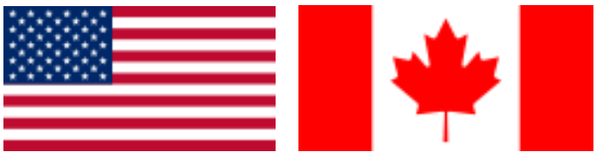
2008 NSDI CAP Interim Report

Category 4: Joint Canadian and United States Spatial Data Infrastructure Project



Cross-Border Content and Services for Critical Infrastructure Identification

http://crossbordersdi.projectspaces.com

Submitted By:

The Carbon Project

25 Mall Road, Suite 300, Burlington, Massachusetts, United States 01803

info@TheCarbonProject.com, www.TheCarbonProject.com

In Partnership With:

CubeWerx

15 Rue Gamelin, Suite 506, Gatineau, Quebec, Canada, J8Y 6N5

cwinfo@Cubewerx.com, www.Cubewerx.com

1. Cross-Border SDI Project Summary

The Carbon Project® is pleased to submit this 2008 NSDI Cooperative Agreement Program (CAP) Category 4 Interim Report for the joint Spatial Data Infrastructure (SDI) project between the United States and Canada. Since project kickoff in July 2008 the Cross-Border SDI Project has made significant progress deploying new online data, services and applications to support critical infrastructure (CI) identification using a common SDI for Canada and the US. In particular, the project has developed and deployed two secure mapping services based on OGC Web Feature Service (WFS), Filter and GML standards and CubeWerx software. The new mapping services will be located in Montana and Quebec and constitute the initial nodes for a Cross-Border SDI Network. Each WFS also implements role-based access control - meaning there is a security framework that ensures CI information goes to the people that are supposed to have it. The project has also made substantial progress integrating critical infrastructure data models used by Montana with the National Infrastructure Data Models (NIDM) from Canada and the DHS Geospatial Data Model - the result of this effort is an integrated "Common" data model and new GML community schema for cross-border infrastructure data exchange. The project has also pioneered the implementation of dynamic, local-to-community GML schema transformation – meaning each WFS speaks both its national schema and a agreed-upon community schema. As of January 2009, cross-border SDI users are now able to access the two data services using the free Gaia application from The Carbon Project and a web-based application from CubeWerx. A third application CarbonArc PRO, an SDI interoperability extension for ESRI's ArcGIS from The Carbon Project is in the final stages of development. The project has been successfully briefed in multiple community venues including CANUS and the FGDC Homeland Security Working Group (HSWG). During the next reporting period, the project will complete deployment of the Cross-Border SDI Network nodes in Montana and Quebec and conduct a comprehensive demonstration program to educate potential stakeholders and users.

The Cross-Border SDI Project is summarized in this free PowerPoint presentation, available online at –

http://www.thecarbonproject.com/presentations/FGDCHSWGCrossBorderSDIProjectOverview_Jan2009v3.ppt

1.1. Canadian and U.S. Lead Organizations

U.S. Lead Organization - The Carbon Project

Key Project Contact: Jeff Harrison, President and CEO

Phone: 703.491.9543, Email: jharrison@thecarbonproject.com

Internet Address: http://www.thecarbonproject.com

Canadian Lead Organization - Cubewerx, Inc.

Key Project Contact: Edric Keighan, President and CEO

Phone: 819.771.8303, Email: ekeighan@cubewerx.com

Internet Address: http://www.cubewerx.com

Other Project Contacts (Collaborating Organizations):

Daniel M. Cotter, Chief Technology Officer

United States Department of Homeland Security (DHS), Geospatial Management Office

Phone: 202.447.3750, Email: Daniel.Cotter@dhs.gov

Internet Address: http://www.dhs.gov

Michael Fashoway, Critical Structures Database Administrator

Montana Department of Administration, Information Technology Services Division

Phone: 406.444.2793, Email: mfashoway@mt.gov

Internet Address: http://giscoordination.mt.gov/critical_infra/msdi.asp

Denis De Gagné, Director, CTIS

Centre for Topographic Information in Sherbrooke (CTIS), Natural Resources Canada

Phone: (819) 564-5600, Email: NTDB@NRCan.gc.ca

Internet Address: http://www.cits.rncan.gc.ca/cit/servlet/CIT/site_id=01&page_id=1-004.html

Maj. Don Christie, Cross Border Project Coordinator

Canada Department of National Defense (DND), Directorate of Geospatial Intelligence

Ed Freeborn, Senior Analyst

L-3 Government Services in Rome, New York

1.2. Geographic Scope or Area

All Cross-Border Regions between Canada and the United States can eventually benefit from this project. In the current effort, the State of Montana and Provinces in Canada directly across the border are positively impacted.

1.3. Project Background

At 5000 miles, the United States and Canada share the world's longest common border and identifying critical infrastructures (CI) is a vital function for organizations in the cross-border region. However, right now organizations must 'cobble' together information sources like paper maps, spreadsheets, data files and others to accomplish the task. This process is not efficient and would be facilitated by online services, software applications and a common spatial data infrastructure (SDI) for Canada and the US.

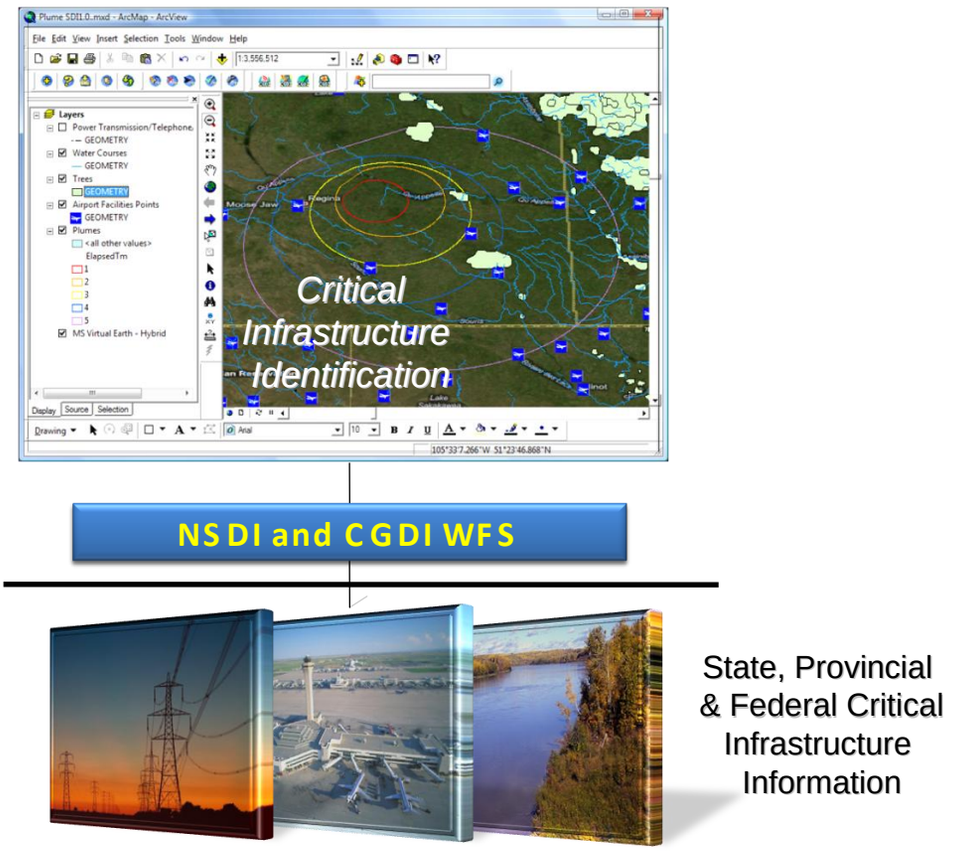


Figure 1 - This project has deployed new online data, services and end-user applications to support Critical Infrastructure Identification using a common Spatial Data Infrastructure for Canada and the US

To help address these challenges a collaborative group is conducting the "*Cross-Border Content and Services for Critical Infrastructure Identification"* project to deploy new online data, services and analytical applications to support critical infrastructure identification using a common spatial data infrastructure (SDI) for Canada and the US. In this project, Critical Structures Databases and Framework Data are deployed as standards-based Web Feature Services (WFS) at state and provincial levels on both sides of the US-Canada border. These resources will be connected to existing US National Spatial Data Infrastructure (NSDI) and Canadian Geospatial Data Infrastructure (CGDI) WFS resources from federal and provincial partners.

This project brings together a collaborative group committed to joint US-Canadian SDI including the:

- *Montana Department of Administration, Information Technology Services Division*
- *United States Department of Homeland Security, Geospatial Management Office*
- *Centre for Topographic Information, Natural Resources Canada*
- *Cross Border Project Coordinator, Canada Department of National Defense*
- *Industry partners CubeWerx and The Carbon Project*

The project will provide significant benefit to the provincial, state and local emergency services, homeland security, and public safety communities on both sides of the US-Canada border. Specifically, the project will result in sustainable online, real-time capability that is widely used for critical infrastructure identification.

Under this effort, the project team has deployed distributed data, services and applications based on Open Geospatial Consortium Web Feature Services (WFS), Filter Encoding (FE) and Geography Markup Language (GML) standards, the NIDM, the DHS Geospatial Data Model (GDM), and the latest NSDI and Canadian Geospatial Data Infrastructure Framework Data standards to support critical infrastructure identification. The new services are located in Montana and Quebec. Cross-border users will access the data and services and identify critical infrastructure using CarbonArc PRO, a standards-based extension to ArcGIS desktop software. A new version of the free Gaia NSDI viewer and a new web-based viewer has also been provided to increase community use of the services and support end-users that do not have GIS software.

2. Project Milestones

The "*Cross-Border Content and Services for Critical Infrastructure Identification"* project is being conducted as a series of tasks using an integrated activities framework, which is an evolution of project management processes developed over the course of numerous SDI engineering efforts. The activities framework outlines tasks that can be combined and adapted as necessary to address the requirements of SDI engineering projects, and are executed in a cross-organizational team infrastructure. This framework forms the basis of the Project Work Plan established and consists of three high-level tasks: Development and Integration, Community Outreach, and Project Coordination.

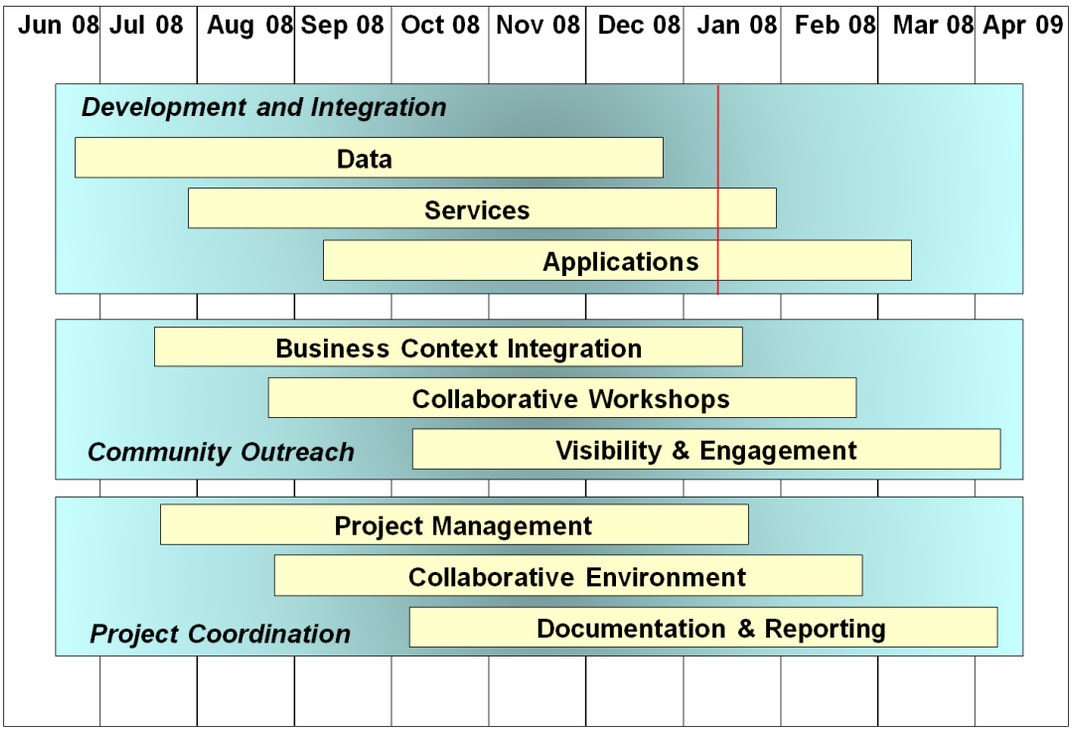


Figure 2 -The project framework for this effort is designed to successfully complete SDI engineering efforts

2.1. Operational Use Cases

As part of this project we interviewed representatives from Montana and Canadian stakeholders prior to project initiation, at the project kickoff and weekly throughout the project. During these discussions it was confirmed by participants that the capability required to efficiently identify critical infrastructures (CI) is not only vital for organizations involved in cross-border regions but leads to the use of an SDI that supports interoperable online services and software applications operating from a common SDI framework between Canada and the US. We also confirmed that the process for accomplishing these tasks with online services, software applications and a common SDI was very similar to previous activities undertaken by GeoConnections for establishing a distributed SDI between the federal government and the provinces in Canada under the CGDI Interoperability Pilot. For this project, a Public-safety Use Case for data download and analysis was used as a key scenario representative of data infrastructure requirements.

For reference, as brief description of the CGDI Pilot “Public-safety Use Case”is as follows - a client application and server used a simulated release plume polygon in GML to construct new critical infrastructure features such as impacted airports and powerlines. This involved intersecting release plume polygons with the impacted areas. To do this the client application used the capabilities of the distributed CGDI architecture and WFS technology. Specifically, the client application used the Filter Encoding specification and WFS-T services.

Our project process reviewed the following use case in collaboration with end user organizations and confirmed its validity -

Use Case - Emergency scenario for critical infrastructure identification and data download

COP application for analysis using vector data from Cross-Border SDI

Users

A disaster and emergency services community of practice (COP)

Summary

A Community of Practice decision support application accesses data via WFS and performs some analysis on the resulting vector data.

The scenario is a fire emergency that requires the evacuation of communities in its path over time. The requirement is to identify critical infrastructures that may be impacted.

Preconditions

Operators trained in the use of the application.

Triggers

A fire beginning in Montana, near a wildland/urban interface zone on the US-Canada border.

Basic course of events

1. County Emergency Operations Center receives notification of the event
2. Operator accesses the application and navigates an interactive map to the geographic area for the event, in a wildland/urban interface zone.
3. Operator generates a filter for fire stations and in police stations the geographic area for the event.
4. Operator loads the filter into the mapping application
5. Operator performs an intersection of the area for the event with fire stations and police stations and generates a list of GML features using the analytic capabilities of the SDI and displays these features on the map.
6. Operator performs an intersection of the area for the event with schools and state-owned or leased facilities, generates a list of GML features using the analytic capabilities of the SDI, displays these features on the map and styles those features differently in the mapping application. (affected facilities filter)
7. Operator adds a new feature for evolving fire incidents and adds this feature to the SDI service and commits this feature using a transaction. (fire incident)
8. Operator saves the state of the map and sends an email with the filter in it to a distribution list. The filter consists of just five lines and is easily transmitted to all parties.
9. Operator at another location just across the border in Canada accesses the SDI services in the US and Canada using another application and sees newly added fire features. The operator downloads his email and launches the affected facilities filter and overlays them on another base map
10. Operator in a federal facility accesses the SDI services in the US and Canada using another application and sees newly added fire features and other aspects of the evolving situation. The operator is able to access and download data from online NSDI services at state, provincial and federal levels.
11. Cross-border operations continue as the fire continues to move.

An initial planned user group for this project was predicted to include disaster and emergency services coordinators at the "county" level. However, this user group is just the first of many that will benefit from the proposed project. As a result of this flexible project execution approach a second operational Use Case was added in November 2008. This Use Case was entitled the *Pipeline Planning - 2010 Scenario*.

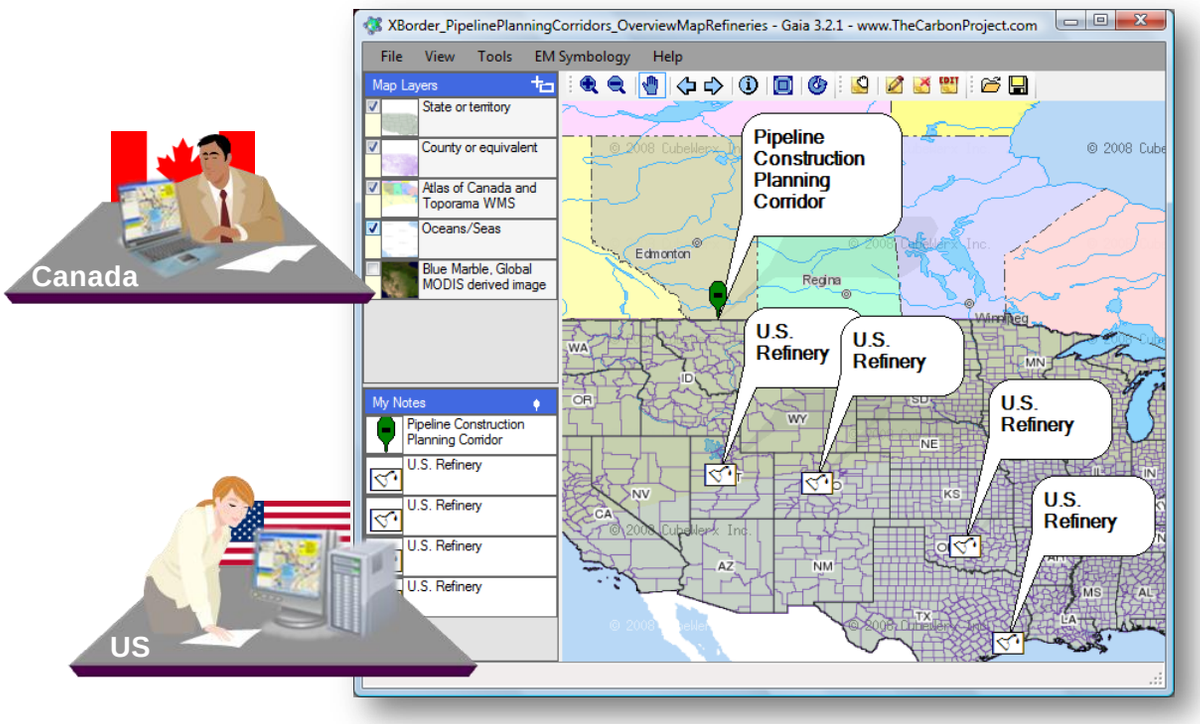


Figure 3 – The Pipeline Planning - 2010 Scenario was added to the Cross-Border SDI Project in November 2008

In this scenario an International Planning Commission is reviewing plans for new oil pipeline. The pipeline will carry crude oil from western Canada provinces to refineries in US. The Planning Corridor for the pipeline crosses Montana/Saskatchewan border, and the Commission tasked with reviewing infrastructure in Planning Corridor & rapidly developing a report on critical infrastructure in the area. The scenario was successfully demonstrated on Dec 23, 2008 and presented to the FGDC HSWG in January 2009 (Figure 4).

NOTE - This scenario is not meant to correlate to any real or planned efforts. Rather, it is designed to highlight the benefits of the cross-border Spatial Data Infrastructure (SDI) technology for planning purposes.

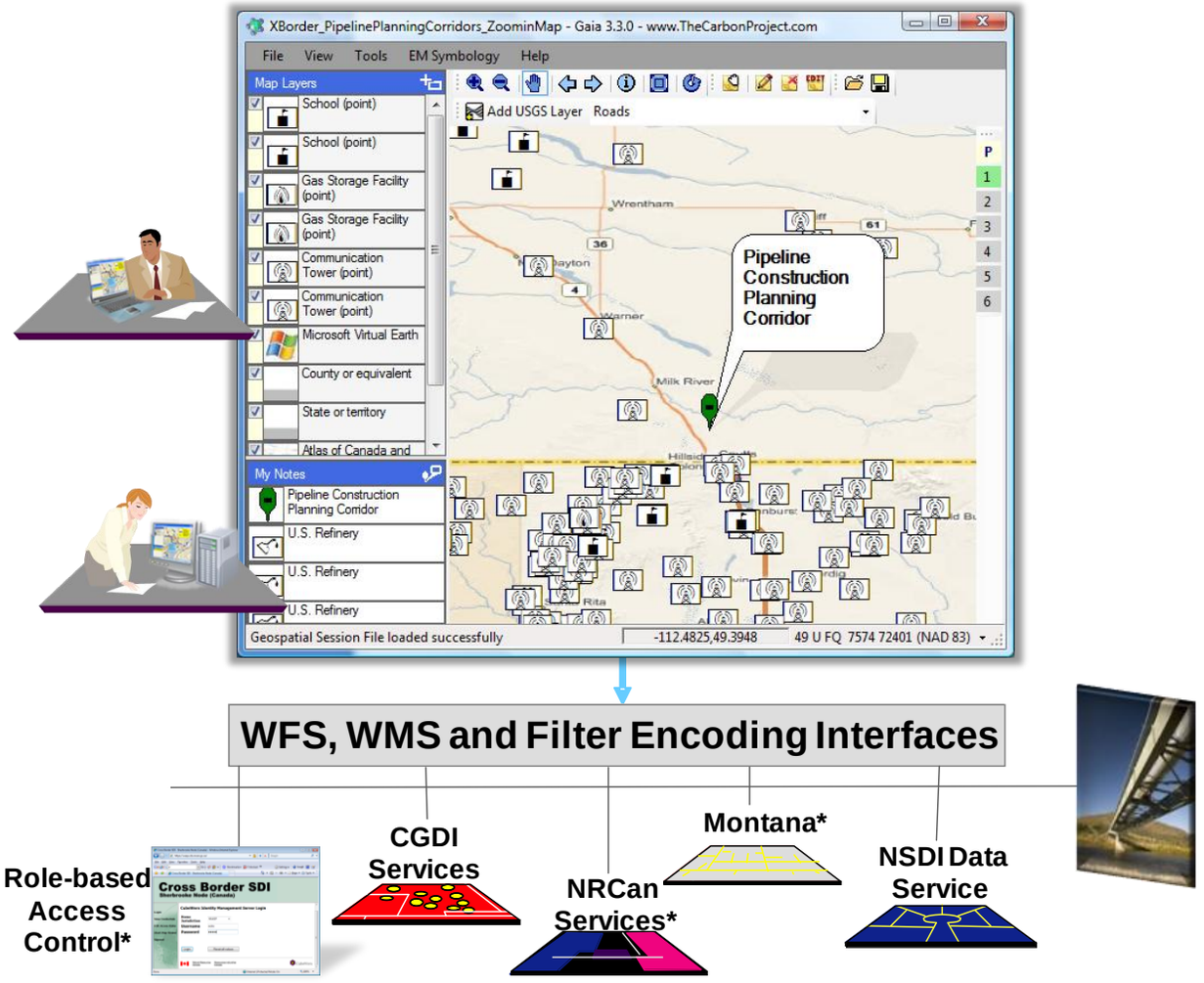


Figure 4 – The Pipeline Planning 2010 Scenario was successfully demonstrated in December 2008 and highlighted the benefits of a Cross-Border SDI

3. Kick-off Meeting

A kickoff meeting for the project was held on July 3 at USGS in Reston, VA, USA. The agenda was:

- **Arrival** **0830-0930**
- **Welcome & Participant Introductions** **0930-0945**
- **Application 'Use Case' Review** **0945-1000**
- **Data, Services & End-User Application Discussion** **1000-1045**
- **Break** **1045-1100**

- **Security Discussion** **1100-1120**
- **Engaging Cross-Border Participants (IBETs etc.)** **1120-1140**
- **Data Model Cross-Walk Process** **1140-1200**
- **Lunch** **1200-1300**
- **CISDM, NIDM, GDM Overviews** **1300-1400**
- **Data Development Working Session** **1400-1500**
- **"DC Rush Hour" Early Departures** **1500**
- **Social at the Lakeside Restaurant** **1600-1800**

The kickoff briefing is available online for project participants at –

http://crossbordersdi.projectspaces.com/documents/index.php?action=detail&id=109&project_id=6

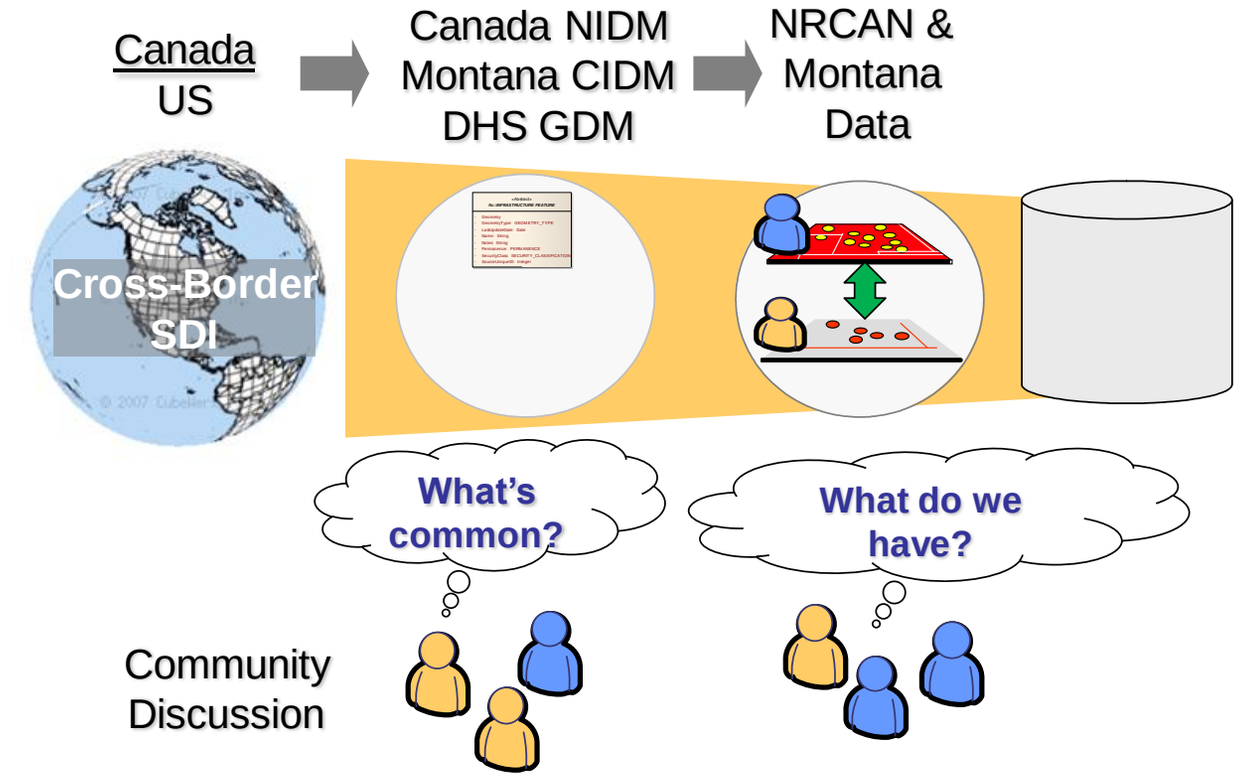
4. Development Summary

During the reporting period the project team made significant progress of Data, Services and Application Development and Integration, as well as Community Outreach. The following sections summarize significant accomplishments and provide details on the development of the data model adopted by participants.

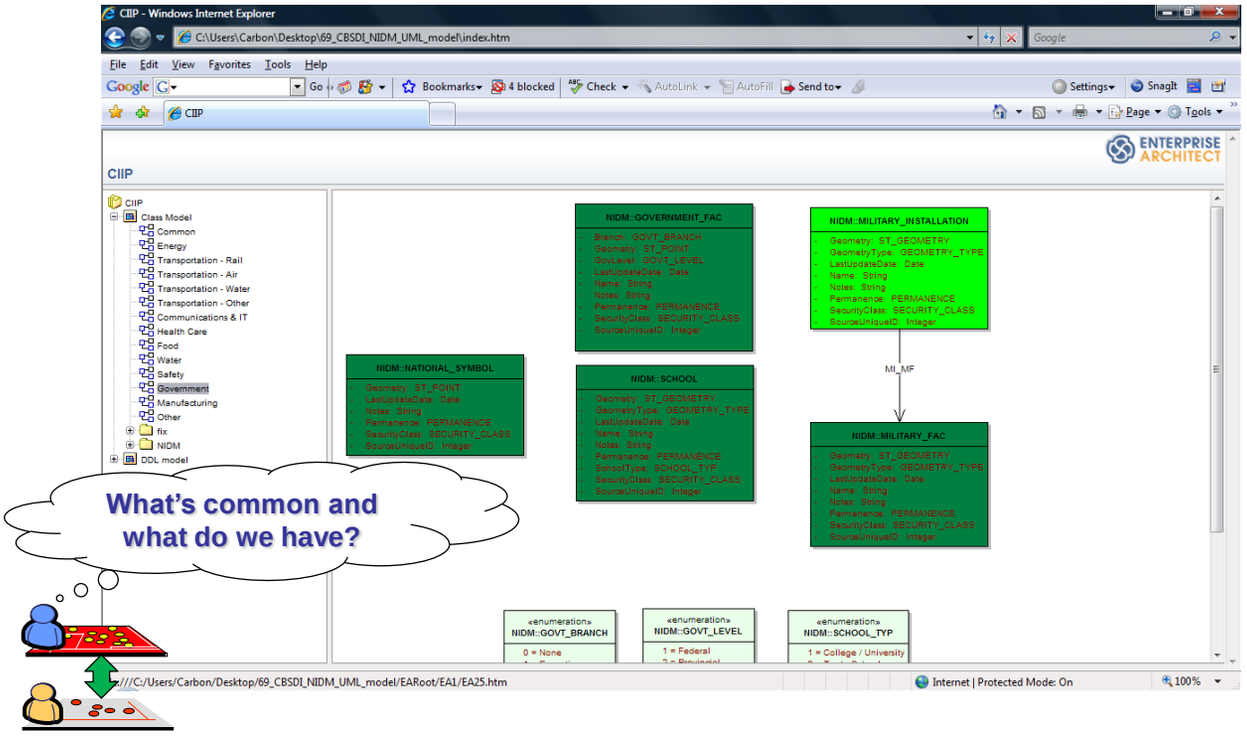
4.1. Data Development and Integration

During the reporting period the project team integrated CI data models used by the State of Montana with the National Infrastructure Data Models (NIDM) recently developed in Canada and the DHS Geospatial Data Model. Project participants brought together expertise in emergency management and practical knowledge of SDI implementations and deployments to undertake this challenge and adopt a common model for disseminating and accessing infrastructure information between the State of Montana and Canada provinces. While much work will still be left at the end of this project in the area of data modeling the team will be able to clearly demonstrate the benefits derived from the implementation and reach out to other CI communities.

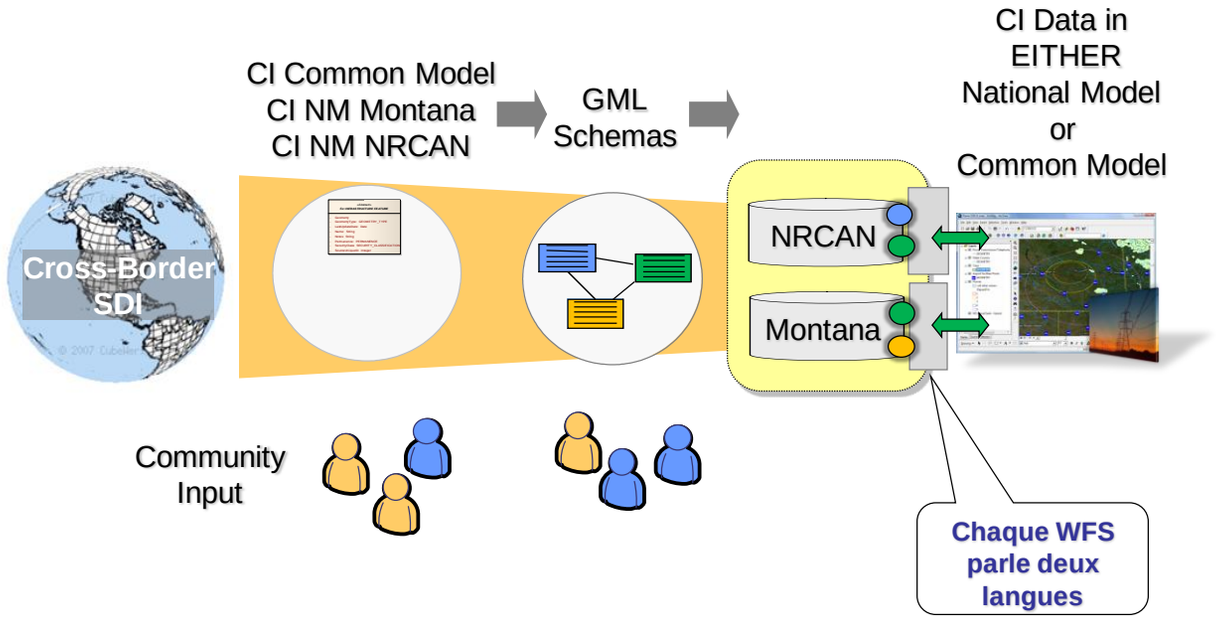
The starting point for data modeling efforts during this reporting period is summarized below:



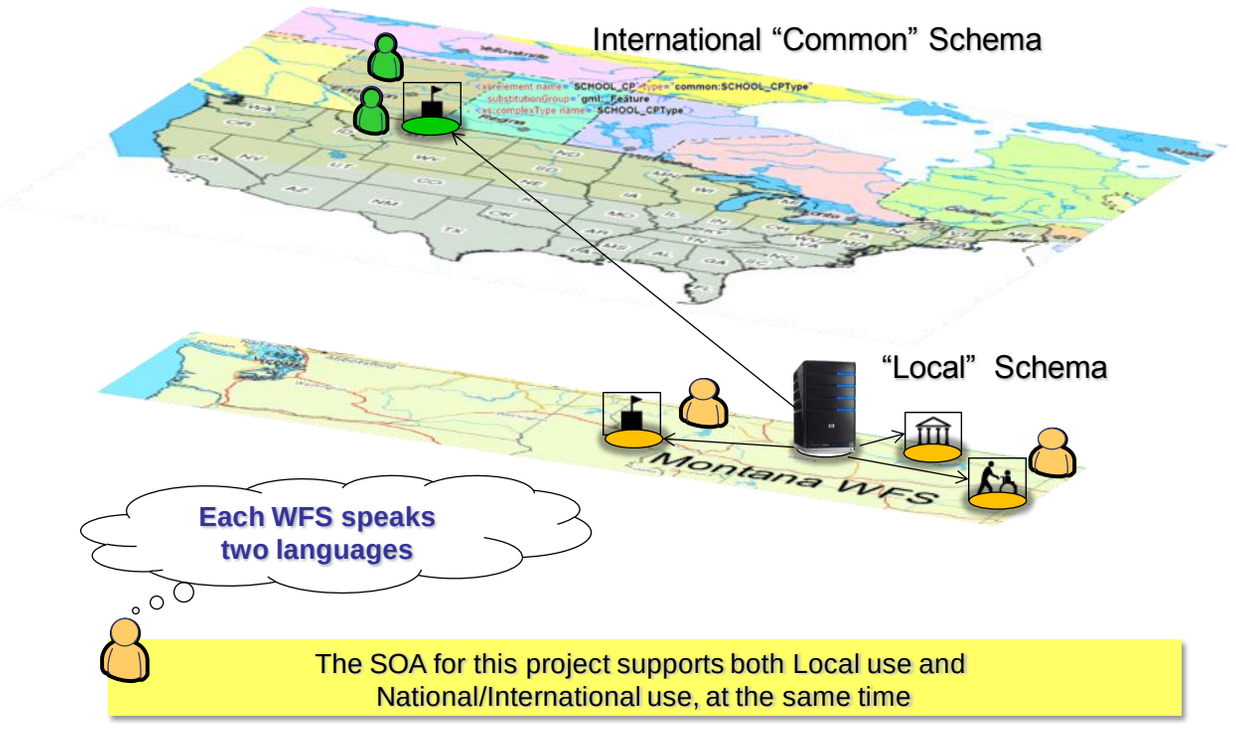
The crosswalk process data modeling efforts during this reporting period are summarized below:



The ending point for data modeling efforts during this reporting period are summarized below:



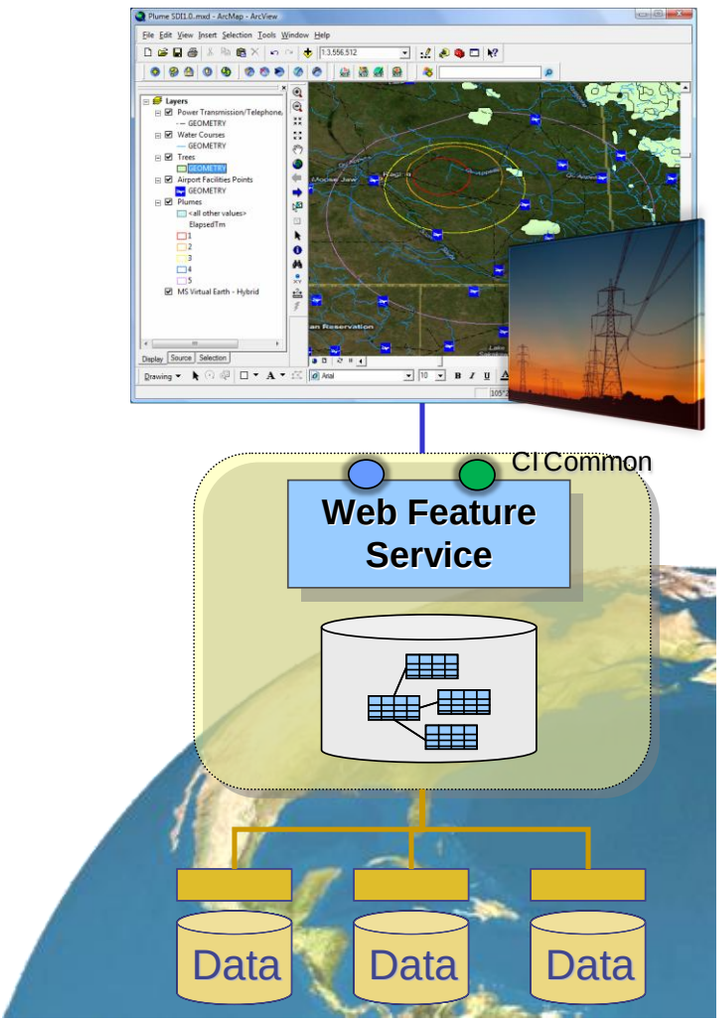
A key aspect of this process is that it the data modeling on what actually available, representing a departure from traditional data modeling approaches. The end result of the modeling process was a draft GML Schema that supports both local and cross-border SDI use, at the same time. This process is summarized below:



4.2. Services Development, Integration, Deployment

A key focus of this reporting period is to deploying an operational capability to use Web map and Web feature server software CI identification. This capability is based on Open Geospatial Consortium Web Feature Services (WFS), Filter Encoding (FE) and Geography Markup Language (GML) standards. As discussed previously, these services provide a common query interface over distributed data sources.

To enable this important part of the project, a substantial portion of the project resources has been directed to establishing distributed WFS at the beginning of the project in coordination with state and provincial collaborators (data providers) in Montana and NRCan in Sherbrooke, Quebec. The implementation schedule for this WMS and WFS deployment is in synchronization with the implementation plan to be ready for an operational delivery. Specific WMS and WFS deployed are summarized in Table 1. These resources will be connected to existing US National Spatial Data Infrastructure (NSDI) and Canadian Geospatial Data Infrastructure (CGDI) WFS resources from federal and provincial partners.



To deploy Framework Data and Critical Infrastructure data in Quebec and Montana are using the CubeSERV® Web Map and Feature Server from CubeWerx®. CubeWerx is the editor of the OGC WFS and Filter Encoding specifications and has transferred knowledge of the latest specifications into the CubeSERV® Web Map and Feature Server; a scalable, interoperable platform for serving geospatial maps and features on the Internet. CubeSERV fully supports all operations of the Web Feature Server, Filter Encoding and Web Map Server specifications, and implements application profiles of GML that enable deployment of truly interoperable Web Feature Service implementations.

The Cross-Border SDI WFS are based on a secure, massively scalable online spatial data warehouse. Web Feature Service technology is used for Web-based access – with HTTP as distributed computing platform. Each CubeSERV® Web Map and Feature integrates the CI

Common and National Schemas, Secure SDI and Transaction-based updates. In addition, the WFSD have the capacity to dynamically translate from one community schema to another – local to national.

Table 1: CGDI/NSDI Data Services being Deployed and Status

Data custodian/service provider	Use in application	Dataset name	Type of infrastructure compliant Web service and Status
Montana Department of Administration, Information Technology Services Division	*Data visualization*	*Critical Structures Database (Common and Local Models)*	*WMS*
Montana Department of Administration, Information Technology Services Division	*Data access and analysis*	*Critical Structures Database (Common and Local Models)*	*WFS*
Centre for Topographic Information, Natural Resources Canada	*Data visualization*	*Framework Data Land Features and CI Layers (Common and Local Models)*	*WMS*
Centre for Topographic Information, Natural Resources Canada	*Data access and analysis*	*Framework Data Land Features and CI Layers(Common and Local Models)*	*WFS*

As part of this effort, the project team has implemeented a full distributed security, role-based access control concepts based on CubeWerx® Identity Management Server. Specific Roles and Access Control Rules will be summarized in the final report.

4.3. Application Development and Integration

This project is unique since it deploys both online content and services and a suite of analytical tools to use them – Gaia, CarbonArc PRO and the CubeWerx Web Viewer.

The primary demonstration tool since the beginning of the project has been The Carbon Project's Gaia geospatial viewer (Figures 4 and 5). For this effort a new version of Gaia, Gaia 3.3, has been deployed using Gaia Extenders API. Gaia provides a robust and open API that allows programmers to develop Gaia Extenders with or without a CarbonTools PRO license. The Gaia Extenders are light, easy to deploy and can alter Gaia's functionality. For this project, the Secure SDI, Emergency Mapping Symbology, US National Grid have been integrated. In particular, the Secure SDI Extender was iteratively tested and enhanced to provide easy access to the secure WFS of the Cross—Border SDI Network.

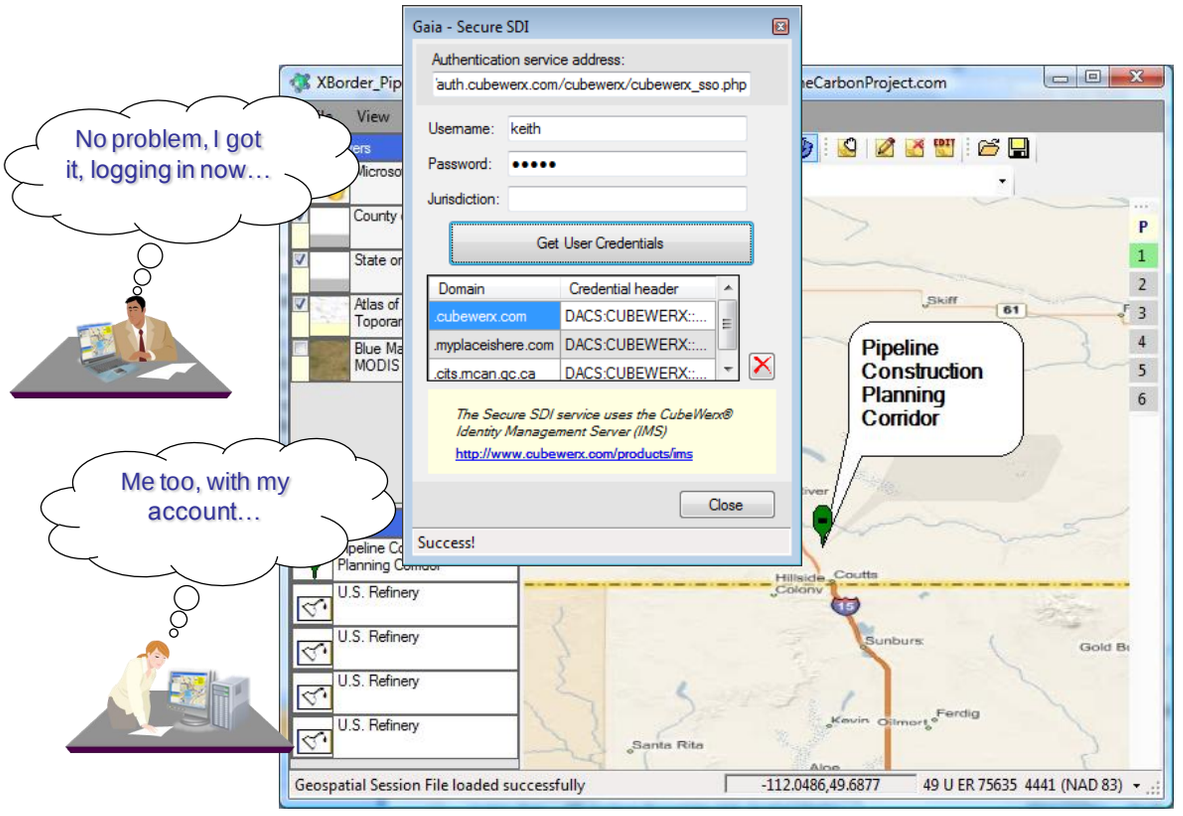
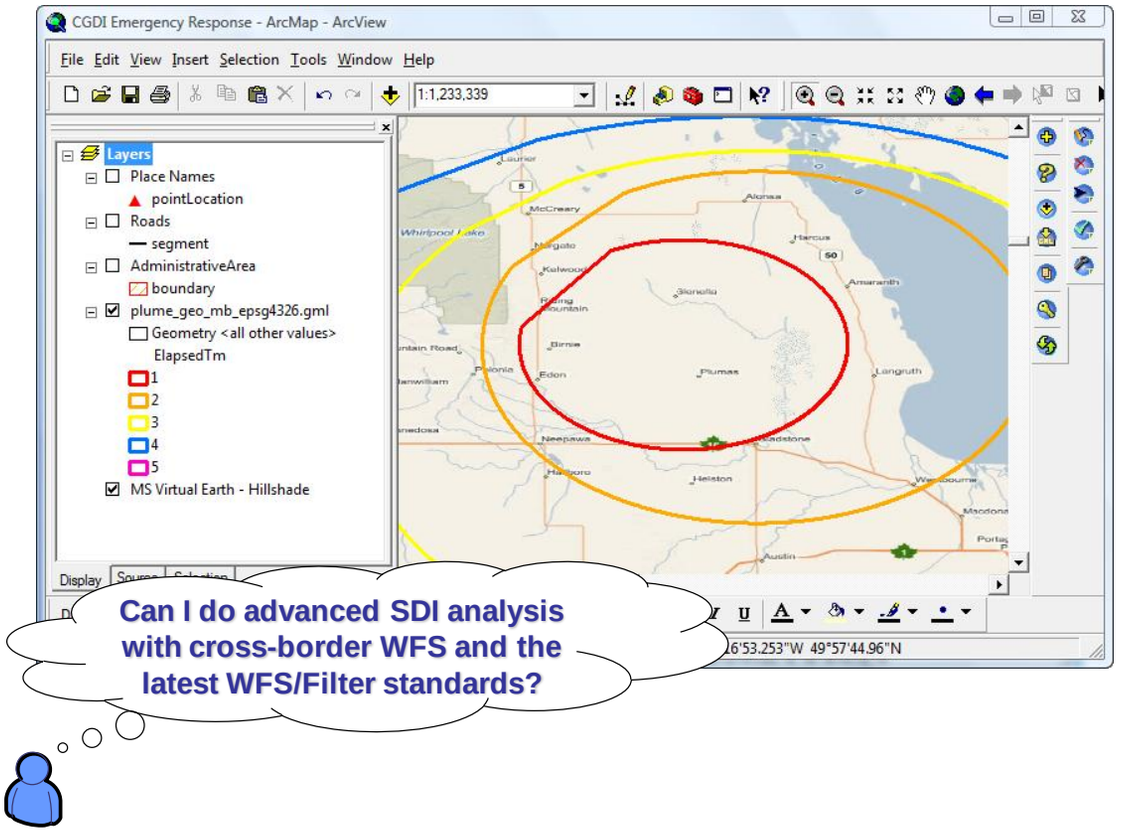
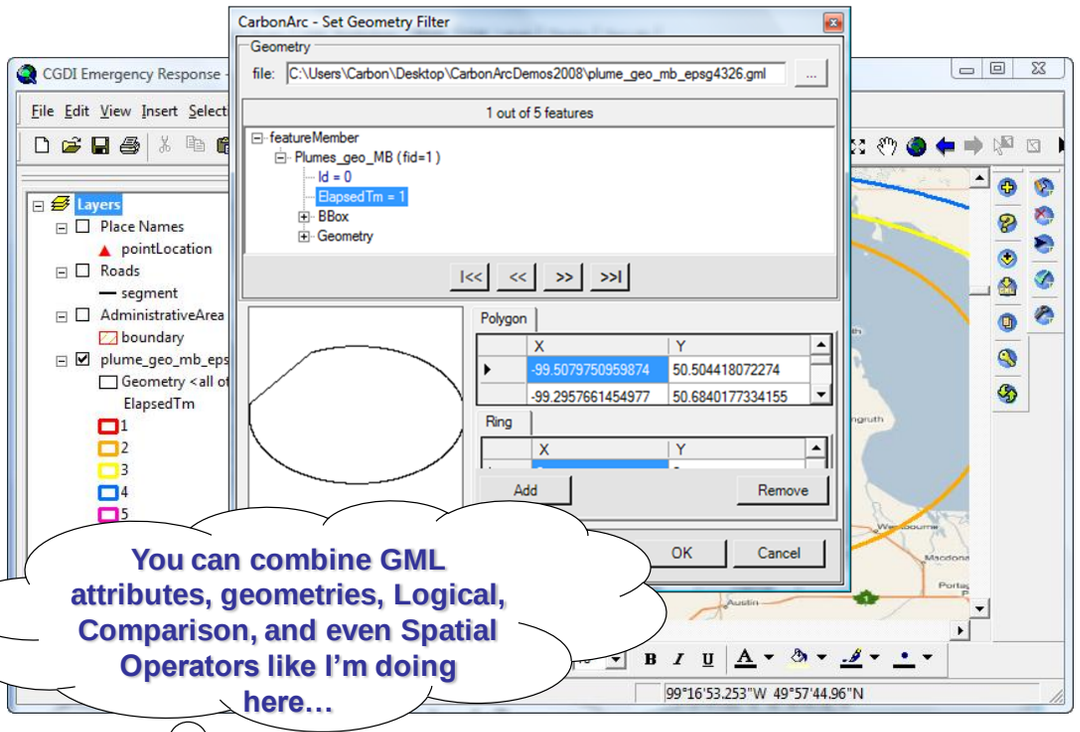


Figure 5 - The Cross-Border SDI Project has implemented a full Role-based Access Control Framework, shown about in use through the Secure SDI Extender in Gaia 3.3

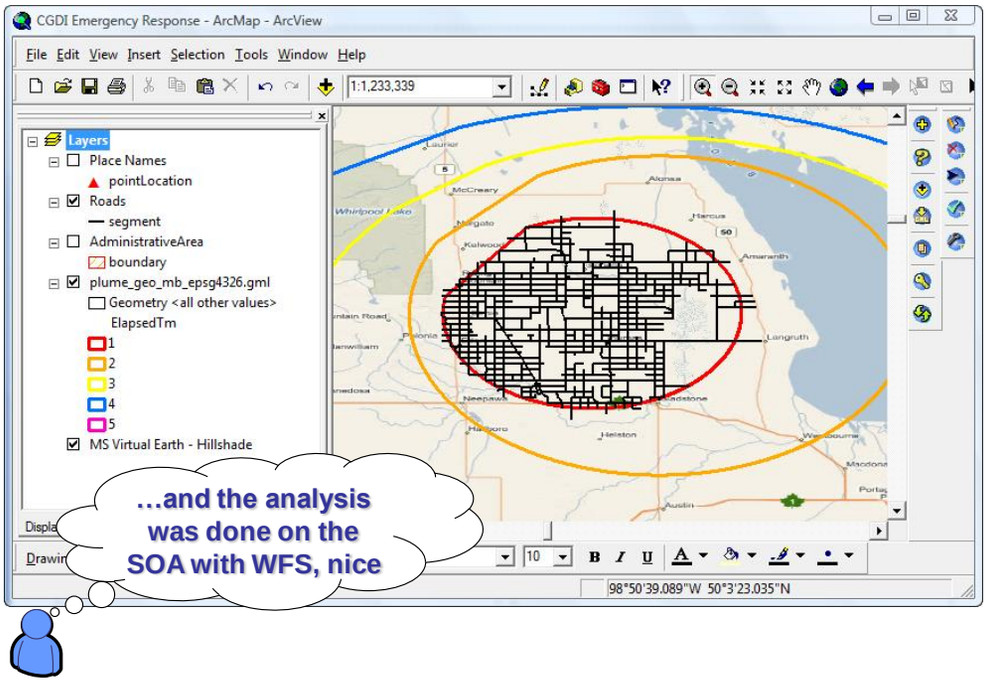
To enable ArcGIS to support critical infrastructure identification via a common, cross-border SDI project will leverage CarbonArc PRO 1.6 Filter Builder tools. Originally, developed as part of the CGDI Interoperability Pilot, this extension supports a Use Case where infrastructure needed to be identified – using the SDI to conduct the analysis. For the CGDI CarbonArc used a simulated release plume polygon in GML to construct new features such as impacted airports and powerlines. This involved intersecting release plume polygons with the impacted areas. To do this CarbonArc used the capabilities of the distributed CGDI architecture and WFS technology. Specifically, CarbonArc used the Filter Encoding specification and WFS-T services – and this same approach is supporting critical infrastructure identification via a common, cross-border SDI. To leverage the common SDI, users access the tools in CarbonArc to create or use an existing feature such as a release plume polygon (or any feature), construct a Filter Encoding request using Spatial Operators (in this case it was the Spatial Operator “Intersect”), then send it to a WFS-T in the SDI and acquire new features such as critical infrastructure from the WFS. All this was demonstrated during the CGDI Pilot using the CubeWerx WFS – and was one of the most popular elements of the project. The Use Case is illustrated below:



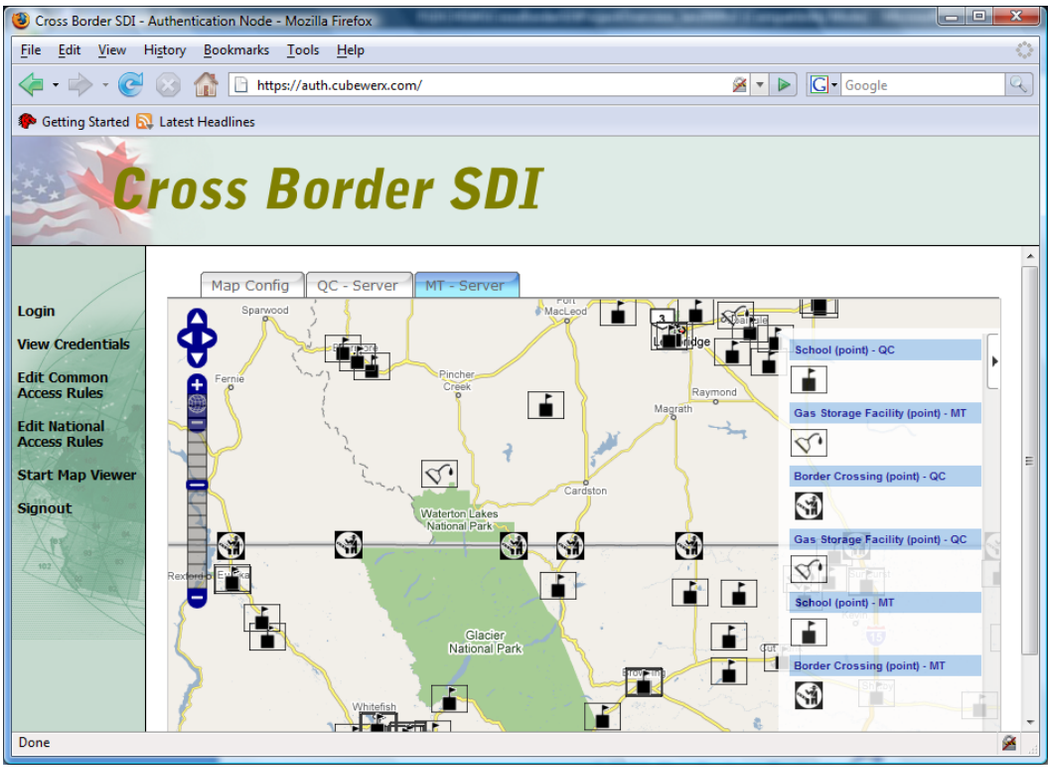
Can I do advanced SDI analysis with cross-border WFS and the latest WFS/Filter standards?



You can combine GML attributes, geometries, Logical, Comparison, and even Spatial Operators like I'm doing here…



CarbonArc PRO 1.6 also includes a suite of SDI tools, including Filter Builder tools, WFS Transaction tools to edit and update information, Secure SDI and Catalog search tools to identify data and services in the SDI - all directly from the ESRI desktop. In addition, CubeWerx has developed a web-based application to access the Cross-Border SDI Network (below).



5. Community Outreach Summary

This project has already delivered distributed data, services and applications that can be widely used for CI identification. All online data, services and interoperable applications are available in non-proprietary formats, including WMS, WFS and GML. The project team has successfully avoided practices that would inhibit the use of the distributed data and deliver short term gains. This project has focused on interoperable SDI solutions and created a CI environment that will entice additional participation from CI community of practices.

As part of this project, we have engaged in a consistent community outreach program that has reached users in both the US and Canada. A significant component of this community engagement has been our efficient use of weekly online meetings and a collaborative project workspace. The Cross-Border SDI Project includes a simple, secure and powerful online workspace provided by The Carbon Project to help us connect, share and collaborate. The project space is available at http://crossbordersdi.projectspaces.com. In addition, we announced the project to both Canadian and US online audiences. See http://www.thecarbonproject.com/news_canadaCBI.php and http://www.cubewerx.com/web/guest/docs/press/13613.

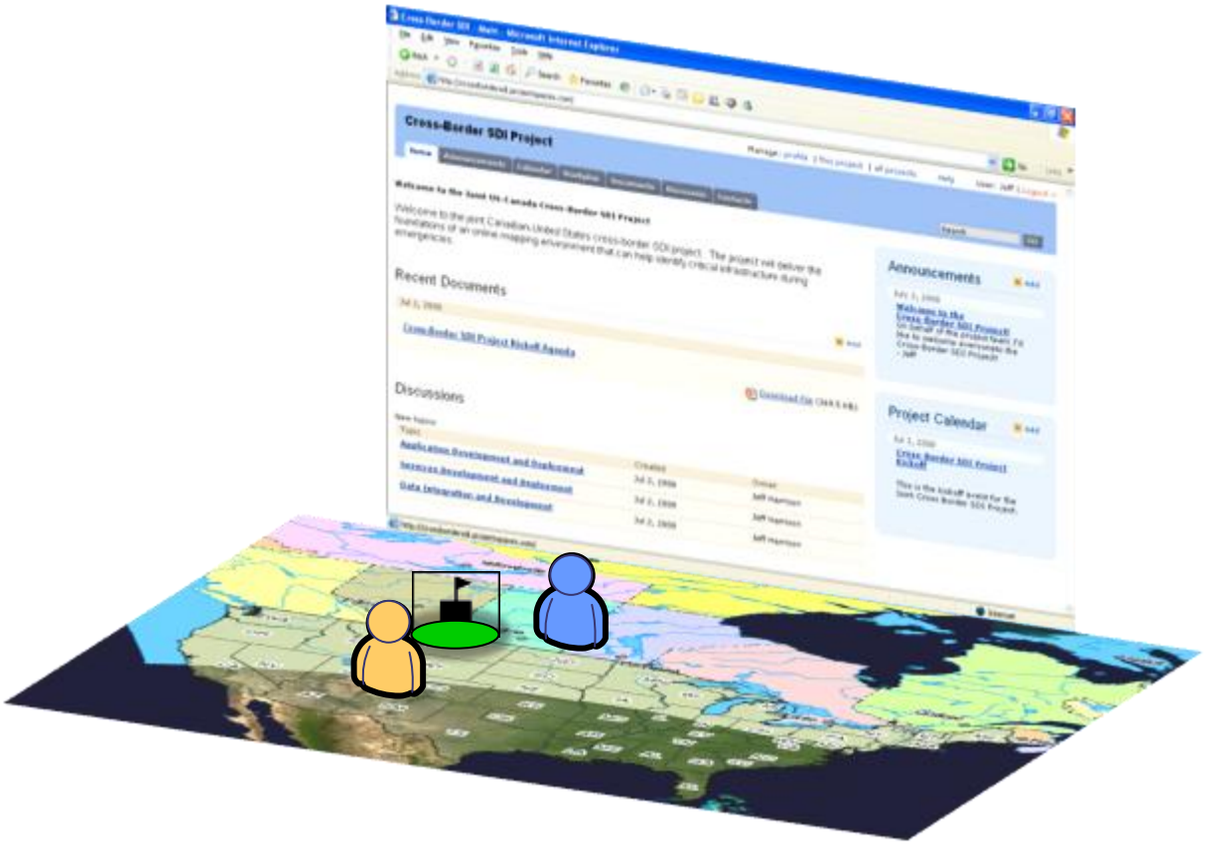


Figure 6 - A significant component of our community engagement has been the efficient use of weekly online meetings and a collaborative project workspace.

During all Community Outreach activities the project team has invited the participation of organizations having similar interests over the project area.

During the reporting period we have successfully briefed the Cross-Border SDI project to the CANUS Military Geospatial Intelligence & Imagery Working Group at NGA in Reston and the FGDC Homeland Security Working Group. The project was also featured during a major Secure SDI demonstration at GEOINT 2008 (see left). In the next reporting period, we plan to showcase the results of this project at a number of key upcoming events, including the HIFLD meeting on January 29, 2009.

6. Summary

Since project kickoff in July 2008 the Cross-Border SDI Project has made significant progress deploying new online data, services and applications to support critical infrastructure (CI) identification using a common SDI for Canada and the US. In particular, the project has developed and deployed two secure mapping services based on OGC Web Feature Service (WFS), Filter and GML standards and CubeWerx software. The new mapping services will be located in Montana and Quebec and constitute the initial nodes for a Cross-Border SDI Network. Each WFS also implements role-based access control - meaning there is a security framework that ensures CI information goes to the people that are supposed to have it. The project has also made substantial progress integrating critical infrastructure data models used by Montana with the National Infrastructure Data Models (NIDM) from Canada and the DHS Geospatial Data Model - the result of this effort is an integrated "Common" data model and new GML community schema for cross-border infrastructure data exchange. The project has also pioneered the implementation of dynamic, local-to-community GML schema transformation – meaning each WFS speaks both its national schema and a agreed-upon community schema. As of January 2009, cross-border SDI users are now able to access the two data services using the free Gaia application from The Carbon Project and a web-based application from CubeWerx. A third application CarbonArc PRO, an SDI interoperability extension for ESRI's ArcGIS from The Carbon Project is in the final stages of development. The project has been successfully briefed in multiple community venues including CANUS and the FGDC Homeland Security Working Group (HSWG). During the next reporting period, the project will complete deployment of the Cross-Border SDI Network nodes in Montana and Quebec and conduct a comprehensive demonstration program to educate potential stakeholders and users.