

Presentation at National Election Integrity Conference Berkeley, CA



2019-10-06 Ray Lutz
Citizens' Oversight Projects
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Ray Lutz

- Master's degree in electronic and computer engineering
- Significant industry and standards experience in document processing equipment, including printer, scanners, facsimile, imaging, etc.
 - Involved in national and international standards development
 - Experience with test-strategy development for VLSI (very large scale integrated) circuits
 - Managed a quality assurance department in a manufacturing setting
- Involved in providing oversight to audits throughout CA, FL, MI, and other states.
- **Recently investigated RLAs incl. Monte Carlo simulations**
- Founder and Executive Director of **Citizens' Oversight**, a 501(c)3 nonpartisan nonprofit charity organization.

Topics of this Presentation

- Brief update of oversight activities
- Explain the limitations of statistically sampled paper audits ("RLAs")
- Provide the best vision for the future:
 - Ballot Image Audits as the primary tool
 - Sampled paper ballots to validate images
- Announcement of AuditEngine.org
 - cloud-based ballot image audit tool that can be used by election officials and oversight groups.

Common Ground

Robust audits are essential in
protecting our elections

But audits done improperly are just
theater and can cover up election
manipulation

Update of Recent Activities

- Organized audit oversight teams in CA and other areas that have audits such as FL (you can help!)
- Discovered that San Diego was leaving out about 37% of the ballots from the audit.
 - Asked them to include them.
 - They decided they would rather fight it in court.
 - We won the lawsuit, but on appeal, CACEO pushed through AB-840 to allow omission of later VBM ballots.
- Also attempted to access 2016 ballots using a contest and Public-records request approach.
 - Both failed (ballots are sealed) but we learned a lot.

What is RISK?

- “Probability Risk Assessment” (PRA) is the primary statistical methodology used by scientists and engineers
 - PRA has been used in nuclear reactors and NASA spacecraft designs esp. since the 1980s
 - Predates elections RLAs in terms of defining “Risk”
- **Risk = (Probability of Adverse Event) x (Consequence)**
- RLA advocates provide an incomplete analysis of the risk and **ignore numerous hazards added by the RLA process itself.**
- In RLA publications (Stark, Lindemann, Rivest, etc), “risk” is **only the sampling error and not the comprehensive risk.**

The Key Election Audit Hazard

- Election officials are auditing themselves!
- Election workers tend to seek a “clean audit”
 - Workers correct problems throughout the election process every hour of every day.
 - During the audit, they may innocently correct problems in the sampled cases rather than reporting them. We call this “**innocent fix-up.**”
 - But such corrections during the audit are not allowed and defeat the audit.
- Audits should be simple or mistakes and innocent fix-up can defeat them.

ELECTION HAZARDS

There are many hazards in processing an election

Some mistakes and errors are EXPECTED in canvass process

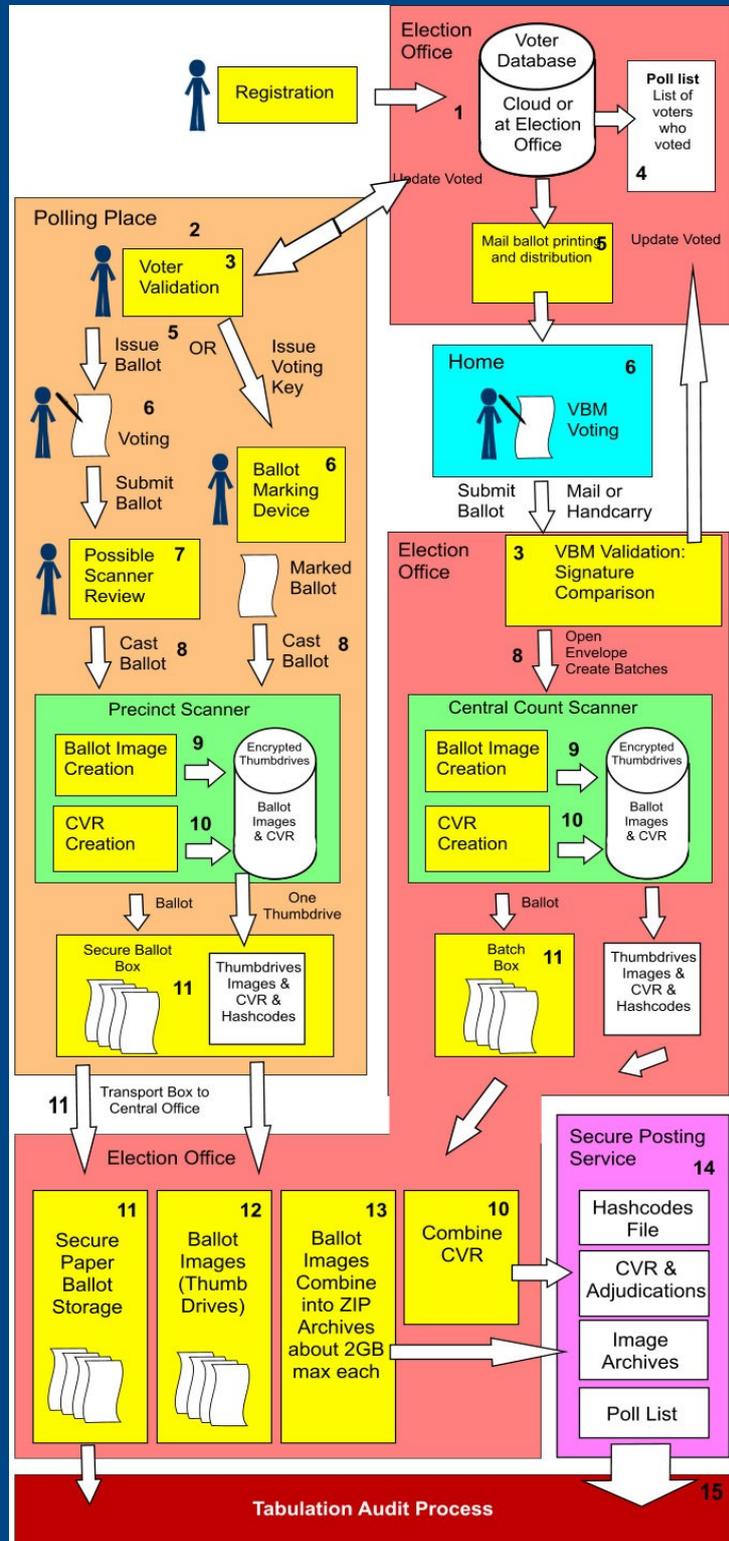
- Voter Intent Interpretation
- Processing mistakes (missing batches or batches scanned twice)

Some hazards are due to malicious attack

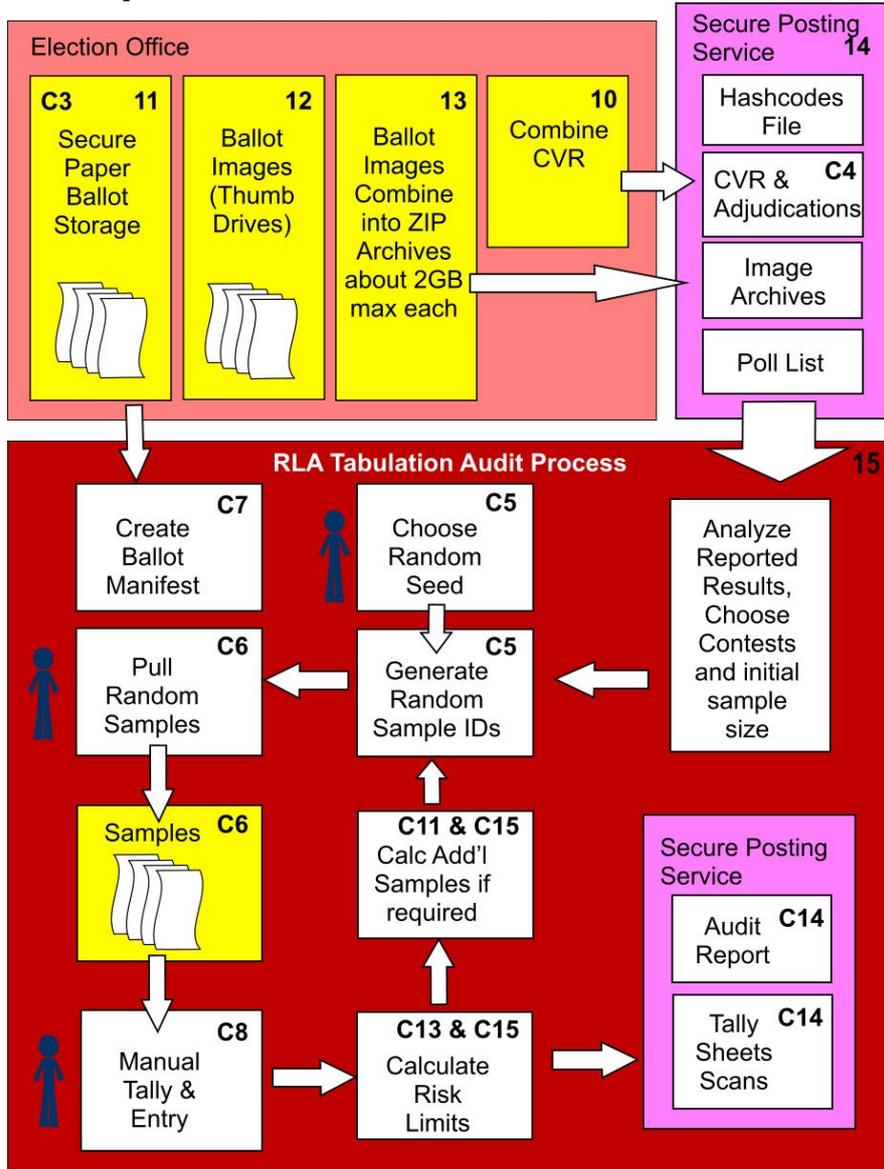
- Such attacks would likely only be launched against CONSEQUENTIAL contests.
- Auditing can catch many but never all hazards.

Election Hazards

1. Registration:
 - > Malicious purges/ changes
 - > Early deadlines
 - Mitigation: same day reg./ERIC
2. Polling Location Access
 - > Last minute changes
 - > too many voters, long lines
3. Voter Validation including Signature Comparison
 - > Difficult to obtain ID req.
 - > Signature comparison faults
4. Poll list errors
5. Issuing ballot errors
 - > Req. to request correct ballot
 - > Correct ballot availability
6. Marking errors (voter Intent) & Submission problems
 - > Use of unreadable bar codes
 - > Confusing ballot design
7. Scanner Review Misdirection
8. Security of Cast Ballot prior to scanning.
 - > Higher risk in central count
9. Ballot Image Manipulation prior to creating the CVR
 - > Higher risk in COTS scanner
 - > Limit risk by sampling paper
10. CVR Modification / Mismatch
 - > Voter Intent Misinterpretation
 - > Malicious CVR changes
11. Paper Ballot Security After scanning
12. Ballot Image on thumb drives Modification.
 - > Would require matching changes to CVR
13. Ballot Image Archive Creation and posting
 - > Would require matching changes to CVR
14. Posting Service Security
 - > Posting service security is key to their business model.
15. Hazards within the audit process that can defeat the audit, including reporting.
 - > Statistical audits that sample individual ballots have many hazards that may defeat the results.
 - > Ballot Image Audits can be redundantly checked to reduce hazard of compromised auditor.



Paper-ballot review audit hazards



Paper-ballot review audit hazards -- Can defeat the audit if:

- C1. Ballots are modified, added, or deleted prior to scanning.
- C3. Ballots are modified, added, or deleted after scanning but prior to sampling.
- C4. Cast-vote-records modified.
- C5. Random sample generated to avoid hacked samples
- C6. Drawing samples with to avoid hacked samples or in favor of desired option.
- C7. Ballot manifest manipulation to avoid hacked samples or in favor of desired option.
- C8. Manual Tally and data entry, "innocent fix-up", or DRE-like data entry w/o paper trail.
- C11. May result in a full manual count if margins are close.
- C12. May confirm a hacked election due to sampling error allowances.
- C13. May not include all contests, esp. small contests.
- C14. Incomplete or inaccurate reporting.
- C15. Calculation mistakes or hacks.

More Information: CitizensOversight.org

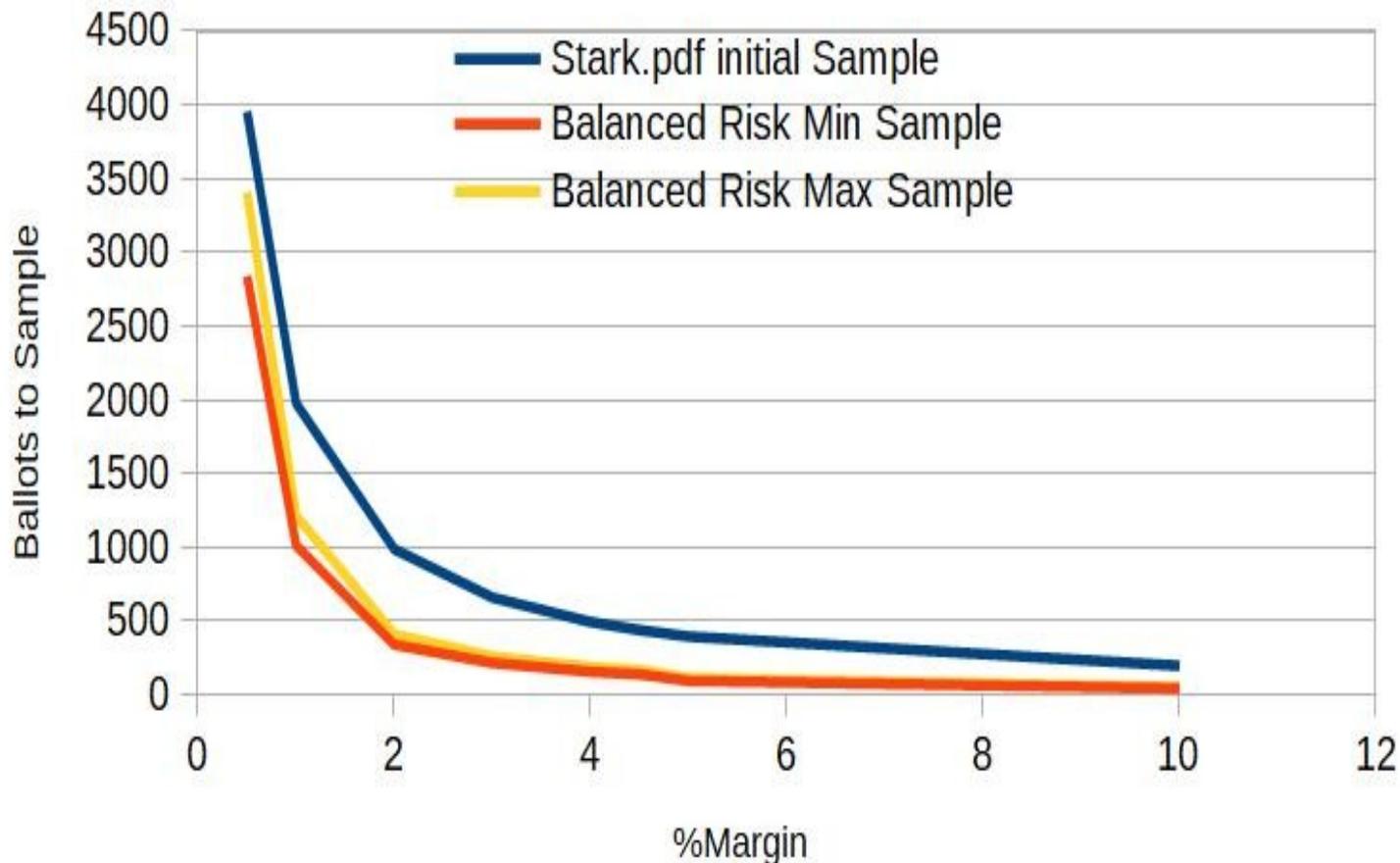
Statistical RLA Weaknesses (1)

- The process of doing the audit is complex, difficult to perform, observe, and understand.
- Stirring soup analogy does not embrace the stark realities of drawing and organizing paper.
- Pushes humans to the limit of their ability to organize paper.
- Many manual steps introduces "innocent fix-up hazard" at every turn as audits are typically SELF AUDITS.
- RLA "Risk" is actually only the error rate of sampling, and not the comprehensive risk
- Close contests quickly expand to a "full hand count" with no other option proposed.

RLA Sample sizes explode at close margins

Samples Required for Ballot Comparison RLA at 5% Risk Limit

Method starts to become infeasible at <2% margin



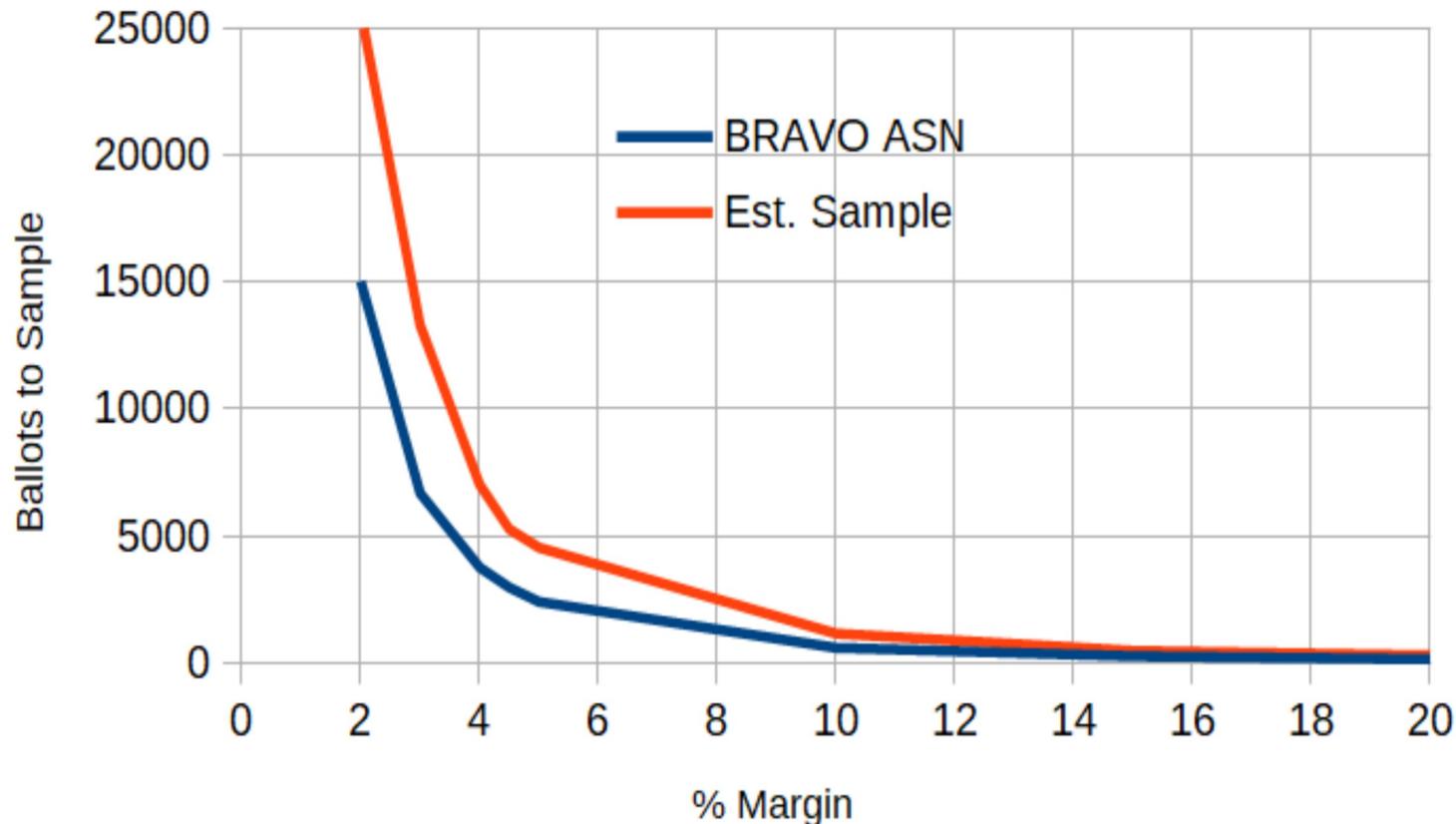
This is the most efficient of the RLA approaches but it typically **CANNOT BE USED** unless the state is an all VBM state that uses central-count scanners exclusively.

Precinct scanners do not maintain the link between paper and cast vote record and must be rescanned and numbered.

Explosion even worse for Ballot Polling method

Samples Required for Ballot Polling RLA at 5% Risk Limit

Method starts to become infeasible at <10% margin



This auditing method can be used with any equipment and does not require a CVR broken down by ballot. But the number of ballots sampled increases quickly at margins less than about 10%

Batch Comparison audit will require almost as many ballots but they are handled by batch, and are easier to implement.

Statistical RLA Weaknesses (2)

- Typical implementation does not cover all contests of consequence.
 - But contests not explicitly audited are not “magically” audited
 - Adding coverage of local contests quickly becomes unwieldy.
 - The sample size is related to the MARGIN not the contest size.
 - Small contests require the same number of ballot samples as large contests, if a risk limit is to be respected.
 - Each contest in a set of non-overlapping districts must be adequately sampled.
- RLA procedures & publications do not help election officials choose contests to be audited.
 - If any set of contests are not all audited, then they should be randomly chosen weighted by consequence:
 - Close contests
 - Seats with highest power (President ~2000x consequence of house seat)
 - **Don't waste time on advisory or unopposed contests.**

Ballot Image Audits (1)

- A ballot image is a high-resolution image of a hand-marked paper ballot.
 - “Ballot image” is no longer used to refer to the memory image of a DRE machine.
 - Most modern equipment produces these images and they should be preserved.
- A Ballot Image Audit (BIA) exhaustively recomputes the result of the election by retabulating *all* ballot images usually by third party services.
- Compatible with crowd-sourced audits.
- If ballot images are validated (compared with paper ballots), a BIA is a risk limiting audit, with lower overall risk than any other method.

Ballot Image Audits (2)

- With validation, BIAs will reduce the overall risk to a lower level than RLAs (I disagree with Dr. Stark that image validation is harder)
- Can cover all contests, even small ones, down to the ballot for most hazards.
- Does not explode into costly hand counts.
- Can detect, even without ballot image validation:
 - All voter intent issues
 - Nearly all election processing errors
 - Nearly all malicious attacks – like "Fraction Magic"
- Provides higher confidence to election officials
- Minimizes “innocent fix-up” errors.
- Compatible with third-party audit services
- Compatible with all precinct scanners which do not keep ballots in order (and some actively scramble the images and CVR).

Ballot Image Validation

- Ballot image Validation is a review of paper ballots to validate that the images are a faithful representation of the paper.
- A limited statistical RLA is sufficient.
 - A limited traditional RLA of consequential contests will also validate ballot images for those contests.
 - Ballot images need not be explicitly inspected.
 - Guards against malicious modification of ballot images prior to being secured.
 - Small local contests are not consequential enough for hackers to manipulate the images, which is computationally difficult.
 - Image validation as easy or easier than full RLA.

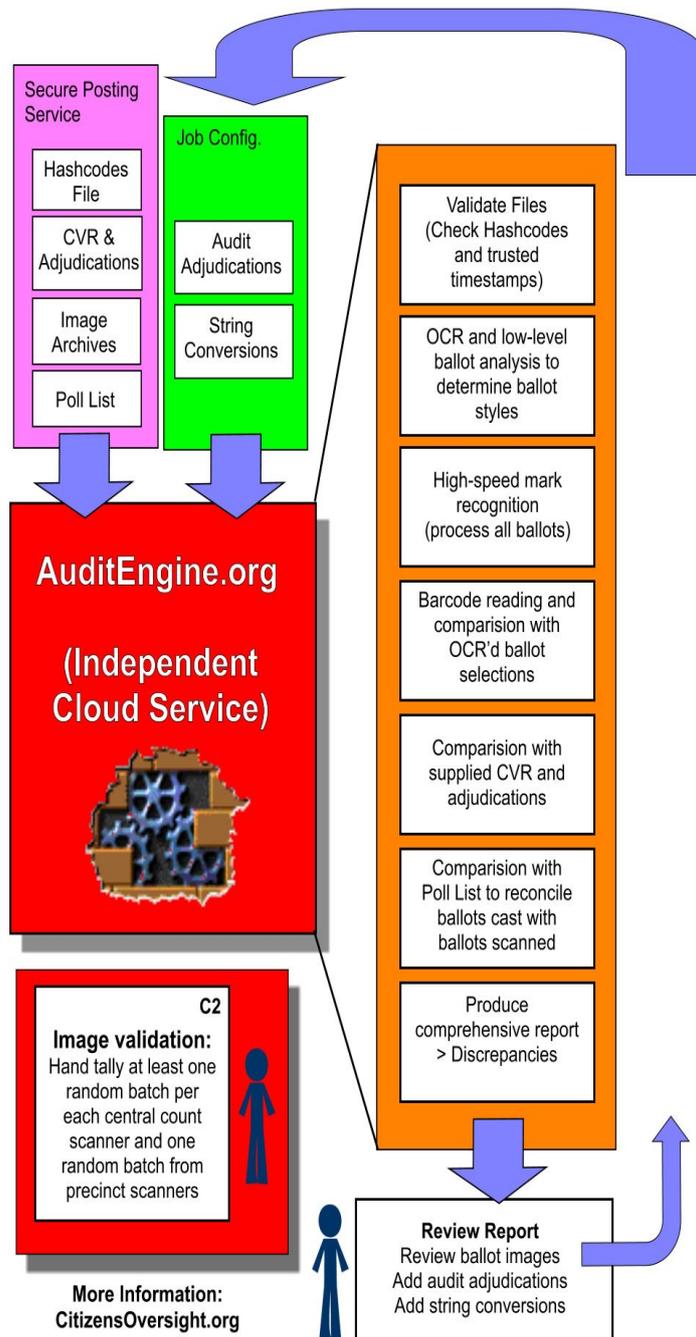
The Only Malicious BIA Attack (During the tabulation phase)

- Malicious attack of BIA secured election would require modifying ballot images prior to being secured and before the Cast Vote Record (CVR) is created.
- Ballot images are used to generate the Cast Vote Record.
- Thus, the CVR is also modified and will not match the paper ballots.
- Such an attack would likely be for consequential races
- An RLA of consequential races therefore also validates ballot images against such a malicious attack.
 - All other contests can be included in the BIA with confidence down to the ballot.
 - The sampling RLAs were not including these contests to any viable level of confidence anyway.

Recommendation for Future

- Use ballot image audits for local races.
 - Ballot image audits will resolve voter intent and processing errors of small local races.
 - Ballot images must be secured and (at least) hash codes posted on a secure server with trusted timestamps (Like Sharefile.com and other services).
 - Independent BIA services can be used for this process.
- Batch Comparison Audit of the most consequential contests
 - Cover any contest with spending over \$1 million per candidate.
 - No need to re-scan ballots
 - Logistics to pull samples simpler, easier to oversee
 - Traditional canvass report will suffice, but must be broken down by precinct.
 - This process also validates the ballot images.

Ballot Image Audit: AuditEngine



AuditEngine.org

Upload files to the website

- Image archives
- Cast vote record (optional)
- Poll List (Total Voters who signed in at polls, and returned VBM ballot)
- Hashcodes file
- Adjudications (manual interpretations of ballots)

Launch audit and Review the report

Review individual ballots and add adjudications

Perform Image Validation of consequential contests

Audit oversight is important

- We need people in every county that performs audits
- Insure the computer report (CVR) is frozen prior to random draw
- Watch and record the random draw
 - Do they include all the ballots in the draw
- Watch what they do **AFTER** the batches are tallied.
 - Do they rescan the ballots (Innocent fix-up).
- Review the reports

Moving Forward

- Volunteer to provide audit oversight in your region.
- We want as many ballot image sets and CVRs as possible, from every vendor for testing.
- Spend more time to understand the trade-offs between different auditing strategies.
- Contact:
 - Ray Lutz – CitizensOversight.org
 - Facebook: Election Scam Clearinghouse (open group)
 - raylutz@citizenoversight.org
 - 619-820-5321
 - Get on our email alert list