
**The U.S. Department of Transportation's
Intelligent Transportation Systems (ITS)
Standards Program:
1996 Status Report**

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EXECUTIVE SUMMARY

The U.S. Department of Transportation's (U.S. DOT) ITS Joint Program Office is supporting an extensive, multi-year program of accelerated standards development to facilitate the successful deployment of the Intelligent Transportation System (ITS), with a special emphasis on the Intelligent Transportation Infrastructure (ITI). The program is supporting and accelerating the existing ITS consensus-based volunteer standards processes already underway in the U.S. This document identifies the strategy U.S. DOT is pursuing in underpinning the ITS standards process and identifies activities currently being supported through Federal funding.

The standards chosen for U.S. DOT funding are typically those needed to implement the ITI, as called out by the National Architecture. These include both key interface standards, including message sets and data dictionaries, and foundation standards, including location referencing and some safety standards, needed to deploy key ITI functions safely and efficiently. In some cases, development of communications standards specific to ITS applications, is required

U.S. DOT has chosen to support, guide, and reinforce the existing consensus standards efforts in the U.S. by providing funding to five existing Standards Development Organizations (SDOs). This "bottoms-up" approach will allow U.S. DOT to leverage significant volunteer resources and to foster public-private partnerships in the deployment of ITS. The five SDOs chosen for funding are:

- the [Society of Automotive Engineers \(SAE\)](#)
- the [American Society for Testing & Materials \(ASTM\)](#)
- the [Institute of Electrical and Electronics Engineers \(IEEE\)](#)
- the [American Association of State Highway and Transportation Officials \(AASHTO\)](#)
- the [Institute of Transportation Engineers \(ITE\)](#).

By utilizing the talents of all 5 SDOs, the U.S. DOT program builds on expertise from the multiple disciplines of ITS. The U.S. DOT program provides an important aspect of coordination and overall planning. Many of the standards identified for U.S. DOT funding are being developed by several of the SDOs. The U.S. DOT program is encouraging and facilitating increased coordination in U.S. national standards efforts for ITS. The U.S. DOT has also considered input from ITS America in choosing the most appropriate standards for near term funding. Longer term funding will focus on additional standards needed to support deployment of the ITI and the remainder of the National Architecture falling outside of the ITI. The overall goal of the program is to accelerate ITS deployment and promote national interoperability through robust non-proprietary, consensus-based national standards.

INTRODUCTION

The U.S. Department of Transportation's (U.S. DOT) ITS Joint Program Office is supporting an extensive, multi-year program of accelerated standards development to strengthen and facilitate the successful deployment of ITS with a specific near-term focus on the Intelligent Transportation Infrastructure. The program is supporting and accelerating the existing ITS consensus-based volunteer standards processes already underway in the U.S. This document identifies the strategy U.S. DOT is pursuing in underpinning the ITS standards process and identifies activities currently being supported through Federal funding.

GOALS AND OBJECTIVES

Program goals with respect to standards development are driven by the following direction provided in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), "The Secretary shall develop and implement standards and protocols to promote widespread use and evaluation of ITS technology...To the extent practicable, such standards and protocols shall promote compatibility among ITS technologies implemented throughout the States...The Secretary may use the services of such existing standards-setting organizations...as appropriate."

In support of these goals, specific objectives of the standards program are:

- To facilitate interoperability at interagency, interjurisdictional, state, and national levels. Common understanding and use of informational message transmissions will promote coordination and interoperability among public agencies, information service providers, and travelers.
- **To provide an environment for which public sector agencies (and others) have multiple vendors from which to choose, when procuring products and services.** This will create competition, resulting in lower cost and higher quality. It will also avoid the situation whereby an agency is locked into a single vendor relationship.
- **To facilitate the widespread deployment of ITS.** Standards will drive efforts towards deploying integrated systems. Public agencies will be able to reference appropriate standards in their procurement packages, deploy "open" systems, and provide platforms for generating private sector interest and investments.
- **To ensure the safety of the traveling public.** Establishment of human factor and operational guideline standards will ensure that ITS products and services be utilized in a safe manner.
- **To provide an environment which will promote the creation of an ITS market.** Development of non-proprietary standards will

make accessible the necessary technical information by which new and innovative companies can break into the ITS market to both products and services. Building to these standards will also ensure interoperability among multiple vendor products much like the integration of a home stereo system.

U.S. DOT'S STRATEGIC PLAN

In order to support the above goals and objectives, a strategic plan has been formulated by U.S. DOT to establishing criteria for prioritizing Federal funding support towards specific standards development activities. As a general rule, standards activities that fall into the following categories will be the most likely candidates for funding support.

The 1st Wave (activities over the next 3 years):

- Standards development organizations' (SDO) activities underway that line-up with Federal objectives, with a special emphasis on promoting national interoperability and supporting the Intelligent Transportation Infrastructure. This includes such things as message set development and ITS specific communications standards.
- Foundation standards, which support the general deployment of ITS and cover multiple interfaces in the National Architecture. This include such things as data dictionaries, location referencing, safety and human factors standards, etc.
- CVO standards, which support primarily Dedicated Short Range (DSRC) Communications and Electronic Data Interchange activities.
- The remainder of the standards requirements that support ITI, typically in the form of message set standards.

The 2nd Wave (activities over the next 3-5 years):

- The remainder of requirements (outside of the ITI) resulting from the National Architecture as called out in the Standards Requirements Documents. This consists primarily of message set development.

To implement these initiatives, the ITS Joint Program Office will work with the SDOs and ITS America to assure timely development of the standards and protocols, providing partial funding when necessary and assuring that the process of the funding does not supplant, weaken or discourage the volunteer consensus process of the SDOs.

Building on the [National Architecture](#)

Standardization of interfaces is a *requirement* for successful implementation of the ITI and National Architecture. Standards are required so that systems that provide similar functions to the traveling public can use interoperable equipment and readily exchange information. Standards are the final step in achieving national compatibility and interoperability - without standards, systems conforming to the national architecture will have very similar conceptual design and perhaps functionality, but won't necessarily be able to easily interchange information. For example, without standards for traffic controller interfaces, local authorities might have to choose proprietary solutions that are not easily upgradeable and/or purchase expensive custom software specialized to their particular equipment configuration. With appropriate standards, compatibility, interoperability, and expandability are much easier and cheaper to achieve.

The National Architecture provided a very important step in the journey towards a fully compatible and interoperable national ITS. The Architecture identified *which* standards are needed in order to achieve the User Services identified in the National Program Plan (which many experts consider the first step in this journey).

Supporting the Intelligent Transportation Infrastructure

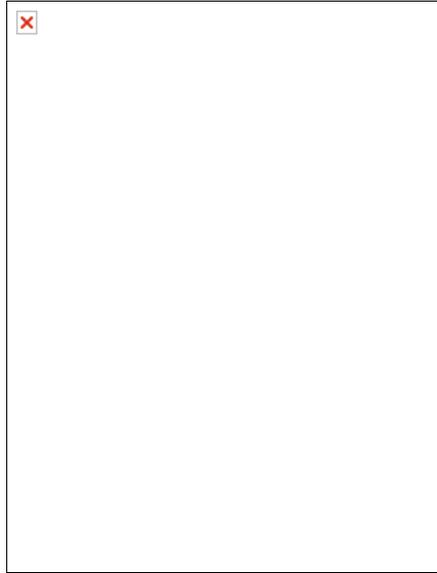
In January 1996, the US DOT announced the "Operation TimeSaver" initiative, challenging State and local officials to plan and buy "smart." The initiative introduced a National goal -- to build an integrated Intelligent Transportation Infrastructure (ITI). The ITI is identified by nine ITS components: Electronic Payment, Traffic Signal Control, Freeway Management, Transit Management, Incident Management, Electronic Toll Collection, Railroad Grade Crossing, Emergency Response Management Services, and Traveler Information. While many cities and rural areas have deployed one or more of these components, most components cannot "communicate" with one another. The goal of Operation TimeSaver is to *integrate* these components so that cities and rural areas can communicate and exchange information, ultimately reducing operating costs, improving mobility, and more importantly, saving lives.

Standards will play a major role in the deployment of the ITI. They will serve as the mechanism for defining the information and how the

information is transferred among the system components (e.g. from Freeway Management to Transit Management). Providing standards, will ensure that the information being transferred will be obtainable and understandable by both parties.

The standards chosen for the U.S. DOT program are typically those needed to implement the ITI. These include both key interface standards, including message sets and data dictionaries, and foundation standards, including location referencing and some safety standards, needed to deploy key ITI functions safely and efficiently. The following charts map the standards chosen, as part of the initial funding efforts, to the ITI building blocks and identify what percentage of the ITI requirements are being addressed by current standards activities. **Funded Standards Efforts Mapped to ITI Building Blocks**

	Traffic Signal Control	Freeway Management	Transit Management	Incident Management	Electronic Fare Payment	Electronic Toll Collection	Railroad Grade Crossing	Emergency Management Services	Regional Multimodal Traveler Information
NTCIP	x	x	x	x					x
Data Dictionaries	x	x	x	x	x	x	x	x	x
Message Set Template	x	x	x	x	x	x	x	x	x
DSRC					x	x			
TCIP (Transit Communications Interface Protocol)	x		x		x				x
TMC to Service Provider		x		x					x
Traveler Information		x		x			x		x
Mayday				x			x		
DSRC Message Set for CVO and ETC						x			
Message Set for External TMC		x	x	x			x		x
Message Set for Mayday Alert				x			x		
Navigation and ATIS Message Set		x		x					x
Message Set for Incident Management		x		x			x	x	x





Coordinating with Deployment Activities

U.S. DOT is moving forward with supporting both ITI and [CVISN](#) model deployment activities, as well as other field installations. Special attention is being provided, to examine how to dovetail standards efforts with field activities. The following language excerpted from the FY 1997 Congressional Conference Report, further emphasizes the need for encouraging coordination among these activities:

"The director of the Joint Program Office shall ensure that the operations of each of the ITS projects funded with either GOE or ISTEA funds is consistent with the national systems architecture and the purposes of section 6053(b) of ISTEA. These projects shall contribute to the implementation of the standards development work and shall promote interoperability of ITS systems among the states."

As standards documentation becomes developed, we will look towards and work with field activities to implement such standards. Some candidate possibilities for early implementation are the NTCIP, location referencing, and traveller information over the FM subcarrier.

CURRENT ACTIVITIES

Background

There are a number of activities that have taken place which form the foundation for current and future standards. This foundation is in the form of requirements (i.e., needs) by the various application communities (ATMS, ATIS, APTS, etc.). Major contributions have been inputted into the standards process through the consensus based National Architecture, as well as from the extensive committee involvement at [ITS America](#). In addition, current research will provide data for the formulation of future standards. This section identifies some current research efforts, as well as standards activities that are taking place today.

Research

Current research that supports near and far term standards needs is currently underway. Activities include such items as safety and human factors and spatial data transfer, to name a few. As the research matures in these areas and others, standards efforts will be launched, as appropriate.

Supporting Organizations

In order to ensure that the standards developed have broad consensus support and benefit as much as possible from the accumulated

wisdom of the ITS industry, U.S. DOT has chosen not to impose standards from above. Instead, U.S. DOT has chosen to support, guide, and reinforce the existing consensus standards efforts in the U.S. by providing funding to five existing Standards Development Organizations. This will allow U.S. DOT to leverage significant volunteer resources and to foster public-private partnerships in the deployment of ITS. The private sector participates in and supports the consensus-based SDOs, providing volunteer resources and in some cases field testing. The U.S. DOT chose these five SDOs because they had considerable volunteer expertise and experience in developing standards for ITS. In addition, each of these SDOs represents an important area of expertise in ITS, as described below. By utilizing the talents of all 5 SDOs, the DOT program builds on expertise from the multiple disciplines of ITS.

[The Society of Automotive Engineers \(SAE\)](#)

In-vehicle and traveler information.

[The Institute of Transportation Engineers \(ITE\)](#)

Traffic management and transportation planning systems.

[The Institute of Electrical and Electronics Engineers \(IEEE\)](#)

Electronics and communications message sets and protocols.

[The American Association of State Highway and Transportation Officials \(AASHTO\)](#)

State level agency participation and roadside infrastructure.

[The American Society for Testing & Materials \(ASTM\)](#)

Dedicated short range communications systems.

The funding provided to the SDOs will allow them to obtain the following support for facilitating the development process:

- *Hiring dedicated technical support:* This will provide for a concentrated effort that will expedite the writing process. Once a draft standard is generated, the committee will be able to comment and revise the document as necessary. By having the dedicated support, as opposed to only volunteers, during this up front effort, a tremendous amount of time saving may be achieved.
- *Coordination of public sector participation:* Buy-in and use of standards by the public agencies will be better achieved if they are part of the development process, thereby ensuring that their requirements are being met. Funding is provided to allow public sector participation in appropriate standards meetings.
- *Test and Evaluation:* In some cases, it may be necessary to conduct test and evaluation efforts to verify standards requirements and compliance of the developed standard or protocol with the initial requirements. This effort would support the development of test and evaluation plans and some portion of testing activity.
- *International Standards Support:* As U.S. national standards develop, there may be a need to move such activities into the international arena. This activity will support participation, as appropriate, in national and international committees.

Status

There are literally several hundred national and international standards efforts underway which are potentially relevant to the deployment of ITS, but only a few dozen are appropriate targets for U.S. DOT funding. The ITE provides significant insight as to which of these efforts are most relevant to public sector deployment of an efficient, safe, nationally interoperable transportation infrastructure in the United States. For example, standards to achieve regionally integrated multimodal traveler information have been identified as high priority for ITE deployment, while standards for parking lot smart cards have been identified as low priority for national standardization and interoperability.

The U.S. DOT has used a rigorous set of criteria to select which standards are funded by U.S. DOT. The need to support of the ITE and facilitate widespread deployment of ITS leads to some obvious criteria such as urgency for ITE deployment success. DOT used questions such as, "Is this standard crucial to the deployment of one of the 9 ITE building blocks?", "Will a lack of this standard delay interoperability?", and "Is the application to which this standard applies already being deployed?" to choose the most urgent standards needs for the first year of funding. An example of a standard which met these criteria was location referencing, which is needed to allow multiple ITE applications to unambiguously and automatically locate passenger vehicles, road equipment, and incidents/emergencies.

U.S. DOT also took into account standards needs which were deemed top priority by the overall ITS community. U.S. DOT's prioritization of standards efforts followed closely and were guided by the ITS America survey of standards priorities. This survey was distributed by ITS America to over 4000 industry participants. Respondents indicated their top priority standards for immediate development, for development in 3 years, and for development in 5 years. The different time periods were chosen because some very important standards might not be needed right away, such as the standards needed to deploy the automated highway system, and the survey wished to poll participants on both urgency and importance of standards requirements. All the very high priority standards on the ITS America list (important standards needed for immediate development) were chosen as part of the initial wave of U.S. DOT funding.

The U.S. DOT standards program builds upon the efforts of existing U.S. standards organizations in the field of ITS. This rest of this section highlights some of the highest priority standards chosen for immediate funding. These standards are key to early deployments of ITI building blocks. For a detailed listing of all currently funded standards activities, see Appendix A.

Location Referencing - SAE

One of the highest priority enabling standards identified in the ITS America survey is that of Location Referencing. For the past several years, the Federal Highway Administration has been funding research at Oak Ridge National Laboratories on this complex technical issue. The SAE Map Database Standards Committee decided to build upon the work of Oak Ridge, using that work as the basis of an SAE standard. This standards effort represents a true public-private partnership - the private sector map database vendors and navigation system integrators on the SAE committee are endorsing and building upon the work of an FHWA-funded project. Says project leader Cecil Goodwin, "This represents a foundation standard needed by countless interfaces in the architecture - someone did try to count the number of information flows in the National Architecture which depended upon this standard, but I think they lost track at 275 or so." The standards program funding is being used to support several consensus-building workshops and field testing to ensure that the U.S. national standard for location referencing meets all user requirements. A SAE standard on location referencing will be ready for ballot within the first year of the program.

The National Transportation Communications for ITS Protocol - AASHTO

The NTCIP standard represents another public-private partnership success story. This specification was developed with several years of FHWA funding and guidance. A joint committee of AASHTO, ITE and the National Electronics Manufacturers Association (NEMA) put the consensus touches on the final version and acted to promote the standard and develop user guides and conformance testing software. It is estimated that this standard will save traffic control centers literally millions of dollars in software costs and equipment replacement costs. NTCIP promotes not only interoperability but interchangeability. For example, it will greatly simplify and reduce costs for traffic system maintenance - the person driving the maintenance truck will be able to reach into the box of "spares" and replace a piece of traffic controller equipment with interchangeable parts from multiple vendors. Says AASHTO representative Bo Strickland, "NTICP represents a family of about a dozen standards that are extremely important to the successful deployment of ITS. This standard was the number one priority on the ITS America survey of standards priorities. AASHTO, ITE, and NEMA are committed to complete these very important standards on an aggressive schedule in order to meet user requirements." The preliminary specification will be available by the end of 1996. The standards program funding is being used to finalize the specification, develop conformance testing tools and develop additional profiles for specialized applications which are crucial to deployment of the ITI.

Transit Communications Interface Protocol - ITE

The Institute of Transportation Engineers has identified key communications infrastructure standards needed for successful deployment of the ITI. One important standards effort is a Transit profile for the NTCIP, known as TCIP (the Transit Communications Interface Protocol). Notes standards project manager Eva Lerner-Lam of the Palisades Group, "The TCIP covers important transit requirements that aren't being covered in any other forum. This represents a valuable opportunity to develop standards based on actual user requirements, which regrettably isn't always possible without U.S. DOT funding for consensus workshops." The standards program funding is being used to fund consensus workshops and development of specifications based on the results of these workshops.

Traffic Management Data Dictionary - ITE

ITE is also developing an extensive Traffic Management Data Dictionary, fulfilling an important user requirement identified at several ITS America workshops. This standard is especially important to deployment of the ITI, since it allows TMCs to efficiently and automatically transfer information and coordinate strategies. In addition, the early funding for this project will lead to a draft standard by early 1997, providing an important foundation for data dictionaries for other application areas.

Umbrella data dictionary structure & message template - IEEE

Before selecting the standards for first year funding, the Joint Program Office did an extensive study of standards requirements identified in the ITI and existing standards efforts. This study identified several gaps in the consensus standards efforts in the U.S. One of the most important and urgently needed standards - an umbrella structure for data dictionaries - wasn't being developed by any consensus group. The JPO facilitated consensus-building discussions between ITS America, the Council of Standards Organizations, the National Architecture teams, and relevant standards groups. After discussion, IEEE volunteered to lead the effort to develop an umbrella data dictionary structure. Federal funding is being used to facilitate consensus building meetings on early user requirements, and to develop an umbrella structure as soon as possible. Given the urgent need for this standard, it is hoped that a first draft structure will be developed by the end of 1996. Notes IEEE consultant Ivor Knight, "We certainly appreciate the vote of confidence the ITS industry has given us. It's a tough job, but hopefully with our decades of expertise in developing robust national and international standards we'll be up to this task."

Dedicated Short Range Communications Protocol - ASTM

ASTM has tackled one of the most difficult issues in ITS standardization today - a difficult issue that illustrates precisely why early and aggressive standardization is a good idea. In the U.S. today, multiple electronic toll systems exist which are not compatible in terms of communications protocols, basic technology (passive versus active RF technology), or even frequency. There is considerable investment in these "legacy" systems, which makes it very difficult to agree on the appropriate standards. European standards groups are developing standards for frequencies not available in the U.S. for this application. If standardization had begun before so many systems were deployed, the task of standardization would not be so difficult.

Recognizing the difficult political and institutional issues involved in standardizing in an area where the market currently includes incompatible systems, ASTM has decided to focus on the requirements for "next generation" systems. Dedicated Short Range Communications are a crucial part of the ITI for many applications, including toll and traffic management. Incompatible systems mean that drivers often have to buy more than one "tag" in order to pay tolls in multiple jurisdictions in a single state, which significantly reduces the efficiency and cost savings over the "throwing coins in the bucket" systems. In collaboration with ITS America, ASTM is hoping to develop a standard which can satisfy American manufacturers and consumers.

Richard Weiland (SEI Technology Group), Chairman of the ITS America Standards and Protocols Committee, notes, "Representatives of DOT have made it very clear that DOT was not going to spend money that would further splinter communication standards for ITS, which has certainly helped accelerate consensus. It was extremely encouraging that all of the parties present at the DSRC Industry Roundtable in October, agreed to work toward a harmonized set of draft standards on levels 1 and 2 for the DSRC."

NEXT STEPS

The U.S. DOT Standards Development Program is a multi-year, multi-task program. Significant evolution of the program is expected. The standards chosen for Year One funding will hopefully be completed relatively quickly. Important but less urgent standards will be chosen for funding in the coming years. As ITS is deployed nationwide, new standards needs may emerge which are not obvious at this time - and U.S. DOT will be ready to respond to those needs. Innovative public-private partnerships to develop and test required standards will be implemented, as appropriate. The U.S. DOT Standards Program will be as flexible and dynamic as the Intelligent Transportation sector itself, adapting rapidly to meet the changing mobility and safety needs of the traveling public.

The U.S. DOT program is intended to reinforce and support the volunteers standards efforts in the U.S. If you'd like to join the volunteer standards process, all five SDOs mentioned in this document welcome input and support. If you'd like more information on a specific standards effort, please contact the SDOs directly (see Appendix B). If you need additional information on the U.S. DOT's standards program, contact the ITS Joint Program Office.

Appendix A: List of Currently Funded Standards Support Activities

<u>ACTIVITY</u>	<u>DESCRIPTION</u>	<u>ORGANIZATION</u>
NTCIP	Develops physical and data link protocols and application specific object sets.	AASHTO
Traffic Management Data Dictionary	Defines specific data elements that make up messages used within an ATMS traffic management center (TMC) and exchanged with other external systems and subsystems.	ITE
DSRC Message Set for CVO and ETC	Defines the application specific message sets.	IEEE
Location Reference Specification	Evaluates preliminary specification in a test and modifies it as necessary into a draft standard.	SAE
Dedicated Short-Range Communications Protocol	Develops physical and data link standards for beacons.	ASTM
Message Set for External TMC Communication	Defines the application messages transferred between TMCs and other ITS centers.	ITE
Spatial Data Interchange	Supports development of an ITS profile to the Spatial Data Transfer Standard.	ORNL Study*
Survey of Communications	Survey and analysis of existing standards and those under development	IEEE

Technologies, Practices, and Standards Relevant to ITS **	applicable to the needs of the ITS Short Range and Wide Area Wireless and Wireline Communications.	
High Speed Data Subcarrier Protocol	Defines the FM subcarrier modulation format for ATIS message sets.	SAE
Message Set for Incident Management	Prescribes the form and content of the messages for real-time emergency notification from the Emergency Management Subsystem to other centers and providers.	IEEE
Umbrella Standard for ITS Data Dictionaries	Defines the format and content standards for ITS data dictionaries.	IEEE
Message Set for Commercial Vehicle Safety & Credentials Information	Defines the message structure with which authorized parties can request and obtain information on the safety performance, regulatory compliance, and credential status of commercial motor vehicles.	APL***
Message Set for Commercial Vehicle Credentials	Defines the message structure with which owners, lessees, and drivers of commercial motor vehicles can electronically apply for and receive credentials necessary to legally operate.	APL***
Commercial Vehicle Operations Data Dictionary	Defines the data elements pertaining to CVO messages and information transfer.	APL***
Traveler Information Data Dictionary & MS	Defines the message set and data dictionary for ATIS applications.	SAE
Traffic Controller 2070 (NTCIP)	Develops hardware, software, and user interface standards for the 2070 Advanced Traffic Controller.	ITE
Navigation and ATIS MS Evaluation	Implements, tests, evaluates, and validates a message set for two-way, vehicle to infrastructure ITS communications, based upon SAE J2256 and advances the message set to become an accepted standard.	SAE
Transit Communication Interface Protocol	Defines the physical, data link, and application layer standards for the Transit Management Center (TrMC) and vehicle and between TrMC, vehicle, and other centers.	ITE
In-Vehicle Databus Interface	Develops a set of standards that will permit plug and play integration of multiple ITS electronics devices into a vehicle while ensuring the safety and integrity of the vehicle and on-board systems is maintained.	SAE
Message Set for Mayday Alert	Prescribes the form of messages exchanged between and ISP and in-vehicle systems.	SAE
Vehicle Navigation/Route Guidance Standards	Defines human factor standards for safe operation of navigation/route guidance equipment in vehicles.	SAE
Automatic Vehicle Identification	Defines the messages used to report vehicle identification.	IEEE

*ORNL is providing additional requirements definition to support subsequent standards development activities.

**Although not specifically a standard, this effort cuts across and supports multiple standards development activities.

***APL is supporting the ANSI X12 committee for the development of electronic data interchange standards.

Appendix B: For More Information

Additional information on standards activities may be found on the [ITS America](#) Web site.

Additional information on specific Federally funded standards projects may be found on the U.S. DOT Web site (www.its.dot.gov)

Additional information on the ITI and [National Architecture](#) is available from ITS America and the Publications Office of the U.S. DOT Joint Program Office.

Additional information on the ITS activities of the five SDOs is available from:

(Note: these are the specific contacts for the ITS standards.)

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