Challenging the Norms and Standards of Election Administration:
Standards for U.S. Voting Systems

Mr. Roy Saltman

I. Introduction

In the United States, voting systems have not been nationally standardized because—following the principles of federalism established in its Constitution—responsibility for election administration has primarily rested with the states. The latter, in turn, have devolved many of the responsibilities to their counties, and in some cases, to townships and municipalities. With the invention and deployment of mechanical lever voting machines beginning about 1890, voting technology throughout the nation was non-uniform. That is, some areas, primarily cities, used machines while others cities and rural areas continued to employ paper ballots. Following the start of computerization of vote-counting equipment in the 1960s, a map of voting systems in use across the country would have produced a patchwork look. Even within a single state, several different methods could be in use, ranging from hand-counted paper ballots to the latest computerized equipment. The initial impetus towards development of national standards was twofold: the difficulties experienced by local governments in implementing the first computerized systems and the recognized need for a single point of quality assurance to eliminate duplicate testing. A major change in concept resulted from the difficulties of the 2000 Presidential election in Florida.

This paper will explore the impetus for standardization and will trace the gradual development of national voluntary standards over the past several decades. It will also discuss the areas in which standards are most needed and will evaluate the new process for developing them.

II. The Process of Creating Federal Standards

In 1971, several years after computers started to become part of the voting process, the U.S. Congress created a limited advisory role for the federal government. It established the Clearinghouse on Election Administration with just 5 civil servants. While the federal government has a Constitutional oversight role in elections for the President, Vice President and members of Congress, it had not exercised that role with mandated requirements for vote-counting equipment in the 20th century. (Federal oversight responsibility for elections for state and local government offices is limited to assurance of civil rights embodied in Constitutional amendments and enforcement of criminal statutes.) During most of the 20th century, each state evaluated and approved manufacturers' equipment on its own and usually allowed local jurisdictions to select voting equipment from an approved list. In 49 of the 50 states, more than 5,000 local jurisdictions (including counties, towns, townships and cities) used a variety of equipment and methods, and states worried little about the mix. Only one state, Alaska, administered its elections at the state level; that state and a small number of others required a particular type of equipment statewide.

In the 1970s, pushed by the introduction of computers and the desire of state election officials to avoid review of all available voting technology, election officials and vendors began to consider the advisability of national voting system standards. An initial difficulty was that no national body (governmental or otherwise) had jurisdiction or funds to carry out such a task. However, in 1975, the Federal Election Commission (FEC) was established to regulate campaign financing and it incorporated the Clearinghouse, later called the Office of Election Administration. This office, before it was part of the FEC, had funded a study carried out by the National Bureau of Standards (NBS, now called the National Institute of Standards and Technology or NIST) on the "Effective Use of Computing Technology in Vote-Tallying." As a result, both vendors and election officials turned to the NBS to take a leading role in setting standards.

In 1980, Congress called on the FEC to study the feasibility of developing voluntary engineering and procedural performance standards for voting systems "with the cooperation and assistance of the NBS." Completed in 1983, the study concluded that "performance standards for voting systems are both needed and feasible." In 1984, Congress approved an FEC budget that included a small amount of money for standards development. The development process proceeded slowly.

Finally issued in 1990 (and revised in 2002), the standards were voluntary in use by the states, although about two-thirds have adopted them as requirements. The standards covered both hardware and software. For hardware, they regulated the equipment's functionality, its reliability (mean time to failure), its operability under the outer limits of expected temperature and humidity, and its ability to withstand a drop from a limited height. For software, they assured that the software actually operated as specified by the vendor.

Both vendors and election officials agreed that independent testing authorities (ITAs, now called voting system testing laboratories, VSTLs) were required to assess vendors' equipment. These organizations are private businesses that perform similar testing for government agencies, such as the U.S. Air Force or NASA. They were, through 2002, accredited by the National Association of State Election Directors (NASED, a voluntary association of election officials), and their work as VSTLs is typically a sideline to their main business. The election officials accredited at least one VSTL for hardware and one for software, and they replaced them when incumbents no longer wished to perform the service. VSTLs charge vendors for the accreditation process. Many states require that voting equipment receive VSTL approval before they allow vendors to sell equipment. It was not until the passage of the Help America Vote Act (HAVA) in 2002 that the development of guidelines for voting technology was institutionalized in a process supervised by federal agencies. Under the new law, the standards documents are to be called guidelines to emphasize their voluntary nature. A major aspect of the law was that it made available up to $3 billion (thousand-million) to the states as inducements to replace mechanical lever voting machines and voting equipment using computer-readable punch-card ballots. (No absolute requirement to abolish the use of these devices was included in the law.) The new arrangements were instituted to address the problems encountered in Florida during the 2000 presidential election.

In Florida's 67 counties, in the 2000 election, six types of voting equipment were used. Those six types were represented by 13 different models provided by eight vendors. Specifically, 15 counties (with more than 60% of the population) used the pre-scored punch-card (PPC) system, nine counties used the Datavote punch-card system, 26 counties used equipment with mark-sense ballots read at the precinct, 15 counties used equipment with mark-sense ballots read at a central location, one county used hand-counted paper ballots, and one county used mechanical lever voting machines that did not use ballots but tallied the number of votes cast for each candidate on counters that were read after the close of polls. Thus, Florida in 2000 used nearly every major type of voting equipment available but, notably, not direct-recording electronic (DRE) systems.

In its review of the 2000 presidential election, the U.S. Supreme Court did not object to Florida's use of several types of equipment. However, for the counties that used the PPC system, it rejected the different rules used in various counties to determine the voter's intent. With the PPC system, the voters' attempts to record choices are sometimes unsuccessful. The small pieces of ballot card (the "chads"), whose removal indicates votes, fail to be completely dislodged. A voter's error of this type results in an ambiguous situation resolvable, in close elections, by human interpretation. The different rules, the court said, violated the U.S. Constitution's requirement that no person shall be denied "equal protection of the laws."

III. The Voting Process as a System

The 1980 Congressional study into the feasibility of developing standards for voting systems considered procedural performance standards as well as engineering standards, because voting (from registration to the announcement of results) is the sum of numerous procedures that make up a complete system. This system has many parts—voters, vendors, vote-counting equipment and election agencies—and its actors carry out a wide range of procedures. Vendors manufacture hardware and software, voters register to vote, VSTLs certify the equipment, election officials set up and run the polls and maintain security, voters use equipment to vote, the machines tally voters' choices, election officials certify the results and the results from each local jurisdiction are totalled and certified at a higher level.

However, the voting process is not a static one, and state standards, adapted from federal guidelines, must recognize this variation. An election can be a primary for each party, a special vote or a general poll. It may contain differing types of races with varying numbers of candidates per contest, and, of course, candidates are often different from those of the last election's races. Winners may retire and losers may be replaced. Most contests ask voters to choose one candidate, but some races allow voters to select a larger number of names. Given this variety, software provided by vendors must be sufficiently adaptable so that it can be easily customized to fit the requirements of the election at hand. The customization should be easy for local officials and should not require them to change the logic of the vendor's software.

IV. Additional Candidates for Standardization

In addition to hardware and software, several other areas of the voting process may require standards. They involve procedures carried out by election officials and voters, and they significantly affect election administration. The most pressing issues include (but are not limited to) the following:

1. the integrity and security of the voting process;
2. human factors in voters' interactions with voting equipment;
3. the use of ballots vs. DRE voting systems; independent voting by the blind is a related issue;
4. consideration of three possibilities of software ownership: (a) outright vendor ownership with trade secret protection and no public access, (b) vendor ownership of software copyright, where public access would be permitted, or (c) public ownership;
5. the acceptability of remote-access Internet voting; voting by mail is a related issue; and
6. updating files of registered voters.

If no standards are developed and mandated in any of these areas, then current conditions will prevail.

1. Integrity and Security

It is essential that voting systems be secure in order to assure the public that the process has integrity and that contest results exactly mirror voters' choices. Therefore, the system must be protected both from malfunctions and from malicious human interference that could change or destroy data. Many experts do not want voting systems to connect to the Internet, as they feel this would compromise security. (See **Section IV.5.**)

To achieve integrity and security, every step of the process must be closely monitored and any intrusions prevented. Election administration offices should have employees who focus exclusively on security and ensure the integrity of elections. For example, the transfer of hardware and software from vendors to VSTLs, and from the laboratories to election administrators, must be secure. In addition, election administrators must control access to all sensitive aspects of the system and all people involved in operations and maintenance must have specific, predetermined duties. Personnel in sensitive areas should display picture IDs examinable by security personnel. Any change in procedure must be clearly documented. Only when the system is thoroughly monitored by the security staff, establishing that effective procedures are being implemented, can integrity be assured.
Prior to an election, local jurisdictions should carefully check both hardware and software to assure voters of working equipment when the polls open. Before Election Day, officials should verify that the equipment in each precinct displays the correct set of choices, and during Election Day, they must monitor equipment (while protecting voters' privacy) to ensure that no malfunction or sabotage has occurred. Officials must have backup procedures in place to enable voting to continue in the event that some or all of the equipment fails.

Election officials must also ensure the secure transfer of results from each precinct to the central location where results are aggregated. Officials should not send tallied results over communication lines while the polls are open, and in fact, they should send only unofficial counts in this way after the polls are closed. After ensuring adequate protection, they should hand-carry the original documentation, from which certified results are obtained, to the central location. The use of cryptography could enhance security of communications, but legal requirements may demand the presence of signed documents. Furthermore, some part of the public may object to the use of cryptography as an unacceptable modification of a process that should be transparent.

2. Human Factors in Voting

During the 2000 presidential election, the ability of voters to accurately record their choices became a concern. Though the issue existed before that time, the extent of its impact was not recognized until the very close election in Florida made it obvious. Since then, many studies have shown that voters are not always able to correctly record their intentions and that their abilities are influenced by the equipment they use and their socio-economic status. When voters employ easier-to-use voting equipment, they make fewer errors. Additionally, voters with higher incomes or higher educational levels are, on

average, better able to record their intentions correctly than voters with lower incomes or lower educational levels.

No national guidelines have yet been set in this area, and it will take more research and experimentation to identify parameters for the design of voting machines.[1] However, points of general consensus can be established. For example, most ballot designers agree that all candidates for a particular office should be displayed together on the same side of the ballot (or on the same computer screen). In 2000 in Florida, this principle was not followed in several counties; the result was that many voters unintentionally overvoted. That is, they voted for more than one competing Presidential candidate and none of their choices could be counted. A well-accepted method for rating machines on ease of use is by the percent of no-votes (the lack of a recorded vote) for the first contest listed on the ballot. The no-vote may be due to an overvote or an undervote, where the latter may be an error or a deliberate abstention. Overvotes are almost always unintentional. Typically, in general elections, the presidential, gubernatorial or U.S. senatorial contest is listed first (depending on the year). As it is likely that the largest number of voters will intend to vote in this first race, most experts agree that the percent of no-votes on this contest is a good indicator of voters' inability to effectively use the voting equipment.

Election officials should select machines that experience has shown are easier for voters to use. Several analyses have demonstrated that punch-card voting systems display the highest mismatch between voter intentions and the recorded ballot. In addition, ongoing research is evaluating different layouts of ballots or screens in order to provide guidelines for voter-friendly operation.

A final issue that clearly impacts a voter's ability to accurately record his or her intention is language. The United States has accommodated non-English-speaking citizens by requiring election officials in areas with a given percent of speakers of a certain language to provide ballots in that language. In Brazil, to assist illiterates, voting machines require voters to enter a number (not a name) identifying the candidate of their choice. It has been shown that illiterate individuals can recognize identifying numbers more easily than names. This has not been done in the U.S. However, in many countries, including the U.S., when a ballot is used with party columns or rows (such as with mechanical lever voting machines or mark-sense ballots), a party logo—which is easily recognized by both the literate and the illiterate--often heads the listing of each party's candidates. When an "office-block" ballot form is used, as with touchscreen DRE equipment, often no logo is shown.

3. Ballot vs. Non-Ballot Voting Systems (and Independent Voting by the Blind)

Election officials in the U.S., with public support, have moved back and forth between the use of ballots and non-ballot voting systems. By the 1964 Presidential election, about 65% of all U.S. voters used non-ballot mechanical lever voting machines, but in lightly populated and rural areas, hand-counted paper ballots continued to be used. Ballots returned to urban areas following the initial application of

1 Some states mandate the minimum size of type on ballots.

computer-readable punch-cards and mark-sensing beginning in the early 1960s. By 1986, about 51% of U.S. voters were using equipment with ballots. The use of mechanical lever voting machines declined. In 2000, about 69% of voters used systems with ballots.

In the 1990s, DRE voting machines became readily available. In 2000, about 13% of U.S. voters used them while 18% still used lever machines. With DREs, a voter directly enters a choice using a pushbutton or touchscreen; the selection is recorded electronically. Following the disaster in Florida in 2000 and the passage of HAVA in 2002, DREs became much more popular (about 31% of voters used them in 2004). Georgia and Maryland mandated their use statewide, joining Delaware in that condition, and other states permitted their procurement. An advantage of DREs is that there is no question of a voter's intent. With a paper ballot (such as with PPC ballots, discussed above), a question of intent may arise when a voter fails to follow instructions in filling it out. A report from the chief election official of Georgia noted the strong reduction in the no-vote on the top contest that occurred after that state implemented DREs for the 2002 general election. Another benefit is that voters who are blind may vote independently on DREs using an associated audio device. Advocates for the visually impaired strongly support the use of DREs, and HAVA mandates that blind voters be given the tools to vote independently.

Fierce controversy exists over the use of DREs. Some people, including a number of computer scientists, have demanded the machines produce a "paper trail" in addition to the electronic ballot images (EBIs) of each voter's choices that are retained in the machine. They claim that because it is impossible to ensure that the software functions correctly, voters should receive a paper receipt with which they can confirm their vote. Supporters of DREs counter that the printing and review of paper receipts would add cost and delay; that the printed receipts will introduce another element capable of failing; and that the software has been extensively tested and sufficient hardware redundancy provided to ensure that the machines tally the correct results. This issue of the paper trail will be resolved politically, not by rational and technical analysis.

Standards for the use of DREs could require extensive pre- and post-election software checks by local election administration. These checks might involve trial runs whose results are known to determine the accuracy of the machine.

4. Public Access to Voting Software

Another controversial issue related to DREs is the degree to which the public has access to the machines' software. Currently in the United States, vendors of election equipment consider their software source codes to be trade secrets and refuse to release them. (Only the VSTLs are permitted to see the source codes, and they must agree to nondisclosure.) Many voters knowledgeable about computers are troubled by this restriction, particularly because the DREs do not normally generate paper records. If a dispute occurs in an election that employed ballots, those ballots can be recounted. If a dispute occurs in an election that used mechanical voting machines, there can be only a re-canvass.

The machine's odometers can be re-checked to determine if there was a transcription error. (The retention of voters' individual choices is not possible and lever machines are known to have occasional mechanical errors that cannot be easily discovered.) In the case of DREs, each machine retains the EBIs of each voter's choices recorded on a diskette or equivalent. The EBIs can be transferred by diskette and recounted on a different machine. This process produces a verification only if the software that generated the EBIs functioned correctly. With DREs, properly functioning software is absolutely essential.

Many critics of DREs are not satisfied by the fact that the software has been verified by a VSTL and that the EBIs may be recounted. Many want both a paper trail and accessible software, and a group of computer scientists are attempting to fulfill the latter wish. Their new group, the Open Voting Consortium (OVC), has employed volunteer labor to build a demonstration voting system with open-source code. If the OVC is to stand behind its output, correct any errors found, and provide support in actual elections, it will have to create a company with paid employees. Volunteerism can carry a process only so far. In addition, the fact that software is public does not guarantee its correctness. Users should demand the same kind of thorough testing for open-source code as that undergone by software protected by trade secret.

A compromise solution between those who want to use open-source code and those who want to use privately owned code would require vendors to copyright their source codes. In this case, the codes would be protected by law against duplication or plagiarism, but they could be reviewed by the public. Because vendors have not agreed to copyright, this solution would require an important jurisdiction, such as the federal government or the state of California, to legislate it. This scenario does not seem likely in the foreseeable future.

5. Voting Over the Internet and by Mail

In the late 1990s, when the Internet became a viable network used by the general public, some experts began to consider its use as a means of remote voting. A small number of elections have been conducted using the Internet, including the Arizona primary of the Democratic Party in 2000. The debates over voting by Internet involve both political and technical issues.

Those who favor Internet voting point to the convenience it offers people who have trouble getting to the polls. They believe that it would increase turnout by enabling people who cannot take time off from work to vote from their offices. Polling stations are in voters' residential neighborhoods, whereas many persons travel far to work. U.S. federal elections are held on a Tuesday, generally a working day. Some states require employers to grant citizens time to vote, and polls typically open around 7 a.m. and do not close until 7 or 8 p.m.

Those in favor suggest also that Internet voting would assist U.S. citizens (such as members of the military) who are outside the United States on Election Day. Registering and voting from overseas are

problematic due to the uncertainties of international mail. For this reason, in 2003, the Federal Voting Assistance Program(FVAP) of the U.S. Department of Defense (DoD) began to develop an Internet voting system for overseas citizens. Funding was cancelled in 2004 in part because technical experts warned that hackers could interfere with the transmission of the supposedly secret vote.

With respect to employees voting at work, privacy experts have noted that employees use computers that belong to their employers, who have the right to review material sent to or from those computers. There is additional concern that administrators might not be able to properly verify the identity of a person using a computer terminal to cast votes.

Some of those who oppose Internet voting are concerned with the economic problem of the "digital divide." Clearly, Internet voting is easier for those who have personal computers, and this population is likely to be skewed towards upper and middle income families. Thus, a benefit would be created for those least in need of public benefits. This problem was demonstrated in the 2000 Arizona Democratic Party primary. Authors of a book evaluating Internet voting stated that "counties with large nonwhite populations had the lowest turnout rates. ... [There is] strong evidence that race played an important role in determining the relative turnout rates across Arizona counties." Nonwhite race in this case implies lower income.

Additionally, opponents of Internet voting argue that the end of widespread use of polling stations would reduce citizens' sense of neighborliness. Voting from their homes, citizens would not participate in the community aspects of voting. While elections fill national and statewide offices that may seem distant to many citizens, they also designate local leaders who make decisions on local issues: schools, roads, police, open space, zoning, property tax rates, etc. At polling stations, voters see supporters of many different candidates and their campaign literature. It is a broadening experience, and it keeps voters in touch with the community.

The debate over vote-by-mail elections, such as those held statewide in Oregon, raises the same issue, as does the increasing use of the no-fault absentee ballot, now available in many states. Furthermore, in both Internet voting and vote-by-mail elections, there is an increased risk of voter intimidation. At a polling station, where a voter can vote in private, intimidation is not likely. In any multi-person household or office where ballots are cast, one person may impose his or her will on other voters. Such a problem has already been encountered in nursing homes where, in some cases, absentee ballots have been filled out by people other than the registered voters.

6. Updating Voter Registration Data

HAVA mandates that each state maintain a computerized list of registered voters. However, better procedures need to be in place to update registration lists as voters move or die. Because Americans are a mobile people and it is common for them to move between states, it would be very useful for states to exchange and compare voter registration data in an automated fashion. To enable such an exchange, a standard could specify the parameters of a digital message transmitted from the state of a citizen's new residence canceling his or her registration in the state of his or her former residence. This standard could be developed by NASED, for example, or through the Election Assistance Commission, as discussed below.

V. Managing the Process to Develop and Maintain Standards

HAVA established a new organization, the Election Assistance Commission (EAC), to manage the process of developing and maintaining voting standards. The first four commissioners of the EAC, two from each major political party, were appointed and confirmed in December 2003. The Office of Election Administration was transferred from the FEC to the EAC, which provided the Commission with a few civil servants experienced in the subject matter.

The EAC was charged with three duties relevant to voting standards: (1) to develop and adopt EAC guidelines (formerly known as FEC standards), (2) to undertake "studies and other activities" that might lead to the development of additional guidelines, and (3) to accredit the nongovernmental VSTLs that test and certify voting systems' hardware and software. There were no requirements imposed on the states with regard to the guidelines. The states remain free to adopt or ignore the guidelines within their jurisdictions and to accept or reject the decisions of the VSTLs as they see fit.

1. Development of Voting System Guidelines

A Technical Guidelines Development Committee (TGDC) is specified under HAVA. This committee is chaired by the Director of NIST and includes 14 other individuals. NIST is to provide technical support to the TGDC. Proposed guidelines originate in the TGDC, and the committee is beginning to carry out this mandate. Adopted guidelines are reviewed by the Commission's Executive Director and by two advisory boards. One board contains election administrators from every state and territory; the second has members representing several types of professional expertise and "voter interests." The Commission may then approve the guideline, taking into consideration all reviews and recommendations.

2. Subjects for Further Study

The EAC is to study (1) voter notification of overvotes and undervotes, (2) ballot design, (3) processes of voter registration, (4) the accessibility of polling places to people with disabilities, (4) the collection of nationwide statistics for investigating fraud, (5) methods of preventing voter intimidation, (6) the development of standards for what constitutes a valid vote in each type of voting equipment in use, (7) human factors research, (8) the use of the Internet, (9) necessary security measures, and (10) others topics. For a complete list, see the text of HAVA, Public Law 107-252, October 29, 2002, Sections 241 through 245.

3. Certification of Testing Laboratories

The director of NIST may recommend VSTLs for accreditation to the EAC, which makes the final decision. NIST will conduct ongoing evaluations of these laboratories and recommend retention or revocation of their accreditation. It is implied that the methods the laboratories use to certify vendors' hardware and software could be a factor in the accreditation decision.

VI. Future of the Process

Since the EAC has begun to operate only recently, there has not been sufficient time to evaluate the process that has been established. Chairmen of the Congressional committees responsible for oversight of HAVA have refused to consider proposals for revision at the present time. However, HAVA makes room, in its advisory boards and public hearings, for every type of interest group to be involved. Whether the result is many and varied views but little action taken remains to be seen. In addition, the process requires Congressional appropriations to keep it moving forward. In the past, many programs have been effectively ended by insufficient funds. This possibility has been raised already with respect to the EAC. The National Association of Secretaries of State (NASS), most of whose members are the chief election officials of their respective states and the supervisors of the members of NASED from their states, adopted a relevant resolution in February 2005. The document stated that NASS "encourages Congress not to reauthorize or fund the Election Assistance Commission after the conclusion of the 2006 federal election, and not to give the EAC rulemaking authority." The organization was possibly responding to the demands of a pro-EAC faction which wants the commission to be given greater authority to impose federal requirements for elections. At this time, under the U.S. political system, the states have the final say as to the implementation of the guidelines. Given these various challenges, one can only hope for the best.