The 2001
ACT Legislative Assembly Election
Electronic Voting and
Counting System Review

Elections ACT

Australian Capital Territory

ISBN 0 642 60142 9

Produced by Publishing Services for the
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Publication No 02/1169

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Dear Attorney-General

This report on the review of the 2001 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	Phillip Green	Christabel Young
Chairperson	Electoral Commissioner	Member
19 June 2002	19 June 2002	19 June 2002

Table of Contents

Table of Contents (continued)

The 2001 ACT Legislative Assembly Election Electronic Voting and Counting System Review

Executive Summary

The October 2001 ACT Legislative Assembly election represented a major milestone in the conduct of elections in Australia with the first use of electronic voting at polling places for parliamentary elections. This election also saw the introduction of electronic counting of all ballots for the first time in the ACT.

This review of the conduct of electronic voting and vote counting at the 2001 election describes the processes undertaken in developing and introducing the Electronic Voting And Counting System (EVACS), examines issues for consideration, and makes recommendations for taking electronic voting and electronic vote counting forward to the next election, due to be held in October 2004.

How electronic voting and counting worked in 2001

The ACT Electoral Commission considers that the use of electronic voting and electronic vote counting was a success and a valuable improvement on democratic processes in the ACT. A total of 16,559 electronic votes were recorded at 4 pre-poll voting centres and at 8 polling places on polling day.

The electronic voting system:

- Eliminated the need for manual counting of electronic votes, thereby reducing the possibility of counting error and speeding the transmission of results;
- Was reliable and secure;
- Effectively eliminated unintentional voter errors;
- Reduced the number of informal votes;
- Allowed blind and sight-impaired people to vote entirely without assistance and in secret through use of headphones and recorded voice instructions; and
- Provided on-screen voting instructions in 12 different languages.

The electronic counting system also 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:

- Effectively eliminated errors such as incorrectly sorting or counting ballot papers;
- Increased the accuracy of the election count;
- Reduced the time needed to accurately count the votes and announce the election result; and

- Increased the amount of information available about errors made on paper ballots by electors.

The electronic voting and counting system was delivered on budget, using ACT Government in-house resources for supply of hardware and technical support, and external contractors for software development. However, implementation time was very short following passage of enabling legislation in December 2000, and electronic voting commenced one week later than anticipated – 2 weeks before polling day rather than 3 weeks before.

While the electronic voting and counting system experienced some problems, such as difficult to use barcode readers and minor delays in displaying results on and after election night, it was well received by voters. The Commission considers that these minor problems can be dealt with, and an improved system can be made available for the 2004 Legislative Assembly election.

While there were some concerns publicly raised about the accuracy of the electronic count, the Commission is satisfied that the built-in checks in the methodology used for the data entry system meant that the system was close to 100% accurate and that these concerns were unfounded. This view was confirmed by post-election verification checks.

Electronic voting and counting for future elections

In the light of the 2001 election experience, the Commission recommends that data entry of preferences shown on paper ballots and electronic counting be made standard practice at ACT elections. Use of data entry and electronic counting can be achieved within the Commission's existing election year budget regardless of whether computer voting is provided or not.

The Commission also recommends that electronic voting be provided to more electors in 2004. As the extra funding provided in 2001 for electronic voting was a "once off" supplement, additional funding may be needed to provide electronic voting at future elections, depending on which option is chosen.

The challenge for electronic voting in the future is 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, the cost of achieving this at all 81 polling places around the ACT would be very high and, logistically, deployment of computers at this number of polling places for a single day would be impractical and prohibitively expensive. Therefore electronic voting could not be offered to all electors under current polling arrangements.

The Commission identified 2 main alternatives for provision of electronic voting at the 2004 election:

- Working within existing polling arrangements, whereby most electors vote on polling day at their local polling place, and providing electronic voting at pre-poll centres and a small number of polling places. This would mean that most voters would continue to use paper ballots.

- Moving away from the traditional concept of "polling day" and replacing it with a "polling period" which could be from 1-3 weeks. By extending the right to vote throughout a polling period to all electors, electronic voting could be made available at (say) 12 locations strategically placed near main shopping centres and workplaces. Rather than concentrating voting on 1 day at local polling places, electors could vote over (say) a 3 week period at a regional voting centre. In this way, electronic voting could be made available to almost all electors.

Table 5 in this report gives more detail about a range of options within these 2 broad categories, including estimated numbers of electronic votes and expected costs and savings.

The Commission recognises that moving away from the concept of most electors voting on polling day to extending the polling period for all electors by up to 3 weeks would be a significant departure from current practice. In particular, it is recognised that political parties and candidates tend to design their election campaigns to "peak" just before polling day, so as to achieve maximum impact.

However, the Commission also notes that over 31,000 electors (or over 15% of all voters) voted in the 3 weeks before polling day by post or at a pre-poll centre in 2001. The significance of these early voters cannot be over emphasised, given that seats were won and lost in 2001 with margins of only around 50 votes. It could be argued that it would be in the best interests of parties and candidates to be treating the whole pre-poll period as a time to maximise their appeal to voters, rather than concentrating primarily on polling day. Given that such a large number of electors cast their votes before polling day, extending early voting to all electors might not be such a dramatic step.

Considerable cost off-sets would be achieved by reducing the number of polling places from 81 relatively small polling places used on polling day only to around 12 polling centres open for a 3 week period. As table 5 shows, these cost off-sets could be used to offer electronic voting to all electors without an unreasonable increase in the cost of elections, and may even be used to reduce the cost of elections. The inconvenience of closing local polling places would be offset by extending the time available for voting from 1 day to 3 weeks and placing polling facilities near where people shop and work.

Other benefits could be obtained by restricting polling to only 12 locations. One such benefit could be to use networked computers to replace printed certified lists when marking electors' names off rolls. While this system would not prevent multiple or fraudulent voting, it would reduce the opportunity for fraud significantly. The cost of providing and networking computers would be offset against the considerable cost of printing and scanning certified lists, which would no longer be needed.

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.

As all but 1 of the options identified for continuing to provide electronic voting require additional funding, and as the suggestion to replace polling day with a polling period requires legislative change, the Government and the Legislative Assembly must decide how they wish to progress the implementation of electronic voting in the ACT. It may be appropriate to refer this matter to an Assembly Committee to allow members of the public to be consulted and to have their say on the future of electronic voting in the ACT.

Recommendations

The Commission recommends that:

- Electronic counting using the EVACS computer system be made standard practice at ACT elections. Continued use of this system does not require legislative change or additional funding.
- Electronic voting using the EVACS computer system be continued at the 2004 election. Use of this system does not require legislative change but may require additional funding, depending on the implementation option chosen.
- The ACT Government and the ACT Legislative Assembly consider the options set out in this report for increasing the proportion of electronic votes cast, and decide to either:
  - ► Retain existing polling arrangements, whereby most electors vote on polling day at their local polling place, and provide funding to enable electronic voting at pre-poll centres and a small number of polling places; or
  - ► Amend the *Electoral Act 1992* to replace the traditional concept of "polling day" with a 3 week "polling period" when any elector may vote at a polling centre, and provide funding to enable electronic voting at 12 locations strategically placed near main shopping centres and workplaces.
- To assist with making the above decision, the ACT Legislative Assembly refer the issue of the future of electronic voting and counting to an Assembly Committee, so that a public inquiry can be held.
- Any relevant Government decisions be made in a timely fashion so as to allow sufficient time for the development, testing and implementation of any new electronic voting and counting software and procedures.
- The Commission make the following enhancements to EVACS and to related procedures:
  - ► Improving the performance of the barcode readers attached to the voting terminals;
  - ► Extending the range of statistics that can be published electronically during the count;
  - ► Improving the set-up process to automate the loading of election details, particularly candidate names and sound files;
  - ► Minimising the likelihood of down-time of computers used at polling places;
  - ► Enhance the useability of the error-control reports used in the data-entry process;

- Revising the election night system to improve internet access facilities and to extend the range of available data;
- Providing more comprehensive interim preference results to candidates and the media, and more clearly identifying close contests; and
- Providing enhanced training for scrutineers, particularly political party "managers" of scrutineers, on the operation of the electronic voting and counting system, especially the data-entry process.

Development of the electronic voting and counting system (EVACS)

The successful implementation of the electronic voting and counting system was the culmination of an extensive and complex project begun by the Commission after the 1998 Legislative Assembly election. At the 1998 election, the close result in the Molonglo electorate (when 2 candidates were 3 votes apart at the point where one of them had to be excluded) and the resultant recount (which saw the relative order of these candidates change due to mistakes made in the original manual count) led to calls for computerised voting and counting processes to increase the speed and accuracy of the ACT's Hare-Clark counting system.

In 1998-1999 the Commission examined the available options for computerising the voting and counting processes, and in October 1999 the Commission published a Request for Proposal, seeking proposals for using technology to improve the speed and accuracy of ACT election counts. Fifteen proposals were received.

After evaluating the proposals, the Commission decided that no one proposal provided a complete solution for electronic voting and vote counting that would meet all the Commission's needs. However, the proposals did clarify possible options for proceeding to some form of electronic voting and vote counting for the October 2001 election.

After further investigation the Commission concluded that electronic voting should be provided in a controlled environment at pre-poll voting centres and polling places. The Commission was not convinced that it would be appropriate to use the internet for voting for the 2001 election.

In December 1999 the Commission submitted a business case seeking in principle support from the ACT Government to proceed with an electronic voting/vote counting system. After securing Government agreement for the Commission's proposed model, legislation to amend the *Electoral Act 1992* was prepared and introduced in the Legislative Assembly on 18 October 2000.

The *Electoral (Amendment) Act 2000 (No 2)*, which amended the Electoral Act to allow for the use of electronic voting and computerised vote counting, was passed by the Legislative Assembly on 5 December 2000. The timeframe in which to deliver a complex system was therefore very tight.

Following passage of this Electoral (Amendment) Act the Commission published a Request for Tender for software for the electronic voting and vote counting system on 11 December 2000. Seven tenders were received. After a thorough tender evaluation process, the successful tenderer, Software Improvements Pty Ltd, was announced on 19 April 2001.

Development of the EVACS system commenced as soon as the contract had been signed in April 2001, with the product successfully used at the October 2001 election.

Consultation

In 2000, the Electoral Commissioner consulted with MLAs and party representatives on the design of the electronic voting system, particularly the voting interface.

After the software contract was let in 2001, the Commissioner established 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 development of EVACS and provided feedback on it.

The Reference Group met on 8 June, 6 September and 21 September. At its first meeting, the Reference Group was shown a demonstration of a prototype voting interface. At the later meetings the Reference Group reviewed the voting interface and the electronic counting/data entry systems. Comments made by the Reference Group were taken into account as much as possible in the implementation of EVACS.

Testing and auditing of the system

EVACS was extensively tested before the Commissioner was satisfied that it was suitable for use at the election.

In consultation with the Commission, Software Improvements prepared a series of documents that were used in the design and testing of the software, including software requirements specifications, detailed design specifications, acceptance test plans, and test cases and procedures specifications. These documents were based on appropriate industry standards, particularly IEEE Standards 829-1998 and 830-1998. The system software was then developed and tested in accordance with the documented requirements.

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 and manual counting of known sets of ballot papers, comparing the results obtained by EVACS and the Commission's Excel spreadsheet Hare-Clark program (used to ensure that EVACS 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 was simulated and 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 improvements in the software and hardware configuration and to demonstrate that EVACS was accurately counting votes and distributing preferences under the Hare-Clark system.

The Commission then 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 affect 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 certified that the code for EVACS:

- Appeared to neither gain nor lose votes;
- Appeared to faithfully implement the Hare-Clark algorithm for vote counting provided to BMM by the Commission; and
- Was written in a consistent, structured and maintainable style.

BMM International also checked the final version of the code containing the candidate information after the close of nominations that was used in the election, against the audited code, to ensure that any changes that had occurred in the interim would not affect the outcome of the election. This was confirmed by BMM International.

The electronic voting system

The electronic voting system used at the October 2001 election was the first of its kind to be used for a parliamentary election in Australia. The system was based on the use of standard personal computers as voting terminals, with voters using a barcode to authenticate their votes. Voting terminals 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 16,559 electronic votes were recorded.

A detailed description of the EVACS voting system is contained at Attachment A.

This section of the report deals with issues arising from the use of electronic voting.

Electronic voting at pre-poll voting centres

Electronic voting commenced on Monday 8 October 2001. It was used continuously at the 4 pre-poll voting centres over the remainder of the pre-poll period (every day between 9 October and 19 October, except for Sunday 14 October, when the pre-poll centres were closed).

The 4 pre-poll voting locations were geographically dispersed across the ACT at Belconnen, Canberra City, Tuggeranong and Woden. Electronic voting was therefore made available at the largest town centre in each of Brindabella and Ginninderra, and the two largest town centres in Molonglo.

The Commission had originally intended to commence electronic voting on Tuesday, 2 October 2001, on the first day of pre-polling. While the electronic voting software was finalised, tested and ready to use on 2 October, the electronic counting software to be used after the close of polls on election day was still undergoing final development and testing. This software was finalised later that week. Therefore the start of electronic voting was deferred until 8 October.

Electronic voting commenced on the afternoon of Monday 8 October at the Woden pre-poll centre, which took 15 electronic votes that day. Electronic voting commenced at the other 3 pre-poll centres on the next day, Tuesday, 9 October.

Table 1 shows the number of ordinary votes issued at the pre-poll centres, and compares the number of electronic votes issued with the number of paper ballots issued. The table shows that, during the period when electronic voting was available, 52.4% of votes cast at the pre-poll centres were electronic.

The proportion of electronic votes cast at the pre-poll centres varied from place to place. Woden pre-poll centre issued the largest proportion of electronic votes, issuing 3526 electronic votes from 9 October, 76.8% of its total. At the other extreme, the City pre-poll centre issued 2226 electronic votes from 9 October, 38.1% of its total. Of the total pre-poll votes issued from 9 October, 52.4% were electronic. Overall, 46.9% of all pre-poll votes cast from 2 October were cast electronically.

The variations in the proportion of electronic votes issued at the varying locations are to some extent attributable to the confidence with which the staff promoted the electronic voting option. The Woden pre-poll centre, where the proportion of electronic votes issued was highest, was also used as the testing site for the electronic voting project, and the staff at that location were most familiar with its use. The electronic voting numbers were down in the Civic pre-poll centre as many of its votes were taken at lunch times, with the result that the 10 electronic voting booths were fully occupied at those times and voters had to be issued with paper ballots to avoid build-up of queues.

At future elections, it is expected that greater knowledge of the computer voting option by voters and greater familiarity with its use by staff would lead to an increase in the proportion of electronic votes issued. Increasing the number of electronic voting booths available would also increase its use, particularly at the Civic pre-poll centre.

There were no major "down times" at any of the pre-poll locations. On a few occasions at some locations the computer system had to be turned off and re-booted when the system froze. Whenever this happened, any voters who were unable to complete their votes (as indicated by on-screen error messages) were issued with replacement paper ballots. No votes were lost by reason of computer failure at any stage.

Use of electronic voting at the pre-poll centres reduced the scrutiny workload by almost one-half.

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. These were selected to increase the geographic spread of available locations. Electronic voting was provided at Gungahlin, 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 (Gungahlin 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 2 weeks, and most of the staff employed on polling day had worked at the pre-poll centres.

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 the software was not loaded (for security reasons) until 7 am on Saturday morning, ready for the start of polling at 8 am.

At Weston polling place, the start of electronic voting was delayed as one of the set-up disks failed to operate. Further down time was experienced later in the day at Weston when the server froze and had to be re-booted. Late in the day the server froze once more and electronic voting was not provided again.

At Melba polling place, the computer used as the server suffered a hardware failure. Electronic voting was unavailable at this location for about an hour while a replacement server was installed by InTACT support staff. The fail safes built into the computer system proved reliable, as the data stored on the mirrored hard disks on the failed server was recoverable and was included in the election count. No votes were lost as a result of this hardware failure.

No difficulties were experienced at Gungahlin or Richardson.

As with the pre-poll voting experience, while there was some computer down-time evident on polling day, no votes were lost as a result of computer failure.

The difficulties experienced in deploying electronic voting for one day of polling indicates that, for future elections, some solution needs to be found that will minimise the down-time of the electronic voting terminals.

Voter reaction to electronic voting

Voter reaction to using electronic voting was largely positive. In exit polling conducted for the Commission (with a sample size of around 295), 89% of voters who used electronic voting found it easy to use (11% not easy, unsure 0%). Of those same voters, 81 % thought the system had clear instructions (15% not clear, 4% unsure) and 70% thought the system fast and efficient (21% not fast and efficient, 9% unsure).

A very 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 for the instructions on the screen.

Other complaints were that some voters had found an "open" ballot on the screen, indicating that the previous voter had not completed his or her vote by swiping the barcode after pressing the "Finish" key. While it is regrettable that some votes were effectively lost in these cases, the number of such votes was very small compared to the number of paper ballots that were informal through voters leaving them blank or failing to mark their ballots in accordance with the instructions. This issue is discussed in detail under *Informal votes*.

Many electors had difficulty getting the barcode to read as it was swiped through the barcode reader. Polling staff responded by providing staff dedicated to assisting electors with the electronic voting process, particularly the swiping of the barcode. This issue will need to be addressed for future elections.

Differences in voting patterns using electronic voting

The electronic voting interface presented voters with a ballot screen with the cursor resting on the party name at the top of the left hand column. In order to cast a preference for a candidate, the voter had to use the up/down or previous group/next group keys to navigate to a candidate's name.

Concern was expressed by some Reference Group members that this could have unduly influenced voters to start voting at the left hand column of candidates (column A). As an alternative, it was suggested that the cursor should be located randomly on each consecutive ballot paper.

The Commission took the view, supported by other Reference Group members, that this would have been confusing to voters, as they might have difficulty in locating the cursor if it was not in a logical position. Given the convention in the English language to read text from top left first, the Commission considered that positioning the cursor at top left was the most logical. Another reason for starting in this position was to simplify the audio instructions. It would not have made sense to blind or sight-impaired voters to have started at a random column on the ballot paper, again because of the convention of reading left to right.

In the event, there was a noticeable difference in the voting pattern between those who voted electronically and those who voted on paper ballots. Table 2 shows the numbers of electronic votes cast in the 3 electorates and in total. Table 3 shows the number of paper ballot votes cast by all electors. Table 4 shows the number of votes cast by all electors.

It can be seen that the party in column A in Ginninderra and Molonglo, the Australian Democrats, received a higher percentage of electronic votes compared to the paper ballots: 13.56% electronic compared to 9.33% paper ballots in Ginninderra, and 11.42% electronic compared to 7.30% paper ballots in Molonglo. By contrast, the party in column A in Brindabella, the Australian Labor Party, received a lesser percentage of electronic votes compared to the paper ballots: 42.26% electronic compared to 44.14% paper ballots.

However, other differences in voting patterns are apparent. For example, the ACT Greens received a higher percentage of electronic votes compared to the party's proportion of paper ballots in all 3 electorates. The Australian Democrats electronic vote was also higher in Brindabella than its proportion of the paper ballots. The ALP's percentage of the electronic votes was lower in all 3 electorates than the party's proportion of paper ballots. The Liberal Party's electronic percentage was slightly less than its proportion of paper ballots in all 3 electorates.

These results indicate that there was a discernible difference in voting patterns between the electronic votes and the paper votes, but they do not indicate that the party in column A always did better on the electronic votes than on paper votes. While the Australian Democrat electronic vote was higher when it was in column A, it was also higher in Brindabella where it was in column E. Conversely, the ALP electronic vote in Brindabella in column A was less than its overall vote.

Electors who used electronic voting actively chose that option. It would appear from these results that a higher proportion of the people who chose electronic voting favoured the Australian Democrats and the ACT Greens, regardless of their ballot position, compared to all voters. This would seem to explain the difference between the electronic and the paper results, more than any positional advantage enjoyed by the party in column A.

Elimination of Unintentional Voting Errors

The electronic voting system was programmed to automatically number candidates as they were 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, 2866 voters who cast formal paper ballots made errors in numbering. These voters constituted 1.6% of all voters who cast formal ballots. A total of 1141 voters missed a number in their preference sequence (eg, 1, 2, 4, 5) and 1725 voters repeated a number in their preference sequence (eg 1, 2, 3, 3, 4, 5). (More detail on the breakdown of numbering errors on formal paper ballots will be published in the Commission's forthcoming review of the 2001 election.)

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 votes

The proportion of informal votes cast by those people using the electronic voting system was far less than those cast on paper ballots. Only 0.57% of the votes cast electronically were informal. If "discarded" electronic votes are also taken into account, where a vote was issued to an elector but not recorded by the elector on the computer, only 1.22% of the electronic votes were informal or discarded, compared with 4.27% informal paper ballots.

A total of 94 informal votes were recorded electronically. To record an informal vote on EVACS, the elector would have had to swipe the barcode to start voting and then press the "finish" key without selecting any preferences for candidates. This would have brought up a "warning" screen informing the voter that proceeding would result in an informal vote being cast. The voter would have then had to swipe the barcode a second time. While there were reports (around 3-5) of some voters casting informal votes in this way accidentally, it would appear likely (given the number of apparently deliberate informal ballots counted in the survey of informal paper ballots) that most informal electronic votes were deliberate.

A further 109 electronic vote barcodes were issued to electors, but not recorded on the computer system. There were some reports that some of these barcodes were used by electors to attempt to vote, but that the votes were not completed by swiping the barcodes a second time, and hence were unintentional discarded votes. However, it seems that other barcodes were either placed directly into a ballot box or removed from the polling place without an attempt being made to vote, and hence were deliberately wasted votes, in much the same way as some thousands of paper ballots are scribbled on or placed unmarked in ballot boxes.

The numbers of discarded electronic and paper ballots are shown at the foot of tables 2, 3 and 4. In this context, "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. A paper ballot that was not placed in a ballot box would be counted as discarded. The number of discarded paper ballots is very low, as paper ballots placed unmarked in ballot boxes are counted as informal votes, whereas unused electronic voting barcodes placed in ballot boxes are not recorded as votes.

By comparison, of the informal paper ballots, 2112 were totally blank, 1556 contained only marks, writing, lines or scribbles, and 3971 contained ticks, crosses or numbers, but no unique first preference. Of the latter category, 3662 paper ballots showed 2 or more figure "1"s. (More detail on the breakdown of errors on informal paper ballots will be published in the Commission's forthcoming review of the 2001 election.)

While the trial of computer voting allowed for a self-selecting sample, and it is difficult to determine the intent of voters from informal ballot papers, some tentative conclusions can be drawn from the above outcomes. The information available suggests that those voters who chose to vote electronically were more likely both to want to vote formally and to actually vote formally. This suggests that the provision of electronic voting to more people would tend to reduce the proportion of informal votes cast. It is probable that at least some of the 3971 paper ballots 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 in this way.

Electronic voting facilities for people with disabilities

An innovative feature of the EVACS voting interface was the audio facility, that enabled sight-impaired people to vote using recorded spoken instructions broadcast over headphones.

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 very positive.

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 a large 21 inch monitor (compared to the 17 inch monitors used in the normal monitors), which significantly enlarged the text for easier reading. These terminals were also equipped with headphones broadcasting recorded spoken instructions.

When a voter used headphones to vote, the system invited the voter to press any key on the voting keypad to hear a description of what that key did. This enabled the voter to ascertain the purpose of each key before voting commenced. Each function key was also labelled with a tactile label indicating its purpose.

Once the voter was satisfied as to the functions of the keys, swiping the voter's barcode started the voting process. When the ballot paper appeared on screen for the first time, the voter was informed of the name of the electorate and the instructions printed on the screen. The system then read out the group letter and the registered party name (if any) at the top left hand column, where the cursor was situated when voting started. As the voter moved around the ballot paper with the direction keys, the audio would broadcast the group letter, registered party name and candidate name highlighted by the cursor. When the voter indicated preferences by pressing the "select" key, the system would also broadcast the preference number assigned to each candidate by the voter.

In this way, voters could navigate around the ballot paper and cast their votes simply by following the voice prompts and without any need to see the ballot paper on screen. When the voter had finished allocating preferences, pressing the "finish" key brought up the confirmation screen. At this point the system read out the voter's preferences in numerical order. The voter could at this point choose to return to the ballot paper and correct any errors or keep voting for more candidates, or to confirm the vote by swiping the barcode for a second time. If the voter had difficulty swiping the barcode without assistance, pressing the select key hid the confirmation screen so that it was not visible, and an electoral official could swipe the barcode for the voter without seeing the person's vote.

Electronic voting facilities for Australians from culturally and linguistically diverse backgrounds

Another innovative feature of EVACS was the provision of on-screen voting instructions in 12 different languages.

At the "welcome screen" – the first screen displayed for voters on EVACS – 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).

Electronic counting

The 2001 election saw the introduction of electronic counting of all ballots for the first time in the ACT. 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. This data-entry method of converting handwritten ballot papers into computer-readable data was not an ACT first – similar systems have been used for recent elections for the Senate and the upper houses in New South Wales, Western Australia and South Australia. However, adapting this system to the Robson rotation method of printing variations of the ballot papers was an ACT innovation, used for the first time in Australia at the 2001 election.

A detailed description of the electronic counting process is at Attachment A.

This section of the report deals with issues related to the electronic counting system.

Transfer of electronic voting data

In traditional paper elections, ballot papers are transferred from the polling place in a locked and sealed ballot box. The transfer of electronic ballots aimed to ensure the same level of security as for electronic ballots.

To achieve this, electronic votes were copied to zip disks in the polling place. An outline of the details of this transfer and the security measures included in the software are outlined in Attachment A.

Counting on election night

With the need for manual counting eliminated, for the first time in Australia 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 computer program then calculated the interim results on this small number of votes.

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

While these figures were posted later than anticipated, by the end of election night, interim preference distribution results from some 16,000 votes were available. As discussed above, this result was not fully representative of the final outcome as it was a self-selecting sample of electors with a greater than average proportion of Green and Democrat voters. In the future, should electronic voting become more widespread, the sample on election night should become more representative.

Even though the electronic tally was not fully representative, the result posted at the end of election night did allow commentators on election night to correctly predict 16 of the 17 Members elected (see *On election night – Posting of results* below).

Data entry of ballot papers

Data entry of all the preferences contained on ballot papers began on the Monday following polling day. Two teams, each consisting of 30 data entry operators, worked six hour shifts each day, with scrutineers in attendance. Each batch of ballot papers (with usually 50 ballot papers in a batch, totalling 3880 batches) 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 representing candidates were also present during the data-entry process. Scrutineers were entitled to observe all data-entry, error correction and verification operations. If a scrutineer wished to question the data-entry of a ballot paper, the scrutineer asked the data-entry operator to "flag" the ballot paper with a coloured label. Scrutiny supervisors checked such "flagged" ballot papers by comparing the preferences shown on the ballot papers with the preferences recorded on the computer system. No cases were identified where a "flagged" ballot paper uncovered a data-entry error that was not otherwise identified by the computer system.

Using this system, out of a total of 175,270 ballot papers that were data-entered, 1303 ballot papers were identified where single data entry errors had been made, 895 ballot papers were identified as informal, 1141 ballot papers were identified with a number missing in the sequence of preferences, and 1725 ballot papers were identified with a number duplicated in the sequence of preferences. Every one of these ballot papers was examined by a supervisor and corrections were made if necessary. Even where corrections were not needed, the system required that a supervisor confirm that each of these ballot papers was recorded correctly.

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 Monday after polling day. Final error-correction and verification of the data-entry results was completed by the second Wednesday after polling day, with the final results announced the following morning.

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 only manual part of the scrutiny, 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. The level of rigour applied was significantly greater than that applied to the Molonglo manual recount undertaken in 1998, which was conducted with great care. Thus, except for the very small possibility of undetected data entry errors, the new process removed all 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.

Following the election the Commission surveyed a random sample of 95 batches of ballot papers, containing 4,640 ballot papers from the three electorates, and compared the written ballots with those that had been data entered. No data-entry errors were found. The sample of ballot papers checked included 1,501 from Brindabella, 1,709 from Ginninderra and 1,430 from Molonglo.

This survey indicates that the incidence of undetected errors was less than 1 out of 4,640. While the actual number of undetected errors could only be determined by comparing every ballot paper with the computer records, the incidence of detected errors can be used to estimate the likely incidence of undetected errors.

The computer system recorded 1303 cases where the first data entry of a paper was different from the second data entry. With a total of 175,270 ballot papers data-entered twice, this equates to an operator error rate of around 1 in every 268 ballot papers. This indicates that the likelihood of the same error being made by two operators on the same ballot paper is around 1 in 268 squared, which is 0.000014. This is less than 1 in 71,800 ballot papers, or 2.5 ballot papers in the whole of the ACT.

A probability of undetected errors of 0.000014 would also suggest that the final data-entry was 99.9986% accurate. In fact, the undetected error rate may have been lower still, since the only errors that would not have been identified were those where the same mistake was made by both operators on the same paper, *and* the resulting incorrectly entered paper contained an unbroken sequence of preference numbers.

These results indicate that the process of double-keying the ballots was demonstrably an accurate and efficient process for dealing with large numbers of Robson Rotated ballot papers.

Using EVACS to conduct the Hare-Clark distribution of preferences

The computerised distribution of preferences conducted by the EVACS software used the Hare-Clark method set out in the Electoral Act. The accuracy of the computerised scrutiny system was extensively tested before it was used in production.

On one occasion during the data-entry stage, scrutiny sheets were produced that included a calculation error. This problem was quickly identified and corrected. At no stage was the integrity of the data-entry or counting process at risk. On the contrary, the accuracy of the data-entry process and the Hare-Clark scrutiny calculation was demonstrably of a far higher standard than the comparable manual counting process.

Before the final result was announced on the second Thursday after polling day, the Hare-Clark calculations produced by EVACS were cross-checked by entering the results of the distribution of ballot papers generated by EVACS into a separate spreadsheet program. This spreadsheet program calculated transfer values and running totals using algorithms that were independent from EVACS. This process confirmed that EVACS was correctly calculating the distribution of preferences results for all 3 electorates.

Interim preference distributions and release of results

By using the EVACS computer program to distribute preferences shown on electronic votes and data-entered paper ballots, it was possible for the first time in ACT Legislative Assembly elections to conduct "interim" distributions of preferences. Previously, under the manual count system, the preference distribution process could not commence until the count and recheck of all first preferences shown on all ballot papers had been completed after the receipt of the last postal votes on the Friday after polling day.

The first interim distribution of preferences took place on election night, using electronic voting data only. These results were published in the Tally Room. The number of electronic votes available for counting in the Tally Room increased as the evening progressed, as results from different locations were entered into the central computer.

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.

After polling day the data entry of paper ballots commenced on the following Monday. At the end of each day's data entry (with some exceptions), an updated interim distribution of preferences was published. This process continued until all available ballots were data entered, computer checked, manually corrected if necessary and confirmed as correct.

A series of printed reports was generated by the system giving the result of the distribution of preferences as well as the count of first preferences at various levels (polling place, electorate, ACT total, etc).

The Commission considers the release of these interim preference distribution useful in providing the media, parties and candidates, and through them the public, with information about the progress of the count. Unfortunately, some commentators did not give sufficient weight to the interim nature of the results and their interpretation may have given the impression that the interim results were final or close to final. This caused some confusion to the public and some candidates, as the interim results changed from day to day.

The tendency of the interim results to produce different lists of successful candidates on different days reflected the close nature of the election outcome, particularly in Ginninderra. Where an election outcome depends on margins of less than 100 votes, interim counts must always be treated with caution, regardless of the electoral system being used.

The uncertainty generated by the changing results indicated by the interim distribution of preferences led to suggestions that the practice should be discontinued at future elections (see the *Canberra Times*, 2 November 2001, page 2). The Commission does not agree that they should be discontinued.

The ability to provide interim preference distributions is a marked advance over the manual counting system where preferences could not start being disseminated until the quota can be calculated after the day on which postal votes could be accepted (the Friday after polling day). By using interim preference distributions, by the end of polling night the public knew which party was likely to have won the majority of seats and was therefore most likely to form Government.

By releasing interim distributions of preferences as data entry progressed after election night, the identity of candidates likely to win seats was confirmed progressively, while those candidates who were close to winning or losing a seat were also identified. The progressive release of data therefore allowed candidates and parties to focus on close contests. Without these interim distribution of preferences, it would have been difficult to predict which candidates were close to winning or losing until the final distribution of preferences was published.

The Commission considers that one way to reduce the confusion caused by the interim distribution of preferences is to provide more information about the data being released. In particular, the Commission intends to release full preference distribution sheets, rather than the summaries used in 2001, and to highlight which candidates are close to winning or losing a seat. Unfortunately, the EVACS software did not allow for easy electronic publication of preference distributions, so that simplified summaries were published instead. The Commission intends to upgrade EVACS so that more meaningful statistics can be published electronically and distributed to candidates, party workers and the media.

The role of scrutineers

The introduction of computer voting and computer counting, to some extent, changed the nature of scrutineering at the election. At most polling places the role of scrutineers did not change. Scrutineers could be present during polling to ensure correct procedures were followed, and were 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 zip disk and the sealing of those zip disks for transfer to the tally room and the central counting centre. 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. Scrutineers could ask data entry operators to tag any ballot papers that were in dispute and these were inspected by the supervisor team. 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.

At future elections, to ensure that scrutineers are aware of all the processes in which they can be involved at election time, the Commission recommends introduction of a "train the trainer" program for managers of scrutineers. This training would be provided by the Commission at no cost prior to the election.

"Recounts" under electronic counting

The adoption of electronic counting of ballots has significant implications for the concept of "recounts" of ballot papers.

The ability to conduct a recount is intended to ensure that the correct outcome has been achieved and that mistakes in the original count can be uncovered and corrected. A recount was conducted in 1998 for Molonglo, when two candidates were within 3-5 votes of one another at the point where one of the two candidates had to be excluded. The recount showed that the original count was in error, and the result was changed accordingly.

The 1998 recount for Molonglo demonstrated that manual counting of Hare-Clark ballots was prone to error, and that a high degree of accuracy was needed when margins between candidates were tight, in order to ensure that the correct outcome has been achieved. This experience was a motivating factor for the development of EVACS.

The adoption of electronic counting introduced new ways in which ballots can be recounted. Section 187A of the Electoral Act lists the ways in which a recount of electronically counted ballots can be conducted. These include:

- Using backup copies of data;
- Rerunning data through the counting program;
- Loading the data into a different copy of the counting program;
- Re-examining the accuracy of the data entry process;
- Conducting a partial or full manual scrutiny of paper ballots; or
- Combining a manual scrutiny of paper ballots with an electronic scrutiny of electronic votes.

EVACS was developed so as to minimise the need to conduct recounts. As discussed elsewhere in this report (see *The accuracy of the data entry of ballot papers* above), the data entry process was designed to deliver an extremely accurate outcome. In particular, the "double entry" data entry method and the extensive electronic identification and manual checking of apparent data entry errors and voter numbering errors was intended to provide a level of accuracy that was higher than could be achieved by the most careful manual recount.

Following the announcement of the election result in 2001, Mr Harold Hird, a Liberal Party candidate in the electorate of Ginninderra, sought a recount of the votes in that electorate. Mr Hird was 55 votes behind fellow Liberal Party candidate, Ms Vicki Dunne, at the point at which one of the two candidates had to be excluded.

Mr Hird's request for a recount was rejected by both the Electoral Commissioner and, on appeal by Mr Hird, the full Commission. In considering the request, the Commissioner and the full Commission had regard to the level of accuracy achieved by the data entry of paper ballots and the computer count. The Commission was satisfied that the level of accuracy was so high that a recount in any form could not have improved on the accuracy of the original count, and that there was no probability that the original count had indicated that the wrong candidates had been elected, given the margins between the winning and losing candidates.

On election night

Posting of results

The 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. ENS was a separate system to EVACS.

ENS 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. For the first time at an ACT election, results were displayed using an overhead projector directly from the computer system. This replaced the manual tally board used in previous years.
- Results were displayed on the Electoral Commission's internet site. These results were updated as the count progressed. This was the first 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.
- Printouts of results were available for the media and the public in the Tally Room.
- End-of-night results were provided to the *Canberra Times* on computer disk.
- For the first time for an Australian election, interim preference distribution data was available from the votes cast electronically.

With the introduction of electronic voting, the process of entering data into ENS was by necessity different from previous elections.

The electronic voting data from the pre-poll centres was ready to load onto 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 zip disks and taken to the Tally Room after the polls closed and entered into the system later in the night.

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 ENS by data-entry operators in the Tally Room.

The vote counting server set up in the Tally Room also served as a secure internet server, so that the results could be published on the internet on election night. This server was not used for the final counting process, and the ballot paper preference data loaded into this server was not used in the "official" counting server at the counting centre. This ensured that connection of the election night system to the internet did not compromise the security of the final counting process.

Some difficulties were experienced with ENS on election night. These included a later than expected posting of the first results and significant internet down-time. Despite these problems, ENS delivered more information about the election result than has ever been made available before in an Australian Hare-Clark style election, because of the inclusion of interim preference distribution data.

ENS was developed by Software Improvements as an adjunct to EVACS, as it was designed to take EVACS electronic voting data. However, priority was given to the development of EVACS, so that testing and delivery of ENS took place later than anticipated. This meant that there was insufficient time to set up and test the system to the Commission's satisfaction.

The Electoral Commissioner optimistically raised expectations that electronic election results from the pre-poll centres would be available soon after the polls closed at 6 pm. Unfortunately, the electronic data took longer to load into the system than expected, and the first results were not made available in the Tally Room until around 7.15 pm. While this result was later than the anticipated 6 pm start, this start time was still comparable to start times for previous elections using manual counting only. In addition, around 11,000 votes were reported at this time, higher than the proportion of votes usually made available at this early stage of the count.

In an Australian first, ENS also published an interim distribution of preferences result on election night, using electronic voting data. While this data was not a representative sample of the final outcome (see *Differences in voting patterns using electronic voting* above), it provided more information about preference distributions than has ever been available before on election night for a Hare-Clark style election.

The most significant problem experienced on election night was the need to turn off the internet feed to the general public at various times. The 2001 election was the first ACT election to make progressive election results available on the internet on election night. A single server was used for data entry, Tally Room display, the data feed to the ABC and website access to the public. In hindsight, this was not sufficient.

The popularity of the website on election night increased the load on the data entry process, so that the server was running very slowly and delaying the entry and transmission of results in the Tally Room. In order to allow for the efficient data entry of results, at two or three times during the night, the Commissioner decided to cut the public internet access to free up the server for data entry. This was a deliberate decision, and at no stage did the computer "crash", as was suggested in the media. Once the demand on the data entry process was reduced, the internet server was reconnected.

While the Commission's internet site was down at some stages in the night, the Tally Room display and the feed to the ABC continued to function throughout the night.

For the next election the Commission will learn from the 2001 experience and ensure that the election night system performs more effectively.

Another aspect of the Tally Room with room for improvements was the electronic tally board used for projection of results. While the new board was quick to show results as they came to hand, the brightness of the projection caused some difficulties with reading the information from the back of the tally room. The Commission will investigate the provision of a more powerful projector for the 2004 election.

Casual vacancies

Under the ACT's Hare-Clark electoral system, casual vacancies in the membership of the Legislative Assembly are in most cases filled by "count-back" of ballot papers counted to the vacating Member at the general election.

As all preferences marked on all ballot papers at the 2001 election were recorded electronically, a count-back to fill a casual vacancy can now be conducted electronically, with no need to recount or resort the physical ballot papers. The amendments to the Electoral Act that enabled electronic voting and counting also allowed for count backs to be conducted by approved computer program.

EVACS includes a casual vacancy module. After the October 2001 election, this casual vacancy module was finalised and extensively tested. As a result, any future casual vacancies can be filled within minutes of the declaration of the names of the candidates contesting the vacancy. By contrast, the last recount held to fill a casual vacancy in the ACT, the recount held in January 2001 to fill the vacancy that followed the resignation of Mrs Kate Carnell, took 2 days to count.

Cost of electronic voting & counting

The Explanatory Memorandum to the Electoral Amendment Bill 2000 (No 2) noted that the introduction of electronic voting and vote counting for the 2001 election would cost an estimated $405,000 over 2000/2001 and 2001/2002. To meet this cost, the Government allocated supplementation of $235,000 for this project from the Electronic Services Delivery budget. The remaining $170,000 was to be funded from within the Commission's budget.

The ACT Government information technology provider, InTACT, supplied hardware for the electronic voting and vote counting system for the 2001 election. In order to minimise the cost of the hardware, standard ACT Government hardware was used and deployed to other ACT agencies after use in the election.

The cost of the project in total was $406,000.

Of this amount, the re-usable EVACS software accounted for $200,000. The cost of providing hardware in polling places amounted to $125,000 with $25,000 of this amount invested in hardware that can be re-used at future elections. Other costs included venues, security, auditing, printing of barcodes and professional and technical assistance.

The supplementation of the Commission's budget for the 2001 election to allow electronic voting to take place was a once-off payment, given the "trial" nature of the project. Under most of the options discussed below, the Commission would require additional supplementation of its election-year budget for it to provide electronic voting for the 2004 election.

InTACT Charging

While the use of standard ACT Government hardware meant that all the PCs provided were identical and of a very high quality, InTACT leasing arrangements meant that the Commission generally paid the lease costs for three months for each PC when many of the PCs were used for only a day. While the Commission agreed to this arrangement for 2001, discussions for future elections between InTACT and the Commission should focus on ways to reduce this cost and thereby make computer voting more affordable.

The way ahead – Options for future elections

In the light of the 2001 election experience, the Commission recommends that data entry of preferences shown on paper ballots and electronic counting be made standard practice at ACT elections. The extremely high level of accuracy demonstrated at the 2001 count indicates that this process is far superior to manual counting and sorting of paper ballots.

Use of data entry and electronic counting can be achieved within the Commission's existing budget regardless of whether computer voting is provided or not.

The Commission also recommends that electronic voting be provided to more electors in 2004. 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 possibility of data entry error of paper ballots. The accessibility of electronic voting to blind and sight impaired people is another valuable reason for continuing to provide electronic voting.

Suggested improvements to the current system

After using the EVACS system for the 2001 election, there are several enhancements the Commission would like to implement. These enhancements should be achievable within the Commission's existing budget. These include:

- Improving the performance of the barcode readers attached to the voting terminals;
- Extending the range of statistics that can be published electronically during the count;
- Improving the set-up process to automate the loading of election details, particularly candidate names and sound files;
- Improving the process of setting up polling places;
- Minimising the likelihood of down-time of computers used at polling places;

- Improving the error-control reports used in the data-entry process to enhance useability; and
- Revising the election night system to improve internet access facilities and to extend the range of available data.

Using the internet for voting

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 both Parliamentary and 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.

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

Options for offering electronic voting to more electors

The challenge for electronic voting in the future is 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, the cost of achieving this at all 81 polling places around the ACT would be very high and logistically, deployment of computers at this number of polling places for a single day would be impractical and prohibitively expensive. Therefore electronic voting could not be offered to all electors under current polling arrangements.

The Commission identified 2 main alternatives for provision of electronic voting at the 2004 election:

- Working within existing polling arrangements, whereby most electors vote on polling day at their local polling place, and providing electronic voting at pre-poll centres and a small number of polling places. This would mean that most voters would continue to use paper ballots.
- Moving away from the traditional concept of "polling day" and replacing it with a "polling period" which could be from 1-3 weeks. By extending the right to vote throughout a polling period to all electors, electronic voting could be made available at (say) 12 locations strategically placed near main shopping centres and workplaces. Rather than concentrating voting on 1 day at local polling places, electors could vote over (say) a 3 week period at a regional voting centre. In this way, electronic voting could be made available to all electors.

Table 5 gives more detail about a range of options within these 2 broad categories, including estimated numbers of electronic votes and expected costs and savings.

The options presented are based on the Commission's estimate that a maximum of only 8 non-pre-poll electronic polling places could be set up for use on polling day only, given the logistical set-up considerations, particularly the fact that most polling day locations are schools, which are unlikely to be made available before the afternoon before polling day.

Under all of these options, it is intended that paper ballots would continue to be made available at all electronic polling locations. Paper ballots would be provided as an alternative to electronic voting, for those who did not want to vote electronically, and as a backup should the computer system be unavailable for any reason. The estimates of electronic votes likely to be taken in table 5 are based on 75% of voters using electronic voting, with 25% of voters choosing to vote by paper.

Options A and B are based on the existing polling arrangements remaining the same, with only those unable to attend a polling place on polling day entitled to cast a pre-poll vote. It can be seen that it is estimated that no more than 27,000 electronic votes would be expected to be taken if the existing "polling day" model is retained, for a relatively high additional cost per vote.

Options C, D and E would involve moving away from the traditional concept of "polling day" and replacing it with a 3 week "polling period", during which time any voters would be entitled to vote at any polling centre. Option C would retain a mix of electronic and non-electronic polling places, while options D and E would use only electronic voting centres at a limited number of locations. Only option E, providing voting facilities at 12 locations only, is anticipated to result in a cost saving, while maximising the number of votes expected to be taken.

The Commission recognises that moving away from the concept of most electors voting on polling day to extending the polling period for all electors by up to 3 weeks would be a significant departure from current practice. In particular, it is recognised that political parties and candidates tend to design their election campaigns to "peak" just before polling day, so as to achieve maximum impact.

However, the Commission also notes that over 31,000 electors (or over 15% of all voters) voted in the 3 weeks before polling day by post or at a pre-poll centre in 2001. The significance of these early voters cannot be over emphasised, given that seats were won and lost in 2001 with margins of only around 50 votes. It could be argued that it would be in the best interests of parties and candidates to be treating the whole pre-poll period as a time to maximise their appeal to voters, rather than concentrating primarily on polling day. Given that such a large number of electors cast their votes before polling day, extending early voting to all electors might not be such a dramatic step.

Considerable cost off-sets would be achieved by reducing the number of polling places from 81 relatively small polling places used on polling day only to around 12 polling centres open for a 3 week period. As table 5 shows, these cost off-sets could be used to offer electronic voting to all electors without an unreasonable increase in the cost of elections, and may even be used to reduce the cost of elections. The inconvenience of closing local polling places would be offset by extending the time available for voting from 1 day to 3 weeks and placing polling facilities near where people shop and work.

While a range of options are available, the Commission favours extending the right to vote early to all electors for the full 3 week period, for a number of reasons. Spreading

the "voter flow" over 3 weeks would minimise the number of electors to be processed each day, whereas restricting the polling period to only 1 week would mean that very large numbers of voters would need to be processed at a relatively small number of locations each day. It may be difficult to find premises large enough to cater for this need. Of course, even with a 3 week voting period, many electors could be expected to leave voting until late in that period, and the Commission would anticipate conducting a public relations and advertising campaign intended to encourage electors not to leave voting until the last minute.

Extending the right to vote to the full 3 week period would also avoid the confusion that might arise if the 3 week pre-poll period was divided into (say) a 2 week period during which only those who could not vote in the last week could vote, and the final week when any elector could vote.

In any case, it would be necessary to retain the existing 3 week pre-poll period to allow time for electors to apply for, receive and return postal votes. However, the Commission does not recommend extending the right to cast a postal vote to all electors. The Commission considers that this right remain open only to those who were unable to attend a polling centre. In the Commission's view, postal voting is the least desirable method of casting a vote. It is a process prone to error, as postal votes can be rejected through errors made by electors on the application form or on the voting declaration. As postal ballots must by their nature be cast on paper ballots, they are subject to the problems identified above with the marking of paper ballots, and they do not have any of the benefits inherent in electronic voting. Postal voting will be discussed further in the Commission's report on the conduct of the 2001 election.

Other benefits could be obtained by restricting polling to only 12 locations. One such benefit could be to use networked computers to replace printed certified lists when marking electors' names off rolls. This would be practicable to implement in a limited number of locations that were used for a longer period, where it would not be practicable to implement in 80 or so polling places on polling day.

Such a system could be used to prevent the issuing of an ordinary vote to a person whose name has already been marked off the roll at any other location. While this system would not prevent multiple or fraudulent voting, it would reduce the opportunity for fraud significantly. The cost of providing and networking computers would be offset against the considerable cost of printing and scanning certified lists, which would no longer be needed. A computerised, networked electoral roll marking system would not be linked to the electronic voting system, so as to preserve the secrecy and security of the ballot.

As all but one of the options identified for continuing to provide electronic voting require additional funding, and as the suggestion to replace polling day with a polling period requires legislative change, the Government and the Legislative Assembly must decide how they wish to progress the implementation of electronic voting in the ACT. It may be appropriate to refer this matter to an Assembly Committee to allow members of the public to be consulted and to have their say on the future of electronic voting in the ACT.

Acknowledgments

The trial of computer voting and vote counting 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 delivering a system of excellent quality.

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

Thank you also to Commission staff who enthusiastically embraced the new system and made it available to the public, to the media for publicising the system and to the electors of the ACT who used the system and made the trial a success. Particular thanks are due to Alison Purvis, the Deputy Electoral Commissioner, who was the EVACS project manager for the Commission.

Attachment A – The electronic voting and counting system (EVACS) in detail

Electronic voting component

Before the close of nominations

50,000 unique barcodes were produced and stored under security. Each barcode was coded so that it had a unique number and so that it was unique to an electorate and to a polling place. The number, electorate name and polling place name was printed on each barcode. A digital signing process was used to prevent barcodes from being forged. This was achieved by using a "one way hash" which is a cryptographic technique for turning one number (the barcode) into another number (the hash), which has no known way of reversal (short of trying every possible combination). This meant that the polling place server could compare the hash of the barcode with the list of hashes it was set up with to verify that a barcode was genuine, but even obtaining the list of hashes from the polling place server would not allow someone to reproduce a valid barcode.

After the close of nominations

Data for candidate name, group name, column order and Robson rotation position order was loaded into system.

Images for candidate names and group names were prepared and loaded into system.

Sound files for the audio system were recorded, including candidate and group names, and loaded into system.

All of the above inclusions in the system were checked and tested, including proof-reading of all names and verifying Robson rotation orders against ballot paper masters.

The production version of the software was burnt onto CD-ROMs. A master copy of the software on CD-ROM was certified by the Commissioner under section 118A of the *Electoral Act 1992*.

The production version of the software was rechecked by auditors to ensure that it conformed with the earlier version.

Preparation for polling

The hardware in each polling place was installed by officers from InTACT (the ACT Government in-house IT services provider). Each polling place was equipped with:

- 1 server, containing 1 computer processor, standard keyboard, monitor, 2 hard disks and a removable zip disk;

- an “uninterruptable power supply” for the server;

- 9 “standard” voting PCs, including computer processor, 17” monitor, “cut-down” keyboard and barcode reader, mounted horizontally in a cardboard voting screen with perspex over monitor screen and instruction poster;

- 1 "accessible" voting PC, including computer processor, 21" monitor, "cut-down" keyboard, barcode reader and headphones, mounted vertically on a wheelchair-accessible table with instruction poster and privacy screen;

- 1 hub and cables connecting the 10 PCs to the server;

- 1 stand-alone "demonstration" voting PC (not connected to the network), including computer processor, 17" monitor, "cut-down" keyboard and barcode reader, mounted on a table in the foyer of the polling place, with an instruction poster.

Software was loaded onto server and PCs using CD-ROMs that were copies of the master production version of the software. This software overwrote any data on the hard drive of the server or PC when it was loaded.

Tests were run to confirm voting PCs were correctly communicating with the server.

An on-screen report was run showing that the vote database was empty.

Polling

Issuing a barcode

As voters queued up to vote, a queue controller directed each voter to an issuing officer for the voter's electorate.

If the issuing officer determined the voter was entitled to an ordinary vote, the issuing officer inquired if the voter wished to vote electronically or on paper. If an electronic vote was chosen the voter was issued with a barcode for the voter's electorate.

The voter was directed to a voting PC.

Choosing a language

The "welcome screen" was displayed when the voter began voting. 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).

Swiping the barcode for the first time

The voter swiped the barcode in the barcode reader to bring up the ballot paper screen. The barcode reader "beeped" if it read the barcode. If it failed to read the barcode, it did not beep. Unfortunately, in practice the barcode readers used for this process were somewhat "temperamental" and often did not register a successful swipe on the first try. Repeated swipes were sometimes needed to register a correct read of the barcodes. Polling staff were on hand in polling places to assist voters with swiping the barcodes.

If a barcode:

- was not for that polling place,
- had been used before; or

- was not a valid barcode for the election,

the error message screen was displayed, instructing the voter to ask a polling official for help. A number on the error message screen informed the polling official of the nature of the error.

If a barcode was damaged or could not be read properly there would be no response (since the barcode reader could not detect damaged barcodes).

If a barcode could not be read or an error message was displayed, voting could not proceed from that point. The polling official used the error message number to determine what steps to take. A keystroke combination was used by the polling official to reset the screen to the welcome screen. No record of the first barcode swipe was kept at this point.

If an error message warranted further action, at the server PC the OIC could enter the barcode number in the system to determine whether the system recognised that barcode and whether it had a record of that barcode's use. Scrutineers could observe this process.

If it appeared that a barcode has already been used, but the voter claimed not to have used it, the voter could be issued with a declaration vote. The barcode was inserted in the declaration vote envelope. If the Commissioner determined from the computer records that the barcode had been used, the declaration vote would not be admitted to the scrutiny.

If it appeared that a barcode had not been used before, but that the system was unable to read it, and the OIC was satisfied that the voter was entitled to cast a vote, the voter was issued with another barcode (in the same way that a "spoilt" paper ballot can be replaced).

If a barcode was read by the system and verified as a valid barcode that had not been used before, the ballot screen was displayed.

Voting on the ballot screen

The ballot paper was displayed on the screen so that all columns of all candidates were visible. If necessary, 2 or 3 rows of columns were displayed, with point sizes of the characters adjusted to fit the required number of columns and candidates on the screen.

The highlighted cursor was displayed at the group name of column A, in the top left-hand corner.

The voter navigated to other column headings using the [left arrow] and [right arrow] keys. If the cursor was at a right-hand column, the [right arrow] key would take the cursor to the top of the left-hand column below that row or, if the cursor was on the last column on the bottom row, back to the top of column A. The [left arrow] worked in similar fashion in the other direction.

When the cursor was on a column where the voter wished to cast preferences, the voter used the [up arrow] and [down arrow] keys to navigate to candidates. At the bottom of a column of candidates, the [down arrow] key moved the cursor to the first candidate, and similarly at the top of a column, the [up arrow] key took the cursor to the last candidate in the column.

When the voter highlighted a candidate he or she wished to vote for, the select key was pressed. The first time the select key was pressed while a candidate was highlighted, the preference number "1" appeared in that candidate's square. As the voter highlighted candidates and pressed the select key, further preferences appeared in sequence.

If the select key was pressed while a candidate was highlighted who had already been given a preference, no action occurred.

If the voter wished to correct a mistake, pressing the [undo] key erased the voter's last choice of preference. Pressing [undo] repeatedly would continue to undo the last choice one by one, until (if the [undo] key continued to be pressed) no preferences were shown.

If the [start again] key was pressed, a confirmation screen was displayed, asking if the voter wanted to start again. The voter could use [up arrow] or [down arrow] to choose yes or no (with yes highlighted as the default) and [select] was pressed to confirm the choice. If 'yes' was chosen, the ballot screen was displayed with all choices erased. If 'no' was selected, the ballot screen was displayed as it was before [start again] was pressed.

If the [finish] key was pressed, and no preferences had been selected, the informal vote screen was displayed.

If the [finish] key was pressed, and at least one preference had been selected, the confirmation screen was displayed.

The informal vote screen

If the [finish] key was pressed while the focus was on the ballot screen, and no preferences had been selected, the informal vote screen was displayed. The voter was warned that proceeding would result in an informal vote. If the voter swiped the barcode at this point, and the barcode was read correctly and matched the barcode used at the first swipe, an informal vote was recorded, and the vote accepted screen was displayed.

If the barcode:

- did not match the barcode used at the first swipe of the barcode, or
- had been used to confirm a vote already,

the error message screen was displayed, instructing the voter to ask a polling official for help. A number on the error message screen informed the polling official of the nature of the error. Appropriate steps were taken (as described above under the first barcode swipe).

In the unlikely event that the barcode had been damaged after being successfully read once, there would have been no response since the barcode reader could not detect damaged barcodes. The voter would need to ask a polling official for assistance if this occurred.

If the voter pressed [undo], the ballot screen was displayed.

The confirmation screen

After the [finish] key was pressed while the focus was on the ballot screen, and at least one preference had been selected, the confirmation screen was displayed.

The confirmation screen listed all the candidates that the voter has selected, in preferential order (1st to last), with group names shown after each candidate.

If [undo] was pressed while on the confirmation screen, the voter was returned to the ballot screen and could continue voting (with the preferences as chosen still displayed).

If the voter needed help at this point and [select] was pressed, the ***vote hidden*** screen was displayed – this hid the details of the vote and allowed the voter to call a polling official and seek help. From the vote hidden screen, a barcode swipe would confirm the vote, or pressing [undo] would take the voter back to the ballot screen, (with the preferences as chosen still displayed).

If the voter wished to proceed to confirm the vote at the confirmation screen, the voter was instructed to swipe the barcode for the second time.

If the voter swiped the barcode at this point, and the barcode was read correctly and matched the barcode used at the first swipe, a formal vote was recorded, and the vote accepted screen was displayed.

If the barcode:

- did not match the barcode used at the first swipe of the barcode, or
- had already been used to confirm a vote,

the error message screen was displayed, instructing the voter to ask a polling official for help. A number on the error message screen informed the polling official of the nature of the error. Appropriate steps were taken (as described above under the first barcode swipe).

In the unlikely event that the barcode had been damaged after being successfully read once, there would have been no response since the barcode reader could not detect damaged barcodes. The voter would need to ask a polling official for assistance.

Storing a completed vote on the server

Votes were recorded on the server after a voter swiped his or her barcode for the second time, while on either the confirmation screen, the informal vote screen, or the vote hidden screen.

As the barcode was swiped, the computer program ran a routine that compared the preferences stored (that is preference number and candidate name, or informal) with the key strokes used by the voter. If the voting result obtained by running the key strokes matched the actual preferences stored, the record of the vote was written simultaneously to 2 hard disks on the server. At that point, the system recorded that the barcode had been used, so that it could not be used again.

If the vote was not accepted because of a mismatch between the keystrokes and the stored vote, or because of some other failure interrupting the storage of the vote, the error message screen was displayed, instructing the voter to ask a polling official for help. A number on the error message screen informed the polling official of the nature of the error. Appropriate steps were taken (as described above under the first barcode swipe).

The vote accepted screen

This screen was displayed after the barcode had been swiped for the second time and the vote had been accepted and written to disk. The vote accepted screen was displayed for 30 seconds, and asked the voter to deposit the barcode in a ballot box. The monitor was then reset to the welcome screen.

Voting using audio through headphones

The "accessible" voting PC included spoken instructions delivered through headphones. The voting process was exactly the same as described above, however as the various keys were pressed, audio instructions were heard.

A notable feature of the audio instructions was the "key tutorial". Before the first barcode swipe, pressing any key triggered a message describing the use of that key. This was designed to allow voters who could not read the labels on the keys (particularly sight impaired people and people with reading difficulties) to familiarise themselves with the keyboard layout and the functions of each key.

Disposing of used barcodes

Voters were asked to place used barcodes in a ballot box on their way out of the polling place. Even if some voters took their barcodes out of the polling place, the barcodes could not be used at any other polling place nor could they be used again at the same polling place if they had already been used to record a vote.

Close of polling

At the conclusion of each day's polling, the power was turned off the voting PCs.

Using an on-screen menu on the server, a copy of the voting database stored on the server was written to removable zip disks.

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 zip disk. 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, three copies of each database were written to disk. One was the master copy, with two backup copies. The disks were sealed with a unique numbered seal, which could be counter-signed by the OIC and any witnesses present, including scrutineers.

The seals were examined before the disks were opened for loading into the counting system.

Disks were run at the close of polling on each day of pre-poll voting. However, each disk contained the cumulation of all votes cast on all days, so that, come polling night, only the most recent disk was needed to be loaded into the counting system. The other disks were retained for verification and disaster-recovery purposes (which in the event were not needed).

Once the disks were written and sealed, 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 taken back to Elections ACT.

Electronic counting component

On election night

A vote counting server was set up in the Tally Room on election night. It was connected to a secure internet server, so that the results could be published on the internet on election night. However, this server was not used for the final counting process, and the ballot paper preference data loaded into this server was not used in the "official" counting server at the counting centre. A second copy of the zip disks was used to load data onto the "official" counting server.

The electronic voting data from the pre-poll voting centres as at the close of voting on the Friday before polling day was transferred on zip disk to the Tally Room vote counting server. This data was used to display results in the Tally Room and on the internet results system. This data was ready to load into the system soon after the polls closed at 6 pm. However, delays in the set-up of the election night system (a separate application from EVACS) meant that the first set of figures from pre-poll centres was made public around 7.15 pm. At this time, first preference results and an interim preference distribution were displayed on the results system.

The electronic voting data from the polling day polling places as at the close of voting on polling day was transferred on zip disk to the tally room vote counting server after the polls closed. This data was added to the data available in the Tally Room and on the internet.

Votes cast on paper ballots were counted in the usual way to first preferences and the results phoned through to the Tally Room. This data was added to the data available in the Tally Room and on the internet.

After election night

Electronic voting data from all electronic polling locations was transferred on zip disk to the central counting server. These zip disks were different (but identical) disks to those used in the Tally Room on election night. A unique identifying "hash" number was used to demonstrate that the data that was loaded on the server was the same as the data that was written to the disk at the polling location.

The electronic voting data was combined with data generated by the data entry of preferences shown on paper ballots, using the following process.

The data entry of preferences at the central scrutiny centre

Unlike at earlier elections, an automatic fresh scrutiny or recheck of the first manual count of all ballot papers counted at polling places was not conducted. Instead, all preferences shown on all formal paper ballots were data entered at the central scrutiny centre.

All preferences shown on every paper ballot counted as formal on election night were entered into a computer system at the central scrutiny centre. Each ballot paper was entered by two different operators, and the results of the two data entries were compared by the computer system. Any apparent errors were identified. This process was designed to minimise the possibility of data entry error.

Scrutineers were entitled to observe this process and seek rulings on interpretations placed on ballot papers.

The data entry process worked as follows:

- All formal ballot papers were parcelled in "batches" consisting of (on average) 50 papers.
- Each batch was allocated a number that uniquely identified the batch, the relevant polling place and electorate.
- Data entry operators were given a batch of ballot papers.
- The data entry operator entered the batch number into the computer system.
- For each ballot paper, the data entry operator first entered the ballot paper's Robson rotation "version number" into the computer system. This number, printed on every ballot paper, brought up a data-entry screen that presented the candidates in the same order as that shown on the ballot paper.
- The data entry operator then entered the preferences shown on the ballot paper into the computer system, in the order in which the candidates appeared.
- Electoral officers were present during data-entry to rule on unclear numbers and on disputed interpretations of preferences. Challenged ballot papers were flagged with coloured stickers for checking by scrutiny supervisors.
- After a batch was data-entered for the first time, it was then given to a second operator, who re-entered the batch in the same manner.
- After a batch was entered a second time, the computer system generated two printed reports.
- The first report listed all papers shown in the batch and the preferences that had been entered for each.
- The second report was similar to the first, but only listed papers where there was a difference between the first and second data entries, or where there were any preferences apparently omitted or duplicated, or where it appeared a ballot paper was informal.

- An Electoral officer investigated the second "apparent error" report by comparing the print-out with the original ballot papers to determine whether there had been any error in data entry.
- An Electoral officer could also conduct "spot checks" of apparently correctly-entered ballot papers against the first report to sample the accuracy of the data entry process.
- Ballot papers bearing coloured stickers indicating a challenged paper were also checked against the computer record to ensure they were correctly entered. Where the voter's intention was difficult to determine, the Commissioner or the Deputy Commissioner ruled on the interpretation of the paper.
- Any identified errors in data entry were corrected on the computer system by a "supervisor-level" data entry operator – generally a permanent Electoral officer or a senior casual officer.
- Once all apparent errors in a batch had been corrected on the system, or confirmation was given that a batch was error-free, the batch was "committed" to the scrutiny system. After this was done, the computer record of the papers in the batch could not easily be altered without restarting the data capture process. Scrutineers were made aware that, if they wished to challenge ballot papers, they should do so before the relevant batch was committed.

The above process continued until all formal paper ballots were data-entered.

All ballot papers identified at the first manual count in polling places as "formal" were data entered. Some 895 of these ballot papers were subsequently classified as informal at the data-entry stage, usually because of duplicated number "1"s that were not identified in the first count. This led to a corresponding change to the first preference totals of some candidates when the election night results were compared to the final results after data entry.

All ballot papers identified at the first manual count as "informal" were manually rechecked by the Commissioner at the central scrutiny centre. Any papers ruled at that stage to be formal were data-entered. Ballot papers confirmed as informal were not data entered.

Table 1: Electronic and paper ordinary votes issued at pre-poll centres

	Belconnen				City				Tuggeranong				Woden				Total Pre-Poll Centres			
Polling date	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic	Electronic	Paper	Total	% Electronic
02/10/2001	0	127	127	0.0%	0	141	141	0.0%	0	98	98	0.0%	0	111	111	0.0%	0	477	477	0.0%
03/10/2001	0	135	135	0.0%	0	156	156	0.0%	0	103	103	0.0%	0	85	85	0.0%	0	479	479	0.0%
04/10/2001	0	123	123	0.0%	0	140	140	0.0%	0	107	107	0.0%	0	126	126	0.0%	0	496	496	0.0%
05/10/2001	0	160	160	0.0%	0	135	135	0.0%	0	107	107	0.0%	0	107	107	0.0%	0	509	509	0.0%
08/10/2001	0	164	164	0.0%	0	194	194	0.0%	0	123	123	0.0%	15	122	137	10.9%	15	603	618	2.4%
09/10/2001	81	111	192	42.2%	98	115	213	46.0%	53	100	153	34.6%	91	78	169	53.8%	323	404	727	44.4%
10/10/2001	125	130	255	49.0%	102	123	225	45.3%	128	88	216	59.3%	120	49	169	71.0%	475	390	865	54.9%
11/10/2001	118	115	233	50.6%	92	132	224	41.1%	86	115	201	42.8%	100	22	122	82.0%	396	384	780	50.8%
12/10/2001	162	124	286	56.6%	124	143	267	46.4%	116	107	223	52.0%	201	51	252	79.8%	603	425	1028	58.7%
13/10/2001	315	165	480	65.6%	103	112	215	47.9%	168	286	454	37.0%	268	46	314	85.4%	854	609	1463	58.4%
15/10/2001	213	330	543	39.2%	170	333	503	33.8%	163	273	436	37.4%	405	58	463	87.5%	951	994	1945	48.9%
16/10/2001	338	273	611	55.3%	273	412	685	39.9%	264	227	491	53.8%	371	119	490	75.7%	1246	1031	2277	54.7%
17/10/2001	487	304	791	61.6%	309	500	809	38.2%	338	282	620	54.5%	510	99	609	83.7%	1644	1185	2829	58.1%
18/10/2001	546	401	947	57.7%	379	641	1020	37.2%	460	366	826	55.7%	435	217	652	66.7%	1820	1625	3445	52.8%
19/10/2001	882	908	1790	49.3%	576	1100	1676	34.4%	599	964	1563	38.3%	1025	326	1351	75.9%	3082	3298	6380	48.3%
Total	3267	3570	6837	47.8%	2226	4377	6603	33.7%	2375	3346	5721	41.5%	3541	1616	5157	68.7%	11409	12909	24318	46.9%
Total from 9/10/2002	*3267*	*2861*	*6128*	*53.3%*	*2226*	*3611*	*5837*	*38.1%*	*2375*	*2808*	*5183*	*45.8%*	*3526*	*1065*	*4591*	*76.8%*	*11394*	*10345*	*21739*	*52.4%*

Source: Daily returns submitted by pre-poll centres. Variations from published election results are due to minor discrepancies in the daily returns and to discarded votes.

Table 2: Summary of first preference electronic votes by electorate/ACT total

	Brindabella		Ginninderra		Molonglo		ACT Total	
Party/Group	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**
AD	437	8.52%	679	13.56%	722	11.42%	1838	11.16%
ALP	2169	42.26%	1913	38.19%	2201	34.80%	6283	38.16%
CFP	0	0.00%	0	0.00%	41	0.65%	41	0.25%
DR	0	0.00%	292	5.83%	0	0.00%	292	1.77%
GEP	0	0.00%	36	0.72%	114	1.80%	150	0.91%
KIG	57	1.11%	0	0.00%	14	0.22%	71	0.43%
LDP	22	0.43%	92	1.84%	55	0.87%	169	1.03%
LP	1606	31.29%	1323	26.41%	2126	33.62%	5055	30.70%
NGGP	80	1.56%	64	1.28%	85	1.34%	229	1.39%
PO	339	6.61%	0	0.00%	0	0.00%	339	2.06%
TAG	354	6.90%	511	10.20%	836	13.22%	1701	10.33%
Other	68	1.33%	99	1.98%	130	2.06%	297	1.80%
Formal	**5132**	**99.21%**	**5009**	**99.54%**	**6324**	**99.53%**	**16465**	**99.43%**
Informal	**41**	**0.79%**	**23**	**0.46%**	**30**	**0.47%**	**94**	**0.57%**
Total	**5173**	**8.08%**	**5032**	**7.95%**	**6354**	**6.96%**	**16559**	**7.57%**
Enrolment	**64020**		**63267**		**91328**		**218615**	
Total votes from all sources	**59216**		**58022**		**81483**		**198721**	
Evotes as % of total votes	**8.74%**		**8.67%**		**7.80%**		**8.33%**	
Discarded	**34**	**0.65%**	**35**	**0.69%**	**40**	**0.63%**	**109**	**0.65%**
Discarded + Informal	**75**	**1.44%**	**58**	**1.14%**	**70**	**1.09%**	**203**	**1.22%**
Total evotes including discarded	**5207**		**5067**		**6394**		**16668**	

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. A paper ballot that was not placed in a ballot box would be counted as discarded.

Table 3: Summary of first preference paper ballots by electorate/ACT total

	Brindabella		Ginninderra		Molonglo		ACT Total	
Party/Group	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**
AD	3501	6.80%	4729	9.33%	5270	7.30%	13500	7.74%
ALP	22722	44.14%	21939	43.27%	28672	39.71%	73333	42.05%
CFP	0	0.00%	0	0.00%	628	0.87%	628	0.36%
DR	0	0.00%	2834	5.59%	0	0.00%	2834	1.63%
GEP	0	0.00%	310	0.61%	630	0.87%	940	0.54%
KIG	579	1.12%	0	0.00%	230	0.32%	809	0.46%
LDP	275	0.53%	953	1.88%	476	0.66%	1704	0.98%
LP	16429	31.92%	14229	28.07%	24677	34.18%	55335	31.73%
NGGP	870	1.69%	640	1.26%	1024	1.42%	2534	1.45%
PO	3549	6.90%	0	0.00%	0	0.00%	3549	2.04%
TAG	2720	5.28%	3915	7.72%	9033	12.51%	15668	8.99%
Other	827	1.61%	1150	2.27%	1564	2.17%	3541	2.03%
Formal	**51472**	**95.24%**	**50699**	**95.68%**	**72204**	**96.11%**	**174375**	**95.73%**
Informal	**2571**	**4.76%**	**2291**	**4.32%**	**2925**	**3.89%**	**7787**	**4.27%**
Total	**54043**	**84.42%**	**52990**	**83.76%**	**75129**	**82.26%**	**182162**	**83.33%**
Enrolment	**64020**		**63267**		**91328**		**218615**	
Discarded	**4**	**0.01%**	**5**	**0.01%**	**7**	**0.01%**	**16**	**0.01%**
Discarded + Informal	**2575**	**4.76%**	**2296**	**4.33%**	**2932**	**3.90%**	**7803**	**4.28%**
Total paper ballots including discarded	**54047**		**52995**		**75136**		**182178**	

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. A paper ballot that was not placed in a ballot box would be counted as discarded.

Table 4: Summary of all first preference votes by electorate/ACT total

	Brindabella		Ginninderra		Molonglo		ACT Total	
Party/Group	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**	**Votes**	**%**
AD	3938	6.96%	5408	9.71%	5992	7.63%	15338	8.04%
ALP	24891	43.97%	23852	42.82%	30873	39.31%	79616	41.72%
CFP	0	0.00%	0	0.00%	669	0.85%	669	0.35%
DR	0	0.00%	3126	5.61%	0	0.00%	3126	1.64%
GEP	0	0.00%	346	0.62%	744	0.95%	1090	0.57%
KIG	636	1.12%	0	0.00%	244	0.31%	880	0.46%
LDP	297	0.52%	1045	1.88%	531	0.68%	1873	0.98%
LP	18035	31.86%	15552	27.92%	26803	34.13%	60390	31.64%
NGGP	950	1.68%	704	1.26%	1109	1.41%	2763	1.45%
PO	3888	6.87%	0	0.00%	0	0.00%	3888	2.04%
TAG	3074	5.43%	4426	7.94%	9869	12.57%	17369	9.10%
Other	895	1.58%	1249	2.24%	1694	2.16%	3838	2.01%
Formal	**56604**	**95.59%**	**55708**	**96.01%**	**78528**	**96.37%**	**190840**	**96.03%**
Informal	**2612**	**4.41%**	**2314**	**3.99%**	**2955**	**3.63%**	**7881**	**3.97%**
Total	**59216**	**92.50%**	**58022**	**91.71%**	**81483**	**89.22%**	**198721**	**90.90%**
Enrolment	**64020**		**63267**		**91328**		**218615**	
Discarded	**38**	**0.06%**	**40**	**0.07%**	**47**	**0.06%**	**125**	**0.06%**
Discarded + Informal	**2650**	**4.47%**	**2354**	**4.05%**	**3002**	**3.68%**	**8006**	**4.03%**
Total votes including discarded	**59254**		**58062**		**81530**		**198846**	

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. A paper ballot that was not placed in a ballot box would be counted as discarded.

Table 5: Options for providing electronic voting at the 2004 election

Options to provide electronic voting using existing "polling day" arrangements

Option Description	No. of pre-poll centres	No. of polling day polling places [1]	No. of voting PCs at each location	Estimated no. of electronic votes [2]	Estimated budget supplementation required
Option A Electronic polling provided at the same number of polling places as at the 2001 election.	4 Civic, Woden, Tuggeranong, Belconnen	8 electronic 73 non-electronic	10 PCs except Civic 20 PCs	22,000	$80,000
Option B Electronic polling provided at more polling places on polling day.	4 Civic, Woden, Tuggeranong, Belconnen	12 electronic 69 non-electronic	10 PCs except Civic 20 PCs	27,000	$130,000

Options to provide electronic voting during a "polling period" arrangement

Option C [3] Open pre-poll to voting to all electors and provide electronic voting for three weeks at 4 pre-poll centres and on polling day at 4 polling places. Keep all other polling places open with paper ballots only.	4 Civic, Woden, Tuggeranong, Belconnen	8 electronic 73 ordinary polling places	30 at pre-poll centres 10 at polling places on polling day	90,000	$210,000 (Cost $240,000 less $30,000 offset saving in scrutiny costs)

Option Description	No. of pre-poll centres	No. of polling day polling places [1]	No. of voting PCs at each location	Estimated no. of electronic votes [2]	Estimated budget supplementation required
Option D Open pre-poll voting to all electors for three weeks and provide 12 pre-poll centres and 8 electronic polling places on polling day only.	12 Civic, Woden, Tuggeranong, Belconnen, Gungahlin, Kippax, Dickson, Manuka, Weston, Conder, Chisholm, Erindale	20 electronic (pre-poll locations plus eight other locations)	30 at pre-poll centres 10 at other polling places on polling day	165,000	$190,000 (Cost $667,600 less offset cost of not opening 61 polling places $427,000 and scrutiny savings $50,000)
Option E Open pre-poll voting to all electors for three weeks and provide 12 pre-poll centres only	12 Civic, Woden, Tuggeranong, Belconnen, Gungahlin, Kippax, Dickson, Manuka, Weston, Conder, Chisholm, Erindale	12 electronic (pre-poll locations only)	30	165,000	Saving of $37,000 (Cost 580,000 less offset of cost of not opening 81 polling places 567,000 and scrutiny savings $50,000)

Note 1: 8 non-pre-poll electronic polling places on polling day would be the maximum logistically achievable due to set-up considerations
Note 2: In calculating the number of votes to be taken it is assumed that 75% of the votes taken where electronic voting is offered will be electronic votes.
Note 3: In Option C, it is assumed that half the voting population (110,000 electors) will vote on polling day