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I am Director of Elections for Guilford County, NC (Greensboro, High Point) with roughly 310,000 registered voters. I have been in this position since February, 1988. Throughout my tenure, Guilford County has used direct electronic voting systems. We currently use the ES&S iVotronic with a state mandated paper trail. 2006 was the first year the paper trail has been required. In my former life, I was a Legislative Assistant to Senator John Culver (IA.) from 1976-1980 and Senator Chris Dodd (CT) from 1981-1982. In recent years I have served on the Election Center's Task Force on Election Law and have participated regularly in National Academy of Science and American Association for the Advancement of Science workshops on electronic voting and Federal Election Assistance Commission working groups on election management guidelines.

As an election official with 19 years of electronic voting experience, I am a strong advocate of "independent" backup and audit mechanisms for DRE voting equipment. I am extremely concerned that the "rediscovery" of paper ballots is going to remind us of all the reasons New York and other large jurisdictions began, in the 1890's, employing mechanical vote recording and tabulation systems. I am absolutely convinced that a paper based backup and audit requirement will, probably sooner rather than later, produce a recurrence of the 2000 fiasco in Florida where, as you will recall, several major jurisdictions were unable to complete a timely manual recount of their (paper) ballots. I am equally convinced that far more reliable alternative technologies, be they electronic, audio or video, can be made brought to commercial viability promptly if the Congress does not statutorily exclude these options. It is my hope that the Congress will not only keep the door open to much needed progress in voting system development but would actively promote such development.

When I sat in those seats behind you during the late 1970's and early 1980's, I often heard your predecessors recite the mantra, "We don't think it is wise to legislate the technology used to achieve these goals." Being young and sure that I knew the best way to do things, I did not fully understand their concerns at the time. Today I no longer know the "best" way to do anything. I do know that, in elections you had better give yourself plenty of time to prepare, train for and test any new system or procedure.....especially going into a presidential election.

Simply put, presidential elections push the election administration process to near its limits. In Guilford County, North Carolina, I have a staff of 12 full time and 2 additional ¾ time employees. Next year we will, once again, recruit, train, supply and support more than 2,000 precinct officials working at 180 locations.

My core staff will average 60 hour weeks for the 4-6 weeks leading up to the November, 2008, election. Some will significantly exceed that. Those 2,000+ precinct officials, whose average age is near 70, will work an average of about 16 hours on Tuesday, November 4th. Together we will issue ballots and record the votes of well in excess of 200,000 county citizens.

As you might imagine, we will have more than a few opportunities to make errors. My admonition to my staff and precinct officials for the past 19 years has been, “Try not to make an irrevocable error.” It is with this admonition in mind that every election administrator chooses and develops the technology and procedures for conducting your elections.

Among the chief historical weaknesses in many direct electronic voting systems has been the lack of a secure, independent ballot record for each voter’s vote.

Among the chief weaknesses of paper voting systems, whether punch card or optical scan, is the frequency of casting ambiguous votes.

North Carolina’s experience in 2006 graphically illustrates both these points.

Attachment 1, VPAT Printer problems in North Carolina, shows the rate of VPAT (“verifiable paper audit trail”) printer failures we experienced across the state during the 2006 general election. Of the more than 5,000 DRE voting machines used in the state for that election, more than 550 experienced problems. The impact of this fact alone on the verification of the tabulation from the paper record is clear.....it cannot be done to the level of accuracy needed in elections.

I believe it is important to note that, the primary impact of the VPAT system mandated by the NC General Assembly for 2006, was the introduction of another point-of-failure into the voting process.

One final note on printer performance. This was not Guilford County’s first experience with backup printers on DRE voting machines. The voting system we used from 1990 through 1999 also had a backup printer. It was not visible to the voters and it was not a thermal printer. Its failure rate was closer to 20%. Fortunately, most printer failures did not stop the voting machine and went unnoticed until tapes were retrieved after an election.

The impact of such printer failures is demonstrated in Attachment 2 – “Guilford County, NC, November 7, 2004, General Election, Manual Audit Results.” Of the 9

machines included in our state mandated audit¹ four experienced printer problems. Fifteen votes were not recorded on the paper tapes. This constituted 2% of the total votes cast in the two precincts that were audited. In one case, the printer jams resulted in our not being able to detect that two voter's ballots had been canceled after being printed but prior to being cast. As a consequence, our manual count indicated two more votes than were electronically recorded on the machine. We learned of the two vote cancellations when we contacted the precinct officials.

This experience demonstrates both the danger of declaring, as the "Official Count," the manual count of the paper record and the requirement of outside auditors. VPAT printer records will be destroyed due to printer failures. North Carolina law recognizes this by stating that the paper record "shall control, except where paper ballots or records have been lost or destroyed or where there is another reasonable basis to conclude that the hand-to-eye count is not the true count."

Outside auditors, unfamiliar with the election's process, will not always know what questions to ask or to whom those questions should be addressed. I would also note that every election administration unit I know of has bipartisan oversight built into its management structure. Enron had professional auditors. I think we do better.

The problems created by reliance on manual tabulations of paper are not confined to DRE VPAT systems. Optical scan voting systems have their own set of issues. As noted above, ambiguous or mismarked ballots are chief among the weaknesses of optical scan systems. Attachment 3, "Error Rate Comparison of Manual Audit by Voting System", and Attachment 4, "Ballot Errors Reflected in Manual Audit," provide an unambiguous example of this. While manual counting of both VPAT records and optical scan ballots experience unresolved tabulation errors, by far the largest source of discrepancy between the automated tabulations and the manual resulted from detection or interpretation of voter intent during the manual audit of the optical scan ballots. Fully 90% of the scanned vs. manual count discrepancy was attributed to ballot marking errors by voters. While this may indicate a need for manual review of optical scan ballots prior to a recount, it demonstrates that a manual "audit" of such ballots will seldom yield the same result as the automated scan. In reality, the manual process exists as an alternative to the scanning process, not as a means of auditing the integrity of the tabulation software.

I am sure you are all aware of the stories of the lost electronic votes in Carteret County, North Carolina, in the 2004 election. You also need to be aware of the ballot box , in the same election and state, of 200+ optical scan ballots that, when

¹ State Statute mandates a "statistically significant" number of precincts to be included in the audit. The audit design was developed by Dr. William Kalsbeek of the University of North Carolina, Chapel Hill. His audit evaluation report of the spring, 2006, primary is included as Attachment 7.

accidentally left in the polling place (a fire station) overnight, was irretrievable sent to the county dump the next day.

Perhaps the greatest weakness of reliance on manual paper tabulation is it consumption of the resource of which we are generally in shortest supply – Time! Attachment 5, “NC—2006 Sample Audit Time” reflects a tremendous disparity between the fastest and slowest audit rates in terms of seconds per ballot. The extremes are likely accounted for by reporting or interpretation errors, never-the-less, at even the average rates manual tabulation is a slow process.

Guilford County was near the average manual tabulation rate for DRE with VPAT systems. Had we been required to perform a manual recount of all 101,271 ballots cast in the November, 2006, general election, it would, at that rate, have taken us 723 hours....that is 90 days! With two counties teams perhaps we could cut that to 45 days....with three, 30 days....with 10, perhaps 9 days. Of course, the 201,000 votes cast in the 2004 presidential election would double all these time/counting team projections.

I don't know how many competent simultaneous counting teams could be managed effectively, maintaining quality control. Generally such teams are made up of experienced election personnel....the same personnel I alluded to earlier who had just completed four to six consecutive 60 hour weeks and the precinct officials who have see all the ballots they care to see for another four years.....or forever.

This human factor in manual tabulation is clearly depicted by the recent report on the Cobb County, Georgia, “Pilot Project on Voter Verifiable Paper Audit Trail.” (See Attachment 6). Perhaps the best example, however, derives from a case with which we are all familiar....Florida, 2000. Keep in mind, not every Florida county failed to complete its manual recount. But apparently not every county has to come up short. As we see in Attachment 6, there is great diversity in election administration circumstances and capabilities. Setting a deadline does not always get everybody there on time.

In comparison, when I recounted the 200,000+ electronic audit records (individual electronic ballot records) from our 2004 election it took 14 seconds to retabulate the entire ballot once the audit records had been imported into the computer.

Some of the problems revealed by the 2006 North Carolina and Georgia experiences were the result of inexperience. Some were the result of new products being rushed to market due to stringent statutory timetables (both state and federal). Some can be ameliorated. Some cannot. Yet, as election administrators, we are charged with the effective conduct of every election....and election day is not negotiable.

Election officials will do everything possible to conduct effective, fair and accurate elections. However, as the law imposes shorter timetables and more failure prone technology, more jurisdictions will fail.

You may have noted that I began my testimony with an endorsement of independent backup and audit mechanisms for electronic voting and tabulation systems. I then proceeded to detail the inevitable failure of paper as a viable means of meeting this goal.

I would like to close my statement with a brief discussion of alternatives. If you give us no alternatives, we will eventually suffer the consequences inherent in reliance on paper records and manual tabulation. This is where HR 811, as the election community sees it, would leave us. Even if you amend some of the provisions others have pointed out as most objectionable, and retain a 2008 effective date, there will be failures which could well be widespread.

My experience is primarily in DRE voting and I will not presume to propose solutions for perceived optical scan system problems. Keeping in mind that the same software generally tabulates the votes for both types of systems, similar, voter verifiable electronic backup and monitoring systems could likely be developed for both.

The December 1, 2006, NIST report to the Technical Guidelines Development Committee (TGDC) established by HAVA stated:

“The approach to software-independence used in op scan is based on voter-verified paper records, but some all-electronic paperless approaches have been proposed. It is a research topic currently as to whether software independence may be able to be accomplished via systems that would produce an all-electronic voter-verified, independent audit trail (known as *software IV* systems). In cryptographic E2E voting systems, there may be no audit trail in the sense of what exists with op scan or DRE-VVPAT, but the correctness of the election results can still be proven via the cryptographic protocol that the system is based upon. E2E systems are an active research topic and one E2E approach has been marketed²”

Further:

“The STS believes that current paper-based approaches can be improved to be significantly more usable to voters and election officials, and that other kinds of all electronic IV (software IV) and E2E cryptographic systems may possibly achieve the goal of secure paperless elections.”

Among the TDGC recommendations arising out of this were:

- Requiring software-independence in future voting systems – this means that future voting systems must use verifiable voting records for independent audits, and
- Creating a process to include new and innovative voting systems with greater usability, accessibility, and security.

² See <http://www.votehere.com>.

HR 811, as currently written, appears to preclude the use of voter verifiable electronic audit mechanisms. As NIST and the TGDC note, voter verifiable elections audit systems need significant improvement. This will only happen through research and development.

North Carolina is currently working toward a test, in the fall of 2007, of the most advanced voter verifiable independent electronic audit system currently available using open source software. Such tests should be encouraged to insure continued progress in the development of improved verifiable voting technology.

Some of the advantages of electronic audit systems include

- Equally accessible to all voters regardless of disability
- Can provide accurate and efficient recounts, in addition to audits, in the event a voting system tabulation error is discovered
- Can be integrated into the voting process so that voters do not have to perform double ballot verifications
- Can offer open source code without impinging on the security or proprietary nature of the voting system software
- Minimizes impact of human error in audit or recount processes
- Enables audits and recounts to be completed in a timely manner

Realistically, the requirements of HR 811 cannot be implemented in 2008 without further destabilizing the conduct of our elections.

Manual tabulation of paper is a technology that became obsolete in the larger jurisdictions in the 19th Century. Nothing has changed during the past 100+ years to revive it to a more reliable status than it had then.

Machines and systems upon which our lives depend are ubiquitously backed up and monitored electronically. Their reliability is not based on computer scientists' assurances that these systems are perfect...that they are defect free. These systems are extensively tested for reliability and carefully monitored by other systems to detect any threat to their proper performance.

Such electronic backup and monitoring systems can be ready for widespread implementation by 2010 if the Congress supports rather than forecloses their development. That is the same timetable that is realistic for the currently proposed paper mandate. I strongly urge you to, not only keep this door open but to open it wide with your active support. Without your support for continued innovation in elections technology, we will suffer major setbacks in our efforts to open the election process to all persons on an equal footing and we will have failed a century of progress.