

ELECTRONIC VOTING AND ELECTRONIC COUNTING OF VOTES

A STATUS REPORT

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ELECTRONIC VOTING AND ELECTRONIC COUNTING OF VOTES: A STATUS REPORT

Background

Over the last few years there have been a number of election commentators who have suggested that Australian electoral organisations should introduce electronic voting at Federal, State and Local Government elections. The general observation is made that as we do more of our business using a number of electronic mediums (from eftpos to electronic banking, ATMs, and purchases over the Internet), it should not be too difficult for us to vote using electronic equipment rather than turning up at a polling place on election day and vote using paper and pencils. It is further claimed that, if electronic voting was used, election results would be known much earlier than is presently the case. The assertion has also been made that electronic voting would be cheaper than the present arrangements.

Commentators and proponents of electronic voting often cite the United States as an example where electronic voting has been in place for years.

The phenomenal use of the Internet as a vehicle for improved communication, access to information and electronic commerce has led to the claim that the Internet could be used as either a replacement to attendance voting or as an additional voting option. Indeed, we have recently seen a US company (Election.com) set up business in Australia aimed at providing Internet voting services in the area of commercial and community elections.

From time to time, a small number of Australian politicians and Parliamentary Committees (both Federal and State) have asked electoral authorities to ascertain the status of electronic voting. Is it an option to introduce electronic voting into Parliamentary and Local Government elections in Australia?

The recent US Presidential elections provided an opportunity to meet with key people in the USA who have an interest and involvement in the introduction of electronic voting in that country. With this in mind, a small delegation of representatives of the Australian Electoral Commission (AEC) and the Victorian Electoral Commission (VEC) visited the USA to observe first hand developments in the use of electronic voting and electronic vote counting at the Presidential elections. Discussions were held with representatives of electoral administrations, commercial vendors and groups who were concerned about the integrity of electronic voting. These people provided a composite picture of the status of electronic voting in the USA together with the issues that would need to be addressed if electronic voting was to be further developed to the point where it could be considered for introduction in Australian government elections.

What is electronic voting?

Electronic voting is a blanket term used to describe a variety of practices using technologies. In one sense, the USA has used a form of electronic voting for years. The punch card system has been extensively used in the USA and has recently been put under close scrutiny at the Presidential election in Florida. Electronic voting may also mean attending at a polling place and voting using a computer terminal and even a touch screen. This technology was first introduced in the USA in 1994 and was extended at the 2000 Presidential elections. Some people regard electronic voting as voting over the Internet, from the comfort of one's home, office, library, kiosk, ATM, or Internet cafe. Indeed, it is possible to say that electronic voting could be any or all of the above.

In any discussion on electronic voting, it is important from the outset to be clear about what type of electronic voting is being discussed. As will be clear from this report, some forms of electronic voting are simply not possible in the context of the Australian election environment. Nevertheless, in an attempt to canvas the main issues associated with electronic voting, we have considered the most common types of technologies and systems that are frequently termed “electronic voting” and commented on the possibility of these being introduced into the Australian environment.

The USA electoral system

The USA electoral system is based on the “first past the post” system of voting. This means that voters only have to vote for the candidate of their first choice. They do not have to rank candidates in the order of choice. The “first past the post” system is very simple to administer and also lends itself to the use of simple electronic technology to tabulate the results and determine the outcome of an election. The winner is simply the candidate with the highest number of votes.

The “punch card” technology has been used in many jurisdictions in the USA for some years. This technology relies on electors punching out a hole in a pre printed card that is then fed into an electronic reader to tabulate the results. There are other systems which are variations of the punch card technology that are used in the USA to calculate the result of the elections. These systems include Optical Mark Recognition (OMR) scanning of ballot papers, touch screen voting, mechanical voting machines and the paper ballots.

It is important to appreciate that the “first past the post” system lends itself to the use of many types of technology to assist with the voting process. Indeed, the “first past the post” voting system is so simple as to make it feasible to develop very user-friendly electronic voting systems to assist electors in casting their votes.

It should also be noted that voting is not compulsory in the USA, a very different situation from Australia.

Voting systems in Australia

We need to contrast the USA system of “first past the post” with the common voting systems that are used in Australia. Voting for the House of Representatives is by the “exhaustive preferential” method, and for the Senate it is by “proportional representation”. The exhaustive preferential system requires a voter to number all candidates on the ballot paper according to the voter’s preference. Proportional representation also requires a voter to number all candidates, or to place a number “above the line” which in turn indicates a preference order for all candidates. Voting for most State Parliaments is by one or other of these systems (or variations).

The preferential voting system (in any of the forms presently used in Australia) does not readily lend itself to the use of the same technology that is used in the USA for the recording of votes. For example, the “preferential system” is not readily compatible with a punch card system as it is very difficult to assign preferences to all candidates using a punch card approach. (Whilst it is not impossible to use punch card technology to assign preferences, it would require the ballot paper to be in the form of a matrix with candidates down the side and preference numbers across the top of the ballot paper

If this system was introduced in Australia, then marking the ballot paper would become more complex as the number of candidates increased beyond two. It would also require a fundamental change to the present way of marking a ballot paper.

There is no evidence to suggest that there is any political or community support for changing the voting systems presently used in Australia. This is an important point to appreciate when considering the possibility of introducing any form of electronic voting in this country. In our view, the introduction of any form of electronic voting must support the present voting systems and voting culture.

Observations of the USA electronic voting systems

It should be noted that there is no single body that is responsible for election arrangements in the USA or within each State. The electoral laws are State laws, however local Counties have considerable autonomy in the implementation of such laws. For example, some Counties within a State may use touch screen voting and other Counties may use punch card technology.

The Federal Electoral Commission in Washington DC has developed standards for the use of electronic voting equipment. The States are not required to adopt the standards but it seems that most do. The following are the most common technologies observed at the recent Presidential elections.

Punch card

This is by far the most common form of electronic voting used in the USA. We have seen the problems associated with this system in the Florida jurisdiction. The technology is very old and the equipment is difficult to service. Questions have been raised regarding the accuracy and the reliability of the equipment. This technology is based on 1960's IBM technology (Figure 1).

Touch screens

This is where a computer is set up at a polling location for electors to vote by touching their preferred candidate's name on a computer screen. At the close of voting the results are copied to disk and imported into a central database.

Touch screens were used on the west coast mainly for pre-poll voting. In many Counties they were also used in polling places. The touch screens were well received, particularly from disabled and elderly voters (Figure 2). This system does not provide a paper ballot audit trail.



FIGURE 2

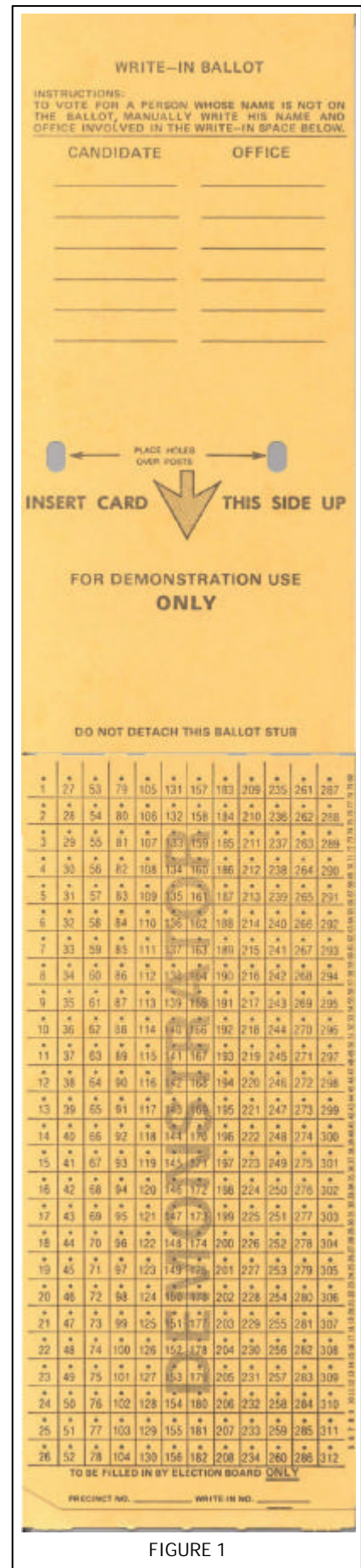


FIGURE 1

Optical Mark Recognition (OMR) of printed ballot

This system is based on the elector marking the ballot by shading an oval shape beside the name of the candidate of their choice. The printed ballots are then read through an OMR reader and the ballot paper is deposited in a ballot box. At the close of voting the results are extracted from the OMR reader and printed out for scrutineers to observe. The results are then transmitted via a modem to a central collation point in the State (Figure 3 overleaf). This system provides a paper ballot audit trail.

Internet voting

Much has been made in the media about the use of the Internet to assist with the Primary elections in June 2000 in the State of Arizona. Indeed, the media attention to this project was so widespread that one was almost led to conclude that Internet voting was now a reality in all USA Government elections. The reality is far from this. It is worth commenting in some detail on the Arizona Internet voting project if for no other reason other than to bring some perspective and proportionality to the exercise.

For the Democratic Primary elections in Arizona, democratic voters could choose to vote at the primary elections over the Internet. One needs to remember that these primary elections are an internal party election (albeit on a very wide and public stage). Voting is based on the party rules. In the case of Arizona, every registered voter was issued with a PIN number that could be used in combination with other personal information to assist with voter identification. It was planned that Internet voting would take place over four days and that attendance voting would take place during a twelve-hour period as was usual practice.

The Arizona Internet voting experiment was a landmark case of using the Internet at a major election. There were many issues raised during the Internet voting and after the election, and there were many conflicting views regarding the success or otherwise of the project. The project was important as it put on the electoral agenda issues such as:

- security of the Internet for government elections;
- cost of providing Internet voting services;
- exposure to fraud and widespread “flooding” of the Internet voting site;
- potential for discrimination against those who cannot access the Internet or those who are not proficient in its use; and
- potential for coercion and intimidation when voting in an unsupervised setting.

It is, however, interesting to note that voter participation in the primary election rose by 600% with 80% of those who participated, (40,000) voting via the Internet.

It should also be noted that there was no use of the Internet for voting at the November 2000 USA Presidential elections (except for the following trial).

**L&A5
TEST DECK**

OFFICIAL PRIMARY ELECTION BALLOT
MARCH 7, 2000
MARIN COUNTY, CALIFORNIA

INSTRUCTIONS TO VOTERS: To vote for the candidate of your choice, completely fill in the OVAL to the LEFT of the candidate's name. To vote for a person whose name is not on the ballot, darken the OVAL next to the word "Yes" or the word "No". All distinguishing marks or erasures are forbidden and make the ballot void. If you tear, deface, or wrongly mark this ballot, return it and get another. **VOTE LIKE THIS:**

AMERICAN INDEPENDENT PARTY

PARTISAN OFFICES	UNITED STATES REPRESENTATIVE	
<p>PRESIDENT OF THE UNITED STATES PRESIDENTIAL PREFERENCE VOTE FOR ONE</p> <p><input type="radio"/> ORRIN HATCH Republican</p> <p><input type="radio"/> L. NEIL SMITH Libertarian</p> <p><input type="radio"/> JOEL KOVEL Green</p> <p><input type="radio"/> ALAN KEYES Republican</p> <p><input type="radio"/> KIP LEE Libertarian</p> <p><input type="radio"/> LYNDON LA ROUCHE Democratic</p> <p><input type="radio"/> AL GORE Democratic</p> <p><input type="radio"/> GEORGE D. WEBER Reform</p> <p><input type="radio"/> DONALD J. TRUMP Reform</p> <p><input type="radio"/> JOHN MC CAIN Republican</p> <p><input type="radio"/> ROBERT BOWMAN Reform</p> <p><input type="radio"/> HARRY BROWNE Libertarian</p> <p><input type="radio"/> BILL BRADLEY Democratic</p> <p><input type="radio"/> GEORGE W. BUSH Republican</p> <p><input type="radio"/> GARY BAUER Republican</p> <p><input type="radio"/> STEVE FORBES Republican</p> <p><input type="radio"/> JOHN B. ANDERSON Reform</p> <p><input type="radio"/> RALPH NADER Green</p> <p><input type="radio"/> HOWARD PHILLIPS American Independent</p> <p><input type="radio"/> CHARLES COLLINS Reform</p> <p><input type="radio"/> DAVE LYNN HOLLIST Libertarian</p> <p><input type="radio"/> LARRY HINES Libertarian</p> <p><input checked="" type="radio"/> JOHN HAGELIN Natural Law</p> <p><input type="radio"/> Write-in</p>	<p>6th DISTRICT VOTE FOR ONE</p> <p><input type="radio"/> JUSTIN "JUSTO" MOSCOSO Green <small>Grant Coordinator</small></p> <p><input type="radio"/> KEN MC AULIFFE Republican <small>Business Owner</small></p> <p><input type="radio"/> ALAN BARRECA Natural Law <small>Editor/Architectural Consultant</small></p> <p><input type="radio"/> RICHARD O. BARTON Libertarian <small>Respiratory Therapist/Author</small></p> <p><input type="radio"/> LYNN WOOLSEY Democratic <small>U.S. Representative</small></p> <p><input type="radio"/> Write-in</p>	<p>PROPOSITION 12 SAFE NEIGHBORHOOD PARKS, CLEAN WATER, CLEAN AIR, AND COASTAL PROTECTION BOND ACT OF 2000. (THE VILLARAIGOSA-KEELEY ACT) This act provides two billion one hundred million dollars (\$2,100,000,000) to protect land around lakes, rivers, and streams and the coast to improve water quality and ensure clean drinking water; to protect forests and plant trees to improve air quality; to preserve open space and farmland threatened by unplanned development; to protect wildlife habitats; and to repair and improve the safety of state and neighborhood parks. Fiscal Impact: State cost of \$3.6 billion over 25 years (average cost of about \$144 million per year) to repay bonds. State and local parks' operating costs of potentially tens of millions of dollars annually.</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>
	<p>STATE SENATOR 3rd DISTRICT VOTE FOR ONE</p> <p><input type="radio"/> JOHN L. BURTON Democratic <small>State Senator</small></p> <p><input type="radio"/> TERENCE FAULKNER Republican <small>County Central Committee Member</small></p> <p><input type="radio"/> CELESTE JOY BLAU JOKI Natural Law <small>Educator</small></p> <p><input type="radio"/> Write-in</p>	<p>PROPOSITION 13 SAFE DRINKING WATER, CLEAN WATER, WATERSHED PROTECTION, AND FLOOD PROTECTION BOND ACT. This act provides for a bond issue of one billion nine hundred seventy million dollars (\$1,970,000,000) to provide funds for a safe drinking water, water quality, flood protection, and water reliability program. Fiscal Impact: State cost of up to \$3.4 billion over 25 years (average cost of about \$135 million per year) to repay bonds. Potential unknown local project operation and maintenance costs.</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>
	<p>MEMBER OF THE STATE ASSEMBLY 8th DISTRICT VOTE FOR ONE</p> <p><input type="radio"/> PAUL NAVE Democratic <small>Businessman/Police Officer</small></p> <p><input type="radio"/> JOE NATION Democratic <small>Teacher/Parent/Businessman</small></p> <p><input type="radio"/> RICHARD OLMSTEAD Libertarian <small>Business Owner</small></p> <p><input type="radio"/> ED SULLIVAN Republican <small>Retired Businessman</small></p> <p><input type="radio"/> FRANK EGGER Democratic <small>Mayor/Paramedic Boardmember</small></p> <p><input type="radio"/> JACK GIBSON Democratic <small>Attorney/Educator</small></p> <p><input type="radio"/> SUSAN L. ADAMS Democratic <small>Nurse Practitioner/Educator</small></p> <p><input type="radio"/> BARBARA HELLER Democratic <small>Councilwoman/Businesswoman</small></p> <p><input type="radio"/> CAROLE HAYASHINO Democratic <small>Educator/County Commissioner</small></p> <p><input type="radio"/> BASIA CRANE Democratic <small>Educator/Traffic Analyst</small></p> <p><input type="radio"/> Write-in</p>	<p>PROPOSITION 14 CALIFORNIA READING AND LITERACY IMPROVEMENT AND PUBLIC LIBRARY CONSTRUCTION AND RENOVATION BOND ACT OF 2000. This act provides for a bond issue of three hundred fifty million dollars (\$350,000,000) to provide funds for the construction and renovation of public library facilities in order to expand access to reading and literacy programs in California's public education system and to expand access to public library services for all residents of California. Fiscal Impact: State cost of \$600 million over 25 years (average cost of about \$24 million per year) to repay bonds. One-time local matching costs of \$190 million, plus potential additional operating costs of over \$10 million annually.</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>
<p>UNITED STATES SENATOR VOTE FOR ONE</p> <p><input type="radio"/> MICHAEL SCHMIER Democratic <small>Attorney at Law</small></p> <p><input type="radio"/> VALLI "SHARP" SHARPE-GEISLER Reform <small>Educator/Technology Coordinator</small></p> <p><input type="radio"/> GAIL KATHERINE LIGHTFOOT Libertarian <small>Registered Nurse</small></p> <p><input type="radio"/> JP GOUGH Republican <small>Businessman/Entrepreneur</small></p> <p><input type="radio"/> LINH DAO Republican <small>High-Tech Entrepreneur</small></p> <p><input type="radio"/> DIANE BEALL TEMPLIN American Independent <small>Attorney/Businesswoman</small></p> <p><input type="radio"/> JAN B. TUCKER Green <small>Licensed Private Investigator</small></p> <p><input type="radio"/> JOHN M. BROWN Republican <small>Telephone Equipment Salesman</small></p> <p><input type="radio"/> MEDEA SUSAN BENJAMIN Green <small>Nonprofit Organization Director</small></p> <p><input type="radio"/> DIANNE FEINSTEIN Democratic <small>United States Senator</small></p> <p><input type="radio"/> TOM CAMPBELL Republican <small>Congressman/Educator</small></p> <p><input type="radio"/> JOSE LUIS "JOE" CAMAHORT Reform <small>Research Scientist/Engineer</small></p> <p><input type="radio"/> BILL HORN Republican <small>County Supervisor/Rancher</small></p> <p><input type="radio"/> RAY HAYNES Republican <small>California Senator</small></p> <p><input type="radio"/> BRIAN M. REES Natural Law <small>Physician</small></p> <p><input type="radio"/> Write-in</p>	<p>MEASURES SUBMITTED TO THE VOTERS</p> <p>STATE</p> <p>PROPOSITION 1A GAMBLING ON TRIBAL LANDS. LEGISLATIVE CONSTITUTIONAL AMENDMENT. Modifies existing gambling prohibitions to authorize Governor to negotiate compacts with federally recognized Indian tribes, subject to legislative ratification, for operation of slot machines, lottery games, and banking and percentage card games on Indian lands. Fiscal Impact: Uncertain fiscal effect on state and local tax revenues ranging from minor impact to significant annual increases. State gambling license fees of tens of millions of dollars annually.</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>	<p>PROPOSITION 15 THE HERTZBERG-POLANCO CRIME LABORATORIES CONSTRUCTION BOND ACT OF 1999. This act provides for a bond issue of two hundred twenty million dollars (\$220,000,000) to provide funds for a program for the construction, renovation, and infrastructure costs associated with the construction of new local forensic laboratories and the remodeling of existing local forensic laboratories. Fiscal Impact: State cost of \$377 million over 25 years (average cost of about \$15 million per year) to repay bonds. Local government costs of \$20 million (one-time) and potentially millions of dollars in annual operating costs.</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p>

FRONT Card 9 Rp00s 1001-10 *1104*

FIGURE 3

Department of Defense Internet trial

The Federal Voting Assistance Program of the US Department of Defense developed a trial of Internet voting for Defense personnel located outside the USA. The trial involved voting at the US Presidential elections. The project had been some years in development, with significant costs being incurred.

The project required the support of States to make necessary changes to their legislation to enable the Defense staff to vote over the Internet. Four States made the necessary changes and participated in the project. The trial was limited in total to 250 overseas Defense Department electors. Only one County in each of the four participating States could participate in the trial. This was considered necessary to limit the risk exposure if there were any problems with the system.

A contractor was commissioned to develop the application and to manage the technical environment. The infrastructure that was set up for the trial was impressive. The procedures that were followed involved:

- Invitation to Defense personnel to volunteer to be involved;
- Selection of a small number of local election officials (returning officers) to be involved in the project;
- Development of a customized computer application to handle the voting process;
- Sending to each voter a security PIN to enable them to log into the application using Public Key Infrastructure (PKI) technology;
- Providing an updated browser on CD ROM to each elector to ensure that the computer being used by the elector had the necessary security and technical environment;
- Providing local election officials with a security access PIN to enable them to retrieve votes for their election;
- Providing training to the local election officials.

The trial was a limited test of Internet voting due to the small number of voters involved (250), and the environment being very strictly controlled. The need to send out PIN numbers to voters as well as an up-dated browser on a CD-ROM, whilst understandable, would limit the scalability of the system to the wider community.

The most challenging issue that the project team faced was dealing with security. It was essential that the system had sufficient safeguards built in to ensure that the voters on the other end of the computer were in fact the voters they claimed to be. The issuing of PINs was considered to be a way of providing this level of security. Notwithstanding the small scale of the project, there were some cases of people losing their PIN or people attempting to vote using their partner's PIN. All of these instances point to the fact that there would be considerable difficulties in implementing this solution in a wider environment.

The need to send each elector a CD ROM to up-date his or her browser would pose a considerable challenge to scale the system to a wider environment.

It had previously been determined that the application would not electronically tally the votes. The project team considered that this was too big a step to introduce in the first trial. The application provided for the local election official to print out the electors' ballots for the purpose of counting. Security arrangements were built into the application that removed the identity of the elector from their vote at the time of printing.

Based on the application and procedures observed in the trial of Internet voting, it was not scaleable into a system that could have wide use in the community.

The project team will conduct an extensive debriefing following the US elections and will publish its findings to assist in developing a future direction for the concept. Members of the Australian delegation attending the US elections will review these findings when they are available.

Other US Internet voting systems

1. Mock poll for the presidential election conducted by VoteHere.net

VoteHere.net is a private company established in 1996 in Washington, USA, as a provider of Internet voting (www.VoteHere.net).

At the US Presidential elections, VoteHere.net conducted a mock poll which they termed a "shadow trial" of internet voting at selected polling places. The purpose of the shadow trial was introduce the concept of internet voting to electors. Computer terminals were set up at selected polling places and once electors had voted in the traditional way, they were invited to experience what voting may be like using a computer and the internet. There was no live internet voting in the trial as it was only designed to test electors reaction to the concept. It should be noted that the shadow trail did not test any of the security issues associated with internet voting. As mentioned, it was aimed to test elector reaction. The shadow trail attracted much media attention especially in Sacramento California where the Secretary of State was a supported of the initiative. Based on limited elector fed back the "shadow trial" of internet voting was well received by electors.

VoteHere.net has run Internet-based elections both in the US and UK. The most recent UK experience was the MSF (union) ballot of 250,000 members as a partner to the Electoral Reform Ballot Services (known as the Electoral Reform Society). This election was conducted using paper, telephone and Internet voting. VoteHere.net ran the Internet voting component and approximately 10,000 voters used this medium to cast their vote with no significant issues arising.

VoteHere.net believes that risk still exists for tampering to occur inside the PC if that environment is not refreshed and controlled in some way. For that reason they believe that the time for allowing voting by Internet from a person's private PC in their home is still some time off. Hacking into the voter's home PC and altering the voter's intent before the encryption module is enacted is where they believe the weakness lies with remote Internet voting. In the polling place, however, they have tied down the specification of each PC and have no floppy disks, no keyboard and a browser which runs in 'kiosk' mode with the voter only being able to access a limited number of screens and only by using a mouse or touch screen. The PCs are connected to a server containing the voter lists via secure (SSL) lines using a 'store and forward' system that prevents flooding and loss of data when communication lines fail. They use a Cisco firewall and have 7x24hr monitoring by a third party company not linked to VoteHere.net.

VoteHere.net believes that there is a dilemma with tying down a voter's personal PC so as to make it secure. Sending the voter a CD to overwrite or limit the functions of his/her PC whilst voting (as is the model of the Federal Voting Assistance Program of the US Department of Defense) would be a disincentive to use the Internet because of the inconvenience factor to the voter. Internet voting should be limited initially to voting in the polling place, where the environment is controlled. Although this keeps security to a high level, it does not improve the convenience factor for the voter. It would also be very expensive to install on a national basis.

As for auditability, VoteHere.net asserts that their system cannot lose a vote because every transaction that is sent to its server is burnt onto a CD so that if there is a hardware problem at any time, there is a hard electronic copy available as a backup. They also use a randomising algorithm to mix up the ballots so that they are not stored on the server in chronological sequence (which would possibly enable tracing back to a voter).

2. Election.com

Election.com was founded in 1999 and has offices in the US, UK, Australia, NZ and France (see www.election.com). They ran the Arizona primary election (see comment earlier in this report). This was their first real election situation to use Internet voting in the US.

Election.com used Public Key Infrastructure (PKI) technology for the identification of the voter with Verisign undertaking the process of certification. The voter had to download the certification application form from the Internet and then complete, sign and mail it to election.com. A private key PIN number was then mailed out to the voter. They were responsible for the complete election process from certification of the voter, through the voting period and the scrutiny system.

Election.com also managed the recent Internet election for the board of directors of ICANN (Internet Cooperation for Signed Names and Numbers), with members worldwide participating via the Internet only. It was a preferential voting system and was very successful in terms of voter acceptance and security. Multiple voting was attempted and detected, but did not occur due to the success of security arrangements.

In January 2001, election.com were awarded a contract to run the Australian NRMA Board of Directors' election using Internet technology. The NRMA has two million members.

Election.com contends that the current paper-based voting process is too complex, costly and slow and that security features with their system have proved to be secure and reliable. There is increasing citizen pressure for the use of Internet transactions in Government, with 118 million Internet users in the US (as at December 1999). There is a growing percentage of expatriate US citizens who would benefit from this system as well.

Election.com stresses that the level of security can be modified to fit with the amount of risk the client is prepared to accept. Validation rules can be changed and the Pin Number is only one of three pieces of ID required to log on to the Election.Com site to vote.

Election.com offers a full audit of the source code for their system if they are employed to undertake any election work for an Australian government. Election.com would like to participate in identifying a standard set of protocols for Internet voting in Australia.

3. Safevote.com

Safevote.com is a private company established in California, USA, to make Internet voting possible (see www.safevote.com).

Safevote trialled Internet voting in Contra Costa County, California, in the lead up to the presidential election in November 2000. Pre-poll voters first cast their normal legally binding vote at the county election office and were then offered the opportunity to cast a mock Internet vote at the same location. Safevote advertised for hackers to try and break the security on the system but none was successful. Their system required the elector to enter their date of birth as a password. A digital vote certificate (PIN) was then issued (calculated using Date of birth and the type of ballot being requested). Keyboards were not used. A mouse was used by the voter to vote for candidates. Touch screens will be used in future elections. An important security feature of Safevote's process is the use of a constantly changing IP number that connects the system to the Internet. This protects the system from flooding and makes hacking very difficult, if not impossible. There is a voter verification system, which checks the PIN against the database and enables the voter to confirm that their vote has, in fact, been submitted for tallying. The votes are stored on a totally separate system to prevent any link with the identity of the voters (this was a normal practice amongst all systems we observed).

Possible options for electronic voting and vote counting in Australia

Electronic voting

There would appear to be a number of options for introducing electronic voting in Australia's election environment.

1. Voting at polling places using computer equipment

This would involve electors casting their vote using computer equipment located at polling places. A computer application would be developed that would enable the voter to cast his/her vote. At the end of voting the computer would tabulate the results and these would be forwarded via modem to a central location for collation. The computer application could be quite simple to develop and would be user friendly.

There are a number of possible technical options for the system's operation, but it could be that electors have their name marked off a roll in much the same way as at present and are given a swipe card by the polling official to activate the computer application. The system would most likely consist of a server and a number of workstations in the polling place.

Advantages

- There would be a minimum change in the voting culture as electors would still attend a polling place on election day (or a pre-poll voting location pre election day).
- The level of informal voting could be minimised as the application could be designed to warn an elector if their vote was going to be informal.
- The system would provide for instantaneous calculation of results at the close of voting and there would be accurate scrutiny of the ballots.
- There would be no need for the time consuming process of the post-election distribution of preferences, as the computer application would perform this task.
- There would be less human intervention in the counting process and thus minimise the risk of errors.
- Any voter could vote at any polling place in the nation.
- If combined with an automated copy of the State/Territory roll in the polling place, any need for declarations to be made by absent voters would be eliminated.
- Similarly, if an automated roll were used for pre-poll voting, it would eliminate the need for declarations to be completed by electors.

Disadvantages

- The cost of the computer hardware necessary to fit out polling places would be considerable. Based on one computer server for each polling place and one workstation for each issuing table, the cost is estimated to be \$3,000 for a server and \$2,000 per workstation (i.e. issuing table). Also it would be necessary to have back up hardware in case of failure. This would be an additional cost of \$20,000 per electorate.

- There would need to be a service contract for support to computer equipment at polling places on election day. This cost would be significant, and perhaps prohibitive on a national basis. Political, cultural and social acceptance by electors and other stakeholders would need to be considered.
- There would be no paper trail of the ballots. This may raise unacceptable risks especially if the system was being introduced on a broad scale.

2. Touch screens

This option would involve electors casting their vote using touch screen computers located at polling places. A computer application would be developed that would enable the voter to cast their vote by selecting candidates in the order of preference. For example, the first candidate name touched would be their first preference, the second candidate name touched would be their second preference, and so forth.

The system would involve electors being marked off the roll in much the same way as at present, at which time a swipe card is given to the elector to identify the election(s) for which the elector is entitled to vote. It would also be possible for the elector to insert the swipe card into the touch screen computer, and to nominate any non-English language they would prefer to use from a pre-determined list. The system would identify the electorate in which the voter resided from the swipe card, and the touch screen would then display the appropriate ballot papers.

The elector at any time could go between ballots to review the way in which they have indicated they would like to vote. The elector could then be shown the ballots a final time for checking before being asked to cast the vote. The computer would then deactivate the swipe card, preventing the card from being used again.

At the end of voting the computer would tabulate the results, and the results would then be forwarded via modem and/or disk to a central location for collation. The computer application could be quite simple to develop and would be user friendly. The touch screen computers could be networked or standalone.

Advantages

The advantages of this type of voting are the same as introducing computers in polling places, with the addition of:

- Electors are able to select from a pre-determined list, their language of preference, not disenfranchising non-English speaking voters.
- No cost involved in printing ballot papers and rolls.
- Sight impaired electors would be able to vote personally using a keypad and earpiece. Positive comments were received from disabled voters using similar systems in the US who claimed it was the first time they had actually cast their own vote.

Disadvantages

- The cost of the computer hardware necessary to fit out polling places would be considerable. Based on one touch screen computer for each issuing table at a cost of \$7,000 per computer, the cost, on a national basis, would be prohibitive. Even for small jurisdictions, the costs would be significant. There would also need to be a service contract for support to computer equipment at polling places on election day. Political, cultural and social acceptance by electors and other stakeholders would need to be considered.
- There would be no paper trail of the ballots. This may raise unacceptable risks especially if the system was being introduced on a broad scale.

3. Voting using the internet

Another option would be to allow voters to cast their vote over the Internet.

Internet voting could fully replace attendance voting. Electors would vote over the Internet either from home or from the workplace, from community locations such as libraries or from locations established by the electoral authority.

From the outset it is clear that this radical approach would be unacceptable in the Australian electoral environment. There is no evidence that stakeholders or the public would support this approach. There seems little point in canvassing all of the issues regarding this option.

A preferable option would be for voters who cannot vote at a polling place on election day to have option to vote over the Internet as an alternative to voting by post or in person beforehand. It may be that electors would be required to register as Internet voters in order that the electoral authority could be satisfied that the elector had sufficiently established a voter's identity before accepting the registration.

Advantages

- It would provide easy access to voting for those electors who live in remote locations and who have some difficulty getting to a polling place (i.e. disabled voters).
- It would provide a service to electors to vote from home or at work during a time convenient to the elector.
- The application could be designed to minimise informal voting.
- The results would be electronically calculated and combined with the paper ballots cast on election day.
- There would in time be a reduction in the number of polling places required and a reduction in polling place staff.

*Disadvantages**Security*

The security of the Internet as a vehicle for critical transactions such as voting in government elections is still a big issue that has not been satisfactorily resolved at this time. In January 2000, California's Internet Voting Task

Force concluded that the “technological threats to the security, integrity and secrecy of Internet ballots are significant”.¹

Widespread Internet voting assumes a secure infrastructure of voter terminals that simply does not exist. The average computer user is relatively untrained in defence procedures regarding viruses.

The US Defense Department identified security as an issue for their trial of Internet voting. As mentioned earlier in this report, they went to considerable lengths to ensure security by sending voters a log in PIN and a CD ROM to update their browser. We have already identified that this would not be a scaleable approach. The issue of Public Key Cryptography (PKI) has yet to mature as a reliable means of providing a level of security necessary to allow electors to vote using the Internet.

In summary, there are two aspects to the security issue that need to be addressed. The first is to ensure that the system is not exposed to attack that would interfere with the electors’ votes. The second is to provide a level of confidence as to the identification of the elector at the time of voting.

It may be that in time with the introduction of PKI and its wider use for critical transactions there will be an appropriate system in place to provide a level of confidence that the elector voting over the Internet is the person they purport to be. This would address one of the security issues mentioned above. It is not feasible for the electoral authorities to issue PKIs for the purpose of facilitating Internet voting.

From information available at this time it seems that there is insufficient maturity in the security of the Internet to accommodate widespread use for government elections.

Other disadvantages:

- Perceived lack of transparency in the voting process. Presently the paper balloting system provides considerable transparency in the entire process from electors voting through to counting votes and distribution of preferences. Internet voting may be seen as less transparent in a number of the key areas.
- Potential for coercion and intimidation when voting takes place outside the view of polling officials e.g. at home or in the workplace.
- Potential for electors to vote before candidates and parties have had sufficient time to present their policies.
- Potential for voters to have the secrecy of their vote violated by unscrupulous employers if electors vote from a work place computer.
- Some candidates may concentrate their campaign messages to the Internet voters at the expense of the attendance voters.

¹ “A report on the Feasibility of Internet Voting, January 2000” California Internet Voting Task Force. Available from California Secretary of State’s website www.ss.ca.gov.

Electronic vote counting

Scanning of ballot papers

This system is based on the elector marking the ballot by shading an oval shape beside the name of the candidate of their choice. The printed ballots are then read through an OMR reader at the same time that the ballot paper is deposited in a ballot box.

At the close of voting the results are extracted from the OMR reader and printed out for scrutineers to observe. The results are then transmitted via a modem to a central collation point in the State.

Advantages

- The level of informal voting could be minimised as the scanner would detect an informal ballot paper at the time of the voter placing the ballot paper in the ballot box, giving the voter the option of casting a formal vote.
- The system would provide for instantaneous calculation of results at the close of voting and there would be accurate scrutiny of the ballots.
- There would be no need for a distribution of preferences, as the computer application would perform this task.
- There would be less human intervention in the voting and scrutiny process and thus minimise the risk of errors.

Disadvantages

The main disadvantages to this system are:

- Based on one scanner per polling place at a cost of \$11,000 per scanner, the cost is estimated to be approximately \$17.6M for a Victorian State election and \$88M for a Federal election.
- There would also need to be a service contract for support to computer equipment at polling places on election day. This cost would be approximately \$250,000 for Victoria and approximately \$2M for a national contract.
- Political, cultural and social acceptance by electors and other stakeholders would need to be considered.

Possible next steps

Technology can be used to assist electors participate in the democratic process. Technology can also be used to speed up the counting of votes. The real question to be answered is how can technology safely enhance the present voting system in Australia?

Electronic voting

There has been little work in Australian electoral jurisdictions in the area of technology to assist in the voting process. There has been a considerable amount of work in this area in the USA i.e. touch screens and Internet voting. It is evident from the US experience that technology is now refined to a point where Australian electoral authorities can more confidently look to technology to assist electors in the voting process. With cautious research and development there is room to safely make use of technologies to assist in the voting process. This transition is most likely to be accepted gradually, with electronic voting options being introduced to voters in special circumstances.

Internet voting

There are a number of existing scenarios where the risks of introducing Internet voting would be low, and Australian electoral authorities should give serious consideration to trialling one or more of these.

Internet voting for Antarctic electors

Internet voting could be an important additional option for electors in special circumstances. In some electoral jurisdictions, there is presently provision for electors in Antarctica to vote using electronic transmission of their vote. It would be possible to provide electors in Antarctica with a PIN to enable them to cast their vote in a secure environment using the Internet. Bearing in mind that the number of electors in the Antarctic is very small and the identity of each elector can be verified, the risk of fraud or impersonation could be reduced to a minimum.

Internet voting for overseas postal voters who apply in advance

Other electors who could possibly vote using the Internet would be those who are traveling overseas and who, before departure, applied to register as an Internet voter. Such electors could be registered as Internet voters and provided with a PIN and any necessary security to update the Internet browser to enable them to access the voting system over the Internet.

Touch screen voting in pre-polls as a service for non-English speaking voters and sight impaired voters

Touch screens could be provided at pre-determined locations, i.e. Returning Officers' offices, to assist electors voting as a pre-poll voter. The touch screens would be of particular benefit to elderly electors, sight impaired electors and non-English speaking electors. Similar systems have been used in the USA for some years, with considerable positive feed back from electors. The system would have the advantage of making it more difficult for people to cast an informal vote.

The touch screen voting system would produce daily reports of the number of voters who used the system and at the close of voting would produce a reconciliation report on the number of electors who voted and the ballots cast. The system would save considerable time in counting pre-poll votes after the close of the poll.

There would be minimum risk associated with the use of this system, as it would be operating in the secure environment of the Returning Officer's office. The basic technology already exists to support this system and has also been successfully implemented in the USA.

Overseas postal voting on a computer in an Australian embassy

Overseas electors could vote at an Australian embassy on a computer linked to the Internet.

It may be feasible to provide a secure computer environment at an Australian embassy particularly if all States and the Commonwealth agreed to fund the computer hardware. It would be necessary to develop protocols and procedures with the Department of Foreign Affairs and Trade to ensure the success of the project.

Electors would be able to access the electoral roll electronically to check their enrolment and be marked as an overseas Internet voter. The computer application would bring up the candidates and enable the elector to vote. The elector's vote would then be sent via the Internet to a secure computer server in the appropriate electoral commission. Procedures would need to be developed to retrieve the elector's vote which preserved so far as practicable the secrecy of the ballot.

This service could be implemented with minimal risk as the environment would be relatively secure and the elector would be voting in the presence of a trained staff member from the Department of Foreign Affairs and Trade.

The advantage of overseas electors voting using the Internet to vote is that it would reduce the time taken for electoral authorities to receive those votes cast at embassies or posted by electors overseas.

The significant number of overseas postal voters warrants serious consideration of implementation. For example, there were some 65,000 overseas voters who voted at the 1998 Federal election, and 5,000 overseas voters who voted at the 1999 Victorian State election.

Trial of hardware (e-voting options) for commercial and community elections

A prototype of Internet voting could be developed that satisfies the issues identified elsewhere in this paper, for use in commercial and community elections. In this way the electoral authorities could trial Internet voting in a restricted environment.

It is possible that some commercial clients would appreciate using the Internet rather than postal ballots for voting. There would be less risk where there is a small number of electors and it could provide electoral authorities with the opportunity to work through solutions to the security issues, elector identification and voter secrecy.

Electronic counting of votes

Electronic voting enables the easy electronic counting of votes, and any of the initiatives in the above section would reduce the requirement for manual counting. However, there are opportunities for the electronic counting of votes that do not rely upon electronic voting.

Australian electoral authorities have been more active in the use of technology to assist in the counting of votes. Systems have been developed and used in Australian elections whereby data from ballot papers has been entered and the election results obtained by a computer application. There has been broad acceptance of this approach from the stakeholders, including political parties and candidates. The next step in refining and improving this process is to scan ballot papers to enter vote data into the computer application automatically.

Research use of Optical Character Recognition (OCR) technology

Based on information and prototypes of equipment demonstrated in the USA, it is possible that existing scanning technology could be further refined to enable hand-written numbers on paper ballots to be accurately read by a scanner.

There would be considerable efficiencies and improvements to the speed and accuracy of ballot counts if ballot papers could be read into a computer application.

A number of electoral authorities in Australia have already developed computer applications that provide for paper ballots to be keyed into computer applications for the calculation of results.

Scanning of the paper ballots would reduce the need for the time-consuming keying. The technology to achieve this already exists, but it needs to be refined and trialled to accommodate the level of accuracy required by electoral authorities.

Summary

Electronic voting has received significant recent media coverage, and, with the Internet becoming more pervasive, the topic will continue to receive much attention. It must be recognised that a lot of the hype being generated is by the vendors of electronic voting systems.

There are currently a range of issues associated with the introduction of electronic voting and vote counting. Each of these needs to be identified and strategies put in place to resolve them.

The possible starting points within Australia, recommended in this report, have significant business cases for providing alternative technical options to voters in order to strengthen the democratic process.

This paper does not suggest that Australian electoral authorities should at this stage embark on a program to fully replace the easily understood, publicly and politically accepted efficient, transparent paper ballot system that currently exists.

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