

ATLANTIC

A Thematic Long-term Approach to Networking for the Telematics & the ITS Community

Work Group 2.3

Electronic Road User Charging Systems and Integration with Smart Cards and Other Payment Systems

POSITION PAPER

-DRAFT-

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1 Introduction

Work Group 2.3 ‘Electronic User Charging Systems and Integration with Smart Cards and Other payment Systems’ is one of eight work groups of the Canadian ATLANTIC project.

In the context of the overall objectives of the Canadian ATLANTIC project, the main objectives of Work Group 2.3 are the following:

- Involve Canadian stakeholders;
- Benefit from experience with Canadian implementations and around the world;
- Identify issues and opportunities for research, development and deployment in Canada.

The report is structured in the form of a position paper that summarizes the current status of technology and implementation of these systems in Canada and identifies issues to be addressed and opportunities to be captured in deploying such systems.

2 Current Status of Road User Charging Systems and Smart Card Implementations in Canada

2.1 Electronic Road User Charging Systems

Electronic Road User Charging systems use different types of technologies to communicate with vehicles, define vehicle category, apply fees and if requirement register and store vehicle information for enforcement purposes.

Some of the technologies used for electronic user charging systems worldwide are summarized in the following:

- Dedicated Short Range Communication (DSRC);
- Infrared technology;
- GPS and GSM;
- Video technology and license plate recognition.

The DSRC and Infrared technology utilize spot (or point) based charging systems. Examples of DSRC systems are the ETR 407, Confederation bridge, etc. There are some examples of Infrared systems implemented in Malaysia.

The GPS/GSM technology allow for wide area charging system. Corridors can be defined around specific zones in urban or rural areas where all vehicles (or specific categories) using roadway will be subject to charges. This technology is being used for the truck tolling systems in Germany and Switzerland.

The video technology can be used to register license plate information and verify status with a central system. This technology can be used as a stand alone system or combined with infrared or DSRC technologies for purposes of enforcement only. Example of this implementation is the ETR 407 and the road user charging system for central London, UK.

Irrespective of technologies used, electronic road user charging systems are further broken down into two separate areas according to location of charging systems:

- (i) Electronic Toll Collection Systems, which are applied mainly of motorways in rural areas and suburbs;
- (ii) Urban Congestion Pricing/Road User Charging Systems which are applied in urban areas.

The main Canadian implementations for Electronic Road User Charging Systems are summarized in Exhibit 2-1. Key points, such as location, operator, commercial name, function, etc., have been provided for each project.

In addition, Exhibit 2-2 provides information about Canadian implementations of DSRC (transponder and roadside antennas) technology for other applications such access management, border crossing, etc.

Exhibit 2-1: Canadian Implementations of Road User Charging Systems

| | Confederation Bridge | Angus MacDonald & Murray Mackay Bridges | Saint John Harbour Bridge | Cobequid Pass | Highway 407 ETR |
|-----------------------------------|--|---|---|--|---------------------------------------|
| Location | Borden, Prince Edward Island (to New Brunswick) | Halifax, Nova Scotia (to Dartmouth) | St. John, New Brunswick | Highway 104, Nova Scotia | Greater Toronto Area, Ontario |
| Operator | Strait Crossing Bridge Limited | Halifax – Dartmouth Bridge Commission | Saint John Harbour Bridge Authority | Highway 104 Western Alignment Corporation Atlantic Highway Management Corporation | 407 ETR |
| Commercial Name | StraitPass | MacPass | Bridge Pass | E-Pass | |
| Initial ETC Operation Date | 2002 | | | 1997 | |
| Function | Transponder ID linked account & credit card for immediate charging. Initially for commercial vehicles. | Transponder ID linked to account for pre-paid charging. | Transponder ID linked to account for pre-paid charging. | Transponder ID linked to account for pre-paid charging | |
| Customer Service | No billing required. Statement is available on Internet. | | | | |
| Plazas – Lanes | 1 plaza – 7 lanes. 2 lanes have ETC. | ETC all lanes | | | Free flow at all entry and exit ramps |
| Gates | Yes | | | | No |
| Video Enforcement | No | | | | Yes |
| Classification | Via database or toll collector. | | | | |
| Toll Amount | \$38.50 to \$219.25 | \$0.75 to \$5.25 ETC discount | \$0.25 to \$1.75 | \$3.50 to \$20.00 ETC Discount | \$0.1295 to \$0.3885 per km |
| Standard | RF Proprietary Backscatter | RF Proprietary Backscatter | RF Proprietary Backscatter | RF Proprietary Backscatter | RF, Proprietary |
| Frequency | 915 MHz | 915 MHz | 915 MHz | 915 MHz | |
| Transponder | Amtech | Amtech | Amtech | | Mark IV |

| | Confederation Bridge | Angus MacDonald & Murray Mackay Bridges | Saint John Harbour Bridge | Cobequid Pass | Highway 407 ETR |
|---------------------------------------|--|--|--|--|--|
| Antenna | Overhead Amtech | Overhead Amtech | Overhead Amtech | Overhead, | Overhead |
| Interoperability – Transponder | Confederation, MacDonald, St. John, Cobequid | Confederation, MacDonald, St. John, Cobequid | Confederation, MacDonald, St. John, Cobequid | Confederation, MacDonald, St. John, Cobequid | None |
| Interoperability – Accounts | None | None | None | None | None |
| Web Site | www.confederationbridge.com/ | www.hdbc.ns.ca/ | www.saintjohnharbourbridge.com/index.html | www.highway104.ns.ca/index.html | www.407etr.com/ |

Exhibit 2-2: Other Applications of the Electronic Road User Charging Systems technology

| | Pearson Airport | Winnipeg Airport | Nexus Border Crossings |
|---------------------------------------|--|-------------------------|---|
| Location | Toronto, Ontario | Winnipeg, Manitoba | Canada & USA Border |
| Operator | | | Various Border Crossings along U.S. – Canadian Border |
| Commercial Name | Toronto Lester B. Pearson Vehicle Monitoring and Control System | | NEXUS |
| Initial Operation Date | 2000 | | 2003 |
| Function | This project automates the airport's dispatching and related operations for Commercial Vehicle Holding Areas and Terminal Curbs, for both annual permit taxis and limousines, using Dedicated Short Range Communications (DSRC) equipment, variable message signs and an integrated central computer system. | | The NEXUS program allows pre-screened frequent travelers between the two countries to use special border crossing lanes. NEXUS identification cards are about the size of a credit card and embedded in the card are a computer chip and a tiny RFID antenna. |
| Customer Service | | | |
| Video Enforcement Standard | | | |
| Frequency | | | |
| Transponder | Mark IV | | |
| Antenna | | | |
| Interoperability – Transponder | | | |
| Web Site | | | |

2.2 Smart Card Systems

This section presents an overview of several existing smart card system implementations in Canada. As well, this section documents the progress of four cities currently deploying smart cards for transit fare collection.

The systems that are examined in this report are:

- Barrie, Ontario;
- Gatineau, Quebec;
- Burlington, Ontario;
- Edmonton, Alberta (in development);
- GTA Region, Ontario (in development);
- Montreal, Quebec (in development);
- Ottawa, Ontario (in development).

2.2.1 Barrie, Ontario

Barrie, Ontario, has a Smart Card program that dates back to 1997 when Scotiabank and Visa Canada ran a pilot program targeting merchants that deal in high volume, low value transactions. Coffee shops, grocers, sports bars, video stores and quick service restaurants were approached because of their high volume turnover and their need for speed when it comes to managing customers. In 1998, five months after the merchant program began, testing began on expanding the service to the buses in the transit system. Soon after, the transit system had one of the ten largest transaction volumes in the city, and specialized transit incentive programs were established, including monthly and weekly discount passes, semester passes for students, \$5, \$10 and \$20 reduced fare tokens.

Presently, the smart card system supports over 350 merchants and 250 vending machines in addition to the public transit system. Merchants pay a fee averaging 1.35 percent based on the volume of their sales by smart card. Merchants are invited to design their own loyalty programs to help boost revenues, and it could be automatically maintained by the smart cards. There are currently 18 loyalty programs offered by merchants and consumers can belong to all of them. The card population in Barrie is in the neighborhood of 50,000 cards. This is quite significant considering the city's population of 100,000. This is attributed to user acceptance of the card across all age groups, including youths and seniors.

2.2.2 Hull/Gatineau

In the fall of 1998, Société de transport de l'Outaouais (STO) began issuing contactless smart cards for the purpose of fare collection on buses. In January 2002 it was rolled-out across Gatineau. Currently, the system supports has incorporated about 210 buses, and also is accepted on the Ottawa-Carleton Transit system with proof of validity.

The cards are re-chargeable/re-loadable, and are accessed when in proximity of the reader (i.e. they are contactless). They have memory capacity that can be used for incentive programs and for authentication/identification purposes. Stored identification data includes Name, Age, Gender and Address of the user for refund purposes.

The smart card system is integrated with the buses Automatic Vehicle Location system that allows for higher-order benefits related to planning and service development. Combining these technologies together allows planners access to smart card usage data as it occurs geographically across the network.

2.2.3 Burlington

The smart card system in Burlington was first introduced for transit payment in 1995. The scope of the smart card system was then expanded as part of the Integrated Mobility Systems (IMS) Consortium, Burlington Transit implemented an on-the-ground demonstration of a multi-modal, multi-application smart card system. The demonstration was launched in October, 2001, and adds on to the existing Burlington Transit ComboCard system to demonstrate:

- Multi-application use of the cards by using the ComboCard for payment at city-operated pools, as well as a loyalty program;
- Multi-modal capabilities of the cards by integrating the Adult GO Transit monthly pass with the existing ComboCard; and
- New payment options through convenient pre-authorized credit card or debit payments.

Users obtain cards for the system for \$5.00 at various issuance locations through the Burlington Transit system. However, once a user has a ComboCard, they can be reloaded/replenished on all Burlington Transit buses, at the Burlington Transit Terminal, and at City pools.

Various incentive programs are offered using the ComboCard. For starters, customers can buy tickets in groups of 10, at a reduced price (\$2.00 for an adult) compared to the single fare charge (\$2.35). If a customer uses the ComboCard three times in one day, any subsequent trips are no longer charged (in effect, a day pass is then costs \$6.00). Finally, users can pay \$71.00 for their ComboCard to act as a monthly pass (31 days).

Burlington Transit has arrangements with GO Transit whereby customers pay an additional \$0.50 and can travel on GO buses to and from the GO Train Service and within the Burlington Transit boundaries. The ComboCard is compatible with this service.

An alternate application that was brought into place through the demonstration was the use of the ComboCard at City Pools. Various incentive programs/pricing discounts have been tested, including free swim entrances for every 10 transit trips as well as discounted pool admission costs when purchased in bulk.

One back office function provided by this system is Pre-Authorized Payments using a credit card or directly from the user's bank account. With this feature, pre-approved customers can have any loading of \$10 or more be automatically charged. The system works by automatically downloading each night all transactions for the day to the Central Database. Once this information is processed, the system communicates with the appropriate banks to complete the requested transactions.

2.3 Smart Card Systems in Development

2.3.1 Edmonton Transit System

Edmonton Transit System (ETS) is considering implementation of a smart card system to meet policy directions set out in the City development plan, and to achieve objectives related to

efficient fare collection, revenue management and control. To that end, they are currently in the process of preparing a “business case” examining issues, questions and concepts that would help Edmonton Transit determine whether the implementation of smart card technology would be of benefit for the organization, customers, and other stakeholders. The business case study is broken down into two phases:

- Phase 1: ‘Definition of smart card system concept and business models’, which defines business model alternatives, prepares an overall system concept, and provides initial equipment costs for an ETS-specific smart card system;
- Phase 2: ‘Development of smart card business case’, will update the business model and complete the business analysis, incorporating costs and benefits and concluding with implementation plan.

2.3.2 GTA Fare System

Presently, all 905 area code municipal transit agencies are planning to replace their fareboxes over the next few years. In addition, GO Transit is looking to replace its current paper ticket/pass fare collection system with one based on smart cards. This has resulted in a unique opportunity to deploy a single GTA Farecard. The single Farecard would allow for seamless travel within the region, allowing customers to ride on any participating transit system without having to know the fare policies of each system in advance.

The contactless smart cards would contain an electronic purse that would provide full fare payment interoperability. It would allow for increased flexibility with respect to incentive programs that could target choice riders.

Three initiatives have been completed to examine aspects of the implementation. An Operational Concept was developed that outlines the policy, functional and technological requirements of the system. Although the TTC has indicated that it would not consider implementation of the GTA Farecard in the foreseeable future, their needs/requirements were nonetheless considered when drafting the concept for the scenario that they should eventually be included in the system. The second initiative was a Business Case Analysis conducted to examine the costs and impacts of introducing a regional farecard system. The final initiative looked at assessing various alternatives for Governance and Business models for implementing and operating the GTA Farecard system.

The above initiatives have been completed, and the agencies have moved on to the next major step of the process. An RFQ for the consulting tasks required for the technical design and procurement of a GTA Fare System has been issued, and work is scheduled to begin on this project by late 2003.

2.3.3 Greater Montreal Area

<tbd>

2.3.4 City of Ottawa

<tbd>

2.3.5 Integrated Mobility Systems

The Integrated Mobility Systems (IMS) initiative was launched in 2000 and is led by Moving the Economy (MTE). The initiative brings together a consortium of service providers, public agencies, and private interests who wish to deliver integrated, sustainable multi-modal and multi-application services to end users through the use of smart card technologies.

The members are:

| Integrated Mobility Systems (IMS) Consortium | | | |
|---|--|--|------------------------------------|
| <i>Project Manager:</i> Moving the Economy | <i>Technical Manager:</i> IBI Group | Ministry of Transportation, Ontario | Toronto Transit Commission |
| GO Transit | City of Burlington | City of Mississauga | Grand River Transit, Waterloo |
| TransLink | STO (Hull) | New City of Hamilton | Edmonton Transit System |
| OC Transpo | 407 ETR Concession Company Ltd. | Toronto Board of Trade | Canadian Urban Transit Association |
| Industry Canada | AutoShare | University of Toronto ITS Centre and Testbed | Green Tourism Association |
| City of Toronto | EasyPark, Vancouver | | |

The IMS members help each other address common barriers toward smart card implementation, including:

- Uncertainty about the current day business case;
- Lack of network infrastructure for systems and communications;
- No set standard for contactless card technology;
- Costs of switching to smart cards, and upgrading the system;
- Lack of consumer education including concerns over privacy and security; and
- Institutional challenges.

To that end, the consortium undertook four activity tracts, beginning in the fall of 2000:

1. Study the feasibility of introducing multi-application, multi-modal smart cards in Canada for transportation, tourism and urban services. This task included identifying business needs, formulating a draft set of business rules, and identifying business models for governance.
2. Develop initial system architecture and recommended practices for implementing and integrating a range of ITS applications. The architecture was developed from an overall system concept and followed an extensive review of the ITS architecture for Canada (<http://www.its-sti.gc.ca/Architecture/english/static/content.htm>).

3. Demonstrate the concept of interoperability of multi-modal, multi-application smart cards through deployment in a medium size urban setting. The deployment in Burlington, detailed in Section 2.2.3 of this report, was the demonstration performed under this task.

Exhibit 2-3 and Exhibit 2-4 summarize the current status of smart card systems implementation in Canada.

Exhibit 2-3: Smart Card Systems Implemented in Canada

| | Barrie | Hull-Gatineau | Burlington Transit |
|---|---|-------------------------|---|
| Location | Barrie, Ontario | Hull/Gatineau, Quebec | St. John, New Brunswick |
| Initial Smart Card Implementation Date | 1997 | 1998 | 2001 |
| Function | Retail Shopping and Transit Fare Collection | Transit Fare Collection | Community Pool Entrance and Transit Fare Collection |
| Standards | | | |
| No. of Cards Distributed | 50,000 | 58,000 | |
| Applications | Retail Store and Transit payment | None | Both Community Pool Centers and Transit Use |
| Modes of Transportations | | | |
| Central System | | | |
| Web Site | | | |

Exhibit 2-4: Developing Canadian Implementations of Smart Card Systems

| | Edmonton Transit System | GTA | Montreal | Ottawa |
|---|---|-------------------------------|------------------|-----------------|
| Location | Edmonton, Alberta | Greater Toronto Area, Ontario | Montreal, Quebec | Ottawa, Ontario |
| Initial Smart Card Implementation Date | In Development | In Development | In Development | In Development |
| Function | Transit Fare Collection | Transit Fare Collection | | |
| Standards | | | | |
| No. of Cards Distributed | N/A | N/A | | |
| Applications | Transit Agencies, Student Services, Parking, Retail, Taxis, Tourism | Other Transit Agencies | | |
| Modes of Transportation | | | | |
| Central System | | | | |
| Web Site | | | | |

3 Experience of Stakeholders

<Input from experts>

4 Issues and Challenge

Stakeholder experience of existing electronic road user charging and smart card systems has provided insight into the outstanding issues and challenges pertaining to further development of these transportation systems.

The issues and challenges tend not to be unique to each type of system instead both systems share common hurdles in their development. The three areas of main concern are:

- (i) Technology;
- (ii) Business Case or Justification;
- (iii) Standards.

With an ever-changing technological environment it is important for system standards to be established providing a simplistic approach to component integration.

5 Opportunities in Canada

A wide-range of opportunities exists throughout Canada for both Electronic Road User Collection and Smart Card Systems.

5.1 Electronic Road User Charging Systems

- Additional applications such as:
 - Parking payment
 - Access management
 - Identification of goods or vehicle
- Interoperability and technical compatibility framework
 - Example of the European CEN TC278 committee standards and the A1 specifications
- Commercial policy and loyalty programs
 - Frequent use of service
 - Use of multiple services
- Public private partnership opportunities
- Other

5.2 Smart Card Systems

- Adoption of standards
- Development of specifications
- Multi-agency systems

- Multi-application systems
- Involvement of the financial sector
- Public private partnership

6 Experts

The following is a list of member groups anticipated for WG 2.3.

- Service providers, such as toll operators, transit operators, etc.
- Financial industry, such as banks, credit cards issuers, etc.
- Suppliers/vendors, such as transponders and readers suppliers, smart cards suppliers, system integrators, etc.
- Authorities and governments, such as city, province and federal authorities;
- Research institutes/consultants.

The following is a list of organization that will be invited to participate in WG 2.3:

- Ministry of Transportation Ontario
- Toronto Transit Commission
- GO Transit
- City of Burlington
- City of Mississauga
- Grand River Transit, Waterloo
- TransLink, Vancouver
- OC Transpo, Ottawa
- 407 ETR Concession Company Ltd.
- Canadian Urban Transit Association
- AutoShare
- Confederation bridge toll system operator
- Coquihalla toll system operator

WG 2.3 will benefit from the IMS (Integrated Mobility System) initiative in establishing and extending the list of experts. IMS is a Canadian consortium of 23 service providers who share the objective of implementing interoperable smart card systems in Canada. IMS is led by Moving the Economy/City of Toronto and technically managed by IBI Group.

7 Conclusion

<td>

8 Initial List of References

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