Electronic Voting Machines

A Summary Comparison of the Optical Scan (OS) and the Touch Screen (TS) Voting Terminals

This summary presents an impartial discussion of the two voting technologies in wide use as of this writing (2007): Optical Scan and Touch Screen technologies. The purpose of the presentation is to better the understanding of the pros and cons offered by these two technologies.

We begin by describing some advantages that the Optical Scan (OS) terminals offer over the direct-recording electronic (DRE) Touch Screen (TS) terminals.

Voter-Verified Paper Trail. A very important criterion in assessing voting technology is the provision of the Voter Verified Audit Trail (VVAT), that is a physical copy, for example, a paper record, of the actual vote that the voter verified before it was cast. VVAT is sometimes referred to as the Voter Verified Paper Ballot (VVPB). For the OS terminals this is the actual ballot sheet. For the TS terminals, this is the printed record that the voter can accept or reject. An obvious advantage with the OS terminals is that there is no need for an additional voter verifiable audit trail, as each hand-marked ballot is automatically "voter verified". The TS terminals on the other hand, do not provide a direct VVAT, as the system may need print several ballots that are rejected by the voter, following by the accepted ballot. This necessitates the need for automatic separation (and possibly mechanical or manual destruction) of the rejected ballots from the accepted ballots. This process is more cumbersome, and relies on a less direct correspondence between the casting of a vote and its verification by the voter. (We also note that not all commercial TS terminals provide printed VVPBs.)

Authentication Issues. Another noticeable distinction is in the actual voting process itself. Regardless of the technology used, each voter needs to be authenticated (say, by an authentication token) before s/he can be allowed to cast the vote. The OS technology simplifies this process by eliminating an authentication layer, i.e., by saving the time, expenses and the security considerations in making/securing voting cards, card readers, etc. When using the OS terminals the voter goes to the polling place, gets a ballot sheet

(which serves as an authentication token). When using the TS terminals the voter card plays the role of the authentication, necessitating further security measures and expense.

Although the OS terminals may save on the time/money spent on the voter cards and card readers they have the disadvantage of having to print and securely transport paper ballots ahead of time. The TS machines do not require many magnetic cards ready since they can be quickly cleared and reprogrammed. There is a tradeoff in practical terms: how many paper ballots to print vs. time spent creating, clearing, and reprogramming the magnetic cards. In most situations where OS is used, it is very hard to come to a polling place with multiple (possibly falsified) ballot sheets without getting noticed (walking in with a stack of ballots). The magnetic ID cards for TS systems may or may not be hard to reproduce, but it is yet one more security issue that the voter and poll workers need to deal with.

Private Time with the Voting Terminal. The next point of interest is that in the case of the OS terminals there is no need for private time for the voter with the voting terminal. The actual ballot-casting time is minimal, i.e., the time of interaction of the voter with the terminal is very small. Consequently, the OS machines can offer better throughput, i.e., they can serve more people per terminal since the voters can fill out the ballots simultaneously without having to use the machine while doing so. The OS machine can scan accept a voter's ballot in a few seconds, while the TS machine can serve one person at a time and this can take from a few minutes to a noticeable fraction of an hour per voter, depending on how complicated is the electronic ballot and how much the voter might need to make all necessary decisions. Thus, while the OS terminals are not only more efficient, but also more secure in the sense that since the voter has less time with the machine, there is also a lesser chance that an attacker can tamper with the voting terminal.

Hardware Failures During an Election. If an OS terminal fails, voting can continue, as the voters are still able to mark ballots that can later be manually or automatically counted. When a TS terminal fails, voting cannot continue, and there are non-trivial concerns of what votes have been recorded, and what ballots have been printed (if any).

We now overview some potential advantages that the TS technology can offer over the OS technology.

User Interface Issues: Multilingual Access and Voter with Disabilities. TS technology makes it easier to have user interfaces in multiple languages (e.g., English and Spanish, etc.). As with ATMs, the voter may simply select the language in which he or she wishes to vote at the start of the voting process. While ballots for OS systems can also be provided in multiple languages, there is expense associated with printing ballots in the required languages. TS terminals can also be designed for voters with limited manual dexterity and other physical disabilities, and can incorporate assistive technologies (e.g., headphones for the visually impaired), allowing the disabled to vote without forfeiting the anonymity of their vote.

Assistance with Vote Validation. The TS machines can provide better assistance to the voter in handling vote miscounting in comparison to the OS terminals. The OS machines can miscount when a voter marks the bubbles poorly or ambiguously. The TS systems provide feedback to the voters, showing unambiguously whether or not the terminal has received the selection made by the voter, and in case of malfunction, a voter may be able to observe that a TS terminal is not operating correctly. Both technologies provide adequate ways of dealing with overvotes. TS technology provides additional assistance in the case of undervotes, for example the terminal may ask a voter whether an apparent undervote is intentional.

No Need for Paper Ballots. Finally, with the TS voting systems there is the savings associated with not having to print paper ballots, and there is no risk of exhausting the supply of paper ballots.

Finally we note that this overview deals with the broad issues associated with the OS and TS technologies. The overview does not address the specific features, the security vulnerabilities, or the reliability issues associated with available commercial models of voting terminals.