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**From:** Harvie Branscomb [REDACTED]  
**Sent:** Friday, March 30, 2007 3:25 PM  
**To:** Voting Systems  
**Cc:** [REDACTED]  
**Subject:** public comments for CA Top-To-Bottom Review  
**Attachments:** TOP2BOTTOM\_hb3.doc; H\_Branscomb\_070329\_SoS.doc; Election\_Reform\_Points.doc

Secretary Debra Bowen  
1500 11th Street  
Sacramento, CA 95814  
ATTN: Voting Systems Review, 6th Floor  
By e-mail:  
votingsystems@sos.ca.gov

March 30, 2007

Please see attached comments (TOP2BOTTOM\_hb3.doc) concerning TOP-TO-BOTTOM REVIEW OF ELECTRONIC VOTING SYSTEMS CERTIFIED FOR USE IN CALIFORNIA ELECTIONS.

I have also provided two other documents, one prepared for the Colorado Secretary of State (H\_Branscomb\_070329\_SoS.doc) and another which is a simple list of election reform topics (Election\_Reform\_Points.doc) .

The documents contained here are the product of my best understanding about the topics concerned and not the official report from any organization to which I belong,

Harvie Branscomb  
Coloradoans For Voting Integrity  
Eagle County Colorado Canvass Board  
CEO, StandbySoft LLC

TOP-TO-BOTTOM REVIEW OF ELECTRONIC VOTING SYSTEMS  
CERTIFIED FOR USE IN CALIFORNIA ELECTIONS

Secretary Bowen:

Thankyou for accepting public comments on this vital topic. I have also been invited to provide similar comments to the Colorado Secretary of State in conjunction with the recertification of voting machines pursuant to Dennis vs. Conroy, and have produced my own proposal for revision of Colorado Rule 45 on Certification, although in Colorado we have not been asked to help create the basic criteria for success of the election system. Your approach is admirable.

Note that I have also elsewhere provided my comments to the Colorado Secretary of State for background information.

I have inserted my remarks into the original paper, in green color and underlined.

In addition to criteria for voting systems, one ought to first establish a couple of principles for the handling of decision-making about criteria, about specifications, about equipment acquisition and about acceptance and statutory testing... and these are:

**Public involvement and accountability-** elections have undergone an unnecessary trend from the simple and humanistic to the highly technical, but even as voting systems become complex, the public remains a great resource for oversight, information, technical assistance, etc. Often members of the public can be more qualified to assist in voting system improvement than the experts working for manufacturers or election officials. In any case the members of the public are less likely to have a vested interest which detracts from representation of the public interest, which both manufacturers and election officials have... and that difference comes down to issues like cost, efficiency and re-electability.

For these reasons it is imperative that members of the public are involved in the process. Members of the public have an essential interest in the election quality which does not branch from a primary desire to achieve election confidence. Rather, their primary interest is election accuracy. Therefore all election information also ought to be made available to the public, even in raw unedited form, such as on the internet. This access will empower the specialists among the public to be able to make their recommendations.

The superficial appearance of election confidence must not be built upon the fact of undisclosed information.

In addition, it is very typical for all the members of advisory boards or decision-making bodies for election decisions to share common interests and habits and shortsightedness. To offset this effect it is crucial to be sure that there is a role for a **devils advocate (equivalent to red-team)**, a critical thinker who will ask all the hard questions. This should not be left up to serendipity... it should be an identified role and a specific individual or individuals who are aware of and paid to conduct their role.

## DRAFT CRITERIA

The original criteria are incomplete. Among major categories of criteria-- accuracy, reliability, transparency, verifiability and anonymity are all missing. . Considering the intention to perform a top to bottom review... a great deal is left to be desired here which must be added. I have not created what I would accept as a complete set of criteria. I have only filled in the outline of what should be here and started to add the meat to each section. *I hope that on behalf of California voters that the Secretary of State's office will work overtime to create a complete document of appropriate criteria before launching into the top to bottom reform.*

Reasoned thinking would suggest that there ought to be a natural order of precedence for the criteria for voting system performance metrics and certification. Security does not belong at the top of this list. I would propose the alternate order of precedence as follows: accuracy, reliability, accessibility(usability), security, transparency (verifiability), anonymity and secrecy.

If these criteria are not placed and employed in an order of precedence, then it is impossible to design a practical scheme for operating elections under unexpected or exceptional conditions (such as too many voters arriving unexpectedly at the polls at one time, or failure of computer hardware, power failure, etc.). In such a case for example, would not one prefer election officials to distribute paper ballots to enough voters to be sure that no one leaves the polls without voting due to a waiting line even if these ballots can not be voted in perfect privacy?

Accuracy must be first, as without accuracy there is no point in having any of the other criteria or the election... security is clearly secondary as without security it remains possible to have a good election... likewise without ballot secrecy and anonymity a good election is still possible, but without accuracy and accessibility, a good election tally is extremely unlikely.

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Section 19205 of the Elections Code authorizes the Secretary of State to establish specifications for voting machines, voting devices, vote tabulating devices, and any software used for each, including the programs and procedures for vote tabulating and testing. These criteria must include suitability for the purpose for which a machine or device is intended, preservation of the secrecy of the ballot and safety of the voting system from fraud or manipulation. Pursuant to the authority established in Elections Code Section 19205, as well as the authority established by Section 12172.5 of the Government Code and Sections 10, 19222, 19227 and 19250 of the Elections Code, the Secretary of State hereby establishes criteria for the review of all voting systems currently certified for use in the State of California.

In each of the examination and testing processes set forth below, qualified

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reviewers selected by the Secretary will evaluate compliance with the mandatory provisions of the Elections Code, voluntary federal voting system standards as incorporated into California law by the Elections Code, and other applicable requirements imposed by state and federal law, including, but not limited to, Article II, Sections 2.5 and 7 of the California Constitution.

## 1. ACCURACY and RELIABILITY

### A. Standards for Accuracy and Reliability

The criteria for accuracy must include an acceptable rate at which intended votes are not correctly interpreted or (separately) counted. This rate must be tested.

The processing of the cast ballot consists of three separable fundamental stages which decision-makers about election equipment and procedures must be concerned. First the interpretation of the vote, second the counting of the vote, third the tallying of the vote. The first involves the determination of the voter intent, the second the initial accumulation of interpretations into a set of numerical quantities, and the third involves the accumulation of these numerical representations of the vote into the totals for the race which determines the outcome.

First and foremost it must be recognized that human beings are always superior to machines at interpreting the voter intent. In questionable and close election cases, humans must be relied upon to perform this function. Second it must be recognized that while humans have the potential for error, there are humanistic techniques for reducing this error below the threshold of significance. Criteria for performing hand counting successfully should be developed. There are methods, for example the sort before counting method, in which subsequent passes through the process actually increase the accuracy, and hence with enough passes the accuracy always becomes sufficient to achieve significance.

Third it must be recognized that machines are also subject to error which must be accounted for. Machines can be produced which have very high reliability, which means that they are capable of performing the same function, given the same input, close to identically for many repetitions. This is a very desirable characteristic for the counting and tallying of ballots. Machines are capable of counting and tallying ballots with great accuracy as well, that is, they are not likely to make a mistake during this counting function, but it is possible they will and we must therefore set standards for success at performing this function.

Machines will also have difficulty to interpret voter intent accurately. This is the case with optical scanned ballots where the marks may have been made sloppily, or where extraneous marks or folds intercede. Likewise with the DRE type equipment the machine may likely have difficulty to ascertain the voter intent, but

unlike with paper ballot records, the record of this difficulty will be maintained only in either the misunderstanding or frustration of the voter who failed to be understood by the hardware and departed from the polls.

For all the above reasons we must have quantitative standards for both accuracy and reliability for voter interpretation and for counting and these must be expressed and tested separately. Quantitative standards are important because a decision must be made on technical and quantitative grounds whether or not the device or procedure is adequate to determine the outcome of the election. The accuracy needed depends on the spread of votes, and this is why special attention and methods should be applied for narrowly differing results in a specific race.

#### B. Testing

Testability is a sub category of accuracy, for if the voting system is not testable, then its accuracy can not be determined. Furthermore, if it is not practical to test the voting system in the field to determine if it can properly conduct the election under the conditions of the typical ballot programming present in the machine, then it also can not be known to be accurate.

Equipment and procedures specifications must permit adequate pre-election testing and adequate post election auditing. For testing this means that it must be possible to simulate the election during a test to the extent that all relevant modes of the device are exercised under conditions identical to that of the actual election (date, method of voting, etc.). It must be the case that results from such a test election will not be confused with the results of the actual election, and if the test is made on only a subset of equipment, then the decision over which equipment to test must be made at the time the test is done to assure that conditions for all machines is identical.

[The Secretary of State should make a determination of criteria for testability of the voting system... ie how long it should take to determine if the election programming is proper to allow the selection of candidates and issues, and to fairly present the alternative choices in both audio and visual form. On a DRE, where it is impossible (short of having a programmed robot) to create a standard sample of test votes to be counted by each machine, in fact test voters must operate the voting system for each ballot style programmed for each possible combination of choices, in each mode of operation (audio and visual) and in each and every order of presentation, and exercising any other options made available to the voter. The purchasing jurisdiction should be made aware of the cost required in time and money for sufficient logic and accuracy testing to take place.]

#### C. Auditing

For the purposes of post election audit, it is critical to be able to audit an actual election subtotal, a count which has been included in the election tally, and to be

able to determine by hand( and eye) the voter intent, and to hand interpret and count all of the votes which constitute the count included in the election tally.

Alternatively the voting device must be capable of producing truly randomly chosen specific instances of records of voter intent (paper ballots) and the corresponding interpretation of voter intent by the machine (cast vote records) for comparison by hand matching. And all the cast vote records must be produced and delivered in a fashion which allows them to be counted by a technique independent of the original machine count, and which is human verifiable.

The accuracy and reliability of these tests must be sufficient to determine that the accuracy and reliability of the equipment and procedures under test meet the specifications according to the criteria.

The length of time and resources required to perform adequate testing (to well within the accuracy expected of the election system), must be well within reasonable and practical limits. When election tally differences fall under a pre-established threshold set by the accuracy of the testing (which itself determines the known accuracy of the system) then the ballots must all be counted by a more accurate system such as sort-before hand counting.

## II. ACCESSIBILITY/USABILITY

### A. FOR ALL VOTERS

Accessibility refers to more than just access for voters with disabilities using alternate languages... it must also refer to general availability of the opportunity to vote for anyone, without unreasonable waiting in line, or improper denial of enfranchisement for any reason. To prevent unreasonable waiting in line, it may be necessary for some form of parallel alternate voting opportunity to be offered which does not require the time consuming use of a limited number of very expensive electronic devices during the voting process. For several reasons voters deserve a right to optionally vote on a paper ballot: to avoid waiting in line, to be sure they can express their voter intention, and to be sure that there is a permanent hand countable record of their voter intention. (such a paper ballot may be optional, but it is necessary).

### B. FOR DISABILITY VOTERS

#### 1. Disability Access Standards.

The federal Help America Vote Act (HAVA) requires that all polling places in elections for federal office have at least one voting system that is "accessible for individuals with disabilities, including nonvisual accessibility for the blind and visually impaired, in a manner that provides the same opportunity for access and participation (including privacy and independence) as for other voters."

Under Elections Code Section 19250(a), the Secretary of State may not certify a DRE unless the system “includes an accessible voter verified paper audit trail.” Elections Code Section 19250(d) requires that all DRE voting systems “shall include a method by which a voter may electronically verify, through a nonvisual method, the information that is contained on the paper record copy of that voter’s ballot.” Under Elections Code Section 19251(a), “[a]ccessible’ means that the information provided on the paper record copy from the voter verified paper audit trail mechanism is provided or conveyed to voters via both a visual and a nonvisual method, such as through an audio component.”

## 2. Disability Access Testing.

Each voting system will be examined to determine whether it complies with the accessibility requirements of HAVA and the Elections Code. The examination will be conducted with the assistance of persons from the disabled community. For purposes of this review, a voting system complies only if it provides all of the following features and capabilities in at least one voting system available for use in every polling place:

- (a) A dual-switch input control interface that permits use of “sip and puff” or other adaptive devices by voters with paralysis or severe manual dexterity disabilities who are unable to use touch screens or tactile key inputs.
- (b) The capability for the voter to select simultaneous and synchronized audio and visual outputs, audio outputs only or visual outputs only.
- (c) Voter-adjustable magnification, contrast and display color settings to improve the readability of text on the video displays.
- (d) Variable audio output levels and playback speed for voters with hearing impairments.
- (e) Privacy curtains or shields that effectively prevent others from observing or hearing the selections of a voter using such features as audio output, simultaneous, synchronized audio and visual output, display magnification or modified display font, contrast or color settings.
- (f) In the case of a DRE, the capability to permit a voter to verify electronically, through a nonvisual method, the information that is contained on the voter verifiable paper record copy of that voter’s ballot. This requirement is satisfied by a method of nonvisual confirmation that draws the information provided to the voter from either (1) the paper record copy itself or (2) the same electronic data stream used to print the voter verifiable paper record copy.

[Method 2 is not adequate to handle the case where the printer fails to print due to technical difficulty with the printer, or the case where by fraud or unintentional error, the printer does not print the contents of the electronic data stream correctly. To justify this

back door special case provision would logically require additional unequivocal testing to prove that the printing system works with extremely high accuracy and reliability.]

(g) insure that the access to various choices within one line of the ballot is equal and fair in the audio modality, other than the simple order of appearance of candidates or choices.

(h) acknowledging that independence and privacy do not require a definition of casting of the ballot which prevents a paper ballot from being produced by an assistive device, delivered within a secrecy device such as a sleeve and subsequently carried by the voter or an election official to a ballot box or optical scanning device .[This permits the ballot marking device style of equipment to be used.]

### 3. Disability Access Findings.

The Secretary of State may make written findings, based on the results of the disability access testing described above, that a voting system fails to include any of the foregoing disability access features and capabilities, in which case the Secretary of State may immediately initiate the process to withdraw certification from the voting system for disability access use.

### C. FOR ALTERNATIVE LANGUAGE VOTERS.

HAVA requires that every voting system used in an election for federal office “shall provide alternative language accessibility pursuant to the requirements of Section 203 of the Voting Rights Act of 1965 (42 U.S.C. 1973aa-1a).” Every certified voting system will be tested to determine whether it provides alternative language accessibility in the federally mandated language or languages for each county that uses or intends to use the system. If the Secretary of State makes written findings, based on the results of the minority language access testing, that a voting system does not provide alternative language access as required by federal law, the Secretary of State may immediately initiate the process to withdraw certification from the voting system with respect to the affected county or counties.

### D. USABILITY FOR ELECTIONS OFFICIALS AND POLL WORKERS.

Each certified voting system must be designed, configured and accompanied by sufficient documentation and training materials so that, in the absence of extraordinary circumstances, elections officials and poll workers can independently and without assistance or intervention by employees or contractors of an election system vendor, carry out all operations necessary to open the polls, set up and calibrate voting system equipment, instruct and assist voters in registering votes and casting ballots, respond to voting system error messages or temporary power failures, close the polls, print end-of-day vote totals, take down voting system equipment, transfer polling place results to central tally computers and tally final results.

The Secretary of State will **conduct a review of each voting system’s**



**documentation and records** regarding the use of the voting system by elections officials and poll workers in California elections. The Secretary of State may make written findings, based on the results of the review, that a voting system does not reasonably permit such independent operation. Based on such findings, the Secretary of State may immediately initiate the process to withdraw certification from the voting system.

[Obviously this is a place where functional tests are required, not a review of documentation and records. Usability or user friendliness can not be determined by a simple review of documentation. Perhaps if national testing was sufficient in this regard, a demonstration of the successful completion of usability testing at a national test lab might be sufficient.]

### III. SECURITY.

#### 1. Security Standards.

For purposes of these standards, “untraceable vote tampering” means preventing the accurate electronic recording of votes, or altering the record of votes, to change the result of an election in a manner that leaves no electronic record of tampering. “Denial of service attack” means disabling a voting system other than through sheer physical destruction in a manner that renders the voting system inoperable for voting.

It must be remembered that merely because vote tampering is traceable does not imply that it will be found and corrected for. Criteria must make provisions for discovery of breaches of security or tampering which circumvents security measures, and appropriate correction for these breaches, assuming that human error may tend to lead to both lack of discovery and also failure to correct or notify the public.

a. DREs. Each direct recording electronic voting system (“DRE”), as defined in Elections Code Section 19251(b), must incorporate, as part of its design, hardware, firmware and/or software program features that effectively secure the DRE and all electronic media used with the DRE against untraceable vote tampering or denial of service attacks by any person with access to the DRE, its firmware, software and/or electronic media during their manufacture, transport, storage, temporary storage, programming, testing and use, including the electronic ballot definition or layout process.

b. Vote Tabulating Devices. Each “vote tabulating device,” as that term is defined in Elections Code Section 358, must incorporate, as part of its design, hardware, firmware and/or software program features that effectively secure the vote tabulating device and all electronic media used with the vote tabulating device against untraceable vote tampering or “denial of service” attacks by any person with access to the vote tabulating device, its firmware, software and/or electronic media during their manufacture, transport, storage, temporary storage, programming, testing and use.

c. Ballot Tally Computers and Ballot Tally Software. Each computer used to tally ballots and each “ballot tally software program,” as that term is used in Elections

Code Section 19103, must incorporate, as part of its design, hardware, firmware and/or software program features that effectively secure the computer, the ballot tally software program and all electronic media used with the computer and program against untraceable vote tampering or “denial of service” attacks by any person with access to ballot tally software program, the ballot tally computer, its firmware, software and/or electronic media during their manufacture, transport, storage, temporary storage, programming, testing and use.

## 2. Security Testing.

The security of each DRE, vote tabulating device and ballot tally computer will be tested using two complementary methods, “red teaming” and source code review. The Secretary will select qualified industry and academic experts in computer and software security, including experts in electronic voting systems, to perform both types of tests.

a. Red Teaming. The “red teaming” process is analogous to military training exercises in which the members of the “red team” are adversaries trying to defeat friendly, “blue team” forces. The red team exercise will be designed to simulate conditions in which a voting system might be vulnerable to attack in the actual cycle of manufacturing, programming, delivery, testing, storage, temporary storage and use in California elections. Initially, the team will approach the system knowing nothing of its source code. Knowledge of source code may be used in subsequent attack attempts. The objective will be to determine whether and to what degree it is possible to compromise the security of the voting system to interfere with the accurate recording of votes or alter the record of votes to change the result of an election.

This approach can be used to great advantage at all levels of discourse regarding system design and function including testing and certification. The participation of persons whose role it is to take on a position of devils advocacy within every test and every deliberation is key to both securing the system adequately and also increasing the likelihood of its performance vis a vis other more important criteria such as accuracy.

b. Source Code Review. The second component of security testing will be source code review. The objective of the source code review will be to identify anything in the code that could be used maliciously to interfere with the accurate recording of votes or alter the record of votes to change the result of an election. The source code review may be performed prior to, during or after completion of the risk assessment.

[Why one wonders is it ok to perform the source code review prior to during or after? Above it indicates that knowledge of the source code may be used in the design of the red-team efforts.]

## 3. Security Findings.

Upon completion of either component of the security testing, the Secretary of State may make written findings that a DRE, vote tabulation device or ballot tally

computer is not reasonably secured against untraceable vote tampering and “denial of service” attacks by features included in the design of its hardware, firmware and/or software. On the basis of such written findings, the Secretary may immediately initiate the process to withdraw certification.

[The above section does not address the probability that traceable vote tampering will be traced and actually made known to the public in sufficient time for corrective action to be taken.. And therefore specifications should include a means for breaches of security to become known in a manner which permits them to be responded to in a timely and effective manner.]

#### IV. TRANSPARENCY/VERIFIABILITY

##### A. Transparency

The voting systems shall record in a log, preferably in an independent piece of equipment all externally effected events such as resets of various kinds, normal and abnormal commands and operations, and exceptions for the purpose of creating an audit trail which would allow a post facto determination of the cause of any given outcome. To the extent possible, all data related to the election shall be in a human readable and electronic form suitable for publishing on the internet. Many election exception events are volatile and of immediate consequence and are only correctable within a short period of time and must be acted upon for example before casting the ballot. These events and associated data must be treated with the utmost urgency and must be made available to election officials and interested parties immediately. Likewise some data is of major consequence in informing the candidates and committees early enough to provide justification for an election contest and must therefore be made known to the public as it is encountered. The election equipment and procedures must acknowledge and facilitate the urgent publication of these events and exceptions.

##### B. Verifiability

The voter should have the ability to verify that the marks made upon the permanent physical record of the ballot actually represent the true voter intent. (this might be by VVPAT or the ballot marked by ballot marking device, or a human marked ballot). The markings on said record shall be sufficient to allow full and proper verification (ballot issues shall be marked by name or full text and not only by number, etc.).

#### V. ANONYMITY and PRIVACY

A. Vote records after casting shall have no marks related to the specific identity of any individual voter, nor shall they be kept in order of appearance of voters at the polls nor in any other manner which would have the side effect of possibly permitting a retroactive determination of the specific identity of the voter for any given ballot.

- B. Voters shall to the extent possible be permitted to vote in a manner in which no other individual or election official will have the ability to determine the vote choices of that particular individual. This will not be guaranteed to the extent that it causes any single voter to be disenfranchised, or the election system to become in any manner less accurate.

Harvie Branscomb  
Canvass Board, Eagle County Colorado  
Board Member, Coloradoans for Voting Integrity  
CEO, StandbySoft LLC

The Secretary of State intends within the next several weeks to begin a top-to-bottom review of voting systems currently certified for use in California elections. The goal of the review is to determine whether currently certified voting systems provide acceptable levels of security, accessibility, ballot secrecy, accuracy and usability under federal and state standards. For those that do not meet acceptable levels, the review will help determine whether certification should be withdrawn unconditionally, or withdrawn subject to re-certification with additional conditions on use for elections in 2007 and 2008.

Pursuant to Elections Code Section 19222, any decertification decision would only be effective for elections held more than six months later. Accordingly, a decertification decision made on or before August 3, 2007, would be effective for the February 5, 2008, presidential primary election. Every effort will be made to complete the top-to-bottom review of all voting systems before August. This will ensure that no voting system known to fall short of California's high standards will be used in any of the three major statewide elections scheduled for 2008. It will also assure local elections officials, poll workers and voters that they will not be required to change voting systems during the short intervals between the February and June 2008 elections and between the June and November 2008 elections, unless a serious new flaw is discovered that makes a later decertification unavoidable.

What follows is a set of draft criteria to guide the review of currently certified voting systems. The Secretary of State welcomes questions, comments and recommendations for changes from local elections officials, voting system vendors and any member of the public. This is only a draft; the final criteria may reflect substantial revisions based on the responses received and/or further review.

Please submit your questions, comments and recommendations regarding the draft criteria in writing no later than March 30, 2007 to:

By mail:  
Secretary Debra Bowen  
1500 11th Street  
Sacramento, CA 95814

ATTN: Voting Systems Review, 6th Floor. . . . .

By e-mail:

[votingsystems@sos.ca.gov](mailto:votingsystems@sos.ca.gov)

After considering all questions, comments and recommendations submitted in response to the draft criteria, the Secretary of State will adopt final criteria no later than April 6, 2007.

**Written expansion of the 10 minute speech for special meeting with Secretary of State Jan 15, 2007: submitted for inclusion with the other testimony from February 15.**

**Harvie Branscomb, [harvie@media.mit.edu](mailto:harvie@media.mit.edu), Coloradans for Voting Integrity**

I am here representing Coloradans for Voting Integrity, and I am a Canvass Board Member for Eagle County. I also run a small software company which provides a product to enhance the reliability to the Microsoft Windows Operating System. Participating in and discussing elections is entirely a volunteer role for me which does not contribute to my ability to support myself.

I know that there has been a lack of participation by the public in designing and defining election procedures and this has not been from lack of interest. There is a real danger that public participation here today will be considered somehow sufficient, and that there will be no accountability or follow up for what we all have to say. I am hoping and asking for an alternative result.

Members of the public who are interested in their elections have been given a great opportunity by electing a new Secretary of State who is committed to follow up with election reforms. Election activists and elected officials would be smart not to miss this chance for reform. There are good reasons to question our election processes, even beyond the superficial evidence and stories which reach public consciousness through the press.

There is a systematic problem with information about elections... information outside the realm of simple voting results is accidentally or casually or sometimes deliberately blocked.... (e.g. canvass board notes on audits which are not published on the web with the audit counts). There is a great need for public access to the details of our elections and no effective argument against making these things public. Without much public involvement, and with election officials remaining in office for a long time, processes of the election system get rusty over time. They need to be periodically oiled and now is the time.

The first step is to open up channels of communication and provide for a responsibility to gather and distribute information about exceptions and surprises both good and bad which are encountered by voters and by election officials. We need to extend the role of the county canvass board, establish a similar role at the state level, and make sure that all information about our elections, not just the results, but the unusual situations encountered along the way, are logged and analyzed for the express purpose of improving the system.

There is an impression that the press is performing this function. That could not possibly be true. Election details are exactly the kind of information the press is not interested in... unless it happens to meet certain other criteria for excitement. Bloggers are also not performing this role effectively.

The second step to be taken is to re-examine our election as a whole from basic principles using an engineering point of view, taking into account the human factors of voters and of course election officials. We have been engaged in retrofitting solutions for the most visible problems without taking a systematic approach to the entire system. And this has been going on for too long, while various technical devices have been added to our options with in many cases drastic and unexpected side effects. The DRE is has some of these side effects.

Voting machines are just one component of the election system...and until recently they were an optional part of our election system. Its important to remember that equal scrutiny needs to be applied to all of the components, voting machines and procedures:

There are:

1) the testing of voting machines... national, state, acceptance test, hardware test, LAT test, and post election audit- all of these rules and procedures need review and repair. I am participating to the extent I am allowed in the re-write of state certification rules, and have written a proposed alternative version for the Secretary of State. There is a great deal to be said about the weakness of each of these tests.

2) ballot design, programming procedures,

3) registration procedures and eligibility checking,

4) procedures for polling place management, including the management of waiting lines, and

5) oversight of election officials by canvass boards.

Are we dealing with simply a lack of security and hiccups with relatively unfamiliar DRE machines? Or is Judge Manzanera right about a systematic failure to develop standards and a corresponding lack of testing? Are we primarily concerned with the security aspect of voting machines? I think not. Is our concern limited to the recent arrival of the DRE? No, based on what I have found, the accuracy, reliability of optical scanners and various election procedures have equal reason to be questioned.

Those who have control of this system... Mr. Secretary, and the clerks, seem to have a primary vested interest in voter confidence. An easy way to build voter confidence is to keep various election details behind closed doors and buried in bureaucracy, but this does not well serve the public interest. Are we concerned about low voter confidence? Voter confidence is not the primary goal of the election system. It is simply a desirable side effect of a well designed and well operated election system.

I think it is safe to say the public would rather have an accurate voting system than one which simply appears to be accurate. The best election officials are those who admit to their own lack of knowledge, know that the system can be improved, try their best to learn and to be effective in improving the system, invite the public to participate in the process and accept the eventual likelihood of moving on to another job.

We still often hear the phrase "the voting system performed perfectly" and "no problems found". Unfortunately this does not necessarily mean that the voting system was accurate in interpreting and tallying voter intent. It usually means that minimal negative feedback was heard from the voters and from the press. One possible reason for this is that voters had no access to any feedback themselves about whether or not their particular vote counted. Unlike a voting machine, what the user gets from an ATM machine is a precise amount of money and a receipt. Since the voting machine provides no immediate evidence of its function and credibility, the voter depends on election officials to prove the accurate function of the machines and the procedures in concert.

There is a general need for prioritization of election goals. Election rules by the time they are being looked up in a book are going to be taken literally and therefore need to have intelligence built in to allow less perfect backup systems to take over in case of major problems, unless we are willing to set a rain date for problem elections. Attracting eligible voters to the polls long enough to vote, and the accuracy of the interpretation and counting of that vote are the highest goals on my list. It is

always better to have the voter vote on an improper piece of paper than to have them walk away from an election in which they will lose their right to vote.

To reiterate the most important improvements needed: information flow; redesign from basic principles; work for reality over appearances; new rules giving priority to accuracy and enfranchisement.



## **Election Reform** , Feb 15, 2007

There is an impression that elections are by and large successful and well performed, with a few spectacular examples of failures which are due to technical problems, and for this reason, blaming spectacular stories in the media, voter confidence is lagging behind the actual quality of the election.

While the evidence brought before Judge Manzanares was primarily related to security issues, in fact there is ample evidence for applying a failing grade to all of the elements of testing and certifying and auditing of voting machines, as well as suspecting the nature of election rules and procedures which are either not well thought through or have been in place too long to account for changes in systems and habits.

It is my understanding, after considerable personal experience and investigation, that in fact voter confidence exceeds actual election quality, even in what superficially seems to be a problem free county.

I will try to explain how this could happen, and what we need to do to fix it.

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The state statutes and SOS rules do not contain adequate requirements for recordkeeping of problems encountered or improvements suggested by election officials and voters during the election process. In practice, valuable information about exception cases, good and bad, within the election are lost- by the voter walking away from an unsuccessful voting experience, by an election judge who prefers not to make a criticism, by election staff who feel the need to protect their job, by clerks who want to be re-elected. Even those who are self motivated to log and report election exceptions find it difficult to report, and difficult to find out a suitable place to make a report. Colorado post election audits have a mechanism for reporting to the public, but important notes attached to the report are stripped out by the SOS office before publishing. There are countless examples of this in the Colorado election system. It is correct to say that the election is not quite what it appears to be. There are details which are not coming to light.

The makeup of the canvass board is such that the Clerk, who is actually a candidate in the election every four years, is generally in control of the canvass board, and in control of the canvass board's access to information. The canvass board itself has a vestigial role in making sure that the number of votes counted does not exceed the number of voters casting ballots, but in fact it has no recourse even when this case arises. We need effective oversight in every county by a board which is independent of the election officials and candidates in the election. And we need this kind of oversight for the Secretary of State's office, to insure that there is sufficient critical thinking and follow through in the public interest around that office.

We now have mounting evidence of problems at every level of testing... national testing is under criticism from national election organizations, state testing has been debunked by Judge Manzanares for failing to set standards which would allow adequate testing to take place, county acceptance testing is generally performed by the manufacturer and similar to pre-election hardware testing succeeds to prove that the batteries are charged and the lights come on and little else. Logic and Accuracy testing isn't intended to check whether the voting machine counts votes or not, and is merely expected to prove that the ballot is programmed correctly. When this testing finds a fault, which is then presumably corrected in response, it is not likely the LAT test will be repeated as is

critically needed. Post election audits are conducted in a variety of ways, some of which are recommended by the SOS office, most of them are not an audit at all but a recount, and a recount under different circumstances than the circumstances in which the election was held.

Under the conditions noted above, we can't say that a "no problem found" election is a good election. We have quite a bit of work to do to.

In Eagle County as a canvass board member I have come to be aware that there are numerous exceptions encountered in elections, some of which are very significant, and others can be worked around with a few extra steps. These generally are not ever made known to the public, for fear of a loss of voter confidence. It may be that awareness of these facts is thought of as someone else's responsibility (such as that of the press). Or just that the voters just do not need to know how difficult it is to run an election. The press can not possibly take responsibility for obtaining and spreading knowledge of election problems. It just isn't exciting enough (until it is exciting enough, and by then it is way too late).

Testing of DRE machines in comparison to testing of optical scanners and the paper ballots that are read by them is more time consuming and almost sure to be inaccurate. The simple reason for this is that with a paper ballot you can be sure of what the "vote" is before you test the machine. In the case of DRE, each time test voters approach the machine, there is a new case of "the votes". This small fact is well worth appreciating in all of its implications.

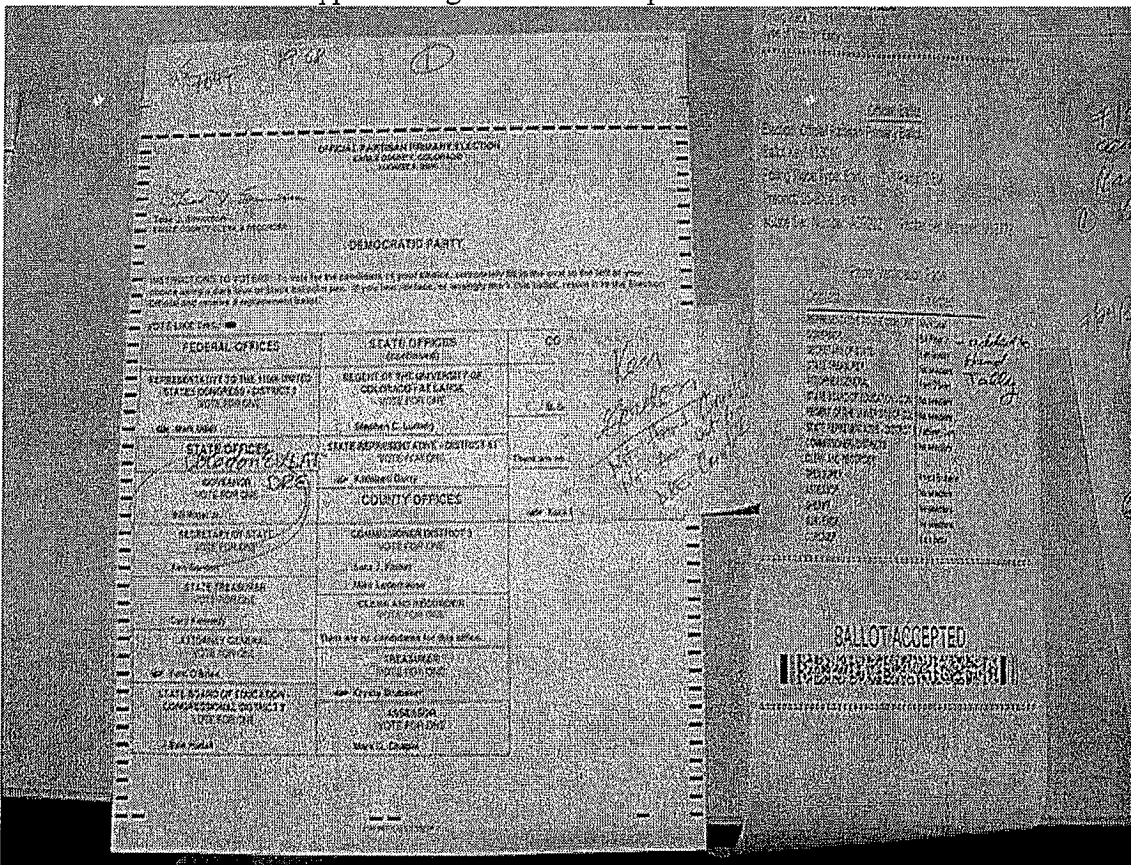


Figure 1: Reconciliation of DRE LAT

A strange but interesting side effect of using absentee ballots for recording the intended test vote is

that when there are vote marks present which are more difficult for the machine to interpret, a side effect is that test voters also can make more than the usual mistakes in test voting on DRE. This suggests that in LAT testing, one should use a very clear indication of voter intent as the template, and use uncertainly marked ballots only for absentee or paper at the polls testing. Of course, in most tests in most places, problematically marked ballots are never tested, but of course these are exactly the ballots which need to be tested to know how successful the optical scan equipment is. Our usual test procedure is more like "don't ask, don't tell", where the voting equipment is given the benefit of the doubt as long as it doesn't show us any evidence of mistake.

Interestingly, during LAT testing while you can and do find that the V-VPAT and the intended vote pattern occasionally mismatch, there is no way to know if the test voter voted the ballot correctly and the machine put the wrong information on the V-VPAT, or if the voter incorrectly voted and the machine performed correctly. Of course, the election officials assume the second case, that the human is in error, but there is no basis or proof for this, short of having a video tape of each machine being test-voted to be able to check if the original voter action was indeed made according to the vote plan.

In Ireland, I have been told, there was a functionality test of DRE involving tens of thousands of test votes, all recorded by video. Although the votes were made by teams of three (one to vote, one to watch and one to check the V-VPAT before casting) the rate of mismatch was found to be one in three thousand test votes. Video was used to check every case of apparent mis-test-voting. This is what is required to successfully run a functionality test on a DRE device. Anything less involves improper assumptions.

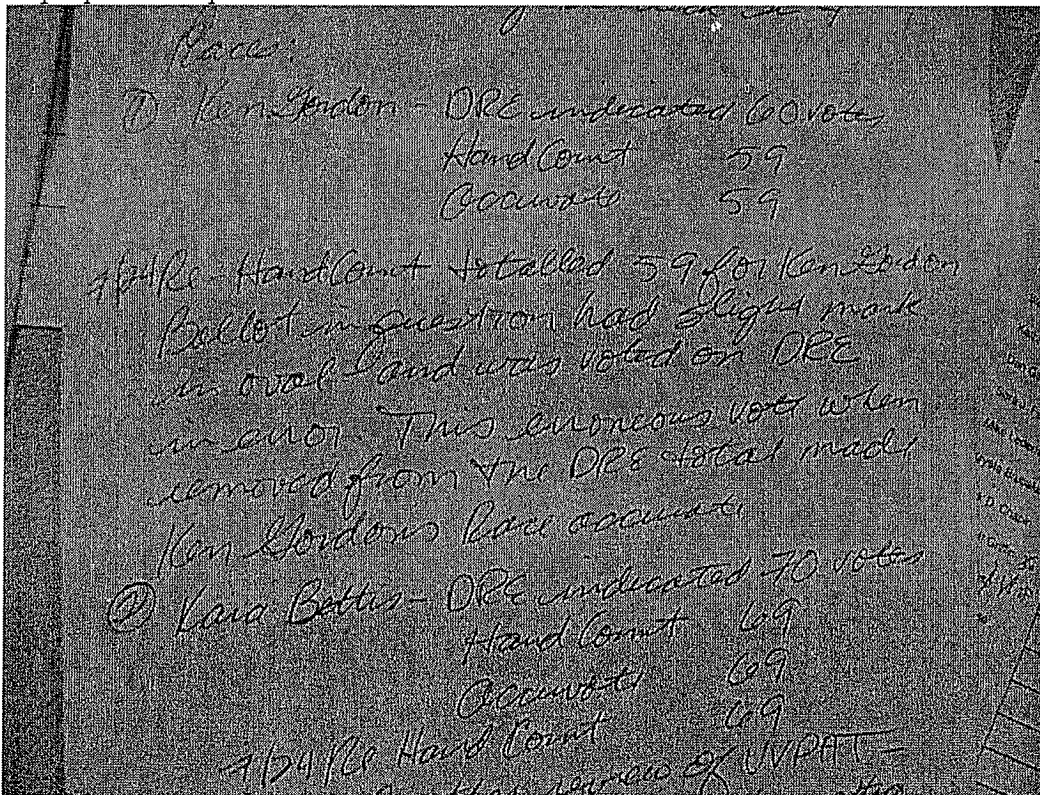


Figure 2: LAT Reconciliation explanation

I include photos showing the typical result of such a reconciliation, incompletely claiming that the

test vote was wrong instead of showing the possibility of either a test voter error or a DRE machine error. This is an example of how human error can be responsible for explaining away differences in reconciliation as human error and not machine error. Every time a mismatch occurs in a LAT or a post election audit, a search begins to find any evidence of the human error, and this search ends as soon as some evidence is found. This search for and belief in human error an endemic problem in the process of reconciliation for testing and audits, and it is rarely brought up for discussion, but surely ought to be.

For the same accuracy test, the time it takes to test a paper ballot and an optical scanner is much less than the time required for DRE. This is because paper ballots may be re-used in the testing, both with repeated observations (and counting) to be sure of the meaning of the marks on them, but also by repeated introduction into the optical scan machines to get better accuracy in the test. It is physically impossible to achieve any increase in accuracy by re-using the human effort in test voting DRE. This is the principal cause of insufficient testing, and excessive time spent in testing DRE. This is not a minor matter, but also rarely mentioned.

Logic and Accuracy testing for the DRE needs to be more of a simulation of the election, with the intention in mind to discover in advance the possible failure modes of the election. This must be done in sufficient time in advance of the first use of these machines in the election to allow a reprogramming of the ballot and full retesting. Reprogramming of the ballot without full testing has been seen to have unfortunate results in our county, leading to the need for reprogramming again under duress.

To its credit, the DRE (as well as other Ballot Marking Devices) allow easier support for multi-language, potentially better readability (on screen but usually not the V-VPAT); probably better formatting for clarity but less ability for random access and quick overview and verification. And both DRE and BMD have the interface for a variety of input devices for the disabled, including the audio ballot.

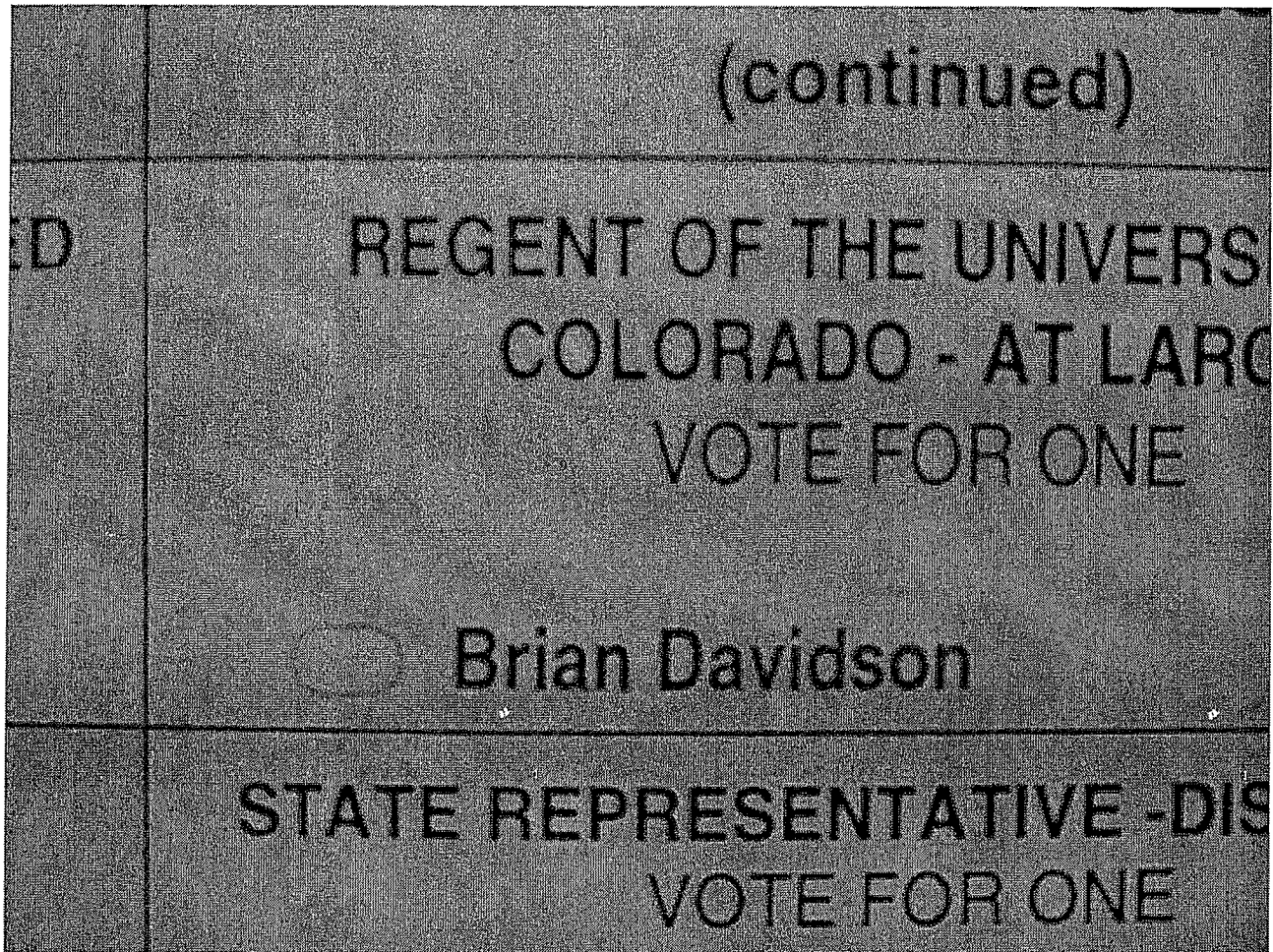
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The DRE may allow adequate auditing if specific procedures are followed and if the voter really verifies but many disabled can not verify with current system and all voters are somewhat unlikely to verify. The V-VPAT is an essential supplement to a DRE to preserve the possibility of audit, but directly marked paper provides a more credible audit if properly done as an audit and not as a recount.

To my knowledge there are fundamentally two ways to properly audit the voting device results. One way is to hand count all of the paper ballots or V-VPATs which were combined into a reportable sub-tally of the election results, in a number which is large enough to provide statistical credibility. Another method which is available only if the ballot image or the cast vote record is maintained by the voting device is to randomly (mathematically random, not just arbitrary selection) select a statistically significant number of ballots and to match all of these ballots with their respective cast vote records to be sure that the interpretation was correct and all votes on all lines match. This is done by interpreting the ballots or V-VPAT by human eye with the usual partisan oversight, and comparing this to the cast vote record. Then all of the cast vote records should be counted by an independent counting mechanism and the respective sub-tallies compared to the reported election sub-tallies. Both of these methods are acceptable and while the first is available for any device where a paper ballot (including V-VPAT) is available, the second is limited to particular designs of



equipment. The current rules and the respective advice to clerks regarding the audit are simply in a disarray and do not constitute an audit.



**Figure 3: Possibly incorrect vote interpretation**

The DRE avoids any uncertainty about interpretation of voter intent, meaning that any problem or misunderstanding of the voter about the machine or the machine about the voter is conveniently lost when the voter leaves the booth. It is left to the voter's responsibility to make sure they have understood the directions and input their vote correctly. But the digital record is simply not an effective proof of voter intent. Foul play and accidental programming and poor interface design and simple hardware failure could all be responsible for a misinterpretation of the voter intent. We need to have measures in place to make sure that none of these sources affect the ability of the machine to recognize and record the voter's intent.

I have observed a notable frequency of purely blank cast vote records coming out of the DRE system in the 2006 primary election in Eagle County, during the post election audit. Explanations I have heard for this phenomenon are hard to believe (such as that voters come to the polls just to make sure they stay on the active list for a future election). I think it is important for the election rules to require that the voting devices of a direct recording type (DRE or BMD) record the incidence of entirely blank cast vote records for later public review.

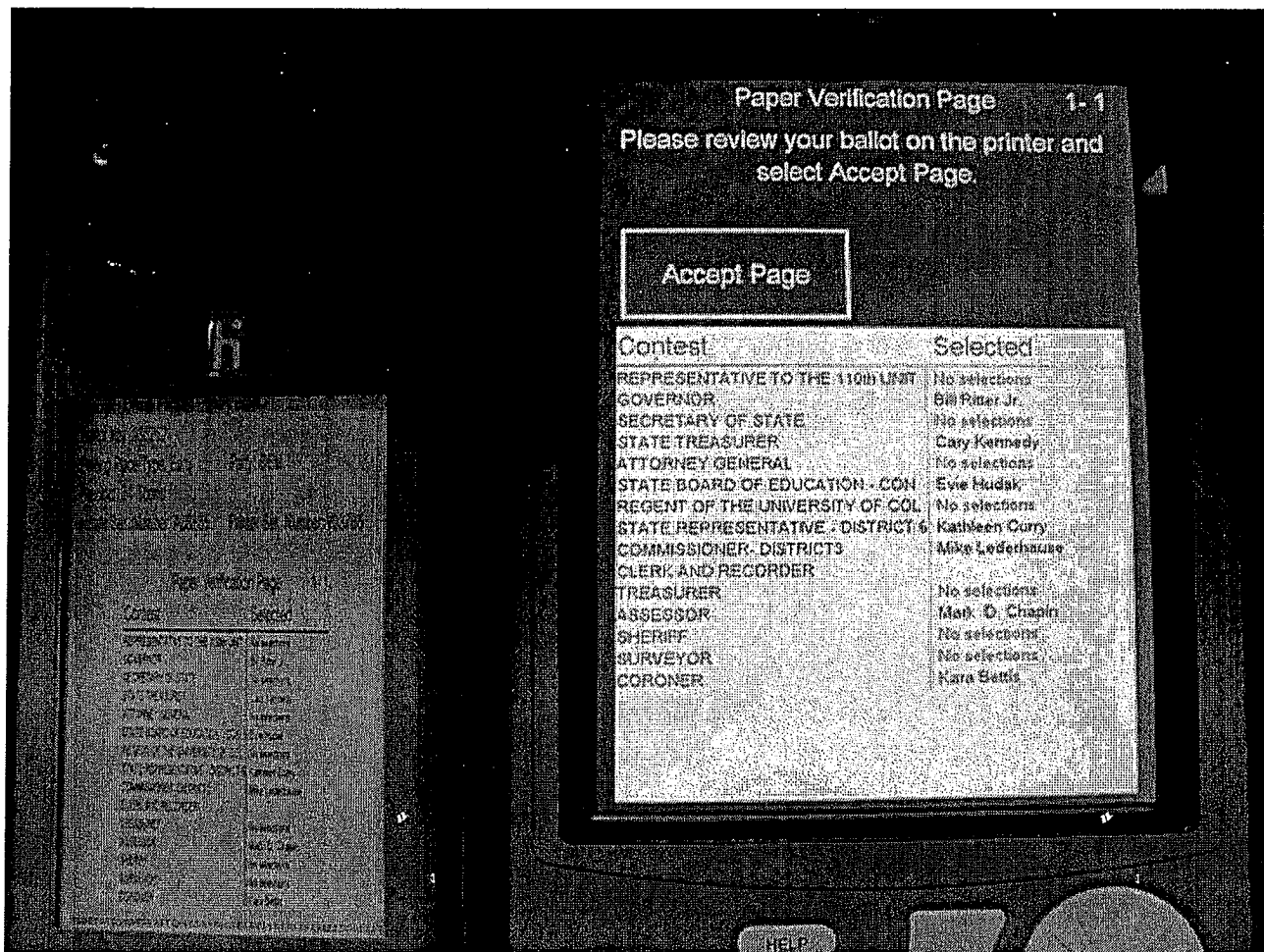


Figure 4: Verification of the V-VPAT

DRE devices often do not encourage voter to verify and in fact may distract the voter with another simultaneous display of the vote selections. Furthermore and perhaps more problematic, alpha-numerically identified issues on the V-VPAT are difficult to verify simply because the letters and numbers are not easy to identify with the actual text of the issue, and the V-VPAT does not contain this text for verification. A BMD (ballot marking device) would if it reproduced the actual ballot, have to reproduce this text as well which would mitigate this deficiency.

Note that the Tupa Weissman Bill in the 2007 Colorado Senate calls for numerically identified issues on the V-VPAT. This provision would only set in stone the problem which I am identifying here. This provision of the Tupa bill would not serve the public's need for real verification of the V-VPAT.



**Figure 5: DRE LAT Reconciliation**

From the election official point of view, the DRE may be unexpectedly costly per voter minute compared to the optical scan/paper system if you include the up front cost, plus maintenance, plus paper consumables, plus testing time, etc. It is important to evaluate cost by combining all of the hidden costs of DRE ownership and operation.

The DRE is also time consuming for the voter, per unit dollar spent on elections, causing inevitable lines in some places if it is the only allowed method of voting. The DRE system is inflexible in the number of voters it can accommodate because each voter requires the exclusive use of an expensive device for an extended period of time. The paper system allows for a forgiving opportunity to allow extra voters to vote in parallel. The election rules should acknowledge this opportunity by giving Colorado voters the right to a vote on paper and a right to a minimal waiting line to vote.

Each DRE based system costs thousands of dollars, yet serves only 12 hours of voters maximum at about 5 or 10 or in the case of 2006 election, 15 minutes each. These rates correspond to a range of 50 to 150 voters per machine per election, only if fully occupied all day. Using that best case calculation requires an assumption of the existence of lines at the polls. While the lure of a HAVA subsidy motivated clerks to adopt the DRE as the universal method of voting at the polls, they would have to have made an inordinately optimistic prediction as to the viability of these devices if they made these simple calculations. The 2008 election is sure to bring out even more voters than 2006, and perhaps to a ballot of similar length.

In El Jebel Colorado, there were 3 precincts voting together, and 5 DREs for approximately 2000 who did not vote absentee or early (total registered 2351). About 610 (out of 2000 possible) voters appeared to vote and were found eligible in these three precincts. Of these about 360 were able to vote on DRE (which coincides with estimates of a bit more than 70 voters per fully occupied DRE during election hours).

Although paper ballots and a Diebold Accuvote 2000 Optical Scanner were at the polls, by special arrangement, and election judges trained to operate them, the instructions from the County Clerk were that paper ballots were not optional for the voter, but could be supplied at the discretion of the election judges and should be provided in order to avoid lines. The clerk specifically objected to spreading information about the availability of paper ballots at the polls and criticized me for spreading that information, and made no particular effort to know the extent of the lines or to have the paper ballots used. For much of the voting day there were a maximum of 4 positions to vote on paper (and 5 DREs) and lines waiting to vote, but voters were generally only using paper when they happened to autonomously ask for paper ballots. There were lines at times when voters were not offered a chance to vote on paper.

Early in the voting day there were long lines and people turned away from these lines with the intention of returning later. Unlimited access to the available paper ballots would have made this unnecessary. At 5PM there were 74 people waiting to check their eligibility, and at least another 10 waiting to vote. The line at that point was well over 1 hour to vote and people were giving up and leaving upon seeing the line. By this hour the 4 positions to vote on paper were always filled, but no additional places had been added. Poll watchers asked the election judges to expand the number of places of vote and this happened in several stages, the last part of which came when poll watchers agreed to leave the polls entirely if the election judges would expand the number of places to vote once again. At 7PM when the polls doors closed, there were about 30 people waiting to vote and 5 DRE machines were supplemented with 13 places to vote on paper. The last voter left at 7:45. The eventual access to many extra places to vote on paper did finally relieve the pressure and shortened the line, but not before a number of people failed to vote sometimes after waiting in line at least once during the day.

This a clear indication that current election rules do not protect the voters interest, and even the most obvious failure of the system, dis-enfranchisement, is possible when the attention of election officials is focused elsewhere, such as on preserving a minimal stock of paper ballots.

Here are some arguments for and against exclusive use of paper or DRE, and for and against a dual system of voting:

**Arguments for voting exclusively on paper:**

- 1) no chance of unverified ballot;
- 2) technical failure unlikely and can be overcome by replacing a single optical scanner;
- 3) election judges find paper easier to operate;
- 4) all voters use same system- potentially lower cost

**Arguments for using DRE only:**

- 1) no ambiguous voter intent- either the voter either succeeded to get intent recorded or failed to do so- no overvotes can be recorded;



- 2) Possibly lower cost of training election judges;
- 3) all voters use the same system- except absentee;

**Arguments for single system:**

- 1) fewer election judges needed- in theory;
- 2) less complexity for clerks (but absentee system still remains to be tested and trained)

**Arguments for dual or multiple system:**

- 1) DRE helps disabled community, Paper easier and faster for other voters;
- 2) Two systems allow cross check of vote patterns, making fraud and accident more visible, therefore less likely;
- 3) can absolutely avoid lines with proper procedures (enough ballots and enough space) using paper;
- 4) can avoid consequences of technical failures when paper is available for backup;

In conclusion, the arguments for us boil down to the following: The DRE interface provides opportunities for many special needs voters, but adds cost, complexity, and reduces transparency and reliability and confidence in audit-ability. For an equal amount of funds and time applied in testing and auditing, the resulting confidence in the DRE is substantially less than that for the paper system.

Voters now have a right to vote on an enhanced system such as DRE but no right to vote on a paper ballot. To appear at the polls to vote on paper is still the best way for any voter to be sure that their vote will be counted correctly. If there are no paper ballots at the polls, there is a great danger of encountering a line of unacceptable length. Two systems together benefit the largest number of voters and have the side benefit of providing a valuable cross-check. ***Traditional paper ballots plus a DRE which marks anonymous paper ballots to be counted by an optical scanner or hand counting process when the results are sufficiently close, is the best of both worlds and that configuration is acceptable to a wide range of voting evangelists.*** Now that voting machines are effectively no longer optional, its time for the voters of Colorado to receive the right to vote on a paper ballot as well as to vote with some kind of electronic assistance. And we should keep in mind that the final and best way to count votes in a close election is by hand, not by machine.

Harvie Branscomb  
[harvie@media.mit.edu](mailto:harvie@media.mit.edu)  
Eagle County Colorado Canvass Board  
Coloradoans for Voting Integrity  
CEO, StandbySoft LLC

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**Major Points which require consideration in statute and election rules:  
(Harvie Branscomb, harvie@media.mit.edu)**

**Testing**

Improved Logic and Accuracy Test and equipment acceptance test procedures- e.g. no use of "test mode", no use of test printed ballots; require date of voting machine to be set to election day for all tests, required bipartisan participation throughout testing; test a sufficient quantity of test ballots to achieve accuracy of ¼ percent or better; test conditions to mimic election conditions in every respect including method of combining and reporting tallies; retest required for any change in software or ballot programming; results of test exceptions made part of public record;

**Audit**

improved and better specified procedures for post election audit- e.g. never recount during the audit, always hand count a group of ballots which produces a real election tally subtotal, or use a two stage audit method if cast vote records are available; always count at least two races which are contested and significant plus any races which are under any suspicion; report all exceptions and findings in understandable text form to SOS for public review; actual audit procedures and full results should be forwarded as part of the public record; make sure all categories of election equipment are audited; the two stage audit is performed by matching randomly selected ballots with their associated cast vote records, followed by an independent tally of all of the cast vote records for the selected device (when cast vote records are available);

**Recount**

require hand count for all recounts and specify procedures to be used;  
- e.g. sorting before counting method preferred; The cost and reliability of different methods of hand counting should be measured, understood, compared and explained; require that hand counts not be done selectively for the purpose of reconciling inconsistencies- because this may result in reconciling by mistake.

examine the recount threshold ( currently 1/2 percent) and reset the percentage to fit the accuracy of testing

**Voter verification**

Recommend new rules for naming all issue lines on V-VPAT (voter verified paper audit trail) so voter verification can practically be done. This will require a procedure for creating an agreed upon 2-3 word description of all ballot initiatives.

Recommend requiring voting machine manufacturers to strongly motivate actual V VPAT verification, by hiding the screen display at the time of verification of the paper record or displaying only the text of the resolution and not the voter's choice in the DRE display, while the choice is verified on paper;

V VPAT record to be printed on archival paper (not thermal type) and cut into pages for better anonymity and compatibility with the sort before hand counting method;

### **Certification**

update county equipment acceptance procedures and State certification to remove the influence of manufacturers; require proof of election scale testing for accuracy and reliability and security; insure that critical questioning is included in the team who sets the standards in the rules and executes the certification tests; require certification process to test and verify all phases of election procedure (including suitability of forms, etc. from establishing eligibility, through tallying votes, auditing, LAT, etc.

### **Motivation and Incentive**

Provide clerks with motivation to support public interest ahead of their own personal interest in re-election; provide limited immunity from prosecution; provide better sharing of experience with the public; including a reset of the unreasonable public expectations about the perfect accuracy of voting devices and procedures.

Stop placing the restoration of voter confidence at the top of priority lists ahead of substantive election reform... This naturally produces obfuscation of election problems and poor or nonexistent testing and oversight;

### **Paper ballots**

Seriously consider the alternative to return to all hand counting on paper as a viable alternative in discussions of potential voting systems; also consider low or special tech solutions to assist the disabled in voting on paper ballots;

Give voters a right to a paper ballot option in every county in every polling place; require sufficient ballot inventory and adequate physical positions are available for paper ballot voting in order to completely prevent the buildup of lines. Establish a specific quantitative metric for acceptable lines e.g. no more than one person waiting in line per available voting station (DRE plus paper); motivate polling places to be organized so that eligibility determination is independent of waiting for a voting station (meaning that the wait for the voting station is after the wait to establish eligibility.

### **Voter Registration**

Voter registration forms should include the major political parties as a check box, not just unaffiliated. Voter registration drive requirements should be eased to permit a continuation of widespread efforts to get people registered.

### **Provisional Ballots**

Provisional ballots should be curtailed in preference for establishing the voters eligibility

at the time they are at the polls. If a provisional is given to the voter, that voter should have the opportunity to prove their eligibility to vote (including updating their address, ID, etc.) after they leave the polls and until the deadline for resolving the provisional. Provisional ballots should be counted for every race for which the voter lives within the jurisdiction matching the ballot they are voting on, including local and county wide races. Provisional ballot counting should not be used as a sanction to motivate voters to update their address. The requirement to present a receipt from voter registration drive registration must be dropped. National voter registration drive forms do not provide receipts.

### **Eligibility Determination**

ID requirements should be reconsidered. Voters who appear at the wrong poll should be advised of the location of the correct polling place where they may vote, as well as being notified of an opportunity to vote on a provisional ballot and of the likely restrictions that will be placed on the counting of their provisional ballot..

### **Information Collection/Reporting**

Establish a repository for expected and unanticipated election exception reports state wide- this to be made available to county officials and the public for the purpose of improving SOS election procedure, to help counties to decide which equipment to purchase, and for voting manufacturers to consult in designing their equipment

### **Oversight for SOS and expanded role for Canvass Boards**

Establish a bi partisan board to oversee the decisions of the SOS and to review contents of the reports to the SOS, similar to the function of canvass board; such a group to include expert and experienced members of the public; expand the role of the county canvass board to include participation in establishment of local LAT testing procedures, equipment purchase decisions, equipment acceptance tests, design of forms for use by election judges such as reconciliation forms; require the canvass board to produce a brief and succinct public report of inconsistencies and exceptions found in the election, including number of absentee votes not returned or not counted for reasons of signature, etc., number of provisionals counted and number not counted and for what reasons, explanations for inconsistencies in the poll book count and the number of votes cast and inconsistencies in voting patterns between DRE and paper ballot voting (which provides a very powerful cross check on the accuracy of each system, above and beyond the spot check provided by the post election audit).

### **DRE**

Require each DRE to keep a count of totally blank ballots voted to be examined by the canvass board. This number to be reported to the canvass board and made part of the election report. Election officials to provide an anonymous means for election judges and voters to report to the canvass board dissatisfaction with the election including any

dissatisfaction with the DRE voting machines. This report to become part of the public record.

### **Optical Scanners and additional pre-election function testing**

Optical scanners should be required to be recertified once by the State according to standards which reflect the need to know if the devices count correctly on election scale. The legislature and the SOS should require a separate pre-election equipment test for paper ballot scanners, beyond what is currently required, to determine if each device is operating according to normal and expected specifications. This should be done with a standard batch of diverse ballots obtained from a previous real election but not the specific election about to be conducted. A batch of 250 ballots which have a well known hand counted voting pattern would be counted by each scanner using the program for the specific test election to check for mistakes in counting or other indications of differences between scanners. When differences are found, the error prone scanners are to be returned to manufacturer and their status reported to the public. The SOS should establish reasonable standards for performance of all election devices accounting for expected error. This error margin should be well below the threshold (currently 1/2 percent) for instituting a prepaid hand recount of ballots.

### **Reporting Deadline**

The pressure to report election results as quickly as possible on election night is inconsistent with the correct execution of procedures and harms the quality of the results. Election results should not be revealed publicly until at least 24 hours after the close of polls.

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