Standards Gap Analysis for Cooperative Intelligent Transportation Systems

Results: Solution Perspective: Japan

Document HTG7-3-1-JP
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Standards Harmonisation Working Group
Harmonisation Task Group 7

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1. Introduction

1.1 Background

Advancements in transportation technologies are rapidly transforming the world's strategies for increasing safety; gaining operational, mobility, and cost efficiencies; opening access to underserved communities; and reducing environmental impacts from transportation. Using new forms of short-range communications, vehicles and devices are now capable of broadcasting or receiving data that allow them to sense the movements and status of other surrounding devices. These cooperative exchanges create a three hundred sixty degree awareness that, when further fused with other open data, can enable drivers and other users of the transportation system to receive alerts and warnings regarding the formation of threats and hazards. The alerts and warnings created through these communication technologies provide the opportunity to prevent some crashes, thereby reducing fatalities, injuries, and property damage. The cooperative exchange of data in this manner can also enhance the benefits of automation.

Access to new data sets can also transform network operations and minimize the capital investment costs of infrastructure owners and operators. Broadcast data sets from users within a highly mobile environment can complement or potentially supersede the need for significant roadside equipment on major roads. These new data can also form a more complete representation of conditions on the arterial network, including road weather impacts, effects of traffic signal timing, support for incident and emergency responders, or changes in traveller decisions, among other conditions.

Standards for interfaces in the public interest can play a key role in delivering these benefits to communities that implement cooperative-ITS technologies. Technical standards are developed to address coordination problems and overcome technical barriers that exist when different organizations need to work together while preserving their institutional and proprietary processes. The International Organization for Standards (ISO) defines a standard as, "… a document, established by a consensus of subject matter experts and approved by a recognized body that provides guidance on the design, use or performance of materials, products, processes, services, systems or persons." The end documents, which frequently represent the interests of the experts and parties that gather to develop them, are vetted by experts. Recognized benefits include improved safety, mobility, and sustainability for the travelling public and enhanced interoperability within an open market environment.[1]

[1] See definitions at: the European Committee for Standardization (CEN): https://www.cen.eu/work/ENdev/whatisEN/Pages/default.aspx; the International Organization for Standards (ISO): https://www.iso.org/sites/ConsumersStandards/1_standards.html; Wikipedia: https://en.wikipedia.org/wiki/Technical_standard; the National Institute of Standards and Technology (NIST): https://www.nist.gov/services-resources/standards-and-measurements.

1.2 History

In 2011, the United States (US) Department of Transportation (USDOT) and the European Commission (EC) approved a **Harmonisation Action Plan** to guide EC-US standards development via Harmonisation Task Groups (HTGs). The plan recognises that successful, interoperable, nationwide or regional, cooperative technology implementations are critically dependent upon consistent application of complete, technically sound standards and policies for critical functions, interfaces, and ***information flows***[2]. This worldwide need applies to the common services of a cooperative systems environment as well as to global markets for vehicles, devices, and applications. While the envisioned end state appears very similar in many parts of the world, past analyses have been regional and independent in nature and have proceeded with varying levels of coordination. The HTGs allow participating countries to collaborate on technical ITS issues that are of common interest and thus leverage critical expertise and resources while potentially realizing more compatible worldwide solutions.

Transport Certification Australia (TCA) joined the HTG initiatives in January 2014 by bringing security expertise and co-leadership to the sixth HTG (HTG6).[3]

1.3 HTG7

With the emergence in 2015 of plans in the US, Europe, and Australia to develop pilot ***Cooperative Intelligent Transportation Systems*** (***C-ITS***)[4] projects, a new HTG was established to identify how existing standards could support new C-ITS installations (i.e., "standards solutions for C-ITS") and, in doing so, identify the issues in standards that could pose risks for deployers. This seventh HTG (HTG7) began in late 2015 as a joint effort between the EC, the USDOT, and TCA, with the Japan Ministry of Land, Infrastructure, Transport and Tourism (MLIT) joining in 2017.

Specifically, the objective of HTG7 was to identify standards that comprehensively support large-scale C-ITS deployments. HTG7 expects that fulfilling this objective will allow:

[2] Terms that are in ***bold italics*** in this report are defined in a companion report, the **HARTS Reference Compendium (HTG7-5)**, which defines all of the terms used throughout this report set. Terms defined in the reference compendium are bold faced and italicised within each HARTS report upon their first use.

[3] Results of HTG6 are located here: https://ec.europa.eu/digital-single-market/news/harmonized-security-policies-cooperative-intelligent-transport-systems-create-international.

[4] C-ITS is a subset of ITS that requires the mutual, secure exchange of data between *independent* trusted entities (i.e., parties that have no contractual relationship). In other words, while traditional ITS typically deals with exchanges among system components owned and managed by a single or limited number of entities; these new ITS services expand this scope to include system components (e.g., vehicles) that may be owned and managed by any number of different entities. The scope of the HTG7 analysis included the C-ITS interfaces (i.e., exchanges between parties with no contractual relationship but with security and authentication as the basis for trust) as well as the more traditional "back-office" flows (between contracted parties) that enable the provision of the C-ITS services. This architecture presents a level of connectivity suggesting an "Internet of Things" for transportation.

1. **Governments, standards organisations, and other interested stakeholders** to track ***issues*** regarding those interfaces and information flows that are of significant public interest within the C-ITS ***architecture***, facilitating engagement with experts to address them;
2. **ITS deployment teams, device manufacturers, and application developers** to identify candidate standards-based ***solutions*** that are available to them for planning, understand the issues associated with those solutions, and mitigate the risks associated with those issues in their deployments. Future ITS deployment teams around the world will have a clearer understanding about which system functions and interfaces are critical for ***interoperability*** and where standards are defined (or not yet defined) to support interoperability.

1.4 Globally Harmonised Reference Architecture

To establish a foundation for analysing standards, the international HTG7 team first developed the **Harmonised Architecture Reference for Technical Standards (HARTS).** HARTS facilitates the understanding of the applicability of standards (ITS standards and other Information and Communications Technology (ICT) standards) for the successful implementation of ***C-ITS services***[5]. HARTS provided the framework for the HTG7 team to identify key interfaces that need to be standardised in the public interest and served as the basis for performing the ***gap*** and ***overlap*** analysis of C-ITS standards for those interfaces.

HARTS is an internationally harmonised reference architecture based on:

- **National ITS Architecture Framework (NIAF) from Australia**
- **EU's Framework Architecture (FRAME) from Europe**
- **Connected Vehicle Reference Implementation Architecture (CVRIA) from the US**
- **C-ITS architecture constructs from Japan**

The body of work produced by HTG7 includes key resources for industry, such as HARTS and the accompanying HTG7 reports. These tools not only provide a starting point for the ITS community to address the technical and interoperability challenges that face wide-scale ITS deployment; but also provide tactical guidance on standards, solutions, and risks for current or near-term project teams planning and implementing ITS systems. Although the reports are based on a globally harmonised ***reference architecture***, they formally recognise and accommodate regional and local approaches to ITS services, solutions, and standards.

1.5 Format of HTG7 Reports

The results summarized in this Executive Summary are presented in greater detail in the HTG7 series of reports:

- **Executive Overview (HTG7-1)** - A high-level summary of the approach, process and the key results of HTG7.

[5] For the purpose of this report, the term "C-ITS service" is intended to include all ITS services encompassed by the HARTS service packages; at the time of publication 34 are available on the HARTS website (http://htg7.org).

- **Analysis Methodology (HTG7-2)** - Presents the HTG7 methodology used to develop HARTS, perform the gap analysis, and develop proposed resolutions.
- **Issues and Proposed Resolutions (HTG7-3, this document)** - Summarises the issues identified through HTG7 analysis and proposes actions to resolve the issues. It introduces a series of more detailed reports, detailed below, each of which identifies the same set of proposed resolutions but adopts a presentation format and includes details relevant to a different perspective.
    - **Results: Solution Perspective for Deployers (HTG7-3-1-AU, HTG7-3-1-EU, HTG7-3-1-JP, HTG7-3-1-US)** - Addresses development or implementation teams in their planning and procurement processes. This detailed report lists each solution along with its associated issues and proposed resolutions and is divided into four regional sub-reports, one for each participating region. (The region is reflected by the appended 2-letter region code[6]).
    - **Results: Resolution Perspective for Standards Developers (HTG7-3-2)** - Presents each proposed resolution along with its associated issues and the data exchanges affected by these issues. This detailed report can assist standards development communities and governments in their planning and work processes.
    - **Results: Service Package Perspective (HTG7-3-3-AU, HTG7-3-3-EU, HTG7-3-3-JP, HTG7-3-3-US)** - Offers road operators the opportunity to evaluate the "readiness" of ***service packages***. This detailed report lists each service package, the data exchanges contained within the service package, and the issues associated with each solution for each data exchange. In this respect, this report helps deployers understand the levels of risk due to the standards gaps. The report is divided into 4 regional reports, one for each participating region. (The region is reflected by the appended the 2-letter region code[6]).
- **HARTS Website Overview (HTG7-4)** - Provides an overview of the HARTS public website, available at http://htg7.org. It describes each aspect of the website and provides instructions on how to submit comments about the information on the website.
- **HARTS Reference Compendium (HTG7-5)** - Provides reference material including:
    - A glossary of terms and associated definitions
    - Acronyms and associated meanings
    - Graphic symbols and associated meanings
    - Explanations of key terms and their inter-relationships

[6] As defined by ISO 3166-1:2013 *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

1.6 Conventions

While the HTG7 Report set was developed using United Kingdom (UK) English, the HARTS (toolset and website) was developed using US English. Whenever an extract from HARTS is presented within the HTG7 Report set, it will retain its US English spelling.

As noted in footnote 2 on page 2, this report is supplemented by the HARTS Reference Compendium (HTG7-5), which defines all of the terms used throughout this report set. Terms defined in the reference compendium are bold faced and italicised within each HARTS report upon their first use.

1.7 Purpose of this Document

This document, **Results: Solution Perspective: Japan** (HTG7-3-1-JP), is one of nine detailed reports designed to report the issues found and their proposed resolutions, each from a unique perspective. They are adjuncts to the Summary of Issues and Proposed Resolutions (HTG7-3) report, which summarises the results of the HTG7 analysis, summarises the key issues identified during the analysis, and provides a comprehensive set of proposed and prioritised resolutions. The nine detailed reports offer three different technical perspectives, with two of those perspectives further broken out into the four regions encompassed by the HTG7 analysis. The specific detailed reports are as follows:

- **Solution Perspective:** Assists implementation teams in understanding the issues surrounding each solution contained within the HARTS analysis; there is one detailed report for each of the four regions covered by the HARTS analysis. The name of each of the four reports will have a two-letter identifier (-AU, -EU, -JP or -US) at the end of the report identifier and the electronic filename.
- **Resolution Perspective:** Provides an overarching view of the work that still needs to be completed to provide a fully interoperable C-ITS environment and is intended primarily for standards development organisations and governmental entities.
- **Service Package Perspective:** For entities that are deploying C-ITS, such as governmental agencies, product vendors and others that are interesting in the complete end-to-end implementation of an ITS service package; there is one detailed report for each of the four regions covered by the HARTS analysis. The identifier of each of the four reports will have a two-letter identifier (-AU, -EU, -JP or -US) at the end of the report title and the electronic filename.

Please note that each of these detailed reports is extremely large and therefore not intended for printing.

2. Report Perspective

There is a separate regional report within this detailed report collection for each of the participating regions: Australia, the European Union, Japan and the United States. In accordance with guidance in ISO 42010-2011, "*Systems and software engineering — Architecture description*", this detailed report is designed to address a specific set of concerns, or perspective, of a specific group of stakeholders.

This detailed report provides the solution perspective for Japan. It provides a table of HARTS analysis results structured to provide insight to project teams within Japan who are tasked with assessing, designing, and deploying standards-based solutions when deploying new, or augmenting existing, service packages.

This detailed report is intended to assist these teams in the implementation of specific solutions. This guidance provides an awareness of the issues and associated risks associated with each potential solution. Once a project team is aware of the issues, they will be better prepared to develop appropriate and effective workarounds.

To assist this type of project team, the results in this detailed report are organised by solution, listing each issue/proposed resolution pair that is applicable to the solution. Under each issue/ proposed resolution pair that is applicable to the solution, the detailed report then alphabetically lists each ***information triple*** (***source***, ***destination*** and information flow) that uses the solution and is associated with the indicated issue/ proposed resolution pairs. This is summarised in Figure 1.

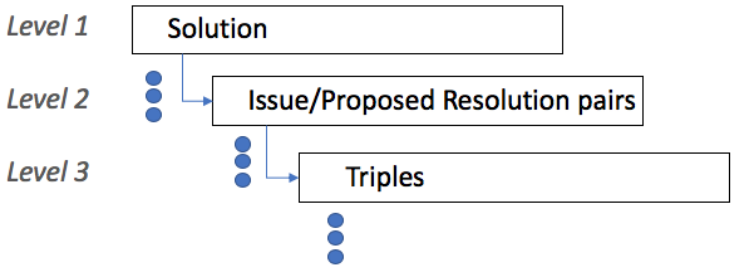

Figure 1: Solution Perspective Overview

3. Report Structure

As shown in Figure 1 above, there are multiple levels within the detailed report. Each level will consist of one, or possibly two, header rows followed by one or more content rows. Given the multi-level detailed report structure, higher-level sorting fields are typically displayed in header rows (e.g., at the start of the detailed report and when values change) while the lowest-level sorting fields may only appear in content rows. When the header field value is changed, the page header for each subsequent page is changed accordingly. Figure 2 below illustrates the detailed report structure, and each field included in the detailed report is subsequently defined in Table 1.

Level 1

Solution Name:	Text	Number of Issues:	5	Total Issue Severity:	54
text					

Level 2

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
text	text	Ultra	text	text	Urgent	AU, EU

Level 3

Information Triples using this solution and affected by this issue that would be addressed by this Proposed Resolution		
Source	Destination	Flow
Source 1	Destination 1	Flow 1
Source 1	Destination 2	Flow 1
Source 2	Destination 5	Flow 23
Source 3	Destination 9	Flow 45

Figure 2: Solution Perspective Report Structure

The following table contains the field name, its description and its value range for each of the detailed report fields in Chapter 4. They are listed in the table below according to the order in which they appear in the detailed report in Chapter 4. Additionally, the table also shows the sorting criteria used for the detailed report, including the order of sorting fields, the sorting method used, and the sort direction.

Table 1: Solution Perspective Report Field Descriptions

Report Level	Field Information			Sort Criteria		
	Title	Description	Value Range	Order	Measure	Direction
1	**Solution Name**	The name of the solution expressed as a hyphenated concatenation of the HARTS ***data profile*** and the HARTS ***communication profile*** that collectively define the solution.	ASCII[7]	1	Alphabetic	↓
	Number of Issues	A count of the issues that have been assigned to the solution.	Non-negative integer	–	–	–
	Total Issue Severity	The sum of the severity rating values of all issue instances associated with the solution. The severity rating value for each severity level is assigned below: 1. Low = 1 2. Medium = 3 3. High = 8 4. Ultra = 32	Non-negative integer	–	–	–
	Solution Description	A summary description of the information flow. NOTE: Only the description text is displayed; the title of this field is not shown.	ASCII	–	–	–
2	**Issue**	The name of the issue, which will correspond to one of the 43 defined issue types.	ASCII; See HTG7-5 for a complete list of issue types.	3	Alphabetic	↓
	Issue Description	A textual description of the issue type.	ASCII	–	–	–

[7] ASCII (American Standard Code for Information Exchange)

Report Level	Field Information			Sort Criteria		
	Title	Description	Value Range	Order	Measure	Direction
	Issue Severity	An indication of how severe the issue is deemed to be. If the severity of the issue needs to be decided when assigning the issue, multiple issues can be created with slightly different names and definitions. For example, “Data may not be fully defined (low)” and “Data not fully defined (medium)”.	Ordered List (Ultra, High, Medium, Low)	2	List Order	↓
	Proposed Resolution	The name of the proposed resolution, which will correspond to one of the 112 defined proposed resolutions.	ASCII	–	–	–
	Resolution Description	A description of the proposed resolution.	ASCII	–	–	–
	Timeframe	The timeframe in which the proposed resolution needs to be addressed in order to eliminate, or mitigate, the associated issues(s) which will facilitate wide-scale deployments of impacted solutions, information triples and service packages.	Ordered List (Urgent, Near-Term, Medium-Term, Future)	–	–	–
	Applicability	The HARTS region or regions in which the proposed resolution is relevant.	Multiple from the following list (AU, EU, JP, US)	–	–	–
3	**Source**	The HARTS ***physical object*** that is the source of the information in the flow. The combination of the source, destination and the information flow constitute the “information triple”.	ASCII	4	Alphabetic	↓

Report Level	Field Information			Sort Criteria		
	Title	Description	Value Range	Order	Measure	Direction
	Destination	The HARTS physical object that is the destination of the information in the flow. The combination of the source, destination and the information flow constitute the “information triple”.	ASCII	5	Alphabetic	↓
	FlowName	Name for the information that is exchanged between two physical objects in the ***physical view*** of HARTS. Information flows and their communication requirements define the interfaces which formed the basis for the standards analysis conducted by HTG7. The combination of the source, destination and the information flow constitute the “information triple”.	ASCII	6	Alphabetic	↓

4. Report Content

The table of results is shown below.

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HTG7-3-1-JP: Solution Perspective Japan

Wednesday, December 19, 2018
11:51:47 AM

Solution Name:	JP: F-V Short Range Wireless Data(JP) - F-V Short Range Wireless Downlink Comm (JP)	Number of Issues:	2	Total Issue Severity:	6

Solution Name:	JP: F-V Short Range Wireless Data(JP) - F-V Short Range Wireless Downlink Comm (JP)	Number of Issues:	2	Total Issue Severity:	6

This solution is used within the Japan. It combines standards associated with JP: F-V Short Range Wireless Data(JP) with those for JP: F-V Short Range Wireless Downlink Comm (JP). The JP: F-V Short Range Wireless Data(JP) standards include F-V shrort Range Wireless data format standard. The JP: F-V Short Range Wireless Downlink Comm (JP) standards include F-V DSRC communication standars used in japan.

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
Security inadequate	The solution does not provide adequate communications security for the information triple, which potentially jeopardizes C-ITS operations.	Medium	V-L: Develop security requirements for DSRC communication (AIRB-T75)	Current security requirements for DSRC are only a general guideline. Detailed security requirements need to be developed.	Near-term	Japan

Information Triples using this solution and affected by this Issue that would be addressed by the Proposed Resolution

Source	Destination	Flow Name
Connected Vehicle Roadside Equipment	Transit Vehicle OBE	vehicle signage data
Connected Vehicle Roadside Equipment	Vehicle OBE	lane closure information
Connected Vehicle Roadside Equipment	Vehicle OBE	reduced speed notification
Connected Vehicle Roadside Equipment	Vehicle OBE	road weather advisories
Connected Vehicle Roadside Equipment	Vehicle OBE	vehicle signage data

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
Performance not fully defined (medium)	The performance rules are not fully defined for this information flow.	Medium	V-L: US traveler information	Develop an ITS application specification for providing in-vehicle signage and other traveler information to the vehicle from the roadside. This will also need to address issues such as when and how to locally generate traveler information messages and how to sign these messages.	Urgent	United States

Information Triples using this solution and affected by this Issue that would be addressed by the Proposed Resolution

Source	Destination	Flow Name
Connected Vehicle Roadside Equipment	Vehicle OBE	lane closure information

Solution Name:	JP: V-F Short Range Wireless Data (JP) - V-F Short Range Wireless Uplink Comm (JP)	Number of Issues:	3	Total Issue Severity:	7

This solution is used within the Japan. It combines standards associated with JP: V-F Short Range Wireless Data (JP) with those for JP: V-F Short Range Wireless Uplink Comm (JP). The JP: V-F Short Range Wireless Data (JP) standards include V-F shrort Range Wireless data format standard. The JP: V-F Short Range Wireless Uplink Comm (JP) standards include V-F DSRC communication standars used in japan.

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
Security inadequate	The solution does not provide adequate communications security for the information triple, which potentially jeopardizes C-ITS operations.	Medium	V-L: Develop security requirements for DSRC communication (AIRB-T75)	Current security requirements for DSRC are only a general guideline. Detailed security requirements need to be developed.	Near-term	Japan

Information Triples using this solution and affected by this Issue that would be addressed by the Proposed Resolution

Source	Destination	Flow Name
Vehicle OBE	Connected Vehicle Roadside Equipment	vehicle ID
Vehicle OBE	Connected Vehicle Roadside Equipment	vehicle situation data

Solution Name:	JP: V-F Short Range Wireless Data (JP) - V-F Short Range Wireless Uplink Comm (JP)	Number of Issues:	3	Total Issue Severity:	7

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
Accuracy of data	The standard is missing accuracy requirements for some of its data, which may result in anomalous behaviour.	Low	V-L: Develop data accuracy requirements for probe data (DSRC-A11400)	Define accuracy requirements for probe data for various uses.	Near-term	Japan

Information Triples using this solution and affected by this Issue that would be addressed by the Proposed Resolution

Source	Destination	Flow Name
Vehicle OBE	Connected Vehicle Roadside Equipment	vehicle ID
Vehicle OBE	Connected Vehicle Roadside Equipment	vehicle situation data

Issue	Issue Description	Issue Severity	Proposed Resolution	Resolution Description	Timeframe	Applicability
Performance not fully defined (medium)	The performance rules are not fully defined for this information flow.	Medium	C-V: Situation data	Develop an internationally acceptable ITS application specification for the use case of distributing collected situation data (e.g., BSMs/CAMs, sensors, probe data, etc.) between vehicles and remote interested parties (e.g., centres).	Urgent	Australia, European Union, United States

Information Triples using this solution and affected by this Issue that would be addressed by the Proposed Resolution

Source	Destination	Flow Name
Vehicle OBE	Connected Vehicle Roadside Equipment	vehicle situation data