Future Travel Document for Canadians - Biometrically Enabled Travel Cards

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EXECUTIVE SUMMARY

Canadians enjoy travelling and do not shy away from adventure. Most Canadians travel internationally and almost 67% have a passport. The United States is the most frequently visited country for Canadians, roughly 300,000 people cross the US-Canada border each day (US Department of Homeland Security & Public Safety Canada, 2012 p.2). Although passports are the internationally recognized documents for crossing borders, in order to ensure an ease of flow of travellers, and provide Canadian citizens with convenient alternative to passport books, provincial and federal agencies in Canada have initiated programs to issue other documents that could be used by Canadian citizens to cross the border and visit the United States. The Enhanced Driver's Licence issued by four provinces is acceptable by border officials in both countries. Another document that facilitates travel (between Canada and the US) is the NEXUS card, a federal government initiative for cross-border travellers. The United States has also been issuing Passport Cards for its citizens, a wallet-size travel document only used to re-enter the United States at land border crossings and sea ports-of-entry.

This paper explores the possibility of introducing a Canadian Passport Card, but unlike the US Passport Card, this card would not just enable land border crossing; it would also have the potential to better facilitate air travel. The envisioned Canadian Passport Card would act as a trusted document to allow the traveller to use fully automated services at airports such as check-in, security clearance, automated border clearance, etc.

The question we consider is: *Would the use of biometrically enabled travel cards enhance the clearance and facilitation process at Canadian airports?*

Issuers of travel documents have adopted the innovative RFID (Radio Frequency Identification) chip, and border officials, airports, and airlines have welcomed it – a small chip embedded in the travel document of a passenger. The NEXUS card, Enhanced Driver's Licence, and US Passport Cards have an RFID chip that does not contain personal identifying information; it only stores a database record identifier which, once scanned by an authorized scanner, can retrieve the photo and biodata of the bearer from a secure database. The chip in these documents is a "vicinity-read" chip, which allows a card to be read from a distance of approximately 4 to 5 metres.

In an ePassport, the chip is different. The bearer's personal information and digitized picture are stored on the embedded chip. However, the chip in an ePassport is a "proximity-read" chip and can only be read from a short distance, in a Canadian e-Passport within 10 centimetres of the scanner. The RFID scanner can retrieve the information from the chip, and in some cases it can also perform a biometric algorithm comparison – a computer-based comparison of biometrics, such as a digitized photo in a travel document compared with a new digital image of the individual captured on the spot. The focus of this study is to propose a Canadian Passport Card

that would encompass similar technology as an ePassport, and also be used for land border crossing with vicinity-read chip.

A number of airports have been using this aspect of the ePassport for an innovative passenger handling system – the automatic border clearance (ABC). The success of Incheon International Airport serving Seoul, South Korea is notable. A comparison with Vancouver International Airport shows Canadian airports would also benefit immensely from similar systems. Vancouver has already implemented a form of ABC where eligible passport holders can clear customs faster, but they still need to proceed for a visual inspection of passport by a border officer since the process is not fully automated.

In Incheon airport, passengers using their e-Passports can take advantage of a fully automated system; when departing, they can proceed from airport check-in to self-boarding and when arriving, complete an ABC, with no contact with border officers.

A self-service kiosk, also known as SmartGate in some countries, retrieves the digital photograph from the ePassport chip, creates a template, and stores it in a database. The SmartGate then takes a photo of the traveller's face, converts it into another template, and compares this with the original template created at the kiosk .

A study by Border Research Policy Institute found that passengers with RFID-enabled documents cleared border procedures 33% to 60% faster than non-RFID document holders. A move towards a Canadian Passport Card is recommended, and to make it more attractive to Canadian citizens Passport Canada should consider issuing a card with a dual functionality chip with proximity and vicinity readability. This card would address the needs of millions of citizens living in border communities who frequently cross the border to the United States via land, and air travellers could utilize the proximity-read chip for automated border clearance and other innovative air passenger solutions.

This paper is a preliminary attempt to establish the problem, raise the question about Canadian passport card, explore the potential benefits and challenges and suggest a way forward in terms of further studies. More case studies should be conducted comparing findings of this paper with the experience of other countries. It is an opportune time for exploring other value-added functionalities for a Canadian Passport Card. Further stakeholder consultation and buy-in will also be necessary with CBSA, CATSA, Transport Canada (TC), US Homeland Security, and major Canadian air carriers. As well, further studies should address the technological, political, legislative, institutional, and financial frameworks.

LIST OF ACRONYMS

ABC	Automated Border Control
BAC	Basic Access Control
CATSA	Canadian Air Transport Security Authority
CBP	Customs and Border Protection (US)
CBSA	Canada Border Services Agency
CPO	Canadian Passport Order
EDL	Enhanced Driver's Licence
EIC	Enhanced Identification Card
ePassport	Electronic Passport
FR	Facial Recognition
GOES	Global On-line Enrolment System
IATA	International Air Transport Authority
IIAC	Incheon International Airport Corporation
ICAO	International Civil Aviation Organization
ICBC	Insurance Corporation of British Columbia
MRP	Machine Readable Passport
MRTD	Machine Readable Travel Document
MRZ	Machine Readable Zone
NFC	Near Field Communication
NTWG	New Technology Working Group
OVI	Optical Variable Ink
PKD	Public Key Directory
PKI	Public Key Infrastructure
PPTC	Passport Canada
RFID	Radio Frequency Identification
TC	Transport Canada
UFA	User Fees Act
WHTI	Western Hemisphere Travel Initiative
YUL	Montreal's Pierre Elliott Trudeau International Airport
YVR	Vancouver International Airport

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1. Introduction

This paper examines the possibility of introducing a Passport Card which would enable land border crossing and facilitate air travel. The envisioned Passport Card will act as a trusted document that will allow the traveller to utilize fully automated services at airports such as check-in, security clearance, automated border clearance etc.

Why would the Canadian government be interested in enhancing its existing travel documents?

Airlines and airports are reporting an ever-increasing number of passengers. Meanwhile, security requirements have also been intensifying since 2001, causing additional use of existing security measures and straining efficiency. Instead of expanding airport terminals and employing more staff, both airlines and airports are now looking at process optimization, using more efficient methods to handle passenger volumes and aviation security.

Airport terminal capacities, moreover, are reaching their limits. With increased passenger numbers, the flow through the hubs is slowing down (Költzsch, 2006). In order to address this problem, most North American airports have adopted on-line check-in, paperless boarding, self-baggage tagging, express and remote baggage drop-off and mobile information delivery (McAllister, 2012). Some airports around the world have also adopted self-boarding technology.

Increased security requirements and scarce terminal resources result in passengers spending more time undergoing security checks, waiting in lineups to drop off baggage or board their planes, causing passenger dissatisfaction. As a result, airlines and airports are optimizing their existing capacities and processes by embracing innovative technology. Airports are now relying on non-aeronautical revenue generation (Graham, 2009), which means airports have evolved from public utilities to commercialized and in some cases private entities, motivated to exploit commercial opportunities. Automated processes assure that passengers will spend less time in line-ups and more time in stores and other commercial entities which in return bring in more revenue to the airport. As a means for revenue most airports in Canada are even charging “airport improvement fees” on each ticket sold in order to expand and modernize the terminals.

Airlines have been facing other challenges in the past ten years. Increased fuel prices have given rise to shrinking margins and higher ticket prices. The emergence of new competitors, mostly “low cost” carriers, has forced bigger airlines to restructure and transform their business models. Therefore, airlines are joining airports by partnering and investing further in IT infrastructure in an effort to reduce their overhead cost.

Radio Frequency Identification (RFID) is one such innovative technology that airports and airlines have welcomed. This technology involves a small chip embedded in the travel document of a passenger. The information stored in the chip can be retrieved and used by the airport,

customs, or airline officials simply by scanning the RFID-enabled document. Not only can the RFID-enabled document retrieve the information from a chip, in an ePassport it can also perform a biometric algorithm comparison: a computer-based comparison of biometrics such as a digitized photo in a travel document with a new digital image of the individual captured on the spot; the passenger can check in, clear security, border control, and even board a flight using the same document. A number of airports around the world have successfully implemented this technology.

The use of RFID-enabled travel documents is not new at Canadian/US land borders. The two forms of RFID chip technology used for border management are "vicinity-read" chip and "proximity-read" chip, the difference between the two being the distance at which they can be securely and accurately read. A vicinity-read chip can be read from up to 4 -5 meters away from a scanner, whereas a proximity-read chip should only be few centimetres away from the scanner (Homeland Security, 2007). All alternative travel documents (non-passport), such as Enhanced Driver's Licence (EDL), NEXUS, or US Passport Cards have vicinity-read chips.

1.1 Research Objective

The research question this paper intends to address is this:

Would the use of biometrically enabled travel cards enhance the clearance and facilitation process at Canadian airports?

There has been some discussion regarding streamlining the process of crossing the Canadian border to enter the United States and vice versa. The federal government estimates that about $16 billion is lost annually to regulatory red tape and border congestion under the current system (CBC, December 8 2011). In an effort to tackle this issue, several initiatives have been announced by the federal government, including expansion of the NEXUS program for trusted travelers and adding extra NEXUS lanes at specific border crossings (Action Plan, 2011 p.22). NEXUS members can also take advantage of the US Global Entry program which is a US Customs and Border Protection (CBP) program that allows expedited clearance for pre-approved, low-risk travelers upon arrival in the United States. NEXUS members may enter the United States by using automated kiosks located at select airports (CBP, 2012).

Many Canadians are also utilizing the Enhanced Driver's Licence to cross the border by land. These Enhanced licenses act as a document that provides proof of identity and Canadian citizenship; embedded with Radio Frequency Identification (RFID) capability it allows the border officials to read the information once the card is scanned. It appears that documents with such technology are being favoured at border crossings as they expedite the process (Border Policy Brief, 2012 p.2). If fewer lanes are available for traditional non-RFID documents (e.g.

regular passports), which leads to longer wait times in these lanes, there may be growing demand for RFID enabled documents. Canadian ePassports will be introduced in the coming year which is also an RFID enabled document, however the RFID chip is a proximity-read chip which is not similar to other documents used at Canadian and US land borders.

The Western Hemisphere Travel Initiative (WHTI) introduced new regulations on travel document requirements for entry into the United States. These new requirements were rolled out in two phases: Phase 1 went into effect on January 23, 2007 and affected air travel into the US from other Western Hemisphere countries (such as Canada, Mexico, Caribbean nations, and Bermuda), making it mandatory for travellers going via air to the United States to present a valid passport. Phase 2 went into effect on June 1, 2009 and affected entry into the US at land and sea ports. Before the implementation of the WHTI, Canadian citizens travelling to the United States did not require a passport or any other "WHTI compliant document" such as the NEXUS card, or an enhanced driver's licence to cross the border (CBSA Fact Sheet, 2010).

Passport Canada reported a total of 3,663,182 passports issued (Passport Canada 2006–2007), compared to 4,836,784 issued in 2007–2008 fiscal year (Passport Canada 2007–2008). For many Canadian travellers, the United States is a top destination, either for short day trips or overnight visits (see Figure 1).

Figure 1: Travel by Canadians to foreign countries, top 5 countries visited

	2010		
	Overnight visits		
	Visits	**Nights**	**Spending in country**
	thousands		***C$ millions***
Country visited			
United States	**19,964**	**160,943**	**14,730**
Mexico	**1,354**	**14,551**	**1,427**
Cuba	**1,010**	**8,410**	**748**
United Kingdom	**880**	**10,683**	**1,011**
Dominican Republic	**753**	**6,392**	**664**
Source: Statistics Canada, Tourism and the Centre for Education Statistics.			

If this relatively large proportion of Canadian travellers chooses the United States as their preferred destination and does not travel to other international destinations, they may benefit by applying for a more convenient travel document – a Canadian Passport Card. Similar to the Passport Cards issued in the United States, this Canadian card would also have RFID technology and better facilitate crossing the border.

This paper will explore the possibility of introducing a Canadian Passport Card, but unlike the US Passport Card this card will not just have RFID technology to enable land border crossing but also the potential to better facilitate air travel i.e. use both vicinity and proximity chips. The envisioned Canadian Passport Card will act as a trusted document that will allow the traveller (domestic or to the United States) to check-in, clear security, and board an airplane. The objective of this report is to examine if a Canadian Passport Card could be a viable option and become another travel document, not only for land travel to the United States, but also travel by air to the United States and perhaps other destinations. Could this card extend its functionality to facilitate the airport experience (check-in, security clearance, border clearance, and self-board)?

1.2 Research Rationale

This project is relevant, given the changes to land border management described in the previous sections which may encourage the development of an RFID-enabled card. While this is all in the exploratory stage, if a new product was to be developed by Passport Canada to meet the travel needs of Canadians, then it is an opportune time for exploring other value-added functionality. As airports and airlines have been experimenting with technology to facilitate travel and enhance the airport experience through automation and self-service, they appear to be likely partners if such a platform is developed.

Internationally, we are witnessing increasing use of facial recognition technology in facilitation schemes that leverage documents containing chips with digital photos of the bearer. An RFID-enabled passport card would contain this type of chip. Some RFID documents only transmit file numbers that are linked to databases containing identity information of the traveller. The chip envisioned for a card however, would contain personal information of the traveller and a digital photo, with associated privacy safeguards.

The idea of issuing a passport card of some sort was raised during public consultations in April-May of 2010 as part of the ongoing *User Fees Act* (UFA) process, whereby government agencies must consult Canadians, prior to the announcement of a new fee proposal to Parliament.

1.3 Methodology

Given that there are a number of different documents currently being used by Canadian and US citizens to cross borders via land, sea, or air, the initial section of this paper will be devoted to understanding each of these documents – the technology used and how each one facilitates travel. The paper will then examine an airport that has adopted a biometrically enabled form of technology for processing passengers. In order to assess the potential implications of this type of card, the paper will analyse passenger processing time, from check-in to boarding for international departures. These data will then be compared to a Canadian airport, Vancouver International (YVR).

A number of airports around the world have implemented similar technology and are processing passengers using ePassports, utilizing the biometric data stored in the ePassport chip. Our main interest is whether Passport Cards could be the future for Canadian air travel? If so, we should assume the technology that will be used to produce Canadian Passport Cards will be similar to the ePassport, i.e., a similar chip, with similar data, and similar functionality.

1.4 Limitation of the Report

The focus of the report is largely on air travel. However most alternative documents referred to in this report is utilized by Canadian and US residents for land border crossing, therefore there will be occasional reference to other modes of travel, in particular land border crossing.

This report is a preliminary attempt to highlight the problem, raise the question about Canadian passport card, and explore the potential benefits. Therefore it will be premature to delve into the cost of producing a Canadian Passport Card, and other in-depth technological matters. This report will mainly focus on privacy and security issues around travel documents, and will act as a starting point for further research.

1.5 Organization of the Report

Since a passport is the most commonly accepted travel document for international borders, in Chapter 2, I provide some background on the evolution of International Civil Aviation Organization (ICAO) standards for passports, the introduction of ePassports, and the technology used and privacy concerns around the use of such technology. I then analyse alternative travel documents used by Canadian and US citizens such as the Enhanced Driver's Licence (EDL), NEXUS cards, and US Passport Cards. I will highlight the technology used, the privacy issues raised, and mitigating strategies to address the concerns of citizens.

Most of these documents have now incorporated RFID technology, a chip that allows an authorised reader to access the bearer's information. In this paper, I expand on the RFID technology. I also touch briefly on what a biometric system is and how it is stored in an RFID chip and retrieved for the purpose of identifying the bearer of a document.

In Chapter 3, I explore how these documents are being used to enhance security and at the same time facilitate passenger movement through airports by studying Incheon International Airport, which provides passengers with fully automated services, from self-check-in to use of departure gates to self-board flights using RFID-capable passports (ePassports). I use Incheon International as a successful case study and compare the ease of travel between Incheon and

Vancouver International Airport, where there has also been some success in using automated customs clearance and other such innovative solutions, and where there may be further interest in adopting innovative processes.

In Chapter 4, I then investigate the concept of introducing a Canadian Passport Card. As mentioned earlier, the demand for passports and other travel documents has increased since 2007 with the introduction of the WHTI. In order to provide added service to citizens, Passport Canada may need to look beyond its core business of issuing passport books and broaden its service to provide alternative documents such as a Canadian Passport Card. This format of travel document would be smaller and more convenient for Canadian travellers. The envisioned technology for the Canadian Passport Card should permit not only travel across land border crossings but also facilitate air travel. Its technology could be used by airlines and airports for quicker check-in, clearance, and boarding.

In closing this exploratory paper in Chapter 5, I identify areas where further studies will be required and in Chapter 6 provide some concluding remarks.

2. Travel Documents

2.1 Introduction

New technologies, such as using physical or behavioural characteristics for the purpose of identification and verification, known as biometrics (Mitcham, 2005, p.211) and RFID tags, are increasingly being promoted as a means of assuring people's identity. In this section, I briefly review the evolution of passports, specifically four different travel documents issued in Canada and the United States and provide a brief introduction to the technologies used in each type of document: (1) Current Canadian passport (2) ePassport, (3) NEXUS card, (4) Enhanced Driver's Licence, and (5) US Passport Card.

The ePassport as compared to other documents has a relatively sophisticated technology. The ePassport stores personal information as well as biometrics and therefore allows for computer-based verification, with increased security and greater efficiency. The computer authenticates the individual presenting the document after comparing the biometrics with the stored data. Since the type of RFID chip used by each document is important and will be highlighted in this paper, Section 2.4 provides a brief review of RFID and types of chip.

Section 2.5 - 2.7 describe the NEXUS card, Enhanced Driver's License and US Passport Card which also have RFID chips; but unlike the ePassport, these chips do not hold any personal information. Instead they have a unique identifier number that points to information in a secure database, which can be retrieved only by an authorized organization.

Since the focus of this paper is on Canadian Passport Cards, I will examine and compare the more secure proximity chip of the ePassport with the vicinity chip of the Passport Card, Public Key Infrastructure (PKI) of the ePassport and US Passport Cards in detail.

In section 2.8 and 2.9 the privacy issues concerning RFID technology will be discussed along with Privacy Commissionaire's comments and section 2.10 will highlight some mitigating strategies. I will then move onto some details on biometrics in section 2.11 and the remainder of the chapter will compare the documents and what the future holds for these documents.

2.2 Evolution of Passports

The International Civil Aviation Organization (ICAO) is the United Nations agency created to promote aviation standards in facilitation and security through cooperative multilateral regulation. ICAO establishes international standards for travel documents.

An important aspect of international travel and border security is the need to establish that a traveller presenting a travel document is the person to whom the document was issued legitimately by a state. In order to make the passports secure, ICAO established standards for printing of the machine readable zone (MRZ) (Vaudenay & Vaugnoux, 2007, p.2). This is a set of two lines of data on a passport that are printed using a standard format and font (called OCR-B), as shown in Figure 2. The MRZ replaces typed or handwritten personalized information, which were easy to alter. The MRZ has a standard format showing bearer's name, date of birth, and other details as well as arithmetically derived security verifying check digits.

Figure 2: Machine readable passport (Canada)

Machine Readable Passport (Canada)

Image from Passport Canada website:
http://www.ppt.gc.ca/pptc/specifications.aspx?lang=eng

In 1995, ICAO recognized that computerized biometric comparison is a better and secure way to link the travel document to its rightful bearer (ICAO-NTWG, 2007, p.6). ICAO's New Technologies Working Group (NTWG) began examining various technologies to accomplish

this objective. As a result of that effort, the NTWG developed specifications for an enhanced Machine Readable Travel Document (MRTD); this type of travel document would have an embedded integrated circuit (IC) chip encoded with biometric information. A passport containing such a chip with stored biometric information conforming to ICAO specifications is called an ePassport (ICAO-NTWG, 2007, p.16).

In these chip-enabled passports, the biometric data stored are placed there by the issuing state through the use of special electronic "document signing" information that can be validated and associated only with that issuing state (Passport Canada, 2012a). These chips are encrypted and can only be verified by authorised party. The verification of this "digital signature" is performed using Public Key Infrastructure (PKI) techniques. PKI is a worldwide standard-based encryption scheme for ePassport chips that can be verified by border control. Details on how the PKI technique works are elaborated in Section 2.7c of this paper.

2.3 Current Canadian Passport

Section 2 of the Canadian Passport Order defines a passport as an official Canadian document that shows the identity and nationality of the person for the purpose of facilitating travel by that person outside of Canada (CPO article 2). The regular Passport book is issued to Canadian citizens for a maximum validity of 5 years.

The current passports are printed using the state of the art printing technology. This printing technique digitally prints and integrates the personal information, including photo and signature, into the page. Some of the security features of the passport include using optically variable ink (OVI), i.e. ink changes colour as the page is viewed from different angles. Also, there is a series of holographic images embossed on the information page and under a ultraviolet light, a copy of the bearer image appears on the right side of the data page (Passport Canada 2012c).

The passport issuance system follows a stringent guideline. Passports are issued to Canadian citizens only. This document reflects the identity of the bearer which is determined by documentary evidence of citizenship and documents to support identity.

a) Privacy

All personal information provided to Passport Canada on a passport application form is protected and used in accordance with the provisions of the *Privacy Act*. Personal information is collected by Passport Canada under the *Canadian Passport Order*, to determine the applicant's current and ongoing entitlement to a Canadian passport, to administer passport services

2.4 Canadian ePassport

As announced in Budget 2008, the Government of Canada committed to an electronic passport with a 10-year validity period (Department of Finance Canada, 2008, p.186). To prepare for full implementation of the ePassport, Passport Canada launched a pilot for diplomatic and special ePassports, with the first of these issued in January 2009. Now, more than 36,000 have been issued with no reported problems (Passport Canada Annual Report 2010–11). Starting in the spring of 2013, all new Canadian passports issued will be ePassports. These passports will have an electronic chip embedded in the back cover of the book. The chip in the ePassport will store the same personal information that is seen on the biodata page of the passport (except for the holder's signature), the photo, and a country-specific "digital signature" to prove that the passport was issued by the Government of Canada (Passport Canada, 2012b).

a. Technology

The ePassport contains an embedded contactless computer chip (proximity-read) and antenna using RFID technology. The designed operating range of the chip circuitry is very small; it must be held within 10 centimetres of the reader (Passport Canada, 2012b).

The ePassport bearer's personal information and digitized picture are stored on the chip. To prove this data has not been tampered with and is authentic, a security feature called "passive authentication" is performed – which cryptographically verifies the digital signature of the data stored on the chip and traces the signature back to the issuing authority. This way, it can be determined if the issuing authority actually stored the ePassport data on the chip and it has not been tampered with (Passport Canada, 2012b).

b. Privacy

The personal information stored on the chip is privacy protected by basic access control (BAC), a secure mechanism that ensures that ePassport readers will only be given access to the information on the chip if the data page machine-readable zone or MRZ (at the bottom of page 2 of the Canadian ePassport) has been read (Passport Canada, 2012b). Basically, if the reader can prove to the chip that it has scanned and has knowledge of the printed MRZ, the chip can be read. This is based on the principle that if a passport is open for border authority verification, the bearer is allowing it to be read. When information is first stored on the chip, the chip is locked and no data can be added or changed without invalidating the passport. Due to these security measures, the Canadian ePassport does not need a protective sleeve or case to prevent unauthorized parties from reading the data on the chip (Passport Canada, 2012b).

A primary benefit of ePassports is automated border clearance (to be discussed in detail in Chapter 3). In such situations, a passenger presents the travel document to an automated reader device, which reads the passenger's biographical information and biometrics from the contactless chip. Then, when the passenger's facial or iris image is captured in the reading system, the stored biometric image is compared to the one presented. If the images match, the traveller may pass through immigration without interacting with an immigration officer.

2.5 RFID Basics

RFID technology is not new; in fact, it has been commercially available in one form or another since the 1970s. It can be found in car keys, employee identification cards, highway toll tags, and security access cards. There are generally two types of RFID technology for border management – vicinity-read and proximity-read:

- Vicinity RFID-enabled documents can be securely and accurately read by authorized readers from up to 20 to 30 feet away.
- Proximity RFID-enabled documents must be scanned in close proximity to an authorized reader and can only be read from a few centimeters away.

(Hagl & Aslanidis, 2009, p.9)

A study by the Border Policy Research Institute claims that RFID-enabled documents are favoured at border crossings since they can reduce delays (Border Policy Brief, p.2). For instance, it takes some time to check a traditional identification document (non-RFID). The process typically includes handing the document to a border officer, who must review the information on the document and authorize the bearer to pass, record the bearer's passing, or, if appropriate, detain the bearer. The border officer must also compare the information on the document with the bearer to ensure that the bearer is the person identified by the document. An RFID-enabled document, however, can quickly communicate information from the document to a reader at a distance. Transmitting information in advance can allow information to be readily available for verification before an individual approaches a border booth or checkpoint.

While this may improve efficiency at the borders and checkpoints, the border officer must still review authorizing information and compare the information from the card with the bearer in order to ensure that the RFID document is being carried by the person with whom it is associated. We will discuss later how this aspect of the process can also be automated by using biometrics.

2.6 NEXUS Card (Joint US/Canada program)

NEXUS is designed to expedite the border clearance process for low-risk, pre-approved travellers into Canada and the United States. CBSA and US Customs and Border Protection (CBP) are cooperating in this joint venture to simplify border crossing for members while enhancing security (CBP, 2012).

Once the application for a card is complete and accepted, the applicant is asked to provide an iris scan and fingerprints. An important point to note is that the biometrics provided (iris scan and fingerprints) are not stored on the chip itself but in a secure database that can be accessed only through an authorised chip reader. NEXUS members receive a membership identification card to use when entering Canada or the United States at all designated NEXUS air, land, and marine ports of entry. Membership enables travellers to save time by:

- using automated self-serve kiosks in dedicated areas at designated international airports;
- using designated lanes at the land border; and
- NEXUS holders can use the "Trusted Traveller Canadian Air Transport Security Authority (CATSA) Security Line" at major Canadian airports to expedite airport pre boarding security screening.

  (CBSA, 2012)

NEXUS members can also use the US Global Entry program. This program allows expedited clearance for pre-approved, low-risk travellers upon arrival in the United States.

a. Technology

The NEXUS card has the bearer's name, surname, and date of birth, issue date, expiry date and photo. The NEXUS card also has a vicinity-read chip containing a unique identifier (reference number) to a data base, along with an RFID antenna. For land border crossing, the traveller uses the designated NEXUS lane, holds the membership card in front of the card reader. The information associated with the reference number is instantly displayed on a computer monitor inside the border agent's booth. The customs official then performs a visual inspection and the traveller(s) may cross the border and proceed into the United States or Canada (CBSA, 2012).

In case the border crossing is not equipped with RFID scanners, the NEXUS card has a machine-readable zone that can be scanned by a border officer.

An added feature of these cards is the iris recognition biometric technology that works with the unique patterns of the iris (the coloured ring around the pupil of the eye). At the time of application, a photograph of the bearer's iris is taken, and the patterns are processed and encoded into a record that is stored and used for comparison any time a live iris is presented for verification. When using the self-serve kiosk at airports, the system compares the live irises with the record stored in the database (CBSA, 2012).

b. Privacy

Since this is a joint US/Canada project, the program is subject to both countries' privacy acts and regulations. The information an applicant provides, including supporting documentation and biometric data, is collected under the *Customs Act* and is protected under the *Privacy Act*. The privacy statement clearly indicates that the information may be shared with other government agencies in Canada and the United States.

2.7 Enhanced Driver's Licence (EDL) or Identity Card (EIC)

An Enhanced Driver's Licence (EDL) is a Western Hemisphere Travel Initiative (WHTI) compliant document which shows the identity and citizenship of the bearer and can be used as a passport alternative at Canada-US land and water border crossings. The EDL is a dual-purpose document. Applicants are required to provide documentation that supports their identity and Canadian citizenship. The issuing authorities examine the citizenship documents presented. If applicable, they will cross-check the information applicants provide about their citizenship with vital statistics data from the applicant's respective province (ICBC 2009).

EDLs are available in the provinces of British Columbia, Ontario, Quebec, and Manitoba. EICs are available in the provinces of British Columbia and Manitoba.

a. Technology

Similar to the machine readable zone in a passport, the EDL has a machine-readable zone and an RFID vicinity-read chip. Similar to the NEXUS card the chip in each EDL has a unique identifier number that points to information in a secure database stored at the Canada Border Services Agency (CBSA). No personal information is stored on the chip. US land border crossings equipped with RFID readers will read the unique identifiers as travellers approach the border crossing. Officers then use the identifiers to access information about specific EDLs from

the CBSA's secure database, which helps to facilitate and expedite traveller processing at the US border (Service Ontario, 2012).

In case the border crossing is not equipped with RFID scanners, the EDLs also have a machine-readable zone that can be scanned by a border official. The inclusion of RFID technology in the EDL is a US requirement; however, no personal information can or will be transmitted via the EDL RFID chip (CBSA fact sheet, 2009).

b. Privacy

The inclusion of RFID technology in the EDL is a US requirement; however, no personal information can or will be transmitted via the EDL RFID chip. (CBSA fact sheet, 2009) The issuing authorities for these documents have been working with provinces, government privacy officials, and the Office of the Privacy Commissioner of Canada to ensure that all Canadian privacy requirements are met in the development and implementation of these documents.

According to a news release by CBSA in 2009, CBSA is the intermediary between the provincial licensing authorities and US CBP. Provinces share their EDL data with the CBSA and the information is stored in the CBSA's secure database. EDL cardholder information that is disclosed to the CBSA is protected under the provisions of the federal Privacy Act and respective provincial privacy legislation.

When an EDL holder seeks to enter the United States by land, US CBP will use the unique identifier from the traveller's EDL RFID chip to contact the CBSA's secure database. The CBSA will then forward encrypted information over a secure line connection. This is the only information that the CBSA will disclose to US CBP, the biodata of the bearer of the document, citizenship, photo and expiry date of the document (CBSA, 2009).

In a document issued by the Insurance Corporation of British Columbia (ICBC), titled "Privacy and information sharing and BC's enhanced driver's licence program" ICBC claims that an EDL holder's driving qualifications, driving conviction history, penalties or medical conditions are not disclosed to the CBSA or to any other authority. The document goes on to explain that the Government of Canada has signed an information-sharing agreement with the US government that restricts the use of personal information related to the EDL program. When an EDL holder enters the United States, his or her information is retained in a secure US CBP database as a border-crossing record. This is no different than if a traveller were to use his or her passport. US CBP may store, use and disclose a traveller's personal information to determine his or her eligibility to enter or remain in the United States or for any other purpose authorized by US law (ICBC, 2009).

2.8 US Passport Card

The US Passport Card is the wallet-size travel document that can only be used to re-enter the United States at land border crossings and sea ports-of-entry from Canada, Mexico, the Caribbean, and Bermuda. The card is a less expensive, smaller, and convenient alternative to the passport book for those who travel frequently to these destinations by land or by sea (US Department of State, 2011a). The chip contains a unique identifier number which identifies a stored record within secure government databases. The card is issued with a protective sleeve that prevents the card from being read when not in use (Department of State, 2011b).

Both the passport card and the traditional passport book (in US) are issued on the basis of the same documentary requirements: Application forms, and examination standards for establishing citizenship and identity. US citizens are able to hold both a passport card and a traditional passport book concurrently (Department of State, 2011b).

a. Technology

The chip in a US Passport Card is a vicinity-read RFID chip. Similar to the RFID chip in an EDL/EIC and the NEXUS card there is no personal information written on the electronic chip itself. The vicinity-read technology conforms to International Standards Organization (ISO) specifications (Department of State, 2011a).

The ePassport is the only travel document that has proximity-read technology, which means that enabled documents must be scanned in close proximity to an authorized reader (Department of State, 2006).

b. Privacy

The same privacy standards that apply for US passports apply to US Passport Cards. Passport information is protected by the provisions of the *Privacy Act* passed by Congress in 1974. Information collected for the purpose of issuing passports and/or Passport Cards may be made available to other government agencies and private contractors to assist the US Department of State in adjudicating passport applications. This information may also be available to law enforcement officials or pursuant to a court order issued by the court of competent jurisdiction (Department of State, 2011a).

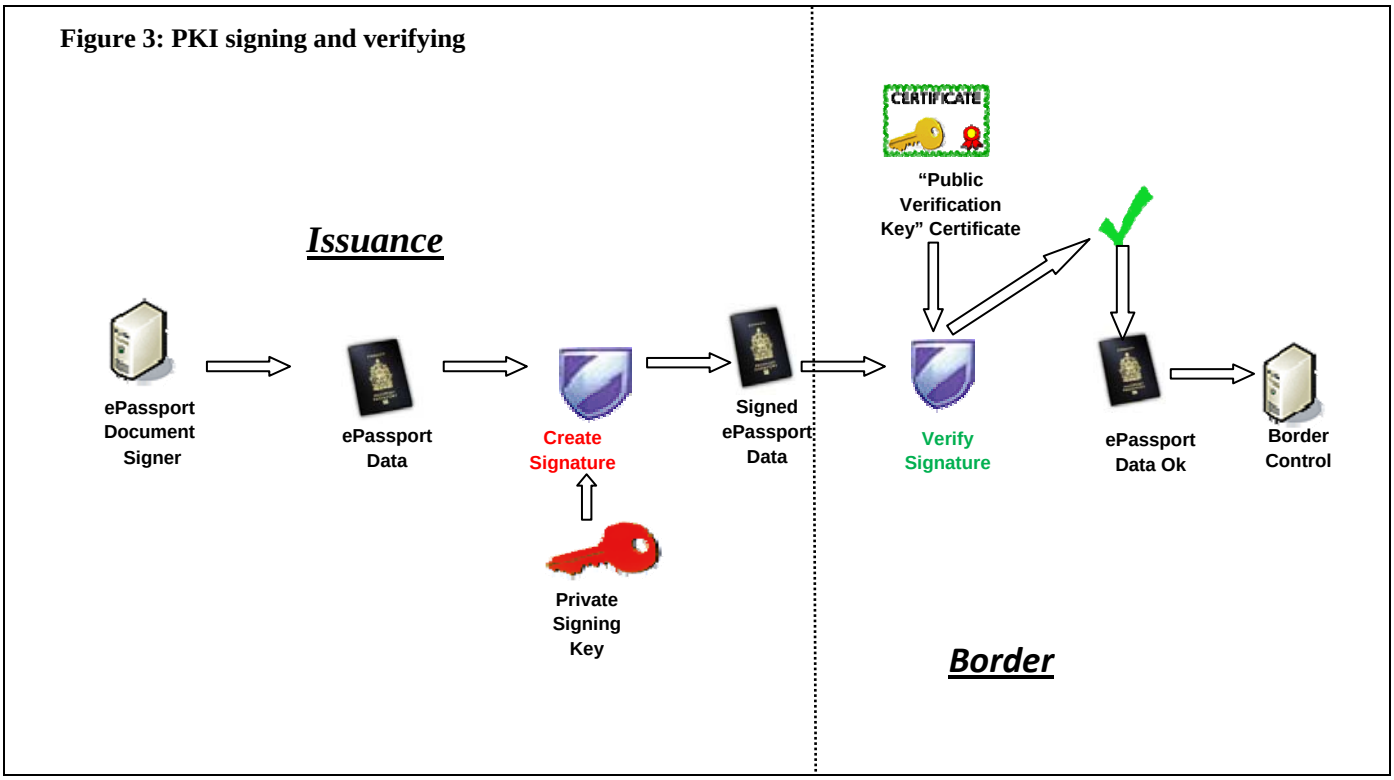
c. Does the US Passport Card Have a Similar PKI Infrastructure to the ePassport?

Public Key Infrastructure (PKI) is identified as the essential design upon which security and trust are built in order to provide authentication, identity verification, and encryption in electronic transactions (Lekkas & Zissis, 2011). The basic theory of PKI is that it enables users of an unsecure public network to securely and privately exchange data through the use of a public and a private cryptographic key pair that is obtained and shared through a trusted authority.

In public key cryptography, a public and private key are created simultaneously using the same algorithm by a certificate authority (CA). The private key is given only to the requesting party, and the public key is made publicly available in a directory that all parties can access, for ePassports this directory is known as the Public Key Directory (PKD).

The mechanism works as follows: The ePassport issuing authority signs the data using cryptographic signing key, creating a unique signature. Signing keys consist of a related private and public key pair which is mathematically linked i.e., data are encrypted/signed with a private key and can only be decrypted/verified with a corresponding public key. The “document signer” uses its private key to digitally sign the ePassport data on the chip and produces a “signed ePassport data”, at the border, public verification key placed in a digital certificate allows for the verification of the digital signature, also known as “passive authentication.”

Figure 3: PKI signing and verifying



ePassports are being issued and inspected across the globe in accordance with ICAO standards for MRTDs. To achieve interoperability, a common understanding between participants on data structures and communications has been established by following a standardized layout to facilitate reading of data on a global basis by both manual and machine readable means. The ICAO Public Key Directory (PKD) facilitates the validation process at international borders (Hartmann, Körting & Käthler, 2009, p.3).

As mentioned earlier, the US Passport Card has a vicinity-read RFID chip which can be scanned at a long range. We know that the RFID chip in the US Passport Card does not contain personal identifying information; it only stores a database record identifier. Thus, concerns about read ranges revolve more around counterfeiting than privacy. However it is important to point to the fact that, the US Passport Cards do not have cryptographic protection and just broadcast a number.

2.9 Privacy Concerns About RFID

With the introduction of vicinity-read RFID chips embedded in identification documents, many concerns have been raised about the vulnerability of the information in the chip. The main areas of concern are these:

Cloning: Privacy and security concerns come into question when the vicinity-read RFID chip can be read from a distance and without the knowledge of the card holder. The fact that this can happen makes it relatively easy for a person with an RFID reader to read the chip and perhaps copy the information. This information could be used to populate a blank chip to assume the identity of the legitimate traveller (Fontana, 2006, p.18).

Overloading: The duplication of the vicinity-read RFID chip could create multiple copies of the same chip and overload the RFID reader to jam it and render it useless.

Tracking: Tracking by reading the chip's unique identifier number from a distance is another concern (Dimitriou, 2009, p.59). The card holder is vulnerable to tracking by revealing their location when the vicinity-read RFID chip responds to any RFID reader since the card does not require authority to be given before it is read.

2.10 Office of Privacy Commissioner 2007–2008 report on RFID

In her annual report to the Parliament (2007–2008), the Privacy Commissioner expressed concern regarding the RFID technology being deployed by provinces for their enhanced driver's licence programs, stating, "our Office, along with our counterparts in every other provincial and territorial office responsible for privacy protection, have concerns about the personal information of participating drivers leaving Canada and the potential that RFID chips in the licences could permit surreptitious location tracking. We also have concerns about our inability, in practice, to oversee how U.S. authorities receive and use this information." (Annual Report to Parliament, Report on the Privacy Act, 2007–2008, p.2).

The Commissioner also emphasised the issue of technology, claiming the technology may not encrypt or otherwise protect the unique identifier number assigned to the holder of the EDL and would not protect any other personal information stored on the RFID (p.56).

2.11 Mitigating Strategies

Most concerns can be mitigated by taking the following measures:

Protective Sleeve: The NEXUS cards, EDLs, and the US Passport Card come with a protective RFID-blocking sleeve which blocks any reader from accessing the vicinity RFID chip when the card is in the sleeve.

Secure Database: In the event that information on a vicinity-read RFID chip is read, copied, and cloned on to a blank chip, the unique identifier number on the cloned chip will be read at the border and the legitimate traveller's information will be retrieved. At this point, the border

officer will compare the data from the secure database with the information on the face of the card, which is protected by physical security features, and visually inspect the individual. The border officer is trained to detect counterfeit or altered physical security features and printed data alterations, as well as the mismatch of the photo and the person carrying the card.

No Personal information: The vicinity-read RFID chips on EDLs and the US Passport Card do not have any personal information on them; instead they only contain a number that is linked to a secure database. The number on the chip does not contain any personally identifiable information.

RFID-Blocking Accessories: Accessory vendors selling wallets and purses have also introduced new RFID-blocking merchandise. In their advertisements, they refer to RFID technology as vulnerable to cloning and warn it may lead to identity theft.

2.12 Basic Biometric System

A biometric system is a pattern recognition system that acquires biometric data from an individual, extracts a feature set from the data, compares this feature set against the feature set stored in a database, and executes an action based on the result of the comparison (Jain, Flynn & Ross, 2007, p.3). Although there are many types of biometric systems, all biometric systems involve processes that can be divided into two stages: enrollment, and either verification or identification (GAO, 2002, p.40).

a) Enrollment: The enrollment process captures the biometric information so that it can be used in a verification process at a later time.
b) Verification: The biometric system authenticates an individual's claimed identity from their previously enrolled biometric template. An individual claims an identity, usually a name or user name, or holds a smart card which is entered into the biometric system prior to presenting a biometric sample.

Figure 4: Biometric enrollment and verification

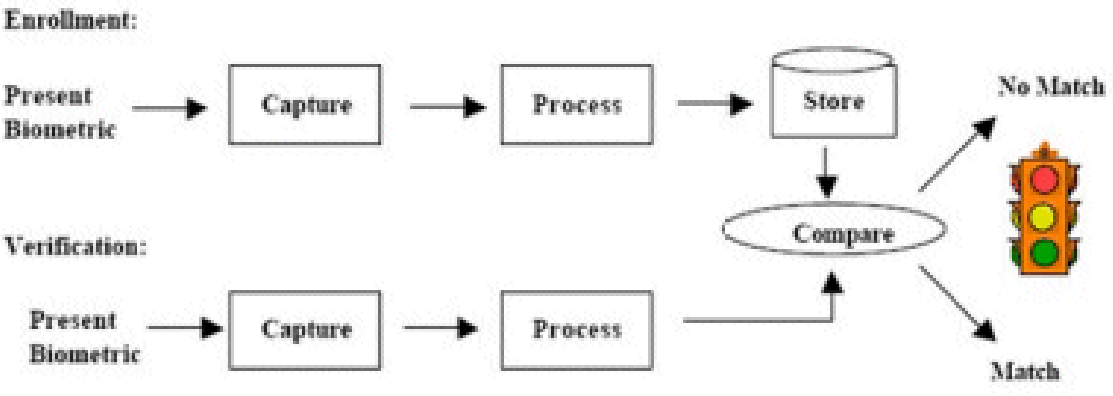


Image from Global Security Website: http://www.globalsecurity.org/security/systems/biometrics.htm

There have been successful examples of biometric (face recognition) deployment: one in Australia – SmartGate , and another in Germany – EasyPASS. In both examples, passengers arriving from international flights using their ePassports proceed to a kiosk, they answer few standard questions, and a photo of the passenger is captured at the kiosk. The computer/kiosk then completes a facial recognition (verification) to ensure the photo captured at the kiosk is in fact the photo stored in the chip (enrolled when the bearer of the document applied for a passport). The kiosk issues a printed ticket which passengers take to an automated exit gateway, which again completes another biometric verification (facial), and passengers can collect their baggage.

2.13 Comparison of Different Types of RFID-Enabled Travel Documents

Figure 5: RFID-enabled travel documents

	Electronic Passports	Enhanced D/L and ID Cards	NEXUS	US Passport Cards
Electronic Chip with RFID	Yes	Yes	Yes	Yes
Information stored in e-chip	Bearer's personal information and digitized picture	Identifier number/reference number	Identifier number/reference number	Identifier number/reference number
Type of chip	Proximity RFID-enabled chip	Vicinity RFID-enabled chip	Vicinity RFID-enabled chip	Vicinity RFID-enabled chip
Information that can be retrieved by border officials	All information on biodata page including photo, excluding signature on the **chip itself**	All information on the face of the card, bearer's citizenship, and digital photograph **from a database**	All information on the face of the card, and bearer's photograph **from a database**	All information on the face of the card, and bearer's photograph **from a database**
Additional biometric information retrieval	Any inspection point that can read ePassport.	None	Iris scan, for air travel; the iris is photographed and compared to existing data	None

Apart from the security issues, another benefit of ePassports is automated border clearance, which will be discussed in detail in the following chapters. In such situations, a passenger presents the travel document to an automated reader device, which reads the passenger's biographical information and biometric from the contactless chip. Then, when the passenger's facial, or iris image is captured in the reading system, the stored biometric image is compared to the one presented. If the images match, the traveller may pass through immigration without interacting with a border officer.

The designed operating range of the ePassport chip is very small; it must be held within 10 centimetres of the reader. Therefore, unlike the NEXUS card, US Passport Card or Enhanced Driver's Licence, it cannot be read by a reader that is far away from the border officer at a land border crossing.

The EDL/EIC card has similar technology to the US Passport Cards: it can be read at land border metres away from the border officer, and by the time the driver arrives at the border control booth, the information on the traveller(s) is available for the officer to examine.

The Passport Cards and EDL/EIC do not carry any biometric information and therefore could not be used for automated border clearance.

Currently, NEXUS card holders enjoy the most benefits in cross-border travelling between Canada and the US. Since NEXUS is a joint Canada–US program, it allows citizens and permanent residents of both countries to apply for and receive a "trusted traveller status," basically a pre-approved low-risk member. NEXUS members have designated lanes at land border crossings, self-serve kiosks at airports and, if arriving in the United States, can use the US Global Entry program, which is an expedited clearance for pre-approved travellers.

2.14 Future for Passports and Alternative Travel Documents in Canada

The passport is the internationally accepted document for travel and the document of choice for all border officials. Adopting the ePassport is a critical technological advancement, and Passport Canada will need to continue to invest in research and development in order to stay abreast of new technologies and implement security features and processes as necessary. Passport Canada has seen unprecedented growth due to rising passport demand, going from over 1.8 million passports issued in 2000–2001 to almost 5 million in 2009–2010.

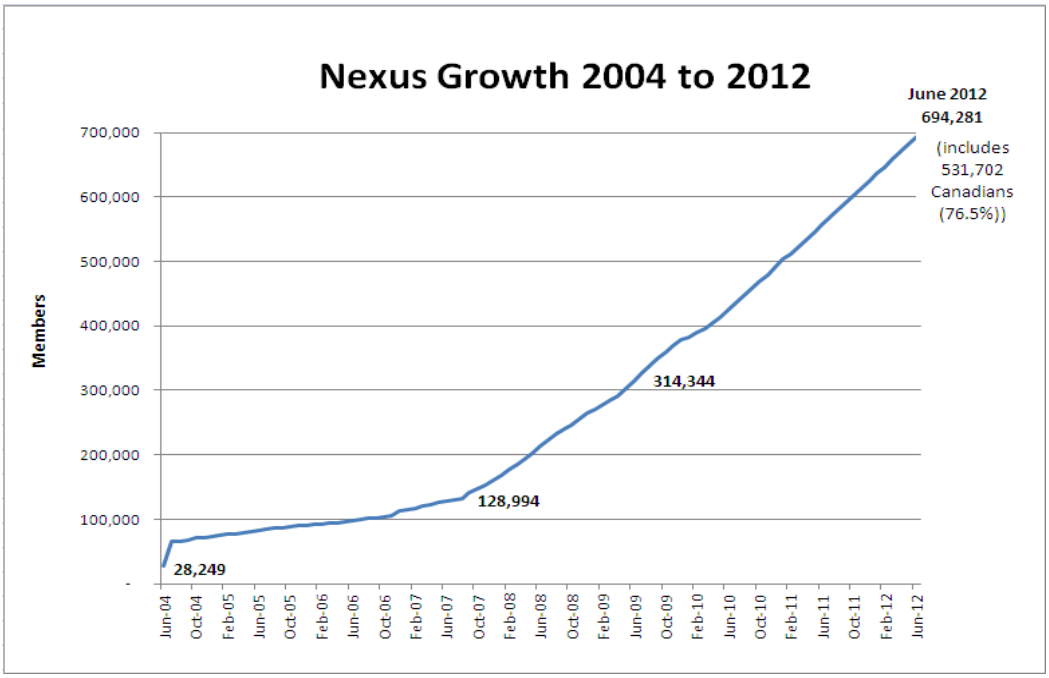
Results from interviews with representatives of the travel and tourism industry in 2010 show that the participants agreed that the benefits of ePassports are faster processing at point of entry, compliance with international standards, maintaining the strongly positive reputation of the Canadian passport, and increasing security/preventing identity fraud/forgery (Passport Canada, In-depth Interview Report, 2010).

Not only passports, but one other document that facilitates travel (between Canada and the US) has been immensely favoured by the Canadian travelling population– the NEXUS card. A recent article by the *Vancouver Sun* claims that there has been a 17% increase in application for NEXUS cards (Pedwell, 2012) since earlier this year.

With the increased number of day trips from Canada to the United States and the increase in duty-free customs allowance for travellers which came into effect on June 1, 2012, more and more Canadians are crossing into the United States and opting for a NEXUS card to avoid long line-ups. This commitment further encourages cross-border travel, supporting both Canadian and American economies.

NEXUS enrollment has been on the rise. Statistics from the Passport Canada Strategic Research and Analysis Unit show that, as of June 2012, there are 694,281 NEXUS card holders.

Figure 6: NEXUS growth chart



Information from Passport Canada Strategic Research and Analysis, July 2012

While the federal NEXUS program is expanding, the future is uncertain for provincially issued enhanced drivers licences (EDL) and enhanced identification cards (EIC). The CBSA internal membership data on Passport Canada's 2011 Environmental Scan shows that the EDL/EIC, combined enrollment for all four issuing provinces was just over 200,000 cardholders in August 2011. Ontario has recently announced that although its EDL will remain available, it will not pursue the implementation of an EIC, and Saskatchewan will not pursue the concept of EDL (CBSA, 2011).

Figure 7: Possession rate

	US	Canada	Total
NEXUS	262,579	531,702	694,281
EDLs	1.2M	236,000	1.44 M
US Passport Card	5M	n/a	5M
Regular Passports	102M	22M	124M
Numbers are approximate and rounded. Source: Passport Canada Strategic Research and Analysis Division -			

The most important task of a 'travel document' is to confirm the identity and nationality of the traveler and to facilitate the movement of the traveller across international borders. As we notice in this chapter the most commonly used travel document is a passport in Canada and United States. Different travel requirements have given the federal and provincial/state governments the incentive to issue different forms of travel documents.

2.15 Conclusion

In this chapter, different types of travel documents have been analysed and it is worth noting that all four documents examined have now incorporated RFID chips, except for the current Canadian passports which are expected to commence issuance of the ePassport in 2013. RFID-enabled documents are favoured at border crossings since they can reduce delays by quickly communicating information from the document to a reader. The information is retrieved and available to a border official to then make their determination to either allow entry or detain a traveller.

Since the ePassports capture and store biometric information as well, we also noted that in a few airports kiosks are being used to retrieve the biometric information and compare such information with a real-time photo taken of the person presenting the ePassport.

A major difference that is noteworthy is that NEXUS holders may have an iris scan; however, since the NEXUS card chip is a vicinity-read chip, it only has an identifier number, which can be recalled by border agencies only. The bearer's iris image is processed and encoded into a record that is stored and used for comparison any time a live iris is presented for verification. At the self-serve kiosk at airports, the system compares the live iris with the record stored in the database.

The ePassport captures and stores biometric information as well; however, the difference with the NEXUS card is that since the chip is a proximity-read chip, the information is stored on the chip and unlike NEXUS it does not have a record identifier. A number of airport kiosks are being used to retrieve the biometric information and compare such information with a real-time photo taken of the person presenting the ePassport.

The NEXUS program was initiated under the Shared Border Accord in 2001 and as mentioned in this chapter has been successful. The Enhanced Driver's Licenses came into effect following the WHTI travel requirements. These documents have been in circulation and to varying degrees successful. The intent of this report is not to propose a replacement to the existing travel documents. This report is meant to bring forward the topic of a new format of travel document with a capacity to facilitate traveler's experience at airports and simultaneously be used for land border crossing.

The emphasis of this report is on air travel and therefore in the next chapter, we will have a closer look at how this technology has benefited airports – in particular, how using the ePassport has improved efficiency, increased security, and benefited airports, airlines, and passengers.

3. Air Border Initiatives

3.1 Introduction

With increased traveller volumes and security threats, border control authorities are under intense scrutiny to improve security and at the same time ensure a smooth flow of people. Similarly airlines and airports are under pressure to make their money go further and ensure the smooth flow of passengers. As traveller volumes are increasing and budgets are falling, the obvious way to achieve this is through greater automation.

This section defines and explains the central concept of this study, relating to the research question: *Would the use of biometrically enabled travel cards enhance the clearance and facilitation process at Canadian airports?* In Chapter 2, I listed the documents available for travel and provided some details on the documents. As noted earlier, biometric data have become pertinent in ePassports and are being used by several border agencies and airports.

Airlines and airports work to balance traveller convenience with the need for security. They are in the process of increasingly integrating advanced biometrics-based identity authentication technologies into the growing range of self-service processes within air travel, such as passenger and baggage check-in kiosks. Following a discussion of ABC and SmartGate, I will focus on Incheon International Airport (ICN), which has been successful in integrating the various stages of the air passenger experience with a biometric authentication system to uniquely identify each passenger. ICN has implemented a fully automated passenger experience from check-in to boarding and from arrival to baggage claim.

In this chapter, I also review the procedures in place at one Canadian airport, Vancouver International Airport (YVR), and draw attention to some innovative steps taken by YVR and CBSA for simplified passenger solutions. Although not fully automated, it will be worthwhile to review YVR's arrival and departure processes, which will enable us to make a case that implementing an arrangement such as that in place at Incheon, and using a biometrically enabled document such as a Canadian Passport Card, could further improve passenger experience at YVR.

3.2 Automated Border Clearance and Smart Gates

Increasing border traffic has created a need for faster, safer and more secure ways of processing travellers. Automated border clearance (ABC) systems represent one solution to this problem, and an increasing number of countries are implementing these systems.

Canada started an ABC pilot project at Vancouver International Airport in April 2009. The pilot project provides a partial customs clearance, since it is not fully automated to allow a passenger to independently clear customs and immigration and requires a border officer to inspect documents and/or interview passenger. In order to use an automated kiosk, a traveller needs a Canadian passport or permanent resident card. Although travel documents are still verified by a border services officer, the program aims to move travellers away from the regular lineups and direct them to use the kiosk.

SmartGate, another ABC initiative, is currently in full swing in Australia and New Zealand. It allows eligible New Zealand and Australian ePassport holders aged 18 and over to clear customs faster through an automated system that uses facial recognition. SmartGate has been developed to work with an ePassport; it uses the electronic information in the ePassport microchip and face recognition technology to verify that the holder of an ePassport is the owner of that passport. First, the kiosk retrieves the digital photograph from the ePassport microchip, creates a template mapping key underlying facial features and stores it in a database. At the gate, SmartGate takes a photo of the traveller's face, converts it into another template, and compares this with the original template created at the kiosk. If the templates match, SmartGate can then confirm that the person carrying the ePassport is the same person whose details are held on the ePassport microchip (Smartgate biometric, 2010).

In Australia, uptake has increased from 35 percent in 2009 to around 50 percent in 2010, and SmartGates have cleared some 1.4 million travellers during this period. The program has generated positive feedback from travellers. In New Zealand, uptake is around 50 percent of eligible travellers, and to date, 1.2 million people have transited the gates (Government of New Zealand Treasury, 2011).

In the UK, travellers have been using ePassport ABC gates with facial recognition since 2008. These gates are now at every major UK airport including Heathrow. The gates can be used by adults who hold ePassports from countries in the European Economic Area (Using ePassport gates).

3.3 Case Study – Incheon InternationalAirport

Incheon International Airport (ICN) in Seoul, South Korea opened in March 2001. The airport has continued to see increased volume in both passenger and cargo, with a daily average

of 600 takeoffs and landings and a total of 120,000 passengers, Incheon now ranks eighth and second among all the airports in the world in terms of international passenger volume and cargo, respectively. In 2011, it handled 33.48 million international passengers, including 5.19 million transit passengers (Lee, 2012, p.94).

The Incheon International Airport Corporation (IIAC) went through phase 2 of its expansion and modernization project from 2002 to 2008. As a part of its efforts to simplify services and enhance operation efficiency, IIAC built a fully automated terminal known as the U-Airport.

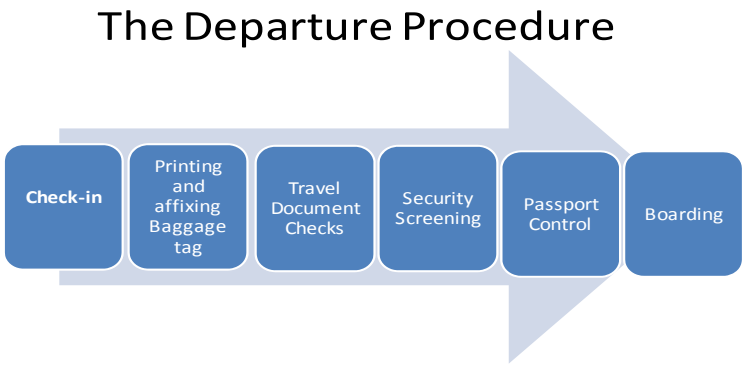
In the U-Airport, passengers using their ePassports have access to automated services, which include self-check-in, automated immigration, and boarding. Incheon International has boasted self-boarding capabilities since 2008. During the initial years, passengers could use the automated service by providing fingerprints. In July 2010, the airport moved from fingerprints to facial recognition. Four brand new gates were implemented using Machine Readable Passport (MRP) and facial recognition biometric technology. Passengers present the picture page of their passport to the passport reader in front of the boarding gate; if their name and passport number is on the passenger list for the flight, the gate opens for them to enter. The self-boarding gates have added facial recognition technology to ensure a high level of security. As a direct result, the passenger boarding time has been reduced to just 13 seconds (Ghee, 2011).

A second passenger terminal, due to be complete before the end of 2016, will also adopt the U-Airport concept, allowing passengers to travel through the facility using just their passport.

a. Arrival and Departure Procedures in a non U-Airport environment

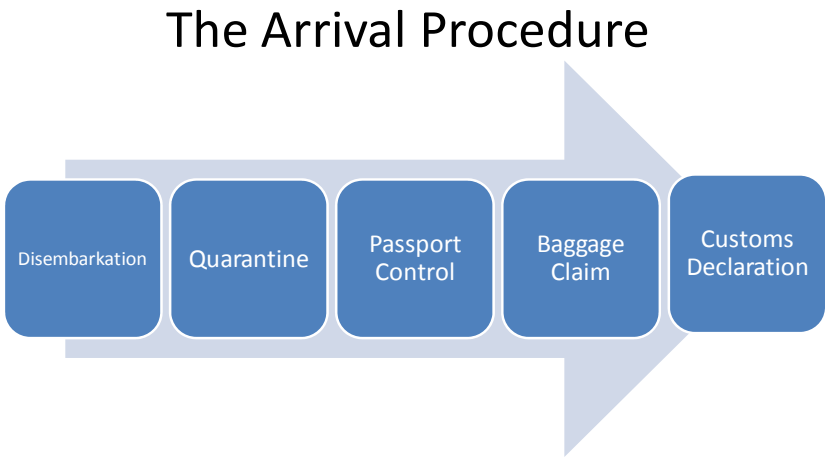
A research paper published by IIAC in 2009 outlines the steps involved in boarding an airplane for departure from Incheon in a non U-Airport terminal. The process would involve six five steps: (1) Check-in, (2) Printing and affixing baggage tag (3) Travel document checks prior to security screening, (4) Security screening, (5) Passport control, and (6) Boarding (see Fig. 8).

Figure 8: Incheon departure procedure – non U-Airport terminal



Passengers arriving at Incheon would also go through a five-step process comprising (1) Disembarkation, (2) Quarantine control, (3) Passport control, (4) Baggage claim, and (5) Customs declaration (Choi, 2009, p. 4). See Figure 9.

Figure 9: Incheon arrival procedure non U-Airport ICN



b. Arrival and Departure Procedures in U-Airport environment

The U-Airport environment has been in development at Incheon International since April 2007, when U-Self Check-in was introduced. A touch screen machine reads the passport's machine readable zone (MRZ) or magnetic stripes on cards and prints the boarding pass. In June 2008, U-Immigration came into effect, where the technology reads the machine readable passport and biometrics (fingerprints); this service was designed for pre-registered Korean nationals, and foreigners approved by the Korean Immigration Agency. In July 2008, only a limited number of Korean airliners used the U-Boarding Gate, where the technology reads the machine readable passport and allows boarding.

By July 2010, U-Immigration had expanded to include facial recognition (FR) for all ePassport holders. The FR technology was also expanded to U-Boarding, where any ePassport holder could use U-Immigration and U-Boarding. In 2011, passengers using the U-Immigration Gates can simply place their ePassport on a reader and then confirm their identity via either fingerprint or FR technology. This allows the immigration process to be completed in less than 20 seconds, or in as little as 9 seconds for transfer passengers (Ghee, 2011)

U-Airport focuses on the four basic processes that the passenger encounters in an airport environment: check-in, security, immigration, and boarding. At Incheon International Airport, each of these processes can be completed with just the ePassport and biometric information. The average time to be processed for arrival is 12 minutes and 16 minutes for departure, well below the 45-minute and 60-minute averages recommended by ICAO. Time needed for transit passengers is 45 minutes, far below the 60–70 minutes recommended by ICAO. U-Self Check-in machines, U-Immigration, and U-Departure Gates have accelerated the entire process (Lee, 2012 p.100).

As Choi (2009) outlines in her research on "balancing facilitation and aviation security," the overall aim of the U-Airport concept is summarized below (Figures 10 and 11):

Figure 10: Departure and transfer procedure U-Airport ICN

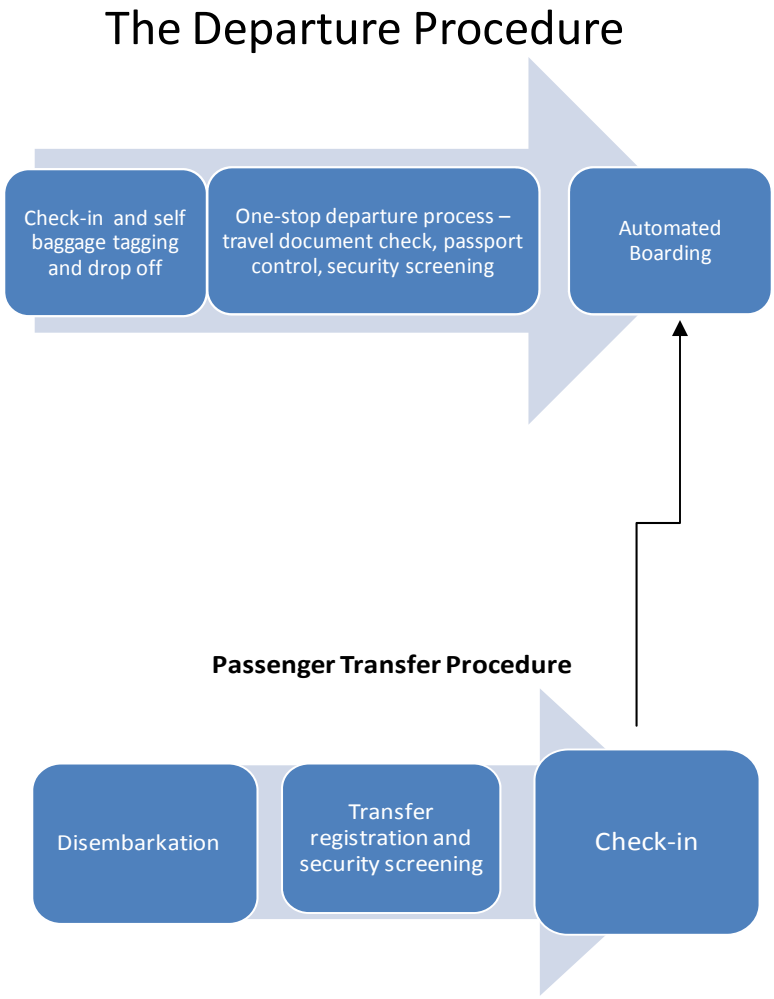
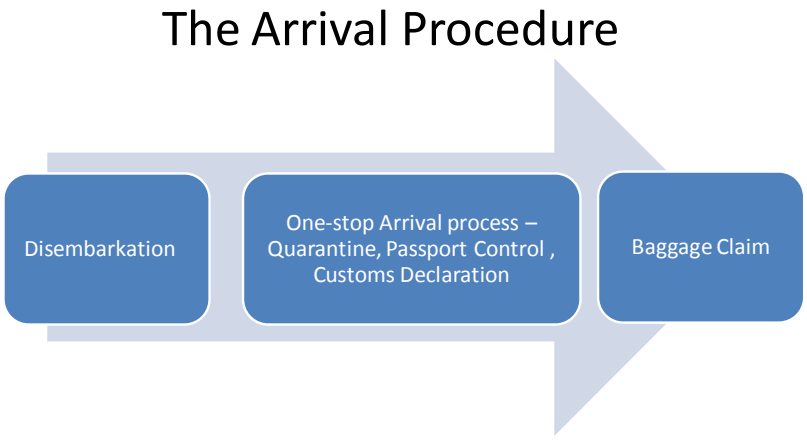


Figure 11: Arrival procedure U-Airport ICN



3.4 Case Study – Vancouver International Airport

By comparing Vancouver International Airport (YVR) to Incheon's U-Airport, we will primarily identify where the bottlenecks are in YVR and how an ePassport (or equivalent document and technology) could pave the way to enhance operational efficiency and simplify passenger processing.

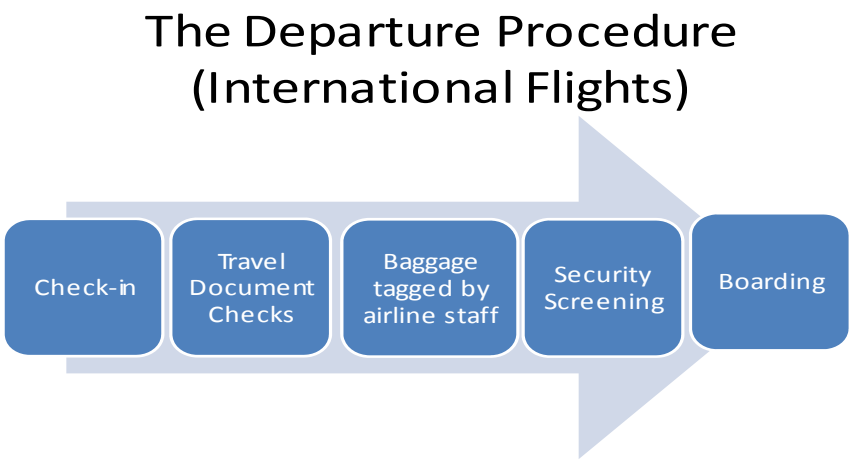
Canada's second busiest airport, Vancouver International welcomed 17.0 million people in 2011, facilitated more than 296,000 aircraft takeoffs and landings, a 1.5 percent increase over the previous year (Vancouver International Airport, 2011). Statistics indicate that, compared to 2011, January to April 2012 passenger traffic increased 5%, and the total number of enplaned and deplaned passengers at Vancouver International was 5,492,830 (Vancouver International Airport, 2012). Since 1992, when the Airport Authority assumed responsibility for the airport, passenger traffic increased more than 71% from a 1992 base of 9.9 million passengers (Vancouver International Airport, 2011).

3.5 Departure and Arrival Procedures at YVR

Using the same format of diagram and procedures as in Section 3.3 (based on Choi, 2009), I will outline departure and arrival procedures at YVR.

YVR international departure does not include passport control as CBSA officers are only checking inbound passengers. The steps involved in boarding an airplane for international departure from Vancouver (except to the US as described below) involve (1) Check-in, (2) Travel document checks (by airline staff) prior to security screening, (3) Security screening, and (4) Boarding (see Fig. 12).

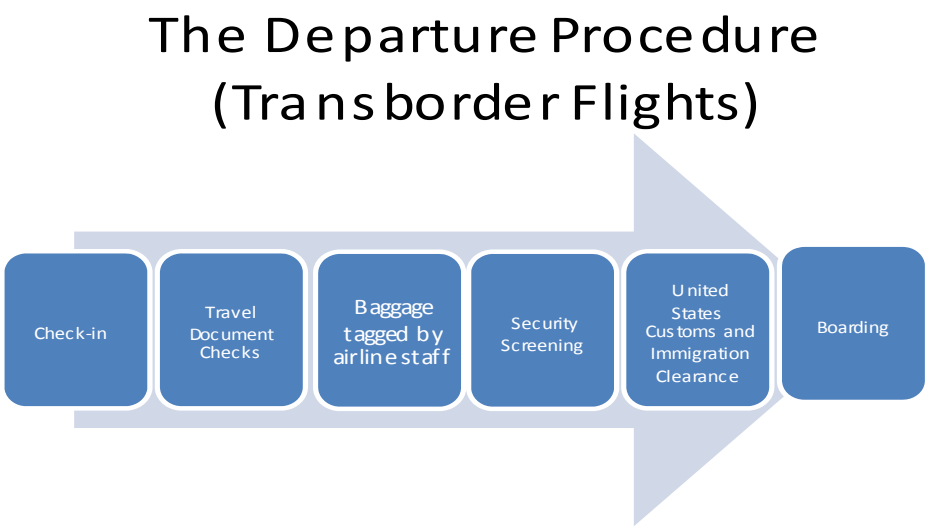
Figure 12: International departure procedure YVR



We should be anticipating an added step in departure procedures, since there will be exit control/document check performed by CBSA in the future.

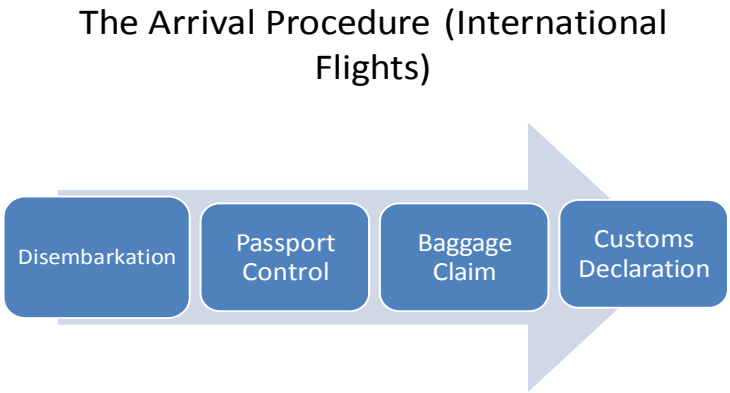
Passengers departing from YVR to the United States pre-clear US customs and immigration process as follows (see Fig. 13):

Figure 13: Departure procedure trans-border from YVR



The arrival procedure involves the following steps: (1) Disembarkation, (2) Passport control, (3) Baggage claim, and (4) Customs declaration (see Fig. 14).

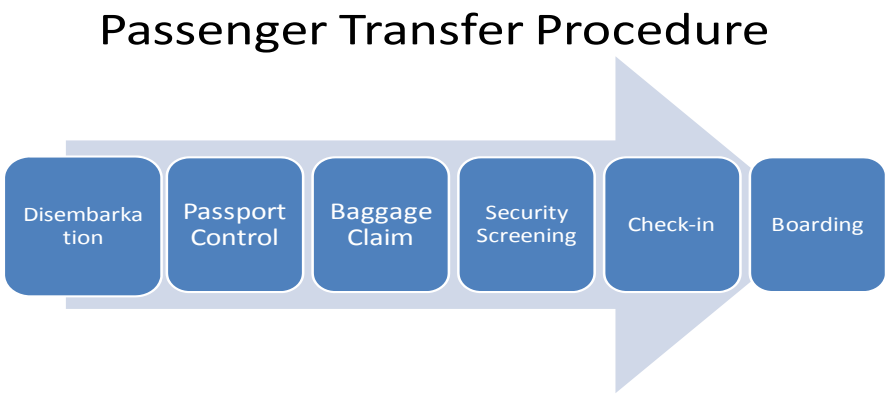
Figure 14: Arrival procedure international YVR



One of the bottlenecks at Vancouver International is that it is not competitive on its connecting times for international flights (see Figure 15). On March 27, 2012, Mary Jordan, Chair of the Board, Vancouver Airport Authority, explained to the Canadian Senate Standing Committee on Transport and Communication that the airport is now probably at 90 minutes at

least for an international connection. With an aim to be competitive in the world, this time will need to be reduced. Jordan went on to explain the need for two things. First, process improvements were needed such that passengers do not have to reclaim their bags, go through customs, and so forth. They can stay in the secure area, and if there is a need to see a passenger's bag, the bag can be produced; second, there was a need to build the facilities to allow passengers to easily connect and for bags to be easily transferred from one gate to the next (Parliament of Canada, 2012)

Figure 15: Passenger transfer procedure YVR



3.6 U.S Customs and Immigration Pre-Clearance

As mentioned earlier, Vancouver International provides pre-clearance service. Pre-clearance involves US customs, immigration and other inspection processes taking place at the Canadian origin airport rather than at the US destination. For passengers, there is a real convenience with US Customs pre-clearance, as once they arrive in the US, they are processed the same as a US domestic passenger, without any need for an international arrivals process. If the passenger is connecting at a US airport, their connection time will be considerably shorter.

3.7 Vancouver International ABC (Automated Border Clearance)

In 2009, a pilot project was started at YVR to reduce Customs Hall wait times and improve the overall passenger experience. This program was launched at YVR as a partnership between CBSA and Vancouver Airport Authority; it achieved full program status and will expand to other

Canadian airports, starting in 2012 with Montreal's Pierre Elliott Trudeau International Airport (YUL).

YVR currently has substantially shortened Customs Hall wait times by taking eligible travellers out of the traditional process of lineups at the border inspection line. Canadian citizens and Canadian permanent residents who have a valid Canadian passport or Canadian permanent resident card have the option of using an ABC kiosk to clear the border. According to a media release from YVR more than 2.4 million passengers have used the service since it was implemented (YVR, 2012).

A CBSA official has provided the following numbers in a memo indicating the success of the ABC scheme at YVR:

- wait time average of 20 to 50 minutes reduced to an average of 8.5 to 28 minutes for eligible population;
- on average approximately 60% of the eligible user population now uses ABC;
- depending upon the time of the year this usage rate removes approximately 25 to 40% of the overall arrival population (visitor and resident totals) from being processed at an officer booth
- very high levels of client satisfaction
- daily use fluctuates between a high of around 5000 and a low of around 3200
- per hour throughput capability has increased from pre ABC of approximately 1800 to post ABC of approximately 2400

Although titled ABC, it would be important to note here that the process is an automated *customs* clearance, since the kiosk/computer does not authenticate the identity of the bearer. The passenger still needs to see a border officer since the kiosk/computer does not clear the passenger to enter the country, or be referred for further questioning.

3.8 Conclusion

The primary intent of this chapter was to develop a basis to answer the research question. Some background information was given on how Incheon International Airport has successfully implemented the concept of the U-Airport using biometric technology and on the success of the SmartGate initiative in Australia and New Zealand. Canada has also seen success in its ABC pilot project at YVR, which expanded in June 2012 to Montreal's Pierre Elliott Trudeau International Airport (YUL).

As mentioned in chapter 2, from a passenger's perspective, frequent travellers are willing to provide extra information to governments and airport authorities to prove they are low-risk and to benefit from fast-tracked security and immigration options. Schemes like these show how using biometrics can speed up the customs, immigration, and departure process.

Airports such as YVR are constantly taking into consideration innovative solutions for providing better service to passengers and greater automation. A prime example is YVR being the first airport in Canada to pilot ABC.

A quick comparison of ICN and YVR shows that the average time for a passenger to deplane and clear immigration at ICN is 12 minutes. With the implementation of ABC, YVR claims the average wait time has decreased from average of 20 to 50 minutes to 8.5 to 28 minutes, keeping in mind that passengers still need to see a Border Officer after being processed through the kiosk. This wait time could further decrease if the kiosks evolve to fully clear immigration formalities similar to the kiosks at ICN.

Although the Canadian ePassport will only be available in the spring of 2013, it may be time for Passport Canada to enter into a partnership with airports and other stakeholders such as the airlines and border services to consider the development of a new product that could benefit all travellers. This new product should be a biometrically enabled document that would allow, not only a passenger travelling internationally but also domestically, to check-in and board a flight, or upon arrival to clear immigration process and claim baggage.

Chapter 4 engages in a discussion regarding the concept of a Canadian Passport Card and how it could benefit the travelling public.

4. Future of Air Travel Documentation in Canada

4.1 Introduction

With different types of travel documents available for travellers, as surveyed in chapter 2, and the move by airlines and airports towards automating airports terminals and passenger handling, discussed in chapter 3, would it be worthwhile for Passport Canada to develop the concept of Passport Cards for Canadian citizens? With increased number of passengers and added departure and arrival security requirements would this document be the solution for facilitating travel?

Since the United States is already issuing US Passport Cards, I will answer these questions in this chapter by first examining the US Passport Cards, the technology and safeguards in US Passport Cards, then considering what other features should be included in the envisioned Canadian Passport Card and the need for future research on this subject.

Statistics Canada's report on "Air Carrier Traffic at Canadian Airports" (2010) highlights the fact that passenger traffic at Canadian airports increased 4.4% in 2010. The total number of enplaned and deplaned passengers in Canada was 109 million. Passenger traffic in all sectors (domestic, transborder, and other international) increased in 2010; overall, Canadian airports experienced an increase in the number of flights arriving and departing; flights were up 1.8% in 2010 as compared to 2009 (Statistics Canada, 2011).

The number of passengers arriving in Canada via air and other modes is on the increase. It would be worthwhile to note that just in the month of March 2012 Canada received 841,391 international visitors , recording a 9.3% increase compared with the same month in 2011 (Canadian Tourism Commission, 2012).

Most airports in Canada are aiming to optimize existing capacities and processes based on implementation of innovative technology. Security activities are particularly complex during the passenger clearance process, which is conducted by the airlines, airport operators, and border authorities. All these activities take extra time, which increases costs and diminishes convenience. Automated systems based on biometrics to recognize persons enable fast, user-friendly and highly secure identification and verification processes. Among the most used biometric technologies are facial, fingerprint, iris, signature, and voice recognition (Albrecht et al., 2003, p19).

This would be an opportune time for Passport Canada to further analyse the possibility of building on the existing vicinity infrastructure, issuing an RFID-enabled passport card, which could contain a chip similar to a Canadian ePassport chip with personal information of the traveller and a digital photo, with associated privacy safeguards. This card could potentially be the document, not only for international travel but for domestic air travel as well, which could allow the bearer a fully automated airport experience.

4.2 Passport Card

Part 1, volume 1 of ICAO Document 9303 provides the standards that member countries must adhere to for a passport card, it reads:

"Should a State or organization wish to issue a machine readable passport card specifically for purposes such as facilitating travel to States accepting a passport card without visa for entry (*recognizing that issuing States or organizations must reach specific agreements with such receiving States on acceptance of the passport card*), facilitating identity confirmation of the rightful holder to enhance security or in case of loss/theft of the MRP, and/or *approved* use in automated passenger clearance schemes, the issuing State or organization shall issue an ID size card in accordance with the ICAO specifications" (ICAO doc 9303 part 1, 2006, p. IV29).

The United States has been issuing Passport Cards since July 2008 (Figure 16).

Figure 16: United States passport cards

United States Passport Card

Passport Card number

Validity same as passport 10 years

Passport Card number

Machine Readable Zone

Image from US Department of State website
http://travel.state.gov/passport/ppt_card/ppt_card_3926.html

The United States Passport Card is similar to a US passport in that both documents are issued to convey proof of a bearer's identity and US nationality or citizenship. The purpose of the US Passport Card is to facilitate frequent travel for those persons living in border communities, and it is available to applicants at a fraction of the cost of a passport book.

4.3 Should Canada have a Passport Card?

Passports are widely recognized documents that facilitate travel. A large proportion of the Canadian population travel to other countries for different purposes, for example, to visit family and friends, for work, shopping, or vacationing. The overall passport possession rate in Canada is 67% (Passport Canada, 2010–2011), international travel is on the rise, Statistics Canada reported in 2010 that international tourist arrivals worldwide rose 6.6% to 940 million (Statistics Canada, 2010, p.6). If it continues to rise, one could only assume that the passport possession rate will be on the rise as well.

The Border Policy Research Institute published a report indicating US border clearance has been 33% faster for travellers using travel documents that have incorporated RFID, such as EDL, and the US Passport Card. Clearance is even faster for NEXUS holders (60%) since apart from RFID technology, NEXUS card holder are subject to minimal questioning at the border due to their "trusted traveller" status (Border Policy Brief, 2012).

For Canadian travellers, the use of RFID-enabled travel document seems to be the future. It is important to remind ourselves that the RFID used in EDLs, the US Passport Card, and even NEXUS cards is a vicinity-read RFID. An ePassport is not designed for this purpose since it has a proximity-read RFID. If Passport Canada issues Canadian Passport Cards, it would be beneficial to issue a card that could be used with both technologies: vicinity-read for land border crossings and proximity-read for ABC schemes – perhaps a multi-function chip or a double chip card. This would increase the Canadian Passport Card's versatility and make it a much more attractive option.

The intent of a Passport Card is to provide Canadian citizens with a convenient alternative to the regular passport for specific border crossing situations. This card would address the unique circumstances of millions of citizens living in border communities who frequently cross the border to the United States. It is in our interest to use the flexibility that exists in the underlying WHTI legislation, which requires "a passport or other document" (Department of Homeland Security, 2006, p. 428), just as the United States Passport issuing authority has done and is now issuing US Passport Cards.

Canadians who do not travel frequently may not need a long-validity passport. However, some may travel frequently but only to the United States and may find a Passport Card more

convenient to transport and safeguard. Canadian citizens have raised the idea of issuing a Passport Card during the public consultations as a part of the ongoing *User Fees Act* (UFA) process. If a large proportion of Canadian travellers travel to countries that will accept an alternative to Passport books, such as the United States, it would be worthwhile for Passport Canada to engage in further research in issuing such alternative documents, perhaps at a lower fee and for a shorter validity period, similar to US Passport Cards.

The *National Post* reports that Toronto's Pearson International Airport has been voted the country's worst airport for the second time. In an online survey by FlightNetwork.com, Pearson International was deemed the poorest by 36.6% of Canadians, in a poll of 400 conducted by the travel site. Montreal's Pierre Elliott Trudeau Airport was ranked second-worst at 17.7%, followed by Edmonton's airport at 9.9% (Gheciu, 2012, p.1). For Pearson International, "slow security" was cited by 57.2% of the respondents. In a recent report prepared for the Standing Senate Committee on Transport and Communication, the authors expressed the need for federal government to use its influence to bring relevant stakeholders to the table to work out new policies and systems to address inefficiencies and continually improve the air travel experience in Canada (Dawson & Greene, 2012, p. 1).

It would therefore be beneficial for Passport Canada to engage in discussion with other agencies and stakeholders in development of a Canadian Passport Card. Canadian experience with programs designed to expedite border clearances such as NEXUS have demonstrated that successful implementation requires inter-agency cooperation, adequate resources, effective communications planning, and outreach activities. In the NEXUS program, both the Canadian and US governments have invested a lot of resources in existing RFID technology equipment. This program appears to be a successful program with increased membership every year.

Another argument in favour of proceeding with RFID-enabled Passport Cards is the adoption of "exit control" at Canadian borders. CBC reported a Canada–US border deal was proposed in December 2011, where travellers to the US would have their departure from this country recorded with Canadian border authorities. This exit control will ultimately be for everyone leaving Canada to all foreign destinations by land, air, or sea (Weston, 2011). The need for faster and more accurate passenger processing will therefore increase, since it will add one extra step at any border location, whether land, air, or sea.

4.4 Added Functionality to Canadian Passport Card

If it is feasible for Passport Canada to pursue issuance of a Canadian Passport Card, it would be beneficial to do further research on developing a Passport Card that would not only function as a proof of citizenship to allow cross border travel but also have functionality to facilitate the airport experience by leveraging the fact that it is (1) a trusted identity document; (2) it has the

biometric that can link the identity to authorization to move about the airport; and (3) a card that could facilitate modern features – for example, the use of a 2D bar code on the card that could contain the same information as the MRZ.

In the past several years, we have witnessed how airlines and airports are automating many steps related to check-in and gate controls. For example, for most airlines the traveller can now proceed to online check-in before they even get to the airport. Many airlines have started to include boarding pass kiosks in major hotels. Some airports are also piloting baggage tagging and dropping through self-serve kiosks. This feature, as well as automated airplane boarding, is often achieved by linking the biometric information on the travel document to the airline boarding information, e.g., the use of facial recognition to move through gates. As noted in this paper, Incheon International Airport is using the ePassport technology for its U-Airport for international travel. The Canadian Passport Card could be used similarly for domestic and trans-border (United States) travel. This card would be used similarly to ePassport at Incheon through security, border clearance, and even self-boarding.

4.5 Advantages of a Canadian Passport Card

With proper safeguards, a Canadian Passport Card with an electronic chip would hold the same information that is printed on the card: the holder’s name, date of birth, and other biographic information. It would also contain a biometric identifier. Similar to the Canadian ePassport , the chip may contain a digital photograph of the holder; this card will need to have security features to prevent the unauthorized reading or skimming" of data stored on the chip.

Overall the Passport Card would achieve the following:

- securely identify the traveller (could be used by airlines and airport authorities across Canada);
- provide protection against identity theft (by making it impossible for anyone else but the owner of the card to use it for travel purposes);
- protect privacy;
- streamline border crossings and customs processes; and
- have the potential to be recognized by the US trusted traveller program.

Biometrically enabled Passport Cards may be the solution for future air travel. The International Air Transport Association (IATA) and other stakeholders, such as airports, border services, and airlines are working on cross-industry initiatives to improve the facilitation of

passengers. Various industry working groups are developing recommended practices for technology solutions and processes, facilitating the early adoption of innovative solutions. As mentioned in this study, there has been a move towards off-airport processing and self-service applications, which is expected to grow, reducing the time needed for check-in and processing at the airport. Advances such as ABC (as at YVR) and using a combination of an ePassport or identity card are on the rise.

The ICAO Technical Advisory Group has been working on the issue of expanded functionality for a passport chip. The report on the Logical Data Structure 2.0 Optional Expanded Chip functionality (NTWG, 2011) suggests that work has begun to add chip functionality such as visas. In the future, if stamps and stickers are no longer needed, then the more portable card may be the preferred platform as a travel document, as opposed to a traditional passport book.

5. Recommendations and Further Studies

This paper is a starting point for what can be a new era for travel documents. A Canadian Passport Card can offer unique and secure travel identification with full authentication.

The primary recommendation of this paper is to conduct more case studies to assess whether the findings of this paper are consistent with the experience of other countries. The concept of a Canadian Passport Card is at its exploratory stage; if a new product is to be developed by Passport Canada to meet the travel needs of Canadians, then it is an opportune time for exploring other value-added functionality. This can be achieved by partnering with the airport authorities in Canada, perhaps as a pilot project. Other stakeholder consultation and buy-in will be necessary, such as with CBSA, CATSA, Transport Canada , US Homeland Security, and major Canadian air carriers.

With the underlying goal of facilitating travel for Canadians, developing a Canadian Passport Card appears to be a step in the right direction. However, further studies will be needed to address concerns that may be raised by Canadians. Among them are the following:

a) Since this technology is evolving, from enhanced cards to use of smartphones for reading RFID, how often will Passport Canada re-design its cards?
b) What will be the fees for this card? Will the card be valid for shorter period of time than a regular passport book?
c) Will same level of scrutiny be involved in issuance of a Passport Card that is used when issuing Canadian Passport books?
d) Since this card will be used not only for travel across border but potentially domestic travel, should applicants expect their travel information is being monitored. If so, would this information be protected?
e) Should Passport Canada be concerned if the Canadian Passport Card suffers from a “function creep” and becomes a secondary identity document accepted by banks and other private entities? What safeguards will be in place for the biometric information in the chip, so that it is not exploited by non-government entities?

Other considerations and future studies would involve the issues (illustrated in Figure 17) in a number of frameworks.

Figure 17: Considerations and future studies

Condition	**Elements**
Participatory framework	– Participation of external stakeholders such as CBSA, CATSA, Airport Authority, TC, Homeland Security, etc – Participation of internal stakeholders, IT (Shared Services), Security, Operations, Legal, Communications, etc.
Legal framework	– Amendments required to the *Canadian Passport Order*? – Privacy Impact Assessment – Protection of information under the *Privacy Act* and *Access to Information Act* – Complies with the all national security legislations – Is not perceived to be a “National Identity Card”
Political framework	– In line with Canada–US Perimeter Security and Economic Competitiveness Action Plan
Institutional framework	– Passport Canada is responsible for issuing, refusing to issue, revoking, withholding, and recovery of passports. – Existing database and security safeguards are in place for issuance of passport books; can this be extended to passport cards? – How will Canadians access this service, through what channels -- directly by applying at a Passport Office? On-line? or through a third party such as Service Canada locations?
Technology	– The card will need to have a dual purpose chip which will be both a vicinity-read chip and proximity-read chip – either one dual-purpose or a two-chip card. – Can this card be the next generation of travel documents? – Can there be an application developed for a smartphone system whereby the smartphone could transmit the holder’s ID "number" to the border point?
Financial framework	– Passport Canada operates on a cost-recovery basis, which means that it funds its daily operations using the fees paid by passport applicants. – Will Passport Canada be able to receive special funding for new products and technology?

6. Conclusions

Based on enhanced international security requirements at borders, Canada will roll out ePassports with the intent to increase the security features of its travel documents in early 2013. Citizens will have an option to choose either a 10-year or 5-year validity passport. In order to provide Canadians with further options, Passport Canada could consider issuing Canadian Passport Cards. This line of product will need to include technological capabilities to promote efficiencies for travellers. It is clear that with increase in travel and acceptability of a variety of documents by different countries in lieu of a regular passport book, e.g., Enhanced Driver's License or NEXUS card for US-Canada border crossing, there is a market for a smarter and more convenient travel document that could be issued by Passport Canada

The traditional passport book is an important document that should be used to travel to any country. However, if the traveller is only travelling to a destination where an alternate document will also be accepted, for example, Canadians travelling to the United States, the traveller may want to apply and receive such document.

In order to move ahead in this exploration, Passport Canada must focus on a product that would improve travel experience at airports and also provide the traveller an option for land travel. The envisioned Canadian Passport Card should bring with it the benefits that the ePassport, such as using check-in kiosks, clearing border formalities, and boarding flights. This would increase the Passport Card's versatility and make it a much more attractive option.

With a recent surge in applications for NEXUS cards, we can assume the most attractive aspect to these alternative documents is their capability to allow the passenger to bypass long border line ups and expedite through border crossings. The ePassport does not have a vicinity-read chip and therefore may not be able to provide this benefit – the bearer of an ePassport may need to wait in longer lineups. Unlike the other documents, ePassport needs to be scanned only in close proximity.

Passport Canada will need to ensure the card is unique. It should use similar technology to the current US Passport Card, which has no personal information embedded in it and only a record identifier number, and also have the technology to allow its bearer to use innovative border solutions such as ABC or SmartGate. This paper has focused on air travel and it is important to note that the land border crossing issues using a Canadian Passport Card will need a separate and more focused report.

The journey of the travel document is remarkable, from a hand-written passport and glued-on photo to a document that has a chip with the bearer's personal information. It is vital for document issuing agencies such as Passport Canada to consider innovative solutions and also take advantage of the technology available. In some circumstances, critics have noted that smartphones may read an RFID chip, and consider it as a downside to RFID-enabled documents.

If Near Field Communication (NFC), which is reading an RFID with a smartphone app, has advanced to such a point, why not use it to our advantage? A Canadian Passport Card that can use a smartphone app for check-in and perhaps other air travel formalities?

ICAO technical advisory group has started looking at the next generation chip and its use for e-visas. So why retrofit a book meant for stamps and stickers when a card will be an obviously more dynamic platform?

This paper is a preliminary attempt to establish the problem, raise the question about Canadian passport card, explore the potential benefits and challenges and suggest a way forward in terms of further studies. A series of discussions and research will need to take place to address, not only the technology but also the legislative, legal, and political framework. The next step would be to bring the advantages of a Canadian Passport Card and the ever-increasing possibilities to all stakeholders. This concept will most likely raise their interest and bring them on board with Passport Canada's pursuit of next-generation travel documents.

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