Updating the ITS Architecture for Canada: Preliminary Study

Prepared for:

ITS Canada

on behalf of

ITS Office of Transport Canada

by:

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NOTICES

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The contents of this report do not necessarily reflect the official views or policies of Transport Canada.

Une traduction de ce document est également disponible en français : «Mise à jour de l'Architecture des STI pour le Canada : Étude préliminaire»

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1. INTRODUCTION

1.1 Background

The Intelligent Transportation Systems (ITS) Architecture for Canada was completed in 2000, with the goal to promote, unify, and ensure interoperability in the deployment of ITS across all modes of surface transportation throughout Canada and within a North American context. The development of this ITS architecture was essentially an expansion on the U.S. National ITS Architecture at that time (Version 3.0) in the following service areas:

- Operations and Maintenance;
- Intermodal Freight;
- Non-Vehicular Safety;
- Environmental Monitoring;
- Disaster Management; and
- Automated Enforcement.

Since that time, the U.S. National ITS Architecture has incurred two major revisions and the third revision (Version 6.0) is currently being undertaken. With these separate paths of enhancements from the common U.S. architecture, there are significant differences between the two national ITS architectures. The objective of this project has been to assess the following with respect to updating the ITS Architecture for Canada in coordination with the most recent U.S. architecture:

- Need;
- Scope;
- Principles/methodology; and
- Estimated costs.

This report provides a summary of the analysis and results of the above.

1.2 Steering Committee

The effort to undertake this assessment project has been guided by the insight and direction of Transport Canada, ITS Canada, and stakeholders from the ITS industry, including:

- Susan Spencer – Transport Canada
- Yann Malara – Transport Canada
- Pierre Bolduc – Transport Canada
- Jonathan Sabean – Transport Canada
- Raynald Ledoux – Transport Canada
- Colin Rayman – ITS Canada

- Kara John – ITS Canada/DMTI Spatial
- Garland Chow – University of British Columbia Sauder School of Business
- Stephen Erwin – Ministry of Transportation of Ontario
- Denis Gingras – Université de Sherbrooke
- Les Kelman – City of Toronto
- Keenan Kitasaka – TransLink
- Luc Lefebvre – Ministère des transports du Québec
- Allan Lo – Alberta Ministry of Transportation
- Nancy Lynch – New Brunswick Department of Transportation
- Jean Meyssonnier – Agence Métropolitaine de Transport
- Timothy Schnarr – Delcan Corporation
- Lizuarte Simas – Region of York
- Blair Wagar – Saskatchewan Highways and Transportation

2. COORDINATION WITH THE U.S. NATIONAL ITS ARCHITECTURE

2.1 U.S National ITS Architecture

The U.S. National ITS Architecture is currently undergoing its third major revision since the development of the ITS Architecture for Canada in 2000, with the completion of Version 6.0 expected in June 2007. The following provides a brief summary of each revision:

- **Version 4** – was introduced to add the functionality for the Maintenance and Construction Operations (MCO) User Service, ensure alignment with Commercial Vehicle Information Systems Network (CVISN) and make minor changes. Although the initial starting point used to seed the development was the Operations and Maintenance (O&M) services of ITS Architecture for Canada, through the course of a number of stakeholder workshops and corresponding development iterations, the functionality supported is much more comprehensive than that of the Canadian architecture.

- **Version 5** – added the new user service Disaster Response and Evacuation (DRE). In addition, it added enhancements for increased functionality relating to security. It also included updated ITS Standards information and a number of general “house-cleaning” updates. Although the update resulted in limited new architecture elements (e.g. subsystems, market packages), there were modifications to a large number of elements.

- **Version 6** – will include modifications to address a series of FHWA Initiatives, including Vehicle Infrastructure Integration (VII), Clarus, and Integrated Corridor Management. In addition, changes to incorporate aspects of BIFA (Section 2.2) and CVISN Phase 2 are included, along with standards updates and further “house-cleaning” issues.

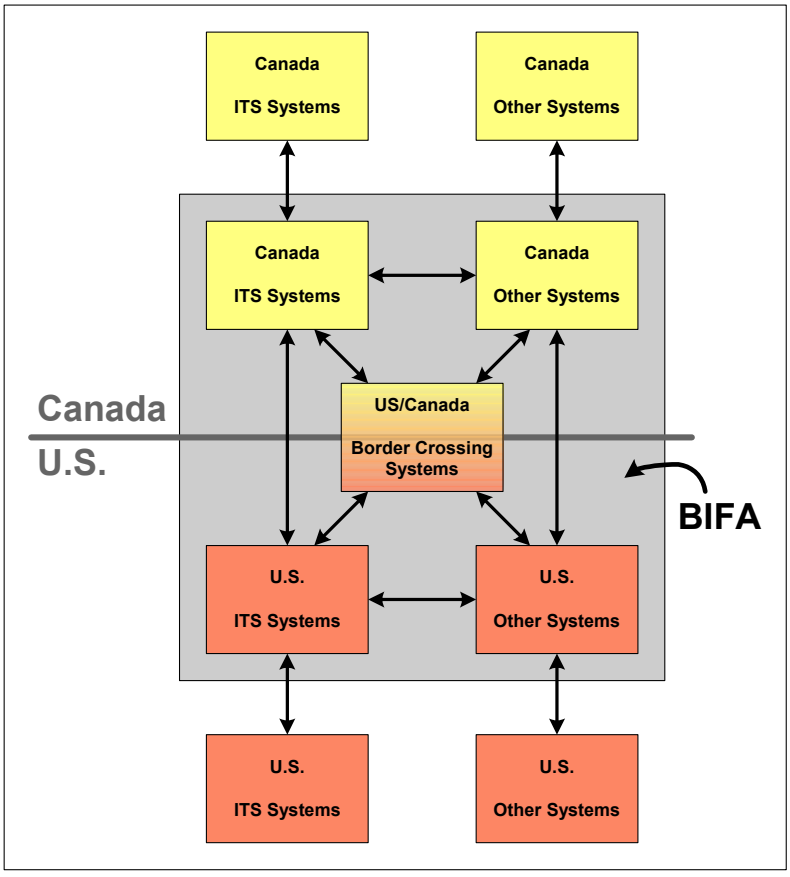
As part of this scoping exercise the Project Team met with the FHWA Architecture Project Manager and representatives of the U.S. Architecture Team. The meeting was successful in a number of ways: it provided insight into their plans for the architecture, it re-established a dialog between TC and FHWA with respect to the architecture, and resulted in an agreement in principle to share information, and to coordinate architecture development and maintenance activities.

2.2 BIFA

As part of a joint Transport Canada and FHWA effort, the Border Information Flow Architecture (BIFA) is intended to promote information sharing and coordination among border stakeholder agencies. The architecture provides a framework that depicts the flow of information among government (federal, state and local) agencies and components of the transportation system, as they relate to border processes (e.g., the flow of advanced traveller information from inspection and enforcement agencies to transportation organizations).

The scope of the resulting BIFA is illustrated in Exhibit 2-1 and focuses on information sharing and coordination between ITS and other systems to support operations and facilitate traffic flow near all 130 U.S./Canada land crossings, and extends to include the agencies and jurisdictions that manage these systems.

Exhibit 2-1 – BIFA Scope



The BIFA was developed using Version 3.1 of the Turbo Architecture Tool, which itself uses Version 5 of the U.S. National ITS Architecture as a base. The tool was augmented with Canadian Market Packages that were relevant, but not included in the U.S. architecture.

2.3 Current Inventory of Architecture Differences

A significant task of this project has been an analysis of the differences between the current Canadian (Ver. 1.2) and U.S. (Ver. 5.1) versions. The differences were documented for the following architecture elements:

- Subsystems;
- Terminators;
- Architecture Flows; and
- Market Packages.

In order to compare the two current architectures, Version 3 of the U.S. National ITS Architecture was used as the common point of reference. Changes in the various architecture elements (e.g. subsystems) include the addition of new elements and modification or discontinuation (removal) of Version 3 elements. Exhibit 2-2 provides a summary of these changes.

Exhibit 2-2 – Architecture Changes in Comparison to U.S. Version 3.0

	ITS Architecture for Canada			U.S. National ITS Architecture			
	Total	New	Mod.	Total	New	Mod.	Disc.
Market Package	79	16	7	85	12	53	N/A
Subsystem	23	4	9	22	3	20	N/A
Terminator	71	14	11	71	15	14	13
Architecture Flow	404	95	14	439	169	173	39

Exhibit 2-3 uses Market Packages to illustrate the functional areas where the two architectures differ. A review of this inventory indicates that there are ITS applications, such as Signal Enforcement, which are deployed in Canada and are part of the Canadian architecture, yet not included in the U.S. architecture. Conversely, there are ITS applications which are deployed in Canada, such as Roadway Automated Treatment, which are included in the U.S. architecture but not the Canadian architecture.

Exhibit 2-3 – Functional Differences

Functional Area	Relevant Market Packages	
	Canada	**United States**
Non-Vehicular Safety	• ***(NEW) ATMS29 Mixed Use Warning Systems*** - supports the near term sensing and warning systems used to interact with pedestrians and bicyclists.	• N/A
	• ***(NEW) ATMS30 Automated Non-Vehicular Road User Protection*** - supports more advanced systems of sensing and warning for pedestrians and bicyclists.	• N/A
Automated Enforcement	• ***(NEW) ATMS27 Variable Speed Limit and Enforcement*** - supports the ability to dynamically vary speed limits in response to roadway conditions.	• ***(NEW) ATMS19 Speed Monitoring*** - monitors the speeds of vehicles traveling through a roadway system.
	• ***(NEW) ATMS28 Signal Enforcement*** - supports the detection and enforcement of roadway control signals.	• N/A
Operations and Maintenance	• ***(NEW) ATMS24 Maintenance Fleet Management*** - supports automated management of fleets of maintenance, construction, or special service vehicles.	• ***(NEW) MC01 Maintenance and Construction Vehicle and Equipment Tracking*** - tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. • ***(New) MC07 Roadway Maintenance and Construction*** - supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Includes links for Asset Management.
	• ***(NEW) ATMS25 Smart Work Zones*** - includes systems that gather, store, and disseminate information relating to work zones.	• ***(NEW) MC08 Work Zone Management*** - directs activity in work zones, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity. • ***(NEW) MC09 Work Zone Safety Monitoring*** - includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles.
	• N/A	• ***(NEW) MC02 Maintenance and Construction Vehicle Maintenance*** - performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment
	• N/A	• ***(NEW) MC05 Roadway Automated Treatment*** - automatically treats a roadway section based on environmental or atmospheric conditions

Functional Area	Relevant Market Packages	
	Canada	**United States**
Operations and Maintenance (Continued)	• N/A	• ***(NEW) MC06 Winter Maintenance*** - supports winter road maintenance including snow plow operations, roadway treatments, and other snow and ice control activities.
	• N/A	• ***(NEW) MC10 Maintenance and Construction Activity Coordination*** - supports the dissemination of maintenance and construction activity to centres that can utilize it as part of their operations.
	• N/A	• ***(NEW) EM04 Roadway Service Patrols*** - supports roadway service patrol vehicles that monitor roads that aid motorists, offering rapid response to minor incidents.
Environmental Monitoring	• ***(NEW) ATMS23 Roadway Micro-Prediction*** - supports advanced systems to create micro-predictions of roadway conditions which can support improved maintenance planning and dispatch.	• N/A
	• ***(NEW) ATMS26 Dynamic Roadway Warning*** - supports the dynamic presentation of warning information to drivers response to roadway weather conditions, road surface conditions or traffic conditions.	• N/A
	• ***(NEW) ATMS20 Roadway Environmental Sensing*** - monitors current road and weather conditions using data collected from environmental sensors deployed on and about the roadway.	• ***(NEW) MC03 Road Weather Data Collection*** - collects current road and weather conditions using data collected from roadside environmental sensors and from sensor systems located on vehicles.
	• ***(NEW) ATMS21 Roadway and Weather Data Fusion*** - supports the fusion of roadway environmental data with general weather forecasts and observations.	• ***(NEW) MC04 Weather Information Processing and Distribution*** - processes and distributes the environmental information.
	• ***(NEW) ATMS22 Environmental Information Dissemination*** - supports the dissemination of roadway and weather data to centres which can utilise it as part of their operations.	
Security	• N/A	• ***(NEW) CVO11 Roadside HAZMAT Security Detection and Mitigation*** - provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology.
	• N/A	• ***(NEW) CVO12 CV Driver Security Authentication*** - provides the ability for Fleet and Freight Management to detect when an unauthorized commercial vehicle driver attempts to drive their vehicle based on stored driver identity information.

Functional Area	Relevant Market Packages	
	Canada	**United States**
Disaster Management	• ***(NEW) EM04 Disaster Command and Control*** - supports the co-ordinated response to large-scale disasters.	• ***(NEW) EM08 Disaster Response and Recovery*** - enhances the ability of the surface transportation system to respond to and recover from disasters.
	• ***(NEW) EM05 Disaster Information Dissemination*** - supports the dissemination from a central co-ordinating point of disaster-related information.	• ***(NEW) EM10 Disaster Traveler Information*** - uses ITS to provide disaster-related traveler information to the general public. • ***(NEW) EM06 Wide-Area Alert*** - uses ITS driver and traveler information systems to alert the public in emergency situations.
	• N/A	• ***(NEW) ATMS21 Roadway Closure Management*** - closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited.
	• N/A	• ***(NEW) EM05 Transportation Infrastructure Protection*** - includes the monitoring of transportation infrastructure for potential threats.
	• N/A	• ***(NEW) EM07 Early Warning System*** - monitors and detects potential, looming, and actual disasters including natural disasters and technological and man-made disasters.
	• N/A	• ***(NEW) EM09 Evacuation and Reentry Management*** - supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area.
Multi-modal	• ***(NEW) APTS9 Multi-Modal Connection Protection*** - supports the co-ordination of multi-modal services to optimize the travel time of travellers as they move from mode to mode.	• ***(MODIFIED) APTS7 Multi-modal Coordination*** - information is shared between Multi-modal Transportation Service Providers, Transit Agencies, and ISPs.
	• N/A	• ***(NEW) ATMS20 Drawbridge Management*** - supports systems that manage drawbridges at rivers and canals and other multi-modal crossings.
Intermodal Freight	• ***(NEW) CVO11 Freight In-Transit Monitoring*** - covers the ability to track and monitor intermodal containers and intermodal freight shipments.	• N/A
	• ***(NEW) CVO12 Freight Terminal Management*** - supports the operation of the roadway aspects of an intermodal terminal.	• N/A
	• N/A	• ***(NEW) CVO13 Freight Assignment Tracking*** - provides for the planning and tracking of the commercial vehicle, the freight equipment, and the commercial vehicle driver

When the changes are compared between the two architectures the result is a complicated matrix of possibilities, as illustrated in Exhibit 2-4. The most significant combination, and the one that will be the most difficult to align, is where Canada made modifications to an element and the U.S. has made different changes to the same element. It should also be noted that the number of these cases will increase with the current Version 6 update to the U.S. architecture.

Exhibit 2-4 – Architecture Changes in Comparison to Version 3.0

Change	Canada	U.S.
New	• U.S. has added similar • Nothing similar in U.S.	• Canada has similar • Nothing similar in Canada
Modified	• U.S. has since made similar change • U.S. has made different change • U.S. remains same	• Canada has similar change • Canada had different change • Canada remains same
Discontinued	• N/A	• Remains in Canada

3. GUIDING PRINCIPLES FOR THE UPDATE

3.1 General Principles

Through the course of the development of the ITS Architecture for Canada in 1999/2000 a fundamental principle was established in that the ITS Architecture for Canada would be based upon that of the U.S. Through the course of this assessment, the Steering Committee has confirmed that this remains a core objective. With the changes that have occurred in the three subsequent releases of the U.S. National ITS Architecture, it is now difficult to clearly establish the linkages between the two architectures. Accordingly, the primary driving factor for the update of the ITS Architecture for Canada is to provide the realignment with the current U.S. National ITS Architecture. This alignment is particularly relevant for Canadian transportation stakeholders planning and deploying ITS in border regions where there is the requirement to co-ordinate systems applications among stakeholders on both sides of the border. This coordination is relevant for Canadian stakeholders across the country, ranging from the new crossing at St. Stephen-Calais, the activities of Niagara International Transportation Technology Coalition (NITTEC) along the Niagara frontier, and the International Mobility & Trade Corridor (IMTC) on the B.C.-Washington frontier. Furthermore, alignment with the U.S. National ITS Architecture more readily facilitates interactions with the ITS industry and standards efforts.

Further to establishing the need for undertaking an update to the ITS Architecture for Canada, the Steering Committee has defined a series of principles which will guide the nature of the update effort, listed as follows:

- **Alignment with the ITS Plan for Canada** – the ITS Architecture for Canada should maintain the role of providing the framework for integrating applications among agencies, as defined in the ITS Plan for Canada, and successor programs.

- **Alignment with the U.S. National ITS Architecture** – to facilitate cross border initiatives, the ITS Architecture for Canada should be aligned as much as possible with the U.S., with a view to the potential evolution of a NAFTA ITS architecture. To support

this, ongoing formal dialog with the FHWA and the U.S. Architecture Team should be established to coordinate efforts and keep apprised of each other's current programs.

- **Linkages to the U.S. National ITS Architecture** – for the reasons as noted above, the Canadian architecture should utilize the U.S. architecture entities where applicable. Where there are differences in the nature or organization of the entities, the architecture should provide direct linkages to the most relevant corresponding entities within the U.S. architecture.

- **Linkage to the current ITS Architecture for Canada** – the updates to the architecture should provide full traceability to the current architecture to facilitate migration to the updated version. This should also include a "What's New" inventory as has been used with the U.S. updates.

- **Fully Bilingual** – all entity definitions within the architecture should be documented in English and French.

- **User Oriented** – the update initiative should be undertaken with a view to facilitating ease of use and accessibility for Canadian stakeholders. The update should include specific tools to readily facilitate the development of regional architectures.

- **Web-Enabled** – the architecture should continue as a web-enabled resource and readily facilitate the development of web-enabled regional architectures.

- **Maintenance and Support** – the update program should give consideration to initiatives to enable the architecture to remain evergreen and provide support in terms of training, mapping existing legacy systems to the architecture, and regional architecture development.

With these guiding principles in mind, the following sub-sections define the strategies to achieve the update and associated support and maintenance activities.

3.2 ITS Service Areas

As part of the workshop that was held in December 2006 in Ottawa, the key ITS service areas where the two national ITS architectures differ were examined in order to establish a strategy for an update to the ITS Architecture for Canada. The following provides a summary of the key decisions made by the Steering Committee with respect to how to proceed with an update:

- All functionality that was added to create the Canadian architecture in 2000 and has not been since added to the U.S. should be kept in the updated version. Some examples include:

  - Non-vehicular safety;
  - Automated enforcement; and
  - Intermodal freight.

- Where the U.S. has subsequently added functionality that is similar to functionality that was added to the Canadian in 2000, any additional enhancements implemented in the U.S. should be incorporated. Some examples include:

  - Monitoring crew movements in work zones;
  - Interface to asset management;

  - Automated treatment (e.g. Fixed Automated Spray Technology); and
  - Winter maintenance management.

- Where the U.S. has added functionality that does not exist in the Canadian architecture (e.g. Security), it should be integrated in the update. Some examples include:

  - Roadway closure management;
  - Transportation infrastructure protection;
  - Wide-area alert;
  - Early warning systems;
  - Evacuation and re-entry management;
  - Dangerous goods security;
  - Commercial vehicle driver security; and
  - Freight assignment tracking.

It should be noted that the above list of updates will be expanded based upon the changes for Version 6 of the U.S. National ITS Architecture, but fill follow similar principles. An area where the update may be expanded further than what is in the U.S. would be with respect to BIFA. As noted in Section 2.1, Version 6 of the U.S. architecture will incorporate elements (systems and information flows) from the BIFA that relate directly to ITS services. The degree to which BIFA elements are integrated into an updated ITS Architecture for Canada should be assessed in cooperation with the Steering Committee, and as part of the Update project itself, after the Version 6 revision is complete.

3.3 Market Packages

Market Packages are a key entry point into the architecture and a well-used component by stakeholders, as they generally focus on a single ITS service and include other architecture elements, such as subsystems, terminators and architecture flows. As such, Market Packages were used as the element of choice for comparison of the architectures at the workshop and it is recommended that this approach be kept for the follow-on update work.

The inventory of differences (see Section 2.3) discussed areas where the Canadian and U.S. architectures differed based on ITS functionality. However, as a result of the parallel architecture developments the naming and numbering of common Market Packages do not match in all cases. Furthermore, the update will necessitate the addition of new ITS services and functionality which will require the development of new Market Packages and these should be added in succession to existing ones. It is recommended that the updated architectures adopt the current U.S. numbering and organization, with a distinct identification for unique Canadian Market Packages. This numbering should provision for potential future additions to the U.S. or Canadian elements.

To assist users of the architecture, as well as support any subsequent updates, the updated architecture material (e.g. website, documentation) should include a comprehensive mapping of Market Packages, and corresponding Physical Elements, to the U.S. National ITS Architecture Version 6.

3.4 User Services and Sub-services

3.4.1 USER SERVICES

User Services document what ITS should do from the user's perspective. User Services are a key building block for the development efforts as they define the requirements that the architecture

should meet. As well, User Services are used as part of ITS strategic planning for stakeholders and agencies by allowing system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs.

Similar to Market Packages (Section 3.3), there is a disconnect between the naming and numbering of User Services in the two architectures. It is also of note that since 2000 (e.g. Version 3), the U.S. has since undertaken an effort to simplify the User Service definitions.

The following provides the recommended approach for the update with respect to User Services:

- Current Canadian naming and numbering should be maintained;
- New User Services required for the update should be added sequentially using the existing organization and numbering; and
- Updated architecture material should include a comprehensive mapping to the U.S. User Services.

3.4.2 USER SUB-SERVICES

User Sub-services are essentially more focused views of User Services and are unique to the Canadian architecture. During the initial development User Sub-services were defined based on the Market Packages of Version 3 of the U.S. architecture and were useful in facilitating stakeholder outreach when discussing areas of modification and enhancement in comparison to the U.S.

Since the initial development effort, the value of User Sub-services has diminished, as explained below:

- User Services provide higher level aggregation of ITS services and have proven useful to identify needs as part of ITS strategic planning efforts.
- Market Packages provide lower-level definition of ITS services that specifically identify the physical architecture elements and information flows that address the service.
- Market Packages have gained wide acceptance as the building blocks for regional architectures.
- In the U.S., Market Packages have served a role similar to User Sub-services for recent updates to the national architecture. As noted in Section 3.3 it is recommended that Market Packages be used for the planned update for Canada.

Due to these reasons, and their strong correlation, it is recommended that User Sub-services and Market Packages be merged as part of the update, as follows:

- Rename as “Market Packages/User Sub-services”.
- Use Market Packages as basis for:
  - Naming and organization; and
  - Content (e.g. definitions, physical elements, architecture flows, diagrams).
- Use User Sub-services as basis for linkages with User Services.

- Move the linkages to User Service Requirements from User Sub-services to User Services.

3.5 Logical Architecture

The Logical Architecture defines what has to be done to support the ITS User Services in terms of the processes that perform ITS functions and the information or data flows that are shared among these processes. The Physical Architecture (Subsystems, Terminators, Architecture Flows) then provides a high-level structure around the processes and data flows defined in the Logical Architecture.

The Logical Architecture has proven to be a useful tool, and first step, when developing an ITS architecture from User Service Requirements, as was the case for the initial development of the U.S. National ITS Architecture and revisions to add new User Services. Conversely, the original scope of work for the ITS Architecture for Canada was for only the Physical Architecture, while the Logical Architecture was developed under an extension to the project.

While both national architectures include a Logical Architecture, experience has indicated that use of the architectures has been focused on planning activities and development of regional architectures, both of which relate to User Services and Market Packages. Regional architectures focus on the Physical Architecture by identifying existing and planned ITS (subsystems and terminators) and interfaces (architecture flows) among them. The Logical Architecture identifies the processes and internal data flows of ITS applications, and therefore lends itself to detailed system design and software development. In practice it is generally private sector system developers and equipment manufacturers that need this level of detail, and these stakeholders are free to, and do, design their products internally as they wish. What is important for integration is for these stakeholders to ensure external interfaces are based on established standards. These inter-system/device interfaces are identified in the Physical Architecture as Architecture Flows and are mapped to applicable ITS standards, which allows agencies to plan and procure interoperable ITS projects based solely using the Physical Architecture.

This project has focused on the Physical Architecture elements to assess the need for an update to the ITS Architecture for Canada. These updates would in turn necessitate extensive revisions to the corresponding elements within the Logical Architecture. Based on the initial development for Canada and updates in the U.S., it is fair to say that the effort would be in the same order of magnitude as updating the Physical Architecture.

It is recommended that the update should be structured to initially undertake the work on the Physical Architecture, and a need for the corresponding update of the Logical Architecture can be determined as part of the initial stakeholder outreach or subsequently based on demand identified as part of the training or ongoing maintenance.

3.6 Equipment Packages

Equipment Packages are the building blocks of the Physical Architecture Subsystems and group similar processes of a particular subsystem together into an “implementable” package. Equipment Packages are not currently included the ITS Architecture for Canada, but it is recommended that they be incorporated for the following reasons:

- They provide a direct link between the Physical Architecture and high-level functional requirements;

- They are a component of the Turbo Architecture Tool; and
- The effort to add them is not great.

As Equipment Packages are not currently part of the Canadian architecture, it is recommended that the naming and organization be kept as much in line with the U.S. as possible, allowing for Canadian spelling and terminology.

3.7 Standards Mapping

A significant resource that the two architectures provide is a mapping of relevant standards to the Architecture Flows. The mapping in the Canadian architecture is based on what was included in Version 3 of the U.S. Since that time, standards have evolved and the U.S. has continued to update its architecture in parallel. It is therefore important that the update incorporate the most up to date mapping to standards based on the U.S. efforts and augmented with relevant international standards efforts.

3.8 Traceability

As highlighted in Sections 3.3 and 3.4.1, it is important that the updated architecture material (e.g. website and documentation) include a mapping between Canadian and U.S. elements. It is equally important that there be similar mapping to Version 1 of ITS Architecture for Canada to assist stakeholders updating work developed based on the current version.

It is recommended that the browser-based version of the updated architecture should include live links to the corresponding mapped elements of the U.S. architecture, as found at http://www.iteris.com/itsarch/.

3.9 Spelling and Terminology

A significant effort during the original development of the ITS Architecture for Canada was extended to ensure that the Canadian specific spelling (e.g. centre vs. center) and terminology (e.g. dangerous goods vs. HAZMAT) was used. To ensure that the architecture continues to be representative of the Canadian environment, the update should follow the same principle of using Canadian spelling and terminology.

3.10 Bilingual

The majority of elements of the ITS Architecture for Canada have been translated into French. This includes the names of all elements and descriptions of all elements except for the Process Specifications and Data Flows of the Logical Architecture. It is recommended that the same degree of translation be employed, which will include all elements in the initial update. Further translation of the Logical elements can be considered later as part of Logical Architecture update.

It should be noted that, similar to the Version 1 of the ITS Architecture for Canada, it is assumed that the translation of the material will be the responsibility of Transport Canada.

3.11 Architecture Tool

The U.S. Turbo Architecture tool has gained wide acceptance and has proved useful to allow stakeholders to make use of the architecture. As part of the workshop in December 2006, a

demonstration of Turbo was done and there was general agreement within the Steering Committee on the benefits of, and the need for, a similar tool for the Canadian architecture. The primary objectives of the architecture tool are to:

- Provide the Turbo Architecture type of functionality;
- Function with the Canadian architecture database; and
- Provide bilingual capability.

Ideally, the tool would also incorporate a browser-based user interface.

The following is a summary of alternatives for such a tool that were discussed, and an indication of some of the pros and cons of each:

- **Canadian Turbo Databases** − The core database for the U.S. Turbo Tool can be modified to consist of the Canadian elements and relationships. This will allow stakeholders to purchase the Turbo tool, copy over the database, and use the tool as designed (but with Canadian content). Separate databases will be required for English and French.
  - **Pros:** fairly easy to develop, low maintenance and low cost.
  - **Cons:** tied to a specific Turbo version, user interface would be unchanged (English language, U.S. spelling).
- **Modification of U.S. Turbo Tool** – The actual tool itself could be updated specifically for Canadian use, and potentially for French language. This would provide the same functionality as above, but would provide a 'Canadian-specific' used interface. This option would require help from the FHWA and the U.S. Architecture Team as it would require work on the source code.
  - **Pros:** more user friendly interface for Canadian stakeholders.
  - **Cons:** tied to specific Turbo version, substantial development, unknown but likely high cost and dependent on U.S. involvement.
- **New Canadian Tool** – A similar tool could be developed from the ground up. This option would allow the development of a tool that only includes those elements of the U.S. Turbo tool that are considered needed, while also allowing additional functionality to be added if identified as warranted (e.g. potentially use a web-based input utility). However, this creates another 'element' of the ITS Architecture for Canada that is not directly linked to the corresponding U.S. equivalent.
  - **Pros:** more complete tool that meets the needs of Canadian stakeholders; potentially enhanced functionality, can ensure bilingual interface(s), easier to maintain.
  - **Cons:** substantial development and considerable cost, potentially high maintenance.

Either of the last two options can make use of the Canadian Turbo Databases. For that reason, and to provide a tool in the short term, it is recommended that the Canadian Turbo Databases be developed as initial step, followed by one of the other two options to develop a custom Canadian user interface. The selection of the appropriate option should be subject to the review of the Steering Committee, in consideration of the relative level of effort for each option.

3.12 Training and Outreach

The update initiative provides the opportunity to engage ITS stakeholders, both in the public and private sectors, and provide education and support for the application of the architecture. Following the completion of the update, it is recommended that a training and outreach effort be undertaken. This effort will serve a number of purposes, including:

- Providing training on what the architecture is and how it can be used;
- Informing stakeholders of the nature of the update; and
- Promoting the successful use of the updated architecture.

This initiative is particularly important in the Canadian context in that there has not been a national scale training initiative since 2001/2002. The Version 1 material that was used in 2001 can be modified based on the updates and expanded as appropriate to further promote the use of the architecture at the municipal and provincial levels. As was done in 2001, the training can be done at a number of locations across Canada.

It is also recommended that a Guide to Developing Regional ITS Architectures be developed to further promote usage of the architecture and assist stakeholders in doing so.

3.13 Maintenance and Support

The preceding sub-sections examined the current relationship between the two national ITS architectures and the recommended guiding principles to update the Canadian to align it with the most recent U.S. version. For the most part these principles translate directly to any subsequent updates in the future and provide a structured approach that may be followed.

In the interim between the updates it is recommended that an ongoing maintenance and support program be established. The program would allow for ongoing observation of changes to the U.S. architecture and minor modifications for inter-version updates, which in turn can minimize the effort required for subsequent updates. In addition, a maintenance and support program can potentially include:

- Minor revisions to the architecture based upon U.S. updates or needs/deficiencies as identified by Canadian stakeholders;
- Ongoing end-user support in the form of online help;
- Supplemental training sessions on an as-needed basis; and
- Regional architecture development support in the form of workshops and a guidebook/online resource.

To provide the above maintenance and support, it is recommended that there be bi-monthly meetings to review stakeholder feedback and U.S. architecture activities and assess the need for, and timing of, minor updates to the architecture.

3.14 Summary

Based on the review of differences between the two national ITS architectures, there was steering committee consensus that it was warranted to pursue an update of the ITS Architecture for Canada and to re-align it with the imminent Version 6 of the U.S. National ITS Architecture. The following provides a summary of the Project Team's recommended guiding principles to be followed for the update:

- The Physical Architecture should be completed as a first step, and the Logical Architecture should be updated based on demand determined as part of the stakeholder outreach or subsequently based on demand identified as part of the training or ongoing maintenance.
- The update effort should include the development of an approach to rationalize the naming and numbering of existing and new Market Packages and User Services.
- User Sub-services and Market Packages should be merged as common "Market Packages/User Sub-services", based on the naming and content of the current Market Packages and with linkages to User Services.
- The update should adopt the current U.S. numbering and organization of Market Packages, with a distinct identification for unique Canadian Market Packages.
- Equipment Packages should be added based on those of the U.S. National ITS Architecture.
- Comprehensive mapping to Version 1 of the ITS Architecture for Canada for all elements should be included.
- Comprehensive mapping to Version 6 of the U.S. National ITS Architecture for all elements should be included.
- The most up to date mapping to U.S. and international standards should be incorporated.
- All Physical elements should be translated for the in the initial update, and the degree of translation of Logical elements can be considered later as part of the Logical Architecture update.
- A bilingual architecture tool with Turbo Architecture functionality should be developed, either through modification of Turbo Architecture or the development of a custom tool.
- Training and Outreach should be undertaken to advise stakeholder of the update and promote use of the architecture.
- A Guide to Regional ITS Architecture should be developed.
- A Maintenance and Support program should be established.

4. NEXT STEPS

The following sub-sections provide a summary of the recommended implementation plan for the update for the ITS Architecture for Canada, including a scope of work to be completed, anticipated schedule and the associated estimated costs.

4.1 Scope of Work

4.1.1 UPDATE PHYSICAL ARCHITECTURE

The Physical Architecture, User Services and Market Packages of the ITS Architecture for Canada shall be updated to align with Version 6 of the U.S. National ITS Architecture, as per the recommended guiding principles outlined in Section 3 and summarized in Section 3.14. The following identifies the tasks for this effort:

- ***Meetings and Project Management***
  A Steering Committee will need to be established to help manage the project scope and direction as it proceeds. As much as possible, the Steering Committee for the update assessment should remain in tact for the update effort and should be augmented as required to provide a cross section of Canadian ITS industry. Steering Committee meetings shall be a mix of in-person gatherings and teleconferences and should at a minimum include a kick-off meeting and periodic status/review meetings.

- ***Environmental Scan***
  An environmental scan of international ITS architectures will need to be undertaken to assess the state of practice and identify elements that may be applicable for Canada and potential enhancements for the update. The Environmental Scan should distinguish the experience of other agencies in adapting the U.S. architecture for their needs. The results of the Environmental Scan will be documented in a Technical Memorandum and distributed to the Steering Committee and Stakeholder Outreach group.

- ***Stakeholder Outreach***
  The purpose of the Stakeholder Outreach will be to gain wider consensus on the procedure and scope of the update. At a minimum there will be two stakeholder workshops. The initial workshop will be early in the project and will present and solicit input on the environmental scan and guiding principles for the update, an inventory of proposed changes, a summary of the anticipated structure and organization of the updated architecture, and detailed examples of results of some of the proposed changes. The second workshop will be held once a draft of the final updated architecture is completed and will provide a comprehensive overview of the update. Stakeholder comments and feedback from both workshops will be incorporated into the update.

- ***Implementation of Updates***
  Based upon the guiding principles and input from the Steering Committee and Stakeholder Outreach, the modifications required to align the ITS Architecture for Canada with the U.S. architecture shall be implemented. As a minimum, modifications will be required for:

  - User Services;
  - Market Packages and User Sub-services;
  - Subsystems and Terminators;

- Architecture Flows; and
- Standards (mapping to Architecture Flows).

The updated architecture shall be documented in MS Access and include mapping of updated elements to Version 1 of the ITS Architecture for Canada and the most recent U.S. architecture.

- ***Final Documentation***
  Once the updates are complete and finalized, the architecture shall be documented in hypertext and report form. The hypertext format shall be suitable for CD distribution and hosting on the Internet and shall provide a comprehensive and easily navigated presentation of the architecture and should include, at a minimum, all linkages among related elements of the current version, and linkages to the corresponding U.S. elements. The final design of the hypertext, and how closely it matches the current version, will be approved by the Steering Committee. The final documentation shall also include updates for all relevant ITS Architecture for Canada documents. It should be noted that all documentation is required in English and French, and that Transport Canada will assume responsibility for translation.

4.1.2 ARCHITECTURE TOOL

An architecture tool with functionality similar to Turbo Architecture shall be developed for the updated ITS Architecture for Canada. Section 3.11 identified general requirements for a tool and recommended that the Canadian Turbo Databases be developed as a short term solution, followed by one of the following options to achieve a Canadian-specific user interface:

- Option 1: Modify U.S. Turbo Tool
- Option 2: Create Custom Canadian Tool

The effort associated with each option would include stakeholder consultation and definition of functional requirements, software development, prototype testing and review, and final production. The course of action with respect to which option is pursued will be determined by the Steering Committee based upon the respective level of effort.

4.1.3 GUIDE TO REGIONAL ITS ARCHITECTURE DEVELOPMENT

The U.S. Department of Transportation's Regional ITS Architecture Guidance Document shall be modified as appropriate to reflect the ITS industry in Canada and unique features of the ITS Architecture for Canada. Tasks for this effort will include the preparation of a draft guide document, a review by, and presentation to, the Steering Committee, and a final document based on Steering Committee feedback.

4.1.4 TRAINING AND OUTREACH

Following the completion of the Physical Architecture Update, there should be a structured Training and Outreach effort, as described in Section 3.12. The following identifies some of the tasks for this effort:

- ***Training and Outreach Material***
  The training material developed in 2001 shall be modified to reflect the Architecture

Update. The Steering Committee shall have input into the content and areas of emphasis.

- ***Session Preparation***
  For each session there will need to be preparation, including:

  - Identification of a local champion to assist in the preparation and organization;
  - Selection of convenient date;
  - Arrangement of facilities; and
  - Management of registration.

- ***Convene Workshops***
  Qualified instructors familiar with the ITS Architecture for Canada facilitate a total of five sessions convened across Canada, including one French version.

4.1.5 MAINTENANCE AND SUPPORT

Section 3.13 provides a summary of the needs for, and the benefits of having, formal maintenance and support for the ITS Architecture for Canada. A Maintenance and Support program shall be proposed and approved by Transport Canada addressing some or all of the following potential activities:

- Minor revisions to the architecture based upon U.S. updates;
- Minor revisions to the architecture to address needs/deficiencies as identified by Canadian stakeholders;
- Ongoing end-user helpdesk support;
- Supplemental training sessions on an as-needed basis; and
- Regional architecture development support in the form of workshops.

4.1.6 UPDATE LOGICAL ARCHITECTURE

The Logical Architecture, including Data Flows, Data Flow Diagrams and Process Specifications, shall be updated accordingly based on the results of the Physical Architecture Update. As identified in Section 3.5, the timing of the update to the Logical Architecture shall be based on demand identified as part of the stakeholder outreach or subsequently based on demand identified as part of the training or ongoing maintenance. The scope of work for this update shall be determined at that time; however, it can be assumed that there will be limited stakeholder involvement required as the scope of the modifications should be consistent with those of the Physical Architecture update.

4.2 Anticipated Schedule

Exhibit 4-1 summarizes the anticipated schedule for the recommended update of the architecture:

Exhibit 4-1 – Anticipated Schedule

Task	Start	Duration
Update Physical Architecture	Notice to Proceed	6-8 months
Architecture Tool Core: Create Canadian Turbo Databases Option 1: Modify U.S. Turbo Tool Option 2: Create Custom Canadian Tool	Following Physical Architecture Completion	 2-3 months 3-4 months 6-9 months
Guide to Regional ITS Architecture Development	Following development of Architecture Tool	2-3 months
Training and Outreach	Following Physical Architecture Completion	2-6 months
Maintenance and Support	Following Training and Outreach	Annually
Update Logical Architecture	TBD	6 months

4.3 Estimated Costs

The following provides a summary breakdown of the estimated costs for the recommended update of the architecture:

- Update Physical Architecture – $175,000 to $250,000, depending on the degree of stakeholder involvement.
- Architecture Tool
  - Core: Create Canadian Turbo Databases – $75,000 to $100,000, depending on functionality supported.
  - Option 1: Modify U.S. Turbo Tool – approximately $50,000, depending on functionality and subject to U.S. Architecture Team support and software access.
  - Option 2: Create Custom Canadian Tool – $125,000 to $200,000, depending on the degree of stakeholder involvement, required functionality, and third party CASE tools required.
- Guide to Regional ITS Architecture Development – $60,000 to $75,000.
- Training and Outreach – $25,000 to $40,000 to develop material and $20,000 to $30,000 per session, depending on location.
- Maintenance and Support – $25,000 to $100,000 annually, depending on scope.
- Update Logical Architecture – $125,000 to $175,000 based on Physical Architecture content and scope.