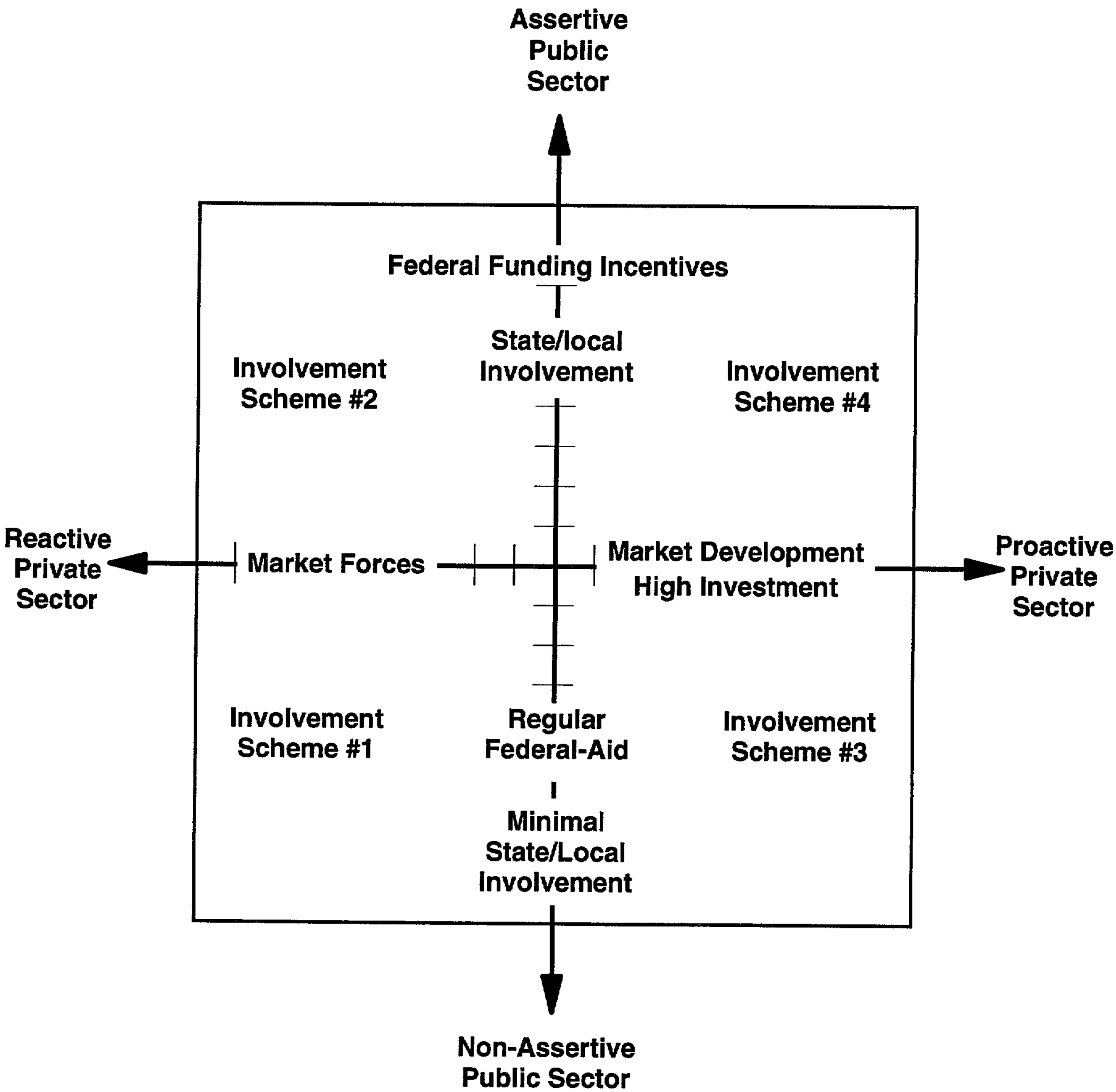


Figure S-5 ITS Participant Involvement Schemes

Assertive State and local agencies would pursue ITS deployment vigorously, in general, and form partnerships with the private sector to enhance system effectiveness. They would coordinate activities with neighboring jurisdictions and among agencies.

By postulating both a reactive and a proactive private role for ITS, and combining those assumptions with projections for both a non-assertive and an assertive public role in ITS deployment, four scenarios for deployment emerge. An examination of these four extremes can help to identify when ITS benefits can be realized, how extensive deployment might be, and frame an analysis of several other important issues in ITS deployment.

Scenario 1: Reactive Private Sector/Non-Assertive Public Role

This scenario for deployment will unfold much as deployment is proceeding today. The private sector will actively pursue established market opportunities, such as CVO and electronic toll collection, but may be conservative about taking new risks to develop markets. Uncertain about public sector infrastructure, how and when it might be available, private companies will invest in development of products that function independently.

Most state and local agencies will deploy ITS only in accordance with their most pressing needs, and ITS projects will compete with traditional transportation investments for limited Federal-aid funds. In some metropolitan regions, jurisdictions will cooperate to build coordinated travel operation centers, and pockets of high-level deployment will appear.

At the national level, the Federal government would continue to support ITS research, testing, and planning and would encourage state and local agencies and the private sector to comply with the national ITS architecture. Uniform traffic information on a national basis will not be available in the near term.

This scenario offers the advantage of keeping all transportation investment decisions on a level plane and preserves local prerogatives over how services will be deployed. Overall public costs for deployment, operations, and maintenance will be lower with its slower pace of deployment. On the other hand, there are several drawbacks to this scenario. It is unlikely that strong alliances between public agencies to share travel data will emerge in the near term, postponing development of active transportation management systems for as much as 5 to 10 years and providing only limited information for private information distribution services. It is unlikely that transit systems will be effectively linked to other travel information systems. Widespread system deployments will be slow to emerge and the potential of a system architecture which ensures compatibility will not be realized.

Scenario 2: Reactive Private Sector/Assertive Public Role

In this scenario, the Federal government takes an active role in promoting state and local deployment, providing funding incentives to stimulate alliances among agencies to share travel information and, over time, to perform transportation management. Individual jurisdictions would have discretion to establish alliances according to their preferences. They would not be required to release any local authority to work cooperatively with other jurisdictions, but a demonstrable compact would be required as a condition for use of special Federal deployment funds.

Likewise, state and local governments could establish partnerships with private companies for information distribution or system operation as they desire. Because this scenario presumes limited market confidence, however, aggressive public agencies could “freeze out” private sector participation so that joint investment potential is not sufficiently realized.

This scenario offers the advantage of ensuring cooperation among public agencies and addresses public transportation goals such as intermodal coordination and equity in providing travel services. National compatibility would be emphasized, and this, combined with the boost in funding for public infrastructure, would stimulate business development for public services over the long term.

However, state and local choice in use of transportation resources may be driven by Federal funding in this case, and overall capital, operations, and maintenance costs will be higher than in other scenarios. Without strong private market development, private funds are not leveraged to share implementation costs. Overall effectiveness in reaching the traveling public may be diminished without the consumer focus, diversity, and innovation of private distribution services.

<u>Scenario 3: Proactive Private Sector/Non-Assertive Public Role</u>

Lively competition, variety in consumer product choice, and private infrastructure development characterize this scenario. Confident in market demand, the private sector leads deployment, dominating information gathering and dissemination. State and local government cooperation and investment in ITS will vary greatly by region without Federal incentives and stimulus for creating public ITS alliances. Individual and commercial consumers will bear much of the cost of deployment through private purchases. Some areas would establish public/private partnerships for information distribution and eventually transportation management, but overall public sector participation would be secondary to private deployment.

This scenario offers the advantage of rapid deployment of travel information, commercial vehicle, electronic payment, and in-vehicle services. Competition could stimulate variety in products and services, bring costs down to affordable, mass market levels, and establish U.S. industries as clear leaders in the world marketplace. On the other hand, public agencies would have little leverage over private ITS services to obtain data and to meet intermodal, transportation management, and equity in service goals. Without a strong Federal presence, national compatibility may suffer as some private companies push to promote their own products as de facto standards.

Scenario 4: Proactive Private Sector/Aggressive Public Role

Federal leadership to stimulate interjurisdictional alliances and ITS investment, coupled with strong private sector market confidence, presents a scenario in which ITS deployment can occur rapidly throughout the country. State and local agencies would have incentives to install core public infrastructure to gather travel data and eventually to implement travel management systems. Knowing public infrastructure would be available, private companies would make their own market development investments. Economies of scale would be reached more quickly in this scenario, bringing costs down to affordable levels for public, commercial, and consumer purchases. State and local governments would have more practical choices for deployment, with options ranging from complete control of public services to privatization. Markets for both public and private travel information could flourish, and information without strong independent demand could be packaged with more marketable information.

This scenario has the advantage of stimulating ITS deployment without domination by either private or public sector interests. Federal funding and guidance will promote cooperation in the exchange of data, coordination of systems operation, and adherence to a national architecture. Support for development of the private sector in the early stages of deployment will help U.S. companies become successful in the competitive international ITS marketplace.

State and local governments may be concerned that this scenario limits their choices in use of their transportation resources by leading their investments toward ITS. Also, public capital, operations, and maintenance costs will be greater with the deployment of more public infrastructure. However, state and local governments would have the flexibility to establish alliances and infrastructure in the manner that best addresses local conditions. Private partnerships for delivery of ITS would not be required, but could provide additional funding support for public investments or perform services that achieve public goals in lieu of public operation.

VII. DEPLOYMENT SUPPORT

In any successful evolution of ITS deployment, dedicated efforts will have to be directed at reducing the friction inherent in change. The objective of deployment support is identification of the major challenges to achieving the deployment visions set out in the Program Plan so that the public and private ITS community can begin to resolve them.

Nontechnical considerations may, in the long run, present the more demanding challenges to sustained and widespread expansion of ITS user services. The very nature of ITS deployment predicts some fundamental changes in the institutional aspects of how transportation business has been conducted for many years. Congress recognized the importance of nontechnical issues by requiring U.S. DOT to submit a report assessing these challenges to deployment. In response, U.S. DOT and ITS America have implemented a research and support program to investigate key institutional matters and move toward addressing them as a routine aspect of ITS deployment.

Challenges to deployment cannot be overcome in one comprehensive, concurrent effort. Some problems will be posed in the near term, such as issues raised by involving private sector companies in the distribution of publicly generated travel information, and some, such as liability, could become more serious in later stages of deployment.

MAJOR CHALLENGES FOR NEAR-TERM DEPLOYMENT OF USER SERVICES

For many ITS services already in deployment phase and for those which could be deployed in a three to five year time frame, several key challenges can be identified.

- *Lack of Market Information*

  Before committing resources to marketing and deploying ITS services, many stakeholders feel they need a better understanding of the potential market for ITS. Public agencies want to know if ITS will influence traveler behavior and whether ITS might help generate revenue. Private companies need to determine the market risk involved in ITS investments and how soon investments can be recouped.

- *Uncertain public infrastructure base*

  Although most ITS stakeholders believe a public ITS infrastructure will eventually be in place, they are uncertain about its nature and extent. Private companies do not want to rush to build private infrastructure, such as transportation data collection infrastructure, if public platforms will soon emerge. They also want greater assurance that their products and services will be compatible with the technologies that will ultimately dominate the public infrastructure.

Competition for scarce resources

Current transportation funding demands outstrip resources at all levels of government. Public ITS deployment investments compete with traditional projects such as highway resurfacing and reconstruction, transit fleet replacement, and other types of important capital improvements. Proposed ITS deployments must demonstrate that they will deliver significant travel efficiencies and other public benefits to win funding commitments for initial deployment as well as continuing operation and maintenance expenses.

Need for new skills

In many cases, public agencies do not have the new technical and engineering skills that are needed to manage the application of electronics and communications technologies to transportation services. Public transportation agencies must seek employees with appropriate technical training and provide updated training for current personnel. Greater use of private sector technical expertise can either substitute for or augment public agency skills.

Inexperience in partnerships

In contrast to traditional transportation systems built and operated by a single jurisdiction, ITS will cross city, state, and even international boundaries. ITS also will link services which have traditionally been delivered by separate public agencies. Successful ITS deployment will depend upon the formation of new partnerships among different levels of government, across geographical lines, and even among agencies within jurisdictions. Possibly the most significant partnerships to be established in the near term are those between the public and private sectors to distribute travel information. Reluctance to enter into new public/private partnerships is often founded on uncertainty about governmental policies, particularly those related to commercialization of traffic information and services, willingness to grant sufficient franchise rights to balance market risk, and long-term commitment.

Potential Loss of Privacy

To the extent ITS services identify a specific traveler or vehicle, substantial privacy concerns are raised which could ultimately affect public acceptance of ITS. Because ITS is still in the initial stages of deployment, the ITS community can formulate and apply principles and safeguards to address privacy. Extensive consideration must be given to the circumstances under which travelers or vehicles need to be identified, how identifying information will be stored and used, who will have access to the information, and which secondary uses of the information will be permitted.

LONGER-TERM INSTITUTIONAL CHALLENGES

- *Implications of ITS Deployment for Society*

  The application of advanced computing, electronic, and communications technologies in ITS will provide many benefits for society, but attention must also be given to the effect ITS will have upon land use and communities. Care must also be taken to ensure that the benefits and costs of ITS are fairly distributed. ITS services must not be available only to those who can afford high-end consumer products but must be accessible across a broad range of social, economic, and geographic groupings.

- *Concern for the Environment*

  As ITS deployment advances into more mature stages, environmental issues must continue to be addressed on a comprehensive basis. For example, it will be necessary to clarify appropriate processes for environmental review under the National Environmental Policy Act and the Clean Air Act Amendments, continue to refine assessments of ITS environmental impacts, and promote involvement of the environmental community in project level ITS deployment decisions.

- *Zmproving Procurement* ***of*** *ITS*

  Procurement issues will require substantial attention as deployment progresses and could require some degree of legislative change. ITS procurements involve new, complex technologies, new partners, and multiple levels of legal requirements. The number and variety of public agencies involved in ITS procurements is unusual, if not unprecedented. Some specific procurement issues encountered in ITS deployment include requirements pertaining to competitive bidding, organizational conflicts of interest, bonding, treatment of intellectual property, and cost accounting and audit, as well as project uncertainties resulting from the procurement process.

- *Managing Liability Risks*

  Private ITS developers have expressed the view that while motor vehicle drivers presently bear the burden of the cost of automobile accidents, ITS user services which begin to exercise more vehicle control may shift liability to developers and operators of these services. The perceived vulnerability to lawsuits has resulted in calls for techniques to manage liability risk in certain ITS deployments.

To date, U.S. DOT, ITS America, academic institutions, and many other members of the ITS community have made significant achievements in identifying and researching nontechnical barriers to ITS development and operational testing. However, these efforts have addressed

ITS in its broadest sense; they have not focused on the specific institutional infrastructure that must be in put into place to support the specifics of ITS deployment.

The institutional challenges touched upon here deserve greater analysis through the lens of the deployment visions established in this Plan. Near-term objectives, a long-term strategy, and a plan for action--with both public and private sector roles--must be formulated to address institutional issues in ITS deployment.

VIII. RECOMMENDATIONS FOR ITS DEPLOYMENT

The Program Plan has established a vision of what can be accomplished in ITS deployment for the near future and explored the implications of different public and private deployment roles. Several conclusions can be drawn about the appropriate steps that must be taken to achieve national ITS deployment.

There is a clear national interest in:

- Realizing the benefits of enhanced transportation management, traveler services, safety, and productivity; and
- Establishing the U.S. ITS market early to gain a competitive global advantage for the domestic ITS industry.

To further this interest, it is recommended:

- That the U.S. DOT be more assertive initially in facilitating the deployment of ITS information and communications infrastructure, leveraging off of private sector facilities and services wherever feasible -- a first step could include establishing and stimulating the communications and information infrastructure needed to deliver many of the ITS services,
- That the private sector retain primary responsibility for the development and commercialization of transportation information delivery and in-vehicle systems, and
- That ITS America continue as the focal point for the public-private partnerships needed for national deployment of ITS user services.

To accomplish this, the following roles are recommended:

<u>Federal Role</u>

To support the timely deployment of the information and communications infrastructure necessary to foster a range of ITS user services, the U.S. Department of Transportation (U.S. DOT) will need to

- catalyze public and private institutional relationships;
- facilitate the development and coordination of travel and transportation management data bases; and

- stimulate and help to fund the design, development, and deployment of major elements of the information and communications infrastructure.

The U.S. DOT should carry out these objectives through funding incentives rather than regulatory mandates. Where appropriate, new Federal funds should be identified to seed the development and deployment of infrastructure utilizing or in partnership with the private sector wherever feasible. Consideration should be given to requiring contributions of private funds to match Federal-aid transportation funds.

To help meet these objectives, it is also appropriate for the U.S. DOT to:

- play an active role in defining and securing communications spectrum; and

- facilitate the near-term development of key communications and interface standards in such areas as traveler information, commercial vehicle electronic clearance, and electronic toll collection.

The U.S. DOT should continue to invest in long-term research, such as automated highway systems, as well as intermediate development and operational testing in partnership with the private sector.

State and Local Government Role

The role of state and local governments is to determine the needs of their communities and deploy information and communications infrastructure to satisfy those needs. To fulfill this role, they must become aware of the ITS user services available to address their transportation problems and make short and long-range plans for the deployment of ITS in their jurisdictions. State and local governments should work closely with the U.S. DOT, the private sector, and ITS America to coordinate deployments to achieve national compatibility.

Private Sector Role

The primary role of the private sector is to build and commercialize ITS products and services for consumers, industry, and the public sector. To fulfill this role, the private sector needs to invest and engage in a variety of activities, including research and development, market research, operational tests, and system evaluations. However, the private sector will not make decisions to take these actions collectively; these actions will be based on hundreds of independent decisions based on feasibility, marketability, and levels of acceptable risk. The private sector must be prepared to take substantial risk in deploying both ITS infrastructure and products in advance of a well established market.

A well-balanced public sector role in deploying the basic infrastructure to support in-vehicle, traveler, and other end-user information products is vital in encouraging such decisions. The public sector role must be vigorous enough to stimulate private sector participation, but not so aggressive as to preempt private sector involvement. Close cooperation between the private and public sectors is indispensable for achieving this balance.

ITS America Role

The ITS community, along with Congress through the ISTEA, recognizes that ITS will be most effectively developed and deployed through a partnership of the public sector, the private sector, and the academic community. ITS America is the embodiment of this partnership and has been critical to establishing a cooperative working relationship in promoting a national ITS program.

ITS America has a continuing role in bringing new interests and constituencies into the ITS deployment process, broadening the base of ITS involvement through its technical committees and state chapters, disseminating information, and building international relationships. ITS America plays a major role in guiding and building consensus for the national ITS architecture and for coordinating the development of standards and protocols. It plays an important role in building support and providing education about ITS through its outreach program. ITS America's involvement in consensus building has focused attention on technical and non-technical issues as well as promoting intermodalism. ITS America represents a consensus forum through which the its community and U.S. DOT can communicate ideas and concerns.

In summary, the recommendations and issues presented in the National ITS Program Plan must be considered and discussed by the ITS community. A strategy for deployment and the most effective involvement of the participants must be implemented. ITS deployments will continue to take place. Without a consensus direction of how ITS should proceed and without actions to steer its course, ITS deployments are left to forces that may not yield a nationally compatible ITS system.