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## Why our voting systems are safe

Jill Stein called Pennsylvania's voting system a 'national disgrace.' That's flat wrong

December 31, 2016 12:00 AM



By Michael Shamos

Every four years concerns are raised about the effectiveness and safety of the nation's voting systems — usually too close to an election for anything practical to be accomplished. Lawsuits are filed alleging that voters' constitutional rights are infringed because there is supposedly no guarantee that everyone's vote has been counted properly. These claims are regularly rejected by the courts. This election year has been no different, and the outcome will, and should be, the same.

A voting system must satisfy competing goals: (1) present a slate of candidates and issues to voters clearly and understandably; (2) capture and record voters' preferences accurately and unambiguously; (3) tabulate vote totals correctly; (4) prevent tampering with votes; and (5) provide an audit mechanism that will not reveal the choices of any individual voter. No voting system in actual use meets all of these criteria perfectly, especially when additional requirements must be met, such as disabled accessibility, write-in voting, absentee voting, provisional ballots and early voting.

Voter registration and authentication are not handled by voting systems themselves to avoid any suggestion that a voter's identity can be tied to their ballot. Sometimes voters wonder why they don't receive a paper receipt showing how they voted. The reason is that such a receipt could easily be used to foster vote-buying schemes. What prevents vote-buying is that there is no way for the buyer to know how the voter actually voted.

There are generically three types of electronic voting systems in common use: (1) optical scan, in which a voter marks a paper ballot that is scanned by a machine for tabulation and retained for possible recount; (2) direct-recording electronic (DRE), in which a voter interacts with a computer, usually by touchscreen, and votes are recorded electronically in multiple memories and printed out at the close of polls; and (3) paper-trail DREs, in which a printed record is made during voting which the voter can inspect and approve prior to casting the ballot. Systems (1) and (2) are used in Pennsylvania.

Systems of type (3) are not approved here, for the simple reason that they are illegal and violate the Pennsylvania Constitution. The U.S. Constitution does not guarantee a secret ballot; the Pennsylvania Constitution does: "All elections by the citizens shall be by ballot or by such other method as may be prescribed by law: Provided, That secrecy in voting be preserved" (Art. VIII, §4).

Paper trail machines do not preserve secrecy because they provide a sequential record showing how every voter voted. Knowing the order in which people voted, which is a record required by law in Pennsylvania, enables each voter's ballot to be discovered after the election.

Various computer scientists having legitimate credentials in the field of computer security have pronounced system (2), DREs without paper trails, to be "insecure," and insist that (1), optical scan,

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is the only safe method of voting. There is no such thing as a “secure” system — every system of every type ever made can be penetrated. The issue is always whether the risks of using a system known to be insecure are acceptable.

For example, optical scan has several vulnerabilities, primarily centering on ballot-handling procedures. When a voter marks a ballot, that ballot is the only record in existence of the voter’s choices. If anything happens to that ballot — if it is lost, deliberately misplaced, destroyed or altered — then the voter’s choices will not be counted correctly in the event of a recount. It is surprising, but there is no generally accepted set of ballot-handling security procedures — each county develops its own. Unfortunately, no sophistication or training is needed to alter paper ballots, especially when they are out of sight of the public.

Recounts of optical scan ballots are problematical. Recounting is tedious and inaccurate. Repeated hand tabulations never give the same results twice, and placing ballots in people’s hands provides an avenue for vote alteration. The belief that the ballots being counted are identical to the ones cast is an act of faith.

You will commonly see the word “paperless” attached to “DRE.” To be clear, there are no paperless DREs used in Pennsylvania, or anywhere else in the U.S. All DREs in Pennsylvania must by law “provide for a permanent physical record of each vote cast.” The secretary of the commonwealth interprets this to mean that purely electronic records are insufficient, and paper or its equivalent must be provided. At the close of polls, every DRE machine in Pennsylvania can produce a printout of each ballot. The printout is in random order to prevent learning how any particular voter voted.

You will hear it said that, in the event a recount is needed, DREs have “nothing to recount.” That is incorrect. Five records are made of each ballot. Three are electronic and are retained in the voting machine itself. A fourth is also electronic but is stored on removable media and sent to the county elections office after the close of polls. The fifth is the paper record, which can be printed at any time after election.

An objection to this process is that if the machine has been tampered with so it fails to record votes correctly in the first place, then all five records will be wrong, and a recount will not correct them. That is true (and is also true of altered optical scan ballots), so attention must be paid to prevention of tampering.

It is always possible to modify a voting machine in a laboratory. That proves nothing. The question is whether any tampering is feasible involving a large number of machines under real election conditions. No one has even proposed, let alone demonstrated, a plausible scenario by which that might be done. Each machine is an island never connected to the internet. The software cannot be modified during an election — any tampering would have to be done in advance in a guarded warehouse that is under video surveillance. It can’t be done quickly, either. Machines must be forklifted off high shelves, seals must be broken, new stealth software installed and forged seals applied. To do this for 4,200 machines in Allegheny County would take months of unobserved activity.

Much has been made of the fact that Russia hacked the email server of the Democratic National Committee. That server was not subject to government inspection (as voting systems are), was not subject to legal regulation, was not monitored by officials and was not security-tested. There is no single point of entry into any Pennsylvania voting system that could have been penetrated to cause any alteration of votes.

It is also pointed out that Russia attempted to access state voter registration systems. It was not successful, but, even if it had been, no votes would have been altered. Damaging voter registration at the right time could have caused temporary havoc, but the effect would be apparent immediately. A voter whose name was removed could cast a provisional ballot on Election Day. A voter (presumably an imposter) whose name was added would not be able to produce valid identification as a first-time voter.

Every county has an administrative computer system that is used to set up ballot styles and to tabulate the results of an election. There is a popular, but incorrect, belief that if such a system were

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penetrated, an attacker could change the outcome. That is wrong because centrally tabulated results are unofficial only, used for fast reporting of winners on Election Night. The official returns in Pennsylvania are paper documents printed out at polling places and signed by judges of election. When the results are posted in polling places, party watchers telephone the results to their headquarters. Any later alteration would be noticed immediately.

Some computer scientists have suggested that a determined attacker could create miraculous malware that would reside in many voting machines and, via an internal clock, would know when the actual election was taking place. It would behave correctly at all other times, thus evading pre-election testing. During the election, it would record votes as it pleased, regardless of how a voter actually voted. It would erase itself at the close of polls, leaving no trace of its evil existence.

It would have to be very clever, however, because it would have to know for each precinct how many votes could be swapped without raising undue suspicion.

It would also somehow have to be installed in large numbers of non-networked machines. No one has ever demonstrated, or even designed, such malware, but let us assume that it is possible. A method used in Allegheny County, called parallel testing, would reveal it. On Election Day, a number of machines are sequestered and not voted on by the public, but are used by county employees to cast a predetermined set of ballots, the correct totals of which are known in advance. The machine has no way of knowing that it is being "tested" because it is placed in normal election mode. If any such malware is present, the reported totals will not correspond to the known totals, and the malware will be detected. Even though it may have erased itself at the close of polls, it will still be present on spare machines that have not been used in the election, and a forensic examination of the machines will reveal it.

Jill Stein, in her lawsuits seeking a recount, has referred to Pennsylvania's voting system as a "national disgrace." Pennsylvania, unlike some other states, does not have a uniform statewide voting "system." Instead, we have more than 67 systems, at least one for each county (sometimes more because of absentee and accessible systems), and we benefit from that diversity, which makes it infeasible to perform any large-scale manipulation and exposes no central point of attack.

To this day, no evidence exists that any electronic voting machine used in an election in the United States has been tampered with, or even that any attempt has been made to perform such tampering. In 2015, the Pennsylvania Supreme Court ruled that our DREs do not violate the rights of any voter. On Dec. 12, 2016, U.S. District Judge Paul Diamond in Philadelphia wrote that the hacking scenario proposed by Ms. Stein's witnesses "borders on the irrational."

I have voted in Allegheny County for 42 years, and I am perfectly satisfied with our present system. The security of any system can always be improved with money and effort. The debate about voting systems should not be about which ones to throw away but how to enhance the security and usability of the systems we already have.

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