

January 29, 2002

Dr. Christine M. Johnson  
Program Manager, Operations  
Director, ITS Joint Program Office  
Federal Highway Administration  
400 7<sup>th</sup> Street, S.W.  
Room 3401  
Washington, D.C. 20590

Dear Dr. Johnson:

We are pleased to transmit this letter report of the Transportation Research Board's (TRB) Committee for Review of the U. S. Department of Transportation's (DOT) Intelligent Transportation Systems (ITS) Standards Program. This letter is focused on the committee's recent discussions, conclusions, and recommendations concerning obstacles to rapid ITS standards deployment and how DOT might help to overcome these obstacles.

## **BACKGROUND**

This letter has been produced under TRB's continuing study to advise DOT on matters arising from ongoing and planned activities of the ITS Standards Program, particularly concerning DOT's role in achieving widespread adoption of ITS infrastructure standards in practice. The study is being conducted by a committee appointed by the National Research Council (NRC) and at the request of DOT's Joint Program Office (JPO), which is responsible for developing a national architecture and selected standards to encourage the development and deployment of ITS technology in the United States. A list of the committee's present membership is shown in Attachment 1.

The study plan envisioned that the committee would meet three times each year to review issues arising from JPO's Standards Program and present the outcome of its deliberations in the form of one or more reports. Issues considered in the past have included processes for standards development, obsolescence and long-term maintenance of standards when technology is rapidly evolving, and the appropriate federal posture toward participation in international standards-setting forums. The committee's scope has been refined through negotiations between JPO and

TRB staff to focus current discussion on gaining understanding of the dimensions of emerging obstacles to effective standards deployment and potentially effective strategies to overcome these obstacles.

The committee met three times in 2001, in March, June, and November. Each meeting, approximately two days in length, was held at NRC's facilities in Washington, D.C. Agendas of the meetings are shown in Attachment 2. At each meeting JPO staff presented relevant aspects of the Standards Program's current status, activities, and plans, and knowledgeable guests participated in the discussions.

## **UNDERSTANDING OBSTACLES TO ACHIEVING EFFECTIVE STANDARDS DEPLOYMENT**

The committee observes that, as the first generation of standards has begun to be made available to vendors and purchasers of ITS components and other standards users, potential obstacles to achieving the standards' widespread adoption in practice have become more evident. Many of these obstacles reflect a mismatch among the interests of purchasers and vendors of ITS components and the public at large who will benefit from deployment of ITS technology. For example, purchasers' budget constraints limit demand for new products, but product providers need larger markets to justify the initial costs of new-product introduction. Furthermore, purchasers of ITS technology are primarily public-sector agencies whose purchasing decisions are often based on criteria other than simply the price and product characteristics that vendors offer. Given the large number of state and local jurisdictions and private companies currently and potentially involved in ITS deployment, DOT has a meaningful leadership and coordination role to play in achieving effective deployment of the standards it has sponsored.

The Standards Program has been giving increasing priority to defining such obstacles and DOT's role and specific strategies for overcoming them. This letter presents the committee's conclusions and recommendations intended to enhance the Standards Program's efforts.

Slow Migration and Technology Legacy. One set of potential obstacles is related to the typically slow rate of technology "migration" or upgrading to new capabilities in traffic control systems. This obstacle is to some extent unavoidable, since most agencies purchase only a few signals or signs at any one time. Such equipment is often purchased with substantial federal funding assistance and, regardless of the sources of funds, is typically expected to remain in service for 30 to 40 years. These agencies then have substantial "legacy" investments—with institutional and cultural components—that constrain their willingness and ability to adopt new technology meeting new standards. In addition, the prospect that continuing technology evolution may quickly make new investments obsolete deters some users from making early commitments to newly introduced applications. While recognizing that greatly increased spending for new equipment may not be practical, the committee recommends that DOT manage federal funding programs in ways that will speed the transition from existing traffic control to ITS, for example, by facilitating early replacement of otherwise functional signal system components that do not meet ITS standards.

### Private and Public Roles at the Interface Between Infrastructure and In-Vehicle ITS

Components. Another set of obstacles relates to the overlapping and shifting distribution of responsibilities for development and operation of ITS applications. For example, traffic flow and congestion information is now collected primarily by public agencies. Some committee members suggest that private firms may find it feasible to collect and use their own traffic information to support their Internet-based ITS applications. Private firms that become both primary sources and users of traffic flow and traffic incident information define for themselves the “messages sets” that structure how traffic flow data are stored and transmitted. Similarly, government agencies have been responsible for buying and operating the fixed “infrastructure” of traffic control, but the distinction between the functions provided by infrastructure (e.g., satellite and probe-vehicle components as well as fixed roadside facilities) and those provided by in-vehicle ITS components is becoming more difficult to define. These observations prompted the committee’s conclusion (stated in our previous letter and reiterated here) “that the larger goals of encouraging rapid ITS adoption warrant expansion of the DOT’s programs to embrace more fully the broader scope of ITS technology.” Committee members discussed government roles in developing “911,” “511,” and “311” services and impending requirements for Global Positioning System capabilities in cellular telephones and concluded that DOT can help motivate, facilitate, or direct private-sector actions to address concerns at the ill-defined but increasingly important interface between infrastructure and in-vehicle ITS components. These concerns could include security of data and traffic control systems, coordination of product performance characteristics among otherwise competitive producers, and allocations of liability in cases when privately collected traffic data are unavailable or erroneous.

Criteria and Tests for Ensuring That Standards Are Met. A third and very immediate set of obstacles to effective standards deployment is the lack of objective and generally applicable criteria, tests, and demonstrations to ensure that particular ITS applications do indeed conform to those standards and are interoperable. For example, most of the small number of U.S. vendors of products and services used for traffic control centers claim to offer applications that conform to the NTCIP (National Transportation Communications for ITS Protocol) standards. However, functional characteristics differ among different producers’ systems, and purchasers have no objective means for testing whether these varied products do indeed meet the claim of conformance to standards. Furthermore, there are no generally accepted tests for verifying center-to-center interoperability, an important objective of federal policy that is not assured simply by conformance with existing NTCIP standards. While the committee found the lack particularly apparent with regard to traffic signal systems and control centers, the need for objective criteria for judging standards conformance and interoperability is being encountered in all ITS infrastructure standards applications areas. The committee recommends that standards development generally include establishing ways that users can ensure that new components meet those standards and are interoperable and that DOT provide funding and other appropriate incentives to ensure that such tests and criteria are available.

### **WAYS TO ENSURE THAT STANDARDS ARE MET**

The committee devoted considerable attention to strategies that might be used to overcome this third set of obstacles. Several of these strategies are proposed in the following paragraphs.

Independent Validation and Verification (IV&V). IV&V, recommended in our September 12 letter, involves the use of independent testing laboratories to certify that equipment and software conform to standards. IV&V is a proven means for ensuring that technology-based components and systems meet standards and are interoperable. Because ITS products and services will be provided primarily by the private sector, the committee agreed that reliance on the federal government alone for maintenance of such laboratories is undesirable.

To avoid such reliance, the committee proposed that ITS IV&V be established with three key characteristics. First, buyers of ITS should be responsible for ensuring that ITS products they purchase are subjected to IV&V. Second, suppliers should pay the immediate direct costs of contracting with an independent testing laboratory to verify that their products meet required standards. Third, DOT should facilitate ITS IV&V by encouraging public agencies to accept supplier-paid IV&V and encouraging candidate testing organizations to participate in the program, and should work with both to ensure that a viable business model for ITS IV&V is implemented. Such a model ideally will be self-supporting, will not impose excessive costs or constrain technological innovation, and will be staged to ensure that early participants do not bear a disproportionate share of start-up costs. Because the aggregate market for ITS infrastructure technology is relatively small and served by a small number of vendors, development of IV&V capability at a national level is warranted, although more than one testing facility may be required to address the variety of ITS applications areas.

Committee members acknowledged that institutional capability for ITS infrastructure IV&V in the U.S. market is currently lacking, and that their collective experience alone is not an adequate basis for recommending specifically how to establish a viable IV&V business model. However, members noted useful precedents and existing institutions that might become providers of ITS IV&V.

For example, California's "qualified products list" has been widely accepted as de facto assurance of standards compliance for items on the list and sometimes of the competence of producers as well. An individual state acting on behalf of larger organizations (e.g., "lead state" programs) or multistate groups such as the coalitions that have formed along I-95 in the mid-Atlantic and the I-75 corridor could play a useful role as sponsors for the IV&V function. The lead state's agency laboratory or other existing institutions might become the provider of ITS IV&V, such as DOT's Turner-Fairbank facility, other DOT facilities, other federal laboratories, private-public partnership programs such as the Civil Engineering Research Foundation's HITEC program, and university-based centers. Sponsors would be responsible for pooling funds from participating IV&V users, which could include foreign as well as domestic ITS vendors and government agencies.

Test Suites and Test Environments. For standardized communications protocols and message sets, the committee proposes that "test suites" be developed for vendors and agencies to use in verifying interoperability. Such suites could be made widely available on CD-ROM or as "test environments" on the Internet. The agency or laboratory responsible for IV&V could develop and distribute these test suites or test environments. DOT should encourage development of such instruments.

Sample Specifications. The committee proposes that well-formulated sample standard or “model” specifications can be another very effective means for encouraging wide application of ITS standards, primarily for products such as signal controllers. However, education and training of agency staff would be needed as well, because most agencies lack the technical expertise to use such specifications most productively. DOT should encourage development of such specifications, for example through the standards development organization–based standards development process, coordinated with JPO’s ongoing activities to provide education and training.

Reference Implementations. The committee proposes a “reference implementation” as another instrument that may be used to verify conformance with standards and interoperability. The reference implementation is a prototypical complete system that is generally agreed to provide desired functionality and to meet desired standards. The capabilities of a new piece of equipment or software may be tested by demonstrating that it works within the context of the reference implementation. A demonstration project can function as a reference implementation. However, setting up the reference implementation within an independent testing facility may be a way of avoiding giving particular competitive advantage to one ITS vendor, as would be the case, for example, if a demonstration project were used.

## **INCENTIVES TO EARLY ADOPTERS**

The committee agrees generally that providing objective criteria and tests that can be used by purchasers and vendors to ensure that ITS components conform to standards and are interoperable will do much to speed effective ITS standards deployment. Developing such tests, prototypical implementations, and the like should be part of all standards development. Nevertheless, the early attempts to apply new standards in practice will almost always encounter unanticipated difficulties. Anecdotal evidence suggests that current early adopters of ITS infrastructure technology have incurred higher costs than expected because untried equipment or software incorporating untested standards initially failed to perform as expected. These higher costs, borne primarily by the early adopter, may discourage others from participating in prototyping and demonstration of new ITS infrastructure. The committee observes that more explicit incentives may be needed to encourage early adopters to demonstrate ITS applications incorporating federally supported standards.

By providing a setting for working out unexpected problems and then demonstrating the benefits of new technology conforming with federally sponsored standards, these early adopters play an important role in ensuring that standards are mature, usable, and effective. Excess costs that early adopters incur return benefits when subsequent users avoid the need to repeatedly adjust or even replace systems designed to meet poorly formulated standards. The avoided costs are a benefit that accrues to DOT and the nation as a whole. The committee therefore recommends that compensating early adopters for the higher costs they incur is an appropriate use of federal funds, provided such compensation is distributed in a replicable and equitable manner.

We appreciate this opportunity to comment on the ITS Standards Program and look forward to continuing to work with DOT's staff, consultants, and the professional community as a whole on this important program.

Yours truly,

A. Ray Chamberlain  
Chair, Committee for Review of the U.S. Department of Transportation's  
Intelligent Transportation Systems (ITS) Standards Program (II)

Attachment 1: Committee Membership  
Attachment 2: Meeting Agendas and Attendees

## Attachment 1

### Committee for Review of the U.S. Department of Transportation's Intelligent Transportation Systems (ITS) Standards Program (II)

#### Members

A. Ray Chamberlain, Ph.D. (Chairman)  
Parsons Brinckerhoff  
Denver, CO

Jules A. Bellisio, Ph.D.  
Telemediators, LLC  
IEEE and Telcordia Fellow  
Farmingdale, New Jersey

Irwin Dorros, Dr. of Eng. Science  
Dorros Associates  
Morris Township, NJ

Jonathan L. Gifford, Ph.D.  
Department of Public &  
International Affairs and the School of Public Policy  
George Mason University  
Arlington, VA

William F. Johnson, Sc.D.  
Transport Canada (Ret.)  
Ottawa, Ontario  
Canada

Samuel Krislov, Ph.D.  
Professor, Political Science and Law  
University of Minnesota  
Minneapolis, MN

Alexander Lopez  
Metropolitan Transit Authority  
of Harris County  
Houston, TX

James R. Robinson  
Virginia Department of Transportation  
Richmond, VA

Steven E. Shladover, Sc.D.  
University of California  
Institute of Transportation Studies  
Richmond, CA

William M. Spreitzer  
General Motors Corp. (Ret.)  
Beverly Hills, MI

Scott E. Stewart  
IBI Group  
Toronto, Ontario

Philip J. Tarnoff, Ph.D.  
University of Maryland  
College Park, MD

James L. Wright  
Minnesota Department of Transportation  
Roseville, MN

#### Staff

Stephen R. Godwin  
Transportation Research Board  
Washington, DC

Andrew C. Lemer, Ph.D.  
The Matrix Group, LLC  
Baltimore, MD

**Attachment 2**

**Committee for  
Review of the U.S. Department of Transportation's Intelligent Transportation Systems  
(ITS) Standards Program (II)**

**Meeting Agendas and Attendees**

**Meeting 1, March 8–9, 2001**Attendees

<u>Committee members</u>	<u>Sponsors and guests</u>	<u>TRB Staff</u>
A. Ray Chamberlain, chair	Jeffrey Paniati (DOT/JPO)	Stephen Godwin Andrew Lemer
Jules A. Bellisio	Michael Schagrin (DOT/JPO)	Jocelyn Sands
Irwin Dorros	Gary Carver (JPL)	
Jonathan L. Gifford	Alan Stern (JPL)	
William F. Johnson	Anne Tsang (JPL)	
Samuel Krislov	Emil Wolanin	
Alexander Lopez	(Chief,	
James R. Robinson	Transportation	
Steven E. Shladover	Systems Mgt.,	
William M. Spreitzer	Montgomery	
Scott E. Stewart	County, MD)	
Frederick M. Streff		
Philip J. Tarnoff		
James L. Wright		

Agenda

Thursday, March 8 10:00 a.m.–noon: Closed session

10:00–10:30	Opening statements - Welcome - Introductions - Introduction to the NRC, TRB, study process
10:30–11:30	Bias and balance discussion
11:30–12:00	Plan for the meeting, initial discussions of topic
12:00	Break, sponsors and guests join group

Noon–8:00 p.m.: Open session

- 12:30–1:00      Introductory remarks from sponsors
- Introductions of sponsors and guests
  - JPO objectives in sponsoring study
  - JPO concerns regarding the widespread adoption of ITS infrastructure standards in practice
- 1:00–5:30      Presentations and discussion on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure”

Friday, March 9

8:30–11:30 a.m.: Open session

- 8:30–9:00      Review of previous day’s discussion, key points
- 9:00–11:30      Continuing discussion on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure”

11:30 a.m.–2:30 p.m.: Closed session

- 11:30–12:30      Committee members propose key points, findings, conclusions, recommendations
- 12:30–2:00      Discussion of proposals
- 2:00–2:30      Summary and report preparation schedule
- 2:30              Adjournment

**Meeting 2, June 11–12, 2001**Attendees

<u>Committee members</u>	<u>Sponsors and guests</u>	<u>TRB Staff</u>
A. Ray Chamberlain, chair	Jeffrey Paniati (DOT/JPO, Monday only)	Andrew Lemer
Jules A. Bellisio	Michael Schagrin (DOT/JPO)	Jocelyn Sands
Irwin Dorros	Gary Carver (JPL)	
Jonathan L. Gifford	Alan Stern (JPL)	
William F. Johnson	Anne Tsang (JPL, Tuesday only)	
Alexander Lopez	Glen Hansen [Howard County (MD) Dept. of Police, Tuesday only]	
James R. Robinson	Robert Deroche (Peek Traffic Systems, Inc.)	
Steven E. Shladover		
William M. Spreitzer		
Philip J. Tarnoff		

Agenda

Monday, June 11	<u>10:00 a.m.–noon: Closed session</u>	
	10:00–12:00	Opening statements <ul style="list-style-type: none"> <li>- Welcome</li> <li>- Review of meeting objectives and standards deployment strategy analysis framework</li> <li>- Issues related to National ITS Architecture</li> </ul>
	12:00	Break, sponsors and guests join group
	<u>Noon–8:00 p.m.: Open session</u>	
	12:30–1:00	Introductory remarks and introduction of guests
	1:00–3:00	Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for NTCIP for DMS—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion based on staff working paper
	3:00–3:15	Break

	3:15–5:15	Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for NTCIP for Signals—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion based on staff working paper
Tuesday, June 12	<u>8:30 a.m.–12:30 p.m.: Open session</u>	
	8:30–9:00	Review of previous day’s discussion, introduction of guests
	9:00–11:00	Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for EMS/incident management—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion based on staff working paper
	11:00–12:00	Preliminary discussion on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for “center-to-center” transit- and traffic-management standards—DOT comments on standards status, followed by open discussion based on staff working paper
	12:00–12:30	Summary of key points from discussions on methodology and applications to DMS, EMS, NTCIP for signals and center-to-center management standards, and directions for future committee activities
	<u>12:30–2:30 p.m.: Closed session</u>	
	12:30–2:30	Agreement on principal conclusions and recommendations to date, planning for next meeting, meeting summary, and report preparation schedule
	2:30	Adjournment

## Meeting 3, November 14–15, 2001

### Attendees

<u>Committee members</u>	<u>Sponsors and guests</u>	<u>TRB Staff</u>
A. Ray Chamberlain, chair	Michael Schagrin	Stephen Godwin
Jules Bellisio	Gary Carver (Wed. only)	Andrew Lemer
Irwin Dorros (Wed. only)	Alan Stern	Amelia Mathis
Jonathan Gifford	Robert Rausch	Jocelyn Sands
William Johnson		
Samuel Krislov		
Alexander Lopez		
James Robinson		
Scott Stewart		
William Spreitzer		
James Wright		

### Agenda

Wednesday, November 14	<u>10:00 a.m.–noon: Closed session</u>	
	10:00–12:00	Opening statements (Chamberlain, Lemer) - Welcome - Review of meeting objectives and issues from previous meetings - Outlook for future committee activities
	12:00	Break, sponsors and guests join group
	<u>Noon–5:30 p.m.: Open session</u>	
	12:00–12:30	Lunch available in the meeting room
	12:30–1:00	Introductory remarks and introduction of guests (Chamberlain, Lemer)
	1:00–3:00	Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for <u>“center-to-center” transit- and traffic-management standards</u> (see Attachment A)—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion (Chamberlain, Lemer, DOT staff, and guests)
	3:00–3:15	Break
	3:15–5:30	Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for <u>“center-to-center” transit- and</u>

traffic-management standards (see Attachment A)—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion (Chamberlain, Lemer, DOT staff, and guests)

Thursday,  
November 15

6:00–8:00

Committee Dinner

8:30 a.m.–12:30 p.m.: Open session

8:30–9:00

Review of previous day’s discussion (Lemer, Chamberlain)

9:00–12:00

Discussions on “DOT’s role in achieving widespread adoption of common standards for ITS infrastructure” with particular regard for issues of “interoperability” (see Attachment B)—review of previous discussion, DOT comments on standards status, comments by guests, followed by open discussion (Chamberlain, Lemer, DOT staff, and guests)

12:00–1:00 p.m.

Lunch available in the meeting room

12:00–12:30

Summary of key points from discussions on methodology and applications to DMS, EMS, NTCIP for signals and center-to-center traffic- and transit-management standards, and directions for future committee activities (Chamberlain, Lemer)

12:30–2:30 p.m.: Closed session

12:30–2:30

Review of principal conclusions and recommendations to date, and report preparation schedule (refer to staff working papers, meeting summaries, and letter report) (Lemer, Chamberlain)

2:30

Adjournment