A Comparative Assessment of Electronic Voting

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Note to the Reader

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Executive Summary

In the past decade various types of electronic voting, particularly Internet voting, have won considerable attention as possible additional voting methods that promise to make the electoral process simpler and more efficient for political parties, candidates, election administration, and most importantly, for electors. Many types of Internet or remote voting have been implemented with varying degrees of success. While some systems have worked well, pilots of prototypes in other jurisdictions have been cancelled, some even before they were introduced, because of concerns or issues relating to security, technical reliability and privacy. The variable results of these projects highlight that there are important risks as well as benefits associated with Internet voting, and both should be weighed when considering including electronic voting as a method of voting in elections.

The models that enjoy success are effective because they have been tailored to meet the specific needs of a particular jurisdiction. The lesson behind these success stories for Canada is that no specific model should be directly copied for use here, although specific features of them may be. The development of an electronic voting model should be based on the requirements of the electoral process as well as the specific needs of electors and other affected parties. Compared to other countries where Internet voting has been trialled or implemented more fully, there appears to be sufficient accessibility and public support in Canada to introduce that method. Furthermore, the basis for a legal framework that supports Internet voting and a government mandate to conduct Internet voting research are important facilitating factors.

Various measures need to be considered before the next steps are taken for implementing Internet voting in Canada. These could include the gathering of additional data to measure public attitudes and those of political parties and candidates towards electronic voting. Consideration should also be given to establishing clear requirements that an additional method of voting would fulfill, as well as creating and consulting with an interdisciplinary committee of experts. Before selecting a type of software and specific system design features to suit Canada and drafting an electronic voting proposal to present before Parliament (including policies and procedures), further research should be conducted on various Internet voting models. This would lay the groundwork for designing an initial small-scale trial and then progressively increasing the number of electors who vote electronically with each additional trial. These are important aspects of the process which, based on the experiences of other jurisdictions and a review of the academic literature, appear to be both relevant and necessary toward creating a successful framework upon which an electronic voting model can be effectively developed in Canada.

Introduction

In the past decade the Internet has grown exponentially. Private companies, governments, civil society groups and individual citizens all rely on the Internet for business, networking, research and a variety of other uses. Today, citizens can use the Internet to conduct their banking, make purchases and donations, sign petitions, renew and apply for government licenses and pay their taxes. The power of the Internet to transform the nature of traditional service delivery, particularly to improve communication and access to information, has raised interest in its uses to enhance the accessibility of the electoral process as well. Its ability to create new participative spaces as well as expand existing ones suggests it has the capacity to improve accessibility to voting for many electors. Furthermore, the Internet's influence on other aspects of elections and government, such as campaigning, fundraising, membership recruitment, protest, lobbying and access to information for media and citizens, signifies that it now has an increasingly important relationship with electoral politics and will likely continue to have a considerable impact on the character of democracy in nations worldwide. The newly emergent concept of electronic democracy suggests it may be useful to further explore the potential of the Internet to improve the electoral process for parties, groups, election administration, and of course, citizens. At the same time however, there remain many concerns surrounding the notion of Internet voting, primarily related to public confidence and trust in the security of the voting process. The goal of this report is to assess the considerations involved in the potential introduction of various types of electronic voting in Canadian elections.

Canada is one of the more technologically advanced countries in the world and, at the federal level, has one of the most efficient and respected election administration bodies (KPMG, 1998). Compared to other member countries of the Organisation for Economic Co-operation and Development, Canada is among those with the highest percentage of households having access to a home computer and the Internet (OECD, 2009). National election studies indicate substantial public support for the introduction of Internet voting within all age groups, particularly among younger cohorts of electors. Currently, the *Canada Elections Act* includes a provision authorizing research regarding alternative voting methods and the potential to study and/or test electronic voting processes (*Canada Elections Act*, s. 18.1). Taken together, these elements provide a foundation of support for the implementation of electronic voting pilot projects in Canadian federal elections.

This report is structured in six sections. First, it presents a discussion regarding methodology and a justification for the cases selected and examined throughout the report. Second, it offers an overview of the meaning of electronic voting and the available types of such voting as well as an inventory of their potential benefits and risks. The report primarily examines remote Internet voting, since it has been the subject of the greatest number of trials, and appears to have the greatest potential to improve accessibility for electors and impact voter turnout. The section concludes with a brief analysis of public attitudes in Canada, drawing on data from Elections Canada surveys. Public attitudes toward Internet voting are examined, particularly expressed public willingness to make use of it, as well as reported rationales for not voting.

Third and fourth, the report proceeds with critical overviews of experiences of electronic voting trials in other jurisdictions. This portion is divided into two sections. The first pays special attention to the three large municipalities within Canada that have conducted Internet voting pilot projects: Markham, Peterborough and Halifax. The second addresses cases in Europe, including Estonia, Geneva and the UK, to give an overview of the scope and dynamics of the implementation of remote Internet voting projects on larger scales (either national or sub-national). An overview of these case studies addresses the models of development used to implement electronic voting and the benefits and risks associated with them, levels of public acceptance and public confidence in government and election administration, as well as the effect, if any, on voter turnout. Technical elements such as legal implications, financial cost, security considerations and specific methods of implementation are also reviewed where information is available. An overview of each group of jurisdictions is followed by an assessment of remote Internet voting from the examples and their potential applicability in Canada. Canadian and European lessons are examined separately given that their contextual differences make direct comparison difficult.

The fifth section of the report examines two other types of electronic voting, namely telephone voting and remote kiosk voting, and their potential implementation and effectiveness for Canada. Particularly, it assesses whether one or both of these methods could be used in conjunction with remote Internet voting.

Finally, the report examines what general assessments can be made, and lessons learned, from Canadian municipal and European trials, concerning the potential for electronic voting, particularly remote Internet voting, in Canada. It reviews considerations Canada may face in exercising such an undertaking – be they technical, cultural, political, economic or social. An overview of steps that could be taken in the development of a Canadian Internet voting model is also provided. The report concludes by offering an overview of general conclusions and suggesting directions for further research, particularly interdisciplinary projects with the co-operation of election officials, researchers and IT personnel.

Part I: Methodology and Justification for the Cases Examined

The material for this report comes from government documents, academic books and articles, newspaper and magazine articles, personal interviews and communications, and survey data where available and applicable. Aside from examining the theoretical literature addressing remote electronic voting, the report also closely examines trials that have taken place in Canada at the municipal level, notably the cases of Markham, Peterborough and Halifax, and at the local, state and national level in Europe by drawing on the experiences of Estonia, Geneva and the UK. All of the Canadian trials were initiated from and administered by municipal governments. The European cases by contrast, regardless of the level at which the remote electronic voting pilot took place, were all launched and overseen at the national level, although local authorities did have input. The difference in scales, contexts and the magnitude of issues associated with both the Canadian and European examples justify examining them as separate sets of cases, even though some elements may be closely related.

While the report examines Canadian and some of the more prominent European instances of remote Internet voting, we can initially consider the situation in the United States. Although widely discussed, there has been no actual implementation of Internet voting in regular American elections. Furthermore, the debate surrounding Internet voting in the USA is considered poorly informed because of a lack of research (Alvarez and Hall, 2004). The bulk of the discussion focuses on the technical requirements of Internet voting, and has not proceeded to a real-world implementation of such a project. In fact, some argue that many of the problems that have occurred in the trials are the result of insufficient testing (Alvarez and Hall, 2004).

There has been an abundance of research and smaller trials of Internet voting in the USA, such as a state-wide straw poll of Republican party members in Alaska in January of 2000, the Arizona Democratic Party primary in March of 2000, as well as an experimental project (Voting Over the Internet Pilot Project) as part of the Federal Voting Assistance Program (FVAP) in conjunction with the 2000 presidential election, and the 2004 Michigan Democratic Party's Democratic caucus vote. Nevertheless, no larger scale projects have been implemented because of a culture of uncertainty surrounding the safety and security of Internet voting (Alvarez and Hall, 2004; Alvarez and Hall, 2008; Mohen and Glidden, 2001). In addition, the recommendations of the major American voting reports, the California Internet Voting Task Force report, the Report of the National Workshop of Internet Voting and the Caltech/MIT Voting Technology Project, all warn against the introduction of Internet-based voting methods given the perceived level of risk associated with them – notably the potential for fraud, vote buying and voter coercion as well as security issues and the threat of attacks (Alvarez and Hall, 2004). The advice of these reports serves to reinforce security concerns and acts as a deterrent from pursuing such projects or pilots.

All remote Internet voting projects that have been initiated for use in USA elections have been terminated in the planning stages of the projects. The 2000 California project is an important example of this. It was considered an ideal jurisdiction to trial Internet voting because the state possessed a high rate of Internet access (compared to the national average), an abundance of Internet related business and, according to survey research, general support for the notion of Internet voting. Prior to implementation however, the California legislature passed a bill,

The Digital Electoral System Act, which required the state of California to assemble a task force to study the feasibility of using technology in elections (Alvarez and Hall, 2004). The final task force report concluded that Internet voting could not be used as a replacement for existing paper ballot procedures for a variety of reasons relating to security (notably computer security and voter identification) and made two major recommendations: (1) that, for the time being, Internet voting be tested solely within the absentee voting process; and (2) that it be very gradually phased in throughout the state, after considerable additional research. Overall, the report's findings regarding Internet voting were very tentative and any recommendations to proceed with an Internet voting program were laced with caution (Alvarez and Hall, 2004; California Secretary of State Bill Jones, 2000).

Created to target absentee electors, the one major initiative, the Department of Defense's *Secure Electronic Registration and Voting Experiment* (SERVE), which developed as an extension of FVAP, was created to test Internet voting as an alternative to traditional absentee voting for military personnel, their dependents and overseas citizens. Though more than 6 million citizens qualified for the program, it was decided to only offer it to 100,000 people for the 2004 primary and general elections to allow for adequate testing and evaluation. Even on that reduced scale, the project was cancelled before it could come to fruition due to opposition from a small segment of the scientific community. Specifically, SERVE was terminated not because of its system design or architecture, but rather due to concerns surrounding the Internet itself and the view that any transaction conducted over the Internet is not secure and considered vulnerable to system breakthroughs. It has been observed that the report that raised these concerns failed to note that the threats associated with Internet voting are analogous to threats surrounding traditional absentee voting such as vote selling, buying and coercion and denial of service attacks that occur without the Internet (Alvarez and Hall, 2008).

Other major American research projects, such as the *National Workshop on Internet Voting* and the *Caltech/MIT Voting Project*, also take negative positions on the introduction of remote Internet voting and have helped to affirm the legitimacy of fears surrounding Internet voting (Internet Policy Institute, 2001; *Caltech/MIT Voting Project Report*, 2001). Despite recognizing its potential to enhance accessibility for certain groups of electors, these reports come to similar conclusions that such systems pose "significant risk," such as potential attacks to the elector's computer, the server and/or network as well as issues of ballot legitimacy and secrecy, and conclude that Internet voting should not be introduced on a large scale (Alvarez and Hall, 2004:23). A culture of uncertainty in the USA surrounding the notion of Internet voting has prevented serious research and testing.

While there is lack of testing and practical research in the USA, Europe by contrast has been a breeding ground for Internet election projects and, as a whole, can be considered to have advanced the furthest with respect to Internet voting technologies and approaches. The important differences between the USA and Europe in this regard are aptly highlighted by Alvarez and Hall in their most recent book, *Electronic Elections* (2008), on the applicability of electronic elections in the USA:

> When we published *Point, Click, and Vote: The Future of Internet Voting* in January 2004, we had little idea that we should have been publishing the book in Europe,

> not the United States. The road map we lay out in the book is being followed, just not in the United States. Instead, it is in countries like Estonia, Switzerland, the Netherlands, and France that e-voting experiments are being conducted (71).

Though the concerns raised in American literature are important, they are taken into consideration in Internet voting experiments in Canada and Europe. Furthermore, in these settings, the potential problems are examined in the context of real-life examples and pilots, rather than in theoretical discussions. Therefore, the remainder of this report concentrates on European as well as Canadian trials.

What is Meant by Electronic Voting and Internet Voting? What Types are Examined in this Report and Why Do We Predominately Focus on Remote Internet Voting?

The term electronic voting is a blanket term used to describe an array of voting methods that operate using electronic technology. There are three primary types of electronic voting, namely machine counting, computer voting and on-line or Internet voting.[1] With respect to the last of these types, there are four kinds of electronic voting that use the Internet; these include kiosk Internet voting, polling place Internet voting, precinct Internet voting and remote Internet voting (Alvarez and Hall, 2004). Kiosk Internet voting typically involves the use of a computer at a specific location that is controlled by election officials. This differs from electronic machine voting because, among other things, the ballot is cast over the Internet. Polling place Internet voting is conducted at any polling station through the use of a computer that is controlled by election representatives. Precinct Internet voting is analogous to polling place voting except that it must occur at the voter's designated precinct polling place (Alvarez and Hall, 2004). Remote Internet voting is voting by Internet from a voter's home or potentially any other location with Internet access.

The following section discusses the benefits and risks associated with Internet voting in general, primarily concentrating on remote Internet voting. This is because, in the first place, in most of the literature addressing electronic voting the term 'Internet voting' has become synonymous with remote Internet voting and is addressed as such (Mercurio, 2004). Furthermore, remote Internet voting has the greatest potential to positively impact accessibility for voters. Internet voting machines that are either located at a polling station or another central location still require electors to travel to the poll or location. While in some cases travel to a central location such as a mall or supermarket may be convenient, their use still requires additional effort that voting from home or work does not. Finally, remote Internet voting is most consistent with the development of other political aspects of society that have changed with technology. While kiosks and machines can be useful, people are now using home computers to conduct more transactions than ever before and this will only increase in the next decade.

[1] Machine counting requires voters to punch a hole in their ballot which is then scanned and counted by a central computer. Computer voting or direct-recording electronic voting machines involve the use of either a keyboard, touch screen or some kind of pen or pointer and computer terminal and are immediately factored into the tally of votes (Parliamentary Office of Science and Technology, 2001).

Part II: Benefits, Drawbacks and Risks Associated with Internet Voting

Benefits

Proponents of electronic voting, particularly Internet voting, make a number of arguments in favour of its implementation. These are related to technology, social issues and election administration. First, electronic voting has the potential to make the **voting process easier** and **more accessible** for electors. This is especially true for remote Internet voting and telephone voting given that ballots can be cast from any computer with an Internet connection or any working telephone. These latter methods substantially lower the cost of voting for many electors by creating many more access points from which they are able to vote. There is the potential to eliminate long line-ups at polling stations and better address accessibility issues for persons with disabilities, those suffering from illness, those serving in the military or living abroad, those away on personal travel, snowbirds and other groups of citizens such as single parents who may find it difficult to visit a traditional polling station. Additionally, remote methods of Internet voting, and in some cases kiosk Internet voting, afford electors the opportunity of being able to **vote at any time**, a feature that further enables electors' ability to cast a ballot.

With regard to special populations of electors, Internet (especially remote) and telephone voting may also be methods of engaging those voters who are considered the hardest to reach, particularly **young people** aged 18 to 30. These electors are most familiar with the technology, are the most frequent reported users and would likely benefit the most from the extension of remote types of electronic voting. Remote Internet and telephone voting seem to be especially useful ways of engaging young people away at university and who are not registered to vote in that particular constituency.

Second, Internet and telephone voting could allow **greater secrecy** for special populations of electors with disabilities (including visually or hearing impaired). By voting electronically and therefore unassisted, these electors are afforded a greater degree of anonymity when casting a ballot. Enabling secrecy for these groups enhances the equality of the vote.

Third, enhancing accessibility and creating more participatory opportunities for electors holds promise to positively impact **voter turnout**. Generally, the academic literature addressing electronic voting and turnout decline presents inconclusive results concerning whether the extension of on-line voting has a positive effect on electoral participation. In most cases where polling place voting machines that relied on the Internet for operation were used turnout did not increase. However, cases in which remote methods were implemented have produced mixed results. Though some areas, such as the UK, have not consistently noted increases, others, such as Estonia and Geneva as well as the Canadian municipalities, do report some instances of increased turnout. The length of time remote Internet voting options remain in place appears to be related to increases in both its use and in voter turnout.

Fourth, related to administration, Internet and telephone voting are claimed to produce **faster and more accurate election results**. Internet and telephone voting systems are said to deliver a faster official ballot tabulation process and are alleged to be more accurate than other types of machine counting (such as punching cards) which are sometimes criticized for error.

Fifth, over the long term all types of Internet voting have the potential to be **less expensive** to operate and execute than traditional paper ballots which require setting up and staffing polls. However, the start-up costs for machines or kiosks can be very high.

Finally, all types of Internet voting and telephone voting have the potential to improve the overall quality of ballots cast by reducing or eliminating ballot errors and by creating better informed electors. There can be **no ballot errors**, and, depending on the system, **no spoiled ballots** because the computer will not permit it. However, if the legal structure in a jurisdiction requires the option to spoil a ballot or allows for protest votes, a button can be added in some programs to give electors the option to cast a protest vote (or decline to vote). Furthermore, depending on the architecture of the Internet voting system, there is the possibility for additional information to be displayed regarding candidates and their policy positions in conjunction with the on-line vote. This would provide voters with basic information about the candidates and party platforms, and therefore better informing them to vote.

Drawbacks and Risks

Those opposed to, or skeptical of, electronic voting point to several drawbacks and perceived risks that are associated with types of Internet voting and telephone voting methods. The most prominently cited risk relates to **security**. Threats of computer viruses or hacker-orchestrated 'denial of service' attacks are most commonly mentioned as problems that could compromise an election and public confidence in electronic voting. This concern is most prevalent with regard to the security of personal computers. In light of this, the maintenance of **ballot secrecy** is presented as an issue when using computers that are unprotected, located in public places, or which may be susceptible to virus attacks. Other potential technical problems or issues include power outages or malfunctions in Internet connectivity as well as the possibility of servers shutting down or crashing. The reliable recording and storage of votes is also an important consideration.

Second, problems with **access** are raised. The material on remote Internet voting discusses the potential for a "digital divide", which can occur in two ways. There is a digital divide between those who have home computers with Internet connections and those who do not. Second, there may be a digital divide between those who have faster access and those who have slower connections and hence lower quality access. People with higher incomes are more likely to be able to afford access. Furthermore, access is often less expensive and of higher quality in urban areas. Those with lower incomes and who live in rural areas are at a disadvantage. Therefore, the extension of Internet voting has the potential to create divides with respect to many socio-economic variables, namely income, education, gender, geography and race and ethnicity. These potential divides could be problematic for participation and representation.

Third, it is said that remote Internet and telephone voting present greater opportunity for **fraud** and **coercion** or vote-buying. Fraud occurs when someone votes on another's behalf without their permission, whereas coercion or vote-buying takes place when a voter is pressured by others to vote in a way that he or she would not have otherwise. Both present problems for ballot integrity since it is important that every vote cast be tallied as the voter intended. There is additional opportunity for fraud in electronic voting systems if voter notification cards, which contain unique passwords required to cast a ballot, are intercepted. In the case of ballots not cast in person it is more challenging to verify a voter's identity. Remote voter authentication can be a problem since it may be difficult to confirm that the person voting is actually who he or she claims to be. While digital signatures and passwords can help, they are not foolproof and could potentially be shared.

Fourth, the issue of **voter education** is cited as a concern. A lot of time and money must be invested to ensure that the public is aware that electronic voting is an option and that voters are able to understand and use the on-line system to cast a ballot. Without correct marketing and advertising it will be difficult to engage electors.

Fifth, **privatization** is a concern when electoral administrators cede control to a hired firm. Contracting elections out to private companies to run the electronic operations has negative implications for some people, and hence has the potential to negatively impact public confidence and trust in government and elections.

Finally, perhaps the most significant social concern is the threat of **disintegration of social capital** or civic life. The proliferation of electronic election services has the power, some say, to alter the nature of electoral participation by causing more electors to vote alone instead of at a polling place with others. This threatens to erode civic life, local social networks and groups related to elections (see Putnam, 2000).

While this provides a general treatment of the major advantages and drawbacks to Internet and telephone voting, there are pros and cons which are unique to each particular electronic method. These are presented in Table 1 (pp. 19–21). It also includes instances where these methods have been trialled or implemented.

Public Attitudes

Implementation of electronic voting would not be possible without a culture of support from citizens. It is important that the public retain a strong sense of confidence and trust in the electoral process and be generally supportive of the notion of electronic voting. In the jurisdictions to be described in the next part of the report, where types of electronic voting have been successfully trialled, developed and maintained as a component part of the vote in elections there has been no widespread opposition to its use. Any public concerns about it seem to have been addressed at the time. Although there is no directly comparable data for Canadians' public attitudes over time since the wording in survey questions differs slightly from year to year in Canadian election studies, it is possible to gain an understanding of general public attitudes toward Internet voting and whether electors would use the service if it were an option. Both acceptance of Internet voting and reported levels of use are important considerations in developing a model or trial of Internet voting. To assess whether the Canadian public would be

supportive of the introduction of alternative voting methods in elections at the federal level the report draws upon data from Elections Canada survey data from 2000 to 2008.[2]

Elections Canada survey data offers important insights regarding the Canadian publics' expressed likelihood to vote by Internet. Overall, the data shows that there is a moderate increase in the proportion of respondents who report being likely to make use of Internet voting over time. While in 2000, for example, 47 percent of respondents report being likely to vote on-line, in 2008, interest rose to 54 percent of respondents. We also see that respondents' reported likelihood to use on-line voting either increases over time or remains consistent for all age groups. In fact, aside from those electors over the age of 54, a majority of respondents in all age groups indicate that they would be likely to make use of on-line voting if the service were available.

Except in 2008, where the numbers are virtually identical, non-voters responding to election surveys are more inclined than voters to say that they would be more likely to vote on-line in the future. In fact, a greater proportion of respondents aged 18 to 34 reports being likely to make use of on-line voting than having voted.[3] This suggests that some non-voting electors may be encouraged to participate through Internet voting. Overall, the figures suggest that the extension of Internet voting may be a useful way of appealing to younger electors as well as encouraging some non-voters to participate in the electoral process.[4] It also highlights that older electors are less likely to make use of on-line voting.

Another important consideration with respect to public attitudes is the rationale provided by electors for not voting. If the extension of Internet voting is to encourage participation then it should address one or more of the reasons respondents cite for not casting a ballot. Elections Canada survey data reveals that among the general population in all survey years time constraints or accessibility issues are mentioned most commonly to account for respondents not voting. For example, three of the top four reasons respondents provided as rationales for not voting in 2008 include being too busy (16 percent), traveling or holidays (16 percent) and their work or school schedule (11 percent). In 2006 by comparison, 27 percent of respondents reported not voting because their work or school-related obligations prevented them from casting a ballot. In 2004, two of the top four reasons mentioned for not voting were being too busy with work (12 percent), or personal and family life (11 percent). Twenty-seven percent of respondents rationalized not voting in the federal election in 2000 by citing a lack of time or work obligations. In addition, reasons for not voting, such as illness, absence from the country or constituency, and missing registration information (including poll location), could potentially be remedied with an available remote Internet voting option.[5]

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[2] This comprises data from four federal elections in 2000, 2004, 2006 and 2008.

[3] For instance, whereas 63 percent of youth aged 18 to 24 reported voting in 2008, 70 percent said they would be likely to vote on-line if it were an option. Among those electors aged 25 to 34, self-reported voter turnout was 62 percent, while 67 percent report being likely to make use of Internet voting.

[4] However, since voter turnout is often over-reported in election surveys there is also the chance that likelihood of making use of on-line voting is being over-reported as well. Voting is typically over-reported for reasons relating to social desirability.

[5] See Table 4, page 312 in Lawrence LeDuc and Jon H. Pammett, "Voter Turnout in 2006: More than Just the Weather", in Jon H. Pammett and Christopher Dornan, eds., *The Canadian Federal Election of 2006* (Toronto: Dundurn, 2006).

Table 1: Benefits and Drawbacks of Various Electronic and Remote Voting Methods

System Type	Benefits	Drawbacks and Risks	Where Method Has Been Used[6]
Remote Internet voting	– Convenience and accessibility for electors who have computers with Internet access at home, at work, or abroad; and for certain groups of electors (persons with disabilities, the military, single parents, electors who are traveling, etc.) – Flexible voting time for electors – Flagging of ballot errors – Replication of ballot images without voter information for counting or audit purposes – Lower cost than traditional methods – Potential to increase voter turnout – Potential to enhance electoral efficiency – Faster and more accurate election results – Elimination of long line-ups – Instant absentee ballot – Font size and screen language can be modified	– Limited access to Internet or limited understanding on part of some electors – Possibility of stolen voter packages or identification cards – Misuse of elector's ID card and personal information voting by others without the knowledge of the elector – Difficulty verifying voter ID – Possible pressure on electors to vote a certain way if in the presence of others – Hacks or viruses attacking the system and altering election results – Technical difficulties, programming errors or server malfunctions – Inaccuracies on the voters' list, resulting in one elector receiving a card intended for another elector	– Australia (for military and persons with disabilities only and the project has since been cancelled), Austria, Canada, Estonia, Netherlands, Switzerland, USA (for military only project was abandoned), UK (project also cancelled)
Kiosk Internet voting	– Placement in convenient high-traffic locations (e.g. malls and supermarkets) – Flexible voting time for electors – Flagging of ballot errors – Replication of ballot images without voter information for counting or audit purposes – Potential to help address the voting needs of certain groups of electors (persons with disabilities, single parents, etc.) – Potential to enhance electoral efficiency – Faster and more accurate election results – Elimination of long line-ups	– Lack of paper trail to allow auditing and recounts – In the case of a power outage, no alternate method is available – Expenses of machines – Software can sometimes be unreliable – Electors may leave the voting screen before ballot is officially cast – Hacks or viruses attacking the system and altering election results – Electors may be pressured to vote a certain way if in the presence of others – Technical difficulties, programming errors or server malfunctions – Machine updating and cost	– France

[6]Country information taken from www.tiresias.org.

System Type	Benefits	Drawbacks and Risks	Where Method Has Been Used[6]
		– Candidate representative's scrutineer function may be diminished – Inaccuracies on the voters' list could result in one elector receiving a card intended for another elector	
Polling place Internet voting	– Eliminates mismarked or spoiled ballots and other invalid results – Programmable machines to dispense ballots for any riding – Removal of authentication questions so voter identification is most similar to the traditional process – Assistive devices to improve accessibility for electors with disabilities – Faster and accurate election results – Font size and screen language can be modified	– Auditing and recounts can be questioned if there is no paper trail – In the case of a machine failure (i.e. power outage) no alternate method is available – Machines are expensive – Software can sometimes be unreliable (many of these machines have a negative reputation based on failure in USA trials) – Electors may leave the voting screens before their ballot has been officially cast – Little advantage for electors in terms of convenience – Machine updating could also be an issue and costly	– Australia, Belgium, Brazil, Canada, Finland, France, Germany, India, Ireland, Netherlands, Norway, Portugal, Spain, Switzerland, UK, USA
Precinct Internet voting	– Elimination of mismarked or spoiled ballots and other invalid results – Programmable machines to dispense ballots for any riding – Removal of authentication questions so voter identification is most similar to the traditional process – Assistive devices to improve accessibility for electors with disabilities – Faster and accurate election results – Font size and screen language can be modified	– Auditing and recounts can be questioned if there is no paper trail – In the case of a machine failure (i.e. power outage) no alternate method is available – Machines are expensive – Software can sometimes be unreliable – Electors may leave the voting screens before their ballot has been officially cast – Little advantage for electors in terms of convenience – Machine updating could also be an issue, and be costly	

System Type	Benefits	Drawbacks and Risks	Where Method Has Been Used[6]
Telephone voting	– Convenience and accessibility for electors who have telephones; and for certain groups of electors (persons with disabilities, military, single parents, electors who are traveling, etc.) – Flexible voting time for electors – Flagging of ballot errors – Familiar technology, especially for those familiar with telephone banking – No ballot printing – Fewer election staff and poll locations – Less costly – Potential increase in voter turnout – Enhance electoral efficiency – Eliminate long line-ups	– Traditional recount not possible because no paper trail – Possibility of stolen voter packages or identification cards – Difficulty verifying voter ID – Must ensure candidate representative's function is written into the program (e.g. Halifax candidate module) – Electors may be pressured to vote a certain way if in the presence of others – Possibility of telephone lines overloading or phone service interruption – Inaccuracies on the voters' list could result in one elector receiving a card intended for another elector	– Netherlands, UK

Part III: Canadian Municipal Trials

To date, the Internet has been used to conduct a number of elections in Canada at the local level. The following section examines the experiences of Markham, Peterborough and Halifax with remote Internet voting to shed light on the potential of an Internet voting system in Canada. To date, six provinces have passed legislation as part of their respective *Municipal Elections Act* affording municipalities the opportunity to either implement alternative voting methods or some form of electronic voting, or to pass a bylaw that would authorize the use of alternative voting methods. Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario and Saskatchewan have all done so (see municipal or local government election act of each province).[7] Though the option of using another method of voting is written into Ontario and Nova Scotia legislation, before implementing an alternative approach it was required that the local councils of Markham, Peterborough and Halifax pass bylaws specifying the type of method they wished to use and a rationale for its execution.[8] Along with this, the three municipalities created a formal list of procedures to be followed and forms to be used in the context of electronic voting. This was done for Internet and vote tabulators in the cases of Markham and Peterborough and Internet and telephone voting for Halifax (Brouwer, August 27, 2009; Grant, August 25, 2009).

There have been many instances where Internet voting has been actively used in elections in Canada, but these occurrences were all at the local level, either in municipalities or townships. The first experiences with electronic voting by the Internet occurred in 2003. These trials occurred in the town of Markham; in six municipalities in Stormont, Dundas and Glengarry (as part of a joint trial); and in five municipalities in Prescott-Russell (City of Peterborough, 2005).[9] In 2006, Markham and Peterborough used the Internet in their municipal elections, as did eight townships throughout Ontario who also offered telephone voting with an Internet option.[10] In 2008, Halifax, and the Nova Scotia towns of Berwick, Windsor, and Stewiacke, conducted their municipal and school board elections by incorporating the Internet and telephone voting as an alternative voting method and Halifax recently implemented an expansion of that approach in a September 19, 2009 by-election. In this report we focus on experiences of Markham, Peterborough, and Halifax, since these jurisdictions adopted more developed models and also have higher populations than the other cases noted above.

[7] Prince Edward Island also has legislation approving the use of electronic voting, but only for referendums or plebiscites.

[8] Halifax had to pass two separate by-laws for the 2008 and 2009 elections given that the 2008 election only offered electors the opportunity of voting online for three days during the advance poll, whereas in the 2009 election Internet and telephone voting were an option for the entire election period including election day (Grant, 2009).

[9] Ten of these municipalities used both Internet and telephone voting in their elections. The electronic services in these elections were supplied by CanVote, a company based in L'Original, Ontario. Markham only offered Internet voting in addition to their paper balloting; the Internet voting portion of the election was supplied by ES&S. The Halifax and other Nova Scotia elections were conducted with Intelivote, a Nova Scotia based company. In terms of turnout, East Hawkesbury, with only 3,100 electors, experienced a turnout rate of 65 percent, South Dundas with 8,417 electors had a turnout of 58 percent, North Dundas with an electorate of 8,289 had an overall turnout of 48 percent, South Glengarry with 10,988 electors had a turnout of 53 percent, and North Glengarry with 8,900 electors had an overall turnout of 60 percent. The average voter turnout in 2003 for all eleven municipalities in these regions was 52 percent (City of Peterborough, 2005; Smith, August 26, 2009).

[10] These townships include Addington Highlands, Archipelago, Augusta, Cobourg, Edwardsburgh–Cardinal, Perth, South Frontenac and Tay Valley and their elections were also conducted by Intelivote (Intelivote, 2009).

Markham

Rationale for introducing electronic voting

Markham was the first municipality in Canada to introduce electronic voting as part of a comprehensive engagement strategy to increase participation in elections.[11] By increasing the range of services available to electors and making voting more convenient for residents, the Town of Markham hoped to not only increase electoral involvement, but also have a positive effect on voter turnout. In addition to the Internet voting option, vote tabulators were introduced as part of the engagement strategy to help incorporate electors with disabilities (including visually or hearing impaired) and allow them to cast a secret ballot. Tabulators had audio, touch and sip and/or puff abilities to enable these groups of electors to vote unassisted. Tabulators were also incorporated because the town believed they provide a more efficient counting mechanism than traditional tabulation procedures (Brouwer, August 27, 2009).

Development, technical features, cost and general operations of the Markham model

Prior to introducing electronic voting, the town conducted considerable research in anticipation of the 2003 and 2006 projects. Though more extensive research was carried out prior to 2006, some of these initiatives included evaluations of trials in other jurisdictions; a comparative risk analysis of traditional, Internet and other types of voting; consultations and recommendations from information technology companies; and examination of public attitude data from the Delvinia reports (Brouwer, August 31, 2009). The electronic model used by Markham included the option of remote Internet voting in advance polls during the 2003 and 2006 municipal elections as well as the use of optic scan vote tabulators in every polling station on election day. The electronic portion of the elections was run by Election Systems & Software (ES&S), of Omaha, Nebraska, a company that previously conducted multi-channel voting trials in the U.K. Markham paid ES&S $25,000[12] in 2003 and $52,000 in 2006 for the development, execution and operation of the Web site.[13] The vote tabulators were rented to the town at an additional cost of around $160,000 per election (Town of Markham, 2007).

On-line voting was only offered during the advance polls, and electors wishing to vote in this manner were required to pre-register. In 2003, electors were able to vote on-line during a five-day period and in 2006 the advance polling period lasted for six days.[14] Every elector received an on-line registration package by mail as part of the voter notification process. The rationale behind pre-registration was that it would serve as an additional security precaution and would give the town a better sense of which electors opted to use electronic voting. When electors registered they were prompted to create a unique security question whose response was required before casting their ballots. Registration also removed elector names from the manual voter list and they no longer had the option of voting at a traditional polling station. Upon registering, electors were also mailed a unique PIN. Use of the PIN and the response to the unique security

[11] Previously remote Internet voting had been trialled in some small townships in 2000 (Nicholson, September 23, 2009).
[12] Markham was able to negotiate such an excellent price on the contract given that the company was new to Canada and wanted to break through the market here (Brouwer, August 27, 2009).
[13] Printing, postage, communications and IT resources were an additional cost. In 2006 for example Markham spent $104,000 in additional costs related to Internet voting (Town of Markham 2005, 2007).
[14] In 2003 electors were able to vote from November 3rd to 7th and in 2006 from November 4th to 9th.

question allowed electors to vote on the Town of Markham Web site (Brouwer, August 27, 2009; Flaherty, August 28, 2009; Town of Markham, 2007).

The Town of Markham also took a unique outreach approach to inform its electors of the electronic voting service by working with Delvinia Interactive, a firm that specializes in creating digital experiences to create awareness of on-line voting. Delvinia created an interactive Web site that not only encouraged electors to register to vote on-line and informed them of how the process worked, but also educated them on the importance of voting. The Web site also included links to the various candidates' Web pages in case electors wanted to learn more about them or their mandates. The town advertised both the Web site and on-line voting through mailings, fridge magnets, print ads, in malls and by e-mail and telephone. This aggressive marketing approach is very likely one of the keystones to the success of Internet voting in Markham, and the notable increases in voter turnout. The same services were used in both election years. (Froman, October 2, 2009; Froman, December 8, 2009).

Model success and elector and government feedback

While turnout overall remained unchanged in the 2003 election (28 percent), turnout in the advance polls increased by 300 percent. To put this in perspective, voter turnout in most other Ontario municipalities declined during the 2003 election. Markham electors had the option of voting from home, their workplace, a library or public place where Internet was available as well as touch-screen kiosks that were set up in city hall (Sibley, 2003). In 2003, 12,000 out of 150,000 electors pre-registered to vote on-line and slightly over 7,000 voted on-line. In 2006, advance voting on-line increased by 48 percent, as 10,639 voters chose to use the service to cast their ballots (Internet News Unlimited, 2006). Eighteen percent of all votes cast in 2006 were electronic ballots, a one-percent increase from 2003, and a 38-percent increase in turnout overall (CANARIE, 2004). Public attitude data that was collected by Delvinia highlights use of and satisfaction with on-line voting in Markham.

In terms of remote location, 82 percent of electors who voted on-line did so from home and 88 percent of on-line voters cited convenience as the primary reason for doing so (Delvinia, 2007).[15] When asked if they would like to see on-line voting offered in elections at other levels of government 90 percent report being very likely to vote using the Internet in a provincial election and 89 percent in a federal election (Delvinia, 2007). These percentages indicate that there is strong public support for remote Internet voting in the Town of Markham, at least among those who use the service. In addition, a portion of previous non-voters (25 percent in 2003 and 21 percent in 2006) declared that they had decided to cast a ballot because of the convenience of Internet voting (CANARIE, 2004; Delvinia, 2007). One hundred percent of the voters who voted on-line in 2003 reported they would vote on-line again in the future and 91 percent in the 2006 survey indicated they would be "very likely" to do so (CANARIE, 2004; Delvinia, 2007). Overall, based on the positive public feedback and increase in turnout, Markham plans to continue to refine its model and employ a similar electronic strategy in the forthcoming 2010 election.

[15] These statistics are based on the 2006 election.

Peterborough

Rationale for introducing electronic voting

The rationale behind the introduction of Internet voting in Peterborough was to reduce the need for proxy vote applications and to enhance accessibility for electors, creating more opportunities for them to cast a ballot. In addition, the city was impressed by the increase in voter turnout in Markham's advance polls in 2003 and perceived on-line voting as a means of increasing turnout in the municipality. The potential to lower election costs was also an important consideration. Overall, the extension of Internet voting was seen as a positive step toward making elections more accessible by creating more voting options for electors (City of Peterborough, January 30, 2006; Wright-Laking, November 23, 2009).[16]

Peterborough initiated electronic voting for the first time in its 2006 municipal election and like Markham plans to continue and expand the use of electronic voting in its 2010 election.[17] Peterborough is demographically different from Markham, in that it is less urban, and has a smaller electorate with 52,116 electors. Nevertheless, its experience with electronic voting was very similar to that of Markham. A large percentage of its electors have home computers with access to the Internet.[18] Peterborough is particularly interesting because it has a very large senior population (the second largest in Canada) and so to see a high rate of use among older electors highlights that remote Internet voting is not just something to attract young people.

Development, technical features and general operation of Peterborough's model

Prior to the introduction of Internet voting, the City of Peterborough did not collect public attitude data to gauge electors' reactions toward the service; however, they did analyze previous cases as well as different Internet voting providers and the types of alternative voting methods available. They also closely reviewed the ability to provide Internet voting and vote anywhere technology. The city also implemented an aggressive promotional campaign to inform electors of the service, which primarily involved visiting seniors' residences and community centres in hopes of appealing to older electors. Like Markham, Peterborough chose to use remote Internet voting for a five-day period in its advance polls and introduced vote tabulators into all polling stations on election day.[19] City officials awarded the electronic election contract to a Toronto-based company, Dominion Voting Systems, for a total cost of $180,400, including the rental fee for the tabulators.[20] The system operated on a two-step process very similar to the one used in Markham (City of Peterborough, January 30, 2006; Wright-Laking, October 1, 2009; Wright-Laking, November 23, 2009).

[16] By using Internet voting and vote tabulators, the city of Peterborough was able to reduce the cost of the 2006 election by less than the 2003 budget (City of Peterborough, January 30, 2006).

[17] The Clerk's office hopes council will approve continuous Internet voting in the 2010 election right up until and on election day (Wright-Laking, October 1, 2009).

[18] Although the City of Peterborough is unsure of exact percentages in terms of home computers and Internet access, it reports that access is relatively high within the area (Wright-Laking, October 1, 2009).

[19] Twenty-one vote tabulators were used for faster and more reliable reporting of election results as well as to reduce manpower and costs (City of Peterborough, January 30, 2006).

[20] This price excludes PST and GST (City of Peterborough, January 30, 2006). This was the first time Dominion Voting Systems had provided Internet voting (Wright-Laking, October 1, 2009).

All electors on the voters list were mailed a notice of registration card or letter with, among other information, a unique elector identifier (EID). To access the on-line election services electors were required to login to the system prior to registering using their EID as well as retyping a security code called a CAPTCHA challenge[21]. To register, electors were required to provide their address (as shown on their notice card) and their year of birth. They also had the option of choosing whether they preferred to have their PIN mailed (as in the Markham trials) or e-mailed to them. Registered electors were then either mailed or e-mailed another card with a PIN. Both the PIN and the login information (EID number and CAPTCHA challenge entry) were required prior to casting a ballot on the City of Peterborough Web site (City of Peterborough, 2006)

Model success and elector and local government feedback

Overall, the introduction of electronic voting in Peterborough can be considered a success. Public reaction to the introduction of Internet voting was positive and although initially negative media coverage was an obstacle, this was overcome by providing media sources with additional resources and educating them about the Internet process and the security of the system (Wright-Laking, October 1, 2009; Wright-Laking, November 23, 2009). No security issues or risks required attention. The City of Peterborough reports that they put "tremendous security methods in place and felt very comfortable the system was secure" (Wright-Laking, November 23, 2009). The only drawback of the process cited by city officials was that Internet voting was limited to advance polls only and this is something they would like to see expanded in future elections (Wright-Laking, November 23, 2009).

There was no noticeable effect on turnout overall (it remained unchanged from 2003 at a rate of 48 percent), but turnout in the advance polls was moderately higher than the figures for 2003 (Hoover, August 27, 2009). The increase in advance turnout may be a consequence of the fact that aside from the on-line polls, only one traditional advance polling station was open to the public. Also, turnout may have been artificially high in the 2003 election given that there was a referendum question on the ballot (Wright-Laking, October 1, 2009). In all, 14 percent of electors who voted cast their ballots over the Internet (3,473 of 25,036). The largest group of on-line voters was baby boomers (City of Peterborough, 2009; Wright-Laking, October 1, 2009). Specifically, 70 percent of on-line voters were 45 and older, and the highest rate of use was among electors aged 55 to 64. Only 14 percent of those aged 18 to 34 voted on-line (Sawatzky, December 9, 2009). The higher rate of use among baby boomers is interesting because most survey data indicates that young people are more inclined to report using, or saying they would make use of, Internet voting than other cohorts of electors. If seniors, or older cohorts of electors, are interested in making use of on-line voting, its implementation is more likely.

[21] CAPTCHA (Computer Assisted Program to Tell Computers and Humans Apart) is a security procedure whereby the user is prompted to re-type a series of distorted characters located in a blurred box (Bousquet, 2008; Smith, August 26, 2009).

Halifax

Rationale for introducing electronic voting

Halifax Regional Municipality (HRM) first introduced remote Internet voting in its municipal and school board elections in 2008 as part of a pilot project that sought to establish the viability and reliability of electronic voting. The municipality decided to offer remote Internet and telephone voting, given that voting over the phone appealed to a wider demographic; especially older electors who might have greater difficulty using the Internet. Furthermore, HRM contains both an urban core and suburban areas, so while some areas are highly connected to the Internet, other parts are only now getting Internet connectivity. By implementing both remote Internet and telephone voting Halifax offered those residents who have limited or no Internet access the possibility of voting electronically (Mellett, September 29, 2009).

Prior to the 2008 trial, HRM researched electronic options for three years and closely monitored the experiences of other municipalities that had used the Internet as a voting method. There were five main principles to which Council wanted the introduction of an alternative voting method to adhere. These were, foremost, maintaining the integrity of the electoral system, as well as increasing voter choice by incorporating additional voting methods, potentially increasing voter turnout, improving cost effectiveness, and improving the speed of both tabulation and the reporting of results. The four most important considerations in the process were deemed to be outsourcing to a trusted partner, the level of security (HRM decided on two shared secrets)[22], the quality of the voter data (to control potential duplicates and have verifiable data), and finally a credible audit process to give voters confidence in the voting process. In the case of HRM this last consideration was accompanied by the development of a very detailed bylaw as well as a policies and procedures document (Mellett, September 11, 2009).

Development, technical features and general operation of Halifax's model

The trial included a potential 276,000 voters and was contracted to a locally established company, Intelivote, who had previously run elections for eight small Ontario townships in 2006,[23] and for two districts in the UK in 2007[24]. For a total cost of $487,151[25] Intelivote incorporated remote Internet and telephone voting as a component of the advance polls. The remote Internet and phone portion of the election took place during a three-day period two weeks prior to election day (Bousquet, September 18, 2008; HRM, January 22, 2008; Smith, August 26, 2009).

[22] There are different levels of sign-in security that may be selected with using remote Internet voting, namely pre-registration, just a PIN, or two shared secrets. Although using shared secrets requires the electoral office to have access to a reliable second data source and increases the complexity somewhat, HRM went with this option because officials felt it was more secure and had the greatest potential to affect turnout. HRM decided not to use pre-registration, unlike Markham and Peterborough, based on the UK's experience with it and how it greatly reduced electronic voting participation rates there. The use of only a PIN was deemed to be too insecure (Mellett, September 11, 2009).

[23] The largest of these townships was South Frontenac with a total of 18,528 voters (Bousquet, September 18, 2008).

[24] This includes the district of Rushmoor Borough (101,000 voters) and South Bucks (68,000 voters). Intelivote has now worked extensively in the USA, Bermuda, Bulgaria, Romania and Poland (Smith, August 26, 2009).

[25] This portion of the cost is just the contract with Intelivote. The actual election cost of $1.3 million, which is more expensive than a regular municipal election given that the school board elections were held simultaneously (Grant, 2009; HRM, January 22, 2008).

The Halifax experience differs slightly from the Markham and Peterborough projects given that electors were not required to register prior to using remote Internet or telephone voting – residents were instead able to choose to use the service at any time. Whereas in the other two trials electors who expressed a willingness to use remote Internet voting (by registering on-line) were taken off the manual voting lists, the technology used in the Halifax trials enabled voters to select their preferred method of voting when they wanted to cast a ballot and not before (Smith, August 26, 2009). The Halifax approach is also exceptional in that electors were able to spoil a ballot. Not being able to spoil a ballot is often cited as a major disadvantage of electronic voting systems since many typically do not offer an official way to decline a ballot. Intelivote created a "decline to vote" button which was presented along with the candidate names so that electors could exercise this right. Another important feature of the model used in Halifax is that voters were able to switch voting channels if they wished. For instance, an elector could start voting on his or her cell phone on the way home from work (e.g. vote for mayor) and then continue voting for the remaining positions (e.g. councillors and school board members) from his or her home computer (Smith, August 26, 2009).

To ensure security and anonymity, a specific set of steps was undertaken. Every resident of HRM on the voters list was mailed a letter explaining how to vote electronically and providing a PIN. At any point during the three-day period electors were able to log on to a secure Web site controlled by Intelivote or call a phone number and cast their ballot electronically. The on-line process required electors to complete a CAPTCHA challenge, and then use their PIN and date of birth to confirm their identity. Once these security steps were complete a menu prompted electors on how to vote for mayor, councillor and school board representatives (Bousquet, September 18, 2008).[26]

In terms of security more specifically, the system used in HRM (developed by Intelivote) used four levels of security checks. The first, a "penetration test", involved a contracted IT firm trying to break through the Intelivote system to evaluate whether existing security mechanisms were capable of adequately preventing another person or group from tampering with the system. The second check involved analyzing the encryption system used in the communication between computer servers.[27] The third was an external audit of the entire voting process undertaken by an auditing firm.[28] Finally, the fourth check analyzed the network's overall security to ensure prevention of attacks and problems (Bousquet, September 18, 2008).

[26] The telephone vote walked electors through a similar system (Bousquet, September 18, 2008). The telephone system is the same network used in *Canadian Idol* and can accommodate more than 6,000 calls at once (MacDonald, November 22, 2006).

[27] During an election computer servers share and pass on information regarding the votes; this information must be encrypted to prevent someone or some other server from gaining access to this information. In the case of Halifax the Intelivote servers are so close together that this is not really an issue, but it is taken into consideration as a general precaution (Bousquet, September 18, 2008).

[28] Halifax used Ernst & Young in 2008. The auditing process involves a careful examination of the treatment of the voters' list, the distribution of PINs and the protection of voters' identity (Bousquet, September 18, 2008; Grant, August 25, 2009; Smith, August 26, 2009).

Continuous by-election, model success and elector and local government feedback

Public acceptance and support of electronic voting in Halifax was relatively strong. As early as 2004, HRM began conducting polls in which more than 70 percent of respondents said they would be in favour of HRM implementing an electronic voting option. While 44 percent reported that voting at the polls was their preferred method, 35 percent indicated that they would prefer Internet voting if it were available. No objections were raised at council meetings and there was no public protest.[29] Though voter turnout did not increase overall (from 2004 to 2008 it dropped from 48 percent or 125,035 voters to 38 percent or 100,708 voters), turnout on advance voting days (where remote Internet and telephone voting were offered as options) increased by more than 50 percent (from 14,000 electors in 2004 to 29,000 electors in 2008) despite it only being offered for a three-day period (Mellett, September 11, 2009; Smith, August 26, 2009).[30] Though the 2008 election was deemed a close mayoral race it was also held near the Canadian federal election and this may have been an important factor in the lower turnout (Bousquet, October 19, 2008).[31]

Municipal officials were sufficiently pleased with the 2008 pilot project[32] that they recently conducted another remote Internet and telephone voting trial as part of a special by-election that took place on September 19, 2009 (Mellett, September 11, 2009). This time, however, the option to vote using the Internet or telephone from remote locations was continuous (from the first voting day up until and including election day).[33] Voter turnout was 35 percent, a 12 to 25 percent increase from turnout in the three previous by-elections (21, 10 and 23 percent respectively) and 75 percent of all votes cast were electronic (Mellett, September 29, 2009).

This by-election was also unique in that HRM launched a candidate module (designed by Intelivote), which allowed candidates the opportunity to track participation by searching electors by name or address to see if they had participated. This module was received well by all candidates and used by most of them to varying degrees. It was also positively received by election administrators, who reported being pleased that candidates' representatives were not crowding the polling place during the election. While candidates' representatives still had the legal right to attend the polls, being able to track participation on-line apparently eliminated the need to do this (Smith, October 3, 2009).[34]

Overall, HRM personnel are sufficiently pleased with the trials that they plan to eliminate a substantial number of polling stations in the 2012 municipal election. Council anticipates this

[29] There was only one letter in a local newspaper questioning the issue (Bousquet, September 18, 2008).
[30] It should be noted that turnout in the 2004 election saw a 12 percent increase given that there was a question regarding Sunday shopping on the ballot, which had been an important issue in the municipality (Smith, August 26, 2009). In addition, an important consideration is that although turnout overall did not increase, it did not decrease either, which it did in both provincial and federal elections held the same year (Mellett, September 11, 2009).
[31] HRM's 2nd advance polls were held the same day as the federal election, Tuesday, October 14, 2008, but the ordinary polls were held Saturday, October 18, 2008 (Mellett, November 25, 2009).
[32] Council rated it a 9 out of 10 based on their evaluation criteria (Mellett, September 11, 2009).
[33] This contract is also with Intelivote with an approved budget of $85,000. Electors were still able to vote by traditional paper ballots (Mellett, September 11, 2009).
[34] This module was not tested in 2008 because officials had concerns that it may make some changes to how campaigning occurs, but were ready to pilot it in the more controlled environment of a by-election (Mellett, September 11, 2009).

will result in "increased turnout, lower election costs, and happier electors" (Smith, August 26, 2009). If these considerations are accurate, the Halifax model may be an important methodology to consider in the development of an electronic voting program in other Canadian jurisdictions.

Municipal Trials and Developing a Model for Canada

The experiences of Markham, Peterborough and Halifax indicate some broad consequences when voter participation becomes more convenient (Hoover, August 27, 2009). While general conclusions cannot be drawn regarding the effect of alternative voting methods on overall turnout, these instances illustrate that there can be a positive effect on accessibility. The three most prominent communities to introduce electronic voting programs so far (notably remote Internet voting) are different in nature. Markham is urban, has a higher average income among its residents than the others, and is one of the largest municipalities in the Greater Toronto Area. The Markham community also has a high comfort level with and access to technology (Brouwer, August 27, 2009). Halifax, although the most urban and developed of the Atlantic municipalities, still has considerable undeveloped areas, some which are just gaining Internet access. It also has a larger electorate than Markham (approximately 276,000 electors in Halifax compared with 156,000 in Markham), is located in a different region of the country, and has contrasting contextual features and demographic characteristics. Peterborough's electorate consists of approximately 52,000 electors, is less urban, and its residents have a lower average income (Smith, August 26, 2009; Wright-Laking, October 1, 2009). Despite these demographic and cultural differences, the introduction of Internet voting was well received by the public in all three communities and is something residents would like to see continue. These examples illustrate the importance of public acceptance, and also that alternative voting methods can be effectively implemented in a variety of communities with different characteristics and in different contexts.

While the public opinion data cited earlier indicate that there is general public support for the extension of Internet voting, particularly among young electors, it should not be discounted that there may be some negative attitudes towards it. Discontent with electronic voting, even if it is not widespread and isolated to one area, is an important consideration and something that should be researched and surveyed further. However, evidence from Peterborough's experience suggests that older cohorts of electors may become comfortable with and make use of Internet voting, particularly if awareness is created among the group.

With respect to voter turnout, making assessments from these municipal cases regarding the impact of remote Internet voting on turnout is difficult given that, with the exception of HRM's recent by-election, remote electronic voting options were only offered for a specific time during advance polling and so it is not possible to know what effect these options might have had on overall turnout. The extension of remote Internet voting did have a positive impact on advance turnout in Markham and Peterborough (albeit very modestly in Peterborough). And, while it is difficult to evaluate how much turnout increased in Halifax's advance polls since they were only open for a three-day period, 30 percent of electors who voted in the 2008 HRM election did so electronically. Though overall turnout in Halifax decreased from the previous election, in 2004 there was a plebiscite on Sunday shopping held in conjunction with municipal elections, which

increased turnout in all municipalities.[35] Furthermore, turnout in the recent by-election increased substantially to 35 percent (the three previous special elections had voter turnout of 21 percent, 10 percent and 23 percent) (Mellett, September 28, 2009; Mellett, November 25, 2009). So, while we cannot evaluate the overall impact of remote electronic voting on turnout until there are more substantive trials, its effect in the recent by-election is promising.

Other important considerations can also be taken from these trials, particularly the marketing scheme employed in Markham and some specific elements from HRM's approach. Making electors aware of the availability of electronic voting methods and informing them of how they may access these services is an important prerequisite. The strong positive impact Markham experienced with respect to voter turnout may also very well be linked to the town's aggressive marketing campaign. This may also be the case with regards to the promotional campaign Peterborough targeted to older groups of electors.

The Halifax case is particularly valuable to study given that it did not require electors to pre-register to vote on-line, offered a "decline to vote" button enabling electors to refuse a ballot, offered telephone and Internet voting simultaneously, allowed voting for the whole election period in its most recent by-election, and implemented a candidate module that allowed for the maintenance of candidates' representatives for electronic ballots. This combination of features had the goals of reducing barriers to voting, maintaining the traditional integrity of the voting process, and increasing ballot accessibility. The absence of pre-registration in Halifax makes the remote Internet and telephone voting options of maximal utility.

Further, HRM's incorporation of both remote Internet and telephone voting was an important decision to maximize accessibility. While a majority of households in a given jurisdiction may have access to the Internet, many rural areas may experience limited connectivity and those with lower incomes may not be able to afford access. Instituting Internet kiosks in public places such as shopping malls, libraries and community centres is one method of making remote Internet voting more widely accessible to these groups of citizens, but the extension of remote telephone voting offers these electors the option of remote voting. Traveling to an electronic polling location may very well present as much of a barrier as traveling to a traditional polling station. In addition, the ability of Intelivote's system to allow electors to switch voting channels is a model of enhanced accessibility and efficient delivery of service. A multi-channel model such as this, where remote voting options are interchangeable, makes voting much more feasible for certain groups of electors, notably those who are out of the country, busy professionals and single parents as well as electors with disabilities.

Finally, the introduction of a candidate module, which allowed candidates' representatives to exercise the same scrutineer function they do in traditional polling places helps maintain tradition as well as the integrity of the voting process. Taken together, these features as well as the marketing campaign adopted by the Town of Markham are salient features that should be seriously considered in the development of a Canadian model because they add value to the electoral process while allowing for technological advancement.

[35] Turnout in 2000 is a more accurate comparison given that there was no plebiscite. It was 39 percent in 2000 (Mellett, November 25, 2009).

Part IV: European Trials

Estonia

The country of Estonia is a significant case with regard to Internet voting for several reasons. First, Estonia is the only country worldwide to have introduced remote Internet voting on a national scale. Second, its model of remote electronic voting incorporates plans to expand and incorporate other remote electronic voting methods, such as SMS text message voting, by 2011. Third, Estonia is the only country in the world to have legislated Internet access as a social right (Trechsel, 2007:9). Estonia is one of the most electronically enabled countries in Europe, rating fourth among the EU-25 in terms of the availability of on-line public services (Estonian National Electoral Committee, 2009). These elements, and the fact that Internet voting in Estonia can be considered an electoral success, make it an important case for examination, particularly to observe features that have supported and allowed for the successful operation of a remote Internet voting system.

Rationale for introducing remote Internet voting and necessary preconditions

The motivation to introduce remote Internet voting in Estonia was primarily to increase the number of voting methods that are available to electors and to make the process simpler and more convenient. One of the objectives of making the voting process more accessible was to increase turnout and dissipate feelings of political alienation, particularly among youth. The Estonian Parliament also felt remote Internet voting allowed for more efficient use of existing technical infrastructure, and that voting on-line remotely should be considered an essential convenience in modern society (Lumi, September 19, 2009; Madise and Martens, 2006). More generally, the Estonian government is focused on developing policies and services that are citizen-centric and highly inclusive (Estonian National Electoral Committee, 2009).

A number of key features were present that made introducing remote Internet voting viable and that have enabled it to work well in Estonia. These include the degree of Internet penetration and electronic readiness among citizens, a supportive political culture, a legal structure that addresses remote Internet voting, a digital identification system, modern infrastructure and government IT programs, as well as a partnership between public and private sectors (Alvarez et al., 2009; Lumi, September 19, 2009). Data from the European Commission reports that Estonia is among the top 12 in the European Union in terms of Internet penetration: 53 percent of all Estonian households own a computer, and 89 percent of these are connected to the Internet (Alvarez et al., 2009; Estonian National Electoral Committee, 2009).

Estonia has also taken great care to develop a legal framework that supports the development and use of remote Internet voting. This began with the passage of the *Digital Signature Act* in 2002, which allows citizens to use approved digital signatures to confirm their identity in on-line transactions, including government transactions and voting. While the USA has also legislated digital signatures, Estonia is the only country to have simultaneously mandated and introduced an identity card with an embedded digital certificate. The card is the basis for the Estonian remote Internet voting model and allows for remote identification with the use of the signature and a unique personal identification number. The cards can be used at home with the addition of

a smart card reader, or at a public access terminal (55 terminals per 100,000 citizens) (Alvarez et al., 2009; Lumi, September 19, 2009; Madise and Martens, 2006).

The second part of the legal framework was the passage of various acts that permitted the use of electronic voting in the different types of Estonian elections and specified their administration. The laws also established related procedural elements such as the period of time wherein on-line ballots could be cast, the process for certifying that on-line ballots could not be cast on election day, the authentication process, and the process for merging and counting all ballots after the election.[36] The Estonian system also allows on-line electors to change their electronic ballot any number of times, with only the final ballot counting toward the actual vote (Alvarez et al., 2009; Madise and Martens, 2006).[37]

Development, technical features and general operation of Estonia's model

Remote Internet voting in Estonia was introduced in the 2005 municipal elections, and then used again in 2007 for national parliamentary elections and in 2009 for European Parliament elections. The Estonian model is based on three principles: (1) the identity card for voter identification, (2) the possibility of re-voting electronically with only the final ballot counting, and (3) the priority of traditional voting (should an elector vote by paper ballot on election day their electronic ballot is deleted). Other basic principles to which the system is required to adhere include a reliable, secure and accountable method of counting, simplicity for electors as well as experts who may audit the system, transparency, and one vote per voter. All ballots must be uniform and secure and all electors must be able to vote (Maaten, 2004).

To use remote on-line voting, electors require a smart card reader and relevant software, an Internet connection and a Windows, MacOS or Linux operating system. The voting process begins by inserting a valid ID card into a computer whereby a list of candidates is displayed based on the elector's personal identification number. The voting system uses a "double envelope scheme", typically used in other countries for postal voting, and was designed to ensure voter privacy and security. Once the voter completes the ballot it is encrypted by the voting application (i.e. the voter seals the ballot in a blank inner envelope). The voter then confirms his or her choice with a digital signature and receives confirmation that the vote has been recorded (i.e. the voter puts the inner envelope into the outer one and writes his or her name and address on it) (Estonian National Electoral Committee, 2009). When the votes are counted, the digital signature (outer envelope) is removed and the anonymous encrypted vote (inner envelope) is placed in the ballot box. Remote Internet voting is only available for a certain period, usually from four to six days prior to advance voting days, and therefore not on election day. Electors are able to change their vote as many times as they like as long as the on-line polls are open and can still vote by paper ballot on election day, although this would disqualify their electronic ballot (Maaten, 2004).

[36] Although passed in 2002, the legislation specified that remote Internet voting not be applied until 2005.

[37] This rule was brought before the Supreme Court based on the argument that it constitutionally violated the principle of uniformity, that each citizen has the right to vote once and in a similar manner. The Court upheld the legislation arguing that electors who voted electronically still only cast one ballot and had the same effect on the final results as any other voter (Madise and Martens, 2006).

Indicators of success

The Estonian model can be considered a success on a number of levels, particularly with respect to public use and voter turnout. For example, while in the 2005 local elections only 1.9 percent of votes were cast remotely by Internet, in the 2007 parliamentary elections it increased to 5.4 percent, and in the 2009 European Parliament elections to 14.7 percent of votes cast (Estonian National Electoral Committee, 2009).[38] Estonian officials now describe remote Internet voting as an accepted and expected feature of the electoral process, and one that is essential in engaging electors. Turnout in parliamentary elections increased from 58.2 in 2003 to 61.9 percent in 2007 and from 26.8 percent (2004) to 43.9 percent (2009) in the European parliament elections, which had record-low turnout levels among some other countries (International IDEA, 2009). Furthermore, recent research confirms that electors have a high degree of trust in remote electronic voting (Alvarez et al., 2009; Lumi, September 19, 2009). Research also shows that the Estonian system is neutral with respect to many socio-economic factors such as income, education, gender and geography. This finding suggests that no undemocratic biases or digital divides (specifically biases that are socio-economic in nature) have developed as a consequence of remote Internet voting with respect to those variables. Research also supports that there is no left/right political bias among remote Internet voters in Estonia (Alvarez et al., 2009:501).

Not surprisingly, electors who choose to vote remotely by Internet have better computer knowledge than others. Twenty percent of remote on-line voters in 2005 reported that they otherwise would have abstained, and 11 percent in 2007 reported that they "probably wouldn't have" or "for sure wouldn't have" voted if not for the option of an Internet ballot. This suggests that the accessibility of the Internet from remote locations has an impact on the engagement of some types of electors. Nearly one quarter of electors who cast an Internet ballot voted when the paper ballot polls would have been closed, indicating that accessibility may be a factor. There is also a "faithfulness effect" present, as in the Canadian municipal trials, whereby those who vote remotely by Internet are very likely to continue to do so. For example, all electors who used remote on-line voting in 2005 did so again in 2007. Furthermore, survey data shows that Internet voters are greater consumers of on-line election information. This may mean that more informed votes are being cast as a result of remote Internet voting, or perhaps that those who seek to better inform themselves about the election are drawn to on-line voting. Finally, although remote Internet voting in Estonia is considered more attractive for younger electors than seniors, the highest levels of usage are among those aged 18 to 44 and those 60 and older (Alvarez et al., 2009), suggesting that the conclusions about age usage may be overdrawn. The facts that remote Internet voting appears to be engaging non-voters to a certain extent, is used after hours, has a devoted following in terms of use, and that many on-line voters actively seek out information regarding candidates, are significant points in its favour.

[38] In the most recent set of local elections held on October 18, 2009, the number of Internet voters increased to 15.75 percent of all voters. Turnout in this election was 60.6 percent, an increase of about 13 percent from the 2005 local elections, which had a turnout of 47.4 percent (Estonian National Electoral Committee, 2009).

Addressing challenges

The most prominent concerns surrounding the implementation of remote Internet voting in Estonia were related to potential fraud and privacy. In response, the principle of multiple votes was created, which allows electors to cast an electronic ballot as many times as they like during the on-line voting period. In case an elector is pressured at any point in time to vote a certain way, that individual can go back and change his or her vote from a secure and private place or can vote in person on election day, mitigating vote-buying and ensuring voter secrecy (Madise and Martens, 2006).

There were also concerns regarding the possibility of a digital divide or disparities in Internet access related to generation, gender and socio-economic factors. To mitigate these effects, the state launched an Internet and computer training program for adults in 2001 as well as the Village Project which provided more libraries with computers and Internet access. More recently, they have launched public/private projects, such as "Computer Security 2009" and the state-run Information Society Awareness Program that seek to promote the use of electronic services by targeting security issues and improve the identity card application process (Estonian National Electoral Committee, 2009; Maaten, 2004).

There are also some problems with the system that have not been addressed. Foremost, the electronic voting system is only provided in Estonian (the official language) despite the fact that there is a very large Russian-speaking population in Estonia. This has created a barrier resulting in many Russian speakers not voting on-line (Alvarez et al., 2009).

In terms of accessibility, more than 80 percent of Estonians have identity cards, but this means that for some citizens voting on-line is not an option. Furthermore, even with an identity card citizens must have a smart card reader, which costs about 20 euros (Maaten, 2004). While smart card readers are available at public access points, these are still obstacles to voting that have not been fully resolved.

Geneva, Switzerland

There are several reasons for examining Geneva's experience with Internet voting. Switzerland was one of the first countries to develop a remote Internet voting application, and because it developed and fully implemented a remote Internet voting program, the Swiss model is much more advanced. Second, the remote Internet voting program in Geneva is the most experienced worldwide, having conducted more elections than any other country or jurisdiction where remote Internet voting is a viable voting option (Alvarez et al., 2009). Third, the Geneva model has followed a tightly controlled development process, which has been cited in large part as contributing to its success (Chevallier et al., 2006). Finally, Geneva has established a permanent legal basis for Internet voting. Since the Genevan model of remote Internet voting is perhaps the most refined in the world, the Internet application it relies on during elections is of importance when developing models elsewhere.

Rationale for introducing remote Internet voting

Geneva decided to pursue remote Internet voting for several reasons; foremost among them was enhancing convenience for electors and increasing turnout. Swiss voter turnout is one of the lowest of established democracies worldwide, averaging about 50 percent (Auer and Trechsel, 2001). Partially this is because of Switzerland's direct democracy system whereby electors are called to the polls an average of 4 to 6 times yearly (Geneva Internet voting system, 2003). Switzerland also had great success with postal voting, suggesting that the introduction of remote Internet voting might yield similar benefits. Familiarity with postal voting also meant that voters were accustomed to voting from home and having several weeks to vote. Other reasons include the large proportion of Swiss citizens who live abroad (580,000 of 7 million) and a norm that Geneva's public service prides itself on its proactive attitude toward technologies (BeVoting, 2007; République et Canton de Genève, 2009; Geneva Internet voting system, 2003). Internet penetration in Switzerland is such that slightly more than half the households have Internet access (55 percent), and survey data showed that two thirds of Internet users wished they could vote on-line.

At the federal level there were several parliamentary motions in 1999 and 2000 "that called the Confederation to do something in the field of" information and communication technologies, although Internet voting was not mentioned specifically, and in 2002 Parliament adopted an article that allowed for Internet voting trials (Chevallier, 2009). At the Geneva level, in 1982 Parliament passed a law on political rights enabling experimentation with voting methods. This provision was used to develop Internet voting until Parliament (June 2008) and the citizens (February 2009) approved a constitutional amendment that permitted Internet voting (Chevallier et al., 2006; Chevallier, 2009). Other factors that supported the success of the Swiss remote Internet voting application include a centralized and computerized voters list, experience with direct democracy and a "soft" approach to voter secrecy (République et Canton de Genève, 2009).[39]

Development, technical features and general operation of Geneva's model

In 1998, the Swiss Federal Executive first launched its e-government project, which included the possibility for remote Internet voting and other forms of electronic participation. The federal government invited three of the most urbanized cantons (Neuchâtel, Geneva and Zurich) to pilot remote voting methods and agreed to jointly fund the project. In Geneva, beginning in 2001, the system underwent numerous trials, initially restricted to participation in referendums, and later followed by eight official ballots between 2003 and 2005 (Chevallier et al., 2006; Kies and Trechsel, 2001).[40] During these trials electors were able to vote by traditional ballot, postal voting or remote Internet voting, although postal voting and remote Internet voting were only available prior to election day. The success of these initial trials prompted the federal

[39] Though the Swiss constitution guarantees voter secrecy it can still be considered customary in some cantons to vote by a show of hands. This is considered to be a "soft" approach to voter secrecy as opposed to frameworks that are more strict with regard to privacy (République et Canton de Genève, 2009).

[40] The legal basis for this project was established in 2002, with an amendment to the 1976 federal law on political rights (Braun and Brändli, 2006). In addition, authorities also adhered to the recommendations of the Council of Europe, which required that e-voting follow all the principles of democratic elections, and be as reliable and secure as traditional voting (République et Canton de Genève, 2009).

government to legalize remote Internet voting throughout the country in 2006 (République et Canton de Genève 2009).

The remote Internet model used in Geneva is an adaptation of its postal model. All electors are sent a voting card, which can be presented when voting by paper ballot, mailed back with a postal vote or used to obtain codes which permit on-line voting. Each card contains a unique 16-digit number designating the particular election, a 4-digit control key, and a secret 6-digit code that is concealed under a scratch-away opaque layer (Chevallier et al., 2006:439).[41] The elector begins by entering the 16-digit code on-line. This code is verified by the server and the 4-digit key is sent back to the user as a self-authentication. The server then constructs the electronic ballot and establishes a protected connection between the elector and the ballot. Once the ballot is completed the choices are presented to the voter for confirmation. Selections are then either confirmed or altered by the elector, who is prompted to provide his or her date of birth, municipality of origin and the 6-digit secret code printed on the voting card. The vote is then authenticated and the voter receives electronic confirmation that a ballot has been cast (Chevallier et al., 2006).

In terms of security Geneva does not use digital signatures or require additional computer hardware like Estonia. The system does however operate similarly with respect to the envelope feature which keeps the ballot and voter's identity separate. Once cast, the ballot is encrypted with alphanumerical characters, which masks its content (the first envelope is sealed). When the voter confirms and attaches his or her identity to the ballot, it is encrypted with another protective layer (second envelope). Once the vote is received, the identity and the ballot (the two envelopes) are kept in different files. Before the ballot box is opened the ballots are shuffled so that they do not correspond with the voter registry. Other security mechanisms include a certified Web site, and a secure channel between the elector's computer and the server facilitating the vote (Chevallier et al., 2006; République et Canton de Genève, 2009).

Indicators of success

Overall the system is considered highly successful, notably because the public is very responsive and actively makes use of remote Internet voting, and because it appears to have a positive effect on voter turnout. For example, public opinion data revealed that electors who chose to vote remotely on-line were likely to continue to do so (90 percent of voters) and that remote Internet voting is used as the primary voting channel for electors under the age of 50 (République et Canton de Genève, 2009).[42] Data reveals that there is no digital divide with respect to education or gender, but one is visible in terms of age and Internet competence. Furthermore, although there are no comprehensive figures regarding turnout, 12 to 27 percent of on-line voters previously described themselves as being frequent abstainers, particularly among electors aged 18 to 39 years (République et Canton de Genève, 2009). These statistics suggest that the extension of remote Internet voting has positively impacted turnout and encouraged the participation of younger electors.

[41] If this layer is removed on-line voting is no longer possible because the elector controls the card (Chevallier et al., 2006).

[42] It also displayed a positive relationship with education and income level. That is, the greater an elector's education and income the more likely he or she was to vote on-line.

System approval can be attributed to three aspects of the development process. First, the project was initiated and sponsored by the highest official of political rights in Geneva, the State Chancellor. The Chancellor delivered regular progress reports to government as well as representatives from all political parties, confirming each step of the way that system developments met the needs and expectations of the parties and the public. Second, system development and implementation took a step by step approach in which trials were gradually expanded along two dimensions: the stakes of the vote and the number of potential voters (Chevallier et al., 2006:439). This process allowed officials to improve the project as it developed and to better manage risk. Finally, the teams assigned to project development were multidisciplinary, including experts from a variety of fields. This combination of knowledge and alternate perspectives helped foster a well-rounded system that was not overly centered on any one aspect of model development, such as security or technical considerations (Chevallier et al., 2006).

Addressing challenges

Despite its success, Geneva faced some important challenges. Two obstacles in particular are worth noting. In terms of legalities, the right of every Swiss citizen to attend ballot counting at his or her polling station was solved by creating an electoral commission with representatives selected by political parties and appointed by government to oversee the counting of postal ballots. The body controls the ballot box reading and the role of the electoral commission was expanded for the introduction of Internet voting.[43] Furthermore, though initially the issue of vote-buying was also a prominent concern, this was mitigated by providing voters with confirmation that their ballot had been cast, but including no details regarding its content.[44] There have been no concerns or problems with regard to remote Internet voting that are considered insurmountable in Geneva.

United Kingdom

The UK is an important case study because it was one of the first countries to experiment with multiple types of remote Internet voting and because of the sheer number of trials and types of electronic voting methods it has tested. Furthermore, the UK experience is salient because its Electoral Commission decided to end electronic voting trials. While it is useful to examine cases where Internet voting models have been implemented successfully, it is also important to look at the considerations that led another jurisdiction to terminate the project.

Rationale for introducing remote electronic voting and necessary preconditions

The UK chose to pursue an electronic voting model in an effort to modernize the electoral system and generate public confidence in these modifications, attract younger voters and, most importantly, increase electoral participation. Making the process more accessible for electors of all kinds was also an important consideration (Local Government Association, 2002). By introducing remote voting options the government had the option of extending the voting period, further enhancing accessibility for electors.

[43] That said there are still questions surrounding the development of this part of Internet voting (E-voting, 2009).
[44] In Estonia this was addressed by allowing the voter to update his or her ballot while the polls remained open.

The government created the Electoral Commission in 2000, a body whose mandate is to organize some elections, carry out research, and seek out reforms that have the potential to positively impact British elections. The Commission was supported by two bodies, the Department of Constitutional Affairs and its Electoral Modernization Unit, which initially pressured the government to investigate establishing new voting opportunities to increase turnout. The UK's Electoral Commission conducted extensive research prior to the inception of the trials, notably a full analysis of all potential options and technologies, a review of experiences in other jurisdictions, legal framework analysis as well as survey research probing the perceptions of different stakeholders and public attitudes and opinions toward electronic voting (this included data regarding reported likelihood of use and public confidence). In terms of public acceptance for example, survey research revealed widespread support for electronic voting. More than half (55 percent) of eligible voters reported that the extension of electronic voting would encourage them to vote in the next election. Among young people (aged 18 to 24 years) this figure rose to 75 percent (The Electoral Commission, 2003).

The development of the UK's legal framework is also particularly interesting because before the trials could proceed an amendment to existing legislation was required whereby the local authority ceded control to the central government and relinquished its autonomy with respect to elections (Liptrott, 2006). The passage of the *Representation of the People Act* (2002) enabled this and allowed Parliament to develop regulations which permitted the conduct of pilots with alternate voting arrangements (Barry et al., 2002). These prerequisites were considered important steps before proceeding with actual implementation.

Development, technical features and general operations of the UK trials

Aside from the research conducted by the Electoral Commission, the actual model development for each local council began when the Department of Transport, Local Government and Regions (the department responsible for electoral policy) issued a request for proposals from companies to supply electronic voting and electronic vote counting and recording. Upon selecting a list of successful providers, local councils were invited to submit suggestions for pilots that held promise to modernize the electoral process. Those councils whose proposals were selected chose an industry partner from the list of providers and the pilots were developed on an individual basis.

The first electronic voting pilots took place in May 2002.[45] Thirty different electoral districts from across the country took part in the trial, sixteen of which piloted electronic methods. The trials were made available to 2.5 million electors and operated with a budget of 4.1 million pounds (Barry et al., 2002). Electronic trials used a variety of technologies and combinations of those technologies in different districts, including touch-screen kiosks (in polls and remote locations), remote Internet voting, telephone, SMS text message voting and electronic counting schemes. While some districts trialled one or two methods, many piloted multiple channels of electronic voting, making two or more methods available (4 in 2002 and 13 in 2003). The

[45] The 'modernisation' process actually began in 2000 with postal voting trials. Although postal voting was successful in that most localities in which it was offered reported an increase of at least 50 percent in electoral participation and it improved the public's reported satisfaction with the electoral process, overall turnout declined prompting the government to expand the project and experiment with other methods (Barry et al., 2002; Norris, 2005).

multi-channel approach was facilitated by an on-line electoral register that was developed to provide the necessary infrastructure for districts trialing more than two electronic methods (Xenakis and Macintosh, 2004).

In May 2003 the UK Electoral Commission conducted another 59 pilots in local districts, 18 of which trialled various types of electronic voting, at a cost of 18.5 million pounds (Open Rights Group, 2007). Again, the electronic trials offered different electronic services depending on the jurisdiction. The same potential methods that were used in 2002 were again made available, with the addition of digital television voting and smart card technology (Xenakis and Macintosh, 2004). In most instances different combinations of multi-channel voting were offered. For example, the council of Ipswich made remote Internet, telephone and SMS text messaging ballot options available, whereas Shrewsbury and Atcham offered remote Internet, telephone, digital television and all-postal voting as well as electronic counting. Sheffield, by comparison, used remote Internet voting, telephone, public kiosks and mobile phone text messaging as alternative voting channels. All-postal ballots were offered in over half of the municipalities and electronic counting was implemented in many areas, as were extended voting hours (Norris, 2005). Overall, the 2002 and 2003 pilots consisted of 14 trials of remote Internet voting, 12 trials of telephone voting, 8 trials of electronic voting at polling stations, 4 trials of SMS text message voting, 3 trials of touch-screen kiosks, and 1 digital television trial reaching approximately 6.4 million electors (BeVoting, 2007; Liptrott, 2006).

It is difficult to offer a summary account of the specific procedures or technical features of the electronic voting methods used in the UK for two reasons. First, many combinations of these technologies were offered simultaneously, resulting in the application of many different combinations of electronic voting systems. Second, there was no consistent framework used for each type of technology. With respect to remote Internet voting for example, the locales of Swindon Council, Liverpool Council and St. Albans Council all offered remote Internet voting to electors, but used different electronic systems with different features, operated by different providers. These differences also make evaluating these models challenging since different approaches may produce different consequences even if the same technology is being used. Additionally, it is difficult to decipher what is working and what is not when multiple channels are offered concurrently.

Unsuccessful trials

Despite extensive research and the fulfillment of the noted prerequisites, part of the problem with the UK trials is that from the beginning they did not allow sufficient time for testing or development given that they chose to trial so many methods of electronic voting simultaneously. Whereas most jurisdictions in other countries chose to develop and test one or two methods, the UK attempted to pilot as many potential combinations of electronic voting methods as possible, in order to identify the most effective options. Unfortunately, the amount of diversity in the trials made it very difficult for the UK Electoral Commission to determine the impact of any one method.

The Electoral Commission officially terminated all electronic voting trials in August 2007 and in 2008 the government announced that electronic voting would not be used in either the 2009 local or European elections. The continued presence of concerns in government reports regarding the

underdevelopment of electronic voting systems, security and secrecy as well as the success of postal voting, and highly critical reports from other sources (the BBC and Open Rights Group) diminished support for electronic voting. Finally, a serious problem with electronic counting in the May 2007 Scottish elections led to multiple reviews and was the final catalyst to end the electronic voting projects in Britain. On the whole, the decision to halt electronic voting can be attributed to two sets of concerns, the first relating to the ability of the Internet and other electronic methods to increase turnout, and the other to security considerations (The Electoral Commission, 2007).

First with respect to turnout the results of the UK trials were mixed. Turnout overall in the 2003 local elections rose to 37 percent, a 3-percent increase from 2002 and 5-percent increase from 1999. Despite this modest increase, it is difficult to tell how much of the rise can be attributed to the extension of electronic voting options. While in 2003 three municipalities noted a rise in participation ranging from 9 to 12 percent (these include Vale Royal, Shrewsbury and Atcham and South Salisbury), two-thirds of the other districts recorded a modest drop in turnout (Norris, 2005). Furthermore, in terms of use in 2003 only 9 percent of voters cast their ballots electronically. Overall, when presented with the option to vote by paper or electronic ballot most electors chose to use paper ballots (BeVoting, 2007). Surveys conducted among the councils that participated suggest that of the methods offered remote Internet voting was not only used most frequently, but also had the greatest positive impact on turnout, even if only marginally and allowing for the fact that in some cases overall turnout showed no increase (Barry et al., 2002). However, the government did not feel turnout increased sufficiently, or rates of use were high enough, for the pilots to be considered successful.

Second, major concerns about security and malfunctions influenced the decision to end the project. These included the possibility of hacking, viruses, lack of a paper trail, a lack of security testing prior to the trials, and breeches of ballot secrecy with door-to-door canvassers helping electors cast their ballots. Technical issues included some voting channels (such as laptops) becoming inoperable, polling cards being mailed with incorrect log-in information, and delays in the delivery of electoral registers to polls. In one municipality electors who experienced technical difficulty were not permitted to vote at traditional polling stations and so effectively disenfranchised. Most seriously, the technical counting problems that occurred in Scotland highlighted that more development and testing were needed (The Electoral Commission, 2007; Open Rights Group, 2007). Taken together, these reasons and challenges motivated the Electoral Commission and UK government to end all electronic voting projects.

Leaving aside these valid concerns about security, the electronic voting project in Britain was not given enough time to germinate or develop, and was expected to achieve too much. It appears to have failed because of the many different types of electronic voting that were introduced simultaneously and the multitude of models used to carry these out. The push for rapid implementation also imposed time constraints that resulted in best practices not always being followed and in some instances a lack of security testing (Barry et al., 2002).

Part V: Kiosk and Telephone Voting Methods

The above sections have focussed primarily on remote Internet voting methods primarily involving use of computers not under the direct control of the electoral authorities. Here we examine more closely two other remote voting options, namely remote Internet kiosk voting and telephone voting methods.

Kiosk Voting

Next to remote Internet voting, remote kiosk Internet voting seems to have the highest potential to positively impact the electoral process, given its ability to enhance accessibility for electors. Unfortunately however, there has been little written on the subject of kiosk Internet voting and few trials of the technology. Although remote Internet kiosks can make the voting process more convenient for electors, they do not have the same potential to do so as remote Internet voting given that the latter enables so many more points of access for electors. And while they have lower potential to enhance accessibility, kiosks generally raise the same concerns with respect to security and secrecy since in most cases voting kiosks are unsupervised. The need to secure data, lack of a paper trail for recount and auditing purposes, and the susceptibility to machine malfunctions are also concerns. Notably, the kiosk fallibility caused Ireland and the Netherlands to end the use of the voting machines which were to be trialled as remote Internet kiosks (Evans, 2001).[46] Controversy over voting machines and negative experiences with electronic voting machine trials in the USA have also tarnished the reputation of voting machines in general and kiosks by association. The UK, Ireland, the Netherlands and Finland are four countries that have conducted, or attempted to commence, remote kiosk voting trials. In all instances the projects were terminated.

As outlined above, the UK offered touch screen Internet kiosks in councils that elected to use the service. In total, 808 kiosks were tested, some in traditional polling places and others in remote locations, such as supermarkets and other places within the city centre. However, as explained, the project was cancelled because of security concerns and the fact that the extension of electronic voting methods did not have a significant positive effect on voter turnout. Survey research conducted by the UK Electoral Commission also revealed that respondents were more positive toward remote Internet and telephone voting than toward kiosk voting (BeVoting, 2007). For example, 87 percent of telephone voters and 81 percent of remote Internet voters reported feeling positively about the secrecy of the vote compared with 57 percent of Internet kiosk voters. Furthermore, 87 percent of telephone voters reported being positive about the security of the vote, whereas remote Internet voters (59 percent) and remote kiosk Internet voters (60 percent) reported similar assessments. Electors who voted electronically reported finding remote Internet (93 percent) and telephone voting easy to use (88 percent) in slightly greater proportions than those who used kiosks (84 percent) (BeVoting, 2007).

[46] Machine security can be increased by employing certain measures, such as a centralized account system, whereby voters must register before being allowed to vote, or by issuing electors a personalized card that must be inserted into the machine (Evans, 2001:3).

In 2000, the Netherlands implemented remote Internet kiosks in the 2003 Provincial Council Elections as part of a program to enable non-place-dependent voting. With a budget of 8.1 million euros, the goal of the Remote (Electronic) Voting project was to allow electors the option of voting from remote electronic kiosks installed in public areas other than polling places. In 2002 however, two government ministers informed the House of Representatives they felt the original program would not be feasible and decided to pursue an alternate model. So, while the remote electronic voting project continued, it deviated from its original intention, instead focusing on allowing internal electors the option of voting at any polling place and external Dutch electors the possibility of remote Internet and telephone voting.

While the specific concerns that prevented the introduction of remote Internet kiosks in the Netherlands are not entirely clear, media reports indicate that the chosen Nedap machines produced radio emissions which could allow remote detection of how a vote was cast. While the government also had security concerns regarding remote Internet voting and telephone voting, they felt these issues were manageable enough to proceed with implementation (BeVoting, 2007; Kitcat, 2007). In fact, the Netherlands' experience with kiosk Internet voting was so negative that a 2007 government commission concluded that it was not feasible to introduce kiosk Internet voting and suggested that paper and pencil voting remained the best method for complying with election requirements, including transparency, controllability and integrity (Dutch News, 2007; Slashdot, 2007).

The impetus for electronic voting in Ireland was unrelated to turnout, having the purpose to "improve the speed, efficiency, accuracy and user friendliness of the Irish elections" (BeVoting, 2007:29). Since turnout was not a consideration, the government selected the Nedap voting machines. A substantial amount of money (51 million euros) was invested in the purchase of the machines that were to be used in polling places as well as remote locations. They were tested in 3 and then 7 constituencies in 2002 and although they were supposed to be tested in the local and European elections in 2004, the electronic voting project was abandoned just prior to these pilots. More recently, in 2009, the electronic voting system was officially cancelled.

Skeptical and unfavourable reports came from the Commission on Electronic Voting concerning issues with the software (they recommended it be open source code). Protest groups, such as the Irish Citizens for Trustworthy eVoting, also created considerable controversy concerning the lack of a paper-based audit trail, the initial cost of the machines, the 700,000 euros it cost to store them annually and the additional 20 million euros Nedap speculated would be necessary to adequately develop the machines. These efforts resulted in the termination of the project (BeVoting, 2007; Electronic Voting in Ireland, 2009). The failure of the Dutch experience has also been an important consideration for not pursing machine development in Ireland, but the government is not ruling out the possibility of trying to introduce electronic voting again (BeVoting, 2007; MacCárthaigh, 2009).

Finland also sought to incorporate remote Internet kiosks into its electoral process by placing the machines in three small municipalities in its 2008 local elections. Approximately 30 kiosks were used and although they were not all remote, they were all supervised by election officials. For example, one supervised remote Internet kiosk was located in a mobile library (on a bus) that drove around the municipality. Electors could use the kiosks both on advance voting days and on

election day. The system attempted to integrate software provided by a Spanish company (Scytl) with the standard Finnish Election Information System. Overall however, the trial was considered a failure due to flaws in the machines. A total of 232 votes were not recorded because the voting was interrupted and so the ballots did not register into the electronic ballot box. Finnish officials also report no noticeable effect on voter turnout. The government is currently discussing whether it will use electronic methods of voting in the future (Aaltonen, October 7, 2009).

These examples illustrate that more research and thorough testing and development are needed prior to the implementation of (remote) kiosk Internet voting, at least with respect to the machines that have been trialled in Europe. Though Internet kiosk voting can enhance accessibility while still giving election officials a moderate degree of control, cost is a serious consideration and there appear to be more technological problems associated with machine voting in general (whether polling place Internet kiosks or machines or remote Internet kiosks) than with remote Internet or telephone voting options.

Telephone Voting

Telephone voting holds considerable promise for improving the operation of elections, most of all by increasing accessibility. It not only enables remote accessibility and allows electors the option of voting at any time, but the presence of telephones in Canadian households is also nearly universal. The existence of cell phones makes this method even more mobile than Internet voting and creates many more access points from which electors could cast a ballot. Furthermore, many electors, especially older cohorts of potential voters, are much more accustomed to telephone technology than the Internet, and so the opportunity cost of voting by telephone is lower because electors would not have to familiarize themselves with new technology. It is also much less costly than voting machines.

Telephone voting has the same benefits for election administration as other types of electronic voting in terms of efficiency and accuracy of electoral results, but does pose risks regarding security and ballot secrecy, especially since election officials have little or no control over the process. Generally however, concerns relating to security and secrecy of the ballot can be minimized through system design, as shown in Halifax's experience with telephone voting. Other issues however, such as the impossibility of a traditional recount (because there is no paper trail), and the possibility of a service interruption, are aspects which should be given consideration. Despite its potential, there have been few trials of telephone voting in Europe with the exception of the UK (detailed above) and the Netherlands. In both cases the development and use of telephone voting has been stopped. There have been multiple instances where it has been used in Canada at the municipal level in small townships.

The Netherlands offered remote Internet and telephone voting to citizens living abroad. To permit these remote types of voting in the 2004 European Parliament election, an on-line voting experiments act was passed in December 2003. Electors were required to pre-register by mail and were then sent a vote code or login and a list of candidates, each with their own candidate code. Of a potential 600,000 electors (20 to 30 thousand of whom would normally vote by postal ballot), 5,351 votes were cast electronically, 480 by telephone and 4,871 over the Internet. Most of the concerns raised in government reports related to the security of voting over the Internet,

although a lack of transparency about the software programs that operated both systems, provided by LogicaCMG, was also criticized. Public attitude surveys showed that electors reported using the services because they were simple and fast. Sixteen percent of voters who cast their ballots electronically reported only having voted because these methods were available. The majority of positive feedback however centered on remote Internet voting, and in 2006, when the government decided to pursue another trial, telephone voting was removed as an option and only remote Internet voting was available (BeVoting, 2007).

Overall, while there has not been much testing using telephone voting, the potential benefits are worthy of further exploration and discussion. Notably, that telephone voting appears to be a useful complement to remote Internet voting given electors' familiarity with the telephone and its widespread presence in households. As the case of Halifax highlights, offering telephone voting in conjunction with remote Internet voting is one solution to accessibility problems associated with a remote Internet option. At the same time, rates of use of telephone voting are much lower than remote Internet voting for the data that is available and so, while it is more accessible, it may not have the same effect with respect to engagement as the Internet.

European Trials and Developing a Model for Canada

The preceding European examples impart some salient lessons for the development of Internet voting models elsewhere. In particular, there are eight important considerations that should be taken away from the experiences of Estonia, Geneva and the UK.

First, prior to model development it is essential to clearly establish the principles that the electoral process must live up to as well as lay out any constitutional or legal requirements. It is imperative that the characteristics of the selected model fulfill these obligations and requirements. Where applicable, the criteria used to evaluate an electronic voting system should be the same as those benchmarks used to assess the effectiveness of the traditional paper ballot voting system. The principles and criteria will be different for every country and jurisdiction, given variations in expectations, legal structures and political, cultural and contextual features. Therefore, while we can learn about model development from other cases and experiences, a Canadian application must be customized to the benchmarks and features required by the Canadian electoral process to ensure system success and maintain electoral integrity. The success of remote Internet voting systems in Estonia and Geneva can be attributed to this approach to development.

Second, while there may be a desire to test multiple methods of electronic voting, it is more useful to pick one or two methods and work on developing and integrating those before considering others. Further, whatever types of electronic voting are selected, each should be based on a unified prototype. Adopting a single approach is likely to produce a system that is more thoroughly developed and will make it easier to identify which elements do and do not work well. This is the major lesson imparted from the UK experience. Evidence from Estonia and Geneva suggests that a unified model is a superior approach in terms of administrative and technical considerations.

Third, a step-by-step approach in developing a model is important, and was one of the primary reasons for the success of remote Internet voting in Geneva. Each successive trial reached more electors and occurred in elections of greater prominence. Gradually increasing the salience of the vote across these two dimensions allowed for optimal risk management and enabled officials to measure and understand the effects of the extension of electronic voting. This approach allows election officials to systematically build on established success before progressing. Part of the failure of the UK trials was due to its overly hasty and ambitious approach. The time constraints imposed as a result of rushed implementation made adequate testing impossible, resulted in technical malfunctions and likely undermined support for the project as a whole.

Fourth, the engagement of key stakeholders seems to be a useful mechanism to ensure all affected parties are satisfied with proposed changes or additions to the electoral process. While there was not much mention of these with respect to Estonia and the UK – with the exception of government officials, election administrators and public attitudes – the approach taken by Geneva focused on regular communications with representatives from all the political parties, feedback from all levels of government, and an emphasis on what the public wanted. This is considered to be one of the major contributing factors to the success of remote Internet voting in Geneva (Chevallier et al., 2006).

Fifth, it may be useful for the system to be made available in multiple languages, in order to maximize accessibility. A large Russian-speaking minority in Estonia is hindered from voting remotely by Internet because the interface is only available in Estonian, the only official language in the country.

Sixth, the Estonian and Swiss examples suggest that it is possible to adequately address concerns pertaining to security and secrecy. While the USA and UK cases do raise valid issues regarding the security of Internet voting, their significance should be placed in perspective. The USA has not attempted formal testing in official polls. The UK did encounter technical issues, but mostly with regard to Internet machines and kiosks rather than remote Internet voting. On the other hand, all successful trials examined in this report illustrate that, with careful model development, potential security and secrecy problems can be minimized. The feature of the Estonian system that allows electors the option of recasting the ballot is a good example of how the system can be adapted to prevent the threat of vote buying. The intricate envelope schemes used in both Estonia and Geneva are examples of how concerns about voter anonymity can be addressed. These examples show that it is possible to develop model features that not only meet the requirements of the political and legal framework, but can also effectively address important concerns.

Seventh, while some digital divides appear to be of less concern, there are others which should be taken into account. Available evidence from the European trials illustrates that a digital gap is not necessarily a concern in terms of gender, education or geographical location. However, there appears to be a distinct gap with respect to age, as younger electors are more likely to make use of Internet voting than older electors. Furthermore, there is a gap in use among those who have better computer knowledge than others. The more knowledgeable are naturally more likely to use on-line voting. The Estonian case suggests some program options that could be instituted to

educate older electors and increase their comfort with using the technology. The age and knowledge disparities are important considerations in ensuring equality of access and potential for engagement.

Finally, although broad conclusions regarding the potential of Internet voting to positively affect voter turnout are not possible, there is evidence (particularly in the cases of Estonia and Geneva) that the extension of remote Internet voting can engage some groups of electors who do not currently vote at high levels. There are two trends in particular. One is that, where data is available, we see electors voting on-line who previously classified themselves as abstainers or said they would not have been likely to vote otherwise. Second, there is evidence of a 'faithfulness effect', whereby electors who opt to vote on-line will continue to do so in subsequent elections if given the opportunity. It appears that making voting accessible through the Internet has the potential to engage additional electors in the voting process, and these electors will faithfully continue to use the service.

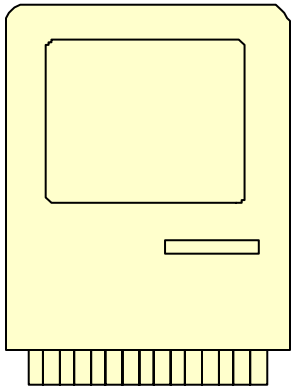
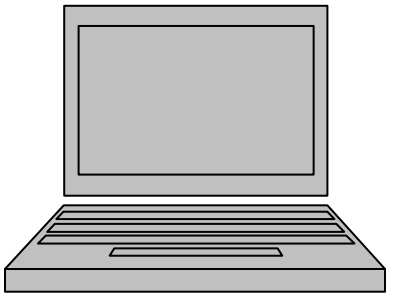
Part VI: General Considerations for Canada

As noted above, while we can learn from the experience of others, a Canadian application of remote Internet voting must take account of specific features of the Canadian context. This section identifies some of factors that might be considered in the development of a Canadian model.

The Trade-off Between Accessibility and Security

Though remote voting has the highest potential to enhance accessibility and encourage participation, it also gives election officials the lowest amount of control over the process. In selecting a voting method, it is useful to evaluate the types of Internet voting in the model below (Figure 1). For the most part, as election officials sacrifice direct control over the voting process access is enhanced. However, a loss of direct control need not imply an unacceptable increase in security risks. Practical cases have shown that more technical difficulties appear to be associated with Internet voting machines located in polling places or Internet kiosks than with remote Internet voting. The decision to pursue remote Internet voting does hold promise to yield the greatest benefit to electors in terms of increasing access while minimizing security risks, assuming adequate protective measures are put in place. However, these benefits must be weighed against the effect of reduced control on election administration and the electoral process more generally.

Figure 1: Types of Internet Voting

High degree of control Higher degree of security	Moderate degree of control High degree of security	Low degree of control Moderate to low security
	Greater technical issues	Fewer technical issues
Polling Place Internet Voting →	**Remote Kiosk Internet Voting** →	**Remote Internet Voting** **Telephone Voting**
		
Less accessibility	Slight increase in accessibility	Increased accessibility

Access

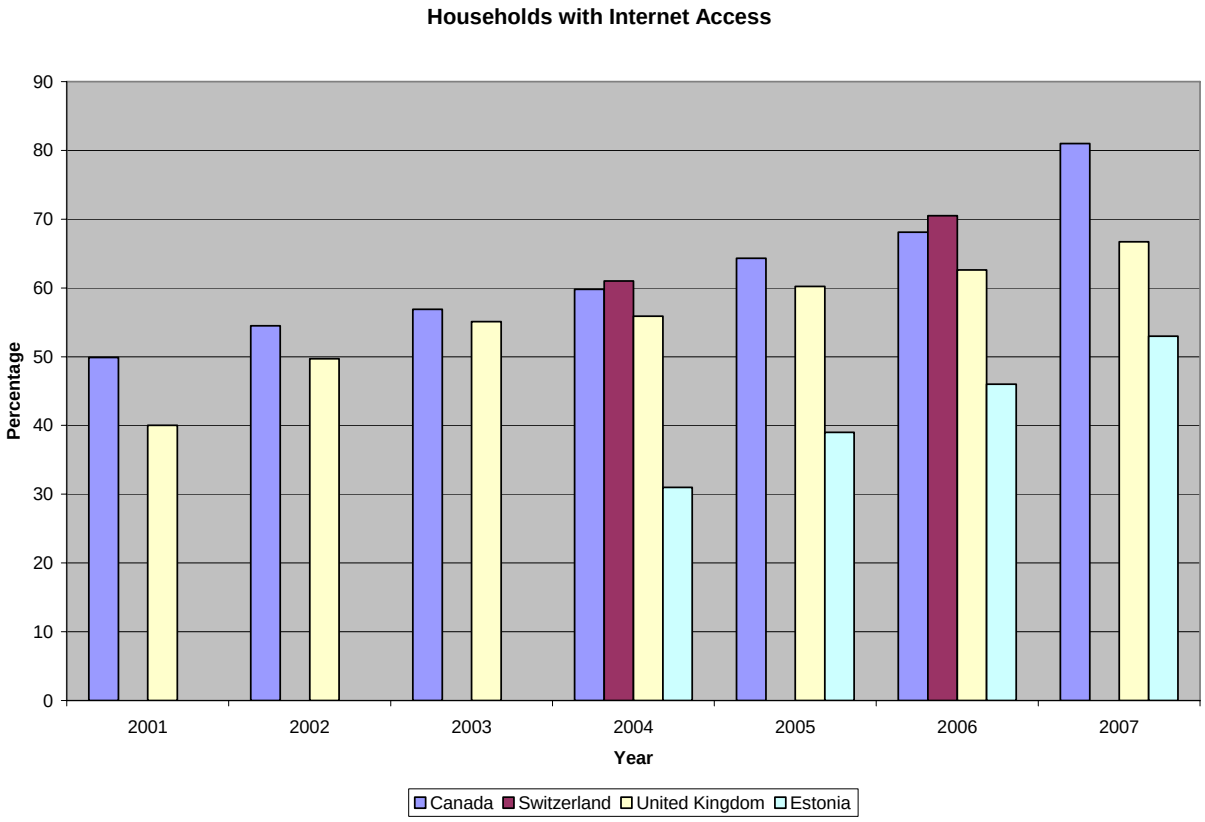
While a key goal of remote Internet voting is to improve access, it depends on a substantial proportion of the population having computers and Internet connectivity. In the remote Internet voting projects discussed above, the governments instituting the programs believed that the rates of access in their areas were high enough to successfully proceed (though Halifax chose to also offer telephone voting). Comparative data suggests that Canada, overall, compares well with other countries in terms of Internet access.[47] The number of households with personal computers and Internet connectivity in Canada is actually higher than the European countries examined here.

However, Internet access may be unevenly distributed in various parts of the country. Rural areas, the North, and other regions may have reduced access. The size and diversity of the country might suggest a diversified approach, where traditional balloting methods, kiosk voting or telephone voting may be more appropriate in areas where Internet access is less widespread. In addition, trials of various methods would need to take account of this factor.

Figure 2: Households with Home Computers

[47] Please note that the Canadian percentages for 2007 are actually based on the 2008 figures because no 2007 data were available. The 2008 data were obtained from the *Survey of Electors Following the 40th General Election*.

Figure 3: Households with Internet Access



Note: Data are taken from the Organisation for Economic Co-operation and Development Web site and are not complete for all years.

Turnout

The potential impact of electronic voting on voter turnout has been an important reason for considering such a system in the European and Canadian municipalities that have implemented pilot projects. While it is difficult to generalize from these examples, in all Canadian municipal trials conducted thus far, turnout increased in whichever part of the election electronic services were offered. For example, in the cases of Markham and Peterborough, although remote Internet voting was only offered during advance polling, turnout in those polls registered strong increases from past elections that relied solely on paper ballots. Halifax, Markham, Estonia and Geneva all noted significant increases in the second official ballot where remote Internet voting was an option. And, with respect to Estonia and Geneva (the only cases that offered remote Internet voting in three elections), turnout climbed again in the third contest. It does appear, therefore, that where remote Internet voting is offered, increasing numbers of people use that method over time. It is still unclear, however, whether this results in an overall turnout increase.

Cost

Cost is an important consideration in election administration. Methods of electronic voting may be more costly in the initial stages than traditional paper ballots, but many of the companies responsible for running electronic elections claim they have the potential to save the jurisdictions that use their services a large amount of money over the longer term. In Canada, for example, the

2008 federal election cost approximately ten dollars[48] per eligible voter. This money covered expenses relating to the printing of ballots, staffing the polling stations and other general costs associated with running the election. Typically a provincial election can cost anywhere from seven to nine dollars per eligible voter, whereas municipal elections range from four to six dollars. While kiosk Internet voting and polling place Internet voting machines can be very cost-intensive to initiate, maintain and store, the cost to conduct remote Internet and telephone voting is substantially lower. Though exact prices differ based on the service provider, the standard rate worldwide is approximately two dollars[49] per elector plus the cost of the mailer or any voter cards that the electoral agency mails out with PINs and other essential information. This cost includes the general operation of an electronic election (services like a call centre for electors to phone if they have questions, a scrutineer system for candidates' representatives, and all other protocols required by election officials) (Smith, August 26, 2009).

Initially, these electronic election costs would be in addition to the normal cost of the paper ballot process currently employed. In addition, advertising expenses would be required to familiarize the public with the operation of the electronic system. Over time, however, as use of the electronic election methods increased, costs associated with the regular election process could be reduced, rendering the ultimate situation more cost-neutral. Reliable cost estimates are impossible to make in advance.

Legal implications

At the local level in Canada, municipalities are able to pass by-laws that allow for the use of alternative voting methods. If there is any conflict between a by-law and the existing legislation, the by-law supersedes anything contradictory in the legislation. At the federal or provincial levels, since there is no by-law option, the government must grant the chief electoral officers the power to try different forms or methods of voting. At the federal level, for instance, section 18.1 of the *Canada Elections Act* (introduced by Bill C-2 and assented on May 31, 2000) authorizes the Chief Electoral Officer to carry out studies and tests on alternative voting means, including electronic voting processes. However, prior to the implementation of such a process in an official vote, it is required that the proposed method or system be approved by House of Commons and Senate committees.

In addition to the approval of parliamentarians, the introduction of electronic voting may require the passage of legislation or an amendment to the Act allowing for the use of alternative voting methods, especially if the methods were to become a permanent fixture in the electoral process. The wording could be more open, allowing for multiple alternative voting methods, or could specify the exact methods to be used such as remote Internet and telephone voting. This would depend on whether Parliament wanted to be able to approve any specific methods that may be proposed for use in the future. Official approval of electronic voting would have to be accompanied by an election policies and procedures document that would establish the rules and guidelines outlining various components of the election. Three items that must be outlined in this

[48] The cost was actually $13 per eligible elector, but the remaining $3 per elector goes toward paying back the political parties for their campaigning costs (Smith, August 26, 2009).
[49] This cost is based on remote Internet and telephone voting and not the electronic machines.

document include the form of a ballot,[50] a mechanism to count the ballots and a process to contest a ballot (Smith, August 26, 2009). Other items could cover issues pertaining to authority, definitions, secrecy, voters lists, voter qualifications, the voting process, the electronic voting system, candidates' representatives, results, recount procedures, emergencies, financial disclosure for candidates and various other aspects of the election process (Intelivote, 2009).

Implications of the federal structure

European experience indicates that a step-by-step approach, involving introduction of only one or two Internet options at a time, in a well-designed program, increases the likelihood of success. If federal, provincial and municipal election offices simultaneously introduce their own mix of Internet or remote voting options, using different approaches and technologies, this may result in voter confusion. An open consultative process between various jurisdictions within Canada would be important to reduce the likelihood of such a situation**.**

Software

When selecting a type of Internet voting software, there are two options: proprietary and open-source. The central distinction between the two relates to ownership and intellectual property. Proprietary software is owned by the company that provides it, unless otherwise stipulated, and can only be used based on licensing conditions. Open source software by comparison still has a software licence, but the licence exists to protect the freedom of the software and the users (Gallagher, October 2, 2009).

All Internet voting projects to date, with the exception of the Australian Capital Territory project, have used proprietary software. Geneva, in particular, hotly debated the issue and then held a referendum concerning which type of software it was going to use. In the end, it decided that proprietary software would instil greater public confidence in the on-line voting process. Interestingly, although the USA has yet to trial remote Internet voting, many prominent American scholars (particularly Alvarez and Hall, 2004 and 2008) are proponents of open-source software. One of the major criticisms of the kiosk Internet voting project in Ireland was the lack of transparency with respect to the source code because it was not open-source. In the future consideration of electronic voting methods, the Commission on Electronic Voting recommended that only open-source software be considered for use (Interim Report of the Commission on Electronic Voting, 2006). Given these conflicting opinions, it is important that Canadian electoral agencies be informed of and carefully considers both types of software prior to developing a model for the conduct of elections.

In Canadian local elections, no municipalities chose to use an open-source software provider for the electronic portion of their elections because of convenience and small or non-existent research budgets. In addition, there are no Canadian companies that offer open-source election programs, so it is easier and more convenient for municipalities to select a company that not only has a program, but has also implemented it in official votes in other jurisdictions.

[50] The form of a ballot is what the ballot actually looks like, i.e. the order in which the candidates are arranged on the ballot and so on.

There are several important benefits associated with an open-source software product. For one, the source code (the language the computer program is written in) is open. That means it is transparent and can be peer-reviewed by anyone, anywhere. It is a common misconception that closed-source software is more secure than an open-source product because it is assumed that security is created by obscurity instead of by design (Gallagher, October 2, 2009). The development of Internet voting machines using open-source code in the Australian Capital Territory is a practical example of the benefit of the transparency open-source software provides. A local academic identified a mistake in the code that, although not a functional or security error, was a serious flaw nonetheless. Were it not for the code being open to public scrutiny, this flaw may not have been detected (Zetter, 2003). While some proprietary companies will allow their software to be peer-reviewed, provided the reviewing party signs a non-disclosure agreement, this is not always the case.

Furthermore, with proprietary software, a fee must be paid for every use and the software provider is relied upon for updates. This is not the case with open-source software, since the copyright could be owned by the purchaser. Open-source software products also allow for a greater role in product development and degree of control in verifying the development of desired software elements (Gallagher, October 2, 2009). Finally, the open nature of the code allows the model to be copied and used by others. While no one else is able to change the framework, if an open-source Internet voting model is used in Canada, there would be the potential for other governments to refer to it as an 'ideal type' for Internet voting. In this sense, the open-source software could provide an opportunity for others to follow and learn directly from the Canadian experience.

Other effects on the electoral process

The emergence of Internet voting in Canada would not only impact electors' choices and the way they vote, but also other aspects of the electoral process, notably the nature of campaigning. The implementation and popularity of Internet voting would have a significant effect on the campaign and the predictability of elections as well as on how candidates and parties mobilize voters. In Markham, for instance, one notable comment from officials was that on-line voting altered the landscape of how candidates needed to campaign. While canvassing, candidates encountered many electors who had already voted. A greater number of electors voting in the advance polls because of Internet convenience meant there were fewer votes to mobilize on election day. In addition, in Halifax, candidates were able to keep track of supporters during campaign timelines using an Internet candidate module. This allowed for the generation of multiple support lists such as a special list of undecided voters or categorization by area (i.e. street), which was a useful vehicle for mobilization. It also reduced the need for the traditional candidates' representative function because parties were able to track participation on-line. Though these are only some examples, there are many other potential effects that the extension of Internet voting could have on the campaign process, particularly voter mobilization.

Steps Needed to Achieve Internet Voting in Canada

Many of the steps needed to achieve Internet voting in Canada have been outlined throughout the report. The following eight steps can be identified in particular, although they would not be required to occur sequentially.

First, ensuring access is essential. This includes making sure that an adequate number of households have computers with access to the Internet, while taking account of differences between constituencies. Ensuring equality of access may require the inclusion of additional public Internet voting sites or making other voting methods more accessible in areas of lower income or rural areas where connectivity may be an issue.

Second, a culture of support – from government, the election administration body, political parties and candidates as well as electors – is required. To allow for a smooth introduction, it is important that all parties affected by the change are generally supportive, and that concerns are addressed.

Third, there is a need for a legal framework that supports the use and implementation of alternative electronic voting methods. In most cases, Canadian trials will require approval of the specific method by parliamentarians, and likely additional legislation if the method is to become a permanent fixture of the Canadian electoral process.

Fourth, thorough research and an assessment of trials and tests in other jurisdictions as well as an analysis of their outcomes is essential. It will be helpful to pursue the cases discussed in this report to identify particular features of superior approaches that may be useful in developing a given model for Canada.

Fifth, it is important that there be a clear picture of the benchmarks and requirements an additional voting method would be expected to fulfill, as this will provide a framework for distinguishing which electronic or Internet voting method is a good fit for the Canadian electoral process.

Sixth, a marketing and information campaign appears to be an important step toward not only launching, but also maintaining a successful Internet voting program. In addition to informing electors of the choice of alternate voting methods, information concerning the importance of voting or other details regarding candidates or their platforms could be included.

Seventh, gradual, practical testing appears to be a necessary step. Gradual trials would involve introducing Internet voting in sequential electoral races whereby the number of voters affected would increase with each pilot as well as the perceived importance of the election.

Finally, adequate evaluation of pilots is recommended to ensure the method is meeting desired objectives, and that all stakeholders are satisfied with the change and its consequences. This would involve conducting surveys among political parties, candidates, election administrators and electors.

Conclusion

This study indicates that no one specific model of remote or Internet voting used elsewhere is directly transferable to a Canadian context. Selectively adopting features tested in other jurisdictions will best help to assure maintenance of the integrity of the Canadian electoral system. In terms of what will work in Canada, there is a particular need for more research and pilot projects related to remote Internet voting. And while theoretical research is useful, only practical experience and trials can determine the particular impact Internet voting would have on Canadian electoral democracy.

Interdisciplinary research may be able to provide further guidance on which variants of the available models would be best suited to the Canadian context. In particular, it would be useful to collect additional attitudinal data that probe electors' reported level of comfort and trust with Internet technology and specific types of Internet voting. It would also be useful to gauge how likely Canadian electors would be to make use of telephone voting. In addition, it would be important to investigate regional and other socio-demographic features of the likely use of electronic voting methods.

It would also be useful for the Canadian electoral agencies to develop a number of principles or benchmarks that Canadians would expect an electronic voting system to live up to. This could include and expand upon their operational values and principles, such as maintaining the integrity of the electoral system, increasing accessibility and convenience for electors, the potential to increase electoral participation, being innovative while maintaining traditional customs and conventions, improving the speed of tabulation and the reporting of election results, maintaining or enhancing the inclusiveness of the electoral process, responding to technological and attitudinal changes in society, preserving or increasing system transparency, continuing to earn and maintain public trust, and ensuring cost effectiveness. Additional research on the type of software, security protocols, and risk assessment methods would be beneficial as well.

Practical testing and pilot projects are the only ways of knowing what will work and what will not. Trials of particular methods will give the best insight into understanding what requirements must be met for Internet voting to work well in Canada as well as the actual pros and cons of electronic approaches. A by-election is perhaps a useful starting point, but a more expansive trial would be necessary prior to the introduction of Internet voting nationally. A regionally concentrated trial, or a group of selected constituencies that are regionally representative, would be a useful approach to testing. Only after such testing would it be feasible to offer remote Internet voting as an option for all Canadian electors, as a complement to the traditional process.

Careful examination of the literature on Internet voting as well as the pilot experiences of many jurisdictions suggests that both the extremely optimistic and pessimistic positions about the effects of Internet voting are overstated. Internet voting will not act as a panacea for the social causes responsible for electoral disengagement, nor will it remedy negative attitudes toward political entities. It will, however, increase voting opportunities for electors and make casting a vote more accessible. On the other side, Internet voting will not erode democracy or result in vote buying and election fraud any more than does the existing system. The Internet will undoubtedly change the political landscape in Canada with or without the introduction of Internet voting, since it already is impacting electoral campaigns and overall election administration. While there are valid concerns that should be considered and thought out in the development of a given model, the successful operation of Internet voting in other jurisdictions shows that it can be implemented and, in fact, improve the electoral process for electors and election administrators.

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