Connected Vehicle Data Capture and Management (DCM) and Dynamic Mobility Applications (DMA)

Focused Standards Coordination Plan

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16. Abstract

The Connected Vehicle Mobility Standards Coordination Plan project links activities in three programs (Data Capture and Management, Dynamic Mobility Applications, and ITS Standards). The plan coordinates the timing, intent and relationship of activities planned over the five-year period in these three programs. The plan shall assist all three programs to identify the appropriate scope of individual program project activity to maximize complementary activity and to ensure that programs are not pursuing duplicative, uncoordinated or contradictory efforts.

This document, the Focused Standards Coordination Plan, fulfills Task 4 of the project. This document is the last of three documents for this project and performs the following activities:

- Reviews the relevant standards to each of the applicable DCM and DMA programs
- Presents if there are any gaps in the applicable standards, or if a new standard is suggested
- Provides a focused Standards Coordination Plan summary
- Provides a proposed action plan which includes a description of activities, milestones, and a schedule. This action plan will provide the project managers for the selected applications activities to better coordinate their standards and ensure that the gaps in those standards are addressed.

17. Key Words Connected Vehicle, DCM, DMA, ITS Standards, standards coordination plan, focused standards coordination plan	**18. Distribution Statement**		
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1 Introduction

The United States Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office initiated the Real-Time Data Capture and Management (DCM) Program to assess the potential of a multi-source active acquisition data paradigm to enhance current operational practices and transform future transportation systems management. The key concept of the DCM program is the development of data environments which support the collection, management, integration and application of real-time transportation data. The objectives of the program are to enable systematic data capture from connected vehicles, mobile devices and infrastructure, to develop data environments that enable integration of data from multiple sources, to reduce costs of data management and to determine the required infrastructure for transformative applications implementation.

Likewise, the Dynamic Mobility Applications (DMA) Program was initiated to create, test, and demonstrate innovative mobility applications exploiting frequently collected and rapidly disseminated multi-source data drawn from connected travelers, vehicles, and the infrastructure. The DMAs focus on vehicle-infrastructure connectivity using Dedicated Short Range Communications (DSRC) and other wireless communications methods. The objective of the DMA program is to develop open source applications that use multi-source ITS data to transform surface transportation management and information.

There are hundreds of standards used across the transportation industry. Another USDOT program, the ITS Standards Program, oversees the development of ITS standards by working with state and local transportation agencies, non-profit organizations, and private industry to develop strategies for standards-based ITS deployments and by providing outreach, education and training to facilitate the use of ITS Standards. *ITS standards* are open-interface standards that define how ITS systems, products, and components can interconnect, exchange information and interact to deliver services within a transportation network.

Transportation-related standards defining the communications between vehicle-to-vehicle, vehicle-to-roadside, vehicle-to-center, roadside-to-center, and center-to-center have been developed in the U.S. and worldwide to address the need to provide communications between these entities. While some of these standards were developed to address vendor- or manufacturer-specific needs and are proprietary, most of the standards, or suites of standards, were developed as open standards. However, many of these standards may not address the needs of the DCM or DMA programs because the Connected Vehicle Initiative is relatively new.

The Connected Vehicle Data DCM-DMA Standards Coordination Plan project has produced three documents to address the coordination of standards. The first was the high level Standards Coordination Plan which was developed to coordinate the standards-related activities of the DCM, DMA and the broader ITS Standards programs. The Standards Coordination Plan will aid the USDOT in building on the existing standards and determining if any additional standards or any expansions to existing standards will be needed for the Connected Vehicle Initiative to be successful.

The second document, the Assessment of Relevant Standards Gaps for Candidate Applications, details the assessment of the relevant standards for candidate DCM/DMA applications and the identification of any gaps in the standards.

This final document is the Focused Standards Coordination Plan which targets a set of applications assigned for further development and/or testing in Phase 2 of the program. The focused SCP centers on specific opportunities, decision points and milestones associated with standards related to the selected Phase 2 applications.

The scope, the approach, and document overview of the Focused Standards Coordination Plan are discussed in the following sections.

1.1 Scope

This document fulfills Task 4 of this project: to develop a Focused Standards Coordination Plan for a set of DCM/DMA applications. Table 1-1 lists the applications which are addressed in this document. See Section 4.1 of the DCM-DMA Gap Analysis Report for a full overview of the application bundles and their functions.

Table 1-1. Focused Standards Coordination Plan Applications

Bundle	Application	Status
M-ISIG	I-SIG	Funded, active
	TSP	Funded, active
	PED-SIG	Funded, active
	PREEMPT	Funded by Pooled Fund (See Note 3)
	FSP	Funded by Pooled Fund
INFLO	SPD-HARM	Funded, active
	CACC	Funded, active
	Q-WARN	Funded, active
EnableATIS	ATIS	See Note 1 below
	T-MAP	See Note 1 below
	S-PARK	See Note 1 below
	WX-INFO	See Note 1 below
R.E.S.C.U.M.E.	INC-ZONE	See Note 2 below
	RESP-STG	See Note 2 below
	MAYDAY	See Note 2 below
IDTO	T-CONNECT	Funded, active
	T-DISP	Funded, active
	D-RIDE	Funded, active

Bundle	Application	Status
FRATIS	Freight Dynamic Travel Planning	Funded, active
	Drayage Operations Optimization	Funded, active
Weather	VDT	Unknown
	Freight	Unknown
	Weather Traveler Information	Unknown
	EMS	Unknown
Data Capture Management	Data Capture Functionality/Application	Funded, active
Smart Roadside	Smart Roadside	Unknown

Note 1: The ATIS applications are not being pursued or developed as individual applications, but the data communication requirements necessary to provide those functions are appropriate for Task 4.

Note 2: Jointly funded by DMA and Public Safety programs.

Note 3: :The Cooperative Transportation Sysem Pooled Fund is a FHWA-sponsored research program jointly funded by various federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms that seek to combine resources to achieve common research goals.

1.2 Approach

Several steps were taken to develop the Focused Standards Coordination Plan (SCP). Applicable standards and existing standards gaps identified in Task 3 of this project are reviewed. Also reviewed is a discussion on potential new standards identified in Task 3 of this project. Next, the Standards Coordination Plan considerations are explored, along with a summary of the Focused SCP assessment. The final section presents the proposed action plan activities, milestones and proposed schedule for addressing each item identified in Section 3 of this document.

1.3 Document Purpose and Overview

The purpose of this document is to provide an action plan for the project managers of the applications selected for this Focused SCP. The action plan details the steps required to assist the project managers in coordinating the standards-related activities for each application, as well as filling in the gaps identified. This document is presented with the following sections:

- **Section 2, Background on Standards Gaps:** provides relevant background information related to the Assessment of Relevant Standards and Gaps for Candidate Applications.
- **Section 3, DMA Application Standards Considerations and Assessment:** addresses considerations related to the final DMA Standards Coordination activities.
- **Section 4, Focused Action Plan Activities:** presents the action plan activities, milestones, as well as the proposed schedule.

- **Section 5, References:** contains the document references
- **Appendix A:** contains a glossary of terms

2 Background on Standards Gaps

In this section, relevant background information is provided related to the Assessment of Relevant Standards and Gaps for Candidate Applications. This discussion includes a listing of the applicable standards for each application, as well as those standards where gaps have been identified, and new standards are being suggested.

2.1 Applicable Standards and Standards Gaps

During Task 3 of this project, a detailed assessment was conducted to determine any gaps in the standards. Table 2-1 identifies all applicable standards for the candidate DCM-DMA applications, as well as areas of gaps in the standards. In Table 2-1, an "X" in the cell indicates that a standard applies to the application or environment, but no specific gap has been identified associated with this application or environment. If a "G" has been entered, the standard applies and a gap has been identified. Section 4 of this document revisits the specific gaps in more detail.

Table 2-1. ITS Standards Applicable to DCM and DMA[1]

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
AASHTO/ITE																			
ITE TMDD v 3.0	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC). This standard contains data elements for roadway links and for incidents and traffic-disruptive roadway events. The standard includes data elements for traffic control, ramp metering, traffic modeling, video camera control traffic, parking management and weather forecasting, as well as data elements related to detectors, actuated signal controllers, vehicle probes, and dynamic message signs. The standard also contains the message sets for communication between traffic management centers and other ITS centers, including information service providers, emergency management systems, missions management systems, and transit management systems.	G	G	G	X	G	G	G	G	G	X	X	X	X	G	X	X	X	P
ITE TMDD v 3.02	Message Sets for External TMC Communication (MS/ETMCC). A message set standard for communication between traffic management centers and other ITS centers, including information service providers, emergency management systems, missions management systems, and transit management systems.	G	G	G	X	G	G	G	G	G	X	X	X	X	G	X	X	X	D
AASHTO/ITE/NEMA																			
NTCIP 1103 v2	Transportation Management Protocols (TMP). Specifies 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.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P

[1] X = Standard applies to the application or environment; G = Standard applies to the application or environment and a gap in the standard has been identified

[2] P: published; A: approved; B: in ballot; D: in development

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
NTCIP 1103 v 3	Transportation Management Protocols (TMP). Specifies 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. This standard further defines trap management used to report the occurrence of defined events.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	D
NTCIP 1104	Center-to-Center Naming Convention Specification. Defines the standard mechanism to name entities within CORBA systems. CORBA is a distributed processor system, where information needed by one processor could be actually stored on some other computer, or several computers. To enable finding the required information, a common naming convention is required and used.																		P
NTCIP 1201 v3	Global Object Definitions. This document defines those pieces of data that are likely to be used in multiple device types such as actuated signal controllers and dynamic message signs. Examples of this data include time, report generation, scheduling concepts, etc						X	X	X			X							P
NTCIP 1202 v2	Object Definitions for Actuated Traffic Signal Controller (ASC) Units. Specifications for objects that are specific to actuated signal controllers and definitions of standardized object groups that can be used for conformance statements.				X		G	X				X							P
NTCIP 1203 v3	Object Definitions for Dynamic Message Signs (DMS). Defines data that is specific to dynamic message signs including all types of signs that can change state, such as blank-out signs, changeable signs, and variable signs.				X			X	X			X							A

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
NTCIP 1204 v3	Object Definitions for Environmental Sensor Stations (ESS). Definitions of objects that are specific to environmental sensor stations (ESS) and object groups which can be used for conformance statements. The communication 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.	X	X	X		X		X	X	X		X			X	X	X	X	P
NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control. A database for closed circuit television systems. The format of the database is identical to other NTCIP devices and uses ASN.1 representation. Targeted devices include cameras, lenses, video switches, and positioning controls for aiming and identification, such as video text overlays. The standard will support various levels of conformance.	X	X		X							X							P
NTCIP 1206	Object Definitions for Data Collection and Monitoring (DCM) Devices. Specifies object definitions that may be supported by data collection and monitoring devices, such as roadway loop detectors.	X	X		X		G	X				X		X					P
NTCIP 1207 v2	Object Definitions for Ramp Meter Control (RMC) Units. This standard deals with the data required to control and monitor a ramp meter.				X			X				X							P
NTCIP 1209 v2	Data Element Definitions for Transportation Sensor Systems (TSS). Object definitions that are specific to and guide the data exchange 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.	X	X		X		G	X				X							A

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
NTCIP 1211 v2	Object Definitions for Signal Control and Prioritization (SCP). Defines the management information base for Signal Control and Prioritization (SCP) Systems. It defines individual parameters that represent the configuration, status, and control information that is unique to an SCP and also defines specific groupings of these parameters and others to address the operational configuration, monitoring, and control of the device/entity in a baseline system configuration.	X			X		X	X				X	X						D
NTCIP 2202	Internet (TCP/IP and UDP/IP) Transport Profile. A set of transport and network layer protocols to provide connectionless and connection-oriented transport services.	X	X	X	X	X	X	X		X	X		X						P
NTCIP 2302	Trivial File Transfer Protocol (TFTP) Application Profile. Defines how to use the Trivial File Transfer Protocol within transportation networks. A common application profile providing connectionless file transfer services.			X						X	X								P
NTCIP 2303	File Transfer Protocol (FTP) Application Profile. A common application profile providing connection-oriented file transfer services.			X	X				X	X	X		X						P
NTCIP 2304	Application Profile for DATEX-ASN (AP-DATEX). Fulfills the need for a communications stack that supports routing, sequencing, and file transfer over point-to-point links, based on (sockets) TCP, IP, and PPP.		X		X				X			X							P
NTCIP 2306	Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML). This standard allows transportation agencies and center managers the ability to specify and implement communications interfaces for transmitting information encoded in the Extensible Markup Language (XML) between their center and an external center.	G	G	G	X	X	G	G	G	G	X	X	X	G	X	X	X	X	P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters. This document will define the objects necessary to manage a field master. A field management station would be used to implement a polling scheme whereby the field management station could be programmed by a central controller (or other management stations) to poll its agents. These agents could be Actuated Signal Controllers, Ramp Meters, Dynamic Message Signs, or other NTCIP conformant equipment.	X			X		G					X							D
ANSI																			
ANSI TS284	Commercial Vehicle Safety Reports. An electronic data interchange (EDI) transaction set to allow authorized parties to electronically request and send reports on information related to the safe operation of commercial road vehicles, such as inspection reports, safety and compliance review reports, and hazardous material incident		X	X							X			X					P
ANSI TS285	Commercial Vehicle Safety and Credentials Information Exchange. An electronic data interchange (EDI) transaction set to permit enforcement officials, government administrators and other authorized parties to retrieve information electronically on the safety performance, regulatory compliance, and credentials status of commercial motor vehicles, carriers, and drivers		X	X							X			X					P
ANSI TS286	Commercial Vehicle Credentials. An electronic data interchange (EDI) transaction set that can be used by owners, leasers, and drivers of commercial motor vehicles to apply electronically for credentials necessary to legally operate those vehicles, and by authorizing jurisdictions to electronically transmit credential data to applicants and other authorized entities.		X	X							X			X					P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
APTA																			
APTA TCIP-S-001v3.04	Standard for Transit Communications Interface Profiles. Its primary purpose is to define standardized mechanisms for the exchange of information in the form of data among transit business systems, subsystems, components and devices. The standardization of these interfaces is intended to reduce the cost of future procurements of transit computer based systems, and to facilitate a greater degree of automation and integration of those systems.	X			X		G					X	G						P
ASTM																			
ASTM E2213-03	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications. This standard describes a medium access control layer and physical layer specification for wireless connectivity using dedicated short range communications services.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P
ASTM E2259-03	Standard Guide for Archiving and Retrieving ITS-Generated Data. This guide covers desired approaches to be considered and followed in planning, developing, and operating specific ADMS for the archiving and retrieval of ITS-generated data.	X	X	X	X	G	X	X	X	X	X	X	X	X	X	X	X	X	P
ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems. Specifies how to annotate data for subsequent uses.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P
ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data. Specifies a data dictionary for archiving traffic data.	X	X	X	X	X	G	G	G	X	X	X	X	G	G	X	X	X	P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
IEEE																			
IEEE 1512-2006	Standard for Common Incident Management Message Sets for use by Emergency Management Centers. Standards describing the form and content of the incident management messages sets for emergency management systems (EMS) to traffic management systems (TMS) and from emergency management systems to the emergency telephone system (ETS) or (E911).	G	G	G	X			G	G	X		X							P
IEEE 1512.1-2006	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers. Enables consistent standardized communications among Incident Management centers, fleet and freight management centers, information service providers, emergency management centers, planning subsystems, traffic management centers and transit management centers.	G	G	G	X			G	G	X		X							P
IEEE 1512.2-2004	Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers. A comprehensive set of messages required for incident management that is unique to public safety communications. These message sets will be generated and transmitted among the emergency management subsystem to all the other subsystems and public safety providers.	G	G	G	X			G	G	X		X							P
IEEE 1512.3-2006	Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers. Enables consistent standardized communications among incident management centers, HAZMAT teams, police, local government, fire, special emergency and emergency management centers.	G	G	G	X			G	G	X		X							P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
IEEE P1512.4	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers. This standard will address Traffic Incident Management Message Sets which will be exchanged by and between mobile data terminals in response vehicles including mobile command posts and to their respective response and/or dispatch centers such that the exchange of information will be standard and produce the needed response(s). This standard will be limited to common message sets for use by emergency management including transportation, fire/rescue, enforcement, HazMat, etc.		G						G										B
IEEE 1570-2002	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection. This standard defines the logical and physical interfaces, and the performance attributes for the interface between the rail subsystem and the highway subsystem at a highway rail intersection.				X						X								P
IEEE P1609.0	Standard for Wireless Access in Vehicular Environments (WAVE) – Architecture. This standard describes the Wireless Access in Vehicular Environments (WAVE/DSRC) architecture and services necessary for multi-channel DSRC/WAVE devices to communicate in a mobile vehicular environment. The purpose of this standard is to describe the architecture of the DSRC/WAVE operations currently represented by the family of IEEE 1609 standards and IEEE P802.11p.						X	X	X		X			X	X	X	X	X	D
IEEE 1609.1-2006	Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager. This standard describes a resource manager that arbitrates requests for transponder usage.						X	X	X		X			X	X	X	X	X	P

		Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
Standard	Description	Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
IEEE 1609.2-2006	Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages. Secure message formats, and the processing of those secure messages, within the DSRC/WAVE system are defined. The standard covers methods for securing WAVE management messages and application messages, with the exception of vehicle-originating safety messages. It also describes administrative functions necessary to support the core security functions						X	X	X		X			X	X	X	X	X	P
IEEE 1609.3	Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services. Describes standard that supports higher layer communication stacks, including TCP/IP.						X	X	X		X			X	X	X	X	X	P
IEEE 1609.4-2010	Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation. Describes various standard message formats for DSRC applications at 5.9 GHz.					X	X	X	X		X			X	X	X	X	X	P
IEEE 802.11-2012	Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks IEEE 802.11 is a set of standards for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6 and 5 GHz frequency bands. They are created and maintained by the IEEE LAN/MAN Standards Committee (IEEE 802.). This revision specifies technical corrections and clarifications to IEEE Std 802.11 for wireless local area networks (WLANS) as well as enhancements to the existing medium access control (MAC) and physical layer (PHY) functions. It also incorporates Amendments 1 to 10 published in 2008 to 2011. IEEE 802.11p has been rolled up into 802.11-2012.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	B

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
NEMA/AASHTO/ITE																			
ITE ATC Controller 5.2	Advanced Transportation Controller (ATC). Standard for advanced transportation controller (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 application program interfaces.						G												P
SAE																			
SAE J1663	Truth-in-Labeling Standard for Navigation Map Databases. This standard defines consistent terminology, metrics, and tests for describing the content and quality of navigable map databases. (This standard does NOT specify the physical format of the database or minimum performance standards.) The focus of this document is to support the navigation applications that automotive manufacturers and suppliers are currently developing for marketplace delivery.	X	X	X	X			X		X	X	X							P
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications. Defines a recommended practice for implementing a bi-directional, serial communication link among modules containing microcomputers. Defines those parameters of the serial link that relate primarily to hardware and basic software compatibility such as interface requirements, system protocol, and message format.										X			X					P
SAE J1746	ISP-Vehicle Location Referencing Standard. A referencing format for information service provider (ISP)-to-vehicle and vehicle-to-ISP references. This standard 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).	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
SAE J1757	Standard Metrology for Vehicular Displays. The scope of this SAE Standard is to provide methods to determine display optical performance in all typical automotive ambient light illumination - with focus on High Ambient Contrast Ratio, which is critical for display legibility in a sunshine environment. It covers indoor measurements and simulated outdoor lighting. It is not the scope of this document to set threshold values for automotive compliance, however some recommended values are presented for reference.						X	X	X		X	X	X	X	X	X	X	X	P
SAE J1760	ITS Data Bus Data Security Services. Specifies definition of data security requirements between devices on the ITS data bus (IDB) and definitions of device and message level security. Also includes a mechanism to discourage theft of data bus modules.						X	X	X	X	X	X	X	X	X	X	X	X	P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
SAE J2266	Location Referencing Message Specification (LRMS). The Location Referencing Message Specification (LRMS) standardizes location referencing for ITS applications that require the communication of spatial data references between databases. ITS databases may reside in central sites, vehicles, or devices on or off roads or other transportation links. The LRMS is applicable to both homogeneous (same database) and mixed database environments that may be implemented on wireless or landline networks. While developed for ITS applications, the LRMS may be used for non-ITS applications as well within the field of geographic information processing.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P
SAE J2313	On-Board Land Vehicle Mayday Reporting Interface. A general specification that prescribes protocol methods which enable vendors with different communication methods to communicate with response agencies in a standard format.		X						X										P
SAE J2354	Message Set for Advanced Traveler Information System (ATIS). A basic message set using the data elements from the ATIS data dictionary needed by potential information service providers to deploy ATIS services and to provide the basis for future interoperability of ATIS devices.			X				G	G	G	G		G		G		X		P
SAE J2365	Calculation of the Time to Complete In-Vehicle Navigation and Route Guidance Tasks. Guidelines for the implementation of specific man-machine interface transactions and classes of transactions.				X								X						P

		Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
Standard	Description	Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
SAE J2366/1	ITS Data Bus - IDB-C Physical Layer. A physical interface device (connector) that will ensure compatibility between vehicles and aftermarket devices. Physical interface performance requirements, circuit identification and configuration, and electrical requirements for the physical						X	X	X		X		X	X	X	X	X	X	P
SAE J2366/1L	ITS Data Bus - Low Impedance Stereo Audio. This SAE Recommended Practice describes the Low Impedance Stereo Audio (LISA) bus, which may be used in conjunction with the Physical Layer of the IDB-C, as described in SAE J2366-1. The audio arbitration messages used to control access to the LISA bus are specified in SAE J2366-7. The IDB-C is a non-proprietary virtual token passing bus, designed to allow disparate consumer, vehicle, and commercial electronic components to communicate and share information.						X	X	X		X		X	X	X	X	X	X	P
SAE J2366/2	ITS Data Bus - Link Layer. Requirements for the link layer (layer 7 of the OSI model) for the ITS data bus. Requirements for the link layer (layer 7 of the OSI model) for the ITS data bus.						X	X	X		x	x	X	X	X	X	X	X	P
SAE J2366/4	ITS Data Bus - Thin Transport Layer. Requirements for the thin transport layer (Layer 4 of the OSI model) for the ITS data bus. Requirements for the thin transport layer (Layer 4 of the OSI model) for the ITS data bus						X	X	X		X	X	X	X	X	X	X	X	P
SAE J2366/7	ITS Data Bus - Application Message Layer. Requirements for the application layer (layer 7 of the OSI model) for the ITS data bus. Requirements for the application layer (layer 7 of the OSI model) for the ITS data bus.						X	X	X		X	X		X	X	X	X	X	P

Standard	Description	Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
		Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
SAE J2369	Standard for ATIS Message Sets Delivered Over Reduced Bandwidth Media. A flexible waveform defined for the physical and data link layers for delivery of data to mobile and fixed users using a sub-carrier on a broadcast FM station. It supports: ATIS message sets (SAE J2369); differential GPS message sets defined by Radio Technical Commission for Maritime Services Special Committee No. 104; emergency alert system messages defined by CFR Title 47, Part 11; and Retransmission of Radio Broadcast Data System data.								X	X	X								P
SAE J2395	ITS In-Vehicle Message Priority. Specifies orderly temporal and spatial presentation of ITS information to the driver.						G	G	G		X	X		X	G	X	X	X	P
SAE J2399	Adaptive Cruise Control (ACC) Operating Characteristics and User Interface. This standard presents the minimum requirements for safety-related elements of the operating characteristics and user interface of vehicles equipped with adaptive cruise control (ACC). It also coordinates the operating characteristics and user interface with collision warning and avoidance, along with other driver systems.	X	X					G											P
SAE J2400	Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements							G											P
SAE J2540	Messages for Handling Strings and Look-Up Tables in ATIS Standards. Describes the process used in various SAE ATIS message set standards to deliver textual strings and provides national tables used in the delivery of incident description.			X						X	X								P

		Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
Standard	Description	Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
SAE J2540/1	RDS (Radio Data System) Phrase Lists. This SAE Standard provides a table of textual messages meeting the requirements for expressing "Radio Data Systems" (RDS) phrases commonly used in the ITS industry. They can be used both over the RDS subcarrier transmission media as part of a 37-bit long "Group 8a message" as well as being used to provide a common content list of phrases used in a wide number of other media and applications.						X	X	X	X	X	X	X	X	X	X	X	X	P
SAE J2540/2	ITIS (International Traveler Information Systems) Phrase Lists. This SAE Standard provides a table of textual messages meeting the requirements for expressing "International Traveler Information Systems" (ITIS) phrases commonly used in the ITS industry. The tables provided herein follow the rules of SAE J2540 and therefore allow a local representation in various different languages, media expressions etc., to allow true international use of these phrases. The phrases are predominantly intended for use in the description of traffic related events of interest to travelers and other traffic practitioners.		X	X					X	X	X	X	X						P
SAE J2540/3	National Names Phrase List. This SAE Standard provides a table of textual messages meeting the requirements for expressing the names of street and roads and some basic building blocks for phrases commonly used in the ITS industry.	X	X	X	X			X	X	X	X	X	X						P
SAE J2630	Converting ATIS Message Standards from ASN.1 to XML. This SAE Standard presents a set of rules for transforming an Abstract Syntax Notation (ASN.1) message set definition into an Extensible Markup Language (XML) schema. The result is intended to be a stand-alone XML Schema that is fully consistent with an existing ASN.1 information model.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P

			Applicable DCM Data Environments					Applicable DMA Application Bundles								Weather Bundles				Status
	Standard	Description	Arterial	Freeway	Regional	Corridor	Weather	M-ISIG	INFLO	R.E.S.C.U.M.E.	Enable ATIS	FRATIS	ICM	IDTO	Smart Roadside	VDT	Freight	Traveler Info	EMS	P, A, B, D[2]
	SAE J2735 v2009-11	Dedicated Short Range Communications (DSRC) Message Set Dictionary. This standard will assure that DSRC applications will be interoperable. Applications such as collision avoidance, emergency vehicle warnings, and signage require this standard before they can be effective.	X	X	X	X	X	G	G	G	G	G	X	G	G	G	G	G	G	P
	SAE J2735 SE	Dedicated Short Range Communications (DSRC) Message Set Dictionary. This standard will assure that DSRC applications will be interoperable. Applications such as collision avoidance, emergency vehicle warnings, and signage require this standard before they can be effective. The SE version has applied the System Engineering Process.	X	X	X	X	X	G	G	G	G	G	X	G	G	X	X	X	X	D

2.2 New Standards

The assessment conducted in Task 3 also identified areas where there could potentially be a new standard. Two such potential new standards were identified and are described below.

Connected Vehicle Performance Measures
Performance measures are essential to the Connected Vehicle program. While there do exist individual performance measures within currently existing standards, the vastness of the Connected Vehicle program warrants an assessment at a higher, more encompassing level. For each of the DMAs, performance goals, performance measures, and transformative performance targets have been or are being identified associated with how connected vehicle applications can dramatically change transportation system performance, some rather extensively. The role of this standard will be to frame which performance measurement data is gathered, how performance measurement is performed and most importantly, that the right performance measurement functions are taking place. As an example, INFLO has identified the following parameters should be measured to assess if this application is being transformative and is meeting the specified transformative targets:

- Number of Shockwaves formed
- Length of shockwaves
- Propagation speed of shockwaves
- Recommended Vehicle Speeds
- Level of Speed Compliance
- Speed Variability
- Average travel Times
- Travel Time Reliability
- Number of Primary and Secondary Crashes
- Severity of Crashes
- Emissions levels
- Consumed Energy
- Public Opinion Ratings
- Speed Harmonization System Costs

In turn, it would be beneficial to have a standard that specifies that this data is collected and how it is reported. The ASM would be the most likely candidate to investigate creating this potential new standard.

Connected Vehicle Application Updates
In-vehicle applications are a key component of the Connected Vehicle program. As with any system, there will be a need for updates or patches to be made to the system over time. There are currently no standards that address how the updates will be applied. The following are some considerations that need to be assessed for a potential new standard:

- Types of updates
- How to apply the updates
- When to apply the updates
- Who can apply the update
- Other factors such as backwards compatibility

The SAE would be the most likely candidate to investigate creating this potential new standard.

3 DMA Application Standards Considerations and Assessment

During Task 2 of this project, an assessment of standards considerations was discussed. These are highlighted here again.

3.1 Discussion of the Core System Concept and the Safety Pilot Program

While not part of the Connected Vehicle initiative's DCM program, two of the most important developments affecting the DCM program and its data environment concept are the Systems Engineering (SE) project for the Core Systems and the Safety Pilot Program. The following sections briefly discuss these initiatives.

3.1.1 Core Systems

The Core System concept is focused on the delivery of services that will be used to support Connected Vehicle initiative's Safety, Mobility, and Environmental applications. Services to be provided by the Core System concept are proposed to include data protection, authorization management and verification, time base definition, data request, data provision and data forwarding, network services support, geographic broadcast, communications status, core system integrity, core system independence (but also core system interdependence), as well as core system interoperability to name the most important services. The descriptions and definitions of these and all other services are contained in the Core Systems SE Concept of Operations document under the 'Core System Needs' section.

The USDOT initiated the Core Systems SE project to define the Concept of Operations, requirements, and architecture for the Connected Vehicle's core system that will enable the safety, mobility, and environmental applications including the exchange of data between mobile and fixed transportation users. The SE project has developed a Concept of Operations document[3], which defines the combination of applications, services and systems needed to enable the objectives of the Connected Vehicle initiative. The Concept of Operations, Architecture[4] and Functional Requirements[5] have also been finalized.

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[3] Core System – Concept of Operations (ConOps), Revision E2 dated October 24, 2011, Lockheed Martin, project number DTFH61-10-F-00045

[4] Core System - System Architecture Document (SAD); dated October 14, 2011; prepared by Lockheed Martin/Iteris, document project number DTFH61-10-F-00045

[5] Core System Requirement Specification (SyRS); dated October 28, 2011; prepared by Lockheed Martin/Iteris, document project number DTFH61-10-F-00045

The following list, generated by stakeholders tasked with deploying, maintaining, and operating Core Systems and their applications, describes the characteristics that a Core System must demonstrate.

- Flexibility: The Core System design must be able to adapt to external change without requiring redesign.
- Extensibility: The Core System implementation must take future growth into consideration. Extensions may be achieved by adding new functionality or by modifying functionality that exists at the time extension is required.
- Scalability: The Core System must be able to handle growing amounts of work in a graceful manner or to be enlarged to handle growing amounts of work, without requiring redesign.
- Maintainability: The Core System must be maintainable in such a way so as to minimize maintenance time, with the least cost and application of supporting resources. More specifically, the figures of merit that must be defined are:
    - The probability that a given item within the Core System will be restored to operating condition within a given period of time when maintenance is performed as designed.
    - The probability that maintenance will not be required more than a given number of times in a given period, when the system is operated as designed.
    - The probability that the maintenance cost for the system will not exceed a designated value when the system is operated and maintained as designed.
- Deployability: The Core System must be able to be deployed in existing transportation environments, without requiring replacement of existing systems in order to provide measurable improvements.
- Reliability: The Core System must perform in a satisfactory manner when operated and maintained as designed.[6]

3.1.2 Safety Pilot Program

The Safety Pilot program comprises several phases, including Driver Clinics and the Model Deployment. Approximately six Driver Clinics have been held for light vehicles and two to four for heavy vehicles with the purpose of introducing drivers who have no special training on safety systems embedded in vehicles they are driving to a set of in-vehicle safety systems and to evaluate their reactions.

In support of its goal of accelerating the introduction and commercialization of DSRC-based safety-related systems, the USDOT has defined a set of objectives for the Safety Pilot deployment. The USDOT wants to achieve the following objectives as stated in the RFP[7] issued to select a firm or consortium (referred to as the 'Test Conductor'), even though some of the objectives, such as the gathering of driver acceptance data for in-vehicle DSRC systems, will be addressed via other USDOT projects:

[6] Core System – Concept of Operations (ConOps), Revision E2 dated October 24, 2011, Lockheed Martin, project number "DTFH61-10-F-00045"

[7] RFP "Safety Pilot Model Deployment of Vehicle-to-Vehicle and Vehicle-to-Infrastructure Safety Applications", dated Feb 14. 2011; Solicitation Number: DTFH61-11-R-00006

1. *Demonstrate Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) safety-related applications in a real-world environment using multiple vehicle types (at a minimum, light and heavy vehicles and buses).*
2. *Collect data to project potential safety benefits of V2V safety applications in support of the National Highway Traffic Safety Administration (NHTSA) 2013 agency decision on that program area.*
3. *Assess options for accelerating the safety benefits through the use of 'Vehicle Awareness Device, aftermarket, and retrofit safety devices providing safety-related applications.*
4. *Evaluate the scalability, security, and interoperability of devices using DSRC 5.9 GHz technology.*
5. *Test the use of Signal Phase and Timing (SPaT) messages in V2I safety-related applications.*
6. *Provide industry access to Basic Safety Message (BSM) and SPaT messaging in a live operating environment, for use by additional applications.*
7. *Collect and store data (e.g., BSM messages, vehicle-based sensor data, SPaT messages) for later use by other researchers, including universities and private industry.*

While not part of the Mobility Program within the Connected Vehicle (CV) initiative, the planned Safety Pilot program ties together and will test many aspects of the CV initiative, and the vehicle and contextual data from this program will become a major data environment in the DCM Research Data Exchange. In terms of interface standards coordination, the Safety Pilot program will require the use of existing interface standards such as J2735 and the 5.9 GHz DSRC transmission standards to transmit data from and to vehicles and the roadside equipment. It is expected that the findings of the Model Deployment will determine potential gaps in the necessary data exchanges both on the data definition level as well as on the data transmission level. This information will be provided back to the ITS Standards program and the SDOs responsible for the particular interface standards.

3.2 Alternatives for Standards Development and the Coordination of Standards Development Efforts

Different methods exist to develop new interface standards or to enhance existing interface standards. When attempting to create a new, complex system like the Connected Vehicle initiative, it is very important to have a mechanism in place that coordinates the selection and development of interface standards for the various interfaces required to enable the creation of this system. The following subsections present considerations and different approaches to develop or enhance standards as well as a comparison of the advantages and disadvantages associated with these approaches. This section is a review of what was contained in the Task 2 report (Standards Coordination Plan).

3.2.1 Alternatives for Standards Development Activities

Standards to interface systems and/or devices can be developed using various approaches. This subsection presents the most common alternatives being used in standards development, followed by a comparison of the advantages and disadvantages.

3.2.1.1 Option 1 - SDO-based Standards Development

Standards Development Organizations (SDOs) have defined processes in place, which are meant to be strictly followed in order to create and preserve the integrity of the standards being developed. In addition, SDOs operating in the U.S. are either American National Standards Institute (ANSI)-

accredited or follow an ANSI-like standards development process. ANSI itself does not develop standards but accredits organizations that develop American National Standards—standards that are being used in the U.S. SDOs must maintain their accreditation by periodically responding to ANSI-issued compliance forms. The ANSI accreditation requires that upon the intention to create a new standard, the responsible SDO must provide a notification notice, called the Project Initiation Notification System (PINS) form or equivalent, to announce a standards action. The form is intended to allow for standards coordination among SDOs nationally and internationally and must include the following details:

a. *an explanation of the need for the project, including, if it is the case, a statement of intent to submit the standard for consideration as an ISO or ISO/IEC JTC-1 standard; and*
b. *identification of the stakeholders (e.g., telecom, consumer, medical, environmental, etc.) likely to be directly impacted by the standard.*[8]

All SDOs use a similar process where the need for a new standard is identified and a group of volunteers is assembled in a Working Group (WG) that prepares the draft and final documents. Membership in the SDO in general and the WG in particular is associated with the goals and objectives of the SDO; for example, NEMA is a group representing manufacturers, so its membership comprises manufacturers (roadside equipment manufacturers, in the context of the Connected Vehicle initiative), while AASHTO represents department of transportation, and ITE and IEEE represent individual members interested in transportation engineering (ITE) and electrical and electronics engineering (IEEE).

3.2.1.2 Option 2 - Contracted Standards Development

A different approach is the development of a standard by non-SDO entities, such as consultants paid for and acting on behalf of agencies or SDOs. This approach was utilized, for example, for the development of version 3.0 of the TCIP suite of standards and was performed by consultants on behalf of APTA, and it is currently being used to update the SAE J2735 standard via the USDOT-funded Indefinite Development and Indefinite Quantity (IDIQ) contract vehicle. Although the consultant is responsible for developing the standard, the SDO is still responsible for adopting and publishing the standard.

With this approach, the entity desiring to create a standard assigns or awards the standards development work to a consultant or consultant team, which will create the first draft of the standard. This first draft is reviewed by the contract-issuing entity and/or its stakeholders.

This approach eliminates the availability problem of volunteer staff by using dedicated consultants. However, treating the development/update of a standard like a project will mean that the work might be driven more by the need to stay within schedule and budget. The consensus-building process is likely limited to the review of the first draft standard once it has been prepared and limited by review timeframes imposed by the project's schedule to which many potential volunteers who would otherwise provide input might not be able to comply.

[8] See "http://publicaa.ansi.org/sites/apdl/Documents/Standards Activities/American National Standards/Procedures, Guides, and Forms/2010 ANSI Essential Requirements and Related/2010 ANSI Essential Requirements.pdf" for further details

3.2.1.3 Option 3 - Partially funded Standards Development Approach

A hybrid method of the previous two methods could be used, where an entity funds dedicated consultants performing the basic work of creating and editing the draft standard, capturing any comments and comment resolutions, and producing other standards development documentation. However, the development of the standard is performed by the most suitable SDO under the direction of a Working Group, which follows its standards development process, including the consensus-building process (stakeholders organized in the SDOs will guide the standards development during its entire development cycle, comment on the various drafts, and declare whether a standard is ready for acceptance and ballot). Once the standard is deemed to be ready for ballot, the process follows the rules and regulations of the responsible SDO. This process could also involve several SDOs using a joint standards development agreement.

This approach has also been used in the U.S., where the USDOT has funded consultants to perform these activities for the NTCIP suite of standards development. The USDOT has expedited the standards development effort by providing funding for certain activities during the standards development process. The standards development effort was performed by a joint standards development effort of AASHTO, ITE, and NEMA.

This method of standards development could include the following activities and funding opportunities:

- The funding of the document editing function to ensure well written standards, including the application of the Systems Engineering process (SEP). Further discussion on the SEP process will occur in Section 3.3.
- The funding of public sector staff to enable adequate public sector involvement, which would otherwise be very limited considering the budget concerns experienced by the public agencies

The USDOT already funds the support of document editing and public sector travel for existing standards. This support should be expanded to the new Connected Vehicle-related ITS interface standards.

3.2.1.4 Comparison of Standards Development Methods

Each of the preceding options has its advantages and disadvantages, which are listed in Table 3-1.

Table 3-1. Standards Development Methods -- Comparison

Approach / Method	Advantages / Strengths	Disadvantages / Weaknesses	Risks
Option 1 - SDO-based Standards Development	1. Consensus-based standards development 2. Domain expert developed and reviewed standards, which provide for standards with a high level of domain technical expertise, and that are consequently deployable. 3. Proven, traceable process 4. SDO credibility supports standard being used as a citable reference in procurement specifications 5. The consensus domain led standards efforts are most likely to result in market acceptable standards, with wide acceptance and deployment. 6. Participation by industry increases market acceptance and speed of deployment.	1. Slower development time due to need to build consensus among stakeholders 2. Difficulty of getting sufficient number and breadth of volunteers	1. Standards development might take too long for certain Connected Vehicle applications during research phase 2. USDOT may wish to have more oversight for safety critical standards that will be subject to legislative enforcement.
Option 2 - Contracted Standards Development	1. Fastest method 2. Driven by identified needs (and requirements) for standards 3. Focused on schedule and budget adherence in addition to needs and requirements	1. Limited stakeholder involvement 2. Schedule/budget drive the development 3. Potential for limited acceptance by vendors	1. Standards development might create 'standard' that is not accepted by industry (even if it is used during CV research phase)
Option 3 – Partially Funded Standards Development (Hybrid)	1. Provides largely a consensus-based approach 2. Follows SDO process 3. Normally faster than pure volunteer-based effort	1. Some SDOs might not allow this approach in order to preserve impartiality 2. Budget and Schedule are still driving forces	• Depending on the exact hybrid method used, time to develop standard might still be relatively long (12+ months)

To understand the lead times associated with these options, one must consider that most standards development processes by the SDOs participating in standards for use in the U.S. are based on volunteers composed of SDOs membership and that these are highly consensus-based both in the standards development stage as well as the standards approval stage. Such a process does take time—experience indicates a development time of 1-5 years, depending on the urgency of the need for a particular standard as well as the volunteer time that can be made available. An update to an existing standard can take 1-3 years, depending on the urgency of the requirement and if the changes are major or minor.

Standards development based on the Option 2 - Contracted Standards Development approach and the Option 3 - Hybrid have been accomplished within 1-2 years. An example is the TCIP suite of standards development, which was developed within one year, and similar timeframes can be expected by other efforts following these processes.

3.3 Support for the Standards Coordination Plan

Each of the SDOs involved in the ITS Standards Development process have different types of memberships. The membership of each SDO is different as are the methods of allowing members to join the working groups responsible for the development of specific standards. For example, in order to participate in the standards development process within IEEE, one has to become a member of IEEE. Similar membership requirements exist for most all SDOs with the exception of AASHTO, which has state department of transportation agencies as their members (other agencies can become Associate Members), and NEMA, which is a trade association with companies as members. The memberships of each SDO varies but are typically geared towards particular interest and domain expertise – for example, SAE's membership consists of parties interested in the automotive sector, while ITE's membership are transportation engineers. However, there are overlaps, particularly since the advent of USDOT's Vehicle Infrastructure Integration (VII) initiative, a multi-disciplinary program to develop V2I and V2V communications to support transportation safety and operations and a precursor to the current Connected Vehicle program.

3.3.1 Standards Development Process – Content Development Approaches

Most initial ITS standards were developed containing the critical data required for manufacturers of equipment to develop conformant products. Two issues arose quickly:

1. Due to the complexities inherent to interface standards, ambiguities were contained in the standards that lead to interoperability problems between products of the same type developed by different manufacturers. This problem compromised the purpose and goals of the ITS Standards, mainly the goal of interoperability between systems and devices.
2. In the transportation industry, equipment and products are purchased via competitive bids using specifications within the procurement documents. These procurement documents now needed to include detailed references to very low-level definitions contained in the ITS standards, which was often beyond the capabilities of the procurement developers.

To address these issues as well as others such as backwards compatibility between different versions of a standard, all newer ITS standards are now including a SEP. The International Council on Systems Engineering (INCOSE)[9] developed an internationally respected and utilized best-practice-process that can be tailored to standards development needs. For the ITS Standards development efforts, the INCOSE process has been adopted and modified to best meet the needs. The resulting modified process has been demonstrated to enable the development of high quality standards. This is exemplified by the fact that of the approximately 100 ITS Standards that have been developed so far, 10 have or are undergoing the inclusion of the SEP approach, with another 13 being under consideration. The SEP process used for ITS standards development efforts includes the development of the following items:

[9] INCOSE – for further details, see www.incose.org

1. Concept of Operations including the identification of user needs. Each user need must be mapped to at least one requirement in the next section.
2. Functional Requirements including a Protocol Requirements List (PRL), which maps the user needs identified in the Concept of Operations to one or more requirements and which is intended to be used within Procurement Specifications.
3. Dialogs detail the sequence of events to achieve the exchange of the data if these are interrelated and require a particular sequence of data exchange.
4. Data Definitions precisely define the data elements needed to fulfill the functional requirements and dialogs, and which use a common data presentation such as ASN.1.
5. Test Procedures define how the items of the preceding sections will be tested to ensure conformance to the standard, which allows verification that a deployment is conformant with the standard (as well as compliant with the specifications).
6. Requirements Traceability Matrix relating requirements to dialogs, data definitions, and test procedures.
7. Backwards Compatibility issues as well as history and relationships to other standards must also be defined.

The SEP should be followed and the above outline must be included in every standards development effort performed to benefit the Connected Vehicle initiative in order to ensure the interoperability goal. However, interoperability can truly only be achieved if the standards are unambiguous and without any room for different interpretations.

It is also important that the standards which are defined via the SEP should strive for requirements to avoid ambiguities as well as to define requirements for clean and clear backward compatibility.

The inclusion of the SEP approach has proven to ease the correct and unambiguous inclusion of ITS standards in procurement documents and therefore achieving the goal of interoperability. A successful ITS standard, the NTCIP standards for Dynamic Message Signs, has proven to support this conclusion.

The USDOT should encourage the integration of the systems engineering process (SEP), including concept of operations, functional requirements, data definitions, dialogs, traceability matrices and test procedures, into standards development efforts. In addition, the USDOT should encourage backwards compatibility between different versions of an ITS interface standard that have been implemented in the field to support interoperability among different deployed versions of an interface standard to unless there is clearly a demonstrated need to break backwards compatibility.

The USDOT has already established that the SEP be integrated in all new standards development efforts. This should be applied to the ITS interface standards development effort envisioned in the SCP. These efforts are in line with the Moving Ahead for Progress in the 21st Century Act (MAP-21) passed in July 2012.

3.4 International Harmonization of Connected Vehicle Standards

The concept of creating interface requirements as part of the Concept of Operations and Functional Requirements for the Connected Vehicle-related applications was introduced and recommended in previous sections. The analysis of these interface requirements provides the basis to determine

whether existing interface standards used in the U.S. can address those interface requirements (gap analysis). Should any gaps be determined, the next step is to evaluate whether existing international standards could fill those gaps. This effort would serve several purposes:

1. Using international standards will reduce costs to industry and consumers in that hardware and/or software development costs will be spread over a larger user base, resulting in reduced unit costs.
2. It is easier and much less time consuming to use / reference an existing international standard satisfying the needs of a determined gap than to create a new standard or even to update an existing standard.

The U.S. DOT has signed "Harmonization Opportunity Assessment Plan (HOAP)" agreements to harmonize standards development efforts with Canada, the European Union, and Japan for Connected Vehicle standards (the Connected Vehicle initiative is called Cooperative Systems in the international arena). The HOAP agreements encourage the joint development of Connected Vehicle-related (cooperative systems-related) interface standards, and this approach should be followed for any new interface standards development efforts that might be resulting from the gap analyses. Additional detail on the global harmonization efforts of the ITS Standards program can be found in the Intelligent Transportation Systems (ITS) Standards Program Strategic Plan for 2011-2014 – April 2011. The concepts for these international standards coordination activities include:

- Establish agreements on the international standards coordination process and resources
- Form a task force to execute the work.
- Conduct high-level evaluations to determine candidate standards for harmonization
- Conduct a detailed assessment on candidate standards
- Propose recommendations for harmonization
- Involve SDO partners, working group chairs and subject matter experts.
- Review the detailed assessment and recommendations and determine level of involvement and funding

3.5 Adoption and Promotion of ITS Interface Standards

The coordination activities among the three programs, plus addressing the needs of the Connected Vehicle Initiative, play an important part in publishing the resultant interface standards. There is another equally important and critical coordination need associated with the adoption of the interface standards. CV-related ITS interface standards that are not safety-related (and will therefore likely not be mandated), but that are important to the effective and efficient operation of the Connected Vehicle initiative will require other support activities, such as outreach, training, training materials and implementation support to encourage and educate procuring agencies and manufacturers about the benefits of these CV-related interface standards.

The promotion of developed ITS interface standards could be supported by USDOT funding deployments using real-life testing of these ITS interface standards to demonstrate their applicability and usefulness to achieve the operational goals. For example, this testing is currently being initiated with the Connected Vehicle initiative's Safety Pilot deployment, which is using DSRC-based wireless communications and data definitions defined in SAE J2735. All three programs have currently active education and professional capacity building programs to introduce and educate practitioners about the purpose and use of the purposes, goals, and activities of the programs as well as the developed ITS standards within the ITS Standards program.

Another USDOT activity to promote the widespread usage of adopted ITS interface standards is the continuation of the current practice to reimburse the SDOs publishing ITS interface standards for the no-cost distribution of these standards. This practice is currently being used for the NTCIP interface standards.

3.6 Data Consistency Between Standards to Support the Standards Coordination Plan

This section looks at what methods are available to ensure quality measures for both standards development and standards coordination.

Issues such as consistency of standards, particularly the presentation of data, in order to allow data management tools to be used for standards created by different SDOs, determination of standards overlaps and gaps, and addressing quality control in standards development are addressed in this section. Additionally, the use of the systems engineering process in the development of new or updated standards is discussed.

In addition, the issue of the CV-related certification program and the need to address CV-related issues in the National ITS Architecture are contained in this section.

3.6.1 The Need for Consistent Standards

Each of the SDOs has its own methodology to develop standards, including internal document formatting standards. For the Connected Vehicle initiative to be able to map data definitions from every standard using automated tools, it would be most beneficial to use the methodologies and definitions defined in ISO 14817:2002 – Transport information and control systems -- requirements for an ITS/TICS Central Data Registry and ITS/TICS Data Dictionaries. This ISO standard contains a framework, an information modeling method for defining data concepts (data definitions and message sets), meta attributes used to describe, standardize, and manage each of the data concepts, requirements used to record the definitions, and format procedures to register these data definitions within a data registry.

The creation of tools to automatically transpose the data dictionaries from standards developed by the SDOs into the Connected Vehicle initiative's chosen common data presentation, ASN.1, is dependent on the SDOs creating standards that follow consistent data definition and message set conventions.

3.6.2 The Need for a Common Data Presentation

The data ('messages') to be exchanged need to be defined within the various functional, information layer interface standards. While there are many different possibilities to define the data definitions, it is important to agree to a common methodology to define the data definitions and message sets (logical groupings of data definitions) for use within the Connected Vehicle initiative to enable and ensure interoperability as well as to enable the creation of automation tools that can automatically read data definitions and execute automated functions such as tests.

One of the most flexible methodologies is the Abstract Syntax Notation One, or ASN.1, which is an International Standards Organization (ISO) data representation format. It is a standard and flexible

notation that describes data structures for representing, encoding, transmitting, and decoding data. It provides a set of formal rules for describing the structure of objects that are independent of machine-specific encoding techniques and is a precise, formal notation that removes ambiguities. ASN.1 is used to achieve interoperability between systems.

ASN.1, together with specific ASN.1 encoding rules, facilitates the exchange of structured data especially between application programs over networks and interfaces by describing data structures in a way that is independent of machine architecture and implementation language. The issue of different standards using different encoding rules is something that needs to be addressed. For example J2735-2009 uses different encoding than the NTCIP standards.

ASN.1 has been used successfully within the USDOT's ITS Standards development program for almost all NTCIP standards as well as other ITS standards. The update for the SAE J2735 SE standard will also use ASN.1 as the data notation presentation.

Therefore, ASN.1 is proposed to be used as the base standard for all standards within the Connected Vehicle Standards initiative that need to be developed or updated.

Note that it is understood that there is need to be able to express data elements in forms other than ASN.1, such as XML, for specific interfaces such as web services interfaces. Tools are available to automatically transform an ASN.1 schema into an equivalent XML schema.

The USDOT should encourage the utilization of common data presentation by SDOs for interface standards that standardize the exchange of real-time or safety data (such as the interface standards for DMA applications).The standards should be based on ASN.1.

As this recommendation is already followed in most published ITS Standards, the USDOT via the Connected Vehicle Standards Coordination Committee should make this a policy as soon as possible, before new ITS interface standards are developed or standards currently under development or update are finalized.

3.6.2.1 Common Data Presentation – ASN.1 and XML

The Connected Vehicle initiative relies on the wireless exchange of data. The data for the end applications such as safety-related messages, traffic signal information, etc. will need to be defined within relevant standards by the various SDOs. The data could be expressed in various different formats and within existing standards produced by the various SDOs. Several different data presentation formats have been used. However, it is important to agree to a common methodology to define the data elements for use within the Connected Vehicle initiative in order to facilitate interoperability.

ASN.1 is a joint ISO/IEC and ITU-T standard, originally defined in 1984 as part of CCITT X.409:1984. ASN.1 moved to its own standard, X.208, in 1988 due to wide applicability. The substantially revised 1995 version is covered by the X.680 series. The latest available version is dated 2002, and is backward compatible with the 1995 version. The latest version of ASN.1 is defined in the following standards:

- ITU-T Rec. X.680 | ISO/IEC 8824-1
- ITU-T Rec. X.681 | ISO/IEC 8824-2
- ITU-T Rec. X.682 | ISO/IEC 8824-3

- ITU-T Rec. X.683 | ISO/IEC 8824-4

ASN.1 defines the abstract syntax of information but does not restrict the way the information is encoded. Various ASN.1 encoding rules provide the transfer syntax (a concrete representation) of the data values whose abstract syntax is described in ASN.1. The standard ASN.1 encoding rules include:

- Basic Encoding Rules (BER)
- Canonical Encoding Rules (CER)
- Distinguished Encoding Rules (DER)
- XML Encoding Rules (XER)
- Packed Encoding Rules (PER)
- Generic String Encoding Rules (GSER)

ASN.1 together with specific ASN.1 encoding rules facilitates the exchange of structured data between application programs over networks by describing data structures in a way that is independent of machine architecture and implementation language.

ASN.1 was further specified in the International Standard ISO 14817:2002 “Transport information and control systems -- Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionaries”, which specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. Specifically, ISO 14817:2002 specifies:

- A framework used to identify and define all information exchanges;
- A framework used to extend standardized information exchanges to support local customizations and combinations;
- An information modeling method for defining ITS/TICS data concepts;
- Meta attributes used to describe, standardize and manage each of the data concepts defined within this framework;
- Requirements used to record these definitions; and
- Formal procedures used to register these definitions within the Data Registry.

This description and recommendation to use ASN.1 is valid for all data presentations contained in ITS interface standards, particularly those that have real time and/or safety data exchange requirements with low latency requirements such as the DMA applications. However, the realities of current deployments and preferred interface definitions need to be considered. When looking at the characteristics of the DCM program in the context of connecting vehicles with other vehicles and other entities, they can be defined as:

- Many sources of data
- Many consumers of data
- Large quantities of data
- Generally “back office” in nature, with limited real time and latency requirements

The currently preferred interfaces between applications that have the above characteristics are commonly called “web service” interfaces. For example, the NTCIP Center to Center interface standard (NTCIP 2306), together with the Transportation Management Data Dictionary standard (TMDD 3.0), describes such a web service interface. Web Services Definition Language (WSDL)is used to describe the data elements that are available at the interface. WSDL is written in XML so that it can be read and understood by both humans and computers.

Adopting the requirement that interface standards for DCM be in XML/WSDL format means that there will be a common basis for the exchange of data at entity interfaces.

The USDOT should encourage the utilization of common data presentation by SDOs for interface standards that standardize the exchange of real-time or safety data (such as the interface standards for DMA applications), and the standards should be based on ASN.1. For interface standards that standardize the exchange of data envisioned in the DCM Program, the standards should present data elements in XML utilizing WSDL. The XML data elements should be derived from an ASN.1 construct when possible.

Interface standards addressing 'non-web-services-like' interfaces, such as the NTCIP Center-to Field Device interface standards, contain data definitions in ASN.1 presentation. Interface standards addressing 'web services-like' interfaces are defined in both ASN.1 (first) and XML/WSDL (derived from the ASN.1 data presentation). The recommendation above is already used in some ITS Standards. For example, the NTCIP standards contain data definitions in ASN.1 presentation, and the ITE TMDD v03 data definitions are defined in both ASN.1 and XML/WSDL.

3.6.3 Review of National ITS Architecture for DCM and DMA

The latest incarnation of the National ITS Architecture (NITSA) is Version 7.0, last published in June 2012, which in part addresses the Vehicle Infrastructure Initiative (VII), the precursor to the Connected Vehicle initiative. The NITSA was extended to include and address potential applications identified through the VII. The Architecture included selective access control, limited height warnings in association with parking facilities, providing gap assistance by allowing transit vehicles to communicate with surrounding vehicles, HOV managements and emissions monitoring, grade crossing warnings as well as intersection safety to account for the Cooperative Intersection Collision Avoidance Systems (CICAS) initiative.

Additionally, the Standards section of the Architecture was updated to account for the messages contained and defined in SAE J2735. The National ITS Architecture was also revised to better support the new Intersection Collision Avoidance and SPaT (Signal Phase and Timing) messages. A new architecture flow "vehicle intersection safety data" was created and the flow "intersection_status" was modified. Currently, the J2735 standard is undergoing a major update to apply the Systems Engineering Process. This updated standard is referred to as the J2735SE. Also in development is the J2945.x standard. This new standard addresses the minimum communication performance requirements of the DSRC Message sets.

Table 3-2 shows a listing of Source-Destination pairs as well as Architecture Flows that are directly relevant to the Connected Vehicle initiative.

Table 3-2. Connected Vehicle Source-Destination Pairs

Source	Architecture Flow	Destination
Emergency Vehicle Subsystem	emergency vehicle alert	Vehicle
Emergency Vehicle Subsystem	vehicle signage data	Vehicle
Maintenance and Construction Vehicle	vehicle signage data	Vehicle
Other Vehicle	vehicle intersection safety data	Vehicle
Other Vehicle	vehicle safety data	Vehicle
Roadway Subsystem	intersection status	Vehicle
Roadway Subsystem	roadway safety data	Vehicle
Transit Vehicle Subsystem	vehicle signage data	Vehicle
Vehicle	vehicle intersection safety data	Other Vehicle
Vehicle	vehicle safety data	Other Vehicle
Vehicle	environmental probe data	Roadway Subsystem
Vehicle	probe archive data	Roadway Subsystem
Vehicle	traffic probe data	Roadway Subsystem
Vehicle	vehicle intersection safety data	Roadway Subsystem
Vehicle	vehicle safety data	Roadway Subsystem

The latest version of the NITSA contains the following list of standards pertaining to the Connected Vehicle initiative:

- SAE J2725 (with no additional information)
- ASTM E2213-03: Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications
- IEEE 802.11p: Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification
- IEEE 1609.4-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation
- IEEE 1609.3-2010: Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services
- IEEE 1609.2-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages
- IEEE 1609.1-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager
- IEEE P1609.0: Standard for Wireless Access in Vehicular Environments (WAVE) - Architecture

3.6.3.1 NITSA Update Needs

The investigation of the current version of the NITSA revealed that certain areas will need to be updated to account for and address the Connected Vehicle initiative's DCM and DMA programs, as well as other Connected Vehicle programs such as the Environmental and Safety programs. Specifically, the following issues will need to be addressed:

ITS Standards:
Since the NITSA was last updated in February 2012, some additional Connected Vehicle-related standards were developed and/or are being updated. These updates and additions must be added to the NITSA. Specifically, the new version of the SAE J2735, which will include updated versions of SPaT, BSM, Map, and other information and which is currently under development, must be added. The NITSA will also need to address allowances for other vehicle-to-vehicle and specifically vehicle-to-roadside communications based on wireless communications other than 5.9 GHz, which was the only means defined in the previous VII program.

It should also be evaluated whether references to international standards covering Connected Vehicle initiative-related interfaces that are not currently addressed or are augmenting/superseding U.S.-developed relevant standards should be added to the standards listing in the NITSA.

The results of new to-be-determined policies associated with Security pertaining to vehicle-to-vehicle, vehicle-to-roadside, and vehicle-to-center data transmissions will need to be addressed by the standards development organizations responsible for such data transmission security-related standards.

3.7 Quality Control in Standards Development

3.7.1 SDO Standard Development Processes - Quality Control

Each of the SDOs involved in the ITS Standards Development process has its own specific processes to develop, ballot, and maintain standards. The SDOs' processes have in common that they all ensure quality by providing the draft standards to larger audiences outside the working group developing (or updating) the standard. However, almost all SDOs will only distribute the standards under development and ballot to their members, who are asked to review and comment. Additionally, all SDOs have internal review processes in place where the SDO staff reviews the standards prior to publication to ensure that copyright issues, formatting, and other internal processes have been followed. For example, prior to the publication of every NEMA-produced or NEMA-endorsed standard is a review by the legal department.

An exception to this approach is the USDOT-sponsored development of ITS standards developed under the leadership and guidance of the USDOT's ITS Standards program such as the suite of standards developed for NTCIP, TCIP, and ATC, where the standards are made available for review and quality assurance to any interested party – and past experiences have shown that this approach provides comments coming from different perspectives providing valuable input into the standards development process. Additionally, this process introduced the preparation of a 'standards development report (SDR)' that provides information about the name and version of the standard, working group membership, development history (date and location of meetings), comments received and comment disposition, declaration that other national and international standards have been reviewed and considered in the preparation of this standard, and an abstract of the standard. The SDR provides a tracing of the standards development process that can be reviewed by others and it can be used in the preparation of new versions of the standard.

The USDOT, and specifically the Standards Coordination entity for Connected Vehicle-related ITS standards, should continue to encourage SDOs responsible for the development of ITS interface standards to adhere to established and proven quality control and assurance procedures. The

USDOT should also check the quality control and assurance procedures of any new SDO getting involved in the Connected Vehicle initiative.

3.7.2 Standard Development Process – Verification Testing and Certification

Verification is the process that proves the system (or sub-system or component) meets its requirements and matches the design. In terms of ITS interface standards, this means that the process proves that the device/product meets the requirements, dialogs, and definitions contained in those interface standards. Part of the SEP is the development and inclusion of test cases and test procedures establishing conformance to the interface standards, when those test procedures have been passed successfully.

One verification method is the certification process of products implementing ITS interface standards. The USDOT investigates the suitability of a certification-based process for certain products claiming conformance to Connected Vehicle initiative-relevant ITS interface standards. Certification is different from other forms of conformance testing in that the certification process seeks to confirm conformance to a set of one or more ITS standards deployed in a model version of a particular product. Changes and modifications will require a retesting and a new certification of the product, as it now is a new model. The certification is granted by successfully passing test procedures complying with the implemented standards and can certainly be based on the test cases and test procedures now included in the new versions of the ITS interface standards. While the exact certification process for use with the Connected Vehicle initiative is under development, this method is certainly valid and has been used successfully in other industries. It has the additional advantage that the costs for the conformance testing are paid for by the product manufacturers.

Another form of verification must take place to determine the suitability, applicability, and scalability of these ITS interface standards in real-life deployments. This is to ensure that the products and projects using and claiming conformance to the ITS interface standards have been correctly implemented. The USDOT has supported this type of standards quality control for deployments of the NTCIP interface standards in the past, which led to the determination of issues and ambiguities which subsequently led to the development of enhancements of the NTCIP standards by preparing either amendments or new versions.

A third form of verification is the testing and ensuring that the device implementing and claiming conformance to an ITS interface standard does not only correspond correctly to the actual exchange of data, but also that the actions and functions associated with the data exchange are actually performed. For example, a DMS claiming conformance to NTCIP 1203 must not only be able to receive and confirm the receipt of the command to display a message on the sign display, but it must also actually display the message and to do this within the maximum time defined in performance requirements defined within the interface standard (or the specifications referencing the interface standard). Another more complex example involving dialogs defined in the NTCIP 1203 standard is the downloading and displaying of a message to be displayed. The standard requires a 5 step process to download, verify and subsequently request the display of the message on the DMS display. This 5-step method has to be followed exactly as defined in the dialog defined in the standard in order to ensure interoperability. Again, it is important that both the data exchange takes place as defined in the dialog and the subsequent display of this message on the DMS display are performed. This is called ‘resultant observable behavior’.

The USDOT should encourage SDOs developing ITS interface standards as soon as possible to continue to determine and standardize test procedures and other verification procedures for all new and ITS interface standards being updated. This would again include the development of standardized test procedures verifying the results that can be observed visibly after the data exchange.

The USDOT should continue to encourage SDOs responsible for the development of ITS interface standards to continue to include test procedures. The USDOT should also continue to proceed with the Connected Vehicle Certification Program that was recently initiated.

3.7.3 Other Quality Control Aspects

Several other **very** important aspects to achieve a high-level quality standard are:

- Early and continued involvement of domain area stakeholders from all entities affected by a particular standard. Exclusion of certain stakeholders because of their status (e.g., not being a member of the lead SDO) must be avoided to create generally accepted standards. This also avoids duplication of standards development efforts.
- Consensus-based standard development – meaning that all stakeholders may vote on the standard if they are not all in agreement. Concerns expressed and comments provided by anyone – even those having chosen not to be involved in the development of a standard but choose to review and comment on it – must be recorded, reviewed, discussed, and disposed of.
- Volunteer-based standards development allows stakeholders and any interested party to participate and ensures the commitment of the involved stakeholders. However, a volunteer-based approach normally requires more time, which means that standards development processes must be provided with the time necessary to develop a stakeholder-/industry-backed, consensus-based ITS interface standard. Funded positions to actually write a standard could reduce the time to development but the ultimate decision should be with the stakeholders and working group participants. The current approach to have consultants develop or enhance entire standards based on defined schedules and with little involvement of the SDO and/or its responsible working group ultimately responsible for that standard will likely create industry acceptance problems.
- Several iterations to develop a standard – development of an outline, an initial draft, a user comment draft, and a recommended standard each with its own iteration of development, review, comment disposition, and update should be followed for each standards development effort before it will become ratified and published.

The DCM and DMA programs both include a research track identifying ITS standards. Both programs assume that the standards development needs are coordinated with each other because many of the interfaces and functions addressed in one program will need to be available in the other. The main focus of these programs is the vehicle-to-vehicle and vehicle-to-roadside interfaces, albeit the vehicle-to-center and roadside-to-center interfaces have to be considered to transport data in raw or aggregated form to the processing and distribution points. These may be traditional centers, as in transportation management centers, but could also be e-commerce centers. The aforementioned Connected Vehicle Core System is a concept to provide the services envisioned to transport the data between the various points (vehicle, mobile devices, roadside equipment, and centers) while providing services such as authorization of users and authentication of messages.

The ITS Standards program is currently still mainly focused on the development of standards for the center-to-roadside standards development, albeit some efforts covering vehicle-focused ITS standards. The USDOT is supporting the efforts to update the crucial SAE J2735 standard as well as the IEEE standards defining the DSRC standards.

3.7.4 Quality Assurance Considerations

Further to the general Quality Assurance discussion and recommendation in Section 4.7 of the Standards Coordination Plan, the following focused actions are suggested to improve the quality of the standards developed in support of Connected Vehicles:

1. The USDOT should consider preparing a Quality Plan for recommended use by SDOs when preparing standards for use in Connected Vehicles. This will result in all SDOs having access to the same quality framework. This Quality Plan should include the following elements:
   a. For standards that include data elements, dialogs and/or performance requirements the standards should be developed using the Systems Engineering Process.
   b. Protocol standards should be developed using the SEP to ensure that the protocol standard meets the requirements for the protocol.
   c. Standards should include methods for determining whether implementations are in accordance with the requirements, including test procedures and certification processes as applicable.
   d. Standards development should include consideration for validating the standard itself. This includes considering pilot deployments, prototypes, and verification and validation activities.
   e. Standards development should include education and outreach into the stakeholder community. This is to ensure that wide input is received into the standard, and also so that implementation community will be ready to adopt the standard when released.
2. During the preparation of standards, the USDOT should continue the practice of quality oversight for those standards that are prepared using USDOT funds.
3. During preparation of the Quality Plan, the USDOT should solicit comment from SDOs within the transportation community, and also from outside the transportation sector (such as from the W3 Consortium and the Open Geospatial Consortium for example) to learn lessons which can be applied to the Connected Vehicle standards development effort.

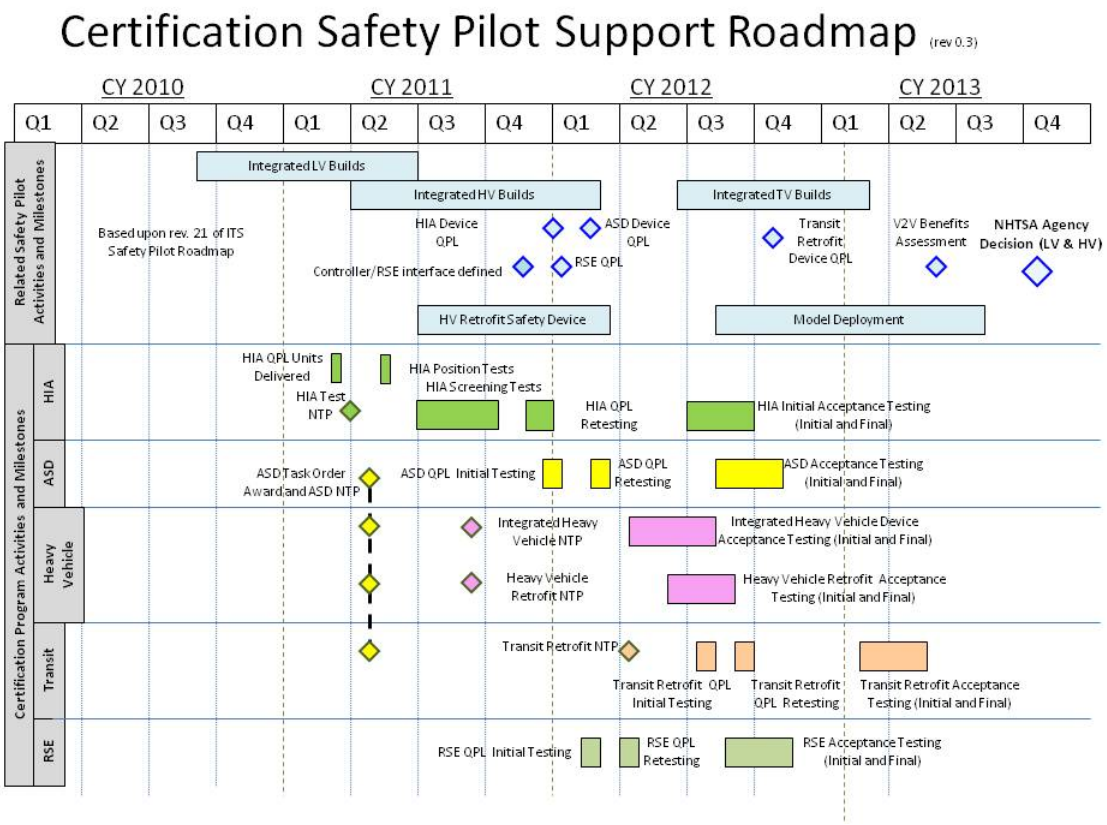
3.8 Assessment of the Connected Vehicle Certification Program

This section is focused on the certification program for the Connected Vehicle initiative. As with other programs of the Connected Vehicle initiative, the Certification program has several tracks to accomplish its goals and objectives.

3.8.1 Status of the Connected Vehicle Certification Program

Figure 3-1 contains the Certification Safety Pilot Support Roadmap, which depicts the plan for the certification program. Based on the roadmap, many of the tasks are complete, with the V2V Benefits Assessment anticipated in the 2nd quarter of calendar year 2013. The NHTSA Agency decision is anticipated in the 4th quarter of calendar year 2013.

Figure 3-1. Certification Safety Pilot Support Roadmap



[Source: ITS JPO ITS Roadmap http://www.its.dot.gov/roadmaps/certification_safety_roadmap.htm, February 24, 2012.]

The certification program is at the beginning as of June 2011 with the project award to determine the guideline for a certification process pending. Therefore, it is presently too early to relate this program specifically to the DCM and the DMA programs.

However, some generic statements pertaining to testing and certification that should be considered for the overall Connected Vehicle initiative can be made and are shown below.

3.8.2 Review of Certification Program Status and Determination of Goals

The Connected Vehicle initiative has identified certification of Connected Vehicle-compliant devices as one of the components that must be addressed. The following information has been largely adapted from the Certification portion of the Connected Vehicle webpage (http://www.its.dot.gov/connected_vehicle/connected_vehicle_cert.htm).

The Certification program has identified its objectives and desired research outcomes as follows:

Research Goals

- To work with industry to define certification needs and develop supporting test methods and tools.
- To develop a plan so that in the future, certification activities will become self-sustaining through fees for testing; development of new requirements and test methods will be shaped by the organizations seeking those requirements.

Research Outcomes

The results of this program are intended to deliver:

- Nationwide interoperability of system components.
- Elimination of inherent risks to consumer safety, security and privacy in the event of a whole or partial system breakdown.
- Establishment of an oversight structure (governance structure) that will provide the processes and procedures for system access as well as system enforcement.
- An open, well-defined process that allows manufacturers to know the system requirements necessary to provide trustworthy components.

3.8.3 Anticipated Certification Standards

The Connected Vehicle Certification research is at the very beginning. A contract to develop the Certification Process Framework has been awarded and work is currently underway. This first project is scheduled to lead to other efforts within the Certification program to fulfill the above program/research goals and outcomes.

In terms of 'standards' applicable to the DCM and DMA programs, the need for certification to ensure safety, security and privacy will require the definition and development of test requirements and testing methods. Testing always needs to address different items associated with the item to be tested including:

- Environmental - is the item suitable for the environment in which it operates?
- Performance - will the item perform within the response time frames required over the desired infrastructure(s)?
- Hardware compliance - does the item conform to the required hardware standards?
- Software - does the item conform to the required software standards?
- Interface – does the item conform to the interface standards applicable to the interfaces over which the item needs to exchange data with other items or entities?

This last item is the topic of the Standards Coordination Plan as it is concerned with the interface standards. Interface standards developed for the Connected Vehicle initiative will be required to follow the SEP and will therefore create test cases and test procedures, which will be used during the Certification testing to determine conformance to the applicable interface standards.

However, the certification of products is concerned with and must address all forms of testing requirements. Determination of compliance with requirements and test procedures is obviously not new and compliance testing is performed by either the purchasing entity, self-certification, and/or entities specialized in certifying products. Examples of compliance testing entities include:

- Testing by purchasing entity: the Florida Transportation Engineering Research Laboratory (TERL) tests every product allowed to be bid in Florida. TERL certified device list is also used by neighboring states.

- Self-certification is often performed by the producing vendors by either completing test procedures made available or hiring a semi-independent (they are paid by the vendor) certification company.
- Certification entities such as the Underwriters Laboratories (UL) are specialized in certification testing of products towards stringent test procedures and guaranteeing that the certified products are safe – according to the test procedures.

Because many DMA-related products are likely mass-produced items, a certification performed by specialized entities such as UL or the OmniAir Consortium, where the entity would perform the certification of all products in this category, would probably be more suitable instead of relying on several or many different certification entities, which would increase the oversight requirements by the USDOT.

The DCM-related products, however, are different. It is anticipated that there will be a few data capture and management entities that will capture data and provide the raw or aggregated data via defined application programming interfaces (APIs) to any interested party. In this case, the USDOT might choose to create one or more online interface testing applications allowing interested parties to test their devices (likely software packages). The testing interface(s) could include a certification document that is automatically created and provided once the product passes the automated testing. Since the establishment and maintenance of such online testing application(s) will also require funding, it is expected that this certification will also not be free.

Since it is USDOT's desire to create a self-sustaining certification program, the certification process sought by vendors and manufacturers will need to be administered by private or semi-private entities. However, USDOT will have the oversight obligation to ensure that the certification process is fair and stringent to achieve the goals as well as interoperability of the certified devices.

3.9 Considerations Relating to Transit and Freight Management Standards

The following standards relating to transit and freight management are applicable:

ANSI TS284 "Commercial Vehicle Safety Reports" (Dec 1998). This standard provides an electronic data interchange (EDI) transaction set to allow authorized parties to electronically request and send reports on information related to the safe operation of commercial road vehicles.

ANSI TS285 "Commercial Vehicle Safety and Credentials Information Exchange" (Dec 1996). This standard provides an EDI transaction set to permit enforcement officials and other authorized parties to retrieve information electronically on the safety performance, regulatory compliance, and credentials status of commercial motor vehicles, carriers, and drivers.

ANSI TS286 "Commercial Vehicle Credentials" (Oct 1997). This standard provides and EDI transaction set for owners, leasers, and drivers of commercial motor vehicles to apply electronically for credentials necessary to legally operate those vehicles.

IEEE 1482.1-1999 – IEEE Standard for Rail Transit Vehicle Event Recorders. This standard covers on-board devices/systems that record data to support accident/incident analysis for rail transit vehicles.

IEEE 1570-2002 – IEEE Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection. This standard defines the logical and physical interfaces and the performance attributes for the interface between the rail subsystem and the highway subsystem at a highway rail intersection.

ISO 14816:2005 – Road transport and traffic telematics – Automatic vehicle and equipment identification – Numbering and data structure. This standard establishes a common framework data structure for unambiguous identification in RTTT/ITS systems.

ISO 17262 – Intelligent transport systems – Automatic vehicle and equipment identification – Numbering and data structures. This standard defines generic numbering and data structures for unambiguous identification of equipment used for Intermodal goods transport. It relates to AVI/AEI units but not to smaller containers and units (pallet loads, trays, etc.) being transported.

ISO 17687:2007 – Transport Information and Control Systems (TICS) – General fleet management and commercial freight operations – Data dictionary and message sets for electronic identification and monitoring of hazardous materials/dangerous goods transportation. This standard supports the application of automated identification, monitoring, and exchange of emergency response information regarding dangerous goods carried on board road transport vehicles. The information is electronically carried on-board the road transport vehicle and may be transferred to interested roadside systems by whatever communications means are appropriate to that roadside system.

ISO 26683-1 – ISO Work Item 26683 – Intelligent Transport Systems – Freight land conveyance content identification and communication – Part 1: Context, architecture and referenced standards. This standard specifies the context for application interface profiles for the exchange of land transport data using current technologies and existing standards for item, package, and container identification.

ISO 26683-2 – ISO Work Item 26683 – Intelligent Transport Systems – Freight and conveyance content identification and communication – Part 2: Application interface profiles. This standard provides profiles for land cargo transport data agglomeration and defines a number of application interface profiles for land cargo transport data.

Other transit and freight standards, e.g. ITE TMDD, are previously listed in Section 2, and are not duplicated here.

3.10 Standards Development Life Cycle using Systems Engineering Principles[10]

In the early stages of ITS standards development, the standards development process proved to be insufficient. As a result, the Systems Engineering Process (SEP) has been incorporated into the

[10] Applying Systems Engineering Principles to the Development of Transportation Communication Standards, Paul Gonzalez, Jeris White, Blake Christie.

standards development life cycle. Using a systems engineering process (See Figure 3-1) would yield the following benefits:

- Provides a context for the standard, a concept of how the standard would be used in actual operation of a system, expressing the user needs that the standard would address
- Develops clear-cut requirements, based on user needs, for the interfaces and devices requiring standardization
- Traces the requirements back to user needs, to show users how the standard evolved and how these requirements met their needs
- Designs standard solutions that addressed those requirements, to support consistent solutions and interoperability
- Traces standard solutions back to the requirements that they addressed
- Creates a mechanism for testing products that claimed conformance to the standard

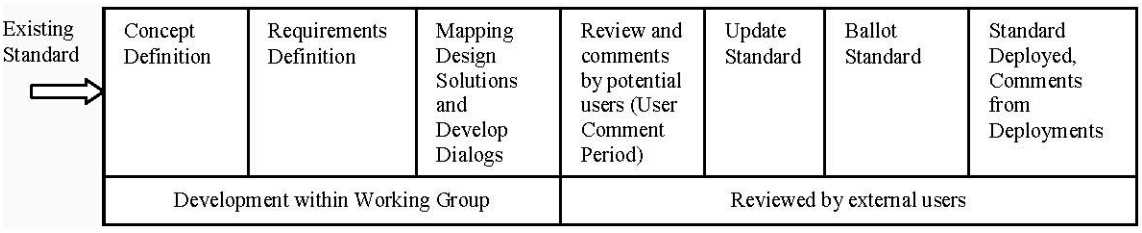
Since any good systems engineering process is tailored to the specific area in which it is expected to function, an engineering profile was created to define the purposes, qualities, and development life-cycle needed for ITS standards. This profile identified the following:

- Purpose: Provide transportation related interface standards that support the integration of interoperable systems.
- Qualities: These are the set of qualities needed by the documents that define ITS standards. The specific qualities to be sought were identified as:
    - Usability
    - Readability
    - Maintainability
    - Interoperability
    - Flexibility

The above qualities focus on how ITS standards are to be used by deployers to satisfy their needs.

- Development Life-cycle: The development life-cycle is similar to the previous one in that it addresses both the development of the standard within the working group and the external reviews that provide feedback to the working group. However, in detail, there are some key differences. Figure 3-2 illustrates this revised standards development life-cycle.

Figure 3-2. ITS Standards Development Life-Cycle Using Systems Engineering Principles



[Source: Applying Systems Engineering Principles to the Development of Transportation Communication Standards, http://www.noblis.org/NewsPublications/News/NewsReleases/Documents/ApplyingSystemsEngineeringPrinciplestoITSStandards.pdf, April 22, 2011.]

There are three stages for which ITS Standards Working Groups are solely responsible. These are:

- Concept definition – this corresponds to what would be the system conception stage in the product development life-cycle depicted in the INCOSE Systems Engineering Handbook3, ending in the preparation of a Concept of Operations document. In this systems engineering process for ITS standards, an abbreviated Concept of Operations is embedded in the standard.
- Requirements definition – this corresponds to the requirements definition activities within the development stage in the product development life-cycle depicted in the INCOSE Systems Engineering Handbook4 that usually ends with the preparation of a System Requirements Specification (SyRS), if one is using IEEE standards. For ITS standards, requirements are developed and a Needs-to-Requirements traceability matrix is created.
- Design – in the ITS standards process, this step leads to the design of interface dialogs and messages. It also involves the creation of a Requirements Traceability Matrix (RTM) that traces requirements to specific design elements that fulfill said requirements. The design stage relates to interface design activities within the development stage in the product development life-cycle depicted in the INCOSE Systems Engineering Handbook.

At each stage in the process, the Working Group performs Verification and Validation (V&V) to ensure that they are both building the right thing and building it right.

The first three stages in the process, shown in Figure 3-1, correspond to ones found in the product development life-cycle depicted in the INCOSE Systems Engineering Handbook. The second three stages (User Comment Period, Update Standard, and Ballot Standard) are part of the standards approval process required by the SDOs. The second three stages relate to the acceptance activities that are part of the production stage of the INCOSE Systems Engineering Handbook and the last ITS Standards development stage (Standard deployed, comments from deployments) relates to the INCOSE Systems Engineering Handbook‟s utilization and support stages.

Several ITS standards profiles were developed as a result of following these systems engineering concepts. These include:

- A concept of operations (ConOps) section
- A requirements section
- A design solutions section

The ConOps profile (adapted from IEEE 1362-1998) focused on identifying user operational needs as they relate to the interface. The ConOps accomplishes the following:

- Defines what the user wants to do in terms of operational needs (highest level requirements)
- Defines operational policies and constraints (e.g. what policies govern the operation of the system, and what constraints does the system have to accommodate)
- Delineates modes of operation (e.g. normal mode and exception modes)
- Provides operational Scenarios (optional) – used to give examples of how the user (or system) may operate with the capability desired
- Provides one or more common architecture descriptions wherein the interface can be employed
- Tells a story and is easy to read

The Requirements profile is organized into functionally logical sections and introduces the following characteristics of well-formed requirements:

- Necessary

- Concise (minimal, understandable)
- Attainable (achievable or feasible)
- Complete (standalone)
- Consistent
- Unambiguous
- Verifiable

4 Focused Action Plan Activities

This section of the SCP presents the standards coordination plan activities. The plan consists of a table naming and describing the specific actions that are suggested to take place and specifying who should implement them. There are also recommendations on when these actions should be completed. A schedule is presented related to the timing of DMA, DCM and ITS standards program activities over the 5-year planned period of the DCM, DMA and ITS standards programs.

The action plan includes:

- A list of the actions to be taken
- A description of each action
- Identified completion date for each action
- Responsible party for the each action

The end result is a "punch list" of items that USDOT and/or each project manager should complete or coordinate to have completed.

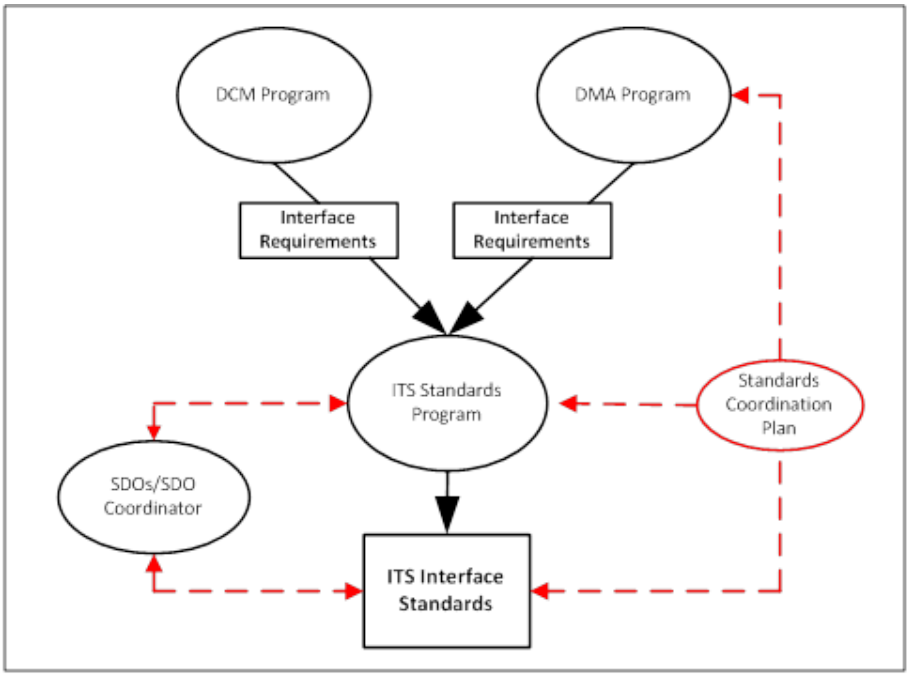
4.1 Action Plan Activities

Prior to identifying the action plan activities, it is important to identify the relationship between the DCM, DMA and ITS Standards programs as it relates to standards modifications and new standards development. Figure 4-1 is a representation of this relationship.

There is an existing ITS Standards development process that is established and understood, as discussed in Section 3-10. It is not foreseen that process will be changed. The coordination plan activities identified below discuss how interactions will occur with the existing ITS Standards development process and how input and interaction will occur with the ITS standards development process. As can be seen by Figure 4-1, it is recommended that the DCM and DMA project managers will only have direct interaction with ITS standards program. There will be no direct interaction with the SDOs nor will there be any direct ITS Interface standards development activities by the project managers. Only the ITS Standards program staff will interact with the SDOs. There will, however, be involvement of the project managers in the verification and validation efforts to make sure their intents are satisfied. This Focused Standards Coordination Plan will be used as a guide for:

1. Project Managers to assist with the identification of the activities they are responsible for completing as well as to understand which standards gaps should be addressed.
2. ITS Standards program staff to understand which specific standards areas must be addressed as well as which activities should be addressed by them.
3. Project Managers and ITS Standards program staff to identify the interface standards that should be modified or developed.

Figure 4-1. DCM/DMA Programs – ITS Standards Program Relationship



[Source: Science Applications International Corporation (SAIC), February 24, 2012.]

Currently, potential DCM and DMA applications have been identified and preliminary assessment and design is completed or underway in the form of research assessments, concepts of operation and system requirements. The majority of these are in the process of completing Functional and Performance Requirements, and High-Level Data and Communication Needs for these applications. For example, the DMA program includes the Integrated Dynamic Transit Operations (IDTO) bundle, which includes the Dynamic Ridesharing (D-RIDE), Connection Protection (T-CONNECT), and Dynamic Transit Operations(T-DISP)applications. The development of the applications for this transit-oriented bundle is estimated with the following timeline:

1. ConOps and Functional Requirements development = 6-8 months from award
2. Modeling – Cost/Benefits Analysis phase = approximately 6-8 months after ConOps and Functional Requirements development
3. Development and laboratory / proof-of-concept testing =approximately6-8months after completion of the Modeling stage
4. One or more regional demonstration = starting afterwards

As a result of the assessment of the DCM, DMA, and ITS Standards programs completed under Task 2 of this project and the Gap Analysis completed under Task 3, along with the considerations related to the coordination of standards, the following are key recommendations for coordinating the standards:

1. The existing ITS Standards Development process should be maintained with input being provided by the DCM and DMA project managers directly to the ITS Standards Program Office, especially as it relates to application interface requirements and standards testing.

2. Project Managers must remain engaged with the ITS Standards Program office to ensure their needs are being met through the standards modification and development processes, i.e. the ITS Standards program should not proceed toward standards development or modification on its own without the correct input and checkpoints from the Connected Vehicle PMs.
3. The ITS Standards Program will coordinate and arrange for the SDOs to develop the interface requirements for each DCM and DMA application that are of following types: (1) functional requirements that describe what the interface will do, and (2) Performance requirements describing what timing is to be met for the interface. These interface requirements will help develop standards that follow standard Systems Engineering (SE) Process.
4. The USDOT should fund critical supporting activities of standards development, in particular the document editing function (to ensure well written standards), and public sector travel (to ensure adequate public sector involvement).
5. The ITS Standards Program office should encourage the use of a common data presentation for interface standards and establish a policy.
6. Standards Engineering Process (SEP) should be used for all new standards and standards modifications to ensure correct interface requirements are developed.
7. The USDOT should coordinate with the SDOs to ensure they adhere to quality control and assurance procedures.
8. When the USDOT deems it to be necessary, identify a list of key standards coordination stakeholders to help execute the plan itself.
9. Perform outreach activities related to the new standards development and coordination processes including regular updates to the existing ITS standards website.
10. Perform pilot testing of the new or modified standards, thus assisting in the standard QA/QC.
11. Conduct international standards harmonization coordination activities, including analysis of differences between U.S. and international standards and research into whether and to what degree international standards should be adopted by NITSA.
12. Working with the industry, the USDOT should develop vehicle-to-vehicle, vehicle-to-roadside, and vehicle-to-center data transmission security policies and coordinate with the SDOs to ensure that such data transmission policies are reflected in applicable standards.

Described below are the recommended Standards Coordination Plan (SCP) Activities and descriptions. These activities address the key recommendations above plus other important activities. Each activity in this list corresponds to one or more entries in the activity list presented in Table 4-1 below.

- **Organize Regular Coordination Meetings** – It is recommended that DCM and DMA project managers and the ITS Standards Program staff have an initial meeting and then meet at regular intervals to discuss standards coordination activities and progress. The regular meetings should occur quarterly or at such an interval that activities and progress can be clearly assessed. These meetings are envisioned to be teleconference meetings with formal meeting minutes, agendas and action item lists. The group will discuss action items, coordinate activities and ensure that appropriate coordination activities are taking place.
- **Standards Stakeholder List** - This activity of the SDOs involves the creation of a list of all individuals who should receive communications related to the standards development activities. This list would essentially be a centralized contact list of mailing addresses, email addresses and phone numbers for those people who should receive regular updates on standards coordination activities as well as those individuals from whom input and reviews

would be sought from time to time. The USDOT may make recommendations to the SDOs for additions to the list.

- **Finalize/Modify Concept of Operations** – All of the mobility applications identified in this report have or are undergoing exercises to develop Concepts of Operations. These documents should be finalized or revisited, as necessary, to appropriately address standards needs.
- **Gather/Develop System and Interface Requirements** – This SCP recommends the development of interface standards for each bundle or environment. Standardizing the data, communication and performance characteristics of interfaces, including data elements, messages, dialogs and communication protocols to carry the messages, allows entities such as vehicles, centers, roadside equipment and mobile devices engaged in the connected vehicle system to interact with each other via the exchange of data that will provide for the functionality, long term durability, and growth of the system. Through the various DCM and DMA project efforts, certain system and interface requirements are being identified and others must be developed. Through this activity SDOs will develop system and interface requirements for the applications and impacted standards. The SDOs should organize them as separate standards groupings and assist with the development of new interface standards.

  It is expected that the interface requirements describe the following information in detail:
  - Data Related Interface requirements, including:
    - What data elements need to be sent under what conditions for the application to deliver the required application functionality.
    - What data sources must provide data in order to generate a complete set of information as required by the application in order to function correctly (for example, combining infrastructure-collected traffic conditions data with Connected Vehicle-collected data in order for an INFLO application to have a detailed and accurate view of traffic on the road network).
    - Which data elements should be available at the interface to allow a requesting entity to determine the state of the responding entity (the properties of the entity hosting the interface), so that the requesting application can function correctly. This should include requirements for the accuracy of the data as applicable, for example, the accuracy of the data such as geo-location data.
    - The data exchange transaction which will allow a requesting entity application to request a control function which will change the state of the responding entity application (the methods of the entity hosting the interface).For example, this could include a request for priority at a traffic signal.
    - The data which should be transmitted by an entity without request which may be transmitted periodically or triggered by an event, and could be broadcast or sent to a set of subscribing entity applications. An example is the Basic Safety Messages broadcast from vehicles.
  - Requirements related to data transmission, including:
    - Allowable latency in data transmissions (i.e., how long it should take to transmit data from the sending entity until the receiving entity receives the data)
    - Reliability of data transmissions, including the requirements for high speed data throughput under severe or difficult conditions.

- **Identify Funding** – A key activity is the need to identify and secure funding for standards modifications and/or development. Money will need to be allocated to support the standards coordination activities and standards development activities, as required. This money may be internal dollars to support standards development plus potentially government staffing and contractor dollars to support the various activities outlined in the plan. During this activity, individuals will be responsible to identify and secure funding for the promotion, adoption and deployment of Connected Vehicle and related ITS interface standards using training, outreach, professional capacity building, pilot schemes and other techniques to ensure that the standards are effectively deployed.
- **Standards Website** – This activity is required to make sure the ITS Standards website is modified to keep everyone up-to-date on the DCM and DMA Standards and Standards Activities. This is the responsibility of the ITS Standards program. This activity involves extending or modifying the existing USDOT website to provide additional information related to Connected Vehicle standards, related standards development activities, and the status of new standards that involve connected vehicles. Quarterly updates are recommended to the website/website pages to update information and status related to Connected Vehicle Standards and standards development and coordination activities.
- **Standards Outreach** – As the standards are modified and new ones developed, the appropriate outreach must occur to keep everyone informed. This outreach will come in the form of formal Knowledge and Technology Transfer documents as well as other outreach materials. The USDOT should establish a contract to fund the promotion, adoption and deployment of ITS interface standards using training, outreach, professional capacity building, and other techniques to ensure that the standards are effectively deployed.
- **Pilot Scheme** – As standards are modified or developed, a pilot program or scheme should be created to test each of the standards before deciding whether to introduce them on a larger scale. During this activity, the assigned individuals will select the right pilot project or projects for the use and testing of draft and final standards. For example, it is planned that certain pilot DMA applications or bundles will be selected for initial testing in a defined geographical area. It is recommended that this is done with draft interface standards wherever possible.
- **SDO Meetings** – Since it is assumed that the Standards Development Organizations are responsible/involved with the development of the majority of the existing ITS standards that are either finalized or in the review process, working with the SDOs is critical to the success of the DCM and DMA standards. The ITS Standards office should conduct meetings with the various SDO representatives including individuals from ASHTO, NEMA, IEEE, ITE, APTA, ANSI and SAE to discuss the DCM and DMA Standards needs. The meetings can be individual meetings with independent SDOs or potentially joint meetings with multiple SDOs. These meetings are a precursor to development of standards and standards modifications, as well as contracts.
- **Develop Agreements** - Formal agreements should be created with SDOs and other required parties related to the development and modification of standards. This in particular applies to joint standards development activities, including approval and publication, to ensure that the resulting standard will be acceptable to the contributing SDOs. The ITS Standards Program Office will work with the SDOs to create the necessary agreements to get the standards modified and/or developed, as required.
- **Conduct Standards Development and Modification Efforts** – Based on the activities outlined in the previous bullets, including the DMA and DCM Standards Implementation Plans, new standards will need to be developed or existing ones will need to be modified. An

input to this activity is the gathering of interface requirements that will feed the modification and development efforts.

- **International Standards Coordination** - Per the ITS Standards Program Strategic Plan for standards development activities, there are some basic plans/strategies for coordinating ITS standards at the international level, DCM and DMA related standards inclusive. Such activities include establishing international coordination processes, assigning resources, formulating task forces, conducting high-level evaluations to determine candidate standards for harmonization, assessing candidate standards, providing recommendations for harmonization, etc.
- **Legislation** - Legislation should be created mandating that the key recommendations presented in this SCP are required/mandatory when a particular ITS interface standard defines a safety- or system-critical interface.
- **Develop/Modify Standards QA/QC Process -** A Quality Assurance/Quality Control (QA/QC) process should be established for the standards development process to ensure that standards meet the intended requirements and are implemented as required and desired. Quality Control involves the process of verifying predefined requirements for quality. For a software system, as an example, the QC function may involve checking the software against a set of requirements and verifying that the software meets the predefined requirements. Quality Assurance, on the other hand, is much more about providing the continuous and consistent improvement and maintenance of the process that enables the QC of the standards. The QC process is to verify that the standard (or the implementation of the standard) does what we think it should, and the QA process gives us confidence that the standard will meet the needs of the customer.

Table 4-1 represents the Standards Coordination Plan (SCP) Activities including assigned attributes for the identified responsible parties to complete the actions as well as the estimated time frame to complete the actions.

Table 4-1. Standards Coordination Plan Activities

Activity Name	Activity Description	Action By	Completion Date
1. Organize Regular Coordination Meetings	The DCM and DMA project managers and the ITS Standards Program staff have an initial meeting and then meet at regular intervals to discuss standards coordination activities and progress. The regular meetings should occur quarterly or at such an interval that activities and progress can be clearly assessed. These meetings are envisioned to be teleconference meetings with formal meeting minutes, agendas and action item lists. The group will discuss action items, coordinate activities and ensure that appropriate coordination activities are taking place.	DCM-DMA Standards Coordination Project Manager	Initial quarterly meeting in calendar year Q4 2012[11]
2. Identify Standards Coordination Stakeholder List	This activity by the SDOs involves the creation of a list of all individuals who should receive communications related to the standards development activities. This list would essentially be a centralized contact list of mailing addresses, email addresses and phone numbers for those people who should receive regular updates on standards coordination activities as well as those individuals from whom input and reviews would be sought from time to time. The USDOT may suggest additions to the SDOs stakeholder lists.	DCM-DMA Standards Coordination Project Manager	Q42012
3. Finalize/Modify Concepts of Operations	All of the mobility applications identified in this report have or are undergoing exercises to develop Concepts of Operations. These documents should be finalized or revisited, as necessary, to address standards deficiencies and needs.	DMA and DCM Project Managers	• FRATIS: Q3 2012 • IDTO: Q4 2012 • INFLO: Q4 2012 • EnableATIS: Q4 2012 • R.E.S.C.U.M.E.: Q4 2012

[11] All dates are referenced by calendar year, not fiscal year.

Activity Name	Activity Description	Action By	Completion Date
			• M-ISIG: Q2 2013 • Weather Applications: Q2 2013 • Smart Roadside: Q2 2013 • DCM Applications: Q2 2013
4. Develop IDTO System and Interface Requirements	This activity will develop the IDTO system requirements for the T-CONNECT, T-DISP, and D-RIDE applications, develop interface requirements for these applications, and organize them as separate standards groupings.	SDOs	Q1 2013
5. Develop INFLO System and Interface Requirements	This activity will develop the INFLO system requirements for the Q-WARN, SPD-HARM, and CACC applications, develop interface requirements for these applications, and organize them as separate standards groupings.	SDOs	Q1 2013
6. Develop Enable ATIS System and Interface Requirements	This activity will develop the Enable ATIS system requirements for the Vehicle Systems, Infrastructure Systems, Traffic Operations Systems, Parking Systems, Transit Operations Systems, CVO Systems, Transportation Demand Management Systems, develop interface requirements for these systems, and organize them as separate standards groupings.	SDOs	Q1 2013
7. Develop R.E.S.C.U.M.E. System and Interface Requirements	This activity will develop the R.E.S.C.U.M.E. interface requirements for the Crashed Vehicle Sensors to In-Vehicle AACN-RELAY, Crashed Vehicle-in-Vehicle AACN-RELAY application to Relay Vehicle-in-Vehicle AACN-RELAY application, Relay Vehicle In-Vehicle AACN-RELAY application to Driver Interface System, Relay Vehicle In-Vehicle AACN-RELAY application to Roadside Equipment applications, develop interface requirements for these applications, and organize them as separate standards groupings.	SDOs	Q1 2013
8. Develop FRATIS System and	This activity will develop the FRATIS system requirements for the	SDOs	Q4 2012

Activity Name	Activity Description	Action By	Completion Date
Interface Requirements	Regional Pre-Trip Planner, Dynamic Routing System, Oversized Overweight Vehicle Routing System, Data Environment, and Freight/Marine Port Systems, develop interface requirements for these systems and applications, and organize them as separate standards groupings.		
9. Develop M-ISIG System and Interface Requirements	This activity will develop the M-ISIG system requirements for the ISIG, TSP, PED-SIG, PREEMPT and FPS applications, develop interface requirements for these DMAs, and organize them as separate standards groupings.	SDOs	Q3 2013
10. Develop Weather Application System and Interface Requirements	This activity will develop the Weather Application system requirements for the Motorist Advisories and Warnings, Information for Freight Carriers, Information and Routing Support for Emergency Responders, and VDT applications, develop interface requirements for these applications and systems, and organize them as separate standards groupings.	SDOs	Q3 2013
11. Develop Smart Roadside System and Interface Requirements	This activity will develop the Smart Roadside system requirements for the CMV On-Board Systems, Back Office Systems, Roadside Data Environment/Regional Data Environment, External Systems, CMV Driver, CMV Enforcement Officers Back Office, Motor Carrier Back Office, MCSAP Lead Agency Manager Back Office, FMCSA Personnel Back Office, and FHWA Size and Weight Personnel Back Office applications, develop interface requirements for these applications and systems, and organize them as separate standards groupings.	SDOs	Q3 2013
12. Develop DCM Application System and Interface Requirements	This activity will develop the DCM Application system requirements for the Arterial, Freeway, Regional, Corridor, and Weather data environments, develop interface requirements for each of these environments, and organize them as separate standards groupings. and provide them to the ITS Standards development office.	SDOs	Q3 2013
13. Identify and Secure Funding	Identify and secure funding for the promotion, adoption and	USDOT ITS Standards	(Ongoing)

Activity Name	Activity Description	Action By	Completion Date
	deployment of Connected Vehicle and related ITS interface standards using training, outreach, professional capacity building, pilot schemes and other techniques to ensure that the standards are effectively deployed. This includes funding for the development of new standards, as applicable.	Program Manager Professional Capacity Building (PCB) Program Manager	
14. Connected Vehicle Standards Website Development	This activity involves extending or modifying the existing USDOT website to provide useful information related to Connected Vehicle standards, related standards development activities, the status of new standards that involve connected vehicles.	ITS Standards Program Manager/ITS Standards Webmaster	Establish website modifications by Q2 2013.
15. Connected Vehicle Standards Website Updates	Quarterly updates will be provided to the website/website pages to update information and status related to Connected Vehicle Standards and standards development and coordination activities.	USDOT ITS Standards Program Manager	Updates should occur quarterly starting in Q3 2013
16. Standards Outreach	The USDOT should establish a contract to fund the promotion, adoption and deployment of ITS interface standards using training, outreach, professional capacity building, and other techniques to ensure that the standards are effectively deployed.	USDOT ITS Standards Program Manager	January 2013
17. Standards Pilots Schemes	As part of the eventual DMA and DCM deployment, pilot system deployments are envisioned. This activity will select the right pilot project for the use and testing of draft and final standards,	DCM and DMA Bundle Program Managers/COTM	Q3 2014-Q2 2016
18. Meeting with IEEE	A meeting(s) should be arranged between the ITS Standards Program office and representatives from IEEE to discuss modifications to IEEE 1512-2006, 1512.1-2006, 1512.2-2006, 1512.3-2006, 1609.1-2006, 1609.2-2006, 1609.4-2006.	USDOT ITS Standards Program Manager	Q2 2013
19. Meeting with SAE	A meeting(s) should be arranged between the ITS Standards Program office and representatives from SAE to discuss modifications to the SAE J2735, J2935, J2354, J2540, J2399, J2400, and J2313 standards.	USDOT ITS Standards Program Manager	Q2 2013
20. Meeting with APTA	A meeting(s) should be arranged between the ITS Standards Program office and representatives from APTA to discuss modifications to APTA TCIP-S-001v3	USDOT ITS Standards Program Manager	Q2 2013
21. Meeting with ANSI	A meeting(s) should be arranged between the ITS Standards Program office and representatives from ANSI to discuss	USDOT ITS Standards Program Manager	Q2 2013

Activity Name	Activity Description	Action By	Completion Date
	modifications to the ANSI TS284, TS285, and TS286 Standards.		
22. Meeting with AASHTO, ITE and NEMA	A meeting(s) should be arranged between the ITS Standards Program office and representatives from AASHTO, ITE and NEMA to discuss modifications to NTCIP 2306, 1202, 1206, 1209, 1210 and TMDDv3.	USDOT ITS Standards Program Manager	Q2 2013
23. Meeting with ASTM	A meeting(s) should be arranged between the ITS Standards Program office and representatives from ASTM to discuss modifications to the ASTM E2259-03, E2468-05, and E2665-08 standards	USDOT ITS Standards Program Manager	Q2 2013
24. Develop Agreement with IEEE	Agreements should be created with IEEE associated with modification to IEEE 1512-2006, 1512.1-2006, 1512.2-2006, 1512.3-2006, 1609.1-2006, 1609.2-2006,1609.4-2006.	USDOT ITS Standards Program Manager	Q1 2014
25. Develop Agreement with SAE	Agreements should be created with SAE associated with modification to the SAE J2735, J2395, J2354, J2399, J2400, and J2313 standards.	USDOT ITS Standards Program Manager	Q1 2014
26. Develop Agreement with APTA	Agreements should be created with APTA associated with modification to APTA TCIP-S-001v3.	USDOT ITS Standards Program Manager	Q1 2014
27. Develop Agreement with ANSI	Agreements should be created with ANSI associated with modification to the ANSI TS284, TS285, and TS286 Standards.	USDOT ITS Standards Program Manager	Q1 2014
28. Develop Agreements with AASHTO, ITE and NEMA	Agreements should be created with AASHTO, ITE and NEMA associated with modification to NTCIP 2306, 1202, 1206, 1209, 1210 and TMDDv3.	USDOT ITS Standards Program Manager	Q1 2014
29. Develop Agreement with ASTM	Agreements should be created with ASTM associated with modification to ASTME2259-03, E2468-05, and E2665-08.	USDOT ITS Standards Program Manager	Q1 2014
30. Standards Development/Modification	Existing standards (as identified in Activity 24-29) should be modified and two new standards should be developed concerning: 1. Connected Vehicle Performance Measures **2.** Connected Vehicle Application Updates	ITS Standards Program & SDOs	Q4 2014
31. International Standards Coordination -	There should be plans/strategies for coordinating ITS standards at the international level. Such activities include establishing international coordination processes, assigning resources, formulating task forces, conducting high-level evaluations to	ITS Standards Program & SDOs	Q4 2013

Activity Name	Activity Description	Action By	Completion Date
	determine candidate standards for harmonization, assessing candidate standards, providing recommendations for harmonization, etc.		
32. Legislation	Legislation should be promoted, mandating that the key recommendations presented in this SCP are required/mandatory when a particular ITS interface standard defines a safety- or system-critical interface.	Contracted Legal Firm	Q4 2013
33. Develop/Modify Standards QA/QC process	A QA/QC process should be established to ensure standards meet the intended requirements and are implemented as required/desired.	USDOT	Q3 2013

4.2 Project Manager Standards Coordination Task Punch List

This section and Tables 4-2 through 4-10 detail the punch list of activities that should be completed by the project managers associated with their standards coordination activities.

4.2.1 IDTO Standards Coordination Punch List

Table 4-2. IDTO Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the IDTO bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify IDTO Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure IDTO Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop IDTO Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The IDTO gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) APTA TCIP-S-001 v3 defines standardized mechanisms for the exchange of information in the form of data among transit business systems, subsystems, components and devices. This standard should be modified to include the following information: • Number of passengers • Personal device information • Driver information • Rider information • HOV/HOT lane locations • Ride-match information Meeting location	
	(2) SAE J2354 standards should be modified to include the following: • Transfer requests, operational status of vehicle • Route and schedule adherence (RSA) status and Vehicle capacity for Transit Agency CAD/AVL System • Number of passengers with rider and Ride-match information for Personal Device for Requesting Ride-match • Ride-match information, Meeting location, In-vehicle occupancy information for In-	

#	Activity	Complete
	Vehicle Rideshare System	
	(3) SAE J2735 standards should be modified to include the following: • Transfer requests, operational status of vehicle, vehicle schedule updates, real-time schedule adjustments • Route and schedule adherence (RSA) status, Arrival predictions for Transit Agency CAD/AVL System • Transit Agency route and schedule information , Real-time status information and Service alerts for Regional Trip Planner • Real-time schedule adjustments for Automated Vehicle Announcement (AVA) System • Trip request with origin, destination, and time (ODT), Return trip request, Trip request status for Rider's Personal Device/web app • Rider trip requests for TMCC Scheduling System • Manifests for In-Vehicle Operator Interface • Origin/destination, Time preference, Travel profile, Number of passengers with rider, Ride-match information, Meeting location for Personal Device for Requesting Ride-match • Personal identification information, Traveler preferences, User ID and password, Personal device information, Payment transaction information for Rideshare Data Entry System • In-vehicle occupancy information, Vehicle information, Driver payment information for Managed Lane Payment System	
	(4) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(5) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot IDTO application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.2 INFLO Standards Coordination Punch List

Table 4-3. INFLO Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the INFLO bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	

#	Activity	Complete
3	Finalize/Modify INFLO Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure INFLO Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop INFLO Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The INFLO gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) NTCIP 2306 should be modified to accommodate additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for INFLO, e.g. in-vehicle speed and Q-Warn recommendations. Note: NTCIP 2306 defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	(2) ITE TMDD v3 standards should be modified to include the following: • Speed target and advisory messages for SPD-HARM • Number of shockwaves formed, length of shockwaves, propagation speed of shockwaves, level of speed compliance, speed variability, travel time reliability, number of primary and secondary crashes, severity of crashes, emission levels, consumed energy, duration of formed queues. • Queue prediction notification and queue prediction message for Q-WARN	
	(3) The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • Notification of activated CACC functions as a result of incident response • Duration of formed queues, Queue detection message and queue prediction notifications • Vehicle Classification information to both inform fleet and freight management agencies related to known incidents related to different vehicles classifications as well as to more clearly identify the type of vehicle involved in incidents	
	(4) The Performance Measurement aspects of INFLO require storage and retrieval of ITS data, so the ASTM E2665-08 standards for data archiving will need to be modified to accommodate storage and reporting for the following information: • Number of Shockwaves formed • Length of shockwaves • Propagation speed of shockwaves • Recommended Vehicle Speeds • Level of Speed Compliance • Speed Variability • Average travel Times • Travel Time Reliability • Number of Primary and Secondary Crashes • Severity of Crashes • Length of formed queues	

#	Activity	Complete
	• Duration of formed queues • Number of false positive queue detection alerts • Number of non-detected queue detection alerts	
	(5) SAE J2354 standards should be modified to include the following: • Number and location of primary and secondary crashes • Variable Speed Limit sign messages and locations.	
	(6) SAE J2395 is a recommended practice for addressing in-vehicle message priorities. Both SPD-HARM and Q-WARN as well as potentially CACC will relay messages to and within the vehicle and these messages will need to be prioritized as well, so the recommended practice will need to be modified as necessary to accommodate these messages within the priority queue.	
	(7) SAE J2399 is a standard for vehicle self-contained adaptive cruise control (ACC) defining a minimum set of parameters and some formulae for designing ACC systems. This standard should be modified to accommodate the CACC application specifically for safety related elements of the CACC characteristics, operating characteristics and user interfaces.	
	(8) SAE J2400 addresses Human Factors in Forward Collision Warning Systems. Since Q-WARN relates to forward collision warning and CACC also addresses this to some degree, SAE J2400 should be modified to address the additional human factor needs of these applications, as appropriate, including the appropriate means to display and alert the driver of pending queues and slow downs approaching backup areas due to fixed queue points (e.g. border crossings, construction zones, wait areas, etc.) and other unplanned queue events (e.g. traffic incidents, weather events, etc,). The standard does not address data types, so gap is identified for this specifically.	
	(9) SAE J2735 standards should be modified to include the following: • Classification and traffic queue information for roadway traffic detection subsystems • Presence and location of shockwaves, travel time reliability, location of traffic queues, length of formed queues, and duration of formed queues, • Information on the number of primary and secondary crashes, severity of crashes, location of crashes • Notification of activated CACC functions	
	(10) Performance measures are essential to the Connected VehicleInitiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(11) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot INFLO application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard is meeting the application's intended needs	

4.2.3 EnableATIS Standards Coordination Punch List

Table 4-4. EnableATIS Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the Enable ATIS bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify Enable ATIS Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure Enable ATIS Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop Enable ATIS Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The Enable ATIS gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) NTCIP 2306 should be modified to accommodate additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support aspects of the EnableATIS Bundle. Note: Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	(2) ITE TMDD v3 standards should be modified to include the following: • Confidence information associated with crown sourced social media data, e.g. the number of crowd source responses or a “confidence value” on the reported information • Airline data for Transit Operations Systems • Vehicle registration data, Weigh in motion data, Freight operations data/records, Historical manifest data for CVO Systems • Origin/Destination data, Carpool / vanpool data, Telework availability/location, High Occupancy Toll (HOT) lane data, Bike sharing locations and availability, Origin/Destination data for Transportation Demand Management Systems	
	(3) SAE J2354 standards should be modified to include the following: • Crowd sourced social media data for Infrastructure Systems and Parking Systems • Transportation video feeds, Probe-based speed data, Mobile-source data/traveler opted in data, Crowd sourced social media data for Traffic Operations Systems • Vehicle diagnostic data, Vehicle headways, Transit vehicle location data & next transit vehicle arrival times, General Transit Feed Specification (GTFS), Carpool & Vanpool data, Crowd sourced social media data for Transit Operations Systems • Carpool / vanpool data, Telework availability/location, Bike sharing locations and availability for Transportation Demand Management Systems	

#	Activity	Complete
	•	
	(4) SAE J2735 standards should be modified to include the following: • Toll tag data for Vehicle Systems • Airline data for Transit Operations Systems • Vehicle registration data, Weigh in motion data, Freight operations data/records, Historical manifest data for CVO Systems • Origin/Destination data, Carpool / vanpool data, Telework availability/location, High Occupancy Toll (HOT) lane data, Bike sharing locations and availability, Origin/Destination data for Transportation Demand Management Systems • The Origin/Destination data for Transportation Demand Management Systems is a privacy issue. The policy issue regarding its use must be resolved by Intelligent Transportation Systems Joint Program Office (ITS-JPO).	
	(5) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(6) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot Enable ATIS application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.4 R.E.S.C.U.M.E. Standards Coordination Punch List

Table 4-5. R.E.S.C.U.M.E. Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the R.E.S.C.U.M.E. bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify R.E.S.C.U.M.E. Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure R.E.S.C.U.M.E. Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop R.E.S.C.U.M.E. Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap	

	Analysis to verify specific standards gaps. The INFLO gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) The ITE TMDDv3 standards should be modified to include the following: • Estimated time of arrival, Route taken • Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • In-vehicle alerts and instructions, In-vehicle warnings and instructions for INC-ZONE Application / Traveling Public • Road diversions, Number of victims and status, On-scene assessment information • Evacuation order, Utility status, Mass warning notifications, Evacuation plans	
	(2) NTCIP 2306 should be modified to accommodate specific additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for R.E.S.C.U.M.E that result from the data made available from connected vehicle communications. Note: Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	(3) The Performance Measurement aspects of R.E.S.C.U.M.E. require storage and retrieval of ITS data, so the ASTM E2665-08 standards for data archiving will need to be modified to accommodate storage and reporting for of certain information which may include: • Estimated Vehicle arrival time • Actual vehicle arrival time • Incident clearance time • Evacuation time • Recovery time	
	(4) The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • AACN message information, HAZMAT transport vehicle identification information , Credentials to access HAZMAT contents, vehicle occupant identification information, Credentials to access electronic medical records, Incident location, Crash injury severity predictions, Number of victims for Crashed Vehicle • Correlated incident information, Electronic shipping papers, Vehicle occupant's electronic medical records, and Medical care facility capabilities • Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance • Utility status • Shelter options, Return home information • Dynamic dispatching and routing guidance for picking up and transporting special needs evacuees to shelters for EVAC Application / Information Broker	
	(5) SAE J2354 standards should be modified to include the following: • Pickup times and location options, Shelter options, Return home information • Routing information, Roadside resources and routing, Shelter options, Return home information	
	(6) SAE J2735 standards should be modified to include the following: • AACN message - Incident location, AACN data, Crash injury severity predictions, Number of victims, HAZMAT transport vehicle identification	

	information, Credentials to access HAZMAT contents, Vehicle occupant identification information, Credentials to access electronic medical records for RSE / TMC-based Information Broker System • Correlated incident information, Electronic shipping papers, Vehicle occupant's electronic medical records, Traffic data near incident zone, Snow plow data, Medical care facility capabilities and availability • Estimated time of arrival, Summary of equipment/personnel, Staging intentions, Arrival approach • Route taken, Traffic/travel conditions encountered • Characteristics of vehicles in incident zone • Incident zone coordinates, Lane closures, Road diversions, Number of victims and status, On-scene assessment and need for more/fewer assets Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance, Status of responder assets • Status of responder assets • Pickup times and location options, Shelter options, Return home information, routing information • Dynamic dispatching and routing guidance	
	(7) SAE J2395 is a recommended practice for addressing in-vehicle message priorities. R.E.S.C.U.M.E. will relay messages to and within the vehicle and these messages will need to be prioritized as well, so the recommended practice will need to be modified as necessary to accommodate these messages within the priority queue.	
	(8) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(9) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot R.E.S.C.U.M.E. application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.5 FRATIS Standards Coordination Punch List

Table 4-6. FRATIS Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the FRATIS bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify FRATIS Concept of Operations as necessary to better support standards modification/development efforts	

#	Activity	Complete
4	As necessary, coordinate with the SDOs to ensure FRATIS Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop FRATIS Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The FRATIS gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) SAE J2354 standards should be modified to include the following: • Historical traffic pattern and preferred freeway access paths long a designated truck route for Regional Pre-Trip Planner • Real-time intermodal terminal queue information, queue length for intermodal terminal queues , estimated wait times, match an empty container with a truck, match an empty container for return only if the container is in reloadable condition, match an empty container for return only if it is determined that the value of the reload is sufficient to justify picking it up, all for Freight/Marine Port Systems	
	(2) SAE J2735 standards should be modified to include the following: • Regional truck trip planning information and the following data along a designated truck route - historical traffic pattern, real-time traffic, truck-specific route designations, truck-specific route restrictions, bridge heights, bridge weight restrictions, preferred freeway access paths, toll road information, construction zone information for Regional Pre-Trip Planner • Notification to a user when the current/planned route is estimated for predicted congestion • Information needed for automated OSOW permitting and routing by State systems, Submit requests (for automated permitting) and request results for Oversized Overweight Vehicle Routing System • Parking reservations for Data Environment System • Real-time intermodal terminal queue information, queue length for intermodal terminal queues , estimated wait times, match an empty container with a truck, match an empty container	
	(3) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(4) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot FRATIS application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.6 M-ISIG Standards Coordination Punch List

Table 4-7. M-ISIG Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the M-ISIG bundle	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify M-ISIG Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure M-ISIG Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop M-ISIG Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The M-ISIG gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) NTCIP 2306 should modified to accommodate specific additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for M-ISIG that result from the data made available from connected vehicle communications Note: Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	(2) ITE TMDD v3 Standards should be modified to include the following: • Connected vehicle data (location, speed, braking, windshield wiper activation, headlight activation, temperature, traction), for Arterial Data Environment. • Emergency Vehicle movement data and preemption priority information, Freight Vehicle movement data and priority information for Traffic Signal Controllers. •	
	(3) Assess NTCIP 1202 to include connected vehicle object definitions for Actuated Traffic Signal Controller units. Within this bundle, it is feasible for dynamic traffic signal controller modification triggers to come from connected vehicles or connected vehicle data made available to the signal system and controller via these applications. In turn, the standard should be Modified to include: • Object Definitions and dialogs in support of SPaT • Connected vehicle data (location, speed, braking, windshield wiper activation, headlight activation, temperature, traction) • Transit Vehicle, Emergency Vehicle , Freight Vehicle and Connected Pedestrian movement data • Transit Vehicle movement data and TSP information • Emergency Vehicle movement data and preemption priority information • Freight Vehicle movement data and priority information • Passenger count data, Service type, Scheduled and actual arrival time, Heading information, Vehicle headways • Response type and priority	

#	Activity	Complete
	• Scheduled, actual, and projected freight movements • Transit Vehicle movement data and TSP information • Heading information	
	(4) NTCIP 1209 should be modified to include: • Connected vehicle and connected pedestrian object definitions for Transportation Sensor Systems • Connected vehicle data (location, speed, braking, windshield wiper activation, and headlight activation Connected Pedestrian movement data • Automated pedestrian call messages • Pedestrian movement and alignment information •	
	(5) NTCIP 1206:2005 Standards should be modified to include the following: • Connected vehicle data (location, speed, braking, windshield wiper activation, headlight activation, temperature, traction), for Arterial Data Environment. • Connected pedestrian object definitions for data collection and monitoring	
	(6) SAE J2735 Standards should be modified to include the following: • Pedestrian movement data for Arterial Traffic Management Systems and Traffic Signal Controllers. • Pedestrian call messages for Connected Pedestrian Mobile Devices. • Passenger count data, Service type, Scheduled and actual arrival time, Vehicle headways for Transit Vehicle Systems. • Response type and priority for Emergency Vehicle Systems. • Scheduled, actual, and projected freight movements for Freight Vehicle Systems. • Connected Pedestrian movement data for Arterial Traffic Management Systems and Traffic Signal Controllers. • Freight Vehicle movement data and priority information for Arterial Traffic Management Systems. Freight Vehicle movement data and priority information for Arterial Traffic Management Systems.	
	(7) NTCIP 1210 should be modified to include: • Objects related to connected vehicle-based detection of lane-specific platoon flow, platoon size, and other driving characteristics for Field Management Stations (FMS)	
	(8) Assess APTA TCIP-S-001 to accommodate new Priority Request Generator rules in the TSP business area of M-ISIG.	
	(9) The Performance Measurement aspects of M-ISIG require storage and retrieval of ITS data, so the ASTM E2665-08 standards for data archiving will need to be modified to accommodate storage and reporting needs of this bundle	
	(10) Assess ITE ATC Controller 5.2 standard to accommodate V2I communications and the API as it relates to ITSS, TSP, MAPSS, PREEMPT and FSP.	
	(11) SAE J2395 addresses in-vehicle message priorities. The M-SIG applications of ITSS, TSP, PREEMPT and FSP may relay messages to the vehicle, these will need to be prioritized as well, so the standard will need to be modified to accommodate the M-ISIG messages as well.	
	(12) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(13) Updates or patches will need to be installed for in-vehicle applications. There are	

#	Activity	Complete
	currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot M-ISIG application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.7 Weather Application Standards Coordination Punch List

Table 4-8. Weather Application Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the Weather Applications	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify Weather Application Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure Weather Application Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop Weather Application Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The Weather Application gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	(1) ITE TMDD v3Standards should be modified to include the following: • Regional forecast and other meteorological model output data for Weather Exchange Data Sources / VDT • Radar Weather data - Storm Locations, Storm Size, Storm Velocity, Storm Severity, Tornado Warnings, Thunderstorm Warnings, Flashflood Warnings for Radar Weather Data	
	(2) ASTM E2665-08 (Standard Specification for Archiving ITS-Generated Traffic Monitoring Data) does not reflect the road weather condition data that can be gathered by Road Weather Application-enabled connected vehicles. A roadway condition dataframe add would provide useful information to support the ADMS operational scenarios as described in Section 7.2. Modification of ASTM E2468-05 should include a description of data elements related to the capture and storage of roadway condition information.	

#	Activity	Complete
	(3) SAE J2354 defines and describes standardized messages applicable to ATIS. However, ATIS Message weather information (Element: weatherReport) does not reflect weather predictions of the kind that can be produced by the Vehicle Data ranslator (VDT) in conjunction with Road Weather Application-enabled connected vehicles. Modification of SAE J2354 to include: • Weather prediction elements and types Schedule restrictions and Routing restrictions based on weather	
	(4) SAE J2395 (Surface Vehicle Recommended Practice ITS In-Vehicle Message Priority) provides recommended practice for in-vehicle message priority to help insure the orderly presentation of ITS information to the driver, considering both temporal and spatial restraints. This recommended practice should be modified or expanded to include the correct priority for weather related driver alerting.	
	(5) For EMS, traveler information and freight, the SAE J2735 Standards do not currently contain a "weather report" dataframe for the mobile environment. Key dataframe variables that are lacking include: • Pressure/Wind o Spot Wind Direction o Spot Wind Speed • Temperature o Dew point Temperature o Surface Temperature • Precipitation o Adjacent Snow Depth o Roadway Snow Depth o Roadway Ice Thickness • Visibility	
	(6) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(7) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot weather application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.8 DCM Application Standards Coordination Punch List

Table 4-9. DCM Application Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the DCM Application	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify DCM Application Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure DCM Applications Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop DCM Application Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The DCM Application gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	
	ITE TMDD v3 standards should be modified to include the following: • Speed target User interface diagnostics and notification of activated CACC functions • Number of shockwaves formed, length of shockwaves, propagation speed of shockwaves, level of speed compliance, speed variability, travel time reliability, number of primary and secondary crashes, severity of crashes, emission levels, consumed energy, duration of formed queues. • Queue prediction notification and queue prediction message for Q-WARN •	
	ITE TMDD v3 standards should be modified to include the following: • Airline data for Transit Operations Systems • Vehicle registration data, Weigh in motion data, Freight operations data/records, Historical manifest data for CVO Systems • Origin/Destination data, Carpool / vanpool data, Telework availability/location, High Occupancy Toll (HOT) lane data, Bike sharing locations and availability, Origin/Destination data for Transportation Demand Management Systems	
	The ITE TMDDv3 standards should be modified to include the following: • Change in velocity, Vehicle orientation, Airbag status for Crashed Vehicle Sensors/In-Vehicle AACN-RELAY Application • AACN message information- AACN data, Crash injury severity predictions, Number of victims for Crashed Vehicle In-Vehicle AACN-RELAY Application / Relay Vehicle In-Vehicle AACN-RELAY Application, Relay Vehicle In-Vehicle AACN-RELAY Application / Roadside Equipment (RSE), • AACN message , , credentials to access HAZMAT contents, Vehicle occupant identification information, Credentials to access electronic medical records for RSE / TMC-based Information Broker System • Correlated incident information, Vehicle occupant's electronic medical records, medical care facility capabilities and availability • Estimated time of arrival	

#	Activity	Complete
	• Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • Number of victims and status, On-scene assessment information • Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance, Status of responder assets • Evacuation order, Utility status, Mass warning notifications, Evacuation plans • Pickup times and location options, Shelter options, Return home information • Roadside resources and routing, Shelter options, Return home information for EVAC Application / Non-Special Needs Evacuees Communication Subsystem • Dynamic dispatching and routing guidance for picking up and transporting special needs evacuees to shelters	
	ITE TMDD v3 Standards should be modified to include the following: • Emergency Vehicle movement data and preemption priority information, Freight Vehicle movement data and priority information for Traffic Signal Controllers. • Response type and priority for Emergency Vehicle Systems.	
	The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • Notification of activated CACC functions as a result of incident response	
	The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • AACN message information, HAZMAT transport vehicle identification information , Credentials to access HAZMAT contents, vehicle occupant identification information, Credentials to access electronic medical records, Incident location, Crash injury severity predictions, Number of victims for Crashed Vehicle • Correlated incident information, Electronic shipping papers, Vehicle occupant's electronic medical records, and Medical care facility capabilities • Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance • Utility status • Shelter options, Return home information • Dynamic dispatching and routing guidance for picking up and transporting special needs evacuees to shelters for EVAC Application / Information Broker	
	NTCIP 2306 should be modified to accommodate additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for INFLO (in-vehicle speed and Q-Warn recommendations), EnableATIS, R.E.S.C.U.M.E., and M-ISIG. • Note: Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	ITE TMDD v3 standards should be modified to include the following: • Speed target and advisory messages for SPD-HARM • User interface diagnostics and notification of activated CACC functions • Wiper status, headlight status, accelerometer, anti-lock braking system status,	

#	Activity	Complete
	traction control, stability control, rate of change of steering wheel , yaw rate, differential wheel speed, brake status, brake boost and impact sensor information • Number of shockwaves formed, length of shockwaves, propagation speed of shockwaves, level of speed compliance, speed variability, travel time reliability, number of primary and secondary crashes, severity of crashes, emission levels, consumed energy, public opinion ratings, duration of formed queues. • Queue prediction notification and queue prediction message for Q-WARN •	
	ITE TMDD v3 standards should be modified to include the following: • Vehicle registration data, Weigh in motion data, Freight operations data/records, Historical manifest data for CVO Systems • Origin/Destination data, Carpool / vanpool data, Telework availability/location, High Occupancy Toll (HOT) lane data, Bike sharing locations and availability, Origin/Destination data for Transportation Demand Management Systems	
	The ITE TMDDv3 standards should be modified to include the following: • Change in velocity, Vehicle orientation, Airbag status for Crashed Vehicle Sensors/In-Vehicle AACN-RELAY Application • AACN message information- AACN data, Crash injury severity predictions, Number of victims for Crashed Vehicle In-Vehicle AACN-RELAY Application / Relay Vehicle In-Vehicle AACN-RELAY Application, Relay Vehicle In-Vehicle AACN-RELAY Application / Roadside Equipment (RSE), • AACN message , HAZMAT transport vehicle identification information, credentials to access HAZMAT contents, Vehicle occupant identification information, Credentials to access electronic medical records for RSE / TMC-based Information Broker System • Correlated incident information, Vehicle occupant's electronic medical records, medical care facility capabilities and availability • Estimated time of arrival, Route taken • Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • In-vehicle alerts and instructions, In-vehicle warnings and instructions for INC-ZONE Application / Traveling Public • Road diversions, Number of victims and status, On-scene assessment information • Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance, Status of responder assets • Evacuation order, Utility status, Mass warning notifications, Evacuation plans • Pickup times and location options, Shelter options, Return home information • Routing information, Roadside resources and routing, Shelter options, Return home information for EVAC Application / Non-Special Needs Evacuees Communication Subsystem • Dynamic dispatching and routing guidance for picking up and transporting special needs evacuees to shelters	
	The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • Notification of activated CACC functions as a result of incident response • Anti-lock braking system status, traction control, stability control, rate of change of steering wheel, differential wheel speed, brake boost for the on-board connected vehicle sensors • Duration of formed queues, Queue detection message and queue prediction notifications • Vehicle Classification information to both inform fleet and freight management agencies related to known incidents related to different vehicles classifications	

#	Activity	Complete
	as well as to more clearly identify the type of vehicle involved in incidents	
	The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 standards should be modified to include the following: • AACN message information, HAZMAT transport vehicle identification information , Credentials to access HAZMAT contents, vehicle occupant identification information, Credentials to access electronic medical records, Incident location, Crash injury severity predictions, Number of victims for Crashed Vehicle • Correlated incident information, Electronic shipping papers, Vehicle occupant's electronic medical records, and Medical care facility capabilities • Alerts of vehicles present in incident zone, Personal warning device of oncoming dangerous vehicle, Routing instructions to medical care facility • Requests for evacuation transportation assistance, Requests for transportation routing guidance, Requests for shelter, Requests for roadside assistance • Utility status • Shelter options, Return home information • Dynamic dispatching and routing guidance for picking up and transporting special needs evacuees to shelters for EVAC Application / Information Broker	
	NTCIP 2306 should be modified to accommodate specific additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for INFLO, EnableATIS, and R.E.S.C.U.M.E that result from the data made available from connected vehicle communications. Note: Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	ITE TMDD v3 standards should be modified to include the following: • Following data along a designated truck route - historical traffic pattern, truck-specific route designations, truck-specific route restrictions, bridge heights, bridge weight restrictions, preferred freeway access paths, toll road information for Regional Pre-Trip Planner • Notification to a user when the current/planned route is estimated to coincide with newly discovered or predicted congestion along with alternate route information in such a case for Dynamic Routing System • Information needed for automated OSOW permitting and routing by State systems, Submit requests (for automated permitting) and request results for Oversized Overweight Vehicle Routing System • Real-time point-to-point travel time predictive information for freeways, port and terminal intermodal connectors and major freight arterials for Data Environment System • Truck parking reservations for Data Environment System Match an empty container with a truck, match an empty container for return only if the container is in reloadable condition, match an empty container for return only if it is determined that the value of the reload is sufficient to justify picking it up, all for Freight/Marine Port Systems	
	ITE TMDD v3 standards should be modified to include the following: • , Airline data for Transit Operations Systems • Vehicle registration data, Weigh in motion data, Freight operations data/records, Historical manifest data for CVO Systems Origin/Destination data, Carpool / vanpool data, Telework availability/location, High Occupancy Toll (HOT) lane data, Bike sharing locations and availability, Origin/Destination data for Transportation Demand Management Systems	
	ITE TMDD v3Standards should be modified to include the following:	

#	Activity	Complete
	• Regional forecast and other meteorological model output data for Weather Exchange Data Sources / VDT	
	The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 Standards should to be modified to include the following: HAZMAT cargo, Driver identity, HOS status, Vehicle condition, Vehicle weight, Vehicle dimensions, Credential status: carrier, driver, vehicle, Safety history: carrier, driver, vehicle	
	NTCIP 2306 should be modified to include the required functionality to transport the weather data required to support EnableATIS, Smart Roadside, VDT and the other weather applications. Note: NTCIP 2306 Defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries supplied by schemas are defined under other standards.	
	ITE TMDD v3Standards should be modified to include the following: • Regional forecast and other meteorological model output data for Weather Exchange Data Sources / VDT	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot weather application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.2.9 Smart Roadside Standards Coordination Punch List

Table 4-10. Smart Roadside Standards Coordination Punch List

#	Activity	Complete
1	Attend Initial Coordination Meeting with ITS Standards Program Office to kickoff process for standards modification and development associated with the Smart Roads initiative	
2	Attend Regular Coordination Meetings with ITS Standards Program Office	
3	Finalize/Modify Smart Roadside Concept of Operations as necessary to better support standards modification/development efforts	
4	As necessary, coordinate with the SDOs to ensure Smart Roadside Functional and Performance Requirements and High-Level Data and Communication Needs are addressed to better support standards modification/development efforts which includes interface standards where appropriate	
5	As necessary, coordinate with the SDOs to assemble/develop FRATIS Interface Requirements	
6	Verify Interface requirements against Standards Coordination Plan Gap Analysis to verify specific standards gaps. The Smart Roadside gaps that should be verified, addressed and provided to the ITS Standards program as input to the SDOs are as follows:	

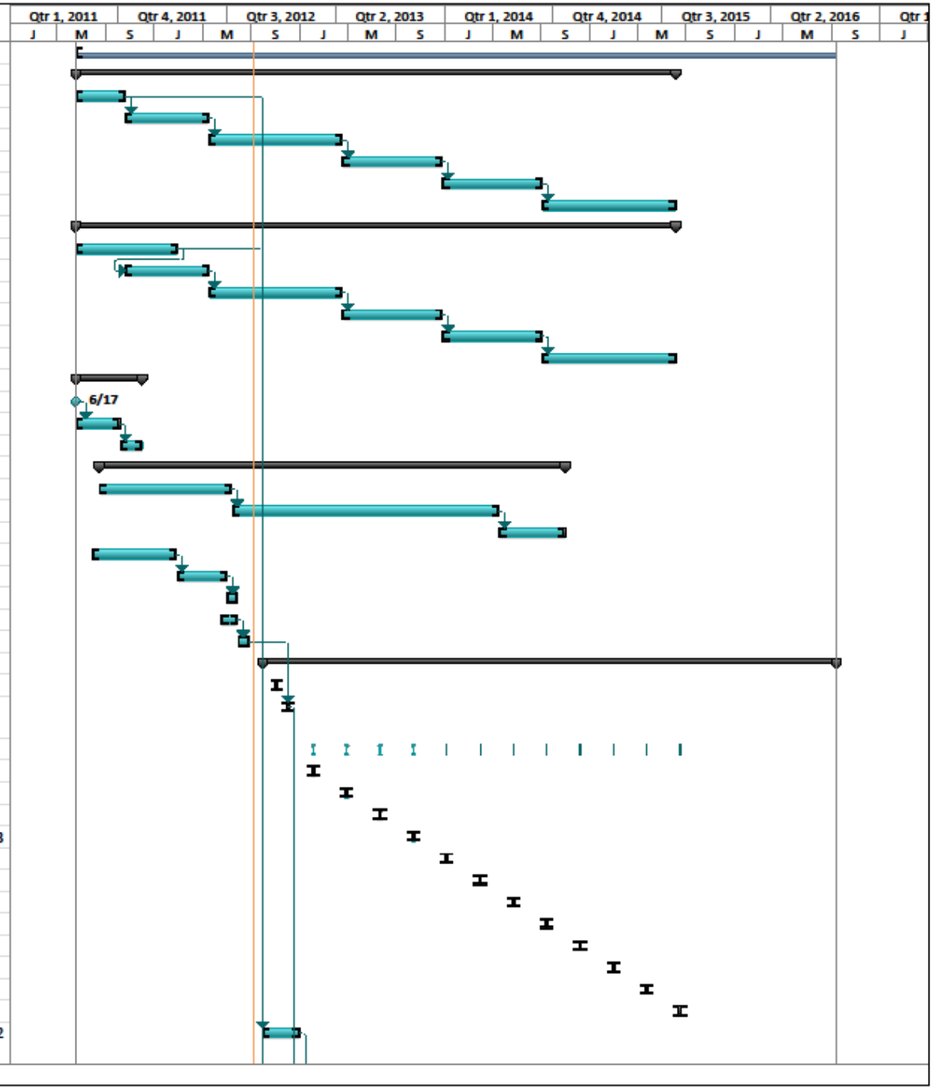
#	Activity	Complete
	(1) The IEEE 1512-2006, IEEE 1512.1, IEEE 1512.2 and IEEE 1512.3 Standards should to be modified to include the following: • HOS status, Credential status: vehicle, Safety history: carrier, driver, vehicle	
	(2) SAE J2735 Standards should to be modified to include the following: • Credential and permit status, Carrier identity, Driver identity, HOS status, Travel time, Parking availability, Road Condition Data, Types and locations of accidents and CDL endorsements for Commercial Motor Vehicle (CMV) On-Board Systems • Travel time, Parking availability, CDL endorsements, Credential and permit status, Carrier identity, Driver identity, Credential status: carrier, driver, vehicle, Safety history: carrier, driver, vehicle, Policy and operations guidance information, Travel time, Parking availability, Roadside enforcement results, Driver reports, Change in driver status, Types and locations of accidents	
	(3) NTCIP 2306 should be modified to accommodate specific additional functions such as dialog specific functions, call backs, quality of service and transaction rollback which may be required to support the more sophisticated C2C messages for Smart Roadside that result from the data made available from connected vehicle communications. • Note: NTCIP 2306 defines SOAP and WSDL wrappers for XML data exchange. Data dictionaries and schemas are defined under other standards.	
	(4) The Performance Measurement aspects of Smart Roadside require storage and retrieval of ITS data, so the ASTM E2665-08 standards for data archiving will need to be modified to cover the attributes and performance measures for Smart Roadside which include performance measures for roadside CMV inspections, electronic screening/ virtual weigh stations, universal electronic commercial motor vehicle (CMV) identification and truck parking.	
	(5) Performance measures are essential to the Connected Vehicle Initiative, and although some performance measures could be covered under the ASTM standards, the Connected Vehicle Initiative comes with a wealth of its own unique performance measures. The USDOT should consider the possibility of adopting a new performance measure standard unique to Connected Vehicle.	
	(6) Updates or patches will need to be installed for in-vehicle applications. There are currently no standards that address how the updates will be applied. Factors such as what updates to apply, when to apply, and how to apply the updates will need to be addressed. The USDOT should consider the possibility of adopting a new standard to address these in-vehicle application updates.	
7	Review and provide input to USDOT Standards Development QA/QC Plan	
8	Arrange for testing of revised standards in a pilot Smart Roaside application or deployment area, or laboratory/simulation environment	
9	Based on pilot testing of standards, provide report to ITS Program office on how well the modified standard meeting the application's intended needs	

4.3 Milestones and Schedule

Figure 4-2 lists the milestones and schedule for DCM/DMA ITS standards coordination.

Figure 4-2. Milestones and Schedule for DCM/DMA ITS Standards Coordination

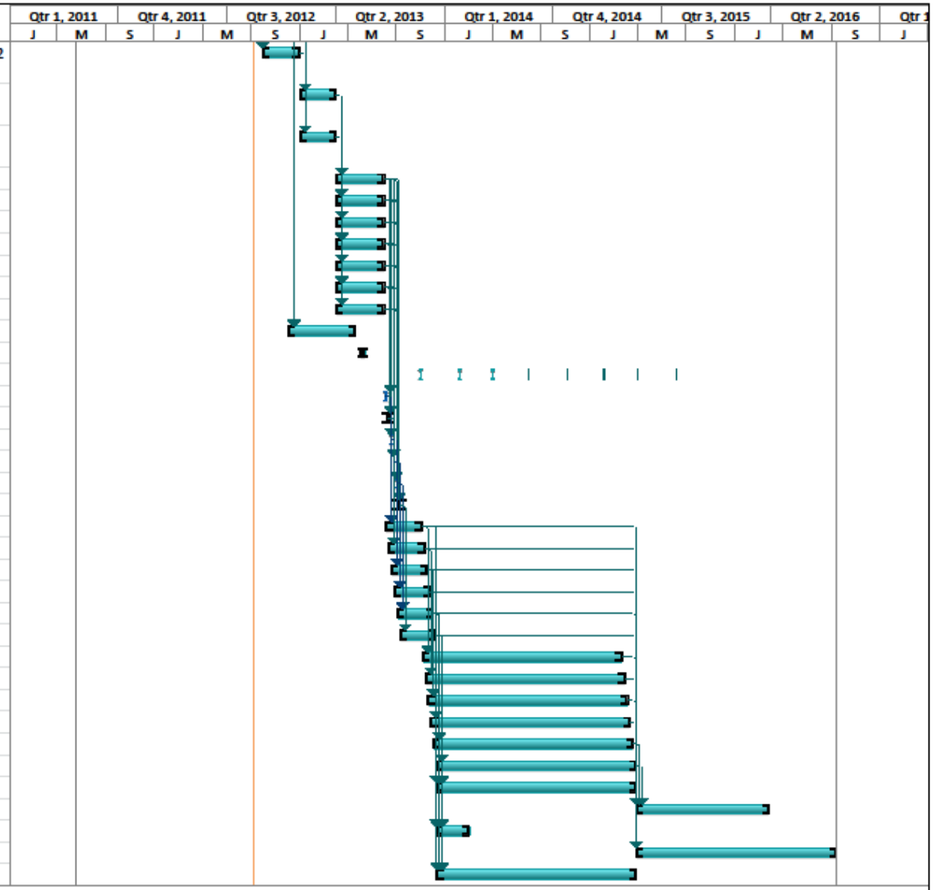
ID	Task Name	Duration	Start	Finish
1	**DCM/DMA ITS Standards Coordination**	**1083 days**	**Fri 6/17/11**	
2	**DCM Applications Research and Preliminary Design**	**1080 days**	**Fri 6/17/11**	**Thu 8/6/15**
3	ConOps	4.5 mons	Fri 6/17/11	Thu 10/20/11
4	Functional Requirements	7.5 mons	Fri 10/21/11	Thu 5/17/12
5	Modeling / C/B analysis	12 mons	Fri 5/18/12	Thu 4/18/13
6	Design/Dev of DMA apps	9 mons	Fri 4/19/13	Thu 12/26/13
7	Laboratory/POC testing of DMA apps	9 mons	Fri 12/27/13	Thu 9/4/14
8	One or more regional deployments	12 mons	Fri 9/5/14	Thu 8/6/15
9	**DMA Applications Research and Preliminary Design (Typical)**	**1080 days**	**Fri 6/17/11**	**Thu 8/6/15**
10	ConOps	9.2 mons	Fri 6/17/11	Wed 2/29/12
11	Functional Requirements	7.5 mons	Fri 10/21/11	Thu 5/17/12
12	Modeling / C/B analysis	12 mons	Fri 5/18/12	Thu 4/18/13
13	Design/Dev of DMA apps	9 mons	Fri 4/19/13	Thu 12/26/13
14	Laboratory/POC testing of DMA apps	9 mons	Fri 12/27/13	Thu 9/4/14
15	One or more regional deployments	12 mons	Fri 9/5/14	Thu 8/6/15
16	**Core Systems Development**	**120 days**	**Fri 6/17/11**	**Thu 12/1/11**
17	Concept of Operations Dev (complete)	0 days	Fri 6/17/11	Fri 6/17/11
18	Functional Requirements / Architectural Dev	4 mons	Fri 6/17/11	Thu 10/6/11
19	Interface Requirements	2 mons	Fri 10/7/11	Thu 12/1/11
20	**Safety Pilot Model Deployment**	**840 days**	**Mon 8/15/11**	**Fri 10/31/14**
21	Pre-Model Deployment Stage	12 mons	Mon 8/15/11	Fri 7/13/12
22	Model Deployment Stage	24 mons	Mon 7/16/12	Fri 5/16/14
23	Post Model Deployment Stage	6 mons	Mon 5/19/14	Fri 10/31/14
24	Standards Coordination Plan - Task 2 (SCP)	7.55 mons	Fri 7/29/11	Fri 2/24/12
25	Standards Coordination Plan - Task 3 (Gap Analysis) - Draft	4.55 mons	Mon 2/27/12	Mon 7/2/12
26	Standards Coordination Plan - Task 3 (Gap Analysis) - Final	19 days	Tue 7/3/12	Fri 7/27/12
27	Standards Coordination Plan - Task 4 (Focused SCP) - Draft	1.5 mons	Mon 6/18/12	Fri 7/27/12
28	Standards Coordination Plan - Task 4 (Focused SCP) - Final	21 days	Mon 7/30/12	Mon 8/27/12
29	**Standards Coordination Plan Activities**	**1032 days**	**Mon 10/1/12**	**Tue 9/13/16**
30	Identify Standards Coordination Stakeholder List	5 days	Thu 11/1/12	Wed 11/7/12
31	Initial Meeting with ITS Standards Program Office and Mobility Program Managers	1 day	Mon 12/3/12	Mon 12/3/12
32	**Regular ITS Standards Coordination Meetings**	**661 days**	**Mon 2/4/13**	**Mon 8/17/15**
33	Regular ITS Standards Coordination Meetings 1	1 day	Mon 2/4/13	Mon 2/4/13
34	Regular ITS Standards Coordination Meetings 2	1 day	Mon 4/29/13	Mon 4/29/13
35	Regular ITS Standards Coordination Meetings 3	1 day	Mon 7/22/13	Mon 7/22/13
36	Regular ITS Standards Coordination Meetings 4	1 day	Mon 10/14/13	Mon 10/14/13
37	Regular ITS Standards Coordination Meetings 5	1 day	Mon 1/6/14	Mon 1/6/14
38	Regular ITS Standards Coordination Meetings 6	1 day	Mon 3/31/14	Mon 3/31/14
39	Regular ITS Standards Coordination Meetings 7	1 day	Mon 6/23/14	Mon 6/23/14
40	Regular ITS Standards Coordination Meetings 8	1 day	Mon 9/15/14	Mon 9/15/14
41	Regular ITS Standards Coordination Meetings 9	1 day	Mon 12/8/14	Mon 12/8/14
42	Regular ITS Standards Coordination Meetings 10	1 day	Mon 3/2/15	Mon 3/2/15
43	Regular ITS Standards Coordination Meetings 11	1 day	Mon 5/25/15	Mon 5/25/15
44	Regular ITS Standards Coordination Meetings 12	1 day	Mon 8/17/15	Mon 8/17/15
45	Finalize/Modify DMA Program Concept of Operations Documentation	66 days	Mon 10/1/12	Mon 12/31/12



[Source: Science Applications International Corporation (SAIC), February 24, 2012.]

Figure 4-2. Milestones and Schedule for DCM/DMA ITS Standards Coordination (continued)

ID	Task Name	Duration	Start	Finish
46	Finalize/Modify DCM Program Concept of Operations Documentation	66 days	Mon 10/1/12	Mon 12/31/12
47	Finalize/Modify DMA Program System Requirements Documentation	66 days	Tue 1/1/13	Tue 4/2/13
48	Finalize/Modify DCM Program System Requirements Documentation	66 days	Tue 1/1/13	Tue 4/2/13
49	Develop/Assemble IDTO Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
50	Develop/Assemble INFLO Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
51	Develop/Assemble Enable ATIS Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
52	Develop/Assemble R.E.S.C.U.M.E. Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
53	Develop/Assemble FRATIS Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
54	Develop/Assemble M-ISIG Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
55	Develop/Assemble DCM Application Interface Requirements	88 days	Wed 4/3/13	Fri 8/2/13
56	Identify and Secure Funding	6 mons	Tue 12/4/12	Mon 5/20/13
57	Connected Vehicle Standards Website Development	10 days	Mon 6/3/13	Fri 6/14/13
58	**Connected Vehicle Standards Website Updates**	**461 days**	**Fri 11/1/13**	**Fri 8/7/15**
67	Meeting with IEEE	1 day	Mon 8/5/13	Mon 8/5/13
68	Meeting with SAE	1 day	Mon 8/12/13	Mon 8/12/13
69	Meeting with APTA	1 day	Mon 8/19/13	Mon 8/19/13
70	Meeting with ANSI	1 day	Mon 8/26/13	Mon 8/26/13
71	Meeting with AASHTO, ITE and NEMA	1 day	Mon 9/2/13	Mon 9/2/13
72	Meeting with ASTM	1 day	Mon 9/9/13	Mon 9/9/13
73	Develop Agreement/MOU with IEEE	66 days	Tue 8/6/13	Tue 11/5/13
74	Develop Agreement/MOU with SAE	66 days	Tue 8/13/13	Tue 11/12/13
75	Develop Agreement/MOU with APTA	66 days	Tue 8/20/13	Tue 11/19/13
76	Develop Agreement/MOU with ANSI	66 days	Tue 8/27/13	Tue 11/26/13
77	Develop Agreement/MOU with AASHTO, ITE and NEMA	66 days	Tue 9/3/13	Tue 12/3/13
78	Develop Agreement/MOU with ASTM	66 days	Tue 9/10/13	Tue 12/10/13
79	IEEE Standards Development/Modification	18 mons	Wed 11/6/13	Tue 3/24/15
80	SAE Standards Development/Modification	18 mons	Wed 11/13/13	Tue 3/31/15
81	APTA Standards Development/Modification	18 mons	Wed 11/20/13	Tue 4/7/15
82	ANSI Standards Development/Modification	18 mons	Wed 11/27/13	Tue 4/14/15
83	AASHTO, ITE, NEMA Standards Development/Modification	18 mons	Wed 12/4/13	Tue 4/21/15
84	ASTM Standards Development/Modification	18 mons	Wed 12/11/13	Tue 4/28/15
85	Standards Outreach	18 mons	Wed 12/11/13	Tue 4/28/15
86	Standards Pilot Schemes/Pilot Testing	12 mons	Wed 4/29/15	Tue 3/29/16
87	Develop QA/QC Process	3 mons	Wed 12/11/13	Tue 3/4/14
88	International Standards Coordination	18 mons	Wed 4/29/15	Tue 9/13/16
89	Legislation	18 mons	Thu 12/12/13	Wed 4/29/15



[Source: Science Applications International Corporation (SAIC), February 24, 2012.]

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APPENDIX A. List of Acronyms

ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
AVL	Automatic Vehicle Locator
CAD	Computer Aided Dispatch
ConOps	Concept of Operations
COTM	Contracting Officer Task Manager
CMV	Commercial Motor Vehicle
CV	Connected Vehicle
DCM	Data Capture and Management
DMA	Dynamic Mobility Application(s)
DSRC	Dynamic Short Range Communications
EMS	Emergency Medical Services
FRATIS	Freight Advanced Traveler Information System
FSP	Freight Signal Priority
IDTO	Integrated Dynamic Transit Operations
ICM	Integrated Corridor Management
IEEE	Institute of Electrical and Electronics Engineers
INFLO	Intelligent Network Flow Optimization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
MAP-21	Moving Ahead for Progress in the 21st Century Act
MAPSS	Mobile Accessible Pedestrian Signal System
M-ISIG	Multi-Modal Intelligent Traffic Signal System
NTCIP	National Transportation Communications for ITS Protocol
PREEMPT	Emergency Vehicle Preempt
QA	Quality Assurance
QC	Quality Control
PCB	Professional Capacity Building
PSAP	Public Safety Answering Point
R.E.S.C.U.M.E.	Response, Emergency Staging and Communications, Uniform Management, and Evacuation
RWMP	Road Weather Management Program

SDO	Standards Development Organization
SEP	Systems Engineering Process
SRI	Smart Roadside Initiative
TSP	Transit Signal Priority
USDOT	United States Department of Transportation
VDT	Vehicle Data Translator
VII	Vehicle Infrastructure Integration

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