Standards Gap Analysis for Cooperative Intelligent Transportation Systems

HARTS Website Overview

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Standards Harmonisation Working Group
Harmonisation Task Group 7

Harmonisation Task Group 7 Project Team	
Gianmarco Baldini	European Commission's Joint Research Centre
Hans-Joachim Fischer	Fischer Tech
Chuck Gendry	Iteris
Junichi Hirose	Highway Industry Development Organisation (HIDO)
Ron Ice	Ice & Associates
Tom Lusco	Iteris
Jim Marousek	Booz Allen Hamilton
David Rowe	Transport Certification Australia (TCA)
Ken Vaughn	Trevilon
Jason Venz	Queensland Transport & Main Roads
Takeshi Wada	Highway Industry Development Organisation (HIDO), formerly
William Whyte	Onboard Security
Bob Williams	Consultancy Services International (CSI)
Harmonisation Task Group 7 Leadership	
Knut Evensen	Q-Free, European Commission
Peter Girgis	Transport Certification Australia (TCA), formerly
Wolfgang Höfs	European Commission: DG Communication Networks, Content and Technology
Shinji Itsubo	National Institute for Land and Infrastructure Management (NILIM) – Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan
Phillip Lloyd	Transport Certification Australia (TCA)
Steve Sill	US Department of Transportation (USDOT)
Suzanne Sloan	US Department of Transportation (USDOT)

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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, this document)** - Presents the HTG7 methodology used to develop HARTS, perform the gap analysis, and develop proposed resolutions.
- **Issues and Proposed Resolutions (HTG7-3)** - 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, **HARTS Website Overview (HTG7-4)**, describes the HARTS website, which was developed by HTG7 to identify standards that comprehensively support large-scale C-ITS so that:

- Implementers can identify candidate standards for implementing specific interfaces and to identify known issues regarding those standards as they relate to the specific interface;
- Governments, standards organisations, and interested stakeholders can identify and manage known issues with standards that are of significant public interest so that they can be addressed in a timely and efficient manner.

2. Overview

The HARTS website is intended to assist the ITS industry in the development and successful deployment of interoperable standards. Industry experts are encouraged to use the site, but we realise that the state of standards development is in constant flux. As such, users should be aware that information on the site may be somewhat dated. The HTG7 Team is interested in receiving feedback from the ITS standards community regarding the technical accuracy of the information presented on the website. Users are encouraged to contact the HTG7 team at htg7@dot.gov to alert us to any information that appears to be incorrect or out-of-date.

The HARTS website is available at http://htg7.org/. The website home page includes a hyperlinked table of the HARTS service packages that provide the entry point to the detailed content, as partially shown in Figure 1.

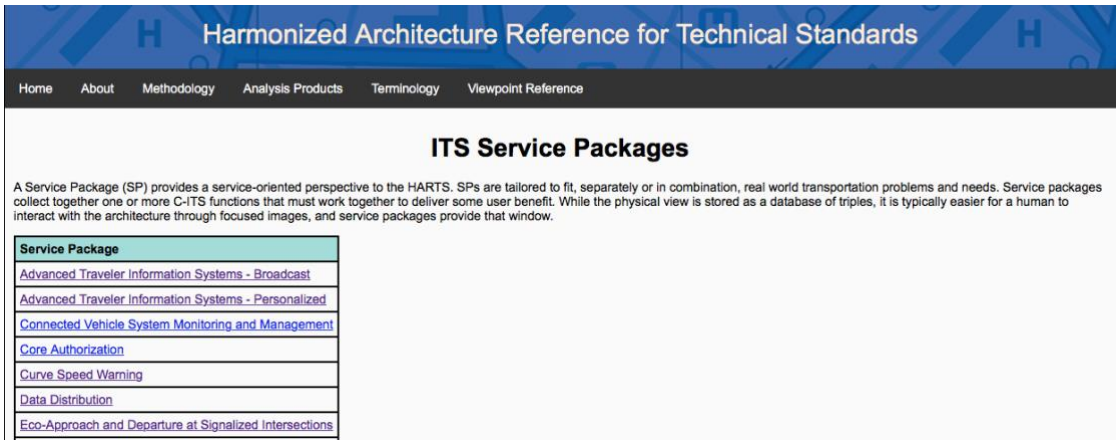

Figure 1: Partial Listing of Service Packages

The contents of the HARTS architecture is largely based on:

- National ITS Architecture Framework (NIAF) from Australia
- European ITS Framework Architecture (FRAME)
- Connected Vehicle Reference Implementation Architecture (CVRIA[7]) from the US

The HARTS architecture is defined through the use of three distinct views, based on the corresponding views in CVRIA:

[7] Since the start of HTG7 in early 2016, the USDOT's CVRIA has been merged with the USDOT's National ITS Architecture to form the USDOT's Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), found at http://local.iteris.com/arc-it/. The Connected Vehicle content within ARC-IT is very similar to CVRIA, and ARC-IT contains these same three views.

- ***Physical View***: Depicts interactions between ***physical objects,*** such as ***vehicles, centres,*** etc.
- ***Functional View:*** Defines the inputs, outputs, and processes necessary to implement ITS services; this view is part of the inner structure of the architecture, and so is not directly represented on the HARTS website, but it is referenced by the ***functional objects*** contained within the physical objects in the Physical View
- ***Communication View***: Depicts the standards available to implement each specific information exchange

The HTG7 team, in cooperation with industry subject matter experts, developed the contents of the Communication View.

A complete description of the methodology used to develop HARTS can be found in the Analysis Methodology (HTG7-2) report.

3. Service Packages

Intelligent transportation systems provide benefits to external actors through the provision of specific ITS services. Benefits might include increased safety, efficiency, sustainability, comfort, etc. External actors could be the traveling public, system operators, freight operators, among others.

The current ITS landscape includes hundreds of ITS services, many of which are inter-related. The HARTS website groups these ITS services into 96 service packages based on their inter-relationships. For example, Maintenance and Construction Centre Personnel may wish to use services for:

- Monitoring and configuring ITS Roadside Equipment, such as message signs and video cameras
- Monitoring and configuring ***Connected Vehicle Roadside Equipment*** (RSEs), which handle short-range electronic communication to vehicles
- Interfacing with other centres to disseminate information to drivers

Drivers are interested in receiving relevant information, which might be generated from RSEs, Maintenance and Construction Vehicles, and/or Wide Area Information Disseminators.

Rather than analysing each ITS service in isolation, the HARTS website efficiently groups inter-related services into service packages for analysis. Throughout the remainder of this document, the service package ‘Warnings about Upcoming Work Zones’ will be used as our primary example. For a complete list of service packages see the HARTS website.

4. Physical View

The main entry point into any HARTS service package listed on the website is the Physical View**.** Each service package is described in one or more[8] ***service package diagrams***, which depict the interactions between physical objects that enable the services within the service package. Figure 3 presents the service package diagram for the 'Warnings about Upcoming Work Zone' service package, as shown on the website. To view this service package diagram from the website, scroll down the list of service packages and click on 'Warnings about Upcoming Work Zone.'

Each service package diagram depicts a set of defined physical objects that interact and exchange information to support ITS. Physical objects include ***ITS subsystems*** and ***terminators***. ITS subsystems are defined to represent the major physical components of ITS; terminators are defined to represent physical components outside of ITS that exchange data with ITS subsystems. Physical objects are represented by coloured boxes; the different colours represent different categories of physical objects (e.g., centres, field equipment, vehicles, etc.). A sample ITS subsystem is shown in Figure 2.

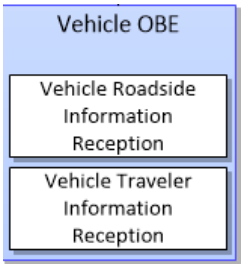

Figure 2: Sample Physical Object

The formal definition of each physical object can be found in the HARTS Reference Compendium (HTG7-5).

ITS subsystems contain functional objects, representing the Functional View, which define more specifically the functionality and interfaces that must be supported within the ITS subsystem for the particular service package. Functional objects are represented by white boxes, as depicted in Figure 4, inside of the coloured box representing the encompassing physical object, as in Figure 2. Terminators are not analysed to this level of detail and are not assigned any functional objects. Figure 3 includes two terminators, 'Driver' and 'Maint and Constr Center Personnel'. In this case, both terminators represent human operators that participate in this service, but terminators can also represent external systems (e.g., a weather service or social media).

[8] The majority of service packages are depicted in a single service package diagram linked to the name of the service package. Service packages with multiple diagrams are labelled with the service package name followed by a qualifier, such as "Advanced Traveler Information Systems - Personalised" and "Advanced Traveler Information Systems - Broadcast".

Please note the following:

1. Physical service package diagrams are hyperlinked so that the user can drill down to the communications view.
2. Some flows were not analysed. These include any flow that has a human terminator or a vehicle databus terminator, or those flows that were deemed to be outside of the public interest.
3. The formal definitions of the physical and functional objects are not provided on the website but are defined within the **HARTS Reference Compendium (HTG7-5)**
4. The diagrams are provided in two formats. SVG provides hyperlinks to the communications view, but PNG is available if SVG isn't browser supported.

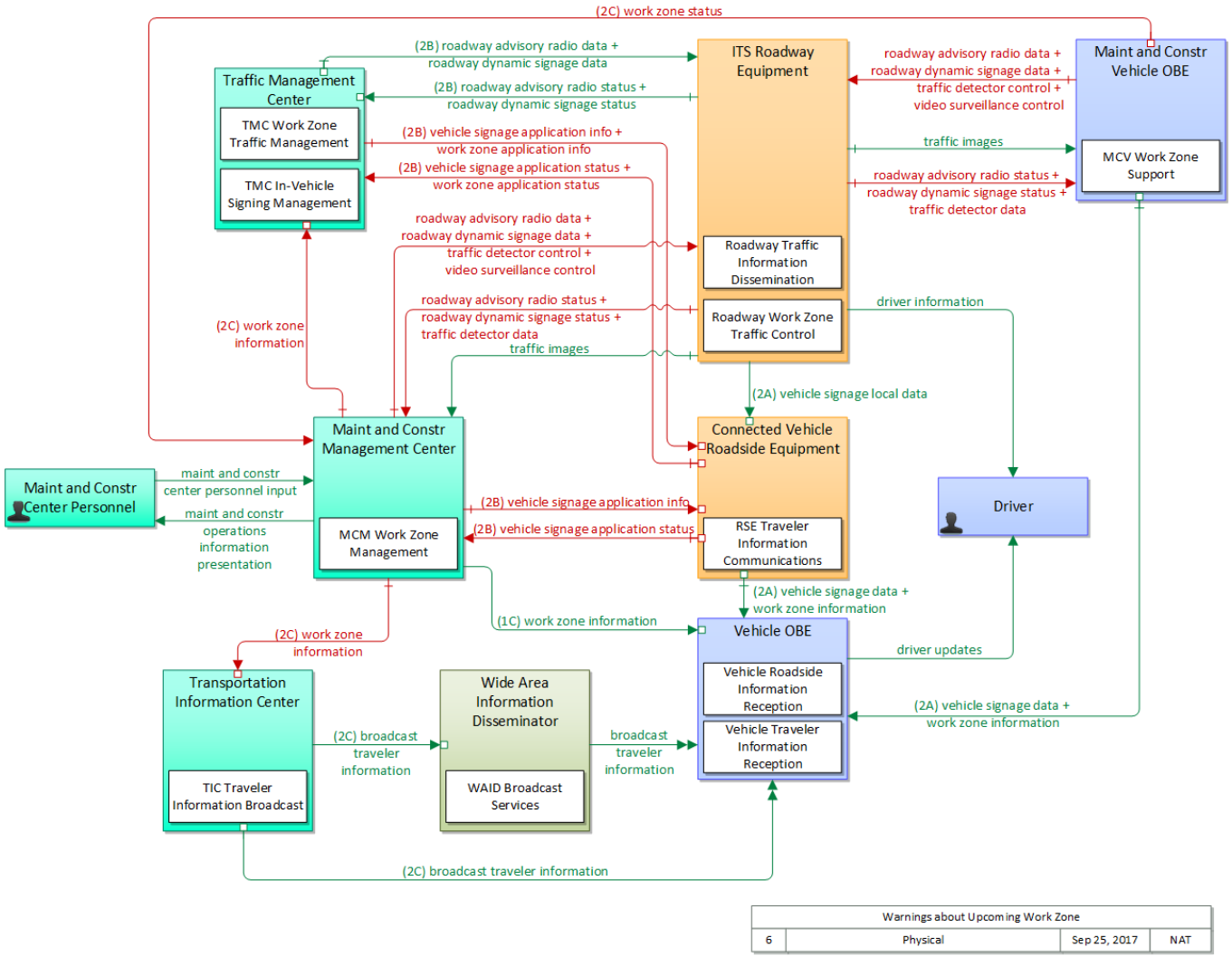

Figure 3: Sample Physical View Diagram for a Service Package

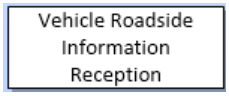

Figure 4: Sample Functional Object

The formal definition of each functional object can also be found in the HARTS Reference Compendium (HTG7-5).

Information flows define the information that must be exchanged between physical objects in order to realise ITS services. Information flows are depicted in the service package diagram as a named line, as shown in Figure 5, used to connect two physical objects.

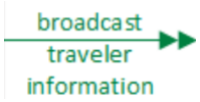

Figure 5: Sample Information Flow

A specific information flow (i.e., the named flow) may appear multiple times with different ***sources*** and/or ***destinations***. The combination of a specific information flow with a specific source (the physical object from which the line originates) and a specific destination (the physical object pointed to) is called an ***information triple***[9] (or just ***triple***). For example, in Figure 6, the ***work zone information*** information flow is depicted in three information triples (as circled in red):

- ***Connected Vehicle Roadside Equipment*** to ***Vehicle OBE***: work zone information
- ***Maintenance and Construction Management Center*** to Vehicle OBE: work zone information
- Maintenance and Construction Management Center to ***Transportation Information Center***: work zone information

[9] The naming convention for an information triple is "source to destination: information flow."

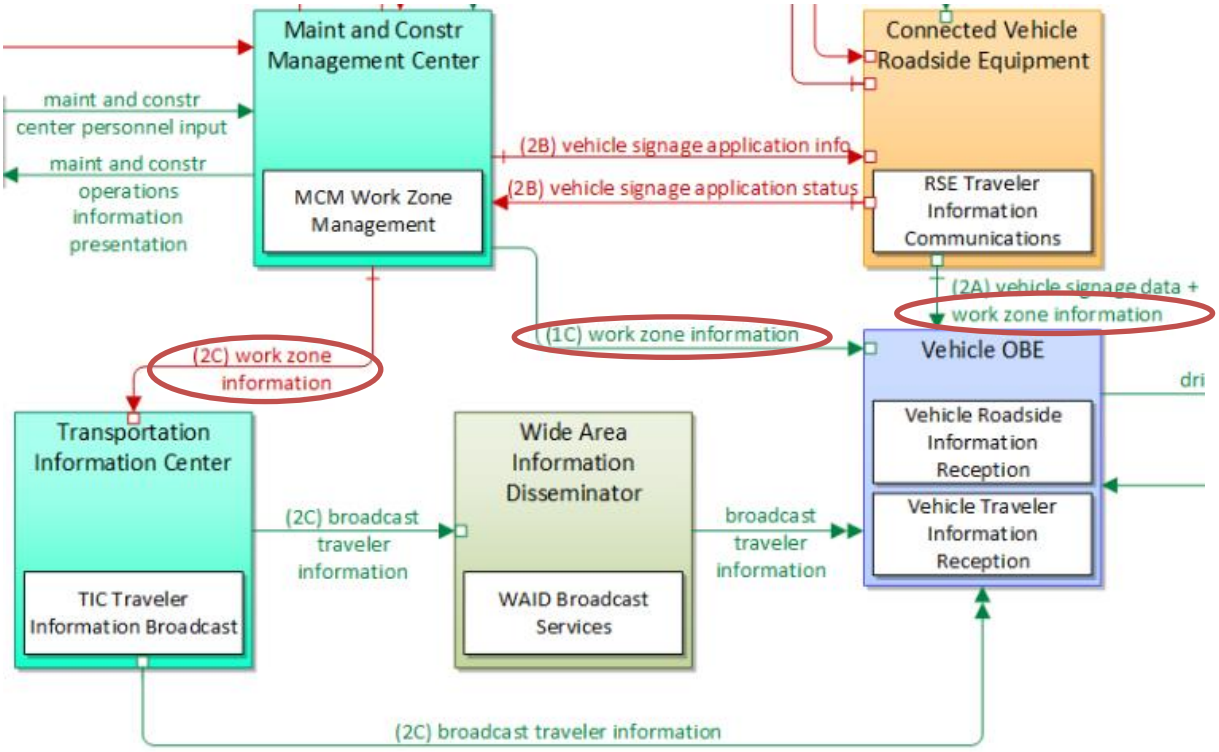

Figure 6: Identifying Information Triples Graphically

The ***broadcast traveller information*** information flow is also shown in three triples.

The depiction of each triple also conveys other information through graphical and notational shorthand. For example, a single arrowhead on a line indicates a unicast exchange while a double arrowhead indicates a broadcast exchange. A green line indicates authenticated, clear text data while a red line indicates authenticated and encrypted data.

The formal definition of each graphical and notational shorthand symbol can be found in the HARTS Reference Compendium (HTG7-5), or on the HTG7 website by selecting “Physical” under the Viewpoint Reference dropdown menu.

5. Communication View

A ***triple solution*** is a specific set of standards that specifies one way in which a data exchange might be implemented for an information triple. Each triple solution defines a precise ***communication stack*** to implement the information triple. An information triple may be realised by one or more triple solutions. On the HARTS website, a user may click on any information triple in a service package diagram (e.g., Figure 6) to see its Communication View, which includes all triple solutions that have been identified for the selected information triple.[10] Figure 7 provides a sample of a Communication View based on the 'Connected Vehicle Roadside Equipment to Vehicle OBE: work zone information' information triple depicted in Figure 6.

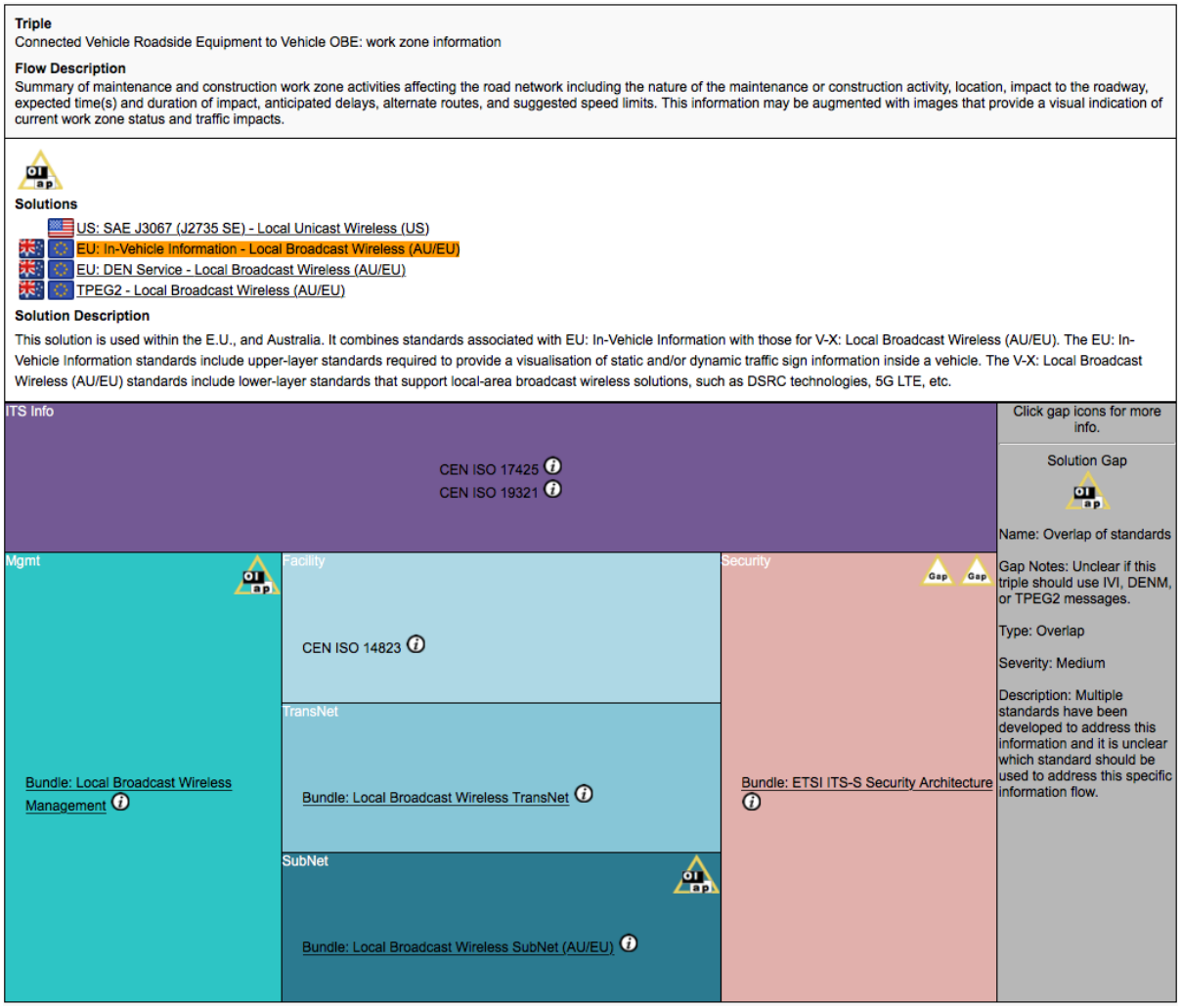

Figure 7: Sample Communication View

[10] Triple solutions have only been identified for those information triples where a standardised interface is deemed to be within the public interest.

In this example, four triple solutions are listed:

- US: SAE J3067 (J2735 SE) - Local Unicast Wireless (US)
- EU: In-Vehicle Information - Local Broadcast Wireless (AU/EU) – *highlighted in Figure 7*
- EU: DEN Service - Local Broadcast Wireless (AU/EU)
- TPEG2 - Local Broadcast Wireless (AU/EU)

Reasons that ***alternate triple solutions*** may exist include, but are not limited to:

- Regional differences (e.g., geographical regions adopting different solutions)
- Legacy issues (e.g., an existing solution with ***gaps*** and a new solution still under development)
- Competitive developments (e.g., different standards development organisations developing similar standards)

Triple solutions are depicted in order of the number and severity of issues related to the triple solution; solutions with fewer and less severe issues appear on top. In this case, only one alternative is identified for the US, while three are identified for the EU and Australia. The US solution is listed first partly due to the ***overlaps*** that exist among the other three solutions in this case.

The user is able to view the desired triple solution by selecting from those listed. Once selected, the triple solution is depicted according to the ***HARTS Reference Model***, which is similar to the ITS Station Architecture (ISO 21217:2014).

One of the main purposes of the HTG7 Gap Analysis is to identify issues in the standardised triple solutions for implementing defined triples. To identify issues, the HTG7 Analysis Team documented standardised ***solutions***, assigned them as appropriate to each triple, and then identified and documented all known issues with the triple solution.

Figure 7 lists four triple solutions, three of which were associated with Europe and Australia. Figure 8 depicts the first of these triple solutions, US: SAE J3067 (J2735 SE) – Local Unicast Wireless (US).

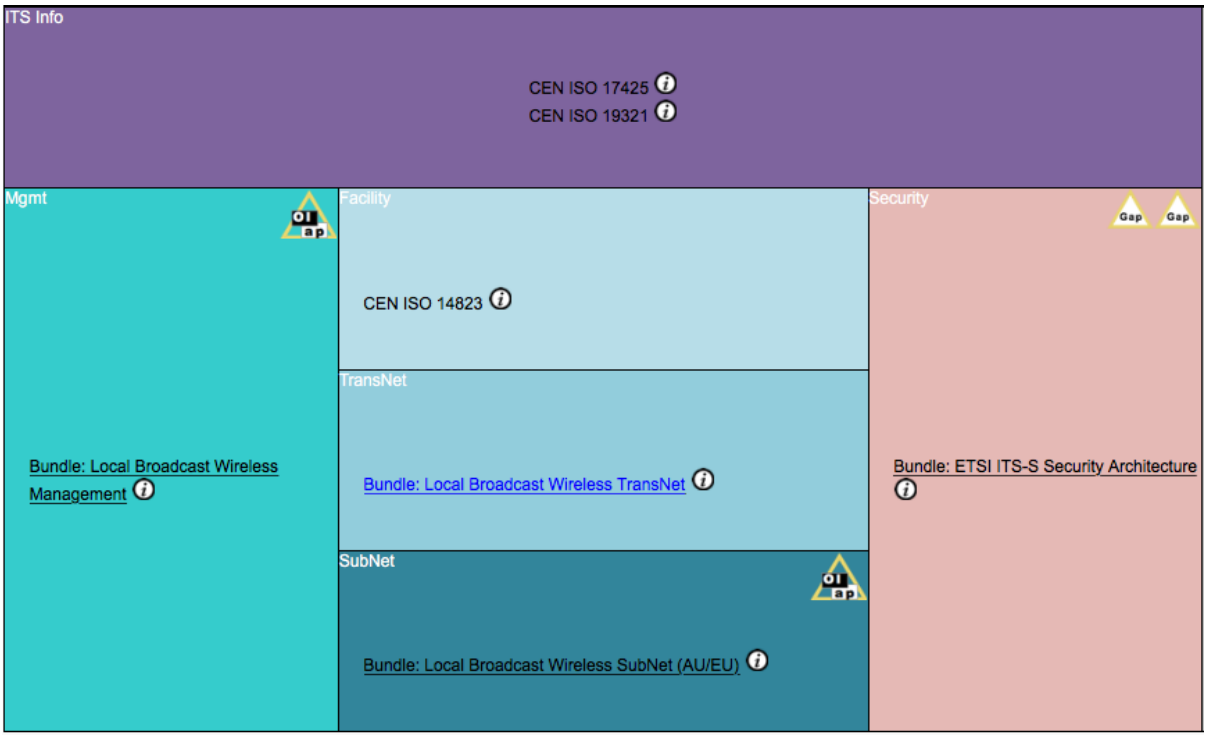

Figure 8: Sample Triple Solution

Each standard has an information icon (lowercase 'i' in a circle) next to it. Clicking on the information icon will bring up detailed information about that standard, including its full name, description, version, and Internet link. For example, clicking on the information icon next to standard CEN ISO 19321 in the 'ITS Info' box in Figure 8 will reveal detailed information on that standard, as shown in Figure 9.

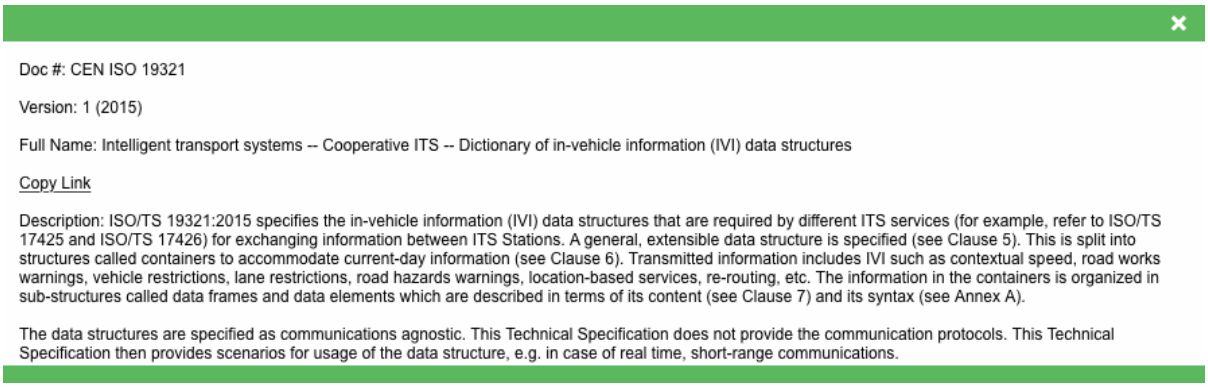

Figure 9: Sample Information Pop-up Box

In some cases, an item shown in the HARTS Reference Model may represent more than one standard. A ***bundle*** is a set of standards that work together to serve the needs of one specific layer in the HARTS Reference Model and is identified by a single name. Clicking on this name will reveal the standards contained in the bundle and their applicability (i.e., required, optional, or an alternative). Figure 10 shows an updated view of Figure 8 after clicking on each bundle in the diagram. Note that there can be bundles within bundles.

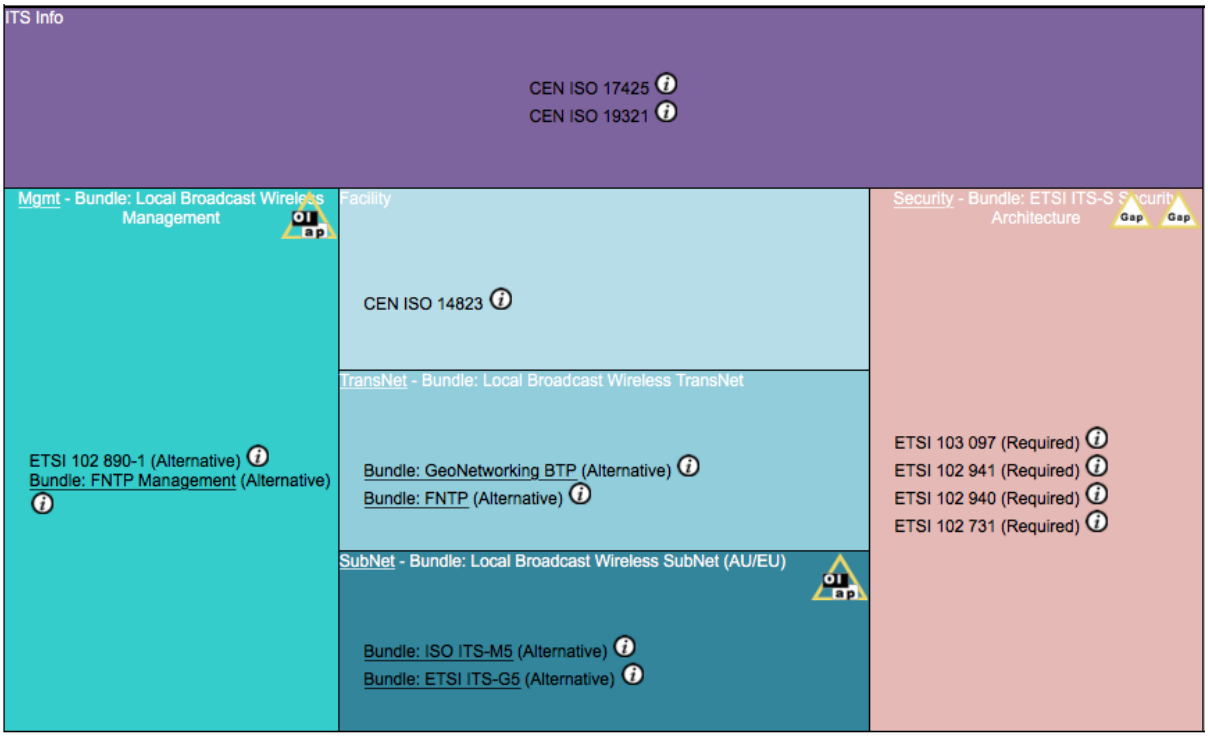

Figure 10: Sample Triple Solution, One Level Deeper

When alternatives are contained within a single layer, they are presented as a bundle known as an ***alternative set***, rather than defining completely separate ***alternative triple solutions***. For example, Figure 8 shows the ‘Bundle: Local Broadcast Wireless SubNet (AU/EU)’ at the ***SubNet Layer***. Figure 10 reveals that this bundle includes two alternatives: ’Bundle: ISO ITS-M5’ and ’Bundle: ETSI ITS-G5.’ Grouping detailed alternatives in this manner assists in reducing the number of triple solutions presented while still conveying options to the reader at an appropriate level.

6. Issues (Gaps & Overlaps)

HARTS identifies two types of known ***issues*** within triple solutions:

- ***Overlap***: The identified triple can be implemented in different ways within the defined regions based on competing standards
- ***Gap***: The identified triple solution has a missing standard or is missing details within the standard(s)

Gaps are assigned a four-tier severity code. All issues are visually denoted by a symbol as explained in Table 1.

Table 1: Issue Symbols

Shorthand	Gap Icon	Definition
Overlap		The identified information triple has multiple, competing solutions within the region(s). This issue may not prevent a pilot deployment but there is unlikely to be sufficient interoperability to enable proper, full-scale deployment. Implementers will likely need to coordinate with each other to identify how the overlap should be addressed in their pilot deployments.
Ultra Gap		No standard exists.
High Gap		The standard(s) fail to provide even a base level of interoperability and security as recommended for pilot deployments. The solution either fails to provide: • Interoperable data exchange for the triple for typical occurrences of the triple • Minimally secure communications as required by the triple A reasonably secure, interoperable deployment is not possible using only the documents identified by the solution even as a pilot project. Implementers will need to develop additional specifications to resolve the issue jointly before a successful and secure pilot can be deployed.

Shorthand	Gap Icon	Definition
Medium Gap		The identified triple solution may be sufficient for pilot deployments but fails to provide sufficient interoperability, management, and security to enable proper, full-scale deployment. For example, wide-scale interoperable deployment is hindered due to: • A limited ability to manage remote equipment • Inadequate security for a full-scale deployment • Inability to handle special cases of the information flow Implementers will likely need to coordinate with each other to identify how the issues should be addressed in their deployments and/or to ensure all parties are aware of the limitations of the deployment.
Low Gap		The identified triple solution may be sufficient for wide-scale deployment, but known issues exist that deployments should consider.
No issues	(None)	The identified triple solution is believed to be technically ready for full-scale deployment without any known issues, but complete test suites may not yet exist for the triple solution.

The issues are depicted within the portion of the HARTS Reference Model to which they relate. For example, security issues are shown as icons within the ***security plane*** of the HARTS Reference Model. When an issue applies to the solution as a whole, the icon appears above the HARTS Reference Model.

When the user clicks on any issue icon, the Communication View will display details about the issue to the right of the HARTS Reference Model, as shown in Figure 11.

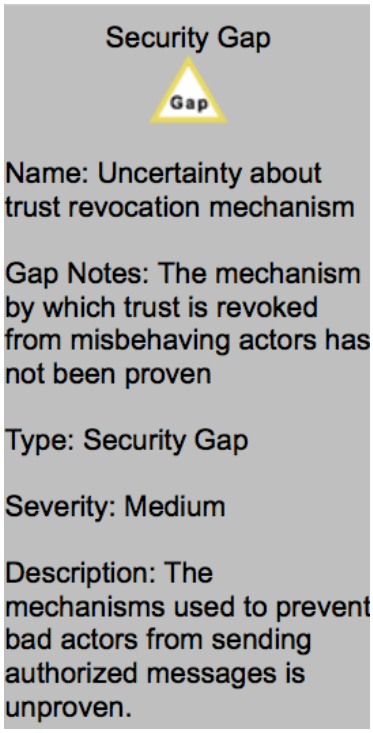

Figure 11: Sample Issue Details

Within the HARTS analysis, there are a total of 43 named issues (e.g., 'Uncertainty about trust revocation mechanism') that are assigned as needed. Each one is associated with notes recorded when it was assigned to the specific solution, an even more general issue type, a severity, and a description.

7. Website Menu

The previous sections of this document focus on the main flow and content of the website; however, the site also includes several other tabs containing valuable information as follows:

- Home: This link takes the user to the home page that summarises recent changes to the website
- About: This link provides an explanation of harmonisation task groups
    - HTG7: This link provides additional details about HTG7
- Methodology: This link provides an overview of the process used to develop the information on the HARTS website
    - Architecture: This link explains the process used to merge the various regional ***reference architectures*** into a single reference architecture as defined by HARTS
    - Standards Basis: This link explains the standards used within the analysis
    - Analysis Methodology: This link details the process used in performing the analysis
- Analysis Products[11]: This link provides an overview of the products that resulted from the analysis effort
    - Service Packages: This link presents the entire list of service packages published on the website
    - Solutions: This link provides an overview of how solutions are formed
    - Triples and Solutions: This link provides a mapping from the information flows contained in the architecture to their specific instances in triples with hyperlinks to the Communication View page that depicts the various triple solutions defined for each triple
- Terminology: The definitions of the terms used within the HARTS website
- Viewpoint Reference: This link provides an overview depicting how various elements of the Physical, Communication, and Functional Views inter-relate to one another
    - Physical: This link explains the details about the graphical symbols used to convey information within the Physical View diagram
    - Communication: This link explains the layout of the Communication View diagram
    - Functional: This link explains how an underlying Functional View serves as the basis for the Physical View
    - Enterprise: This link explains that HARTS does not currently include an Enterprise View

[11] Links to HTG7 reports are posted on this page.