



# Scantegrity II

Vote confirmation for Optical Scan Machines



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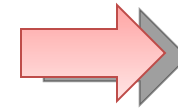
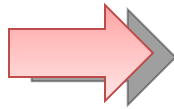
# So what's the problem?

- Countries moving to newer technology for efficiency
    - Decrease cost
    - Faster results
    - Independence for Voters w/Disabilities
    - Fewer people needed
  - For Example: US (Florida, 2000)
  
  - This technology also makes fraud more efficient.
  
  
  - New voting technology **should** make fraud harder/impossible.
- 

# Why Voting Machines are bad

```
printf("input loop count: ");
scanf("%ld",&junk);
time = clock();
for(i=0;i<junk;i++)
    deltime = clock() - time;
secs = (float) deltime/CLOCKS_PER_SEC;
printf("for %ld loops, #tics = %ld, time =
%f\n",junk,deltime,secs);
goto LOOP;
return 0;
```

Your vote

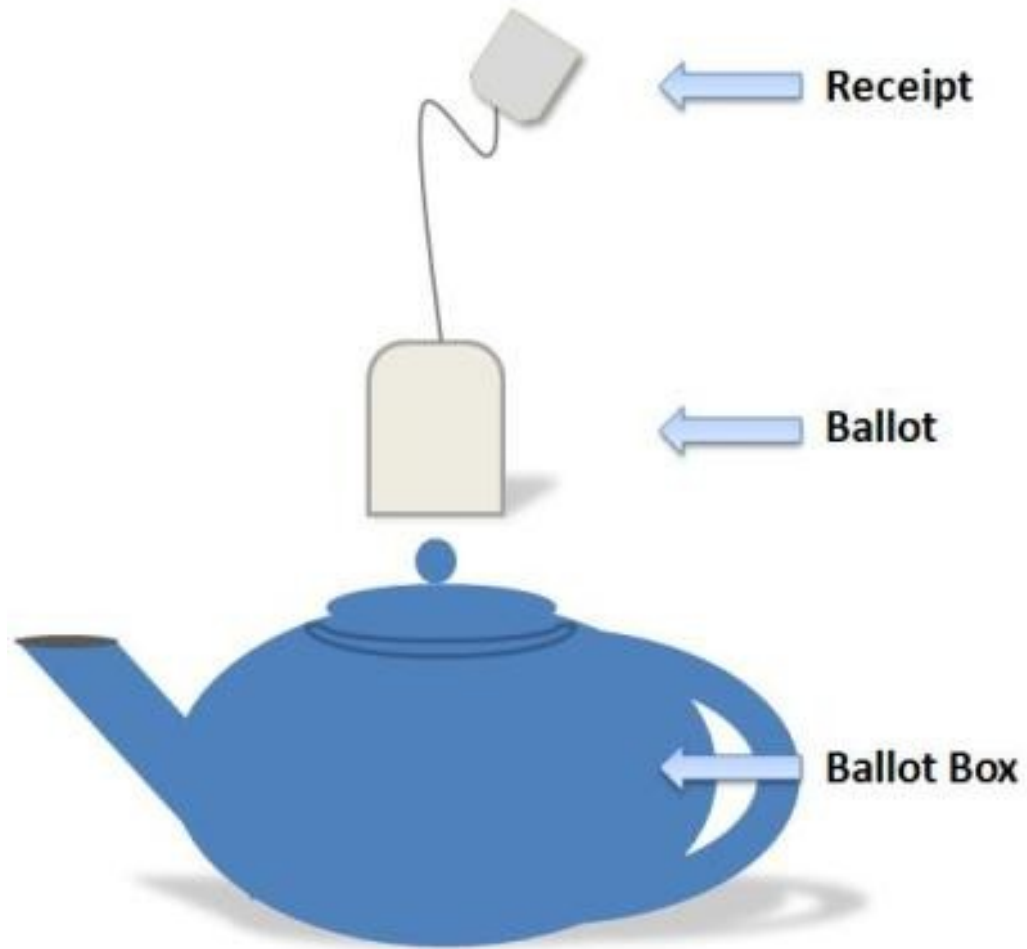


The next president

# Why Voting Machines are bad



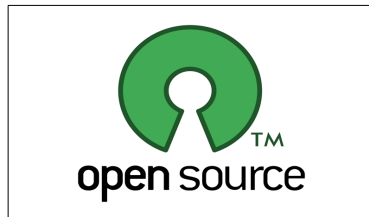
# E2E is your cup of tea



# Software Verification Models



Authority/vendor



Community/You

$$e^{iu} = \cos(u) + i \sin(u)$$
$$\gamma = \lim_{n \rightarrow \infty} \left( 1 + \frac{1}{2} + \dots + \frac{1}{n} - \log(n) \right)$$

Mathematically specified operation

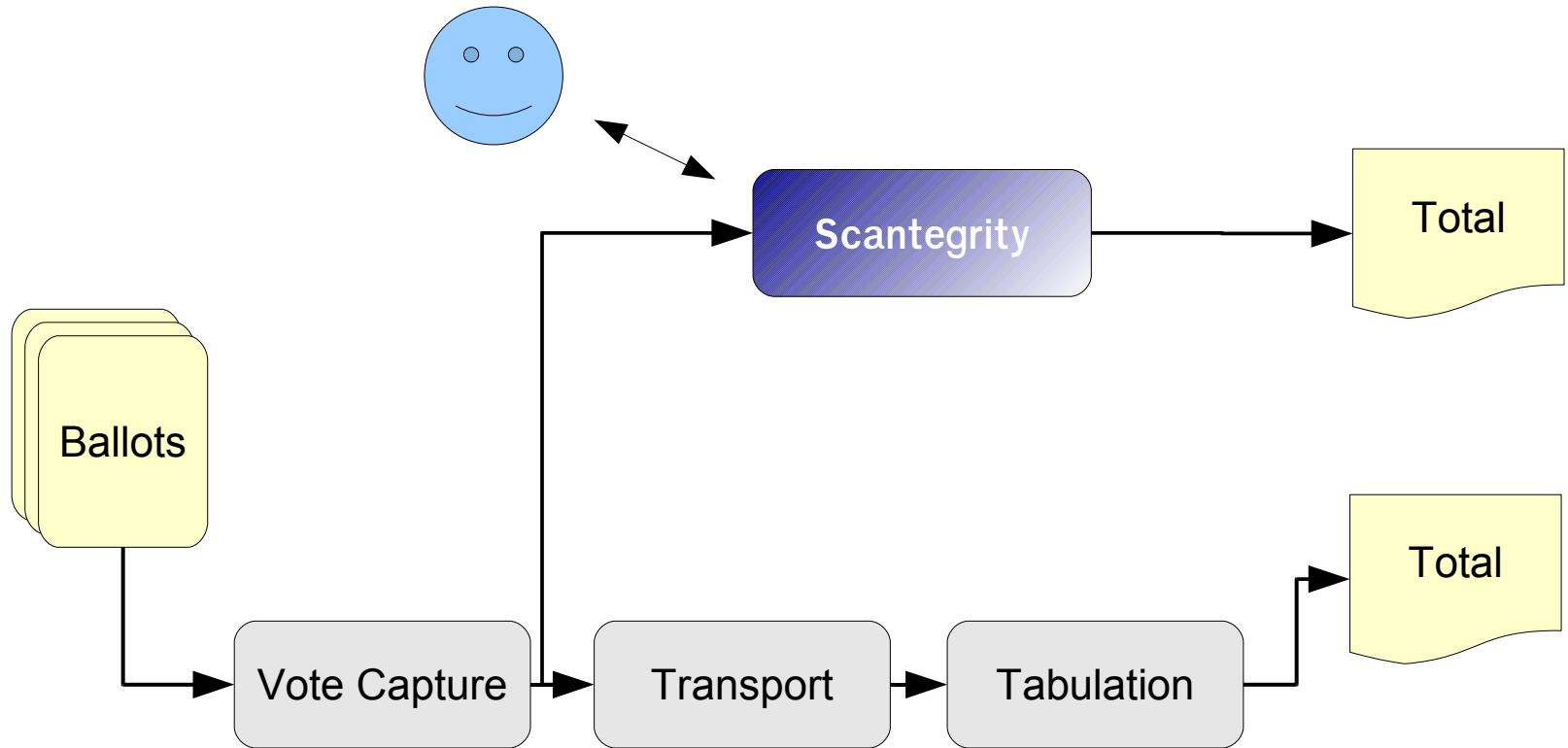


# Punchscan



# Scantegrity II

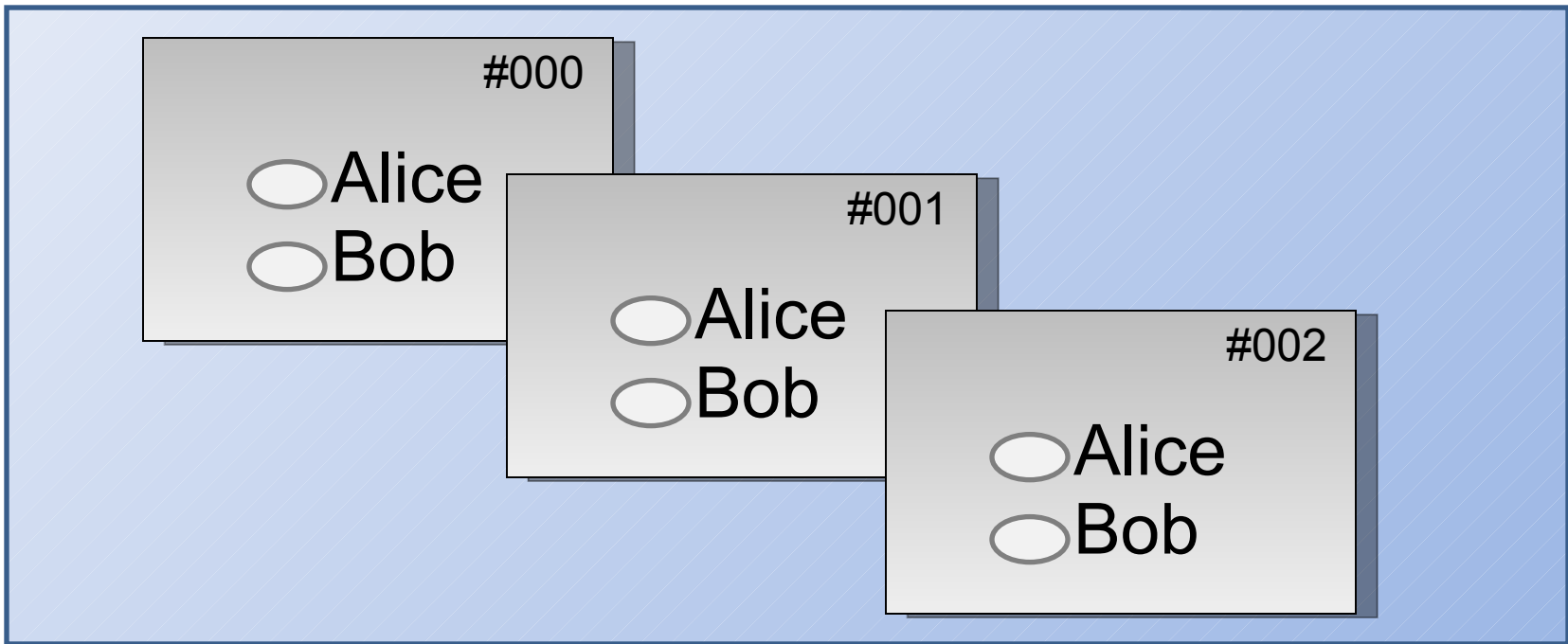
## The process is the same



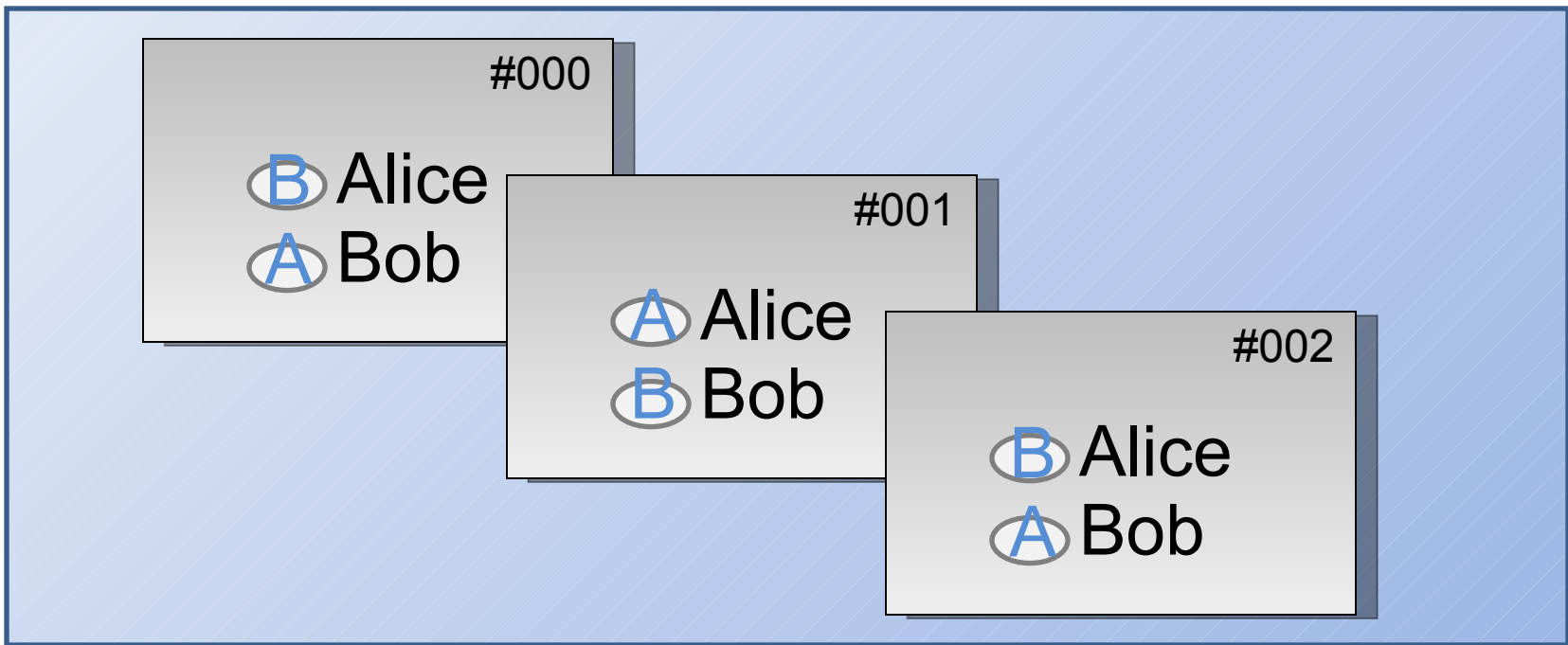


# Simple adoption

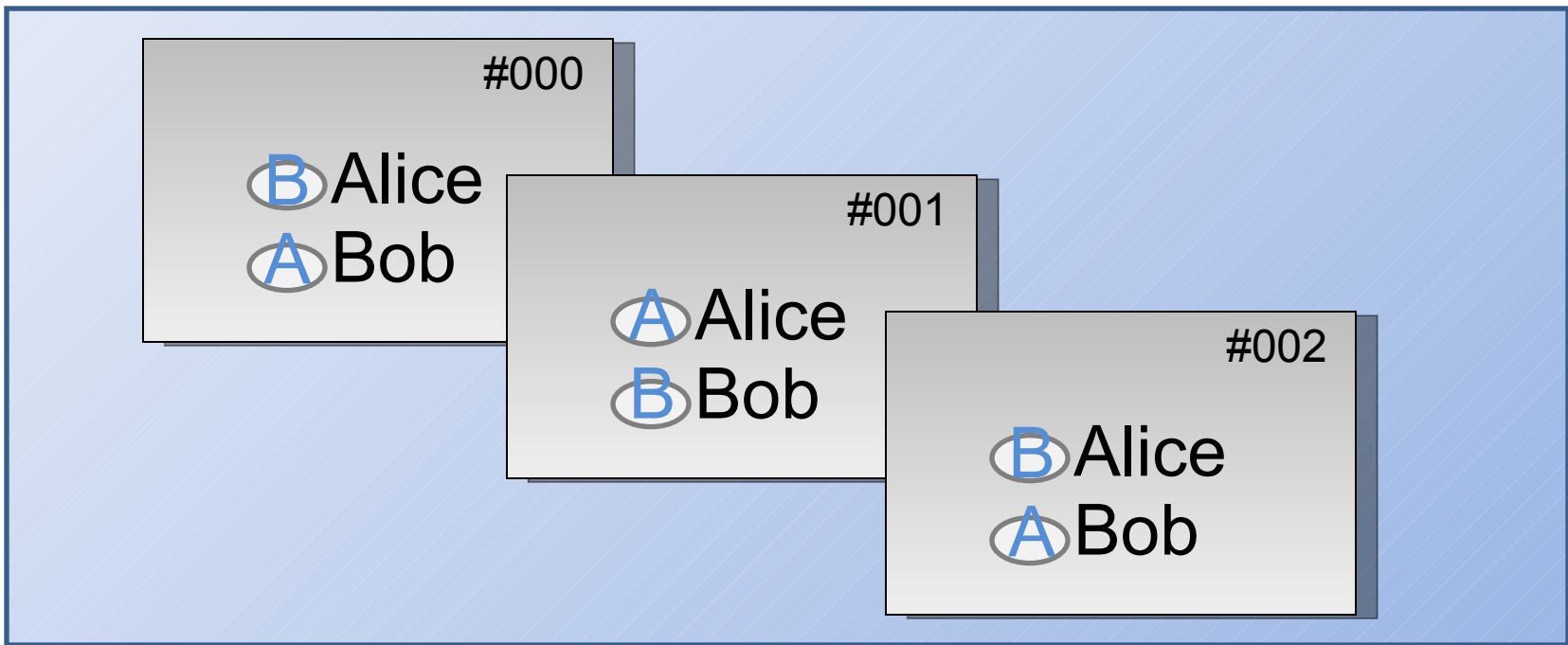
- ▶ Optical scan is most widely used platform
- ▶ Secures existing optical scan and tabulation equipment
- ▶ Maintains established election procedures
- ▶ Value added features are opt-in



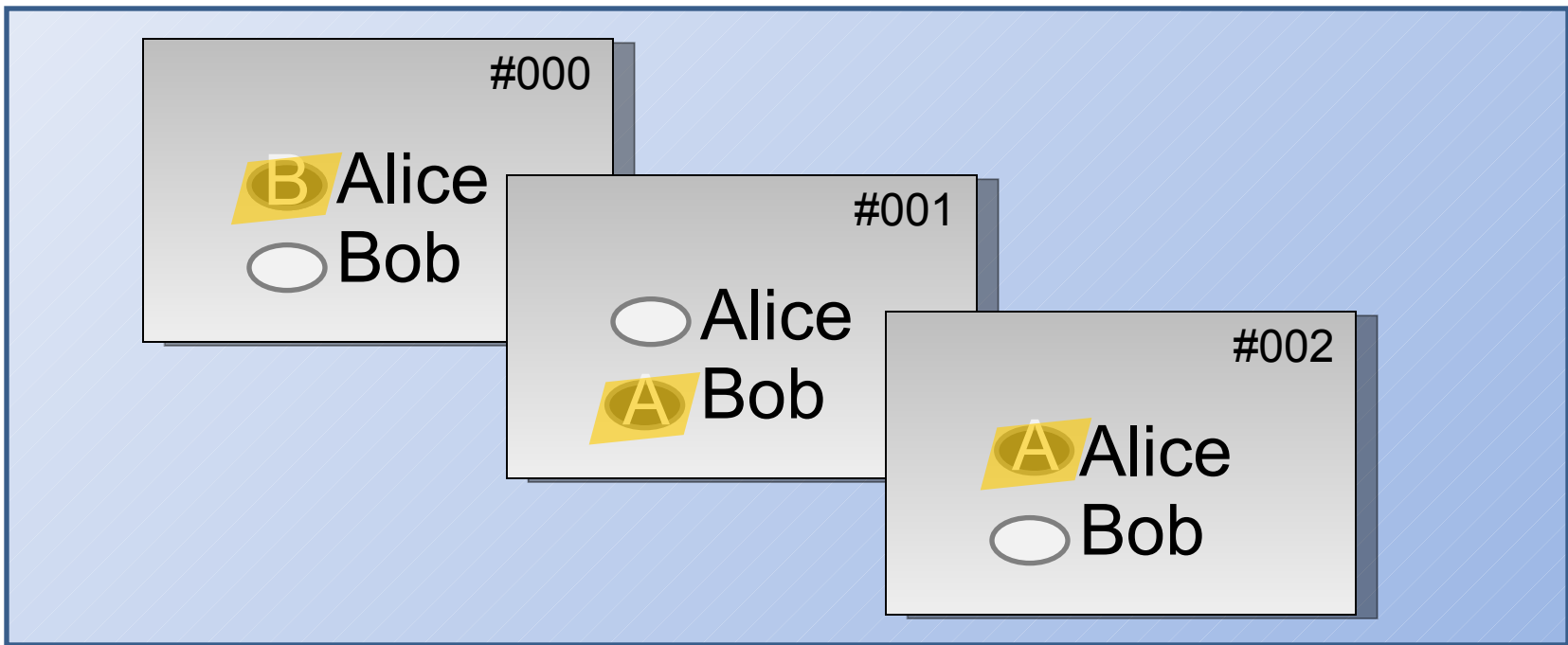
- Regular optical scan ballot



- Regular optical scan ballot
- Confirmation codes



- Regular optical scan ballot
- Confirmation codes
  - Randomly assigned



- Regular optical scan ballot
- Confirmation codes
  - Randomly assigned
  - Appear when marked by voter

# Confirmation with Invisible Ink



Scantegrity II Election Website - Ballot Lookup - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://scantegrity.org/washington/lookup.php

Scantegrity II  
Invisible Ink

Home Ballot Lookup Contact Scantegrity.org

## Ballot Lookup Tool

Enter your ballot serial number into the form below.

**View Ballot**

1. Ballot Serial Number

© 2008 [Punchscan](#) | [xhtml](#) | [css](#) | Generated in 0.010s.

Done

My ballot  
0001

1. CX
2. CF
3. YN

Scantegrity II Election Website - Ballot Lookup - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://scantegrity.org/washington/lookup.php Google

**Scantegrity II**  
Invisible Ink

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### Ballot Lookup Tool

Options  
Refresh [View Another Ballot](#)

**Ballot Number: 00001**

Question	Confirmation Number
Polling Place Vote Verification	CX
Mail-In Ballot Vote Verification	CF
Mail-In Ballot Vote Secrecy	YN

Done

My ballot  
0001

1. CX
2. CF
3. YN

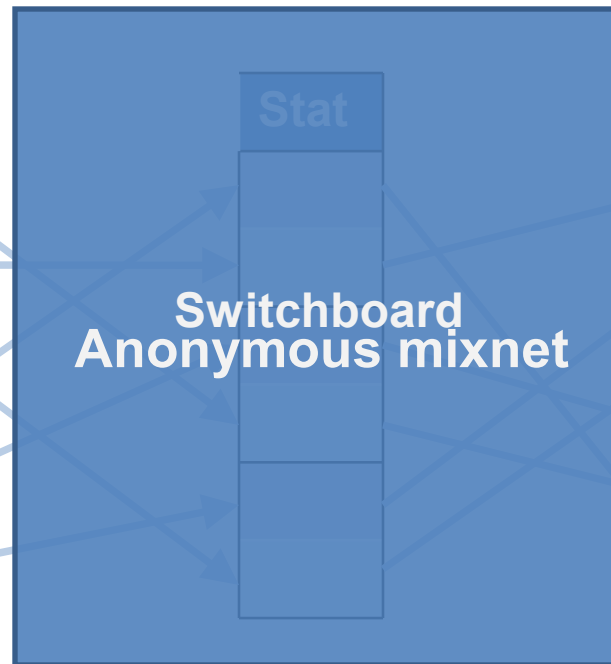


Ok, so they got the codes right, so what?

Tags

Confirmation	State
000-A	
000-B	
001-A	
001-B	
002-A	
002-B	

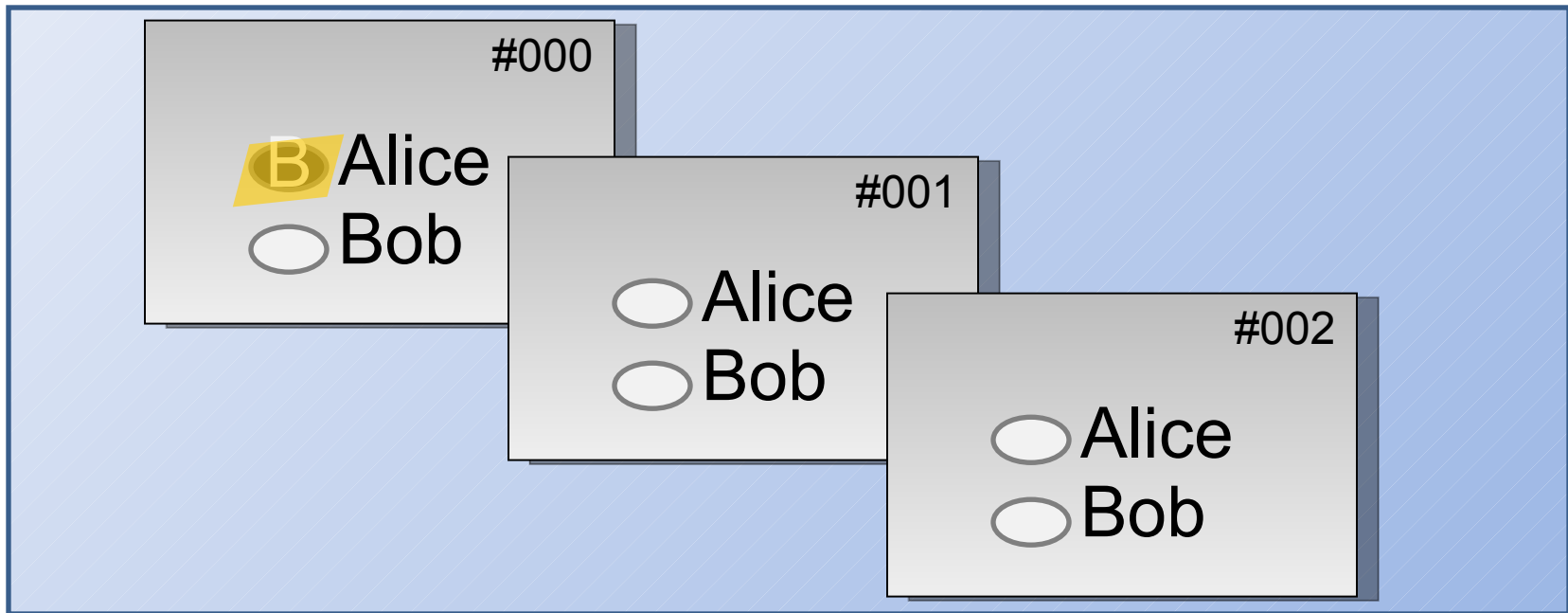
Strings



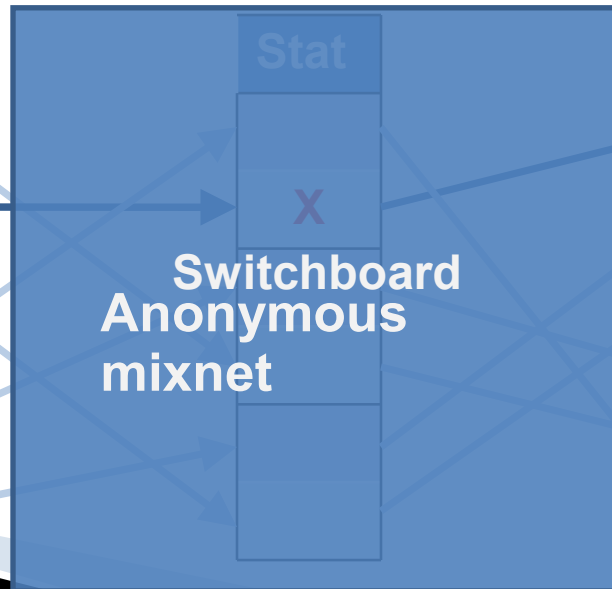
Teapot

State	Candidate
	Alice
	Alice
	Alice
	Bob
	Bob
	Bob

# A peek under the hood



Confirmation	State
000-A	
000-B	<b>X</b>
001-A	
001-B	
002-A	
002-B	



State	Candidate
<b>X</b>	Alice
	Alice
	Alice
	Bob
	Bob
	Bob

## Switchboard integrity established by

- Commitments to the Switchboard
  - Online XML data files
  - Available to anyone
- Software audit tool
  - Randomized partial checking
  - Runnable or codeable by anyone



# Election Integrity

## Scanner integrity established by

- Online receipt check of confirmation codes

## Switchboard integrity established by

- Software audit tool

# Concluding Remarks

- ▶ For voters
  - See their votes count
  - Greater confidence and increased satisfaction
- ▶ For election officials
  - End-to-end verification at low cost
  - Reduces reliance on chain of custody



**scantegrity.org**