

NEW ERA IN SURFACE TRANSPORTATION

Intelligent Transportation Systems Under TEA-21

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During the latter half of the 20th century, a national highway network, centered around the Interstate system, has been created to tie the country together across its vast open spaces. The Intermodal Surface Transportation Efficiency Act of 1991 initiated a transition from a focus on building highways to a new emphasis on improving the efficiency with which the surface transportation system—highways, streets, bus and rail lines, intermodal terminals—is operated and managed.

The Transportation Equity Act for the 21st Century continues and expands this transition by authorizing efforts aimed at creating a seamless transportation network that will support the movement of people and goods across all modes of transportation. Intelligent transportation systems will help meet this challenge by providing the information and communications infrastructure necessary to operate and manage the transportation network as a single system, thus enhancing the network's efficiency, productivity, and safety.

Just as the approach to surface transportation in the United States has evolved, so, too, has the ITS program. TEA-21 continues the program along a path that is leading from a research and development focus, through operational testing, to deployment as an integral part of the delivery of transportation services. To understand the current state of the ITS program and the impact of TEA-21, it is important first to reflect on how the program has grown and evolved since its inception.

Background

Pre-ISTEA: Establishing a Vision for ITS

Prior to the development of the Intelligent Vehicle-Highway System (later renamed ITS) program during the late 1980s, ITS technologies were confined

largely to the imagination of a few visionaries who recognized the potential impact of ITS on the delivery of transportation services. The origins of ITS in the United States can be traced as far back as research and development carried out by the Bureau of Public Roads, the predecessor to the Federal Highway Administration, in the 1960s. That program developed concepts that continue to be reflected in today's ITS program. The best known of these is the Electronic Route Guidance System, designed to provide drivers with route guidance based on real-time traffic conditions. Because of a lack of policy and funding support, however, these initial efforts were terminated in the early 1970s, and the concept behind ITS lay largely dormant until the mid-1980s.

Rapid technological advances in electronics and computing power, combined with declining costs, subsequently spurred the development of innovative technologies for application in surface transportation. At the same time, increasing traffic volumes and the associated congestion led to the realization that simply adding conventional roadway capacity was not a viable long-term solution.

In 1988 senior U.S. Department of Transportation research officials, along with representatives from several universities, state DOTs, and the private sector, formed a group called Mobility 2000. This group served as the catalyst for ITS by establishing a vision for what an intelligent vehicle-highway system would look like, developing a plan of evolutionary steps to achieve that vision, and creating a public- and private-sector constituency for a national ITS program.

ISTEA: Building a Foundation for ITS

As part of ISTEA, the Intelligent Vehicle-Highway Systems Act was passed. That act formally established the IVHS (ITS) program and called for the

implementation of a "national system of travel support technology, smoothly coordinated among modes and jurisdictions to promote safe, expeditious, and economical movement of goods and people." ISTEA authorized \$644 million for the ITS program. This amount was supplemented by \$580 million in funds from the General Operating Expense budget, for total funding of \$1,224 million during the ISTEA period.

One of the first activities undertaken by the ITS program under ISTEA was the creation of a strategic plan reflecting the collaborative vision of U.S. DOT and the Intelligent Transportation Society of America (ITS America): to have a safer, more responsive, and more efficient national transportation system within 20 years through the application of ITS technologies. This vision is one of intelligent infrastructure and intelligent vehicles working together to create an intelligent transportation system.

The ITS program during the ISTEA era was devoted largely to building the foundation on which deployment of ITS could take place. These efforts included an aggressive research and technology program aimed at addressing concerns about the technological limitations of ITS, an extensive operational test program to demonstrate the viability of first-generation ITS technologies and services, and an architecture and standards program to create the framework needed for the deployment of integrated ITS.

The research and technology program produced significant technical understanding in many areas

crucial to the future success of ITS. The resulting achievements included the development of real-time adaptive software that allows traffic control systems to respond immediately to changes in traffic flow; improved vehicle tracking technologies for use in public transportation; advances in emergency response and commercial vehicle operations; and the Commercial Vehicle Information Systems and Networks (CVISN) program for improving commercial vehicle safety, streamlining regulatory processes, and enhancing the efficiency of the trucking industry.

Perhaps the most significant achievement was demonstration of the technical feasibility of smart vehicles—systems that provide route guidance, monitor driver alertness, and help drivers avoid collisions. The program demonstrated that advanced systems such as automated collision notification and intelligent cruise control were ready to move from the laboratory to field testing, and showed the world the long-range potential of cooperative vehicle-highway systems through the demonstration of an automated highway system in San Diego in 1997.

Under ISTEA more than 80 operational tests were conducted throughout the United States to demonstrate the range of ITS technologies and services that could be developed, and provide important evidence of the potential impact of ITS on transportation efficiency, productivity, and safety. These operational tests helped foster new public-private partnerships, new institutional arrangements between state and local agencies,



Infrastructure for intelligent transportation systems is beginning to be deployed in cities and states across the nation. U.S. DOT has set a goal to deploy integrated ITS in the 75 largest metropolitan areas by 2005. Traffic control centers, which integrate management of highway, transit, and emergency response services, exemplify such systems.

and innovative approaches for overcoming institutional barriers to deployment.

The Metropolitan Model Deployment Initiative has taken the operational test program a step closer to deployment by showcasing integrated ITS infrastructure in four major metropolitan areas—Phoenix, Seattle, San Antonio, and New York–New Jersey–Connecticut. These sites are demonstrating the benefits of integrated applications for managing traffic and transit, coordinating emergency services, and providing real-time transportation information to travelers, thus beginning to fulfill the initial vision of ITS.

A National ITS Architecture was developed, providing a flexible and expandable framework for the development and deployment of ITS. Instead of a single design, the architecture provides an inclusive setting within which different designs can be implemented, yet operate compatibly. The National ITS Architecture also provides a framework for the development of national standards to support nationwide compatibility and interoperability of ITS user services. Development of these standards was initiated in 1996 through cooperative agreements with five standards development organizations (the American Association of State Highway and Transportation Officials, ASTM, the Institute of Electrical and Electronics Engineers, the Institute of Transportation Engineers, and the Society of Automotive Engineers).

Work has been initiated on more than 70 standards, 14 of which had been adopted by their respective standards development organizations as of September 1998. Although significant testing, evaluation, and training will be required before widespread implementation of ITS standards, their impact is beginning to be felt as industry leaders include these standards in applicable procurements, and compliant products begin to appear in the marketplace.

TEA-21: Entering the Age of ITS Deployment

As noted earlier, TEA-21 shifts the focus of the ITS program from research and operational testing to a much greater balance between research and deployment. The legislation states that the scope of the ITS program is to “conduct an intelligent transportation systems program that allows for the research, development and operational testing of Intelligent Transportation Systems (ITS) and to advance the nationwide deployment of these systems as a component of the surface transportation systems of the United States.” With the foundation for ITS—technical knowledge, institutional part-

nerships, national architecture—having been created under ISTEA, TEA-21 establishes a program that fosters integrated deployment in a manner that supports the vision of a seamless transportation network. This increased emphasis on deployment is evident in the program funding.

Although the funding for the ITS program as a whole under TEA-21 is roughly equivalent to that available under ISTEA, slightly more than 50 percent of this funding is targeted to deployment incentives (see Table 1). The result will be a research and operational test program that is significantly smaller and more focused than that under ISTEA.

Research and Development Program

This portion of the program includes ITS research and development, operational tests, architecture and standards, technical assistance, training, and program management activities. The activities carried out under this portion of the program will be similar to those carried out under ISTEA, albeit with a stronger emphasis on the technical support necessary to achieve integrated ITS deployment.

The top priority of the research program will be the Intelligent Vehicle Initiative. Achieving the vision of an integrated, intermodal transportation system will require research on intelligent vehicles and on their ability to work cooperatively with an intelligent infrastructure. This work will build upon the collision avoidance and automated highway system research conducted under ISTEA.

Further infrastructure research will also be conducted, with a growing emphasis on rural applications of ITS, such as automated collision notification, weather information, and rural paratransit. In addition, given that effective ITS deployment can take place only under the direction of a knowledgeable, trained workforce, priorities under TEA-21 will include developing effective technical guidance and maintaining an aggressive professional capacity-building program.

Deployment Program

This portion of the program provides incentives for the integration of ITS technologies. The deployment program funded under TEA-21 has two primary subparts.

ITS Integration Program. TEA-21 directs U.S. DOT to conduct a comprehensive program aimed at accelerating the integration and interoperability of ITS in metropolitan and rural areas. As the program title suggests, the funds are to be used primarily for activities necessary to integrate intelligent transportation infrastructure elements that are either already deployed or to be deployed with other

sources of funds. For an individual project, the federal share from ITS program funds is not to exceed 50 percent, and the federal share from all sources is not to exceed 80 percent.

TEA-21 stipulates that not less than 10 percent of the ITS Integration Program funds be used in rural areas. Projects are to be selected through a competitive process and must meet a variety of criteria. The project must be part of approved plans and programs under applicable statewide and metropolitan planning processes. There must also be a demonstrated commitment to cooperation among agencies, jurisdictions, and the private sector; a demonstrated commitment to fully integrated ITS deployment; and evidence of fiscal capacity for long-term operations and maintenance without federal support.

Commercial Vehicle Intelligent Transportation Infrastructure. TEA-21 directs U.S. DOT to deploy ITS technologies that will improve the productivity and safety of motor vehicles and drivers, and reduce the costs associated with commercial vehicle operations and federal and state commercial vehicle regulatory requirements. TEA-21 includes the goal of having CVISN operational in the majority of states by September 30, 2003.

To achieve these goals, this part of the deployment program will be aimed at implementing CVISN. CVISN will provide automated roadside inspections that target unsafe carriers; electronic screening systems that automate the screening of commercial vehicles at weigh stations and international border crossings; and electronic credentialing that provides for electronic issuance of credentials, as well as automated tax reporting and filing. As with the ITS Integration Program, the federal share from ITS program funds for an individual project is not to exceed 50 percent, and the federal share from all sources is not to exceed 80 percent.

While ITS deployment funds under TEA-21 provide powerful incentives for the integration of ITS technologies, widespread deployment of ITS must be planned for and funded through the mainstream federal-aid programs—the National Highway System, Surface Transportation System, Congestion Mitigation and Air Quality Program, and Transit Capital Program. TEA-21 clarifies and expands the definition of ITS project eligibility for funding under these programs from the traditional “traffic monitoring, management, and control facilities” specified in ISTEA to “infrastructure-based intelligent transportation system capital improvements.” As technical guidance interpreting this new reference is developed, the range of activ-

TABLE 1 ITS Program Funding Under TEA-21 (millions of dollars)

Program	1998	1999	2000	2001	2002	2003	Total
ITS Research and Development	95.0	95.0	98.2	100.0	105.0	110.0	603.2
ITS Deployment	101.0	105.0	113.0	118.0	120.0	122.0	679.0
Total	196.0	200.0	211.2	218.0	225.0	232.0	1,282.2

ities eligible for federal-aid funding will likely be broadened, thus enhancing the deployment of ITS.

In addition to the major funding programs, TEA-21 provides for important efforts that will affect the deployment of ITS technologies. These efforts include national architecture and standards development, preparation of a National ITS Program Plan, spectrum allocation, and procurement.

Other Deployment-Related Provisions

National Architecture and Standards

TEA-21 directs U.S. DOT to develop, implement, and maintain a national architecture and supporting standards and protocols to advance the widespread use of ITS technology, promoting interoperability and efficiency. TEA-21 includes two specific requirements aimed at achieving this goal.

Critical Standards. The Secretary of Transportation is directed to submit a report to Congress no later than June 1, 1999, identifying which standards are critical to ensuring national interoperability or to the development of other standards. If standards identified as critical are not adopted by January 1, 2001, the Secretary is to establish provisional standards. TEA-21 does provide the Secretary with the authority to waive the requirement for establishment of provisional standards if doing so would further the above goal.

U.S. DOT established an aggressive standards development program under ISTEA, using a consensus-based approach involving the standards development organizations. TEA-21 supports this approach, but also conveys the urgency of reaching consensus and allows the Secretary to intervene should the industry be unable to do so. Currently, U.S. DOT has more than 70 standards in various stages of development.

The Department intends to review each of these standards in consultation with affected parties to identify those standards critical to national interoperability. For each critical standard, a comprehensive plan for development, testing, and implementation support will be prepared to ensure



The Intelligent Vehicle Initiative (IVI) is accelerating development, introduction, and commercialization of in-vehicle driver assistance products such as intelligent cruise control, collision avoidance warning, and vision enhancement to reduce motor vehicle crashes. IVI is a joint partnership between U.S. DOT and the motor vehicle and trucking industries.

that the standard is both technically and functionally ready.

Architecture Conformance. TEA-21 directs U.S. DOT to ensure that ITS projects carried out with funds made available from the Highway Trust Fund conform to the national architecture, applicable or provisional standards, and protocols. Exceptions to this provision may be authorized by the Secretary.

Since a similar requirement for architecture conformance was included in the fiscal year 1997 and 1998 transportation appropriation bills, U.S. DOT has been working actively on the policies and guidance necessary to implement this requirement. A series of 10 outreach sessions on this topic, involving more than 500 representatives from all levels of government and industry, was held across the United States in early 1998.

A two-level approach to architecture conformance has emerged. At the planning level, the goal is to ensure that ITS projects are considered through the applicable existing metropolitan or statewide planning processes. Achieving this goal will provide for the development of a regional vision for ITS deployment and will make it possible to begin mainstreaming ITS into well-established transportation planning processes. At the project level, the goal is to ensure that the regional impacts of individual ITS projects are considered during the project development process. Individual projects will have to be examined in light of an established regional ITS architecture (or in the absence of a regional architecture, the National ITS Architecture). The intent is to integrate both the planning- and project-level architecture conformance requirements into existing federal oversight procedures.

Interim guidance on architecture conformance was issued on October 2, 1998, in a joint memorandum from the Federal Highway Administration and Federal Transit Administration administrators. The intent of the interim guidance is to foster integration, encourage the incorporation of ITS into the transportation planning process, and focus on near-term projects of regional significance. The interim guidance is effective immediately and is expected to be in effect for a year while a final policy is developed through formal rulemaking.

National ITS Program Plan

TEA-21 calls for U.S. DOT, working with ITS America, to develop, maintain, and update a National ITS Program Plan. This program plan is to chart a course for the federal ITS program both during TEA-21 (5-year timeframe) and beyond (10-year timeframe). It is envisioned that U.S. DOT and ITS America will carry out concurrent efforts to ensure that the plan is both comprehensive and timely.

Spectrum Allocation

TEA-21 directs the Federal Communications Commission (FCC) to consider, in consultation with U.S. DOT, spectrum needs for the operation of ITS. The legislation further directs that no later than January 1, 2000, the FCC shall have completed a rulemaking addressing the allocation of spectrum for ITS. U.S. DOT has been supporting ITS America in its petition to the FCC for an allocation of spectrum for ITS services. In June 1998, the FCC issued an Advance Notice of Proposed Rulemaking recommending the requested allocation.

Procurement

TEA-21 directs U.S. DOT to develop technical assistance and guidance to assist state and local agencies in evaluating and selecting appropriate methods of procurement for ITS projects, including innovative and nontraditional methods. TEA-21 further directs the use of risk assessment methodologies to reduce the cost, schedule, and performance risks associated with ITS system software.

U.S. DOT has recognized the unique nature of ITS procurement and has been aggressively developing associated technical guidance materials. An *ITS Procurement Resource Guide* has been published to provide assistance to the public-sector implementors of ITS. The Department will seek to improve the availability of procurement technical guidance through enhancement of this guide; develop improved guidance for U.S. DOT field staff involved in ITS procurement; and provide for widespread dissemination of a procurement training seminar, expected to be available by the end of 1998.

Beyond TEA-21: Maintaining the ITS Vision

The ITS vision that was developed by the Mobility 2000 group, articulated by Congress through the passage of ISTEA, refined in the ITS Strategic Plan, and reaffirmed in TEA-21 is based on a long-term perspective that transcends legislation. Much has been accomplished toward this vision:

- ◆ An industry with technical expertise and commercially viable products exists.
- ◆ Research and development has proven ITS to be technically feasible.
- ◆ Operational tests have shown the benefits of first-generation ITS.
- ◆ The National ITS Architecture exists, and ITS standards are under development.
- ◆ ITS technologies are being deployed.

TEA-21 rightly focuses the ITS program on accelerating deployment in an integrated manner that cuts across agency, jurisdictional, and system boundaries. While deploying the ITS of today, however, we must not lose sight of the importance of a strong research and development program to the creation of the ITS technologies of tomorrow. Efforts such as the Intelligent Vehicle Initiative are

needed to continue moving the ITS program ever closer to its vision of seamless transportation, with intelligent vehicles and an intelligent infrastructure truly functioning as an intelligent transportation system.

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The Reports to Congress, on which this article is partly based, are available electronically at the ITS Joint Program Office Web site at www.its.dot.gov or by calling 202-366-9536.

For Further Information...

As the implementation of the ITS program under TEA-21 begins to move forward, U.S. DOT will be seeking input and involvement from the transportation community at all levels of government and within the private sector. The ITS Joint Program Office (JPO) intends to use a wide variety of mechanisms to obtain this input and involvement, including the JPO Web site, the *Federal Register*, and public forums. For more information on the ITS program under TEA-21, visit the ITS JPO Web site at www.its.dot.gov, or call 202-366-9536.

TRB Studies Requested in TEA-21

The Transportation Equity Act for the 21st Century (TEA-21) contains requests for several studies to be conducted by the Transportation Research Board on behalf of the National Research Council:

- ◆ Congestion Mitigation and Air Quality Improvement Program—Evaluation of the program's effects on emissions and air quality and its cost-effectiveness.
- ◆ Future Strategic Highway Research Program—Determination of the goals, purposes, research agenda and projects, administrative structure, and administrative needs for a new strategic highway research program.
- ◆ School Transportation Safety—Review of the safety issues associated with student transportation by various modes, including past and current experience and adequacy of data, as well as vehicle design, driver training, and operational issues.
- ◆ Contracting Out Transit Services—Examination of the effects of contracting out of mass transportation operations and administrative functions, including competitive awards to public agencies. Existing literature will be reviewed to determine what is known about the effects on cost, availability and level of service, efficiency, safety, quality of services provided to transit-dependent populations, and employer-employee relations.
- ◆ Commercial Motor Vehicles—Review of federal regulation of the dimensions of commercial motor vehicles (trucks and buses), including whether changes to the regulations are advisable and how such changes would affect the economy, the environment, safety, and service to communities.

On behalf of the National Research Council, TRB will also carry out a request by Congress to review the strategic plan for surface transportation research and technology development for the U.S. Department of Transportation. In addition, the Federal Highway Administration and the Federal Transit Administration may request that TRB establish an advisory committee to recommend environmental and energy conservation research, technology, and technology transfer activities related to surface transportation.