Election Security
From Ballots to Trust

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The Electoral Cycle

Source: IDEA INT
"To convince the loser that he or she lost."
Dan Wallach
Texas Senate Hearing, 2008

"To guarantee a peaceful resolution of this civic battle."
Jordi Barat, 2018
Personal communication
THE ANATOMY OF PUBLIC CONFIDENCE

- Hand-marked ballots
- Machine-marked
- Proofs of knowledge
- Digital signatures

EVIDENCE

COLLECTION
- Storage & protection
- Temper-proofing
- Transport

CURATION

AUDIT
- Risk limiting audit
- Recounts
- Post-election audits
USA [GEORGIA 2018]

- DRE
- COLLECTION CURATION
- AUDITS
- EVIDENCE

DENMARK

- BALLOT BOX
- COLLECTION CURATION
- AUDITS
- TWO INDEPENDENT COUNTS
- PAPER BALLOTS
- CONTROLLED RESOURCE
- EVIDENCE

PHILIPPINES

- COLLECTION CURATION
- AUDITS
- EVIDENCE
CHALLENGES TO PUBLIC CONFIDENCE

1) ELECTION TECHNOLOGIES
   - COMPLEX
   - UNOBSERVABLE

2) DISINFORMATION CAMPAIGNS
   - POLITICALLY MOTIVATED
   - NEW MEDIA
   - GLOBAL INSTANTANEOUS DISTRIBUTION
<table>
<thead>
<tr>
<th>VOTING TECHNOLOGIES</th>
<th>Optical Scanners</th>
<th>Ballot Markers</th>
<th>Internet Voting</th>
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</thead>
<tbody>
<tr>
<td><strong>Colorado 2020</strong></td>
<td>![Diagram1]</td>
<td>![Diagram2]</td>
<td></td>
</tr>
<tr>
<td><strong>Georgia 2020</strong></td>
<td>![Diagram3]</td>
<td>![Diagram4]</td>
<td></td>
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<tr>
<td><strong>Switzerland 2022</strong></td>
<td>![Diagram5]</td>
<td>![Diagram6]</td>
<td></td>
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</table>
KENYA 2017
REACTIONS OF THE WINNER / LOSER

Kenya election 2017: Raila Odinga says election systems hacked

9 August 2017

Kenya's day of tension after polls
Aug 8:  **General Elections**

Aug 28:  **Supreme Court Hears Odinga’s Case**
- Suspicious log files
- No access to servers

Sept 1:  **Supreme Court Nullified Result Orders Fresh Election**

Oct 26:  **Fresh Presidential Election**
EVIDENCE

MAINTENANCE
KPMG 2017

- FINGERPRINT
- ID + FINGERRPRINT
- FORM 32A

- IMAGE
- DIGITAL DATA

BVR

KIEMS

Biometric Voter Register

Voter Registration

Paper Ballots

Results Transmission System

RTS
KENYA INTEGRATED MANAGEMENT SYSTEM
From Ballot to Result

Ballots Physical
34 A Physical
34 A Digital
34 B Digital
34 B Physical
34 C Physical
34 B Excel
34 C Database

Fresh Presidential Election Oct 26, 2017
Evidence
- BVR
- Paper Ballots
- 34A, 34B, 34C Forms
- Result Transmissions

Collection Curation
- Voter Station
- Jurisdiction Warehouse
- Secure Clear Ballot Boxes

Audits
- Digital Data vs Paper Trail
- No Audit of Ballots
RISK-LIMITING AUDITS

A BETTER WAY TO AUDIT

[ LINDEMANN & STARK 2012 ]
<table>
<thead>
<tr>
<th>Candidate</th>
<th>Votes</th>
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<tbody>
<tr>
<td>Uhuru Kenyatta</td>
<td>8,223,369</td>
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<tr>
<td>Raila Odinga</td>
<td>6,822,812</td>
</tr>
<tr>
<td>Joseph Nyagah</td>
<td>36,029</td>
</tr>
<tr>
<td>Abduba Dida</td>
<td>36,004</td>
</tr>
<tr>
<td>Ekuru Aukot</td>
<td>27,400</td>
</tr>
<tr>
<td>Invalid/Blank</td>
<td>411,510</td>
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<tr>
<td><strong>Total</strong></td>
<td>15,593,050</td>
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<tr>
<td><strong>Eligible</strong></td>
<td>19,611,423</td>
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Risk Limiting Audit (RLA)

**Procedure that has a large pre-specified chance of correcting an erroneous result**

*Step 1: Set the chance (Risk-Limit)*

99.9% Certainty

*Step 2: Size of Random Sample*
RLAs & Disinformation

- Prolific Platform
- US Demographic
- 105 Participants

Hypothesis:
When asked about # ballots to audit, participants answer higher than RLAs.

[Dalela, Kulyk, CS '21]
Conclusions
EVIDENCE

DISINFORMATION

PUBLIC CONFIDENCE

COLLECTION

CURATION

AUDIT
# 1 Bad election technology implies higher risk of disinformation

# 2 Underestimating risks of election technologies can destabilize democracies