

ANALYSIS OF VOTING SYSTEMS UNDER REVIEW BY THE SHELBY COUNTY ELECTION COMMISSION

The Shelby County Election Commission (SCEC) has hosted demonstrations of voting machines from 4 vendors according to their attorneys.

- 1) Dominion Voting Systems- Image Cast X ballot marking device, Image Cast Precinct, Image Cast X VVPAT, Image Cast Central, and Image Cast Adjudication
- 2) ES&S- Express Vote DS200
- 3) Unisyn- Open Ballot and Freedom Vote Tablet
- 4) Hart Intercivic- Verity Touch with controller voting system.

Definitions:

- 1) BMD- Ballot Marking Device- These are new machines as components of voting systems and have not been rigorously tested. This allows the voter to express his/her preferences on an electronic device (computer, tablet, etc.). The BMD then prints out a ballot for the voter to review and presumably place into a scanner to be counted.
- 2) Hybrid voting machines- Think of these like all-in-one printers. These machines are a combination of a BMD or DRE, a thermal printer, and an optical scanner. One machine handles regular voters and voters needing assistance, provides a paper trail, an optically scanned ballot, and precinct level or central tabulation of the vote.

The Debates:

- 1) BMD vs. directly marked paper ballots:
 - i. BMD machines are very popular with election administrators. Linda Phillips, Shelby County Administrator of Elections, has publically expressed a preference for BMDs and against paper ballots. We must point out that the SCEC has yet to recognize the dangers of paperless DRE machines such as our currently used Diebold Accuvote TSX machines. They maintain new machines are needed only because the current machines are too old. As a class, election administrators have been resistant to criticism and defended paperless DRE voting far too long contributing significantly to our vulnerabilities in 2016.
 1. BMDs insert an electronic device between the voter and the scanner. Instead of the simplicity of the voter marking the ballot directly, the voter uses the electronic device, often through a touchscreen, to record the vote.

2. We then inherit all the problems of the current machines- vote flipping, hacking the vote, etc.
 3. Some BMDs print a report of the recorded vote for the voter to verify. The vote itself is stored in a barcode or QR code.
 4. Start-up costs are significantly higher with hybrid & BMD machines as each voting site requires multiple machines compared to a single machine for accessibility with paper ballots. Claims have been made that ongoing costs are higher with paper ballots, but this has not been borne out in practice, including in Hamilton County and by analysis. Verified Voting has demonstrated that paper ballots are cheaper over time (<http://www.VerifiedVoting.org>. Are Voter Verified Paper Ballots Cost Effective?) as have others (Oset Georgia Systems Cost Analysis, 2019). The University of Pittsburgh claims that, in Pennsylvania, using BMD machines doubles the per voter start-up costs. (<https://www.tribdem.com/content/tncms/live/>. “Paper-ballot voting machines cost far less than alternative, researchers say”, John Finnerty, August 15, 2019)
 5. BMDs add significant complexity and risk to a system with little perceivable benefit. There have been no rigorous peer-reviewed tests and given complexity, uncertainty and cost, these are not established as a safe way for voting.
- 2) The problem with Voter Verified Paper Trails: Voter verified paper trails have been strongly recommended. However recently their usefulness has been questioned. (R. DeMello, R. Kadel, and M. Marks. What voters are asked to verify affects ballot verification: A quantitative analysis of voters’ memories of their ballots, November 2018. <https://ssrn.com/abstract=3292208>.) A direct observation study of voters here in Tennessee utilizing a BMD for marking the ballot, demonstrated that half the voters do not inspect their ballots to verify them. Those that do spend less than 5 seconds on the task. Voters’ ability to recall their own ballots was questioned. The value of voter verified paper trails is being questioned. This was a small study and more data is needed.
- 4) Voter Marked Paper Ballots- These paper ballots filled out directly by the voter obviate the problems of interposing an electronic device between the voter and marking of the ballot. Since the voter is paying attention as they fill out their own ballot, the proofreading problems do not exist. However, there are problems with stray marks, inadequate filling-in of the designated marking area, and the need for high quality scanners. This also requires a high-speed demand printer at each early

voting site. California has published a list of demand printers for this purpose (<https://votingsystems.cdn.sos.ca.gov/cert-and-approval/ballots/cert-bod-2019-02.pdf>).

1. Many experts, including the prestigious National Academy of Sciences, Engineering and Medicine and the Senate Select Committee on Intelligence recommend voter marked paper ballots ((NAS. Securing the Vote, Sept., 2018) (Senate Intel Report on Election Interference, p.59).
- 3) Precinct level vs. Central scanning
- i. Ballots can be scanned at each precinct, requiring a scanner at each site. Alternatively, ballots can be transported to a central site and all scanned with a high-speed scanner.
 - ii. This discussion is just starting and there is no consensus
 - iii. Central scanning saves money due to purchasing fewer scanners despite the higher cost of the high capacity scanners. It allows for better quality control.
 - iv. Precinct scanning decentralizes vote counting making it harder to alter results by hacking the scanners.
 - v. Central scanning allows for easier matching of a ballot with its cast voter record (CVR), enabling ballot comparison risk-limiting audits. (Morrell, Jennifer, “Knowing It’s Right: A Two-Part Guide to Risk Limiting Audits” Democracy Fund, May, 2019.
 - vi. Other states, such as Virginia and Michigan, use hand-marked paper ballots and precinct marked scanners and utilize ballot polling risk limiting audits.

Conclusions

- 1) BMDs are unproven and inappropriate for use by all voters in that it is unknown if they securely report accurate election results. They are appropriate for voters with disabilities if the printed ballot style is identical to the one voters mark by hand.
- 2) BMDs and hybrid machines are inappropriate for use by all voters and represent an unnecessary expense due to the need for multiple machines for each voting site.
- 3) Apart from a pure paper ballot and hand-count system, voter-marked paper ballots with optical scanners is the best solution to secure the vote, in conjunction with risk-limiting audits.
- 4) Voter proofread paper trails are not adequate to ensure the voter’s intent is recorded.

- 5) Central scanning of ballots is required for ballot comparison risk limiting audits. Precinct count optical scanning can be secured with ballot polling risk limiting audits. Procedural audits are still required, such as ensuring all paper ballots are counted to maintain the integrity of the audit trail.
- 6) Hand-marked paper ballots with risk-limiting audits are a proven solution to count votes.

REVIEW OF ADMINISTRATOR'S PROPOSED SYSTEMS

Dominion Voting Systems: These items are part of their Democracy Voting System. The entire system has been certified by the Election Assistance Commission to the 2005 standards (the latest available standards).

- I. The Dominion web site no longer contains information on the ImageCast X machines. They will not answer questions from the general public. The web site features Evolution. The BMD and VVPAT functions of the X class may have been superseded by Evolution which is a true hybrid machine. In addition to the general concern about hybrids, Evolution has a specific concern. (<https://whowhatwhy.org/2019/03/19/permission-to-cheat-audits-cant-detect-fake-votes-on-new-hybrid-voting-machines/>). The pathway for the VVPAT printer and the scanner cross. Thus, it is possible for the printer to alter the markings on the ballot after it leaves the hand of the voter but before it is scanned.
 - i. The Image Cast X family is the equipment demonstrated here and sold to Georgia recently. Pro paper ballot advocates in Georgia maintain that Dominion demonstrated a system without barcodes. The system purchased uses barcodes to transmit the vote. Texas refused to certify the Image Cast X family with a laundry list of complaints including poor quality scan reports and inability to compensate for machine/power failure. (Voting System Examination Dominion Voting Systems Democracy Suite 5.5 Prepared for the Secretary of State of Texas James Sneeringer, Ph.D. Designee of the Attorney General)

 - II. Precinct is a scanner/tabulator that contains encryption of data with end to end transparency utilizing audit logs at every step
 - i. Has dual memory cards to store the ballots to provide safety through redundancy. Unintended access to the memory cards presents a security problem.
 - ii. Will read voter marked ballots.
 - iii. Is designed for handicapped voters who need assistance.
 - iv. Will accept undervotes without notifying the voter
- 1) Conclusion: These Dominion products are unacceptable.

ES&S: Express Vote is a touchscreen BMD certified to 2005 standards by the EAC. If Express Vote is used in tabulator mode, it has the same problem of the potential for post

insertion to the scanner alteration of the ballot. ES&S is suing Dominion over patent infringement for this technology.

- 1) In BMD mode, the ExpressVote has the same problems as other BMDs noted above
- 2) The DS 200 is a precinct level digital scanner. It can handle up to 18 Election Day precincts. Thus, it will not be acceptable as a central scanner to do ballot comparison RLA as noted above. The DS850 may need to be evaluated as a central scanner.
- 3) No information is stored in the unit. All data is stored on a USB flash drive stored externally in a key locked compartment.
- 4) Conclusion: ES&S ExpressVote is unacceptable. DS 200 will need to be evaluated depending on the post-election audit strategy. This conclusion does not include analysis of a DS200 stand -alone scanner.

Unisyn: The combination of the Open Tablet optical scanner and the Freedom tablet touchscreen makes a hybrid system.

- 1) The Open Tablet system utilizes USB ports for transfer of data. These are inherently insecure.
- 2) Unisyn products are unacceptable due to the lack of a verified paper trail.

Hart Intercivic: The Verity Touch is a direct recording electronic (DRE) system. Records of votes cast are stored in three different locations. Hart Intercivic has other systems that would represent an improvement from our current DRE system. While the Hart equipment probably is a stronger system than our current Diebold equipment, there seems to be no reason to stick with another insecure DRE system.

- 1) Hart Intercivic Touch with Controller System is unacceptable.

None of the systems currently under consideration by the SCEC are acceptable as a new voting system for Shelby County. Concerned citizens will need to open a dialog with the SCEC to select a new voting system that reliably expresses the voter's intent and adequately addresses security concerns.