

ACT Legislative Assembly Election 2004

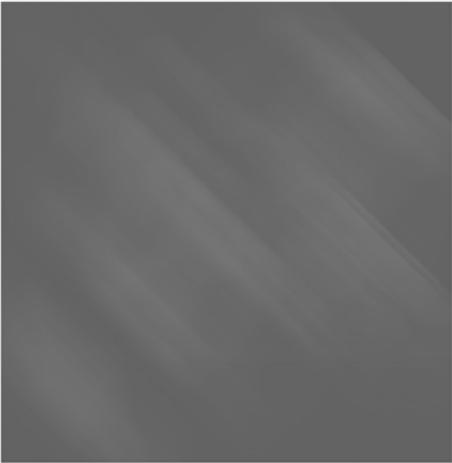


# Electronic Voting and Counting System | *Review*





ACT Legislative Assembly Election 2004



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ISBN 0 642 60349 9

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Produced by Publishing Services for the  
ACT Electoral Commission  
PO Box 272, Civic Square ACT 2608.

Email: [elections@act.gov.au](mailto:elections@act.gov.au)

Phone: 6205 0033

Publication No 05/0863

<http://www.elections.act.gov.au>

<http://www.act.gov.au>

Telephone: Canberra 13ACT1 or 132 281

Mr Jon Stanhope MLA  
Attorney-General  
ACT Legislative Assembly  
London Circuit  
CANBERRA ACT 2601

Dear Attorney-General

This report on the review of the 2004 ACT Legislative Assembly Election Electronic Voting and Counting System is presented to you under section 10A of the *Electoral Act 1992*.

Subsection 10A(2) of the Electoral Act requires you to cause a copy of this report to be laid before the Legislative Assembly within 6 days of receiving the report.

Yours sincerely



Graham Glenn  
Chairperson

27 June 2005



Phillip Green  
Electoral Commissioner

27 June 2005



Christabel Young  
Member

27 June 2005



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# ACT Legislative Assembly Election 2004 Electronic Voting and Counting System *Review*

## Executive Summary



The ACT's electronic voting and counting system, which was introduced for the 2001 ACT Legislative Assembly election, was successfully used again for the 2004 election in an improved form.

This review of electronic voting and counting system describes the enhancements made since 2001, discusses the use of the system in 2004, examines issues for consideration and makes recommendations for taking electronic voting and counting forward to the next election.

### *Electronic voting and counting*

Following the 2001 election several enhancements were made to the electronic voting and counting system, including changes to automate the set-up for the election so that all election details could be loaded into the eVACS<sup>® 1</sup> software by CD-ROM without the need for programmer intervention. The format of the barcodes was also altered to allow them to be more easily used and read.

In 2004 a total of 28,169 electronic votes were recorded at 4 pre-poll voting centres and at 8 polling places on polling day. This number of electronic votes represents a 70% increase on the 16,559 electronic votes cast at the 2001 election. The proportion of electronic votes in relation to all votes counted increased from 8.3% in 2001 to 13.4% in 2004. At each electronic polling place the number of voting machines was increased from 10 in 2001 to at least 15 in 2004 to ensure that those wishing to use computers to vote could do so with minimal queues.

For the first time in the ACT purpose built voting tablets were trialled. Their use showed that it is possible to provide a highly portable and robust alternative to the PC model of voting machines.

Enhancements to the electronic voting and counting system ensured robust security and ease of use for electors.

The electronic voting system once again:

- Eliminated the need for manual counting of electronic votes, thereby removing the possibility of counting error and speeding the transmission of results;
- Was reliable and secure;

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<sup>1</sup> eVACS<sup>®</sup> which stands for electronic voting and counting system, is the registered software developed by Software Improvements Pty Ltd.

- Significantly reduced the number of unintentional voter errors and contributed to an overall drop in the proportion of informal voters at the election;
- Allowed blind and sight-impaired people to vote without assistance and in secret through use of headphones and recorded voice instructions; and
- Provided on-screen voting instructions in 12 different languages.

As in 2001, at the 2004 election the electronic counting system had significant benefits. Preferences shown on paper ballots were data-entered by two independent operators, electronically checked for errors, and manually corrected if needed. This data was then combined with the results of the electronic voting, and a computer program was used to distribute preferences under the ACT's Hare-Clark electoral system.

The electronic counting system once again proved accurate and reliable.

The electronic voting and counting system at the 2004 election was delivered in a cost-effective manner, using hardware purchased from external suppliers, ACT Government in-house resources for supply of technical support, and external contractors for software development.

While there were some concerns publicly raised about the need for a paper audit trail of electronic votes the Commission is satisfied that the use of open source software, the independent audit of the software code, and the security built into the system, including its physical security, ensured that the system was transparent and reliable. Therefore the Commission believes that these concerns were unfounded.

#### *Electronic voting and counting for future elections*

In the light of the 2004 election experience, the Commission considers that electronic voting should be provided again to ACT electors in 2008.

The Commission is also satisfied that data entry of preferences shown on paper ballots and electronic counting should continue to be standard practice at ACT elections. The Commission is investigating the feasibility of scanning technology to determine if data capture by scanning ballot papers is a viable alternative to manual data entry.

The Commission is mindful that the deployment of the required hardware to polling places for a single day poses logistical challenges and is of questionable cost-effectiveness. By contrast, computer voting in pre-poll centres is an effective and efficient use of resources. With the cost of hardware reducing and the options for portable solutions expanding the Commission intends to investigate emerging cost-effective and portable technologies to deliver computer voting to more voters.

The Commission also intends to explore the possibility of using touchscreens for electronic voting, to simplify the voting process. The adoption of touchscreens will depend on the availability of suitable cost-effective hardware. Voting by keypad would be retained for sight-impaired voters.

Subject to the emergence of a more cost-effective hardware solution, the Commission is of the view that, due to the logistical issues of deployment, electronic voting should be provided only in pre-polling venues (which become polling places on polling day). With the ACT voting population increasing the Commission will give consideration to opening further pre-poll centres in locations such as Gungahlin and south Tuggeranong. Advertising of the availability of electronic voting at these pre-poll locations on polling day would be a priority to ensure that all those voters who wish to use electronic voting may do so.

The Commission remains of the view that it would not be appropriate to use the internet for voting for Legislative Assembly elections in the near future. Security concerns and the difficulty of providing electors with unique on-line identifiers are still seen as obstacles that have not yet been overcome. Therefore the Commission continues to hold the view that electronic voting should only be provided in a controlled environment at polling centres.

The Commission intends to further investigate options for providing hardware for electronic voting and for scanning of paper ballots before determining the details of the systems to be used in 2008 and seeking appropriate funding from the ACT Government.

#### *Recommendations*

The Commission recommends that:

- Electronic counting using the eVACS<sup>®</sup> computer system continue to be standard practice at ACT elections;
- Electronic voting using the eVACS<sup>®</sup> computer system be offered again at the 2008 election in pre-poll venues and the polling places the pre-poll venues become on polling day;
- The Commission explore advances in technology to determine:
  - ▶ If a low-cost portable alternative to using PCs and monitors for the delivery of computer voting to electors can be found;
  - ▶ If cost-effective touchscreen technology could be adopted for electronic voting; and
  - ▶ If a cost-effective scanning alternative to the data entry of ballot papers is available;
- Enhancements be made to the eVACS<sup>®</sup> system to ensure that:
  - ▶ The volume of the spoken word instructions can be varied to make them easier to hear in noisy environments;
  - ▶ The screen display of the ballot paper can be set with different fonts for the party names and the candidates for ease of reading by voters;
  - ▶ The data-entry error-correction process needed to correct entries where papers are missed or duplicated is simplified; and
  - ▶ The data-entry module is modified to require a second operator to validate changes made by supervisors, where a change is made to both original data entry records of a ballot; and
- That use of headphones be encouraged for voters who may have difficulty with written instructions.

## Development of the electronic voting and counting system since 2001



At the 2001 election, the electronic voting and counting system was used successfully for the first time. A report produced by the Commission following that election recommended the use of the system again in 2004 and presented some options for improving electronic voting and counting and for increasing the use of the system by electors.

The Government considered the Commission's report and decided that electronic voting should be provided in the same number of polling places as at the 2001 election. The Government also agreed that enhancements be made to the system to improve its security and ease of use.

A business case was submitted to Government by the Commission seeking resources to facilitate the enhancements to the electronic voting and counting system and to provide for computer voting at the 2004 election. These extra resources were granted in the 2003/2004 budget to fund enhancements to the electronic voting and counting system in 2003/2004 (\$70,000) and to provide electronic voting again in 2004/2005 (\$80,000).

The original software provider, Software Improvements Pty Ltd, was chosen to provide the enhancements to the eVACS<sup>®</sup> software, with work on these changes beginning late in 2003 and completed in October 2004.

Electronic voting and counting was used successfully at the 2004 election with both proving once again to be accurate and reliable.

### Consultation

During 2004, the Electoral Commissioner consulted with MLAs and party representatives on the enhancements to the electronic voting system. This consultation was achieved through the establishment of a Reference Group, consisting of representatives from parties, MLAs and special interest groups, including ACT Blind Citizens Australia and the Proportional Representation Society. The Reference Group was consulted on the enhancements, testing, audit and provision to voters of the electronic voting and counting system and provided feedback on it.

The Reference Group met on 27 April and 25 June 2004. Members were invited to observe a series of tests on the working electronic voting and counting system on 9 September. Comments made by the Reference Group were taken into account in the implementation of the enhancements to the electronic voting and counting system. In addition, the independent audit reports of the system were made available to members of the Reference Group.

### The Enhancements

Several enhancements were made to the system including changes to ensure that:

- the set-up of the system for the election was automatic;

- barcodes were more easily used and read;
- the voting computers could be more easily installed by adopting new cardboard voting screens;
- the cursor on the electronic ballot paper opened at the top of a party column randomly (rather than always starting in the top left-hand corner);
- data could be saved to CD-ROM;
- first preference results were available in polling places after the polls closed; and
- a variety of reports was available electronically from the system.

*The Automated Set-Up of eVACS<sup>®</sup>*

Enhancements to eVACS<sup>®</sup> automated the election set-up of eVACS<sup>®</sup> allowing for data to be exported from the Commission's existing information technology systems directly to eVACS<sup>®</sup>.

The automated set-up ensured that all electoral data required to provide electronic voting and counting (name, date, list of polling places, list of electorates, batch and barcode distribution lists, multilingual images, Robson rotations, party/candidate names, party/candidate image rendering details, party/candidate audio, fonts and electorates) could be loaded electronically into the eVACS<sup>®</sup> election server without the need for programmer intervention.

eVACS<sup>®</sup> was programmed to accept election data in a series of text, image and sound files from CD-ROM and to use that information to set up the instruction screens, the spoken word instructions, barcode information and ballot papers. This information was also used by eVACS<sup>®</sup> to set up reports and scrutiny sheets for the counting of votes.

Once the data transfer was complete and the Commission was satisfied with the format of the on-screen ballot papers, the eVACS<sup>®</sup> server produced the polling place set-up disks and barcode image printer's disks without the need for programmer intervention. These disks were kept secure by the Commission throughout the election.

The enhancement to automate the set-up of eVACS<sup>®</sup>:

- ensured that the setting of the ballot papers and sound files for the system was simplified;
- reduced the risk of errors occurring in the setting and proofing of ballot information;
- reduced the time taken and cost of the set-up;
- allowed for the early printing of barcodes for the system;
- allowed electronic voting to commence approximately three weeks before polling day compared to two weeks using a manual set-up in 2001; and

- enhanced the security of eVACS<sup>®</sup> by ensuring that Commission staff were able to load candidate and other details into the system without outside assistance and that the eVACS<sup>®</sup> program certified for the election was locked and could only be opened for changes using a password held only by the Commission.

#### *Barcode Changes*

Enhancements were completed in 2004 that ensured that the size and font of the barcode printed by eVACS<sup>®</sup> was compatible with the barcode readers used by the Commission. This change ensured that a voter was generally only required to swipe the barcode once to get a successful read and open their ballot paper or submit their vote. This change was popular with voters frustrated in 2001 by having to swipe the barcode several times to get a correct read and meant that votes could be cast more quickly.

#### *New cardboard voting screens*

Special cardboard inserts were developed by the manufacturer of the Commission's cardboard voting screens that allowed the voting computers to be easily installed in standard cardboard voting screens. This made deployment of the computers much easier than in 2001, and reduced the space needed for each voting computer.

In 2001, each voting computer was installed in two modified voting screens mounted side by side. The 2004 design fitted each computer into one standard screen, effectively halving the amount of space needed for each voting terminal.

#### *Randomising the cursor starting position*

Another enhancement to the electronic voting interface presented voters with a ballot screen with the cursor resting on a party name or column heading effectively chosen by the system at random. At the 2001 election the cursor was always initially positioned on the party name at the top left-hand column. In order to cast a preference for a candidate, a voter needed to use the up/down or previous group/next group keys to navigate to a preferred candidate's name.

The enhancement was made in response to concerns expressed by some Reference Group members that this left-hand cursor starting position could have unduly influenced voters to start voting at the left-hand column of candidates (column A). While research carried out by the Commission following the 2001 election did not indicate that the starting position of the cursor had demonstrably affected voting behaviour, the Commission felt this change was worthwhile to remove any possibility that the starting position influenced voting.

Table 1 shows the numbers of electronic votes cast for each party in the 3 electorates and in total. Comparable summary information for the 2001 election is shown in Table 2. Table 3 shows the number of paper ballot votes cast at the electronic voting polling places. Table 4 shows the number of paper ballot votes cast by all electors. Table 5 shows the total number of votes cast by all electors.

Comparison of the 2004 voting behaviour of those who cast electronic votes compared to those who cast paper ballots does not indicate any marked differences between them. While there are some minor differences between the voting patterns of electronic voters compared to paper voters – such as the ACT Greens receiving a higher proportion of electronic votes than paper votes (as was seen also in 2001) – these differences do not seem to indicate that there is any systemic bias in the electronic voting system.

As the Commission did not receive any complaints about the random starting position of the cursor, the Commission concludes that this change to eVACS<sup>®</sup> was worthwhile.

#### *Saving data to CD-ROM*

In line with changes to technology, particularly the storage of data, enhancements were made to eVACS<sup>®</sup> to allow for voting data to be copied to CD-ROM rather than to zip disks, as occurred in 2001. This allowed the data to be securely copied to write once only CD-ROMs at the end of polling each day in the pre-poll centres and in all electronic polling places on polling day.

Existing eVACS<sup>®</sup> security features to protect the voting data were maintained. That is, both a master and slave disk were created and a “hash” number recorded. Both the master and slave disks and the hash number were required to load the data into the counting server. More detail about this process is contained in the Commission’s report *The 2001 ACT Legislative Assembly Election: Electronic Voting and Counting System Review*.

#### *First preference results in electronic polling places on polling night*

After the close of polling at ordinary polling places at an ACT election, polling staff count the paper ballots to first preference, allocating them to the candidate indicated by the number 1 on each ballot paper, and transmit these results to the tally room. At the 2001 election eVACS<sup>®</sup> did not provide a facility to allow staff at electronic polling places to carry out a first preference count of electronic votes cast at their polling place.

Enhancements were made in 2004 to allow an electronic first preference count to be carried out on the polling place server. This feature was password protected to ensure that the count could only be carried out once passwords were provided to the Officer In Charge (OIC) of the polling place. Passwords were phoned through to the OICs just after 6pm on polling night. Scrutineers were able to watch the process of the extraction of these results.

#### *New eVACS<sup>®</sup> reports*

Further enhancements ensured that the scrutiny sheets produced by eVACS<sup>®</sup> could be exported electronically for publication on the internet and for use in other IT systems such as the election results system. Reports produced during the data-entry process were reformatted for ease of use by supervisors.

This change enabled the posting of complete scrutiny sheets on the Commission’s website on election night and on each day of data entry. This was a much more useful facility than that provided in 2001, which only included summary information.

## Testing and auditing of the system

The enhanced eVACS<sup>®</sup> software was extensively tested before the Commissioner was satisfied that it was suitable for use at the election.

Testing methods employed included:

- Conducting structured test cases in controlled situations (used to ensure individual modules perform as expected);
- Conducting Hare-Clark scrutinies in parallel, using eVACS<sup>®</sup> and manual counting of known sets of ballot papers, comparing the results obtained by eVACS<sup>®</sup> and the Commission's spreadsheet Hare-Clark program (used to ensure that eVACS<sup>®</sup> was correctly applying the Hare-Clark system, using a variety of test election outcomes to test specific cases);
- "Real user" testing, whereby large numbers of users cast electronic votes in a mock polling place and data-entry operators entered the results from paper ballots (used to test useability and to simulate realistic loads on the system);
- Load testing, where large quantities of ballot data were loaded into the counting system; and
- "Whole of life" testing, where the entire process was simulated, taking test electronic votes from a polling place, loading it into the counting server, adding data-entered results from paper ballots, and using the counting system to generate a Hare-Clark result.

This testing served to identify and solve problems with the software and hardware configuration and to demonstrate that eVACS<sup>®</sup> was accurately counting votes and distributing preferences under the Hare-Clark system.

The Commission contracted a software auditing firm, BMM International, to audit the software code of the system to ensure that the software did not contain code that would have the effect of altering the result of the election. For example, checks were undertaken to ensure that no code had been included that would change the votes recorded by electors or would insert or substitute fraudulent votes, or would in any other way alter the election outcome.

BMM International reviewed the source code for eVACS<sup>®</sup> and indicated that it did not find evidence of any:

- Code which could substitute a vote;
- Code which could delete a vote;
- Code which could enable fraudulent insertion of votes.

BMM also reviewed the Hare-Clark algorithm used to distribute preferences and indicated that the algorithm appeared to be correctly implemented in the source code. This was confirmed by the detailed functional testing conducted by the Commission.

## The electronic voting system in 2004



The electronic voting system is based on the use of standard personal computers as voting terminals, with voters using a barcode to authenticate their votes. A minimum of 15 voting terminals (an increase of 5 voting terminals compared to the 2001 election) were linked to a server in each polling location using a secure local area network. No votes were taken or transmitted over a public network like the internet. A total of 28,169 electronic votes were recorded. The increase in voting terminals worked to reduce the queuing time at all electronic polling places.

A detailed description of the eVACS<sup>®</sup> voting system is contained in *The 2001 ACT Legislative Assembly: Election Electronic Voting and Counting System Review* published by the Commission following the 2001 election.

### *Electronic voting at pre-poll voting centres*

Electronic voting commenced on the first day of pre-poll voting on the afternoon of Monday 27 September 2004 at Woden pre-poll centre. Electronic voting commenced on the following day, 28 September 2004, at Belconnen, Civic and Tuggeranong. It was used continuously at the 4 pre-poll voting centres over the remainder of the pre-poll period.

The 4 pre-poll voting locations were geographically dispersed across the ACT at the largest town centre in each of Brindabella and Ginninderra, and the two largest town centres in Molonglo.

Table 6 shows the number of ordinary votes issued on each day of polling at the pre-poll centres, and compares the number of electronic votes issued with the number of paper ballots issued.

Table 7 shows the number of ordinary votes issued at the pre-poll centres for each electorate and in total, and compares the number of electronic votes issued with the number of paper ballots issued. (Note that pre-poll votes issued at interstate electoral authorities are not included in this table. These votes are included in the total number of pre-poll votes shown in the 2004 *Election Statistics*.)

Table 8 shows the number of ordinary votes issued on polling day at each electronic voting polling place for each electorate and in total, and compares the number of electronic votes issued with the number of paper ballots issued.

Table 9 shows the total number of ordinary votes issued at all electronic voting polling places for each electorate and in total, and compares the number of electronic votes issued with the number of paper ballots issued.

These tables show that 68% of votes cast at the pre-poll centres were electronic. This figure compare favourably with the 2001 election where 52% of pre-poll votes were cast electronically.

The proportion of electronic votes cast at the pre-poll centres varied from place to place. Tuggeranong pre-poll centre issued the largest proportion of electronic votes, issuing 5,657 electronic votes, 78% of its total. At the other extreme, the City pre-poll centre issued 4,845 electronic votes, 59% of its total. Of the total pre-poll votes issued, 20,849 were electronic.

The variations in the proportion of electronic votes issued at each location are to some extent attributable to the demographics of the target voting population. The Tuggeranong pre-poll centre, where the proportion of electronic votes issued was highest, was also used as the testing site for the new voting tablet. While the electronic voting numbers were relatively low in the Civic pre-poll centre, they were considerably higher than the 2001 result. Only 38% of pre-poll votes in Civic in 2001 were electronic, compared to 59% in 2004.

For this election, more voting terminals were provided at all venues with 15 at Woden, Tuggeranong and Belconnen and 20 at Civic. This was aimed at ensuring that a terminal was always free for use even at peak times. At future elections, it is expected that greater knowledge of the computer voting option by voters would lead to an increase in the proportion of electronic votes issued.

There were no major “down times” at any of the pre-poll locations. Due to unexpected demand Tuggeranong pre-poll ran out of barcodes for use on the system on the last Friday afternoon of pre-polling and issued paper ballots for the rest of the day.

Use of electronic voting at the pre-poll centres significantly reduced the scrutiny workload with regard to counting the votes cast at the pre-poll centres after the polls closed.

#### *Entech Voting Tablets*

After the successful use of eVACS<sup>®</sup> at the 2001 election, a South Australian company, the Entech Group, developed, on its own initiative, a portable voting “tablet” as an alternative form of hardware on which eVACS<sup>®</sup> could operate. Prototypes of the new tablets were offered to the Commission in sufficient quantity to be used as voting clients at a single polling place in 2004.

The voting tablet used standard PC electronics, contained in a shockproof, waterproof, dustproof, tamperproof, solid-state casing with no internal moving parts. The tablets used removable flash memory cards rather than the CD drives used in the other computer voting terminals. The casing also incorporated a computer screen on its top face. (A photo of the Entech voting tablet is shown on page 23.) This design meant that the tablet could sit on top of the Commission’s standard cardboard voting screens, with cables for power and data transfer connected through a hole cut in the cardboard screens underneath the tablets. The tablets used the standard barcode readers and voting keyboards. The screen on the tablets could be set up as a touchscreen; however, eVACS<sup>®</sup> was not programmed to make use of a touchscreen.

Entech agreed to provide 14 prototype voting tablets to the Commission for the election with three being retained by the Commission after the election. The Commission paid \$15,000 for the use of the tablets.

The Commission saw considerable value in trialling the tablets. The design appeared to have the potential of simplifying the deployment and operation of electronic voting while adding to the security of the system. After evaluating and testing the tablets, the Commission decided to use the tablets at the Tuggeranong pre-poll voting centre.

The Tuggeranong pre-polling centre presented some special challenges to the Commission as it was hired on the proviso that other hirers could use the premises in the evenings during the pre-poll period. No other suitable premises were available in the Tuggeranong area for pre-polling.

The voting tablets, which were very portable, allowed Commission staff to pack them up and lock them away each night in approximately ten minutes. It was essential that the computers be locked away when not directly in the control of the polling staff. This type of portability would not have been possible if standard PCs were used as computer voting terminals.

Voter reaction to the tablets was very positive and staff of the polling centre were impressed with the reliability and portability offered by the tablet. The tablets operated for the 3 week polling period without any hardware failures.

The Commission will watch with interest the development of the Entech voting tablet and other hardware of similar type in the next few years.

#### *Electronic voting at polling places on polling day*

The 4 pre-poll voting locations were also used as ordinary polling places on polling day, continuing to offer electronic votes. Another 4 locations were equipped with electronic voting facilities for election day. This additional electronic voting was provided at Ngunnawal, Melba, Richardson and Weston polling places.

As a result, on polling day, electronic voting was available at 2 locations in each of Brindabella and Ginninderra, and at 4 locations in Molonglo. Two of the Molonglo locations (Ngunnawal and Woden) were also close to the boundaries of adjoining electorates.

Set-up of polling at the 4 pre-poll locations for polling day was straightforward, as these locations had been successfully taking electronic votes for the previous 3 weeks, and most of the staff employed on polling day had worked at the pre-poll centres. New servers were installed by senior Commission officers at the pre-poll centres on the Friday night before polling day. These new servers were used on polling day, when the pre-poll centres became ordinary polling places. The new servers replaced the servers which had been used throughout pre-polling, which were retained with all their pre-poll voting data intact in case they were needed in the event of a challenge to the election.

Set-up of polling in the other 4 locations was more difficult, as access to these locations was not made available until the Friday afternoon or evening before polling day. The computers were installed on the Friday evening and software loaded ready for the start of polling at 8 am. A technical team was deployed to each of the locations to effect the set-up of the hardware and Commission officers were directly responsible for the loading of software onto the machines.

No difficulties were experienced at the electronic voting centres during polling day.

7,447 electronic votes were counted on polling day.

*Voter reaction to electronic voting*

Voter reaction to using electronic voting was very positive. In exit polling conducted for the Commission 86% of voters who used electronic voting found it easy to use (of a sample of around 54 voters). Of those same voters, 88% thought the system fast and efficient and 83% thought the system had clear instructions.

A small number of complaints were received (less than 10). Some of these were from voters who indicated that they had voted informally unintentionally. However, an informal vote could only be cast by pressing the “Finish” key without selecting candidates and then swiping the barcode a second time while the screen displayed a clear message to the effect that “if you swipe your barcode now your vote will be informal”. Voters who accidentally voted informally in these circumstances must have done so without regard to the instructions on the screen.

It may be that some people who have difficulty using the computer voting system cannot read and digest information quickly, and are loathe to ask for help. Making the spoken word instructions available to more voters by encouraging the use of the voting terminals with headphones may alleviate this problem. The Commission will consider this approach at the 2008 election.

The fast and efficient rating of 88% was a significant improvement on the same measure taken at the 2001 election. In 2001 only 70% rated the system as fast and efficient. This difference was most likely due to the changes made to the barcodes to ensure that they read successfully the first time they were swiped.

*Paper receipts of electronic votes*

During the 2004 election period there was some discussion about whether there was a need for eVACS<sup>®</sup> to provide a paper receipt of each electronic vote – sometimes referred to as a “voter verified paper trail”. This issue was raised at the Reference Group meetings by one representative and discussed in the media during and after the election.

The Electoral Commission published its views on this issue in a paper presented to the electronic voting and counting system Reference Group in May 2004. An extract from this paper is at Attachment A. The Commission concluded that providing paper receipts of electronic votes would not necessarily meet the needs of those calling for an auditable paper trail, and that providing printing facilities would add an unnecessary level of cost and complexity. The Commission noted that the extensive checks and balances built into the electronic voting and counting system already provided a substantial audit trail that should be sufficient to demonstrate that electronic votes were accurately recorded and counted.

All members of the Reference Group except one were persuaded by the Commission’s viewpoint and were satisfied that electronic voting and counting could proceed without a paper record of each vote.

*Elimination of Unintentional Voting Errors*

eVACS<sup>®</sup> is programmed to automatically number candidates consecutively as they are chosen by the voter. When the voter highlighted the first candidate he or she wished to vote for and pressed the select key, the preference number “1” would appear in that candidate’s square. As the voter highlighted other candidates and pressed the select key, further preferences appeared in sequence. Accordingly, this built-in feature of the system did not allow errors in sequential numbering.

In contrast, 2,296 voters (2,866 in 2001) who cast formal paper ballots made errors in numbering. These voters constituted 1.3% of all voters who cast formal paper ballots. A total of 981 voters (1,141 in 2001) missed a number in their preference sequence (eg, 1, 2, 4, 5) and 1,315 voters (1,725 in 2001) repeated a number in their preference sequence (eg 1, 2, 3, 3, 4, 5).

While it is not known whether these errors occurred accidentally or intentionally, this result indicates that a large number of voters failed to cast fully effective votes because of the error-prone nature of paper ballots. Extension of electronic voting to more voters would be expected to reduce the number of electors who inadvertently make numbering errors.

*Informal and discarded votes*

The proportion of informal votes cast by voters using the electronic voting system was less than those cast on paper ballots. A total of 320 electronic ballots were informal which is 1.1% of the votes cast that way compared to 2.9% informal paper ballots.

As indicated above, it is likely that almost all of the 320 electronic informal votes were deliberate, as these voters received a warning message that their vote would be informal if they proceeded to swipe their barcode a second time. By contrast, analysis of the informal paper ballots indicates that up to 33% of these votes may not have been deliberate, as the voters had attempted to vote using an invalid method, such as two or more first preferences, or ticks or crosses instead of numbers.

A further 209 electronic barcodes were issued to electors but were not recorded on the computer system. These are classified as discarded votes. There were reports that some of these barcodes were used by electors to attempt to vote but that the votes were not completed by swiping the barcode a second time and hence were unintentional discarded votes. It seems that other barcodes were either placed directly into a ballot box or removed from the polling place without an attempt to vote and hence were deliberately discarded votes.

Taken together informal and discarded votes amounted to 1.9% of the votes cast electronically, which is still significantly better than the 2.9 % informal paper ballots.

The numbers of discarded electronic votes are shown at the foot of Tables 1 and 6.

These figures indicate (as they did in 2001) that the use of electronic voting tends to reduce the proportion of voters who vote informally, and is more likely to lead to voters casting an effective vote. In particular, it is probable that at least some of the paper votes showing two or more figure “1”s or ticks or crosses were marked by voters who wanted to vote formally, but were unable to comply with the voting instructions. Extending electronic voting to more electors would be expected to reduce the number of electors who inadvertently voted informally in this way. This was no doubt a contributing factor in the reduction of the total informal vote from 4.0% in 2001 to 2.7% in 2004.

*Electronic voting facilities for people with disabilities*

Once again eVACS<sup>®</sup> incorporated an audio facility that enabled sight-impaired people to vote using recorded spoken instructions broadcast over headphones.

Every electronic polling place was equipped with a voting terminal that could be used by a person seated in the supplied chair or in a wheelchair. Each of these terminals had headphones and a large 21 inch monitor (compared to the 17 inch monitors normally used), which significantly enlarged the text for easier reading.

While it was not possible to accurately record the number of voters who used the audio assistance, feedback from those voters who commented on using it was mostly positive. Some comments were received about the volume level of the spoken word being too low and difficult to hear in a noisy polling place. This issue will be addressed for future elections.

*Electronic voting facilities for Australians from culturally and linguistically diverse backgrounds*

eVACS<sup>®</sup> once again provided on-screen voting instructions in 12 different languages.

At the “welcome screen” – the first screen displayed for voters on eVACS<sup>®</sup> – the voter was instructed in 12 languages to select a language using the [up arrow] and [down arrow] keys. The default language highlighted was English.

After a language was chosen, all on-screen images used that language (and, for languages other than English, also included English sub-titles).

As the system does not record which language screens are used by voters, it is not possible to calculate the number of voters who used a language other than English.

## Electronic counting in 2004



Electronic counting of all ballots occurred again for the 2004 election. Votes were “captured” electronically in 2 ways: recorded directly by electors through the electronic voting system, and recorded by data entry operators who entered electors’ preferences marked on paper ballots into a computer system.

A detailed description of the electronic counting process is contained in the Commission’s report *The 2001 ACT Legislative Assembly Election: Electronic Voting and Counting Systems Review*.

### *Transfer of electronic voting data*

The transfer of electronic ballots aimed once again to ensure that the same level of security was afforded electronic ballots as is given to paper ballots. In traditional paper elections, ballot papers are transferred from the polling place in a locked and sealed ballot box. To achieve the same security, electronic votes were copied to write-once-only CD-ROMs in the polling place.

At the conclusion of each day’s polling, the power was turned off the voting PCs after a software controlled shut down. Using an on-screen menu on the server, a copy of the voting database stored on the server was written to write-once-only CD-ROMs.

The screen on the server also displayed the number of votes stored in the database, and a program was run to produce a digital signature “hash” that was unique to the data stored on each CD-ROM. This hash was recorded and used to verify that the results had not been altered when the disk was read into the counting program.

At the close of polling at each location, two copies of each database were written to CD-ROM. One was the master copy, with one backup copy. Each copy consisted of two CD-ROMs, a master and a slave, both of which were required for loading into the counting server. The CD-ROMs were clearly labelled by the Officer In Charge (OIC) of the polling place with labels only available to the OIC.

The vote database was backed-up to CD-ROM at the close of polling on each day of pre-poll voting. However, each set of CD-ROMs contained the cumulation of all votes cast on all days, so that, on polling night, only the most recent CD-ROM set from each polling place was needed to be loaded into the counting system. The other CD-ROMs were retained for verification and disaster-recovery purposes (which in the event were not needed).

Once the CD-ROMs were written and labelled, the server was powered off and the server either locked away in a secure cabinet (if the location was a pre-poll centre and voting was to resume on another day) or, on election night, all servers were removed and returned to the Commission.

In the case of 2 polling place servers on election night, the CD-ROM burners did not work in the polling place as they had been connected incorrectly by the technicians who assembled the servers. In these cases, the OIC of the polling place recorded the number of first preference votes for each candidate from the server screen and phoned those results through to the Tally Room. The servers were then transported directly to the Tally Room by a Commission staff member, where the CD-ROM burners were correctly connected by technicians, in the presence of senior Commission officers. The results from those servers were then burned to CD-ROM by Commission staff in the Tally Room. These results tallied with the first preference results recorded in the polling places by the OICs.

*Counting on election night*

With the elimination of the need for manual counting of those votes cast electronically, a preference distribution of those votes cast electronically was possible on election night.

The data from electronic votes cast at pre-poll voting centres prior to election day was the first data loaded into the counting server located at the Tally Room for the election. The eVACS<sup>®</sup> program then calculated the interim results of 20,722 votes with results being available through the Commission's website by 6.10 pm on election night.

Later in the night a further 7,447 electronic votes cast on polling day were loaded into the server and another, updated, result was made available.

Before 10.00 pm on election night, interim preference distribution results from 27,849 formal electronic votes were available, representing 13.6% of all formal votes. The information generated from this interim preference distribution allowed commentators on election night to correctly predict that the Territory would have majority government for the first time.

Of the 17 candidates indicated as elected on election night using the 27,849 formal electronic votes, 16 of them were ultimately elected. Only one candidate indicated as elected on election night was not ultimately successful – Australian Labor Party candidate Andrew Barr was the last candidate indicated as elected in Molonglo on election night. After the full distribution of all preferences, the last position in Molonglo was taken by Liberal Party candidate Zed Seselja.

*Data entry of ballot papers*

Data entry of all the preferences contained on around 176,340 papers ballot began on the Monday following polling day. Two teams, each consisting of 30 data-entry operators, worked six hour shifts each day, with scrutineers (who represent candidates) in attendance. Each batch of ballot papers (with usually 50 ballot papers in a batch) was independently entered by two different operators.

Exception reports were produced by the computer program for a batch of ballot papers when the data entry of the two operators did not match, if the batch contained any informal ballot papers (including 2 or more figure “1”s), or when any ballot papers contained other errors made by the elector (such as a duplicated number or a missed number). Supervisors then looked at each of the batches identified, checked the keying against the original ballot paper and made appropriate corrections. A batch of ballot papers could not be committed to the count unless the same information had been entered twice for a ballot paper.

Scrutineers were also present during the data-entry process. Scrutineers were entitled to observe all data-entry, error-correction and verification operations.

In 2004, batches were entered from all polling places in alphabetical order. By contrast, the data entry in 2001 was less systematic. The more ordered approach in 2004 helped to keep scrutineers informed during the count and helped to reduce the volatility of the changes in the scrutiny sheets produced after each shift during the count.

The process of data-entering the preferences shown on paper ballots proceeded smoothly, with the main process of double-entering every handwritten preference completed by the second Tuesday after polling day. Final error-correction and verification of the data-entry results was completed by the second Wednesday after polling day, 27 October 2004 – when the final outcome was known. The formal declaration of the poll took place on Friday 29 October 2004.

*The accuracy of the data entry of ballot papers*

The double-entry method of data entry, combined with the computerised identification of apparent data-entry errors and voter numbering errors, and manual checking and confirmation of all such apparent errors, was intended to provide a very high level of accuracy.

This method ensured that the data-entry process was subjected to both an electronic check and a manual check by supervisors. After all apparent errors were corrected, the subsequent counting and distribution of preferences was done electronically. This process was much more accurate than hand sorting and counting of ballot papers, removing many potential sources of human error.

The only way in which a data-entry error could be undetected by this method would be if two data-entry operators made exactly the same mistake on the same ballot paper, *and* that the resulting list of preferences still constituted an unbroken series of numbers. As demonstrated in the 2001 report, the chance of this happening is estimated to be less than 1 in 71,800.

Another possible source of error can occur at the error-correction stage. As a single supervisor can correct instances where both of the original data entries were incorrect, the error-correction system does allow a single operator to change both records of a ballot without requiring separate validation. If a mistake was made by a supervisor at this stage, the mistake could go undetected. This possible source of error was brought to the Electoral Commissioner’s attention early in the count in 2004 by a scrutineer. Procedures were adopted to require all changes made by supervisors to both records of a ballot to be separately validated by a second supervisor. The Commission intends to require an enhancement to the eVACS<sup>®</sup> counting system to require a second validation to be mandatory, when eVACS<sup>®</sup> is used again in 2008.

The Commission also intends to require an enhancement to the eVACS<sup>®</sup> counting system to simplify the data-entry error-correction process needed to correct entries where papers are missed or duplicated in the initial data entry. While this process was not believed to have led to any errors in the count, it was a cause for delay as the process is currently overly complex.

*Using eVACS<sup>®</sup> to conduct the Hare-Clark distribution of preferences*

The computerised distribution of preferences conducted by the eVACS<sup>®</sup> software used the Hare-Clark method as set out in the Electoral Act. The accuracy of the computerised scrutiny system was extensively tested before it was used in production and proved accurate during each day of the election count.

*Interim preference distributions and release of results*

By using the eVACS<sup>®</sup> program to distribute preferences shown on electronic votes and data-entered paper ballots, it is possible in ACT Legislative Assembly elections to conduct interim distributions of preferences. Under a manual counting system, it is not practicable to commence the preference distribution process until the count and recheck of all first preferences shown on all ballot papers has been completed. In the ACT this count could not occur until after the receipt of the last postal votes on the Friday after polling day.

In both 2001 and 2004, the first interim distribution of preferences took place on election night, using electronic voting data only. These results were published on the Commission's website. As noted above, this initial distribution of preferences identified 16 of the 17 candidates who were ultimately elected.

During each day's data entry, an updated interim distribution of preferences was published.

The Commission took steps to advise the media, scrutineers and other observers that:

- interim distributions of preferences only took account of a subset of votes, and the results could only be taken as possible indicators of the final results (including the identification of candidates likely to be elected);
- As further votes were entered in the system, the results could change from time to time; and
- The final distribution of preferences, conducted after all ballots were entered in the system, could give a result different from any earlier interim distribution.

As described above, batches were entered from all polling places in alphabetical order in 2004. This helped to inform scrutineers during the count and to reduce the volatility of the changes in the scrutiny sheets produced after each day's data entry.

The Commission considers the release of these interim preference distributions useful in providing the media, parties and candidates, and through them the public, with information about the progress of the count. Communication with media outlets about the nature of the interim preference distribution prior to the election ensured the media were aware of the limitations of the interim preference data.

### *The role of scrutineers*

The introduction of computer voting and computer counting, to some extent, has changed the nature of scrutineering at the election. At most polling places the role of scrutineers did not change, but at the electronic polling places and at the data entry stage of counting, scrutineers were able to observe the new electronic processes.

In all polling places, scrutineers could be present during polling to ensure correct procedures were followed, and could be present at the count of paper ballots after the close of the poll. At the electronic polling places they could observe the writing of voting data to CD-ROM and the extraction of first preference results after the polls closed. At these polling places they could also witness the counting of the paper ballots.

While ballot papers were being data-entered scrutineers were able to witness that process, challenge any data entry and observe the correction of errors in batches of ballot papers. All informal ballots identified at polling places were inspected by the Commissioner personally and scrutineers were invited to be present during this process. As in the past, final adjudication on challenged ballots was made by the Commissioner or the Deputy Commissioner.

## **On election night**

### *Posting of results*

The Commission's in-house election night computer system (ENS) was used to publish election results in the Tally Room and on the internet after the polls closed on polling day. The election night system was a separate system to eVACS<sup>®</sup>. ENS was a new system built for the 2004 election.

The election night system provided election results in a number of different ways:

- Results were displayed in the Tally Room at the gymnasium at the Reid campus of Canberra Institute of Technology. As in 2001, results were displayed using an overhead projector directly from the computer system.
- Results were displayed on the Electoral Commission's internet site. These results were updated as the count progressed. This was the second time that ACT election results were displayed on the internet on election night.
- Results were fed by direct link to the Australian Broadcasting Corporation (ABC) election night computer system. This data was used by the ABC in its television coverage and on its ACT election website.
- End-of-night and final results were provided to the *Canberra Times* via e-mail.
- For the second time for an Australian election, interim preference distribution data was available from the votes cast electronically.

An ACT Government internet server was connected to the election night system so that results could be viewed on the Internet.

Votes cast on paper ballots were counted in the usual way in the polling places to first preferences and the results phoned through to the Tally Room. This data was entered into the election night system by data-entry operators in the Tally Room.

A stand alone eVACS<sup>®</sup> server for counting electronic votes was set up in the Tally Room. The electronic voting data from the pre-poll centres was ready to be counted on the Tally Room vote counting server as soon as the polls closed. The electronic voting data from the polling day polling places was loaded onto CD-ROMs and taken to the Tally Room after the polls closed and entered into the system later in the night.

Scrutiny sheets generated by this server were electronically loaded into the election night system for display on the Internet.

Some minor difficulties were experienced with the ACT Government computer network on election night. There was a delay of around one hour between 7pm and 8pm when results could not be loaded into the system. This problem did not affect access to the internet or the tally board to view results that had already been posted. Fortunately the network problem coincided with the time when most polling places were counting their ballot papers and few results were available for posting to the election night system. The networking issues were fixed by 8 pm and results posted successfully throughout the rest of polling night.

The use of computer voting at the election combined with the new election night computer system meant that for the first time at a parliamentary election in Australia, an interim preference distribution of approximately 10% of all votes cast was available by 6.10 pm on polling night. This increased to over 13% of all votes cast by the end of election night.

### **Cost of electronic voting & counting**

The Government agreed to the provision of an additional \$70,000 in the 2003/2004 year to make enhancements to the electronic voting and counting system and to the provision of \$80,000 for the election year to provide computer voting at the election. The Commission also found additional funds from within the Commission's normal budget using savings generated by various initiatives, particularly reducing the scrutiny costs through electronic voting and counting.

The cost of the enhancements in 2003/2004 was around \$72,000. The cost of the provision of computer voting at 8 polling places was around \$90,000. This included increased expenditure on augmenting the number of voting PCs available at each polling location from 10 to 15 or 20 and is reflected in the increased number of electronic votes recorded. A further amount of around \$17,000 from within the Commission's budget was spent on trialling the voting tablets and purchase of hardware that can be used at future elections.

## The way ahead – Options for future elections



In the light of the 2004 election experience, the Commission recommends that electronic voting, the data entry of preferences shown on paper ballots and electronic counting be used again at the 2008 election. The extremely high level of accuracy demonstrated at the 2001 and 2004 counts indicates that this process is far superior to manual sorting and counting of paper ballots. Changes in technology and the reduction in price for scanning services may make it economically viable to reconsider scanning ballot papers rather than the more exhaustive data entry process in the future. The Commission will investigate advances in this area of technology and the use that is made of it by other Electoral Commissions.

The benefits that accrue from electronic voting are significant, particularly the way in which electronic voting maximises the impact of each person's vote by ensuring that inadvertent numbering errors do not occur. There are also considerable benefits and savings obtained by recording electors' preferences directly on computer, thereby removing the need for data entry of paper ballots. The accessibility of electronic voting to blind and sight-impaired people is another valuable reason for continuing to provide electronic voting.

The challenge for electronic voting in the future continues to be the ability to make the facility available to more voters. The ideal situation would be to provide electronic voting as an option to all voters at all voting locations. However, achieving this at all 84 polling places around the ACT using current personal computer hardware would be logistically impractical and prohibitively expensive.

In 2004, the 4 polling places that were set up to take electronic votes on polling day only took 4,901 electronic votes. By contrast, the 4 pre-poll centres took 23,268 electronic votes during the pre-poll period and polling day. These figures indicate that the pre-poll centres give a much better return on investment than those polling places that are only set up for electronic voting on one day.

Without deployment of a very portable and cheap computer voting machine, the Commission considers that, for future elections, it may only be cost-effective to equip pre-poll centres with computer voting equipment, ensuring these centres are open on polling day and advertised widely as computer voting locations. One way of extending the opportunity to cast an electronic vote to as many voters as possible might be to extend the number of pre-poll voting locations to, for example, Gungahlin and south Tuggeranong.

The Commission will investigate advancements in the area of cheap and portable voting hardware over the next few years with a view to its use to extend the reach of computer voting in the ACT.

*Suggested improvements to the current system*

After using the eVACS<sup>®</sup> system for the 2004 election, there are four enhancements the Commission would like to make to the system for 2008. These enhancements should be achievable within the Commission's existing budget. These include ensuring that:

- The volume of the spoken word instructions can be varied;
- The automatic set-up of the on screen ballot paper is more flexible, allowing different font sizes to be used for party and candidate names;
- The data-entry error-correction process needed to correct entries where papers are missed or duplicated is simplified; and
- The data-entry module is modified to require a second operator to validate changes made by supervisors, where a change is made to both original data-entry records of a ballot.

In addition, with the aim of increasing the ease of use of the system and of reducing inadvertent informal votes, the Commission will review the on screen communication of the electronic voting system to see if improvements are possible within the limited space available on the computer screen.

The Commission will also investigate whether using touchscreens of electronic voting is feasible.

*Using the internet for voting not supported*

The Commission remains of the view that it would not be appropriate to use the internet for voting for Legislative Assembly elections in the near future. Security concerns and the difficulty of providing electors with unique on-line identifiers are still seen as obstacles that have not yet been overcome.

While there have been some Australian and overseas trials of internet voting for non-Parliamentary elections since the Commission last reported on this issue, these trials have not served to satisfy the Commission that its concerns are unjustified.

In March 2005 the Electoral Commissioner presented a paper on the ACT's electronic voting and counting system at the *E-Voting and Electronic Democracy: Present and the Future* conference held in Seoul, South Korea. Papers were also presented on internet voting trials in Austria, France, the Netherlands and Switzerland. The Electoral Commissioner concluded that the internet voting examples showcased at the conference did not include any models that would be suitable for adoption in Australia.

For example, some models included cumbersome methods of providing unique identifiers to voters – such as requiring voters to collect their identifiers from post offices after producing identity documents – while others were clearly insecure, such as sending identity numbers through the post. The internet screens used and the methods of voting used in some of the examples would also be unsuitable for the ACT's preferential voting system. For example, one system required voters to key in identity numbers for their preferred candidates.

Therefore the Commission continues to hold the view that electronic voting should only be provided in a controlled environment at polling centres.

## Acknowledgments



The use of computer voting and vote counting at the 2004 election was a success and would not have been so without the help of a great many people.

The Commission would like to thank the software developer, Software Improvements Pty Ltd, for their professionalism in once again delivering a system of excellent quality.

The Commission would also like to thank the company that designed and supplied the voting tablets, the Entech Group, for their innovative solution to the provision of electronic voting hardware.

The Commission would also like to thank InTACT for their advice and help in providing considerable support for the system.

Finally, the Commission wishes to thank the Commission staff who enthusiastically embraced the system and made it available to the public, the media for publicising the system and the electors of the ACT who have embraced the system and made computer voting and vote counting a success.



## Attachment A



Paper prepared by the ACT Electoral Commission for the electronic voting and counting system Reference Group, May 2004 (extract)

### Electronic Votes and Printed Receipts

The ACT Electoral Commission has given consideration to whether there is a need to provide printed receipts of electronic votes for its electronic voting and counting system.

Much of the discussion of electronic voting in the United States of America is currently addressing whether there is a need to produce a “voter-verifiable audit trail” of electronic votes. It is suggested that this would take the form of a printed receipt that could be read by the voter (but not kept or altered by the voter) and that could be used for a manual count to verify that the computer count was accurate.

Proponents of a voter-verifiable audit trail claim that printing paper receipts would:

- Reassure voters that their vote has been correctly recorded,
- Create a disincentive to the manipulation of the system by providing an external check on accuracy,
- Enable recovery from a serious system failure; and
- Guard against computer tampering.

(See [http://www.cev.ie/htm/report/part4\\_4.htm](http://www.cev.ie/htm/report/part4_4.htm) - Ireland’s Commission on Electronic Voting, and <http://www.blackboxvoting.com/> for relevant discussion.)

The ACT Electoral Commission is of the view that providing for paper receipts of electronic votes would add a layer of cost and complexity onto electronic voting without necessarily providing the expected benefits.

One of the concerns with the electronic voting systems used in the USA is the fact that the computer code used in their proprietary systems is kept secret by their vendors and not made available for public inspection or even inspection by courts in the event of a legal challenge to an election result. This, combined with a history of anomalous results, means that voters and other political participants have no way of being reassured that “what goes in is what comes out”. In this context, providing for an independently-verifiable paper audit trail is a reasonable proposition.

By contrast, the ACT's electronic voting and counting system has been designed to be transparent and verifiable by making each step of the voting and counting system verifiable by public examination of the computer code used in the system, combined with a high level of physical security and the use of data verification and encryption techniques. Another feature of the system is the comprehensive testing and independent audit of the software prior to the election. The enhancements currently being implemented to eVACS<sup>®</sup> will see the entire system run from a series of auditable CD-ROMs, which could be used by a court to verify that the election result was accurate and had not been tampered with.

The checks and balances built into the electronic voting and counting system are intended to ensure that electronic votes are accurately recorded and that they cannot be lost or altered in any undetectable way. In particular:

- All votes are cast in a public polling place over an isolated local network, staffed by independent electoral officials;
- Voters are given an opportunity to review their votes (in preference order) before committing their votes to the “electronic ballot box”;
- The computer program verifies that the vote recorded by the voter is correct by comparing the voter's keystrokes with the final record of the vote;
- Votes are stored in the polling place server on two identical hard disks to guard against hardware failure;
- The voter does not receive the message saying “your vote has been accepted” until after the vote has been successfully written to the two hard disks on the server – if the data is not successfully recorded the voter receives an error message that indicates the vote has not been recorded –this also guards against hardware failure;
- The software used in the polling place is loaded from CD-ROMs containing audited program code that is made available for public inspection;
- Polling place servers are physically locked away and constantly monitored by electoral officials;
- Voting data is written to write-once CD-ROMs at the end of each day's polling, with the data encrypted and identified by a “hash” number that is derived from the contents of the data – this data cannot be altered after the event without detection;
- The use of data encryption means that a greater level of security is applied to electronic votes than to paper ballots; and
- The number of electronic votes counted is compared to the number of electronic votes issued at each polling place to verify that the correct number of votes has been counted.

The ACT Electoral Commission does not consider that providing a paper receipt in addition to these measures would enhance the verifiability of the electronic voting and counting system.

Providing for a system of printing receipts that could be seen by, but not altered by, each voter in secret, would present several difficulties. For example:

- An additional item of hardware used at each voting station would add another thing that could malfunction. Printers could jam, run out of ink or run out of paper. If this happened, it might not be clear whether a vote had been successfully stored on the computer server. Printer failure would also mean that a manual count would not duplicate the computer count.
- Requiring use of a printer that displayed a printed receipt to a voter that could not be removed or tampered with by the voter would involve use of non-standard hardware. Such a system might increase the cost of the electronic voting and counting system to the point that it might not be feasible for use in the ACT.
- Producing a printed receipt might violate the principle of the secrecy of the ballot by making it possible to determine how a person voted.
- It is not clear how it could be made possible for a voter to challenge a paper receipt if it did not accord with their memory of their electronic vote – presumably a paper receipt would not be printed until after the vote had been written to the computer disk. It would be difficult to implement a system where the voter was able to review a paper receipt before submitting the vote to the computer. If this was done, the paper receipts would be difficult to recount as it would be necessary to determine for each receipt whether it had been committed to the computer or not.
- A printed receipt would not by itself be proof that a person’s vote had been recorded in the computer system as shown on the receipt. If a computer system was deliberately programmed to give fraudulent results, a receipt would not necessarily replicate the vote stored in the database. The only way to verify this would be to conduct a complete check count comparing the printed receipts with the electronic vote count for any given set of votes.
- Conducting a full or partial manual recount using printed paper receipts would be prone to the errors that currently beset hand counting of ballots. It is likely that a hand count of paper receipts would not be as accurate as a computer count.
- Some have argued that paper receipts should be counted by a scanner rather than by hand. Providing a separate scanning system for counting paper receipts would be an expensive add-on to the current eVACS<sup>®</sup> system. Such a system would need to be tested and audited before it could be used in production.

Taking all of these matters into account, the ACT Electoral Commission considers that paper receipts of electronic votes would not necessarily meet the needs identified above. A printed receipt would not necessarily be any guarantee that a voter could be assured that their vote was correctly recorded in the computer system. A manual recount of paper receipts would not be an efficient or effective means of recovering from a system failure. A printed receipt is also not necessarily going to be proof that a system had not been tampered with.

The ACT Electoral Commission considers that the other measures incorporated in the electronic voting and counting system will give more assurance to voters, candidates and other political participants that the votes recorded and counted are an accurate record of the voters’ intentions.

## Tables



**Table 1: Summary of first preference electronic votes by electorate/ACT total – 2004 election**

Party/Group	Brindabella		Ginninderra		Molonglo		ACT Total	
	Votes	%	Votes	%	Votes	%	Votes	%
ACTEP	24	0.3%	26	0.3%	68	0.6%	118	0.4%
ALP	3913	43.3%	3834	48.3%	4912	45.2%	12659	45.5%
CDP	242	2.7%	0	0.0%	0	0.0%	242	0.9%
CROSS	0	0.0%		0.0%	302	2.8%	302	1.1%
DEM	150	1.7%	406	5.1%	215	2.0%	771	2.8%
FRC	47	0.5%	80	1.0%	77	0.7%	204	0.7%
GREENS	752	8.3%	839	10.6%	1418	13.0%	3009	10.8%
HIRD	0	0.0%	167	2.1%	0	0.0%	167	0.6%
LDP	82	0.9%	149	1.9%	338	3.1%	569	2.0%
LP	3740	41.4%	2400	30.3%	3258	30.0%	9398	33.7%
Other	90	1.0%	31	0.4%	289	2.7%	410	1.5%
<b>Formal</b>	<b>9040</b>	<b>98.6%</b>	<b>7932</b>	<b>98.9%</b>	<b>10877</b>	<b>99.1%</b>	<b>27849</b>	<b>98.9%</b>
<b>Informal</b>	<b>130</b>	<b>1.4%</b>	<b>88</b>	<b>1.1%</b>	<b>102</b>	<b>0.9%</b>	<b>320</b>	<b>1.1%</b>
<b>Total</b>	<b>9170</b>		<b>8020</b>		<b>10979</b>		<b>28169</b>	
<b>Enrolment</b>	<b>65279</b>		<b>65271</b>		<b>95548</b>		<b>226098</b>	
<b>Total votes from all sources</b>	<b>61451</b>		<b>61063</b>		<b>87235</b>		<b>209749</b>	
<b>Evotes as % of total votes</b>	<b>14.9%</b>		<b>13.1%</b>		<b>12.6%</b>		<b>13.4%</b>	
<b>Discarded</b>	<b>67</b>	<b>0.7%</b>	<b>54</b>	<b>0.7%</b>	<b>88</b>	<b>0.8%</b>	<b>209</b>	<b>0.7%</b>
<b>Discarded + Informal</b>	<b>197</b>	<b>2.1%</b>	<b>142</b>	<b>1.8%</b>	<b>190</b>	<b>1.7%</b>	<b>529</b>	<b>1.9%</b>
<b>Total evotes including discarded</b>	<b>9237</b>		<b>8074</b>		<b>11067</b>		<b>28378</b>	

Note: "Discarded" means a ballot that was issued to an elector but not counted as a vote. An electronic vote barcode that was issued to an elector but not recorded on the computer system would be counted as discarded. Discarded paper ballots that were not placed in a ballot box are not included in this table.

**Table 2: Summary of electronic votes by electorate/ACT total – 2001 election**

Party/Group	Brindabella		Ginninderra		Molonglo		ACT Total	
	Votes	%	Votes	%	Votes	%	Votes	%
Formal	5132	99.2%	5009	99.5%	6324	99.5%	16465	99.4%
Informal	41	0.8%	23	0.5%	30	0.5%	94	0.6%
<b>Total</b>	<b>5173</b>		<b>5032</b>		<b>6354</b>		<b>16559</b>	
Enrolment	64020		63267		91328		218615	
Total votes from all sources	59216		58022		81483		198721	
Evotes as % of total votes	8.7%		8.7%		7.8%		8.3%	
Discarded	34	0.7%	35	0.7%	40	0.6%	109	0.7%
Discarded + Informal	75	1.4%	58	1.1%	70	1.1%	203	1.2%
Total evotes including discarded	5207		5067		6394		16668	

**Table 3: Summary of first preference paper votes counted at electronic voting polling places by electorate/ACT total – 2004 election**

Party/Group	Brindabella		Ginninderra		Molonglo		ACT Total	
	Votes	%	Votes	%	Votes	%	Votes	%
ACTEP	2	0.1%	10	0.2%	37	0.6%	49	0.4%
ALP	1226	44.0%	2057	47.2%	2775	44.7%	6058	45.4%
CDP	50	1.8%	0	0.0%	0	0.0%	50	0.4%
CROSS	0	0.0%	0	0.0%	151	2.4%	151	1.1%
DEM	34	1.2%	134	3.1%	79	1.3%	247	1.9%
FRC	14	0.5%	26	0.6%	36	0.6%	76	0.6%
GREENS	196	7.0%	303	7.0%	631	10.2%	1130	8.5%
HIRD	0	0.0%	149	3.4%	0	0.0%	149	1.1%
LDP	22	0.8%	49	1.1%	142	2.3%	213	1.6%
LP	1200	43.1%	1600	36.7%	2173	35.0%	4973	37.3%
Other	41	1.5%	29	0.7%	182	2.9%	252	1.9%
<b>Formal</b>	<b>2785</b>	<b>96.7%</b>	<b>4357</b>	<b>96.0%</b>	<b>6206</b>	<b>96.3%</b>	<b>13348</b>	<b>96.3%</b>
<b>Informal</b>	<b>96</b>	<b>3.3%</b>	<b>183</b>	<b>4.0%</b>	<b>239</b>	<b>3.7%</b>	<b>518</b>	<b>3.7%</b>
<b>Total</b>	<b>2881</b>		<b>4540</b>		<b>6445</b>		<b>13866</b>	

Note: this table does not include 80 paper votes that were amalgamated with other votes from polling places where fewer than 20 votes were cast for an electorate.

**Table 4: Summary of all first preference paper votes counted by electorate/ACT total – 2004 election**

Party/Group	Brindabella		Ginninderra		Molonglo		ACT Total	
	Votes	%	Votes	%	Votes	%	Votes	%
ACTEP	76	0.1%	171	0.3%	297	0.4%	544	0.3%
ALP	23424	46.2%	25948	50.4%	33604	45.3%	82976	47.1%
CDP	1128	2.2%	0	0.0%	0	0.0%	1128	0.6%
CROSS	0	0.0%	0	0.0%	2306	3.1%	2306	1.3%
DEM	774	1.5%	2037	4.0%	1013	1.4%	3824	2.2%
FRC	301	0.6%	371	0.7%	553	0.7%	1225	0.7%
GREENS	3584	7.1%	4046	7.9%	8358	11.3%	15988	9.1%
HIRD	0	0.0%	1204	2.3%	0	0.0%	1204	0.7%
LDP	360	0.7%	574	1.1%	1163	1.6%	2097	1.2%
LP	20390	40.2%	16869	32.8%	24426	32.9%	61685	35.0%
Other	692	1.4%	251	0.5%	2420	3.3%	3363	1.9%
<b>Formal</b>	<b>50729</b>	<b>97.0%</b>	<b>51471</b>	<b>97.0%</b>	<b>74140</b>	<b>97.2%</b>	<b>176340</b>	<b>97.1%</b>
<b>Informal</b>	<b>1552</b>	<b>3.0%</b>	<b>1572</b>	<b>3.0%</b>	<b>2116</b>	<b>2.8%</b>	<b>5240</b>	<b>2.9%</b>
<b>Total</b>	<b>52281</b>		<b>53043</b>		<b>76256</b>		<b>181580</b>	

**Table 5: Summary of all first preference votes counted by electorate/ACT total – 2004 election**

Party/Group	Brindabella		Ginninderra		Molonglo		ACT Total	
	Votes	%	Votes	%	Votes	%	Votes	%
ACTEP	100	0.2%	197	0.3%	365	0.4%	662	0.3%
ALP	27337	45.7%	29782	50.1%	38516	45.3%	95635	46.8%
CDP	1370	2.3%	0	0.0%	0	0.0%	1370	0.7%
CROSS	0	0.0%	0	0.0%	2608	3.1%	2608	1.3%
DEM	924	1.5%	2443	4.1%	1228	1.4%	4595	2.3%
FRC	348	0.6%	451	0.8%	630	0.7%	1429	0.7%
GREENS	4336	7.3%	4885	8.2%	9776	11.5%	18997	9.3%
HIRD	0	0.0%	1371	2.3%	0	0.0%	1371	0.7%
LDP	442	0.7%	723	1.2%	1501	1.8%	2666	1.3%
LP	24130	40.4%	19269	32.4%	27684	32.6%	71083	34.8%
Other	782	1.3%	282	0.5%	2709	3.2%	3773	1.8%
<b>Formal</b>	<b>59769</b>	<b>97.3%</b>	<b>59403</b>	<b>97.3%</b>	<b>85017</b>	<b>97.5%</b>	<b>204189</b>	<b>97.3%</b>
<b>Informal</b>	<b>1682</b>	<b>2.7%</b>	<b>1660</b>	<b>2.7%</b>	<b>2218</b>	<b>2.5%</b>	<b>5560</b>	<b>2.7%</b>
<b>Total</b>	<b>61451</b>	<b>94.1%</b>	<b>61063</b>	<b>93.6%</b>	<b>87235</b>	<b>91.3%</b>	<b>209749</b>	<b>92.8%</b>
<b>Enrolment</b>	<b>65279</b>		<b>65271</b>		<b>95548</b>		<b>226098</b>	

**Table 6: Electronic and paper ordinary votes issued at pre-poll voting centres by day – 2004 election**

Polling date	Belconnen				City				Tuggeranong				Woden				Total Pre-Poll Centres			
	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic
27/09/2004	0	254	254	0.0%	0	244	244	0.0%	0	196	196	0.0%	16	120	136	11.8%	16	814	830	1.9%
28/09/2004	177	72	249	71.1%	186	56	242	76.9%	85	80	165	51.5%	107	60	167	64.1%	555	268	823	67.4%
29/09/2004	205	23	228	89.9%	130	71	201	64.7%	147	30	177	83.1%	96	14	110	87.3%	578	138	716	80.7%
30/09/2004	200	46	246	81.3%	146	67	213	68.5%	176	25	201	87.6%	141	25	166	84.9%	663	163	826	80.3%
01/10/2004	215	43	258	83.3%	140	67	207	67.6%	232	11	243	95.5%	158	22	180	87.8%	745	143	888	83.9%
05/10/2004	353	170	523	67.5%	282	150	432	65.3%	362	109	471	76.9%	249	86	335	74.3%	1246	515	1761	70.8%
06/10/2004	456	170	626	72.8%	329	199	528	62.3%	391	66	457	85.6%	250	70	320	78.1%	1426	505	1931	73.8%
07/10/2004	502	203	705	71.2%	313	183	496	63.1%	377	60	437	86.3%	212	73	285	74.4%	1404	519	1923	73.0%
08/10/2004	600	240	840	71.4%	377	197	574	65.7%	486	70	556	87.4%	258	95	353	73.1%	1721	602	2323	74.1%
09/10/2004	678	255	933	72.7%	0	280	280	0.0%	575	41	616	93.3%	308	47	355	86.8%	1561	623	2184	71.5%
11/10/2004	318	181	499	63.7%	360	192	552	65.2%	344	2	346	99.4%	289	134	423	68.3%	1311	509	1820	72.0%
12/10/2004	327	234	561	58.3%	396	216	612	64.7%	418	10	428	97.7%	348	150	498	69.9%	1489	610	2099	70.9%
13/10/2004	424	309	733	57.8%	556	336	892	62.3%	521	52	573	90.9%	404	214	618	65.4%	1905	911	2816	67.6%
14/10/2004	626	349	975	64.2%	632	440	1072	59.0%	762	52	814	93.6%	537	187	724	74.2%	2557	1028	3585	71.3%
15/10/2004	1088	583	1671	65.1%	998	724	1722	58.0%	781	797	1578	49.5%	805	237	1042	77.3%	3672	2341	6013	61.1%
Total issued	6169	3132	9301	66.3%	4845	3422	8267	58.6%	5657	1601	7258	77.9%	4178	1534	5712	73.1%	20849	9689	30538	68.3%
Total votes counted	6134	3132	9266		4809	3418	8227		5624	1599	7223		4155	1534	5689		20722	9683	30405	
Discarded votes	35	0	35		36	4	40		33	2	35		23	0	23		127	6	133	

**Table 7: Electronic and paper ordinary votes issued at pre-poll voting centres by electorate – 2004 election**

Electorate	Belconnen (Pre-Poll)				City (Pre-Poll)				Tuggeranong (Pre-Poll)				Woden (Pre-Poll)				Total Pre-Poll			
	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic
Brindabella	170	40	210	81.0%	653	447	1100	59.4%	4968	1412	6380	77.9%	1156	365	1521	76.0%	6947	2264	9211	75.4%
Ginninderra	4693	2577	7270	64.6%	933	748	1681	55.5%	158	14	172	91.9%	271	50	321	84.4%	6055	3389	9444	64.1%
Molonglo	1271	515	1786	71.2%	3223	2223	5446	59.2%	498	173	671	74.2%	2728	1119	3847	70.9%	7720	4030	11750	65.7%
Total issued	6134	3132	9266	66.2%	4809	3418	8227	58.5%	5624	1599	7223	77.9%	4155	1534	5689	73.0%	20722	9683	30405	68.2%

**Table 8: Electronic and paper ordinary votes issued at electronic voting centres on polling day by electorate – 2004 election**

Electorate	Belconnen				City				Melba				Ngunnawal			
	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic
Brindabella	12	3	15	80.0%	49	24	73	67.1%	7	2	9	77.8%	13	11	24	54.2%
Ginninderra	488	125	613	79.6%	121	72	193	62.7%	1214	934	2148	56.5%	100	34	134	74.6%
Molonglo	48	12	60	80.0%	707	326	1033	68.4%	26	14	40	65.0%	1260	1017	2277	55.3%
Total issued	548	140	688	79.7%	877	422	1299	67.5%	1247	950	2197	56.8%	1373	1062	2435	56.4%

Electorate	Richardson				Tuggeranong				Weston				Woden				Total Polling Day			
	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic
Brindabella	1266	543	1809	70.0%	764	21	785	97.3%	46	29	75	61.3%	66	0	66	100.0%	2223	633	2856	77.8%
Ginninderra	5	3	8	62.5%	21	0	21	100.0%	12	10	22	54.5%	4	0	4	100.0%	1965	1178	3143	62.5%
Molonglo	29	8	37	78.4%	53	3	56	94.6%	923	1037	1960	47.1%	213	35	248	85.9%	3259	2452	5711	57.1%
Total issued	1300	554	1854	70.1%	838	24	862	97.2%	981	1076	2057	47.7%	283	35	318	89.0%	7447	4263	11710	63.6%

**Table 9: Electronic and paper ordinary votes issued at electronic voting centres in total by electorate – 2004 election**

Electorate	ACT Total			
	Electronic	Paper	Total	% Electronic
Brindabella	9170	2897	12067	76.0%
Ginninderra	8020	4567	12587	63.7%
Molonglo	10979	6482	17461	62.9%
Total issued	28169	13946	42115	66.9%