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A Novel Protocol to Allow Revocation of Votes in a Hybrid Voting System

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Outline

Motivation - Integrated Voting Systems

Hybrid Voting Systems

The Protocol

Conclusion

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Internet E-Voting Systems in Practice

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  - → Governments need to avoid the risk of introducing new technology in a big bang.
  - → Not all voters have access to the internet.
  - → Not all voters are able to handle a computer.
  - → Voters do not neccessarily like e-voting systems.
- As a matter of fact, the traditional, paper-based channel is preserved as an alternative channel.
  - → *Example*: Swiss Cantons of Geneva, Zurich and Neuchatel.
  - → *Example*: Estonia.

Integrate Traditional and Electronic Voting

- It is not possible to run both the traditional and the electronic channel independently.

Minimal requirement for integrated voting systems

- Ensure that at most one vote is cast per voter.

Note, that the integrated system is only as secure as the weaker voting channel.

What are the features of a good voting channel?

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These requirements are very hard to meet simultaneously in the e-voting channel of an integrated system.

Individual Verifiability vs. Coercion-Resistance

- *Individual Verifiability* grounds on an electronic bulletin board.
- Unfortunatelly, the voter can generally reproduce the encryption procedure to demonstrate to an adversary (voter coercer or vote buyer) how he voted.
- The information a voter needs to do so is called a voter's *receipt*.
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- *Receipt-freeness* of the electronic voting channel is thus a precondition to *coercion-resistance* of the *integrated system*.
- Unfortunatelly, *receipt-freeness* is very difficult to achieve with e-voting systems over the internet.
- We propose *hybrid systems* to solve the dilemma of simultaneously providing *Individual Verifiability* and *Coercion-Resistance* in *integrated systems*.

Outline

Coercion-Resistance in Hybrid Voting Systems

- Voters can revoke and replace their electronic vote at the polling station.
- It is infeasible for an adversary (voter coercer or vote buyer) to verify whether voters have revoked their vote.
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Benefits

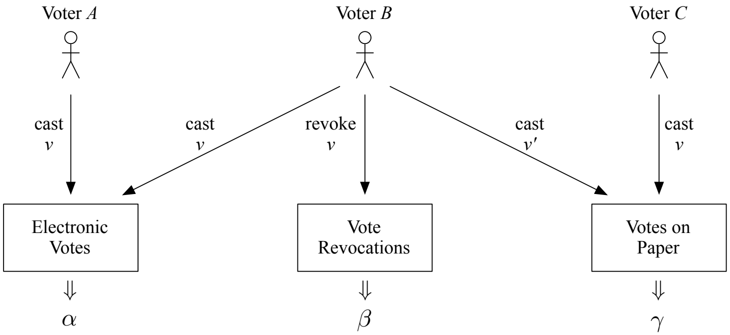
- *Individual Protection*: Voters that were put under pressure can still express their real political opinion.
- *Universal Protection*: Attacks will not influence the outcome of the vote, since adversaries must assume that voters revoke.

  Thus, launching an attack in the first place seems unattractive.

Revoking Votes in Hybrid Voting Systems

We need an additional ballot-box (β) to contain the revoked votes.

- *Remember*: The ballot-box of the electronic voting channel is public.



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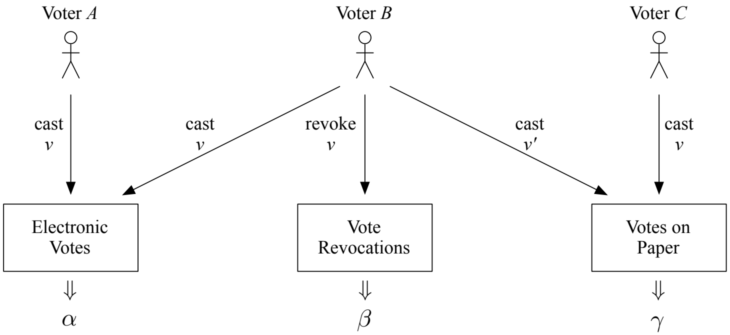

$$FinalTally = Tally(\alpha) - Tally(\beta) + Tally(\gamma)$$

Requirements on Electronic Channel

1. **Proof of Eligibility**: Voters at the polling station must be able to prove that their electronic vote has not been cast.
2. **Proof of Ownership**: Voters at the polling station who own an electronic vote must be able to identify its encryption on the bulletin board and prove that they have done so truthfully.

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   $\rightarrow$*vote identifier*.
   $\rightarrow$*receipt* $\Rightarrow$ *vote identifier*.

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This only has to be done once.

A First Naive Approach wihout Privacy

This is the public bulletin board.

Voter Roll			
Marianne			
Hein			
Marijke			

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So what about Privacy?

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Proof of Eligibility:

1. Marijke reveals her Pseudonym $\hat{S}_2$.
2. She proves $ZKP[(s_3) : S_3 = g^{s_3} \wedge \hat{S}_2 = \hat{g}^{s_3}]$

Proof of Ownership: Simple

Use s_i to disclose vote for revocation: Same as in naive version.

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- It is safe to offer individual verifiability unconditionally.
- The presented protocol complies with the requirements on a hybrid voting system: Voters can reveal their vote even if a coercer casted it.

Thank You

Questions / Remarks

Find
"*Coercion-Resistant Hybrid Voting Systems*"
by Oliver Spycher / Prof. Rolf Haenni in

www.e-voting.ti.bfh.ch