

Advantages of Paper Ballot / Precinct Based Optical Scan Voting Systems Over Electronic Touch Screen Voting Machines

Hand marked paper ballots and precinct based optical scan voting systems, augmented by ballot marking devices to provide accessibility for voters with disabilities, are fully compliant with the provisions of the Help America to Vote Act of 2002 (HAVA). In addition, such systems offer many advantages over electronic touch screen voting machines (DREs), including those with voter verified paper ballots (VVPB).

Approximately 25% of jurisdictions across the country use paper ballot and optical scan systems.

This paper details the many advantages paper ballot/precinct based optical scan systems offer compared to DREs. One significant advantage of paper ballot/optical scan systems not detailed here is that the acquisition, operation and maintenance costs are significantly less than DRE systems. Detailed cost comparisons between the two voting systems are dealt with in a separate paper.

Advantages of Paper Ballot/Optical Scan Systems

1. All Voters Use an Identical Ballot
2. Paper Ballots Are Easily Understood by Voters
3. Paper Ballots Are Inherently Voter Verified
4. Paper Ballots Allow Each Voter to Vote Only Once
5. Precinct Count Optical Scanners Allow Voters to Correct Mistakes
6. Optical Scanners Provide Over-Vote and Under-Vote Protection
7. Conflicts Between Electronic Ballots and Paper Ballots Are Eliminated
8. Optical Scanners Have Lower Rates Of Invalid Votes
9. Optical Scan Ballots Are Easy To Recount by Hand
10. Optical Scan Ballots Allow Voters to Verify Correct Ballot Type
11. Paper Ballot Systems Easily Accommodate Additional Voters at Low Cost
12. Voters Can Continue to Vote in the Event of Equipment Failure

Disadvantages of Electronic Touch Screen (DRE) systems

1. Ergonomic, Logistic, Security, Fraud, and Mechanical Problems With VVPB DREs
2. Voters Complain DREs Provide Inadequate Privacy
3. Logic and Accuracy Tests on DREs Are Cumbersome and Opaque
4. VVPB Printers Increase the Complexity and Cost Of DREs
5. In Recounts, DREs Could Result in a Legal Catch-22

Advantages of Paper Ballot/Optical Scan Systems

1. All Voters Use an Identical Paper Ballot

In a paper ballot/optical scan system, ballots for all types of voters - absentee and non-absentee voters, abled and disabled, can be handled and counted using the same type of equipment. With DRE systems, absentee and provisional voters must use a different type of ballot from everyone else. Election workers must learn, operate, and be able to instruct voters in the use of two completely different voting systems. And states, counties and towns must bear the additional cost of maintaining two separate methods of voting.

2. Paper Ballots Are Easily Understood by Voters

Optically scanned ballots, also known as "mark sense" or "bubble" ballots, are familiar to anyone who has taken a standardized test or filled out a paper form. The voter is given a paper ballot that lists the names of the candidates and the options for referenda, and next to each choice is small circle. The voter darkens in the bubble next to the preferred option for each office or referendum.

Contrast this with touchscreen computer interfaces which for many individuals, especially the elderly, can be difficult to read, comprehend, and use.

Using and hand marking a paper ballot is an easy and familiar method for all voters who are physically able to mark a paper ballot. For those who cannot, ballot marking devices, such as the Automark (<http://www.essvote.com/HTML/products/automark.html>) can provide full accessibility features (audio interface, sip/puff input, etc.) to the paper ballot.

3. Paper Ballots Are Inherently Voter Verified

Paper ballots are inherently voter verified because they are marked directly by the voter. But a "voter verified" paper ballot produced by a DRE printer might not be verified by the voter. *A question we should ask is whether voters will actually be able to quickly and accurately inspect a VVPB.*

Indeed, many voters may never verify their VVPB for basic usability reasons. The VVPB is in a different format than the ballot, in a different place, is verified at a different time, and has a different graphical layout. These and other ergonomic factors will prevent many voters from actually verifying their machine printed ballot.

People are extremely good at remembering hundreds of precise images and comparing them against the same image. But the format of the VVPB will be quite different from the touch screen ballot. These differences make it difficult for voters to verify their vote after the fact. Most people have experienced how difficult it is to compare two columns of numbers to verify that they have not missed a number. Comparing dozens of selections on a voter verified paper ballot will be similarly difficult. Also, comparing two separate ballots in different formats may add extra difficulty for people with or learning or reading disabilities, or with poor eyesight.

During the first use of VVPB in an election, in November 2003 in Wilton, CT, virtually all voters had to be prompted to find and verify their receipt. *This turned into extra effort for poll workers and extra time for voting.*

Paper ballots on the other hand, are the actual ballot, so no separate verification step on a differently formatted ballot is needed.

4. Paper Ballots Allow Each Voter to Vote Only Once

Unlike many DRE voting machines whose "Smart Cards" might be compromised enabling a voter to vote multiple times, paper ballots only allow each voter to vote once. Why? Because each voter is given only a single paper ballot when they sign in. No possibility exists to receive or cast multiple ballots.

In addition, existing optical scan paper ballots have many security, anti-counterfeiting, and audit features, including tear-off ballot stubs with serial numbers, and watermarks. When the polls close on Election Day, the total number of optical scan paper ballots that have been cast, spoiled, or which remain unused can be tracked and counted and reconciled against the sign-in logs.

5. Precinct Count Optical Scanners Allow Voters to Correct Mistakes

Paper ballots are scanned at each polling place using precinct based optical scanners. Incorrectly completed ballots (e.g., over-voted ballots, smudged ballots, etc.) will be rejected by the scanner. Voters can then exchange the spoiled ballot for a new blank ballot and correct their mistakes.

Also, since the ballots are counted in the polling place, there is less opportunity for ballots or ballot boxes to be lost in transit as sometimes occurs in central-count tabulation systems.

6. Optical Scanners Provide Over-Vote and Under-Vote Protection

Once voters complete their ballots, they insert them into the precinct-count optical scanner. Over-voted ballots are rejected, and the voter gets a fresh ballot. Under-voted ballots produce a warning, and the voter gets the opportunity to correct the under-vote by marking any unmarked races unintentionally left blank.

After a ballot is successfully completed and accepted by the optical scanner, the votes on the ballot are counted into the scanner's memory, and the scanner deposits the ballot into a locked ballot box.

7. Conflicts Between Electronic Ballots and Paper Ballots Are Eliminated

With a paper ballot/optical scan system there is one and only one ballot of record: the paper ballot that the voter completes and verifies (either with or without the assistance from the ballot marking device).

In DRE voting machine + VVPB printer systems, there are two ballots - the electronic record stored by the DRE, and the paper ballots printed by the DRE. Since there are two separate records of the vote, disputes about which ballot, paper or electronic, is the "real" ballot can result when totals do not match. Given the partisan nature of elections, legal action may prevent resolution of the election for indefinite periods of time.

8. Optical Scanners Have Lower Rates of Invalid Votes

Multiple studies indicate that precinct-based optical scan voting systems provide a lower rate of invalid votes than DREs. Invalid, or “residual” votes, are defined as inadequately marked ballots: under-votes, over-votes, and any other ballots that are cast by voters but uncounted for any other reason. The residual vote metric is the sum of these invalid ballots.

Elections officials compare the performance of alternative voting systems by comparing the percentage of residual votes for each system. The most extensive study was The MIT/Caltech Voting Study (<http://www.vote.caltech.edu/Reports/2001report.html>), which examined residual vote rates among all of the ballot types used in the years 1988 through 2000. The Caltech report shows the optical scan voting systems consistently delivered the lowest rates of invalid votes of any of the voting technologies in use, including DRE voting machines.

A more recent (2004) study conducted in Florida compared the number of under-votes reported by DRE and optical scan systems in elections where there was only a single race or question on the ballot. It is assumed that in such single-contest elections, voters are unlikely to make a trip to the polling place to cast a blank ballot, so that under-votes that occur in such elections reflect a failure of the voting technology in use to record those votes. *This study found that in such single-contest elections, DRE voting systems registered roughly 8 times as many under-votes as were registered by optical scan systems.* While the optical scan systems incurred an over-vote rate of 0.01%, those presumably occurred on central-count optical scan systems. Both DREs and precinct-based optical scan systems prevent over-votes.

For details, see: “Analysis reveals flaws in voting by touch-screen” by Jeremy Milarsky and Buddy Nevins, in the July 11, 2004 issue of the Sun-Sentinel. An archived version of this article is available at: <http://www.verifiedvoting.org/article.asp?id=2473>

9. Optical Scan Ballots Are Easy to Recount by Hand

If a manual recount is called for, most optical scan ballots do not present significant problems when trying to infer voter intent. The races are clearly laid out, and the filled in “bubbles” clearly indicate the voter's choice. This should facilitate efficient recounts, either by machine or by hand. Contrast this to VVPB printer ballots, which are printed on thermal paper, in a small type face, and in a format which makes voter selections difficult to distinguish.

10. Optical Scan Ballots Allow Voters to Verify Correct Ballot Type

A polling-place-based optical scan voting system enables the voter to provide another critical verification: verification that they have been given the correct type of ballot *before they start to vote.*

A recurrent and serious problem with DREs is that voters sometimes receive the wrong ballot type (or an incomplete ballot) but can't find out that this has happened until after they start voting. Such incidents have been documented in several states where DREs are used, including California, Maryland, Georgia, and most recently in Hawaii. *In some of these cases voters have been partially disenfranchised as they have been denied the opportunity to vote on races for which they were entitled to vote.*

With a DRE-based system, when a voter signs into the poll book and is handed an “electronic ballot” by the poll worker, they are given either a “smart card” (on which the ballot is electronically encoded) or a 4-digit code number (e.g., Hart InterCivic eSlate system). *In either*

case, what the voter receives from the poll worker is opaque and inscrutable, because to the eye, all smart cards look identical. The voter has no way to verify prior to entering the voting booth and starting to vote, that he or she has received the correct type of ballot.

It is only after the voter has started voting, and often not until they finish voting, that a voter may realize that the ballot he or she received was the incorrect type or that it is missing one or more races or questions. *In many cases, this realization comes too late, as some voters have inadvertently cast their DRE ballots while searching for the missing races or questions.* And even when voters detect this mistake in mid-ballot, they typically have to compromise the secrecy of their electronic vote when showing poll workers that their partially-voted electronic ballot is of the wrong type.

Contrast this with an optical scan ballot system, where voters can inspect the complete ballot at the time they receive it from the poll worker and can exchange any incorrect ballots for the correct ballot type before they begin to vote. Such exchanges can be done without compromising ballot secrecy.

The problem of poll workers mistakenly giving voters an incorrect ballot type is clearly a human problem that can occur regardless of whatever voting technology is used; it can partially be addressed by better training of poll workers. However, it is a problem that will never be completely eliminated, and one which any voting system must adequately address. *DREs do not adequately address this problem.*

Several recent magazine and newspapers stories show that this ballot verification is a recurring problem that is not isolated to any one state or type of voting machine.

From “The Vexations of Voting Machines”

(http://www.time.com/time/archive/preview/from_redirect/0,10987,1101040503-629410,00.html) by Viveca Novak in the May 3, 2004 edition of TIME Magazine:

“Jeffrey Liss had finished making his selections on Maryland’s Democratic-primary ballot and strolled out of the polling place at Chevy Chase Elementary School on the morning of March 2, Super Tuesday. On the sidewalk, he spied a campaign posted for Senator Barbara Mikulski, who is running for her fourth term. Funny, he thought, he didn’t remember voting in the Senate race.

Liss went back inside to talk to an election official. And another, and another. He was told he must have overlooked the Senate race on the electronic touch-screen voting machine. But Liss, a lawyer, finally persuaded a technician to check the apparatus. Sure enough, it wasn’t displaying the whole ballot.

According to voter complaints collected by Mikulski, who won in the primary, her race didn’t appear on ballots in at least three Maryland counties...

Liss is still awaiting satisfaction. He was finally allowed to cast a provisional ballot for the Mikulski race. Then the state refused to count it. Liss filed a petition with the county board of elections and awaits a decision.”

From “New Voting Glitch Had Old Cause”, in the March 6, 2004 edition of the Los Angeles Times:

“Confusion in Orange County that led to some voters receiving the wrong ballots on Tuesday highlights a problem election officials have been struggling with for years: recruiting and training temporary poll workers. With the advent of high-tech voting, the problem is only going to get worse, some analysts say.

In Orange County, poll workers — including some who said they received inadequate training — gave some voters incorrect access numbers that led some of them to vote for candidates in the wrong political party or in the wrong election district.

Officials are investigating the problem, but say they may never know how many votes may have gone astray...”

From “7,000 Orange County Voters Were Given Bad Ballots”

(<http://www.votersunite.org/article.asp?id=1476>)

in the March 9, 2004 edition of the Los Angeles Times:

Poll workers struggling with a new electronic voting system in last week's election gave thousands of Orange County voters the wrong ballots, according to a Times analysis of election records. In 21 precincts where the problem was most acute, there were more ballots cast than registered voters.

Wide margins in most races seem likely to spare the county the need for a costly revote. But the problems, which county officials have blamed on insufficient training for poll workers, are a strong indication of the pitfalls facing officials as they try to bring new election technology online statewide.

'The principal of democracy is every vote should count. That's why we need a better election system,' said Henry Brady, a political science professor at UC Berkeley and an expert on voting systems.

At polling places where the problem was most apparent because of turnouts exceeding 100%, an estimated 1,500 voters cast the wrong ballots, according to the Times' analysis of official county election data. Tallies at an additional 55 polling places with turnouts more than double the county average of 37% suggest at least 5,500 voters had their ballots tabulated for the wrong precincts.

Problems occurred in races throughout the county — including five out of six congressional races, four of five state Senate contests, and five of the nine Assembly races that are decided in whole, or in part, by Orange County voters.

Election officials acknowledged that poll workers provided some voters incorrect access codes that caused them to vote in the wrong legislative districts but said there was no evidence yet that any result was in jeopardy...

The Times arrived at its estimate of 7,000 improper ballots by comparing precincts with unusually high voter turnout to the average turnout at polling places. Orange County election officials have traced the problem to poll workers who were responsible for giving each voter a four-digit code to enter into the voting machines.

After signing in, each voter received a ticket bearing his or her precinct number and party affiliation from a poll worker. The voter would take the ticket to a second worker, who was supposed to scroll through a computer screen and use the voter's precinct and political party to obtain an access code that would identify the appropriate ballot. Several workers who handled this stage of the process — including some who said they didn't know more than one precinct had been assigned to their polling place — gave voters codes for the wrong precincts, causing the wrong ballots to appear on their screens.

Some voters noticed the problem and were able to get workers to give them access codes for the proper ballots. But many voters did not..."

From “Primary Election Runs Into Problems, Some Errors Caused by Electronic System”

<http://www.thehawaiichannel.com/news/3760175/detail.html>

September 24, 2004, KITV Channel 4 News, Honolulu, Hawaii:

“New paperless electronic voting machines caused some problems in Saturday's primary election... The machines mistakenly allowed voters on Oahu and the Big Island to select Green Party ballots even though there were no Green Party Candidates.”

11. Paper Ballot Systems Easily Accommodate Additional Voters at Low Cost

The record voter turnouts in the November 2004 election resulted in long lines for voters in many precincts equipped with touch screen voting machines. Some voters were disenfranchised when they were unable to wait any longer for their turn to vote.

When voter turnout requires it, it should be easy to add more voting booths. *But with DREs, there is no quick or inexpensive way to acquire and deploy additional machines on short notice.*

With paper ballot/optical scan systems, only one scanner and one ballot marking device is needed per polling place. If turnout is higher than expected, additional voting booths and marking pens are the only equipment needed to accommodate more voters. The privacy booths are simple, cheap, readily available, and easy to deploy. In a pinch, folding cardboard boxes set on tables could be used, since the booth must only provide privacy and a flat surface for marking the ballot

Paper ballots and precinct based optical scanners allow local voting precincts to respond more rapidly to unusually high turn outs and avoid excessively long lines of voters

With DRE systems, it is difficult and extremely expensive to add additional machines. When high voter turnout requires more booths they are difficult to obtain, initialize, and deploy on short notice. In New York State, it may cost \$8,000 for each additional "booth".

12. Voters Can Continue to Vote in the Event of Equipment Failure

Both DREs and optical scanners have battery backup power in the event of power failures. But a lengthy power outage could exceed the battery's capacity, which usually provides backup power for 2 hours or less. If a DRE system fails for any reason, all voting on that machine stops until it can be brought back online.

Paper ballot systems allow voters to continue to mark their ballots even if the optical scanners won't work due to system or power failures.

Of course, if power fails, voters won't be able to check their ballots for errors on the scanner, but most will still be able to mark their ballots and turn them in for later scanning. Marking pens and paper ballots don't require electricity.

Disadvantages of DRE systems

1. Ergonomic, Logistic, Security, Fraud, and Mechanical Problems with VVPB DREs

A Caltech/MIT Voting Technology Project paper, Security Vulnerabilities And Problems With VVPB (http://www.vote.caltech.edu/Reports/vtp_wp13.pdf) considers problems with ergonomics, logistics, security, fraud, and mechanical fragility with using voter verified paper ballots.

The Caltech paper reports:

“Ergonomic problems are introduced by the receipt having a different layout than the ballot, difficulty remembering previous selections to make the verification, by the extra step it introduces after making selections and by it not working well for sightless people.

Logistics problems include difficulties in collecting and organizing the receipts, transporting them, and reading and reconciling them with electronic tallies.

Security issues include the possibility that receipts can be systematically misprinted in a way that cannot be detected and that hand counting will not easily detect fraud.

Mechanical problems include printer breakdowns and supplies running out. VVPBs could add problems by being questioned in various ways or through the development of computer programs that defraud the VVPB systematically.

VVPBs do not address existing sources of disenfranchisement such as registration problems, equipment and ballot problems, and polling place problems.

Experiments and elections have yet to establish that people can in fact verify their ballots using a paper receipt. Effective approaches for accurately counting the paper receipts for auditing purposes have not been established either.”

2. Voters Complain DREs Provide Inadequate Privacy

Voters in many states have complained that DRE voting systems do not provide adequate ballot secrecy due to the lack of voting booth curtains coupled with the fact that the DRE voting displays are nearly vertical.

In many cases, voters voting on adjacent DREs or other voters waiting in line could view the selections made on a given voter’s DRE touch screen display. In other cases, when voters encounter a problem in mid-ballot and invoke the assistance of a poll worker, they often have to give up the secrecy of their ballot in order to page back and forth through their electronic ballot to demonstrate the problem to the poll worker.

3. Logic and Accuracy Tests on DREs Are Cumbersome and Opaque

Logic and accuracy tests can be conducted on DREs in one of two ways. In the first method, election workers follow a script and enter test votes into a DRE via the touch screen. Once all of the test votes have been entered, the vote totals produced by the DRE can be compared with the correct numbers that were determined when the test script was created. Members of the public and representatives of various political parties can witness such tests to make sure that the test votes are entered correctly and that the appropriate totals are produced by the DRE. The

difficulty with this method is that because it is very cumbersome, time consuming, and expensive, it can only be performed on a small fraction of the machines that will be deployed.

The second method bypasses the touch screen completely and uses a “test cartridge” that is plugged into the voting machine to simulate a human casting votes via the touch screen. While this automated test method is more efficient, it is also completely opaque to anyone trying to witness the test; there is no way for such witnesses to view or verify what the test cartridge is actually doing. Instead, they have to take it on faith that the test cartridge is doing what the voting machine vendors and elections officials claim that it is doing. The transparency of the voting system is thus compromised in the interest of efficiency, lowering public confidence in the system.

Optical scan voting systems provide a transparent and publicly verifiable means for conducting pre-election and post-election logic and accuracy tests. A test deck of paper ballots can be marked by election observers and then publicly counted by hand, multiple times and by multiple parties until all agree on the correct count. That test deck can then be run through the optical scanner, and its vote count is then compared to the publicly-verified manual count of that same test deck.

The test deck can even be run through the scanner multiple times to more accurately simulate the actual number of voters whose votes would be counted on that scanner in an actual election. For example, if the test deck is run through the optical ballot scanner 10 times, it should produce a result that is ten times the public-verified manual count for that test deck

In addition, multiple optical ballot scanners can be quickly and efficiently tested using this same deck. This is considerably more cost-effective, open, and transparent than comparable logic and accuracy tests on DREs, particular those conducted via the second method described above

4. VVPB Printers Increase the Complexity and Cost of DREs

The addition of VVPB printers to DREs is needed to provide adequate protection against the possibility of unrecorded or mis-recorded votes. It may also soon be required by state and federal law. But adding an accessible VVPB printer significantly increases both the cost and complexity of what is already an expensive and complicated technology.

Some vendors have estimated the costs of such printers at \$1,000 each. The VVPB printers recently supplied by Sequoia Voting Systems to the State of Nevada for use in their primary election in September cost \$800 each and did not provide audio feedback or a VVPB that could be optically scanned. While some vendors (e.g., Sequoia and Diebold) have contracted to give some jurisdictions VVPB printers for free (e.g., Santa Clara and San Diego counties), they are unlikely to provide such contracts to all jurisdictions. Other vendors (e.g., Avante and AccuPoll) include VVPB printers as a standard part of their DRE voting systems.

In New York State, the full face ballot and the large touchscreen display required to display it pushes the cost of VVPB DRES to nearly \$8000 per unit.

5. In Recounts, DREs Could Result in a Legal Catch-22

Unlike optical scanners, DREs serve two discrete functions - recording individual votes, and counting vote totals. Combining these two roles may cause subtle but potentially critical legal problems.

With DREs, the touch screen and other hardware components record votes. Of course, the same hardware is used in every election. But the DRE's electronic memory, which stores vote totals, must be completely erased between elections. If it were not, residual totals from earlier elections remaining in memory could confuse or invalidate the results of the current election.

Combining vote recording and counting functions in a single machine has put some election districts which use DREs into a serious legal predicament. As of this writing, the November 2004 recount in New Mexico is still being litigated in the courts. Law requires that the contents of the electronic ballot memories for the DREs be preserved until the recount litigation is over. But while the recount may continue for many weeks, some New Mexico jurisdictions need to prepare their DREs for upcoming local elections in February.

Before the February elections can proceed, the electronic ballot memories of the DREs must be wiped clean. But erasing the DRE memory would violate the requirement to preserve the data for any pending recount of the November 2004 results.

This presents a legal Catch-22 situation.

With paper ballot/optical scan systems, the paper ballots record the votes and the optical scanners count the votes. New elections always uses fresh, blank paper ballots, so ballots from previous elections may be stored for as long as legally required.