

E-Vote Your Conscience: Perceptions of Coercion and Vote Buying, and the Usability of Fake Credentials in Online Voting

Louis-Henri Merino, Alaleh Azhir, Haoqian Zhang, Simone Colombo,
Bernhard Tellenbach, Vero Estrada-Galiñanes, Bryan Ford



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

armasuisse

Federal Office for Defence Procurement

EPFL



**Massachusetts
Institute of
Technology**

State-of-the-art Voting Architecture

(e.g., D-Voting @ EPFL, Swiss Post @ Switzerland)

[Forms](#)[Admin](#)[About](#)[+ Create form](#)

Vote

You may cast a ballot as many time as you want while the form is open. Only your last vote will be taken into account.

Elections 2024: School Assembly, CAT

Secrétariat AE, +41 (0)21 693 69 16, secr.assemblee.ecole@epfl.ch

MEMBERS OF THE ADMINISTRATIVE AND TECHNICAL STAFF

Select at most 4 answers.

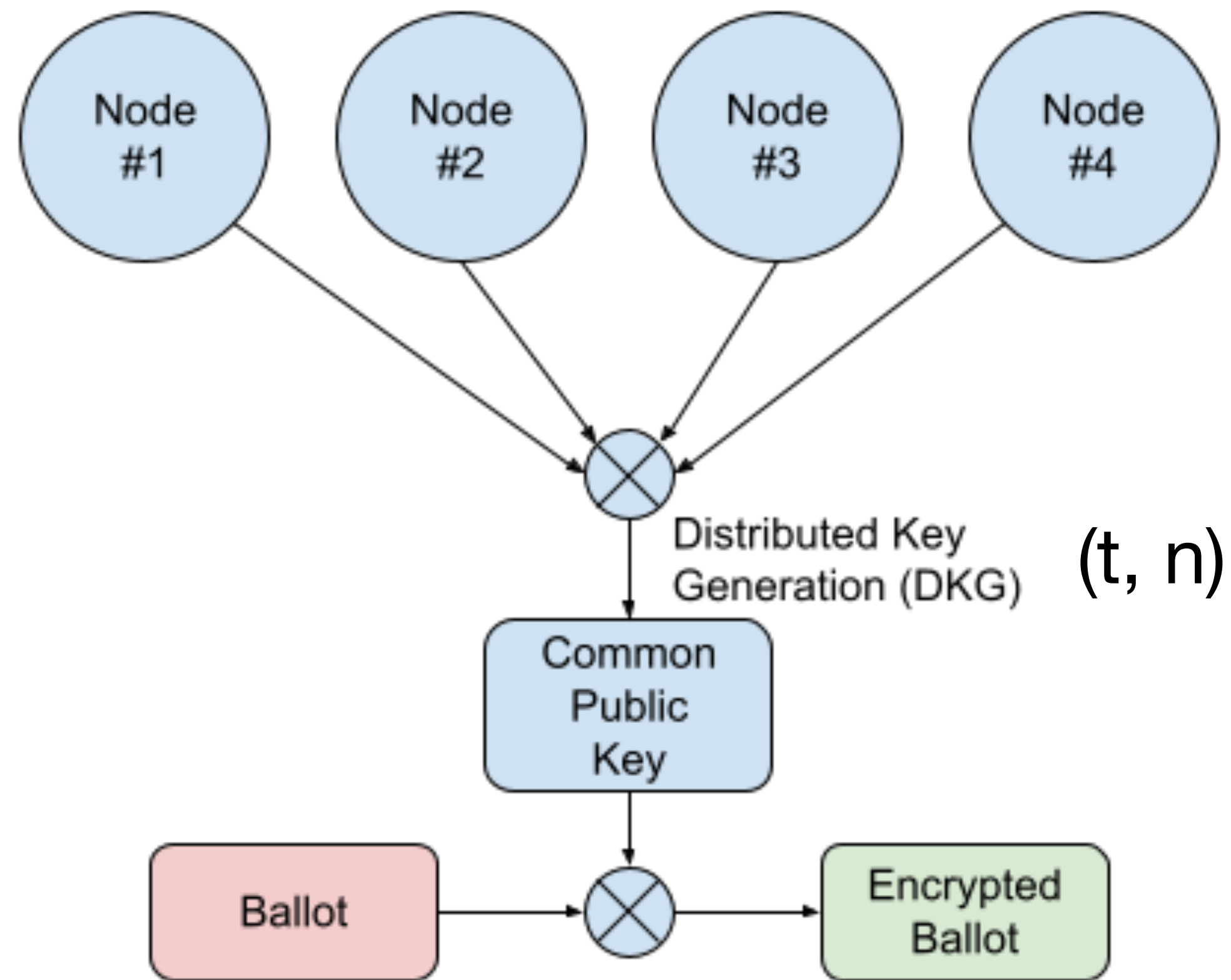
- ☐ [Bastian Gardel](#)
- ☐ [Bertrand Lacour](#)
- ☐ [Chantal Mellier](#)
- ☐ [Charlotte Weil](#)
- ☐ [Consuelo Antille](#)
- ☐ [Frédéric Dreyer](#)
- ☐ [Helena Kovacs](#)
- ☐ [Ian Bourgeois](#)
- ☐ [Iris Capdevila](#)
- ☐ [Marcia Gouffon](#)
- ☐ [Mélanie Kolbe-Guyot](#)
- ☐ [Olivier Colomb](#)
- ☐ [Philippe Abdel Sayed](#)
- ☐ [Samuel Cotture](#)
- ☐ [Sergi Aguacil Moreno](#)
- ☐ [Thomas Reynaud](#)

[✉ Cast vote](#)[Back](#)

Properties

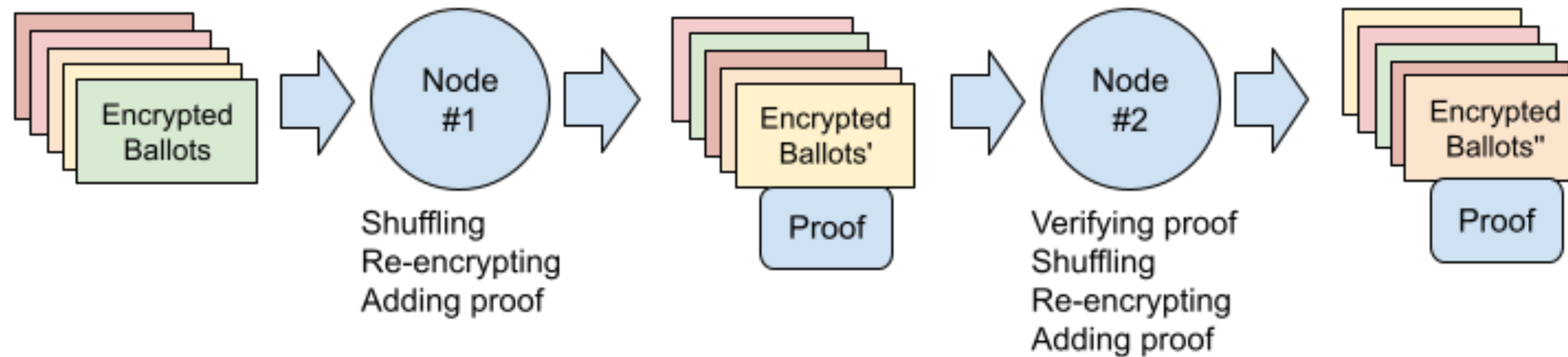
- **Vote Secrecy:** do not reveal a voter's vote to anyone
- **Universal Verifiability:** allow an auditor or the public to check that the election outcome corresponds to the registered votes
- **Individual verifiability:** convincing a voter that the system correctly registered their vote

Vote Secrecy

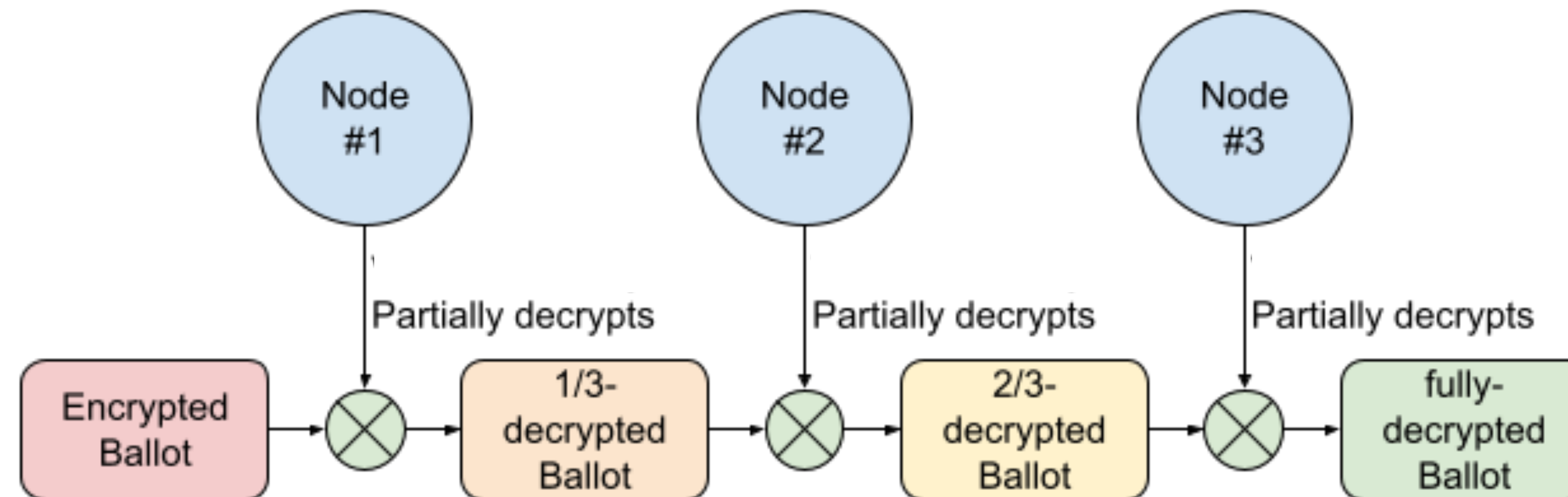


Universal Verifiability

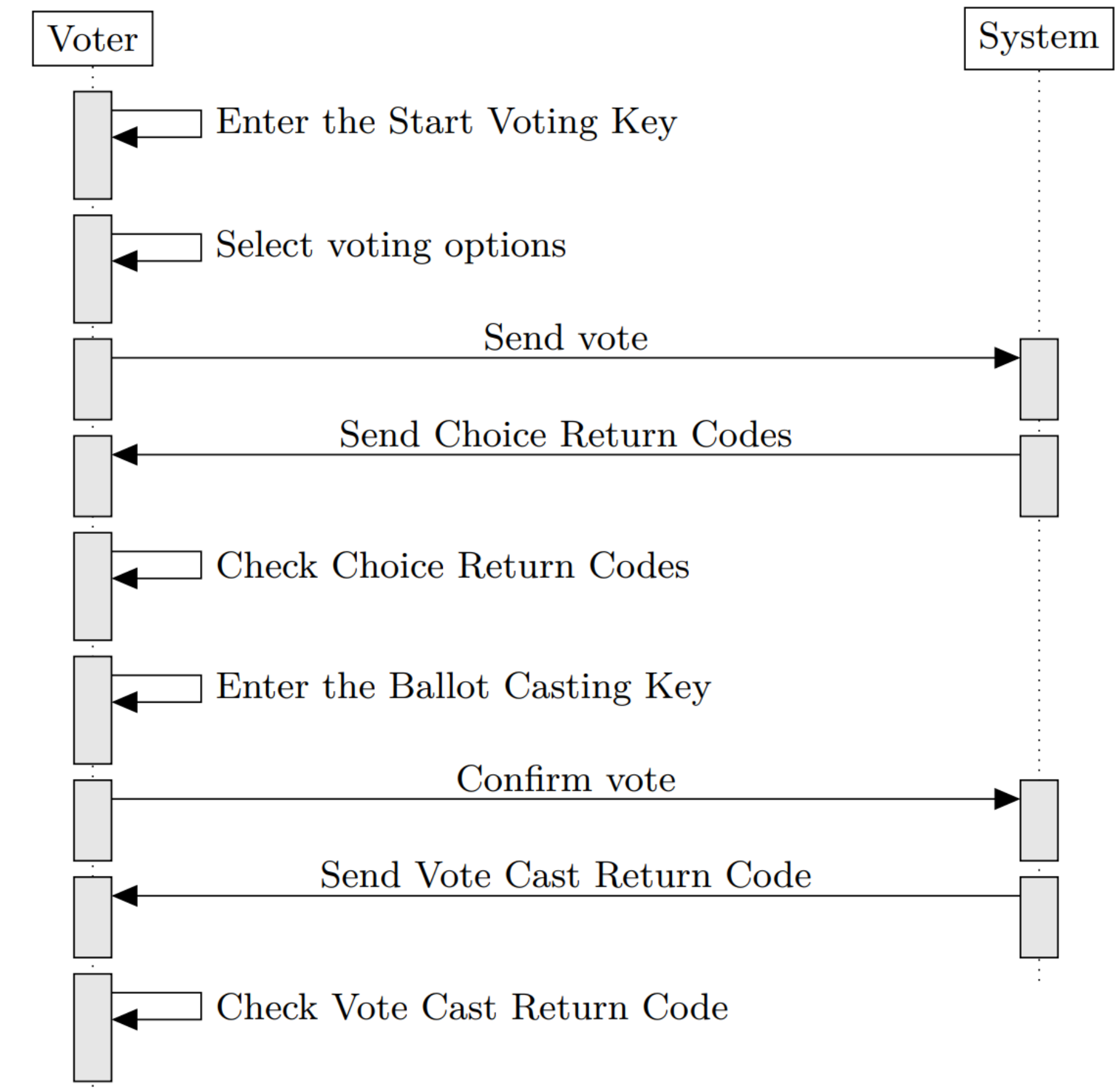
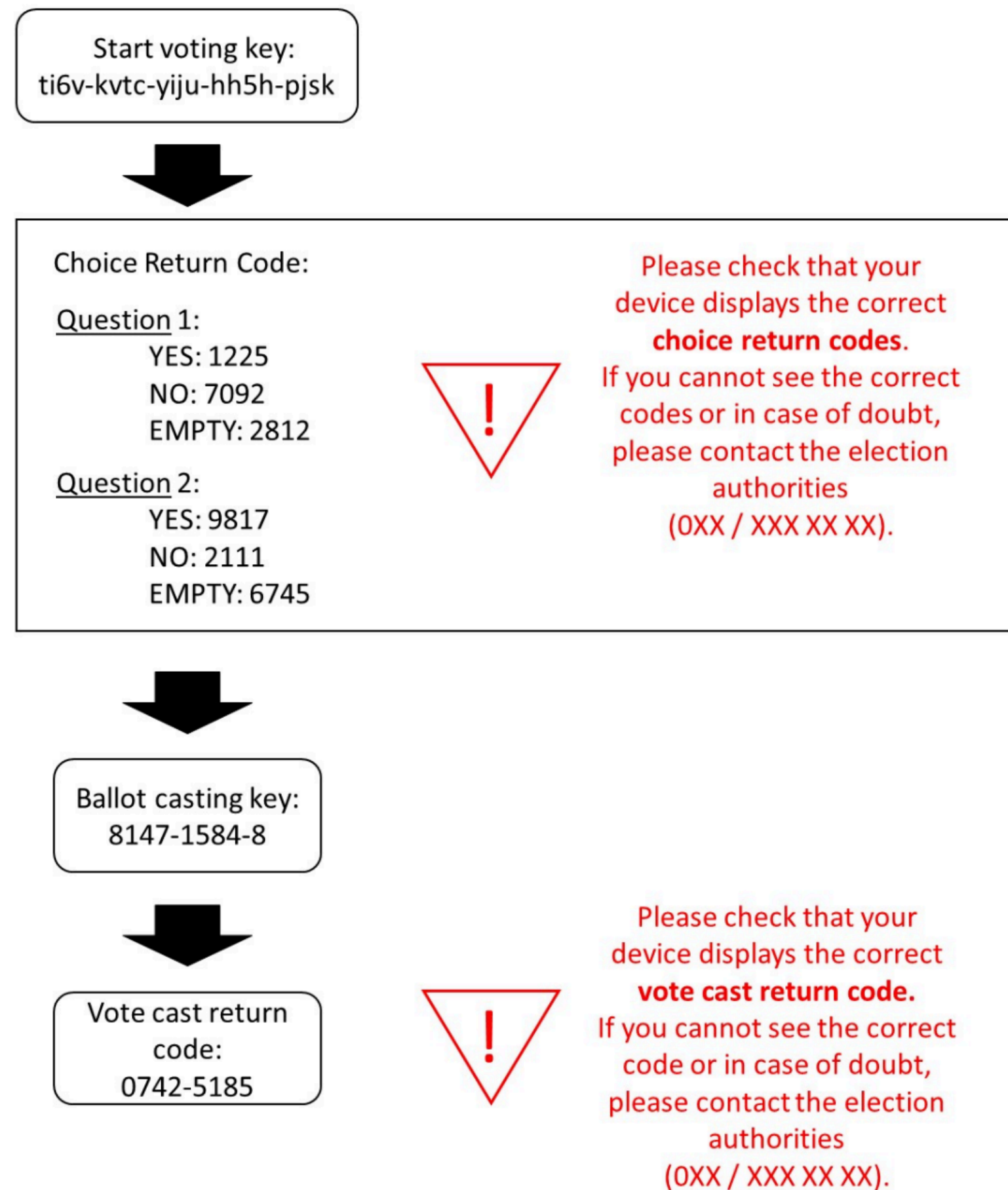
“Mixnet”



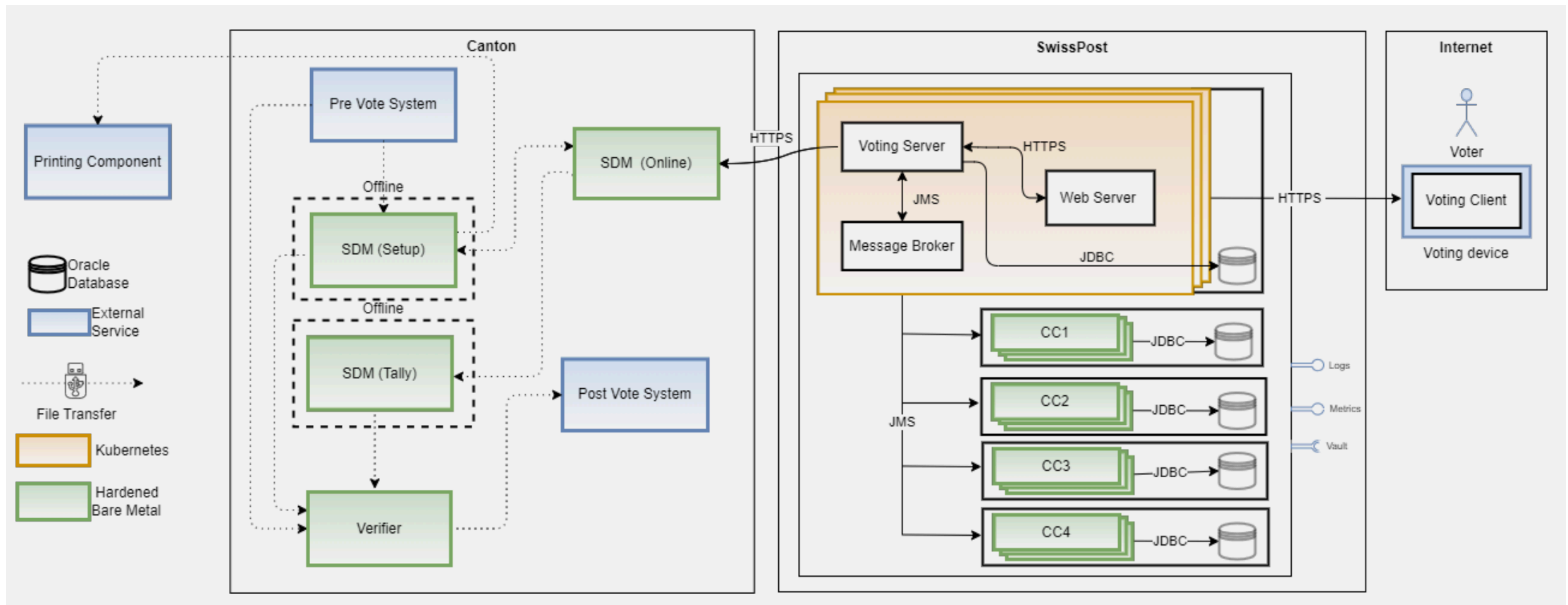
Verifiable
Threshold
Decryption



Individual Verifiability (Swiss Post)



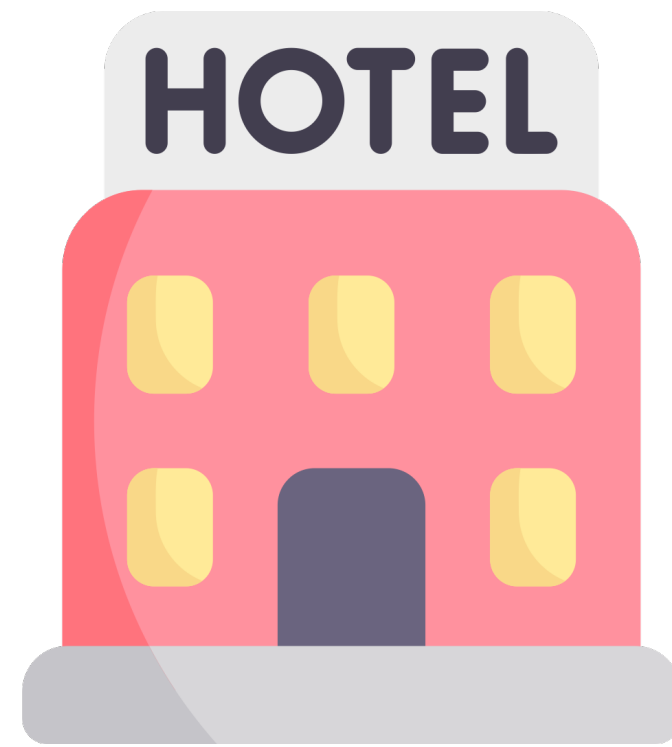
Swiss Post System Model



Online Voting



Home



Hotel Room



Increased
Convenience

Cast **your** vote on your **own** device from anywhere

Online Voting



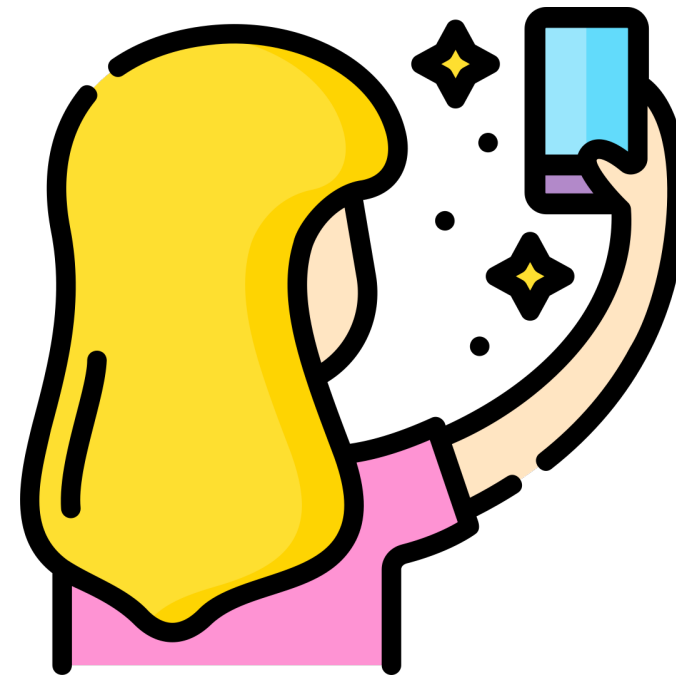
~~Cast **your** vote on your **own** device from anywhere~~

Cast **your coercer's** vote

Coercion in E-Voting



Forceful

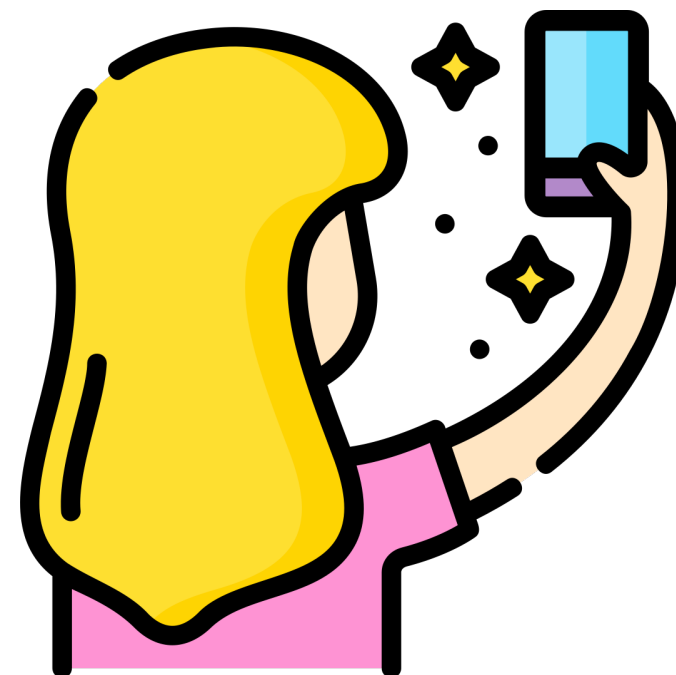


Vote-Buying Selfie

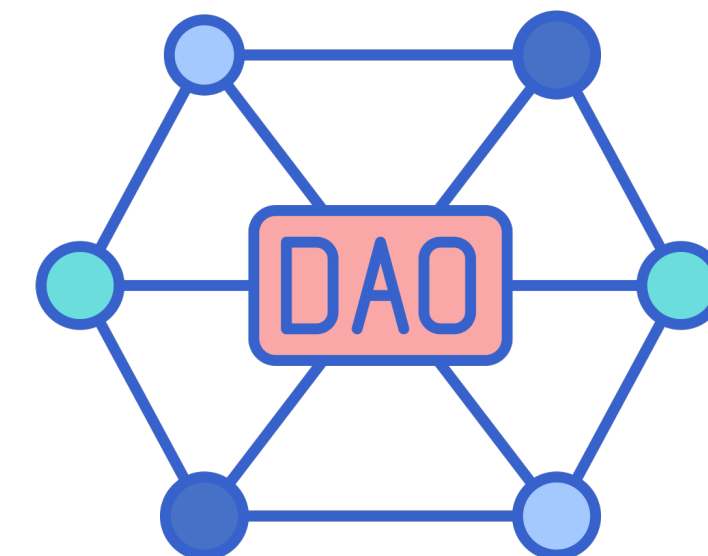
Coercion in E-Voting



Forceful



Vote-Buying Selfie



“Dark” DAOs¹:
Vote Buying at Scale

Online voting is susceptible to more scalable coercion threats

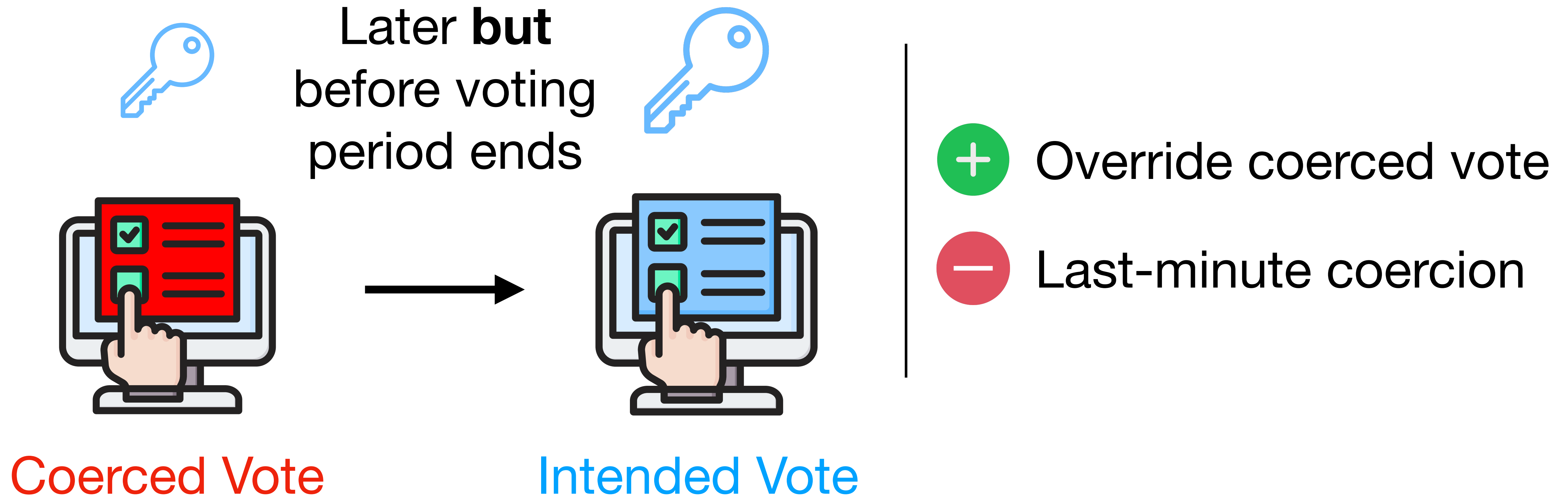
1. Austgen, James, et al. *DAO Decentralization: Voting-Bloc Entropy, Bribery, and Dark DAOs*. arXiv:2311.03530, 6 Nov. 2023.

Roadmap

- **Coercion-Resistance**
- TRIP Registration Scheme
- User Study Design
- User Study Results
- Limitations and Conclusion

Coercion-Resistance

Deniable Re-Voting



Fake Credentials¹

Real Vote

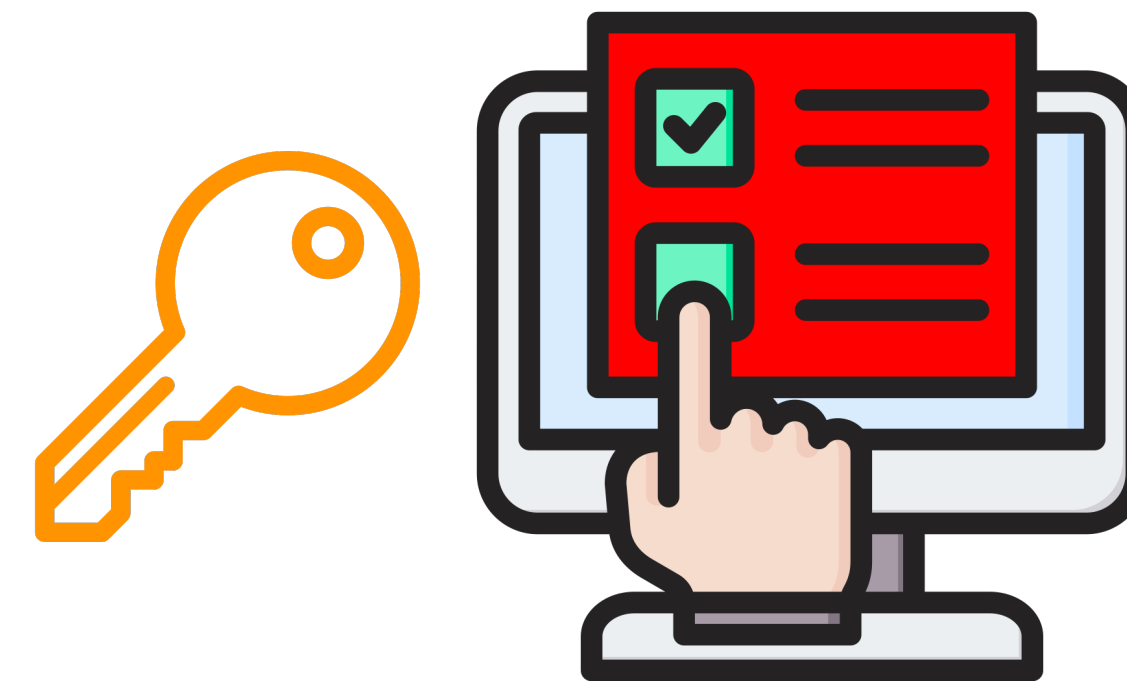
Counts



Intended Vote

Fake Vote(s)

Does NOT count



Coerced Vote

Fake credentials cast votes that **do not** count **while** being **indistinguishable** from **real credentials** which cast votes that **do** count.

1. Juels, Ari, et al. “Coercion-Resistant Electronic Elections.” *Towards Trustworthy Elections: New Directions in Electronic Voting*, 2010.

Usability & Verifiability Concerns



Comprehension?



Real or Fake Credential?

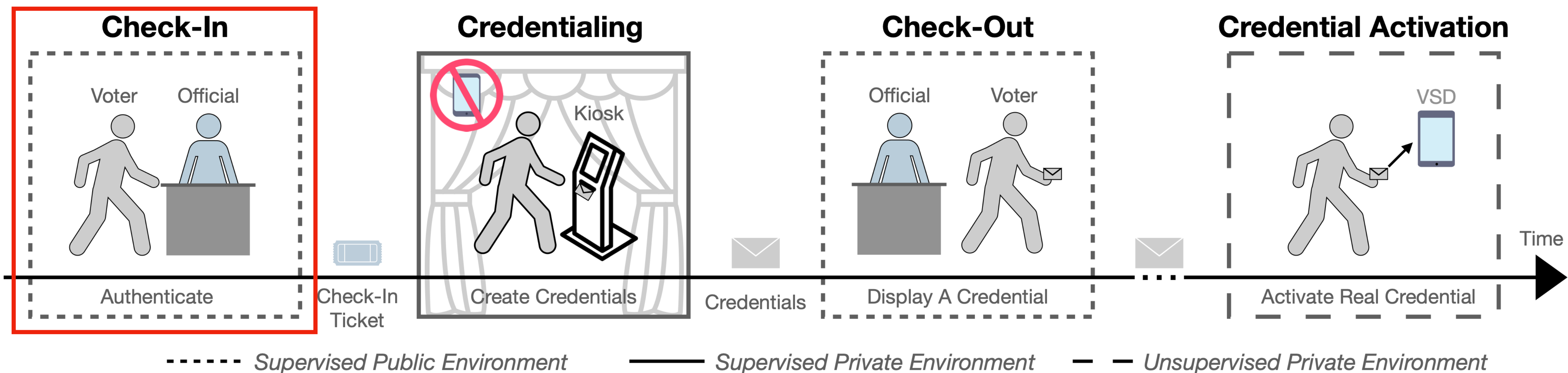


Genuinely real?

Roadmap

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Trust-Limited Coercion-Resistant In-Person Registration¹

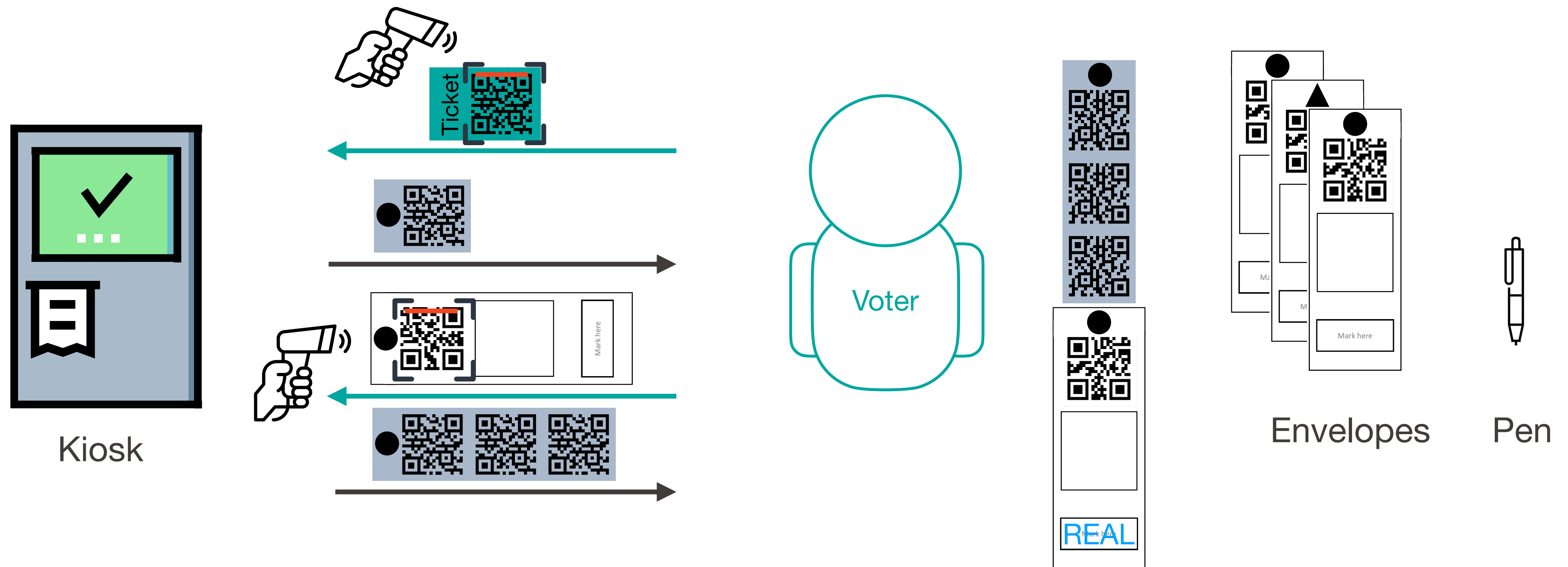


TRIP issues **voter-verifiable** **real credentials** and **indistinguishable fake credentials**

1. Merino, Louis-Henri, et al. *TRIP: Trust-Limited Coercion-Resistant In-Person Voter Registration*. arXiv:2202.06692, arXiv, 17 Mar. 2024

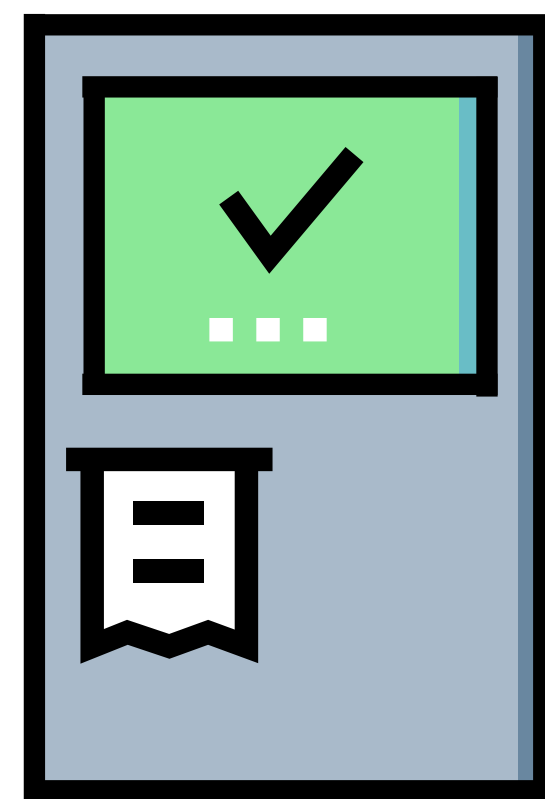
Real Credential Creation Process

(with an interactive zero-knowledge proof)

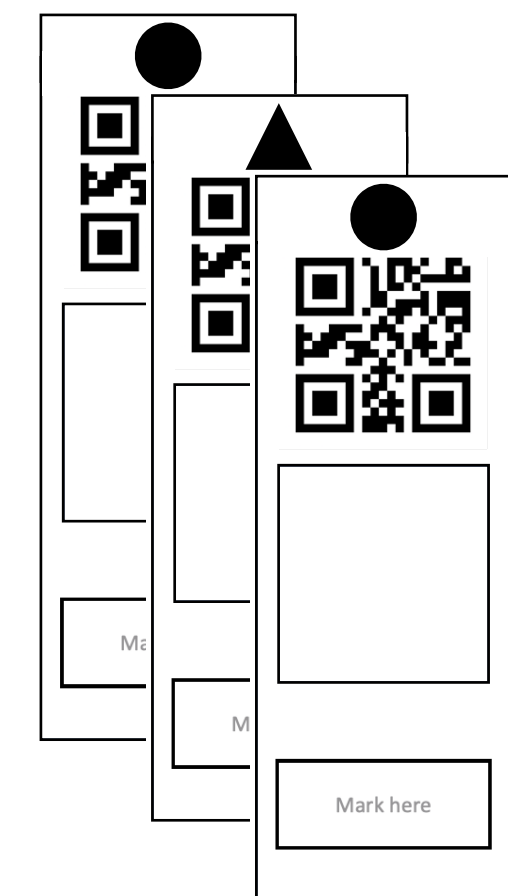
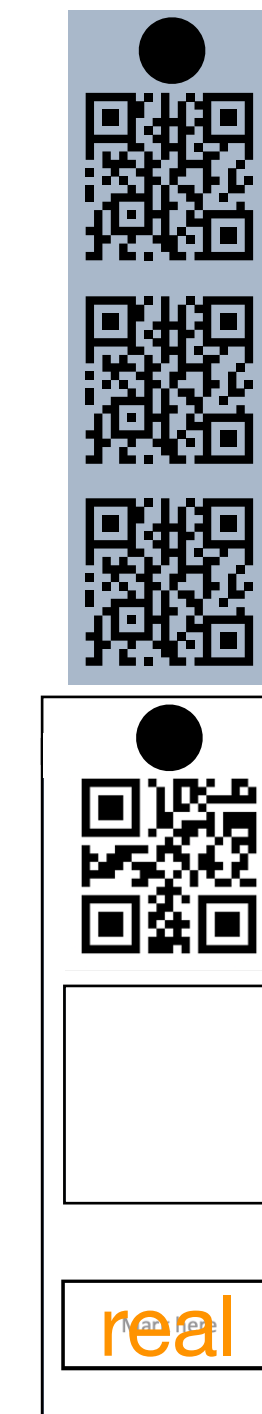
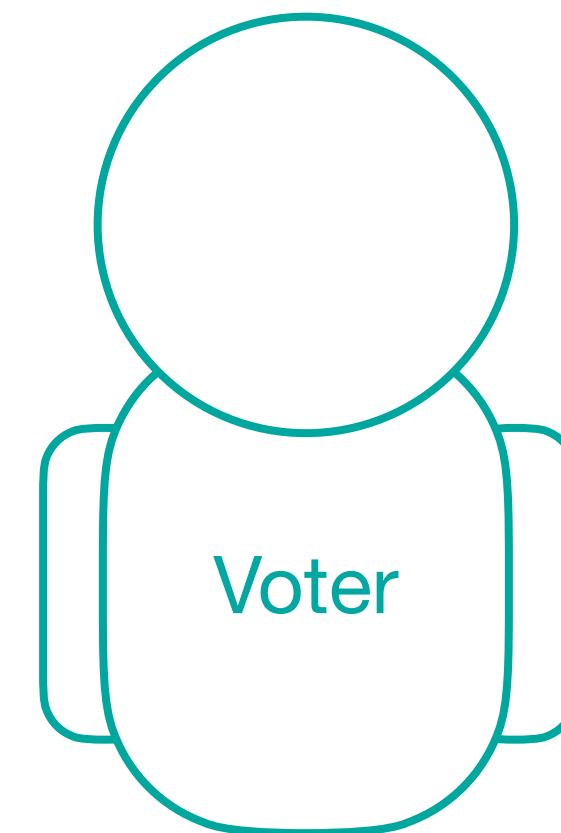
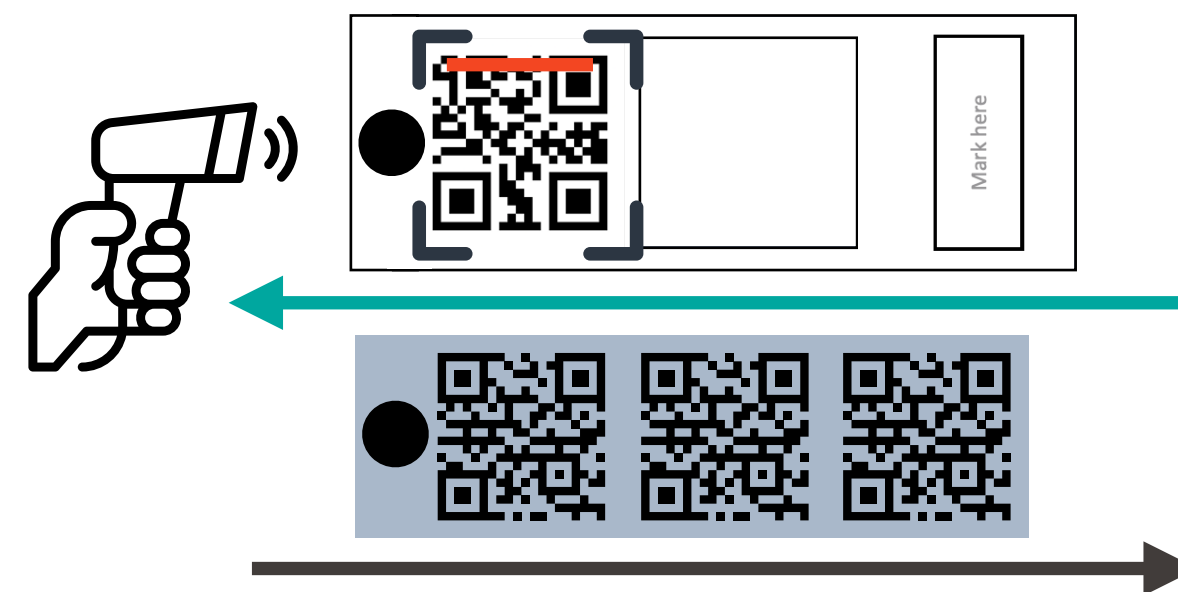


Voter **presents** envelope after kiosk prints **first** QR code

Fake Credential Creation Process



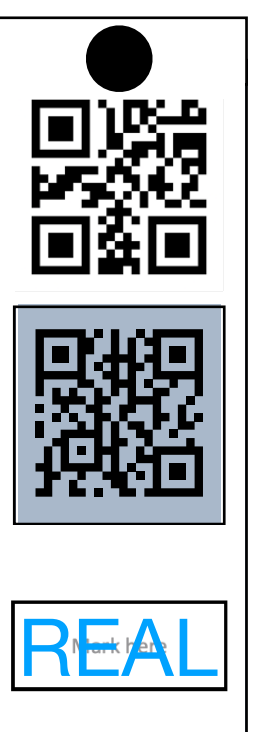
Kiosk



Envelopes



Pen



Voter **presents any** unused envelope

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Study Flow & Location

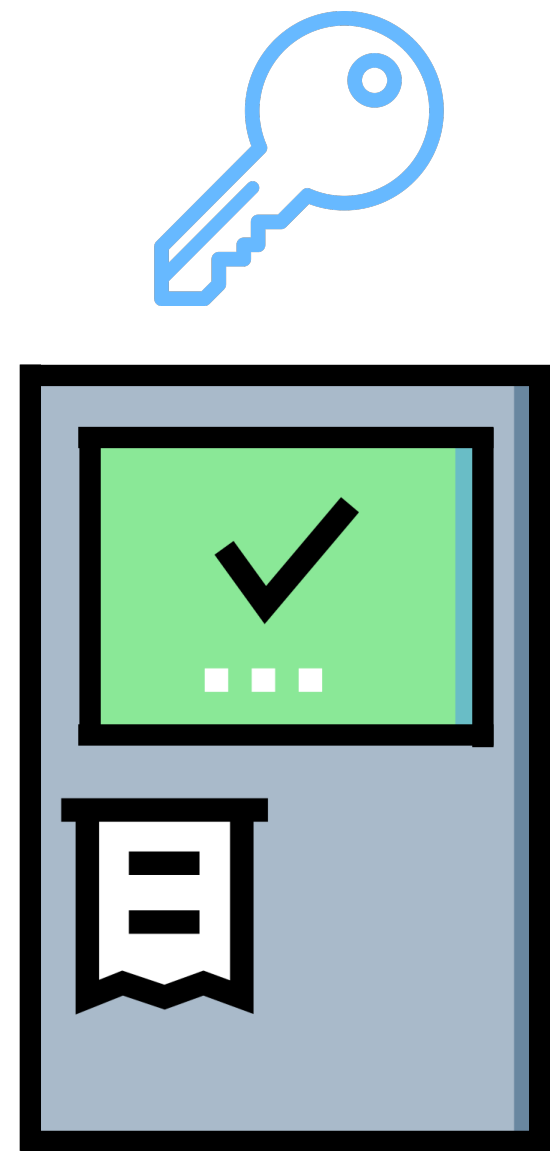
- 1.Enrollment
- 2.Instructional Video
- 3.TRIP Registration
- 4.Voting
- 5.Survey



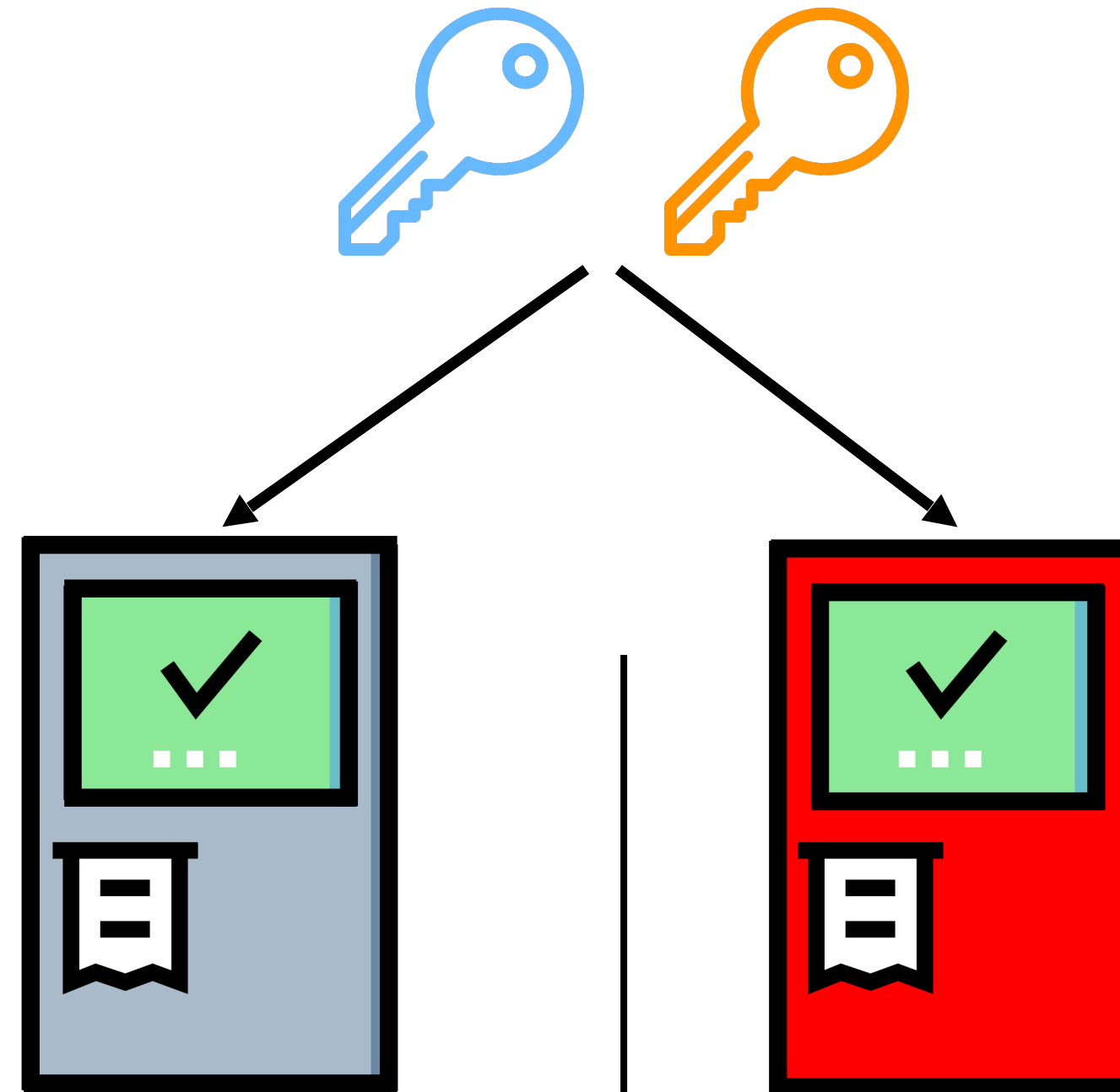
Suburban Park of Boston, MA

5 Study Groups

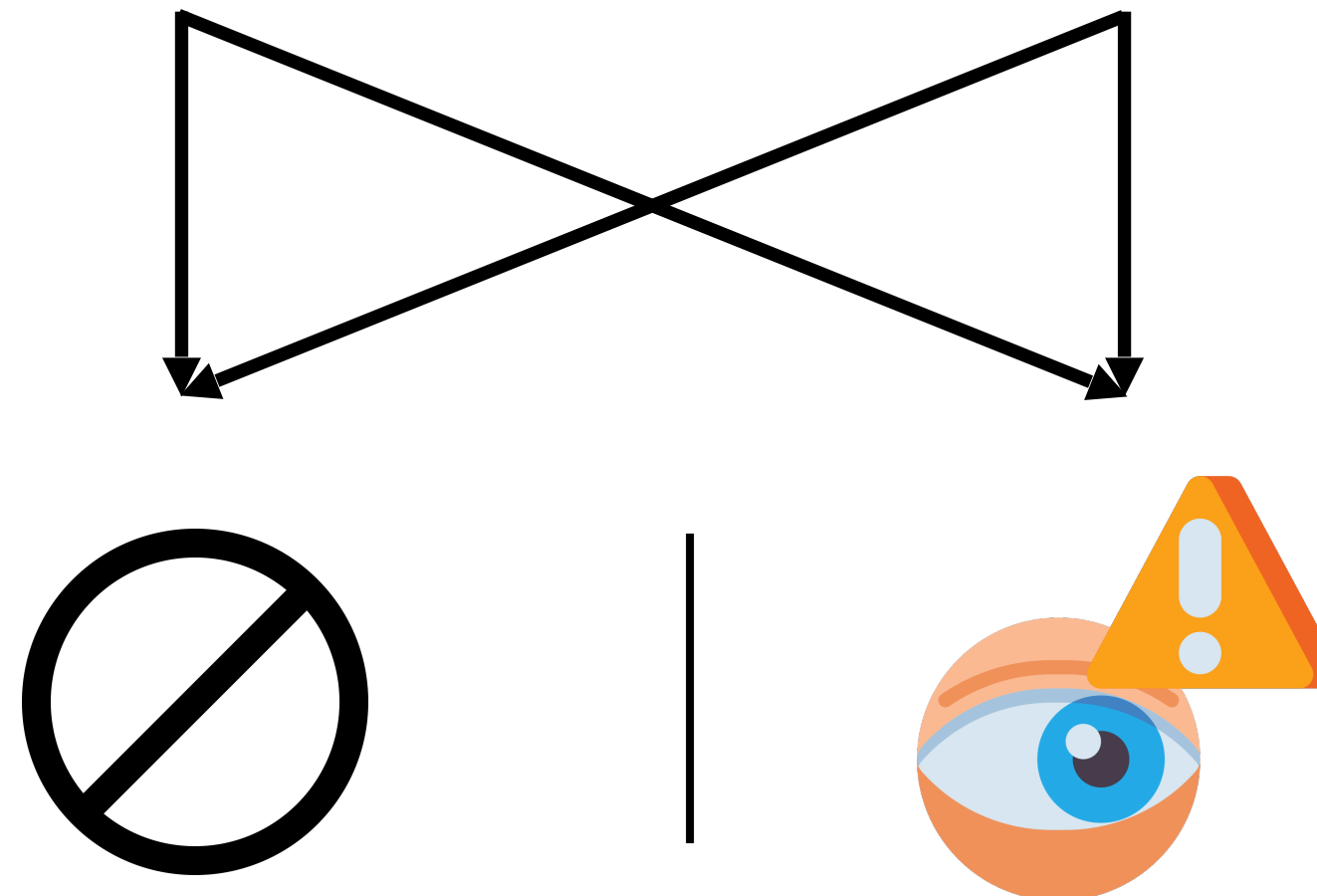
Control Group



Fake Credentials




**Honest OR
Malicious Kiosk**



**With OR Without
Security Priming**

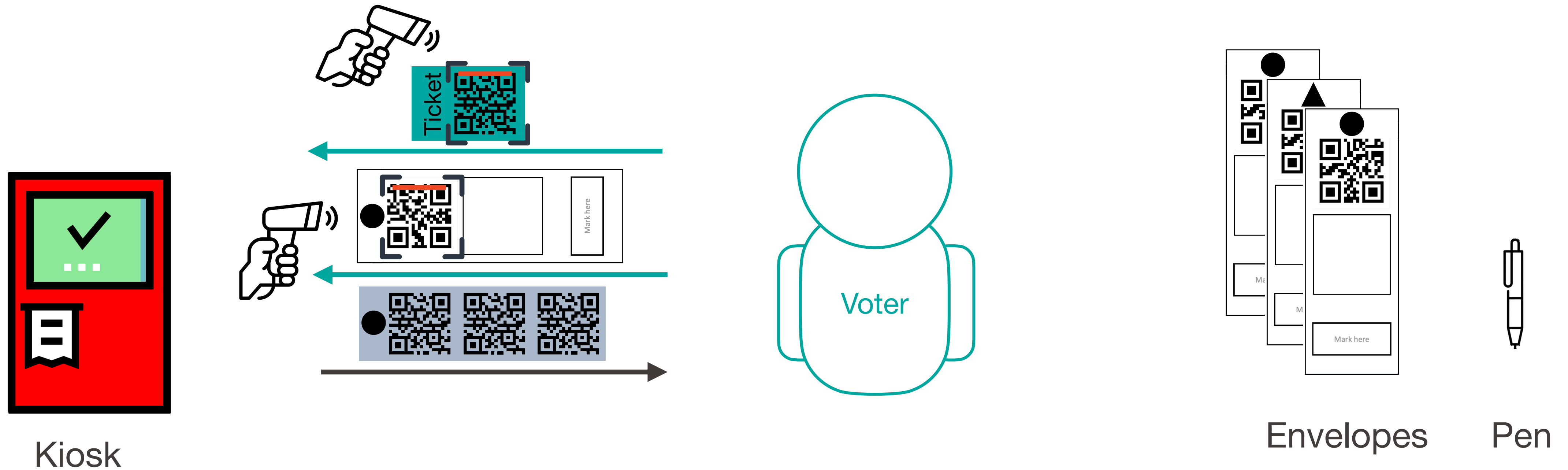
5 Study Groups

	Honest Kiosk	Malicious Kiosk
Real Credential <u>Only</u>	Group C	
Test Credentials	Group F 	Group M

Intended Deployment in Reality

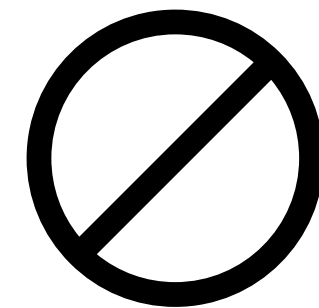
	Honest Kiosk + <u>Security Priming</u>	Malicious Kiosk + <u>Security Priming</u>
Test Credentials	Group <u>S</u> F	Group <u>S</u> M

Malicious Case: Stealing Voter's Real Credential



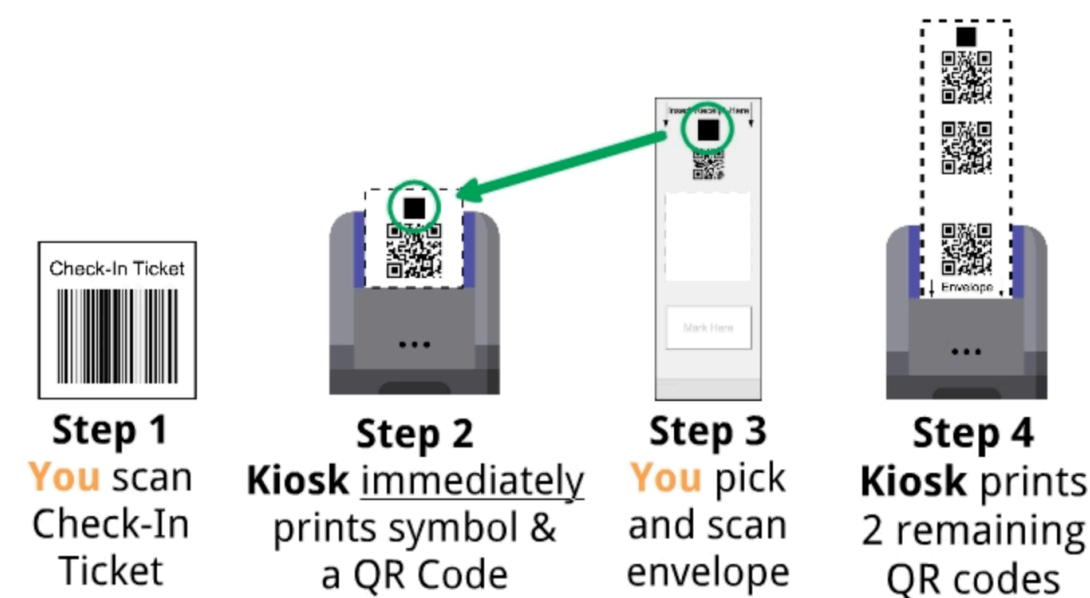
Security Priming?

Without Security Priming
Groups F & M



DISTINGUISHING CREDENTIALS

Real Credential



Test Credential



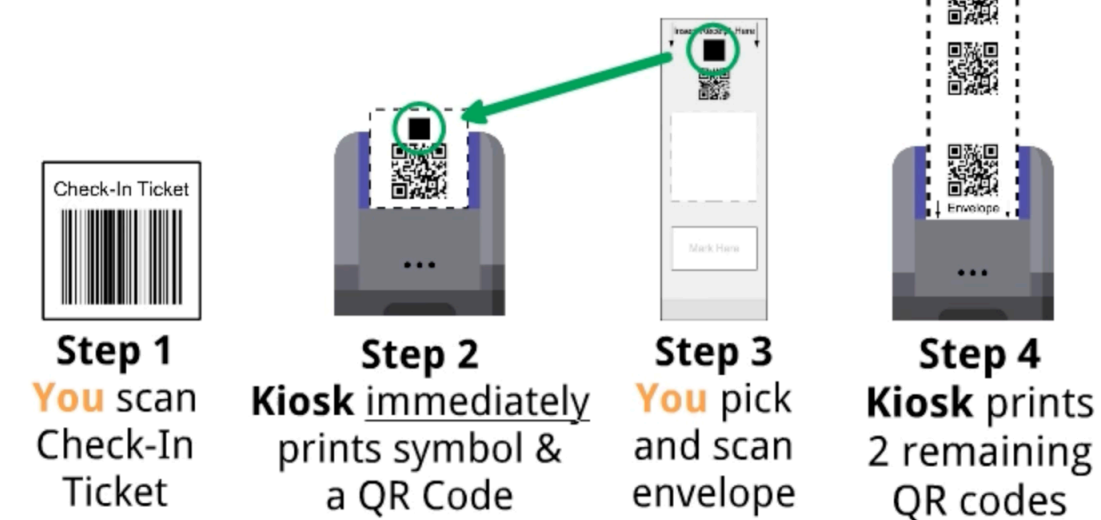
Intended deployment:
“positive vibe” but less instructive



With Security Priming
Groups SF & SM

BEWARE DETECTING A HACKED KIOSK Real Credential

Correct



Incorrect



More instructive but
potentially “scary” or unsettling

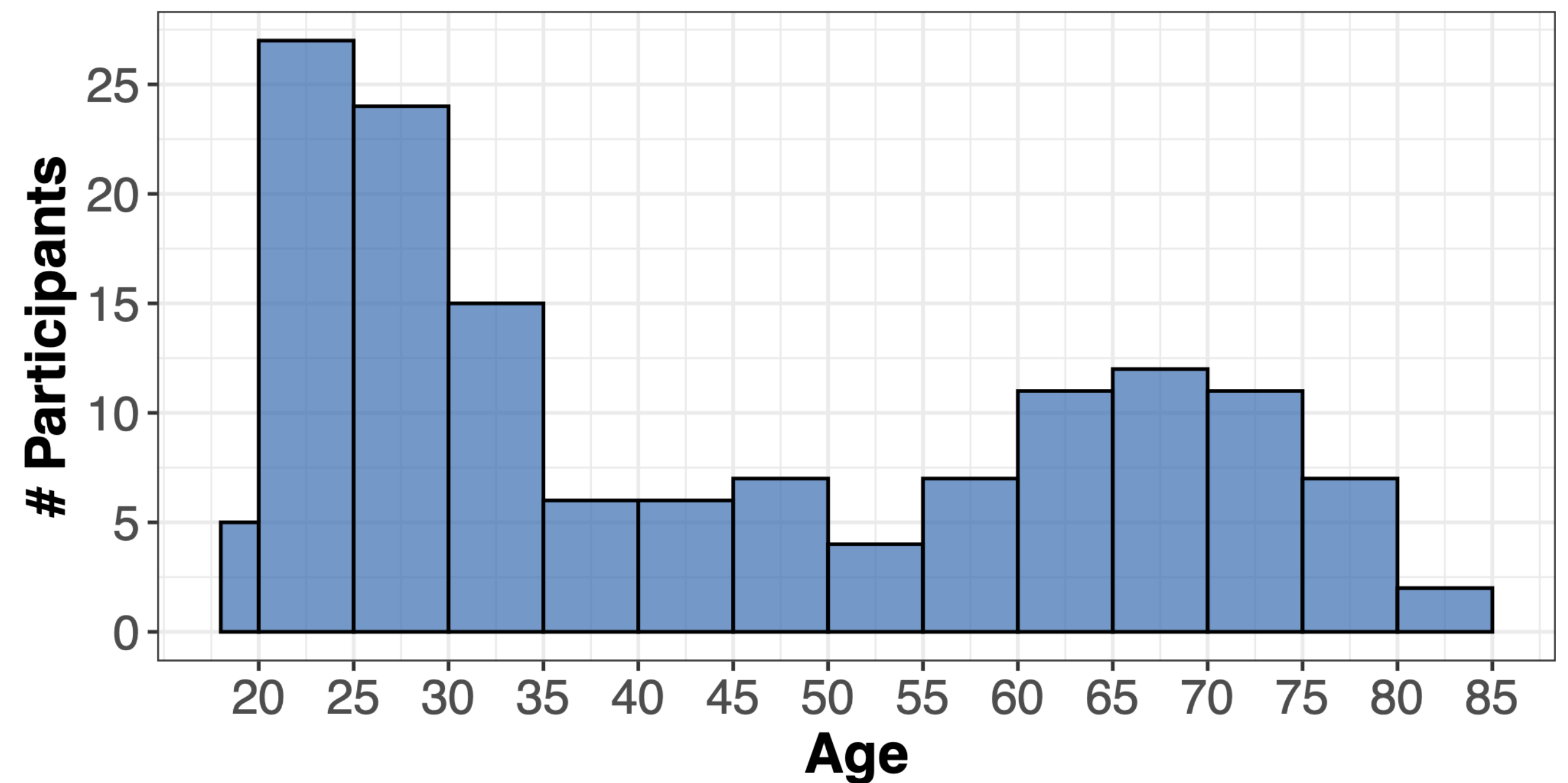
Roadmap

- The Coercion-Resistance Challenge
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- **User Study Results**
 - **Experiences with Coercion**
 - Usability of System with Fake Credentials
 - Verifiability of Real Credential Issuance
- Conclusion

150 Participants

Control Group: 30

Each Treatment Group: 30



Average: 44

Median: 36.5

Reported Coercion Incidents



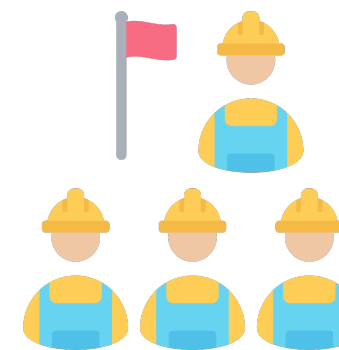
26%

report experiencing or knowing of someone who has experienced at least one form of voter coercion

Reported Sources



Spouse



Labor Unions



Colleagues



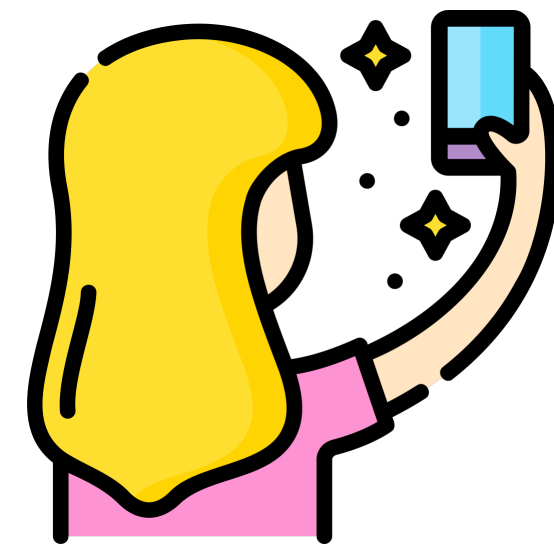
Party Members

Coercion Scenarios

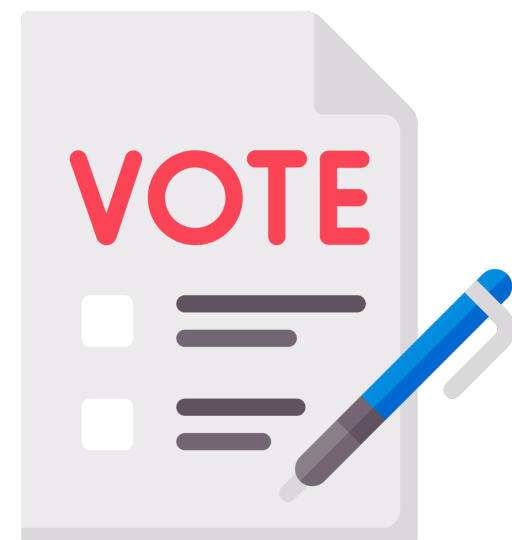
Scenarios in Study



Forceful



Ballot Selfie

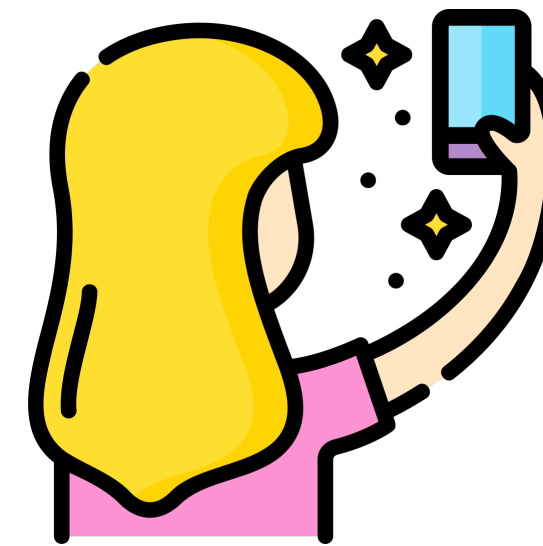


Buying Ballots



Vote-Buying App

Most Likely



Ballot Selfies

Extremely likely: 24%

Reported: 23%*

Most Reported



Forceful

Reported: 46%*

Perceived as **least** likely

* Among the 26% experiencing or knowing of someone who has experienced at least one form of voter coercion.

Coercion Sources

Sources in Study



Family Members



Authority



Employer



Party Members

Most Likely



Family

Extremely likely: 21%

Most Reported



Family

Reported: 58%*

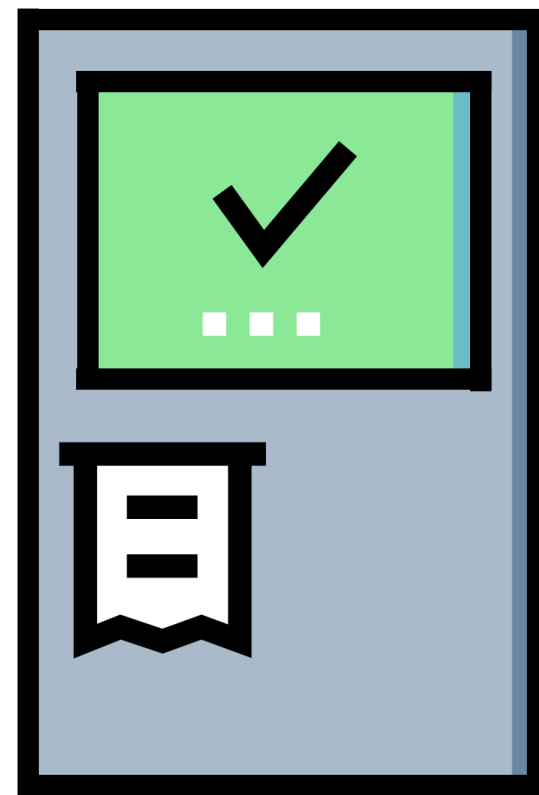
* Among the 26% experiencing or knowing of someone who has experienced at least one form of voter coercion.

Roadmap

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Success Rate

Create
Credentials



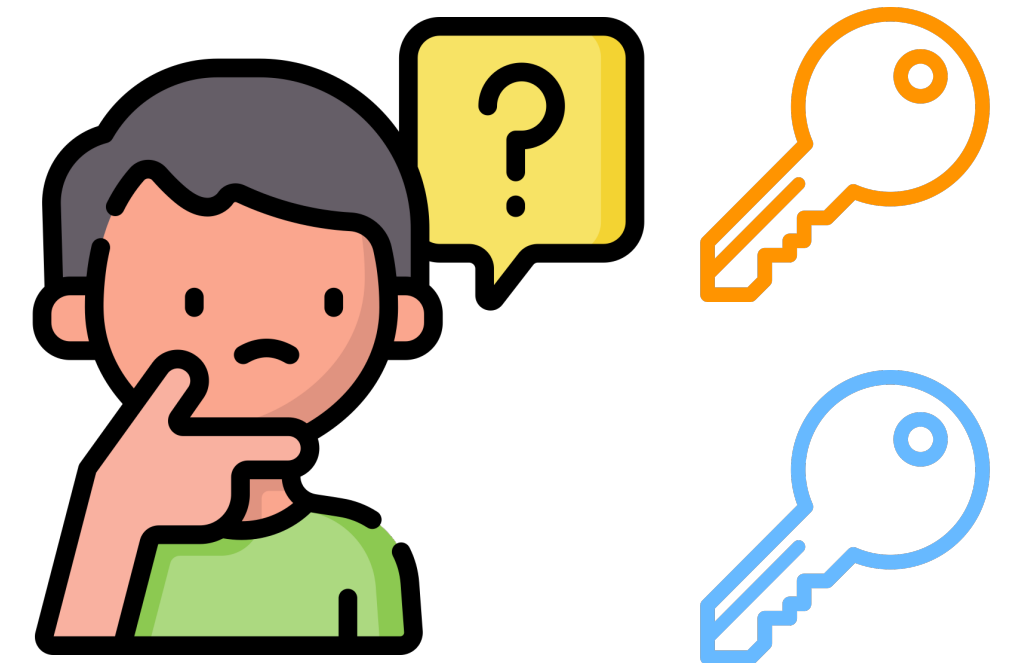
95%

Activate a Credential

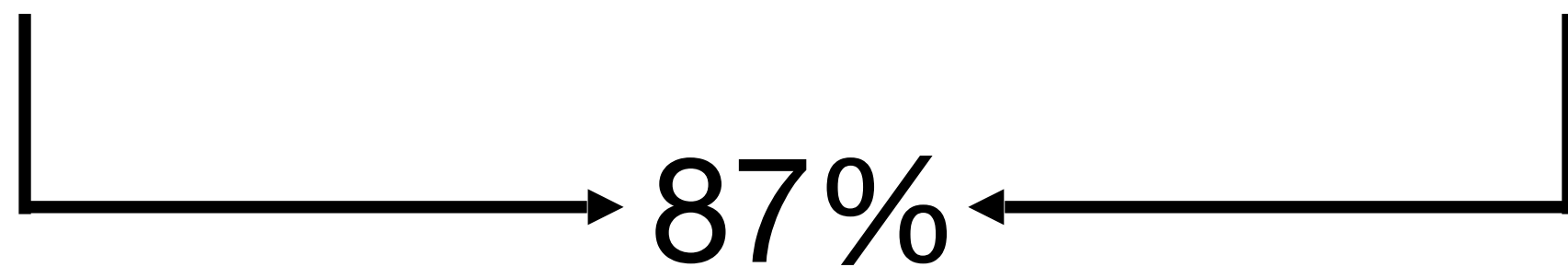


92%

Vote with
Real Credential



90%



Fake Credentials



96% understood its use

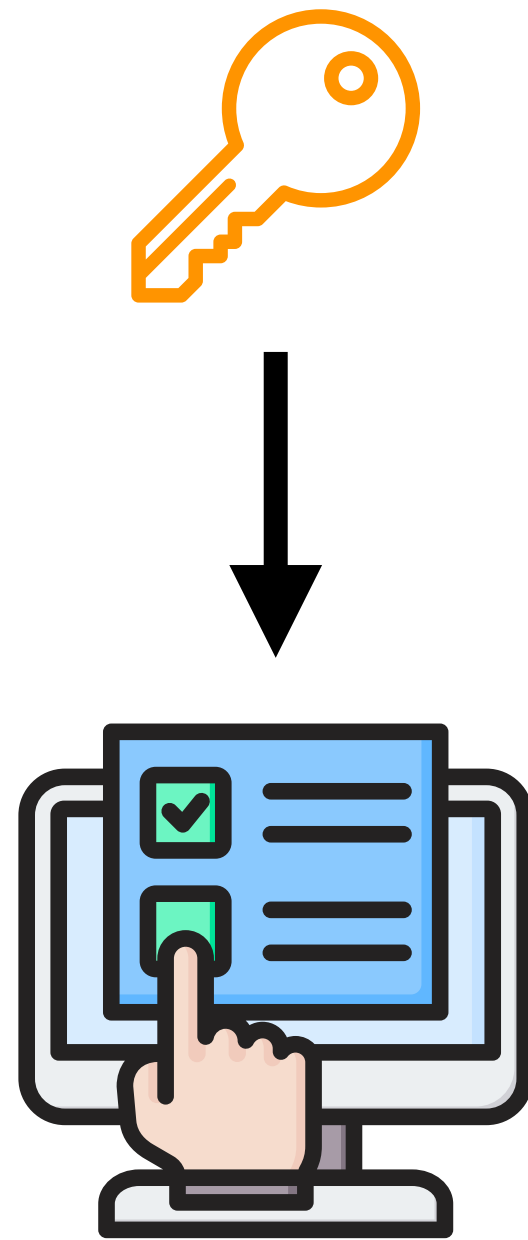


76% create at least
one fake credential



53% would create
in reality

Improper Use of Fake Credentials



10% cast their intended vote
using their fake credential



Memory Lapse?



Environmental
Distractions?



Misunderstanding
Instruction?



Deliberately
Disobeying?

Real World?

Fake
credentials!



Only real
credential



"to argue less to
voting"

"[...] To [...] educate family and
friends"

"create as many [fake]
credentials [...] before the
market became flooded with
[fake] credentials"

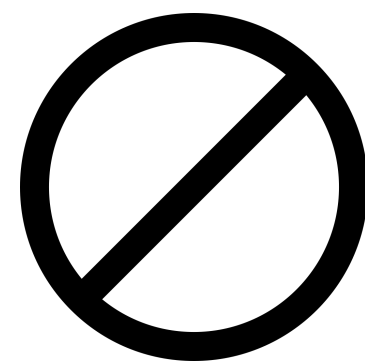
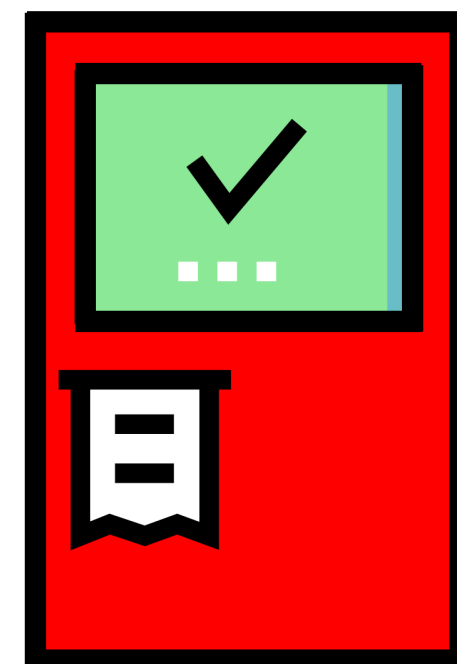
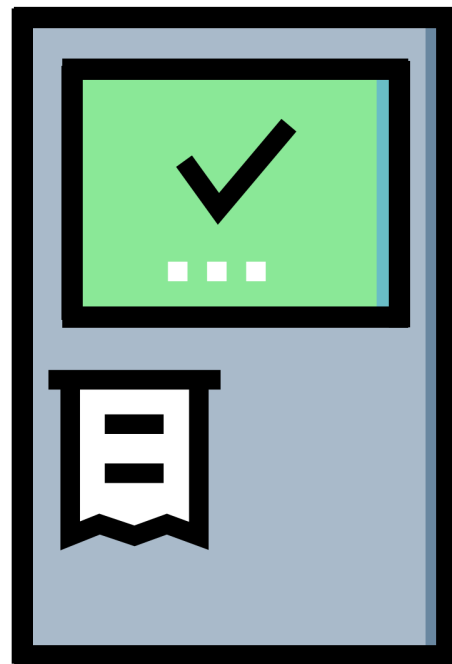
"I cannot imagine
someone [...] I want to take the risk of
[...] on my real
uses"

Roadmap

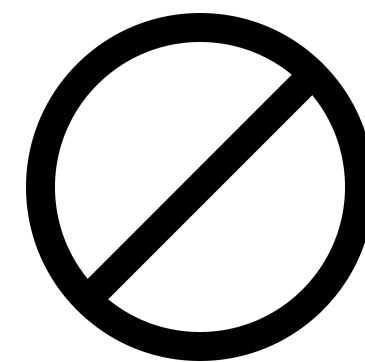
- The Coercion-Resistance Challenge
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Kiosk Reported as Malicious

Without Security Priming

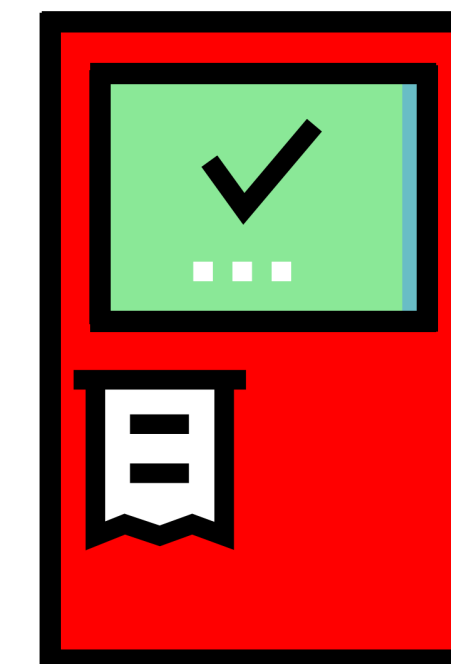
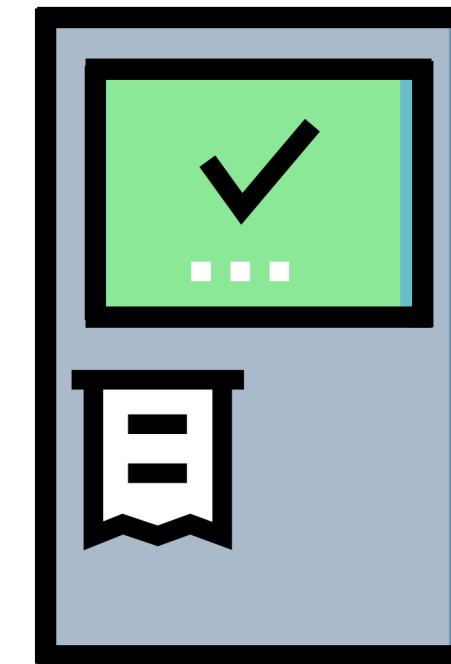


0%



10%

With Security Priming

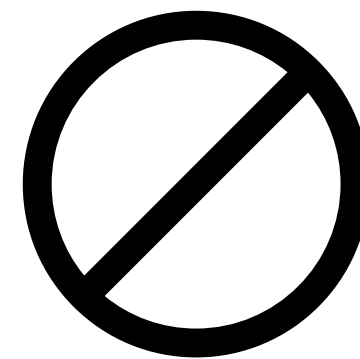
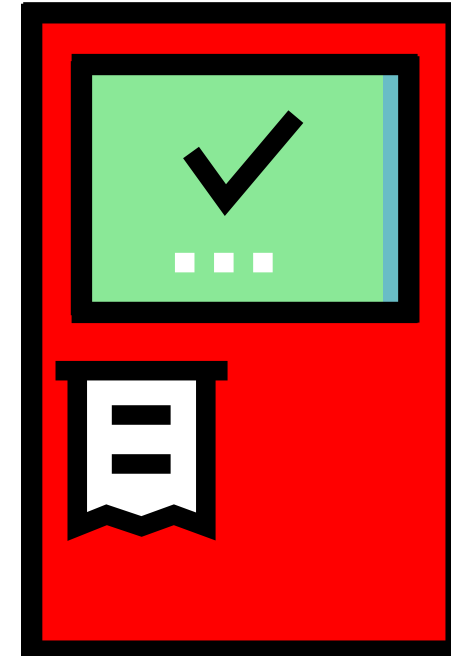


0%





47%

Without Security



7%

	<div>Official Ballot</div> <div>General Election, Tuesday, November 6, 2018 Washtenaw County, Michigan Ann Arbor Township, Precinct 1-BHV</div>	 <div>1009709-21T095751</div>
<div>Partisan Section</div> <div>State</div> <div>Governor and Lieutenant Governor</div> <div>Vote for not more than 1</div> <div><div><input checked="" type="checkbox"/> Bill Schuette</div><div>Lisa Posthumus Lyons</div><div>Republican</div></div> <div><div><input type="checkbox"/> Gretchen Whitmer</div><div>Garlin D. Gilchrist II</div><div>Democrat</div></div> <div><div><input type="checkbox"/> Bill Gelineau</div><div>Angelique Chaiser Thomas</div><div>Libertarian</div></div> <div><div><input type="checkbox"/> Todd Schleiger</div><div>Earl P. Lackie</div><div>U.S. Taxpayers</div></div> <div><div><input type="checkbox"/> Jennifer V. Kurland</div><div>Charin H. Davenport</div><div>Green</div></div> <div><div><input type="checkbox"/> Keith Butkovich</div><div>Raymond Warner</div><div>Natural Law</div></div> <div>Secretary of State</div> <div>Vote for not more than 1</div> <div><div><input checked="" type="checkbox"/> Mary Treder Lang</div><div>Republican</div></div> <div><div><input type="checkbox"/> Jocelyn Benson</div><div>Democrat</div></div> <div><div><input type="checkbox"/> Gregory Scott Stempfle</div><div>Libertarian</div></div> <div><div><input type="checkbox"/> Robert Gale</div><div>U.S. Taxpayers</div></div> <div>Attorney General</div> <div>Vote for not more than 1</div> <div><div><input type="checkbox"/> Tom Leonard</div><div>Republican</div></div> <div><div><input type="checkbox"/> Dana Nessel</div><div>Democrat</div></div> <div><div><input type="checkbox"/> Lisa Lane Gioia</div><div>Libertarian</div></div> <div><div><input type="checkbox"/> Gerald T. Van Sickle</div><div>U.S. Taxpayers</div></div> <div><div><input checked="" type="checkbox"/> Chris Graveline</div><div>No Party Affiliation</div></div>		

Congressional

United States Senator

Vote for not more than 1

☒ John James

Republican

☐ Debbie Stabenow

Democrat

☐ George E. Huffman III

U.S. Taxpayers

☐ Marcia Squier

Green

☐ John Howard Wilhelm

Natural Law

Representative in Congress

12th District

Vote for not more than 1

☒ Jeff Jones

Republican

☐ Debbie Dingell

Democrat

☐ Gary Walkowicz

Working Class

☐ Niles Niemuth

No Party Affiliation

State Boards

Member of the State Board of Education

Vote for not more than 2

☒ Tami Carlone

Republican

☒ Richard Zeile

Republican

☐ Judith P. Pritchett

Democrat

☐ Tiffany Tilley

Democrat

☐ Scotty Boman

Libertarian

☐ John J. Tatar

Libertarian

☐ Karen Adams

U.S. Taxpayers

☐ Douglas Levesque

U.S. Taxpayers

☐ Sherry A. Wells

Green

☐ Mary Anne Hering

Working Class

☐ Logan R. Smith

Working Class

State Boards

Regent of the University of Michigan

Vote for not more than 2

☒ Andrea Fischer Newman

Republican

☒ Andrew Richner

Republican

☐ Jordan Acker

Democrat

☐ Paul Brown

Democrat

☐ James Lewis Hudler

Libertarian

☐ John Jacob

Libertarian

☐ Joe Sanger

U.S. Taxpayers

☐ Crystal Van Sickle

U.S. Taxpayers

☐ Kevin A. Graves

Green

☐ Marge Katchmark Sallows

Natural Law

Trustee of Michigan State University

Vote for not more than 2

☒ Dave Dutch

Republican

☒ Mike Miller

Republican

☐ Brianna T. Scott

Democrat

☐ Kelly Charron Tebay

Democrat

☐ Bruce Campbell

Libertarian

☐ Tim Orzechowski

Libertarian

☐ Janet M. Sanger

U.S. Taxpayers

☐ John Paul Sanger

U.S. Taxpayers

☐ Aaron Mariasy

Green

☐ Bridgette R. Abraham-Guzman

Natural Law

Nonpartisan Section

Judicial

Justice of Supreme Court

Vote for not more than 2

☒ Samuel Bagenstos

☒ Megan Kathleen Cavanagh

☐ Elizabeth T. Clement

Justice of Supreme Court

☐ Doug Dern

☐ Kerry Lee Morgan

☐ Kurtis T. Wilder

Justice of Supreme Court

Judge of Court of Appeals

3rd District

Incumbent Position

Vote for not more than 2

☒ Jane Marie Beckering

Judge of Court of Appeals

☒ Douglas B. Shapiro

Judge of Court of Appeals

Judge of Circuit Court

22nd Circuit

Incumbent Position

Vote for not more than 2

☒ Timothy Patrick Connors

Judge of Circuit Court

☒ Carol Kuhnke

Judge of Circuit Court

Judge of Probate Court

Incumbent Position

Vote for not more than 1

☒ Darlene A. O'Brien

Judge of Probate Court

Judge of District Court

14A District

Incumbent Position


Vote for not more than 1

☒ J. Cedric Simpson

Judge of District Court

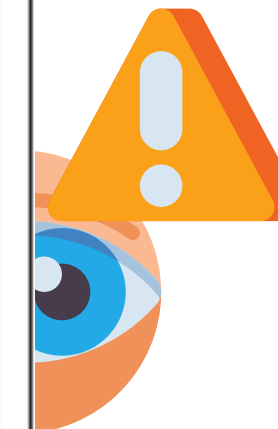
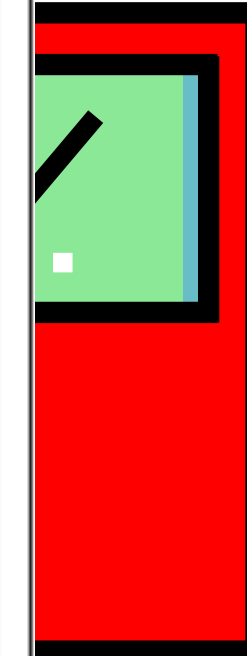
☐ Thomas B. Bourque

1009709-21T095751



from BMDs

Priority Priming

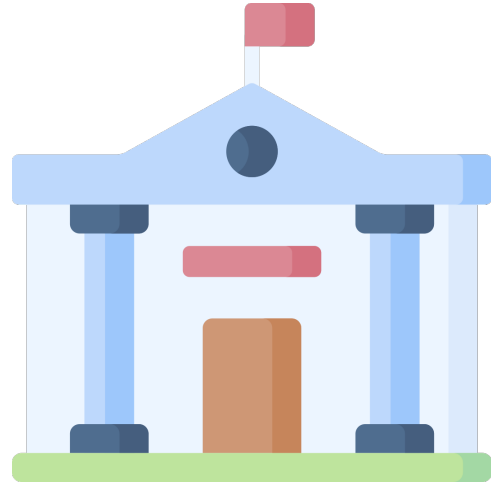


%

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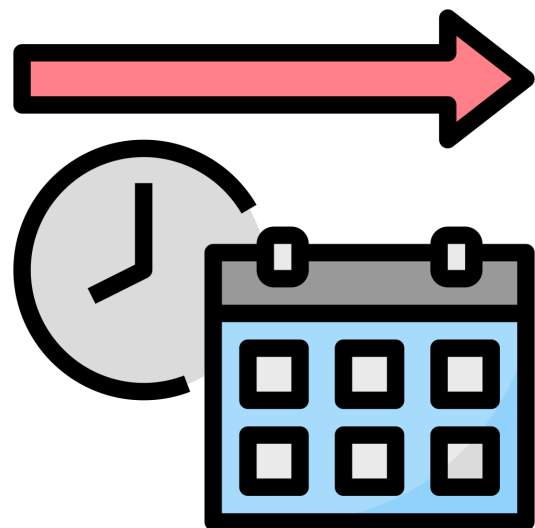
Study Limitations



Did not replicate an official registration environment



Did not study voters actually under coercion



Did not study long term storage, use of credentials



Conclusion

Introduction to Fake Credentials

96%

Understood the use
of fake credentials

53%

Willing to create fake
credentials in reality

Usability of Fake Credentials

STAR-Vote: 93%

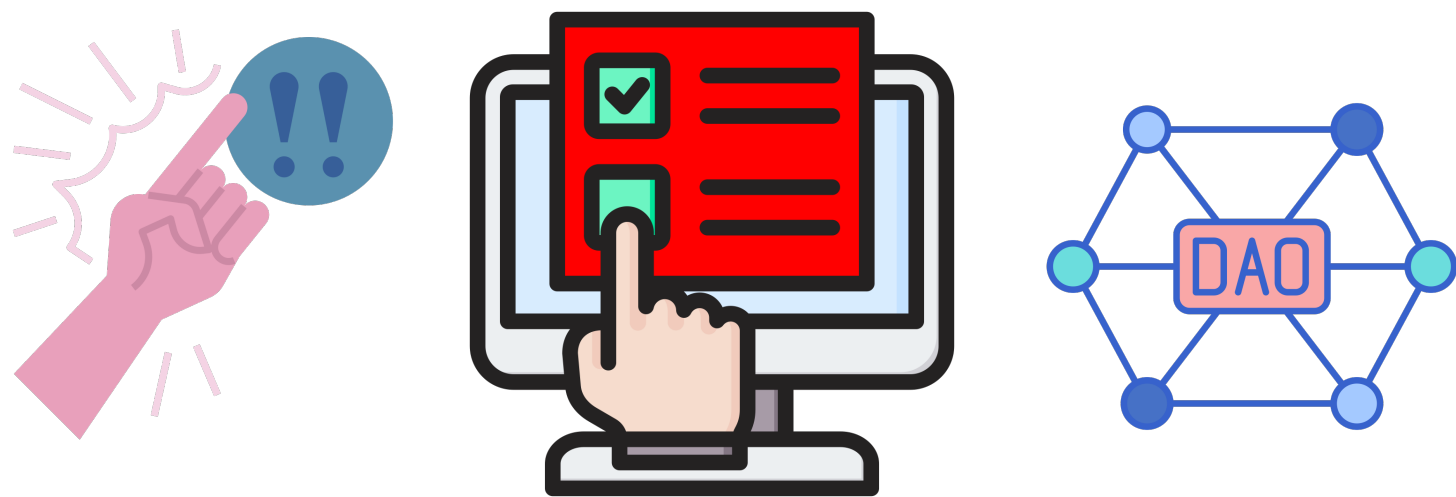
Online Voting

TRIP
83%

Helios: 60%

Prêt à Voter: 60%

The Coercion Problem



26%

faced coercion or know
of someone who did