Technical Memorandum No. 3.5

Standards Application Plan

ITS Corridor Master Plans for Florida's Principal FIHS Limited-Access Corridors

Prepared for:

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List of Acronyms

AASHTO .... American Association of State Highway and Transportation Officials
ACC .... Adaptive Cruise Control
ADMS .... Archived Data Management Subsystem
ANSI .... American National Standards Institute
API .... Application Program Interface
APTS .... Advanced Public Transportation System
ASTM .... American Society for Testing and Materials
ATC .... Advanced Transportation Controller
ATIS .... Advanced Traveler Information System
ATMS .... Advanced Traffic Management Systems
BER .... Basic Encoding Rule
CCTV .... Closed-Circuit Television
CFR .... Code of Federal Regulations
CMS .... Changeable Message Sign
CORBA .... Common Object Request Broker Architecture
CVO .... Commercial Vehicle Operations
DARC .... Data Radio Channel
DATEX .... Data Exchange
DMS .... Dynamic Message Sign
DSRC .... Dedicated Short-Range Communication
EDI .... Electronic Data Interchange
EMC .... Emergency Management Center
ESS .... Environmental Sensor Stations
ETC .... Electronic Toll Collection
ETTM .... Electronic Toll and Traffic Management
FAMU .... Florida Agricultural & Mechanical University
FDOT .... Florida Department of Transportation
FCC .... Federal Communications Commission
FHP .... Florida Highway Patrol
FHWA .... Federal Highway Administration

FIHS ....Florida Intrastate Highway System
FSU ....Florida State University
FTP..File Transfer Protocol
GPS ....Global Positioning System
HAZMAT ....Hazardous Materials
HRI..Highway-Rail Intersection
IDB..ITS Data Bus
IEEE..Institute for Electrical and Electronic Engineers
IMMS..Incident Management Message Set
ISP..Information Service Provider
ITE ....Institute of Transportation Engineers
GC ....General Consultant
ITS..Intelligent Transportation System
LAN ....Local Area Network
LRMS..Location Reference Message Specification
MIB..Management Information Base
MS/ETMCC..Message Set for External Traffic Management Center Communication
NEMA..National Electronics Manufacturers Association
NPRM ....Notice for Proposed Rule-Making
NITSA..*National ITS Architecture*
NTCIP..National Transportation Communications for ITS Protocol
OER..Octet Encoding Rules
OSI ....Open Systems Interconnection
PMPP ....Point-to-Multipoint Protocol
RF..Radio Frequency
RTMC ....Regional Traffic Management Center
RWIS..Road Weather Information System
SAE..Society of Automotive Engineers
SDO..Standards Development Organization
STIC..Subcarrier Traffic Information Channel
STMF ....Simple Transportation Management Framework
STMP ....Simple Transportation Management Protocol
SWRI..Southwest Research Institute
TCD..Traffic Control Devices

TCIP .... Transit Communications Interface Protocol
TCP/IP .... Transmission Control Protocol/Internet Protocol
TEA-21 .... Transportation Equity Act for the 21st Century
TERL .... Traffic Engineering Research Laboratory
TGC .... Telecommunications General Consultant
TMC .... Traffic Management Center
TMDD .... Traffic Management Data Dictionary
USDOT .... United States Department of Transportation
VMS .... Variable Message Sign
XML .... eXtensible Markup Language

1.   Introduction

Section 5206 of the Transportation Equity Act for the 21st Century (TEA-21) requires that intelligent transportation systems (ITS) projects carried out using federal funds "conform to the national architecture, applicable standards or provisional standards and protocols." At present, the United States Department of Transportation's (USDOT) *ITS Standards Program* includes the development of about 100 ITS standards. USDOT policy is that, to be eligible for federal funding, ITS projects will have to employ any applicable ITS standards adopted through the federal rulemaking process.   The rulemaking process includes the determination by USDOT officials that there is a significant public benefit to be gained by requiring conformance to the adopted standards and that the standards are ready to be adopted. Up to this point, no ITS standard has been approved by the USDOT. Thus, the use of these ITS standards is not mandatory at this time. However, the USDOT strongly encourages the adoption and use of ITS standards as soon as possible because it recognizes that deploying ITS standards may help promote and ensure system interoperability now and in the future.

TEA-21 also requires that the USDOT identify "critical standards" that are required to ensure the national interoperability of ITS applications. Under TEA-21, if any of the ITS standards are not completed by January 2001, USDOT is authorized to create "provisional" standards for missing items. Such provisional standards could be made mandatory through the rule-making process.

The USDOT has undertaken an *ITS Standards Program* to measure the operation, correctness, and completeness of standards under realistic transportation operating conditions, to assess the extent to which conforming ITS components are interoperable, and to provide information about the performance of the standards to the ITS community. To date, this process has identified approved standards by the five standards development organizations (SDO) and published standards; however, these have yet to be approved by the USDOT through their rule-making process. A copy of the *ITS Standards Program* is included in Appendix A of this report.

The *ITS Standards Application Plan* for the Florida Intrastate Highway System's (FIHS) limited-access corridors presented in this document:

- Identifies ITS standards that are applicable to corridor ITS implementations;
- Discusses issues related to the implementation of these standards; and
- Identifies high priority standards for ITS deployments.

Technical Memorandum No. 3.4 – ITS Physical Architecture of this study provides a clear understanding of the existing and future ITS elements to be deployed on the corridors. The *ITS Standards Application Plan* as presented in this document builds on this platform by assessing the standardization requirements of the ITS deployments.

The *ITS Standards Application Plan* includes the following:

- Identification of ITS standards that support the corridor ITS deployments;
- Current status/maturity of the identified ITS standards;
- Categorization of ITS standards by corridor ITS market sectors;
- Determination of the interoperability types supported by the identified standards;
- Standards procurement issues;
- Legacy system considerations; and
- High priority standards discussion.

2. Corridor ITS Standards Identification

The Turbo Architecture software was used in the development of ITS physical architecture for the FIHS limited-access corridors, as discussed in *Technical Memorandum No. 3.4 – ITS Physical Architecture*. The Turbo Architecture software has the capability of mapping all selected physical architecture flows to ITS standards. In this study, tables that include the mapping of each corridor architecture flow to one or more ITS standards was extracted from the Turbo Architecture Microsoft Access database. These tables can be generated from the Turbo Architecture files using standards activities by flows in the output report menu selection.

A summary of all ITS standards that support the FIHS corridor ITS physical architecture flows was produced based on the information extracted from the Turbo Architecture software. This summary is included in Table 2.1 and identifies the following information:

- The first column identifies the **SDO** that coordinated the development of the standard. It is the standards publishing authority. The SDOs include:

  o American Association of State Highway and Transportation Officials (AASHTO);
  o Institute of Transportation Engineers (ITE);
  o American National Standards Institute (ANSI);
  o American Society for Testing and Materials (ASTM);
  o National Electronics Manufacturers Association (NEMA);
  o Institute for Electrical and Electronic Engineers (IEEE); and
  o Society of Automotive Engineers (SAE).

- The second column contains the **Document ID.** This specifies the official standards identification assigned to the standard by the SDO.

- The third column is the **Standard Title** and it specifies the official title assigned to the standard by the SDO.

- The fourth column, called **Status**, specifies the current status of ITS standards. (The information presented in this column is discussed in the following section).

Appendix B presents a description of the ITS standards applicable to the corridor ITS deployments.

As stated above, the list presented in Table 2.1 was produced based on the Turbo Architecture identification of standards that support each corridor ITS architecture flow. The advanced transportation controller (ATC) standards, which are currently under development by the ITE, were added to the list to take into consideration the possibility of using the ATC as part of the corridor ITS deployments. In addition, new standards that have not been incorporated as part of the Turbo Architecture software were also added to the list. Table 2.1 does not include

supporting information reports and recommended practices reports, which are produced by the SDOs. These reports are also applicable to the corridor ITS deployments.

It should be recognized that Table 2.1 includes ITS standards that are being developed by the SDOs and are related to data flows and application level information exchange for ITS services. These standards are unique to ITS. The ITS use additional enabling standards. These standards include off-the-shelf communications media and applicable general-purpose data communications standards such as standards for fiber-optic technology, transmission control protocol/internet protocol (TCP/IP), and cellular radio. These standards are also applicable to the corridor ITS deployments, although not included in Table 2.1.

Table 2.1 – ITS Standards that Support Corridor ITS Deployments

SDO	Document ID	Standard Title	Status
AASHTO	1207	NTCIP - Object Definitions for Ramp Meter Control	Approved
AASHTO	1208	NTCIP - Object Definitions for Video Switches	Under Development
AASHTO	2303	NTCIP - File Transfer Protocol (FTP) – Application Profile	Approved
AASHTO	1204	NTCIP - Object Definitions for Environmental Sensor Stations (ESS)	Published
AASHTO	1301	NTCIP – Weather Report Message Set for ESS	Published
AASHTO	2302	NTCIP - Trivial FTP – Application Profile	Approved
AASHTO	2304	NTCIP - Application Profile - Data Exchange (DATEX)	Under Development
AASHTO	2305	NTCIP - Application Profile for Common Object Request Broker Architecture (CORBA)	Under Development
AASHTO	1102	NTCIP - Octet Encoding Rules	In Ballot
AASHTO	1101	NTCIP - Simple Transportation Management Framework (STMF)	Published
AASHTO	1104	NTCIP – CORBA Naming Convention Specification	Under Development
AASHTO	1105	NTCIP – CORBA Security Service Specification	Under Development
AASHTO	1106	NTCIP – CORBA Near Real-Time Data Service Specification	Under Development
AASHTO	2001	NTCIP - Class B Profile	Published
AASHTO	1201	NTCIP - Global Object Definitions	Published
AASHTO	1202	NTCIP - Object Definitions for Actuated Traffic Signal Controller Units	Published
AASHTO	1203	NTCIP - Object Definitions for Dynamic Message Signs (DMS)	Published
AASHTO	2101	NTCIP - Point-to-Multipoint Protocol (PMPP)/RS232 Subnetwork Profile	Approved
AASHTO	1209	NTCIP - Object Definitions for Transportation Sensor Systems (formerly SEN)	Under Development
AASHTO	1206	NTCIP – Object Definition for Data Collection	Under Development
AASHTO	2301	NTCIP - STMF Application Profile	Approved
AASHTO	1103	NTCIP - Simple Transportation Management Protocol (STMP)	Under Development
AASHTO	2104	NTCIP - Subnetwork Profile for Ethernet	In Ballot
AASHTO	2103	NTCIP - Subnetwork Profile for Point-to-Point Protocol Using RS 232	Under Development
AASHTO	2102	NTCIP - Subnetwork Profile for PMPP using FSK Modem	In Ballot
AASHTO	1205	NTCIP - Data Dictionary for CCTV	In Ballot
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	Approved
AASHTO	2201	NTCIP – Transportation Transport Profiles	Under Development

Table 2.1 (Continued)

SDO	Document ID	Standard Title	Status
AASHTO	8003	NTCIP – Profiles – Framework and Classification of Profiles	Approved
AASHTO	2501	NTCIP - Information Profile for DATEX	Under Development
AASHTO	2502	NTCIP - Information Profile for CORBA	Under Development
ITE	TM 1.03	Standard for Functional Level Traffic Management Data Dictionary (TMDD)	In Ballot
ITE	9603-1	ATC Software Application Program Interface (API)	Under Development
ITE	9603-2	ATC Physical Cabinet Functional Design	Under Development
ITE	9603-3	ATC Functionality and Interface Definitions)	In Ballot
ITE	TM 2.01	Message Set for External TMC Communication (MS/ETMCC)	In Ballot
ITE	1400	TCIP – Framework Document	Approved
ITE	1407	TCIP – Control Center Business Area Standard	Approved
ITE	1401	TCIP – Common Public Transportation Business Area Standard	Published
ITE	1408	TCIP – Fare Collection Business Area Standard	Approved
ITE	1402	TCIP – Incident Management Business Area Standard	Published
ITE	1406	TCIP – On-Board Business Area Standard	Approved
ITE	1403	TCIP – Passenger Information Business Area Standard	Published
ITE	1404	TCIP – Scheduling/Runcutting Business Area Standard	Published
ITE	1405	TCIP – Spatial Representation Business Area Standard	Published
ITE	TS 3.TM	TCIP – Traffic Management Business Area Standard	Under Development
ANSI	TS284	Commercial Vehicle Safety Reports	Published
ANSI	TS285	Commercial Vehicle Safety and Credentials Information Exchange	Published
ANSI	TS286	Commercial Vehicle Credential	Published
ASTM	PS111-98	Standard Specification for Dedicated Short-Range Communications (DSRC) – Physical Layer 902-928 MHz	Published
ASTM	PS105-99	Standard Specification for DSRC – Data Link Layer (Draft)	Published
ASTM	AG	Archived Data Management Subsystem (ADMS) Standard Guidelines	Under Development
ASTM	DD	ADMS Data Dictionary Specifications	Under Development
ASTM	N/A	Standard Specification for 5.9 GHz Data Link Layer	Under Development
ASTM	N/A	Standard Specification for 5.9 GHz Physical Layer	Under Development
EIA/CEA	EIA-794	Data Radio Channel (DARC) System	Published

Table 2.1 (Continued)

SDO	Document ID	Standard Title	Status
ASTM	N/A	Standard Specification for 5.9 GHz Physical Layer	Under Development
EIA/CEA	EIA-794	Data Radio Channel (DARC) System	Published
EIA/CEA	EIA-795	Subcarrier Traffic Information Channel (STIC) System	Published
IEEE	1512	Standard for Common Incident Management Message Set (IMMS) for use by EMCs	Published
IEEE	1455	Message Sets for DSRC ETTM and CVO	Published
IEEE	1512.a	Standard for Emergency Management Data Dictionary	Under Development
IEEE	1512.2	Standard for Public Safety IMMS for Use by EMCs	Under Development
IEEE	1512.3	Standard for Hazardous Material (HAZMAT) IMMS for use by EMCs	Under Development
IEEE	1512.1	Standard for Traffic IMMS for Use by EMCs	Under Development
IEEE	1556	Standard for Security and Privacy of Vehicle/Roadside Communications	Under Development
IEEE	1570	Standard for Interface Between the Rail Subsystem and the Highway Subsystem at a Highway-Rail Intersection (HRI).	Under Development
SAE	J1663	Truth-In Labeling Standards for Navigation Map Database	Published
AE	J1760	ITS Data Bus Data Security Services Recommended Practice	In Ballot
SAE	J1746	ISP-Vehicle Location Referencing Standard	Published
SAE	J2256	In-Vehicle Navigation System Communications Device Message Set Information Report	Published
SAE	J2313	On-Board Land Vehicle Mayday Reporting Interface	Published
SAE	J2353	Advanced Traveler Information System (ATIS) Data Dictionary	Published
SAE	J2354	ATIS Message Set	Published
SAE	J2364	Standard for Navigation and Route Guidance Function Accessibility While Driving	Published
SAE	2366/2	ITS Data Bus Protocol - Link Layer Recommended Practice	In Ballot
SAE	J2366/1	ITS Data Bus Protocol – Physical Layer Recommended Practice (J2366-1)	In Ballot
SAE	J2366/4	ITS Data Bus Protocol - Thin Transport Layer Recommended Practice	In Ballot
SAE	J2366/7	ITS Data Bus Protocol – Application Layer Recommended Practice	In Ballot
SAE	J2367	ITS Data Bus Gateway Recommended Practice	Under Development
SAE	J2369	Standards for ATIS Message Sets Delivered Over Bandwidth Restricted Media	Published
SAE	J2395	ITS In-Vehicle Message Priority	In Ballot
SAE	J2396	Measurement of Driver Visual Behavior Using Video Based Methods (Definition and Measurement)	Published

Table 2.1 (Continued)

SDO	Document ID	Standard Title	Status
SAE	J2399	Adaptive Cruise Control (ACC): Operating Characteristics and User Interface	In Ballot
SAE	J2400	Forward Collision Warning: Operating Characteristics and User Interface	Under Development
SAE	J2529	Rules for Standardizing Street Names and Route IDs	Under Development
SAE	J2540	Messages for Handling Strings and Look-Up Tables in ATIS Standards	Under Development

Source: USDOT *ITS Standards Program*, website, updated by PBS&J.

3. Standards Availability / Maturity

Standards maturity is an important consideration in the reduction of risks during standards implementation. Thus, the required ITS standards maturity should be evaluated at the design and procurement stages of the FIHS corridor ITS deployments. Some of the factors that should be considered in assessing standards maturity include:

- Standards deployment and integration experience;
- Number of products that have implemented the standards;
- Stability of standards;
- Availability of standard deployment expertise;
- Availability of testing procedures; and
- Availability of acceptance procedures.

Table 2.1 includes the current status of the ITS standards that will support the FIHS corridor ITS deployments. These standards are classified as:

- *Published:* standards that are published by the SDOs and are available for purchase;
- *Approved:* standards that have passed all necessary ballots and have been approved by a SDO, but not yet published;
- *Ballot:* standards that are being voted upon by a committee or working group or are undergoing other SDO procedures; and
- *Under Development:* standards that are being written, but are not ready for a formal ballot.

As indicated in Table 2.1, of the ITS standards that support the corridor ITS deployments, 29 are published, 11 are approved, 13 are in ballot, and 30 are under development. In general, ITS standards are not yet mature. Although a large number of the ITS standards that support the corridor ITS deployments have been published or approved, ITS standards are still maturing and experience with them is limited.

The rule-making process for standards adoption as described in Section 1 has been initiated for only one standards area. This is a proposed specification for DSRC for CVO. As discussed later in this document, the Federal Highway Administration (FHWA) has decided to postpone the final DSRC for CVO rule until this standards testing is complete.

Most existing standards deployments have been with the National Transportation Communications for ITS Protocol (NTCIP) standards. A number of vendors have products that are compliant with the published NTCIP standards. The NTCIP standards are being implemented across the nation in several states and jurisdictions. Table 3.1 contains a list of NTCIP deployment projects either planned or under construction based on information presented in the NTCIP website. Lessons learned from these projects will provide important inputs to future standards deployments in Florida. As indicated in Table 3.1, the existing and planned

deployments are limited to four types of interfaces: center-to-center, DMS, signal controllers, and weather information systems.

The USDOT is undertaking a comprehensive program to test ITS standards that are emerging from the standards development process. The primary purposes of the standards testing program is to investigate the performance of the standards and to prove the standards in realistic transportation settings under realistic conditions. This effort will allow standards to mature more quickly. The testing effort should also be considered as an excellent source of software and test procedures to test systems using the standards.

The Florida Department of Transportation (FDOT) is currently funding a number of standards development and testing activities in Florida. The Traffic Engineering Research Laboratory or "TERL" is a joint research facility between FDOT and Florida Agricultural & Mechanical University (FAMU)/Florida State University (FSU) College of Engineering. TERL has performed research in the area of ITS standards and specifications, including testing procedures for evaluation and certification. The TERL standards work has addressed the ATC standards. In addition, the work includes the development of test procedures for the evaluation and certification of field traffic control devices (TCD) for conformance to NTCIP standards. An NTCIP migration plan has also been developed by TERL.

The FDOT ITS General Consultant (GC) is currently developing standards specifications for ITS devices including road weather information systems (RWIS) and closed-circuit television (CCTV) systems.   These standards specifications will include the requirement for NTCIP compliance.

The FDOT Telecommunication General Consultant (TGC) has produced a FDOT Management Information Base (MIB) for Permanent DMS. The development of this MIB is based on FDOT's *Permanent Mount Dynamic Message Sign – Minimum Specification Guideline (2ⁿᵈ Revision)*. The purpose of the MIB is to provide DMS vendors and system integrators with a list of data elements that must be supported and to provide FDOT districts with a list of common data elements that can be included in specifications documents.

Table 3.1 – List of Existing and Planned NTCIP Deployments in the United States

State	Project
Arizona	• The Phoenix traffic control system installed over 100 controllers compliant with the NTCIP. All mandatory objects were implemented. • The City of Mesa traffic control system upgrade requires compliance with NTCIP. • The City of Mesa controller specification requires NTCIP compliant controllers for all new purchases.
California	• Santa Monica Smart Corridor Interface project uses NTCIP protocol to communicate with multiple masters.
Colorado	• Lakewood – Installation of DMS requires NTCIP compliance. • The City of Lakewood installed signal controllers.
Florida	• The Dade County (Miami) signal system upgrade requires NTCIP compliance. • The Orlando signal system proposed for upgrading will be compliant with the NTCIP.
Illinois	• The Peoria traffic control system requires NTCIP for controllers. • The Illinois Tollway installed Vultron and Daktronic DMS.
Indiana	• The Indianapolis traffic control system requires NTCIP for controllers for 80+ controllers.
Minnesota	• The Minneapolis/St. Paul Orion is a project in the Minneapolis/St. Paul area that will provide freeway and arterial traveler information, transit innovations, and incident management. The NTCIP Center-to-Center Protocol will be specified. • Statewide – Mn/DOT is implementing a statewide RWIS that utilizes NTCIP. • Statewide – Mn/DOT is specifying NTCIP for statewide ITS deployment projects, specifically for projects in Duluth and St. Cloud starting with DMS.
New York	• Monroe County (Rochester) – Expanding/Updating their signal system in multiple jurisdictions and plans to use NTCIP communications protocol. • The Long Island Southern State Parkway is specifying NTCIP DMS protocol and environmental sensor protocol.
North Carolina	• The Highpoint traffic control system requires NTCIP for controllers, ASC objects, and Class B profile; 160 intersections. • Statewide NCDOT's next annual bid will require NTCIP compliant controllers and masters.
Ohio	• Lima Traffic Control System requires NTCIP for controllers.
Texas	• Houston is specifying NTCIP compliance in DMS procurements and for traffic controllers. • SWRI is developing a central system. • Skyline and FDS are supplying DMS.
Virginia	• Statewide – Installation of variable message signs (VMS) requires NTCIP compliance.
Utah	• Statewide – UDOT will require NTCIP for controllers and arterial masters.
Washington	• Statewide – WSDOT has installed NTCIP-compliant DMS.

Source: NTCIP website, as of 11/07/01.

4. Interoperability Levels and Critical Standards

Tables 4.1 through 4.8 present the standards that support the FIHS corridor ITS architecture market sectors. (There will be more discussion about the market sectors presented in the next section). Each supported interface is assigned an interoperability level based on information collected from the *National ITS Architecture* (*NITSA*) database. The interoperability levels used are explained below.

- *National Interoperability* is specified for interfaces to mobile subsystems (i.e., Vehicle Subsystem, Commercial Vehicle Subsystem, and Personal Information Access Subsystem). This specification is required to ensure that the same mobile subsystem can move around the nation and use the local infrastructure to support ITS services. Examples of these interfaces include the Information Service Provider (ISP) Subsystem to Personal Information Access Subsystem, Toll Collection Subsystem to Vehicle Subsystem, and the Commercial Vehicle Subsystem to Commercial Vehicle Check Subsystem. National standards mitigate issues that may arise as boundaries change and new requirements for information sharing develop over time. If both the mobile subsystem and interfacing infrastructure are owned and operated by the same user, such as in the case of transit operations, then national interoperability is not required.

- *Regional Interoperability* is specified for interfaces connecting subsystems that may be operated by different agencies (interfaces that can span jurisdictional and/or regional boundaries). These interfaces can be standardized to facilitate the sharing of information and control between agencies. Regional interoperability is specified where the underlying coordination issues are regional, rather than national, in scope. For instance, there is no requirement for a signal control system in Daytona Beach to be able to communicate and coordinate with a regional traffic management center (RTMC) in Miami. Examples of the regional interoperability interfaces include the Traffic Management Subsystem to Transit Management Subsystem, Traffic Management Subsystem to ISP Subsystem, and Traffic Management Subsystem to Emergency Management Subsystem.

- *Product Interoperability* is specified for interfaces between subsystems that are operated and maintained by a single stakeholder [i.e., Florida Highway Patrol (FHP) or FDOT District 7]. These interfaces do not require standardization to achieve national and regional interoperability. However, in some cases, these standards are very beneficial since they may consolidate a market to achieve economy of scale efficiencies such as in the case of the Traffic Management Subsystem to Roadway Subsystem interface. Such standards may also support an optional level of interoperability by enabling various cooperative control options to be implemented.

TEA-21 requires the identification and implementation of critical standards. The critical standards under TEA-21 include two types of standards cited by the United States Congress for special attention. These are standards needed for national interoperability of ITS services (national standards) and standards needed to develop other national interoperability standards (foundation standards). In June 1999, the USDOT issued a report that includes a list of 17 critical ITS standards that meet the TEA-21 criteria. The standards in Tables 4.1 through 4.8 are marked as critical or not critical based on this report. It should be recognized that other standards that are not designated as "critical" could be equally important to ITS deployments. For example, the NTCIP standards may not be required for national interoperability. However, if these standards are not completed and used, then transportation agencies will be faced with problems when implementing center-to-center communications (regional interoperability) in addition to limitations of interchangeability and local interoperability of equipment (product interoperability).

Table 4.1 – ITS Standards Supporting Traffic Management Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standard
AASHTO	1207	NTCIP – Object Definitions for Ramp Meter Control	TMC to Roadway	Product	No
AASHTO	1208	NTCIP – Object Definitions for Video Switches	TMC to Roadway	Product	No
AASHTO	2303	NTCIP – FTP – Application Profile	TMC to Construction and Maintenance TMC to EMC TMC to Event Promoters TMC to Media TMC to Other TMC TMC to Roadway TMC to Weather Services	Product Regional Regional Product Regional Product National	No
AASHTO	1204	NTCIP - Object Definitions for ESS	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	2302	NTCIP - Trivial FTP – Application Profile	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and Data Exchange (DATEX) NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	TMC to Construction and Maintenance TMC to EMC TMC to Emissions Management TMC to Enforcement TMC to Event Promoters TMC to Media TMC to Other TMC TMC to Parking Management TMC to Weather Services Parking Management to Other Parking Management	Product Regional Product Regional Regional Product Regional Regional National Regional	No
AASHTO	1102	NTCIP - Octet Encoding Rules (OER)	TMC to Construction and Maintenance TMC to EMC TMC to Emissions Management TMC to Enforcement TMC to Event Promoters TMC to Media TMC to Other TMC TMC to Parking Management TMC to Roadway TMC to Weather Services Parking Management to Other Parking Management	Product Regional Product Regional Regional Product Regional Regional Product National Regional	No
AASHTO	1101	NTCIP - STMF	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	2001	NTCIP - Class B Profile	TMC to Roadway Emissions Management to Roadway	Product Product	No

Table 4.1 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standard
AASHTO	1201	NTCIP - Global Object Definitions	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	1202	NTCIP - Object Definitions for Actuated Traffic Signal Controller Units	TMC to Roadway	Product	No
AASHTO	1203	NTCIP - Object Definitions for DMS	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	2101 2201	NTCIP - PMPP/RS232 Subnetwork Profile NTCIP – Transportation Transport Profile	TMC to Roadway	Product	No
AASHTO	1209	NTCIP - Object Definitions for Transportation Sensor Systems (formerly SEN)	TMC to Roadway	Product	No
AASHTO	1206	NTCIP - Data Collection and Monitoring Devices	TMC to Roadway	Product	No
AASHTO	2301	NTCIP - STMF Application Profile	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	1103	NTCIP - STMP	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	2104	NTCIP - Subnetwork Profile for Ethernet	TMC to Construction and Maintenance TMC to EMC TMC to Emissions Management TMC to Enforcement TMC to Event Promoters TMC to Media TMC to Other TMC TMC to Parking Management TMC to Roadway TMC to Weather Services Parking Management to Other Parking Management	Product Product Regional Product Regional Regional Product Regional Regional Product National Regional	No
AASHTO	2103	NTCIP - Subnetwork Profile for Point-to-Point Protocol Using RS 232	TMC to Roadway Emissions Management to Roadway	Product Product	No
AASHTO	1205	NTCIP - Data Dictionary for CCTV	TMC to Roadway	Product	No
AASHTO	1301	NTCIP – Message Set for Weather Report	TMC to Weather Services TMC to Roadway	National Regional	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	TMC to Construction and Maintenance TMC to EMC TMC to Emissions Management TMC to Enforcement	Product Regional Product Regional	No

Table 4.1 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standard
			TMC to Event Promoters TMC to Media TMC to Other TMC TMC to Parking Management TMC to Roadway TMC to Weather Services Parking Management to Other Parking Management	Regional Product Regional Regional Product National Regional	
ITE	TM 1.03	Standard for Functional Level TMDD	TMC to Construction and Maintenance TMC to EMC TMC to Event Promoters TMC to Media TMC to Parking Management TMC to Other TMC TMC to Weather Services	Regional Regional Regional Product Regional Regional National	Yes
ITE	9603-1	ATC Software API	Roadway	Product	No
ITE	9603-2	ATC Physical Cabinet Functional Design	Roadway	Product	No
ITE	9603-3	ATC Functionality and Interface Definitions)	Roadway	Product	No
ITE	TM 2.01	MS/ETMCC	TMC to Construction and Maintenance TMC to EMC TMC to Event Promoters TMC to Media TMC to Parking Management TMC to Other TMC TMC to Weather Services	Regional Regional Regional Product Regional Regional National	No
IEEE	P1512 2000 P 1512.1 P1512.a	Standard for Common IMMS for use by EMCs Standard for Traffic Incident Management Message Set for use by EMCs Standard for Emergency Management Data Dictionary	EMC to TMC EMC to Other EMC EMC to Emergency Telecommunications Evacuation Management to EMC	Regional Regional Regional	No
IEEE	P1570	Standard for Interface between the Rail Subsystem and the Highway Subsystem at a HRI	Roadway to Railway	Regional	No

Table 4.2 – ITS Standards Supporting Electronic Toll and Parking Collection Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standard
AASHTO	2303	NTCIP - FTP – Application Profile	Toll Administration Center to TMC Toll Administration Center to ISP Parking Management to TMC Parking Management to ISP	Regional Regional Regional Regional	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and DATEX NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	Toll Administration Center to TMC Toll Administration Center to ISP Toll Administration Center to Enforcement Toll Administration Center to Toll Collection Equipment Parking Management to TMC Parking Management to ISP	Regional Regional Regional Regional Regional Regional Regional	No
AASHTO	1102	NTCIP - OER	Toll Administration Center to TMC Toll Administration Center to ISP Toll Administration Center to Enforcement Toll Administration Center to Toll Collection Equipment Parking Management to TMC Parking Management to ISP	Regional Regional Regional Regional Regional Regional Regional	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	Toll Administration Center to TMC Toll Administration Center to ISP Toll Administration Center to Enforcement Toll Administration Center to Toll Collection Equipment Parking Management to TMC Parking Management to ISP	Regional Regional Regional Regional Regional Regional Regional	No
ITE	TM 1.03	Standard for Functional Level TMDD	Toll Administration Center to TMC Parking Management to TMC	Regional Regional	Yes
ITE	TM 2.01	MS/ETMCC	Toll Administration Center to TMC Parking Management to TMC	Regional Regional	No
IEEE	P1455	Message Sets for DSRC ETTM and CVO	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	Yes
IEEE	P1556	Security/Privacy of Vehicle/RS Communications including Smart Card Communications	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	No
ASTM	PS111-98	Standard Specification for DSRC - Physical Layer 902-928 MHz	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	Yes
ASTM	PS105-99	Standard Specification for DSRC - Data Link Layer	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	Yes
ASTM	N/A	Standard Specification for 5.9 GHZ Data Link Layer	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	No
ASTM	N/A	Standard Specification for 5.9 GHZ Physical Layer	Toll Collection Equipment to Vehicle Parking Management to Vehicles	National National	No

Table 4.3 – ITS Standards Supporting Emergency Management Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	2303	NTCIP - FTP – Application Profile	EMC to TMC EMC to Other EMC EMC to Fleet and Freight Management EMC to Weather Services Evacuation Management to Other Centers	Regional Regional National National National	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and Data Exchange (DATEX) NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	EMC to TMC EMC to Other EMC EMC to Fleet and Freight Management EMC to Weather Services EMC to Emergency Telecommunication Evacuation Management to Other Centers	Regional Regional National National Regional National	No
AASHTO	1102	NTCIP - OER	EMC to TMC EMC to Other EMC EMC to Fleet and Freight Management EMC to Weather Services EMC to Emergency Telecommunication Evacuation Management to Other Centers	Regional Regional National National Regional National	No
AASHTO	2104	NTCIP - Subnetwork Profile for Ethernet	EMC to TMC EMC to Other EMC EMC to Fleet and Freight Management EMC to Weather Services EMC to Emergency Telecommunication Evacuation Management to Other Centers	Regional Regional National National Regional National	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	EMC to TMC EMC to Other EMC EMC to Fleet and Freight Management EMC to Weather Services EMC to Emergency Telecommunication Evacuation Management to Other Centers	Regional Regional National National Regional	No
AASHTO	1301	NTCIP – Message Set for Weather Report	EMC to Weather Services	National	No
ITE	TM 1.03	Standard for Functional Level TMDD	EMC to TMC Evacuation Management to TMC	Regional	Yes
ITE	TM 2.01	MS/ETMCC	EMC to TMC Evacuation Management to TMC	Regional	No
ITE	1401	TCIP – Common Public Transportation Business Area Standard	EMC to Other EMC	Regional	No

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
ITE	1402	TCIP – Incident Management Business Area Standard	EMC to Other EMC	Regional	No
ITE	1405	TCIP – Spatial Representation Business Area Standard		Regional	No
IEEE	P1512 2000 P 1512.1 P1512.a P1512.2 P1512.3	Standard for Common IMMS for use by EMCs Standard for Traffic IMMS for use by EMCs Standard for Emergency Management Data Dictionary Standard for Traffic IMMS Sets for Use by EMCs Standard for HAZMAT IMMS for use by EMCs	EMC to TMC EMC to Other EMC EMC to Emergency Telecommunications Evacuation Management to EMC	Regional Regional Regional	No
IEEE	P1556	Security/Privacy of Vehicle/RS Communications including Smart Card Communications	Emergency Vehicles to Roadway	Regional	No
ASTM	PS111-98	Standard Specification for DSRC - Physical Layer 902-928 MHz	Emergency Vehicles to Roadway	Regional	Yes
ASTM	PS105-99	Standard Specification for DSRC - Data Link Layer	Emergency Vehicles to Roadway	Regional	Yes
ASTM	N/A	Standard Specification for 5.9 GHz Data Link Layer	Emergency Vehicles to Roadway	Regional	No
ASTM	N/A	Standard Specification for 5.9 GHz Physical Layer	Emergency Vehicles to Roadway	Regional	No
SAE	J2313	On-Board Land Vehicle Mayday Reporting Interface	EMC to Personal Mayday Devices EMC to Vehicles with Mayday Devices	National National	Yes

Table 4.3 (Continued)

Table 4.4 – ITS Standards Supporting Traveler Information Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	2303	NTCIP - FTP – Application Profile	ISP to EMC ISP to Media ISP to Other ISP ISP to TMC ISP to TRMS	Regional Product National Regional Regional	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and DATEX NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	ISP to EMC ISP to Map Update Provider ISP to Media ISP to Other ISP ISP to Parking Management ISP to TMC ISP to TRMS ISP to Yellow Page Service Provider ISP to Weather Services	Regional National Product National Regional Regional Regional National National	No
AASHTO	1102	NTCIP - OER	ISP to EMC ISP to Map Update Provider ISP to Media ISP to Other ISP ISP to Parking Management ISP to TMC ISP to TRMS ISP to Yellow Page Service Provider ISP to Weather Services	Regional National Product National Regional Regional Regional National National	No
AASHTO	1301	NTCIP – Message Set for Weather Report	ISP to Weather Services	National	No
AASHTO	2104	NTCIP – Subnetwork Profile for Ethernet	ISP to EMC ISP to Map Update Provider ISP to Media ISP to Other ISP ISP to Parking Management ISP to TMC ISP to TRMS ISP to Yellow Page Service Provider ISP to Weather Services	Regional National Product National Regional Regional Regional National National	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	ISP to EMC ISP to Map Update Provider ISP to Media ISP to Other ISP ISP to Parking Management ISP to TMC ISP to TRMS ISP to Yellow Page Service Provider ISP to Weather Services	Regional National Product National Regional Regional Regional National National	No

Table 4.4 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	ISP to EMC ISP to Map Update Provider ISP to Media ISP to Other ISP ISP to Parking Management ISP to TMC ISP to TRMS ISP to Yellow Page Service Provider ISP to Weather Services	Regional National Product National Regional Regional Regional National National	No
ITE	TM 1.03	Standard for Functional Level TMDD	ISP to TMC	Regional	Yes
ITE	TM 2.01	MS/ETMCC	ISP to Personal Information Access ISP to Remote Traveler Support ISP to Vehicle	National Regional National	No
EIA/CEA	EIA-794	DARC System	ISP to Personal Information Access ISP to Remote Traveler Support ISP to Vehicle	National Regional National	No
EIA/CEA	EIA-795	STIC System	ISP to Personal Information Access ISP to Remote Traveler Support ISP to Vehicle	National Regional National	No
IEEE	P1512	Standard for Common IMMS for use by EMCs	ISP to EMC	Regional	Yes
SAE	J1746	ISP-Vehicle Location Referencing Profiles	ISP to Personal Information Access ISP to Remote Traveler Support ISP to Vehicle	National Regional National	Yes
SAE	J2353	ATIS Data Dictionary	ISP to Media ISP to Other ISP ISP to Parking Management ISP to Personal Information Access ISP to Remote Traveler Support ISP to TMC ISP to TRMS Centers ISP to Vehicle	Product National Regional National Regional Regional Regional National	Yes
SAE	J2354	ATIS Message Set	ISP to Media ISP to Other ISP ISP to Parking Management ISP to Personal Information Access ISP to Remote Traveler Support ISP to TMC ISP to TRMS Centers ISP to Vehicle	Product National Regional National Regional Regional Regional National	Yes

Table 4.4 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
SAE	J2529 J2540	Rules for Standardizing Street Names and Route IDs Messages for Handling Strings and Look-Up Tables in ATIS Standards	ISP to Media ISP to Other ISP ISP to Parking Management ISP to Personal Information Access ISP to Remote Traveler Support ISP to TMC ISP to TRMS Centers ISP to Vehicle	Product National Regional National Regional Regional Regional National	No
SAE	J2369	Standards for ATIS Message Sets Delivered Over Bandwidth Restricted Media	ISP to Personal Information Access ISP to Remote Traveler Support ISP to Vehicle	National Regional National	Yes

Table 4.5 – ITS Standards Supporting CVO Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
ANSI	TS284	Commercial Vehicle Safety Reports	Commercial Vehicle Administration to Commercial Vehicle Check	Regional	Yes
ANSI	TS285	Commercial Vehicle Safety and Credentials Information Exchange	Commercial Vehicle Administration to Commercial Vehicle Check	Regional	Yes
ANSI	TS286	Commercial Vehicle Credentials	Commercial Vehicle Administration to Commercial Vehicle Check	Regional	Yes
			Commercial Vehicle Administration to Other CV Administration	National	
			Commercial Vehicle Administration to Fleet and Freight Management	National	
IEEE	P1455	Message Sets for DSRC ETTM and CVO	Commercial Vehicle Check to Commercial Vehicle Equipment	National	Yes
ASTM	PS111-98	Standard Specification for DSRC - Physical Layer 902-928 MHz	Commercial Vehicle Check to Commercial Vehicle Equipment	National	Yes
ASTM	PS105-99	Standard Specification for DSRC - Data Link Layer (Draft)	Commercial Vehicle Check to Commercial Vehicle Equipment	National	Yes

Table 4.6 – ITS Standards Supporting Advanced Public Transportation Systems (APTS) Sector Interfaces

SDO	Document ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	1208	NTCIP - Object Definitions for Video Switches	TRMS to Remote Traveler Support	Product	No
AASHTO	2303	NTCIP - FTP – Application Profile	TRMS to EMC TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to TMC	Regional Regional Regional Regional Regional	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and DATEX NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	TRMS to EMC TRMS to Enforcement Agencies TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to TMC	Regional Regional Regional Regional Regional Regional	No
AASHTO	1102	NTCIP - OER	TRMS to EMC TRMS to Enforcement Agencies TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to TMC	Regional Regional Regional Regional Regional Regional	No
AASHTO	1201	NTCIP - Global Object Definitions	TRMS to Remote Traveler Support	Product	No
AASHTO	2104	NTCIP - Subnetwork Profile for Ethernet	TRMS to EMC TRMS to Enforcement Agencies TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to TMC	Regional Regional Regional Regional Regional Regional	No
AASHTO	1205	NTCIP - Data Dictionary for CCTV	TRMS to Remote Traveler Support	Product	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	TRMS to EMC TRMS to Enforcement Agencies TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to TMC	Regional Regional Regional Regional Regional Regional	No

Table 4.6 (Continued)

SDO	Document ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
ITE	TM 1.03	Standard for Functional Level TMDD	TRMS to TMC	Regional	Yes
ITE	TM 2.01	MS/ETMCC	TRMS to TMC	Regional	No
ITE	1407	TCIP – Control Center Business Area Standard	TRMS to TMC TRMS to Transit Vehicle TRMS to Multi-modal Transportation Service Provider	Regional Product Regional	No
ITE	1401	TCIP – Common Public Transportation Business Area Standard	TRMS to EMC TRMS to Enforcement Agencies TRMS to ISP TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to Remote Traveler Support TRMS to TMC TRMS to Transit Vehicle Transit Vehicle / Payment Instrument Transit Vehicle / Vehicle Equipment	Regional Regional Regional Regional Regional Product Regional Product National Product	No
ITE	1408	TCIP – Fare Collection Business Area Standard	TRMS to Enforcement Agencies TRMS to Remote Traveler Support TRMS to Transit Vehicle Transit Vehicle / Payment Instrument	Regional Product Product National	No
ITE	1402	TCIP – Incident Management Business Area Standard	TRMS to EMC TRMS to ISP TRMS to Remote Traveler Support TRMS to Transit Vehicle	Regional Regional Product Product	No
ITE	1406	TCIP – On-Board Business Area Standard	TRMS to Remote Traveler Support TRMS to Transit Vehicle Transit Vehicle / Vehicle Equipment	Product Product Product	No
ITE	1403	TCIP – Passenger Information Business Area Standard	TRMS to ISP TRMS to Park and Ride Management TRMS to Remote Traveler Support TRMS to Transit Vehicle	Regional Regional Product Product	No
ITE	1404	TCIP – Scheduling/Runcutting Business Area Standard	TRMS to ISP TRMS to Transit Vehicle	Regional Product	No
ITE	1405	TCIP – Spatial Representation Business Area Standard	TRMS to EMC TRMS to ISP	Regional Regional	No

Table 4.6 (Continued)

SDO	Document ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
			TRMS to Multi-modal Transportation Service Provider TRMS to Park and Ride Management TRMS to Remote Traveler Support TRMS to TMC TRMS to Transit Vehicle	Regional Regional Product Regional Product	
ITE	TS 3.TM	TCIP – Traffic Management Business Area Standard	TRMS to TMC	Regional	No
IEEE	P1512	Standard for Common IMMS for use by EMCs	TRMS to EMC	Regional	Yes
ASTM	PS111-98	Standard Specification for DSRC - Physical Layer 902-928 MHz	Transit Vehicles to Roadway	Regional	Yes
ASTM	PS105-99	Standard Specification for DSRC - Data Link Layer	Transit Vehicles to Roadway	Regional	Yes
SAE	J2353	ATIS Data Dictionary	TRMS to Remote Transit Support TRMS to Transit Vehicles TRMS to ISP	Product Product Regional	Yes
SAE	J2354	ATIS Message Set	TRMS to Remote Transit Support TRMS to Transit Vehicles TRMS to ISP	Product Product Regional	Yes
SAE	J2529 J2540	Rules for Standardizing Street Names and Route IDs Messages for Handling Strings and Look-Up Tables in ATIS Standards	ISP to Media ISP to Other ISP ISP to Parking Management ISP to Personal Information Access ISP to Remote Traveler Support ISP to TMC ISP to TRMS Centers ISP to Vehicle	Product National Regional National Regional Regional Regional National	No

Table 4.7 – ITS Standards Supporting Data Archiving Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	2303	NTCIP - FTP – Application Profile	ADMS to Archived Data User Systems ADMS to Construction and Maintenance ADMS to EMC ADMS to Government Reporting Systems ADMS to Multi-modal Service Provider ADMS to Other Archives ADMS to Toll Administration ADMS to Roadway ADMS to TMC ADMS to TRMS ADMS to Weather Services	National Regional Regional National Regional National Regional Product Regional Regional National	No
AASHTO	2302	NTCIP - Trivial FTP – Application Profile	ADMS to Roadway	Product	No
AASHTO	2304, 2305 1104 1105 1106 2501, 2502	NTCIP - Application Profile - CORBA and DATEX NTCIP – CORBA Naming Convention NTCIP – CORBA Security Service Specification NTCIP – CORBA Near Real-Time Data Service Specification NTCIP – Information Profile CORBA and DATEX	ADMS to Archived Data User Systems ADMS to Construction and Maintenance ADMS to EMC ADMS to Emissions Management ADMS to Government Reporting Systems ADMS to ISP ADMS to Other Archives ADMS to Map Update Provider ADMS to Parking Management ADMS to Other Data Source ADMS to Multi-modal Service Provider ADMS to Other Archives ADMS to Toll Administration ADMS to TMC ADMS to TRMS ADMS to Weather Services	National Regional Regional Regional National Regional National National Regional National Regional National Regional Regional Regional National	No

Table 4.7 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
AASHTO	1102	NTCIP – OER	ADMS to Archived Data User Systems ADMS to Construction and Maintenance ADMS to EMC ADMS to Emissions Management ADMS to Government Reporting Systems ADMS to ISP ADMS to Other Archives ADMS to Map Update Provider ADMS to Parking Management ADMS to Other Data Source ADMS to Multi-modal Service Provider ADMS to Other Archives ADMS to Toll Administration ADMS to Roadway ADMS to TMC ADMS to TRMS ADMS to Weather Services	National Regional Regional Regional National Regional National National Regional National Regional National Regional Product Regional Regional National	No
AASHTO	1101	NTCIP – STMF	ADMS to Roadway	Product	No
AASHTO	2001	NTCIP – Class B Profile	ADMS to Roadway	Product	No
AASHTO	1201	NTCIP - Global Object Definitions	ADMS to Roadway	Product	No
AASHTO	2101	NTCIP – PMPP/RS232 Subnetwork Profile	ADMS to Roadway	Product	No
AASHTO	1209	NTCIP - Object Definitions for Transportation Sensor Systems (formerly SEN)	ADMS to Roadway	Product	No
AASHTO	1206	NTCIP - Data Collection and Monitoring Devices	ADMS to Roadway	Product	No
AASHTO	2301	NTCIP – STMF Application Profile	ADMS to Roadway	Product	No
AASHTO	1103	NTCIP – STMP	ADMS to Roadway	Product	No
AASHTO	2104	NTCIP - Subnetwork Profile for Ethernet	ADMS to Archived Data User Systems ADMS to Construction and Maintenance ADMS to EMC ADMS to Emissions Management ADMS to Government Reporting Systems ADMS to ISP ADMS to Other Archives ADMS to Map Update Provider ADMS to Parking Management ADMS to Other Data Source ADMS to Multi-modal Service Provider ADMS to Other Archives	National Regional Regional Regional National Regional National National Regional National Regional National	No

Table 4.7 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
			ADMS to Toll Administration ADMS to Roadway ADMS to TMC ADMS to TRMS ADMS to Weather Services	Regional Product Regional Regional National	
AASHTO	2103	NTCIP - Subnetwork Profile for Point-to-Point Protocol Using RS 232	ADMS to Roadway	Product	No
AASHTO	2202	NTCIP - Internet (TCP/IP and UDP/IP) Transport Profiles	ADMS to Archived Data User Systems ADMS to Construction and Maintenance ADMS to EMC ADMS to Emissions Management ADMS to Government Reporting Systems ADMS to ISP ADMS to Other Archives ADMS to Map Update Provider ADMS to Parking Management ADMS to Other Data Source ADMS to Multi-modal Service Provider ADMS to Other Archives ADMS to Toll Administration ADMS to Roadway ADMS to TMC ADMS to TRMS ADMS to Weather Services	National Regional Regional Regional National Regional National National Regional National Regional National Regional Product Regional Regional National	No
ANSI	TS284	Commercial Vehicle Safety Reports	ADMS to Commercial Vehicle Administration	Regional	Yes
ANSI	TS285	Commercial Vehicle Safety and Credentials Information Exchange	ADMS to Commercial Vehicle Administration	Regional	Yes
ITE	TM 1.03	Standard for Functional Level TMDD	ADMS to Construction and Maintenance ADMS to TMC ADMS to Toll Administration ADMS to Weather Services	Regional Regional Regional National	Yes
ITE	TM 2.01	MS/ETMCC	ADMS to Construction and Maintenance ADMS to TMC ADMS to Toll Administration ADMS to Weather Services	Regional Regional Regional National	No
ASTM	AG	ADMS Standard Guidelines	ADMS to Other Centers	Regional	No
ASTM	DD	ADMS Data Dictionary Specifications	ADMS to Other Centers	Regional	No
ITE	1406	TCIP – On-Board Business Area Standard	ADMS to TRMS	Regional	No

Table 4.7 (Continued)

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
ITE	1403	TCIP – Passenger Information Business Area Standard	ADMS to TRMS	Regional	No
ITE	1408	TCIP – Fare Collection Business Area Standard	ADMS to TRMS	Regional	No
ITE	1401	TCIP – Common Public Transportation Business Area Standard	ADMS to TRMS	Regional	No
ITE	1405	TCIP – Spatial Representation Business Area Standard	ADMS to TRMS	Regional	No
ITE	1407	TCIP – Control Center Business Area Standard	ADMS to TRMS	Regional	No
IEEE	P1512 2000 P1512.a	Standard for Common IMMS for use by EMCs Standard for Emergency Management Data Dictionary	ADMS to EMC	Regional	Yes
SAE	J2353	ATIS Data Dictionary	ADMS to ISP	Regional	Yes
SAE	J2354	ATIS Message Set	ADMS to ISP	Regional	Yes

Table 4.8 – ITS Standards Supporting Advanced Vehicles Sector Interfaces

SDO	Standard ID	Standard Title	Supported Interface	Interoperability Type	Critical Standards
SAE	J1760	ITS Data Bus Data Security Services Recommended Practice	Basic Vehicle to Vehicle	Product	No
SAE	J2364	Standard for Navigation and Route Guidance Function Accessibility While Driving	Vehicle to Driver	Product	No
SAE	J2366	ITS Data Bus Protocol - Link Layer Recommended Practice (J2366-2)	Basic Vehicle to Vehicle	Product	No
SAE	J2366/1	ITS Data Bus Protocol – Physical Layer Recommended Practice (J2366-1)	Basic Vehicle to Vehicle	Product	No
SAE	J2366/4	ITS Data Bus Protocol - Thin Transport Layer Recommended Practice	Basic Vehicle to Vehicle	Product	No
SAE	J2366/7	ITS Data Bus Protocol – Application Layer Recommended Practice	Basic Vehicle to Vehicle	Product	No
SAE	J2367	ITS Data Bus Gateway Recommended Practice	Basic Vehicle to Vehicle	Product	No
SAE	J2368	ITS Data Bus Conformance Test Recommended Practice	Basic Vehicle to Vehicle	Product	No
SAE	J2395	ITS In-Vehicle Message Priority	Vehicle to Driver	Product	No
SAE	J2396	Measurement of Driver Visual Behavior Using Video Based Methods (Definition and Measurement)	Vehicle to Driver	Product	No
SAE	J2399	ACC: Operating Characteristics and User Interface	Vehicle to Driver	Product	No
SAE	J2400	Forward Collision Warning: Operating Characteristics and User Interface	Vehicle to Driver	Product	No

5. Standards Classification by Market Sectors

Based on the mapping of ITS standards to architecture flows discussed in previous sections, the ITS standards that support the corridor ITS project deployments were categorized by FIHS corridor ITS market sectors. This classification by market sector, which is presented in Tables 4.1 through 4.8, allows better understanding of ITS standards application requirements and better prioritization of ITS standards deployment. The FIHS corridor ITS deployments can be classified into the following market sectors:

- Traffic Management;
- Electronic Toll and Parking Fee Collection;
- Emergency Management;
- Traveler Information;
- Commercial Vehicles;
- Transit Management;
- Data Archiving; and
- Advanced Vehicles.

5.1 Traffic Management Standards

The traffic management market sector, as defined in this document, includes all FIHS corridor ATMS market packages except those that are related to electronic toll and parking fee collection. Many of the traffic management market packages were selected for early FIHS corridor ITS deployments, as part of the corridor physical architecture development.

Table 4.1 presents the ITS standards that support the traffic management market sector interfaces. These standards can be classified in center-to-center, center-to-roadway equipment, and ATC standards.

Standards that support center-to-center interfaces include NTCIP standards (AASHTO Standards 2303, 1102, 2104, and 2202 in addition to DATEX and CORBA standards) and two ITE standards (ITE Standards TM 1.03 and TM 2.01). NTCIP standards 2303, 1102, 2104, and 2202 also support TMC to roadway equipment interfaces.

The center-to-center communications standards allow traffic information and control sharing. Center-to-center interfaces can use either DATEX or CORBA. DATEX provides a general purpose center-to-center data exchange. CORBA is a general-purpose center-to-center communications protocol based on the CORBA computing industry standards. The advantages and disadvantages of DATEX and CORBA include:

- CORBA requires more bandwidth;
- CORBA is easier to implement in an object oriented system;

- DATEX is easier to implement in a non-object oriented system;
- CORBA is easier to configure and maintain;
- CORBA is a computer industry standard; and
- DATEX has several standard message sets already defined.

The NTCIP standards for DMS have been implemented at three locations in the states of Virginia, Washington, and Illinois. Below is a summary of center-to-center standards implementation:

- **Dallas – Ft. Worth, Texas** – This implementation uses the NTCIP Data Exchange Standard (DATEX, AASHTO Standard 2305), the TMDD (ITE Standard TM 1.03), and the MS/ETMCC (ITS Standard TM 2.01). Interfaces to legacy TMCs are accomplished by converting the data received from the legacy systems to TMDD format.

- **TANSCOM** – This project covers corridors in New York, New Jersey, and Connecticut. It utilizes the TMDD and MS/ETMCC. In addition, there are more than 60 nodes in the architecture that will use the DATEX interface standards.

An example of a CORBA implementation is in the East San Gabriel Valley in California.

It is expected that most ITS services will support DATEX. Even if some systems in the network are object-oriented and use CORBA, they will also support DATEX to allow interfaces with DATEX-only systems. DATEX is more mature than CORBA and is expected to reach an acceptable level of maturity in two to three years. It is currently unknown when CORBA will reach an acceptable maturity level. The *TMC Software Study Draft Report* produced by the Southwest Research Institute (SWRI) for FDOT (October 2001) recommends the use of the Texas' center-to-center implementation (which is based on the DATEX standards). This seems logical, particularly for the short-term deployment, because of the higher maturity of this type of interface. However, it is recommended that the CORBA standards development effort continue to be monitored to determine if that protocol will be suitable for use in the future.

It is anticipated that the ATC and NTCIP center-to-roadway equipment standards will reach an acceptable level of maturity within the next one to four years, depending on the standard under consideration. For example, the DMS NTCIP standards are more mature than other NTCIP standards and are expected to reach an acceptable level of maturity in one to two years. The *TMC Software Study Draft Report* produced by the SWRI for FDOT (October 2001) recommends the use of NTCIP standards for all new device procurements.

5.2 Electronic Toll and Parking Fee Collection Standards

Electronic Toll and Parking Fee Collection Market Packages were implemented primarily for FDOT's Turnpike District facilities and a few additional FDOT facilities. The standards that support these market packages are presented in Table 4.2. These standards include NTCIP standards that support center-to-center communications and DSRC standards for communications between vehicles and toll collection devices. The DSRC standards are critical for national interoperability.

The specifications for the DSRC physical layer using microwave in the 902-928 MHz band (ASTM 111-98 standards) supports both active and backscatter technologies. DSRC Data Link Layer standards (ASTM PS 105-99) support both synchronous and asynchronous modes. The Federal Communications Commission (FCC) recently approved radio spectrum in the 5.9 GHz. Discussions are underway to determine the need for DSRC 5.9 GHz standards.

Toll agencies in Florida should monitor the maturity and deployments of DSRC standards. The agencies should agree on a migration plan for converting to DSRC standards in the future.

5.3 Emergency Management Standards

Emergency management market packages were selected as early deployment market packages. The standards that support these market packages are presented in Table 4.3. These standards include standards that support center-to-center communications, DSRC standards for emergency vehicle to roadway communications (for emergency vehicle signal preemption), and emergency center to personal and in-vehicle mayday devices. The DSRC and mayday standards are critical for national interoperability.

IEEE Standard 1512-2000 addresses the messages communicated among different agencies' emergency management centers (EMCs). A companion volume, the standard for Emergency Management Data Dictionary, will include data concepts from organizations that are active in incident management situations.

The FIHS corridor ITS architectures include the evacuation market package (EM4), which is a new market package not included in the *NITSA*. This market package will be supported by center-to-center ITS standards, as indicated in Table 4.3. The SDO responsible for developing the emergency management standards, the IEEE, should be contacted to determine what modifications are required for the developed standards to accommodate the evacuation market package.

5.4   Traveler Information Standards

Traveler information market packages were selected for early corridor ITS deployments.   The standards that support these market packages are presented in Table 4.4. These standards include standards that support center-to-center communications and standards that support ISP communications with personal traveler information devices, in-vehicle information devices, and kiosks.   The wireless links between the ISPs and their mobile customers are critical for the creation of wide spread usage and acceptance of these devices. The standards that support these links are critical for national interoperability. The ATIS data dictionary and message sets are expected to reach an acceptable maturity level in the next few years.

The SAE's ATIS Standards Committee has begun work on an eXtensible Markup Language (XML)-based version of their traveler information message set standard.   XML will allow automated server-to-server information exchange. FHWA funded an operational test of a multi-jurisdictional ATIS using XML.   The purpose of the test was to demonstrate the utility of integrating traveler information from multiple jurisdictions and to evaluate the draft ATIS vocabulary and message structure standard developed by the SAE ATIS Standards Committee. These standards are SAE J2353 and SAE J2354.   The test was conducted by Mitertek and included the conversion of the ATIS standards to XML.

The ITS and FM broadcasting communities have not been able to agree on a single standard for high-speed FM sub-carriers.   The prolonged debate and lack of resolution of this issue has chilled the market for such systems.

5.5   Commercial Vehicles Standards

The standards that support the corridor CVO market packages are presented in Table 4.5. These standards include standards that support commercial vehicle administration center interfaces with roadside commercial vehicle checking stations, other commercial vehicle administrations, and fleet and freight management.   The standards also include the DSRC standards for communications between the roadside commercial vehicle checking stations and commercial vehicles.

One of the most mature ITS standards is the commercial vehicle applications of DSRC. A rule-making process for this standard started in December 1999.   For the CVO program to be successful, it is essential that commercial vehicles be able to travel from state to state and within a state using DSRC technology for processing at automated inspection stations. The commercial vehicle application of DSRC is a critical standard. The current set of DSRC standards that have been published by ASTM (ASTM PS111-98 and ASTM PS105-99) allow multiple DSRC technologies to exist, thus promulgating the current interoperability dilemma. For this reason, FDOT defined a provisional standard that incorporated portions of the ASTM standards and the IEEE standard (IEEE P-1455) that was backward compatible with all existing CVO installations. The FHWA Notice for Proposed Rule-Making (NPRM) required that this new provisional

standard be used for all new purchases of DSRC devices for commercial vehicle electronic screening when highway trust funds were used for these purchases.

Because of the concerns voiced by the CVO community about proceeding with a rule before equipment designed to meet the provisional standards has been tested to ensure its technical viability, the FHWA has decided to postpone issuing the final rule until that test program is complete.

5.6   Advanced Public Transportation Standards

The standards that support the APTS market packages are presented in Table 4.6.   These standards include NTCIP and TCIP standards that support center-to-center interfaces.   The TCIP standards also support the interfaces between transit management centers and transit vehicles and remote traveler support (e.g., kiosks at transit stations).   The standards also include the DSRC standards for communications between the transit vehicles and roadside equipment (for transit priority) and the SAE ATIS standards for delivering information to transit vehicles, transit stations, and ISPs.

5.7   Data Archiving Standards

The Data Archiving (ADS) market packages were introduced in a revised version of the *NITSA* in September 1999. These market packages were selected for early corridor ITS deployments. One of the features of the data warehousing market packages is the large number of interfaces between the advanced data management centers and other ITS centers.

According to information collected from the Turbo Architecture database of the corridor ITS architecture and other sources, data archiving market packages are supported by NTCIP standards for interfaces between centers and between centers and roadway equipment (as indicated in Table 4.7). Other ITE, IEEE, and SAE standards support center-to-center interfaces.

The data archiving standards are intimately tied to the standards developed for the ITS entities that serve as data sources for advanced data management centers.   The anticipated data archiving standards will include data dictionaries, metadata, standard practices, and message sets/data transfer protocols.   The SDO leading the development of these standards is ASTM. Because the data archiving market packages use data from different sources, data harmonization (reconciliation of differences between ITS data dictionaries) is very important for these market package standards.

5.8 Advanced Vehicles Standards

Advanced Vehicles (AVSS) market packages were not selected for early corridor ITS deployments, although four of these market packages are included in the future ITS big picture. The standards that support these market packages are presented in Table 4.8, based on results from the Turbo Architecture. However, it should be recognized that these market packages and standards are still in the early stages of development. Additions and modifications to the list presented in Table 4.8 are expected between now and the time that these packages will be implemented.

6. Procurement Issues

It is especially critical to follow an orderly procurement procedure when procuring systems that are intended to meet ITS standards. Additional effort is required to ensure an adequate understanding of the intended requirements and assure adherence to the standards and specifications.

Two alternative approaches have been suggested when considering the preparation of procurement documents for systems and devices that are intended to meet ITS standards:

- The first approach is for the agencies to solicit a proposal during the procurement process that allows the manufacturer, vendor, developer, or system integrator to present detailed information on how the system or devices will comply with the standards. This process includes the preparation of general requirements documents during the initial stages of the process. Then, the agency solicits for approval of a proposal from the system developer or integrator that presents detailed information on how compliance with the standards will be achieved.

- The second approach is for the agency to develop detailed standards specifications. This approach requires extensive knowledge of standards and the required functionality.

Both the agency and the system developer or integrator must ensure that there is an adequate understanding of the requirements set forth in the procurement request and that adequate resources are available to implement the standards.

In many cases, the standards may not support all the features supported by the manufacturer's device or software. This is true because ITS standards allow for innovation and do not standardize every feature of every device. If such features are present, then the system developer or integrator will need to determine how these features will be supported without conflicting with the standards implementation.

As stated in Section 3, the ITS standards have not reached maturity. All ITS standards are subject to amendments. Requiring the use of unproved ITS standards can be risky and agencies should work closely with system integrators and developers if they decide on an early implementation of standards. Consideration should be given to what will happen if an amendment to the standards is issued during the life of the project. A basic understanding of requirements for maintenance and subsequent upgrades should be gained and these issues addressed early during the procurement process with the system developer or integrator.

The agency must also consider how the procured devices and software are to be tested and certified as being standards compliant. In general, testing includes three levels: unit testing, integration testing, and systems testing. Upon delivery, the agency should conduct acceptance testing to ensure that the device or software conforms to the procurement requirements and is compliant with the applicable standards. The agency should require that acceptance testing be

covered in the system developer or integrator's proposal. In some cases, the agency may want to include any applicable test plans as part of the procurement documents.

The agencies should recognize that the implementation of standards may require more sophisticated processors or better communications facilities than traditional systems to achieve the same performance level. The agency should also be aware of any additional time required for the development of or modification to software to implement ITS standards.

7.   Legacy System Considerations

The existing corridor ITS deployments are mainly in the ATMS and electronic toll collection (ETC) areas. The *ITS Corridor Implementation Plans* should protect the investment made in the existing legacy systems. This section discusses the effect of ITS standards on legacy systems. The discussion is also applicable to future legacy systems, which includes future corridor ITS that are deployed before applicable standards are adopted.

7.1   Center-to-Center Interfaces

In general, center-to-center communications standards can be implemented in either of two basic ways:

- Keep the center-to-center protocol software separate from the existing transportation management software. This involves a loosely coupled connection between the two software packages, which may make use of an existing data interface available in the TMC. This approach avoids or minimizes the need for changes to the existing software.

- Tightly couple the center-to-center protocol and management software with the existing transportation management software. This involves alteration of the existing software to provide integration. This option provides a more integrated application but may cost more.

The loosely coupled approach might be more cost-effective to connect existing centers with other centers since it makes use of existing software/hardware. However, the tightly coupled approach and its additional benefits can be obtained much more economically when it is provided as part of a new system development or upgrade.

7.2   Center-to-Roadway Interfaces

It may not be feasible to modify existing field devices to make them NTCIP-compatible due to constraints such as computing power, memory availability, and cost of modifications. If these devices are not scheduled for replacement or upgrade, TMCs will probably have to continue communicating with these devices using the existing protocols. However, current devices and software may be capable of modification to be NTCIP-compliant and vendors of these devices should be consulted regarding this issue.

In general, NTCIP and non-NTCIP devices cannot be mixed on the same communications channel. Therefore, all devices sharing a channel must be upgraded simultaneously. A computer that communicates with both NTCIP and non-NTCIP devices will need to use different

communications ports for NTCIP and for non-NTCIP devices and will need to support both protocols.

An approach that has been recommended for migrating to NTCIP-compliant center-to-roadway interfaces is to operate two separate systems during the transition period. One is NTCIP-compliant. The other is non-NTCIP compliant. Field devices can then be switched to NTCIP-compliant as they are replaced or upgraded.

8. Priority Standards

This section identifies the standards that have a high priority for the FIHS corridor ITS deployments. The high priority standards are those standards that support the corridor early deployment ITS market packages, taking into consideration the benefits of these standards and the anticipated maturity levels of the standards in the next few years.

The FIHS corridor ITS architecture early deployments include many center-to-center interfaces. The standards that support these interfaces will allow regional interoperability and facilitation of the sharing of information and control between agencies. Many of these standards are expected to reach an acceptable maturity level in the next few years and should be considered high priority standards. These high priority standards include DATEX NTCIP standards, TMDD, MS/ETMCC, the ATIS data dictionary, the ATIS message set, and incident management standards. The maturity of these standards should be monitored and experience and lessons learned from early implementation of these standards should be carefully examined. Additions to the center-to-center standards will be needed to accommodate the evacuation market package introduced for FIHS corridors.

Support of the CORBA standards should be considered as this standard matures in the future and if the need to implement this standard arises. The maturity level of this standard in the next few years is unknown. Thus, in the near future, the use of the DATEX standards is recommended. The standard development activities that have been initiated to support the data archiving market packages should be closely monitored to determine their effects on the data warehousing projects.

Many of the early corridor market packages are supported by center-to-roadway NTCIP standards. These standards support product interoperability, allowing equipment from multiple vendors to interoperate, reducing lock-in to single vendors and allowing easier upgrades or expansion of systems. These are high priority standards and consideration should be given to the implementation of these standards as they mature. As stated earlier, most of these standards will mature in the next one to four years. NTCIP standards that are expected to reach an acceptable maturity level before other standards do include DMS and weather information system NTCIP standards.

Critical standards that support early deployment market packages should also be considered for implementation when they reach an acceptable maturity level. These include DSRC standards for commercial vehicles, other commercial vehicle standards, DSRC standards for emergency vehicle preemption, mayday reporting interfaces, and standards that support communications between ISPs and mobile information devices. These standards support national interoperability and their deployment will become critical as their deployment around the nation increases. In particular, it appears that the DSRC standards for commercial vehicles are close to reaching an acceptable maturity level and should be considered as high priority standards.

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Appendix A

United States Department of Transportation's
ITS Standards Program

About ITS Standards

ITS standards are industry-consensus standards that define how system components operate within a consistent framework. The framework is known as the *National ITS Architecture*. By specifying how systems and components interconnect, the standards promote interoperability.

To expedite deployment of nationally interoperable ITS and services, the USDOT supports specific ITS standards initiatives, especially in areas that have significant public benefit.

The ITS Standards Program

The USDOT *ITS Standards Program* is working toward the widespread use of standards to encourage the interoperability of ITS services. Through cooperative agreements with five SDOs, the *ITS Standards Program* is accelerating development of about 100 non-proprietary, industry-based, consensus ITS standards, and is encouraging public-sector participation in the development process.

The *ITS Standards Program* is maturing from a primarily standards development program to a standards deployment program by rapidly moving into standards deployment support. Such support includes helping to build credibility in the standards through testing and case studies, providing standards resource information, supporting training and technical assistance to deployers, developing deployment experience-based guidance such as "lessons learned," and assessing the readiness of standards for deployment. In addition, the program is coordinating the U.S. ITS standards efforts with international standardization activities.

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Appendix B

Description of the Corridor ITS Standards

Table B.1 – Descriptions of the Corridor ITS Standards

SDO	Document ID	Standard Title
AASHTO	1207	Specifications for objects that are specific to ramp metering controller operations. (Formerly TS 3. RMC)
AASHTO	1208	Definition of the data needed to control a video switch enabling multiple monitors to view multiple video feeds
AASHTO	2303	A common application profile providing connection-oriented file transfer services.
AASHTO	1204	Definitions of objects that are specific to ESS and object groups that can be used for conference statements. Communications between remote entities and ESS is accomplished by using the NTCIP application layer services to convey requests to access or modify values of ESS objects. (Formerly TS 3.7)
AASHTO	2302	Definition of how to use the Trivial FTP within transportation networks. A common application profile providing connectionless file transfer services. (Formerly TS 3.AP-TFTP-199x)
AASHTO	2304	Fulfills the needed for a communications stack that supports routing, sequencing, and file transfer over point-to-point links, based on (sockets) TCP, IP, and PPP. (Formerly TS 3.AP-DATEX).
	2305	Real-time peer-to-peer exchange (including some remote control/command capability) between TMCs and systems such as traffic operations centers, transit operations centers, EMCs, and traveler information systems. (Formerly TS 3.AP-CORBA).
AASHTO	1102	A set of encoding/decoding rules for preparing data for transmission or decoding data before sending it to the application. Developed as a derivative of the Basic Encoding Rules (BER), as defined in ISO 8825-1. Within the NTCIP suites of protocols, OER is to be used in conjunction with NTCIP-STMF and NTCIP-DATEX ASN. (Formerly TS 3. BP-OER-1999)
AASHTO	1101	A set of rules and protocols for organizing, describing, and exchanging transportation management information between transportation management applications and transportation equipment such that they inter-operate with each other. (Formerly TS 3.2)
AASHTO	2001	A general method of interconnecting ITS field equipment, such as traffic controllers and VMS. Includes the protocol and procedures for establishing communications between those components and the reference common data sets to be used by all such equipment. (Formerly TS 3.3)
AASHTO	1201	Definition of those pieces of data likely to be used in multiple device types, such as actuated signal controllers and DMS. Examples of these data include time, report generation, and scheduling concepts. (Formerly TS 3.4)
AASHTO	1202	Specifications for objects that are specific to actuated signal controllers and definitions of standardized object groups that can be used for conformance statements. (Formerly TS 3.5)
AASHTO	1203	Definition of data specific to DMS, including all types of signs that can change state, such as blank-out signs, changeable message signs (CMS), and VMS. (Formerly TS 3.6)
AASHTO	2101	A set of data link and physical layer protocols applicable to roadside devices. (Formerly TS 3.SP-PMPP232-1998)
AASHTO	1209	Object definitions that are specific to and guide the DATEX content between advanced sensors and other devices in an NTCIP network. Advanced sensors include video-based detection sensors, inductive loop detectors, sonic detectors, infrared detectors, and microwave/radar detectors. (Formerly TS 3.EP-TSS)

Table B.1 (Continued)

SDO	Document ID	Standard Title
AASHTO	1206	Specifies object definitions that may be supported by data collection and monitoring devices, such as roadway loop detectors. (Formerly TS 3. DCM)
AASHTO	2301	A set of application, presentation, and session layer protocols to provide simple information management services. (Formerly TS 3. AP-STMF)
AASHTO	1103	A set of rules and procedures for exchanging information with a minimum of overhead to provide an interoperability standard for transportation-related devices that operate over bandwidth-limited communications links. (Currently part of TS 3.2)
AASHTO	2104	A subnetwork profile that defines requirements for the data link and physical layers of a communications stack. Specifies the rules and procedures for using the IEEE Link Layer Control (802.2) and Media Access Control (802.3) protocols over coaxial, twisted pair, or fiber-optic media. The intent is to provide an interoperability standard for transportation-related devices that communicate over local area network (LAN) interfaces. (Formerly TS 3.SP-Ethernert)
AASHTO	2103	A subnetwork profile that defines requirements for the data link and physical layers of a communications stack. Specifies the rules and procedures for using the point-to-point protocol over RS-232 related circuits. The intent is to provide an interoperability standard for transportation-related devices that communicate over dial-up circuits. (Formerly TS 3.SP-PPP/RS232)
AASHTO	1205	A database for CCTV systems. The format of the database is identical to that of other NTCIP devices and uses ASN.1 representation. Targeted devices include cameras, lenses, video switches, and positioning controls for aiming identification, such as videotext overlays. The standard will support various levels of conformance. (Formerly TS 3.CCTV)
AASHTO	2202	A set of transport and network layer protocols to provide connectionless and connection-oriented transport services. (Formerly TS 3.TP-INTERNET)
ITE	TM 1.03	Data elements for roadway links and for incidents and traffic-disruptive roadway events. Includes data elements for traffic control, ramp metering, traffic modeling, video camera traffic control, parking management, and weather forecasting, as well as data elements related to detectors, actuated signal controllers, vehicle probes, and DMS.
ITE	9603-1	ATC software APIs that support ITS data flows and standards enabling the deployment of ITS functions. The APIs provide a template for API programming for specific functionality associated with equipment and market packages defined by the *NITSA*.
ITE	9603-2	Functional physical design requirements for an ATC cabinet that supports the deployment of multiple ITS functions in a single unit.
ITE	9603-3	Standard for ATC devices to support ITS data flows and standards that enable deployment of ITS. Capable of operating in the ATC cabinet and using the ATC APIs.
ITE	TM 2.01	A message set standard for communications between TMCs and other ITS centers, including ISPs, emergency management systems, mission management systems, and transit management systems.
ITE	1407	Data objects for transit management center functions related to providing, monitoring, and measuring real-time transit revenue service.
ITE	1401	Data objects for standard data types, data elements, and messages shared by

Table B.1 (Continued)

SDO	Document ID	Standard Title
		and common to other transit business areas. Includes general data concepts related to vehicle, equipment, and facility.
ITE	1408	Data objects related to passenger fare collection, including cash, electronic, and non-electronic payments. Also provides output data to the fare media, processing of financial transactions, equipment status, and planning. (Formerly TS3. TCIP-FC)
ITE	1402	Data objects for detecting, verifying, prioritizing, responding to, and clearing unplanned events (accidents, weather conditions, crime, etc.), as well as information for travelers. (Formerly TS 3.TCIP-IM)
ITE	1406	Data elements for on-board transit vehicle applications. Includes all data for communications between on-board components within the vehicle and other transit applications.
ITE	1403	Data objects relating to providing passengers (and potential passengers) with information for planning and making public transportation trips. Includes schedules, fares, on-line services, trip planning, and facility information.
ITE	1404	Data objects related to scheduling and runcutting. Includes requirements for master schedules, trip sheets, run guides, inventory files, etc., as well as output data for garage management, roadside devices, performance history, etc. (Formerly TS 3.TCIP-SCH)
ITE	1405	Data objects for spatial representations to support other TCIP object sets. Allows for the transfer of location of transit objects and includes primitive elements and complex objects.
ITE	TS 3.TM	Data objects relating to traffic conditions, including planned changes in roadways and real-time traffic movement. Based on the ITE Traffic Management Data Dictionary and uses its data elements for data flowing into the transit agency.
ANSI	TS284	This standard covers the electronic exchange of commercial vehicle safety reports, primarily between private and public computer systems and between government-controlled systems. The standards address the format, contents, and codes used to exchange textual reports.
ANSI	TS285	An ADI transaction set to permit enforcement officials, government administrators, and other authorized parties to retrieve electronic information on the safety performance, regulatory compliance, and credentials status of commercial motor vehicles, carriers, and drivers.
ANSI	TS286	An electronic data interchange (EDI) transaction set that can be used by owners, lessees, and drivers of commercial motor vehicles to apply electronically for credentials necessary to operate those vehicles legally. Can also be used by authorizing jurisdictions to transmit credentials data electronically to applicants and other authorized entities.
ASTM	PS111-98	Specification for the radio frequency (RF) characteristics (physical layer) for DSRC operating in the range of 902-928 MHz. Supports both active and backscatter transponders.
ASTM	PS105-99	This standard defines layer two (data-link layer) of the open systems interconnection (OSI) reference model for DSRC equipment. It provides requirements for the communications medium to be used for the exchange of information between roadside equipment and on-board equipment.
EIA/CEA	EIA-794	Specification of the DARC FM subcarrier waveform for the delivery of traveler information, messages, and data services to mobile, portable, and fixed receivers.

Table B.1 (Continued)

SDO	Document ID	Standard Title
EIA/CEA	EIA-795	A flexible waveform defined for the physical and data link layers for delivery of data to mobile and fixed users using a subcarrier on a broadcast FM station. Supports ATIS message sets (SAE J2369); differential global positioning system (GPS) message sets defined by Radio Technical Commission for Maritime Services Special Committee No. 104; emergency alert system messages defined by the Code of Federal Regulations (CFR) Title 47, Part 11; and retransmission of Radio Broadcast Data System Data.
IEEE	1512	This standard is part of a family of related standards that address the communications needs of emergency and traffic management agencies that are involved in highway incident management who need to exchange information with each other. The standard describes a set of basic messages that allows the exchange of data for information and coordination during the processing of an incident.
IEEE	1455	Standard messages for commercial vehicle, electronic toll, and traffic management applications.
SAE	J1760	Specification of data security requirements between devices on the ITS data bas (IDB) and definitions of device-and message-level security. Also includes a mechanism to discourage theft of data bus modules.
SAE	J1746	A referencing format for ISP-to-vehicle and vehicle-to-ISP references. Will reflect the cross-streets profile of the current location reference message specification (LRMS) document as expressed in the national Location Referencing Information Report. (SAE J2374.)
SAE	J2256	Definition of the form and content of the messages sent between a TMC or ISP and vehicles, including traffic information, emergency services, and route guidance information
SAE	J2313	A general specification prescribing protocol methods that enable vendors with different communications methods to communicate with response agencies in a standard format.
SAE	J2353	A minimum set of medium-independent data elements needed by potential ISPs to deploy ATIS services and provide the basis for future interoperability of ATIS devices.
SAE	J2354	A basic message set using the data elements from the ATIS Data Dictionary needed by potential ISPs to deploy ATIS services and to provide the basis for future interoperability of ATIS devices.
SAE	J2364	Guidelines to help ensure case of learning and ease of use in navigation and route guidance systems and to minimize the visual and cognitive demands associated with the use of these systems.
SAE	2366/2	Requirements for the link layer of the Open Systems Interconnection (OSI) model for the IDB.
SAE	J2366/1	A physical interface device (connector) that will ensure compatibility between vehicles and after-market devices. Includes physical interface performance requirements, circuit identification and configuration, and electrical requirements for the physical layer of the IDB.
SAE	J2366/4	Requirements for the thin transport layer (layer 4 of the OSI model) for the IDB.
SAE	J2366/7	Requirements for the application layer of the OSI model for the IDB.
SAE	J2367	Requirements for the interface between the ITS on the IDB and the vehicle, specifically what vehicle information will be made available to the IDB.

Table B.1 (Continued)

SDO	Document ID	Standard Title
SAE	J2369	A general framework allowing transmission of traveler information via bandwidth reduced media, such as those found in wireless applications. Creates a uniform coding and message structure for link travel times, incident text, weather, and transit for broadcast delivery.
SAE	J2374	A basis for location referencing standardization activities by various application communities and SDOs.
SAE	J2395	Specification of orderly temporal and spatial presentation of ITS information to the driver.
SAE	J2396	Particular system in terms of visual demand. Helps ensure that systems minimize the time a driver's eyes are off the road.
SAE	J2399	Minimum requirements for safety-related elements of the operating characteristics and user interface of vehicles equipped with ACC. Also coordinates the operating characteristics and user interface with collision warning and avoidance, along with other driver systems.
SAE	J2540	This standard is intended to provide information on how textual strings are processed in messages. Such strings typically describe incident events, street or place names, and other textual information. Messages in related SAE ATIS standards can also utilize this format for all textual strings that appear in the message.