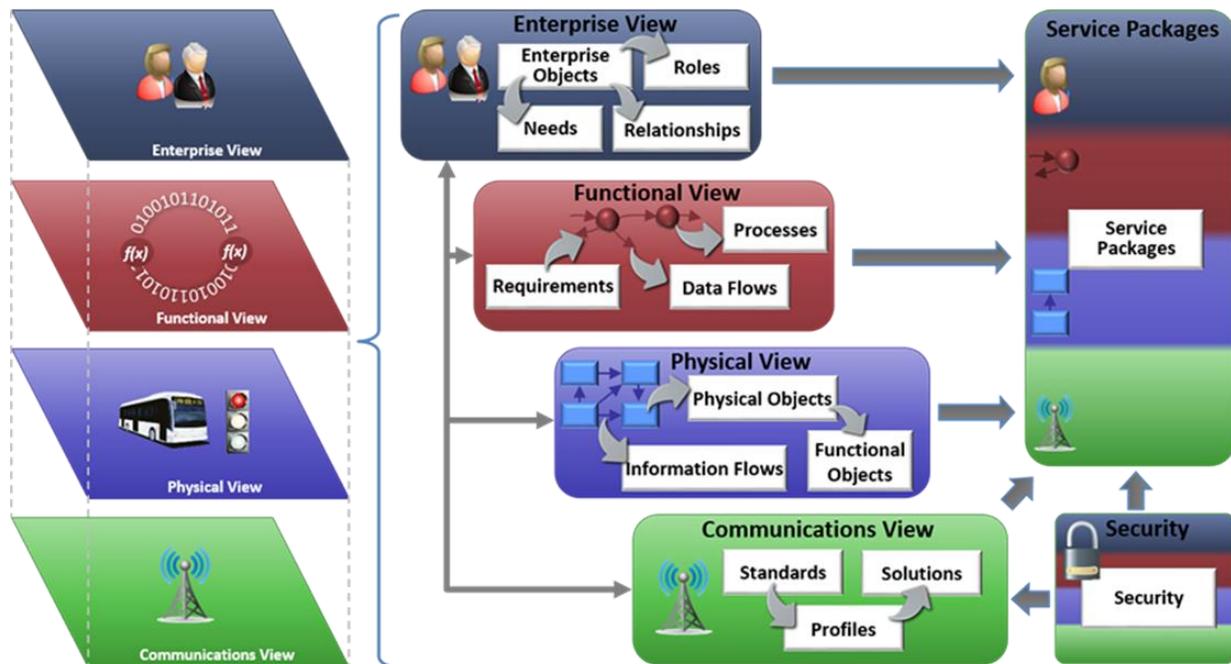


TRANSPORT CANADA

UPDATING THE ITS ARCHITECTURE FOR CANADA PHASE II – ENGLISH UPDATE AND SCOPING FOR FRENCH UPDATE

ASSESSMENT OF CURRENT DIFFERENCES AND PROPOSED UPDATE APPROACH

JULY 24, 2019



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1 INTRODUCTION

Since the last update to the *ITS Architecture for Canada*, to Version 2 in 2010, the U.S. has subsequently undergone two major revisions and integrated the *Connected Vehicle Reference Implementation Architecture (CVRIA)*.

The objective of this project is to undertake an English update of the *ITS Architecture for Canada* to re-align with the current *U.S. Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)* and incorporate the recent and substantial Connected Vehicle (CV) related enhancements. The update will provide a framework and tools that have a national and international benefit. The update will:

- Better reflect new and emerging technologies and initiatives;
- Re-align with the current *U.S. ARC-IT* to better support current and future cooperation; and
- Map to current and relevant standards.

This project focuses on developing an English Version 3 of the *ITS Architecture for Canada*, including working *RAD-IT* and *SET-IT* tools. As was similarly done for the previous Version 2 update in 2010, the choice to defer a French version is based on the following:

- Establishes an ‘Early Win’, as an English version can be prepared with less effort required (as the US architecture is in English) and with a clearer understanding of scope; and
- Establishes a baseline target for a French version, which will allow for a better understanding of the level of effort and amount of translation required.

This Technical Memorandum provides a summary of the progress to date, including the assessment of current differences between the two national architectures (see **Section 2**), and the proposed approach for updating the *ITS Architecture for Canada* (see **Section 3**).

1.1 BACKGROUND / CONTEXT

National ITS Architectures are living documents, that continue to evolve as technologies advance, new applications of technologies are identified, and best practise experience is gained. **Figure 1** illustrates the 20+ year history of the Canadian and U.S. architectures.

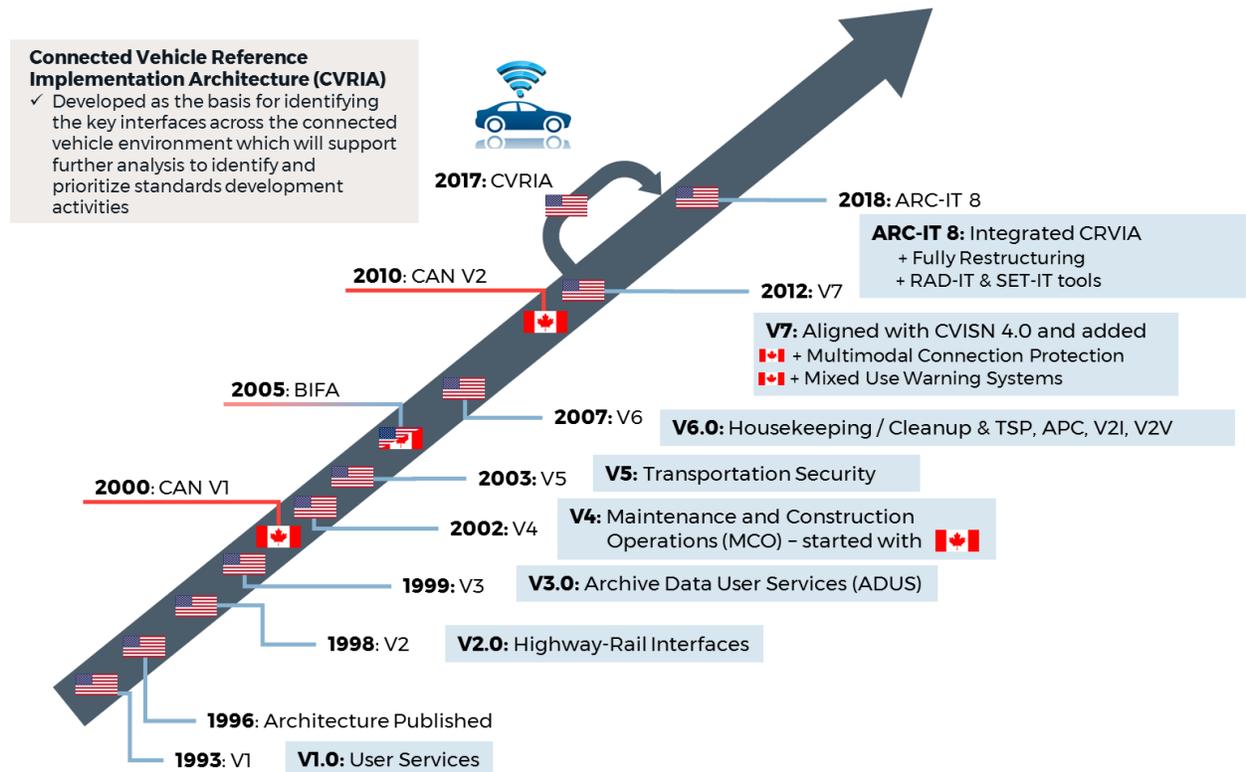


Figure 1: Evolution of the U.S. and Canadian ITS Architectures

In the late 1990s Transport Canada identified the potential need for a national guidance framework for ITS and initiated a study and assessment of current efforts at the time, including those of the U.S., Europe, Japan and others. Based on its maturity and the understandable framework structure, as well as the fact that Canada shares a border with the U.S., it was decided through a series of stakeholder outreach engagements to proceed with a compatible architecture. The resulting Version 1 of the *ITS Architecture for Canada* in 2000 essentially subsumed the entire *U.S. National ITS Architecture* at that time (i.e. Version 3), and using a similar structure developed expanded Physical and Functional (note: referred to as Logical at the time) elements to add ITS Services relating to:

- Winter Maintenance & Weather Data Collection;
- Intermodal Freight;
- Non-vehicular Road Users; and
- Automated Enforcement.

In the interim between Versions 1 and 2 of the *ITS Architecture for Canada*, the U.S. undertook three revisions, including the Version 4 that used Canada's Winter Maintenance & Weather Data Collection' services as a starting point when the developed a comprehensive set of Maintenance and Construction Operations (MCO) services.

The Version 2 update of the *ITS Architecture for Canada* began in 2009 and was completed in 2010, and realigned with the Version 6 of the U.S. based on the following principles (*note: these are similar to the principles of this current update*):

- Re-align framework structure based on U.S. as necessary;
- Sub-sum all new elements and services;
- Update and continue to support unique ‘Canadian’ services included in Canadian Version 1; and
- Update unique ‘Canadian’ services that the U.S. had added since Canadian Version 1, with the U.S. content.

Since 2010, the U.S. has undergone two major revisions and integrated the *Connected Vehicle Reference Implementation Architecture (CVRIA)* that had been developed through a separate parallel process to respond to the rapid evolution of Connected Vehicle (CV) initiatives. The *CVRIA* was developed by the U.S. ITS Architecture Team and focused on identifying the key interfaces across the connected vehicle environment, and supported the identification and prioritization of necessary standards development activities. The *CVRIA* was developed with clear consideration for the established architecture framework, but included expanded structure with additional *Communications and Enterprise Views*.

The latest U.S. architecture update fully integrated the *CVRIA* and updated existing services to services to fully support the revised structure and additional views of the *CVRIA*. Additionally, the architecture has been rebranded as *ARC-IT*, the Turbo tool for regional architecture development has been renamed *RAD-IT*, and the *SET-IT* tool that was developed as part of the *CVRIA* to support the system engineering process and project architecture development has been updated to support all the *ARC-IT* services.

Figure 2 illustrates the current status and relationship between the *ITS Architecture for Canada* and *ARC-IT*. *ARC-IT* is more up to date and has expanded services, particularly as they relate to supporting CVs, while there does remain some unique ‘Canadian’ elements in the *ITS Architecture for Canada*.

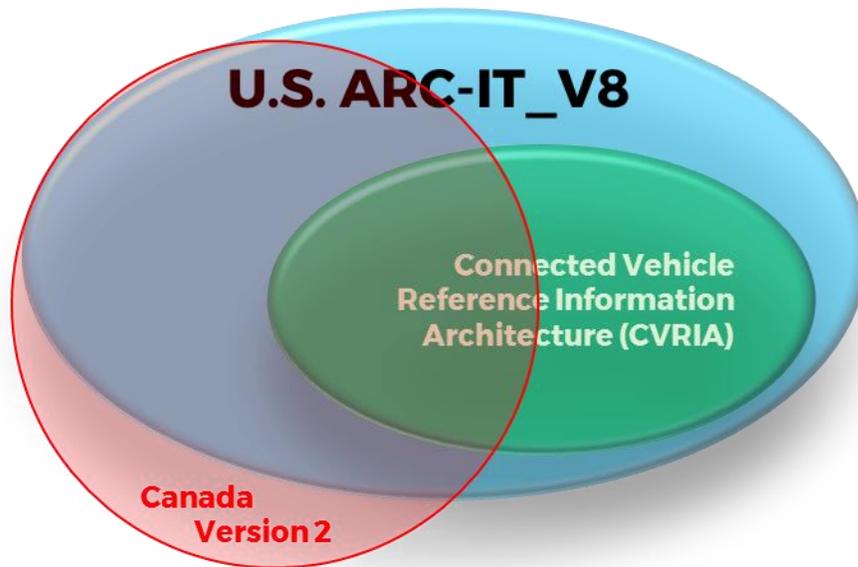


Figure 2: Current Relationship Between Canadian and U.S. ITS Architectures

Governing goals of this current Version 3 update are to realign with the U.S., while ensuring that Canadian unique elements from Version 2 of the *ITS Architecture for Canada* continue to be supported, as illustrated in **Figure 3**.

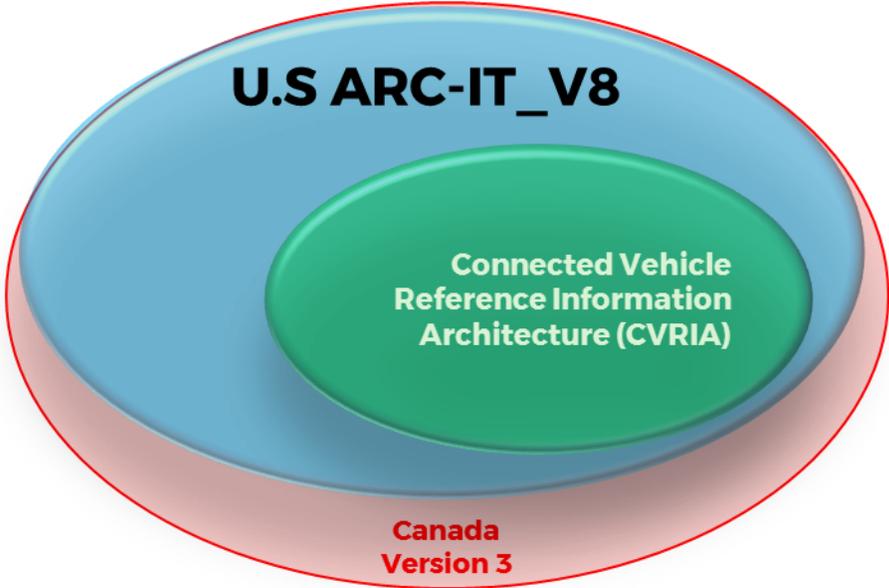


Figure 3: Goal for ITS Architecture for Canada Version 3 Update

1.2 QUICK ITS ARCHITECTURE PRIMER

Service Packages are based on deliverable ITS applications and strategies, and are common building blocks that map to each of the architecture views. Through straightforward and understandable graphic presentations of the Physical View of the architecture, Service Packages represent an entry point to a national ITS architecture. For this reason, this technical memorandum uses Service Packages as a primary reference to frame and summarize the comparisons between architectures, with a focus on the Physical View.

Figure 4 illustrates an example of such a diagram from *ARC-IT_V8* for the PT09 – Transit Signal Priority (note: diagram uses U.S. spelling).

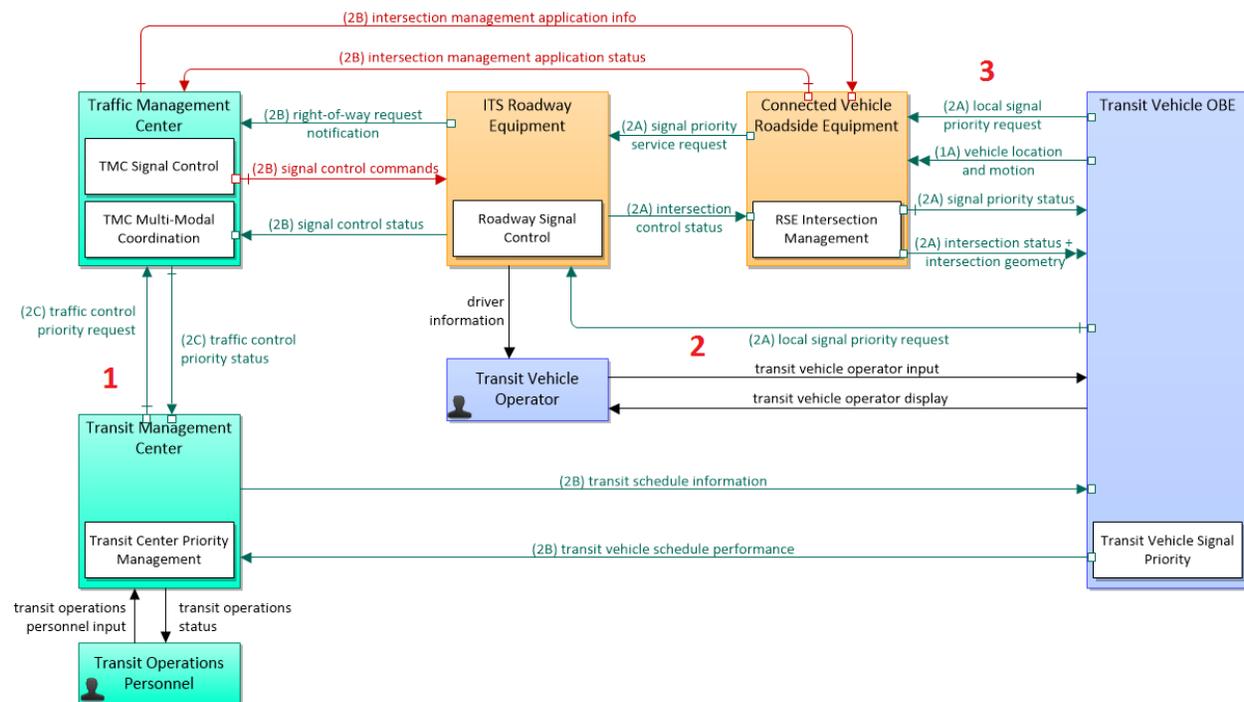


Figure 4: Example Service Package Diagram: PT09 – Transit Signal Priority

The Service Package diagram above highlights a number of key elements of an ITS architecture, including:

- **Physical Objects** – represented by the shaded boxes, are the systems and devices that provide the functionality needed to satisfy the requirements of the particular Service Package.
- **Information Flows** – represented by the connections between Physical Objects, define the interfaces and exchange of information that are required to support the particular Service Package.
- **Functional Objects** – represented by the white boxes, are the building blocks of the Physical Objects and define the functionality that is required to support the particular Service Package. *Note: functional objects were previously referred to as Equipment Packages, but for the purposes of this comparison document, the newer functional object term will be used.*
- **Triple** – as information flows are general directional, with one physical object sharing information with another, and the combination of ‘Source Physical Object → information flow → Destination Physical Object’ is commonly referred to as a triple.

Figure 4 also illustrates that a national ITS architecture provides a reference framework that is:

- Non-specific - identifying physical systems by generic terms (e.g. Traffic Management System);
- Not design prescriptive - identifying adaptable physical frameworks and in many cases multiple options for deployment, which is the case in **Figure 4**, where three different possible implementations for Transit Signal Priority, as follows:
 - 1** Local actuation based on a request from the transit vehicle in the field;
 - 2** Central actuation based on request from Transit Management Center; and
 - 3** Local or central actuation based on Vehicle-to-Infrastructure (V2I) communication.
- Functionally oriented and not technology specific allows the architecture to remain effective over time, as the functions the system performs remain the same while the technology evolves.

2.2 FUNCTIONAL COMPARISONS

As the tables in this comparison section can be quite long, each sub-section has the description and summary of findings of the various comparisons followed by the tables at the end of the sub-section, or in appendices.

2.2.1 CANADIAN UNIQUE ELEMENTS

CAN_V2 has a total of 101 Service Packages, which is ten (10) more than the 91 of US_V6 in 2010. **Table 1** (on Page 9) summarizes the ten (10) uniquely Canadian Service Packages.

In addition to the separate and unique Service Packages, there are Service Packages that are common between the Canadian and U.S. architectures where the Canadian version has expanded the beyond the U.S. application.

Table 2 (on Page 11) provides a summary of the four (4) Service Packages of CAN_V2 that are expanded functionally in comparison to that of US_V6, and highlights the unique functional objects (previously referred to as equipment package) and information flows/triples that provide the additional functionality.

To support additional functionality of the unique and modified Service Packages, the Canadian architecture includes a variety of unique elements, including physical objects, functional objects, and information flows. A complete inventory of the unique elements of CAN_V2 is included in **Appendix A**, as follows:

- *Appendix A-1: Unique Physical Objects*
- *Appendix A-2: Unique Information Flows*
- *Appendix A-3: Unique Triples*
- *Appendix A-4: Unique Function Objects*

Table 1: Unique CAN_V2 Service Packages

SP	Name	Description
APTS101	Multi-Modal Connection Protection	This service package supports the co-ordination of multimodal services to optimise the travel time of travellers as they move from mode to mode (or to different routes within a single mode). A near term function supported by this service package would be for a single transit agency to co-ordinate crossing routes so that passengers on one route would have the opportunity to transfer with minimum wait time to another route within the same transit system. The next level of complexity of this service package would be for this co-ordination to occur across transit agencies, or between transit agencies and other modes of transportation. The most advanced functions of this service package would be to track the route of an individual traveller and ensure that connections are properly scheduled on an individual basis. This final capability represents a very long-term functionality, which could be managed either through an Information Serviced Provider or through a Transit Management subsystem.
ATMS101	Dynamic Roadway Warning	This service package supports the dynamic presentation of warning information to drivers. Warnings may be generated in response to roadway weather conditions, road surface conditions, traffic conditions, obstacles or animals in the roadway, and any other transient events that can be sensed. Warnings may also be generated that recognise the limitations of a given vehicle for the geometry of the roadway, e.g. rollover risk for tall vehicles. This service package differs from “Traffic Information Dissemination” in that it is possible for all processing to occur remotely at the roadside, making this capability autonomous for remote application. It also expands the capabilities of Traffic Information Dissemination by focusing on non-traffic roadway issues.
ATMS102	Signal Enforcement	This service package supports the detection and enforcement of roadway control signals. A common implementation of this capability is “red light enforcement” for signalised intersections. Information documenting a vehicle disobeying a traffic signal is captured and conveyed to law enforcement. This service package is a logical predecessor to “Intersection Safety Warning” and “Intersection Collision Avoidance”, where the signal violation detection is also used to reduce the likelihood of a traffic accident. This same relationship also exists to “Mixed Use Warning Systems” and “Automated Non-Vehicular Road User Protection”, since pedestrians, bicyclists, and other non-vehicle traffic may be threatened by signal violations.
ATMS103	Standard Mixed Use Warning Systems	This service package supports the near term sensing and warning systems used to interact with pedestrians, bicyclists, and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways.
ATMS104	Advanced Mixed Use Warning Systems	This service package supports more advanced systems of sensing and warning for pedestrians, bicyclists and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways. Specifically, advanced imaging sensors are anticipated to provide improved sensing and recognition capabilities, which would allow automated warning or active protection systems for this class of users.

SP	Name	Description
CVO101	Freight Terminal Management	This service package supports the operation of the roadway aspects of an intermodal terminal. The “terminal” may represent the transfer point between roadway and one or more other modes of container transport (rail, air or water), and may be an actual port facility or a private intermodal transfer facility. The key capabilities include the ability to identify and control vehicle traffic entering and departing the facility, guide vehicles to loading and unloading points, maintain site security and monitor container integrity, provide an interface to Customs as appropriate, and acknowledge container pickup and drop-off. Other capabilities include the ability to track container locations within the facility and to manage any other required assets, like truck chassis. This service package may be deployed in conjunction with Weigh-in-Motion and Roadside CVO Safety to provide truck weight and safety assessments for vehicles prior to departing the facility.
CVO102	International Border Registration	This service package covers registration of importers, carriers, conveyance, and drivers for expedited clearance at the border. It represents enrollment in programs such as FAST, NEXUS, Customs Self Assessment, C-TPAT, PIP, ACI, and ACE.
CVO103	International Border Pre-Processing	This service package covers expedited pre-processing of manifest data that identifies the port of entry, date of entry, and information on the carrier, goods, origin, etc.
CVO104	International Border Inspection	This service package covers customs inspection at the border, and includes communications with the traveller card for private travellers and transponders and other electronic identification for commercial shipments.
MC101	Roadway Micro-Prediction	This service package supports advanced systems which use the data from the Roadway and Weather Data Fusion service package, along with roadway maintenance information and advanced algorithms, to create micro-predictions of roadway conditions which can support improved maintenance planning and dispatch.

Table 2: Other CAN_V2 Service Packages with Unique Elements

SP	Name	Description of Uniqueness
APTS08	Transit Traveller Information	<u>Unique Triples (Source - Flow - Destination)</u> <ul style="list-style-type: none"> Information Service Provider - transit trip request - Transit Management Multimodal Transportation Service Provider - service response - Transit Management Transit Management - transit trip plan - Information Service Provider
ATIS01	Broadcast Traveller Information	<u>Unique Triples (Source - Flow - Destination)</u> <ul style="list-style-type: none"> Border Inspection Administration - border traveller information - Information Service Provider
ATIS02	Interactive Traveller Information	<u>Unique Triples (Source - Flow - Destination)</u> <ul style="list-style-type: none"> Border Inspection Administration - border traveller information - Information Service Provider
ATMS19	Variable Speed Limit and Enforcement	<u>Unique Functional Objects (in Physical Object)</u> <ul style="list-style-type: none"> Roadway Variable Speed Limit (Roadway Subsystem) TMC Variable Speed Limit (Traffic Management) <u>Unique Triples (Source - Flow - Destination)</u> <ul style="list-style-type: none"> Roadway Subsystem - variable speed limit - Driver Roadway Subsystem - violation detection - Maintenance and Construction Management Roadway Subsystem - violation detection - Traffic Management Traffic Management - speed limit setting - Roadway Subsystem
ATMS21	Roadway Closure Management	<u>Unique Triples (Source - Flow - Destination)</u> <ul style="list-style-type: none"> Emergency Management - road closure notification - Traffic Management

SP	Name	Description of Uniqueness
CVO02	Freight Administration	<p><u>Unique Functional Objects (in Physical Object)</u></p> <ul style="list-style-type: none"> • Intermodal Freight Equipment Monitoring (Intermodal Freight Equipment) <p><u>Unique Triples (Source - Flow - Destination)</u></p> <ul style="list-style-type: none"> • Commercial Vehicle Subsystem - intermodal status - Fleet and Freight Management • Distribution and Logistics Management Provider - freight data request - Fleet and Freight Management • Distribution and Logistics Management Provider - freight data request - Intermodal Freight Equipment • Fleet and Freight Management - consignment contract - Intermodal Customer • Fleet and Freight Management - container location - Distribution and Logistics Management Provider • Fleet and Freight Management - container status - Distribution and Logistics Management Provider • Fleet and Freight Management - container transport assignment - Commercial Vehicle Subsystem • Fleet and Freight Management - freight transportation status - Other Intermodal Fleet and Freight Management System • Fleet and Freight Management - intermodal status request - Commercial Vehicle Subsystem • Intermodal Customer - freight consignment request - Fleet and Freight Management • Intermodal Customer - shipment status request - Fleet and Freight Management • Intermodal Freight Equipment - cargo data - Commercial Vehicle Subsystem • Intermodal Freight Equipment - cargo data - Distribution and Logistics Management Provider • Intermodal Freight Equipment - cargo data - Fleet and Freight Management • Intermodal Freight Equipment - chassis data - Commercial Vehicle Subsystem • Intermodal Freight Equipment - chassis data - Fleet and Freight Management • Intermodal Freight Equipment - container location - Distribution and Logistics Management Provider • Intermodal Freight Equipment - container status - Commercial Vehicle Subsystem • Intermodal Freight Equipment - container status - Distribution and Logistics Management Provider • Location Data Source - position fix - Intermodal Freight Equipment • Other Intermodal Fleet and Freight Management System - freight transportation status - Fleet and Freight Management

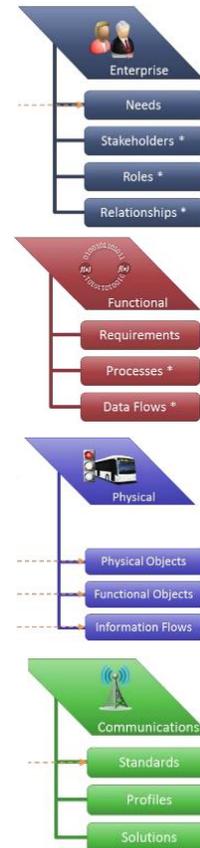
SP	Name	Description of Uniqueness
CVO04	CV Administrative Processes	<p><u>Unique Triples (Source - Flow - Destination)</u></p> <ul style="list-style-type: none"> • Commercial Vehicle Administration - license request - Department of Motor Vehicles • Commercial Vehicle Administration - commercial vehicle permit - Fleet and Freight Management • Commercial Vehicle Administration - commercial vehicle permit coordination - Other CVAS • Department of Motor Vehicles - registration - Commercial Vehicle Administration • Fleet and Freight Management - request for permit - Commercial Vehicle Administration • Other CVAS - commercial vehicle permit coordination - Commercial Vehicle Administration
CVO07	Roadside CVO Safety	<p><u>Unique Triples (Source - Flow - Destination)</u></p> <ul style="list-style-type: none"> • Commercial Vehicle Check - violation notification - Enforcement Agency
EM10	Disaster Traveller Information	<p><u>Unique Triples (Source - Flow - Destination)</u></p> <ul style="list-style-type: none"> • Emergency Management - shelter information - Information Service Provider • Emergency Management - shelter information - Transit Management
MC03	Road Weather Data Collection	<p><u>Unique Triples (Source - Flow - Destination)</u></p> <ul style="list-style-type: none"> • Maintenance and Construction Management - environmental conditions data - Traffic Management • Traffic Management - environmental conditions data - Maintenance and Construction Management

2.2.2 NEW AND UPDATED U.S. ELEMENTS

Building off of the development of the CVRIA, the structure of *ARC-IT* has been updated to maintain four (4) framework views of the reference architecture, as follows:

- **Enterprise View** – describes the relationships between organizations and users, and the roles those entities play in the delivery and consumption of ITS services. These organizations and users represent the owners of systems and devices identified in the *Physical View*.
- **Functional View** – describes the analysis of abstract functional elements and their logical interactions, where these processes identify the set of actions performed by systems and devices to achieve the objectives of the ITS Services. Essentially, this framework view talks to “*the what*” of ITS. Processes are mapped to functional objects, which provides the key link between the *Physical View* and the *Functional View*.
- **Physical View** – describes the transportation systems, devices, and the information exchanges, that support ITS Services (see Error! Reference source not found.). Essentially, this framework view talks to “*the how*” of ITS, and identifies the functional objects to implement ITS processes, which provides a direct link to the *Functional View*. Since the *Physical View* is concerned with constructs in the real world, it tends to be the most approachable view from which to start.
- **Communications View** – identifies and describes the relevant standards and protocols necessary to provide interoperability between systems and devices identified in the *Physical View* to support the implementation of ITS Services.

Service Packages represent slices of the Physical View that address specific services, while also providing linkages to each of the other three views.



Since 2010, the U.S. has also reorganized its Service Packages, including adding three (3) grouping areas, and renaming two previous areas, as illustrated in **Figure 6**.



Figure 6: ARC-IT Service Package Organization

The U.S. reorganization included renaming some Service Packages, and in some cases combined common applications into single services, and in other cases split applications into two or more focused services. **Table 3** (on Page 17) provides a list of the 137 Services Packages of *ARC-IT_V8*, and indicates how they map to those from *US_V6*.

Similarly, but at lower levels of detail, there are a limited number of instances where physical objects and/or information flows have been either combined or split since *US_V6*. The following provides information on two specific physical object examples of interest as they significantly impact the interfaces (i.e. triples) identified in *ARC-IT*.

- **Center** – A generic Center physical object has been defined that may be attributed to any central system for common enterprise/support functions (e.g. permission management, map management, data collection). This minimizes the need for system-specific interfaces. For example, Version 6 had separate triples for eight (8) different central systems (e.g. traffic management, transit management), while *ARC-IT_V8* has a single triple.
- **ITS Object** – Similar to above, a generic ITS Object has been defined in *ARC-IT_V8* that includes core capabilities common to any class of object, whether it is a device or central system, such as security support.

Of the 137 Service Packages in *ARC-IT_V8*, there are forty (40) new Service Packages that address new application areas, including services associated with CVs, support, sustainable travel, public transit, commercial vehicle

operations and traffic management. **Table 4** (on Page 23) provides a summary of these 40 new Service Packages that have been added since *US_V6*.

Of the remaining ninety-seven (97) *ARC-IT_V8* Service Packages, the majority have been modified in some way to provide enhanced functionality, such as through new functional objects and/or information exchanges (triples).

Appendix B provides a detailed summary of how these 86 Service Packages that have been modified since *US_V6*.

For reference, the following eleven (11) *ARC-IT_V8* Service Packages remain essentially unchanged since *US_V6*, in that they do not include new functional objects or additional information exchanges (i.e. triples):

- MC01 - Maintenance and Construction Vehicle and Equipment Tracking
- MC02 - Maintenance and Construction Vehicle Maintenance
- MC03 - Roadway Automated Treatment
- MC08 - Maintenance and Construction Activity Coordination
- PT01 - Transit Vehicle Tracking
- PT05 - Transit Security
- PT06 - Transit Fleet Management
- PT07 - Transit Passenger Counting
- TM05 - Traffic Metering
- TM13 - Standard Railroad Grade Crossing
- WX02 - Weather Information Processing and Distribution

The following inventories in **Appendix B** summarize the supporting new and modified elements in *ARC-IT_V8*, as follows:

- *Appendix B-1 - New Physical Objects*
- *Appendix B-2 - New Information Flows*
- *Appendix B-3 - New Triples*
- *Appendix B-4 - New Function Objects*
- *Appendix B-5 - Modified Service Packages*
- *Appendix B-6 - Modified Physical Objects*

Table 3: Reorganized U.S. Service Packages

US_V6		ARC-IT_V8	
SP	Name	SP	Name
CVO01	Fleet Administration	CVO01	Carrier Operations and Fleet Management
CVO09	CVO Fleet Maintenance		
CVO02	Freight Administration	CVO02	Freight Administration
CVO03	Electronic Clearance	CVO03	Electronic Clearance
CVO06	Weigh-In-Motion		
CVO04	CV Administrative Processes	CVO04	CV Administrative Processes
CVO05	International Border Electronic Clearance	CVO05	International Border Electronic Clearance
NEW	NEW	CVO06	Freight Signal Priority
CVO07	Roadside CVO Safety	CVO07	Roadside CVO Safety
CVO08	On-board CVO and Freight Safety and Security		
CVO06	Weigh-In-Motion	CVO08	Smart Roadside and Virtual WIM
CVO08	On-board CVO and Freight Safety and Security		
NEW	NEW	CVO09	Freight-Specific Dynamic Travel Planning
NEW	NEW	CVO10	Road Weather Information for Freight Carriers
NEW	NEW	CVO11	Freight Drayage Optimization
CVO10	HAZMAT Management	CVO12	HAZMAT Management
CVO11	Roadside HAZMAT Security Detection and Mitigation	CVO13	Roadside HAZMAT Security Detection and Mitigation
CVO12	CV Driver Security Authentication	CVO14	CV Driver Security Authentication
CVO13	Freight Assignment Tracking	CVO15	Fleet and Freight Security
AD1	ITS Data Mart	DM01	ITS Data Warehouse
AD2	ITS Data Warehouse		
AD3	ITS Virtual Data Warehouse		
NEW	NEW	DM02	Performance Monitoring
MC01	Maintenance and Construction Vehicle and Equipment Tracking	MC01	Maintenance and Construction Vehicle and Equipment Tracking
MC02	Maintenance and Construction Vehicle Maintenance	MC02	Maintenance and Construction Vehicle Maintenance
MC05	Roadway Automated Treatment	MC03	Roadway Automated Treatment

US_V6		ARC-IT_V8	
SP	Name	SP	Name
MC06	Winter Maintenance	MC04	Winter Maintenance
MC07	Roadway Maintenance and Construction	MC05	Roadway Maintenance and Construction
MC08	Work Zone Management	MC06	Work Zone Management
AVSS12	Cooperative Vehicle Safety Systems	MC07	Work Zone Safety Monitoring
MC09	Work Zone Safety Monitoring		
MC10	Maintenance and Construction Activity Coordination	MC08	Maintenance and Construction Activity Coordination
MC12	Infrastructure Monitoring	MC09	Infrastructure Monitoring
ATMS16	Parking Facility Management	PM01	Parking Space Management
NEW	NEW	PM02	Smart Park and Ride System
ATMS16	Parking Facility Management	PM03	Parking Electronic Payment
ATMS17	Regional Parking Management	PM04	Regional Parking Management
ATMS17	Regional Parking Management	PM05	Parking Reservations
NEW	NEW	PM06	Loading Zone Management
EM01	Emergency Call-Taking and Dispatch	PS01	Emergency Call-Taking and Dispatch
EM02	Emergency Routing	PS02	Emergency Response
EM02	Emergency Routing	PS03	Emergency Vehicle Preemption
EM03	Mayday and Alarms Support	PS04	Mayday Notification
AVSS12	Cooperative Vehicle Safety Systems	PS05	Vehicle Emergency Response
NEW	NEW	PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
NEW	NEW	PS07	Incident Scene Safety Monitoring
EM04	Roadway Service Patrols	PS08	Roadway Service Patrols
EM05	Transportation Infrastructure Protection	PS09	Transportation Infrastructure Protection
EM06	Wide-Area Alert	PS10	Wide-Area Alert
EM07	Early Warning System	PS11	Early Warning System
EM08	Disaster Response and Recovery	PS12	Disaster Response and Recovery
EM09	Evacuation and Reentry Management	PS13	Evacuation and Reentry Management
EM10	Disaster Traveler Information	PS14	Disaster Traveler Information
APTS01	Transit Vehicle Tracking	PT01	Transit Vehicle Tracking
APTS02	Transit Fixed-Route Operations	PT02	Transit Fixed-Route Operations
APTS03	Demand Response Transit Operations	PT03	Dynamic Transit Operations

US_V6		ARC-IT_V8	
SP	Name	SP	Name
APTS04	Transit Fare Collection Management	PT04	Transit Fare Collection Management
APTS05	Transit Security	PT05	Transit Security
APTS06	Transit Fleet Management	PT06	Transit Fleet Management
APTS10	Transit Passenger Counting	PT07	Transit Passenger Counting
APTS08	Transit Traveler Information	PT08	Transit Traveler Information
APTS09	Transit Signal Priority	PT09	Transit Signal Priority
NEW	NEW	PT10	Intermittent Bus Lanes
NEW	NEW	PT11	Transit Pedestrian Indication
NEW	NEW	PT12	Transit Vehicle at Station/Stop Warnings
NEW	NEW	PT13	Vehicle Turning Right in Front of a Transit Vehicle
APTS07	Multi-modal Coordination	PT14	Multi-modal Coordination
NEW	NEW	PT15	Transit Stop Request
NEW	NEW	PT16	Route ID for the Visually Impaired
NEW	NEW	PT17	Transit Connection Protection
ATMS10	Electronic Toll Collection	PT18	Integrated Multi-Modal Electronic Payment
ATMS11	Emissions Monitoring and Management	ST01	Emissions Monitoring
NEW	NEW	ST02	Eco-Traffic Signal Timing
NEW	NEW	ST03	Eco-Traffic Metering
ATMS12	Roadside Lighting System Control	ST04	Roadside Lighting
NEW	NEW	ST05	Electric Charging Stations Management
ATMS05	HOV Lane Management	ST06	HOV/HOT Lane Management
ATMS05	HOV Lane Management	ST07	Eco-Lanes Management
NEW	NEW	ST08	Eco-Approach and Departure at Signalized Intersections
NEW	NEW	ST09	Connected Eco-Driving
NEW	NEW	ST10	Low Emissions Zone Management
NEW	NEW	SU01	Connected Vehicle System Monitoring and Management
NEW	NEW	SU02	Core Authorization
ATIS06	Transportation Operations Data Sharing	SU03	Data Distribution
NEW	NEW	SU04	Map Management

US_V6		ARC-IT_V8	
SP	Name	SP	Name
NEW	NEW	SU05	Location and Time
NEW	NEW	SU06	Object Registration and Discovery
NEW	NEW	SU07	ITS Communications
NEW	NEW	SU08	Security and Credentials Management
NEW	NEW	SU09	Device Certification and Enrollment
NEW	NEW	SU10	Center Maintenance
NEW	NEW	SU11	Field Equipment Maintenance
NEW	NEW	SU12	Vehicle Maintenance
NEW	NEW	SU13	Personal Device Maintenance
ATIS01	Broadcast Traveler Information	TI01	Broadcast Traveler Information
ATIS10	VII Traveler Information		
ATIS02	Interactive Traveler Information	TI02	Personalized Traveler Information
ATIS03	Autonomous Route Guidance	TI03	Dynamic Route Guidance
ATIS04	Dynamic Route Guidance		
ATIS05	ISP Based Trip Planning and Route Guidance	TI04	Infrastructure-Provided Trip Planning and Route Guidance
ATIS07	Yellow Pages and Reservation	TI05	Travel Services Information and Reservation
ATIS08	Dynamic Ridesharing	TI06	Dynamic Ridesharing and Shared Use Transportation
ATIS09	In Vehicle Signing	TI07	In-Vehicle Signage
ATMS01	Network Surveillance	TM01	Infrastructure-Based Traffic Surveillance
ATMS02	Traffic Probe Surveillance	TM02	Vehicle-Based Traffic Surveillance
ATMS03	Surface Street Control	TM03	Traffic Signal Control
NEW	NEW	TM04	Connected Vehicle Traffic Signal System
ATMS04	Freeway Control	TM05	Traffic Metering
ATMS06	Traffic Information Dissemination	TM06	Traffic Information Dissemination
ATMS07	Regional Traffic Management	TM07	Regional Traffic Management
ATMS08	Traffic Incident Management System	TM08	Traffic Incident Management System
ATMS09	Traffic Decision Support and Demand Management	TM09	Integrated Decision Support and Demand Management
ATMS10	Electronic Toll Collection	TM10	Electronic Toll Collection

US_V6		ARC-IT_V8	
SP	Name	SP	Name
NEW	NEW	TM11	Road Use Charging
NEW	NEW	TM12	Dynamic Roadway Warning
ATMS13	Standard Railroad Grade Crossing	TM13	Standard Railroad Grade Crossing
ATMS14	Advanced Railroad Grade Crossing	TM14	Advanced Railroad Grade Crossing
ATMS15	Railroad Operations Coordination	TM15	Railroad Operations Coordination
ATMS18	Reversible Lane Management	TM16	Reversible Lane Management
ATMS19	Speed Monitoring	TM17	Speed Warning and Enforcement
ATMS20	Drawbridge Management	TM18	Drawbridge Management
ATMS21	Roadway Closure Management	TM19	Roadway Closure Management
NEW	NEW	TM20	Variable Speed Limits
NEW	NEW	TM21	Speed Harmonization
NEW	NEW	TM22	Dynamic Lane Management and Shoulder Use
NEW	NEW	TM23	Border Management Systems
AVSS06	Pre-Crash Restraint Deployment	VS01	Autonomous Vehicle Safety Systems
AVSS09	Advanced Vehicle Lateral Control		
AVSS07	Driver Visibility Improvement		
AVSS04	Lateral Safety Warning		
AVSS03	Longitudinal Safety Warning		
AVSS01	Vehicle Safety Monitoring		
AVSS02	Driver Safety Monitoring		
AVSS12	Cooperative Vehicle Safety Systems	VS02	V2V Basic Safety
AVSS06	Pre-Crash Restraint Deployment		
AVSS12	Cooperative Vehicle Safety Systems	VS03	Situational Awareness
EM02	Emergency Routing	VS04	V2V Special Vehicle Alert
AVSS12	Cooperative Vehicle Safety Systems		
ATIS09	In Vehicle Signing	VS05	Curve Speed Warning
AVSS12	Cooperative Vehicle Safety Systems		
AVSS12	Cooperative Vehicle Safety Systems	VS06	Stop Sign Gap Assist
NEW	NEW	VS07	Road Weather Motorist Alert and Warning
NEW	NEW	VS08	Queue Warning

US_V6		ARC-IT_V8	
SP	Name	SP	Name
ATIS09	In Vehicle Signing	VS09	Reduced Speed Zone Warning / Lane Closure
AVSS12	Cooperative Vehicle Safety Systems		
AVSS12	Cooperative Vehicle Safety Systems	VS10	Restricted Lane Warnings
ATIS09	In Vehicle Signing		
AVSS12	Cooperative Vehicle Safety Systems	VS11	Oversize Vehicle Warning
NEW	NEW	VS12	Pedestrian and Cyclist Safety
AVSS12	Cooperative Vehicle Safety Systems	VS13	Intersection Safety Warning and Collision Avoidance
AVSS05	Intersection Safety Warning		
AVSS08	Advanced Vehicle Longitudinal Control	VS14	Cooperative Adaptive Cruise Control
AVSS10	Intersection Collision Avoidance	VS15	Infrastructure Enhanced Cooperative Adaptive Cruise Control
AVSS11	Automated Vehicle Operations	VS16	Automated Vehicle Operations
NEW	NEW	VS17	Traffic Code Dissemination
MC11	Environmental Probe Surveillance	WX01	Weather Data Collection
MC03	Road Weather Data Collection		
MC04	Weather Information Processing and Distribution	WX02	Weather Information Processing and Distribution
AVSS12	Cooperative Vehicle Safety Systems	WX03	Spot Weather Impact Warning

Table 4: New U.S. Service Packages

SP	Name	Description
CVO06	Freight Signal Priority	The Freight Signal Priority service package (FSP) provides traffic signal priority for freight and commercial vehicles traveling in a signalized network. The goal of the freight signal priority service package is to reduce stops and delays to increase travel time reliability for freight traffic, and to enhance safety at intersections.
CVO09	Freight-Specific Dynamic Travel Planning	This service package provides both pre-trip and en route travel planning, routing, and commercial vehicle related traveler information, which includes information such as truck parking locations and current status. The information will be based on data collected from the commercial fleet as well as general traffic data collection capabilities. The information, both real time and static can be provided directly to fleet managers, to mobile devices used by commercial vehicle operators, or directly to in vehicle systems as commercial vehicles approach roadway exits with key facilities such as parking. The service package can also provide oversize/ overweight permit information to commercial managers.
CVO10	Road Weather Information for Freight Carriers	The service package is a special case of the Road Weather Advisories and Warnings for Motorists service package that focuses on Freight Carrier users. It provides the capability to collect road weather data from connected vehicles and using that data to develop short term warnings or advisories that can be provided to individual commercial vehicles or to commercial vehicle dispatchers. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather commercial vehicle alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial vehicle dispatchers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.
CVO11	Freight Drayage Optimization	This service package covers the information exchanges between all intermodal parties to provide current drayage truck load matching and container availability and appointment scheduling at railroad and steamship line terminals. It includes a link from drivers and freight management systems dispatchers to an intermodal terminal reservation system and integrates an appointment function with Terminal Queue Status and Load Matching. The service package provides information to the dispatcher and driver concerning the availability status for pickup of a container at an intermodal terminal. It also provides drivers and dispatchers with both intermodal terminal queue length, and estimated time from the back of the queue to the gate.

SP	Name	Description
DM02	Performance Monitoring	The Performance Monitoring service package uses information collected from detectors and sensors, connected vehicles, and operational data feeds from centers to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data. Additional data are collected including accident data, road condition data, road closures and other operational decisions to provide context for measured transportation performance and additional safety and mobility-related measures. More complex performance measures may be derived from the collected data.
PM02	Smart Park and Ride System	This service package provides real-time information on Park and Ride capacity and supports traveler's decision-making on where best to park and make use of transit alternatives. Transit operators are provided arrival information to support efficient pickup and drop offs and drivers switching to transit are offered current transit information.
PM06	Loading Zone Management	This service package manages the occupancy of spaces in a loading/unloading zone. It monitors the current status of each loading/unloading zone space under its control and makes this information available to arriving vehicles. The service package also operates a reservation system for loading zones, providing the capability for loading zone users, including commercial vehicle drivers or fleet operators, to reserve and pay for future use of a loading/unloading space. Interfaces to the general Vehicle OBE are included since loading zones may be used by any vehicle, though commercial vehicles are the most frequent users.
PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders	This service package will provide situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The service package also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).

SP	Name	Description
PS07	Incident Scene Safety Monitoring	This service package employs communications technologies to provide warnings and alerts relating to incident zone operations. One aspect of the service is an in-vehicle messaging system that provides drivers with merging and speed guidance around an incident. Another aspect is providing in-vehicle incident scene alerts to drivers, both for the protection of the drivers as well as incident zone personnel. A third aspect is a warning system for on-scene workers when a vehicle approaching or in the incident zone is being operated outside of safe parameters for the conditions.
PT10	Intermittent Bus Lanes	This service package provides dedicated bus lanes during peak demand times to enhance transit operations mobility. An intermittent bus lane is a lane that can change its status from regular lane (accessible for all vehicles) to bus lane, for the time strictly necessary for a bus or set of buses to pass. The status of the IBL is communicated to drivers using roadside message signs and through in-vehicle signage. The creation and removal of dedicated bus lanes is managed through coordination between traffic and transit centers.
PT11	Transit Pedestrian Indication	The Transit Pedestrian Indication service package provides vehicle to device communications to inform pedestrians at a station or stop about the presence of a transit vehicle. In addition, this service package would inform the transit vehicle operator about the presence of pedestrians nearby and those waiting for the bus. It would help prevent collisions between transit vehicles and pedestrians.
PT12	Transit Vehicle at Station/Stop Warnings	The Transit Vehicle at Station/Stop Warnings service package inform nearby vehicles of the presence of a transit vehicle at a station or stop. The service package also indicates the intention of the transit vehicle in terms of pulling into or out of a station/stop.
PT13	Vehicle Turning Right in Front of a Transit Vehicle	The Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV) service package determines the movement of vehicles near to a transit vehicle stopped at a transit stop and provides an indication to the transit vehicle operator that a nearby vehicle is pulling in front of the transit vehicle to make a right turn. This service package will help the transit vehicle determine if the area in front of it will not be occupied as it begins to pull away from a transit stop.
PT15	Transit Stop Request	This service package allows a transit passenger to send a stop request to an approaching transit vehicle. The transit vehicle receives the request and notifies the vehicle operator of the stop request.
PT16	Route ID for the Visually Impaired	This service package assists visually impaired travelers to identify the appropriate bus and route to their intended destination. It provides information from bus stop infrastructure to visually impaired travelers portable devices that can be converted to audible information regarding the appropriate bus and route. It also allows the visually impaired traveler to query the portable device to identify route options.

SP	Name	Description
PT17	Transit Connection Protection	<p>This service package allows travelers to initiate a request for connection protection anytime during the trip using a personal device or on-board equipment and receive a confirmation indicating whether the request is accepted. Connection protection uses real time data to examine the arrival status of a transit vehicle and to transmit a hold message to a vehicle or other mode of transportation (e.g. rail) in order for the traveler to make a successful transfer from one vehicle to another. Connection protection can be performed within a single agency, across multiple agencies, and across multiple modes. In an intermodal, multimodal or interagency environment, a transfer request brokerage system, represented by the Transit Management System, can be used to determine the feasibility of a connection protection request and support schedule coordination between agencies.</p>
ST02	Eco-Traffic Signal Timing	<p>The Eco-Traffic Signal Timing service package is similar to current adaptive traffic signal control systems; however, the service package's objective is explicitly to optimize traffic signals for the environment rather than the current adaptive systems' objective, which is to enhance the intersection level of service or throughput, which might improve the intersection's environmental performance. The Eco-Traffic Signal Timing service package processes real-time and historical connected vehicle data at signalized intersections to reduce fuel consumption and overall emissions at the intersection, along a corridor, or for a region. It evaluates traffic and environmental parameters at each intersection in real time and adapts so that the traffic network is optimized using available green time to serve the actual traffic demands while minimizing the environmental impact.</p>
ST03	Eco-Traffic Metering	<p>The Eco-Traffic Metering service package determines the most environmentally efficient operation of traffic signals at freeway on-ramps to manage the rate of entering automobiles. This service package collects traffic and environmental data from roadside sensors and connected vehicles to allow on-ramp merge operations that minimize overall emissions, including traffic and environmental conditions on the ramp and on the freeway upstream and downstream of the ramp. Using this information, the service package determines a timing plan for the ramp meter based on current and predicted traffic and environmental conditions.</p>
ST05	Electric Charging Stations Management	<p>The Electric Charging Station Management service package provides an exchange of information between the electric vehicle and charging station to manage the charging operation. The agency or company operating the charging station can use vehicle information such as the capability of the vehicle (e.g. operational status of the electrical system, how many amps can the vehicle handle, and % charge complete) to determine that the charge is being properly applied and determine an estimated time to complete charging.</p>

SP	Name	Description
ST08	Eco-Approach and Departure at Signalized Intersections	<p>The Eco-Approach and Departure at Signalized Intersections service package uses wireless data communications sent from a connected vehicle roadside equipment (RSE) unit to connected vehicles to encourage “green” approaches to and departures from signalized intersections. The vehicle collects intersection geometry information and signal phase movement information using V2I communications and data from nearby vehicles using V2V communications. Upon receiving this information, the service package performs calculations to provide speed advice to the driver, allowing the driver to adapt the vehicle’s speed to pass the next traffic signal on green or to decelerate to a stop in the most eco-friendly manner. The service package also considers a vehicle’s acceleration as it departs from a signalized intersection. Finally, the service package may perform engine adjustments that provide increased fuel efficiency.</p>
ST09	Connected Eco-Driving	<p>The Connected Eco-Driving service package provides customized real-time driving advice to drivers so that they can adjust their driving behavior to save fuel and reduce emissions. Eco-driving advice includes recommended driving speeds, optimal acceleration, and optimal deceleration profiles based on prevailing traffic conditions, interactions with nearby vehicles, and upcoming road grades. The service package also provides feedback to drivers on their driving behavior to encourage drivers to drive in a more environmentally efficient manner. Finally, the service package may include vehicle-assisted strategies where the vehicle automatically implements the eco-driving strategy (e.g., changes gears, switches power sources, or reduces its speed in an eco-friendly manner).</p>
ST10	Low Emissions Zone Management	<p>The Low Emissions Zone Management service package supports the operation of a low emissions zone that is responsive to real-time traffic and environmental conditions. Low emissions zones are geographic areas that seek to restrict or deter access by specific categories of high-polluting vehicles into the area to improve the air quality within the geographic area. The service package uses data collected from vehicles using connected vehicle technologies and from roadside equipment as input to the system. The Low Emissions Zone Management service package supports the geo-fencing of a cordon that may be scalable and moveable (e.g., created for a day, removable, flexible in its boundaries) and would be less dependent on conventional ITS infrastructure. The service package would establish parameters including the types of vehicles permitted to enter the zone, exemptions for transit vehicles, emissions criteria for entering the zone, fees or incentives for vehicles based on emissions data collected from the vehicle, and geographic boundaries for the low emissions zone. The service package would also include electronic toll collection functions that support payments of fees or collection of incentives for registered vehicles using connected vehicle technologies. Finally, this service package provides information about the low emissions zone to traveler information centers, including information about criteria for entering the zone, expected fees and incentives, current and predicted traffic conditions, and geographic boundaries of the zone.</p>

SP	Name	Description
SU01	Connected Vehicle System Monitoring and Management	This service package provides monitoring, management and control services necessary to other applications and/or devices operating within the Connected Vehicle Environment. This service package maintains and monitors the performance and configuration of the connected vehicle system. This includes tracking and management of the infrastructure configuration as well as detection, isolation, and correction of infrastructure service problems. It also includes monitoring of performance of the infrastructure and mobile equipment, which includes RSEs, OBEs, the back office applications, as well as the communication links that connect the system.
SU02	Core Authorization	This service package manages the authorization mechanisms to define roles, responsibilities and permissions for connected vehicle applications . This allows system administrators to establish operational environments where different connected vehicle system users may have different capabilities. For instance, some Mobile elements may be authorized to request signal priority, or some Centers may be permitted to use the geographic broadcast service, while those without those permissions would not.
SU04	Map Management	This service package defines interfaces that can be used download or update all types of map data used to support intelligent transportation systems. This map data will be accessed by centers, field, and vehicle physical objects. The service package can also be used to harness the Connected Vehicle Environment to provide rich source data that can be used to verify, refine, and enhance geographic map data.
SU05	Location and Time	This service package identifies the external systems and interfaces that provide accurate location and time to intelligent transportation system devices and systems.
SU06	Object Registration and Discovery	<p>This service package provides registration and lookup services necessary to allow objects to locate other objects operating within the Connected Vehicle Environment.</p> <p>An object registry is like a phone book for all the connected centers, systems, and equipment in the transportation system (the “objects”). In this service package, each object registers itself with the ORDS and tells the registry where it lives in the communication network (e.g., host, port, node name) and information about the services it provides - information that other objects can use to determine the type of service, the geographic scope of the service, and other information that helps users of the registry to make informed decisions about which object(s) support a needed service or information stream. This is the “Discovery” part of the service. Connected objects can use the registry to find (discover) objects that can be used to get needed information or services.</p>
SU07	ITS Communications	This service package provides secure, reliable communications between ITS devices. It provides the layered protocols and communications services and includes the physical network plant and network hardware that supports ITS communications. It also encompasses security services that protect communications and preserve privacy, and the management services that support network management.

SP	Name	Description
SU08	Security and Credentials Management	This service package is used to ensure trusted communications between mobile devices and other mobile devices or roadside devices and protect data they handle from unauthorized access. The service package grants trust credentials to qualified mobile devices and infrastructure devices in the Connected Vehicle Environment so that those devices may be considered trusted by other devices that receive trust credentials from the SCM service package. The service package allows credentials to be requested and revoked and secures the exchange of trust credentials between parties, so that no other party can intercept and use those credentials illegitimately. The service package provides security to the transmissions between connected devices, ensuring authenticity and integrity of the transmissions. Additional security features include privacy protection, authorization and privilege class definition, as well as non-repudiation of origin.
SU09	Device Certification and Enrollment	This service package is used to illustrate the certification of devices, typically but not exclusively those intended for the connected vehicle environment. This assumes some independent certification body that can verify the performance and behavior of devices and applications, and provide that information to credentials-granting entities.
SU10	Center Maintenance	This service package supports maintenance of the computers, networks, video walls, and other information technology assets that are installed in a center to support center operations. Like other support service packages, this SP is drawn at a high level of abstraction so the basic interfaces and functionality associated with maintaining center IT assets can be applied to any center.
SU11	Field Equipment Maintenance	This service package supports maintenance of ITS devices that are installed in the field. Like other support service packages, this SP is drawn at a high level of abstraction so the basic interfaces and functionality associated with maintaining field ITS assets can be applied to any field equipment. In particular, this service package supports maintenance of field subsystems like ITS Payment Equipment, Parking Management Systems, Traveler Support Equipment, and Commercial Vehicle Check Equipment where maintenance is not covered by a more specific Service Package. Two Field subsystems have more specific service packages associated with their maintenance: See MC05 for maintenance of ITS Roadway Equipment and SU01 for more specific interfaces associated with maintaining Connected Vehicle Roadside Equipment.
SU12	Vehicle Maintenance	This service package identifies the interfaces and functionality that support vehicle maintenance, including maintenance of ITS equipment on board the vehicle. An interface with a Vehicle Service Center supports vehicle monitoring to support timely, effective maintenance. It also supports software configuration management and updates as part of maintenance of the software-based on-board systems. While this service package covers only maintenance of the Vehicle OBE, it is defined at the highest level of abstraction so that any center that is contemplating advanced maintenance concepts for its fleet vehicles can use this service package. Other service packages that provide maintenance support for fleet vehicles include CVO01, MC02, and PT06.

SP	Name	Description
SU13	Personal Device Maintenance	This service package supports maintenance of ITS personal devices. Like other device maintenance service packages, this SP is drawn at a high level of abstraction to cover the basic interfaces and functionality associated with maintaining personal devices. The focus here is on devices that are used by transportation professionals. The maintenance of smart phones, tablets, laptops, and other general purpose devices that are used by travelers is coordinated between the travelers and the providers of the devices and communications services, which is beyond the scope of the architecture.
TM04	Connected Vehicle Traffic Signal System	This service package uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The service package utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other service packages provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.
TM11	Road Use Charging	The Road Use Charging service package supports the capability to charge fees to roadway vehicle owners for using specific roadways with potentially differential payment rates based on time-of-day, which specific roadway is used, and class of vehicle or other vehicle-based criteria (a local policy decision by each roadway owner). These payment schemes could be forms of Vehicle Miles Traveled (VMT) or other schemes that are yet to be defined. Vehicle owners need only register with a single payment entity of their choice (a participating state, municipal, or regional DOT, an authority, or a private entity), and payments are reconciled by the entity receiving payment (and travel history) with all roadway owners that participate in the road use payment scheme, which may also include the Federal government. Vehicle owners would pay nothing for distances traveled where there are no payments required (e.g. in jurisdictions that have not implemented a distance-based payment or for roadway operators that collect payment using traditional tolls), although a Federal payment rate might cover some or all roadway operations (a Federal policy decision). Basic operation depends on the vehicle tracking its own location, and periodically reporting its travel history to the registered entity receiving payment using connected vehicle communications.

SP	Name	Description
TM12	Dynamic Roadway Warning	<p>This service package includes systems that dynamically warn drivers approaching hazards on a roadway. Such hazards include roadway weather conditions, road surface conditions, traffic conditions including queues, obstacles or animals in the roadway and any other transient event that can be sensed. These dynamic roadway warning systems can alert approaching drivers via warning signs, flashing lights, in-vehicle messages, etc. Such systems can increase the safety of a roadway by reducing the occurrence of incidents. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.</p> <p>Speed warnings that consider the limitations of a given vehicle for the geometry of the roadway (e.g., rollover risk for tall vehicles) are not included in this service package but are covered by the TM17 – Speed Warning and Enforcement service package.</p> <p>Roadway warning systems, especially queue warning systems are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM22-Dynamic Lane Management and Shoulder Use).</p>
TM20	Variable Speed Limits	<p>This service package sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog), and/or to reduce air pollution. Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits, usually by lane. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.</p> <p>This service establishes variable speed limits and communicates the speed limits to drivers. Speed warnings and enforcement of speeds limits, including variable speed limits, is covered in the TM17-Speed Warning and Enforcement service package.</p> <p>Variable speed limits are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as TM22-Dynamic Lane Management and Shoulder Use and TM23-Dynamic Roadway Warning).</p>

SP	Name	Description
TM21	Speed Harmonization	<p>This service package determines speed recommendations based on traffic conditions and weather information and uses connected vehicle technologies to assist in harmonizing speeds to these recommendations. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events, and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The service package utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies for upstream traffic, and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.</p>
TM22	Dynamic Lane Management and Shoulder Use	<p>This service package provides for active management of travel lanes along a roadway. The package includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control specific lanes and/or the shoulders. This equipment can be used to change the lane configuration on the roadway according to traffic demand and lane destination along a typical roadway section or on approach to or access from a border crossing, multimodal crossing or intermodal freight depot. This package can be used to allow temporary or interim use of shoulders as travel lanes. The equipment can be used to electronically reconfigure intersections and interchanges and manage right-of-way dynamically including merges. Also, lanes can be designated for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. Prohibitions or restrictions of types of vehicles from using particular lanes can be implemented.</p> <p>The lane management system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.</p> <p>Dynamic lane management and shoulder use is an Active Traffic Management (ATM) strategy and is typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM12-Dynamic Roadway Warning).</p>
TM23	Border Management Systems	<p>This service package provides international border crossing management for passenger vehicles and other non-commercial travelers crossing the border. This service package manages traffic at the border crossing, provides technology to support expedited processing of trusted travelers, and collects and disseminates border wait times.</p>

SP	Name	Description
VS07	Road Weather Motorist Alert and Warning	<p>This service package collects road weather data from connected vehicles and uses that data to develop short term warnings or advisories that can be provided to individual motorists. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather motorist alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial service providers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.</p>
VS08	Queue Warning	<p>This service package utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications, to enable vehicles within the queue event to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to centers (such as the TMC). The infrastructure will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions. This service package is not intended to operate as a crash avoidance system. In contrast to such systems, this service package will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. It performs two essential tasks: queue determination (detection and/or prediction) and queue information dissemination using vehicle-based, infrastructure-based, or hybrid solutions.</p>
VS12	Pedestrian and Cyclist Safety	<p>This service package supports the sensing and warning systems used to interact with pedestrians, cyclists, and other non-motorized users that operate on the main vehicle roadways, or on pathways that intersect the main vehicle roadways. These systems allow automated warning or active protection for this class of users. It integrates traffic, pedestrian, and cyclist information from roadside or intersection detectors and new forms of data from wirelessly connected, non-motorized traveler-carried mobile devices to request right-of-way or to inform non-motorized travelers when to cross and how to remain aligned with the crosswalk or pathway based on real-time Signal Phase and Timing (SPaT) and MAP information. In some cases, priority will be given to non-motorized travelers, such as persons with disabilities who need additional crossing time, or in special conditions (e.g., weather) where non-motorized travelers may warrant priority or additional crossing time. This service package will enable a service call to be routed to the traffic controller from a mobile device of a registered person with disabilities after confirming the direction and orientation of the roadway that the individual is intending to cross. It also provides warnings to the non-motorized user of possible infringement of the crossing or pathway by approaching vehicles.</p>

SP	Name	Description
VS17	Traffic Code Dissemination	This service package disseminates current local statutes, regulations, ordinances, and rules that have been adopted by local, state, and federal authorities that govern the safe, orderly operation of motor vehicles, bicycles, and pedestrians on public roads. The focus of this service package is electronic distribution to automated vehicles and their drivers so that automated vehicles can safely operate in compliance with the traffic or motor vehicle code for the current state and locality, though this information would also be useful to human drivers.

2.2.3 LINKAGE TO INTERNATIONAL ARCHITECTURES

In addition to coordinating with Canada, the U.S. tracks other international architecture efforts and *ARC-IT_V8* now includes linkages to four (4) Australian Service Packages that address additional, but complimentary, ITS applications. These Australian Service Packages focus on commercial vehicle operations and are summarized in **Table 5**.

Table 5: ARC-IT's International-Linked Service Packages

* element is core to *ARC-IT_V8*

SP	Name	Description and Details
CVO16	Electronic Work Diaries	<p><u>Description</u></p> <p>The Electronic Work Diaries service package is designed to collect information salient to the operation of a commercial vehicle, to log driver activity (work), and to report that information to regulators as well as fleet managers, while operating under various privacy regimes including that of the fleet manager, the local government and the national government.</p> <p><u>Functional Objects (in Physical Object)</u></p> <ul style="list-style-type: none"> • CV Driver Work Records (Commercial Vehicle OBE*) • CVCE Safety and Security Inspection* (Commercial Vehicle Check Equipment*) • CVOBE-SP Information Exchange (Commercial Vehicle Service Provider Center) • CVOBE-SP Safety and Security Administration (Commercial Vehicle Service Provider Center) • Freight Administration and Management* (Fleet and Freight Management Center*)
CVO17	Intelligent Access Program	<p><u>Description</u></p> <p>The Intelligent Access Program service package enables commercial vehicle operators simplified access to permit operations in exchange for remote compliance monitoring.</p> <p><u>Functional Objects (in Physical Object)</u></p> <ul style="list-style-type: none"> • CV On-Board Access Monitoring (Commercial Vehicle OBE*) • CVOBE-SP Information Exchange (Commercial Vehicle Service Provider Center) • CVOBE-SP Safety and Security Administration (Commercial Vehicle Service Provider Center) • Freight Administration and Management* (Fleet and Freight Management Center*)

SP	Name	Description and Details
CVO18	Intelligent Access Program - Weight Monitoring	<p><u>Description</u></p> <p>The Intelligent Access Program - Weight Monitoring service package enables commercial vehicle operators simplified access to permit operations in exchange for remote weight monitoring.</p> <p><u>Functional Objects (in Physical Object)</u></p> <ul style="list-style-type: none"> • CV On-Board Mass Monitoring (Commercial Vehicle OBE*) • CVOBE-SP Information Exchange (Commercial Vehicle Service Provider Center) • CVOBE-SP Safety and Security Administration (Commercial Vehicle Service Provider Center) • Freight Administration and Management* (Fleet and Freight Management Center*)
CVO19	Intelligent Speed Compliance	<p><u>Description</u></p> <p>The Intelligent Speed Compliance service package uses the Global Navigation Satellite System (GNSS) to independently monitor the speed of a heavy vehicle and provide that information to regulatory authorities. It can be used to verify that commercial vehicles are not exceeding a set speed threshold, and/or to detect faulty speed limiter devices.</p> <p><u>Functional Objects (in Physical Object)</u></p> <ul style="list-style-type: none"> • CV On-Board Speed Monitoring (Commercial Vehicle OBE*) • CVOBE-SP Information Exchange (Commercial Vehicle Service Provider Center) • CVOBE-SP Safety and Security Administration (Commercial Vehicle Service Provider Center) • Freight Administration and Management* (Fleet and Freight Management Center*)

2.2.4 RECONCILIATION BETWEEN CANADA AND U.S.

As evident from the previous sub-sections, in 2010 the *CAN_V2* supported a number of ‘unique’ services and functional applications, and since then the U.S. architecture has been enhanced and expanded significantly. In this section the findings from above will be reconciled to identify where the U.S. architecture now covers unique Canadian services and functions, and identify and inventory where there remains unique Canadian functionality.

Table 6 (on Page 38) provides a summary of the Service Packages that were identified as unique in comparison to Version 6 of the *U.S. National ITS Architecture*, and provides an assessment of on whether, and to what degree, *ARC-IT* Version 8 now supports the previous unique functionality. Where Service Packages, and sub-service functionality, that remain as unique in comparison to *ARC-IT_V6*, these are highlighted in **bold**.

Service Packages, and sub-service functionality, that remain as unique in comparison to *ARC-IT* included the following:

- ***ATMS102 Signal Enforcement*** - remains fully unique.
- ***ATMS19 Variable Speed Limit and Enforcement*** - there remains two (2) unique triple information flows relating to violation information provided to Traffic Management and Maintenance Management systems, while TM17 Speed Warning and Enforcement of *ARC-IT* only shares violation information directly with the enforcement agency.
- ***CVO102 International Border Registration*** - there remain two (2) unique functional objects: Traveller Border Registration and Border Registration.
- ***CVO103 International Border Pre-Processing*** - there remains one (1) unique functional object: Border Pre-Processing.
- ***EM10 Disaster Traveller Information*** - there remains two (2) unique triple information flows relating to traffic management and emergency management providing information on shelter availability, while PS14 Disaster Traveler Information of *ARC-IT* does have shelter information provided directly from the shelters.
- ***MC101 Roadway Micro-Prediction*** - remains fully unique.

Table 6: Comparison and Reconciliation of Unique Canadian Elements by Service Package

SP	Name	Uniqueness vs. V6	Assessment with respect to ARC-IT
APTS08	Transit Traveller Information	Three (3) unique triples.	Information sharing for triples relates to supporting multimodal planning. These flows of information are included in <i>ARC-IT_V8</i> PT17 Transit Connection Protection
APTS101	Multi-Modal Connection Protection	Fully Unique	Maps fully to PT17 Transit Connection Protection in <i>ARC-IT</i> , including all functional objects.
ATIS01	Broadcast Traveller Information	One (1) unique triple.	Information sharing related to 'border traveller information', and is included in the 'border crossing status information' in the mapped <i>ARC-IT_V8</i> TI01 Broadcast Traveler Information.
ATIS02	Interactive Traveller Information	One (1) unique triple.	Information sharing related to 'border traveller information', and is included in the 'border crossing status information' in the mapped <i>ARC-IT_V8</i> TI02 Personalized Traveler Information.
ATMS101	Dynamic Roadway Warning	Fully Unique	Maps fully to TM12 Dynamic Roadway Warning in <i>ARC-IT_V8</i> , including all functional objects.
ATMS102	Signal Enforcement	Fully Unique	<i>Still fully unique, not in ARC-IT_V8.</i>
ATMS103	Standard Mixed Use Warning Systems	Fully Unique	Both map fully to <i>ARC-IT_V8</i> VS12 Pedestrian and Cyclist Safety, including all functional objects.
ATMS104	Advanced Mixed Use Warning Systems	Fully Unique	
ATMS19	Variable Speed Limit and Enforcement	Two (2) unique functional objects Four (4) unique triples.	Maps to both TM17 Speed Warning and Enforcement and TM20 Variable Speed Limits from <i>ARC-IT_V8</i> . The two (2) functional objects and two (2) of the information flows relate to setting the variable speed limits locally and centrally, and there are complimentary functional objects and information flows in <i>ARC-IT_V8</i> TM20. <i>The remaining two (2) information flows relate to violation information provided to Traffic Management and Maintenance Management systems, while TM17 of ARC-IT_V8 only shares violation data with the enforcement agency.</i>
ATMS21	Roadway Closure Management	One (1) unique triple.	Information sharing related to road closure notification between emergency management and traffic management, and is now included <i>ARC-IT</i> TM19 Roadway Closure Management.

SP	Name	Uniqueness vs. V6	Assessment with respect to ARC-IT
CVO02	Freight Administration	One (1) unique functional object Many unique triples.	The unique elements relate primarily to monitoring the commercial vehicle and container separately. <i>ARC-IT_V8</i> CVO02 Freight Administration now includes functionality, with a simplified structure (i.e. a single information flow that includes cargo, chassis and container data), that fully maps to the unique elements.
CVO04	CV Administrative Processes	Six (6) unique triples.	Information sharing related to licenses, registrations, and permits, which have been added <i>ARC-IT_V8</i> CVO04 CV Administrative Processes.
CVO07	Roadside CVO Safety	One (1) unique triple.	The information flow is for direct violation notification from roadside to enforcement, which is now included in CVO07 Roadside CVO Safety in <i>ARC-IT_V8</i> .
CVO101	Freight Terminal Management	Fully Unique	Maps fully to CVO11 Freight Drayage Optimization in <i>ARC-IT_V8</i> , including all functional objects.
CVO102	International Border Registration	Fully Unique	Maps partially to <i>ARC-IT_V8</i> CVO05 International Border Electronic Clearance. <i>Following functional objects are not in ARC-IT_V8: Traveller Border Registration, Border Registration.</i>
CVO103	International Border Pre-Processing	Fully Unique	Maps partially to <i>ARC-IT_V8</i> CVO05 International Border Electronic Clearance. <i>Following functional objects are not in ARC-IT_V8: Border Pre-Processing</i>
CVO104	International Border Inspection	Fully Unique	Maps fully to TM23 Border Management Systems in <i>ARC-IT_V8</i> , including all functional objects.
EM10	Disaster Traveller Information	Two (2) unique triples.	The information flows relate to traffic management and emergency management providing information on shelter availability, which is still not supported in <i>ARC-IT_V8</i> . <i>However, ARC-IT_V8 PS14 Disaster Traveler Information does have shelter information provided directly from the shelters.</i>
MC03	Road Weather Data Collection	Two (2) unique triples.	Information sharing related to sharing environmental conditions data between traffic management and maintenance and construction management, which have been added <i>ARC-IT_V8</i> WX01 Weather Data Collection.
MC101	Roadway Micro-Prediction	Fully Unique	<i>Still fully unique, not in ARC-IT_V8.</i>

2.3 OTHER DIFFERENCES

In order to identify other differences of the *CAN_V2*, a full text comparison was completed on the names and descriptions of the different elements, and the results are included in **Appendix C**.

The following sub-sections provide a summary of the findings.

2.3.1 ELEMENT NAMES

When the *CAN_V2* was updated in 2010, the names of a number of elements were not updated to align with those of the then-current *US_V6*. These differences may have been kept for a variety of reasons, such as:

- Nomenclature preference (e.g. using the term Collision vs. Crash)
- More encompassing terms (e.g. Multimodal Operations vs. Railroad Operations)
- Canadian trademarks (e.g. Yellow Pages TM)
- Highlight specific features (e.g. Intermodal Freight Equipment vs. Freight Equipment)
- Fully spell out acronym (e.g. Hazardous Material vs. HAZMAT)

Table 7 provides a summary of elements in *CAN_V2* that had different names than those in *US_V6*, which almost exclusively had identical core functionality and descriptions. The exception to this are the Intermodal Freight Equipment and Intermodal Terminal physical objects, and the U.S. has since integrated the previously unique functionality, and these physical objects now map directly to those in *ARC-IT_V8*. **Table 7** also lists the current element names in *ARC-IT_V8*, and those that have been renamed since *US_V6* are highlighted in *italics*.

Table 7: Summary of Element Name Differences

Element Type	CAN_V2 Name	US_V6 Name	ARC-IT_V8 Name
Service Package	Automated Highway System	Automated Vehicle Operations	Automated Vehicle Operations
	Hazardous Material Planning and Incident Response	HAZMAT Management	HAZMAT Management
	Multimodal Operations Coordination	Railroad Operations Coordination	Railroad Operations Coordination
	Pre-Collision Restraint Deployment	Pre-Crash Restraint Deployment	<i>Autonomous Vehicle Safety Systems</i>
	Pre-Collision Restraint Deployment	Pre-Crash Restraint Deployment	<i>V2V Basic Safety</i>
	Roadside Hazardous Material Security Detection and Mitigation	Roadside HAZMAT Security Detection and Mitigation	Roadside HAZMAT Security Detection and Mitigation
	Traffic Forecast and Demand Management	Traffic Decision Support and Demand Management	<i>Integrated Decision Support and Demand Management</i>
	Traveller Services Payment and Reservation	Yellow Pages and Reservation	<i>Travel Services Information and Reservation</i>
	Variable Speed Limit and Enforcement	Speed Monitoring	<i>Speed Warning and Enforcement</i>

Element Type	CAN_V2 Name	US_V6 Name	ARC-IT_V8 Name
			<i>Variable Speed Limits</i>
Physical Objects	Business Directory Service Providers	Yellow Pages Service Providers	<i>Travel Services Provider System</i>
	Department of Motor Vehicles	DMV	DMV
	Intermodal Customer	Intermodal Freight Shipper	<i>Intermodal Customer System</i>
	Intermodal Freight Equipment	Freight Equipment	Freight Equipment
	Intermodal Terminal	Intermodal Freight Depot	<i>Intermodal Terminal</i>
	Meteorological Service Provider	Surface Transportation Weather Service	Surface Transportation Weather Service
Information Flows	business directory information	yellow pages information	<i>travel services information</i>
	business directory request	yellow pages request	<i>travel services request</i>
	Commercial Vehicle Check override mode	CVC override mode	CVC override mode
	traffic enforcement control	speed monitoring control	speed monitoring control
	traffic enforcement information	speed monitoring information	speed monitoring information
	volume weather information	weather information	weather information
Functional Objects	Infrastructure Provided Business Directory Service and Reservation	Infrastructure Provided Yellow Pages and Reservation	<i>TIC Travel Services Information and Reservation</i>

2.3.2 SPELLING

There are two consistent spelling differences that *CAN_V2* includes in comparison to the U.S., which are *Centre* and *Traveller* vs. *Center* and *Traveler*, respectively. These words can be found in the names and descriptions of the elements, and **Table 8** summarizes the number of occurrences of these word in *ARC-IT_V8*.

Table 8: Summary of Occurrences of Canadian Spelling Differences in *ARC-IT_V8*

Element Type	Center		Traveler	
	Name	Description	Name	Description
Service Package	1	22	4	22
Physical Object	33	58	4	18
Information Flow	10	27	28	65
Functional Object	26	88	15	61
TOTAL	70	195	51	166

2.3.3 REFERENCES

Element descriptions provide contextual narratives of the role and functionality of the element, and there are instances where there are references and/or examples used that may be country-specific. **Table 9** highlights a number of examples where the descriptions in *CAN_V2* used different references than *US_V6*. As illustrated in the table, although *ARC-IT_V8* has subsequently changed some of the text/references, there remains some US-specific reference.

Table 9: Examples of Different References in the Architectures

Element Name (CAN_V2)	Element Description		
	CAN_V2	US_V6	ARC-IT_V8
Department of Motor Vehicles	This terminator represents a specific (state <u>provincial</u>) public organization responsible for registering vehicles, e.g., the <u>Ministry of Transportation</u> Department of Motor Vehicles .	This terminator represents a specific (state) public organization responsible for registering vehicles, e.g., the Department of Motor Vehicles.	This terminator represents The 'DMV' is a specific (state) public organization responsible for registering vehicles, e.g., the Department of Motor Vehicles.
Government Reporting Systems	This terminator represents the system and associated personnel that prepare the inputs to support the various local, <u>state</u> provincial , and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. This terminator represents a system interface that would provide access to the archived data that is relevant to these reports. In most cases, this <u>This</u> terminator would manually combine data collected from the ITS archives with data from non ITS sources to assemble and submit the required information.	This terminator represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. This terminator represents a system interface that would provide access to the archived data that is relevant to these reports. In most cases, this terminator would manually combine data collected from the ITS archives with data from non ITS sources to assemble and submit the required information.	This terminator ' <u>Government Reporting Systems</u> ' represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. This terminator <u>It</u> represents a system interface that would provide <u>provides</u> access to the archived data that is relevant to these reports. In most cases, this terminator would manually <u>system will</u> combine data collected from the ITS archives with data from non ITS sources to assemble and submit the required information.

Element Name (CAN_V2)	Element Description		
	CAN_V2	US_V6	ARC-IT_V8
National Meteorological Service	<p>This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. -It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service of Canada, private sector providers, and various research organizations. This terminator represents the Clarus systemnational ESS data exchange network, which collects environmental data from ITS systems, assesses the quality of the data, and disseminates the qualified data upon request (including dissemination to ITS systems). The interface provides formatted weather data and forecasts products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.</p>	<p>This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service, private sector providers, and various research organizations. This terminator represents the Clarus system, which collects environmental data from ITS systems, assesses the quality of the data, and disseminates the qualified data upon request (including dissemination to ITS systems). The interface provides formatted weather data products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.</p>	<p>This terminatorThe 'Weather Service System' provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service, private sector providers, and various research organizations. This terminator represents the Clarus system, which collects environmental data from ITS systems, assesses the quality of the data, and disseminates the qualified data upon request (including dissemination to ITS systems).The interface provides formatted weather data products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.</p>

3 PROPOSED APPROACH FOR UPDATE

3.1 STRUCTURE AND ORGANIZATION

To realign with the U.S., it is necessary that the update for *CAN_V3* use the structure and organization of *ARC-IT_V8*, which includes the following:

- Supporting the four (4) Architecture Views:
 - Enterprise View
 - Functional View
 - Physical View
 - Communications View
- Adopting the new Service Package grouping and organization (see **Table 3**)

With regards to the above, any Canadian-unique Service Packages that are included in must support all four (4) views, and integrate into the most appropriate grouping.

3.2 NEW ARC-IT_V8 ELEMENTS

Forty (40) new Service Packages have been added to the U.S. architecture since *US_V6* and the previous *CAN_V2* update (see **Table 4**).

Similarly, there have been many other new lower level elements (i.e. physical objects, information flows, and functional objects) that have been added to support these new Service Packages, as well as the Service Packages that have been modified since *US_V6*. See **Appendix B** for details on these new elements and modified Service Packages.

It is proposed that the *CAN_V3* update include full adoption of these new Service Packages and supporting elements, based on the following:

- It is assumed that these additions are relevant to the ITS industry and environment in Canada; and
 - Comprehensive review and identification of potentially non-relevant elements would require significant effort (and may not identify any such case); and
 - Continued alignment with the U.S., and ongoing maintenance is minimized.
-

3.3 UPDATED ARC-IT_V8 ELEMENTS

Similar to the new elements, there have been many updates and modifications to legacy elements (i.e. those that were in *US_V6* and *CAN_V2*) to support the new and modified Service Packages in *ARC-IT*.

It is proposed that the *CAN_V3* update include full adoption of these modified elements, based on the following:

- It is assumed that these modifications are relevant to the ITS industry and environment in Canada;
- Comprehensive review and identification of potentially non-relevant updates would require significant effort (and may not identify any such case); and
- Continued alignment with the U.S., and ongoing maintenance is minimized.

3.4 CANADIAN-UNIQUE FUNCTIONALITY

Through the comparison tasks summarized in **Section 2**, there were efforts to map between *CAN_V2* and *ARC-IT_V8* and reconcile differences. As detailed in **Section 2.2.4**, there remains a number Canadian-unique Service Package and sub-Service Package functionality from *CAN_V2*.

It is proposed that the ‘still Canadian-unique’ Service Packages, as well as supporting elements (i.e. physical elements, information flows, and functional objects) be reviewed and assessed by stakeholders and the project steering with respect to the following:

- Whether it still relevant, as the industry may have evolved, and *ARC-IT_V8* may support industry-standard approaches.
- Whether a unique reference or clarification is specifically necessary, or whether the content in *ARC-IT_V8* is sufficient and the reference/clarification can be address by practitioners through use and application of the architecture.

For those functionalities that are assessed as warranted, it is proposed that the *CAN_V3* update limit unique functionality, and unique supporting elements, to separate Canadian-specific Service Packages. The reasons and benefits of this approach include:

- Service Packages that Canada and the U.S. have in common are mapped directly, with 1-to-1 mapping of common physical objects, flows/triples, and functional objects;
- Continued alignment with the U.S., and ongoing maintenance is minimized, and
- The U.S., if they choose to, may link to the Canadian-unique Service Packages similar to those of Australia.

3.5 CANADIAN-UNIQUE NAMES

Differences in element names lead to misalignment between the architectures, and potentially confusion with users of both architectures.

It is proposed that the *CAN_V3* update avoid and minimize differences in element names with respect to those in *ARC-IT_V8*. As such, the current mismatches (see **Table 7**) will be reviewed and assessed by stakeholders and the project steering committee with respect to whether the differences are warranted and/or needed.

3.6 CANADIAN-UNIQUE SPELLING

As presented in **Section 2.3.2**, *CAN_V2* uses Canadian spelling for Centre and Traveller, and the benefits of this support is uncertain as there are examples of agencies and practitioners in Canada using the U.S. spelling of Center and Traveler, respectively.

As national ITS architectures are intended as references, and the use and application of them includes customization to the project and/or region, spelling can generally be easily updated through the use and application process.

It is proposed that the *CAN_V3* use the U.S. spelling, as this will allow for more direct alignment and will minimize ongoing maintenance efforts.