

SECURITY, ACCESSIBILITY, VOTER INTENTS AND COST OF OWNERSHIP OF DIRECT RECORDING ELECTRONIC VOTING SYSTEM

Testimony on experience and views of “best practices” in electronic voting for the first public hearing held by U.S. Election Assistance Commission on May 5, 2004

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INTRODUCTION

Thank you for inviting AVANTE to participate in the “Vendor Panel”. I would like to focus my testimony on five points on the voter verified paper audit trail (VVPAT). While seven minutes can only allow some highlights, I have attached the details on the five points that I am going to make at the end of my presentation.

1. “Voter Verified Paper Audit Trail” is the only means to assure secured electronic voting. [1, 2, 3, 4, 5]
2. Blind and visually impaired voters benefit equally from the ballot security from the accessible “voter verified paper audit trail”. [6]
3. Voter verified paper audit trail also enhances the accurate reflection of a voter’s intent. [7] When accessible VVPAT is used along with properly designed error-prevention voter interfaces in touch-screen voting system, 0% residual votes can be achieved. [8]
4. Properly and carefully engineered use of voter verified paper audit trail represents the lowest cost of ownership by the jurisdiction or society as a whole. [3, 4, 5]
5. The minimum requisites for an effective “voter verified paper audit trail”? [4, 5]

1. “VOTER VERIFIED PAPER AUDIT TRAIL” IS THE ONLY MEANS TO ASSURE SECURED ELECTRONIC VOTING

Back in 2000-2001, AVANTE pioneered the use of the “voter verified paper record”. It has been a long road to what is now known as “voter verified paper audit trail”. AVANTE invented the secured “voter verified paper audit trail” in lieu of the common question during the 2000 Florida recount. That is, can a voter know for sure that their ballot is cast correctly and counted correctly?

There are many good arguments made by many well-known computer experts for the prudence and the importance of the voter verified paper audit trail. Instead, I will try to outline what AVANTE practices and believes to be the most critical and important reasons for a “real-time” paper record that voter can confirm and verified.

- Helps those voters that are not familiar with reviewing the summary of choices on the screen to easily identify their choices on paper.
- Helps voters to identify some unintentionally under-voted contests if the electronic voting process confuses them. Some voter interfaces with multiple contests on a single screen may cause as much as 2-3 times the normal under-votes than when a paper ballot is used.
- Helps the voters and the jurisdictions to eliminate those mysterious ballots without any candidates selected even for a ballot with single contest.
- Helps the jurisdictions to correct any programming errors during the ballot preparation process.
- Voters will be able to find out any errors of the system. This can help the jurisdictions to uncover any logic and accuracy problems due to programming.
- Helps to identify any electronic or mechanical errors due to alignment of screen, manufacturing, and other unforeseen problems.
- Discover tampering or unintentional human errors of the voting system if present.
- Exposes all errors or tampering during the process of storing votes into an electronic file after the voter has cast their ballot.
- Exposes all errors or tampering after the ballots have been stored in the electronic memories.
- Exposes any and all software and firmware errors that may have either design flaws or unauthorized and error inducing software.
- Eliminates all legal challenges on the validity of the voting results even for the closest races.

The possibilities of potential inputs of human errors and tampering can be illustrated in the “workflow” of an election process. [4]

Problems and errors can be and have been introduced by vendors during the updating or testing of the software in the systems under the maintenance contract by the jurisdiction. Problems have been found in presenting wrong ballots to the voters and outright inability to present ballots to the voters. Problems and errors also have been found in the consolidation of tallies and counting of ballots. [9]

With all of the positive attributes that can be afforded with a simple paper record that the voter can confirm, there are almost no negative effects. This is one of those things that is always good to do whether you think it is necessary or not. Some may argue that it costs an extra amount of time and money.

However, there is another security issue that was addressed properly before and not very well in the FEC 2002 standard. Even though each ballot as cast may be recorded and printed correctly on a voter verified paper audit trail, the total count of the ballots cast must still need to be accounted for.

In the 1990 FEC standard, there were specifications for each voting unit having two unalterable counters. The first counter is normally called "PROTECTIVE COUNTER" or the "odometer" of a voting unit. Every time there is a ballot cast on the system, the counter will go up by one. It is supposedly not "capable" of going down or changed by other means. The second counter is called "PUBLIC COUNTER" that can be reset with suitable "key" to zero before starting of the voting day. Again, only an authorized election official can reset the counter. The COMBINATION of recording of the total ballot cast in both counters during the Election Day should match to provide duplicate authentication of the total number of ballots cast in each voting unit. The polling officials at each polling place countersign the numbers on the counters.

Of course, if anyone tries to erase any of the electronic ballot records and remove the corresponding paper records in the audit trail, they will presumably be exposed. This simple assurance of the total ballots cast in each voting unit is no longer available in the 2002 FEC standard. Even the "PUBLIC COUNTER" that is supposedly required for each voting system is no longer so secured. Most of the voting systems now only use the software counters. I do not know if anyone will characterize software counters as not alterable?

Of course we still have the sign-in sheets of the voters to tell us how many voters signed in to vote. But the iron-proof of the number of ballots cast in each voting unit is no longer within the requirements of our voting systems. There is always the argument that voters that signed-in can later decide not to vote. Thus, in principle, the signed-in number can be significantly less than the actual ballots cast!

For more detailed why a voter verified paper audit trail and the unalterable counters are important for the voting systems, please refer to the white papers [1, 2, 3, 4, 5] attached below.

2. BLIND AND VISUALLY IMPAIRED VOTERS CAN ALSO BENEFIT FROM THE BALLOT SECURITY FROM THE VOTER VERIFIED PAPER AUDIT TRAIL

A lot of discussions had been made that voters that cannot read the paper audit trail will be disenfranchised. AVANTE VOTE-TRAKKER™ provides a read back of the paper audit trail to those voters that cannot see, those voters that cannot understand the written English well enough, and those voters that feel more comfortable with the available alternate languages.

AVANTE believes that the paper audit trail should not be printed in alternate languages. The reason is that the number of voters that use alternate languages is usually small. The privacy of minority voters may be compromised either as individual or as a minority group. Instead, reading back the printed English ballot in their respective alternate languages should be considered equally accessible to

such voters without compromising their privacy. There is an obvious trade-off between privacy and accessibility.

AVANTE has received many endorsements from organizations of blind voters that they are satisfied with accessibility of the reading back of the paper audit trail. [6]

AVANTE believes that blind voters like the sighted voters also appreciate the fact they are assured that their ballots are cast correctly and recorded correctly with the reading back as part of the verification process. The right to vote independently and privately is obviously the most important goal. The correct counting of the cast ballots is equally important once the voters cast their private ballots independently.

3. VOTER VERIFIED PAPER AUDIT TRAIL ALSO ENHANCES THE ACCURATE REFLECTION OF VOTER INTENT WHEN COUPLED WITH ERROR-PREVENTION VOTER INTERFACES ON TOUCH-SCREEN VOTING

A DRE has one feature that is superior to all other voting systems. All of them are engineered to have 0% over-vote. However, DRE voting systems have also been documented to have substantially higher under-votes. In the year 2000 election in Los Angeles California, the DRE early voting systems actually recorded more than 12.3% no votes for the US Senator race. For the same election, those voted with punch-card ballots only recorded approximately 5% of no votes for the same US Senator race. There is a good 7.3% of the voters that got “disenfranchised” by the confusing electronic ballots and induced them not to vote on such an important national position of a US Senator. [10]

Imagine if a paper record had been printed for the voters to verify, most of these voters would have discovered such an “error” and asked the question, “Where is the US Senate race that I missed?”

With proper construction of voter interfaces, AVANTE was able to guide the voters through the “one-way-electronic-path” so that when the voters finished no unintentional under-vote will be cast. That is, 0% “unintentional under-vote” was recorded in all of the five elections where VOTE-TRAKKER was used. By comparing the same races in Sacramento, Alameda and Riverside counties, we found that more than 65% of voters that under-voted in those contests would have made a choice among the candidates when they were properly guided through the voting rather than giving them a divergent paths of choices.

In those cases where voters did not vote for the US Senator, they were given a split screen with Senate race on the left and Congressional race on the right. After the voter made the choice on the right for their congressman, they pressed the “NEXT” button and two or three more contests were again presented to the voters.

The voters did not vote more contests on the left side just because they did not see them on the screen. The voters may discover some of these errors. They may be presented a chance to correct themselves if they were presented with a paper record for verification.

The capability to use the power of properly constructed interfaces to guide the voters through the analog of “one way path” can only be achieved with touch-screen voting system.

In the case of AVANTE VOTE-TRAKKER, voters are presented with one contest at a time. Voters must either make a selection among the candidates, write-in a candidate if available, or they must press the “SKIP CONTEST/NO VOTE” button before the next contest will be presented to them.

Thus, voters are guided through a virtual one-way-path of error prevention interfaces. For the first time ever in any elections anywhere, 0% residual votes were achieved in all of the races in the five elections that the AVANTE VOTE-TRAKKER was used. The paper record merely confirmed this simple solution to the voters that their ballots were cast and recorded correctly.

4. PROPER USE OF VOTER VERIFIED PAPER AUDIT TRAIL REPRESENTS THE LOWEST COST OF OWNERSHIP FOR ANY JURISDICTION OR STATE

The arguments that are posted by the opponents on voter verified paper audit trail typically increase the following additional costs to the operation.

- The required printers and associated ballot boxes cost \$600 or more for each voting unit.
 - Answer:
The HAVA law requires that every ballot cast must be printed for recount.

Even if we argue that we can print the paper records after the election, we must still print the paper record. Most States require that such paper records be printed at the polling place to ensure the integrity of the voting process.

The costs associated with the increase in time and labor will equal or exceed the costs of printing the voter verified paper audit trail.

- Cost and weight of papers used adds to the burden that jurisdiction must pay and the poll workers must carry.
 - Answer:
A roll of 1500 ft paper weighs approximately 6-8 pounds. It costs less than \$10 each. Thus if 3-5 voting units are used, the cost for each polling place is \$30-50.

Printers using standard printer uses approximately \$0.025 for paper and \$0.025 for “ink”. Thus the cost is approximately \$0.05 for each ballot cast. For a typical polling place of 1000 voters, it costs approximately \$50.

The cost is the same for paper and ink whether you print real-time to allow voter verification or printing the same paper records post election without voter verification.

- In case of paper jam or other paper related problems, poll workers may not be able to fix.
 - Answer:
Certainly, the printers for voter verified paper audit trails should be engineered so that a paper jam rarely happens.

Poll workers should be trained to fix the paper jam if it happens.

From the experience of AVANTE, a properly constructed voter verified paper audit trail printer could be made almost trouble-free.

The counter argument is the potential social costs of close contests. Ever since paperless DRE voting systems have been used, there have been many contentious recounts. The costs in terms of real monetary costs can be accounted for and are sky high. The social cost of conflicts between citizens is priceless.

One fact becomes very clear quickly. There is no REAL recount in DRE voting without voter verified paper audit trail. When you ask the voting system to print out the ballot images after an election, the paper records will always be the same. If the ballots were recorded correctly or incorrectly, exactly the same paper records will be printed.

Florida again makes election history in United States. It is the first state to admit that there is no need to recount in DRE electronic voting because there is no meaningful recount possible.

One is left with the uncomfortable position like Congressman Rush Holt eloquently argued in many different talks that were given. “Are we ready to accept that there will be no recount in any election?”

Yet many voting system glitches repeatedly happened to those paperless electronic voting systems in every election. It defies logic and reasoning to even argue for voting system that cannot be verified in some way for recount purposes. For the computer scientists that really know how to trick these electronic systems, it makes them so shocked that unusually number of these computer “geeks” have become the unwilling “activists”.

Most of these unwilling computer expert “activists” post many impressive websites and organize many of their colleagues to call attention of their concerns to our political leaders. Their successes arguably take us here today to review what are we to do as a nation.

5. THE MINIMUM REQUISITES FOR AN EFFECTIVE “VOTER VERIFIED PAPER AUDIT TRAIL”

There are some that argues that some voter verified or verifiable paper audit trail is better than others. AVANTE believes that any voter verified paper audit trail is definitely better than none.

From the experiences of AVANTE deploying a system with voter verified paper audit trail, we would like to outline here the minimum standards for a meaningful “voter verified paper audit trail”.

1) The paper record must maintain voter’s privacy.

- There should not be a time-stamp.
- There should not be serial number attached to the paper record.
- The paper record must be individualized. **It must not be produced in a roll.**
- There should not be any ribbons or other means that can be used to reconstruct the sequence of voters.
- Voters should not lose their privacy either as individual or as minority group when they use alternate language to vote. That is, paper records of voters using alternate languages should not be distinguishable from other voters.

2) The paper record must not be easily tampered with.

- No one should be able to produce another paper record post election that is not produced during the election process.
- Each paper record must bear a special check-code that cannot be tampered with even by election officials or by the company that produces such system.

3) The paper record must not be defeated by forgery.

- How would we know if a paper record is authentic or forged? No one should be able to “stuff” the ballot box with other paper records after the election.
- What if some one presents a paper record that they claim to be authentic?

On behalf of AVANTE, I thank you very much for the opportunity to tell our story in promoting and implementing the voter verified paper audit trail!

REFERENCES AND ATTACHMENTS

1. Accessible Voting with Voter Verifiable Paper Records in DRE Voting Systems (Attached herein)
www.aitechnology.com/votetrakker2/papers.html
2. IS THERE A “STANDARD” FOR VOTER VERIFIED (OR VERIFIABLE) PAPER AUDIT TRAIL? (Attached herein)
www.aitechnology.com/votetrakker2/papers.html
3. A Manufacturer’s View Point On the Voter Verifiable Paper Record and Audit Trail (Attached herein)
www.aitechnology.com/votetrakker2/papers.html
4. IS “OPEN SOURCE” OR SOFTWARE “ELECTRONIC VERIFICATION” A SOLUTION FOR SECURED E-VOTING? (Attached herein)
www.aitechnology.com/votetrakker2/papers.html
5. Why, when and how should a “Paper Record” mandated by the “Help America Vote Act of 2002” be used? (Attached herein)
www.aitechnology.com/votetrakker2/papers.html
6. Letter of recommendation from Mr. Chris Gray, President of the American Council of the Blind
www.aitechnology.com/votetrakker2/endorsements.html
7. Summary of experience of November 3 2003 Election by Registrars of Voters of Southington, Connecticut
www.aitechnology.com/votetrakker2/endorsements.html
8. Sacramento county report of early voting of 2002 General Election to the Secretary of California
www.aitechnology.com/votetrakker2/endorsements.html
9. Myth Breakers for Election Officials: A Collection of Information Essential to Those Entrusted with Making Decisions about Election Systems in the United States
www.votersunite.org/takeaction/mythbreakers.pdf
10. BALLOT DESIGN: HAS IT IMPACTED VOTING BEHAVIOR IN LOS ANGELES COUNTY, CALIFORNIA? Presented by Conny B. McCormack, Registrar-Recorder/County Clerk

Accessible Voting with Voter Verifiable Paper Records in DRE Voting Systems

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The 2002 Help America Vote Act (HAVA) is by far the most important improvement in providing the accessibility in independent and private voting for voters with disabilities. As a member of manufacturers and solution providers for electronic voting, the management of AVANTE has placed special emphasis in ensuring 100% accessibility to voters with disabilities. In particular, AVANTE has made special effort to ensure that every single requirement of HAVA is met and that none will cause the denial of accessibility to voters with disabilities.

We have witnessed the joy and have seen the smile shown by voters with visual disabilities and voters with limited mobility voting independently on AVANTE VOTE-TRAKKER™ during the 2002 General Election in Sacramento County, California. As a solution provider to the election industry, AVANTE has even developed an online voter registration system with voice assistance for voters. Many members in the visually impaired communities consider VOTE-TRAKKER™ to have the most comprehensive and effective solutions for private and independent voting.

AVANTE has engineered many innovative features and functions that have proven to be effective solutions in ensuring 100% accessibility. The following are some of the features and functions that assure true accessibilities.

1. First and foremost, all DRE voting systems should provide equal accessibility to voters with disabilities and have the same rights for positive confirmation when voter verifiable paper audit trails are printed for the sighted voters.

- AVANTE believes that visually impaired voters not only should be provided with means to vote independently and privately, they should be afforded with positive feedback during the selection process as well as when they cast their vote. This can only be achieved when visually impaired voters are read back with their choices made as stored in the electronic system and printed as paper record. This positive confirmation of how their votes are recorded is equivalent to sighted voters having the opportunity to verify their selections on the paper record.
- The management of AVANTE is aware of the concern of some visually impaired and voters with other disabilities requiring the voter verifiable paper record for every vote cast. This may slow down the implementation of the accessible voting systems. We certainly understand and share the concern and trepidation.

- We believe the members of disabled communities may have not been presented with the complete picture of the “voter verifiable paper record” proposal by the computer scientists concerned with the security of electronic voting system. These distinguished scientists are equally concerned with the accessibility to the disabled communities. We believe they are requiring accessibility and true reflection of voter intents for both sighted and visually impaired voters.
- Like voice assistance provided to the voters, the paper record once printed can of course be read back to the visually impaired voters. This is a simple provision that every one of the current electronic voting systems can do. Yet they are not willing to offer that to the disabled voters.
- As you may know, HAVA actually has a clause requiring printing of every vote cast with a paper record for audit and recount purpose. Logically and logistically speaking, it should be printed while the voter is still around for audit purpose so that these paper records have the meaning of verified ORIGINAL records. Printing of paper records at the end of election is just a paper copy of what may have been mistakenly recorded in the electronic memory.
- Almost all DRE voting system today can be retrofitted with all of the functions and features that we have outlined in the previous discussion. But very few of the manufacturers bother to add functions and features to ensure 100% accessibility and confidence with positive feedback. The same complacency is believed to be the root of their resistance to provide voter verifiable paper records for every vote cast. The argument of adding costs to the jurisdiction is more of a red herring than truth. Nothing cost more than lawsuits after lawsuits as shown in Counties that use DRE systems without voter verifiable paper records. Besides, printing the paper records at the end may actually cost more than printing in real-time for voter to verify.
- The sighted voters can review what was recorded with a printed paper record before the leave. For the visually impaired voters, they should be read back their vote on the paper record before they leave.
- The reading back of the HAVA required paper record is not only easily achievable by every voting system manufacturers, we believe it helps to ensure the visually impaired voters as well as sighted voters to know for sure that their votes are cast correctly and recorded correctly.

2. Provide voice assistance in all languages besides English.

- AVANTE VOTE-TRAKKER™ was the first voting system to provide voice-assistance in all languages used in United States.

- That is, besides English; Spanish, Chinese, Japanese, Korean, Vietnamese, French, Russian, etc. are also available for those visually impaired voters that are not comfortable with the use of the English language.
- VOTE-TRAKKER™ is the only voting system that directly imports the alternate language translation into the voting system to avoid human placement errors. Imagine the havoc that it brings if translated candidates have been misplaced into the voting positions. We have seen this happen and many go undetected.

3. Provide immediate and positive feedback whenever the voters make a selection.

- Many electronic voting systems provide a simple and vague feedback after visually impaired voters make a selection. They simply acknowledge the choice made saying “check” or other similar words. Such vague feedback is not positive and certainly did not have the same effect as the checkmark on the displayed screen to the sighted voters.
- VOTE-TRAKKER™ is the first and may be the only system that immediately reads back the choice that is made by the voter for positive confirmation. This is the case even when the voter starts to type in their write-in candidates. Every alphabet and notation is immediately read back when entered.
- AVANTE believes the positive feedback created by reading back the choices made is the true accessibility, equivalent to the highlighting of choices made that is provided to the sighted voters.
- More importantly, VOTE-TRAKKER™ instructs and trains the voters from the beginning without the need for prior training or instructions by the polling officials. The same instructions are repeated whenever needed for positive reinforcement.

4. Provide the voter the ability to ask for re-reading of any contest if they get distracted.

- Every voting system today provides a simple flow by reading from the top all of the contests of the ballot for the visually impaired voters to make their selections. However, they do not provide the same accessibility to the sighted voters with the ability to read the ballot again when they are distracted.

- When a visually impaired voter is distracted for whatever reason, by simply pressing on upper right hand corner “raised - key” on the keyboard, VOTE-TRAKKER™ will start reading of the ballot from the top of the contest at hand.
- For those voters with knowledge of the keyboard, they can even use the “navigation” up and down keys to go forward or backward on the contest being read.
- For those that do not know keyboard well, they can also use the physically “raised ESC” key on the left upper corner to skip over any choice or instruction.

5. Provide voters the chance to quickly skip through those candidates or choices that they are not interested in. VOTE-TRAKKER™™ also provides easy navigation during the reading of ballots in both backward and forward direction if the voters know how to use the standard computer keyboard.

- As mentioned, for those voters with knowledge of the keyboard, they can use the “navigation” up and down keys to go forward or backward on the contest being read. That is, they can accelerate their selection process if they are familiar with the ballot.
- For those that do not know keyboard well, they can also use the physically “raised ESC” key on the left upper corner to skip over any choice or instruction.
- This accessibility equivalent for “overview” of the choices available is the first and may be the only ever provided to the visually impaired voters.

6. Provide the visually impaired voters the same rights to write-in their candidates as the sighted voters even if they do not know how to type.

- To really provide 100% accessibility equivalent of voting, blind and visually impaired voters must be able to write-in their candidates just like the sighted voters. This is not normally provided by electronic voting systems today.
- VOTE-TRAKKER™ provides the easiest means for voters that know how to type with keyboard to enter their write-in candidates for every available contest.
- For those voters that do not know keyboard, they can use the “raise” upper right hand corner “-” key to scroll through the alphabets in spelling out the write-in candidates.
- AVANTE management believes 100% accessibility is provided only if all of the voting rights of the sighted voters are also available to the visually impaired voters. That includes the ease of voting for write-in candidates.

7. Provide visually impaired voters without the use of fingers and other disabilities to vote easily and independently.

- For those visually impaired voters with other physical disabilities such as without the use of fingers or lack of dexterity such as those with arthritis, most electronic voting systems will make independent and private voting very difficult if not impossible.
- VOTE-TRAKKER™ designed its system with the functional selections and voting keys spaced as wide as possible to make their use easy.
- More importantly, these spatially separated functional keys are physically raised from the rest of the keys on the keyboard to make the finding and use of them easy even if they have never touch a keyboard before. By simply pressing on the raised ENTER key with their elbow or chin or stylus when the selection is read, voter can make their selection. The ESC key for skipping over choices and accelerate the voting process is also raised for ease of use. The “CTRL” key on the lower left-hand corner is also raised for “CASTING” of the ballot when the voter is finished with their selections.

8. Visually impaired voters not only can review their choices before they cast their ballot like the sighted voters; they must also be able to make changes easily during that review process. This function is not always available in most systems.

- VOTE-TRAKKER™ not only enables the visually impaired voters to make changes at the final review of their ballot, it also provides the ability for them to make changes anytime by simply requesting “REVIEW” when the “REVIEW” choice is presented at every contest.
- By simply pressing on the “ENTER” key while the selection is read during the review cycle, the system will automatically return to that particular contest. Voter can make any other choices they wish to make again for that contest. When that change has been made, the system returns to finish the reviewing of the balance of the choices made on the rest of the contests.
- This ease of change and confirmation of choices made on the completed ballot is also the first and only system with such function.

IS THERE A “STANDARD” FOR VOTER VERIFIED (OR VERIFIABLE) PAPER AUDIT TRAIL?

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“There is no standard for producing a voter verified paper audit trail for voting machines! We do not know how, not can we do it!” These are the most recent “reasons” used by the voting equipment manufacturers and election officials who “oppose” the use of a voter verified paper audit trail.

IS THERE A DIFFERENCE IN INDUSTRY STANDARD VS FEDERAL OR GOVERNMENTAL STANDARD?

We believe there are substantial differences between a “standard” crafted by an industry group and “standard” crafted and used by government. It may not be wise to equate the “standard” discussion without clearly understanding the difference in terms of its goals and intents of such standards.

First let us examine the common standards used in different industry. The industry standards such as those written by IEEE or ASTM is written to ensure COMPATIBILITY of devices so that all of the systems manufactured by various manufacturers can be used in the same way. They should be able to communicate with each other and use the same media with the same shape, size and interface. Two examples would be the electrical outlets we use at home, television connections for accessories such as video, DVD, camcorders, games, etc. Any CD or DVD that should be playable by any machine bought in the same country intended for playing such device, etc. It is self-evident why such standards are not only necessary but also benefit all users.

The second common “standards” may relate to safety such as UL or emission of electromagnetic noises that may cause interference between devices and applications or other similar voluntary or mandatory requirements for the device to be used safely or whether such device can be used at all.

We believe there may be a good practice to have a Federal standard to ensure some of the minimum requirements such as “accuracy and security in recording votes”, “voter interface to ensure accessibility”, “ability to have audit trail that bear the mark of authenticity of voter’s vote”, “physical provision to ensure accessibility of voters with different physical limitation”, “physical and software safeguard against tampering or possible intentional and unintentional changes”, “ability of the system to meet the election protocols such as ranked voting, etc.”

Since there is no foreseeable requirement for voting units of different manufacturers to interface with each other or to be used in the same way, there is no real need for an industry standard. If the industry standard organizations try to step in, the standard

created will have to follow the federal guidelines. While there is a recent attempt by IEEE to formulate such standards, they are still in the discussion phase. Frankly speaking, unless they are adopted by the EAC or FEC such standards will not carry any weight at all. While it is good to have inputs from experts in different areas related to voting, there is also a danger in

The second category of standards is the MINIMUM requirements. These include the MINIMUM FEATURES that must be present, the MINIMUM PERFORMANCE LEVELS, such as speed, coding of software and the MINIMUM MUST-NOT-DO LIST as not to violate Federal or State Laws.

At the federal level, for those of us that make the voting equipment, there is a FEC 2002 and 1990 standard to follow. The numbers refers to the year that such standards were established. These standards are the VOLUNTARY MINIMUM for the 30 or so states within the country that have signed-on under the NASED auspices. After HAVA becomes law, that must be viewed as another LEGAL REQUIREMENT in addition to the FEC 20002 standard.

There may yet be another standard established by the new EAC board to “consolidate” all of the requirements down the road. This lack of ABSOLUTE CERTAINTY is part of the way that equipment manufacturers must meet in the course of doing business.

The MINIMUM REQUIREMENT nature of any federal based standard does not dictate HOW the voting units must be made. Every touch-screen voting equipment’s functions are dramatically different. They provide the voters a different interface and way to vote along with different costs for the jurisdiction to run their elections. Every one of these systems must pass the same FEC 1990 or FEC 2002 voting system standard before they can be used in Federal elections.

IS THERE A MINIMUM STANDARD FOR VOTER VERIFIED PAPER AUDIT TRAIL TODAY?

The answer is YES.

In the 1990 FEC voting system standard, the following guideline has been established (E-10 of Standards for P&M and DRE Systems, E.5 Voter Confirmation in DRE Systems):

*“Some jurisdictions may find the incorporation of a voter confirmation capabilities in DRE systems is advantageous. **Voter confirmation provides voters with a further indication of a physical record. That record may also be used in recounts in the same manner that paper ballots in P&M systems are used.***

Voter confirmation does not, however, guarantee that the voter choices are correctly recorded and updated in memory registers. Instead, DRE system accuracy and integrity is best safeguarded by adequately testing the implementation of the requirements for multiple memories and a separate processing path for retention of ballot images.

*The voter confirmation capability may be implemented using the same data processing path that provides for the capture and retention of ballot images. **After a voter has made all voting selections, the DRE machine should display or print on a paper ballot a summary of the voter's selections. If the voter is not satisfied with the confirmation, election workers must have a method of voiding the ballot.***

*If a printed ballot is produced, **it should be a machine readable format and a ballot box must be provided for the deposit of the record after the voter views it. The user jurisdiction must adhere to administrative procedures necessary to ensure that no voter leaves the polls with the printed record, lest it be used for illegal purposes.***" (The highlights above are made by the author).

The voting standard for a voter verified paper audit trail does exist!

As far as meeting the 1990 FEC voting standard in terms of providing a DRE voting solution, you do not need to produce any voter verified paper record or paper audit trail at all.

However, if you so chose to produce a voter verified paper record, you must not allow the voter to take the paper record home! The paper record must contain machine-readable markings or features besides the human-readable voting selections. These paper records may be used for recount.

The voting equipment may be so constructed as to achieve the prevention of paper records from being taken home by the voters. It can be done either with administrative procedures or better yet by the equipment automatically. For example, after the voters have verified their paper records, they are required to drop into a sealed ballot box. This must be monitored and controlled by the polling officials.

In the case of the AVANTE VOTE-TRAKKER™ that pioneered the paper record process, the paper records are printed behind the plastic viewing window. The voters can review but not touch the paper records. After the voters confirm and verify their paper records, they are retrieved automatically and stored inside the voting unit as audit trail.

For whatever reason, this section of the 1990 FEC voting standard disappeared from the 2002 FEC standard!

There are several other good features in 1990 FEC standard that have also disappeared in the 2002 FEC standard as well. For example, there is a well-written requirement for PROTECTIVE COUNTER. This protective counter must not be alterable or tampered with. This requirement is similar to the odometer in a car. The number in the counter can only increase whenever by one whenever a ballot is cast. The counter number is supposedly to be made such that the number cannot be decreased. That also disappeared in the 2002 FEC voting standard.

There was also a requirement in 1990 FEC standard that called for a “PUBLIC COUNTER”. Again the requirement is that such counter can be reset for each election. The count must increased by one whenever a ballot is cast and must not be alterable. The requirement that the counter may not be alterable also is weakened in the 2002 FEC standard.

The combination use of the “PUBLIC COUNTER” and “PROTECTIVE COUNTER” that cannot be altered should provide at least give an indication as to how many votes are cast during the specific election. In some election, some of the DRE voting systems cannot even ensure the number of ballots cast being the same as number of voters.

Did they disappear because most of the established manufacturers cannot and did not meet these requirements? The fact of some of the DRE voting systems certified under the 1990 FEC standard does not have counters that meet these requirements was discussed by Professor Doug Jones of University of Iowa (1).

ARE THERE OTHER REQUIREMENTS FOR A VOTER VERIFIED PAPER AUDIT TRAIL?

The answer is YES.

Lack of a standard does not mean you cannot produce a voting system with voter verified paper audit trail. All it means is that you have much wider latitude to build it in anyway that will not violate other aspects of the voting standards.

These requirements are common for any voting equipment design with or without a voter verified paper audit trail. The following are some that pertain to them:

- 1. The paper record must maintain voter’s privacy.**
 - There should not be a time-stamp, like some systems produce.
 - There should not be serial number attached to the paper record.
 - The paper record must be individualized. **It must not be produced in a roll.**
 - There should not be any ribbons or other means that can be used to reconstruct the sequence of voters.

- 2. The paper record must not be easily tampered with.**
 - No one should be able to produce another paper record post election that is not produced during the election process.
 - Each paper record must bear a special check-code that cannot be tampered with even by election officials or by the company that produces such system.

- 3. The paper record must not be defeated by forgery.**

- How would we know if a paper record is authentic or forged? No one should be able to “stuff” the ballot box with other paper records after the election.
- What if some one presents a paper record that they claim to be authentic?

The above three requirements are some common sense practices that all voting equipment manufacturers should know. These features are all required. If they do not do them, the “Independent Testing Authorities” (ITA) will make sure that they are not certified, and thus will have to be retrofitted to meet these requirements.

For those manufacturers that claim to have no procedures or standards to follow, they are simply making excuses. It would be better by simply stating that they will not do it because it is not required.

CAN THE STATES ADD TO THE REQUIREMENTS EVEN IF THERE IS A FEDERAL REQUIREMENTS FOR A VOTER VERIFIED PAPER AUDIT TRAIL?

Of course, they can and they will.

This is one of the reasons why if we do not have the foresight in making the equipment to have suitable flexibility that will accommodate the needs of different States, we may not survive or prosper.

This is no different from any other industry. For those established voting equipment manufacturers to cry about the lack of a precise prescription to build a voting system that produces a voter verified paper audit trail is simply immature.

The following are some of the new requirements that have been established or are being proposed by the various States that require the voter verified paper audit trail.

State of California in the preliminary stage of establishing the procedures for using paper records and voter verified paper audit trail. So far, besides those guidelines that we established above, the procedure gives the voter three chances to change their ballot after the paper record has been printed. This means the voter can spoil up to two paper records that they reviewed.

In the State of Illinois, the state law requires that the paper record audit trail contain a unique, randomly generated identifier that can directly correspond with the electronic image of the same ballot cast. This requirement helps to further ensure the system integrity can be checked precisely for errors. It further helps to eliminate any chance of tampering from within the unit as well as forgery from outside.

Even if the State does not provide specific testing requirements, this is not an excuse. All it means is that the State gives the vendors more latitude and allows the jurisdiction

more optional choices. The vendors should realize that they must also provide at least the above minimum requirements that we outlined earlier.

IS A VOTING STANDARD ESTABLISHING THE VOTER VERIFIED PAPER RECORD REALLY REQUIRED FOR MANUFACTURERS TO MAKE A VOTING SYSTEM TO PROVIDING THIS FEATURE?

The answer is NO.

Even though they may claim there were no standards for a voter verified paper audit trail in the 2002 FEC standard, all of these manufacturers' voting systems were made based on the 1990 voting standard. As such, they can certainly build it in accordance to this earlier standard.

There are a lot of aspects of voting systems that do not have well-defined standards. Yet, we made voting equipment that has some of these aspects. In fact, that is why the voting equipment all looks different and has different accuracy in reflecting the voter's intent. The difference may depend on their ease of use or their tendency to confuse voters.

One example is that there is a substantial difference in residual votes. In most of the touch-screen voting systems other than AVANTE VOTE-TRAKKER™, they tend to have similar or higher residual votes to that of punch-card system. These residual vote rates (under-votes that may or may not be intentional) are typically around 1-30% depending on the race. Yet, with proper protocol, AVANTE VOTE-TRAKKER™ has 0% residual votes in all elections in which they were used.

Another example is the voting system security. There is not much of an established minimum in the FEC voting standard of 1990 and 2002. Yet, we all manufacture voting systems with different levels and sophistication of system security. In fact, that is why some systems need the Band-Aids of security tape all over their voting equipment during elections (for example, in Maryland). While others such as AVANTE VOTE-TRAKKER™ is already well protected without such tape!

SO, WHY ARE THE MORE ESTABLISHED VOTING SYSTEM MANUFACTURERS SAYING THERE IS NO STANDARD FOR A VOTER VERIFIED PAPER AUDIT TRAIL FOR THEM TO FOLLOW?

These companies have been promising that they can provide a voter verified paper audit trail anytime, if the State requires them. Some even say they already have them ready for use at anytime.

Yet, they are dragging their feet in providing the real solution even with all the public outcry for a voter verified paper record. And worse, they keep crying for the government to come up with a standard for them to follow.

Could it be that they need the EXTRA TIME TO CATCH UP with those companies that already have a NASED certified voting system with a voter verified paper audit trail?

Anything to slow down the inevitable and commonsense requirement is a commercial advantage for them and disadvantage for those pioneering companies such as AVANTE. No one seems to know or certainly wishes to spread the news that VOTE-TRAKKER™ voting systems have been certified since 2002 with a voter verified paper audit trail. These certified systems have been used in five different real life elections in California and Connecticut.

All of these more established companies and their allies in the election communities, while knowing the facts that the VOTE-TRAKKER™ voting systems have been proven in real elections still maintain that there are NO SYSTEMS with a voter verified paper audit trail!

In fact, VOTE-TRAKKER™ may be now the first voting system that has REALLY PASSED testing and meeting every requirement of FEC 2002 standards by the independent testing authorities (ITA). As a company with reasonable foresights, AVANTE has already included in its newer models of VOTE-TRAKKER™ EVC 308-SPR and EVCS08-SPR-FF with all of the newer requirements from HAVA without the Federal or State “standard”.

MORE INFORMATION ON HISTORY AND RATIONALE FOR VOTER VERIFIED PAPER RECORD AND AUDIT TRAIL:

For more details on how should a voter verified paper audit trail should work, please refer to the white paper: “A Manufacturer’s Viewpoint On the Voter Verifiable Paper Record and Audit Trail” posted in AVANTE www.vote-trakker.com web-site.

For the rationale of why a paper record is a good practice and good for the democracy, please refer to the white paper: “WHY, WHEN, and HOW SHOULD A “PAPER RECORD” FROM THE “HELP AMERICA VOTE ACT OF 2002” BE USED?” also posted in www.vote-trakker.com web-site.

A Manufacturer's View Point On the Voter Verifiable Paper Record and Audit Trail

(Rev. C March 16, 2004)

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As the pioneer in the use of voter verifiable paper records, AVANTE would like to clarify some of the confusion and misunderstanding that is being discussed on electronic bulletin boards and in the news media.

VOTE-TRAKKER™ made by AVANTE is certainly voter verifiable in any sense of the word and of course in practice. In fact, there are two options to achieve the voter verification function by the system. *

TWO OPTIONS FOR PAPER RECORDS IN AVANTE VOTE-TRAKKER™:

There are two basic choices on how AVANTE VOTE-TRAKKER™ paper records can be used. The choices are available to the local jurisdiction when they create the ballot.

1. ***Print a FINAL CONFIRMATION PAPER RECORD for the voter to review and verify.*** AVANTE VOTE-TRAKKER™ presents the summary of choices to the voter on the screen upon completion of all contests. The voter can make changes by simply pressing on the box containing the choice that needs to be changed. The system will return to that particular contest for the voter to make changes. Again, the review screen appears and the process can continue until the voter is satisfied with his/her selections.

Once the voter presses the "Cast Ballot" button, the system informs the voter that "CASTING YOUR BALLOT IS IRREVOCABLE, Please confirm by pressing on the "Cast Ballot" button again if you are sure of your selections." The paper record is produced when the voter presses the "Cast Ballot" button for the second consecutive time. Only upon pressing on the "Cast Ballot" button a second time will the paper record be printed. In this case, the paper record is FINAL and will serve as a confirmation establishing the accuracy of the cast ballot.

We anticipate that someone invariably would claim that the paper record is not the same as that of the review screen. This issue will be discussed below.

* Definition of the word verify 1: to confirm or substantiate in law by oath
2: to establish the truth, accuracy, or reality of (from the Merriam-Webster 11th edition © 2003)

2. ***Print a “trial” or “temporary” paper record for the voter to review and verify prior to pressing the final “CAST BALLOT” button.*** Once the voter confirms his/her choices on screen, the voter presses the “CAST BALLOT” button. A paper record is printed with the choices listed on paper. If the voter is not satisfied with the first “temporary” paper record for any reason, he/she can again press a contest box on the review screen to make changes. Once a change is made, another “temporary” paper record will be presented for review and verification. There is NO limit to how many times a voter can make changes.

Once the voter is finished making changes, the “CAST BALLOT” button is pressed two consecutive times and the FINAL and OFFICIAL paper record is printed. This final and official paper record is also presented to the voter to verify.

We STILL anticipate that someone invariably would claim that the FINAL AND OFFICIAL paper record is not the same as that of the review screen or the first “temporary” paper record. This issue will be discussed below.

AVANTE has always made an effort to describe both methods employed by VOTE-TRAKKER™ to every one interested in our system.

WHY DID AVANTE CREATE THE FIRST DRE* THAT PRODUCES A VOTER VERIFIABLE PAPER RECORD?

When AVANTE created the paper record as part of voting system back in November 2000, we were trying to answer the question “How can we let voters know that their vote is counted and counted correctly?” A review of the current voting systems revealed several key features that must be included to answer this question.

- In the “marksense” system, voters mark the paper ballot themselves and submit them for counting. According to CALTECH/MIT studies, the voter error rate can be as high as 10%. This error rate includes incompletely filled ballots (under-votes), marking too many choices (over-votes) and writing on the paper ballots. All typical human errors!
- The punch-card system is of course similar to that of “marksense” system and became notorious since November 2000. Voter intent is the biggest question asked during the recount of that election.
- Lever machines are a faster method for casting a ballot. However, voters can be confused by the full-face format and there is no positive feedback to the voter. The machines are difficult to maintain. In November 2003, the machines were set up incorrectly causing an entire Connecticut town to vote on emergency paper ballots. The system also produces more “under-voting” than other systems.

* DRE – Direct Recording Electronic (including touch screen systems)

- DRE systems induce voter errors by the way the ballots are presented or by the system wrongly interpreting the ballot style presented to the voter. They may be tampered DURING and AFTER the voter finishes his/her ballot.

In every example, the common theme is that the voter does not know whether his/her vote was counted and counted correctly.

The advantages of using a touch screen DRE system are well known. We believe the basic need for the paper record is to provide an INDEPENDENT and AUDITABLE paper record besides the electronic records. A touch-screen system without a REAL-TIME paper record that have been reviewed and verified by the voters lacks the authenticity to provide any meaningful INDEPENDENT AUDIT. We believe that the requirement for an auditable system as well as a system that provides all of the ease of use features desired has lead to the creation of VOTE-TRAKKER™.

THREE MODELS FOR IMPLEMENTING PAPER RECORDS IN AN ELECTION:

Paper records must be printed for each vote cast with an electronic voting system. This is a HAVA requirement. In our opinion, there are many different ways that a “paper record” can be used to help the voter to know his/her votes are counted and counted correctly. We believe that as long as these paper records have been “reviewed”, “touched” or “verified”, they bear the mark of authenticity for use as an independent audit trail.

The following are some of “methods” that have been proposed:

1. The New Hampshire Model:

In this model, the voters use the touch-screen voting units to indicate their choices. The use of touch-screen units is to ensure accessibility to visually impaired and other disabled voters. The electronic records on the touch-screen units are not recorded nor are they used for counting votes. Instead the voting machine prints out a paper record that will be “touched” and “reviewed” by the voter before dropping it into the ballot box for counting.

In this model, the voters can accept or reject the paper ballots as many times as the jurisdiction permits. For example, the voter submits the paper ballot to be spoiled in order to request another turn at the voting machine.

In this model, if the voter does not submit his/her paper ballot then the vote will not be counted. AVANTE DRE VOTE-TRAKKER™ and OPTICAL VOTE-TRAKKER™ can be adopted to follow this model. An official paper ballot is printed with both human readable format as well as machine-readable barcodes for ease of tabulation.

2. The Real-Time Verifiable Model:

Voters to make their selections use the touch-screen units. Voting records are stored on the voting machine. Paper records will be printed in REAL-TIME for the voters to “review” or “confirm”. The paper records are independently verified by the voters and thus bears the mark of authenticity and should be used for recounts. There are at least several variations in the presentation of paper record for voter to verify:

- i. The two variations of paper records currently used by VOTE-TRAKKER™. The voters are presented with the paper record for confirmation and review. The voters never physically touch the paper records. The paper records are stored in a sealed compartment in the system so as to ensure complete and tamper-proof records of the election. In the first approach presented by VOTE-TRAKKER™, voters confirmed their vote as printed to be the same as in the review screen. The second approach provides for an opportunity for the voters to change their mind upon reviewing the “temporary” paper record. The second approach essentially provides a chance for the voter to “accept” or “reject” the paper record.
- ii. A paper record is printed with machine-readable barcodes and is in a human readable format. The voter is presented with the paper ballot to submit for auditing the election. This version allows the voter to not submit a paper ballot, thus making the election records incomplete.

3. The TRUST-ME Model:

In this model, the touch-screen units are used by the voters to make their selections and used to store their voting records. Paper records are printed POST ELECTION. We do not believe this model actually meet the spirit of the HAVA requirements of paper records for audit trail.

In this model, the voters are not provided a chance to “review” or “confirm”. It is claimed by others that the printer will faithfully print out the electronic records in paper form the same way every time.

The problem is that any error made by the voter while voting, by the system DURING the selection process, by the system while STORING the electronic records and by the system AFTER the voter is gone will never be “discovered” or “recovered”.

Worse, it can never be proven or in most cases detected again. Once the “vote” is record in the electronic media, short of direct tampering, the system is going to print out the same electronic file every time you ask them to print again. Thus, all of the errors if made by the voters and by the system **during** the selection process, while **being transmitted and stored** into the electronic records, and any potential errors in the system **before any tallying** happened will also be faithfully printed as well.

Another variation of such a model is to provide another electronic verification by a third vendor to ensure that whatever the voter sees on the screen are recorded faithfully in a different media and system as part of the audit trail.

AVANTE believes electronic verification is a must have feature and is a good practice for any electronic voting system. This basic good practice is currently built-in the AVANTE DRE VOTE-TRAKKER™ system. Each paper record is tied to the electronic ballot images with a randomly generated tracking number. Each of the electronic ballot images is bound to the randomly generated tracking number with a relational check code that is also printed on the paper record. Each of electronic ballot images is sent simultaneously into at least two different electronic media (magnetic hard drive and electronic flash memory). At the end of the election, before the tally can be generated, the ballot images and event logs stored in the hard drive and flash memory are copied onto a write-once CD-R.

As good a practice as it may be, AVANTE does not believe that it can replace the printing of real-time paper records for voters to verify. Any electronic verification method cannot effectively bear the mark of authenticity as paper records that have been “viewed”, “touched”, or “verified” by the voters.

Any electronic media can be tampered with and does not have the mark of authenticity as a TRUE INDEPENDENT AUDIT TRAIL.

WHAT AVANTE BELIEVES A PAPER RECORD SHOULD CONTAIN:

One of the typical questions raised is: what if the paper record is not the same as the electronic record?

The answer is simple. That is exactly the reason why we must have a voter verifiable paper record. It certainly is not the American way to hide our heads and pretend that electronic records cannot be tampered with or programming cannot be wrong or malicious. If they are wrong or tampered with, we must be given a chance to discover and correct them. That is exactly why a real-time paper record must be printed and reviewed by the voters.

Being the pioneer in Voter Verifiable Elections Systems, AVANTE attempted to resolve all of the various problems and issues in producing a paper record. The following are some of the requirements that must be addressed:

4. The paper record must maintain voter’s privacy.
 - There should not be a time-stamp like some proposed systems produce.
 - There should not be serial number attached to the paper record.

- The paper record must be individualized (i.e. cut). It must not be produced in a roll.
 - There should not be any printer ribbons or other means that can be used to reconstruct the sequence of votes.
5. The paper record must not be easily tampered.
 - No one should be able to produce another paper record post election.
 - Each paper record must bear a special check-code that cannot be tampered with even by the election officials or by the company that produces such system.
 6. The paper record must not be defeated by forgery.
 - How would we know if a paper record is authentic or forgery? What if someone stuffed with other paper records after the election?
 - What if some one presents a paper record that they claim to be authentic?
 - AVANTE paper records are each incorporated with an encrypted printing specific to the selections.
 7. The paper record must allow for authentication and traceable to the electronic records.
 - That is, there should be one-to-one correspondence with the paper records and the electronic records.
 - How do we know the same electronic records have not been printed twice?
 8. Should the voters be given a paper record besides what are stored for audit and recount?
 - Some people are afraid that people can sell or buy votes.
 - Some people are worried that people will coerce others to vote a certain way.
 - Whether a voter should be given a paper record as part of their record of voting is a social and political decision to be decided by the political process and not by the vendors. Of course, there are both federal and state laws that can be enforced to protect such tampering as well.
 9. Visually impaired voters should also have the benefits of voter verification similar to that of the paper records for the sighted voters.
 - Contrary to the common belief of the critics, AVANTE believes that visually impaired voters should receive the same benefit of the voter verification in knowing their votes are cast and recorded as they intended.
 - The paper records that are used for voter verification must also be read back after the paper record is printed.
 - The paper record should be deposited quickly once printed while the paper record is being read to voter in order to keep the vote private.
 - AVANTE believes that it is even more critical that visually impaired voters be read back their vote on paper so that they too can be assured that the vote is cast and recorded as he/she intended.

We hope the above list will help those having problems in making a viable voter verifiable paper record system to work. We have seen many of the more established voting system manufacturers purposely make voter verifiable paper records fail in order to prove that it is not practical.

We believe that having a voter verifiable paper record is such a “no-brainer” that it really defies common sense for anyone to object to its use. Like Professor David Dill of Stanford University once said in exasperation, printing a receipt or paper record is not rocket science. People have been doing this for all kinds of business transactions.

WHAT IF SOMEONE CLAIMS THAT THE PAPER RECORD DOES NOT REFLECT HOW HE/SHE INTENDED TO VOTE?

There are two different scenarios that voters may voice such a complaint.

1. The first scenario is that the paper record is the same as that of the review screen. The voter simply changed their mind after the paper record is printed upon their confirmation of touching on the “CAST BALLOT” button.
 - This type of complaint is administrative in nature. That is, how many times the voters are given the right to change their mind? Typically, most state laws for paper voting allows spoiling of three paper ballots. In the case of electronic voting, the voters are given unlimited chances in changing their choices during the selection and at the review screen.
 - In all touch-screen voting systems, the review screen must be presented to the voters so that they can make last minute changes. The voters must be able to change their mind as often as they wish before they press on the “CAST BALLOT” button.
 - VOTE-TRAKKER™ provides the capability for voters to change their selections anytime during the voting process by simply pressing on the “Review Choices” button or choices made on the summary screen.
 - Some systems may allow accidental “CAST BALLOT”. For example, some systems have such button available on the screen at all times which can confuse the voter into pressing it before he/she finishes their vote. This potential error should be corrected.
 - VOTE-TRAKKER™ requires two consecutive touches on the “CAST BALLOT” button before the vote is finally cast. Immediate after the first “CAST BALLOT” button is pressed, the voter is reminded with a reminder screen: “CASTING YOUR BALLOT IS IRREVOCABLE. Please confirm by pressing on the “Cast Ballot” button again if you are sure of your selection.” The voter can still touch on any of the selections to make their changes at this point. Only upon touching on the “Cast Ballot” button twice consecutively will the vote be cast as final.
 - If the “temporary” paper record option is selected, VOTE-TRAKKER™ will print out a copy of a “temporary” paper record for voter to confirm upon the first touch on the “CAST BALLOT” button. The second touch on the “CAST

BALLOT” button is when the final and official paper record will be printed. The final and official paper record is signified with a barcode of choices, a randomly generated tracking number, a relational check code and encrypted printing style.

2. The second scenario is that the voter complains that what is printed on the paper record is not the same as selections shown on the review screen.
 - This is a serious matter. If true, the system is now proven to be inaccurate or it has been tampered with. Voting must not be allowed to continue.
 - However, it can also be simply an error on the voter’s part as well. In a long ballot, voters may not remember exactly how they voted on each and every contest even though they are displayed in the review screen.
 - **It can also be due to the fact that some of the systems available today induce the voters to make excessive unintentional under-votes. Such voices of complaints may help the jurisdictions to correct such system errors.**
 - Any reporting of such serious errors should be in writing. The voter should sign an official complaint. Such complaint should indicate that he or she has observed the discrepancy on the specific machine number and preferably including the specific contest. The voter must not be asked to indicate what was the specific error because this question could affect the privacy of the voter’s choices.
 - AVANTE has always suggested such administrative procedure that if any complaint is raised on any specific voting unit, all of the paper records will be compared with the electronic ballot images that are used to tally the vote. This is why it is critical that each paper record must have a unique random generated tracking number.
 - AVANTE has always suggested such administrative procedure that **if more than one complaint is raised on any specific voting unit**, the specific unit should be shut down for investigation. Again, every paper record must be recounted to compare with the electronic ballot images.
 - In the total of more than 1600 votes cast in the 2002 General Election in Sacramento California, there was not a single complaint of such discrepancy.
 - In the close to 4000 votes cast in the 2003 November Election in four different municipalities in Connecticut, there was not a single official complaint filed of such discrepancy.
 - There was a single reported voicing of error by a voter when a reporter was present. When asked to file an official complaint in writing, the voter declined to do so.
 - However, if any one is interested in such direct verification of paper records on that particular location, AVANTE will make the request to that particular precinct to “recount” and “compare” all of the paper records against the electronic ballot images in public. We believe public confidence in our election process is of utmost importance to the democratic process.

- AVANTE proved that almost all voters are earnest in exercising their voting rights. A slight additional amount of work is well worth the confidence that we gained through the use of voter verifiable paper records.

IS THERE A MORE VOTER-VERIFIABLE PAPER RECORD THAT IS IMMUNE TO ANY COMPLAINT EVEN IF THE COMPLAINT IS FALSE?

As we discussed above, there was all but one person out of six thousand ballots cast on VOTE-TRAKKER™ units that unofficially complained about the discrepancy of the paper record and the review screen. In fact, we do not even know if that particular complaint was made in earnest. However, one may still ask what if there is really a difference? This is one of the more quotable concerns made by the critics.

AVANTE believes that this kind of question is exactly why we should have a real-time paper record for the voter to review and confirm. Any discrepancy voiced should be addressed and recounted in public.

While there may be other modes of operation and presentation of such paper records, because of privacy issues, none is exempt from such complaints. For example, the following sequence has been suggested:

1. The voter selects their choices on the touch-screen.
2. The voter reviews their choices on the review screen and makes changes if needed.
3. The voter cast their vote to print out a paper record for verification.
4. The voter accepts or rejects the paper record. If rejected, the voter can make new choices again until they are satisfied.

This sequence is a variation of the “trial” paper record process and can be easily instituted in VOTE-TRAKKER™ as one of the additional options. However, this sequence like any others is by no means immune to the same complaints.

For example, what if there is a voter that keeps saying that what is printed is not the same as what is shown on the review screen? What is one to do?

- First and foremost, the election official cannot look at the screen to verify such complaint. By doing so, we will have violated the privacy of the voter and secrecy of the vote.
- Secondly we must be able distinguish between the “accepted” and “rejected” paper records that have been printed as stored together. The hardware requirements may pose a little challenge. (AVANTE has a solution to such technical difficulty none-the-less).

The same administrative protocol must now be instituted much the same way as we discussed earlier:

- The voter complaint must be made in writing.

- A one-to-one paper record comparison to the electronic ballot image must be made in public.
- For the one-to-one paper record to electronic ballot image to be compared, there must be a unique identifier for each record.

We actually end up with the same administrative protocol for handling any real or erroneous complaints. For that matter, this sequence is no more voter-verifiable than any others.

AVANTE believes that there are two important values afforded with the use of voter verifiable paper records in the election process.

- Ensure the integrity of the voting process through the direct verification of the voters.
- Help the jurisdictions to monitor and correct system errors if they exist.

AVANTE does not believe any one process is more voter-verifiable than any other process. We believe that any form of paper records that have been reviewed and verified by the voters before they left the polling place is voter verifiable. These paper records should be considered carrying the authenticity marks for use as independent audit trail.

DISCUSSIONS ON SOME OF THE VIEWPOINTS MADE BY CRITICS OF VOTER VERIFIABLE PAPER RECORD?

AVANTE has been outspoken on the lack of truth and validity of these complaints. However, these make-believe viewpoints continue to fester in the media. We would like to address them here again as part of the discussion. This discussion is much more pertinent today than any other time in view of the voter verifiable paper requirement for California made by the Secretary of State Mr. Kevin Shelley.

1. Voter-Verifiable Paper Records Cost More Money for the Jurisdiction to Run an Election

There are several costs in running an election:

- *The initial hardware and software cost of the voting system.*
In our market survey, typical systems without voter verifiable paper record capability cost approximately \$3200 per unit while those with voter verifiable paper records may cost \$3600 per unit (inclusive of training and implementation onsite assistance). There may be some differences in the initial start up cost.
- *The running cost of the hardware and software.*
The cost of running an election with the voter verifiable paper record approach may actually be lower.
 - Most of the opponents to the voter verifiable paper record tend to not mention the fact that they must print the paper record either in real-time or post election at the polling places (some may argue they can do it at the

County office). The paper record is a HAVA requirement for DRE systems. Now the jurisdiction must add some printers to each polling place to print the paper records. This increases the initial cost of capital. Depending on the printing speed requirement, they can easily add a few hundreds to thousands of dollar capital cost to each polling place.

- To print each ballot image takes 4-10 seconds each and thus can add 30 minutes to an hour to each poll closing. The jurisdiction must pay for the poll workers and other staff on the job longer. This labor and management cost may easily add a few hundred to one thousand dollars to each polling place for each election.
- Depending on the systems chosen, some actually cost more to run. For example, if there is a lack of automation in ballot generation and proofing, the cost of running such systems will dramatically increase for each election. If the system is not provided with an automated logic and accuracy testing, there is another additional cost of hundreds of staff-hours, etc. So far, most jurisdictions simply ignored the state laws by not doing logic and accuracy testing on each voting unit at all.
- In the end, the tally of costs using system voter verifiable paper records in the end are actually much lower than those systems that print the non-voter verifiable paper records post election.
- Anyone interested in the real costs should talk to the staff of those jurisdictions that have implemented the older touch-screen voting systems.
- With the lack of voter verifiable paper records, more legal challenges may be posted in close races. Again, this may add to the cost of the jurisdictions or to the contestants depending on the local election laws. This can easily added thousands and tens of thousands to the running cost of each election.
- Better yet, try to estimate the costs of errors and cost of potential retrofits at Broward and Miami-Dade County in Florida, State of Georgia and Maryland, etc.

2. Voter-Verifiable Paper Record Systems Are Unproven and Pose Technical Problems

AVANTE being the only company that has successfully run live government elections using voter verifiable paper records, we feel obligated to answer some of these issues raised. We would like to clarify some of those rumors that have been spread by those that were not there. Anyone really interested to know from those with the first hand knowledge are welcome to call both the staff and management of the jurisdictions involved.

- In the 2002 Sacramento California General Election, there were six polling locations used for early voting. Each polling place was open for approximately 10 days.

- The decision to allow the use of the voter verifiable paper record system by then SOS Bill Jones was literally postponed to the proverbial “eleventh” hour. No outreach or advertisement for such voting opportunity was possible.
 - There were a total of more than 1600 ballots cast.
 - AVANTE was required to performed survey of the voters with the County of Sacramento. More than 86% indicated that they were able to cast their votes with outstanding confidence. In combination more than 96.5% indicated they were able to cast their votes with confidence. In contrast, reported only 70% of the voters in Georgia in 2002 election expressed confidence in voting on touch-screen systems without voter verifiable paper record.
 - Among all the more than 1600 votes cast, there was not a single complaint that the voter verifiable paper record was not the same as what was chosen.
 - There was not a single “unintentional” under-vote.
 - There were 65% less under-votes in comparison to all other DRE systems in use in that particular election in California.
 - There was an un-foreseen static problem for a small percentage of the paper records clinging to the viewing screen during the election. This problem was corrected immediately by shielding the screen and removing the paper record to place inside the storage compartment. This static cling problem has since been addressed and corrected completely.
 - There were no paper jams of the printer units. The rumor that tools were used to un-jam printers is false. Instead, there were attempts made by voters from a competitive company trying to knock down the shield of review window.
- In the 2003 Minnesota Election, there were total of two polling locations using AVANTE VOTE-TRAKKER™ for mock election. Each polling place was open for approximately 12 hours.
 - Close to a thousand votes were cast on two voting units.
 - Every paper record was printed and retrieved successfully.
 - Not a single voter complained that the paper record did not agree with the selections made by the voters on the screen.
 - Again 0% residual vote was achieved. There is 0% error in reflecting voter intent.
 - Not a single “unintentional” under-vote was recorded.
 - In the 2003 Connecticut Election, there were total of five polling locations used. Each polling place was open for approximately 14 hours.
 - The decision to use the voter verifiable paper record system by Connecticut SOS was made early. Good outreach and advertisement for such voting opportunity was made.
 - There were a total of close to 4000 ballots cast.

- Based on the outreach survey, more than 90% of the voters feel confident in casting their votes.
- Every single voting unit ran a full logic and accuracy test where every voting position was “touched” to cast specific votes based on the ITA certified script.
- Among all the votes cast, there was one single voter feeling that the voter verifiable paper record did not match what she believed she chose. However, she did not agree to sign an official complaint. The name of this voter is not known or was recorded.
- Again 0% residual vote was recorded. There was not a single “unintentional” under-vote.
- There was not a single voter verified paper record clinging to the viewing window. Every paper record was printed and deposited perfectly.
- There was not a single voter verified paper record jammed in any voting unit. Every paper record was printed perfectly and retrieved for audit trail perfectly.

3. Voter-Verifiable Paper Record Systems Cannot Provide the Same Accessibility to the Visually Impaired Voter

This is one aspect of the issue that is widely misunderstood. By stating that the sighted voters have the privilege to know that their votes are counted correctly will disenfranchise the visually impaired implies that visually impaired voters will not wish to know their votes are counted and counted correctly!

AVANTE believes otherwise. We think the visually impaired voters, like most of us would appreciate to know that their votes are recorded correctly as well.

AVANTE has developed and proven that not only sighted voters can feel confident of their votes with the voter verifiable paper record, but visually impaired voters can also be assured of their votes being recorded correctly in just the same way.

- Visually impaired voters will be verifying their votes with the reading back of the voter verifiable paper records just as if the sighted voters are reviewing their paper records.
- In fact, some of the visually impaired groups have tried AVANTE VOTE-TRAKKER™ read back process and acknowledge the accessibility of the paper record.
- This capability is not inherent in AVANTE VOTE-TRAKKER™ only. All of the current DRE systems on the market are also capable to provide such read back facilities to the visually impaired voters.
- AVANTE believes all of us delivering services in public sector should make the provision of equivalency in voice assistance to disabled citizens a basic rule. It should be a level of service we should provide regardless of whether it is required by law or not.
- Again, there is no rocket science here either!

CONCLUSION:

YES. A good solution of voter verifiable paper record as part of the audit trails does require detailed and careful engineering. But technical requirement in printing paper records in real-time is not much different from printing the same paper records after the election at the polling places.

However, the effect in voter confidence and in our democratic process in using and not using voter verifiable paper record is dramatic. It should be obvious to all of us involved in the election process by now that the cost to society in using voter verifiable paper record is by far lower than the cost of not using them.

AVANTE has pioneered voter verifiable paper record voting solution and has proven that it can be done successfully and flawlessly.

IS “OPEN SOURCE” OR SOFTWARE “ELECTRONIC VERIFICATION” A SOLUTION FOR SECURED E-VOTING?

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SUMMARY

This is a response to the questions raised by Rachel Konrad of the Associated Press on the issue of “open source” and third party “software verification” in reference to the e-voting security.

To understand the usefulness of open source in mitigating e-voting security problem, we believe we must first review the source of threats to voting. AVANTE has a detailed analysis of this issue in its documentation for FEC NASED certification (attached here for your reference). The following is a simplified version of the analysis.

- Threats from programmers and staff of vendors providing the solution or servicing the solution. For example, they may load unauthorized software into the system such as what happened in California and Indiana by Diebold and ES&S in recent elections. We believe it happened to more systems than being exposed here by the media. It is relatively easy for this group of people since they “know” the software and possesses the source codes. These insiders can be a real threat if the jurisdiction allows easy access to the systems after the systems have been transferred to the jurisdiction.
- Threats from the IT staff and other staff of the jurisdiction that have access to the software and system. That is, either they can change the software or collaborate with outsiders or vendors to change the software. Normally the jurisdiction IT staff does not possess the source codes and will make sophisticated tampering a little more difficult. It will be relatively easy if the staff also possesses the source code.
- Threats can also come from voters during the voting process. If the system is relatively “open” like those discovered in the Diebold system, voters can conceivably pre-program many access cards to vote multiple times. For example, AVANTE has always given this possible scenario to the jurisdictions when we demonstrate our system. What if a voter signs up to vote and gets a ballot access card and disappears with the card without voting immediately? Instead the voter goes and makes multiple “copies” of such access cards. They either give them to their friends or go back to vote themselves. In almost all of the systems certified today, the ballot access cards or codes can be cracked relatively easily and similarly to that demonstrated in Diebold system. Smart voters can actually tap into the I/O of the contact smart card and use a PDA to change the authorized codes or refresh their authorized codes. Since the voters are provided with privacy, they will be able to achieve substantially more votes than they are authorized to. Obviously, it will be easier if the source codes are open to them as well.

Open sources can guarantee one thing only. That the source codes as revealed are “OK” and free of potential threats. However, they are “OK” only if they are not changed. As we have seen before, they are easily changed and quite often and without notice by the vendors during the last election. While, most states have criminal codes against such unauthorized changes the offenders are not prosecuted as we saw from the last election.

A third party software or electronic verification program only means you need another collaborator to carry out the offense. If the source codes are open, that second collaborator may not even be needed!

We believe the “open source” approach is very useful if the system is possessed and used by the public themselves. That is, if the software is used by the individual and under the individuals control. In order for the “open source” to be useful for voting systems that are not under public control but rather under the control of a few individuals, the usefulness is not as obvious.

We believe voting systems that involve software and hardware without voters’ direct supervision or stringent checks and balances and diligent prosecution of offenders must accompany verification. The execution of the two criteria is the measure for whether an election can be carried out without tampering and without direct voter verification.

The first of the two criteria for a proper execution of election is the checks and balances of the voting process. While checks and balances are “officially” in place in some states such as California, as far as we know they have never been really checked. For example, the jurisdiction must submit their ballot counting program to the State before the election is to take place for every election. They are generally submitted by the jurisdictions. But do we ever know if that program has been compared with the “certified” program? Obviously this is rarely done. Or else we would not have to find this out later after a long costly investigation.

Even if the program is submitted, do we really know if the program submitted is not changed after submission? Supposedly, the system is locked up for a possible check if needed. But it is not done unless they are challenged within a defined period. Even when challenged, did anyone ever see a report that the software used had been compared to the “certified” version? This is not in any state election procedure that we are aware of.

The second criteria for the “open source” system are diligent prosecution of the offenders. Did we see anyone prosecuted after the offenses in California during the last election? Tampering with an election system is supposedly accompanied by a 3-5 years jail term. Instead, they received a mere slap on the hand. Almost all of the jurisdictions that “suffered” the offense actually defended the vendors that carried out the offense!

Unless we have stringent procedural controls of election processes and diligent prosecution of offenders, we may be faced with more tampering of the voting systems if the source codes are open.

With our current systems and procedures of elections being distributed to the state and local jurisdictions, any possibilities of detailed controls are simply not possible!

Again, we come back to the same conclusion. The only possible solution to the complex problem of executing an election without fraud is the “voter verified paper audit trail”!

WILL AVANTE BE WILLING TO DISCLOSE THE SOURCE CODES OF ITS ELECTION SYSTEM?

The answer is YES for parts of the system disclosed to the general public.

For example, it will be obvious to disclose the portions that the system reads back verbatim to the visually impaired voters what is being printed for them as paper records.

Another portion of the source codes that may be disclosed are those related to the data flow of the electronic records and how it is recorded in each media used for the election. In the case of AVANTE VOTE-TRAKKER™, it would mean the voter verifiable paper record printer, the magnetic hard drive and the electronic flash memory.

All of these disclosures and any additional disclosures must be authorized by either the state or by the new Federal EAC. We believe a totally open source is still not a good idea with the current election laws and administration systems. We actually believe that it will do more damage than good.

AVANTE endorses the idea of establishing a national “brain trust” for the electronic voting system. It is counter-productive and creates even more distrust when politicians at different states paid for selective consultants to “white-wash” the security issues. This can be an organization of academics working under the auspice of NIST that have the long established history of being scientific rather than political. The evaluation of the security issues can be completely confidential. Companies can submit their system for evaluation on voluntary basis. The companies will be given unlimited chances to modify until meeting their endorsement mark. This security “brain trust” will give out a passing mark whenever any voting system reaches some basic security level. It will be like the UL seal of approval for safety.

A VOTING SYSTEM SHOULD BE INDEPENDENT OF ANY “TRUST” FACTOR:

AVANTE as a election management solution provider is in total agreement with Professor Doug Jones of University of Iowa that an election and a voting system should

not depend on trusting someone. We have engineered VOTE-TRAKKER™ under this guideline since we started the system in year 2000.

The voters should not be asked to trust the “goodness” of the programmers or the system providers like AVANTE that the system is correctly made. The voter should not be asked to trust the “goodness” of the federal or state testing authorities that the system being used are tested so thoroughly that nothing could go wrong. The voters should not be ask to trust a second or third or fourth independent party that they certified the systems are correctly counting their votes. These tests should be the baseline requirement. No matter how good or how many people have tested the voting system it is still a “trust me” model. It may be trustworthier but still a “trust me” model. There are many cases where ES&S and Diebold changed their system software without telling anyone.

At the end the voters, like buyers of anything or any service being sold or served to them, should be “the judge and the inspector” of the system and decide whether their vote has been cast and counted correctly. The only way they can be assured that their ballots are being recorded independently of electronic means is by a “voter receipt” now being called “paper record” or “voter verified paper audit trail”.

The voters should not be asked to trust the election officials to do the correct and right job. There should be a concrete proof for the voters to judge for themselves whether their ballots are cast and counted correctly.

The easiest way this can be carried out is through a paper record that is printed while the ballot is stored inside the electronic box. This paper record can only be meaningful if it carries the mark of authenticity of having been reviewed and verified by the voters. AVANTE also believes that it will be more useful if each paper record also carries an identifier that ties the paper record with the electronic record being stored. That is, there must be a correspondence between the electronic records and the paper records.

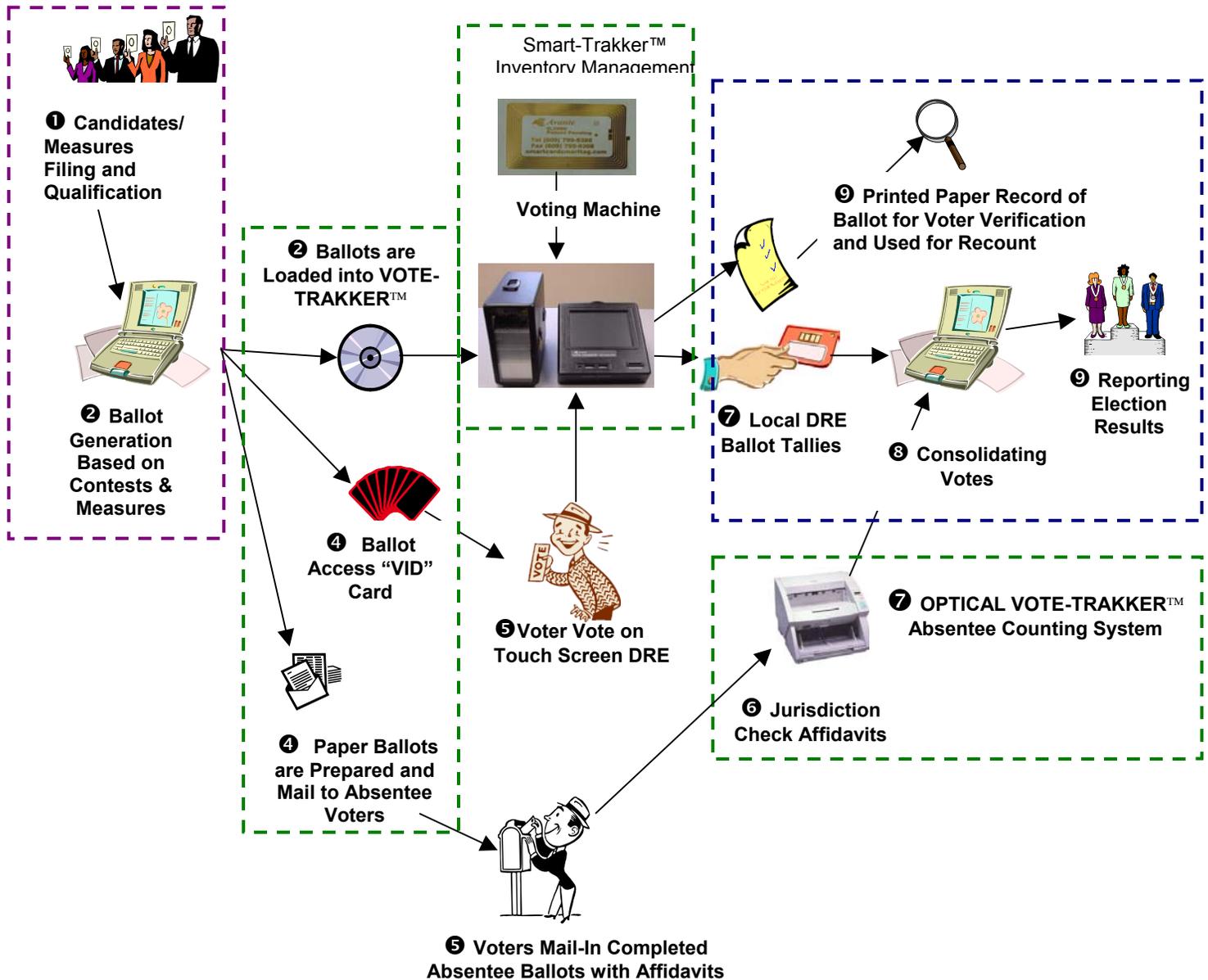
Ideally, these paper records may have a duplicate copy or at least a “tracking” number so that voters may at some point be allowed to check their ballots over the Internet. We understand that there are many people worried about vote buying. But realistically, in some states like California and Oregon, everyone can use the absentee paper ballots anyway. They can certainly “sell” their votes relatively easily already.

AVANTE VOTE-TRAKKER™ has been used in five different elections and is proven to enhance voters’ confidence from the typical 70% for electronic voting systems to over 90%, 96.5% in the case of 2002 early voting of the 2002 General Election in Sacramento County California.

VOTING SECURITY CONSIDERATION MUST INCLUDE THE FULL PROCESS:

To understand the reason why the only solution to voting and election integrity must include detailed analysis of the management of election we have provided this

illustration as the representation of a typical election process (AVANTE VOTE-TRAKKER™ is used as a model for illustration):



VOTE-TRAKKER™ SYSTEM ARCHITECTURE AND OVERVIEW

(Rev. 04-08-2004)

The color brackets are used to identify distinct functional activities that may affect the outcome of the election results. That is, if "tampering" is to be prevented, these functions are best separated and managed under different groups within the election office of the jurisdiction. Those operations with same color are similar activities that may be consolidated within one group of staff. It should be quite clear that DRE voting machines and their operations is only one of the five different election functions.

ANY “SOFTWARE VERIFICATION” CAN ONLY BE PART OF THE SECURITY ENHANCEMENT NOT A SOLUTION

Since correct counting of the ballots within the DRE voting units is only part of the process in ensuring the votes of the voters are correctly cast, “software or electronic verification” can only be one of the beneficial things to do. AVANTE pioneering electronic software verification besides the voter verifiable paper record when we developed that VOTE-TRAKKER™ voting system.

The first model of VOTE-TRAKKER™ demonstrated to the public in March 2001 already incorporated a randomly generated voting session identifier (VSI or tracking code) for each ballot cast. This voting session identifier besides the randomly generated code for voter privacy also includes the voting unit identifier. This VIS is a starting point of any electronic verification system. It is also used in the “VOTE-HERE” electronic software verification system that is being talked about.

The ballot as cast with all of the choices made for each and all of the contests are then bound and encrypted with this VIS code to generate a relational check code. All of this data is simultaneously recorded in at least three different types of media to ensure full audit capability. The two electronic forms are a hard drive that is a magnetic medium and flash memory that is an electronic medium. The third media is the paper records that are first verified by the voters and retrieved as audit trail. The paper record or voter receipt system is now commonly known as a “voter verified paper audit trail”. To provide additional security and authenticity of the paper record, AVANTE included relational print marks on the paper records to ensure that no one can duplicate any paper record outside of the system.

Even though electronic software verification is already incorporated within the VOTE-TRAKKER™, we do not consider that sufficient to claim system security. It is still a “trust me” model for the voters.

AVANTE firmly believes that any voting system should not ask any individuals including voting system manufacturers or even testing companies to trust them. A trustworthy system should bear records that have been verified by the voters that cannot be easily changed. Paper records are the only viable medium that all voters can understand and cannot be modified by anyone. VOTE-TRAKKER™ system has strengthened the “voter verified paper audit trail” with additional security features as mentioned above.

Even if AVANTE “collaborates” with insiders of the election office to change the electronic records in both the electronic verification system and the DRE electronic ballots, the paper records cannot be changed if they are stored separately in hundreds and thousands of sealed and signed envelopes by the poll workers. Storing the paper records along with the electronic storage medium such as CD-R of the ballot images and audit logs is a typical state election code and are recommended by AVANTE for all the jurisdictions deploying VOTE-TRAKKER™.

A PAPER RECORD THAT CAN BE VERIFIED BY THE VOTER IS THE ONLY SOLUTION FOR A TAMPER-RESISTANT ELECTION

Conceivably with proper execution of checks and balances and stringent prosecution, elections may be tamper-proof even without a voter verified paper audit trail. However, we all know humans are corruptible. Maybe as citizens, we should have never even been asked to place our election process in the hands of a faith-based election and voting system!

In a distributed election process such as the democratic election system we have today in America, the possibility of full and complete execution of checks and balances and stringent prosecution of offenders are almost impossible. The proof of this impossibility is abundant and the reasoning is self-evident.

Even if we are not corruptible as some may lead us to believe, we are still humans who tend to make unintentionally mistakes. Voters can and will find that out for us to quickly and timely correct the problems if they can verify their ballots with the paper record presented for them to review.

We are left with the only option. Let the voters be able to supervisor the election of their leaders. The only possible means that has been proposed so far is the “voter verified paper audit trail”.

This fact is so self evident that more than 80% of voters polled in Lou Dobbs’ recent program understood it immediately.

As vendors and election officials, why should the voters trust us more than anyone else? We should do our job as best as we can. But at the end of the day, the democratic process must also be auditable by the voters.

Any attempts by vendors and election officials to convince the voters to trust us without proof is counter-productive. As vendors and election officials, we should focus on improving the quality of the election rather than making excuses. Excuses such as how the paper may jam, how much more time we may have to spend on recount, how much more weight we have to lug into the polling place, etc. sound very similar to a “cry baby”. After all, we are paid to carry out the election properly on behalf of the voters. Who is paying the bills anyway?

New HAVA laws require that a paper record be printed for every electronic vote cast anyway. Even if you try to argue that they can be printed post election, the paper records must be printed. It defies logic to not print the paper record while the voter is around to witness and verify it.

The value created by the “voter verified paper audit trail” will be the trust of the voters and contestants on the integrity and correctness of the election. Many lawsuits will be prevented. This is not only cost saving for society but also certainly saves grief for the election officials.

CONCEPT OF “TOTAL ELECTION MANAGEMENT SECURITY AND QUALITY”

We would like to propose more useful activities for us as vendors and for the election official officials to work on instead of trying to refute the need for a “voter verified paper audit trail”.

Elections like any other discipline of management can and should be judged based on a total system management quality concept similar to manufacturing or medical care dispensing. The following are nine minimum measures to ensure total election management quality and security:

1. Is the voter registration list complete and updated to at least the Federal requirements?
2. Are the voters able to vote within a reasonable time?
3. *Are the voters presented with correct ballots all the time? If not, can the ballot be spoiled and the voter be given the correct ballot?*
4. *Are all the voters able to cast their ballot in private?*
5. *Are the voters intent reflected correctly 100% of the time?*
6. *Are the voters prevented from making errors?*
7. ***Does the voter “know” with confidence that their ballot is cast correctly and counted correctly?***
8. ***Can the voter verify their ballots before and after casting their ballots?***
9. Are all of the ballots consolidated correctly and capable of being verified by interested parties after the election?

It is easy to understand the significance of each of the above nine processes to ensure proper execution of the election process. Out of the nine processes, six of them involve the voting system and its proper operation by the voter in casting their ballots.

We have a lot of work to do!

0.5-3% of the DRE systems registered no vote for the presidential candidates. More than 12.3% voters were confused by some of our electronic voting systems and did not vote for the US senators. AVANTE has demonstrated that more than 65% of them would have voted properly if our election systems had guided them to do so.

The absentee paper ballot system so far has not been able to reflect the voter intents if they have not filled in their ballots completely and correctly. Many times the results were changed when recounts were carried out. A better system must be in place so that they can tell us how many voters have not completely filled in the ovals but intended to vote for the candidate of choice. This should be done automatically and for every election.

We should work on allowing overseas voters to vote by fax from anywhere as pioneered by some jurisdictions. This is much easier to execute and more trustworthy than voting over the Internet. It certainly can overcome the disenfranchising of the overseas voters.

(Rev. C April 14, 2004)

WHY, WHEN AND HOW SHOULD THE “PAPER RECORD” OF “HELP AMERICA VOTE ACT OF 2002” BE USED?

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“PERMANENT PAPER RECORD FOR MANUAL RECOUNTS”:

The new “Help America Vote Act of 2002” changes many of the requirements for holding an election using electronic voting system. One of the changes is that every voting unit used for an election must now produce a permanent paper record for each vote cast as part of an audit trail used for recounts.

The following are the relevant portions of the law as it relates to the paper record.

“Help America Vote Act of 2002” Title III, Subtitle A, Section 301, (2)(A)

In General.—

The voting system shall produce a record with an audit capacity for such system.

(B) Manual Audit Capacity.--

- (i) The system shall produce a permanent paper record with a manual audit capacity for such system.*
- (ii) The voting system shall provide the voter with an opportunity to change the ballot or correct any error before the permanent paper record is produced.*
- (iii) The paper record produced under subparagraph (A) shall be available as an official record for any recount conducted with respect to any election in which the system is used.*

The literal reading and interpretation will generally mean that voting systems must produce a paper record that can be read and understood so that a “manual audit” can be subsequently performed if required. The key here is “manual audit”. A manual audit can only be done with either the ballot image of each contest and measure or the listing of choices made by the voters on each contest and measure.

It does not specify that the voter should have a chance to review and verify their vote on the paper record. But, it certainly makes more sense that after the voter has the chance to correct or change the electronic ballot on screen, that a paper record should be produced when the voter finishes casting their vote.

One may even argue that the wording implies that a printed permanent paper record should be available for the voter to confirm after they finish electronic voting.

For those that do not want to produce the paper record in REAL-TIME in order to provide a chance for the voter to verify their vote, they will point to the fact that the wording is not explicit and therefore not required. They will argue that producing a paper record at the end of an election, in the back office of the jurisdiction can also satisfy the law.

Printing the paper record after the voter has left may lead to some logical absurdity if audit trails and recounts are to be anticipated. Without voter verification, manual recount of the post election printed paper records after the ballots are recorded in the electronic voting unit is meaningless.

INTENT OF THE “PERMANENT PAPER RECORD FOR MANUAL RECOUNTS”:

Technically, when the voter casts their ballot on the screen, that ballot data is stored in the voting unit’s hard disk and flash memory. Once the data is stored, each voting unit will always print exactly the same paper record, even if it is wrong, when asked to print subsequent to the election. Also, if someone tampers with the data either during the election process, or after the election, it will print out the tampered results with no safeguards in place.

If there is anything that went wrong during the election, such as touch-screen calibration misalignment and “lost votes”, as found in many of the systems used in the 2002 elections in Florida and Georgia, there is no way that it can be discovered or recovered. Other errors that were found but not widely reported such as missing candidates, wrong ballots and massive unintentional undervotes (12.3% not voting in US Senate race), there is no way to discover or recover after the voters have left. Like some of the computer experts’ concerns, if there was any systematic tampering, it is impossible to be discovered or recovered without a new election. If there is any unintentional but unavoidable human induced logic or accuracy problems with the ballots with any of the systems, will be no way to recover the results.

Printing of the paper record after the election is a formality that has no merit and wastes a considerable amount of time. In a way, it challenges the intelligence of the voters and public when someone proposes such a solution to the potential problems of electronic voting.

Legally speaking, whether printing paper records after the election will satisfy the intent of the “HAVA” requirement is highly questionable and could definitely be the basis for many future lawsuits.

To logically interpret the law, one must ask: “What is the purpose of printing a permanent paper record for each vote cast?” Historically, voting on paper ballots such as punch cards and the marksense system, voters expressed their intents by punching the paper cards or marking on the paper ballots. Any recount that must be performed with the paper records that have been marked or punched by the voters are taken out and manually recounted like what we saw in the Florida 2000 general election. The defects and errors on paper cards and ballots are unsatisfactory but there is no doubt that they were made by the voters. It would be logical to assume that a “RECOUNT EQUIVALENT” is being conceived and intended in the permanent paper record requirement in HAVA.

Electronic voting without a real-time paper record is like voting in a black box. There is no trace or record that the system actually recorded the voter’s intent. We must now relegate that

to trusting the “system”. The “system” could include programming errors, installation errors, set-up errors, ballot definition errors, touch-screen misalignment errors, massive voter interface induced errors such as 12.3% of the voters not voting in a US senate race, etc. These errors are not hypothetical. They actually happened in every one of the elections using such “systems”.

It is very difficult to trust the “system” when the people involved in the “system” are not even following the State laws and FEC guidelines to perform the required logic and accuracy testing on each voting unit. Some of the States have been lobbied by vendors to perform “half” tests for 5% of the units rather than 100% of the voting units! Logic and accuracy testing on every voting unit is supposedly to be performed by actually touching or simulation of touching every single candidate and choice with a prescribed script. This script must also be related to the nature and characteristics of the contests that would help document and review some of the obvious errors that have occurred in the last few elections held with these electronic systems.

“RECOUNT EQUIVALENT” FOR ELECTRONIC VOTING:

If the concept of “RECOUNT EQUIVALENT” is to be realized, the printed permanent record of the vote cast must be representative of what the voter did. Instead of directly punching or marking on the ballots the system prints out the paper record of the electronic version of the selections to be reviewed and “verified” by the voter.

There are two ways that one can envision this to achieved this “recount equivalency”:

1. The first way is what SACRAMENTO County did in the 2002 General Election for their early voting. VOTE-TRAKKER™ printed out a paper record when the voter finished and cast their ballot. The voter reviewed and verified their ballot through a transparent viewing window. After the voter was satisfied and left, the system retrieved the paper records automatically into a sealed box for any recounts that may be needed.
2. After a voter uses the touch-screen system to register their intent, the voting unit prints out an actual representation of what the voter selected. The voter then deposits the paper representation into a sealed box for subsequent tabulation. This second way is what the State of New Hampshire is contemplating to do to achieve the accessibility requirements of HAVA while maintaining their paper balloting history.

Both of the methods above will achieve 100% compliance in satisfying the intent of “permanent paper record” in HAVA. The voters actually “verify by viewing” or “verify by viewing and touching” the individual “paper record” before they left the voting booth. Whatever is stored within the voting system bears the voter’s direct verification and authentication. The system tabulates the results from ballots that are actually “equivalent to the actual marking or punching of the paper ballots”.

Another important point is that if there are any problems with the voting units, and there is a paper record produced contemporaneously, the voter will have noticed the discrepancy and give immediate feed back to the election official. Timely checking and corrections may be made.

The only logical implication of the proposed law is that the paper record representing exactly how the voter intended to vote should be printed under the jurisdiction of the voter. More importantly, the voter has a chance to verify them so that this audit trail will actually provide the intended purpose of providing a hard black-and-white proof in the case of recounts or challenges.

Whether the law as written is to provide confidence to the voters that the “electronic black box” indeed records the voter’s intent as reflected by the printed record they have had a chance to verify, the confidence of the voters and the candidates will be dramatically improved.

The fact that there is a paper record that has been verified by the voter as part of the audit trail, there will be less of a basis for challenges and law suits to be made in close races.

HISTORICAL DRE SYSTEM AND VOTER ERRORS IN ELECTRONIC VOTING:

Before October 2002, all of the electronic voting systems (direct recording electronic, DRE) were basically electronic black boxes. Once the voter pressed the cast ballot touch button, the screen disappeared. Whether the voter made a mistake, or the system made a mistake, there was no way anyone could tell or make corrections. At the close of polls, tallies are printed out from the system and assumed to be correct.

The only logical reason why such a process was allowed or used was the assumption that there will never be errors made by the voters or by the voting units. But this is far from the truth. There have been many voting system errors, ballot errors, as well as voter errors documented in every election that has been held. There are several well known sources of errors in the voting process:

- 1. Ballots have been created with errors, e.g. typographic and transcribing errors in English and alternative languages, missing contests in English or alternative languages,**
- 2. Ballots already generated do not work well with the ballot interpretation program that has been modified in mid-stream (even though this is generally not recommended but is done universally),**
- 3. Hardware or firmware problems or incompatibility with the ballots being loaded (i.e. human errors at the jurisdiction offices whereby wrong ballots are loaded into the wrong units, etc.).**
- 4. Touch-screens out of calibration, ballot formatting and interfaces that induce excessive voter errors.**
- 5. Voter errors due to lack of understanding, sighting errors because of inexperience in viewing electronic screens, etc.**

Some of these errors from 1 to 4 may be caught if each voting unit undergoes what is called “logic and accuracy” testing before and after each election. The “logic and accuracy” testing requirements in the Federal Election Standard as it exists has been designed to test the **PROCESS, DATA, and SYSTEM INTEGRITY**. It is designed to help flush out any errors that

are hardware and software related. These tests have been proven to be extremely useful in punch card and marksense voting systems over the years.

Because of the time-consuming nature of manually touching on the screen (when not automated) to perform such logic accuracy testing in accordance to a prescribed script, some States only ask that small percentage of the units be tested. Even States that have laws to require that 100% testing (e.g. California Election Code 15000) be performed on all units, they were generally not done for the November 2002 elections. Therefore many errors found in the actual voting processes could not be corrected.

Most of these errors and the magnitude of these problems could not documented or discovered until the end of the election processes. The corrections were too late and cannot be done effectively with the full confidence either the voters or candidates.

One of the easier solutions of the problem is to provide a paper record of every ballot cast electronically with the DRE voting unit. The only meaningful process to produce the paper record is to be done in the presence of the voter. Voters can confirm what is printed and what they have selected. Any errors will be immediately reported to the polling officials. If there are any errors, they can be minimized or eliminated.

Some of these documented errors in the elections of 2002 in Florida and Georgia have caused alarm among computer experts. Professor Rebecca Mercuri of Bryn Mawr College and Dr. Peter Neumann of SRI International have been calling for paper audit trails for DRE systems for years. They have now been joined by Professor David Dill, the Stanford University professor of computer science who launched the petition drive that gathered more than 300 signatures among the experts in the nation calling for “voter verifiable paper audit trail” in all DRE systems. Since then, there are at least two states that have openly expressed the adoption of voter verifiable paper records, New Hampshire and Missouri, as part of the audit trail for their election systems.

PRINTING PAPER RECORDS WITHOUT VOTER VERIFICATION IS COSTLY AND INVITES LAWSUITS AND CHALLENGES:

In the state of California, Proposition 41 helps fund the local jurisdictions to buy new voting systems to avoid the Year 2000 election fiasco. The following is the election code governing such use of public fund.

“Shelley-Hertzberg Act of 2002”

California Codes 19234 (e)

Any voting system purchased using bond funds that does not require a voter to directly mark on the ballot must produce, at the time the voter votes his or her ballot or at the time the polls are closed, a paper version or representation of the voted ballot or of all the ballots cast on a unit of the voting system.

The paper version shall not be provided to the voter but shall be retained by elections officials for use during 1 percent manual recount or other recount or contest.

The California code is written more clearly than the Federal law. There are two options that the jurisdiction can do to satisfy the requirement of providing a paper record of the ballot cast to be retained for the 1% recount or other recount or contest when using the State fund:

- The first being printing the paper record at the time the voter casts their ballot.
- The second being at the time the polls are closed, *a paper version or representation of the voted ballot or of all the ballots cast on a unit of the voting system* must be printed. It does not seem that the printing can be satisfied by a tally of the ballots but by the printing of **all of the ballots** themselves. They must be the “paper version or representation of the voted ballot” (generally referred to as ballot images in the election industry) or “paper version or representation of all the ballots” (a record of every choice made by voters of all of the **ballots not votes**). Because, as further explained by the following as to the purpose of these paper records. *“The paper version shall not be provided to the voter but shall be retained by election officials for use during 1 percent manual recount or other recount or contest.”* It is non-productive to manually recount the tallies!

The second option left a gap in the definition: “at the time the polls are closed” as it is not as definitive as needed. Is it before or immediately after the tallies of the results are generated? Can the writing of “at the time the polls are closed” be stretched to mean anytime **after** the polls are closed as some election officials believe?

There are several California Codes (19370, 19384, 19386) that require each polling place to post the vote tallies of each voting unit “One copy of the statement of return of votes cast for each machine shall be posted upon the outside wall of the precinct for all to see.”. Based on this law, one would expect that the system has printed out all of the paper records of each vote before the poll is closed. Additionally, CA Election Code 15150 requires that “The semifinal official canvass shall commence immediately upon the close of the polls and **shall continue without adjournment** until all precincts are accounted for.” Printing each individual paper records **after** the tallies have been generated would seem to be a waste of time.

If one has to print every paper record of each voting unit at the time of closing under the supervision of voters and the observing parties a reasonable time is needed. For example, if there are 300 votes in each voting unit, and each paper record takes 6 seconds to print, the total time for each unit fitted with a fast printer would take 1800 seconds or 30 minutes. This is doable. The cost is slightly higher as poll workers must be paid when printing at the time the polls are closed.

If the ballot images are to be printed, the quantity of printing will be increased as to the number of contests being voted on. The time will be increased by 30 to 50 times for a typical California ballot. It may take as long as 900 to 1500 minutes or 15-25 hours after the election. It is more than a little challenging to ask the poll workers to stay another 15-25 hours. It is also unreasonable for the public to wait that long for the result of an election.

One of the authors of the Shelley-Hertzberg Act, Mr. Kevin Shelley is the current Secretary of State of California. On January 13, 2003 when interviewed by Mr. Scott Shafer of

Radio Station KQED about the paper record (*“Those touch-screen voting machines eliminate the risks of hanging chads in our machines, but they have no paper trail”*) said, ***“They do. We demanded in Proposition 41, when we wrote it, that a paper trail be placed in the machine as a back-up. So, there is still the mechanical backup to address the new technology.”***

In accordance to Mr. Shelley’s explanation, the requirements would mean either the paper records are to be printed in real-time or immediately when the polls close before the final tallies of the voting units are made. It seems to counter some of the vendors and election officials’ claim that only the capability to print the paper record is needed to satisfy the Proposition 41 funding of new voting equipment that they are purchasing. In fact, if the “back-up” purpose is to be fulfilled, it should really be printed in real-time.

The current California code 15360 requires that 1% of the system print out a paper ballot image of every ballot cast. “During the official canvass of every election in which a voting system is used, the official conducting the election shall conduct a public manual tally of the ballots tabulated by those devices cast in 1 percent of the precincts chosen at random by the election official.” This law applies to every jurisdiction of California whether they use the Proposition 41 money or not. Similar manual recount election codes are found in most of the other States.

The question begged to be asked is:

If the system must print the paper record of each vote, why don’t we print it immediately after the voter cast their electronic ballot so that the voter has a chance to verify it?

WHO’S ELECTION IS IT? DO VOTERS HAVE THE RIGHT TO KNOW IF THEIR VOTES ARE COUNTED AND COUNTED CORRECTLY?

Isn’t it a voter’s right to know if their vote is counted or not? And even better, knowing that their vote is counted correctly?

It is a question that no one seems willing to answer. We have yet to hear any of the County election officials express their opinion. Instead, most of the election officials elected not to print out any paper records in real-time or otherwise. The typical answer is that the law as written did not require such a process.

Of course, now the California codes and all other State election codes must be brought up to the Federal code standard. Whether the state fund is used or not each DRE system must produce a paper record for manual recount purposes.

One may ask, if there are two paths that satisfy the State and Federal laws, if one of them gives the voters the ability to know if their votes are counted and counted correctly, why do the local election officials opt not to choose such a path?

WILL THE PAPER RECORD AND AUDIT TRAIL DISENFRANCHISE OR REDUCE ACCESSIBILITY TO THOSE THAT ARE VISUALLY IMPAIRED?

Many of the vendors that do not want to provide the voter verifiable paper record and audit trail make the following arguments:

Section 301, a (3)(A): “ACCESSIBILITY FOR INDIVIDUALS WITH DISABILITIES.---

“The voting system shall be 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 the other voters;....”

The argument is that since blind voters will not be able to see and most of them cannot use “Braille”, the voter verifiable paper records will disenfranchise them.

- The obvious solution to compensate for the voters having difficulty in reading will be to read back the ballot to them before the ballot is cast. If deemed necessary, also read back the ballot as stored in the voting unit after the ballot is cast. This is not different from providing audio ballots or voice-assistance in making selections.
- At this time, none of the vendors opposing the use of a voter verifiable paper record and audit trail can even come close to reading back the selection. For a complete equivalency in providing the “same opportunity for access and participation (including privacy and independence) as the other voters”, accessible voting units should be able to read back the selection IMMEDIATELY as the selection is made. This is the same as “highlighting” the selection for sighted voters.
- At the end of the selection process the unit should read back the complete ballot of selections to the voters and allow them to make changes or corrections just like the sighted voters.
- How about the write-in capability? All accessible voting system should provide a write-in provision to the voters even if they do not know how to use a keyboard. Very few systems currently in use today provide such a capability.
- What about those blind and visually impaired voters that also have physical limitations in the use of their hands and fingers. Again, very few voting systems today provide this capability.
- VOTE-TRAKKER™ provides instant read back confirmation of the selections made by the voters while they are making their selections. The same confirmation is also used when the voters write-in their candidate. The voter can use either the modified keyboard or the scrolling of the alphabets. At the end of the selections the full ballot is read back to the voter and changes can be made easily. Once the blind and visually impaired voter verifies their selections through the read back process, they then cast their ballots. If deemed desirable, the system can once again read back to the voter the electronic ballot as stored inside the system.
- Every one of the voting systems in the market could achieve accessibility and participation capabilities through the use of text-to-speech technology today. Of course, it does take work and the willingness to comply.

DOES VOTER VERIFIABLE PAPER RECORDS AND AUDIT TRAIL ENHANCE VOTER’S CONFIDENCE IN AN ELECTION?

Before October 2002, only the State of Colorado required any electronic voting system used in the State to produce a paper record when the voter cast their electronic ballot. The State of

California incorporated a new election code in 2002 called the “Shelley-Hertzberg Act” that also specifies the printing of a paper record as part of the audit trail and recount process.

A lot of arguments are being put up so that many jurisdictions can continue using the systems that have been recently purchased. Adding paper records for the voter to verify are viewed as a very bad thing.

Is there any proof that the voter verifiable paper record and audit trail actually helps to enhance voter’s confidence? Or, does voter verifiable paper record actually work?

Even with the State law requirements prior to the November 2002 General Election in Sacramento, CA, there were no elections held using an electronic voting system that ever produced a paper record as part of the audit trail. The successful use VOTE-TRAKKER™ that produced a paper record for the Early voting portion of the General Election in Sacramento County proved that it can be done and received outstanding reviews.

For the same General Election of 2002, there were very little scholarly studies made on the actual data. However, there are two basic surveys that have been carried out and reported. The first survey was performed on Georgia election. The study made by Carl Vinson Institute was on the voter’s confidence that their votes were counted? Before the implementation of the electronic voting, on the average, 56% of the voters felt that their votes were counted when the old paper ballots were used. This number increased to 70% on the average with 79% of white voters and 40% of the black voter feeling highly confident that their votes were counted. For the General Election early voting in Sacramento County, a survey was conducted as part of the certification process. 86.3% felt “great” on the confidence that their votes were counted. When adding the 10.2% of those feeling “so so” on the confidence, the number adds up to 96.5% of the voters that felt that their votes were counted. The differential of 96.5% to 70% in voter confidence cannot be ignored. The key contributor to the difference may be attributed to the fact that VOTE-TRAKKER™ units used in Sacramento provided a voter verifiable paper records for the voters to review while the systems used in Georgia did not.

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