

Cascade Gateway Border Data Warehouse Upgrade & BIFA Integration Project
Report #3

Recommendations for BIFA & Architecture Developers

From the regional architecture maintenance perspective

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1. Introduction

1.1 The Border Information Flow Architecture

The Border Information Flow Architecture (BIFA) was developed jointly by the U.S. Federal Highway Administration (FHWA) and Transport Canada to ensure that technologies deployed at border crossings interact efficiently with one another. It is a:

“Customizable ITS architecture that includes border-unique components that may be used to map flows of information across the Canada – U.S. border as well as between agencies and systems at border crossings.”¹

The BIFA emerged from discussions regarding cross-border ITS coordination at the binational Transportation Border Working Group (TBWG) forum. Federal, provincial, state, and local representatives from transportation and inspection agencies provided feedback which led to the development of the BIFA.

Suggested uses of the BIFA include using it for ITS project implementation, identifying roles and responsibilities of project stakeholders, defining functional requirements of the project, and identifying applicable ITS standards. The BIFA can also be used for border-region ITS architecture development and updating. Lastly, it is supposed to be able to support the transportation planning process, allowing planners to consider transportation services described in the architecture, integration opportunities, and improved definitions of projects.

BIFA is a report and a Turbo Architecture file (available in U.S. and Canadian architecture versions). Both are available online at www.iteris.com/itsarch/bifa.

To facilitate the use of the BIFA, Transport Canada created a BIFA Pilot Project Funding Program to encourage recipients to undertake pilot projects that demonstrate the use of the BIFA to guide the implementation of technology at border crossings.

1.2 The Cascade Gateway Border Data Warehouse Upgrade & BIFA Implementation Project

The Whatcom Council of Governments (WCOG) received funding through Transport Canada’s BIFA Pilot Project Funding Program in 2010 to support ongoing public and private planning and operations of the Cascade Gateway border crossing system², and to advance the BIFA itself. The project was designed to build on an existing data archive and show how the BIFA can help planning of cross-border ITS implementations. The project had three objectives:

1. Improve the binational Cascade Gateway Border Data Warehouse
2. Use the BIFA template to develop a project architecture that will be compatible with both U.S. and Canadian regional ITS architectures

¹ Transport Canada Website (September 2011): <http://www.tc.gc.ca/eng/innovation/its-border-information-flow-architec-270.htm>

² The Cascade Gateway is the system of four border crossings between the Lower Mainland of British Columbia, and Whatcom County in Washington State. The crossings include Peace Arch/Douglas, Pacific Highway, Lynden/Aldergrove, and Sumas/Abbotsford-Huntingdon ports-of-entry.

3. Provide guidelines for other regions considering the BIFA for their cross-border ITS projects, and recommendations for future BIFA development.

The first objective of this project is detailed in the **Border Data Warehouse Upgrade & BIFA Integration Project Report 1: Project Final Report**. The resulting ITS project architecture based on the BIFA is available in **Report 2: Cascade Gateway Border Data Warehouse Project ITS Architecture**³. This report focuses on the third objective; to provide guidelines and suggestions on using the BIFA, and recommendations for both the future of BIFA development, and for architecture as a whole.

2. Process Used

To test the functionality and usability of the BIFA, the Whatcom Council of Governments (WCOG) used the BIFA for designing the project architecture for the Cascade Gateway Border Data Warehouse upgrade.

The U.S. and Canadian Turbo Architecture template files were downloaded from the official website. The architecture was developed using the U.S. architecture, with the intention of then importing that into the Canadian version.

In addition, the BIFA report was referenced during the creation of the architecture.

The entire development of the architecture was documented in a log (see **Appendix A: BIFA User Log**).

The architecture was developed over the duration of the project itself. A draft version of the architecture was sent to architecture consultants at Consystec Inc. and R.C. Ice & Associates for review. Suggested changes were incorporated. A final Turbo version was developed by R.C. Ice & Associates which fixed some of the issues in the initial file. He also converted the entire file into a Canadian turbo file.

3. Benefits of Using BIFA

The greatest benefit of the BIFA, and the architecture process in general, was seen at the initial stages of the project while defining stakeholders and how the system would work at a broad, agency-based level. Going through the BIFA proved to be a valuable exercise specifically in a few areas described below.

3.1 Identifying stakeholders

By starting with a pre-defined list of possible stakeholders that could have a role in a binational data project like this, it was easier to pick out specific stakeholders for the project.

3.2 Mapping data sharing connections

The greatest benefit of architectures as a whole is that they provide diagrams showing the connections between ITS systems, what agencies are responsible for those systems, and what data is shared between them. The final information flow schematic developed through the Turbo

³ All project reports are available on the Whatcom Council of Governments website: www.wcog.org.

Architecture software was a critical piece in capturing the planned structure of the project system, especially useful to those stakeholders being solicited to participate in a data sharing agreement.

3.3 Data-sharing agreements

The fact that the BIFA requires users to consider data sharing agreements brought up this critical issue to the project team. Although no data sharing agreements were ultimately signed at the conclusion of this project, it started the process of research into the benefits of such agreements.

3.4 Mapping connections between U.S. and Canadian services

Perhaps the most useful tool in the BIFA report is the table illustrating the relation between market packages, or services, in Canada and those in the U.S. Since they are similar but have slightly different names, relating a project that spans the border to both architectures can be confusing. This table proved valuable in developing the project architecture and choosing which services to apply.

4. Challenges Using BIFA

Although there were benefits in using the BIFA for this project architecture, numerous challenges affected the overall process for WCOG.

4.1 BIFA usability

The biggest issue with the BIFA report and Turbo file is that it isn't exactly clear what BIFA is. Is it a complete regional architecture on its own, off the shelf and ready to go, or is it a template for other regions to use by filling in the blanks? By trying to serve both purposes, it underserves both purposes.

BIFA as architecture

One of the primary purposes of BIFA, according to the report, is to serve as a regional architecture:

“The Border Information Flow Architecture (BIFA) is an example of a Regional ITS Architecture.”⁴

As an architecture, it is described as a tool to guide planning:

“The architecture is a tool that can be used by agencies...to guide the planning, development, and implementation of ITS and other technology.”⁵

As well as being a tool, it is designed to serve as the regional architecture for regions lacking their own:

“BIFA can also be used directly as the regional ITS architecture in border areas where there is no other regional ITS architecture.”⁶

In this vein, there are specific details in the architecture that would be found in any regional ITS architecture. For example, there is a specific time horizon:

⁴ Border Information Flow Architecture Final Report (National ITS Architecture Team, January 2006), p. 5

⁵ Border, p. 5

⁶ Border, p. 14

“BIFA has a time horizon of 10+ years with particular focus on near-term integration opportunities that will yield real implementations and real results.”⁷

And as a complete architecture, it lists specific stakeholders:

“By mapping the BIFA elements (e.g. Bridge and Tunnel Operations TOC) to National ITS Architecture subsystems (or terminators) (e.g. Traffic Management Subsystem), the interfaces defined in the national ITS architectures can be used as the basis for defining the interfaces in BIFA.”⁸

In other words, there are specific stakeholders and elements listed in the BIFA that would be found in a regional architecture. Just to illustrate a few:

- FMCSA
- IFTA, Inc.
- Meteorological Service of Canada
- Transport Canada
- U.S. Department of Homeland Security

By mapping these very specific agencies to subsystems and terminators in the architecture, the developers have created a full regional architecture.

Additionally, in the Maintenance section of the architecture, it states “the Border Information Flow Architecture is not a static set of outputs. It will need to change as border projects are implemented and as the needs and services relating to the border evolve.”⁹ It is not clear whether this refers to maintaining BIFA the template, BIFA the architecture, or advice for individuals using an architecture.

BIFA as template

The document and corresponding Turbo Architecture files also attempt to serve as a template for regions that already have regional architectures:

“One of the primary purposes of BIFA is to provide a set of standard definitions and interfaces that these other more specific regional ITS architectures can apply to their specific border crossing.”¹⁰

Therefore it suggests that the standard interfaces established by the BIFA could serve as an example for mapping cross-border ITS projects in existing regional architectures.

“By including and merging border-relevant elements of both national architectures, BIFA provides a unified template that can be used to increase the consistency of regional ITS architectures in the border region.”¹¹

This is a specific, unique quality of the BIFA report – by mapping both the Canadian and U.S. components to each stakeholder, element, and system, it creates a way for those with architectures

⁷ Border, p. 12

⁸ Border, p. 7

⁹ Border, p. 89

¹⁰ Border, p. 13

¹¹ Border, p. 14

on either side of the border to directly correspond their ITS components to those in the other country.

As a template, there are pre-set conditions within the BIFA:

“Because BIFA represents a generic architecture that will be further customized by users, all of the element status [sic] have been set to planned.”¹²

Of course the biggest challenge with elements that need to be made less generic is that there is work on the part of the agency responsible for customizing those elements. Likewise, stakeholders are often left generic:

“In some cases, the names may appear as generic agencies compared with the specific companies or government organizations that participated in the meetings.”¹³

Placeholder agency names were included in the BIFA. Just an example of a few include:

- Provincial Ministry of Transportation
- Bridge or Tunnel Operations Agency
- Rail Agencies
- US State Transportation Planning Organization

The challenge for the end user

Because the BIFA is both a template and an architecture, it presents a large amount of work to the end user developing a project or regional architecture based on it. If someone wanted a regional architecture, they would need to filter out all the placeholder agency names to rename them. If someone wanted a template, they would need to filter out all the specific agency names to limit it to those required for their project or region.

For example, the Cascade Gateway has no bridge or tunnel authorities. The effort required to remove each instance of the bridge or tunnel authorities in the BIFA Turbo files far exceeds the effort it would have taken to add them in.

This need for voluminous manual editing extends beyond the stakeholder name lists. Because the BIFA template has already mapped its stakeholders to subsystems, and interfaces are defined within its Turbo file, the end user must then go through the Turbo file and deselect all the interfaces, stakeholders, and other components they don't need for their project or region.

To develop the Cascade Gateway Border Data Warehouse ITS Project Architecture, 91 deletions were needed to be made out of the elements (see **Appendix A: BIFA User Log**). There are over 325 specific information flows identified in the BIFA which, if being customized, need to be looked at individually for inclusion or deletion. Even the report itself acknowledges the amount of customized elements in the BIFA: “The complete set of the BIFA interface definitions is too voluminous to include here.”¹⁴ If there are too many to be included in a template, it brings up the question of whether or not they should be included at all.

¹² Border, p. 40

¹³ Border, p. 16

¹⁴ Border, p. 65

In addition to the customization/lack of customization issue there is also a great deal of repetitiveness in the current BIFA. For example, there is a Canadian Provincial Transportation Planning System, a Canadian Regional Transportation Planning System, and a Provincial Ministry of Transport Field Equipment, all of which could be used to represent the same agency, and need either deletion or customization to be of any use.

What to include in a BIFA architecture

The scope of an architecture is an important question for those developing it. Should it represent every automated interaction of technology that occurs between two agencies? Or should it reflect the data sharing elements only as they are relevant to a specific project or region?

In the BIFA, there are numerous stakeholders listed who do not currently share dynamic data with ITS systems. It is important to clarify that in an ITS architecture, information or data exchanged between elements should be dynamic (electronic) in nature and shouldn't include a map of phone calls, emails, or other non-dynamic communication relays.

But the BIFA does include stakeholders that don't dynamically share or receive data: CBSA's website, private commercial carriers, and freight shippers may eventually have dynamic relays of information, but at this moment they do not. By putting them in the architecture now they require more work for the end user and confuse whether or not non-dynamic connections need to be included.

The issue of generic information versus detailed is a critical one in architecture definition, especially with the BIFA. The report states:

“describing many systems with a single element helps keep the architecture from growing too large.”¹⁵

While this is understandable, it highlights an irony that BIFA's inclusion of hundreds of individual information flows renders it so complex that it could not be shared in this report. It is difficult to imagine using these highly-detailed flows in such a way to make this time-consuming aspect of the BIFA worthwhile.

Another question is whether or not all-encompassing needs incorporated in the BIFA are beneficial. In the BIFA needs section, some are very generic (“improve rail and maritime infrastructure and services”) and some are very architecture-specific (“define information flow between entities”), while others are outside the scope of the architecture entirely (“improve the movement across the US/Canadian border of people, goods, and services”)¹⁶. The BIFA's inclusion of generic needs challenges its ability to serve as an effective template. However if it were a regional architecture the would have to be better defined.

As per the requirements stated in a systems engineering approach, stakeholder needs should specifically state what is trying to be solved and what is a measurable improvement. This means that components of an architecture should be able to be validated. But there is no way to validate “Enhance the economic vitality and Canadian/US trade”¹⁷ in an effective manner. Even the

¹⁵ Border, p. 40

¹⁶ Border, p. 56

¹⁷ Border, p. 57

architecture itself acknowledges that the needs are “too broad to assign to one or even several areas”¹⁸ so including them seems unnecessary.

Language concerns with architecture

Sometimes the usability concerns relate simply to the way things are described in architectures, specifically in the BIFA. For example:

“Functional requirements are a description of the functions or activities that are currently performed by the ITS elements or that are planned to be performed in the future.”¹⁹

This sentence could be simplified to: “Functional requirements are ‘shall’ statements for what the system or center will do.” This lack of clarity obfuscates the intent of the BIFA and confuses the reader.

The Equipment Packages section of the BIFA expends great effort explaining what the concept is without showing the concept. Explanations like “equipment packages, also known as functional areas, represent pieces of a subsystem that performs a single function”²⁰ do not clarify a concept for a reader. If it takes over two pages to explain a term in a report, then the term needs to be altered.

Terminology throughout the BIFA, and architecture in general, require even users well-versed in ITS architecture to consistently cross-reference terms to make sure they’re understanding what is actually a relatively simple concept.

However, because this is more of an architecture issue, it is discussed in greater detail there.

4.2 Turbo Architecture software

The Turbo Architecture tool was developed by FHWA and Transport Canada and is the encouraged mechanism for agencies to use to create and maintain regional and project architectures. Indeed, the tool is specifically designed for designating a project architecture that can later be seamlessly incorporated into a regional architecture. However there are numerous issues using the BIFA versions of the Turbo Architecture that make it difficult for developing a project architecture.

Too large

By trying to be all-encompassing, it ends up being challenging to use, non-intuitive, and affects the structure of the architecture process. Rather than being a tool to allow a region to create their own architecture to serve the planning needs for their region or project, it ends up being the definition of the architecture, structuring and defining it in language not related to planning or the agency responsible for maintaining it.

Interviews conducted with regional ITS architecture managers across the United States found universal dissatisfaction with the Turbo Architecture program. Most found it too cumbersome for their use, or too all-encompassing. In contrast, one MPO that represents a very large regional ITS architecture chose not to use Turbo because they felt their architecture was “too big” for it.

Therefore the software is not serving the needs of small regional architectures, it is far too complex for project architectures. It is also not the tool of choice for large architectures. In fact it becomes a

¹⁸ Border, p. 57

¹⁹ Border, p. 72

²⁰ Border, p. 72

tool that people must take training to learn, research to understand, and struggle to apply to their projects.

Requires too much training

Another comment collected during the interview process reflected on the fact that architecture is rarely something anyone in any agency works on exclusively. That means that it is one aspect of a person's job, performed only on an as-needed basis. Because a person does not work with Turbo Architecture full time, they have to re-learn the technology (and terminology) every time they set about updating their architecture or project files.

Not transferrable

Turbo files are not easily transferrable. Sharing the architecture amongst stakeholders is impossible unless every stakeholder has the Turbo software. Sharing the Turbo file across the border is not possible (see below). Instead of being developed in a universally acceptable and easy-to-understand interface like a spreadsheet, it is based on a Microsoft Access database which many are unfamiliar with.

4.3 Using BIFA for a project

BIFA is designed to be both a template and a regional architecture. However using it for a specific project, like in this context, proved to be far more onerous than starting an architecture from scratch.

Too much customization needed

Because a project architecture is very specific, and the BIFA is all-encompassing and has set out to represent all possible interactions with all possible agencies cross-border, it took extensive amounts of time to customize it when the process could have been simplified by starting an architecture from scratch. Hundreds of deletions had to be made. Dozens of names had to be changed. Flows and interfaces had to be added. Pre-set relationships had to be altered.

While it did serve as a good starting point, this would have been more effective as a document template than as a pre-filled database requiring customization.

Turbo not designed for project architectures

There are a few bugs and technical glitches when using the Turbo files for a project architecture separate of a regional architecture. It was not really designed to be used outside a regional architecture and this caused numerous challenges for the architecture developer.

4.4 Incompatibilities with U.S./Canadian architectures

Although the original inspiration for developing the BIFA was to create a mechanism for mapping cross-border ITS projects and allow for the seamless integration of projects and systems between Canadian and U.S. regional architectures, the actual Turbo interface does not allow for this.

The BIFA report does have a useful table mapping services between the Canadian and U.S. market packages. However the BIFA Turbo files were disappointing. It was assumed that the BIFA-based turbo file would fit neatly in both Canadian and U.S. versions of the Turbo Architecture framework.

That way the project manager could deliver a copy of the project architecture to B.C. counterparts as well as for the Whatcom Regional ITS Architecture, and have the two projects match.

Instead this had to be done for a fee by a consultant, or else WCOG had to re-do the entire architecture from scratch. This is not truly a binational program.

4.5 BIFA-unique components obsolete

Another reason BIFA was created was to develop BIFA-unique services that were lacking in the U.S. and Canadian national architectures but were important parts of a border region ITS system.

Three BIFA-unique components exist:

- IB01: International Border Registration
 - IB01 – International Border Registration – Canadian Registration
 - IB01 – International Border Registration – US Registration
- IB02: International Border Pre-Processing
 - IB02 - International Border Pre-Processing – Canadian Pre-Process
 - IB02 - International Border Pre-Processing – US Pre-Processing
- IB03: International Border Inspection
 - IB03 - International Border Inspection – Canadian Border Inspection
 - IB03 - International Border Inspection – Transnational Interfaces
 - IB03 - International Border Inspection – US Border Inspection

In the most recent update of the Canadian National Architecture, the BIFA-unique services listed above were incorporated. The U.S. National Architecture is planning to add these services in the next update, which would remove the unique aspects of BIFA.

5. Recommendations for BIFA

Given the challenges listed above, the following recommendations are made from the MPO-perspective:

5.1 Make BIFA a template only

The BIFA worked best as a guidance tool for this project, and would have better served the project as an unfilled template (as a form or other simplified format). Because it is easier to build something up than delete and go through to customize, it makes more sense that it would serve as a template that users could build their own architectures based on.

The BIFA should not also serve as a generic regional architecture. Border regions would be better served by developing their regional architectures based on existing examples. It is both too vague and too broad to fulfill the needs of an architecture, and offers little benefit as a template when trying to serve both purposes.

5.2 Stop using Turbo Architecture

Although a great deal of public resources have been expended in developing and maintaining this tool, it unfortunately is not used by anyone but consultants.

If the intention is to equip regional planners to improve systems it would be better if architectures are developed using spreadsheets, documents, or other transferrable formats that could be crafted in a way to better fit the needs of each individual planning agency.

Also, given the fact that the internet allows for world-wide integration and document sharing, it would make more sense to develop a tool online that would allow national, state, regional, and project architectures to map together, rather than requiring the transferring and importing of Turbo files.

5.3 Develop a project-specific template

For architectures developed to represent a project only, a version of the template developed for regional architectures could be developed specifically for individual projects to guide project managers.

5.4 Develop a mechanism for sharing projects across the border

Needing to hire a consultant to have a project converted to a Canadian version of the architecture is not feasible for agency-level management of architectures. Therefore the technology used to develop the architectures/templates should allow for easy sharing between U.S. and Canadian ITS project partners.

5.5 Incorporate BIFA-unique aspects into U.S. National ITS Architecture

Following the Canadian example, the U.S. National Architecture should adopt the BIFA-unique components, thereby reducing the need for a separate BIFA architecture as a standalone document or file. If the BIFA can take on the role of being simply a guide for integrating projects between U.S. and Canadian architectures, it will better serve its original purpose, rather than creating a third, separate architecture.

6. Recommendations for cross-border projects

Based on the experience of this project, the following actions are recommended for any agency engaging in a specific cross-border ITS project:

6.1 Define the schematic of data sharing and entities at the beginning of the project

Draw a picture of how the various systems would interact. Use this as the starting point to define data sharing agreements and hardware/software requirements.

6.2 Use the U.S. required systems engineering process to define and manage the project

The Systems Engineering Guidebook for ITS developed by U.S. Federal Highway Administration includes detailed documentation for how to design and manage ITS projects using a systems engineering approach.

While this is very specific and detail-oriented, because it isn't mandated what format the documentation needs to take, and rather is a guideline, it serves agencies well by giving them the flexibility to interpret the recommended planning process in a way best suited for their project, and does a better job than the architecture in defining what the project needs are, how they will be fulfilled, and final reporting of the project successes.

6.3 Do not spend a lot of time developing a BIFA project architecture

Unfortunately the BIFA process was not worth the amount of effort undertaken to develop a project architecture. The benefits gained could have been achieved with a simple template listing strategies for coordinating cross-border projects.

7. Challenges with ITS Architectures

Several of the most challenging aspects of developing an architecture for this project had nothing to do with BIFA itself but with architecture in general. Although not part of the original scope of this project, further investigation with other architecture managers in the United States brought out interesting questions about the functioning of the architecture and the role it plays in ITS planning.

It is hoped that a discussion of the current architecture process and structure could be held at a national level (both U.S. and Canadian) to address the fact that the architecture is, as it currently exists, not fulfilling its original intent.

7.1 Inaccessible language

From the federal level, there has been a great deal of focus on training to educate representatives from cities, MPOs, and state transportation agencies how to understand ITS architecture, how to incorporate it into planning processes, and how to use Turbo Architecture. However there has been little discussion about why the training continues to be needed and the tools are underutilized. Users have discussed the intimidating nature of architecture, the lack of intuition, and the confusing language of the process as reasons why the process feels difficult and foreign.

Through the interview process, multiple stakeholders at municipal and state levels often said they wanted little to do with architecture because they don't understand it.

And looking at the language of architecture, it is apparent where the confusion lies. Architecture has developed to have its own terminology and language, using existing English words in different meanings. By trying to be all-encompassing to represent every single possible technological application it ends up so large and muddled that individual planners or agencies who aren't fully engrossed in the ITS architecture world often "don't get it."

For example, here are common ITS architecture terms that need constant explanation in each architecture:

- Element = system, center, one or more ITS entities
- Entity = subsystem (22 of them) or terminator (73 of them)
- Services = 8 categories, 85+ market packages
- Flows = architecture flows, information flows, data flows

Other terms used include: equipment packages, stakeholders, physical architecture, transportation layers, communication layers, etc.

Planners get intimidated, and therefore turn to consultants to do the work for them so they can meet their federal requirements. As a result, they have no connection with the process and therefore don't actually use the architecture in their planning process. Architectures become an exercise completed to fulfill a requirement only.

Worse, even ITS engineers who design and construct the projects often have no idea what a lot of these terms mean, because they don't use common language in their work. They don't deal with flows or entities. They are looking for what needs to be built where, and how.

7.2 Repetitive structure

While ITS architecture is not mandated in Canada, in the United States the very structure of a regional or project architecture is defined in law. Even if a functional requirements chapter isn't found to be useful for a project it is required. And for smaller projects or regions many of these sections remain vague and therefore useless. A survey of architecture documents available online show very little in the functional requirements or inventory sections that would truly provide a clear picture of what is specifically going on in a region. All of it remains generic to the point of being ineffective as a planning tool.

If architecture should guide the design and integration of ITS projects, vague language is not going to serve that purpose. However if the specific details for every single possible ITS project are included, it becomes too detailed for smaller projects.

For example, the concept of operations and functional requirements sections for a smaller ITS project or region end up resembling each other to the point of repetitiveness. Similarly, the services and inventory sections serve much of the same needs.

There is also the issue of systems engineering documentation, which takes on many of the detailed sections that would be in an architecture. The required concept of operations developed for a project as part of a systems engineering analysis does a much better job of describing what a project will and will not do than the concept of operations component listed in the architecture. Plus, as a standalone document, it gives the planning agency more freedom in structuring the document to fit the needs of their planning process.

7.3 Specific and generic at same time

A critical question to ask about ITS architecture is, who is the architecture for? Who is referencing it? Who is using it?

If the architecture is for planners, why does it have intricately detailed information flows mapped out like "client id" and "expedited clearance status" which is too much detail for them to use? Planners need to know what kind of project is needed, what the cost benefits are associated with that project, and how that project relates to other regional plans and, in the U.S., the Transportation Improvement Program, or TIP.

For example, planners don't need the level of detail illustrated in the diagram below.

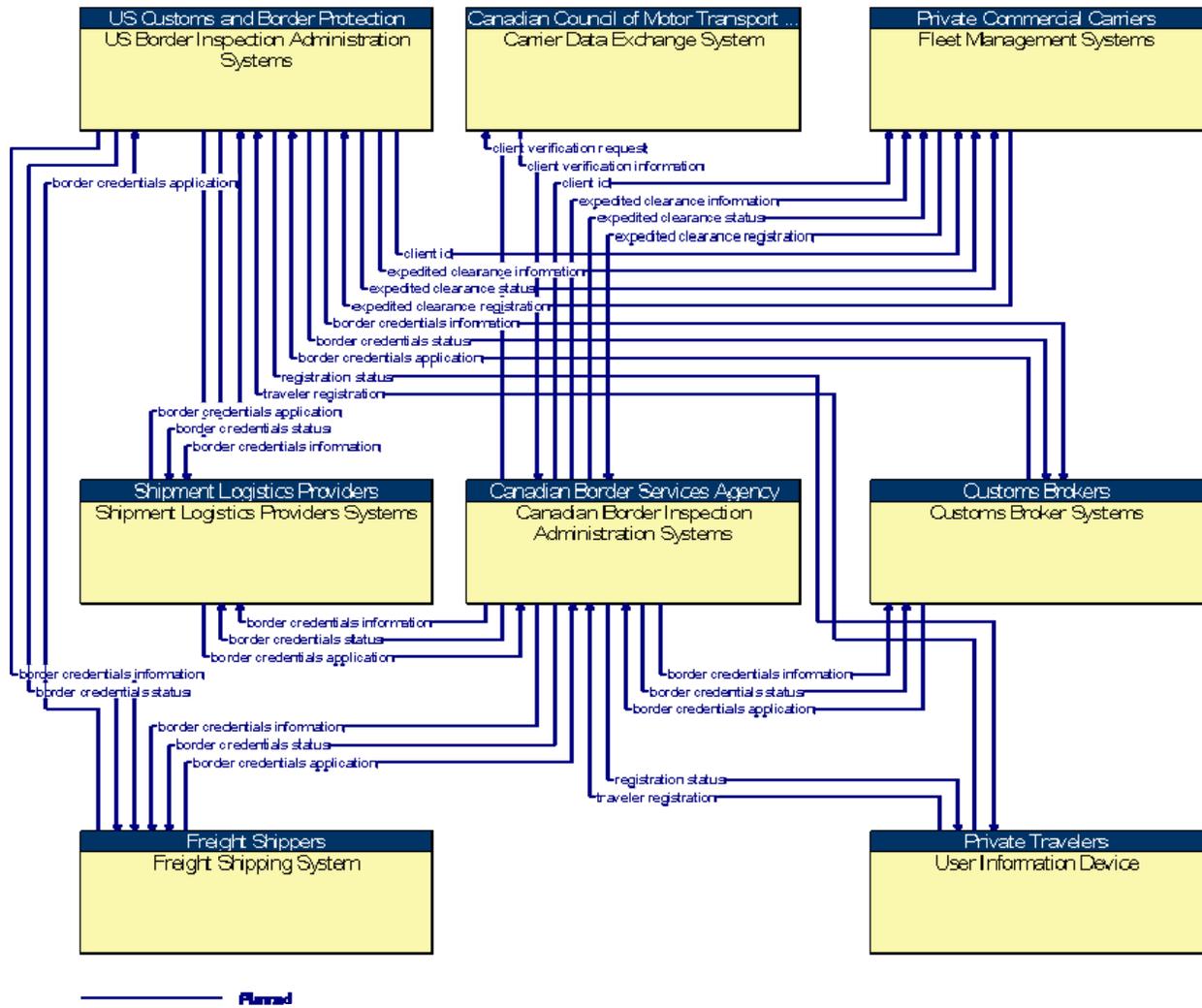


Figure 1: Diagram from the Border Information Flow Architecture for Service IB01 ²¹

But engineers building the systems need specifics – hardware, power requirements, communication, software, vendor reliability. The need details not shown at this level. For example, the following information flows are far too vague for their design schematics:

²¹ <http://www.iteris.com/itsarch/bifa/>

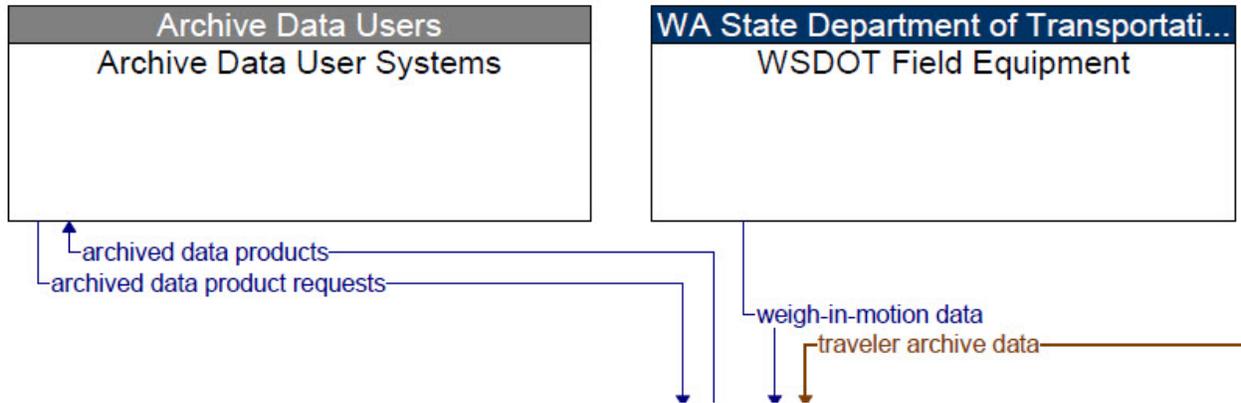


Figure 2: Close-up from the Border Data Warehouse Upgrade Project ITS Architecture ²²

The level of detail illustrated here does not answer any questions an engineer would have on how these systems interact.

7.4 Not being used as intended

Lastly, but most importantly, the architecture is often not being used the way it was originally intended. Instead of being a reference for regions and agencies looking to coordinate system development, it is a document where agencies list projects after they have been identified and planned.

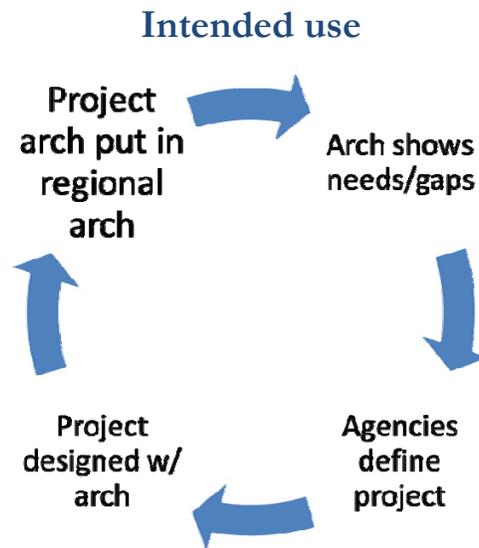


Figure 3: Intended use of the architecture

²² Border Data Warehouse Upgrade & BIFA Integration Project Report #2: Project ITS Architecture, September 2011, Whatcom Council of Governments

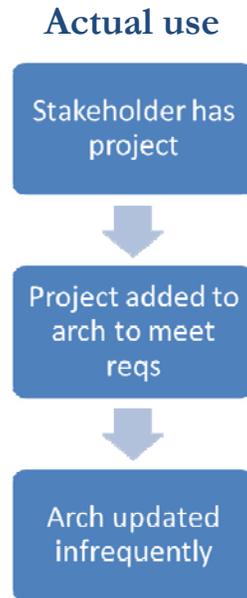


Figure 4: Actual use of the architecture

Note that this is not always true. Some regions have done a much better job integrating the architecture into their processes. It is also important to note that it takes time to develop a new planning element into the pre-established planning process.

The principle behind ITS architecture is sound, but it needs to be easier to achieve the intended use of architecture. The challenges mentioned above restrict its usability.

7.5 Interview comments

To avoid making generalizations about one region's experience, interviews were conducted with architecture managers throughout the United States. The focus was not on statewide ITS architecture managers, instead on MPOs since they are usually responsible for maintaining regional ITS architectures according to U.S. requirements. There was also an attempt to interview agencies with jurisdictions along the U.S. – Canada border.

Since there is no equivalent requirement in Canada, the B.C. Strategic ITS plan was used as reference.

Agencies interviewed included:

- Champaign County Regional Planning Commission (Urbana, IL)
- Niagara International Transportation Technology Coalition (Buffalo, NY)
- N. Central Texas Council of Governments (Arlington, TX)
- Maricopa Association of Governments (Phoenix, AZ)
- Spokane Regional Transportation Management Center (Spokane, WA)
- SE Michigan Council of Governments (Detroit, MI)
- Mid-Region Council of Governments (Albuquerque, NM)

The interviewees represented a broad range of ITS architecture sizes, including areas like the Spokane Regional Transportation Management Center's region which were comparatively small, and the Maricopa Association of Governments in Phoenix, Arizona, with over 28 municipalities included in its region.

Respondents had a variety of strategies for integrating the architecture into their planning process. Some have found it to be a very useful exercise and have developed innovating strategies for incorporating the architecture process into their standard TIP process. The ones who have benefitted the most seem to be larger regions with more resources and more complex ITS projects.

Smaller regions and agencies generally found the process more burdensome and not useful in its current form. No one disagreed with the principles behind architecture – everyone universally felt it to be a good idea to integrate ITS systems and map out how they share information – but there was also agreement that the process was confusing, member agencies and their constituent jurisdictions were leery of the process, and the process is currently done backward, where projects are entered into the architecture after they've been designed.

The most noticeable trend was the role consultants (specifically three firms) play in the development and maintenance of architectures. Of those interviewed, 67 percent of all architectures were developed by consultants. 56 percent of all architectures are maintained or updated by consultants. The breakdown is as follows:

- Developed in-house, maintained in-house = 2
- Developed in-house, maintained/updated by consultant = 1
- Developed by consultant, maintained/updated in-house = 2
- Developed by consultant, maintained/updated by consultant = 4

Other themes that were repeated include the following:

- Six of nine agencies use, but struggle with/don't like Turbo Architecture.
- Three agencies update the architecture with the regional plan.
- Five stated they update infrequently.
- Four don't do project architectures at all.
- Four agencies have tied the architecture updates in with TIP project submissions.
- Five felt the process was burdensome for small MPOs in terms of time and cost.
- Three felt the process as is can be helpful.
- Three have little or no tie-in with the state architecture beyond the initial push for development.
- Three have good tie-ins with their state architecture.
- Four noted that education is needed with their member agencies.

In conclusion, there is a variety of responses to how regions have integrated the architecture process into planning, and while there is almost universal acceptance of the benefits of the concept, there is also a lot of dissatisfaction with the current process.

For all but large agencies it has become a process designed by consultants, maintained by consultants, and understood best by consultants. The agencies responsible for maintaining, and more importantly, using the architecture, are getting little benefit from the process.

8. Questions to consider

Key questions must be raised and considered in the ITS architecture community:

1. Who is using the architecture to define projects?
2. Who is maintaining and designing these architectures?
3. Is this process consultant-defined, consultant-driven, and not being used in-house for the intended purpose?
4. **Is this a cost-effective way to achieve the objectives of architecture?**

Architecture is intended to be a process that benefits stakeholders as a result of their direct and ongoing participation. If the process is outsourced, the architecture becomes a more external product that agency planners use much less because they're not as involved with it. In this seemingly common scenario, the architecture becomes a requirement that's only considered when it's time for the next update.

What can be done to help regional agencies reinvest in the actual process? What if the process itself was redefined?

The most critical question is whether or not this is a cost-effective way to get the objectives of the architecture accomplished. At the moment, it seems not.

9. Recommended changes to architecture design

Based on the experiences from the project, the experiences maintaining the Whatcom Regional ITS Architecture, and feedback from other regional architecture managers, the following recommendations are suggested for consideration.

9.1 Consider a user-focused approach to architecture

Since architectures are supposed to be used by planning agencies and integrated into the planning process, a new approach should be considered that integrates well with regional planning processes, and does not get into vague concepts or detailed minutiae.

Architecture should be maintainable by the agencies themselves; something that doesn't require specific trainings and ongoing consultant support to keep current.

And it should be recast in language and structure that is less intimidating, cumbersome, and confusing.

Removing the required sections of architecture as they currently exist in Section 940.9 of the Federal Ruling listed in the U.S. Federal Register, Volume 66, Number 5 (Monday, January 8, 2001 Rules and Regulations) and instead keeping the architecture structure open for agency interpretation to best define the planning components based on a more generic national standard would better serve a broader range of region and project sizes.

9.2 Consider using easily-accessible architecture templates

If a regional or project architecture were developed in an Excel spreadsheet that could be opened by every single stakeholder involved in the project, shared amongst architecture managers across regions and states, and exchanged across the border, more agencies could effectively use and maintain their architectures. No specialized training would be needed for software, and the process of updating national architecture structures could also be simplified.

9.3 Consider an online graphic architecture to link project, regional, and statewide architectures

Some of the most beneficial outputs of an architecture are the diagrams of systems connections and ownership. This simplified, graphic process is very difficult to achieve using existing Turbo Architecture diagrams, and requires Vizio and other expensive programs to display and modify.

However mapping how those systems connect between projects, regions, or states requires coordination and regular updates between each architecture manager. This level of coordination is practiced in some regions and states, but in other areas of the country there is almost no coordination between what is happening at the regional level and what is included in the state architecture.

The national architecture and the Turbo Architecture tool were developed prior to the full advent of internet functionality and online document sharing and interfacing. A simple online graphic tool that allows regions to draw out the connections between stakeholders and projects, that then ties into a statewide and national architecture, could be a relatively easy and more functional way to diagram the process, link state and regional ITS projects, and allow multiple stakeholders to view the architecture without specialized software or training (see Appendix D: Example of an online ITS map tool).

9.4. Conclusions

Whatever solutions are considered, a binational level dialogue about the structure and function of architecture would benefit agencies responsible for updating and maintain project and regional architectures. For both the BIFA, and architecture in general, it is critical to consider whether current approaches continue to be cost-effective strategies for accomplishing the overarching objectives; or whether the process could be restructured to better fulfill the original goals.

10. For more information

The Cascade Gateway Border Data Warehouse is available online at:
www.CascadeGatewayData.com.

Project reports, appendices, and all documentation are available on the project website which can be found at www.wcog.org/border.

More information is available by contacting:

Whatcom Council of Governments
314 E. Champion Street

Bellingham, WA 98225
(360) 676-6974

imtc@wcog.org.

Further Reading

1. **Border Information Flow Architecture Final Report**, January 2006, National ITS Architecture Team: <http://www.ronice.com/bifa/bifadocument01-19-06.pdf>
2. **Border Data Warehouse Upgrade & BIFA Integration Project Report #2: Project ITS Architecture**, September 2011, Whatcom Council of Governments
3. **Border Data Warehouse Upgrade & BIFA Integration Project Report #3: Recommendations for BIFA and Architecture Developers**, September 2011, Whatcom Council of Governments

Appendix A: BIFA User Log

The following log was maintained in 2010 during the Cascade Gateway Border Data Warehouse Upgrade & BIFA Integration project to track the process of creating a project architecture from a user's perspective.

First Steps

1. Opened the existing BIFA turbo file. This is a separate file not associated with a regional architecture at present, since this is a border-spanning project and therefore will need to fit into two regional architectures, one Canadian, one U.S.
2. Renamed the file.
3. Changed the project description, time frame, status, geographic scope, developer, maintainer, version and date stamp.
4. **Technical Question:** Why is the date/stamp field not automated? It changed but then added the wrong time.

Planning Tab

1. **Technical Question:** BUG. Clicked customize. Chose 2 levels. Changed Terminology to Singular = "Operational Need" and "High Level Requirement" and the plural of each. Got: ADO Error #-:2147217887 Description: "Multiple-step operation generated errors. Check each status Value." Source: Microsoft Cursor Engine" SQL State: [blank] Native Error: "0" Calling Routine: "ModTurboPlanningSettings". This error could be recreated.
2. Tried to customize again. This time I did one word change at a time and it worked as long as I used "Requirement" and not "High Level Requirement" The problem seems to be using more than one word.
3. Added 1 and abbreviated name.
4. Description – repeated what I have.
5. Source? No idea what to put here.
6. **Technical Question:** Performance Measure: I tried to put in number 1.1.1 to relate it to my actual documentation, where I have a matrix with numbers, but this caused a system error. I tried to erase the number but it wouldn't let me cancel or apply. Stuck so I had to restart the computer.
7. The next time I tried I marked the category as 1.1 and the number as 1. This doesn't seem very helpful since it doesn't relate to my actual documentation.
8. By the third item I realized this just isn't fitting the system engineering documentation I've already developed, and is more work than it is worth. Abandoned the planning tab.

Stakeholders Tab

1. Selected the following stakeholders:
 1. Archive Data Users

2. Canadian Border Services Agency
3. Private Sector Probe Information Providers
4. Provincial Ministry of Transportation
5. State DOT
6. US Bureau of Transportation Statistics
7. US Customs and Border Protection
8. US Regional Transportation Planning Organization
2. Deleted the following stakeholders (have to do individually):
 1. Bridge or Tunnel Operations Agency
 2. Canadian Council of Motor Transport Administrators
 3. Canadian Municipal Government
 4. Canadian Provincial Planning Organization
 5. Convention and Visitors Bureau
 6. County or Municipal Public Safety Agencies
 7. Customs Brokers
 8. FHWA
 9. Financial institutions
 10. First Nations Governments
 11. FMCSA
 12. Freight Shippers
 13. IFTA, Inc.
 14. IRP, Inc.
 15. Meteorological Service of Canada
 16. Private Commercial Carriers
 17. Provincial Commercial Vehicle Department
 18. Provincial Ministry of Environment
 19. Provincial, Regional, and Municipal Public Safety Agencies
 20. Public Safety and Emergency Preparedness Canada
 21. Rail Agencies
 22. RCMP
 23. Regional Public Safety Agencies
 24. Regional Transit Providers
 25. Regional Transportation Authority
 26. Shipment Logistics Providers

27. State Commercial Vehicle Department
 28. State Department of Public Safety
 29. Toll Authorities
 30. Transport Canada
 31. Tribal Governments
 32. US Border Patrol
 33. US Department of Homeland Security
 34. US Emergency Management Agencies
 35. US federal lands
 36. US National Weather Service
 37. US Public Health Agencies
 38. US State Transportation Planning Organization
 39. US Transportation Security Administration
3. Kept but did not select the following stakeholders:
 1. Canadian Regional Planning Organization
 2. Local Media
 3. Private Travelers
 4. Changed the name of Provincial MOT to BC MOT.
 5. Change the name of State DOT to WA State DOT.
 6. Change the name and description of US Regional Transportation Planning Organization to WCOG.
 7. Changed the name and description of Canadian Regional Planning Organization to TransLink.
 8. Re-added Transport Canada and FHWA because they're needed for purposes of the agreements section only. They were added but left unchecked.
 9. Did not do Autoselect.
 10. **Content Question:** It's confusing that we have "Canadian Provincial" for some stakeholders and others just called "Provincial". Confusing when I'm looking for a particular stakeholder (e.g. BCMOT).
 11. **Content Question:** I didn't know whether TransLink would be Canadian Provincial Planning Organization, Canadian Regional Planning Organization, Regional Transit Providers, or Regional Transportation Authority. All fit. Went with Regional.
 12. **Content Question:** I've put Private travelers in because they can get information from the website. However that isn't a dynamic information relay so I'm not sure if they should be in there as well as Archive Data End Users. How are they different?

Notes: I only included stakeholders that have a direct role in dynamic sharing of project data. I also question whether it would be better to delete unused stakeholders, or leave them in

unchecked if they possibly could have a future role in a project. Wrestling with this decision, and discussing with advisors I decided to remove stakeholders to keep the architecture clean and very specific to the actual project.

Inventory Tab

1. Project Elements
2. Organized the list by Stakeholder.
3. Archive Data Users
 - i. Archive data user systems – doesn't seem appropriate, but will leave for the moment.
4. BC MOT
 - i. Provincial Ministry of Transport Field Equipment left checked
 - ii. Changed name to BCMOT Field Equipment.
 - iii. Status: Existing
 - iv. Type: Normal (not clear what this really is)
 - v. Left only Roadway Subsystem checked.
 - vi. Unchecked Provincial Ministry of Transport TMC because the TMC is not directly involved in this project.
 - vii. Added a new element based entirely on the BCMOT Border Traveler Information System element (which started in the not specified category).
 - viii. Named the new element Southbound Border Traveler Information System
 - ix. Type: Normal
 - x. Stakeholder: BCMOT
 - xi. Status: Existing
 - xii. Added description
 - xiii. Added the same systems as the ones in the northbound: Archived data management system, information service provider, alerting and advisory systems. May need to change later.
5. CBSA
 - i. Canadian Border Services Field Equipment left checked.
 - ii. Changed name to CBSA Field Equipment
 - iii. Changed description to refer only to lane type
 - iv. Status: Planned
 - v. Type: Normal
 - vi. Security Monitoring Subsystem left checked for now

- vii. Originally Checked Archived Data Management Subsystem for now, seems appropriate. But then got warning it was complex. Leaving only Security Monitoring subsystem, but this seems wrong.
 - viii. Added Roadway Subsystem to be the same as CBP
 - ix. **Technical Question:** Why is this a different default setting than the one for CBP? They should be the same
 - x. **Content Question:** The differences between Canadian Border Inspection Administration Systems, Canadian Border Inspection Systems, and Canadian Border Services Field Equipment are very small, making it difficult to choose the one I wanted. This may have to be changed later, but further clarification on differences would be welcome.
6. Private Sector Probe Information Providers
- i. Private Sector Probe Information Systems – left checked.
7. Private Travelers
- i. User Information Device – left checked.
8. BTS
- i. US Bureau of Transportation Statistics Systems – left everything as default.
9. CBP
- i. US Border Services Field Equipment
 - ii. Changed name to CBP Field Equipment
 - iii. Changed description to be just lane type data.
 - iv. Type: Normal
 - v. Status: Planned
10. WSDOT
- i. State DOT Field Equipment
 - ii. Changed name to WSDOT Field Equipment
 - iii. Type: Normal
 - iv. Status: Existing
 - v. Left only Roadway Subsystem checked
 - vi. State DOT TMC unchecked because not part of this project.
11. WCOG
- i. US Regional Transportation Planning System
 - ii. Changed name to Cascade Gateway Border Data Warehouse
 - iii. Type: Normal
 - iv. Status: Changed to Existing
 - v. Left only Archived Data Management Subsystem checked.

12. Not Specified

- i. Border Traveller Information System
- ii. Name changed to Northbound Border Traveler Information System
- iii. Type: Normal
- iv. Stakeholder: WSDOT
- v. Status: Existing
- vi. Description Changed
- vii. Kept Information Service Provider subsystem checked.
- viii. Added Archived Data Management Subsystem and Alerting and Advisory Systems terminator, although don't know what this will do and may need to fix.
- ix. Commercial Vehicles unchecked
- x. Containers unchecked
- xi. Fleet management systems unchecked
- xii. Regional Field Equipment unchecked
- xiii. State CVIEW System unchecked
- xiv. State CVO Credentials/Permitting Interface unchecked
- xv. State CVO Electronic Permitting System unchecked

13. Checked the listings by element and the lists look good.

14. Checked the listings by Subsystem/Terminator.

Notes: When I first went through the architecture I had more stakeholders unchecked but included for the future. But when I saw they all show up under stakeholder sorting here, even though they aren't part of the system yet, I got annoyed because it makes it much bigger and more confusing.

I also wish I could have copied the Northbound Border Traveler Information System element rather than having to recreate it entirely for the southbound direction. Or else I wish I could have had more than one stakeholder and made just one element that could be shared.

I did not understand the element attribute types Normal, Instance, Shared, Communications. Explanation provided in the help is not very useful.

Services Tab

1. Confused by the choices it has made. Is this a result of being BIFA or just Turbo's response to the elements I've selected in the inventory?
2. Read Help. Slightly less confused.
3. Started with the All Market Packages tab.
4. Unsure whether better to add ITS Data Warehouse or ITS Virtual Data Warehouse. Adding both for the moment.
5. Added AD2: ITS Data Warehouse.

- i. Status: Existing
 - ii. Unchecked all selected elements not in project
 - iii. **Technical Question:** Why are there elements listed in the services section with (Not in Project) included? Can they be automatically unchecked since I have to do that manually now? (It takes 12 clicks).
6. Added AD3: ITS Virtual Data Warehouse
 - i. Status Existing
 - ii. Unchecked 7 selected elements not in project, left only Border Data Warehouse.
7. Noticed that my flows are not accurate and so have gone back here to add some market packages to fix this..
8. Added ATIS01: Broadcast Traveler Information
 - i. Kept NBATIS checked.
 - ii. Unchecked Private Sector Probe Information System
 - iii. Unchecked User Information Device
 - iv. Checked SB ATIS.
 - v. Looking at the MP list underneath the list of ATIS 01, un-checking all but my instance of the Broadcast Traveler Information and renaming Border Traveler Information and making Existing.
9. I don't know where to add CBP and CBSA field equipment.
10. **Technical Question:** After running the report showing inventory to market packages, I noticed there's a ton of things automatically selected that I didn't select. I have to apply, unselect the elements, apply, then unselect the market package and select again. This has been very time consuming. For example:
 - i. ATMS04 has elements selected that I don't want. Grayed out. So...
 - ii. Select ATMS 04 And Apply.
 - iii. Now I can go into project elements and deselect items. Hit Apply
 - iv. Now I go back to the project market packages and unselect ATMS 04. And hit apply one last time.
11. Doing this for ATIS 02. Left one part and changed the rest.
12. ATMS 01
13. ATMS 04
14. ATMS 06
15. ATMS 21
16. MC03
17. MC08
18. Need to add Field Equipment to CVO Weigh in Motion Market Package.

19. Still not getting the flow diagrams to look the way I want. So now I'll change ATMS02 to instance called Probe Surveillance and only select Private Sector Probe Information Systems.

20. Changed ATIS01 to only be NB and SB ATIS.

Note: I'm backward engineering this entire section to develop a schematic that looks like what I want. It seems it would be a lot easier for me to draw out the schematic I want instead, and have Turbo do this part for me.

Operational Concepts Tab

1. Looked at Project Areas for roles and responsibilities.
2. Unchecked Commercial Vehicle Operations
3. Unchecked: Electronic Payment
4. Unchecked Emergency Management
5. Unchecked Incident Management
6. Unchecked Maintenance Management
7. Unchecked Traffic Management
8. Under Archived Data Systems:
 1. Unchecked TransLink
 2. **Technical Question:** Why is TransLink here? It is not in the project!
 3. **Technical Question:** I made a copy (1) of archived data systems. Didn't like how it copied so I deleted it. I do not want TransLink here. But it won't let me delete without saving a copy. Now I see it's because it thinks it's in the regional architecture. But there is no regional architecture, so what is happening? Is this a BIFA bug?
 4. **Technical Question** I tried to delete TransLink from the list of stakeholders under the roles and responsibilities for Archived Data Systems. But it said I can't because "Since this role and responsibility area is shared with the regional ITS architecture, you cannot delete the stakeholder information here. You must select the regional ITS architecture as the current architecture to delete this information." However I can't select the regional architecture since it doesn't exist.
9. Since it won't let me customize this, I'll have to create a copy of the Archived Data Systems roles and responsibilities areas.
10. Next attempt: I will uncheck all the roles and responsibilities for TransLink. It creates a copy. I will just go with that.
11. Renamed "Archived Data Systems (Copy 1)" to "Cascade Gateway Archived Data Systems".
12. Unchecked the original.
13. Went to BC Ministry and looked at All R&Rs.
 1. Checked "Collect and disseminate information on border crossing status and delays" and changed to "existing".

2. Unchecked “operators of traffic management centres provide data on traffic counts, speeds, volumes, accident reports, etc. to the Canadian provincial and regional transportation planning data archive systems.
 3. Added an R&R for the WIM, calling it “collect and disseminate data from highway weigh-in-motion volume counters.” And made “planned.”
 4. Discovered my added R&R doesn’t show up in the region! Garrrr!
14. Went to the WSDOT and looked at all R&Rs.
1. Checked “Collect and disseminate information on border crossing status and delays” and changed to “existing”.
 2. Unchecked “operators of traffic management centers provide data on traffic counts, speeds, volumes, accident reports, etc. to the US State and regional transportation planning data archive systems.”
 3. Added an R&R for the WIM, since it didn’t add my new R&R automatically.
15. Went to the WCOG and looked at all R&Rs.
1. Kept “Collect transportation related data (traffic counts, accident history, etc.) to provide basic data quality, data privacy, and metadata management.” Would like to change the language however, but again I can’t. “This role/responsibility is included in the regional architecture.” Made status existing.
 2. Unchecked “Establish and maintain a system for authenticating archived data users.”
 3. Unchecked “Provide data to authenticated users upon request.”
 4. Kept “Sharing data with other archived data systems in the US. Status existing.
 5. Unchecked “Support transportation planning activities that span the Canadian US border”... While this is true, why is this here?
16. Under Border Inspection Systems
1. Went to Canadian Border Services Agency
 - i. Unchecked all existing R&Rs since outside the scope of this project.
 - ii. Added an R&R pertaining to this project: “Collect and disseminate lane status data to northbound border traveler information system.”
 - iii. Of course it wants me to make a whole new area for this. So I renamed the new area “Border Lane Status Data”
 2. Went to US Customs and Border Protection
 - i. Unchecked all existing R&Rs since outside the scope of this project.
 - ii. Added an R&R pertaining to this project: “Collect and disseminate lane status data to southbound border traveler information system.”
 - iii. I renamed a new area “Border Lane Status Data”
17. Under Traveler Information
1. Went to BC Ministry of Transportation and looked at all R&Rs.

2. Checked “collect and disseminate data from highway weigh-in-motion volume counters,” status planned.
 3. Checked Collect and disseminate information on border crossing status and delays., status existing.
 4. Unchecked everything else.
 5. It wants me to save as something else, so renamed new area “Border Traveler Information”
18. Went to Canada Border Services Agency.
1. Unchecked all.
 2. Checked the new one, “collect and disseminate lane status data to southbound border traveler information system.
19. Went to US Customs and Border Protection.
1. Unchecked all.
 2. Checked the new one, “collect and disseminate lane status data to southbound border traveler information system.
20. Went to WSDOT
1. Checked “collect and disseminate data from highway weigh-in-motion volume counters,” status planned.
 2. Checked Collect and disseminate information on border crossing status and delays., status existing.
 3. Unchecked everything else.
 4. Renamed new area “Border Traveler Information”

Notes: WSDOT has a concept called “Collect and disseminate information on border crossing status and schedules” which is different than the southbound system. I really wanted them both to be the same but it won’t let me.

Because I already have detailed requirements listed in the systems engineering documents I wonder if doing all this is even necessary.

The regional architecture limitations worry me, and I wonder if it may be a bug of some sort.

Requirements Tab

1. **Technical Question:** BUG. I clicked on Elements. Then Autoselect. Decided not to use this, hit Cancel. Then Close. Checked help. Can’t move. Says I have to click Apply or Cancel before switching tabs. Regardless of what I check, I get the same message. Had to end task. However I could not re-create this bug.
2. I started with the elements that already have selected functions.
3. BC MOT Field Equipment
 1. Field Barrier System Control unchecked
 2. Roadway Basic Surveillance unchecked

3. Roadway environmental monitoring unchecked
 4. Roadway equipment coordination unchecked
 5. Roadway freeway control unchecked
 6. Roadway probe data communications unchecked
 7. Roadway work zone traffic control unchecked
 8. Roadway Traffic Information Dissemination only one left on.
 9. Unchecked all of the previous existing requirements.
 10. Created a tailored requirement for field equipment in the context of this project.
 11. **Technical Question:** Why won't it let me include this in the region?
4. Cascade Gateway Border Data Warehouse
 1. Unchecked government reporting systems support
 2. Kept the rest and customized the list.
 5. Northbound Border Traveler Information System
 1. Unchecked all that were checked.
 2. Because it must have one, I checked Virtual Data Warehouse services and customized that list. However still doesn't list "in region."
 6. Private Sector Probe Information Systems
 1. Customized list.
 7. US Bureau of Transportation Statistics Systems
 1. Unchecked all but Online Analysis and Mining, and of that only left 3 requirements.
 8. User Information Device
 1. Unchecked personal interactive information reception
 2. Left Personal basic information reception and customized.
 9. WSDOT Field Equipment.
 1. Set up exactly like BC MOT's.
 10. Moved on to those without requirements listed.
 11. CBP Field Equipment
 1. Clicked Specify Functionality
 2. Clicked Roadway Equipment Coordination
 3. Made a tailored requirement and unchecked the rest.
 12. CBSA Field Equipment
 1. Clicked Specify Functionality
 2. Clicked Roadway Equipment Coordination
 3. Made a tailored requirement and unchecked the rest.

13. Southbound Traveler Information System
 1. Made the same as northbound by unchecking all that were checked.
 2. Checked Virtual Data Warehouse services and customized that list.
14. Leaving Archive Data user systems alone since I can't get the functional areas to show.
15. **Technical Question:** BUG. I made my customized requirement, applied, and now it won't let me out of the section. Keeps giving me the "You must apply or cancel your changes before changing tabs." Even though I did apply my changes.

Interfaces Tab

1. Noticed right away that there are things in here that I don't want included. For example, why is Bridge or Tunnel Operations TOC automatically included here?
2. There are 100 interconnects included for this relatively simple project. Time to go through and customize. Deleted the following:
3. Archive Data User Systems
 - i. Include only Border Data Warehouse
4. BC MOT Field Equipment
 - i. Include only Border Data Warehouse
5. Border-Area TV and Radio Stations – delete all
6. Bridge and Tunnel ETC Administration – delete all
7. Bridge or Tunnel Operations TOC – delete all
8. Canadian 511 Systems – delete all
9. Canadian Border Inspection Administration Systems – delete all
10. Canadian Border Inspection Systems – delete all
11. Canadian Central Road and Weather Forecasting System – delete all
12. Canadian Municipal Traffic Operations Centre – delete all
13. Canadian Provincial Transportation Planning System – delete all
14. Canadian Regional Planning System – delete all
15. Canadian Traveller Information Kiosks – delete all
16. Carrier Data Exchange System – delete all
17. Cascade Gateway Border Data Warehouse
 - i. Include only BTS, WSDOT field equipment
 - ii. Delete the rest
 - iii. Where is BCMOT Field Equipment?
 - iv. Added connect to NB ATIS
18. Even though I set up the Southbound ATIS connection exactly like the Northbound one, it isn't showing up!

19. CBP Field Equipment
 - i. Delete tie with US Border Inspection Systems
 - ii. Need to establish connect with BC MOT SB ATIS.
20. CBSA Website – delete all
21. MOT Maintenance Services – delete all
22. Northbound Border Traveler Information System
23. Private Sector Probe Information Systems
 - i. Delete all
 - ii. Need to connect with Border Data Warehouse
24. State DOT TMC - Delete All
25. State Maintenance Operations – Delete all
26. User 511 Systems – delete all
27. US Border Inspection Administration Systems – delete all
28. US Border Inspection Administration Systems – delete all
29. US Bureau of Transportation Statistics Systems
 - i. Delete all
 - ii. Need to connect with data warehouse.
30. US CBP Website – delete all
31. US State Transportation Planning System – delete all
32. Vehicles – delete all
33. Add new interfaces
 - i. Pull up Southbound Border Traveler Information System element
 - ii. Build and view report of Inventory to market package comparison. See that SB ATIS, CBP Field Equip, and CBSA Field Equip are not associated.
 - iii. Makes me think I need to go back to do market packages.
34. Now I'm going with an interfaces diagram and reverse engineering by removing items:
 - i. Removed user information device
 - ii. Removed US Municipal Traffic Operations Center items
 - iii. Removed US Traveler Information Kiosk item
 - iv. Removed US Weather Service Forecasting System item
 - v. Removed User Information Device items
 - vi. Removed Other Provincial MOT TMC's
 - vii. Removed Regional Traffic Management Center items

- viii. Removed State DOT TMCs
 - ix. Removed State Maintenance Operations
 - x. Removed US 511 Systems
 - xi. Removed US Border Inspection Systems
 - xii. Removed Provincial Ministry of Transport TMC
 - xiii. Removed State DOT TMC
35. Now I need to build some flows. I fixed the market packages needed (See section on Marketing Packages).
 36. To know which adjustments to make, I printed out the Inventory to Market Package comparison. First I looked to find out why Southbound Advanced Traveler Information System doesn't hook up the way the identical Northbound system does. There are lots of differences between the two, so now I need to go back to the other tabs and make adjustments to repair this.
 37. Turns out the problem is that SB ATIS is not in region, and NB ATIS is, which is probably why SB ATIS will never show up on the interfaces. I can't fix this apparently. The only solution I can think of is to import every single possible flow (4478) and then selectively choose them to be planned.
 38. Did this – imported every possible flow. Went through and selected the ones needed.
 39. Fixed Private Sector Probe Information System to go to the warehouse.
 40. Went through a diagram and found all the flows that don't work. Looking at flow list and will edit as needed.

Notes: This was extremely time-consuming. It would have been far easier for a project this size to build up, not tear down, these interconnects, since I'm going to have to create my own anyway.

I'm not sure why bridge and tunnels are still showing up despite having deleted all the stakeholder categories related to them.

Standards Tab

1. I did very little with this. Our schema will be established based on a standard but I don't know which one. Until that's determined:
2. I took out all standards but the generalized ATIS one.

Agreements Tab

1. Added existing agreements:
 1. BIFA 2010-04 between Transport Canada and WCOG
 - i. Realized I have to now put Transport Canada back into the stakeholders list even though they really aren't a stakeholder architecturally speaking.
 2. GCA 6521 between WSDOT and WCOG
2. Adding planned agreements:

1. Data Sharing Agreement – BCMOT and WCOG
 - i. Wrote brief description
 - ii. Status Planned
 - iii. Lead Stakeholder WCOG
 - iv. Selected Stakeholder BCMOT.
2. Data Sharing Agreement – WSDOT and WCOG
 - i. Wrote brief description
 - ii. Status Planned
 - iii. Lead Stakeholder WCOG
 - iv. Selected Stakeholder WSDOT

Changes after consultant review

1. Booth Status Data
 1. As per recommendation I changed CBP and CBSA elements to “Border Inspection Systems” rather than field equipment. I didn’t do this initially since we hope to tie into the equipment itself, not the actual border inspection systems (which they are unwilling to open at the moment).
 2. On interfaces tab, connected those elements to NB and SB inspection systems respectively.
2. API relations in the warehouse
 1. As per recommendation I customized the “Archive Data User Systems” stakeholder to “Other Databases and Applications” and renamed the associated element “Systems Using Warehouse API.”
3. Added flow for User Information Device
 1. As per Bruce’s recommendation I created a custom flow using the existing “border crossing data” and connected it between Archived Data Management Subsystem and Personal Information Access. This was fiddly and difficult to make work but I got it eventually. It now maps and is part of the flow, which it lacked before.
4. Added a market package for future booth status data
 1. As per recommendation added ATIS06 to NB and SB Traveler Information Systems for future booth status data.
5. Ops Concepts roles and responsibilities
 1. As per recommendation I simplified this into one area, Cascade Gateway archived data systems. Deleted Border Traveler Information area, and Border Lane Status Data area.

Appendix B: Feedback from Architecture Experts

WCOG submitted a draft version of the Turbo architecture file developed as the project architecture, as well as a series of questions, to two architecture consultants for review. The following details the questions and responses from each consultant.

Questions were asked by **Melissa Miller**, Project Coordinator at Whatcom Council of Governments. Answers were provided by **Ron Ice**, R.C. Ice & Associates, and **Bruce Eisenhart**, Consystec Inc.

Overview of the project

Melissa Miller

This project architecture is designed to map out the data sharing between the Whatcom Council of Government's (WCOG) Border Data Warehouse (www.CascadeGatewayData.com) and the agencies which provide that warehouse with archived border delay, volume, queue length, vehicle type, and other information. Agencies providing data to the system include WA State Department of Transportation (WSDOT)'s Northbound Advanced Traveler Information System at the four Cascade Gateway border crossings; and B.C. Ministry of Transportation's (BCMOT) Southbound Advanced Traveler Information System. Additional resources which are possibly to be added in this project also include data from three weigh-in-motion detectors owned by BCMOT; data from one weigh-in-motion detector owned by WSDOT; data from the CVISN network of readers up the I-5 corridor; GPS fleet data purchased from a private vendor; and the sharing of archived data between this warehouse and the U.S. Bureau of Transportation Statistics' (BTS) Transborder Surface Freight Database.

Ron Ice

Thanks for the overview. Great job overall.

Booth status data

Melissa Miller

When this project architecture was initially conceived, we also hoped to include elements which would represent the transfer of booth status data from U.S. Customs and Border Protection (CBP) to the Southbound Traveler Information System, and booth status data from Canada Border Services Agency (CBSA) to the Northbound Traveler Information System. I have left both entities in the architecture but have not done any further inclusion since this interface will not occur within the time frame of this project (which ends March 31, 2011). It is hoped that this can be added at a later date.

Ron Ice

Another approach for interfaces like this that are viewed as future extensions would be to include them as "Future" interfaces in the project architecture (or you could define a more specific status than "Future" such as "CBP Project XYZ" or "Phase II" or ...). You could then use filters to include or exclude the future interfaces depending on your need. The benefit is being able to show the current project in the context of the ultimate system that you envision. Your approach of not including them at all is fine, particularly since you say "It is hoped that this can be added..." I infer from "hoped" that it isn't programmed or even planned, so it may be a reach to include these interfaces on your diagrams, even as "future". In this case, it probably makes sense to remove the

inventory elements from the project architecture also, unless you include some documentation somewhere about why these disconnected elements were included in the project.

Also, it looks like you identified the CBSA and CBP field equipment elements in BIFA as the best source for booth status data for the traveler information system. I would have selected and tailored the Canadian Border Inspection Systems and the US Border Inspection Systems elements instead since they seem like a better fit for what you describe. (These two elements already provide “border crossing status information” to the Border Traveler Information System – sounds like it would include booth status data and is the closest fit in BIFA for what you describe I think.)

Bruce Eisenhart

Regarding the booth status data- I agree with Ron that the most likely place to get this would be from the Canadian Border Inspection Systems and the US Border Inspection Systems elements. Field equipment almost always provides the info to the system controlling the equipment, which in this case is the BIS elements. While its possible for an archive to receive field equipment sensor data directly, it’s not very likely.

So our suggestion is to add the two existing elements (from the BIFA arch) to your project. (Note that to add border crossing status information you need to map your warehouse to ISP as well since the border crossing status information flow is from BIS to ISP.)

Application Programming Interface (API) relations to a warehouse

Melissa Miller

As part of this project we are having the software developers create an API to allow outside databases, applications (i.e. Apple apps, Google gadgets, etc.) to query the database and generate quick reports on their own from the database. To represent this, I added the element Archive Data User Systems to represent systems which could query the database. This is separate from the element User Information Device, which I put in to represent the end user who is simply querying our database through the warehouse itself at www.CascadeGatewayData.com

Ron Ice

I like the approach and agree with the mapping to Archived Data User Systems element/entity in BIFA. If I were doing the project architecture, I would have updated the existing BIFA description for this element, which is very agency-oriented, to something more like your specific description here. I would have also felt free to change the element name (but left the entity mapping as you have it) to “Other Databases and Applications” or “Apple Apps, Google Gadgets, etc.” or whatever you felt was more descriptive of this family of devices. We had to use generic names/descriptions in BIFA – you should feel free to use project-specific names and descriptions when applying BIFA IMHO.

Bruce Eisenhart

I agree with Ron’s suggestion regarding the element name- pick something the project stakeholders will easily identify.

Regarding the User Information Device element- it appears to be unconnected to the data warehouse, which is not surprising since it is mapped to PIAS and there are no PIAS to ADMS flows in the architecture. Assuming that you want to connect the users directly to the warehouse you have a couple of options:

- Make User Interface Device another example of an archive data user system then the user devices could get *archive data products* flow same as 1 but create a user defined flow that better describes the info that users get directly (e.g. border crossing data)
- Create a user defined flow directly between PIAS and ADMS called border crossing data

There may be some other options too, but these are the ones that come to mind immediately. I would do either 2 or 3. Note there already is a user defined flow called border crossing data that isn't used so all you would need to do is change the to/from for it (and give it a description, currently it doesn't have one). I like to create user defined flows to better describe the interfaces. They help the users better understand what interface info is important to the project. One key argument for not creating a user defined flow is that you could lose the standards mapping of the existing Arch flow. In this case there are no standards for border crossing data, so you don't lose anything. There are some standards for general archive data, but they apply more to the data going into an archive than data coming out.

Strategy

I go into great detail about every decision I made and the order in which things were done in a BIFA use log, which I have not included here but is available upon request. However to summarize my process, I went tab to tab, and then after an initial build of interfaces, used the diagrams to "backward engineer" the market packages, interconnects, and flows to have it match the diagram that best represents the project architecture. I'd be interested in any comments you may have on this strategy, and recommendations for others who may mimic what I've done.

Ron Ice

I think I would be interested in seeing your log to understand your process in a little more detail. In general, it sounds to me like the process was a little cumbersome for you as you had to spend time reverse engineering the architecture that you had envisioned early in the process. Part of this might be unavoidable, but I'm interested in ways to make Turbo/the process more productive. Once you have a diagram you like, there may not be a lot of benefit to you from revisiting the market packages for example, but I may not be following/appreciating your process. It is clear that you invested a lot of time in selecting market packages and associating elements that were fairly peripheral to your specific project. It would be interesting to discuss when/why you did this. Not a bad thing, but I'm not sure it was on the critical path to developing the specific project architecture you were trying to develop. Based on your strategy, I wonder if a tool that allowed you to directly manipulate the diagrams and have the software update the underlying architecture accordingly would have been more natural for you?

Bruce Eisenhart

My question for you Melissa - were you trying to create a single diagram that covered the project? If the project isn't too complex that is usually what is desired. My suggestion would be get the inventory about what you want (including stakeholders for the inventory). Then pick a couple market packages that make sense, do a moderate build, and customize first the interconnects and then the flows. If the number of flows is fairly small (as in your case) you might be better served to do a conservative build (that adds interfaces but doesn't select any of them) and go element by element to select the interfaces you need. Turbo can use market packages to help do an initial build, but once you do that the details of interfaces don't really use market packages (other than as an aid to making diagrams- where you have to select the elements to be part of the market packages and turbo will print out what flows/ elements belong to a particular market package.

As I may have shown you on regional ITS architectures I start with a set of customized market package diagrams and use those to “build” turbo using some special tools I have. That works great for regional arch, but isn’t always the best approach for a project.

Limits of the architecture

Melissa Miller

One big issue asked earlier is what the limits are of this architecture. Should it represent reality outside of the scope of this project, or be limited to only this project? For example: the Northbound Traveler Information System shares its data with multiple departments, transportation operations centers, and agencies. It ties into WSDOT’s 511 system, highway advisory radio, etc. But in the context of this project architecture, it only is relevant in that its raw data is fed to the Cascade Gateway Border Data Warehouse. Therefore I only showed that connection and deleted all others. Similarly, there are multiple other stakeholders who have interest in peripheral issues related to this project; but I left the stakeholder list limited to those who specifically electronically share data with the system. I look forward to hearing if you think this is too limiting or if it is appropriate for a project of this scale.

Ron Ice

Although I like to include additional interfaces for context – existing interfaces that the project builds on (you have a couple of these) and future interfaces that future projects will add, I think the project architecture you have created is representative of what many or doing with its focus on the interfaces that are actually included in the project – this meets the need. I think the issue of all of the peripheral interfaces is particularly acute for you because you don’t have an up-to-date regional ITS architecture for your region (right?). Ideally, all of the peripheral interfaces you describe in your note would be included in the regional ITS architecture. The regional ITS architecture would then provide all of the context you are missing in your tightly scoped project architecture. The BIFA wasn’t really intended as a substitute for a regional ITS architecture; I think that is essentially what you are using the BIFA as in this project. The BIFA is a start, but it isn’t really a regional ITS architecture, which would include specific systems like WSDOT’s 511 system.

Bruce Eisenhart

Ron has covered this well-no additional comments

Northbound vs. Southbound traveler information systems

Melissa Miller

Whatever I originally did to establish these elements, they have always been treated differently in BIFA, even though I tried my best to make them exactly the same. I went through and matched their subsystems/terminators, their services, every setting I could think of, but I couldn’t get Southbound to map as nicely as Northbound. In fact, I had to eventually just build every single possible interface and then go in there and customize it to even get Southbound to show. The only difference I can see is that, for whatever reason, Northbound is considered to be “in region” and Southbound is not (see next issue). This was eventually resolved but caused a lot of headache and I’m wondering if you have ideas of what could have gone wrong in the design and how to fix this in the future.

Ron Ice

This is something we should fix in Turbo, but I have to think a little more about what the best fix might be. As you point out in #7, it looks like the Northbound Traveler Information System was renamed from the BIFA Border Traveller Information System element and the Southbound Traveler Information System was created from scratch in a file that did not have a regional ITS architecture. Turbo was designed to make it easier to add items that are already in the regional ITS architecture to a project to encourage consistency between regions and projects. It is intentionally biased towards items that are included in the regional ITS architecture for this reason. At face value, the fix here would be to do a better job of clearing out any “in region” status when the regional architecture is deleted or items are imported into another Turbo file. This residual regional architecture status is confusing and should be removed when there is no regional architecture, as you point out. The problem is that this fix would result in Northbound working like Southbound (since neither would be “in region”), and it sounds like you want the opposite. I am adding to the Turbo to-do list: 1) Fix Turbo so that “in region” status is removed when a regional architecture is deleted or items are imported into another Turbo file, and 2) Review the project architecture build algorithms in scenarios where there is no regional ITS architecture included in the file. Depending on the outcome, we may also want to regenerate the “BIFA in a Project” Turbo file that is available on the BIFA web site to remove the residual “in region” status. I can also see a potential enhancement that would have made your life much easier – the ability to make a copy of an element and all of its mappings/interfaces with a single command – added to the Turbo enhancement list.

Bruce Eisenhart

Ron’s addressed this well.

In-region issues**Melissa Miller**

There are some elements, subsystems, and services that show up as “In Region” and some that don’t. The problem is, there is no regional architecture. This project architecture has been developed outside of a regional architecture so that it can be inserted into multiple regional architectures, one U.S. and one Canadian. My theory is that this is something to do with the original creation of the BIFA template. However I cannot change the region checkbox for any of the sections in Turbo, and found this to be puzzling. Although it doesn’t seem to have much of an effect on the turbo file, it may have something to do with issue #4, the differences with my Northbound Traveler Information System and my Southbound Traveler Information System (which was created from scratch, vs. the northbound which was modified from an existing BIFA element).

Ron Ice

When I look at the file you sent, I only see “in region” status on the services tab and the Ops Concept tab. I know it is lurking elsewhere because it shows up when you create a regional architecture in the file, but I don’t see it in the user interface anywhere other than the two tabs. Are you seeing ‘in region’ status elsewhere in the file that you sent us? (This will help me with troubleshooting Turbo.)

Bruce Eisenhart

Same here.

Weird market package selections

Melissa Miller

As I backward engineered my diagram, I ran the report on Inventory to Market Package Comparison and discovered some surprising subsystems and terminators that were included. I think this is a result of the subsystems and terminators that I selected for each element. These choices were based on the generalized descriptions, and some of them weren't appropriate. I had to go through and uncheck a lot of subsystems in order to clean up my diagrams. I'd be interested in any advice you have on avoiding this situation.

Ron Ice

I may be missing something on this one. At this point, your subsystem and terminator mappings for your elements look fine to me. If your log reflects a pattern of including certain subsystems/terminators that did not belong because of overly-general descriptions, we might be able to clean up the problematic descriptions so others don't fall into the same trap. I do see a couple of suspect ("weird") market package selections...more on that later, but first will discuss the Inventory to MP comparison report.

The comparison report helps you do a consistency check by answering two questions: 1) Have I selected enough MPs to keep my inventory busy?, and 2) Do I need to create some additional inventory to support the MPs that I have selected? It answers these questions using the National ITS architecture mappings between market packages and subsystems/terminators. The report currently shows the answer to question #1 is 'yes' except for CBP and CBSA field equipment. It doesn't look like you have defined any interfaces in your project for these two elements (as you mention above in your Item#2), so the cleanest solution might be to remove these elements from your project since there are no interfaces defined for them.

Per my earlier comment, we could discuss further whether these are the best choice for a provider of booth status data from the BIFA elements at any rate. It is very common for the report to include lots of "not selected" and "not in inventory" subsystems/terminators – this is part of the answer to question #2 the report is designed to answer. Since the MPs are so broadly defined, you will almost always have a report with lots of additional subsystems/terminators listed, particularly for a focused project architecture – nothing jumps out to me as unusual there. The one thing that jumps out at me is you have included some market packages that look pretty peripheral to this specific project – for example MC08 – Work Zone Mgmt. Would be interested in hearing why you wanted to include this MP and others that are peripheral to a data warehouse in the project.

Bruce Eisenhart

Melissa, I did see one odd thing in the turbo file. Every market package (including tens of market package instances) is selected. It looks like every MP from BIFA is selected. I am not sure how this happened- you really should only have a one or two MPs selected. This would account for the weird MP comparison report. That report will cover every MP you have selected- so in this case it is a lot.

[Note: This is a default setting in BIFA and had to be changed by Ron Ice in the final version]

Planning Tab

Melissa Miller

Since this is a relatively new addition to Turbo, and to architecture building, I'm interested in whether or not you think it is important to fill out components of this in a project architecture, or if this feature should be limited to a regional architecture

Ron Ice

We were primarily focused on the connection between metropolitan/statewide transportation plans and regional architectures when we created this tab in Version 5.0, but it was intended to be flexible enough to also provide a connection between long range plans and specific projects also. We envisioned it could be used to connect O&M strategies in the MTP (for example) with a project so traceability between plans and projects could be defined in Turbo. We did not envision it to be used to connect to more detailed systems engineering documents

Bruce Eisenhart

I agree this is not a key tab from a project arch standpoint. For project arch we actually called the main field on the left Operational Needs, implying you could make a connection between an operational concept with its listing of needs and the market packages of the project. If you had done this you would probably have been the first one to ever do it.

Adding performance measurements

Melissa Miller

I did attempt to include some system engineering performance measurement items in the planning tab. I had difficulty however. The numbering system couldn't match what we have established for the project (1.1.1 causes an error), the way the data is presented doesn't necessarily apply, and I'm not sure its relevant to put project management documentation here. However if you have tips on ways to use this for this project I'd be happy to hear them. Note there are some bugs in the application. If you want details on the bugs let me know

Ron Ice

Yes, we want details on the bugs if they are easy to provide (in your log?) I will add a note to our Turbo help desk that you wanted to enter hierarchical numbers in the performance measure number so we have a record of that. As mentioned above, the thought was to better connect your project with the LRTP objectives/strategies/project concepts/...(terminology varies from LRTP to LRTP, so we had to make it generic). I don't think it would be useful to try to include a complete hierarchy of project needs/detailed requirements here, which looks like the path you started down. I could also see including a driving statement of need for the project here (e.g., the statement of purpose/need that normally is identified for a project when it is first defined). The real purpose of the tab is to show that the regional and project architectures are grounded in planning. Would be interested in your observations here from the COG perspective.

Bruce Eisenhart

Nothing to add to Ron's comments.

Private travelers

Melissa Miller

I had a question about private travelers who use data from the archive. Should they be included in here if they don't receive info automatically? How is this different from Archive Data End Users?

Ron Ice

I would have broadened the description of Archived Data Users to make it clear that it includes anyone that connects with your archive, public or private. You mentioned in a previous question that you included User Information Device (stakeholder=Private Traveler) to represent simple queries of the archive. You didn't connect the User Information Device to the Data Warehouse because there is no ADMS↔PIAS interface in BIFA or the National ITS Architecture...the ADMS↔Archived Data Users interface serves this purpose. You could connect the two using a user defined flow, but I think it would be better to leave out User Information Device and either: 1) define a second element, also mapped to Archived Data User Systems, that represents direct users (public and private) if you want to show direct users and API users separately, or 2) generalize the Archived Data User Systems element description to cover both. The reason to define two elements is to highlight the distinct API interface and direct query interfaces in your project diagram(s).

Bruce Eisenhart

I think Ron's answer falls in line with the one I wrote in item 3 above. Particularly when you are doing something a bit out of the ordinary (as you are with anyone being able to directly access data warehouse data, I would create elements and interfaces that reflect that distinction. So I would agree that you should have two elements- one for the API type interface and one for the regular web interface. Further I would create some customized flows that are nice and descriptive of what is on the interface.

Element types

Melissa Miller

The "type" has been left as "normal." I'm not clear on what this represents. Instance, shared, communications – I wasn't able to determine the differences through the help, and not sure why choosing communications leads to a cloud image.

Ron Ice

All of your elements are normal, so you did the right thing. You would use "communications" if you wanted to show a communications hub somewhere in your project architecture. For example, a hub that allows center-to-center communications between agencies in NW Washington. If you defined such a hub, you could decide whether to show the hub ("cloud") in your diagrams using the Element Selection form and include the cloud on some diagrams and show direct agency to agency flow of information on others. Element instances come in handy when you want to define a project based on a regional architecture. For example, you might have a single "Archived Data Users" in your regional architecture and then define two instances in your project "Apple Apps and Google Gadget Archive Users" and "Simple Query Access Archive Users". When you don't have a regional arch, I can't think of a good reason to use element instances.

Bruce Eisenhart

Ron gave you an excellent answer on this one.

CBP and CBSA mapping

Melissa Miller

When I looked at CBP, it has two subsystems mapped, but CBSA does not have Roadway Subsystem checked. I had to add this. Is this just a design issue with BIFA or something I programmed wrong?

Ron Ice

There is an apparent discrepancy between US Border Services Field Equipment (mapped to RS and SMS) and Canadian Border Services Field Equipment (mapped only to SMS) in BIFA. Note that this is actually consistent with the broader element description of the US element in BIFA, which includes additional types of devices and a broad reference to sensors. We should review these differences and consider making both the descriptions and entity mappings more consistent in a future update to BIFA, pending input from CBSA and CBP.

Bruce Eisenhart

Ron gave you an excellent answer on this one.

Market package for both status data

Melissa Miller

What market package should I use for booth status data once that becomes available? The customized BIFA-Unique market packages are not really relevant in this project, because what we're talking about exchanging is actually transportation system-related data, not inspection-related functions. I see two possible approaches, and am interested in your thoughts:

- a. I could use one of the ATMS packages (surface street control, HOV lane management), although it isn't a direct fit. But that would better classify it as a lane designation change data element.
- b. I could develop a unique market package, although I'm not sure how that is done or if that would even be recommended. It seems like a bad idea.

Ron Ice

There are lots of ways to do this, but I think the best fit for "booth status data" in BIFA/the US National ITS Architecture is "border crossing status information". This flow is already included in four MPs: Broadcast Traveler Information, Interactive Traveler Information, Transportation Operations Data Sharing, and VII Traveler Information. If the reason for the data transfer is traveler information, then it is covered nicely by one of the traveler information MPs that you have already included in your project architecture. If the exchange supports transportation operations coordination (e.g., coordinating lane closures between WSDOT and CBSA), then you could add the Transportation Operations Data Sharing MP (ATIS06). Turbo currently doesn't allow creation of a user defined market package, but this is a frequently-requested enhancement.

Bruce Eisenhart

Agree with Ron regarding the MP mapping for border status info flow.

Roles and responsibilities

Melissa Miller

How does the inconsistency of having some roles and responsibilities In Region and some not affect the architecture? There are limitations that are concerning when a roles and responsibilities item is in the regional architecture, especially since there is no regional architecture.

Ron Ice

I have an item in the Turbo HelpDesk to fix the issue with phantom “in region” status. I apologize for the issues you ran into in this regard – most files include a regional architecture, but that is no excuse. On the Ops Concept tab, the impact is localized as what is done on the Ops Concept tab does not have much of an impact on other tabs. You will find that RRs that are “in region” cannot be edited from your project architecture. To edit such an RR, you would have to: 1) temporarily create a regional architecture, 2) remove all of the RRs from the regional architecture so that none are associated with the region (you might have to add all areas to the region in order to see assigned RRs), 3) delete the regional architecture. I think I will offer to clean out the “in region” status for you but want to confirm that I have the most recent version of the file first.

Bruce Eisenhart

I can see you hit a glitch in Turbo. I think Ron’s approach is the only way to “fix” it right now. One minor additional comment I would make regards the names for your Role and Responsibility Areas. Usually, the areas have general names such as Traveler Info (so your one called Border Traveler Info fits nicely into that model). But Border Lane Status Data might be better called Border Operations or something general like that and Archived Data Systems would probably be better as just Archived Data. In this area you are looking at the roles and responsibilities of various stakeholders in providing some area of ITS, you aren’t concerned about the “systems” here.

Operational Concepts tab

Melissa Miller

Please check this section carefully. It took a lot of work to customize and I’m not sure I set everything up correctly.

Ron Ice

I spot checked the RRs and they looked fine. It looks like mostly BIFA RRs with some that you added to cover WIM sensor data. Is that right, or did you also do some tailoring of the individual RR descriptions? If so, we may want to fold some of your enhancements back into the BIFA for other users to capitalize on? I’m sorry to hear that you did a lot of work on this tab as there isn’t a lot that is carried forward from this tab to other tabs, so we don’t want users to get too wrapped around the axle here. Were the different R&R areas that Turbo created when you used the “Autoselect” function helpful? I would have recommended trying the “Create one area for your project” option to keep the structure as simple as possible and then focus on selecting the BIFA RRs that applied to the project and adding a few (like the WIM-related RR) that occurred to you that were not already covered.

Bruce Eisenhart

I understand this section is a bit harder to work with than some of the others. The one comment I might have here is to customize the general R&Rs a bit to make them more useful to someone who will use the project arch. Rather than saying “collect and disseminate” say “collect and provide data

to Data Warehouse”- that’s the really relevant R&R for this project. I would suggest you don’t need the three areas. You really aren’t doing traveler info here- its archiving data. So you probably only need the one area on archived data.

Requirements Tab

Melissa Miller

We have a very defined list of System Requirements (see **Border Data Warehouse Upgrade & BIFA Integration Project Report 1: Project Final Report**) for this project. This was established for the project and outside of BIFA. What is the best strategy in this situation? I see a few options:

- a. Have the project systems requirements document as a standalone document, and ignore this section of the Turbo.
- b. Have the project systems requirements document as a standalone and also have a list of requirements in Turbo as recommended by Turbo, although these will not be held to the same systems engineering standards as the standalone document.
- c. Customize the list in Turbo to represent the system requirements developed for the project (if so, how?)

Ron Ice

The requirements included in the National ITS Architecture and BIFA are high-level requirements that are intended as a starting point for project requirements. The envisioned process is that these high-level requirements would be included in a regional ITS architecture and then used as a starting point by project sponsors when it came time to develop project requirements. Since you already have project requirements defined, the architecture requirements probably won’t have a lot of utility and this tab could be deemphasized in your project architecture.

You could still use the requirements included in the architecture as a cross-check of the project system requirements – to ask the question “Are there BIFA requirements that apply to the project that are not covered by the project requirements”? I assume that your project requirements more than cover the requirements that were included in BIFA, but I haven’t checked this by reviewing the project requirements. Any identified changes to the project system requirements would be made directly in the requirements document/tool...I don’t see a lot of benefit in including all of the project system requirements in Turbo. We have discussed a requirements import capability to facilitate this type of operation, but it is floating towards the bottom of the enhancement list and unlikely to be implemented.

Bruce Eisenhart

Ron had a good answer on this.

API Interfaces

Melissa Miller

I did not include interfaces showing how the API being used by outside Archive Data User Systems would query the database and share results. I wasn’t sure how best to represent the activities of APIs and would be interested in any suggestions you have for representing the roles of APIs in the interconnects and flows?

Ron Ice

You could break out the API as a separate element in your architecture, but I don't think it is necessary. I think the key interface is the interface between the API and the user systems, which you have defined in the project architecture as the interface between the warehouse and the archived data user system inventory elements. I would view the software interface between the service that supports the API and the database as more of an internal interface that is internal to the warehouse element. If you wanted to break out the API separately (maybe because you have one team developing the database and another developing the API and want to manage the interface between the two teams at the project level), then I would create a user defined entity for the API that describes the functionality and define user defined flows that connect Warehouse (database) ↔ API ↔ User Systems. I could suggest some more specific element and flow names, but ultimately you want the names to reflect the names used by the system designers.

Bruce Eisenhart

I thought Ron had a good answer on this one. The only other option I would add is that if you want to highlight the interface you could create some user defined flows that better describe the information that comes across the API. These could be done with or without a new element.

Interconnects and flows

Melissa Miller

Is there any way to manually enter in/design interconnects and flows? It was a lot more work trying to backward engineer than just specify what I wanted to show...

Ron Ice

As mentioned in the previous answer, you can define user defined flows to connect any set of elements in any way you want. The problem is that you lose the connections to BIFA/the national ITS architecture if you do this too much. I see that the build settings are set to "All possible flows" and "Conservative" in your file which should have been a good way to get all possible flows onto the interfaces tab without any reverse engineering of market packages, etc. Once you have all possible interconnects and flows on the tab, then it is a matter of manually selecting the flows that apply to your project from all possible flows. Theoretically, with the build settings you used, all flows would be included on the tab regardless of the market packages that you had selected. I would be interested to learn a little more about why you needed to reverse engineer selections on earlier tabs in order to get the flows you wanted on the interfaces tab – maybe I can satisfy my curiosity by looking through the log.

Bruce Eisenhart

When you use the Add Flows feature (under Tools) you are adding an individual flow from one entity (subsystem/terminator) to another. Then through the mapping of element to entity you can have the flow go between the two elements you want. This effectively adds an interconnect between the two elements, but you do it flow by flow.

I actually am a fan of user defined flows since they better describe to the users of the arch what you are trying to do. The one thing you lose with a user defined flow is the connection to standards that comes from BIFA or the National Arch. In some cases (like your border status information) this isn't a loss since there are no information standards for that flow. There would likely be communications standards that apply to broad classes of interfaces, but these are fairly obvious.

Standards Tab

Melissa Miller

I have done very little to this section, because we are finalizing the various schema for data sharing now and they are based on standards, but I have to find out from the software developers which standards are being used. I have only included the general ATIS one. So here's my question: if we develop a set of schema based on a standard, should I list the original standard or create a modified/new standard for each schema that is established?

Ron Ice

The standards tab provides a lot of capability for customization, but few Turbo files include much standards customization. Since standards are the connective glue of the architecture, I would make the effort to define user defined standard(s) that reference the specific standards (or schemas) that support the important interfaces in your project. For example, I would define a custom standard in Turbo for the API that is used by the Archived Data User Systems and tie it to the applicable architecture flows. Ideally, the short description of the standard that is included in Turbo would include enough information for the user to find the actual standard/schema that defines the interface in detail. To some extent, you are defining the architecture late in the process. Ideally, you would define the project architecture early and then use the architecture to identify key interfaces where schemas/APIs would be defined for the project. This is a tab that doesn't get enough attention IHMO.

Bruce Eisenhart

Agree with Ron's comments.

Agreements Tab

Melissa Miller

Two of these agreements are financial in origin and fund the project itself – should they be included? Two are data sharing agreements that are planned but not in place.

Ron Ice

The focus on the agreements tab is naturally on agreements associated with integration and inter-agency coordination since that is the focus of the architecture. It certainly doesn't hurt to include other agreements like the financial agreements associated with the project.

Bruce Eisenhart

I have seen some developers of architectures include the financial type agreements, and some stick only to the data sharing as Ron mentioned. It's really up to you. For me I usually ask the question—does the additional information provide something a value to a potential user. If the answer is yes then I include it.

Conversion to Canadian Architecture

Melissa Miller

When I try to import the BIFA version project architecture into the Canadian architecture (using Canadian Turbo), it is incompatible. What suggestions do you have? What I'd like at the end of this is a project architecture that I can hand over to our Canadian partners for them to easily import into

their regional architectures. The project uses only market packages that are available in both countries.

Ron Ice

You have two challenges here: 1) the underlying National ITS Architectures are different (though very similar) and 2) the underlying versions of Turbo are different – V4.1 vs. V5.0. You can disguise your US file as a Canadian file by hand-editing two tables: tblCountry and tblConfiguration, and then debug your way through an import, but unfortunately, you still run into problems with the import because of the aforementioned incompatibilities. I played with it for a while and found: 1) You also have to shorten your geographic scope description as the older v4.1 format only allows 255 characters max (yours is 386 characters), and 2) there is an error because of equipment package incompatibilities between the US and Canadian architectures that causes import to abort midway through. I'm sure I could create a Canadian version of the project for you, but it would take a little more debugging and probably clearing out data on the requirements tab that is causing Canadian Turbo problems. I will save an hour to help you with this if you like.

Bruce Eisenhart

This is Ron's area of expertise and he is the one who can help you here.

In the case of your particular project- it isn't too large- you could just rebuild from scratch in the Canadian Turbo.

Overall setup

Melissa Miller

Overall, what errors do you see in the way I've set up this file? What strengths? What would you recommend changing? (And please let me know what should be changed and let me change it rather than changing it yourself... the main point of this grant is for me to use the BIFA myself and document how well I am able to develop and architecture with it. I'd love pointers and even step by step directions if necessary but I would like to make the alterations).

Ron Ice

I think it looks good, given the answers that I have made to the previous questions. I ran the suite of "Check Your Architecture" reports and they all report a clean bill of health aside from the three elements reported by the Unconnected Elements report that are all discussed in the previous answers.

Bruce Eisenhart

I don't see any errors in the way you have set up the file. Strengths-the fact that you tried to fill out all the tabs for the project. I think this will allow a useful set of information to be summarized out of the tool. I think you ended up with a good set of interfaces as defined by the underlying architectures. As you built the file some odd things happened (requiring reverse engineering). One of these was I think unavoidable- having all the regional Con Ops R&Rs selected with no way to deselect. I am not sure if the Market Package issue was a direct result of the project creation, but I don't think so.

Some recommendations for changes-

Fix the MP tab- unselect all except for the couple that you actually think this project is performing. Based on the flows/elements it looks like you actually have a Data Warehouse (AD2) and AD3 (virtual Data warehouse- due to the connection from one archive to another).

Add the Border Inspection Systems to Warehouse flows for border status (and make a third status like Future to recognize the desire to put these in later.

Mainly I would customize some of the flows so that the result provides more info to the user. In the Project Start tab you indicate that one of the primary aspects of the project is to “increase the amount and types of data available to all users” then having some flows more specific than “archived data products” would be good. Also the input of info to the warehouse is “traveler archive data”. A more descriptive flow would provide additional info to anyone viewing the architecture. One option to do this is to use the “replace” option when you create a user defined flow. The replace field will show you all the flows in the architecture that are from/to the entities you assign to the user defined flow. If you select a flow then your user defined flow replaces that flow everywhere in your architecture. We don’t often do this in regional Architectures because in many cases you want the more general flow, but in your case you could change all of the “traveler archive data” flows to something like “border archive status data” (unless that is too restrictive).

BIFA-unique market packages

Melissa Miller

The BIFA-unique market packages of the original BIFA template have subsequently been incorporated into the most recent Canadian ITS Architecture, and one can assume that they will similarly be adopted into the U.S. ITS National Architecture at a later date. In your opinion, what does that mean for the longevity of the BIFA itself? Do you still see a role for it in its current incarnation?

Ron Ice

Although we created V6.1 of the US architecture after we created BIFA, we did not include everything in the US architecture that is in BIFA. Perhaps most importantly, the Border Inspection Administration System and Border Inspection System entities that are defined in BIFA are only defined as terminators in the US architecture, while they are defined as subsystems in the Canadian architecture and in the original BIFA. If you look at the User Defined Entities and User Defined Flows in your Turbo file, you will see all of the additional things that are defined only in BIFA, but not in the US National ITS Architecture, mostly due to our decision to define BIA and BIS as terminators in the US architecture.

If we were to define the BIAS and BIS as subsystems in the US architecture and also include all of the BIFA-unique interfaces in the next version, basically matching the scope of the Canadian architecture, then the need for BIFA would be reduced, but it wouldn’t go to zero. In this scenario, the value would really be in the elements and element descriptions that are included in BIFA and the services, ops concept, requirements selections, and interfaces that are specifically defined for border applications in BIFA, which are not in the more generic National ITS Architectures.

You could also say that the need for BIFA would be reduced once all of the region’s along the border have defined solid regional ITS architectures that build on the more generic BIFA. Once this is achieved, the role for BIFA would be further diminished, except for a possible role in maintaining consistency across the regions over time, which might be supported by the US and Canadian National ITS Architectures...have to think more about that scenario.

Bruce Eisenhart

One additional comment to add to Ron’s answer. I think it unlikely that we will add all of BIFA (as currently in the Canadian Arch) to the US architecture. To add something to the US architecture we

have to be able to tie it to a User Service. They are what defines the scope of the National ITS Architecture. The current user services do not really address the full scope of BIFA and the effort to create a new user service or to make a mod to the existing ones is something we could do, but are not likely to do. To adjust the user services we usually have to get a set of representative stakeholders together and get them to agree to the changes. So it is a bit harder for us. The Canadians don't have a detailed set of user services that were developed in the same way. If they want to add something- they get a rather small group together and they just do it.

Redefining BIFA

Melissa Miller

In my documentation on this process, I am most likely going to suggest a redefining of what the BIFA is. I believe one of the challenges has been that it truly seems to serve two purposes; it is both a template for regions like ours to use in developing a binational architecture, and it is an architecture itself to fill in for where border regions do not have a current architecture that would apply.

This split role has led to a tool that is not optimal for circumstances like mine, where I end up spending more time deleting and removing items than it would have taken me to build something from scratch. Therefore, I propose a slight re-development of BIFA as a template only. It will be stripped down with instructions to aid border regions in developing useful architectures but require less work in customization. What are your thoughts on this suggestion?

Ron Ice

I would like to hear more about what you mean by a “re-development of BIFA as a template only” before I give you my thoughts. I think part of your challenge was due to the fact that you were trying to go from BIFA directly to a project architecture, so you were trying to make BIFA specific to your ports of entry at the same time that you were trying to create a subset project architecture. Ideally, you would start with a regional architecture (perhaps the binational architecture you reference?) that is already customized for your ports of entry as your template when you create a project for your region. I think this would have made the creation of your project architecture more straight-forward.

That said, I'm interested to hear what you would like to strip out of BIFA to make it easier to use – I'm sure there is potential there. There might also be quicker ways to get the subset of BIFA you were interested in if you wanted to be as efficient as possible in your extraction process – for example, 1) create a project architecture in the BIFA file, 2) select the core data archive element that is the focus of this project on the inventory tab, 3) go directly to the interfaces tab, which will show all BIFA interfaces to/from the archive, 4) select the interfaces applicable to the project, and then 5) import the project into another file so that your file only includes the core project elements and interfaces and build from there.

Of course, there would be some trial and error involved and you would still have run into the issues you ran into with phantom “in region” status and the difficulty in creating duplicate traveler information elements, but I'm suggesting that there may be more streamlined ways to use even the existing BIFA. Whatever the approach, the “instructions” you mention would be key. Now that you have navigated the process, some instructions from your perspective would be very valuable to the next person that creates a border project architecture.

Bruce Eisenhart

I know that using BIFA was difficult for you in part because of the issue of working a project architecture without the overarching regional architecture. I am developing a regional architecture right now for Maine/New Brunswick that started with BIFA (and the Canadian Architecture V2). Because we are working only in regional architecture it has been easier to use the BIFA information. Unfortunately you were on the “bleeding edge” of trying to use it for a project architecture. Couple that with the difficulty of using Turbo in detail for the first time and it ended up being quite difficult. Regarding BIFA and project architectures, one the items the National ITS Architecture Team has been discussing is creating a “How to Use” document to go with BIFA.

Based on your experiences we would have to carefully describe what to do if creating a project architecture only. As you discovered it is possible with Turbo to start down a rabbit hole and end up in Wonderland (or in your case the land of too many market packages). One suggestion for the future is save copies of your turbo file often and if you start to head into never-never land, go back to an earlier version that was cleaner and attempt to follow a simpler path.

Appendix C: Feedback from Architecture Users

The following phone interviews were conducted in June, 2011 to have a better understanding if WCOG's experiences with both the BIFA project architecture and developing and maintaining the Whatcom Regional ITS Architecture has been similar or different to other regions across the country.

The interviews were mostly conducted with architecture managers at Metropolitan Planning Organizations (MPOs) or similar agencies rather than state departments of transportation to more accurately compare the experiences of WCOG.

Although the interviews did not stick to a specific format, some form of the following questions were asked of the architecture managers in other regions:

1. Did you develop your original regional architecture yourself or did you hire consultants to do that for you?
2. Do you maintain your regional architecture yourself or do you hire consultants to do that?
 1. If consultants, which consulting firm?
 2. How often do you hire them to update your architecture? Or is it a maintenance agreement-type relationship?
3. Do you develop separate project architectures for all your ITS projects?
4. Do you insert projects into the regional architecture before, during, or after the completion of the project?
5. Who uses the architecture, if anyone?
6. How big is your architecture?
7. How does it tie in with local, regional, and statewide transportation plans?
8. Do you have any border projects or work with Canada or Mexico?
9. How much money do you spend annually maintaining your architecture?
10. Honestly: have you found it to be a valuable or burdensome process?
11. What would make it more valuable to you as a planning agency?

Natalie Bettger, North Central Texas Council of Governments (NCTCOG)

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NCTCOG did its original architecture in-house rather than hiring a consultant because their region is large and has a great number of stakeholders. They felt that Turbo wasn't able to capture that complexity. They use Vizio to draw the maps and configurations for their architecture, and have a staff member in-house who uses the software.

The architecture has not been updated often. They look at it annually and do minor updates to reflect any changes. They do plan on doing a full-fledged update next year.

The greatest use of their regional architecture has been in conjunction with their long-range transportation plan. They have a set of critical corridors they focus on, consisting primarily of

highways and frontage roads. Priority deployments are along these corridors and are part of the identified market packages in the architecture. They use these critical corridors, and identified market packages, to select which projects go into the TIP.

They prioritized market packages as part of the architecture development and now pair those with the priorities in the long-range plan, which focuses on filling gaps in the system and connecting regional partners. Projects in the TIP are ranked based on five criteria, the plan, and the architecture market package priority.

In regards to how their architecture fits in with the statewide architecture, there used to be two sub-regional architectures with TxDOT (are there still two?). Their regional arch is part of the state architecture. She feels there is good communication between the state and their agency.

When asked who uses the architecture, she replied they use it from a larger regional perspective. They require their stakeholders to at least look at it before submitting projects so they know which other stakeholders need to be at the table. Before a project can receive funding they review a project architecture statement that is developed by the agency. This project architecture statement has specific questions about what market package it applies to and what connections are made.

In terms of improvements to the architecture process, she hopes that with the next update that can incorporate more of a strategic planning approach. They get a lot of small projects, funded by regional mobility funds, which may connect ITS components like signals that are not on their prioritized list. They'd like to see more definition in what projects move forward rather than just having projects submitted for inclusion. They would then have more leverage when funding is made available, if they can document the approach ahead of time and show the project's place in a strategic plan.

Regarding costs – the start-up took a lot of effort, not just with stakeholders and staff time but bringing together stakeholders to agree. But maintenance has not been expensive now that the architecture is defined. Between reviewing the project-level architecture statements and minor updates to the architecture itself it takes approximately eight hours a month of staff time.

As far as their update goes, they are not sure if they will do it once again in-house or if they will hire a consultant to work with them on it. They don't have a lot of experience in-house with putting together a strategic plan so it may help to have their expertise. However when it comes to updating their drawings that's something they can do.

Tom Bruff, Southeast Michigan Council of Governments

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SEMCOG's regional architecture represents seven Michigan counties around Detroit, with a population around 4.8 million.

The first version of their regional architecture was completed by a consultant (Consystec?) through FHWA. SEMCOG helped organize tier 1 and tier 2 workshops with FHWA, and FHWA paid the consultant for the development of their architecture, and the Turbo database.

SEMCOG later worked with consultant (Ron Ice) to convert their Turbo architecture to a web-based interface.

Since then MDOT started developing architectures for their regions, which do not match up with MPO regions. As part of that process SEMCOG worked with consultant (Kimley-Horn) to update their architecture. This time they did not pursue a web application for the update.

In this last update they also developed a deployment plan which has been very useful. A maintenance plan was also developed. The idea is to update the architecture in conjunction with the long-range plan, although this upcoming plan update in 2013 they may not need a full regional architecture update.

They have developed a form to be filled out if there is new architecture being proposed. The form is sent to both SEMCOG and MDOT. Although this is an MDOT initiative SEMCOG has taken advantage of it for their regional architecture. There have not been many forms submitted.

Both the regional MDOT architecture person and Tom Bruff don't have full comfort using Turbo Architecture given that it isn't used daily. So when it is time to update the architecture again their plan is to sort through the collected forms and provide those to a consultant.

There is a benefit to architecture, although much is done to "check the box" of requirements. It has been used with their congestion management system to look at the maps showing where future ITS projects are proposed and to see if that might assist in reducing congestion in those areas. They are now working with one county on signal improvements, and it was an epiphany for them to see how their system could connect with those around them, and the importance of the architecture.

"It's where you take it." Architecture can be more beneficial if developed and used regularly. In Maricopa County, Arizona, they have an ITS committee which meets every other month.

The deployment plans have been more valuable to end users than the database. It's also good if tied into the TIP survey component (their TIP form has an ITS checkbox and also a box to make sure their proposed project fits within the regional architecture).

There are a few references to cross-border projects in the architecture, and the update process encouraged the participation of neighboring stakeholders, especially Ohio, who is interested in working with Michigan for cross-state projects. SEMCOG has proposed a reciprocal process where they could potentially build systems in Michigan for Ohio and Ohio could build similar systems in their state for connectivity.

An open architecture is a good concept. And it's important to show connectivity. MDOT is going to a new internet-based operating system and connectivity will be an important issue.

When asked if the specific information-flow level of detail was useful, Tom Bruff replied that it can be when designing specific projects. MDOT's consultant has developed concept of operations for specific corridors and Kimley-Horn was able to use example of the diagrams to discuss the connectivity with stakeholders.

At the end of the month they will be doing a table-top exercise for major incident management and some of this connectivity and information sharing will be discussed there.

However Turbo Architecture itself may be overkill. It is too detailed for the actual users who are maintaining and using architecture on a daily basis. There could be easier ways to maintain and update a regional architecture.

Monica Harwood, Spokane's Regional Transportation Management Center (SRTMC)

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The Spokane Regional Transportation Council is part of a multi-agency partnership with the SRTMC. The SRTMC manages and maintains the regional architecture.

The original architecture was developed back in 2000 by a consulting firm (IBI Group). At first it was a very useful document with clear references to the specific projects within. However it has not been updated. They plan to do this in the near future and are looking for funding to accomplish this.

At this point a majority of the projects in the original architecture have been fulfilled and so it is only a loose vision of what is in place. They need to have a visioning process to better identify what should be incorporated in the updated version. When the architecture is current, it is a useful document. But without that maintenance it isn't referenced other than as needed by law.

When asked what would make the architecture more useful, she replied that FHWA's recent presentation on why the plan should be updated had a strong message and support for using Turbo Architecture. From an architecture designer standpoint, or from a well-integrated user, it could be a useful tool, but Turbo isn't useful to those in the agencies who may not feel as comfortable with it. It would be beneficial to have more of a visioning tool.

In discussions with consultants to price out the architecture update, she has mentioned that she isn't a huge Turbo Architecture fan. One consultant came back with the idea of doing a hybrid of a regional architecture/strategic plan, which sounded a lot more useful to the region. The strategic planning process is one many planners and transportation managers are familiar with and they know what the final product will look like – it's more tangible than the diagrams coming out of Turbo.

It may be useful to develop a two-phased approach: phase one is to do the strategic plan with the basic architecture within that, and get the product to reference. Then a second phase could go deeper into the ITS architecture and develop a Turbo-type product to fulfill that need.

She acknowledged that some regions may have full usage of the Turbo and find it beneficial. But for this region it hasn't been as useful as it could be in its current format.

**Athena Hutchins,
Niagara International Transportation Technology Coalition (NITTEC)**

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NITTEC is responsible for updating and maintaining the architecture.

They had an original architecture in 2000-2001, developed by a consultant (Consystec).

They updated their regional architecture in 2005 with a consultant (Consystec). The website component was also developed and hosted on Consystec's website.

Since their update was done in 2005, BIFA came after the fact. They have not incorporated BIFA elements into their regional architecture, because maintenance of the architecture has unfortunately fallen through the cracks, given that it is time-consuming and there's minimal staff to address this. Consystec quoted them a cost of \$50,000 to update their architecture which is currently cost-prohibitive. They are looking for funding to complete this.

FHWA encouraged NITTEC to get their architecture current. However more recently they were told to wait because there is going to be a national architecture update which will incorporate the BIFA components.

NITTEC's architecture does have cross-border projects included. None of these projects are fully binational, most are on one side or the other, but they serve the border environment. NITTEC is looking into a project that would incorporate travel times from both countries and that would span the border.

When the update was done in 2005 Consystec helped develop a maintenance and development plan, although due to a lack of resources they haven't been able to maintain as well as they'd like. Newer arterial projects and some other elements have not been included, as well as the BIFA components are still missing.

They have Turbo Architecture.

Member agencies do use the architecture, specifically NYDOT, the NY Thruway Authority, and the Ministry of Transportation Ontario (MTO). They are the agencies that have the majority of ITS projects in the region.

She was unsure if NYDOT has its own state architecture and how well it integrates with theirs. She will look into it.

She feels the architecture is a useful tool for coordination between agencies. However there is a need for more education about it. Even larger municipalities like Buffalo are not familiar with the architecture. NITTEC is working through the MPOs for greater awareness of the architecture requirements. Recently the regional transit authority wanted help to fill out necessary paperwork to illustrate their projects are in the architecture, and NITTEC assisted them in this process. Understanding what the architecture is about is a struggle, and NITTEC can help them as long as they come and ask.

Regarding what would make the process more valuable or useful, she said more training was critical. Although she learned about the architecture and how to use Turbo during the update process, she isn't working with the tools often enough to stay up to date and remember all the details. They have recently hired a transportation engineer who will help maintain the architecture. He's taken one class online, but that doesn't help much until he starts doing it. The process is confusing and there's a learning curve required. A way to do regular Turbo architecture training is needed. You learn it but then don't touch it for a year, it is all forgotten. Yearly mini-training sessions would help to keep people up to speed.

Leo Luo, Maricopa Association of Governments (Phoenix, Arizona)

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The region represents 25-28 member agencies around Phoenix, Arizona.

They originally worked with a consulting team (Kimley-Horn (prime), Consystec (sub)) to develop the original architecture. Maintenance is also done by consultants and to update the web version of the architecture.

When member agencies submit TIP applications they need to include a specific section on the ITS architecture. If their project already exists in the regional architecture then nothing is done, but if it is something new then it is added to a list of changes for the subsequent architecture update (which is done annually).

They have an ITS committee which meets every month. The architecture itself is just one of the projects they discuss, in conjunction with discussing the TIP planning process (between August and November).

When a member agency submits a project application for the TIP they need to think about the architecture before the project starts.

Turbo Architecture is used, by the consultants. Since the web interface is proprietary, Consystec is hired to populate the web page on an annual basis.

However the region is thinking about developing a different software tool by themselves that would be more useful in connecting architecture with the existing ITS infrastructure. This is still being discussed. They want to develop additional functionality which would show the scope of ITS projects in the region, some of which date past ten years or more. There isn't a place in the current software to demonstrate what infrastructure is out there.

He feels ITS architecture is a useful process. With 28 member agencies all at different development stages, it's been helpful for the regions that are only now beginning to deploy infrastructure to understand what functionality they may want to achieve and what needs to be considered. It helps member agencies better plan their investments.

When asked what would make it a more valuable process or tool for his region, he mentioned more focus would be helpful. The National ITS Architecture tries to capture everything, and many things are not applicable to this particular region. The most common complaint from member agencies is that there's too much that doesn't relate to them. Since dealing with many transportation engineers and planners, they are more concerned about the transportation components, and less the civil engineering parts to the architecture. While it's good to try and have everything included it would be better to have an interface defined by agency need to have a more focused tool to see what they need to see.

Nathan Masek, Mid-Region Council of Governments, New Mexico

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Hired consultant (Consystec) to do original architecture (Bruce Eisenhart).

Sat on shelf without maintenance plan, did not stay current. This caused issues with some projects when FHWA made sure ITS projects they funded used systems engineering analysis and the architecture.

They worked with DOT to revisit the architecture. Hired Consystec to update the architecture and develop a maintenance plan.

The maintenance now goes very well since it has been tied into their two-year TIP process. Built it around an existing MPO mechanism using project proposal forms. It is a project-driven update.

Every project submitted for consideration in the TIP fills out a project proposal form, on which there are sections to fill out if the project includes ITS elements. On the form this is generically described, not "architecture-speak" to make it understandable.

Form also includes contact numbers so the MPO can then follow up to learn more specifics about the ITS project. These are then mapped to market packages and incorporated into the architecture, which is maintained on a spreadsheet and in report form.

Originally they only included projects that were identified as specifically "ITS projects" (6 out of 150). In the next round they also included projects that had ITS elements within the larger project, and bumped that number up to 75.

They use an addendum mechanism to incorporate the projects into the architecture. There is an ITS subcommittee which consists of members who are also involved in the other planning groups and familiar with TIP development, who can be part of the review process.

Once projects are identified they are mapped to logical, applicable market packages already in the architecture. If project includes a MP not currently included in the Architecture, it is then added with the Addendum. If there are specifics available (which often there isn't, since it is in early stages

of design and no specific detail work has been done prior to environmental or other analyses) then a summary of the ITS components is developed for each TIP project.

The goal of this approach is to remain non-intimidating. The intimidation factor has been underestimated in the national ITS discussion, and hindered its “palatability” to many agencies and planners.

They typically insert into architecture after a project has been submitted; however, there have been a few projects that have been driven by the architecture, mainly the ITS Communications Plan put forth by the NMDOT. Architecture is not “commonly” being used to craft future projects, but it is being used “primarily” to map where projects are and what they do.

This approach has successfully resulted in an acceptance of ITS by the planning community. It has helped create a very collaborative environment.

They are now developing a regional geo-database for ITS infrastructure.

They do not develop individual project architectures. Much of the specific details that would be done at this level are accomplished with the systems engineering approach.

(Comment on systems engineering – agrees that much of it is “cut and paste” and repetitive).

The regional architecture has a good tie-in with the state architecture thanks to close working relationships with the state ITS team. They are also not bordered by other MPOs but by State facilities which provide good connections.

Their architecture is maintained using spreadsheets and reporting through the Maintenance Plan addendum process. The NMDOT owns Turbo and administers all updates accordingly.

Over the course of one year he spends approximately 20 percent of his time maintaining the architecture alone, which includes ancillary ITS planning activities associated with the TIP development.

Tying the architecture and market packages to performance is the way to go. Glad to see that being discussed at the national level, and the possibility of connecting to the benefits/cost database being considered.

There needs to be a performance focus in order to bring architecture from being just a “bureaucratic exercise” to an activity tied to illustrate benefits. That process can gain more respect for the value of ITS.

MRCOG represents 17 voting and 8 non-voting members, with approximately a dozen MPO members and/or private consultants attending the monthly ITS subcommittee meetings.

**Rita Morocoima-Black,
Champaign County Regional Planning Commission (CCRPC)**

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Unlike many, they decided to do their architecture in-house because they didn’t have enough funding to hire consultants to do the work. The website component was also done in-house.

They use Turbo Architecture.

They have updated just once in conjunction with their regional transportation plan in 2009. Most projects are small enough that they are within the scope of the existing architecture.

They don't do project architectures. Local stakeholders develop the project scopes and notify us with what they have done. They don't use the Turbo software themselves, and they don't have the staff to do project architectures for them.

None of their participating agencies use the architecture regularly. It is helpful when a signal re-timing or other similar project is underway, they can check to see what is in place. But it is not used prior to the project design.

She feels the process is complicated and cumbersome, therefore difficult to work with their member agencies on. They change the architecture to reflect the current reality but it is not being used the way it was intended. Overall, the process is burdensome for small MPOs that don't have enough staff or resources to dedicate to the complicated process.

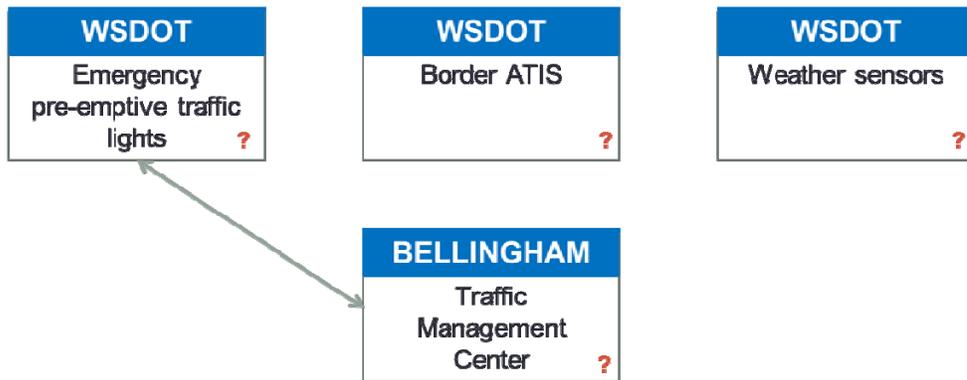
There is a state architecture, and they were consulted as part of the big push at its creation (done by a consultant). Since then however there have been no other meetings regarding coordination between the MPO architectures and the state.

Appendix D: Sample ITS Map Tool

The following illustrations are a suggestion for a way that the architecture could transition to an online service to help facilitate better coordination between agencies, reduce training and maintenance for tools such as Turbo Architecture, and to simplify the process to make it more user-friendly. Note that this is just an example drawn up for further discussion.

Zoom in to a Region

Each regional architecture would be a series of boxes on the map. Similar to the existing architecture diagram process, each box would represent a specific ITS system and which stakeholder manages that system. Lines would illustrate where dynamic sharing of information occurs.

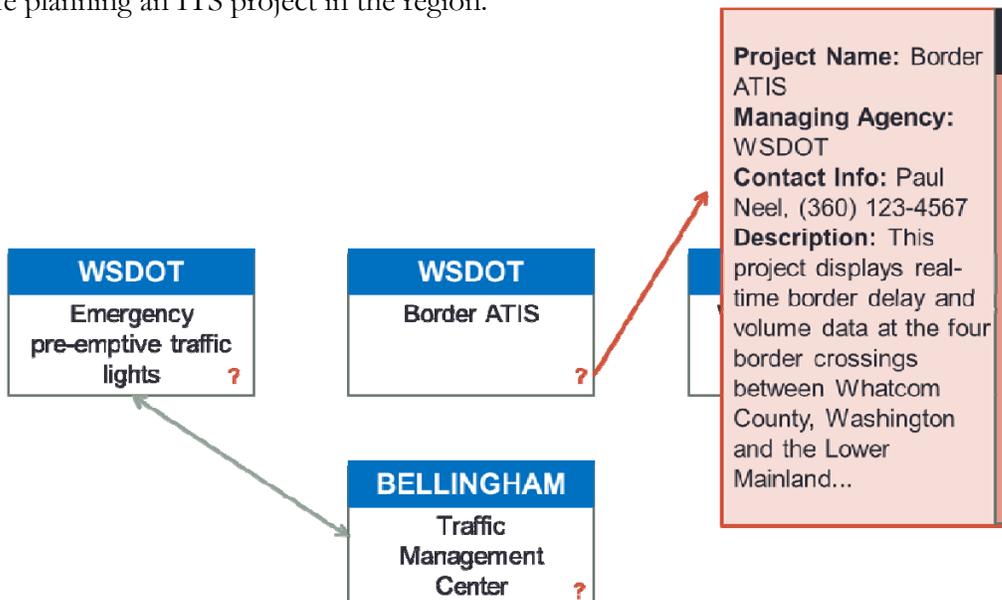


Logged on as: WCOG

More information by clicking

By clicking on any project, the user can view online project details, related stakeholders, and who to contact for more information. The map doesn't need to list ITS standards or agreements. Those can be learned by contacting the agency or person involved, since that information would most likely be shared before implementation anyway.

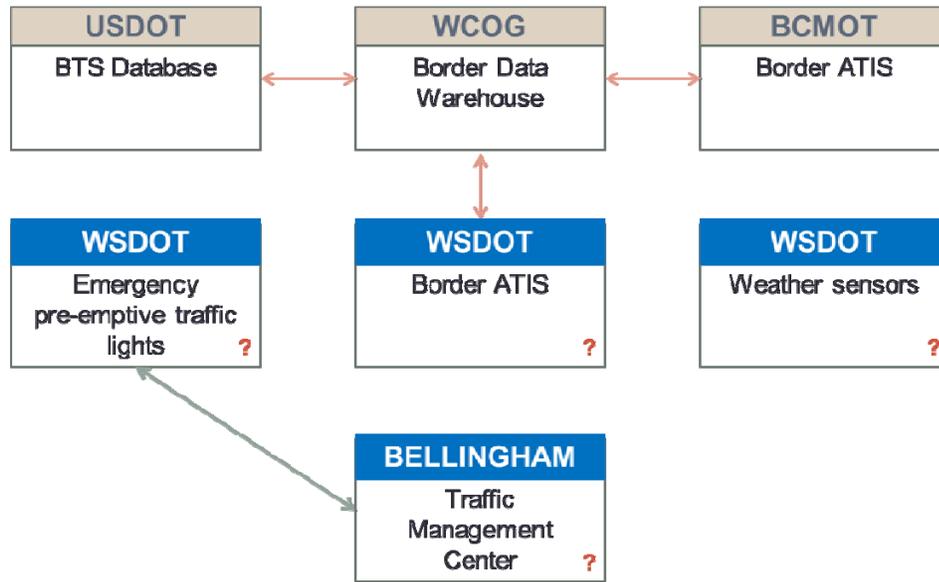
The idea is to keep it simple, accessible, and informative with ways to find out more information if you are planning an ITS project in the region.



Logged on as: WCOG

Register and share your project

Registered agencies like WCOG could log in and virtually, through a web interface, draw connections as needed.



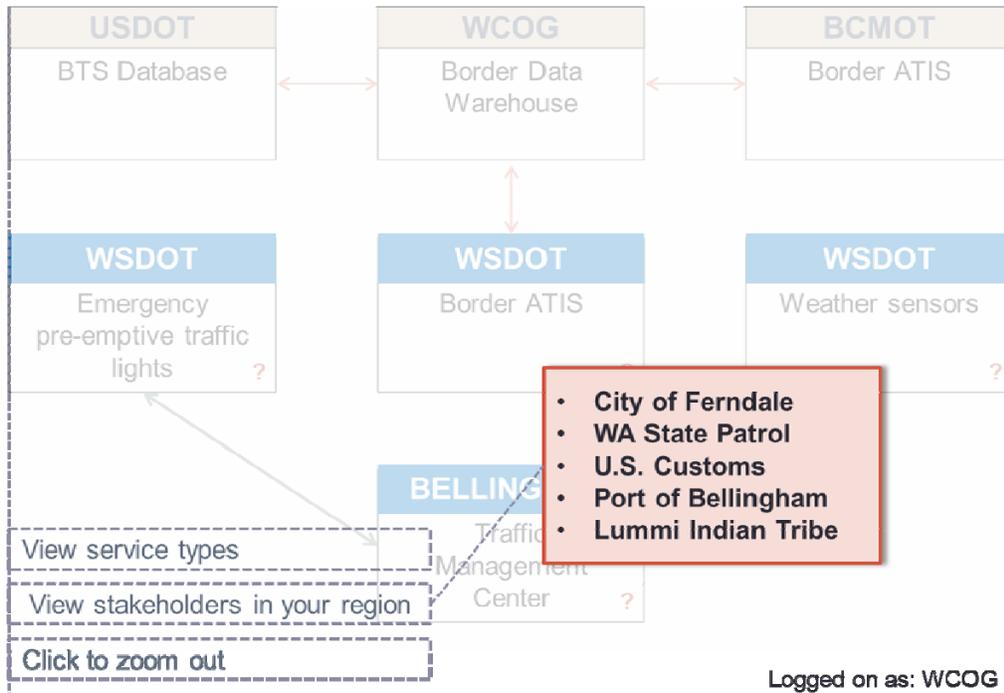
Logged on as: WCOG

Once a project or system is entered, an online form would allow the user to populate the database with the additional information required.

Project Name	Border Data Warehouse
Managing Agency	Whatcom Council of Governments
Contact Information	Melissa Miller, Project Coordinator, (360) 676-6974, Melissa@wcog.org
Description	The Border Data Warehouse is a data archive of cross-border information for the Cascade Gateway system of crossings between Whatcom County, WA and the Lower Mainland of British Columbia
Standards (if applicable)	Project-specific XML Schema (see attached documentation)
Market Packages	AD2, AD3, ATIS01, ATIS02, ATIS06, ATMS01, ATMS02
Attached Documentation?	XML schema (pdf); project report (pdf)

Architecture presented in a new way

There could be pop-up lists of the valuable components of the current architecture structure, such as the list of stakeholders for the region, or market package numbers, or the ability to zoom in and out of the region.



Part of a bigger system

By zooming out a user could also view project within a larger region. The idea is to dynamically update the state architecture with the regional architectures, so there isn't a disconnect between them. This could also span the border for border regions.

