

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

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Schweizerische Eidgenossenschaft
Confédération suisse
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Confederaziun svizra

armasuisse

Federal Office for Defence Procurement



**Massachusetts
Institute of
Technology**

State-of-the-art Voting Architecture

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

EPFL

D-Voting  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.

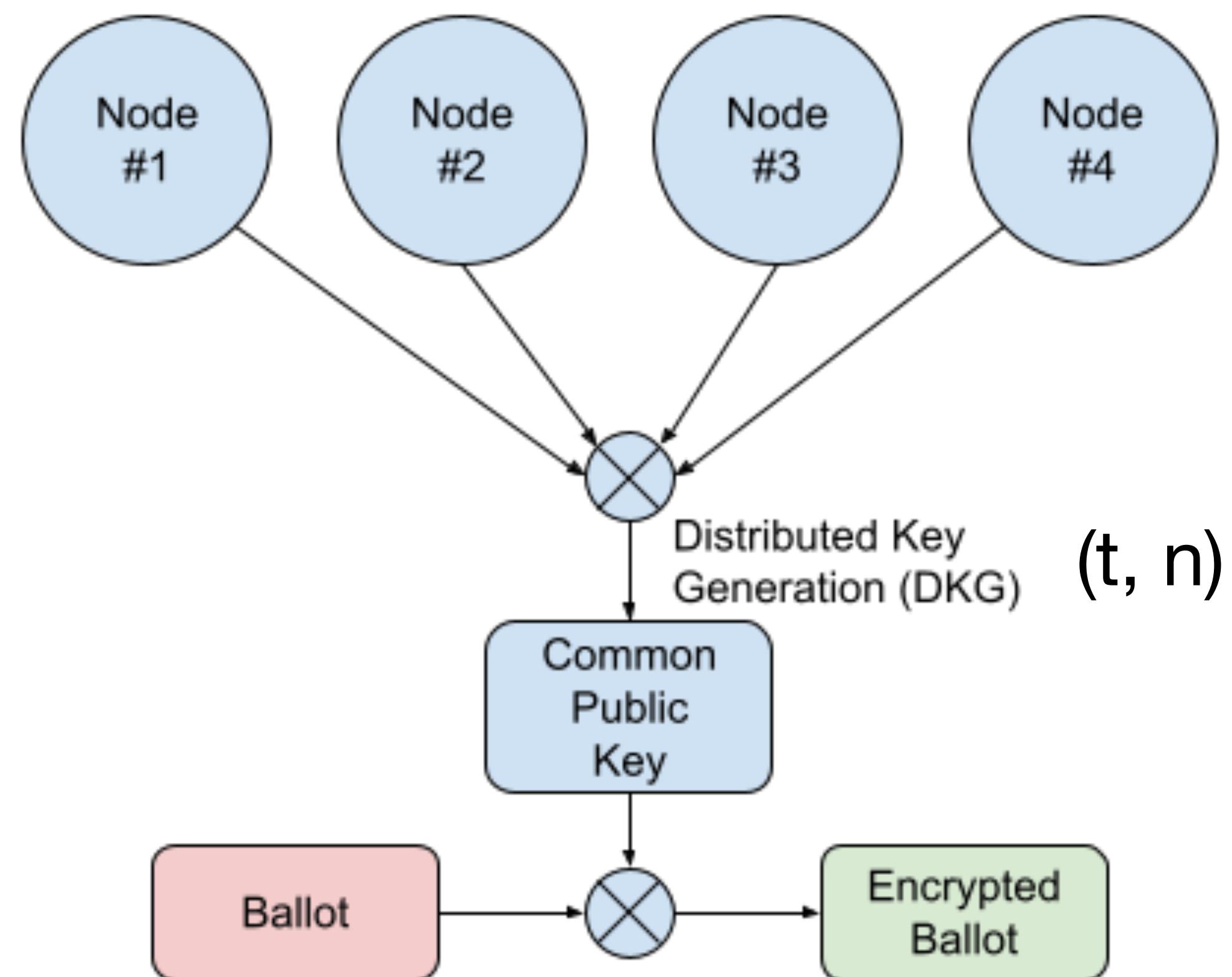
[Bastian Gardel](#)
 [Bertrand Lacour](#)
 [Chantal Mellier](#)
 [Charlotte Weil](#)
 [Consuelo Antille](#)
 [Frédéric Dreyer](#)
 [Helena Kovacs](#)
 [Ian Bourgeois](#)
 [Iris Capdevila](#)
 [Marcia Gouffon](#)
 [Mélanie Kolbe-Guyot](#)
 [Olivier Colomb](#)
 [Philippe Abdel Sayed](#)
 [Samuel Cotture](#)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

 [Cast vote](#) [Back](#)

Properties

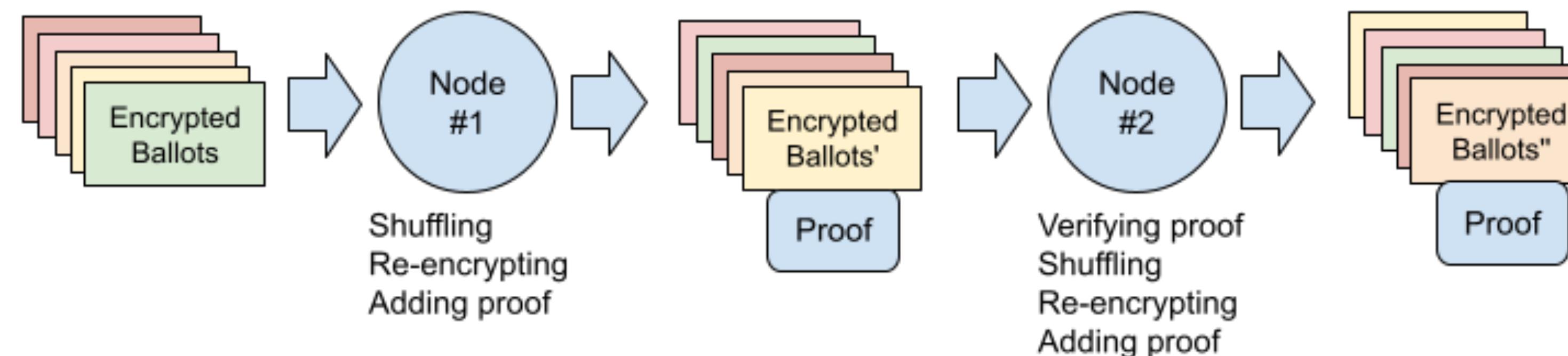
- **Vote Secrecy:** do not reveal a voter's vote to anyone
- **Universal Verifiability:** allow an auditor or the public to check that the election outcome corresponds to the registered votes
- **Individual verifiability:** convincing a voter that the system correctly registered their vote

Vote Secrecy

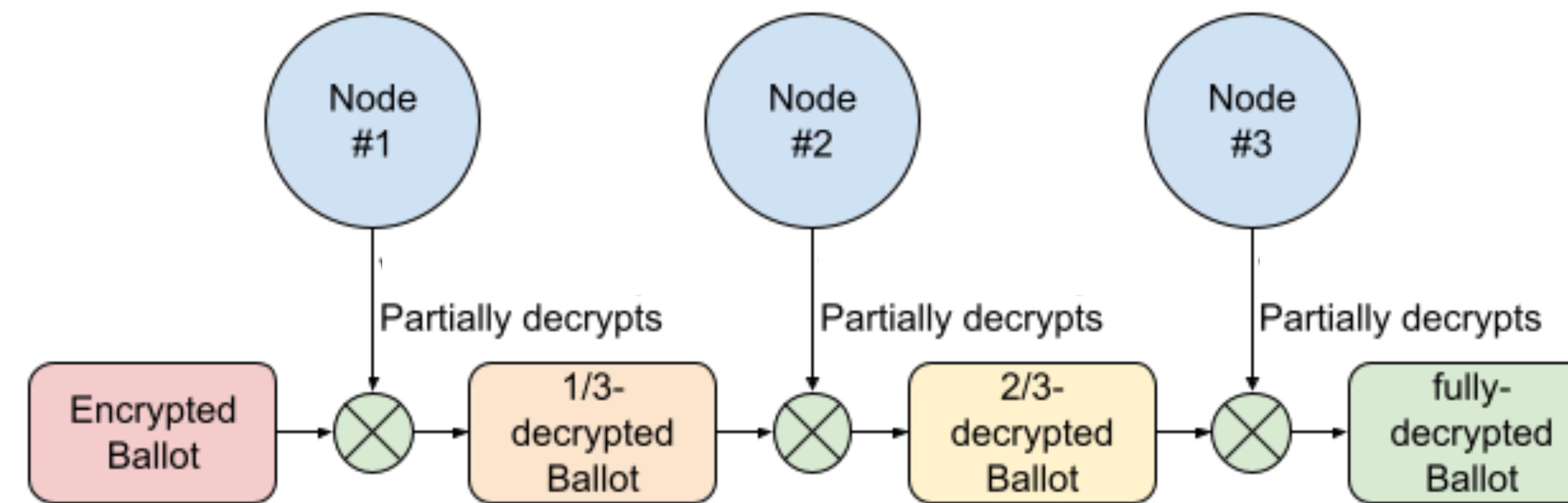


Universal Verifiability

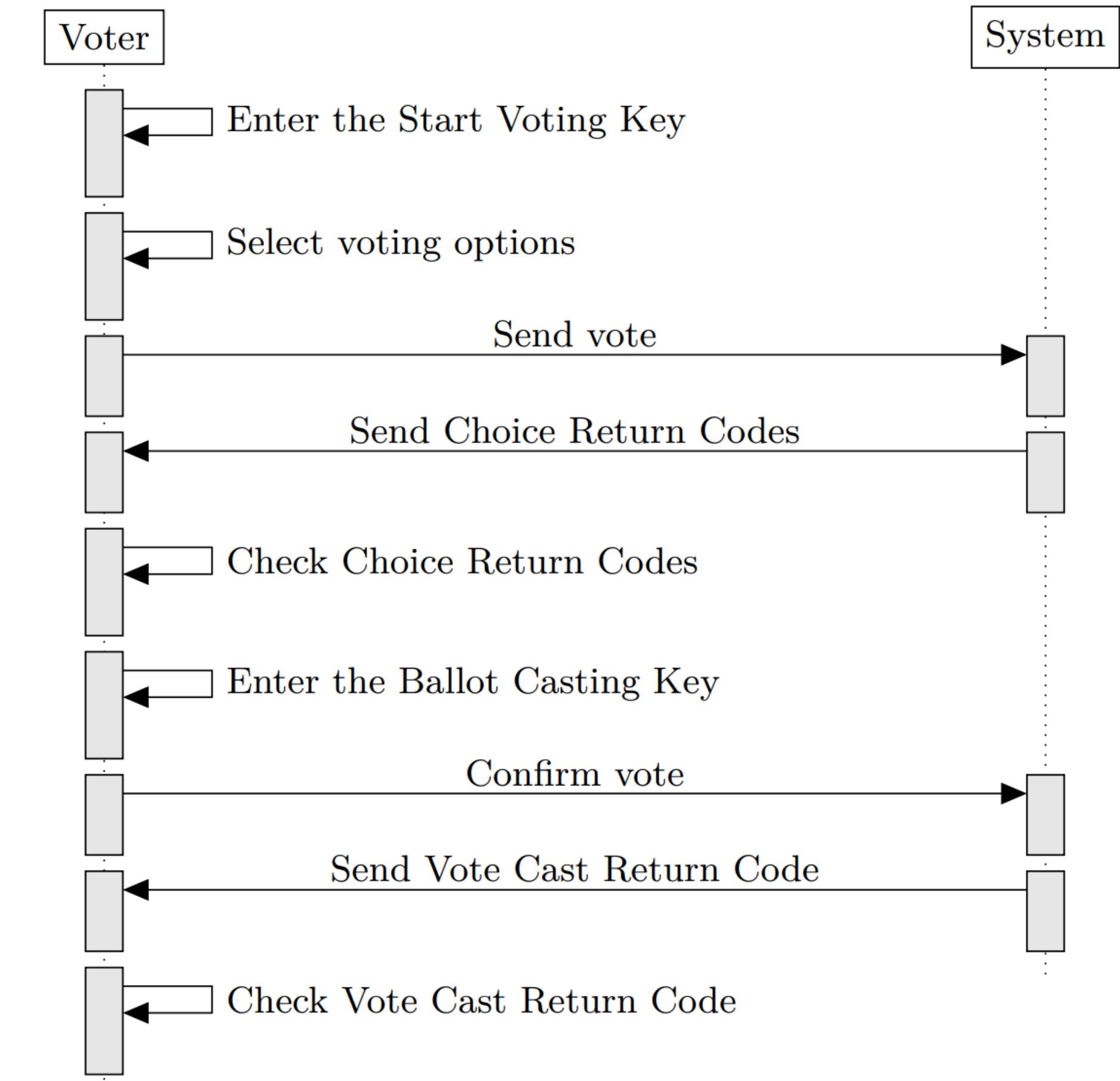
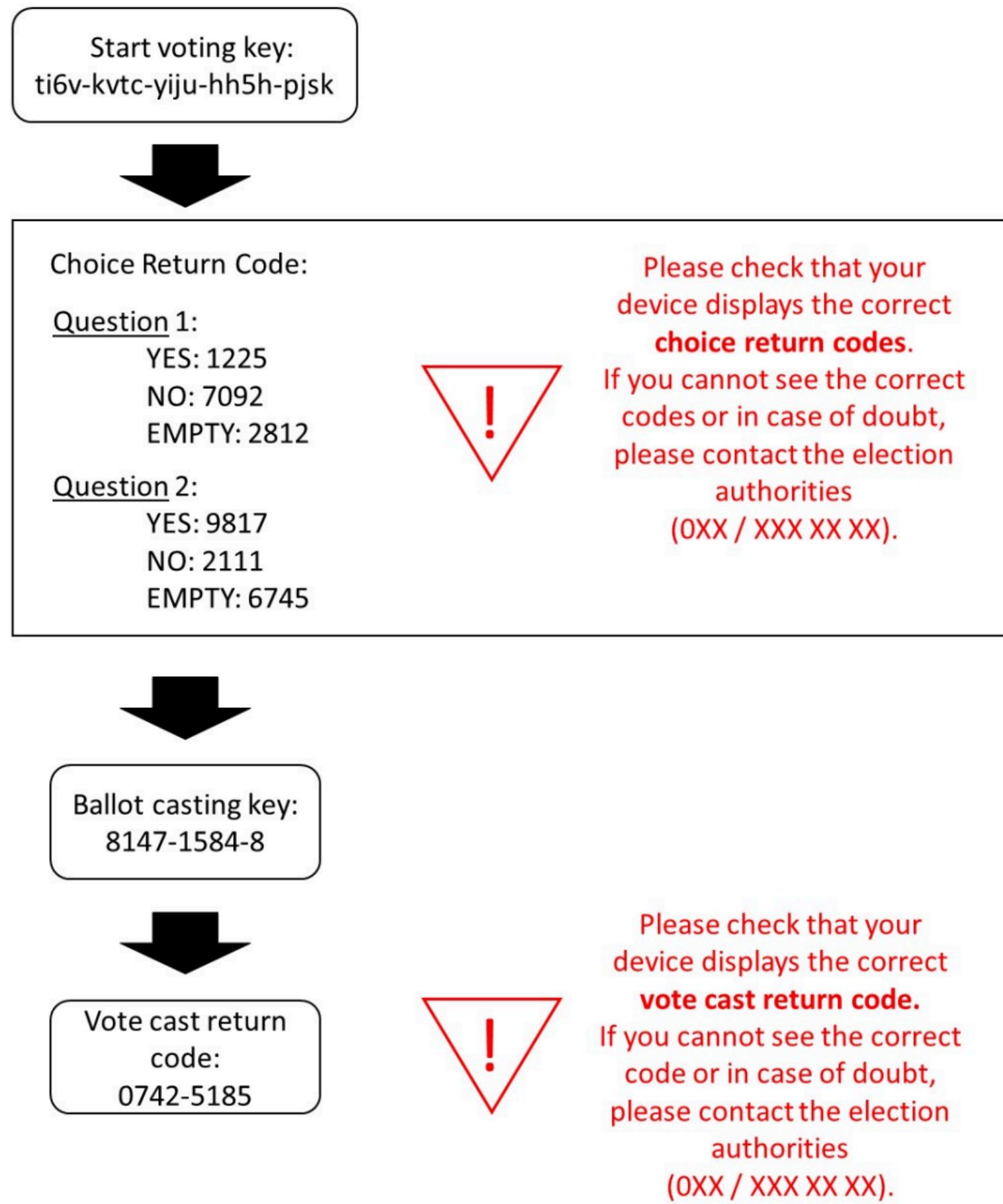
“Mixnet”



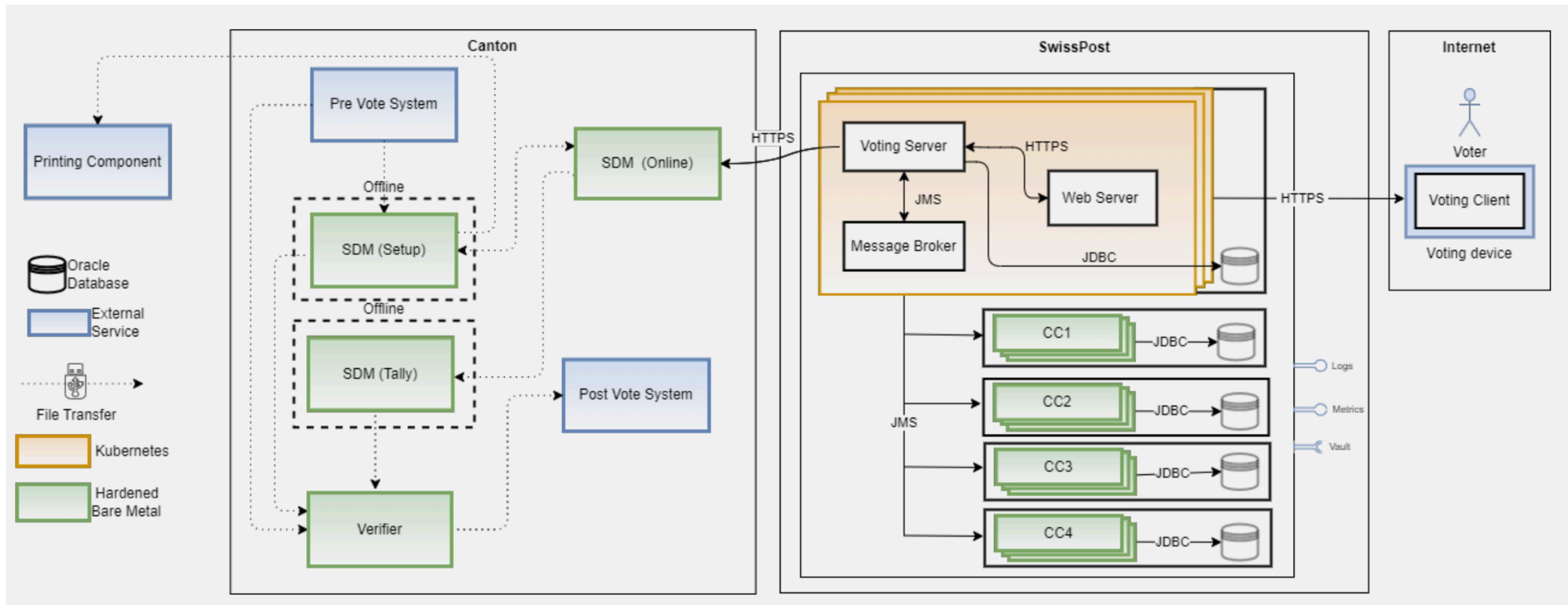
Verifiable
Threshold
Decryption



Individual Verifiability (Swiss Post)



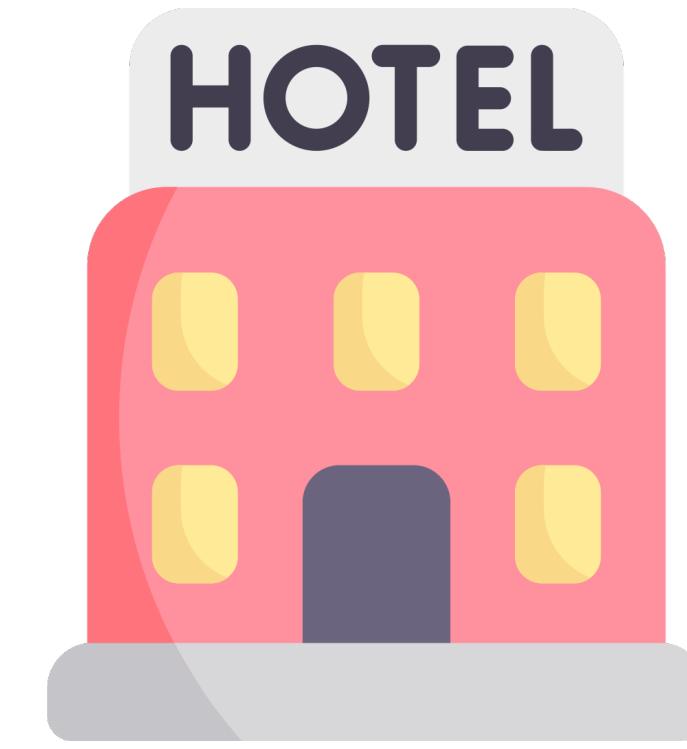
Swiss Post System Model



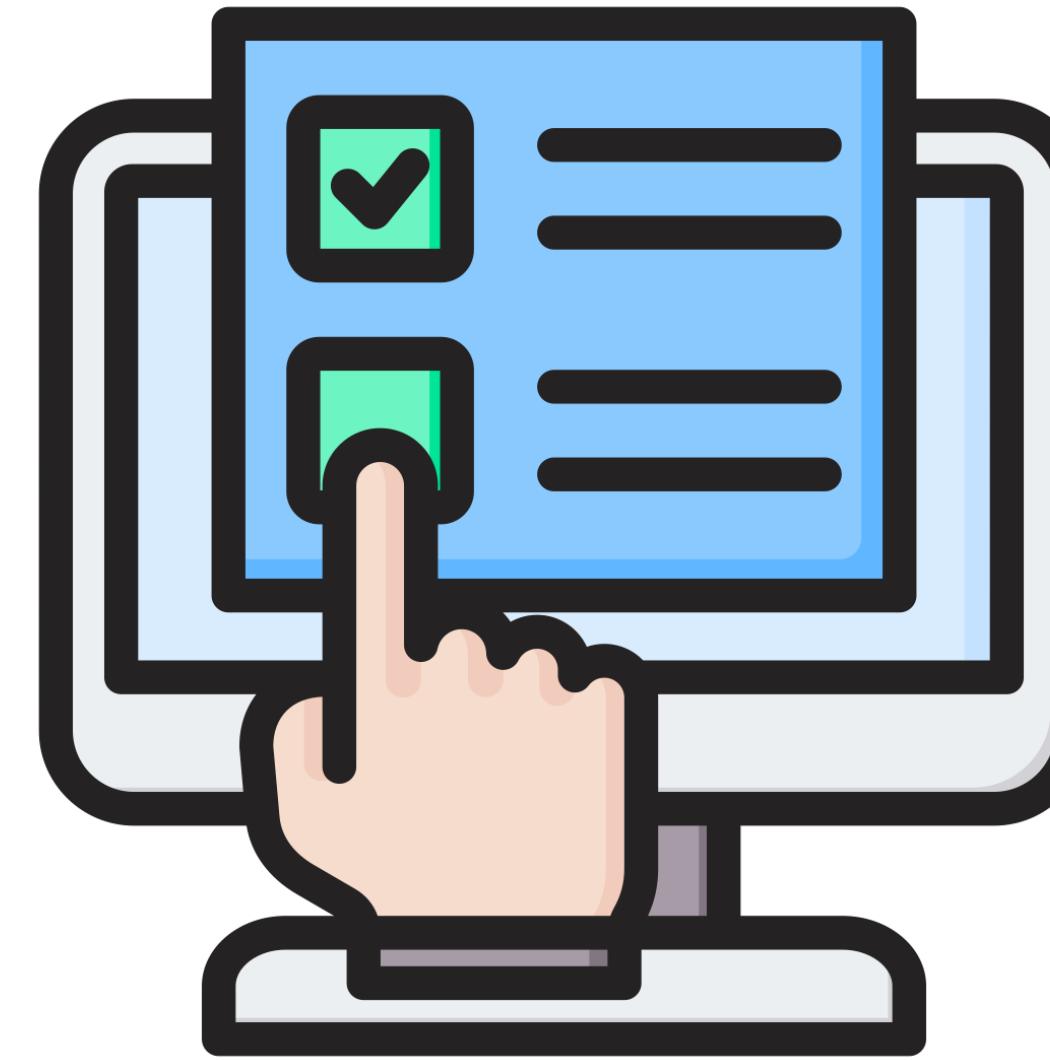
Online Voting



Home



Hotel Room



Increased
Convenience

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

Online Voting



– Risk of Coercion

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

Cast **your coercer's** vote

Coercion in E-Voting



Forceful

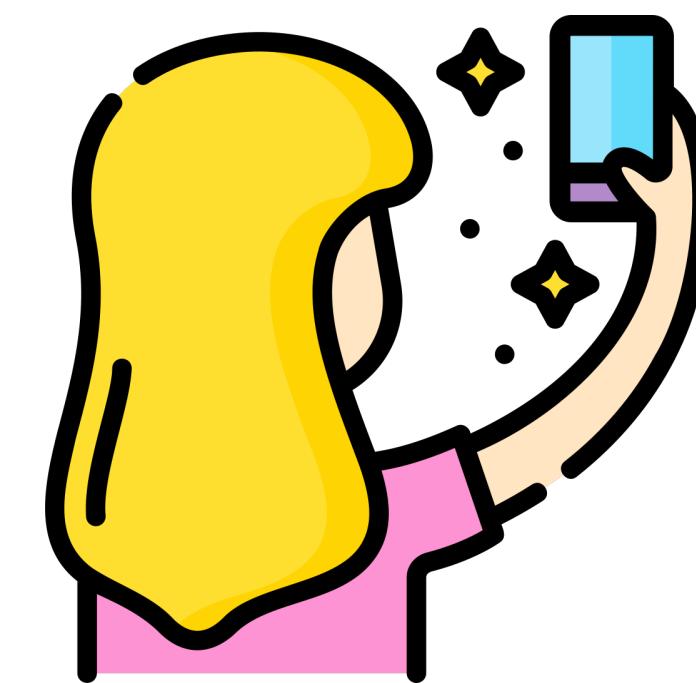


Vote-Buying Selfie

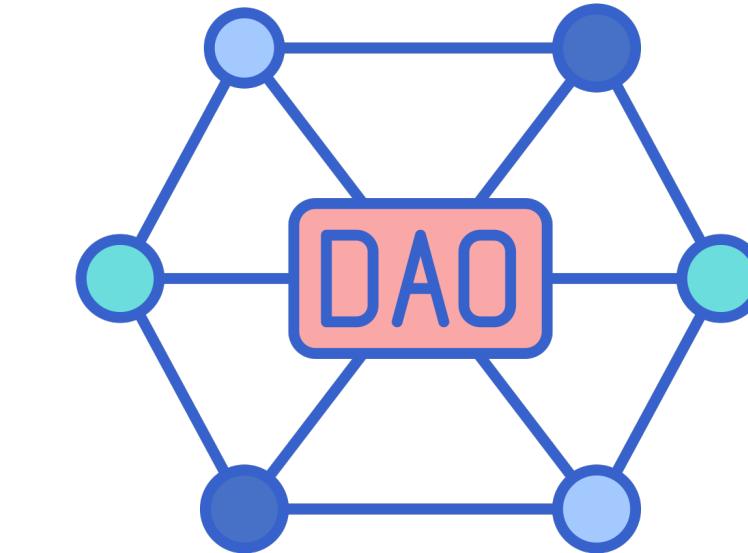
Coercion in E-Voting



Forceful



Vote-Buying Selfie



“Dark” DAOs¹:
Vote Buying at Scale

Online voting is susceptible to more scalable coercion threats

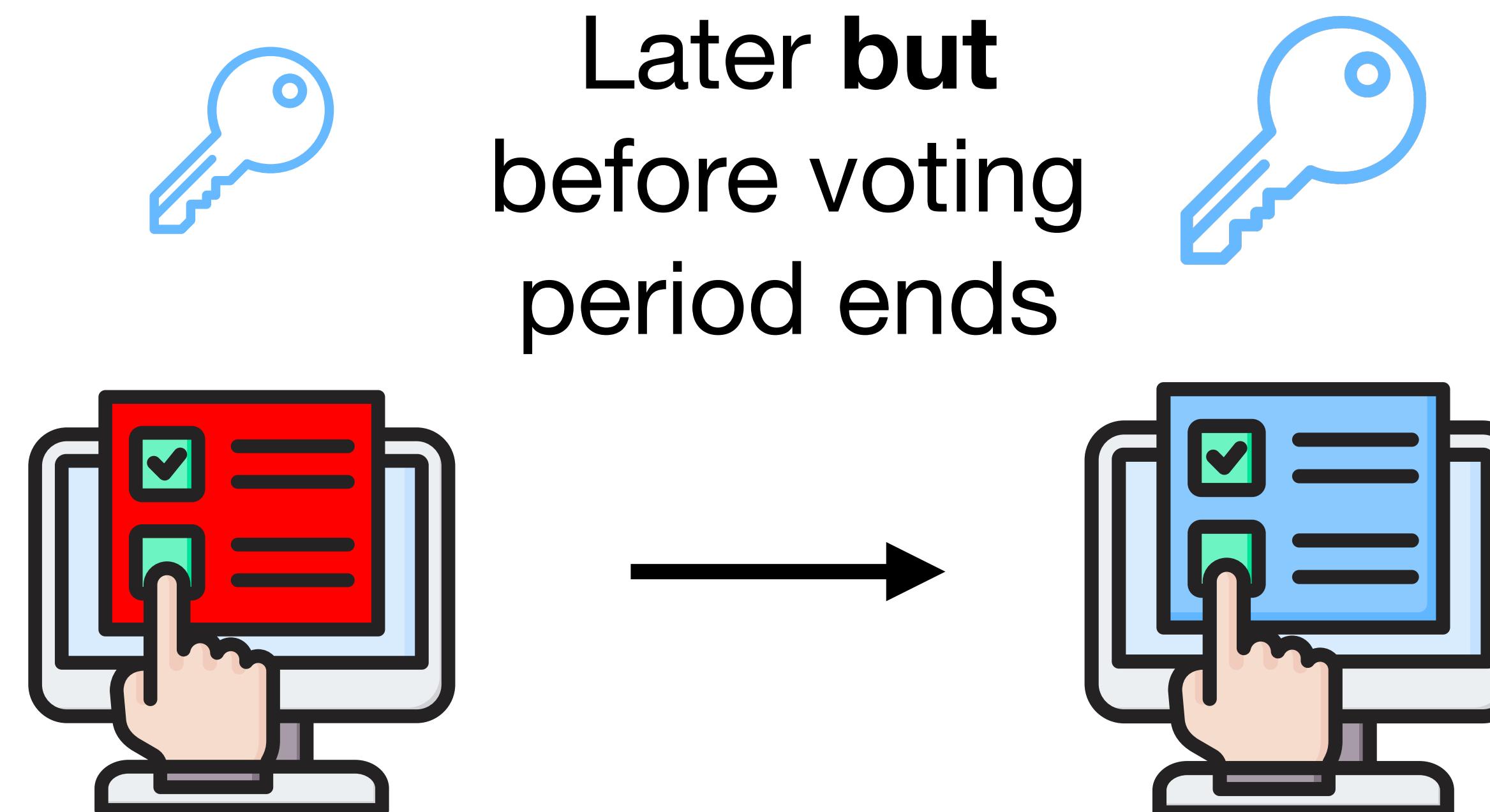
1. Austgen, James, et al. *DAO Decentralization: Voting-Bloc Entropy, Bribery, and Dark DAOs*. arXiv:2311.03530, 6 Nov. 2023.

Roadmap

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

Coercion-Resistance

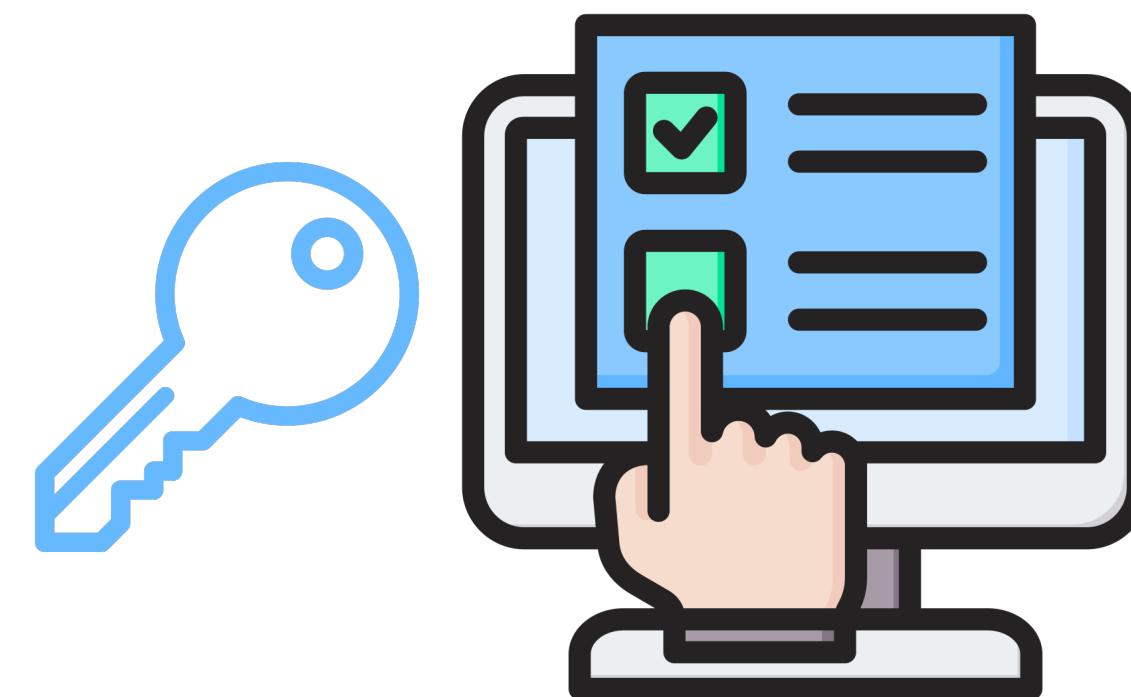
Deniable Re-Voting



- + Override coerced vote
- Last-minute coercion

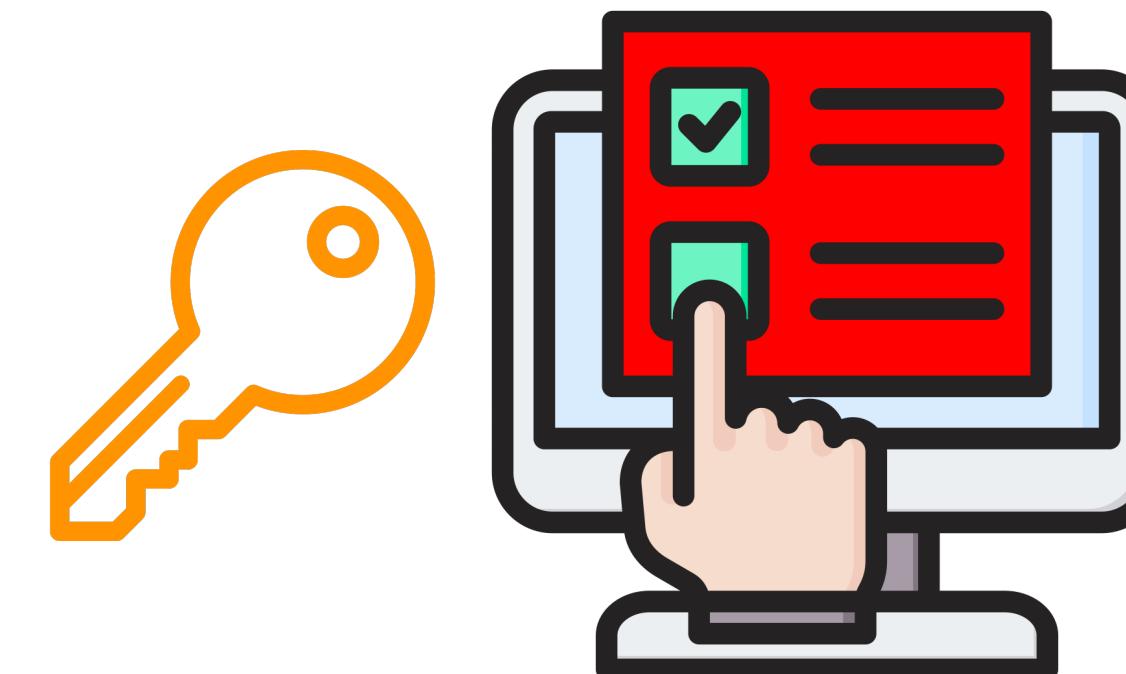
Fake Credentials¹

Real Vote
Counts



Intended Vote

Fake Vote(s)
Does NOT count



Coerced Vote

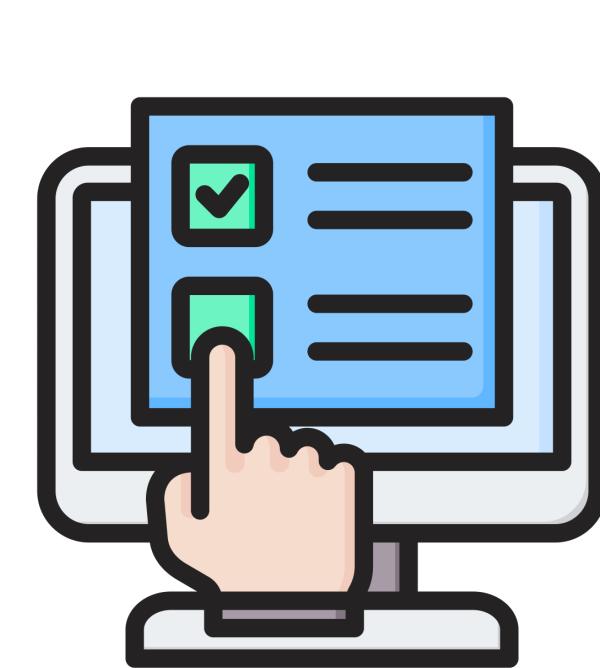
Fake credentials cast votes that **do not** count **while** being **indistinguishable** from **real credentials** which cast votes that **do** count.

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

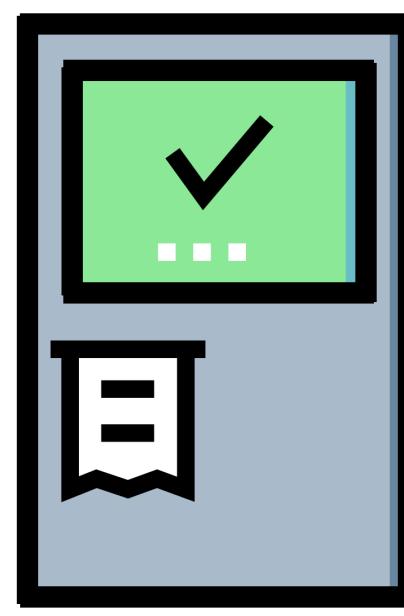
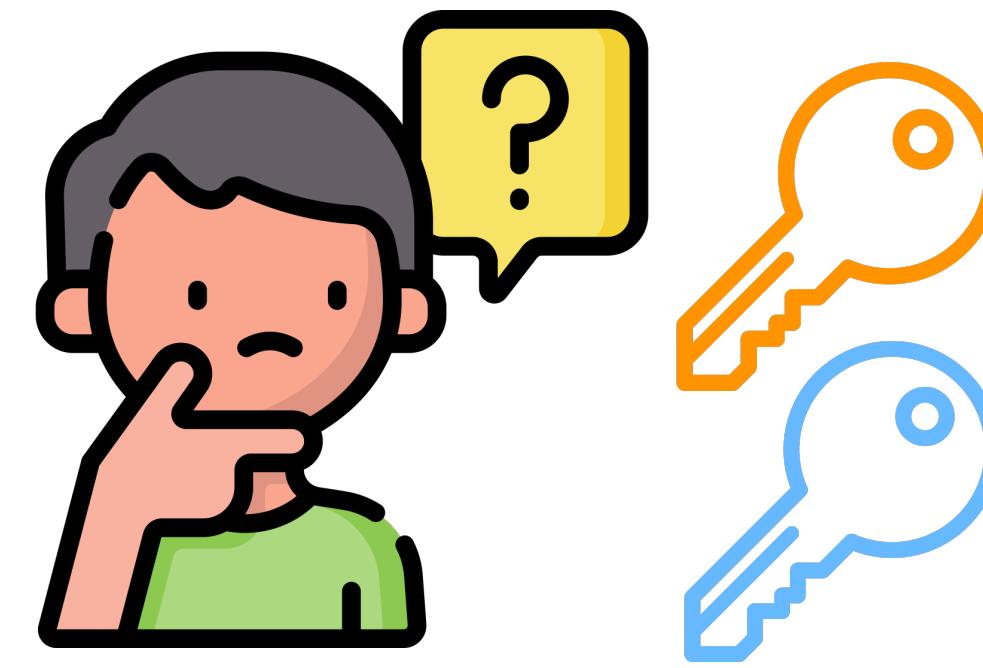
Usability & Verifiability Concerns



Comprehension?



Real or Fake Credential?



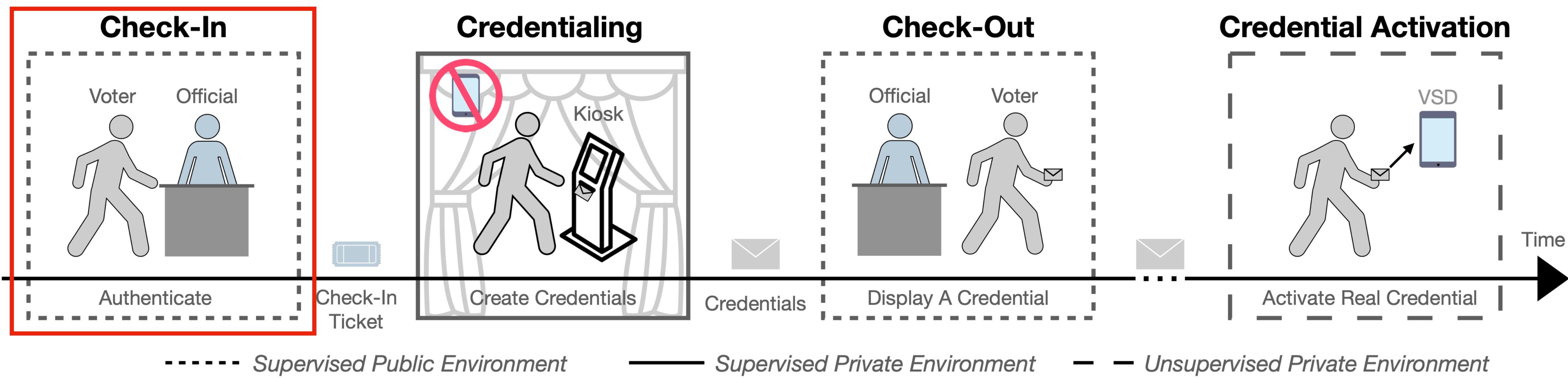
Genuinely real?



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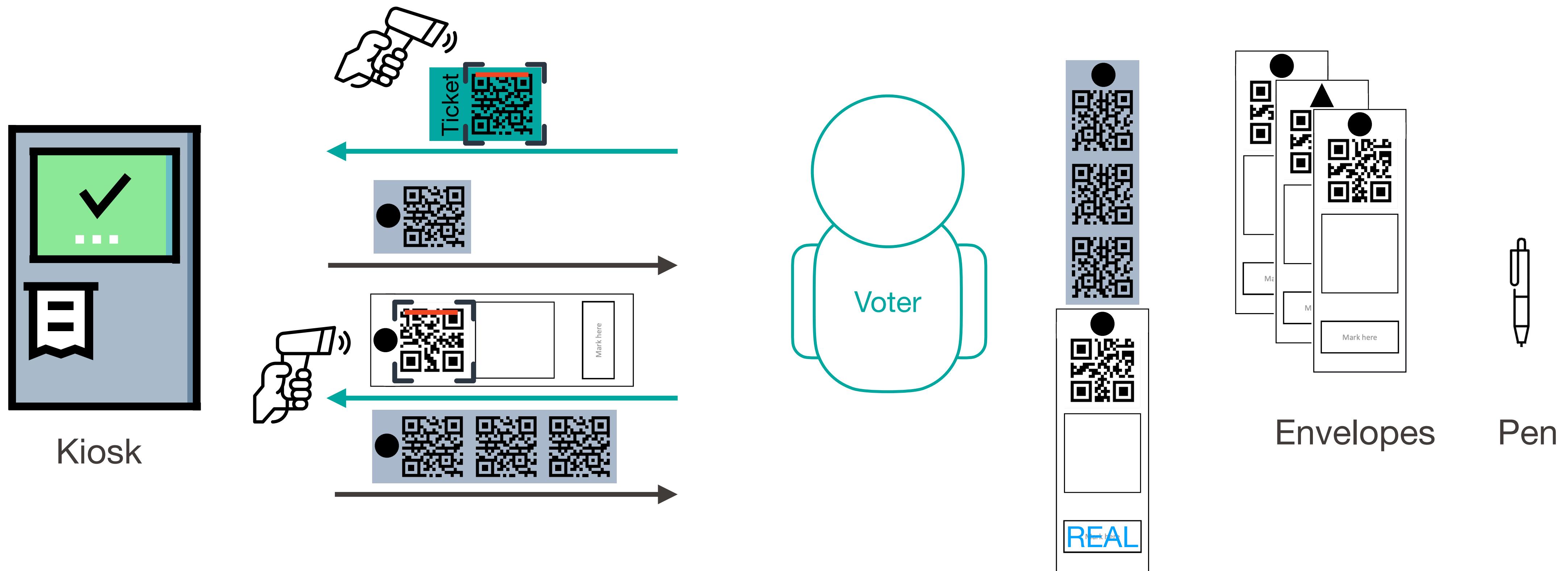
Trust-Limited Coercion-Resistant In-Person Registration¹



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

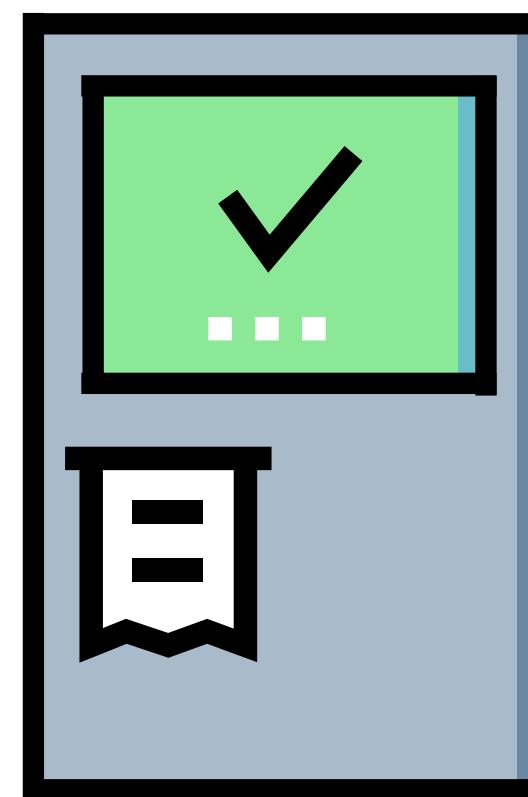
Real Credential Creation Process

(with an interactive zero-knowledge proof)

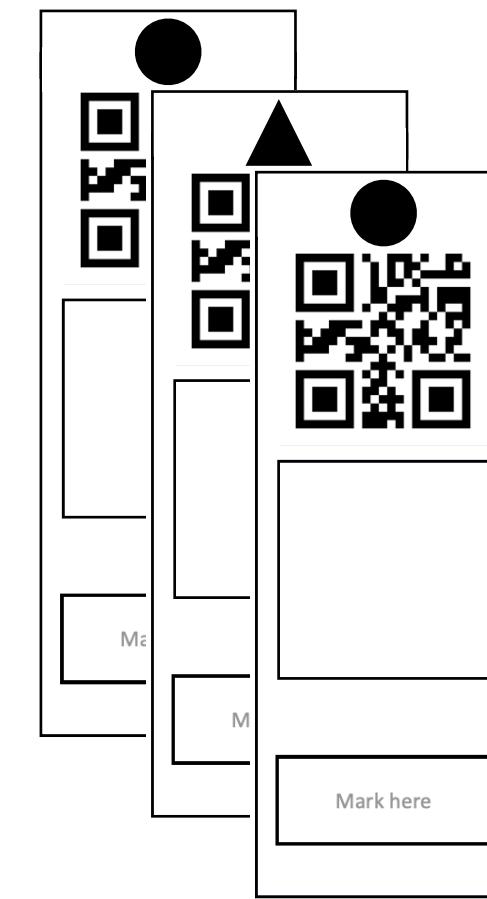
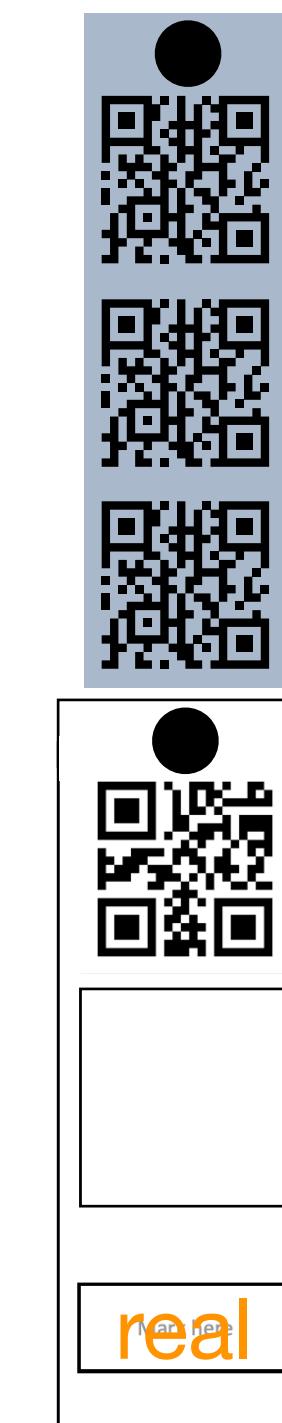
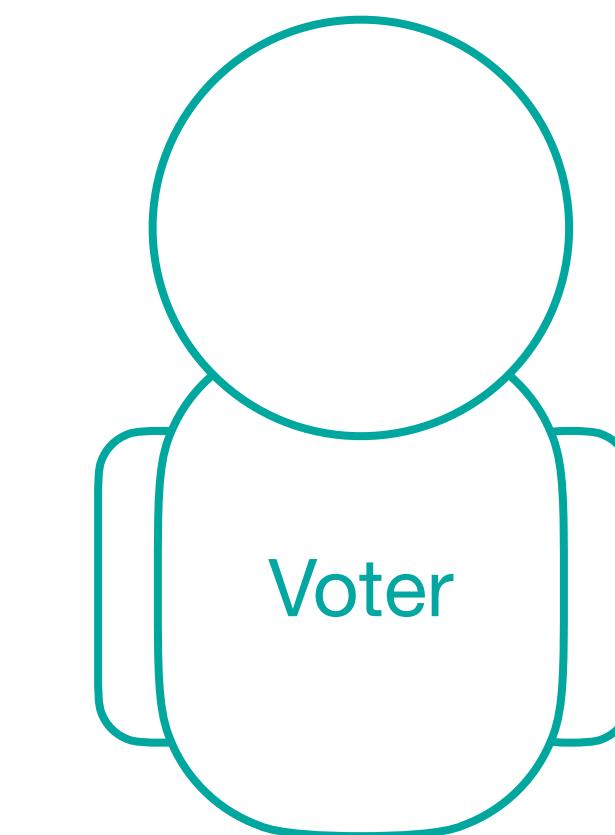
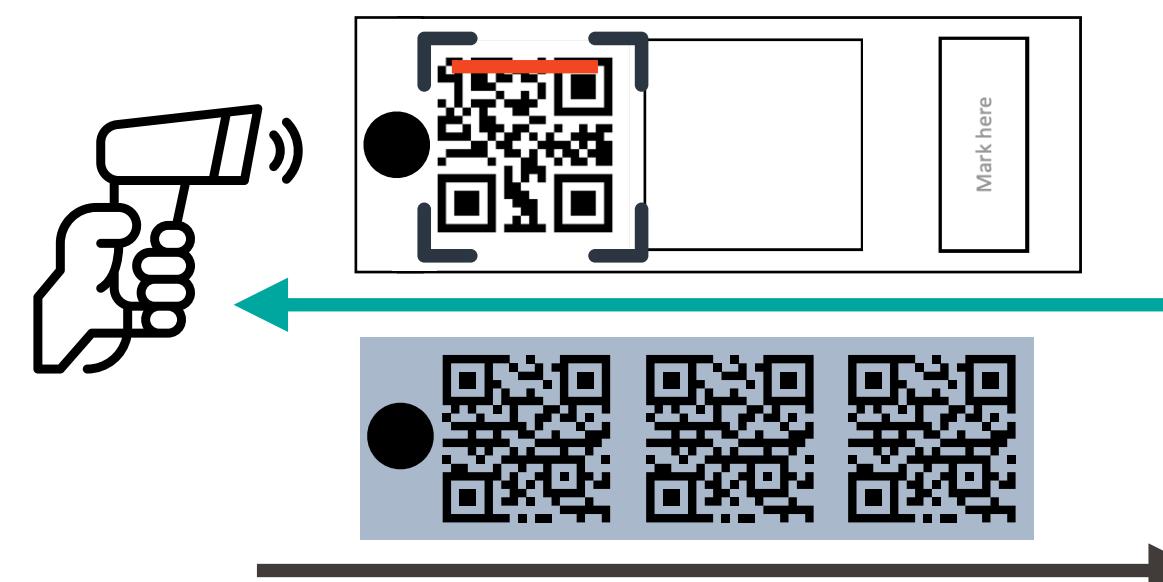


Voter **presents** envelope after kiosk prints **first** QR code

Fake Credential Creation Process ↪



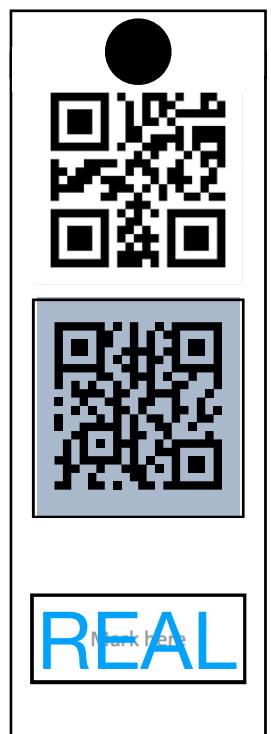
Kiosk



Envelopes



Pen



Voter presents any unused envelope

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Study Flow & Location

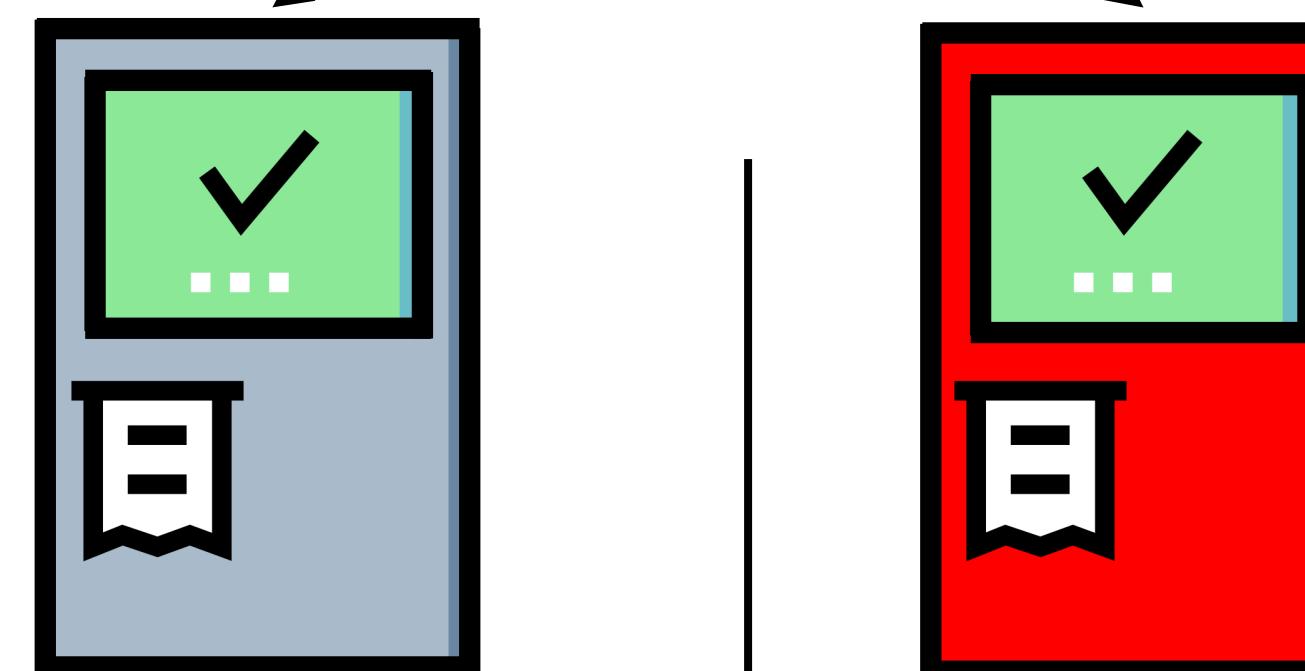
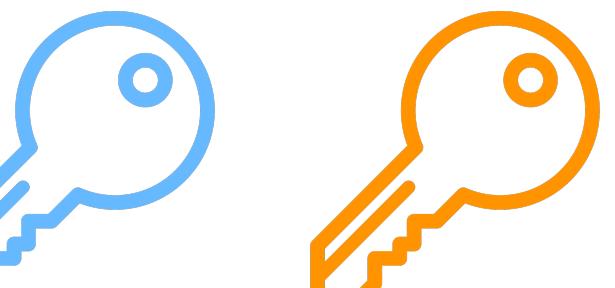
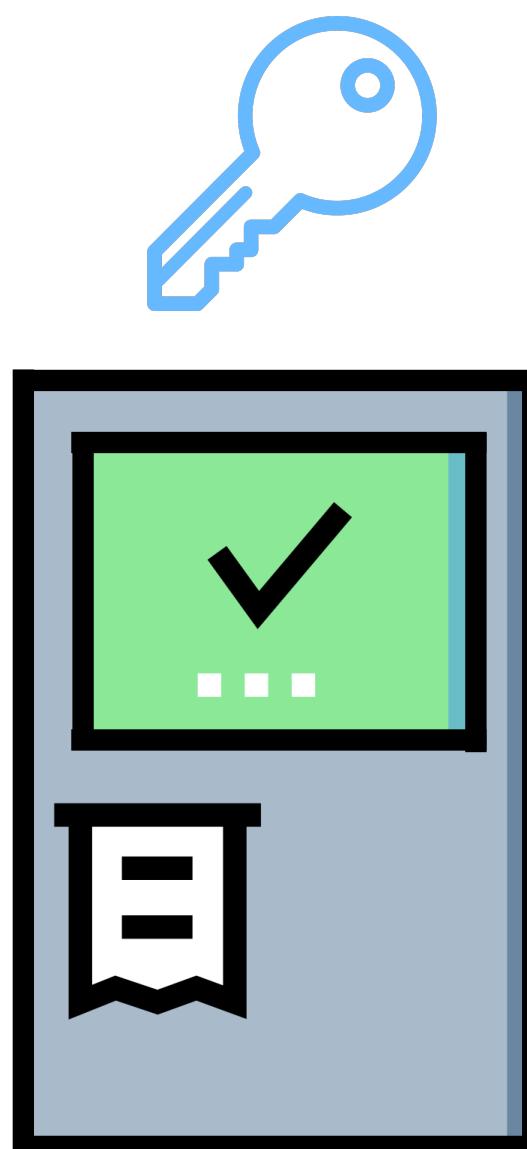
1. Enrollment
2. Instructional Video
3. TRIP Registration
4. Voting
5. Survey



Suburban Park of Boston, MA

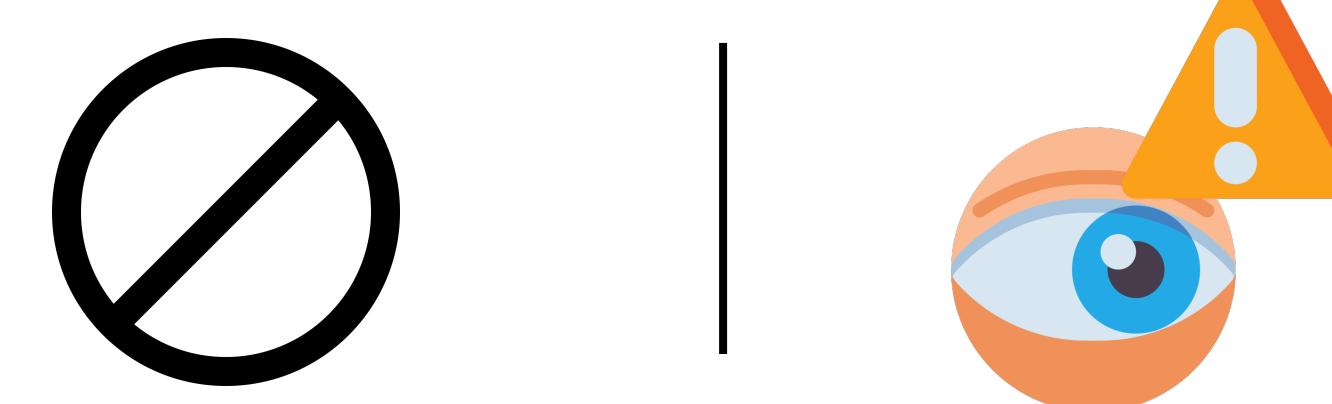
5 Study Groups

Control Group



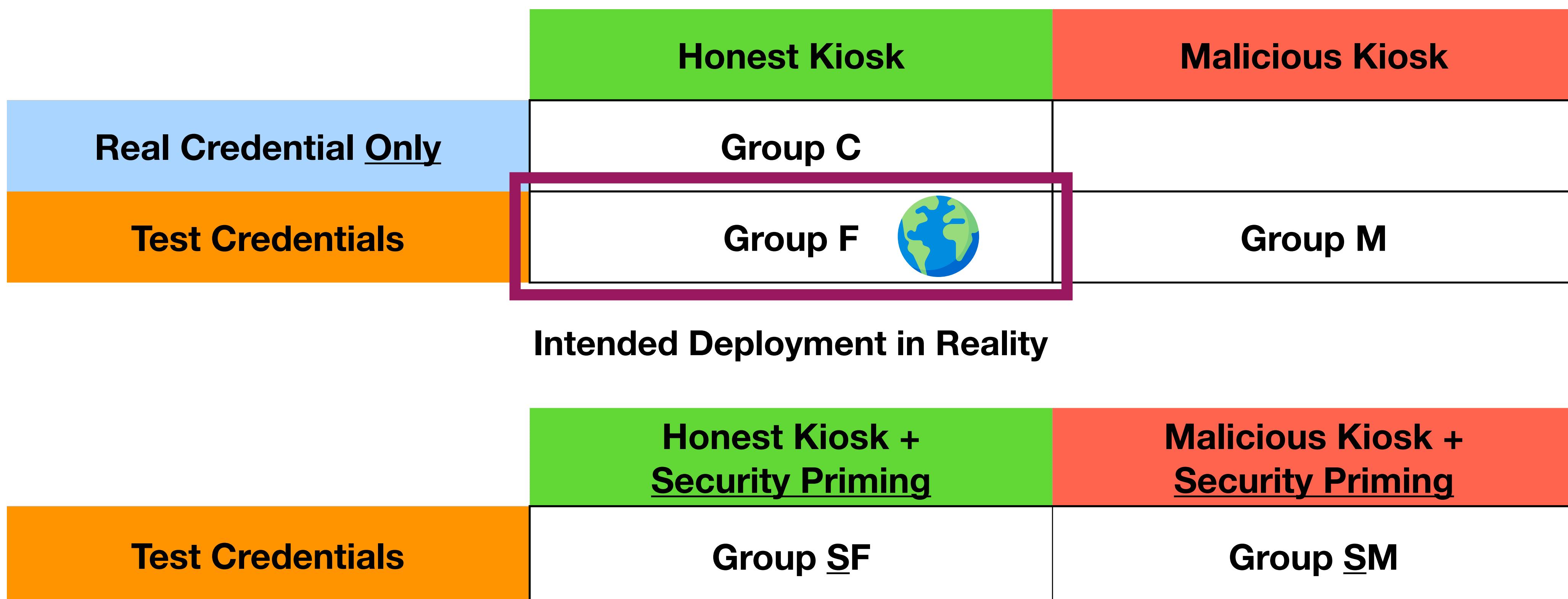
Fake Credentials

Honest OR
Malicious Kiosk

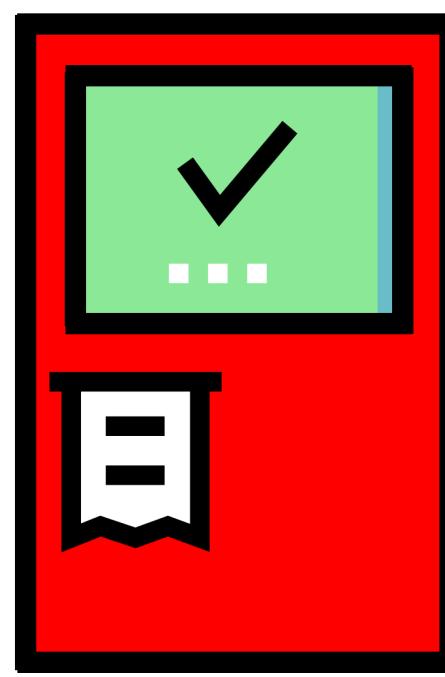


With OR Without
Security Priming

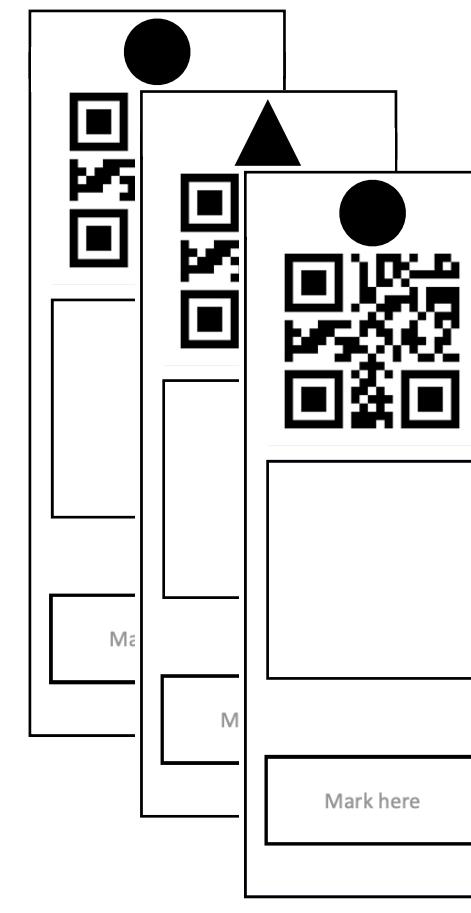
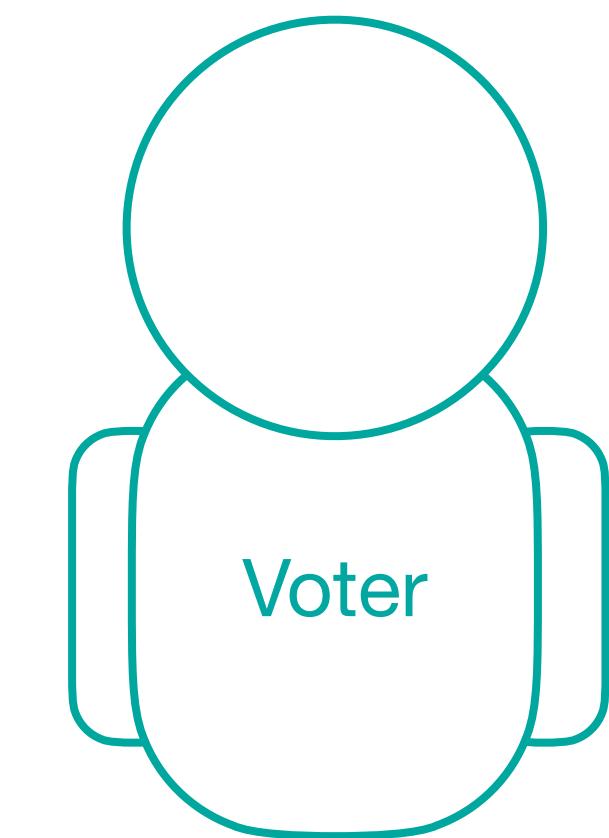
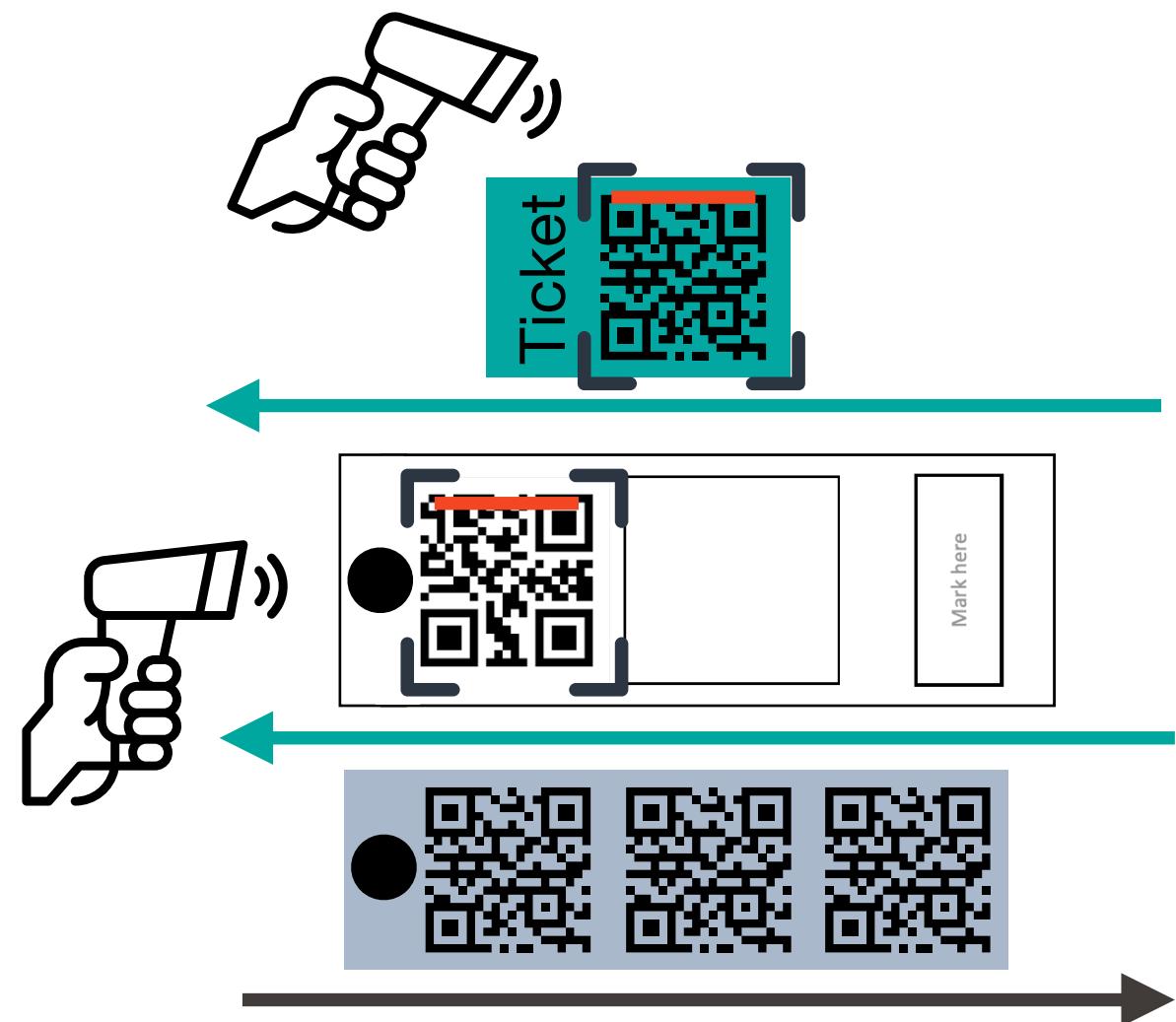
5 Study Groups



Malicious Case: Stealing Voter's Real Credential



Kiosk



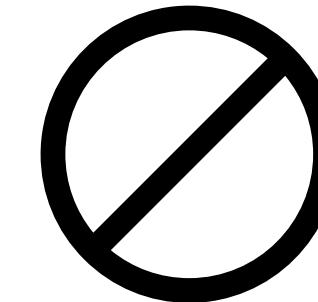
Envelopes



Pen

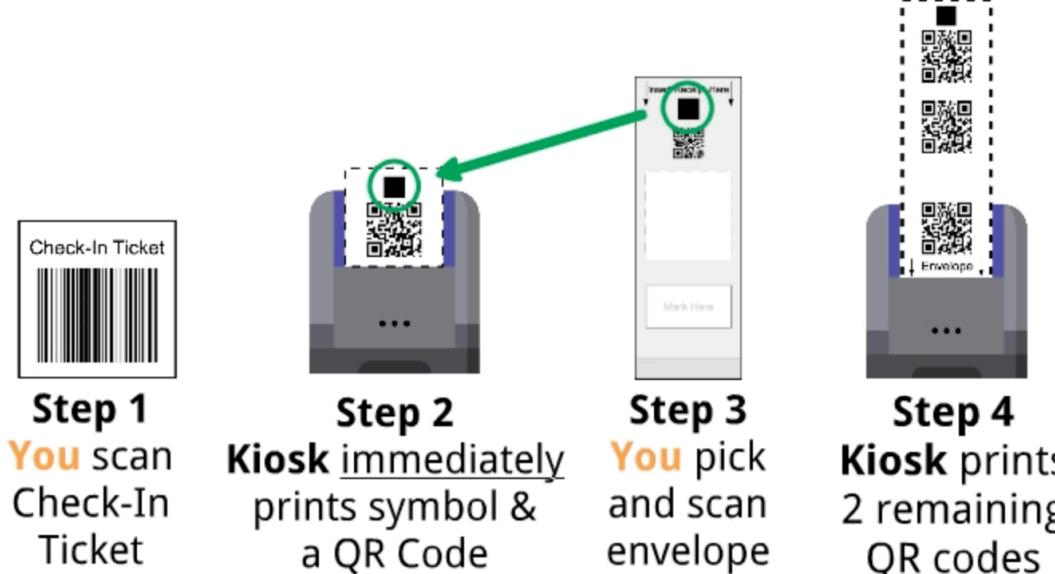
Security Priming?

Without Security Priming Groups F & M

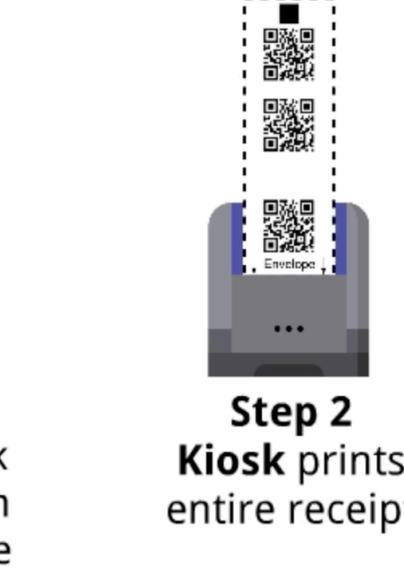


DISTINGUISHING CREDENTIALS

Real Credential



Test Credential



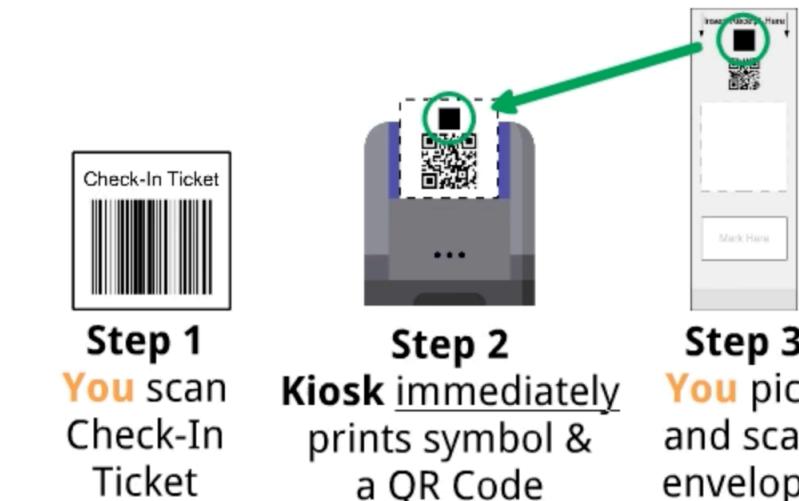
With Security Priming Groups SF & SM



! BEWARE ! DETECTING A HACKED KIOSK

Real Credential

Correct



Incorrect



Intended deployment:
“positive vibe” but less instructive

More instructive but
potentially “scary” or unsettling

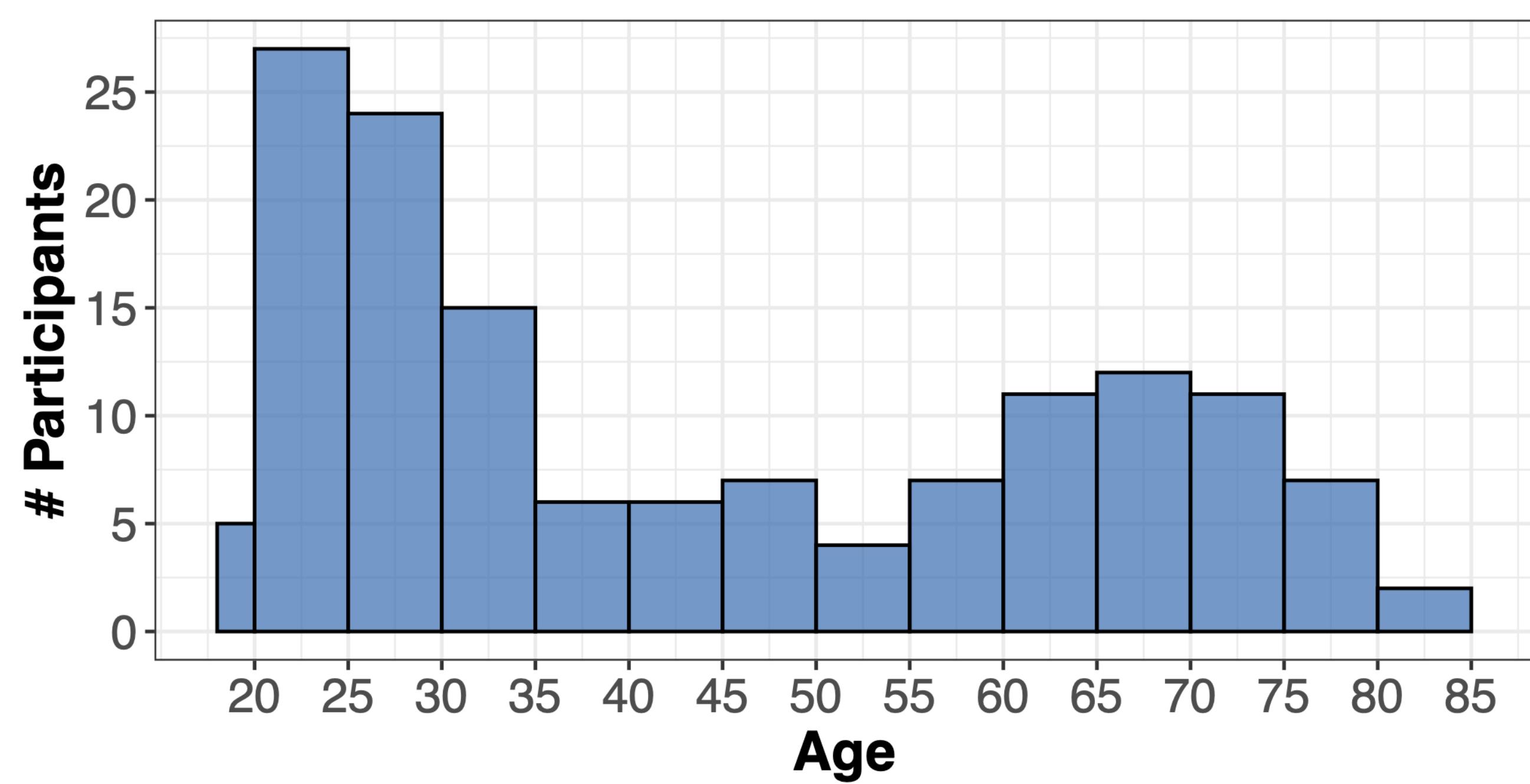
Roadmap

- 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



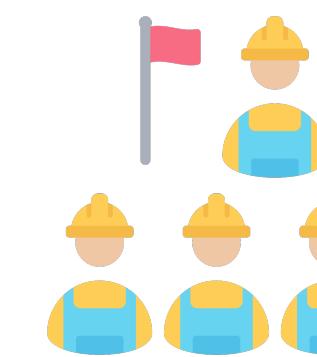
26%

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



Buying Ballots

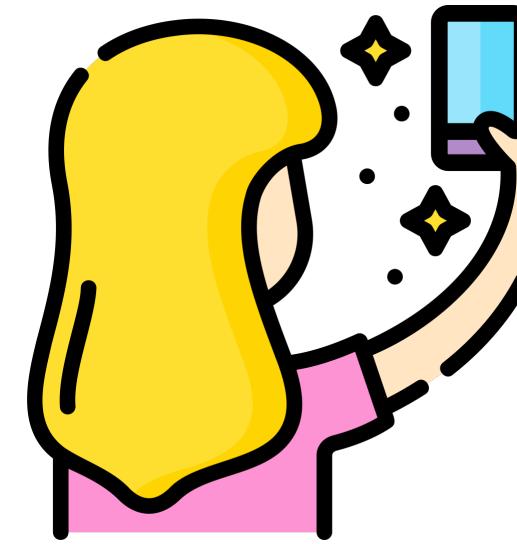


Ballot Selfie



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%*

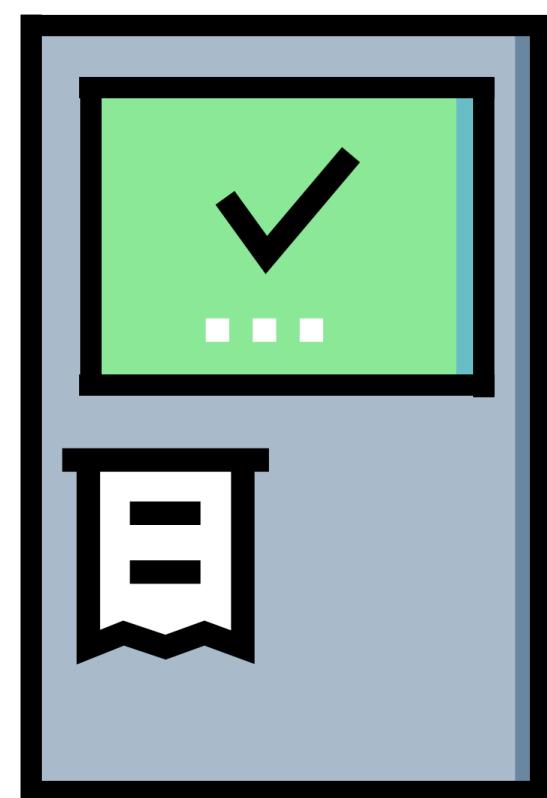
* Among the 26% experiencing or knowing of someone who has experienced at least one form of voter coercion.

Roadmap

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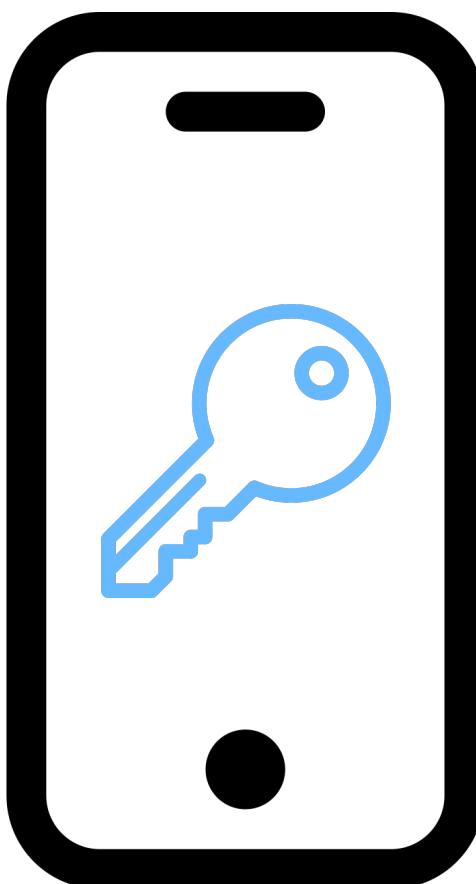
Success Rate

Create Credentials



95%

Activate a Credential

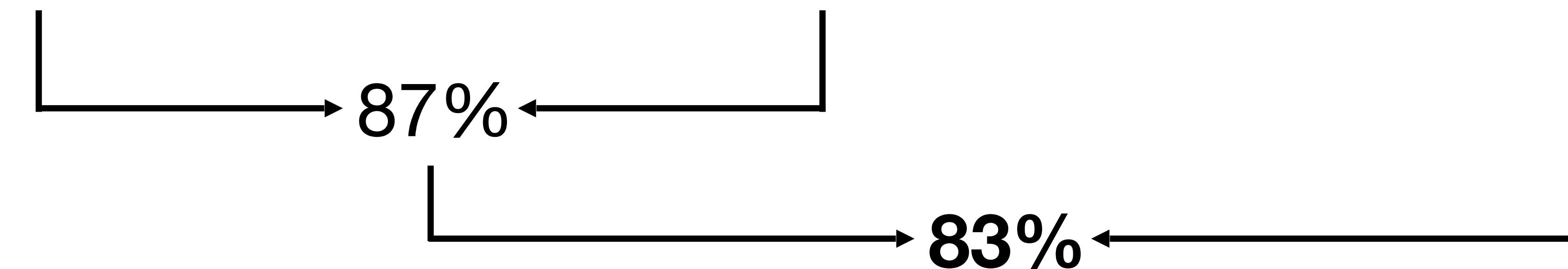


92%

Vote with Real Credential



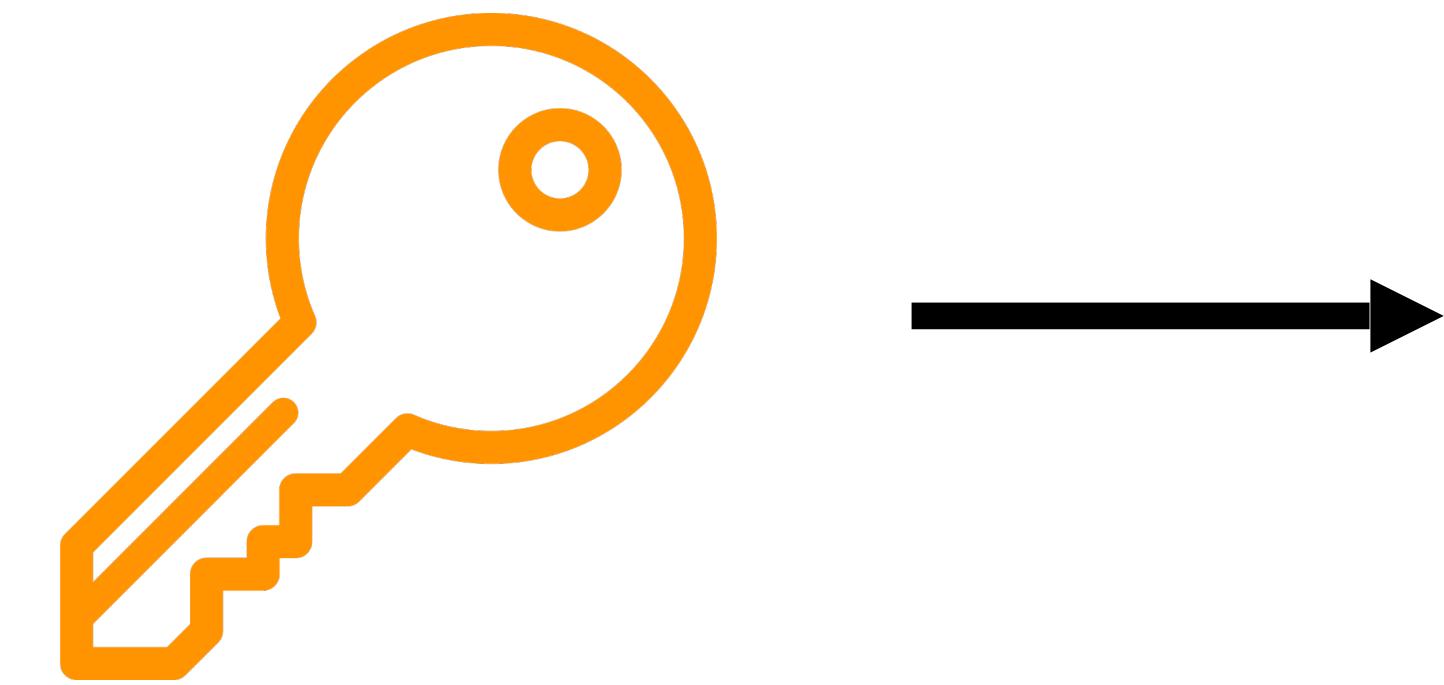
90%



Fake Credentials



96% understood its use

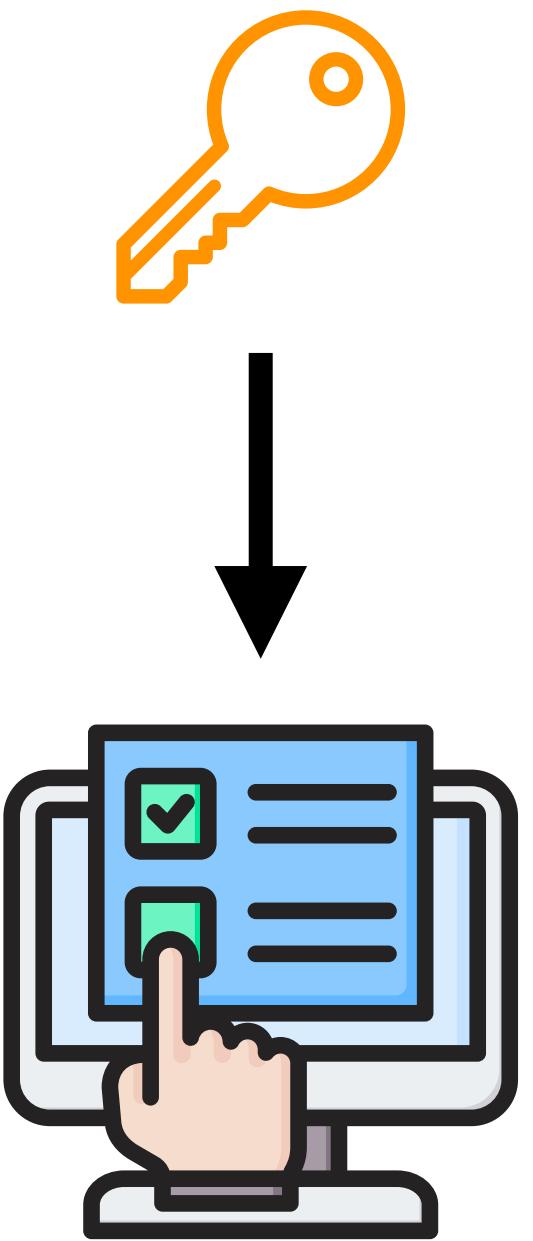


76% create at least
one fake credential

53% would create
in reality



Improper Use of Fake Credentials



10% cast their intended vote
using their fake credential



Memory Lapse?



Environmental
Distractions?



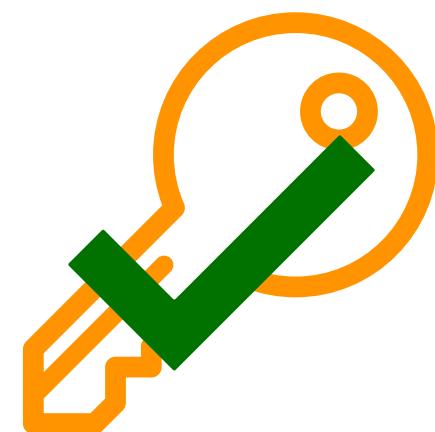
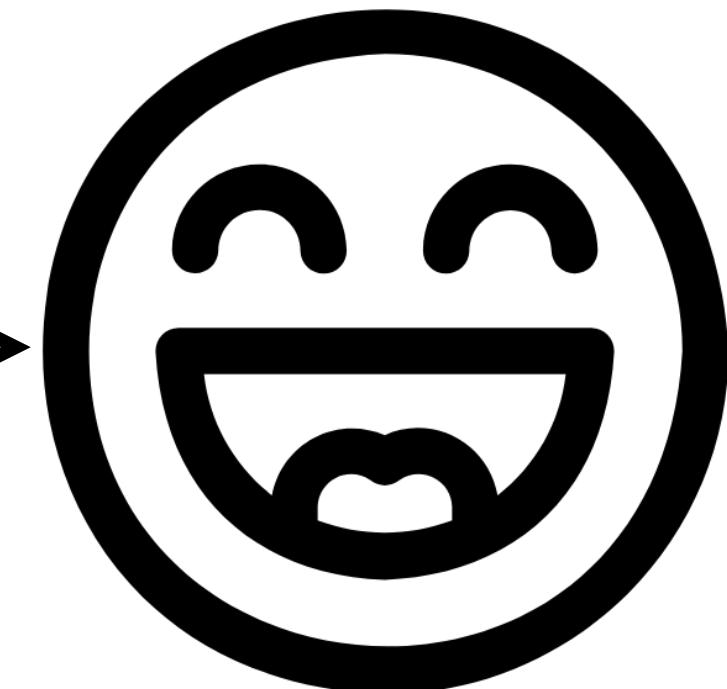
Misunderstanding
Instruction?



Deliberately
Disobeying?

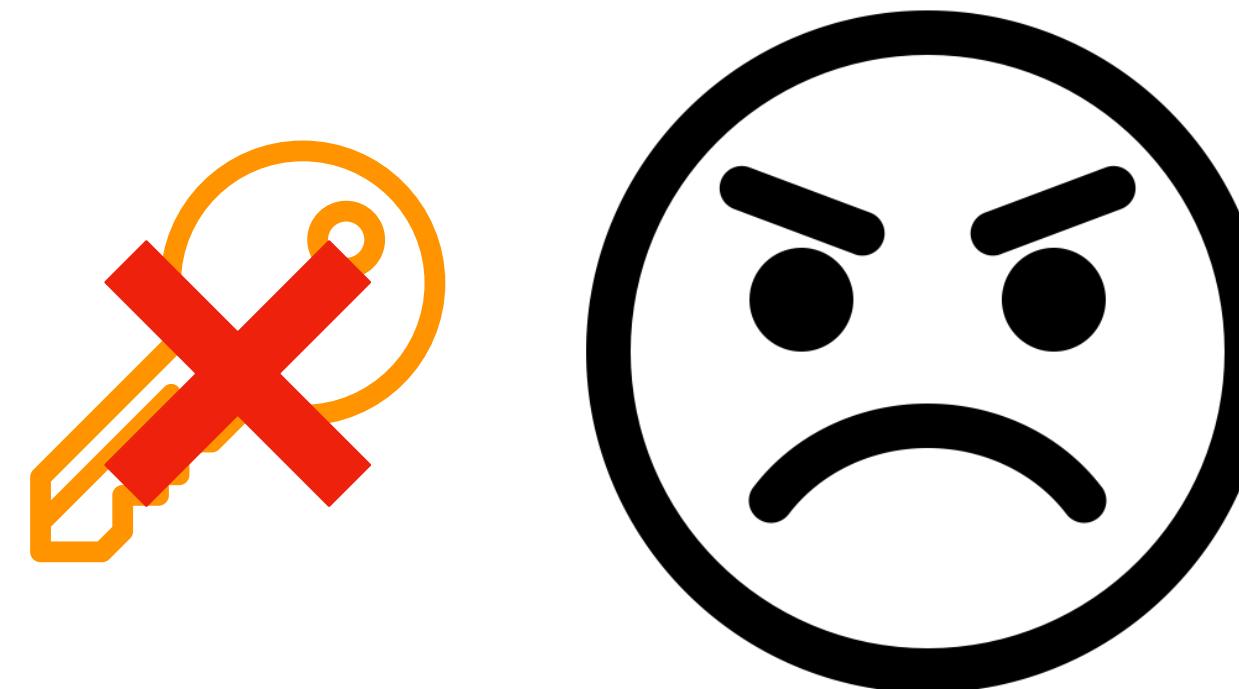
Real World?

Fake credentials!



“[...] “To [...] educate family and friends”
“create as many [fake] credentials [...] before the market became flooded with [fake] credentials”
“to argue [...] voting [...]”

Only real credential



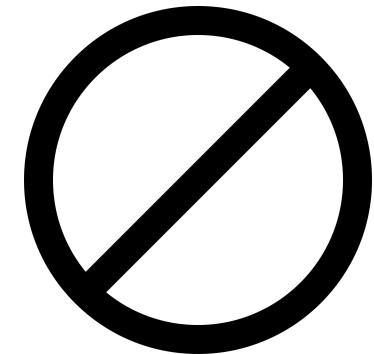
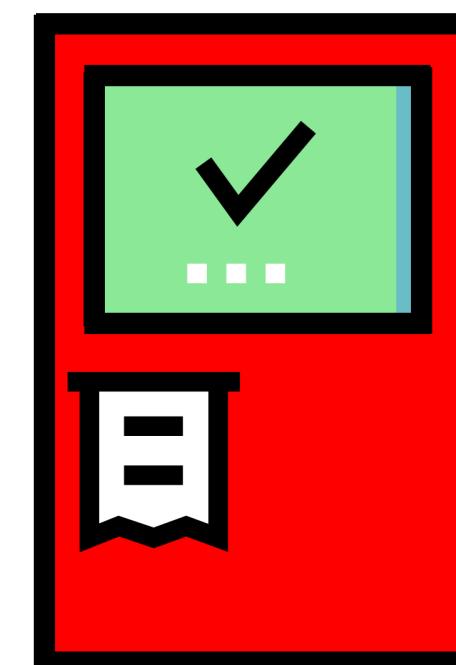
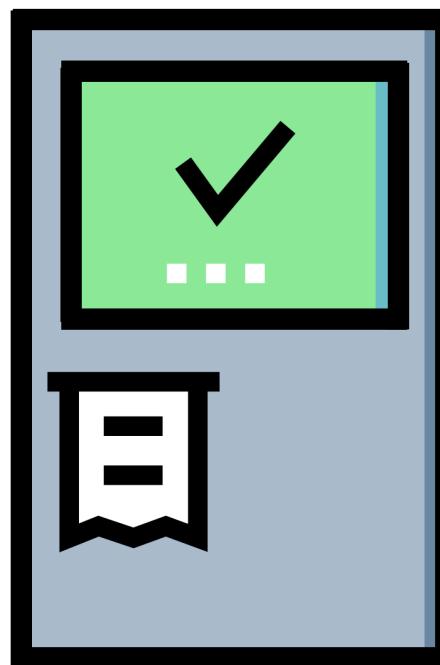
“I cannot impress someone [...] I do not want to take the risk of [...] on my real uses”

Roadmap

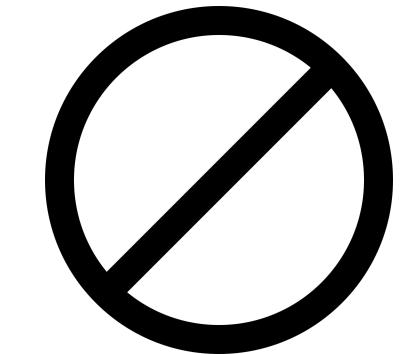
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Kiosk Reported as Malicious

Without Security Priming

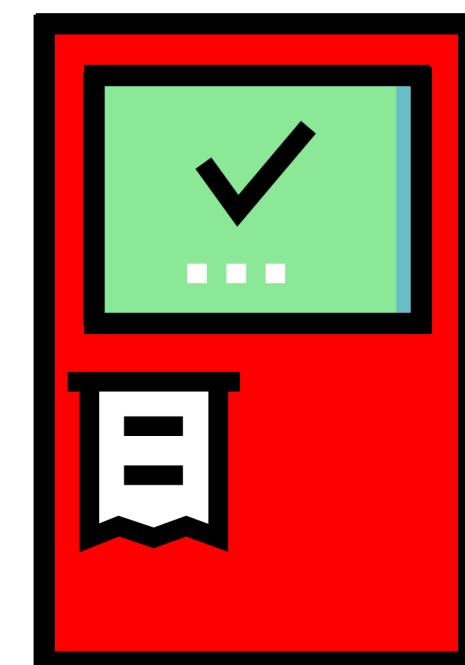
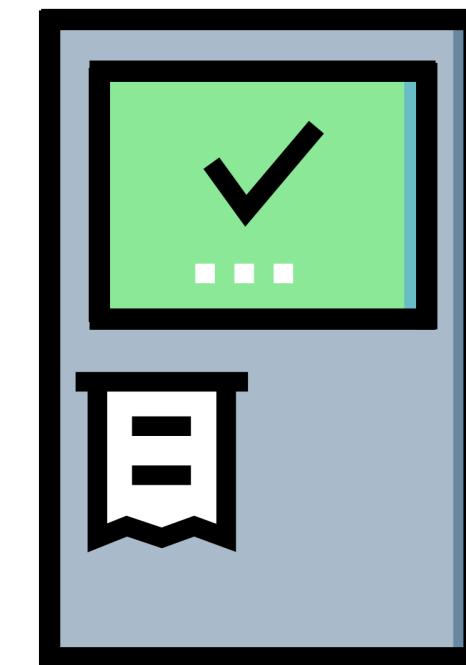


0%



10%

With Security Priming

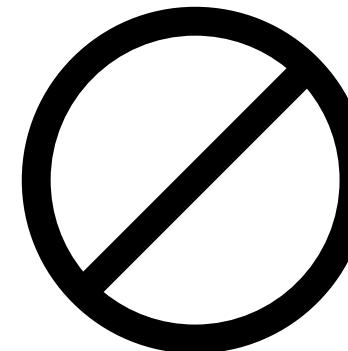
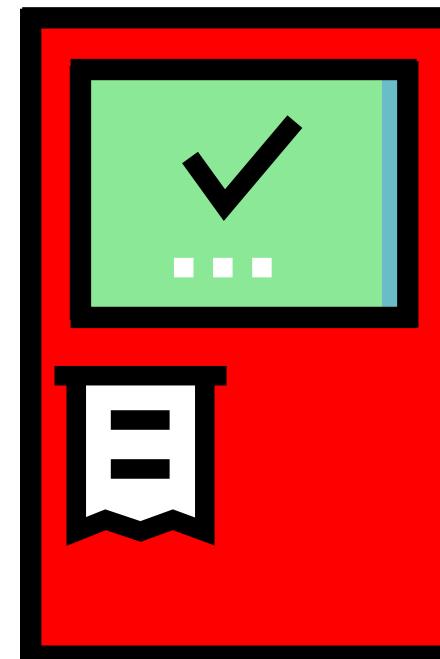


0%



47%

Detecting Bad Without Security



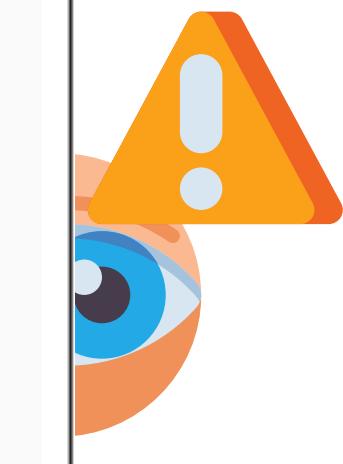
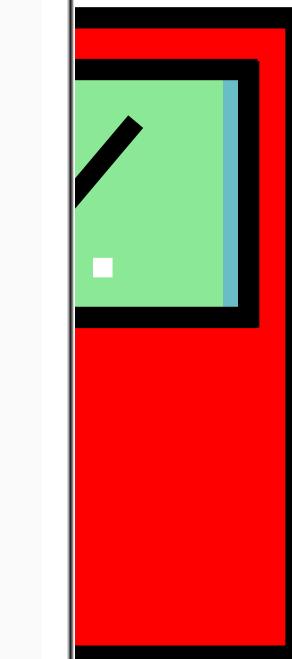
7%

Official Ballot
General Election, Tuesday, November 6, 2018
Washtenaw County, Michigan
Ann Arbor Township, Precinct 1-BHV

1009709-21T095751

Partisan Section	Congressional	State Boards	Nonpartisan Section
State	United States Senator	Regent of the University of Michigan	Judicial
Governor and Lieutenant Governor Vote for not more than 1	John James Republican	Justice of Supreme Court Vote for not more than 2	Samuel Bagenstos
<input checked="" type="checkbox"/> Bill Schuette Lisa Posthumus Lyons Republican	<input type="checkbox"/> Debbie Stabenow Democrat	<input type="checkbox"/> Megan Kathleen Cavanagh	
<input type="checkbox"/> Gretchen Whitmer Garlin D. Gilchrist II Democrat	<input type="checkbox"/> George E. Huffman III U.S. Taxpayers	<input type="checkbox"/> Elizabeth T. Clement Justice of Supreme Court	
<input type="checkbox"/> Bill Gelineau Angelique Chaiser Thomas Libertarian	<input type="checkbox"/> Marcia Squier Green	<input type="checkbox"/> Doug Dern	
<input type="checkbox"/> Todd Schleiger Earl P. Lacle U.S. Taxpayers	<input type="checkbox"/> John Howard Wilhelm Natural Law	<input type="checkbox"/> Kerry Lee Morgan	
<input type="checkbox"/> Jennifer V. Kurland Charin H. Davenport Green	Representative in Congress 12th District Vote for not more than 1	<input type="checkbox"/> James Lewis Hudler Libertarian	Kurtis T. Wilder Justice of Supreme Court
<input type="checkbox"/> Keith Butkovich Raymond Warner Natural Law	<input type="checkbox"/> Jeff Jones Republican	<input type="checkbox"/> John Jacob Libertarian	Judge of Court of Appeals 3rd District
<input type="checkbox"/> Mary Treder Lang Republican	<input type="checkbox"/> Debbie Dingell Democrat	<input type="checkbox"/> Joe Sanger U.S. Taxpayers	Incumbent Position Vote for not more than 2
<input type="checkbox"/> Jocelyn Benson Democrat	<input type="checkbox"/> Gary Walkowicz Working Class	<input type="checkbox"/> Crystal Van Sickle U.S. Taxpayers	<input type="checkbox"/> Jane Marie Beckering Judge of Court of Appeals
<input type="checkbox"/> Gregory Scott Stempfle Libertarian	<input type="checkbox"/> Niles Niemuth No Party Affiliation	<input type="checkbox"/> Kevin A. Graves Green	<input type="checkbox"/> Douglas B. Shapiro Judge of Court of Appeals
<input type="checkbox"/> Robert Gale U.S. Taxpayers	Secretary of State Vote for not more than 1	<input type="checkbox"/> Marge Katchmark Sallows Natural Law	Judge of Circuit Court 22nd Circuit
<input type="checkbox"/> Attorney General Vote for not more than 1	<input type="checkbox"/> Member of the State Board of Education Vote for not more than 2	<input type="checkbox"/> Tami Carlone Republican	Incumbent Position Vote for not more than 2
<input type="checkbox"/> Tom Leonard Republican	<input type="checkbox"/> Richard Zeile Republican	<input type="checkbox"/> Dave Dutch Republican	<input type="checkbox"/> Timothy Patrick Connors Judge of Circuit Court
<input type="checkbox"/> Dana Nessel Democrat	<input type="checkbox"/> Judith P. Pritchett Democrat	<input type="checkbox"/> Mike Miller Republican	<input type="checkbox"/> Carol Kuhnke Judge of Circuit Court
<input type="checkbox"/> Lisa Lane Gioia Libertarian	<input type="checkbox"/> Tiffany Tilley Democrat	<input type="checkbox"/> Brianna T. Scott Democrat	Judge of Probate Court Incumbent Position
<input type="checkbox"/> Gerald T. Van Sickle U.S. Taxpayers	<input type="checkbox"/> Scotty Boman Libertarian	<input type="checkbox"/> Kelly Charron Tabay Democrat	Vote for not more than 1
<input type="checkbox"/> Chris Graveline No Party Affiliation	<input type="checkbox"/> John J. Tatar Libertarian	<input type="checkbox"/> Bruce Campbell Libertarian	<input type="checkbox"/> Darlene A. O'Brien Judge of Probate Court
	<input type="checkbox"/> Karen Adams U.S. Taxpayers	<input type="checkbox"/> Tim Orzechowski Libertarian	Judge of District Court 14A District
	<input type="checkbox"/> Douglas Levesque U.S. Taxpayers	<input type="checkbox"/> Janet M. Sanger U.S. Taxpayers	Incumbent Position Vote for not more than 1
	<input type="checkbox"/> Sherry A. Wells Green	<input type="checkbox"/> John Paul Sanger U.S. Taxpayers	<input type="checkbox"/> J. Cedric Simpson Judge of District Court
	<input type="checkbox"/> Mary Anne Hering Working Class	<input type="checkbox"/> Aaron Mariasy Green	<input type="checkbox"/> Thomas B. Bourque
	<input type="checkbox"/> Logan R. Smith Working Class		

from BMDs ity Priming

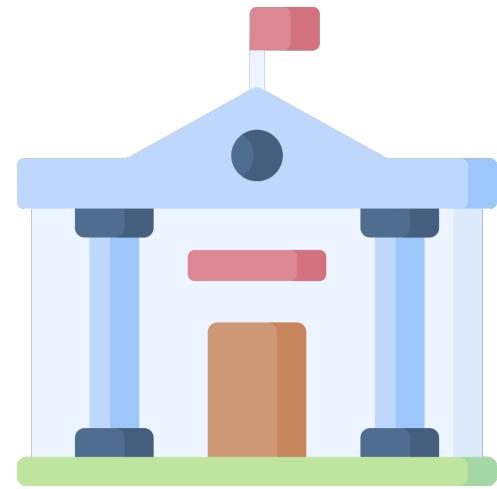


8%

Roadmap

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

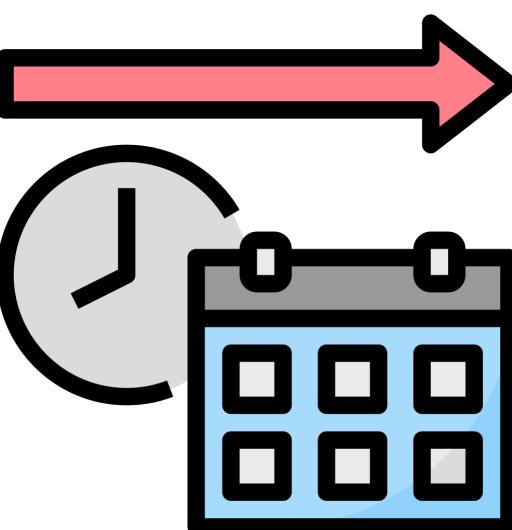
Study Limitations



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

The Coercion Problem

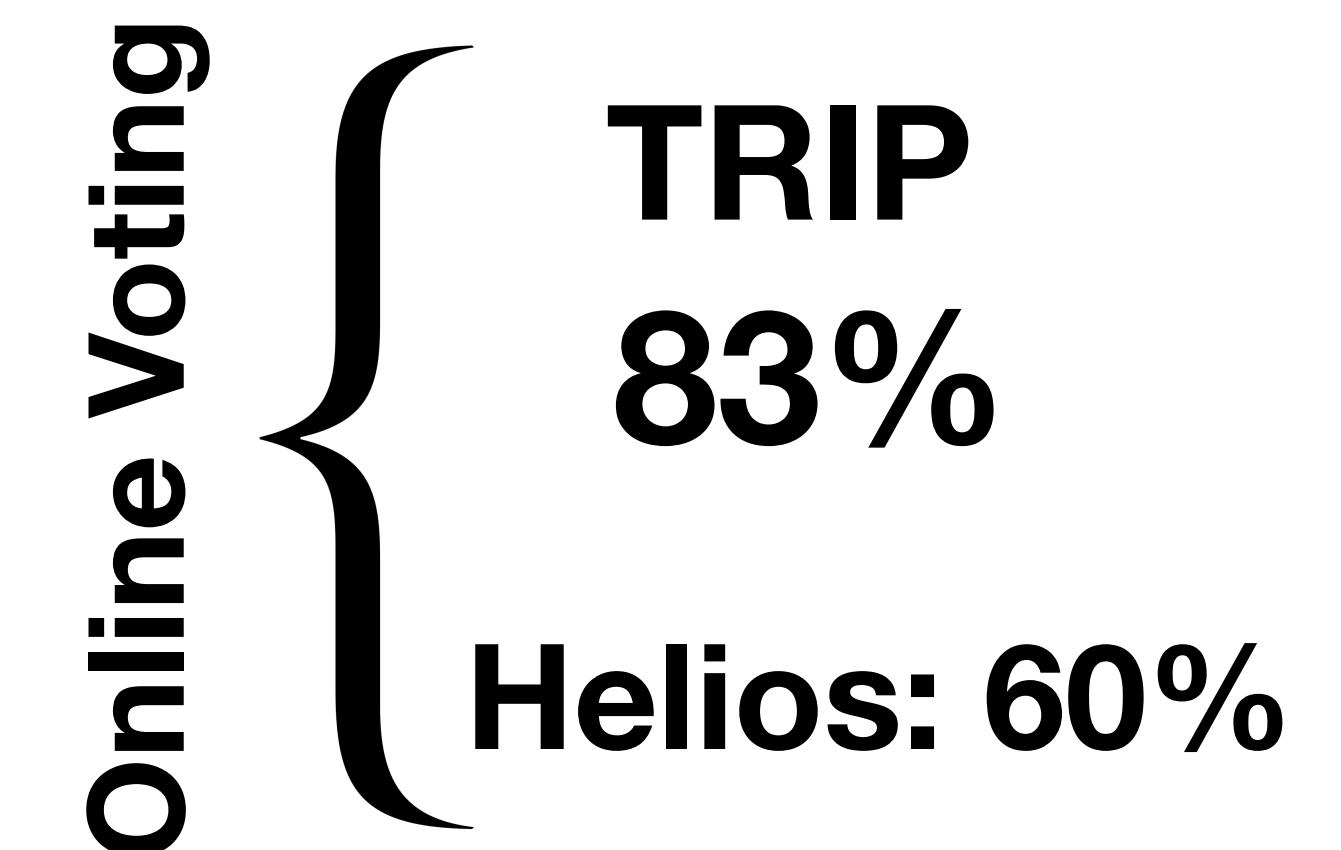


26%

faced coercion or know
of someone who did

Usability of Fake Credentials

STAR-Vote: 93%



Prêt à Voter: 60%