Prioritizing Candidate Connected Vehicle Standards: Candidate Approach and Methodology to Determine USDOT Future Support & Activities

U.S. Department of Transportation

Overview

The US Department of Transportation's (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) is developing a plan to guide our ITS standards-related efforts and activities in support of the USDOT ITS connected vehicle research program and to support broad deployment of connected vehicle (CV) technologies.

As part of this effort, ITS-JPO is developing a *Connected Vehicle Reference Implementation Architecture* (CVRIA), a reference architecture that will support ongoing and future implementation of CV technologies. The CVRIA will be used to identify likely interfaces in a large-scale CV implementation which will be candidates for standardization. These candidate interfaces will then be used to identify candidate standards that may be used to implement those interfaces. This will serve as the foundation for a US DOT CV Standardization Plan. As this is a plan to guide governmental activity, a primary consideration is to assure that Federally –supported standardization efforts support the public interest in CV technology implementation in the US. The decision to standardize an interface, and the approach taken to do so, will reflect the USDOT's mission of promoting a connected vehicle environment as expressed in our "ITS Strategic Research Plan"[1]. The Standardization Plan will be a "living document", intended to evolve as ITS technologies, implementation strategies, and policies evolve.

As the USDOT launches this effort, this document provides an overview of a *candidate* approach and methodology for prioritizing CV-related standards-related efforts and activities. USDOT seeks feedback from stakeholders on this candidate approach.

[1] http://www.its.dot.gov/strategicplan/

Standards Plan Approach

The approach for developing and maintaining a Standardization Plan evolved from an underlying objective of *supporting connected vehicle standards development in the public interest*. This approach involves three major steps: 1) prioritizing CV standards needs, which is the focus of this paper, 2) developing and executing a plan of action for high-priority standards aligned with current USDOT policy and priorities. These steps are described at a high level below, and the first step (prioritizing CV standards) is described in greater detail later in this paper.

1. *Identify CV Standards Needs and Develop Candidate CV Standards Priorities* – The methodology for prioritizing CV standards is based on analysis of alternatives approaches that are acceptable at each point where CV applications, technologies, systems, or communications interface with one another. The approach is a repeatable, transparent process. It is comprised of the following steps:
   a) Establish a prioritized list of CV applications based on USDOT and stakeholder priorities
   b) Develop the CVRIA to identify and define CV interfaces
   c) Analyze interface approaches with CV standards needs; prioritize based on appropriate criteria
   d) Validate with stakeholder.

The criteria for prioritizing the interfaces, applications, and standards were developed to reflect the USDOT's public sector role and emphasis on prioritizing activities in the public interest in implementing Connected Vehicle systems, infrastructure, and capabilities. The criteria are described on page 3 in Table 1.

2. *Develop a Standardization Plan for High-Priority CV Standards Aligned with USDOT Policy* – Based on stakeholder feedback, develop a plans of action/set of strategies for high-priority standards that describe the efforts the USDOT will undertake, the resources required, assumptions and constraints in performing the work, and sequenced/time-phased activities. Ensure that the Standardization Plan aligns with current USDOT policies and program goals and can be accomplished within resource constraints. As policies evolve, changes will be reflected in future updates to the Plan.

The prioritization in *Step 1* is not intended to be absolute; rather it is a tool to assist USDOT in prioritizing candidate interfaces and standards for development funding and support.

Prioritization Approach

The high-level approach to analyzing the CVRIA appears in **Figure 1**, below. This figure shows how interfaces will be identified and defined; prioritized; and associated with standards, which will then be prioritized. This prioritization allows the ITS JPO to focus on what are, from a public interest perspective, the most critical and urgent ITS standards issues.

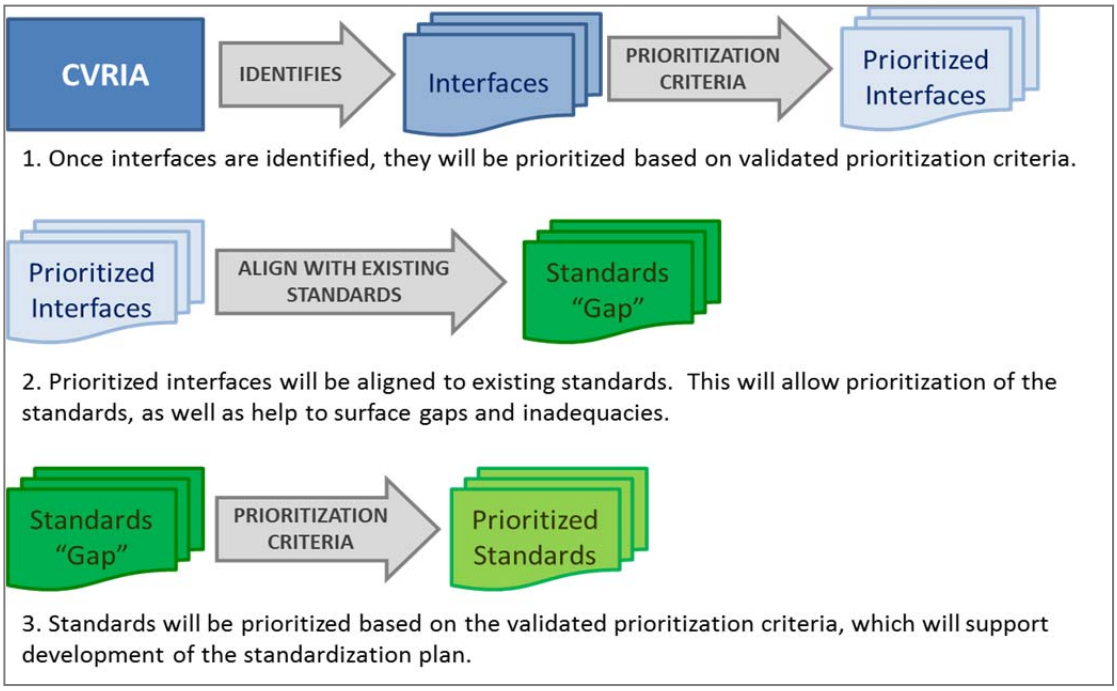

Figure 1 – Prioritization Approach

To establish the standards priorities we have developed a set of candidate criteria against which candidate interfaces and standards can be assessed. For each criterion, a weighting will be assigned to reflect the importance of that particular factor. The interfaces and standards will be then assessed by multiple stakeholders using a specified scoring system. We will then aggregate the scores and rank the interfaces to arrive at an initial prioritization. We will test this prioritization scheme by varying the scores slightly to understand key sensitivities between scores and the resulting prioritization before the prioritized list is finalized.

This approach will rely on thorough documentation of the information and data used as an input, the scoring methodology, the prioritization criteria, and the outcomes. As such, the process will be repeatable, allowing the ITS-JPO to be flexible in its use of inputs and data, while ensuring the integrity of the outcomes through a consistent and transparent process. The result will be a prioritization that reflects an objective assessment of the CV environment, and which the ITS-JPO can use as a starting point for prioritizing upcoming CV standards-related activities and support.

Prioritization Criteria

Interfaces identified in the CVRIA will be scored on three criteria, described below, that will be applied consistently across all interfaces. The detailed scoring methods are not described in this paper.

Table 1: Candidate Criteria for Prioritizing Interfaces

Interface Criteria	Description	Wt.	Inputs	Assumptions
Application Priority	Reflects the criticality of the application(s) in which the interface is present. Interfaces that support high priority applications are considered high priority by association. The scoring mechanisms will emphasize very high-priority applications as well as interfaces that support many applications. This is one of the primary means by which the prioritization reflects the USDOT's mission, and promotes the public interest.	1.8	CV applications will be captured in the CVRIA. This criterion relies on input from USDOT leadership and stakeholders to rank those applications so that they can be used to generate scores.	An agreed upon set of applications to be prioritized will be established prior to scoring. Prioritization will be based on existing information and input from stakeholders.
Implementation Timeframe	Describes the anticipated timing of interface implementation, reflecting the urgency of standardizing the interfaces. Interfaces implemented prior to, or without standards may increase interoperability risk, and increase costs associated with later adaptation/reengineering of interfaces.	1.4	This criterion relies on expert judgment to gauge the expected timeframe of the implementation.	Scores will be based on expected initial implementation within the US.
Integration Complexity	This criterion reflects the anticipated complexity of the implementation environment. Implementation in a complex environment creates a greater need for standards in order to ensure interoperability and system stability.	1.0	This criterion relies on expert judgment to evaluate the expected stability of the interface and the diversity and interdependency of the implementers.	

Once all interfaces are prioritized, they will be analyzed to determine which, if any, standards may be used to implement the interfaces. The association between interfaces and standards will not require a perfect match, or 100% suitability. Identifying and defining the gap between interface requirements and existing standards is at the core of the Standardization Plan. Furthermore, the interfaces identified and defined in the CVRIA are *candidate* interfaces that are expected to evolve.

In the event that no standard is suitable for adoption for or adaption to a given interface; a notional, not-yet-developed standard will be scored. In this case, it will be necessary to develop the framework for the notional standard. The following are the criteria that will be used to prioritize candidate standards identified.

Table 2: Candidate Criteria for Prioritizing Standards

Standards Criteria	Description	Wt.	Inputs	Assumptions
Interface Score	This criterion reflects the priority of the interface(s) that may be supported by the standard. The score is a function of the scores of the interfaces (as described above in the previous section) associated with the standard. Standards that may be used to implement the highest number of high-scoring interfaces are the highest priority.	1.6	This criterion relies on expert judgment to correctly associate interfaces with the standards that may be used to implement them.	

Standards Criteria	Description	Wt.	Inputs	Assumptions
Market Capability	This criterion reflects the expectation that an appropriate standard will develop without USDOT involvement or influence. If a standard is expected to develop without USDOT involvement, it will be given a lower prioritization.	1.3	Scoring will be based on the number of standards that might be used to implement an interface, as well as the expected requirements gap. This criterion relies on expert evaluation of CVRIA interface requirements.	When evaluating standards, the US DOT must consider the specific implications of multiple standard development, and determine if there is an interest in the USDOT promoting the adoption of a single standard and exerting control over its development.
Development Stage	This criterion describes the progress of SDOs to address a given standard. Applies to standards already under development. Standards that are complete or only require minor modification should be considered low hanging fruit. Also, the closer the standard is to adoption, the more urgent it is for USDOT to work to ensure that it meets USDOT needs.	1.0	Completeness will be judged using expert judgment of collected SMEs. Value reflects: increased urgency, limited ability to influence, lower effort-to-return.	

Expected Outputs

The final outputs of this process will be a prioritized list of standards, plus documentation of all of the inputs, scoring and results of the analysis. This will be validated against USDOT goals and objectives, and will be the starting point for developing and maintaining the Standardization Plan. The Plan will address a number of items not contained in the prioritization approach described above. These include specific actions and activities and required resources for supporting connected vehicle standards development. This information will inform decisions regarding how to optimally pursue international standards harmonization and cooperative development activities.

Additional Information & References

Additional information can be found, and feedback may be provided, using the following links.

- List of Connected Vehicle Applications and Interfaces: http://www.iteris.com/cvria/html/applications/applications.html
- Upcoming Workshops and Events: http://www.its.dot.gov/meetings.htm