IEEE P.1622 Use Case

Use case name: Post-election tabulation auditing

Use case number and version: p1622-audit-02

Goal: Facilitate data interchanges needed for local and state-wide auditing

Summary: Risk-limiting post-election vote tabulation audits are one of the best ways to achieve confidence in election results by hand-counting a sample of physical vote records and comparing their contents to electronic records or results. But the data interchange and processing steps involved in aggregating detailed tabulation data from different proprietary systems are challenging, and the schedules for post-election audits are tight. Vote tabulation data for each precinct or other audit unit needs to be quickly gathered and aggregated from counties using different election management systems. Audit units need to be selected and hand counted, and results need to be compared and analyzed, potentially leading to more hand counts if there are significant discrepancies.

Actors: Voter-facing Devices, Election Management Systems and Audit Management Systems.

Stakeholders: State and local election officials, audit coordinators, general public.

Preconditions/Assumptions: none

Background: For more information on election auditing, see

- *Principles and Best Practices for Post-Election Audits*: http://electionaudits.org/principles

- American Statistical Association statement endorsing Risk Limiting Audits and small audit units:

http://www.amstat.org/outreach/pdfs/Risk-Limiting_Endorsement.pdf

- *On the notion of "software independence" in voting systems*

- , Ronald L. Rivest, John P. Wack; Draft July 28, 2006,

- http://vote.nist.gov/SI-in-voting.pdf

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Terminology:

- Audit unit: a batch of ballots representing the smallest practical unit of vote tabulation reporting which also corresponds to an easily retrievable stack of ballots. Examples might be "ballots cast in the polling place corresponding to precinct 101", or "ballots cast by mail corresponding to precinct 102". Or if mail-in ballots are not sorted by precinct, "batch 203 of the mail-in ballots".

Main scenario and High-level election data requirements:

1. Local election officials complete the initial phase of vote counting within a few days of the election, export detailed unofficial vote tabulation results by audit unit, and send them to the audit coordinator as an "auditable tabulation report".

2. When results are in from all jurisdictions, the audit coordinator uses the audit management system (AMS) to transform, normalize, aggregate and publish the data to be audited: results for each contest from all relevant jurisdictions broken down by audit unit. The publication is available on the web in both convenient human-readable form, and in a standard data format that enables the public to analyze the results and look for anomalous audit units (they may nominate these units for targeted auditing).

3. The audit coordinator checks that the totals of the tabulated results from all of the audits units match the reported totals for each candidate. In the event of a mismatch, jurisdictions may re-upload corrected auditable tabulation reports.

4. The audit coordinator then selects the initial audit units to be audited for specific contests on the ballot, and transmits the selections to the local officials for hand counting as the "audit selections". The selections are also published publicly.

5. Local officials hand-count the specified audit units and enter the hand count data into their AMS, which transmits the hand-count data, along with explanations of any discrepancies, to the audit coordinator, as the "audit discrepancy report".

6. The audit coordinator statistically analyzes the results. If necessary the audit coordinator selects additional audit units for local counting, and transmits them to the local officials, returning to step .

7. When all the hand counting is done and the audit judged complete by the audit coordinator, the results are shared with the public as an "audit report", in both a convenient human readable form, and in a computer-readable form that facilitates further analysis. Public progress report data may also be shared as the audit progresses, using a similar format.

Schema:

Each of these schemas must be specified clearly to allow for interoperability between Election Management Systems and Audit Management Systems from different suppliers. If the specification isn't specific enough, additional costly system integration procedures would be needed.

- **Auditable tabulation report**

  For each audit unit this must include the total number of ballots, the type of ballots (absentee, in-precinct, early voting, etc) as well as semantic metadata about the audit unit (such as precinct name and identification number).

  For each contest in each audit unit this should include the number of: votes for each candidate, undervotes, overvotes, unreadable ballots and the number of ballots on which the contest appeared.

- **Audit selections**

A list of audit units selected for hand counting.   Depending on the statistical   eml approach used, a given audit may be selected multiple times ("selection with replacement") and the number of times it is selected may be reflected in subsequent analysis of discrepancies. So each audit unit should have an associated count.

- **Audit discrepancy report**

For each audit unit which was audited, this should include the data from both the original tabulation and the hand count. For each discrepancy between the two tabulations, it should include an explanation.

- **Final audit report**

This includes the data from all the Audit selections and Audit Discrepancy Reports, along with a free-form prose description of the results, possibly including statistical analysis, further actions to be taken, etc.

When we have enough experience with specific sampling and analysis approaches (e.g. Stark's Kaplan-Markov approach), we can include standard ways to report on the analysis.

Optional: Data Model

Here are some example reports from audits of real elections.

Auditable tabulation reports:

- http://bcn.boulder.co.us/~neal/elections/boulder-audit-10-11/kmreports/5/

- http://bcn.boulder.co.us/~neal/elections/boulder-audit-08-11/reports/4/

Audit reports:

- http://bcn.boulder.co.us/~neal/elections/boulder-audit-10-11/kmresults/5/

- http://bcn.boulder.co.us/~neal/elections/boulder-audit-08-11/results/

Here is an incomplete example of an auditable tabulation report using EML 510, produced by the ElectionAudits software

- http://bcn.boulder.co.us/~neal/electionaudits/eml510-example.xml

Notes: When audit units are associated with a specific set of voters (e.g. provisional voters in precinct 101) and they are very small (e.g. less than 10 ballots under New Mexico law), under some circumstances, there is a risk of revealing information about how individuals voted. When this is the

case, they should be combined with other audit units to preserve anonymity, or other techniques that preserve both auditability and anonymity should be used.

Sometimes contests or candidates are named inconsistently in different jurisdictions. The format should provide mechanisms to indicate both local names and names that are standard across an entire state or country.

Beware duplicated audit unit identifiers, e.g. precinct numbers reused in different jurisdictions.

When auditing ranked-choice contests, the list of choices for each (anonymous) ballot must be reported (essentially a batch-size of one), or, equivalently, a count of each ranking permutation that occurred must be reported. When a contest with a large number of candidates permits a large number of choices, steps may need to be taken to prevent vote selling via "pattern voting" before the data is published.

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