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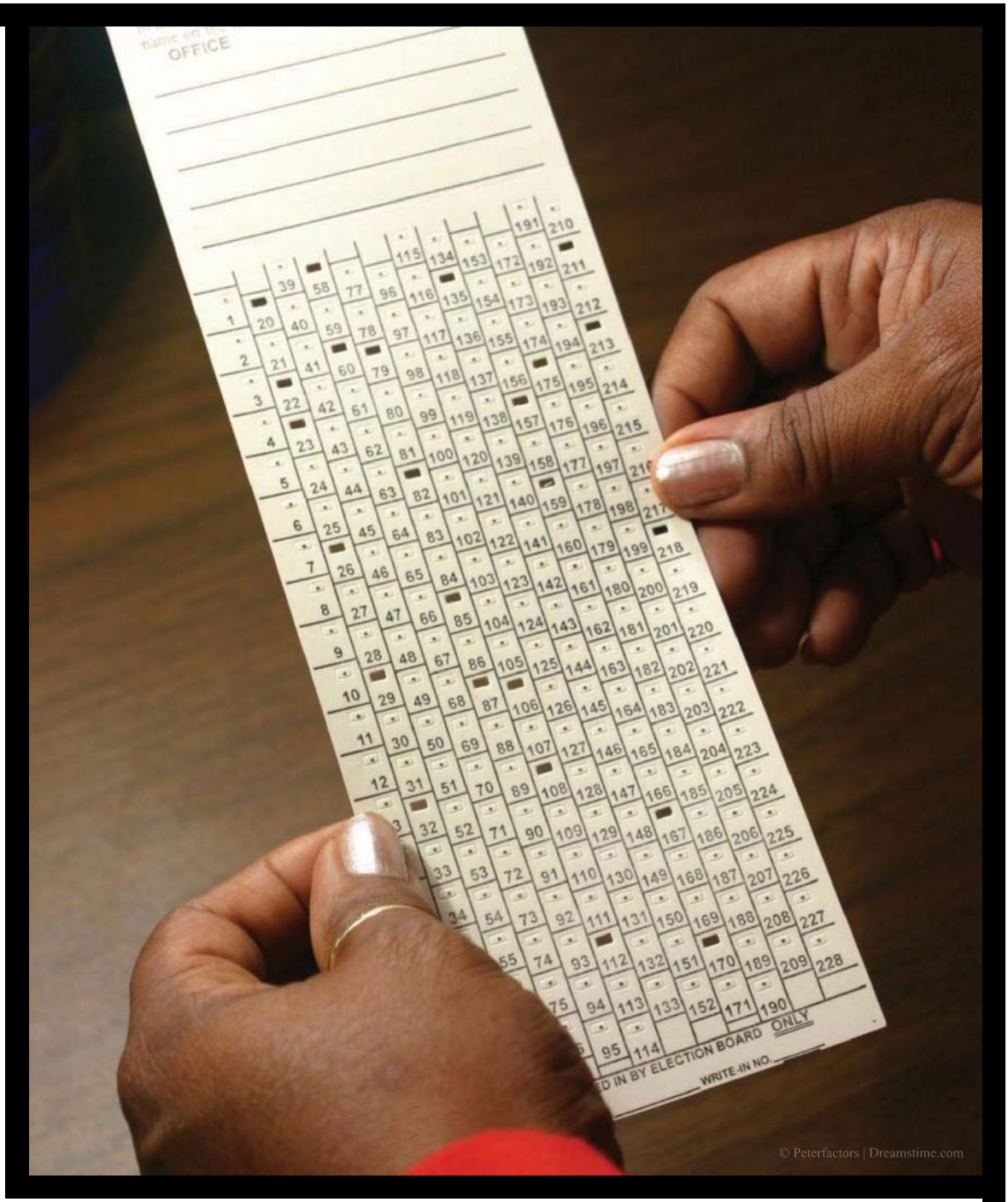
Improving Election Security and Accuracy Part 1

by Stephen Berger, TEM Consulting



A lot has changed in voting system certification since the 2000 presidential election. Those changes have now come to the place where more of the same will start doing more harm than good. Fundamental and needed changes in how voting systems are tested, certified and safeguarded have been made in the past 8 years. However, further improvements in total election accuracy, security, reliability and usability will require new approaches.

Part 1 of this article will look at the changes that have been made, and where the U.S. system for certifying voting systems stands today. It will then analyze the benefits that have been brought, but also the negative unintended consequences that will be brought about by simply doing more of the same.

To gain further improvements in elections new approaches are needed to retain the benefits gained so far and take the system to the next level of accuracy and security. Part 2 of this article will explore the most promising new approaches that could further extend the benefits achieved so far.

Changes in Voting System Certification Since 2000

In response to the problems experienced in the 2000 presidential election, a lot of changes have been made in how voting systems are certified and elections administered. A new federal agency, the Election Assistance Commission, has been created. New standards have been developed. A new system of laboratory accreditation has been put in place. Individual states have responded with a wide variety of initiatives. Some states have made major changes in how elections are administered.

Creation of the EAC

One of the biggest changes is the creation of the Election Assistance Commission (EAC). For the first time the federal government has taken responsibility for certifying voting equipment. Before Congress created the EAC, through the Help American Vote Act, voting equipment was certified on the national level by the National Association of State Election Directors (NASED), a non-profit organization. Approximately 40 states participated voluntarily in the program.

In the Help America Vote Act, Congress not only created the EAC but created a set of requirements for voting equipment. It also charged the National Institute of Standards and Technology (NIST) to support the EAC in creating technical specifications for voting equipment. This was the first time the federal government officially became involved in the equipment certification, although the Federal Election Commission (FEC) had worked very closely with NASED in its certification program for many years.

New Standards

It was not until 1990 that the U.S. had a national standard for voting equipment. The standard, written by the FEC in cooperation with NASED, was created to fill a need recognized at the time. Before that, individual states each created their own requirements and qualified voting systems in a variety of ways. The result was a wide ranging mix of requirements and certification tests. Recognizing that this diversity was both duplicative and inefficient the FEC created the 1990 Voting System Standard (VSS), and in 1994 NASED inaugurated a program to qualify equipment to it.

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In 2002 the FEC published the first and only update to the 1990 VSS standard. After the EAC was created, it adopted the 2002 updated VSS standard as its first standard for voting equipment.

In 2005, the EAC published its first standard, the Voluntary Voting System Guidelines (VVSG), replacing the 2002 VSS. A phased implementation was announced, with equipment being qualified under either standard until December 2007. The EAC continued to work with NIST on revising the standards, and in 2007 a draft revision of the VVSG was delivered to the EAC and is now undergoing a public comment and review.

At this time, no equipment has yet been certified to the 2005 VVSG. The equipment in use today was either certified to the 1990 or 2002 VSS standard. Also, participation in the national certification continues to be voluntary. While most states do participate, approximately 10 states opt to run totally independent programs.

Introduction of NVLAP

With any certification program comes the need to qualify and monitor the laboratories. The EAC assigned that responsibility to NIST's National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP has a long and successful history in laboratory accreditation. Operating under a series of Mutual Recognition Agreements with other countries, NVLAP assesses laboratories to ISO 17025, the international standard for laboratory accreditation. ISO 17025 has two major components, a set of requirements on lab management (including quality and documentation control) and a set of requirements for technical competence in the scope of accreditation.

NVLAP's long history of laboratory accreditation has prepared it well to assess voting system test laboratories (VSTL) as to their management and quality practices. However, the specific technical requirements needed in a VSTL were new ground for NVLAP. Specifically, NVLAP was challenged when trying to evaluate the effectiveness of specific test methods proposed by the labs for their thoroughness and effectiveness. Further complicating the situation is the fact that NVLAP was assessing laboratories at the beginning of the EAC's certification program. This meant that the laboratories did not have any examples of their work to be examined. The initial recommendations from NVLAP were therefore, of necessity, more an assessment that a laboratory could potentially do good work, in contrast to an assessment that a laboratory was doing good work.

Nonetheless, NVLAP made its first recommendations for accreditation to the EAC, and the first VSTLs were accredited. As the program moves forward, NVLAP is gaining experience in the specific marks of quality evaluation. The EAC is learning how to feed its concerns about testing effectiveness into the NVLAP process. The EAC reviews both the final test reports from the VSTLs and receives continual information on how voting systems perform in real elections. The VSTLs are performing evaluations, thereby creating work products that can be examined in order to judge the delivered quality of their work.

Changes in State Certification

Individual states have been far from inactive. State legislatures have been quite prolific. In addition, state and local election officials have used their authority to implement a variety of reforms.

In light of the high state of controversy surrounding elections, some election officials have started running elections on the assumption that there will be lawsuits. Changes have been made to collect evidence and retain documentation so that, when an election is challenged, the election official has the evidence to prove the election was run properly. A great advantage of this extra evidence (some of which is gathered using high tech forensic methods) is that, should election fraud occur, there is ample evidence to prove it.

Controls on software used in elections have become much tighter. Many jurisdictions now routinely check all voting

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systems both before and after an election to confirm that the digital signatures of the software remain identical to the certified version. The use of digital signatures has been proven to be highly reliable in detecting any changes in software, and their use in elections is very promising.

California, Colorado, Ohio and other states have conducted far reaching examinations and retesting of their voting systems. "Red Team" simulated attacks on the voting system have been conducted by highly skilled computer security experts. In some cases, voting systems have been decertified because of problems found. More commonly irregularities in the process have been identified and loopholes closed.

A problem that is getting increased scrutiny is the introduction of patches to either the voting system software or the operating system it runs on. Formerly, such patches were pretty much handled between the local jurisdiction and the vendor. Increasingly, patches are required to undergo their own certification process, and are implemented under a security system designed to ensure that only the intended patch is installed. These measures are intended to protect against the possibility that malicious software might be introduced along with a legitimate software update.

Immediately after the 2000 election, the focus was on accuracy and, specifically, accuracy of punch card systems. The general impression, largely created by the popular media, was that punch card systems were inherently inaccurate and unreliable. The result was the removal of punch card systems from use in U.S. elections.

Changing Issues

An interesting dynamic to observe is how the focus of attention has shifted over time. Immediately after the 2000 election, the focus was on accuracy and, specifically, accuracy of punch card systems. The general impression, largely created by the popular media, was that punch card systems were inherently inaccurate and unreliable. The result was the removal of punch card systems from use in U.S. elections. Today, a vendor would be hard pressed to give away a punch card system.

Sadly the general impression is not supported by scientific evidence. The accuracy of punch card system, when used properly, has consistently been shown to be about the same as other systems. When used improperly all types of voting systems have problems.

The combination of the need to replace punch card system, and requirements in the Help America Vote Act to support independent voting by people with disabilities, created a general movement toward electronic voting machines. As direct record electronic (DRE) voting machines became increasingly popular, the possibility that their software could be hacked became an increasing concern. Between 2000 and 2003 or 2004, the focus issue changed from election accuracy to election security. The movement toward the voter-verified paper ballot became very popular and won support in many states.

However, the move to voter verified paper ballots has introduced problems of its own. First, the idea was so popular and introduced so quickly that it was not examined as to how the solution might introduce its own problems. Early experience with voter verified paper ballot systems have had up to 10% of the paper records partially or totally corrupted. Recounts using the system have taken as much as an hour per vote due to the cumbersome nature of the paper roles and the inaccuracy of human counts, which often require multiple counts to get to a reliable number. Because of these unsettling experiences, new specifications are being developed for future voter verified paper ballot systems.

More fundamentally, there was a failure to analyze the move to voter verified paper ballot on a system level. Did this innovation really improve total election security and accuracy? Fundamentally, the voter verified paper ballot is a move away from dependence on computers and software back to relying on people counting paper. However, people counting paper have the highest levels of inaccuracy and a long history of vote fraud. In fact, in the U.S. there has never been a proven case of election fraud through hacking software but in every election there are proven cases of election fraud using paper. Most of the election fraud that currently happens occurs in various attempts to manipulate the early voting, mail-in paper ballots.

Public perception is an absolutely essential factor in elections, and voter verified paper ballots appear to make the public feel good about elections. However, to stop there avoids the central scientific question, "What system gives us the most secure and accurate elections?" As some originally proposed the concept of voter verified paper ballots, the full concept was to have the voting system create auditable data and then have routine, random audits of that data. The idea was that voters would leave behind a paper record of their vote and routine, random audits could verify that the paper record matched the totals reported. Sadly, in only a few states that adopted the paper record coupled it with routine audits. That is a bit like filling a

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gas tank but forgetting to connect the gas line to the engine. A full gas tank unconnected to an engine does little good.

One way to analyze the election system is that you traditionally have people, paper and processes. That combination has a long history and documented problems with accuracy and fraud. To improve on that situation, computers, software and automation were introduced. However, computers and software have their own vulnerabilities. The right solution is to find the optimum combination that simultaneously: 1) reduces human error; 2) protects against all forms of election fraud; and 3) increases the total system accuracy and security. Setting up an either/or scenario simply offers a choice between two sets of problems. A hybrid system could potentially provide safeguards against the problems of each approach, and result in a much better total outcome.

It is now becoming generally recognized that, as originally proposed, the voter verified paper trail was deeply flawed, and that its implementation, unguided by carefully specified requirements, has created even more problems. The concept of voter verification is sound. What was missing in the original concept was a strategy for assuring that the ballot the voter verified actually made it into the final tally. The proponents also failed to develop a rigorous set of specifications to guide a coherent system design.

It was also not generally recognized that the paper ballot was really a metaphor for a durable, tamper-proof record of the voter's ballot. A serious debate was never held asking simple questions, like "Is paper the best medium for a durable record?", and "What is the most tamper-proof type of record we can create?" Despite great sincerity and enthusiasm, the verified paper ballot systems currently in use are widely being rejected as an approach that no one wants.

Impact of Recent Changes

Improvements

The changes made over the last eight years have been fundamental and far-ranging. For the first time, the federal government has taken responsibility for setting national standards and certifying voting systems. NIST NVLAP has responsibility for accrediting the test laboratories. State and local election officials have introduced a variety of significant improvements. The system for certifying voting systems has been profoundly improved.

Partial Completions

A problem that the system currently faces is determining what further changes might still be needed. It was widely recognized, while the 1990 standards were pivotal as the first national standards for voting equipment, by 2000 they had become dated and were in need of revision. The 2002 revision of the VSS added approximately 40% more requirements and strengthened many existing requirements. The 2005 VVSG added over 100 new requirements, taking the total number of testable requirements to nearly 1000.

Today, equipment qualified to the 2002 standard has only been used in a few election cycles, and no equipment has been certified to the 2005 standard. So while there are many opinions on how the current 2005 VVSG might be improved, there is no field experience to guide further changes.

Repeatedly investigations of field problems with voting systems have shown that requirements were in place in the 2002 standard as well as in the 2005 standards. A common root cause when investigating various field incidents is that flaws get through the testing process, since there are no standard test methods. Each VSTL is responsible for developing their own test methods, and that variability allows for some differences in how systems are tested. The common perception that we need tougher standards actually draws our attention away from what would really do the most good, that is, more effective test methods for the requirements that already exist.

Getting the VSTLs to the place where there is good lab-to-lab repeatability has yet to be seriously addressed. NIST NVLAP is just beginning its second visit to the accredited laboratories. Just how much of the variation in test methods between labs will be improved over time is not yet clear. It is extraordinarily difficult to determine how much improvement will occur naturally over time and where further work will be needed.

Unintended Consequences

One issue that is becoming very clear is that there are unintended consequences from so many changes being made by so many relatively independent agents. The cost of getting a voting system certified at the national level has risen dramatically. In 2000, qualifying a system to the 1990 VSS cost a vendor typically $100-250K in laboratory fees. With the 2002 VSS, that cost rose to between $500K and $1M. No system has yet successfully been qualified under the EAC program or to VVSG 2005, but the final cost for systems in process appears to be $1-2.5M. It is estimated that testing to the draft revision proposed by NIST will require somewhere between $4-6M.

With certification costs that high, a number of consequences roll out. First, new companies, especially smaller companies are locked out. To get into the business today, a company would need to fund the development of a system, pay to have it nationally certified, then pay for state certification in the states where it intends to market. Then and only then could a company market their system and have the chance to generate revenue, making the risk of entering the business enormous.

Another consequence is that established vendors are taking through fewer versions for certification. Changes are being grouped, and going for national certification is a very carefully considered event. This means that some modifications that are much needed by election officials are being held off because of the cost and time it takes to certify a system.

Fewer systems being certified means that there is less testing volume to support the VSTLs. Since VSTLs will see fewer voting systems for testing, laboratory personnel will have less experience testing those systems. Testing labs will also have a harder time justifying test automation and other improvements. So people involved in the testing and certification process get less practice and cannot justify developing better tools, like writing test automation software.

Various state reviews and testing efforts are adding further to vendor cost, draining resources that might be used for further development and system improvements.

Taken as a whole, it is clear that the path to further improvements is not by simply continuning to do more of what has already been done. In some cases, the changes that have already been made need time to manifest their impact before we can know what further changes might be needed.

In other cases, the results have proven to be inefficient or counterproductive. The following is a short list of some trends that have clearly proven to be counterproductive:

- To this point, voting system specifications have been created without guidance from a total systems objective or justification that the benefit will justify the cost. The result is an unending accumulation of more and more requirements, without any support that they result in better voting systems, or in better elections.

- Up to now, voting system specifications have been developed in isolation from the procedures that will guide the use of the systems. This trend results in two great problems. First, systems are over-specified, increasing their cost and complexity. In other cases, assumptions are made that issues will be covered by administrative procedures. When this fails, important loopholes and vulnerabilities are created. What is needed is a coordinated development of system specifications and use procedures for each individual voting system. In some cases the best way to address an issue is in use procedures. In other cases, the best way is to address the issue in equipment specifications. For security, accuracy and other critical issues, the best approach will have redundancy, fault tolerance and defense in depth. Some issue should be covered in both system specifications and use procedures.

- Voting system specifications to this point are developed in isolation from the evaluation methods that will determine system compliance. As any test engineer knows, a tremendous variance can be created in different test methods to the specifications. In many ways, writing specifications without test methods is like writing a book without a dictionary; the result is vague and subject to wide misunderstanding. To have effective specifications, the reverse should be done; first, write test methods, and then decide what specifications will result in the desired outcome.

- Testing in quality has a long and ignoble history. It is widely understood that quality is best designed in, not tested in. However, in the arena of elections, the trend continues to be to test in quality. Perhaps it is an example of the old adage, "When you have a hammer every problem looks like a nail." Writing new specifications has become a knee-jerk response in an effort to bring about improvements. Little consideration is given to the question, "Are new specifications the best, or even a good tool, to bring further improvement?"

- Another negative trend is the continuing escalation of time and cost of certification. National and state efforts operate with little coordination. Certification costs at the national level have gone up an order of magnitude since 2000. Those costs seem destined to go up another factor of two to four. It may soon cost $2-6M to get national certification. The additional cost of state certification has not been estimated, but is considerable. Further, not all states cooperate in the national certification program, preferring to run their own programs. The question needs to be asked, "Is this the best way to spend this money?" □

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