ARTEMIS

SOLVING THE SECURE PLATFORM PROBLEM FOR THE HELIOS E-VOTING SYSTEM

Bachelor thesis - Mike Boss

WELCOME

TO

MYTHOLOGY 101!

Zeus

Apollo

Helios

Artemis

Belenios

MYTH OF
SECURE E-VOTING

SECURITY?

SECURITY?

Verifiability

SECURITY?

Verifiability

+

Privacy

E-VOTING SYSTEM

1. Vote creation
2. Vote submission
3. Tally

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HOMOMORPHIC TALLYING

$$\{1\}_k + \{0\}_k + \{1\}_k = \{2\}_k$$

ZKP: 0 or 1

3. Tally

RE-ENCRYPTION MIX-NET

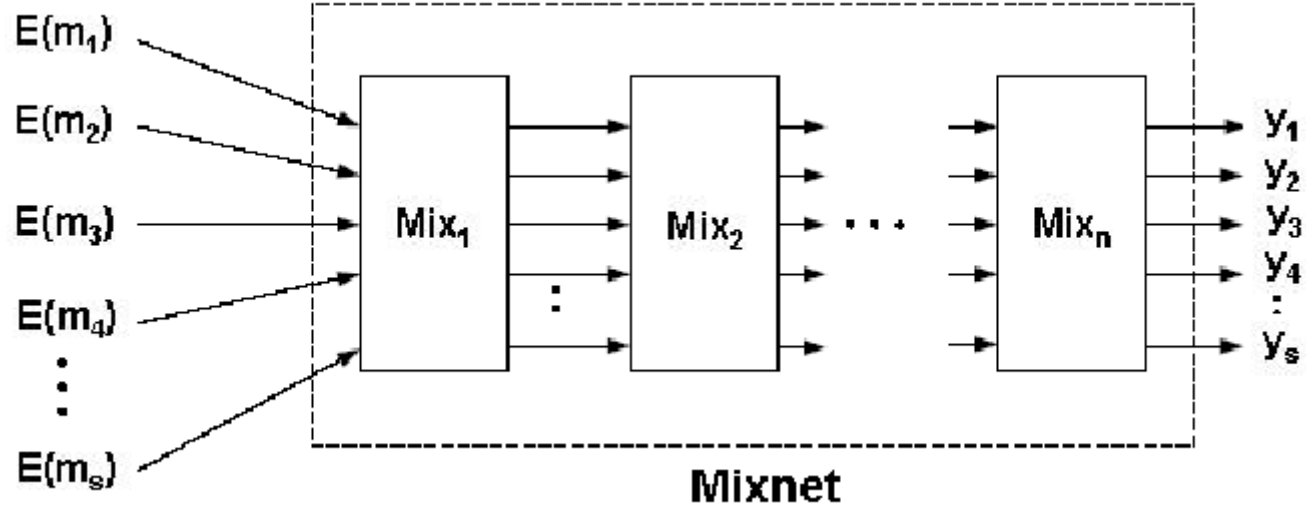
3. Tally

RE-ENCRYPTION MIX-NET

3. Tally

RE-ENCRYPTION MIX-NET

RE-ENCRYPTION MIX-NET



FIRST THERE WAS

HELIOS

1. Vote creation	Benaloh Challenge
2. Vote submission	Just send
3. Tally	Homomorphic tallying

BENALOH CHALLENGE

(Voter-initiated-audit)

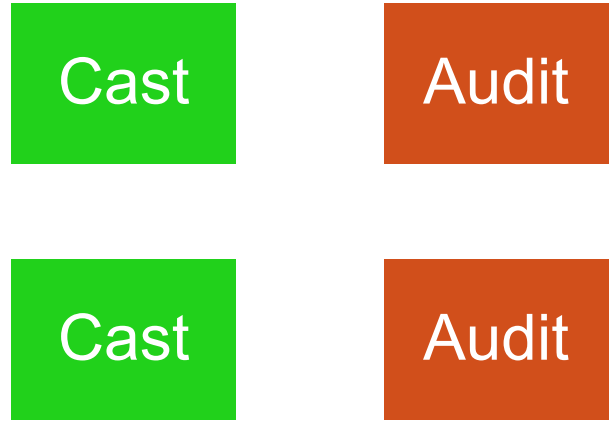
$$\{Alice\}_k$$

Cast

Audit

BENALOH CHALLENGE

(Voter-initiated-audit)



BOOTH AUDIT => SECURITY 

BOOTH AUDIT => SECURITY 

LOCAL AUDIT => SECURITY ✕

HELIOS

HELIOS

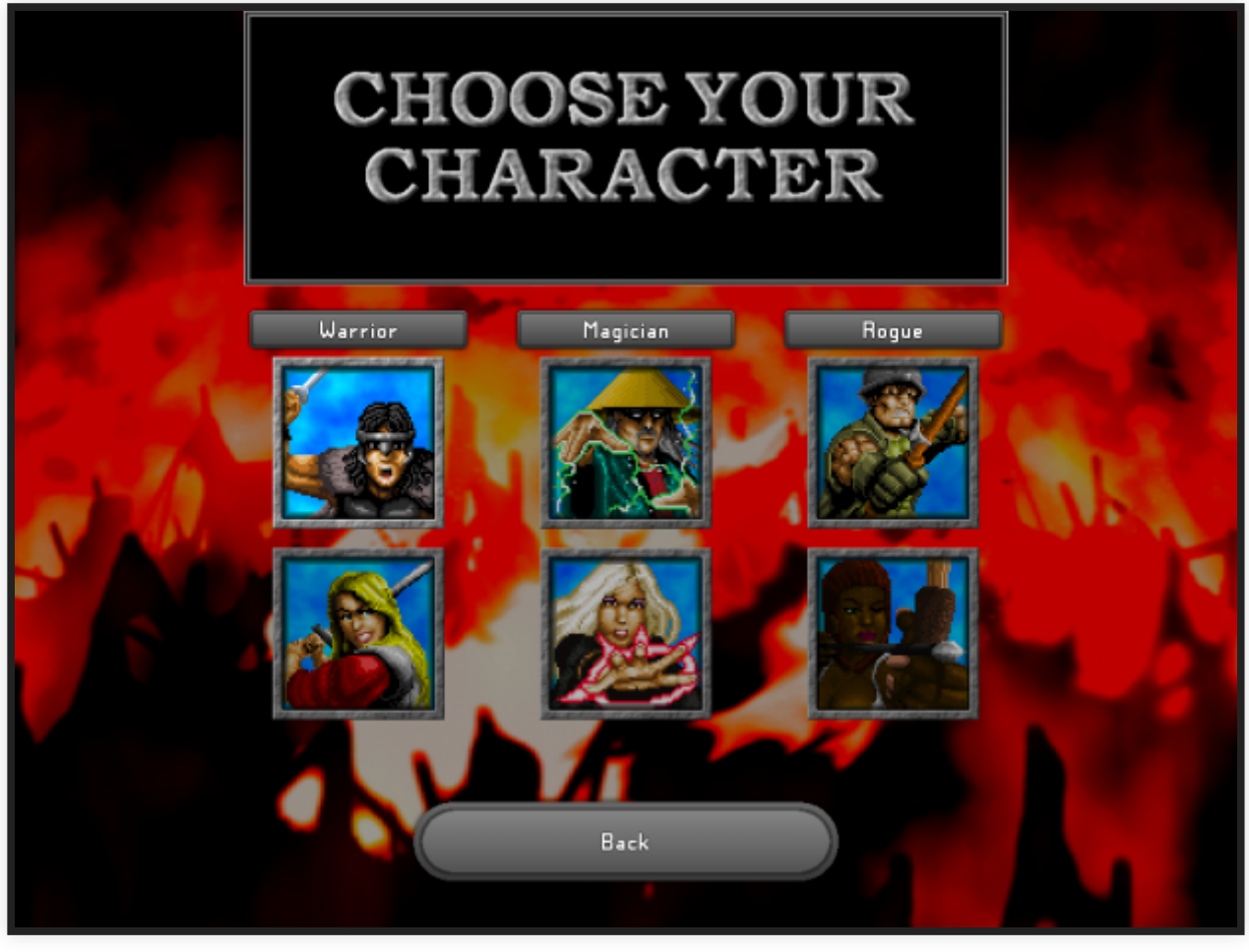
HELIOS

HELIOS

HELIOS


A
ARTEMIS

PLAYERS



PLAYERS

1. Voting terminal 
2. Active voting assistant 
3. Voting assistant(s) 

4. Tallying authority
5. Registrar

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1. VOTE CREATION

1. **Audit on multiple devices** => Security
2. **Interactive creation of indirection** => Privacy

INDIRECTION

Alice	↔	🟩	🟦	↔	l7ngr2d
Bob	↔	🟥	🟥	↔	l02JfTp
Charlie	↔	🟦	🟩	↔	d38Gnd

Problem

 can tell which ballot  submitted

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 can tell which ballot  submitted

Solution

RE-ENCRYPTION

-  for privacy
-  for receipt-freeness

RE-ENCRYPTION

1.  →  →  :

$\{1\}_k^1$ ↔ 

$\{0\}_k^1$ ↔ 

2.  → 

$\{0\}_k^2$

3.  → 

$\{0\}_k^3$

2. VOTE SUBMISSION

TWO AUTHORITES

4. Registrar
5. Tallying authority

TWO AUTHORITES

- Against ballot stuffing
- Against malicious voting terminal

REGISTRAR

sends to all voters

1. Cast codes
2. Lock-in code

SUBMITTING A VOTE

Enter **cast code** => ☑ ? => Enter **lock-in code**

WHY ☑ ?

💻 switches ballot with entered cast code

WHY ☑ ?

💻 switches ballot with entered cast code

Enter lock-in code only if same ballot

3. TALLY

Mix-net => No change

Homomorphic tally => ZKP's invalid ✗

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Mix-net => No change

Homomorphic tally => ZKP's invalid ✗

Groth-Sahai proofs re-randomizable ✓

CONCLUSION

ARTEMIS

PRIVAPOLLO

Multiple devices

Indirection

BELENIOSRF

Re-encryption

Receipt-freeness

PROTOCOL

- Security + Privacy
- Receipt-freeness
- More election modes than BeleniosVS
- Easier to implement

- Benaloh Challenge

IMPLEMENATION

- Functional

- Helios code base
- Not finished