

Electronic Ballot Counting Device Advisory Committee
Meeting Minutes of January 26, 2009 at 10:00 a.m.
71 South Fruit Street, Concord, NH, HAVA Conference Room

Members' Attendance:

Thomas Manning, Assistant Secretary of State & Temporary Chair
Stephen Edwards, Public Member
Wally Fries, Moderator, Danville
Adrienne Hutchison, Public Member
Representative Robert Perry
Anthony Stevens, Assistant Secretary of State

Guest Speaker:

Ronald Rivest, Andrew and Erna Viterbi Professor of Electrical Engineering and Computer Science in the Massachusetts Institute of Technology's Department of Electrical Engineering and Computer Science; Security Subcommittee Chair, Technical Guidelines Development Committee of the United States Election Assistance Commission

Secretary of State & Staff:

Secretary of State William Gardner -12:45pm
David Scanlan, Deputy Secretary of State
Daniel Cloutier, Assistant Secretary of State

Also Present:

James Kennedy, Assistant Attorney General
Representative Tim Horrigan

I. Call to Order

Mr. Manning called the meeting to order at 10:12 a.m.

II. Meeting Business

Mr. Manning recorded attendance.

Mr. Manning requested email addresses of all attendees to ensure electronic documents are delivered to committee members and ensured that email addresses will be secured. There were no concerns using email for communication to members.

Mr. Manning provided copies of the December 15, 2008 Electronic Ballot Counting Device Advisory Committee meeting minutes. He requested the members review the minutes and address revisions at the next meeting, in the interest of time.

Mr. Manning called for a brief recess at 11:31 a.m. Mr. Manning called the meeting back to order at 11:44 a.m.

Mr. Manning called a recess for lunch at 12:30 p.m. Mr. Edwards left the meeting at 12:35 p.m. Secretary of State Gardner arrived at 12:45 p.m. Mr. Manning called the meeting back to order at 1:05 p.m.

Mr. Manning adjourned the meeting at 3:00 PM.

Topics covered include Introduction, Auditing/Parallel Counts, Vetting Voting Systems and Redundancy, Updating the Current Accuvote Optical Scanning System, New System

Development, Open & Disclosed Source Code, Vote-by-mail/On-line voting, and Hand Counting. These subjects are covered by topic:

- **Introduction**

Mr. Stevens provided biographical information on Mr. Ronald L. Rivest.

Dr. Rivest presented a brief history on his background in the technology field. He thanked the committee members for the invitation and noted he is here on his own account and not representing any public or private entity. He is working on advanced technology to provide voters with a new means to verify their vote was counted while maintaining the privacy of the voter. As Chair of the Security Subcommittee of the Technical Guidelines Development Committee, he has been a chief proponent of the principle of “software independence” in the latest draft of the Voluntary Voting Systems Guidelines. He stated that audit accountability is essential for machines to ensure confidence in results.

- **Auditing/Parallel Counts**

Mr. Fries observed that, in order to check the machine count, he, in his role of moderator, has been doing a hand count of one or two selected races on each election night, with races based on what his election officials agree upon. Mr. Fries asked about another source of verification besides the paper ballots. Dr. Rivest noted that mathematical equations could be formulated for auditing samples of paper ballots for accuracy rating. Dr. Rivest explained that he has been working on formulas designed to estimate accuracy and aimed at cost savings, given that precinct sizes are different. Dr. Rivest noted that machines save time but cannot be the only layer of trust. He noted that statistical sampling provides that second layer.

Mr. Fries observed that, if auditing or recounts of paper ballots are conducted, the chain of custody of the ballots themselves becomes an important component of the auditing process. Dr. Rivest acknowledged this point.

Representative Perry noted testimony by Mr. Scanlan last week and wondered whether a state representative race is so important to anyone that they would risk going to jail by tampering with a voting machine. Dr. Rivest said that a mathematical equation for these types of races can be established to audit and ensure accuracy.

Mr. Edwards suggested that all races should be considered the same for potential fraud, particularly local races. Representative Perry noted a state representative is one of 400 and a state senator is one of 24. Dr. Rivest did not claim to know how to judge which races require more scrutiny based on the implication above but suggested all races get audited based on some random sampling. At the legislature’s discretion, it might call for audits at some fraction of the rate for other races.

Attorney James Kennedy, of the New Hampshire Department of Justice, questioned if a random recount should be done for each machine at each location. Dr. Rivest noted that, for the purpose of auditing, segregating and separately auditing the machine batches within a town or jurisdiction is more efficient and is a good use of resources.

Dr. Rivest's rough cut statistical sampling approach is as follows: N (quantity of recounted batches) = $1/\text{margin of victory}$. If there is a 10% margin between candidates, the race could be checked by hand counting $1/0.1$, or 10 batches. If there were a 1% margin, that would entail hand counting 100 batches. This would achieve something like a 92% level of confidence, he said. The advantage of a simple formula such as this is that it (or some fraction thereof) could be inserted into law, and many people could potentially understand its effect and communicate it to others.

Dr. Rivest said that if the state were to cut the above batch number in half, it might achieve something close to a 50 % level of confidence. This quantity still could serve as an effective audit, as most potential wrongdoers would not risk fixing an election if there were a 50% chance of detection. According to a paper entitled "On Auditing Elections When Precincts Have Different Sizes," by Javed Aslam, Raluca Popa, and Ronald Rivest, states can maintain the same level of confidence and further increase auditing efficiency by focusing on the larger polling places which may be more subject to tampering.

Mr. Stevens asked if Dr. Rivest could assist with applying New Hampshire data to mathematical equations that appear in some of his recent analyses. Dr. Rivest agreed to help if he could. (Since then, Dr. Rivest has assigned a student and co-author, Raluca Ada Popa, to the project, and NH data has been provided.)

Dr. Rivest noted that if you can identify a small batch of, say, 300 ballots and count it by hand, that small batch can constitute one of the specified number of batches and be useful in verifying the machine count. Small batches can keep the cost lower, but they must reflect a quantity that is separately counted and reported by the machine, with each batch corresponding to a separate container of ballots and a separate machine tape.

Since the Premier Accuvote machines cannot readily be closed out with a tape and then started up again on election day, it would be challenging to break the election day work of a single voting machine into two or more batches. The time gap required to close the election and print a report, then open a new "election" might be a red flag to voters, who expect their ballot to be treated exactly as those that were cast before and after them. (Currently, there are machine interludes in large polling places when the ballots are taken from the machine and stored in containers to provide enough room to continue operating the machine.) To reduce batch sizes, back-up machines can be brought into service on election day, thereby reducing the batch size and increasing the available quantity of batches.

Representative Perry brought up a particular statistical analysis based on random sampling of ballots. Dr. Rivest suggested that the committee should review what Alex Haldeman (associated with Professor Edward Felton) at Princeton is doing regarding auditing at the individual ballot level. Each ballot would have to be marked with a random number (perhaps in color so the ballots can be found quickly) at the conclusion of machine processing. This number is used to establish which ballots would be subject to a random check. This approach might effectively reduce the number of ballots that must be hand counted in an audit to achieve a target level of confidence.

Representative Perry noted that a random audit bill (HB 186) failed to pass in 2008. He feels that based on the discussion today all machines need random hand counting to ensure accuracy. Dr. Rivest agreed that a random audit does assist in verification and trust in the machines.

Mr. Cloutier asked a question about the audit process. Dr. Rivest stated that the number of batch samples to be audited should vary based on the margin of victory. He said his proposed mathematical equation could lead to a statement of machine accuracy. Dr. Rivest stated that teams and small random samples equal the necessary efficiencies to produce the results in the required amount of time. Mr. Stevens observed that Vermont and Connecticut are conducting audits using hand counts following elections. Dr. Rivest noted that Minnesota uses this process as well. Dr. Rivest suggested a study to determine the mathematical and administrative processes.

There was discussion of previous recounts in New Hampshire. The current process of election night auditing was discussed versus post-election audits and recounts. Recount filings must be made by the first Friday following a Tuesday election, which provides little time for auditing and candidates' decisions to proceed with recounts.

- **Vetting Voting Systems/Redundant Software**

Mr. Stevens explained a concept that would involve the state in creating a second redundant software system for the Premier Accuvote optical scanner that might be designed to check ballot configuration and counting accuracy, based on a reading of data on the memory card's ballot layout.

Dr. Rivest agreed that such software redundancy is a way to help verify the results but it only addresses a narrow set of risks. He explained that a larger scale review should include both memory card analysis and auditing paper ballots to follow the process from start to finish.

Mr. Cloutier explained that a data layout from the memory card would assist in the verification of where the bubble locations are on the memory card so that they may be compared with the paper ballot. Dr. Rivest noted this process could assist in finding ballot configuration and programming errors.

Mr. Stevens asked if this development should be done by others. Dr. Rivest noted that the State of Connecticut has already done some of the groundwork on this and may have access to memory card information and ballot layouts and suggested following up with the officials at the Connecticut Department of State and Premier (Diebold). Relying on UConn might save time and resources, he said. (The Department of State has since spoken with Lesley Mara, Deputy Secretary of State of Connecticut and Alex Svartsman, Associate Head, Department of Computer Science & Engineering, and Principal Investigator, VoTeR Center, at the University of Connecticut.)

Dr. Rivest noted that, to achieve the highest level of accountability, (a) check the voting machine software, and (b) audit samples of paper ballots. Dr. Rivest suggested that, of the two methods, auditing a sample of paper ballots provides a higher level of accountability, verification, and confidence in the results. Hand counting paper ballots in an audit or recount does not involve as tenuous and fragile a reasoning process as reviewing the software would.

Mr. Fries observed that there are ways for someone with malicious intent to alter a machine count. Dr. Rivest noted that the possibilities exist if a person wanted to change the machine count. He said people have a right to be skeptical. Voting systems in current service were not developed with

the highest levels of security, he said. Dr. Rivest suggested that security prevention, protection, and detection are essential as the multiple layers of a security plan. Dr. Rivest explained, using technologies under development, that current machines can be tested to include voter confirmation codes, enabling voters to privately check how their vote was recorded.

Dr. Rivest stated that it is hard to fully vet a voting system, and it is easy to hide malicious software. When teams from Avi Rubin's computer security class at Johns Hopkins University competed against each other to create and find malicious election system software, no team ever found the other's malicious software. Some couldn't even find the bugs they themselves had created in their own vote counting code.

Mr. Stevens questioned the interactions between the scanning technology and the software for the machines. Dr. Rivest noted that the interaction has its complexities but is not as complex as other computer operations. Dr. Rivest explained that some countries send out proposals with specifications and have vendors make equipment to accommodate the requirements, whereas in the United States, the vendors write the specifications.

- **Updating the current Accuvote optical scanning system**

Representative Perry asked if Dr. Rivest knew of any vulnerabilities of the Diebold (Premier) Accuvote optical scanning system. Dr. Rivest said he does not track or follow this subject closely; instead, he focuses on future technologies.

Representative Perry noted that the secondary charge of the committee is to consider updating the current system. He expressed some concern with the older proprietary systems. Dr. Rivest said that this should be the subject of a business discussion with the vendor. States should share information and work together, he said. Dr. Rivest suggested writing into future contracts items such as disclosure of software versions and independent testing.

Representative Perry expressed concern with the cost of the present system versus the next generation system. Dr. Rivest noted that the industry is changing from product-driven to service-driven.

Representative Perry suggested the group survey the region to see what states are conducting random audits. Mr. Stevens noted that this can be readily accomplished. (By law, Connecticut must carry out a 10% random audit after each general election. By administrative practice, Vermont must carry out a 1% random audit, and a 1% targeted audit after each general election.)

Representative Perry questioned Dr. Rivest regarding mandatory pre-election audits. Dr. Rivest supports mandatory random pre-election audits.

Representative Perry asked if Dr. Rivest has been involved in the pursuit of the perfect machine. Dr. Rivest stated there is no perfect machine but has been working towards the design and security side of the process.

If one is contemplating the perfect machine, Dr. Rivest recommends consideration of the following requirements:

- (a) Feedback to the voter at time to scanning
- (b) Random number on ballot after the ballot has been accepted and processed by the machine (not if it is rejected in the event of an overvote)
- (c) Uses election markup language (EML) developed by OASIS, so that when the data passes through interfaces, it is relatively transparent

Mr. Cloutier questioned if memory card information written in ASCII format would be beneficial. Dr. Rivest agreed that this format would be widely readable and noted that OASIS, whose principal is Patrick Gannon, is now in version 4.0 of a standard election language. NIST has not yet seen fit to insert EML in the Voluntary Voting System Guidelines.

Representative Perry questioned if a new design to the memory card would need major hardware changes. Dr. Rivest noted that hardware redesign would be beneficial for additional security. Mr. Stevens explained he received information from Premier that hardware would need to be changed to enable a third party software to verify the version running on an Accuvote. Dr. Rivest suggested that there are other ways to test which version is running on a machine, and noted this could be added to future proposal requirements.

Secretary of State Gardner questioned if optical scanning devices currently being used actually cost \$6,000 to \$7,000. Dr. Rivest said that it does not cost that much but noted that there are company costs and other potential services, including marketing, training, warranty, and perhaps some maintenance services, wrapped into it. Dr. Rivest suggested that if one unbundled all the related services, one might find these prices reflected actual costs.

- **New system development**

Mr. Fries stated that he expected that voting machine vendors would respond to a list of voting system requirements if they knew what they were. Dr. Rivest suggested that vendors could benefit from receiving requirements as direction.

Mr. Fries recommended that the committee develop high level specifications for new machines. Dr. Rivest suggested looking at off-the-shelf equipment (such as scanners), open or disclosed source software, an open source operating system such as Linux, and security review before final rollout. Dr. Rivest suggested enabling the voter to track and check how their vote was recorded, perhaps using a privacy kiosk, so that votes could not be observed by others and thereby sold by voters with others watching them. (He has worked on developing this type of system.) Even then, it should be randomly audited after elections.

Mr. Fries asked what had been done to establish requirements for future systems. Dr. Rivest noted a set of general requirements have been established by the EAC Technical Guidelines Development Committee (which he serves on) and the National Institute of Standards and Technology (NIST). Procedures vary a great deal with different system designs, however. Dr. Rivest noted that states are establishing requirements and these should be shared among the states.

Dr. Rivest noted that the voting industry serves a fragmented market, with many, many product variations designed to satisfy particular laws and practices, requirements that may be known only

to the major industry players that serve those states, counties, towns and cities. The industry is not strong on research and development. Voting equipment changes take a long time to implement, in part because of laws and certification cycles. Most of the industry value and costs are associated with services, such as equipment maintenance and ballot configuration for individual elections.

Mr. Scanlan relayed a question from Representative Drisko as to whether there is a next generation machine out there and how much it would cost. Dr. Rivest said the goals of HB 285, “fail-safe and provably correct and can be supported by an independent technical review to eliminate potential manipulation of election results by tampering,” are not achievable in one fix. There can be gradual improvement in a number of areas. For now, he said, an audit process is the best way to ensure accuracy.

Dr. Rivest said it would take a team of 6 persons over 2 years to develop software and hardware for a new voting system. One would first have to devote a lot of resources to writing the specs, conduct design and usability reviews, etc. Dr. Rivest said he would not be able to give a cost estimate. He said that there was continuing downward pressure on equipment prices, which would help.

Dr. Rivest said that, even when one has a system that passes muster and achieves certification, it must be compiled with very strict protocols, so that the software is provably what is in the National Institute of Standards and Technology’s (NIST’s) National Software Reference Library, and not swapped out. This is a fairly difficult task, he says.

Mr. Scanlan asked about the certification process of new hardware. Dr. Rivest noted there are federal and state certification requirements. There was discussion of the laboratory certification costs. There was discussion of the complexities about requirements and laws.

- **Open & Disclosed Source Code**

Representative Perry asked about open source. Dr. Rivest distinguished between open source code and disclosed source code. Open source code (which has its own software language types) is designed to be vetted and possibly improved by software writers among the general public. Disclosed source code may be written in any software language and is open to review by the general public, but is not designed for such vetting.

Representative Perry asked if open source code would provide more accountability and trust in a voting system. Dr. Rivest said there is an understandable tension between the desire for open source and the need to have something to sell, a way to earn income as the developer. Relying on open source code is a mechanism that could potentially gain public trust, but there should be a source of income for the developer to create and maintain it.

Mr. Scanlan questioned if open source code would increase the likelihood of viruses and malicious tampering of memory cards. Dr. Rivest said open source code may or may not increase the likelihood of a security breach; there are positive and negative aspects from a security perspective. When an open source voting system is introduced, the initial effect might be a decrease in security. Over time, there would be an increase in security, since the public review process would help eliminate existing vulnerabilities.

Dr. Rivest suggested using Joseph Lorenzo Hall, a Berkeley graduate student, as a resource on the advantages and disadvantages of using open source code.

Representative Perry asked about a new proposed open source voting machine that debuted in a show in San Francisco. Dr. Rivest said he did know about this particular machine. Ms. Hutchinson noted that, based on what she has read, the voter is provided a receipt. Dr. Rivest said that although it might slow down the process, such verification from the voter would be helpful.

Mr. Cloutier asked about source code access and what is, on balance, the best approach. Dr. Rivest noted that, overall, open or disclosed source code is better for public confidence. Dr. Rivest suggested that disclosure would potentially gain public support. Dr. Rivest stated that chain of custody and security is needed as part of the process.

Dr. Rivest recommended checking out what Open Source Digital Voting Foundation (OSDV) is doing. (They are a non-profit organization supported by one of the Lotus founders that is developing an open source system, and engaging the states in the planning process from the outset.)

Mr. Cloutier questioned the use of the Python language. Dr. Rivest recommended the Python language for open source development. Dr. Rivest noted that the language would be subject to EAC certification.

- **Hand counting**

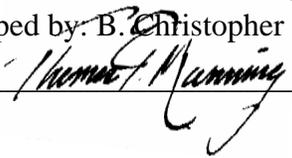
Representative Perry questioned where hand counting as the primary process fits into the process, describing this as “doing it right the first time”. Dr. Rivest said he has no particular concern with hand counting; however, there can be significant costs associated with hand counting. He noted that relying on hand counting to audit machine software stands as the main method used to establish and confirm voting machine software accuracy.

- **Vote by mail/On-line voting**

Dr. Rivest does not think it is a good idea to vote online or by mail. He noted concern with security using these methods.

Mr. Manning announced that the next meeting will be March 16. (**The meeting date was subsequently later revised to March 9.**) The agenda is to establish goals and objectives.

Minutes taken and typed by: B. Christopher Maxwell

Received by: _____  Thomas Manning, Interim Committee Chair