ENTERPRISE Transportation Pooled Fund Study TPF-5 (231)

ENTERPRISE

ITS at International Borders

PROJECT SUMMARY REPORT

Prepared by

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Acknowledgements

This document was prepared for the ENTERPRISE Transportation Pooled Fund TPF-5(231) program (enterprise.prog.org/). The main purpose of ENTERPRISE is to use the pooled resources of its members and the United States federal government from North America to develop, evaluate, and deploy Intelligent Transportation Systems (ITS).

The photo on the cover page of this report is a screenshot of a Washington Department of Transportation (DOT) camera image approaching the border crossing from the Canadian Border Traffic Website. *(Source: http://www.wsdot.com/traffic/border/default.aspx, retrieved 9/20/16)*

Project Champions

Roy Hulli, Ontario Ministry of Transportation, and Bill Legg, Washington State Department of Transportation, were the ENTERPRISE Project Champions for this effort. The Project Champions serve as the overall leads for the project.

Project Team

Project team members that provided input to the project included:

- Roy Hulli, Ontario Ministry of Transportation
- Bill Legg, Washington State Department of Transportation
- Michele Mueller, Michigan Department of Transportation
- Charles Koonce, Texas Department of Transportation
- Alesia Gamboa, Texas Department of Transportation
- Marco Cameron, Texas Department of Transportation
- Rudy Perez, Arizona Department of Transportation

ENTERPRISE Members

The ENTERPRISE Board consists of a representative from each of the following member entities of the program.

- Georgia Department of Transportation
- Illinois Department of Transportation
- Iowa Department of Transportation
- Kansas Department of Transportation
- Michigan Department of Transportation
- Ministry of Transportation Ontario
- Minnesota Department of Transportation
- Oklahoma Department of Transportation
- Pennsylvania Department of Transportation
- Texas Department of Transportation
- Transport Canada
- USDOT Federal Highway Administration

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1.0 Introduction

Several ENTERPRISE member agencies have transportation networks within their jurisdictions that intersect with international borders: Michigan Department of Transportation (DOT), Minnesota DOT, Texas DOT, and the Ontario Ministry of Transportation (MTO).

Management and coordination of traffic operations at borders often requires agency resources. In addition, it is important to provide accurate and timely traveler information, such as border wait times, alerts, and construction notices, to the traveling public.

Intelligent Transportation System (ITS) technologies and systems used at borders often serve a critical purpose in assisting agencies with traffic management and traveler information. Enhanced knowledge of available technologies, uses, and benefits will equip ENTERPRISE members with potential solutions to improve agency coordination and management.

The purpose of this project was to document activities, issues, challenges, practices, coordination approaches, and technologies for managing traffic at highway border crossings.

A project team was established to provide overall input to the project and to identify activities, issues and challenges related to the following five traffic management areas at international borders:

- Category 1: Traffic Management and Response
- Category 2: Wait Time Measurement
- Category 3: Data Collection and Management
- Category 4: Traveler Information
- Category 5: Coordination

Based on the activities, issues and challenges identified by the project team, webinars were held with representatives from state and provincial transportation agencies and other entities that manage highways approaching the United States (U.S.)/Canada and U.S./Mexico borders. The webinars were held to facilitate and document these entities' current traffic management practices (e.g. TMC practices, technologies, data sharing) related to each of the five categories listed above.

In addition, a review of literature and traveler information websites was also conducted to document ITS technologies and systems to enhance the information provided by the project team and the information gathered through the webinars.

This report includes:

- 2.0 Project Team – Identifies the agencies that provided overall input and guidance to successfully complete the tasks of this project.
- 3.0 Activities, Issues, Challenges, and Practices at Border Crossings – Summarizes the activities, issues, challenges, and practices for managing traffic at international border crossings, documented from input provided by the Project Team and through information-gathering

webinars with agencies and entities that manage traffic approaching borders and provide related border coordination.

- 4.0 International Border Crossings: Webinars to Share Key Practices – Provides highlights from presentations given by a panel of experts during the information-sharing phase of the project. The presentations, shared during the "Key Practices Webinars," focused on *Data Collection and Uses at International Border Crossings* and *Agency Coordination Practices at International Borders.*
- 5.0 Overview of ITS Technologies at Border Crossings – Provides a high-level summary of ITS technologies used at international border crossings.
- 6.0 Border Information on Traveler Information Systems – Provides examples of traveler information mechanisms (e.g. websites, mobile apps) for displaying border traveler information.
- 7.0 Summary – Includes an overall summary of highlights of the information gathered for this project.

2.0 Project Team

In order to provide input on traffic management aspects at international border crossings, individuals with expertise and knowledge at border crossings was desired. Therefore, a Project Team was convened to guide and provide input on the project. The Project Team consisted of representatives from the following transportation agencies with experience in managing traffic, implementing ITS technologies, and conducting related coordination activities at international borders. The U.S./Canada border and the U.S./Mexico border were represented on the project team.

- Ontario Ministry of Transportation
- Washington State Department of Transportation
- Michigan Department of Transportation
- Texas Department of Transportation
- Arizona Department of Transportation

The project team met via webinar throughout the duration of the project and provided input and guidance on project tasks.

3.0 Activities, Issues, Challenges, and Practices at Border Crossings

This section documents the activities, issues, challenges and traffic management practices at international border crossings gathered during the project. The Project Team identified in Section 2.0 met via webinar to first discuss activities and corresponding issues and challenges related to traffic management at border crossings under the following categories.

- Category 1: Traffic Management and Response
- Category 2: Wait Time Measurement
- Category 3: Data Collection and Management
- Category 4: Traveler Information
- Category 5: Coordination

After the activities (e.g. identify and monitor events, design and placement of DMS) and corresponding issues and challenges (e.g. awareness of and response to events on other side of the border) were identified by the Project Team, two information-gathering webinars were held in February 2016 to collect and document current practices. Webinar participants included representatives from transportation agencies that manage highways approaching the border, as well as other entities such as border coalitions, bridge and tunnel authorities, and federal agencies that coordinate border-related activities. The first webinar included participation from entities along the U.S./Canada international border and the second webinar included participation from entities along the U.S./Mexico international border. **Table 1** identifies those entities that were able to participate in the information gathering webinars. It is important to note that there was more than one participant on the webinars from many of the entities; a total of 34 participants joined the webinars to contribute their input and experiences. Additional entities were invited to participate in the webinars, however due to scheduling conflicts were unable to participate.

Table 1: Information-Gathering Webinar Participants

Agency
Arizona DOT
Buffalo and Fort Erie Public Bridge Authority (Peace Bridge)
Canada Border Services Agency
Detroit-Windsor Tunnel
FHWA: Canada/U.S. Transportation Border Working Group/Border Planning Team
FHWA: Freight Management and Operations
Manitoba Infrastructure and Transportation
Michigan DOT
Niagara Falls Bridge Commission

Agency
Niagara International Transportation Technology Coalition (NITTEC)
Niagara Region
Ontario Ministry of Transportation
San Diego Associations of Governments
Texas A&M Transportation Institute
Texas DOT
Transport Canada
Washington State DOT

The following pages summarize the activities, issues, challenges and current practices at border crossings for each of the five categories documented through input from the Project Team and from the information-gathering webinars. The information collected during the webinars was not intended to provide detailed information about each practice mentioned but to provide enough detail to understand how each agency or entity is addressing traffic management at international border crossings. The information gathered was reviewed by the Project Team to identify current practices of interest that could be described in more detail during focused information-sharing webinars (See Section 4.0).

Highlights from the information-gathering webinars include:

Category 1: Traffic Management and Response

Many entities have a formal communication protocol or soon plan to provide guidance in managing traffic at borders. Some agencies that do not have protocols are working to formalize documentation for managing and maintaining communication during border events. Some entities have dedicated traffic operations staff or centers to manage border traffic. Technology approaches that include queue warning systems, advanced traveler information mechanisms such as Dynamic Message Signs (DMS), automated messaging systems to alert and update traffic management personnel during incidents, and weigh-in-motion facilities also play a strong role in traffic management and response.

Category 2: Wait Time Measurement

Border crossings may utilize data from one or a combination of technologies including Radio-Frequency Identification (RFID), loop detectors, Bluetooth and Wi-Fi to estimate delay at border crossings to assist in traffic management. At many crossings, however, technology has not been implemented; therefore, data collected manually by border patrol agencies is used to estimate wait times.

Category 3: Data Collection and Management

Each agency that collects traffic management data (e.g. Bluetooth data, loop detector data) utilizes the information differently. Some agencies use the data to estimate wait times and provide the information publicly via traveler information mechanisms. Others may use the data internally to inform real-time traffic management operations or to assist with planning.

Category 4: Traveler Information

Most entities reviewed either currently provide or in the near future will provide wait times or other border crossing information (e.g. still images or live video from traffic cameras, historical delay data, incident alerts) via traveler information websites, mobile apps, and/or DMS. There are various types of information and levels of sophistication in these traveler information mechanisms.

Category 5: Coordination

Many agencies hold meetings periodically with bordering agencies to coordinate efforts on a variety of topics such as construction projects that affect border crossing times, special event planning, and incident management. Borders with high volume crossings, such as the Niagara area between Ontario and the United States, may utilize a higher degree of coordination such as steering committees, boards, or coalitions to formalize processes, procedures, and planning activities.

Category 1: Traffic Management and Response

Activities (provided by the Project Team)

- Identify & monitor events (congestion, crashes, closures, construction, weather)
- Respond: emergency response, notification(s), traveler information
- Assess safety needs and implement interventions

Issues and Challenges (provided by the Project Team)

- Awareness of and response to events on the other side of the border:
  - How to ensure prompt notification?
  - How to communicate impacts to motorists (e.g. can cross but highway then closed)?
- Freight vs. Passenger Vehicles:
  - Priority opportunities for freight
  - Differences in how traffic is managed
- Safety:
  - Crashes due to speed differential of vehicles approaching end of queue approaching crossings

Current Practices (high level notes documented during February 2016 information-gathering webinars)

Washington State DOT

- Utilizes a communication protocol document (flowchart) to provide guidance (e.g. advance notifications on HAR) to applicable agencies involved in managing traffic events.
- Event response is managed in Bellingham, Washington north of Seattle for the border crossings.

Ontario Ministry of Transportation (MTO)

- A Queue Warning System is installed at the Blue Water Bridge to alert motorists approaching slow/stopped traffic. Queue warning systems also in place at 2 border crossings in the Niagara area (Queenston/Lewiston border crossing and Peace Bridge border crossing). There are issues with pavement milling, impacting queue warning system performance where loops are used for detection. Loops have been replaced frequently to keep the queue warning system in operation. For example, Hwy 402 is currently on the third generation of loops.
- MTO is working with Michigan DOT to formalize documentation (e.g. procedures) for managing traffic and maintaining communication between agencies.

Michigan DOT

- Retains staff in the Blue Water Bridge Operations Center which is part of a larger Operations Center in Detroit.
- Currently working with Detroit Winsor Tunnel to expand traffic management coordination efforts.
- Michigan DOT is working with MTO to formalize documentation (e.g. procedures) for managing traffic and maintaining communication between agencies.

Detroit Winsor Tunnel

- Operates an internal messaging system to alert upper management and others of tunnel delays (e.g. emergencies, weather). Considering sharing these types of alerts with the public.

Manitoba Infrastructure and Transportation

- In 2012 Manitoba (MIT) and North Dakota DOT jointly undertook a study of the Pembina-Emerson (P-E) POE to develop a long-range conceptual plan for guiding port improvements. Improvements at P-E POE

are being phased in between 2015 and 2020 with ITS deployments being TBD based on more detailed assessments of technologies and applications.
- Current in-place ITS devices at the P-E POE are limited to DMS .3 km from the border in the SB direction (used to communicate lane assignments) and cameras.

NITTEC
- Operates a 24/7 center on behalf of the NITTEC region. Traffic is monitored on both sides of the border using for example CCTVs.
- NITTEC developed a plan to document protocols (e.g. DMS messaging) for traffic entering Canada from the U.S. NITTEC operates the DMS located on the U.S side of the border, on behalf of the agencies; NITTEC also has access to view MTO's cameras located on the Canadian side of the border. A plan documenting protocols for traffic entering the U.S. from Canada is being developed.
- Considering deploying DMS at key decision points to allow travelers the option to consider another crossing based on wait times.

Niagara Falls Bridge Commission
- Operates a Queue Warning System at the Queenston-Lewiston crossing.
- There are VMS signs located in the Canada-bound direction (NITTEC) and limited VMS signs in the U.S. bound direction (MTO).
- Utilize Internal Operational Procedures.
- Emergency Response Plans are used to divert and redirect or stage traffic.
- Provide a 1-800 NUMBER for travelers to receive information on border crossings.
- Cameras showing traffic conditions at border crossings are available for viewing on traveler information websites.

Niagara Region
- Considering ITS device installation based on deployments of other agencies.

Buffalo & Fort Erie Public Bridge Authority (Peace Bridge)
- An alert is sent internally when traffic delay increases beyond a certain threshold. Coordination with MTO as needed based on delay.
- There are challenges diverting traffic from one crossing to another, since many motorists GPS route guidance tools.

Texas DOT/ Texas A&M Transportation Institute
- There are 3 districts within Texas DOT with an international border.
- Deployed traditional ITS components (e.g. CCTV, DMS) along the highway system that has connections with border crossings.
- Field equipment including ITS (e.g. WIM) at border safety inspection facilities are standalone and not interconnected with the TMC. There are no remote connections to operate these devices from off-site.
- There are limited DMS in locations approaching the borders that can be used to notify travelers of an event near the border.
- Texas A&M Transportation Institute is working on a project for Texas DOT to analyze and investigate TMCs and document technologies needed at border locations.

San Diego Association of Governments (SANDAG)
- Working with Caltrans on a pre-deployment study that includes addressing ITS needs on both sides of the border.
- There is a TMC for State Route 125 that communicates with the regional center operated by Caltrans.
- Utilize VMS around the border to alert motorists (e.g. incidents).
- Communications protocol in place with safety inspection system at Otay-Mesa crossing.

Category 2: Wait Time Measurement

Activities (provided by the Project Team)

- Select algorithm and technologies
- Determine accuracy
- Test/validate/troubleshoot

Issues and Challenges (provided by the Project Team)

- Establish terminology/definitions: wait time vs. delay vs. crossing time. (e.g. commercial vehicle inspection is included in total crossing time)
- How do weather events impact wait times; how can this be accounted for?
- Variable approaches: Toll lanes vs. general purpose lanes, commercial vehicles vs. passenger vehicles.

Current Practices (high level notes documented during February 2016 information-gathering webinars)

Washington State DOT
- Loop detectors at 5 crossings.

Ontario Ministry of Transportation (MTO)
- Blue Water Bridge: Loop detectors and Bluetooth.

Michigan DOT
- Blue Water Bridge: Loop detectors and Bluetooth.

Detroit Winsor Tunnel
- Developing an embedded device to track Bluetooth data. Data to be used to identify queues.

Manitoba Infrastructure and Transportation
- Currently reviewing proposals for an ITS study that will include an assessment of ITS technologies/applications (such as wait time measurement) at the P-E POE and other crossing points that are part of the National Highway System (NHS) in Manitoba.

NITTEC
- Accesses data from agencies/entities with wait time measurement systems and disseminates wait time data.

Niagara Falls Bridge Commission
- Automated wait time measurement system based on Bluetooth data at Lewiston/Queenston crossing.
- Manual calculations at Rainbow Bridge and Whirlpool Bridge.
- Currently only differentiate between truck, cars, and NEXUS.

Buffalo & Fort Erie Public Bridge Authority (Peace Bridge)
- Peace Bridge and Queenston/Lewiston: Traffax readers and BlueFaxWeb software.
- Deploying Bluetooth and Wi-Fi at Peace Bridge.

FHWA/Transport Canada
- Funding is available for wait time measurement systems through Beyond the Border Initiative.
- FHWA issued a solicitation in December 2015 to collect applications for funding to deploy wait time measurement technology. Applications were due February 3, 2016. Four applications are being reviewed. One criteria for award is that the applicant must demonstrate the ability to continue operations and maintenance after the initial deployment of the technology.

- Transport Canada has funding available for wait time measurement technology deployments and is interested in exploring opportunities with potential recipients.
- A Canada-U.S.-Mexico-Border Wait Time Peer Exchange[1] was held in December 2014 (summary published in March 2015).
- A series of Regional Roundtable Webinars on Border Wait Time Measurement Solutions[2] were held in summer 2015.

Texas DOT/ Texas A&M Transportation Institute

- RFID at 7 crossings for northbound commercial vehicles: Veterans International, Pharr-Reynosa, World Trade, Colombia Solidarity, Camino-Real, Ysleta-Zaragoza, Bridge of the Americas (commercial vehicles).
- Bluetooth at Ysleta-Zaragoza (passenger vehicles) crossing for northbound and southbound vehicles.
- Real time and archived data available.

Arizona DOT

- Wi-Fi will be implemented at 4 crossings: San Luis I, Nogales-Mariposa, Nogales-DeConcini, Douglas (passenger/commercial vehicles). The two ports of entry in Nogales will be implemented first, anticipated to be complete in 2016.
- RFID at Nogales-Mariposa (northbound commercial vehicles). An online border crossing information system provides access to real time and archived data. Data is being collected on the Mexico side of the border at two locations to gather end of queue, close to the border, at the primary inspection booth and at the state inspection facility.
- Completed a penetration rate study in November 2015 analyzing Wi-Fi and RFID. Wi-Fi had a much higher penetration rate.

San Diego Association of Governments (SANDAG)

- SR11/Otay-Mesa East Port of Entry[3] – Project in progress. New POE, wait time measurement, variable toll rates. Working closely with the Secretariat of Communications and Transportation (Mexico) SCT to share data. It is estimated full implementation will be completed by 2018. The current pre-deployment study is capturing plans for an ITS system.
- San Ysidro Port of Entry - Border Wait Time Pilot Study underway.
- Conducted an initial 3-day test of Bluetooth and Wi-Fi on I-5 at San Ysidro. There was a higher penetration rate with Wi-Fi as compared to Bluetooth.

Category 3: Data Collection and Management

Activities (provided by the Project Team)

- Determine datasets needed (volumes, speeds, vehicle classifications, wait times)
- Select device types & communications
- Validation, sharing, and use
- Maintenance

Issues and Challenges (provided by the Project Team)

- Traffic Data:
  - Traffic data collected by transportation agency or use of 3rd party data?
  - What data is needed for real-time vs. retrospective analysis?
- Wait Time Data:
  - How are agencies currently using wait time data? What are opportunities for expanded use?
  - How is agency-collected historical data used by other entities such as independent developers?
  - How to know if information provided by independent providers is accurate?

Current Practices (high level notes documented during February 2016 information-gathering webinars)

Washington State DOT

- Hosts a Traveler Informaion API[4] to share border wait time data for use by independent developers.
- Historical data including wait times, traffic volumes, and service rates are stored at the Cascade Gateway Border Data Warehouse[5].
- Portable license plate readers are used to validate data.
- Data sharing occurs between the Canada Border Services Agency (CBSA) and Washington State DOT to help calibrate systems.

Ontario Ministry of Transportation (MTO)

- Data available from queue warning systems.
- There are initiatives underway to expand real time travel time collection into regions approaching the borders, so that data and information (e.g. wait times) are available at decision points where motorists could choose to divert to a different crossing.

Michigan DOT

- Blue Water Bridge wait time data is incorporated into the MiDrive traveler information system.
- Developing a mobile app that will incorporate Blue Water Bridge data.

Detroit Winsor Tunnel

- Working on a prototype to capture and store Bluetooth data. The data is currently used internally, but there are plans to expand to make the data publicly available when funding is secured.
- Data is sent weekly to border patrol for their use with staffing plans.

Manitoba Infrastructure and Transportation

- Prepared, presented (TRB, TAC, CTRF) and published (TRB-TRR) papers on traffic forecasting and Level of

Service (LOS) methodologies for major POE's. (i.e. application to top 5 POEs) Manitoba ITS study will also evaluate data management issues.

NITTEC

- Bluetooth reader data from member agencies is collected and analyzed. A series of metrics reporting aspects of border crossing delay are published in the NITTEC 2015 Annual Report[6].
- Working with the University of Buffalo to develop a data warehouse and a predictive model to predict delay based on historical data.

Niagara Falls Bridge Commission

- Traffic data is collected and provided to a variety of agencies such as NITTEC and MTO.
- Currently use data to post for motorists, develop statistical trends, and determine/predict staffing levels.
- Operators occasionally spot check data to assess accuracy.
- Maintain historical data; able to compare actual data to what was predicted, in order to adjust algorithms.

Buffalo & Fort Erie Public Bridge Authority (Peace Bridge)

- Wait times and traffic data are posted on website. Data used for determining/predicting staffing levels.

Transport Canada

- The Border Infrastructure Investment Plan[7] tracks data such as recent/planned inspection and transportation infrastructure improvements and environmental data.

Texas DOT

- Historical data is analyzed to identify trends and improve operations at ports of entry.
- Historical data is shared with stakeholders (e.g. U.S. Customs and Border Protection (CBP) for staffing plans).
- In the El Paso region, a review of border wait times occurred to identify improvements.

Arizona DOT

- CBP plans to use data from ADOT's new wait time measurement systems to display wait times via their traveler information systems.
- The Border Crossing Information System website[8], developed by Texas A&M Transportation Institute for Texas DOT, has been expanded to include Arizona crossings where wait time data is available. Historical data from the tool can be used by stakeholders such as CBP, trucking industry, and motorists for planning purposes.

San Diego Association of Governments (SANDAG)

- CBP has an interest in border wait times being provided as an automated function.
- The data that is being collected and made available will be an important asset to help assess trends and manage traffic operations and performance at borders.
- Integration of ITS systems and data will provide valuable information to assist in decision making, such as planning and prioritizing capital investments among ports of entry.

Category 4: Traveler Information

Activities (provided by the Project Team)

- Design and placement of DMS
- Selection of mechanisms (web, mobile app, 511 phone, Highway Advisory Radio)
- Information posting method(s): manual or automated

Issues and Challenges (provided by the Project Team)

- Where should DMS be placed in relation to availability of alternate routes/crossings, proximity to rest areas?
- How should content and distribution methods be modified for the traveler? (e.g. passenger vehicles vs. freight industry)?

Current Practices (high level notes documented during February 2016 information-gathering webinars)

Washington State DOT

- Washington State DOT online traveler information: Border Wait Times, DMS Messages, Traffic Conditions/Congestion and Cameras[9].
- Washington DOT traveler information website links to British Columbia Ministry of Transportation and Infrastructure traveler information website[10] that provides information on real-time and planned traffic alerts/problems (e.g. incidents, construction and maintenance activities, special events) and border wait times.
- Online Traffic Map Archive[11] allows users to access maps showing previous traffic conditions, archived every 10 minutes

Ontario Ministry of Transportation (MTO)

- Real-time wait times at Blue Water Bridge - soon to be available.

Michigan DOT

- Real-time wait times at Blue Water Bridge - soon to be available.
- Mobile app under development.

Detroit Winsor Tunnel

- DWT Mobile App[12] (displays wait times, open lanes, cameras).

Manitoba Infrastructure and Transportation

- Border Delay – Pembina, ND/Emerson, MB[13].

NITTEC

- Border Crossing Information[14] (Peace Bridge, Rainbow Bridge, and Lewiston-Queenston Bridge).
- Email/text message alerts

Niagara Falls Bridge Commission

- Current Wait Times[15] (Peace Bridge, Rainbow Bridge, Whirpool, and Lewiston-Queenston Bridge)
- Twitter

Buffalo & Fort Erie Public Bridge Authority (Peace Bridge)

- Current Wait Times[16] (Peace Bridge, Rainbow Bridge, Whirpool, and Lewiston-Queenston Bridge)
- Mobile App

Texas DOT/Texas A&M Transportation Institute

- Border Crossing Information System[8] – Wait times and crossing times: expected and historical

Arizona DOT

- Wait time data will be available via the Border Crossing Information System[8] in 2016 (data at the Nogales-Mariposa border is currently available on the site). Border crossing information to also be available on a phone app and 511.
- Plans underway to utilize DMS at both Nogales crossings as northbound vehicles approach the border, to provide information to assist motorists in determining where to cross.

San Diego Association of Governments (SANDAG)

- New information will feed into existing systems (511, DMS, etc.)
- Traveler information for commercial vehicles is a focus for SANDAG and critical to commercial vehicle operations. Aim to provide accurate information so motorists can trust that the advanced or en-route (e.g. DMS) information is correct and reliable.

Category 5: Coordination

Activities (provided by the Project Team)

- Daily communications
- Ongoing relationships, lines of communication
- Planning for technology deployments

Issues and Challenges (provided by the Project Team)

- Understanding entities involved and their roles: agencies, working groups, consortia
- Ownership and jurisdiction
  - State/provincial agencies, cities, counties, bridge authorities
  - Physical placement of technology: ownership, maintenance
  - Competing crossings
  - Agency neutrality
  - Conflicting goals

Current Practices (high level notes documented during February 2016 information-gathering webinars)

Washington State DOT

- Whatcom International Mobility and Trade Corridor[17] meets monthly. Recent success with obtaining lane usage data from U.S. Customs and Border Protection, which is key for loop based systems to know how a lane is being used (NEXUS lane or other).
- Canada Border Services Agency (CBSA) uses wait time data for staffing plans. This helps to improve delays by improving staff planning efforts.

Ontario Ministry of Transportation (MTO)

- A group of partners is starting to look at ITS and ICM technologies to address a major event structure being built near the border. Agencies are coordinating on construction and construction staging.
- Coordination with law enforcement to ensure border traffic can be maintained when a ramp is closed.
- Coordinate with the Blue Water Bridge Authority, who leads collaborations between MTO and Michigan DOT.

Michigan DOT

- Working on an agreement to share and connect fiber at the Blue Water Bridge crossing (MTO/Michigan DOT). This will involve sharing traffic information between centers and emergency management.
- Working to connect fiber at the Detroit Windsor Tunnel in order to share data.

Detroit Winsor Tunnel

- Agreement in place with local radio stations; antennas installed for vehicles to receive information while driving in the tunnel.
- Good communication with both (U.S. and Canada) border patrol agencies. Data is shared in order to help with their staffing plans.

Manitoba Infrastructure and Transportation

- Daily communication protocols with provincial law enforcement are in place.
- Long term communication occurs on a number of planning and coordination committees that are focused on infrastructure improvements (especially at the Pembina/Emerson crossing).
- Recently established an Inland Border Working Group to coordinate border and port planning issues from Manitoba/Minnesota west to British Columbia/Washington.

NITTEC

- Border Crossing Committee meets every other month. Every year the members develop a work plan of initiatives to focus on. Members have worked on identifying funding for signing and technology deployments.
- Strategic Planning Committee and Technology/Systems Committee work on topic-specific issues and initiatives.

Niagara Falls Bridge Commission

- NITTEC and the relationships locally among stakeholders have been key for the region in terms of coordination efforts.
- Funding for ongoing operations and maintenance of systems is extremely limited.
- Though local efforts are highly coordinated, additional coordination on national efforts is needed. A challenge exists when asked to spend considerable time and resources fielding requests from agencies, universities, consultants, and private companies asking for similar information, tours, demonstrations, etc.

Niagara Region

- Coordination success from involvement with NITTEC.

Buffalo & Fort Erie Public Bridge Authority (Peace Bridge)

- NITTEC provides an important coordination role to facilitate working together and meeting face to face. Personal interaction is useful because if an issue comes up, agency personnel know each other.
- A 2-way radio is used with CBP to keep in contact and facilitate coordination.
- Receive data from CBP and CBSA when their sign information is updated.
- Good working relationship at local levels.

Transport Canada and FHWA

- Transportation Border Working Group[18] - Good formal (e.g. MOUs) and informal working relationships.

Texas DOT

- Coordinate with the Texas Department of Public Safety as inspection facilities are constructed.
- El Paso region coordinates on a regular basis with the city, MPO, county, and CBP. A committee was recently formed to coordinate northbound traveler information.
- Important to coordinate on both sides of the border as new systems are implemented. It is also important to ensure regular coordination as staff turnover occurs.

Arizona DOT

- A key to successful coordination is being inclusive of all stakeholders when convening technical advisory committees for projects. Include local stakeholders such as cities and MPOs as well as state and federal entities.
- Involving representatives from CBP headquarters in technical advisory committees has been successful as it confirms support at the headquarters level.
- Strong relationships with CBP, General Services Administration (GSA), FHWA, and Secretariat of Communications and Transportation (Mexico) SCT.
- It is important to select the right consultant for a project (technical expertise as well as ability to coordinate with agencies on both sides of the border).

San Diego Association of Governments (SANDAG)

- Meet regularly for internal coordination, including consultants. Meetings held quarterly with stakeholders (federal, local, state, Mexico counterparts).
- Weekly conference calls with CBP/GSA staff to coordinate efforts.
- It has been helpful to utilize the Border Information Flow Architecture[19] between Canada and the U.S. to support border crossings, to apply similar strategies at the southern border. This structure confirms ITS functionality as well as standardizes and improves coordination.

4.0 International Border Crossings: Webinars to Share Key Practices

This section includes a summary of two information-sharing webinars conducted during the project. The purpose of the webinars was for experts to share information on two traffic management related focused areas of interest at international borders. The topic areas were selected with input from the Project Team by reviewing the current practices documented during the information-gathering webinars noted in Section 3.0 of this report. The purpose of the information-gathering webinars was for participants to provide brief details on current traffic management related practices. The focus of the key practices webinars was to provide additional details and information on selected practices.

The Project Team reviewed the many current practices noted by participants under each of the five areas of traffic management (Category 1 – Traffic Management and Response, Category 2 – Wait Time Measurement, Category 3 – Data Collection and Management, Category 4 – Traveler Information and Category 5 – Coordination) during the information-gathering webinars. Based on the review, the Project Team recommended conducting one webinar focused on Data Collection and Management (Category 3) and one webinar focused on Coordination (Category 5).

ENTERPRISE invited agencies along the U.S./Canada border and U.S/Mexico border to participate in the webinars and encouraged invited participants to forward the announcements to others that may be interested. Nearly 70 individuals joined the key practices webinars.

The following sections provide highlights from the presentations provided during the two key practices webinars conducted for this project. The presentations and a recording each webinar are available at: http://enterprise.prog.org/Projects/2015/its_international_borders.html

4.1 Data Collection and Uses at International Border Crossings

A webinar was held on July 26, 2016 by ENTERPRISE and featured a panel of experts who shared information about data collection and uses at international border crossings. The webinar was broken into two areas: 1) traffic data collection technologies to estimate wait times; and 2) data uses, tools and trends. The following paragraphs summarize the presentations given under each area. Bill Legg, Washington State DOT, started the webinar by providing an overview of the ENTERPRISE Pooled Fund Study as well as background information and an overview of this project.

Traffic Data Collection Technologies to Estimate Wait Times

- ***Presentation 1: Technology Options – Juan Villa, Texas A&M Transportation Institute (TTI)***
  Many technologies are being analyzed for wait time measurement at land ports of entry. These technologies include inductive loop detectors, Bluetooth, RFID, Global Position System (GPS), connected vehicles, and LED Sensors. This presentation described how the technologies work, the critical elements, and the benefits and concerns of each technology.

  For example, Bluetooth is a wireless technology that allows radio frequency communication between Bluetooth enabled devices. Some border crossings use the data from this technology to calculate wait times. This technology is easily implemented; however, algorithms are required.

- ***Presentation 2: Arizona DOT Bluetooth vs. Wi-Fi Penetration Rate Study – Yung Koprowski, Lee Engineering***
  ADOT initiated a 2-week study to compare Bluetooth and Wi-Fi data for measuring wait times of personal vehicles at 6 Ports of Entry (POE) between Arizona and Mexico.

  The results of the study identified the average penetration rate, average delay per vehicle, and average vehicle-hours of total delay for the 6 POEs. It was determined that the Wi-Fi technology was more successful in match identification for wait times at border crossings.

  Based on the results of the study, permanent installation of the Wi-Fi technology at the 6 POEs was prioritized, however, installing permanent technology at two of the crossings was not recommended due to low crossing volumes.

Data Uses, Tools, and Trends

- ***Presentation 3: Niagara International Transportation Technology Coalition – Athena Hutchins, NITTEC***
  NITTEC is a multi-agency transportation operations coalition with members from transportation agencies, public safety and border enforcement, and emergency services and recovery in the U.S. and Canada. It provides centralized operations in a bi-national multimodal transportation network 24/7 and disseminates joint press releases and public information campaigns.

Photo courtesv of NITTEC

  NITTEC oversees data uses, tools, and trends at three border crossings, collects border crossing delay data, and communicates border crossing information for both northbound and southbound vehicles. NITTEC manages a traveler information website and app and provides standardized border wait times and DMS messaging for the U.S. and Canada. In addition to the Bluetooth technology used at 2 of the 3 crossings, NITTEC is considering adding a Wi-Fi deployment.

  Peak holiday volumes and border crossing delay information in both directions for each crossing are retained by month, day, and time of day. In addition to scenario planning, accumulated crossing data is used to schedule construction projects and technology deployments, determine staffing needs for each bridge, and anticipate traffic for special events such as sporting events and holidays.

- ***Presentation 4: Texas DOT – Juan Villa, Texas A&M Transportation Institute (TTI)***
  Texas DOT utilizes an online Border Crossing Information System (BCIS). BCIS displays border wait time information for border crossings between Texas and Mexico and records real-time data. New features include provisions for both FAST and non-FAST vehicles and equipping some of Mexico's toll booths with RFID to measure wait times for commercial vehicles.

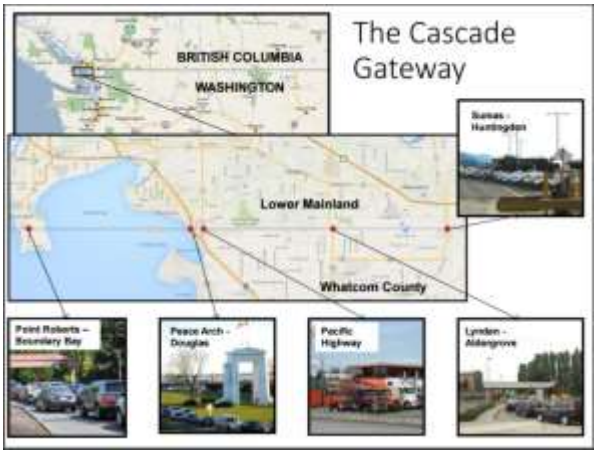
  Data collected for BCIS is archived to allow agencies to query the data to see historical wait times. In addition, an online dashboard allows users to narrow travel time estimates by crossing and day. BCIS also enables users to compare specific months of data and archives the raw data for downloading.

4.2 Agency Coordination Practices at International Borders

On September 26, 2016, a webinar was hosted by ENTERPRISE and featured a panel of experts who discussed agency coordination at international border crossings. The following paragraphs summarize the presentations given during the webinar. Bill Legg, Washington State DOT, started the webinar by providing an overview of the ENTERPRISE Pooled Fund Study as well as background information and an overview of this project. A copy of the presentations and a recording of the webinar are available at: http://enterprise.prog.org/Projects/2015/its_international_borders.html

- ***Presentation 1: Whatcom Council of Governments Border Coordination – Hugh Conroy, Whatcom Council of Governments***

  The U.S. Coordinated Border Infrastructure Program (CBI) allows states to use funds within 100 miles of an international land border with Canada or Mexico to facilitate cross border motor vehicle and cargo movements including international coordination of transportation planning, programming, and border operation. Whatcom County in Washington State and the lower mainland of British Columbia make up the Cascade Gateway which consists of 5 border crossings that are among the busiest and most economically important ports of entry along the border.



Courtesy of Whatcom Council of Governments

  The Whatcom Council of Governments is one of the more than 100 agencies participating in the International Mobility and Trade Corridor (IMTC) Program, a coalition for border coordination. Both public and private sector agencies participate in IMTC including transportation agencies, inspection/enforcement organizations, and at-border municipalities as well as other governmental and non-governmental entities. IMTC does not receive/distribute funds or make policies but it does maintain a future project list and uses the border-related data it collects and stores to participate in border projects. In addition, IMTC assists with coordinating construction schedules and data collection.

  Current IMTC projects include RFID Business Case, 2015/2016 Border Freight Operations Study, Booth Status Data Integration, and Border Simulation Modeling. Past IMTC collaboration efforts include Border Traveler Information and Communication Protocol projects as well as a 2011 FAST Pilot Study.

- ***Presentation 2: Niagara International Transportation Technology Coalition – Athena Hutchins, NITTEC***

  NITTEC oversees operations of 3 ports of entry (POEs) between southern Ontario and western New York by providing regional collaboration and leadership for these POEs including technology deployment, operations, incident management, and traveler and traffic information. NITTEC's mission is to improve mobility, reliability, and safety on the regional bi-national

multimodal transportation network through information sharing and coordinated management of operations.

Overall policy and governance is provided by NITTEC's Board of Directors. NITTEC also utilizes project committees to coordinate and manage a variety of transportation issues. Regional operations require multi-agency collaboration and coordination to manage the transportation system at the border and provide performance measurement reporting. Regional collaboration for traffic management provides centralized 24/7 operations and traffic management services for a bi-national region.

Photo courtesy of NITTEC

NITTEC serves as an information clearinghouse and is able to facilitate multi-agency ITS deployment, regional messaging standards, and traffic management plans through regional collaboration.

Border crossing collaboration is led by a Border Crossing Committee of transportation agencies, bridge operators, and border enforcement agencies. The Border Crossing Committee defines border crossing traffic management plans, identifies consistent border wait times, standardizes DMS messaging, and approves joint press releases and public information campaigns.

- ***Presentation 3: Buffalo-Niagara Integrated Corridor Management (ICM) Project – Keir Opie, Cambridge Systematics, Inc.***

The Buffalo-Niagara Integrated Corridor Management (ICM) Project is a partnership between NITTEC and the Greater Buffalo-Niagara Regional Transportation Council (GBNRTC). ICM members include transportation agencies, bridge authorities, and municipalities.

Courtesy of Cambridge Systematics, Inc.

The objectives of the I-190 ICM Project are to optimize traffic operations by identifying effective traffic management strategies to mitigate congestion and the associated environmental impacts. The project will create a data-driven decision support tool for congestion management on critical transportation corridors in the Buffalo-Niagara Region; develop a Buffalo-Niagara Border Crossing Corridor Management Plan including policies, procedures, and operational strategies; and generate strategic diversion routes to other border crossings in the region.

The ICM project will develop performance measures and evaluation criteria including network usage, mobility, reliability, environmental, and benefit/cost ratios. Project outcomes will include an I-190 ICM Implementation Plan and a Draft Border Crossing Corridor Management Plan.

5.0 Overview of ITS Technologies at Border Crossings

This section provides a high-level overview of ITS technologies used at international border crossings. ITS technologies used at borders often serve a critical role in assisting agencies with traffic management and traveler information.

5.1 Technologies for Collecting Traffic Data at Border Crossings

There are a variety of mechanisms used at border crossings to collect traffic data which is then used by agencies in different ways. For example, an agency may use traffic data to collect and archive traffic volumes for passenger vehicles and commercial vehicles crossing the border, or to understand the speed of vehicles approaching the border for overall daily traffic management operations. Traffic data may also be collected to develop an algorithm to calculate wait times. The wait times are then disseminated to the public and/or used internally by traffic management staff for real-time traffic operations or for planning purposes. Traffic data collected may also be used for safety applications such as developing an algorithm to detect and warn drivers of queues. Queue detection systems can alert drivers in route by posting information on a Dynamic Message Sign of stopped or slowing traffic ahead.

The following bullets provide a list of some traffic data collection devices that may be used at border crossings. The data types collected from each device varies but may include, for example, traffic volume or speed data.

- **Loop Detectors** – A vehicle moves over a loop that is under a lane of the roadway, resonate frequency increases, then a detection is made.
- **WiFi** – Roadside WiFi antennas continually listens for on-board Wi-Fi enabled devices, a wait time is calculated between the difference of the two detection times from the WiFi antennas.
- **Bluetooth** – An on-board Bluetooth enabled device such as a cell phone broadcasts its unique tag, a Bluetooth sensor records the tag and detection time, and then a wait time is calculated between the difference of the two detection times.
- **RFID** – A reader from the roadside generates an electromagnetic field and activates a tag from inside a vehicle, when the tag is active is sends requested data such as the vehicle location, and then a wait time is calculated between the difference of the two detection times.
- **Global Positioning System (GPS)** – An on-board GPS unit determines its coordinates and time stamp while moving, the stored data is extracted by a reader, and then the wait time is determined.
- **LED Sensors** – A vehicle pass under a LED sensor, the LED sensor reports change of amplitude and distance of the reflected beam and a detection is made.

The following two sources summarize various technology detection options at border crossings along with considerations such as advantages/benefits and disadvantages/concerns for the technologies mentioned above. For example, the Technology Options Presentation noted below identifies one benefit of RFID technology is that it performs well for freight wait time measurement at the border. One concern is that there is that there is an investment cost for roadside infrastructure for the RFID technology.

- Canada-U.S.-Mexico Border Wait Time Peer Exchange Summary Report[20] This report describes several detection technologies as presented and discussed during a 2014 peer exchange hosted by FHWA, with a focus on wait time measurement approaches and systems.
- Data Collection and Uses at International Border Crossings – Technology Options Presentation[21] This presentation summarizes data collection technologies used primarily for wait time measurement. (Note: The Technology Options presentation was provided as part of the Key Practices webinar highlighted in Section 4.1)

It is important to note that the state of practice for traffic data collection continues to change and advance with the emergence of new technologies and approaches.

5.2 Wait Time Measurement Systems

Wait Time Measurement Systems may use one or a combination of the traffic detection options described in Section 5.1. An algorithm is developed based on the traffic detection data provided to estimate the amount of time vehicles approaching a border crossing can expect to "wait" before crossing the border, at any given time. Though the exact measurement limits vary from site to site, wait time is typically measured from the end of the traffic queue approaching the crossing to the booth where border patrol operations begin.

ENTERPRISE completed a separate project (Performance Measures and Reporting for International Border Crossings[22]) that focused on learning the roles, practices, and technologies for managing traffic in relation to performance measures at international border crossings. Within the final report for that project, details of wait time measurement systems from select agencies were reviewed. The following table summarizes the traffic detection used to calculate wait times at select crossings documented in that final report. For example, at the Blue Water Bridge between the Michigan DOT and MTO, Bluetooth and Loop Detectors are used to provide wait times for passenger and commercial vehicles.

Table 2: Wait Time Measurement Systems at Border Crossings

Agency	Passenger or Commercial Vehicles	Crossing(s)	Detection Technology
Arizona DOT	Commercial	• Nogales-Mariposa	RFID
Buffalo and Fort Erie Public Bridge Authority	Passenger and Commercial	• Peace Bridge	Bluetooth
Michigan DOT and Ontario Ministry of Transportation (MTO)	Passenger and Commercial	• Blue Water Bridge	Bluetooth and Loop Detectors
Niagara Falls Bridge Commission	Passenger and Commercial	• Lewiston-Queenston Bridge	Bluetooth

Agency	Passenger or Commercial Vehicles	Crossing(s)	Detection Technology
Texas DOT	Commercial	• Veterans International Bridge • Pharr-Reynosa International Bridge • World Trade Bridge • Colombia Solidarity International Bridge • Camino Real International Bridge • Ysleta-Zaragoza International Bridge • Bridge of the Americas	RFID
	Passenger	• Ysleta-Zaragoza International Bridge	Bluetooth
Washington State DOT	Passenger and Commercial	• Peach Arch • Pacific Highway • Lynden-Aldergrove • Sumas	Loop Detectors
	Passenger and Commercial	• Orville	Loop Detectors and License Plate Readers

5.3 Traveler Information Mechanisms

As stated previously in this section there are many options to collect traffic management data. After the data is collected many agencies use the data to provide traveler information (e.g. border wait times) to motorists at border crossings to assist with pre-trip or en-route decision making.

There are a variety of traveler information mechanisms that are used, including:

- **Dynamic Message Signs** – DMS are typically placed prior to a decision point of selecting another crossing based on posted wait times. DMS are also placed as motorists approach a border crossing to inform the motorist of the expected wait time.
- **Mobile Apps** – Mobile apps are used to provide border wait time information as well as additional information regarding a specific border crossing.
- **Traveler Information Websites** – Traveler Information Websites may provide current wait time information for border crossings as well as provide additional information such as a typical wait times based on historical data. Additional details of a specific crossing may also be noted.
- **Traveler Information Phone Numbers** – Traveler Information Phone Numbers such as 511 may provide the user an option to listen to border wait time crossing information or any expected delays (e.g. construction) due to other events.
- **Social Media** – Social media (e.g. Facebook, Twitter) may be used by agencies to notify motorists crossing a border of expected delays or if there are no delays.

The next section (Section 6.0) provides examples of traveler information mechanisms used to display border crossing information.

6.0 Border Information on Traveler Information Systems

This section provides an overview of traveler information systems that feature highway border crossing information to assist travelers with trip planning and en-route decision making. An online review of traveler information systems available from websites, mobile apps, and other mechanisms was conducted in order to present a sampling of approaches to display border crossing data such as wait times, camera images, and lane statuses. Selected traveler information mechanisms hosted by the following entities are summarized in this section:

- Federal Agencies
- State and Provincial Transportation Agencies
- Other Entities (e.g. border coalitions, bridge or tunnel owners, 3rd party web or app developers)

6.1 Federal Agencies

This section features border information provided by federal or national-level agencies that have a vested interest in keeping motorists informed about traffic approaching international borders.

6.1.1 Canada Border Services Agency

The Canada Border Services Agency (CBSA) provides border wait times on the CBSA Border Wait Times website[23]. Current wait times, updated hourly, indicate the estimated time to reach the CBSA primary inspection booth when crossing the Canada–U.S. land border. In addition to current wait times, the website provides forecasted border wait times based on statistical analysis of past traffic volumes and wait times. CBSA also broadcasts wait times through Twitter accounts operated by third-party providers. **Figure 1** shows a screenshot of forecasted wait times for 1st Quarter of 2016 at the Stanstead Port of Entry.

1st Quarter (January to March)

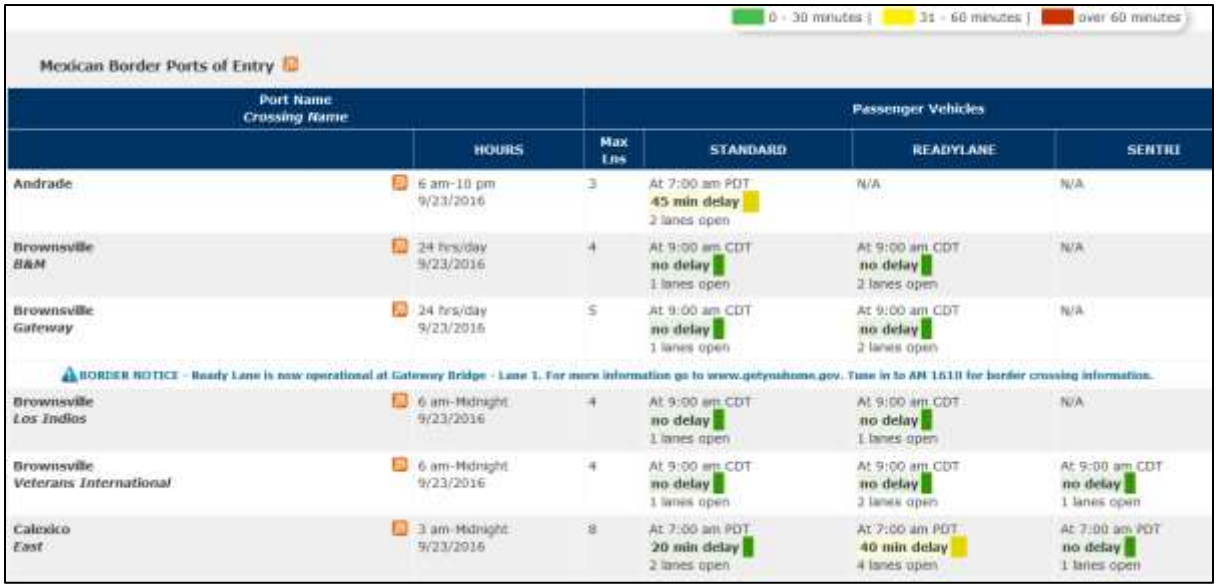
Day(s)	Average Wait Time	Hours
Monday	18 min.	1:00 PM - 4:59 PM
	13 min.	5:00 PM - 7:59 PM
Tuesday	10 min.	1:00 PM - 4:59 PM
	10 min.	5:00 PM - 7:59 PM
Wednesday	35 min.	10:00 AM - 12:59 PM
Thursday	10 min.	1:00 PM - 4:59 PM
Friday	13 min.	10:00 AM - 12:59 PM
	13 min.	1:00 PM - 4:59 PM
	10 min.	5:00 PM - 7:59 PM
	10 min.	8:00 PM - 11:59 PM
Saturday	10 min.	10:00 AM - 12:59 PM
	10 min.	1:00 PM - 4:59 PM
	10 min.	5:00 PM - 7:59 PM
Sunday	10 min.	10:00 AM - 12:59 PM
	18 min.	1:00 PM - 4:59 PM
	16 min.	5:00 PM - 7:59 PM

Statutory Holidays	Day	Peak Hours Wait Time	Peak Hours
Good Friday / Easter - Canada & U.S.A.	No exceptions		
Spring Break Week	No exceptions		

Figure 1: Screenshot of Border Wait Times for Passenger Vehicles from CBSA Border Wait Times Website
(Source: https://bwt.cbp.gov/, retrieved 9/23/16)

6.1.2 U.S. Customs and Border Protection

U.S. Customs and Border Protection (CBP) provides border information for commercial vehicles, passenger vehicles, and pedestrians on the U.S. northern border with Canada and the U.S. southern border with Mexico. The CBP Border Wait Times website[24] allows users to select the border, specific crossing(s), and type of crossing to review, then presents color-coded border wait times to allow users to quickly assess the wait time ranges. The CBP Border Wait Times Mobile App presents estimated wait times and open lane status, displaying information by lane type such as standard, SENTRI, NEXUS, FAST, or ready lane. **Figure 2** and **Figure 3** show screenshots of the CBP Border Wait Times website and Mobile App.



Mexican Border Ports of Entry

Port Name / Crossing Name	HOURS	Max Lns	Passenger Vehicles STANDARD	READYLANE	SENTRI
Andrade	6 am-10 pm 9/23/2016	3	At 7:00 am PDT 45 min delay 2 lanes open	N/A	N/A
Brownsville B&M	24 hrs/day 9/23/2016	4	At 9:00 am CDT no delay 1 lanes open	At 9:00 am CDT no delay 2 lanes open	N/A
Brownsville Gateway	24 hrs/day 9/23/2016	5	At 9:00 am CDT no delay 1 lanes open	At 9:00 am CDT no delay 2 lanes open	N/A
BORDER NOTICE - Ready Lane is now operational at Gateway Bridge - Lane 1. For more information go to www.getyrnahome.gov. Tune in to AM 1610 for border crossing information.					
Brownsville Los Indios	6 am-Midnight 9/23/2016	4	At 9:00 am CDT no delay 1 lanes open	At 9:00 am CDT no delay 1 lanes open	N/A
Brownsville Veterans International	6 am-Midnight 9/23/2016	4	At 9:00 am CDT no delay 1 lanes open	At 9:00 am CDT no delay 2 lanes open	At 9:00 am CDT no delay 1 lanes open
Calexico East	3 am-Midnight 9/23/2016	8	At 7:00 am PDT 20 min delay 2 lanes open	At 7:00 am PDT 40 min delay 4 lanes open	At 7:00 am PDT no delay 1 lanes open

Figure 2: Screenshot of Border Wait Times for Passenger Vehicles from CBP Border Wait Times Website
(Source: https://bwt.cbp.gov/, retrieved 9/23/16)

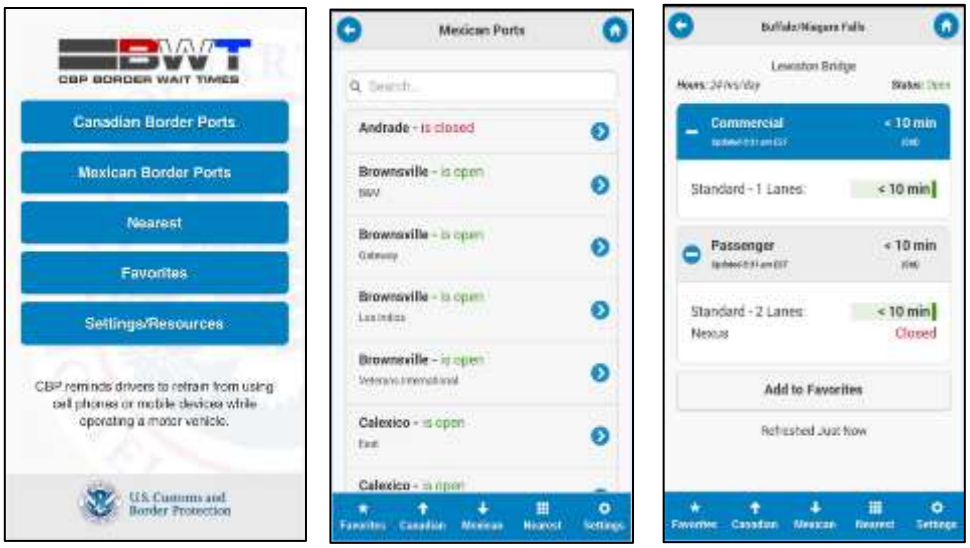


Figure 3: Screenshot of CPB Border Wait Times Mobile App
(Source: https://play.google.com/store/apps/details?id=gov.dhs.cbp.bems.wcr.bwt retrieved 2/29/16)

6.1.3 Government of Canada

The Government of Canada provides border wait times through its Canada to U.S. Border Wait Times website[25]. Travel Smart-Canada is the corresponding mobile app that locates the nearest border crossing and provides estimated wait times in either direction (into the U.S. or into Canada). See **Figures 4 and 5** for screenshots from the Government of Canada website and the Travel Smart-Canada mobile app.

Figure 4: Screenshot of Border Wait Times from Government of Canada Website
(Source: https://travel.gc.ca/travelling/border-times-us, retrieved 9/20/16)

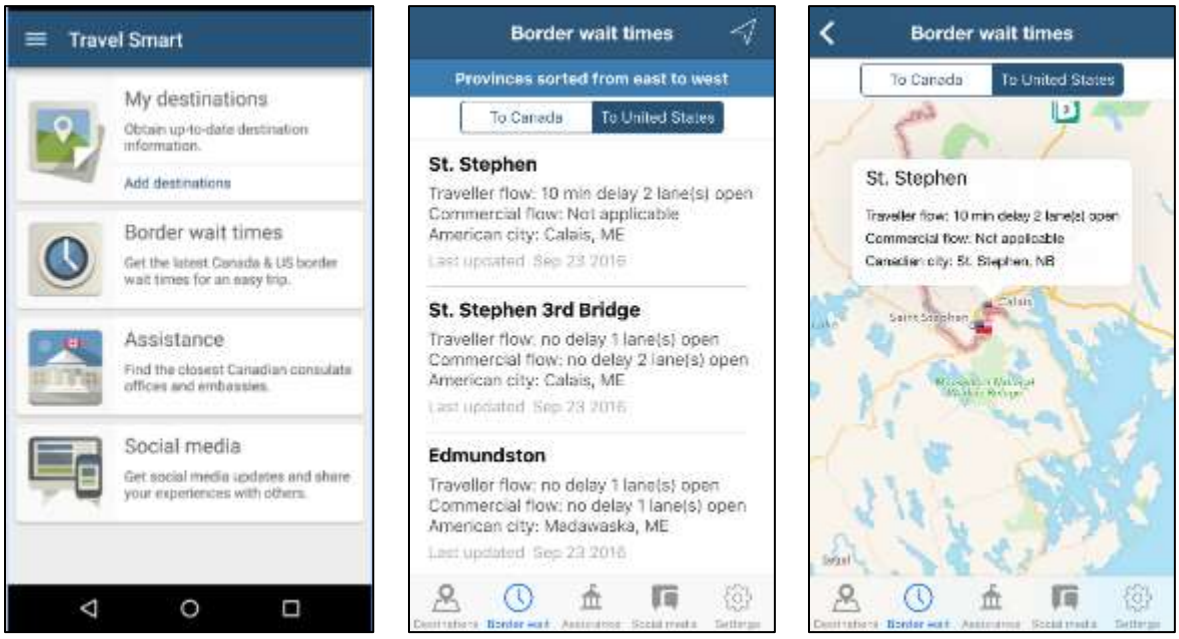


Figure 5: Screenshots of Travel Smart-Canada Mobile App
(Source: https://play.google.com/store/apps/details?id=ca.gc.dfatd.travel.android, retrieved 9/23/16)

6.2 U.S. State Departments of Transportation

This section highlights U.S. State Departments of Transportation that provide border information such as wait times or feeds from traffic cameras around the area for their busiest international highway crossings.

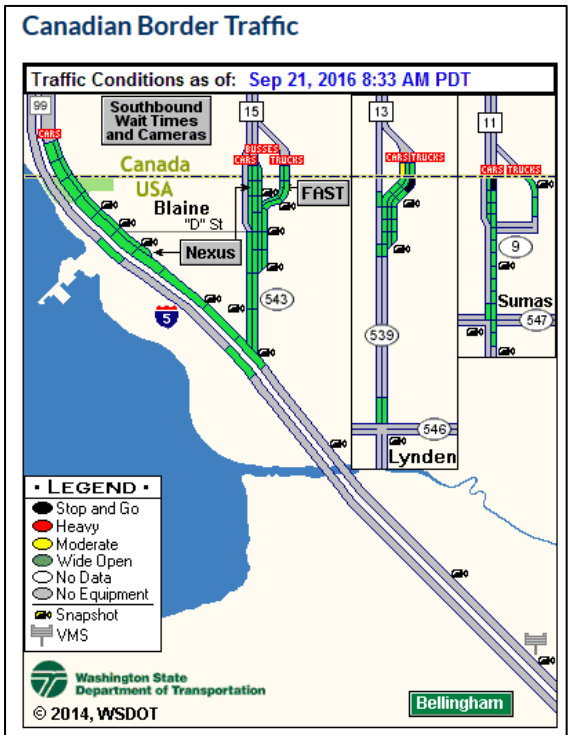
6.2.1 Washington State DOT

Washington State DOT (WSDOT) maintains border crossing information on its Canadian Border Traffic Website[9], WSDOT app, and 511 phone system. Information provided includes border wait times and snapshot camera images (**Figure 6**) at major border crossing locations. Wait times and traffic maps are provided for various lane types (e.g. General Purpose, Nexus, Trucks, Trucks FAST) as shown in **Figure 7**.

The WSDOT website links directly to the B.C./U.S. Border Traveler Information Website[10] hosted by the British Columbia Ministry of Transportation. By selecting "Southbound Wait Times and Cameras" from the WSDOT web page, users are directed to the B.C. Ministry of Transportation website that shows traffic information for southbound from Canada into the United States at the major border crossings into Washington State. See Section 6.3.1 for additional information about the B.C./U.S. Border Traveler Information Website.

The WSDOT app and 511 phone system provide similar information, including a feature in the WSDOT app where users can view northbound and southbound wait times at selected crossings.

Figure 6: Screenshot of WSDOT Camera Image Approaching Border Crossing from Canadian Border Traffic Website *(Source: http://www.wsdot.com/traffic/border/default.aspx retrieved 9/20/16)*



Northbound Border Wait Times 8:30 A.M. Wednesday, September 21, 2016	
I-5 General Purpose	Less Than 5 Min
I-5 Nexus	Less Than 5 Min
SR 543 General Purpose	Less Than 5 Min
SR 543 Nexus	Less Than 5 Min
SR 543 Trucks	Less Than 5 Min
SR 543 Trucks FAST	Less Than 5 Min
SR 539 General Purpose	Less Than 5 Min
SR 539 Nexus	Closed
SR 539 Trucks	Less Than 5 Min
SR 9 General Purpose	Less Than 5 Min
SR 9 Nexus	Less Than 5 Min

Figure 7: Screenshot of WSDOT Wait Times from Canadian Border Traffic Website *(Source: http://www.wsdot.com/traffic/border/default.aspx retrieved 9/20/16)*

6.2.2 Michigan DOT

The Michigan Department of Transportation (MDOT) offers transportation information to the traveling public through the Mi Drive[26] website, the Mi Drive Mobile App, and a Twitter feed. Wait time information is provided for both commercial and passenger vehicles. In addition, border crossing information specific to the Blue Water Bridge international crossing into Canada is available through a Twitter feed which can be viewed at the MDOT Blue Water Bridge Twitter[27] website as shown in **Figure 8**.

Figure 8: Screenshot of Twitter Feed from MDOT Border Information at Blue Water Bridge Website
(Source: https://twitter.com/MDOT_BWB, retrieved 9/23/16)

6.2.3 Texas DOT and Arizona DOT

The Border Crossing Information System[8] website provides border information between the U.S. and Mexico at select Texas and Arizona highway crossings. The website, developed and maintained by the Texas A&M Transportation Institute, was created in partnership with USDOT Federal Highway Administration (FHWA), Texas Department of Transportation (TxDOT), and Arizona Department of Transportation (ADOT). The site offers both expected wait times and crossings times. The starting point for both "wait time" and "crossing time" is at the end of the traffic queue. "Wait time" measures the time for a vehicle to reach the primary inspection booth, while "crossing time" includes the entire time for a vehicle to exit the border crossing process. Crossing times include both FAST and Non-FAST lanes. A screenshot showing real-time expected wait times and crossing times is shown in

Figure 9.

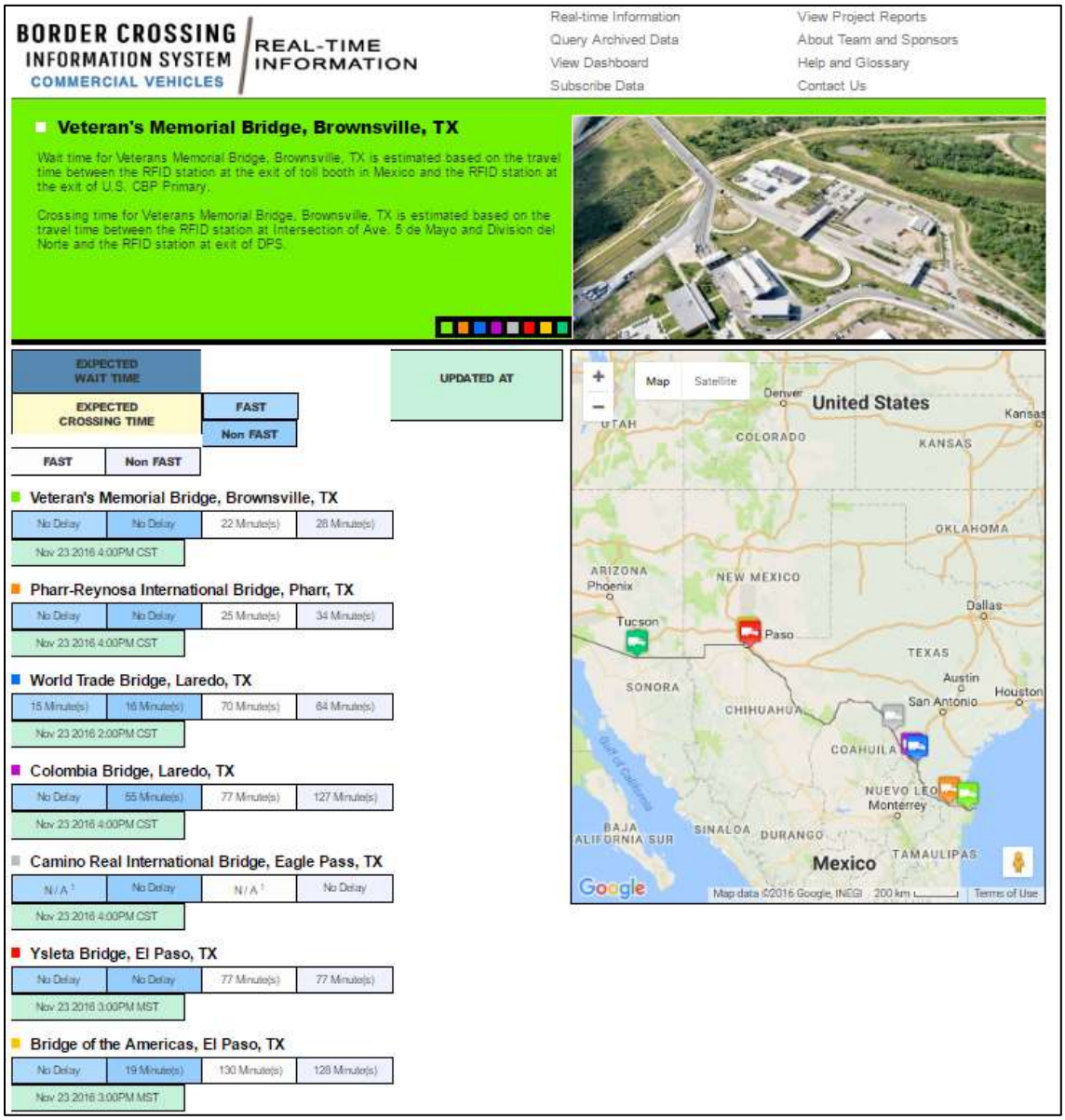


Figure 9: Screenshot of Wait Times and Crossing Times from Border Crossing Information System Website

(Source: http://bcis.tamu.edu/, retrieved 11/23/16)

The Archived Data Query portion of the website provides travelers, including the general public and others such as freight carriers operating commercial vehicles, with a valuable tool to access historical wait and crossing time data over selected time periods. This allows users to view trends to inform decision-making for future trips. **Figure 10** shows examples of archived data query displays from the website.

Figure 10: Screenshots of Archived Data Queries from Border Crossing Information System Website
(Source: http://bcis.tamu.edu/, retrieved 2/9/16 and 2/17/16)

6.3 Canadian Ministries of Transportation

This section features selected provincial transportation agencies that provide border-specific information via traveler information mechanisms.

6.3.1 British Columbia Ministry of Transportation and Infrastructure

The British Columbia Ministry of Transportation and Infrastructure hosts the B.C/U.S. Border Traveler Information[10] website with wait times, camera views, and DMS information. **Figure 11** shows a clip from main webpage, with a DMS message appearing when selecting a "Traffic Sign" icon. **Figure 12** shows the mechanism for accessing data for historical border delays.

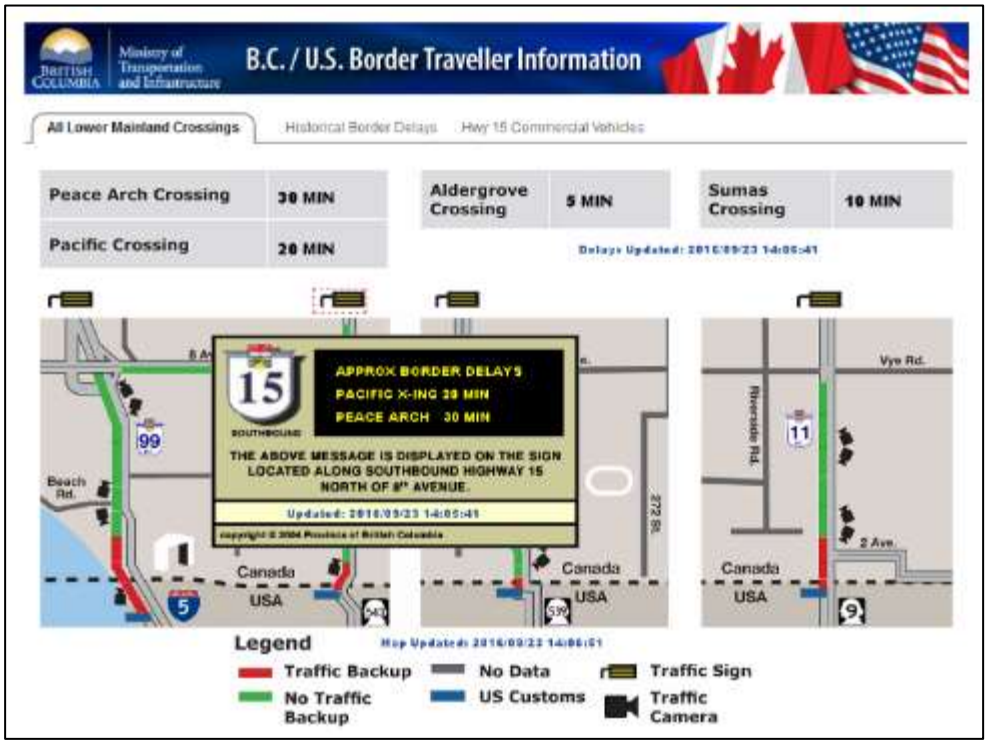


Figure 11: Screenshot of Border Delays from B.C./U.S. Border Traveler Information Website
Source: http://www.th.gov.bc.ca/ATIS/Index.htm, retrieved 9/23/16)

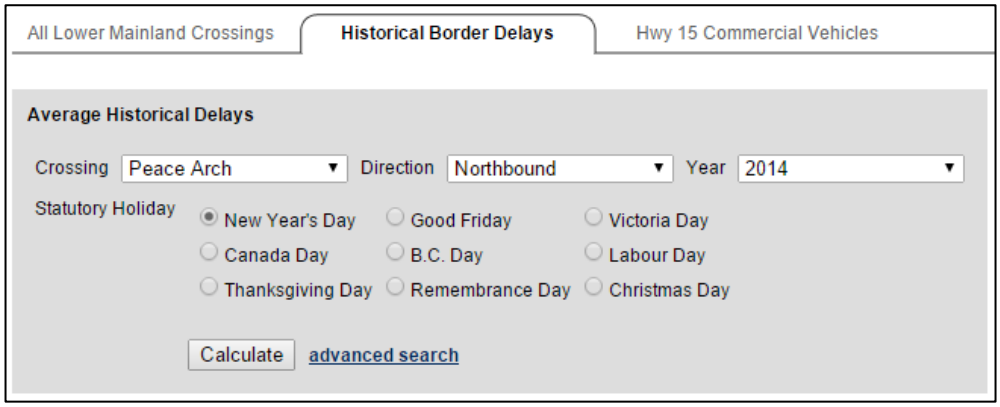


Figure 12: Screenshot of Historical Border Delays from B.C./U.S. Border Traveler Information Website
(Source: http://www.th.gov.bc.ca/ATIS/historical.aspx, retrieved 2/29/16)

6.3.2 Québec Ministère des Transports

The Québec Ministère des Transport provides border information on its Québec 511 website[28]. **Figure 13** shows a screenshot from the "Border Crossings" webpage, with a 5-second video clip that can be viewed when a traffic camera at the border is selected. In addition to the information on the website, the Québec 511 mobile app provides wait times for both passenger vehicles and commercial vehicles.

Figure 13: Screenshot from Québec 511 "Border Crossings" Website
(Source: http://www.quebec511.info/en/cameras/postes_frontaliers/index.aspx, retrieved 9/23/16)

6.3.3 Government of Alberta Ministry of Transportation

The Government of Alberta Ministry of Transportation provides border wait times on its Alberta 511[29] website as shown in **Figure 14**.

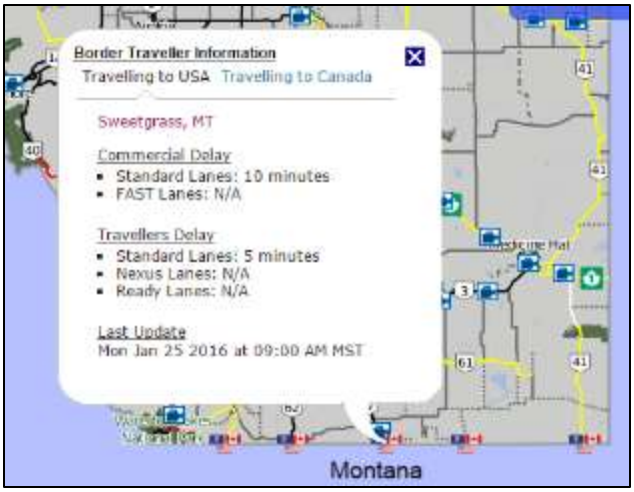


Figure 14: Screenshot of Border Information from the Alberta 511 Website
(Source: http://511.alberta.ca/map, retrieved 1/25/16)

6.4 Other Entities and Resources

In addition to the federal and state agencies that provide border information on traveler information mechanism, numerous other entities provide this type of information, especially via websites and mobile apps. These entities include government or border coalitions, bridge or tunnel owners, or 3rd party website or mobile app developers. These entities may collect their own data (such as wait times) or pull data from other publicly available sources such as the agencies featured in the previous sections. The emergence of new websites and apps is continually growing and changing; this section provides a limited sampling of selected traveler information mechanisms and is not a comprehensive list.

6.4.1 Whatcom Council of Governments

The Whatcom Council of Governments[30] provides a historic border wait time data from U.S.-Canada land ports of entry equipped with wait time measurement systems through the Border Data Warehouse[31]. Data provided includes estimated wait times for ports in the Cascade Gateway region between Washington and British Columbia and the Buffalo-Niagara region between New York and Ontario. Average delays are available by day or for a selected month. Results may be viewed as a graph as shown in **Figure 15** or in a calendar format. Users can access historic wait time information over a designated time period using the query function. Results are presented graphically, are available via Application Programming Interface (API), and can be exported as a CVS file. Users can also subscribe to receive customized data reports.

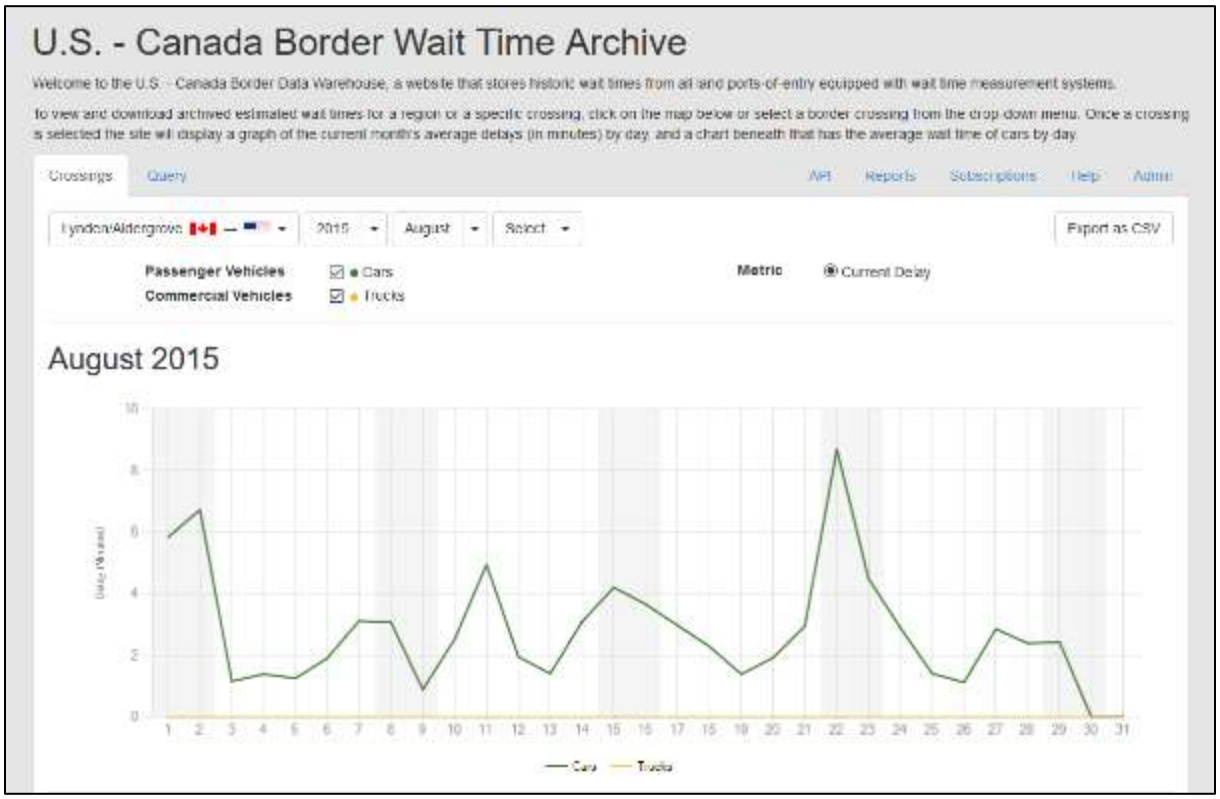


Figure 15: Screenshot of Archived Wait Time Data at Lynders/Algrove Crossing from U.S.-Canada Border Data Warehouse Website
(Source: http://www.borderdatawarehouse.com/Crossings#/laToUsa/2015/8?lanes=Cars,Trucks, retrieved 9/25/16)

The Whatcom Council of Governments also hosts the Cascade Gateway Border Data Warehouse[5], which offers additional data and advanced functionality for crossings specific to the Cascade Gateway region of Washington State – British Columbia. Historical crossing data includes volume, delay, service rate, vehicles in queue, and queue length. Other information available for access includes traffic detector data (volume, occupancy, speed, vehicle length), Weigh-in-Motion, and Bureau of Transportation Statistics (BTS) freight data. These datasets, available for public access, can assist users such as freight carriers and other transportation professionals with planning tasks. **Figure 16** shows traffic detector sites, along with the menu for querying corresponding data. **Figure 17** shows BTS Freight Data.

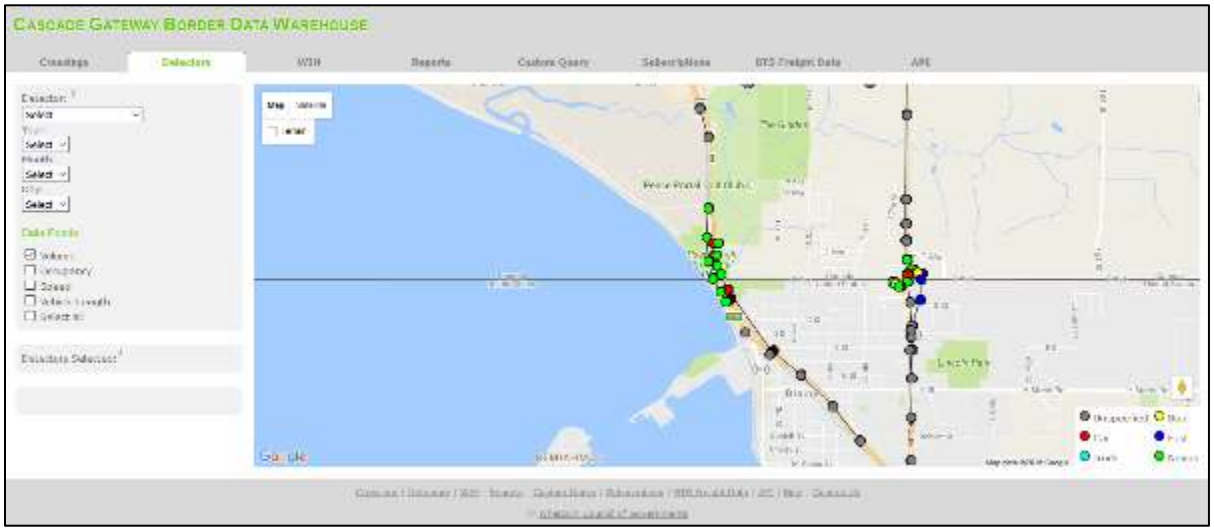


Figure 16: Screenshot of a Traffic Data Query from the Cascade Gateway Border Data Warehouse Website
(Source: http://www.cascadegatewaydata.com/Detector, retrieved 9/25/16)

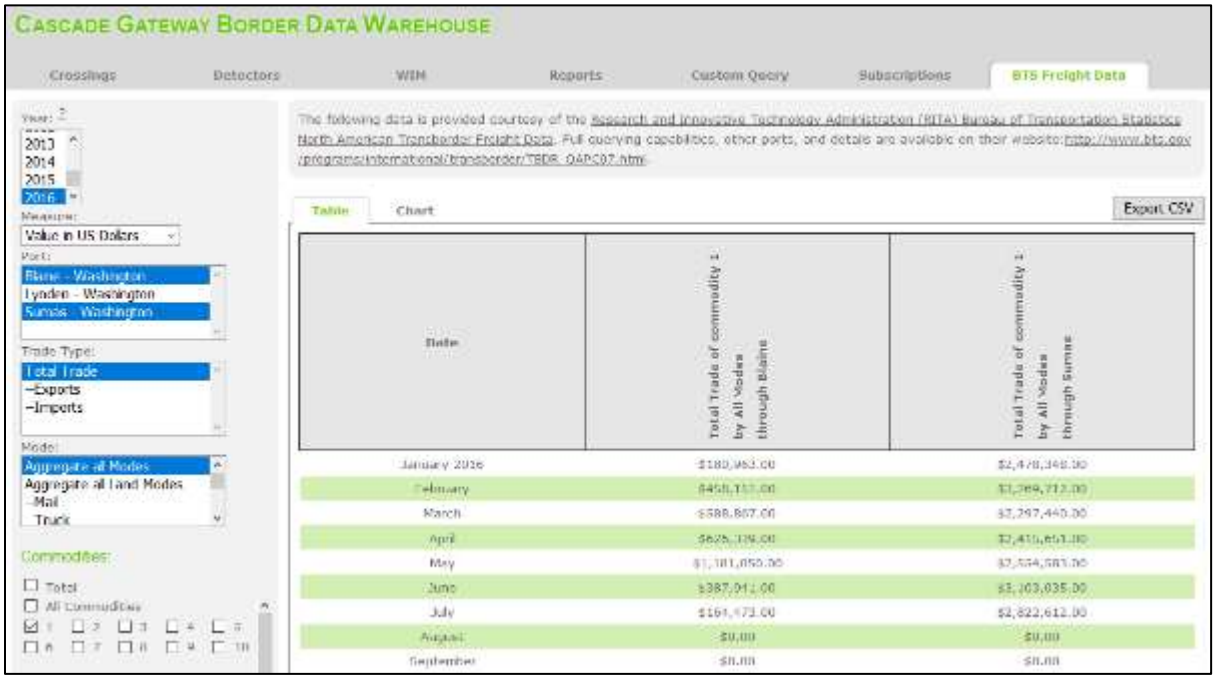


Figure 17: Screenshot of BTS Freight Data from the Cascade Gateway Border Data Warehouse Website
(Source: http://www.cascadegatewaydata.com/Freight, retrieved 9/25/16)

6.4.2 Niagara International Transportation Technology Coalition

The Niagara International Transportation Technology Coalition (NITTEC[14]) collects and disseminates traffic information including border wait times and camera images in the Buffalo-Niagara region. Border information is available on the NITTEC website and a mobile app. NITTEC also offers real-time information through text messaging or email, which serves as a personalized alert system to travelers who subscribe to the service. **Figure 18** shows delay information on the NITTEC website. **Figure 19** shows information available on the NITTEC mobile app.

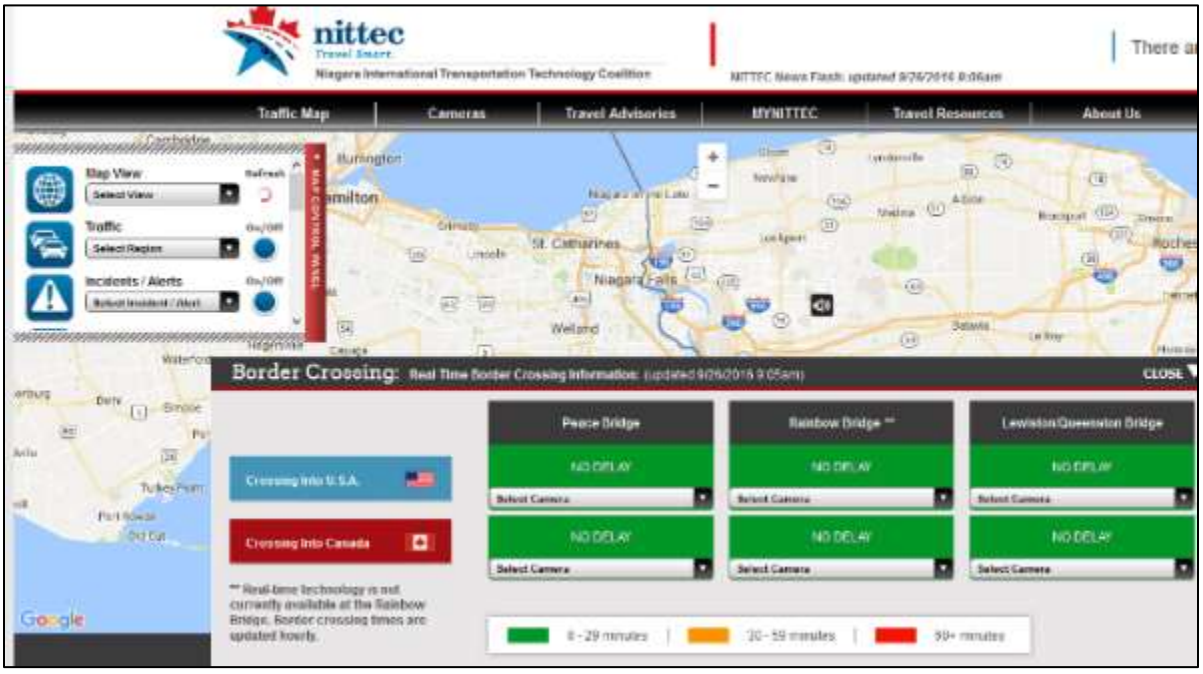


Figure 18: Screenshot of Border Delay Information from the NITTEC Website
(Source: http://www.nittec.org/traffic_map/index.html, retrieved 9/26/16)

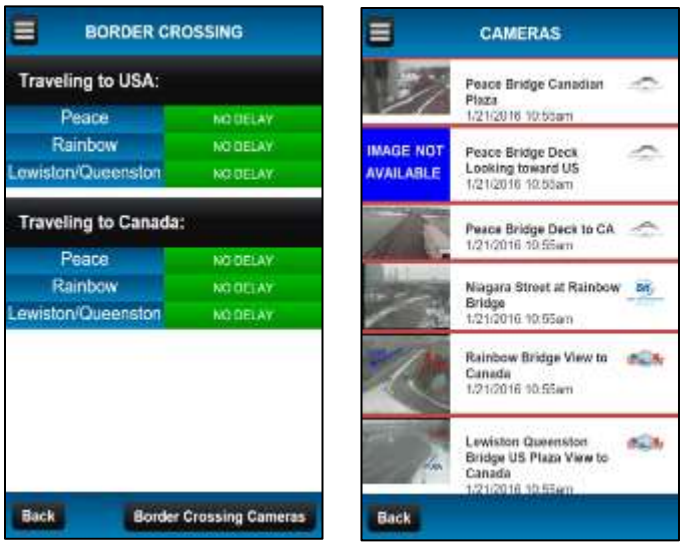


Figure 19: Screenshot of NITTEC Mobile App
(Source: http://m.nittec.org/mobile/index.html#border_crossing and http://m.nittec.org/mobile/index.html#camera_archive, retrieved 2/29/16)

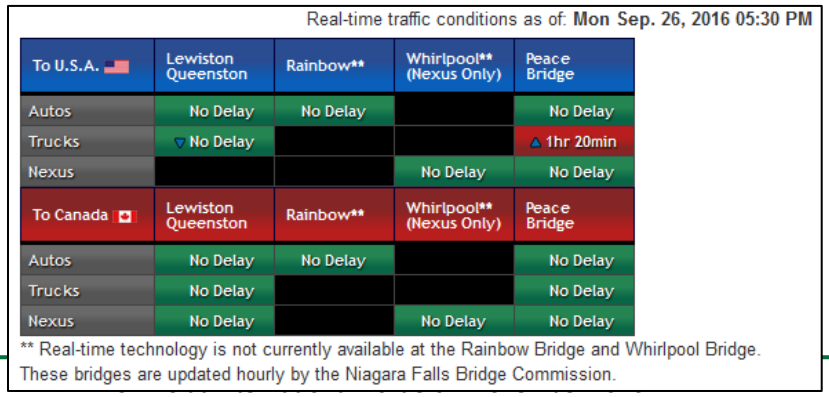
6.4.3 Detroit-Windsor Tunnel

The Detroit-Windsor (DWT) Tunnel[12] website provides traffic information for this U.S. - Canada border crossing including wait times, number of open lanes, and a live camera feed. DWT Mobile is a free app that features border information similar to that offered via the website. **Figure 20** shows a screenshot of the DWT website with a live camera view displayed.

Figure 20: Screenshot of Border Crossing Information from the Detroit-Windsor Tunnel Website
(Source: http://www.dwtunnel.com/, retrieved 9/26/16)

6.4.4 Niagara Falls Bridge Commission and the Peace Bridge

Niagara Falls Bridge Commission[15] and Peace Bridge[16] provide border information via the web for crossings in the Niagara region, including the Peace Bridge, Queenston-Lewiston Bridge, Rainbow Bridge, and Whirlpool Bridge. The Niagara Falls Bridge Commission also offers wait times through Twitter. The Peace Bridge offers a mobile app. Displays from both entities show trends in wait times designated with up or down arrows as appropriate. **Figure 21** shows wait times on the Niagara Falls Bridge Commission website.


Real-time traffic conditions as of: **Mon Sep. 26, 2016 05:30 PM**

To U.S.A.	Lewiston Queenston	Rainbow**	Whirlpool** (Nexus Only)	Peace Bridge
Autos	No Delay	No Delay		No Delay
Trucks	▽ No Delay			△ 1hr 20min
Nexus			No Delay	No Delay
To Canada	**Lewiston Queenston**	**Rainbow****	**Whirlpool** (Nexus Only)**	**Peace Bridge**
Autos	No Delay	No Delay		No Delay
Trucks	No Delay			No Delay
Nexus	No Delay		No Delay	No Delay

** Real-time technology is not currently available at the Rainbow Bridge and Whirlpool Bridge. These bridges are updated hourly by the Niagara Falls Bridge Commission.

Figure 21: Screenshot of Border Wait Times from the Niagara Falls Bridge Commission Website
(Source: http://www.niagarafallsbridges.com/, retrieved 9/26/16)

6.4.5 Best Time to Cross the Border

The California Institute for Telecommunications and Information Technology supports the Best Time to Cross the Border[32] website. This website provides border crossing wait times for vehicles approaching the United States border from Mexico and Canada but does not address wait times for travelers leaving the United States. Current wait times for passenger, commercial, and pedestrian lanes are displayed. Historical hourly and seasonal wait time trends are also displayed as shown in **Figure 22.**

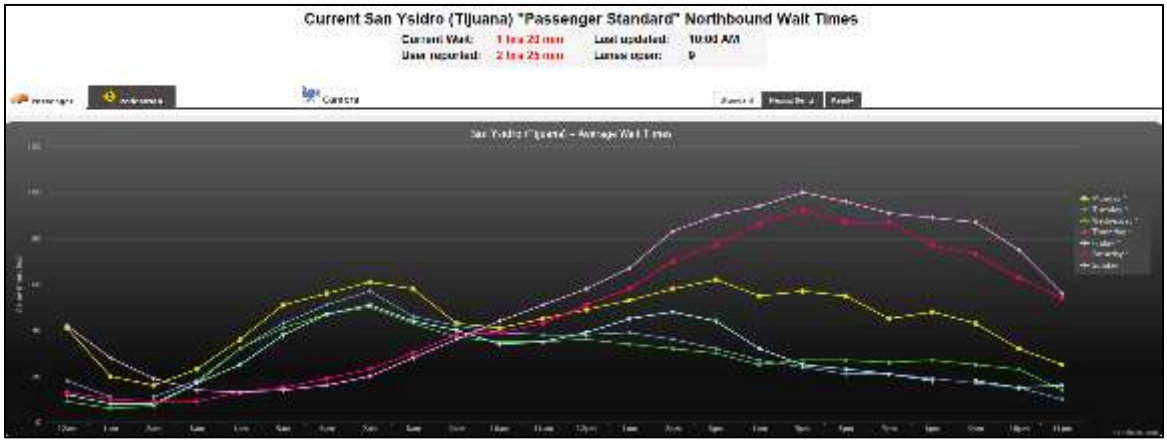


Figure 22: Screenshot of Northbound Passenger Vehicle Wait Times at San Ysidro Crossing from the Best Time To Cross the Border Website
(Source: http://traffic.calit2.net/border/border-wait-times.php?type=passenger&sub=standard&port=250401, retrieved 9/29/16)

The website's companion mobile app, created at the University of California–San Diego, is integrated with Google maps and uses a crowd sourced approach to estimate wait times. The app, shown in **Figure 23** provides wait times updated hourly based on CBP published data, user-reported wait times submitted through the iReport portion of the app, and historical data. The app's integration with Twitter allows users to ask questions and share port information.

Figure 23: Screenshot of Best Time to Cross the Border Mobile App
(Source: https://itunes.apple.com/us/app/best-time-to-cross-the-border/id570288644?mt=8&ign-mpt=uo%3D4, retrieved 9/26/16)

7.0 Summary

This section provides an overall summary of highlights of information gathered for this project.

Engagement Efforts

The project engaged experts from several entities including representatives from state and provincial transportation agencies and other entities that manage highways approaching the United States (U.S.)/Canada and U.S./Mexico borders. During the information gathering phase 34 participants shared current practices for managing traffic at border crossings and nearly 70 individuals joined the key practices webinars.

Traffic Management Practices

Many entities have a formal communication protocol or soon plan to provide guidance in managing traffic at borders. Some agencies that do not have protocols are working to formalize documentation for managing and maintaining communication during border events.

Some entities have dedicated traffic operations staff or centers to manage border traffic. Technology approaches that include queue warning systems, advanced traveler information such as DMS, automated messaging systems to alert and update traffic management personnel during incidents, and weigh-in-motion facilities play a strong role in traffic management and response.

Data Collection and Use

Border crossing entities may utilize data from one or a combination of technologies including RFID, loop detectors, Bluetooth and Wi-Fi to estimate delay at border crossings to assist in traffic management. Each technology presents advantages and disadvantages in terms of cost, maintenance, reliability, accuracy, and sensitivity to environmental conditions.

Technology-based wait time estimation systems are in place at some border crossing sites. At many crossings, however, technology has not been implemented; therefore, data collected manually by border patrol agencies is used to estimate wait times. Arizona DOT conducted a 2-week study to compare Bluetooth and Wi-Fi data for measuring wait times. It was determined that the Wi-Fi technology was more successful in match identification for wait times at border crossings.

Each agency that collects traffic management data (e.g. Bluetooth data, loop detector data) utilizes the information differently. Some agencies use the data to estimate wait times and provide the information publicly via traveler information mechanisms. Others may use the data internally to inform real-time traffic management operations or to assist with planning.

Border Traveler Information

Most entities reviewed either currently provide or in the near future will provide wait times or other border crossing information (e.g. still images or live video from traffic cameras, historical delay data, incident alerts) via traveler information websites, mobile apps, and/or DMS. Entities that provide this information include federal border crossing agencies, state and provincial transportation agencies, border coalitions, bridge and tunnel owners, and third party website or mobile app developers.

There are various information types and levels of sophistication in traveler information mechanisms. The Border Crossing Information System[8] website provides both wait time (end of traffic queue to the primary inspection booth) and crossing time (end of traffic queue to exit of the border crossing process) for current conditions and historical data. The online Cascade Gateway Border Data Warehouse[5] features historical delay data as well as other applicable information including volumes, service rate, vehicles in queue, queue length, traffic detector data, and Bureau of Transportation Statistics (BTS) freight data.

Coordination Approaches

Many entities work closely with their counterparts by interacting on a daily basis to manage incidents. In addition, periodic meetings are often held to coordinate efforts such as planning for upcoming construction projects that affect border crossing times, special event planning, and incident response and management protocols.

Border coalitions such as the International Mobility and Trade Corridor (IMTC) Program and the Niagara International Transportation Technology Coalition (NITTEC) have proven successful in coordinating traffic management activities among a wide variety of stakeholders in regions with high volumes of border traffic. Coalition activities can include dedicated traffic management centers, oversight boards and working committees, annual data tracking and performance monitoring, coordinated planning efforts, and dissemination of traveler information.

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