Committee for a Study of Options for Streamlining Standards for Intelligent Transportation Systems Letter Report: June 18, 2007

DETAILS

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OF THE NATIONAL ACADEMIES

June 18, 2007

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Dear Ms. Row:

On behalf of the Transportation Research Board's (TRB's) Committee for a Study of Options for Streamlining Standards for Intelligent Transportation Systems, I am pleased to transmit this letter report. The study committee was convened in response to Section 5307, Part 4 of the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, which calls on the U.S. Department of Transportation (USDOT) to designate a committee of experts to recommend ways to expedite and streamline processes for developing intelligent transportation system (ITS) standards and protocols. USDOT called on TRB to appoint an independent committee to conduct the study. The committee was asked by USDOT to identify the types of support needed for ITS standards deployment and to recommend the role USDOT should play in standards development and deployment. The enclosures contain the roster of the 12-member committee of experts in ITS product development, procurement and operations, and standards development and deployment. Member biographical information is available at http://www8.nationalacademies.org/cp/CommitteeView.aspx?key=48733.

This report summarizes the committee's discussions and presents its findings and recommendations. It was developed over a 6-month period in which the committee met three times and communicated regularly by e-mail and teleconference. During meetings, the committee benefited from presentations by officials from USDOT, representatives from several standards organizations, and experts in transportation systems and ITS. The committee thanks the many individuals who participated. Their presentations contributed information and insights that were referred to repeatedly during the committee's discussions and are cited often in this report. A listing of presenters and presentation topics is enclosed.

OVERVIEW AND APPROACH

In originally authorizing federal support for ITS standards, Congress urged the use of consensus-based processes for standards development. This provision was interpreted by USDOT to mean the use of processes consistent with those recommended by the American National Standards Institute (ANSI), as employed by many standards development organizations (SDOs) in the United States. USDOT's ITS standards program has now been functioning for more than a

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decade. During this time, it has pursued the development of more than 100 standards that establish common definitions, measurements, and configurations for various ITS components and subsystems. A large majority of the standards have been approved or are awaiting publication; only eight remain in ballot or under development as of May 2, 2007.

Because ANSI processes are open, methodical, and iterative, they can take much time to carry out. Among the scores of standards supported by the ITS standards program, some have required many months and others many years to bring about. Whether some of these standards took an unusually long time to develop is a legitimate question, but one that has limited relevance for the large majority of standards that are now completed. The committee therefore realized that with only a handful of standards still under development, any advice that it could offer on ways to speed their development would have little, if any, practical effect. As a consequence, the committee considers the challenge of timely and useful standards development from the standpoint of the ITS standards program going forward.

In the main, ***the committee's findings and recommendations are intended to aid USDOT in defining and implementing its future role in support of timely and useful ITS standards.*** The committee recognizes that federal resources in support of ITS standards are limited and likely to be much smaller during the next few years than they were during the past decade, when USDOT spent more than $100 million on activities related to ITS standards. Yet, the committee also realizes—and must emphasize—that in a fast-changing field such as ITS, it is seldom possible to establish standards on a one-time basis. Standards setting must be a continuing process involving recurring cycles of standards needs identification, development, verification, deployment, and updating (maintenance).

The advice in this report is offered with the expectation that USDOT's involvement in ITS standards will not end when all standards in its current portfolio are issued. An overarching theme concerns the desirability of USDOT having an ongoing role in support of ITS standards—but the role must be well defined and well planned, especially if it is to succeed with fewer resources.

Advice in Brief

The essence of the committee's advice is for USDOT to

- ***Articulate a strategic vision of the role of standards in furthering the development and use of ITS and define USDOT's role in realizing this vision.*** The vision should be presented in a strategic plan that explains how standards are beneficial to ITS and defines USDOT's roles in all phases of standards support, the expected benefits from this support, and means of evaluating performance and outcomes.

- ***Systematically engage end users in all phases of standards support and explore a variety of processes that involve them to ensure timely and useful standards.*** Deployment must be viewed as an inseparable part of standards development rather than as a distinct follow-on activity. The users of standards, including government purchasers and the broad community of suppliers, developers, and integrators of ITS products, must

be consulted on an ongoing basis and in ways that identify the changing need for standards. They must have a prominent role in all phases of standards development and deployment. The development processes must be suited to the product or service to which the standard applies and must take into account the special importance of timeliness and adaptability for standards pertaining to rapidly evolving technologies. All aspects of the program, from financing to contractual arrangements, must be compatible and aligned with these program goals.

- ***Forge strong connections with other relevant standards activities in the federal government, in the private sector, and internationally.*** Consultation and coordination with other standards activities in the federal government is essential for tapping standards expertise and keeping abreast of standards activities in other agencies that may affect ITS. Participation in international ITS standards activities is vital in ensuring that information and technical barriers do not deprive U.S. purchasers and suppliers of ITS products and services of the benefits of a global marketplace.

The committee was asked to recommend ways to expedite ITS standards development. The actions recommended in this report may not have this effect in all cases. Of greater interest to the committee is the development of relevant and useful standards. Timely development can be important in ensuring a standard's utility in a fast-changing field such as ITS. If a standard does not meet user needs, however, its timely development is not helpful. Findings in this report suggest that USDOT, seeking to demonstrate progress in standards development, did not engage users early and often in identifying standards needs, resulting in a premature commitment to a specific set of standards developed in a specific way. The recommendations in this report are intended to avoid such outcomes in the future.

As is evident from the nature of this advice, the committee is by no means indifferent to the importance of ITS standards or USDOT's role in support of them. Its advice stems from the following strongly held beliefs:

- Standards are vital to the development and deployment of ITS and consequently to the achievement of the promise of ITS in improving transportation system safety, mobility, and efficiency.

- USDOT should take a prominent role in support of standards to help bring about the benefits of ITS more quickly.

- Budgetary decisions that have a lasting effect on USDOT's role in support of ITS standards should be made on the basis of a clear strategy that articulates this role.

- Standards setting in the field of ITS must be viewed as an ongoing process rather than a one-time activity that ends with the issuance of a select set of standards.

The findings and recommendations in the report are policy oriented. They are intended to aid the new leadership of the ITS program, in both the ITS Joint Program Office (JPO) and the

Research and Innovative Technology Administration, in making many critical decisions that will establish the future course of USDOT's support for ITS standards.

Organization of the Report

The remainder of the letter report is organized into four sections. The first is background concerning the history and approach of the ITS standards program. The origins of the program, connections to the national ITS architecture, and processes used for developing standards are explained. Much of this background is given for context, in the knowledge that this report will be made available to Congress and the general public. Information on the development status and deployment of standards is given in the second section. The committee's findings are presented in the third section. They are derived from a review of how ITS standards were selected, processes employed in developing them, and means for assessing their use and effect. Because this is the third time a TRB committee has reviewed and offered advice on the federal ITS standards program,[1] several relevant findings from the two earlier reviews are cited. Findings from all three reviews form the basis of the final section, which presents the committee's recommendations in greater detail.

BACKGROUND

For the better part of two decades, transportation planners, researchers, and engineers have been developing and deploying data and communications systems that collect, process, and distribute information to improve the operations, security, environmental impact, and safety of public highways and transit. These intelligent transportation systems incorporate a broad range of products and services for traffic management; emergency response; incident management; commercial vehicle operations; electronic toll collection; and vehicle safety, navigation, and control.

Congress first authorized a federal program of ITS research, development, and operational tests in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). ISTEA called on USDOT to create a national ITS architecture and a standards program.[2] Their purpose was to help ensure the advent of a well-integrated system, rather than an assortment of incompatible local and regional installations. To undertake these initiatives and administer the entire ITS program, USDOT created JPO.

National ITS Architecture and Relevance to ITS Standards

Developing a national ITS architecture was an early priority of JPO. A well-defined architecture was viewed as a guiding template for federal investments in ITS R&D and ITS standards by identifying

[1] The first TRB review took place in 2000, as scores of ITS standards were in the process of being developed with USDOT support (TRB 2000). The second took place in 2002 and 2003, after many standards had been issued and attention was shifting to their deployment and maintenance (TRB 2004).

[2] The Transportation Equity Act for the 21st Century (1998) reauthorized USDOT's role in support of ITS standards development.

- The key functions of ITS,
- The physical entities and subsystems where these functions reside,
- The information and data flows connecting these functions and physical entities and subsystems, and
- The interfaces that should exist between ITS components and how they will exchange information.

The first national ITS architecture was completed in 1996. It portrayed a future ITS consisting of sets of interconnected centers, roadside devices, vehicles, and travelers. The centers were depicted as places in which data are gathered, analyzed, and acted upon to control traffic flows, collect tolls, route emergency vehicles, report on road conditions, and the like. Dozens of interfaces and data flows in the architecture were identified as candidate areas for future standardization.

Over the past decade the national ITS architecture has been updated several times. While the basic form of the architecture has remained unchanged, new versions have added functions and services. A diagram of the latest ITS architecture is shown in Figure 1.

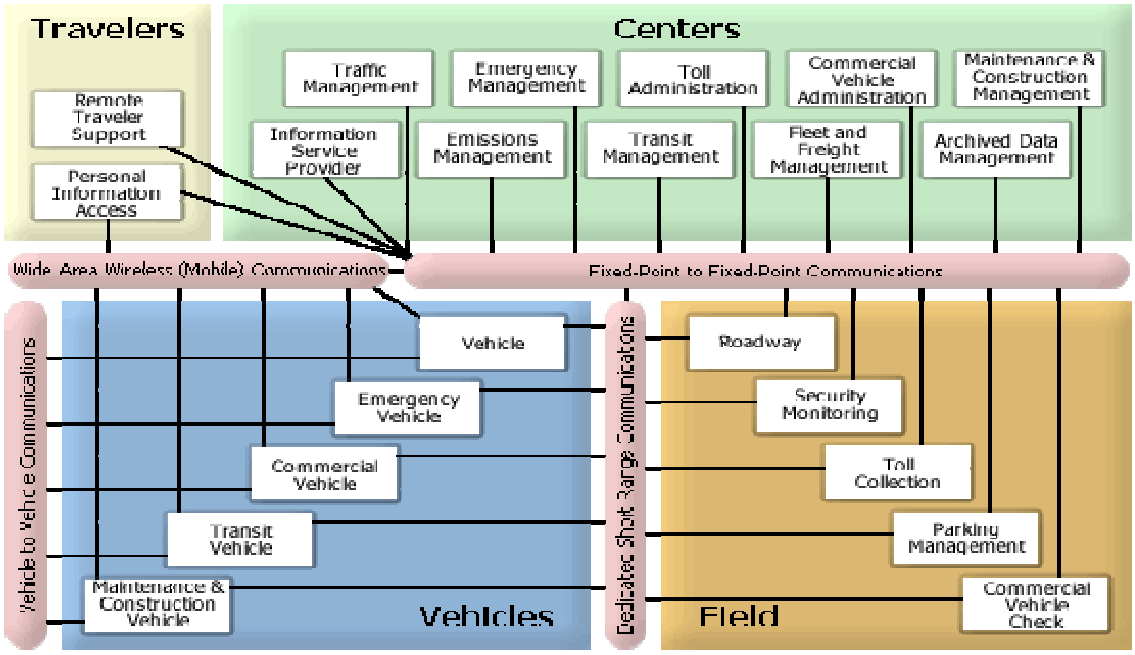


FIGURE 1 National ITS architecture, Version 6.0 (issued April 2007).

Basis for Determining Standards Needs

Many of the interfaces in the national ITS architecture that were originally thought to require standardization involved mobile subsystems, such as vehicle-to-vehicle and vehicle-to-infrastructure systems. The idea was that standards would enable the same mobile subsystem to roam the country and connect with the local infrastructure to support ITS capabilities such as toll collection and commercial-vehicle monitoring and enforcement. In addition, ITS standards were viewed as necessary in achieving a number of other outcomes, including the connecting of systems operated by state and local agencies in the same region and the fostering of innovation and competition in the market for ITS services and products.

An early USDOT status report for the ITS standards program, issued in 1996, listed the following as key program goals (JPO 1996):

- Facilitate ITS interoperability across government agencies.
- Provide an environment conducive to multiple ITS vendors—promoting competition that brings about lower prices and higher quality for ITS products and services.
- Facilitate widespread deployment of ITS through the ability of government agencies to reference standards in their procurement contracts easily.
- Ensure public safety by developing operational and human factor guidelines as part of ITS products and services.

Identifying the areas in which standards were most needed and valuable to the public presented the first real challenge to the ITS standards program. The national ITS architecture identified hundreds of candidate areas for standardization; hence, more specific guidance would be needed to identify standards deserving early attention.

To ascertain where federal support for standards would be most beneficial, JPO sought input from the user community with help from the Intelligent Transportation Society of America (ITS America). ITS America mailed a questionnaire to approximately 4,000 government agencies and suppliers of ITS products and services.[3] The questionnaire contained a listing of more than three dozen possible standards and asked recipients to rate each and to suggest other candidates.

How the results of the survey were assessed is unclear; the committee could find no documentation of the response. Nevertheless, soon after the survey was undertaken, JPO began the process of selecting standards for program support. The "first wave" of standards pursued by JPO emphasized those that would support national interoperability and aid in the development of other standards, such as data dictionaries. The latter were referred to as foundation standards.

[3] National ITS Priority Standards Work Plan Survey, administered by the ITS America Standards and Protocols Committee and developed jointly by the USDOT ITS Joint Program Office and ITS America. Mailed April 12, 1996.

JPO explained that both the national ITS architecture and deployment experience would guide decisions concerning how follow-on standards would be identified and prioritized for federal support. In the 1996 ITS program status report, JPO stated that the standards program would be "as dynamic and flexible as the ITS sector itself, adapting rapidly to meet the changing mobility and safety needs of the traveling public" (JPO 1996, 2). Whether such an iterative and adaptive approach was followed, however, is not known. The first wave of standards was quickly followed by the addition of many more standards to the program portfolio. By 2000, more than 80 standards were being developed.

Processes Used in Developing Standards

In authorizing the ITS standards program, Congress urged USDOT to use the services of existing standards organizations.[4] USDOT therefore sought assistance from a number of standards organizations in related fields. In cases where there was a natural fit between a set of standards and the expertise of a standards organization, recruiting was straightforward. In other cases, JPO had to search for interested organizations. The organizations that were selected and continue to participate in the program are the American Society for Testing and Materials (ASTM), the Institute of Electrical and Electronics Engineers (IEEE), the Institute of Transportation Engineers (ITE), the Society of Automotive Engineers (SAE), the National Electrical Manufacturers Association (NEMA), the American Association of State Highway and Transportation Officials (AASHTO), and the American Public Transportation Association (APTA).[5]

Several of these standards organizations—ASTM, IEEE, NEMA, and SAE—are best described as SDOs because they follow ANSI-recommended procedures for open participation in standards development. Three others—AASHTO, APTA, and ITE—were recruited by JPO because of their role in developing other guidelines and standards for highway and transit systems and because of their strong connections to state and local transportation agencies and professionals. The latter organizations are better described as "standards-related organizations" because they employ some processes open only to their membership.[6] For the purposes of this report, however, all of the standards organizations are referred to as SDOs.

For the most part, the SDOs were expected to follow their regular processes for developing open, consensus-based standards. These processes are methodical and involve multiple steps. Normally, the need for a new standard is raised by one or more developers, vendors, or purchasers of a product or service. Upon receiving a proposal for a new standard, the SDO will task one of its technical committees with examining the need and likely user demand. Consideration will be given to the prospects for attracting volunteers to assist in development of the standard and to whether the level of interest in the standard will be sufficient to generate

[4] Subsequently, OMB Circular A-119, issued February 10, 1998, directed federal agencies to give priority to the use of voluntary consensus standards bodies whenever practicable and appropriate.

[5] Three other SDOs—the Electronics Industry Alliance, the Consumer Electronics Association, and the ANSI-chartered Accredited Standards Committee X12—developed several ITS standards early in the program, as listed in the appendix to this report.

[6] The three membership organizations do not fully comply with ANSI-accredited processes for standards development, since involvement in their standards activities may be limited to their member organizations.

sales revenue to recoup the cost of development. If the committee finds sufficient need and demand, it may form and seek volunteers for a working group to develop the standard.

SDOs do not choose who will participate in the working groups, but they try to maintain a process open to all interested parties. Although each SDO has its own established methods for ensuring a balance of views, the working groups typically consist of subject experts and individuals who would develop, purchase, and use the affected product or system. The working group will set a drafting schedule and submit drafts of the standard to the technical committee for review. The technical committee submits the final draft to a ballot, and the SDO will issue the draft as a standard if it is approved. The standard is generally viewed as the intellectual property of the SDO, which can choose to derive revenue from it through sales intended to cover development and maintenance costs.

In the case of the ITS standards program, it is noteworthy that one of the steps missing from the traditional standard development process is the vetting of standards needs by SDOs. JPO, instead, specified the standards to be worked on by each SDO. JPO then subsidized their development through various means, including the hiring of consultants to provide technical and drafting support. JPO also provided funds to cover travel by state and local officials serving on working groups and to develop tests and evaluation plans for standards verification and compliance. AASHTO, ITE, and NEMA have cooperated in the development of the large family of standards known as the National Transportation Communications for ITS Protocol (NTCIP). JPO has also provided funds to these SDOs to distribute the standards free of charge, since many of the users will be state and local transportation agencies.

In a meeting with the committee, JPO estimated that it has spent approximately $100 million on ITS standards-related activities. Early in the program, some of these funds were used to support U.S. participation in international ITS standards activities. Some of the funds were also used for the hiring of contractors to provide the program with systems engineering and technical assistance (SETA), such as the Jet Propulsion Laboratory, Battelle, and Noblis, Inc. The SETA contractors provide technical assistance to the working groups while monitoring the activity of the groups and reporting progress to JPO.

STATUS OF THE DEVELOPMENT AND DEPLOYMENT OF ITS STANDARDS

Standards Issued and in Development

As noted earlier, within 3 years of the start of the standards program, more than 80 standards were being developed. By 1999, 22 of these standards had been issued. With each update of the national ITS architecture, more ITS functions and interfaces were identified as candidates for standardization. Within 5 years of the program's inception, the number of standards being supported through the program exceeded 100. Today, there are 106 standards in the program. These standards are listed in the appendix by responsible SDO and their publication and development status.

Figure 2 shows the number of standards issued since the program's beginning and the number remaining in various stages of development. As of May 2, 2007, 88 standards had been published, eight had been approved and were nearing publication, three were in ballot, and five remained under development. All are expected to be approved and published by the end of 2007.

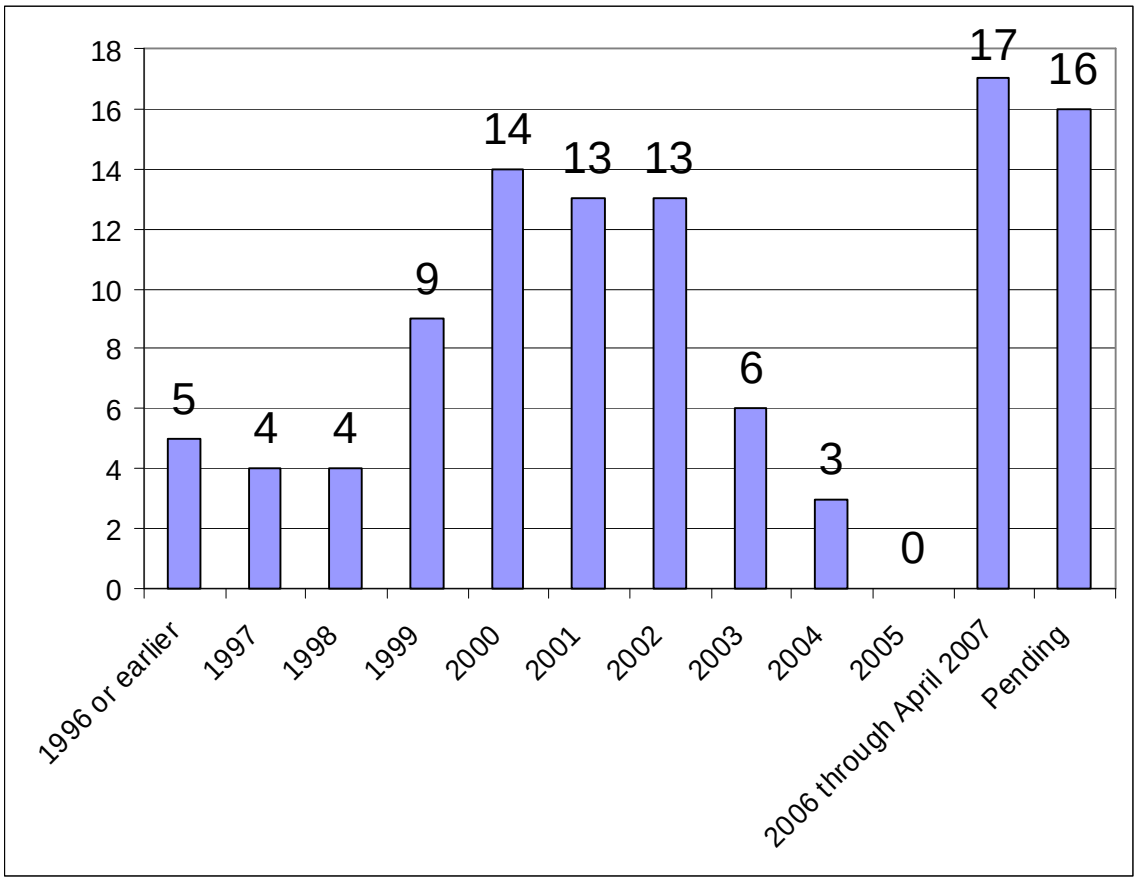


FIGURE 2 Number of ITS standards issued each year and number in progress as of May 2, 2007. (Source: appendix.)

Information on Standards Deployment

TRB's 2004 report on the ITS standards program focused on deployment. It advised JPO to explore a variety of tools to foster deployment, including testing and demonstration and training support for intended users. The report emphasized the importance of taking a judicious approach to deployment support because of limited resources. It advised an approach guided by a clearly delineated assessment of the need for each standard and the public benefits obtained from its accelerated use. The report urged JPO to develop explicit measures of use and effectiveness, and it stressed the value of outcome-based measures rather than simple metrics of program output such as the number of standards issued.

In 2004, JPO sponsored a survey to determine the field use of standards by more than 500 state and local agencies in 108 metropolitan areas.[7] Recipients were asked to report their use of one or more of approximately 40 ITS standards available at that time. The results of the survey indicated that, on average, each standard was being used in 5 to 15 percent of metropolitan areas. The most popular were the NTCIP 1201 (Global Object Definitions), 1202 (Object Definitions for Actuated Traffic Signal Control Units), and 1203 (Object Definitions for Dynamic Message Signs) suite of standards. The survey results indicated that these standards, which were among the first to be developed by the program, were being used in about one-third of the metropolitan areas.

When asked about these survey results, JPO presenters urged a cautious interpretation, expressing concern that some respondents may not have known they were using the specific standards listed in the questionnaire. Except for this survey, however, the committee found no information detailing the use and benefits of the standards supported by the program.

A number of deployment activities are supported by JPO and modal agencies. Examples include courses and workshops offered by the Federal Highway Administration (FHWA) through the National Highway Institute and ITE, which provide participants with an overview of ITS standards and more detailed instruction on the use of standards for particular types of ITS technologies. Other examples are advisories that describe individual standards and give guidance on how to obtain deployment assistance and teams of experts who can assist companies and agencies in using the standards. JPO and FHWA have also sponsored field tests of several standards, which are documented on their websites.

As for maintenance of the standards, the committee was told that budgetary cutbacks will limit the financial support that JPO can extend to this activity. JPO staff explained that SDOs interested in making major revisions to a standard will be able to apply for funding assistance. In most instances, however, maintenance will be the responsibility of the SDO.

Standards Program in the Context of a Changing ITS Program

The history of the ITS standards program must be viewed within the context of the history of the ITS program. During its decade-long existence, the standards program has functioned within an overall ITS program that has changed its leadership, structure, and budgetary priorities on a number of occasions. These changes are reflected in the structure and content of the standards program.

When most of the standards were selected during the 1990s, the focus of the federal ITS program was on supporting development of the Intelligent Transportation Infrastructure, which consisted of the public infrastructure required for traffic signal control, freeway management, transit management, incident management, electronic toll collection, emergency response management services, traveler information, and the like. Accordingly, JPO limited its

[7] The survey covered state and local agencies in the nation's 78 largest metropolitan areas plus a selection of 30 other medium-size metropolitan areas (http://www.itsdeployment.its.dot.gov/SurveyOutline1.asp).

involvement in standards for vehicle-specific elements of ITS, presuming they would be handled by private interests.

Over time, further changes to the priorities and structure of the federal ITS program have had implications for the standards program. One such change occurred in 2003, when activities of the program were focused on the following nine initiatives:

- Cooperative Intersection Collision Avoidance Systems (CICAS),
- Electronic Freight Management,
- Emergency Transportation Operations,
- Integrated Corridor Management Systems,
- Integrated Vehicle Based Safety Systems,
- Mobility Services for All Americans,
- Nationwide Surface Transportation Weather Observing and Forecasting System,
- Next Generation 9-1-1, and
- Vehicle Infrastructure Integration (VII).

These initiatives are aimed at advancing specific ITS capabilities and outcomes. For each of these program areas, JPO has sought user input to help define technical issues and opportunities for R&D assistance. In some cases, advice on needed standards has been sought; for example, the CICAS program has expressed interest in standards to support the use of dedicated short-range communications for data flows between vehicles and the infrastructure for intersection safety. The committee was informed that USDOT is now placing greater emphasis on the potential role of ITS in managing transportation congestion.

The standards program is described by JPO as a "crosscutting" activity. Whether and how the standards program will support the new congestion management initiative was not clear when the committee met with JPO leadership in February 2007.

FINDINGS FROM A REVIEW OF THE ITS STANDARDS PROGRAM

Congress asked for an independent review of the ITS standards development process and recommendations on how to expedite standards development. The committee therefore sought information on the status of the 106 standards in the program portfolio. The committee learned that nearly all of the standards have been issued and that all were expected to be completed by the end of 2007; hence, any advice the committee could offer on ways to hasten completion of these few remaining standards would have little, if any, meaningful effect. The committee concluded that the emphasis of its review should be on examining the standards program with an eye to the future role of JPO and USDOT in support of ITS standards.

The committee's review, which benefits from hindsight, reveals shortcomings in the standards program. Some of them may not have been identifiable when the program was conceived and implemented. In this regard, the committee recognizes the challenge of

developing standards for a fast-changing technological field such as ITS. When the ITS program was started in the mid-1990s, the wide array of relevant technologies and their uses that are commonplace today, from cell phones and handheld GPS to satellite radio and the Internet, could not have been foreseen. The committee also recognizes that the standards program existed within the context of the larger ITS program and therefore was influenced by the broader set of priorities within the ITS program as well as congressional and legislative requirements. Hence, the findings that are presented below are not intended to be critical of decisions made in conceiving and executing the standards program, but rather to identify needs going forward.

A review of the program is appropriate at this juncture. After 10 years it is reasonable to ask whether the program has had the beneficial effects that were expected. Have the anticipated outcomes and goals of the program been realized? Have standards accelerated ITS development and deployment as expected? Are standards fostering innovation and competition among ITS suppliers as intended? Are standards leading to more interoperability, and has interoperability produced public benefits? Of course, such questions need to be asked on a regular basis, since they pertain to the underlying rationale of the standards program.

The overarching finding of the committee is that JPO has not retained a strong vision of how the standards can support ITS and how the standards program can help realize this vision. The committee reviewed work plans, progress reports, and other documents of the ITS standards program from its inception in 1996 to the present. A set of goals for the standards program was laid out in the 1996 status report referred to earlier. However, these goals do not appear to have been carried forward to form the basis of a strategic plan that would guide the design and implementation of the standards program. Examples of the questions such a strategic planning process could have addressed are given in Box 1. They concern fundamental program decisions, such as the kinds of standards to be pursued, standards development processes to be used, the desired scale and pace of the program, plans for assessing program outcomes, standards coordination and technical support functions, and means of coordinating with other standards activities.

Box 1
Example Questions for Guiding the
USDOT Role in Support of ITS Standards

How quickly are ITS standards needed? Under what circumstances is early standards development most beneficial but unlikely to occur without federal support?

What are the key phases in the life of a standard, from its initial development and verification to its deployment and maintenance? What role should the ITS program play in each phase?

What continuing role will the program play in providing a central source of information and technical support for users of standards—for example, in indicating which standards apply, how to obtain them, where to find test results and examples of their use in the field, and how to obtain expert advice on their use?

Given anticipated resources and capabilities, how many standards can the program effectively support from development through maintenance?

On what basis should specific standards be selected for federal support, and when should support be withdrawn for deployment and maintenance?

What are the expectations for the life span of ITS standards? How can standards development, deployment, and maintenance be designed to keep pace?

What kinds of standards, including levels of specificity, are most suitable to the fast-changing technologies and applications of ITS?

How can the program engage the end users of standards during all phases, from selection of standards though development, deployment, and maintenance support?

What are the appropriate roles of contractors and SDOs working under contract, and how might contractual arrangements affect the incentives, interests, and performance of these parties in fulfilling such roles?

How are alternative processes for standards development likely to differ in terms of the time required to develop a standard, the ability to engage end users, and the fostering of deployment?

How will the effectiveness of individual standards and suites of standards be assessed?

What coordination role will the program play in keeping standards compatible and consistent (in order to avoid duplication and to maximize interoperability and cross-use), and how will coordination be maintained among SDOs?

What is the program's role with respect to other related federal standards activities and international activities?

This committee is not the first to question the program's strategic direction. The first TRB committee to review the ITS standards program reported that it "saw no convincing analyses of the national interests served by including some standards currently in the JPO program or under consideration; such analyses should be more clearly presented" (TRB 2000, 3). It noted that such an explanation would make the program more intelligible to the community of practitioners and helpful in determining whether candidate standards deserve financial support from the program. That committee recommended that "in the future, JPO should devote federal funds to developing only those standards for which there is a clearly stated national need for government support" (TRB 2000, 3). The TRB committee that conducted the second review of the program in 2002 and 2003 repeated the recommendation that JPO "invest its standards development and deployment resources in accordance with a clearly delineated assessment of (*a*) the need for the standard as an enabler of important ITS services and (*b*) national benefits to be

gained through that standard's accelerated promulgation" (TRB 2004, 3). That committee noted that such an assessment would allow allocations to be more tightly targeted and expected outcomes to be defined and measured more clearly.

The committee is cognizant of the challenge JPO faced in establishing an ITS standards program when the ITS program itself was in its infancy. This newness, combined with a widely held view that standards were needed quickly to ensure ITS progress, may have caused JPO to underestimate the magnitude of the task before it and the importance of defining the program's goals and a compatible program approach. At the same time, opportunities existed to instill more strategic direction into the program. It bears keeping in mind that the ITS standards program was not a modest or short-lived activity but rather a $100 million program that was expected to operate for many years and significantly influence the development of ITS. A strategic vision and a coherent plan for implementation can reasonably be expected to guide such a program.

The following are findings of specific needs that the committee believes are missing from the current ITS standards program. Many of these needs could have been addressed with a stronger strategic planning process.

Need for a Stronger Basis for Selecting Standards

The committee did not find among the presentations and documents explaining the ITS standards program clear methods and criteria for identifying and selecting standards most deserving of program support.

The ITS standards selected for support were apparently chosen on the basis of requirements called out in the national ITS architecture and from a broad-based survey mailed to ITS suppliers, transportation agencies, and other parties viewed as stakeholders. As explained earlier, however, the national architecture identifies hundreds of candidate areas for standardization and offers little guidance for determining which standards are of the highest priority. Moreover, each update of the national architecture has added more flows, functions, services, and interfaces, which has resulted in an expanding list of candidate areas for standardization (the 2003 version, for example, identifies 375 candidate areas).

In the Transportation Equity Act for the 21st Century, Congress required USDOT to identify which standards are critical to interoperability and to the development of other standards. That report was completed in 1999, but only after scores of standards were already being supported (USDOT 1999). A strategic plan in place at the inception of the program would have been desirable to define methods and criteria for identifying standards having the greatest relevance to program goals. The strategic plan could have defined processes for assessing the most suitable kinds of standards, such as their appropriate level of detail and specificity. Many ITS standards are for short-life-cycle software and hardware rather than enduring physical infrastructure. This, of course, affects how quickly a standard must be developed and how detailed and prescriptive it may be. For example, the Internet Engineering Task Force develops standards and protocols for the Internet that are intended to begin by defining basic levels of functionality; the standards can then evolve and adapt to changing technologies and applications.

Such simple, adaptive standards may have been well suited to some areas of ITS where flexibility and timing are critical. This approach is one way of avoiding any tendency of SDO working groups and technical committees to iterate repeatedly in an effort to develop a comprehensive standard that may be overly complex and lack timeliness.

Related to the question of which standards should be pursued is the question of how many standards should be supported by the program and how quickly. Whether 100 is the right number for development is not clear; however, a sense of the appropriate scale is desirable, especially if resources are required for their deployment and maintenance. While JPO gave early consideration to developing standards in stages, the result was that more than 80 standards were in development within 3 years of the program's inception, and thus the staging occurred quickly. Whether alternative approaches were considered is questionable. For example, one option might have been to support fewer standards and then to learn from this experience before proceeding with the identification and development of other standards deserving program support.

A one-time survey of users is insufficient for determining ITS standards needs in a field as dynamic as ITS, where changes are occurring in technology and its use, national architecture, federal program initiatives, and legislative requirements. Consulting users through a variety of methods and on a continuing basis is critical in keeping pace with changing user needs and the many factors that influence them. Likewise, means for developing standards—including SDO contractual agreements for their development—must be carefully designed to maximize adaptability to these changing needs and requirements (as exemplified by the approach used for Internet standards).

Need to Engage Users of Standards in All Phases of Standards Support

In authorizing the standards program, Congress encouraged USDOT to use the services of existing standards-setting bodies and suggested a preference for traditional SDOs. The first TRB committee to review the ITS standards program questioned the suitability of the traditional SDO model for the full array of standards being pursued by the program. It noted that this model is inherently slow and may not perform as well as other approaches in the face of rapidly changing technology. That committee asked why other models, such as consortia, were not considered for developing some or all of the standards in the program (TRB 2000, 32–33).

The committee shares the concern raised by the earlier TRB committee that insufficient consideration was given by the ITS standards program to alternative processes for standards development, including those that are effective in engaging users in all phases of standards support.

Whether all the shortcomings in the SDO model would have been identified through more systematic exploration of alternatives is not known, but more approaches to standards development might have been tried. In retrospect, a major shortcoming of the model resulted from the contractual relationship between the individual SDOs and JPO. The standards to be developed by the SDOs were specified by JPO. In the usual SDO process, SDOs decide to develop a standard after assessing need and demand within the community of end users. Part of that assessment concerns the potential to derive sales revenues to recoup development costs,

which is also important for long-term standards maintenance and for encouraging SDOs to promote the standard's use. In practice, the SDOs tended to view JPO, as opposed to the government agencies and ITS product developers and suppliers who use the standards, as their customer. Although this relationship may not have constituted a conflict, it weakened the incentive for SDOs to reach out to the user community to ascertain standards needs and monitor uses.

Briefings from representatives of organizations that develop standards in situations comparable with that of ITS suggest to the committee that other models can be effective in identifying, developing, and deploying standards with a high degree of user involvement. One model examined is the Open Geospatial Consortium, Inc. (OGC). OGC has members from private companies and government, most of whom are developers, suppliers, or purchasers of geospatial products and services. OGC members are actively involved in all phases of standards development. They are responsible for identifying standards needs, defining the functionality requirements of the standards, and providing test beds for standards during the course of their development. By thoroughly and repeatedly engaging end users at all stages, OGC strives to ensure the utility of each standard and to create champions for its use in the field. To do so, it tries to involve in its processes not only the technical experts of member organizations but also the individuals who will be responsible for employing the standard in procurements and making use of the products or services that are based on the standard. In turn, these participants in the process are natural champions for the standard in the broader community of end users.

Of course, careful consideration must be given to the advantages and disadvantages of different approaches for standards needs identification and development. Consortia, for example, can become dominated by a few special interests with the financial capabilities to join and support the consortium. Many other models that would merit consideration could not be examined in detail in this study. For example, the committee learned of comparable processes to engage users that are being employed by the Telecommunications Industry Association (TIA)—most notably in the area of public safety communications, which has many of the same public- and private-sector institutional issues as ITS. The importance of stakeholder involvement in all stages of the standardization process is explained in the *United States Standards Strategy* (ANSI 2005). ANSI routinely convenes standards panels and other forums to bring together parties who may be interested in and affected by standards, both domestically and internationally. Indeed, the committee has learned that ANSI is convening a standards panel for ITS stakeholders.

The committee recognizes that JPO has involved end users in its processes but questions whether this involvement has been as comprehensive and continuous as it should be. JPO ensured the involvement of representatives from state and local transportation agencies by paying for their travel to working group meetings when necessary. Such financial support is vital in ensuring that this critical community of standards users can participate in the process, since many state and local agencies have scarce resources for employee travel. While such user participation in working groups is essential, it is not enough. End users need to be involved in a comprehensive manner that begins with selection of the standards and continues through all stages of standards development, testing, and implementation support. Surveying thousands of potential users of standards at the outset of the program to identify standards needs may have

been a helpful starting point, but it was not a sufficient basis for making a final determination of such needs.

As noted earlier, the SDOs did not have the same incentive to engage end users as they do when they develop standards on their own. Because standards needs were given to them by JPO, the SDOs did not need to reach into and maintain relations with the ITS user community to the extent they do when they develop other standards. Whether JPO or the SDOs gave much consideration to this outcome at the start of the program is unlikely; however, it is a concern that should have been recognized and addressed as the program progressed. Similarly, the SETA contractors hired by JPO to participate in working groups and to monitor the program may have created undesirable conflicts and incentives. In their position as both peers and overseers, it is not clear how these contractors were expected to participate effectively in the working groups that were developing the standards.

Need for a Viable Model for Continuing Standards Support

The second TRB committee that reviewed the ITS standards program expressed concern that SDOs participating in the program would be unable or unwilling to devote adequate resources or establish effective mechanisms to ensure that standards are used and maintained (TRB 2004, 52–53). It observed that the ITS standards business model relies on revenues derived from the sale of standards to pay for their maintenance but questioned whether such revenues would be sufficient. As USDOT funding for SDO standards development dwindles, questions are resurfacing about the long-term viability of this business model.

The committee finds that JPO has no coherent plan for determining which ITS standards are most important to deploy and maintain, nor does it have a plan for determining which of these standards are likely to be maintained by the SDOs acting on their own incentive and which are likely to require continued federal support for their maintenance and compatibility with other ITS standards.

A major reason for federal support of ITS standards development is that the market for many ITS services and products is narrow and the government agencies that are primary users of many of these standards do not have sufficient resources to support the processes required for standards development and maintenance. Indeed, the committee's inquiries with the SDOs suggest that most of the ITS standards issued have limited potential to generate sales revenues. It is questionable whether the SDOs, which developed the standards with federal support, have a financial stake in ensuring that the standards are used and in monitoring their use for maintenance needs.

Under these circumstances, the committee was surprised to learn that JPO does not have a plan to identify the standards most in need of continued federal support for their maintenance and compatibility. Some of the standards are likely to warrant such support. The difficulty is in knowing which standards are most deserving because of their value to users, including state and local agencies. JPO officials told the committee that the SDOs could seek federal financial assistance to maintain specific standards but did not explain how the SDOs would make such determinations or how their requests would be evaluated. To make such judgments would

presumably require data on standards implementation and utility; however, such information is not being gathered by JPO or the SDOs. The committee's impression is that JPO's monitoring of SDO and program performance is largely based on measuring program "output"—that is, on the number of ITS standards balloted, approved, and published—rather than on their ultimate use and impact.

Because ITS standards are voluntary, willingness to adopt them depends on users' confidence that the standard will continue to be available and maintained. It is important that the program not only track the number of standards issued but also closely monitor their availability, use, and impact and provide clear and consistent guidance on their continued availability and maintenance. Voluntary adoption is more likely if the standards are accessible and understandable and if they are shown to achieve their objectives of lowering costs, increasing interoperability, and fostering innovation.

Need to Connect with the International Standards Community

At the international level, the main organization involved in the development of ITS standards is the International Organization for Standardization (ISO). ISO Technical Committee 204 (TC204) consists of 12 working groups that cover a broad range of ITS transit-, highway-, and vehicle-related elements, from electronic toll collection to location referencing, emergency management, and short-range radio communications. More than three dozen standards have been issued by TC204 since 1992.

At one time, JPO participated in the ISO technical committees developing ITS standards. It provided financial support to the U.S. delegation and secretariat to TC204. The first TRB committee reviewing the standards program applauded these efforts to ensure that U.S. ITS technology was well represented in global markets. That committee commented that "aggressive U.S. participation in international ITS standards-setting organizations is not only appropriate, but essential" (TRB 2000, 5). However, this financial support has been withdrawn. The explanations offered to the committee for this withdrawal are that budgetary cutbacks have compelled this outcome and that federal involvement in international standards activities for the purpose of promoting U.S. business interests is best handled by the U.S. Department of Commerce.

The committee observes that an original goal of the ITS standards program was to foster an environment in which government agencies benefit from a competitive and innovative marketplace for ITS products and services. In the committee's view, U.S. involvement in international standards forums is consistent with these aims, to ensure not only that U.S. businesses are viable suppliers of ITS (in this country and worldwide) but also that U.S. purchasers of ITS products and services are the beneficiaries of a large number of suppliers from this country and abroad.

The committee finds that JPO's diminished involvement in ITS international standards activities puts its ability to inform and represent the interests of ITS users, developers, and suppliers in the United States at risk.

The committee notes that the *United States Standards Strategy* developed by ANSI emphasizes the importance of engaging in and working to improve standards processes internationally. Standards that reduce technical barriers to ITS product development and trade can lead to more viable suppliers generally and thus benefit the state and local transportation agencies that purchase ITS products and services. Many of the technologies of ITS are now being developed and applied worldwide; hence, there is much to be gained from engaging in, rather than neglecting, the international standards process.

Need to Coordinate and Consult with Other Federal Standards Activities

ITS represents the first time USDOT has financially supported the development of voluntary consensus standards on such a large scale and over so long a period. Yet within the federal government there are agencies such as the Department of Defense,[8] the Department of Health and Human Services, the National Aeronautics and Space Administration (NASA), and the National Institute of Standards and Technology (NIST) with expertise and experience in standards development and deployment. These agencies have grappled with the need to define an appropriate agency role in standards development; expedite development of standards critical to their missions; and ensure that standards are appropriately promoted, implemented, and evaluated.[9] Consulting these agencies during program conception and throughout its life would, in the committee's view, have yielded insights into the challenges lying in wait for the ITS standards program and may have helped avoid or overcome some of the program's shortcomings reported here.

The committee finds that JPO missed opportunities to obtain advice and assistance from NIST and other federal agencies with standards experience; however, opportunities remain for future consultation and coordination.

NIST is the federal government's lead agency for standards policy and practice. It is charged by the National Technology Transfer and Advancement Act with bringing together federal agencies and state and local governments to achieve greater reliance on voluntary standards. NIST also heads the Interagency Committee on Standards policy,[10] which advises federal agencies on standards policy matters. Standards executives from most federal agencies serve on that committee, including an executive designated by USDOT. It became evident to the committee from discussions and exchanges with JPO staff and the USDOT standards executive that interagency coordination has not occurred either within or outside USDOT.

Coordination with NIST and other federal agencies can provide expertise and advice. In addition, it can be helpful in cases where other federal agencies are developing or promoting standards that have a bearing on ITS. One notable example is the National Information Exchange Model (NIEM) being developed by the U.S. Department of Homeland Security and the U.S. Department of Justice. NIEM is being designed to enable jurisdictions to share critical

[8] Defense Standardization Program (http://www.dsp.dla.mil/).
[9] NASA, for example, has undertaken a third-party assessment of the return on investment from geospatial standards supported by the agency [NASA ROI on Geospatial Standards (http://gio.gsfc.nasa.gov/docs/ROI%20Study.pdf)].
[10] http://ts.nist.gov/Standards/Conformity/icspdes.cfm.

information in emergency situations effectively. This topic, of course, has a direct bearing on ITS standards being developed for incident management and communications. The committee observes that in the case of NIEM and in other instances, the federal agencies developing standards have sought assistance from NIST, including technical staff support.

RECOMMENDATIONS

Several strongly held beliefs underlie the committee's recommendations. First, standards are vital to the development and deployment of ITS and consequently to the achievement of the promise of ITS in improving transportation system safety, mobility, and efficiency. Second, USDOT should play a prominent role in support of standards to help bring about the benefits of ITS more quickly. Third, budgetary decisions that will have a lasting effect on USDOT's support of ITS standards should not be made in the absence of a clear strategy articulating and guiding its continuing role. Fourth, standards development in the field of ITS must be viewed as an ongoing process rather than a one-time activity that ends with the issuance of a select set of standards.

The committee's recommendations focus on three major needs: articulating a strategic vision and plan for USDOT's role in support of standards, exploring the use of alternative standards processes that engage end users, and forging strong connections with other standards activities in this country and internationally. In each case, the committee offers a general recommendation followed by a series of related specific recommendations.

1. Articulate a Strategic Vision for ITS Standards and the USDOT Role

JPO, in consultation with developers and users of ITS, should clearly articulate how standards are helpful in achieving the promise of ITS and develop a strategic plan that defines and guides the federal role in support of ITS standards.

The committee believes that JPO should remain a leader in support of ITS standards. Doing so, however, requires a clear vision of how standards are beneficial to the development and deployment of ITS and a strategic plan that defines JPO's role in support of standards.

At its most fundamental level for program guidance, a strategic plan should address the kinds of questions raised in Box 1, such as the desired scale and pace of the program and its role in all stages of standards development, from needs identification to deployment and maintenance. The plan should explain how the standards program relates to other ITS program priorities—for example, how it can enable and support the congestion mitigation initiative and the nine ITS initiatives. It should explain how JPO will engage and coordinate with other government agencies, the private sector, and international bodies with relevant expertise and interest in standards for ITS.

The strategic plan should define outcomes expected from the support of ITS standards and lay out processes for measuring and evaluating them. To inform such processes, the committee recommends that JPO consult other federal agencies with standards expertise to gain insight into methods of measuring and evaluating outcomes in ways that are oriented toward

implementation rather than simply counts of the number of standards issued. Ideally, the measures should capture the value that is added by the standards determined with input from standards users.

The standards strategic plan must correspond to the national ITS architecture. Both must be kept fresh and relevant, reflective of technological developments and changes in ITS applications. One means of ensuring relevance of the national ITS architecture is to involve developers and users in each revision. To ensure systematic and regular involvement by such stakeholders, the use of open, consensus processes analogous to those used in standards development may be warranted.

As a general matter, the ITS standards strategy should be consistent with OMB and legislative requirements for standards programs. A good resource for strategic guidance is the *United States Standards Strategy*. The committee urges JPO to consult the key principles for a standards strategy that are expressed in this guiding document.

2. Engage End Users and Explore Alternative Standards Development Processes
In support of timely and useful standards in the future, JPO should strive to involve end users systematically in all phases of standards needs identification, development, and implementation and to explore alternative development processes that engage users.

In support of future ITS standards, JPO should consult with the users of standards to determine their needs. Such consultations should occur before any new standards activities are undertaken, and effective means for engaging users should be integrated into the standards development process. The strongly supported VII program, for example, is an obvious case where engagement of a broad range of users is essential.

Deployment must be viewed as an inseparable part of standards development rather than a distinct follow-on activity. This requires standards development processes that are structured to foster deployment. Users must not only be involved in determining the need for a standard but also have a prominent role in all phases of its development. They must be thoroughly engaged so as to develop a sense of ownership of the standard and become advocates for its application in the field. Many examples of how to engage end users in an ongoing and integrated fashion are described in this report, including the ANSI standards panel process and methods employed by OGC and TIA. Many other options exist for gaining user input. JPO should be creative, perhaps employing the techniques of product market research and methods used by private companies to assess customer needs and satisfaction. It is important that efforts to engage users be designed to attract the involvement of not only the technical experts from the user community but also individuals who will be responsible for employing the standard in procurements and making use of the products or services to which the standard applies.

JPO should also explore a variety of standards development processes to match those best suited to the kinds of standards being supported. For example, in cases of rapidly evolving technologies and applications, consideration may be given to processes that can lead to a simple standard defining a base functionality and capable of being improved once in use.

In exploring alternative processes, JPO should be mindful that different standards may require different development processes. Trying to develop detailed and well-formed standards will not be practical or timely in most instances when technology is evolving rapidly. Accordingly, if standards development is to be viewed as an iterative and ongoing process, financing arrangements, the allocation of organizational responsibilities, and the like should be carefully considered to ensure that they are aligned with this view. It is more evident now, for example, that contractual relationships in particular can strongly influence how participants view program goals and their roles and relationships with other participants.

3. Forge Strong Connections with Other Relevant Standards Activities

JPO should restore connections with the international standards community and coordinate with the USDOT standards executive, NIST, and other federal agencies with standards expertise and responsibilities.

Forging strong connections with the international standards community should be a central part of the federal role in support of ITS standards. Many of the technologies that make up ITS are global in scope. Incomplete information and technical barriers may preclude U.S. suppliers from entering the global marketplace or deprive state and local agencies and other ITS purchasers of the benefits of global competition. Participation in international standards activities can help inform U.S. standards decisions and reduce barriers. In the committee's view, USDOT is in the best position to represent the full range of U.S. interests in these activities.

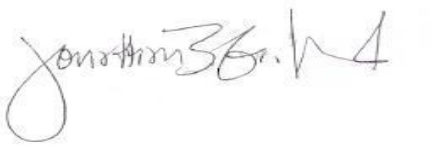
Likewise, coordination with other federal agencies with standards expertise makes good sense. The USDOT standards executive, NIST, and other federal agencies can be valuable resources in developing and implementing a coherent strategy for federal support of ITS standards. Coordination is also important so that JPO can keep abreast of and influence standards being pursued by other government agencies that affect ITS and ITS standards, such as the standards for the exchange of emergency information being developed by the U.S. Departments of Justice and Homeland Security. Again, from the standpoint of the state and local users of these multiple standards, such federal coordination is crucial.

CLOSING REMARKS

The committee is pleased that JPO has sought its advice and is genuinely interested in putting to good use the resources that it provides in support of ITS standards. In the knowledge that this report may be transmitted to Congress, where important program budgetary decisions are being made, the committee concludes by emphasizing that support for ITS standards must be viewed by all as an ongoing process requiring sustained federal funding if USDOT is to continue to exercise a meaningful role. For the many reasons given in this report, the committee believes that USDOT should continue to play a leadership role in support of ITS standards, but this role requires guidance by a well-articulated strategic vision and implementation plan.

The committee has striven to be candid and constructive in its review and trusts that its advice will be received in this spirit. I welcome the opportunity to discuss this review with you and look forward to progress in this important area.

Sincerely,



Jonathan L. Gifford, Ph.D.
Chair, Committee for a Study of Options for Streamlining Standards for Intelligent Transportation Systems

REFERENCES

ANSI. 2005. *United States Standards Strategy*. New York. http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/NSSC/USSS-2005%20-%20FINAL.pdf.

JPO. 1996. *The U.S. Department of Transportation's Intelligent Transportation Systems Standards Program: 1996 Status Report*. http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_PR/1869.htm.

TRB. 2000. *Standards for Intelligent Transportation Systems: Review of the Federal Program*. National Research Council, Washington, D.C.

TRB. 2004. *Special Report 280: Development and Deployment of Standards for Intelligent Transportation Systems: Review of the Federal Program*. National Academies, Washington, D.C.

USDOT. 1999. *Intelligent Transportation Systems: Critical Standards*. Washington, D.C.

Appendix

ITS Standards and Status on May 2, 2007

Published: 88 (ITE TMDD Version 2.1 is listed but not counted in the total)

SDO	Standard	Publication Date	Subsequent Versions
ANSI ASC X12	Commercial Vehicle Credentials—ANSI ASC X12 TS286	Oct. 1997	
ANSI ASC X12	Commercial Vehicle Safety and Credentials Information Exchange—ANSI ASC X12 TS285	Dec. 1996	
ANSI ASC X12	Commercial Vehicle Safety Reports—ANSI ASC X12 TS284	Dec. 1998	
APTA	Transit Communications Interface Profile	Sep. 2006	
APTA	NTCIP 1400 Transit Communications Interface Profiles Part of the National Transportation Communications for ITS Protocol TCIP Framework Standard	Dec. 2000	
APTA	NTCIP 1401 Transit Communications Interface Profiles Part of the NTCIP Standard on Common Public Transportation (CPT) Objects	Dec. 2000	
APTA	NTCIP 1402 Transit Communications Interface Profiles Part of the NTCIP Standard Incident Management (IM) Objects	Dec. 2000	
APTA	NTCIP 1403 Transit Communications Interface Profiles Part of the NTCIP Standard on Passenger Information (PI) Objects	Dec. 2000	
APTA	NTCIP 1404 Transit Communications Interface Profiles Part of the NTCIP Standard on Scheduling/Run-Cutting (SCH) Objects	Dec. 2000	
APTA	NTCIP 1405 Transit Communications Interface Profiles Part of the NTCIP Standard on Spatial Representation (SP) Objects	Dec. 2000	
APTA	NTCIP 1406 Transit Communications Interface Profiles Part of the NTCIP Standard on On-Board (OB) Objects	Dec. 2000	
APTA	NTCIP 1407 Transit Communications	Dec. 2000	

	Interface Profiles Part of the NTCIP Standard on Control Center (CC) Objects		
APTA	NTCIP 1408 Transit Communications Interface Profiles Part of the NTCIP Standard on Fare Collection (FC) Business Area Objects	Dec. 2000	
ASTM	E2158-01 Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer Using Microwave in the 902 to 928 MHz Band	Dec. 2001	
ASTM	E2213-03 Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems—5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications	Oct. 2002	Version 2 published Sep. 2003
ASTM	Standard Guide for Archiving and Retrieving ITS-Generated Data—ASTM E2259-03	Nov. 2003	
ASTM	Standard Practice for Metadata to Support Archived Data Management Systems—ASTM E2468-052	Jan. 2006	
EIA/CEA	Data Radio Channel (DARC) System—EIA/CEA EIA-794	Jul. 1999	
EIA/CEA	Subcarrier Traffic Information Channel (STIC) System—EIA/CEA EIA-795	1999	
IEEE	IEEE Standard for Common Incident Management Message Sets for Use by Emergency Management Centers—IEEE 1512-2006	Jun. 2000	Version 2 published Aug. 2006
IEEE	IEEE Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers—IEEE 1512.1-2006	Mar. 2003	Version 2 published Nov. 2006
IEEE	IEEE Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers—IEEE 1512.2-2004	Nov. 2004	
IEEE	IEEE Standard for Hazardous	Oct. 2002	Version 2

	Material Incident Management Message Sets for Use by Emergency Management Centers—IEEE 1512.3-2006		published Jul. 2006
IEEE	IEEE Standard for Message Sets for Vehicle/Roadside Communications—IEEE 1455-1999	Aug. 1999	
IEEE	IEEE Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway-Rail Intersection—1570-2002	Oct. 2002	
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE)—Resource Manager—IEEE 1609.1-2006	Oct. 2006	
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE)—Security Services for Applications and Management Messages—IEEE 1609.2-2006	Jul. 2006	
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services—IEEE 1609.3	May 2007	
ITE	ITS Standard Specification for Roadside Cabinets—ITE ITS Cabinet	May 2003	Amendment 1 under development, expected to publish Dec. 2006
ITE	Advanced Transportation Controller (ATC)—ITE ATC Controller	Jun. 2006	
ITE	ITE TMDD Guide	Oct. 2000	Version 2.1 published Aug. 2006
ITE	ITE Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD & MS/ETMCC) Version 2.1	Mar. 2006	Version 3 under development, expected to publish Apr. 2008
NEMA/ITE/AASHTO	NTCIP 1101 National Transportation Communications for ITS Protocol Simple Transportation Management Framework	Aug. 1999	Amendment 1 published Dec. 2001
NEMA/ITE/AASHTO	NTCIP 1102 National Transportation Communications for ITS Protocol	Dec. 2006	

	Octet Encoding Rules (OER) Base Protocol		
NEMA/ITE/AASHTO	NTCIP 1201 National Transportation Communications for ITS Protocol Global Object Definitions	Oct. 1996	Amendment 1 published Dec. 2001; Version 2 published Oct. 2005; Amendment 2 in ballot
NEMA/ITE/AASHTO	NTCIP 1202 National Transportation Communications for ITS Protocol Object Definitions for Actuated Traffic Signal Controller (ASC) Units	Jan. 1996	Version 2 published Nov. 2005
NEMA/ITE/AASHTO	NTCIP 1203 National Transportation Communications for ITS Protocol (NTCIP) Object Definitions for Dynamic Message Signs (DMS)	Mar. 1997	Version 2 under development, expected to publish May 2007
NEMA/ITE/AASHTO	NTCIP 1204 National Transportation Communications for ITS Protocol Object Definitions for Environmental Sensor Stations (ESS)	Version 1: Sep. 1998	Amendment 1 published Nov. 2001; Version 2 approved, expected to publish Apr. 2007; Version 3 in development, expected to publish Mar. 2008
NEMA/ITE/AASHTO	NTCIP 1205 National Transportation Communications for ITS Protocol Object Definitions for Closed Circuit Television (CCTV) Camera Control	Dec. 2001	Amendment 1 in ballot, expected to publish Jul. 2007
NEMA/ITE/AASHTO	NTCIP 1206 National Transportation Communications for ITS Protocol Object Definitions for Data Collection and Monitoring (DCM) Devices	Nov. 2005	
NEMA/ITE/AASHTO	NTCIP 1207 National Transportation Communications for ITS Protocol Object Definitions for Ramp Meter Control (RMC) Units	Nov. 2001	Version 2 in development, expected to publish Dec. 2007
NEMA/ITE/AASHTO	NTCIP 1208 National Transportation Communications for ITS Protocol	Nov. 2005	

	Object Definitions for Closed Circuit Television (CCTV) Switching		
NEMA/ITE/AASHTO	NTCIP 1209 National Transportation Communications for ITS Protocol Data Element Definitions for Transportation Sensor Systems	Nov. 2005	Version 2 in development, expected to publish Apr. 2008
NEMA/ITE/AASHTO	NTCIP 2001 National Transportation Communications for ITS Protocol Class B Profile	1996	
NEMA/ITE/AASHTO	NTCIP 2101 National Transportation Communications for ITS Protocol Point to Multi-Point Protocol Using RS-232 Subnetwork Profile	Nov. 2001	
NEMA/ITE/AASHTO	NTCIP 2102 National Transportation Communications for ITS Protocol Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile	Feb. 2006	
NEMA/ITE/AASHTO	NTCIP 2103 National Transportation Communications for ITS Protocol Point-to-Point Protocol over RS-232 Subnetwork Profile	Feb. 2006	Version 2 expected to publish May 2007
NEMA/ITE/AASHTO	NTCIP 2104 National Transportation Communications for ITS Protocol Ethernet Subnetwork Profile	Feb. 2006	
NEMA/ITE/AASHTO	NTCIP 2201 National Transportation Communications for ITS Protocol Transportation Transport Profile	Feb . 2006	
NEMA/ITE/AASHTO	NTCIP 2202 National Transportation Communications for ITS Protocol Internet (TCP/IP and UDP/IP) Transport Profile	Dec. 2001	
NEMA/ITE/AASHTO	NTCIP 2301 National Transportation Communications for ITS Protocol Simple Transportation Management Framework Application Profile	Dec. 2001	Version 2 in development, expected to publish Sep. 2007
NEMA/ITE/AASHTO	NTCIP 2302 National Transportation Communications for ITS Protocol Trivial File Transfer Protocol Application Profile	Dec. 2001	
NEMA/ITE/AASHTO	NTCIP 2303 National Transportation Communications for ITS Protocol File Transfer Protocol Application Profile	Dec. 2001	

NEMA/ITE/AASHTO	NTCIP 2304 National Transportation Communications for ITS Protocol Application Profile for DATEX-ASN (AP-DATEX)	Feb. 2006	
NEMA/ITE/AASHTO	NTCIP 8003 National Transportation Communications for ITS Protocol Profile Framework	Dec. 2001	
NEMA/ITE/AASHTO	NTCIP 9001 NTCIP Guide	Feb. 1997	Version 2 published Feb. 1997; Version 3 published Dec. 2002; Version 4 in development, expected to publish Sep. 2007
NEMA/ITE/AASHTO	NTCIP 9010 National Transportation Communications for ITS Protocol XML in ITS Center-to-Center Communications	Feb. 2006	
SAE	Adaptive Cruise Control (ACC) Operating Characteristics and User Interface—J2399	Dec. 2003	
SAE	Calculation of the Time to Complete In-Vehicle Navigation and Route Guidance Tasks—SAE J2365	May 2002	
SAE	Comparison of GATS Messages to SAE ATIS Standards Information Report—SAE J2539	Feb. 2002	
SAE	Converting ATIS Message Standards from ASN.1 to XML—SAE J2630	Dec. 2003	
SAE	Definitions and Experimental Measures Related to the Specifications of Driver Visual Behavior Using Video Based Techniques—SAE J2396	Jul. 2000	
SAE	Field Test Analysis Information Report—SAE J2372	Dec. 1999	
SAE	Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements—SAE J2400	Aug. 2003	
SAE	ISP-Vehicle Location Referencing Standard—SAE J1746	Dec. 1999	
SAE	ITIS Phrase Lists (International	Feb. 2002	Amendment 1

	Traveler Information Systems)—SAE J2540/2		published May 2004
SAE	ITS Data Bus—Thin Transport Layer—SAE J2366-4	Mar. 2002	
SAE	ITS Data Bus—Application Message Layer—SAE J2366-7	Apr. 2002	
SAE	ITS Data Bus—IDB-C Physical Layer—SAE J2366-1	Nov. 2001	
SAE	ITS Data Bus—Link Layer—SAE J2366-2	Nov. 2001	
SAE	ITS Data Bus—Low Impedance Stereo Audio—SAE J2366/1L	Nov. 2001	
SAE	ITS Data Bus Architecture Reference Model Information Report—SAE J2355	Oct. 1997	
SAE	ITS Data Bus Data Security Services—SAE J1760	Dec. 2001	
SAE	ITS In-Vehicle Message Priority—SAE J2395	Feb. 2002	
SAE	Location Referencing Message Specification (LRMS)—SAE J2266	Nov. 2004	
SAE	Mayday Industry Survey Information Report—SAE J2352	Sep. 1998	
SAE	Message Set for Advanced Traveler Information System (ATIS)—SAE J2354	Nov. 1999	Version 2 published Feb. 2004
SAE	Messages for Handling Strings and Look-Up Tables in ATIS Standards—SAE J2540	Jul. 2002	
SAE	National Names Phrase List—SAE J2540/3	Jan. 2002	
SAE	On-Board Land Vehicle Mayday Reporting Interface—SAE J2313	Sep. 1999	
SAE	RDS (Radio Data System) Phrase Lists—SAE J2540/1	Jul. 2002	
SAE	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications—SAE J1708	Aug. 2004	
SAE	Stakeholders Workshop Information Report—SAE J2373	Apr. 2000	
SAE	Standard for ATIS Message Sets Delivered over Reduced Bandwidth Media—SAE J2369	Mar. 2000	
SAE	Standard Metrology for Vehicular	Jul. 2002	

	Displays—SAE J1757		
SAE	Truth-in-Labeling Standard for Navigation Map Databases—SAE J1663	Aug. 1995	
SAE	Standard for Data Dictionary and Message Sets for Dedicated Short Range Communications (DSRC)—SAE J2735	Dec. 2006	Version 2 in development, expected to publish Mar. 2008

Note: AASHTO = American Association of State Highway and Transportation Officials; ANSI ASC X12 = American National Standards Institute Accredited Standards Committee X12; APTA = American Public Transportation Association; ASTM = American Society for Testing and Materials; CEA = Consumer Electronics Association; EIA = Electronics Industry Alliance; IEEE = Institute of Electrical and Electronics Engineers; ITE = Institute of Transportation Engineers; NTCIP = National Transportation Communications for ITS Protocol; NEMA = National Electrical Manufacturers Association; SAE = Society of Automotive Engineers.

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February 22, 2007

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