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Security and Accessibility: Concerns Over Electronic Voting Systems

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ABSTRACT

In recent years Electronic Voting has become a more practical approach to polling the U.S. public. The unique features of electronic voting systems bring some advantages as well as concerns to the public. In this article, we examine the advantages of electronic voting systems and two principal obstacles in its successful implementation: security and accessibility. Based on current technology, some implementation suggestions are made to provide guidelines for its practical implementation.

INTRODUCTION

In recent years, the development and widespread use of the Internet has lead to brought profound implications to society. Emails, online shopping, and e-payment become common in our daily lives (Galston, 2000). Federal and state governments should embrace this technology wave. Electronic government has quickly become a popular concept that advocates the utilization of various technologies to process work and provide superior political services to the citizens (Watson and Mundy, 2000). Gartner Group (2001) has predicted, "By 2003, more than 60 percent of government agencies in developed countries will allow citizens to conduct some form of electronic remote transaction." In the U.S., every state has set up a state website and has instituted some level of online services.

As a central component in electronic government, electronic voting (e-voting) attracts the attention of researchers and practitioners. How to use advanced technology to make voting activities more efficient and effective is the focus of Government. E-voting is regarded as the inevitable step on the road to "Digital Democracy" (Westen, 2000). Electronic voting systems (EVS) become an important tool to realize this shift to e-voting.

In this paper, as the U.S. is a leading advocate of EVS, we will address the major problems in the acceptance of EVS in the U.S. First, we will define EVS and examine its major advantages. Two concerns about the switch to EVS: security and accessibility are discussed and suggestions to alleviate those problems in practical implementation will be provided.

ADVANTAGES OF ELECTRONIC VOTING SYSTEMS

Traditionally, voters first register and identify their qualification. On Election Day, they are required to appear and cast the ballots in private booths by using a punch-card machine (Posner, 2001). A card is put on a tray, and voter punches a hole next to the candidate's name to select this candidate. Then this piece of card is dislodged and the "chad" falls to the bottom of the tray (Posner, 2001). The card is placed in a machine that counts votes by beaming light through the holes. But if the light can't go through the hole, this vote will not be counted.

Though this method has been used in elections for a long time, it still has many problems. The 2000 presidential election in Florida State is a primary example. Many voters complained they were misled by the "butterfly" ballot in which the name of candidates are listed on both sides of the ballot rather than all on only one side (Posner, 2000). In many cases, a chad remains dangling from the ballot by one or two corners, so that light cannot go through and this ballot cannot be correctly counted by machine. The location of booths is another problem posing an inconvenience to the voter, thus resulting in lower than optimal voter turnout. Only about 50% of U.S. citizens participated in the 2000 presidential election (Hodges, 2001). Furthermore, the mechanical machines do not guarantee ballot count accuracy. The additional corrections method and manual recounting tends to cause other problems. Americans will not forget the complex and time-consuming recounts in Florida and the subsequent political turmoil.

The above-mentioned problems motivate government to take a close look at information technology enabled voting. EVS is developed to meet this need. In this study, an EVS is defined as an electronic technology based voting environment, which enables remote voting, and facilitates monitoring, voting and tallying processes. Currently, a number of companies have successfully developed EVSs and put them into practice, including web-based, telephone-based and touch screen based voting systems. The table below shows some specific products (Electronic Voting Hot List, 2001).

Table 1: Major EVS products

Vendor	Product	Function or Application
Global Election Systems (www.gesn.com)	Global/Diebold turnkey voting system	Used in Brazil nationwide voting
	Accuvote-TS system	Touch screen voting system
Election (www.election.com)	Elecpro	Used in 2000 Arizona Democratic Presidential Election, which is the first online voting
VoteHere (www.votehere.com)	Non-binding online voting system	Used in Arizona and California governmental voting, friendly user interface
American Arbitration Association (www.adr.org)	Telephone Voting System and Online Voting System	Telephone voting system

The emergence of EVS presents some outstanding advantages to the public. In the rest of this section, we will discuss them respectively.

Efficiency

Ballots may be cast electronically and automatically transferred from each distant machine to a central storage database. Time spent for ballot allocation and voting monitoring is greatly reduced. Meanwhile, with the help of EVS, officials can accurately count these electronic ballots and report the results quickly. Delays due to final vote tabulations will cease to exist.

With well-designed user interfaces, voters can clearly understand and follow instructions. In addition, voters have several opportunities to make changes before final submission. Errors caused by ballot misinterpretations will disappear.

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Cost-Saving

Usually, during elections, several physical booths are needed in each county. The costs associated with running booths, including the labor costs to maintain machines and assist registration, physical booths and parking spaces, and other utilities can be a significant amount. EVS can diminish this cost. Some states may need initial investments for hardware, software and other devices, but in the long run, the higher cost will be avoided.

In most states and municipalities, it may not be a heavy burden to add voting, as another online service hosted by established websites (Symonds, 2000). And most popular mechanisms of EVSs, such as telephones, computers, or touch screen machines, are not new to the general public. The newly released report says about 88 percent of adults 18 or older access the Internet at home to send email (Associate Press, 2001). Some newly developed internet-ready devices are only $300 (Symonds, 2000). Internet access fee is generally inexpensive (Symonds, 2000) in the U.S. Especially, for small communities who lack Internet access, advanced telephone-based EVS will be a good choice by using the existing telephone infrastructure, as about 92% of Americans have telephones at home (National Telecommunications and Information Administration, 1999). In addition, some Application Service Providers offering the operation and maintenance for the government during the election, such as Global Voting System Company (Global, 2001), can greatly help small communities to realize E-voting with limited budgets.

Flexibility

By using EVS via telephone, computer or other electronic device, voters can cast ballots at any time at any place.

The wealth of policy-related information available on the Internet may lead to a greater citizen awareness of government activities and candidates' background. EVS can offer 24-hour voting services. Without any restrictions on location, the handicapped can share equal opportunities. And there is considerable evidence that political knowledge is positively related to political participation. About 72% of adults, including two in three who don't use Internet, believe that electronic government will make a valuable contribution to participatory democracy (Intergovernmental Technology Leadership Cons., 2000).

It seems clear that these advantages will motivate the enthusiasm of government and citizens to adopt EVS, which in turn should increase the participation of political lives.

CONCERNS OVER THE MOVE TO ELECTRONIC VOTING

As early as 1996, E-voting was initiated in the Reform Party primary election (Cranor, 1997). In 2000, the first formal online voting recorded was held in the Arizona Democratic primary (Solop, 2000-a). These positive results confirm the opportunities of EVS and imply its wide acceptance in practice.

However, critics of EVS draw attention to a number of concerns associated with the shift away from conventional voting. Only after we can address these concerns to the satisfaction of the public, can the successful E-voting proceed. In this section, we will discuss the two most important issues: security and accessibility.

Security

Perhaps security is the most critical concern regarding e-voting. A hallmark of democratic voting is that ballot choices should be confidential. This concern about privacy is echoed in the Clinton administration's "Framework For Global Electronic Commerce" (2000), which emphasizes that security is to be a pillar of Fair Information Practices, the regulations of online information gathering, including notice, choice, access, security, and legislations. Security means the confidentiality of personal information must be preserved, and protected from unrelated use. In e-voting especially, it refers ballots should not be traced to voters by any public or private organization.

Considering the daily challenges of network and database management and administration, it is not surprising that the public's lack confidence in EVS. The Internet is host to a number of creative computer hackers. In 2000, some hackers invaded Bibliofind website of Amazon.com and stole close to 98,000 customers' credit card records (SinaNews, 2001). Coupled with the presence of unpredictable and damaging computer viruses, the potential risk that hackers could break into internal voting systems without detection threatens the acceptance of EVS, particularly online voting systems.

In addition, this remote and virtual vote may increase the likelihood of voter fraud. In conventional elections (i.e. paper ballots), a voter is required to appear in person and prove his voting eligibility. However, in a virtual election environment, there is no poll watcher to ensure proper voter conformance to election law. One can easily imagine voting campaign vans equipped with laptops offering money or other incentives in return for votes.

And as only professionals can support these highly technological products, the e-voting processes would be transparent to the general public. Without effective monitoring, system administrators could deliberately manipulate the vote.

Accessibility

Another important concern is equal accessibility. A serious accusation against EVS and Internet technology in general is the notion of a "Digital Divide" (Turner, 2001). The appearance of internet-based technology and its increased utilization represents, some argue, a new form of discrimination against certain groups in the population. Furthermore, this discrimination, if appearing in the voting process, threatens the cornerstone of democratic government: equal representation. The U.S. Department of Commerce (National Telecommunications and Information Administration, 1999) states, "the digital divide has turned into a 'racial ravine' when one looks at access among households of different racial and ethnic origins" (p.8). Other studies find income and education have more significant impacts on EVS accessibility than race (Hoffman 1997, Hoffman 1999). That means minority and low-income voters are disadvantaged in using EVS. 2000 Arizona Democratic primary online election was nearly cancelled due to this division (Solop, 2000-b).

This concern with accessibility and disparate impact of EVS in the voting population have led to the criticism that widespread use of EVS may work to the advantage of some political parties or candidates at the expense of others. Will EVS appeal to a certain segmentation of the population? Research on this perspective is still ongoing, however, one recent analysis suggests that EVS may lead to an increasing presence of liberal voters (Hill, 1998).

SUGGESTIONS FOR EVS IMPLEMENTATION

Though a debate about pros and cons over the move to EVS is still going on, academics and scientists are trying to improve the functions of EVS, especially in security and accessibility. In this section, we will examine some efforts and provide the suggestions for practical implementation of EVS.

Security

Generally, security is enhanced at three levels: physical, network and database (EzGov, 2000). Physical security involves server placement, which should be optimally established and effectively maintained to ensure reliable data storage. Server infrastructures should take hardware malfunction and power loss into consideration and provide necessary protection for possible temperature changes (EzGov, 2000).

At the network level, the firewall is the first level of security from network intrusions. In the context of voting, privacy safeguards

have special requirements that allow only eligible participants to vote and vote only once, and that does not allow a way to link a ballot to a specific voter. Computer scientists, in recent years, have continuously developed and enhanced security protocols. In 1981, the public key cryptography was first used on anonymous electronic mail and digital pseudonyms to enhance network security (Chaum, 1981). In 1991, "One Agency Protocol" was published, which guarantees the secure process of ID tag distribution for voter eligibility (Nurmi, Salomaa, and Santean, 1991; Riera et al. 2000). In 1992, the more complicated "Two Agency Protocol" was further developed, which separates validation and tally processes (Fujioka, Okamoto, Ohta, 1993). Currently, this protocol is widely utilized in popular EVSs and the applications are quite satisfied.

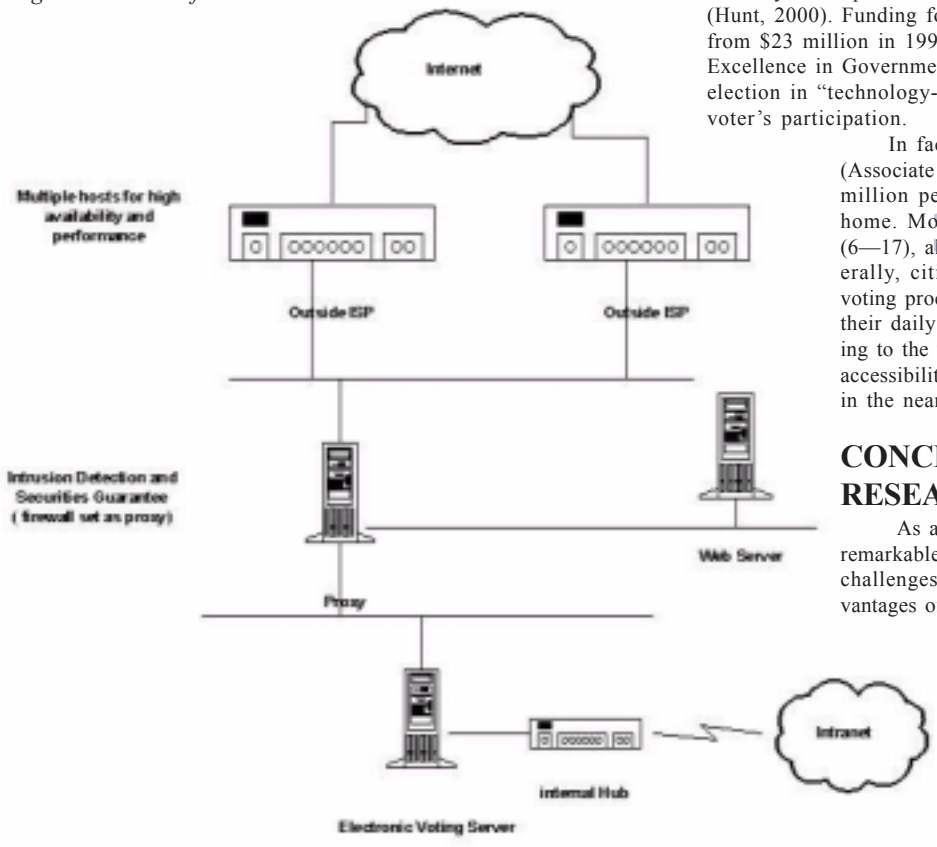
The third level of security protection is data, which includes two categories: transmission and storage. For data transmission, personal and sensitive information needs to be divided into several packages and encrypted before exchanged (EzGov, 2000). At present, a 128-bit Secure Socket Layer (SSL) is the highest level of security standard over the web. Until now, it still provides acceptable performance in protecting data transmission.

For data storage in a database, the data would be separated and stored in different files or servers to prevent fraud (EzGov, 2000). "Sand Boxing" is a frequently used encryption technique, which separates user name, password and other data into various files. In addition, central/distributed storage, authenticity approval, and multi-authority allocation closely related with database all play important roles in guaranteeing security.

Figure 1 illustrates the network connection for web based EVS (Figure 1).

In practice, to ensure EVS reliability, it is necessary to conduct open testing. Only after extensive testing and monitoring, can the vulnerabilities of EVS be detected for further enhancement.

Figure 1: Network frame on Internet-based EVS



Accessibility

As to the concern of "Digital Divide", evidence indicates that demographic difference regarding technological "know-how" may be less an issue than anticipated. For instance, racial and ethnic divide segregation may be a transitory phenomenon that should vanish as computer prices continue to plummet (Westen, 2000) and as government programs to address this issue are implemented. A recent Forrester Research Survey found that Asian and Latino Americans use computer at home, school and work more than White Americans (Irvine, 2000). Indeed, race, income, and education are factors in predicting turnout in conventionally held elections as well (Powell, 1986, Verba, Sclozman, Brady, and Nie, 1993). Hence, the question is whether the impact on elections will be changed after the adoption of EVSs. Solop (2000-a) investigates the Democratic primary election in Arizona and found that the "racial ravine" did not significantly change election outcome in online voting.

Furthermore, EVS is not confined solely to a web-based voting platform. Telephone and touch screen-based EVS are also good mechanisms, especially to telephone-based voting system with high percentage of household telephone. Also, telephones do not require special usage skills, so the digital division effect is not significant. Thus, it might be a good alternative for those lacking computer skills or computer access. As well, new electronic devices are constantly introduced to make EVS more convenient, e.g. wireless palms. In the transition to EVS, Government may also provide mobile voting booths or install computers at certain communities to offer EVS options. In Arizona's 2000 online election, a government-sponsored group took laptops equipped with Internet connections to those who lacked web access (Solop, 2000-a).

The fundamental way to minimize differences in technology accessibility is through education. Government has sponsored many initiatives to address education concerns. In April 2000, former President Clinton visited several communities characterized by their lack of Internet connectivity, showing the willingness of government and industry to help low-income communities connect to the Internet (Hunt, 2000). Funding for educational technology has also increased from $23 million in 1994 to $766 million in 2000 (The Council for Excellence in Government, 2000). Simple training courses before an election in "technology-poor" communities can effectively increase voter's participation.

In fact, a Census Bureau report leased in Sept 6 (Associate Press, 2001) stated that over half of the 105 million people around the country have computer at home. More importantly, among the school-age kids (6—17), almost 90 percent have computer access. Generally, citizen comfort levels with technology-based voting processes should rise as the role of computers in their daily lives increases. With strong evidence pointing to the wide usage of computers, one can expect that accessibility will subside and participation will increase in the near future.

CONCLUSION AND FUTURE RESEARCH

As a continuing changing technology, EVS brings remarkable changes to the political system. Though the challenges still remain to enhance the technology advantages of EVS and educate the public on the adoption of EVS, a January 2000 poll revealed that a majority of people studied (51%) regarded e-voting as an effective way to make local government work efficiently (Westen, 2000). Another study indicates that roughly one-third of American households would be more likely to vote if EVS were available (Benschoten, 2000). So the adoption of EVS will occur sooner or later.

In this paper, we discuss the two main concerns about EVS, security and accessibility, and provide some suggestions about the practical adoption of EVS. But this study is still in an early stage. In the future, more empirical studies will be conducted to investigate the influence of EVS on participation, various factors associated with EVS adoption and practical problems in implementation.

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