



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)

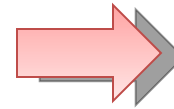
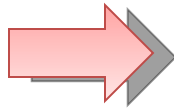
 - This technology also makes fraud more efficient.

 - 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++)
    downtime = clock() - time;
secs = (float) downtime/CLOCKS_PER_SEC;
printf("for %ld loops, #tics = %ld, time =
%f\n", junk, downtime, secs);
goto LOOP;
return 0;
```

Your vote

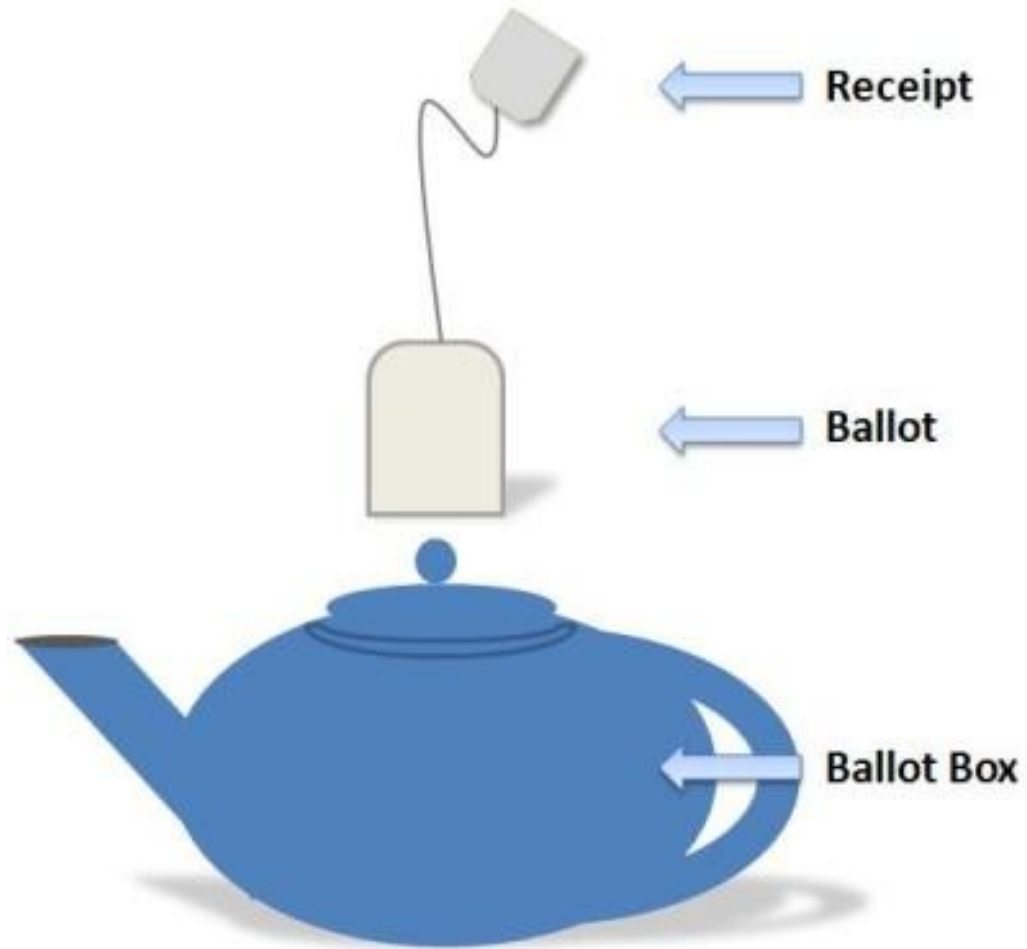


The next president

Why Voting Machines are bad



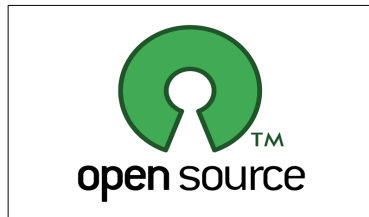
E2E is your cup of tea



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

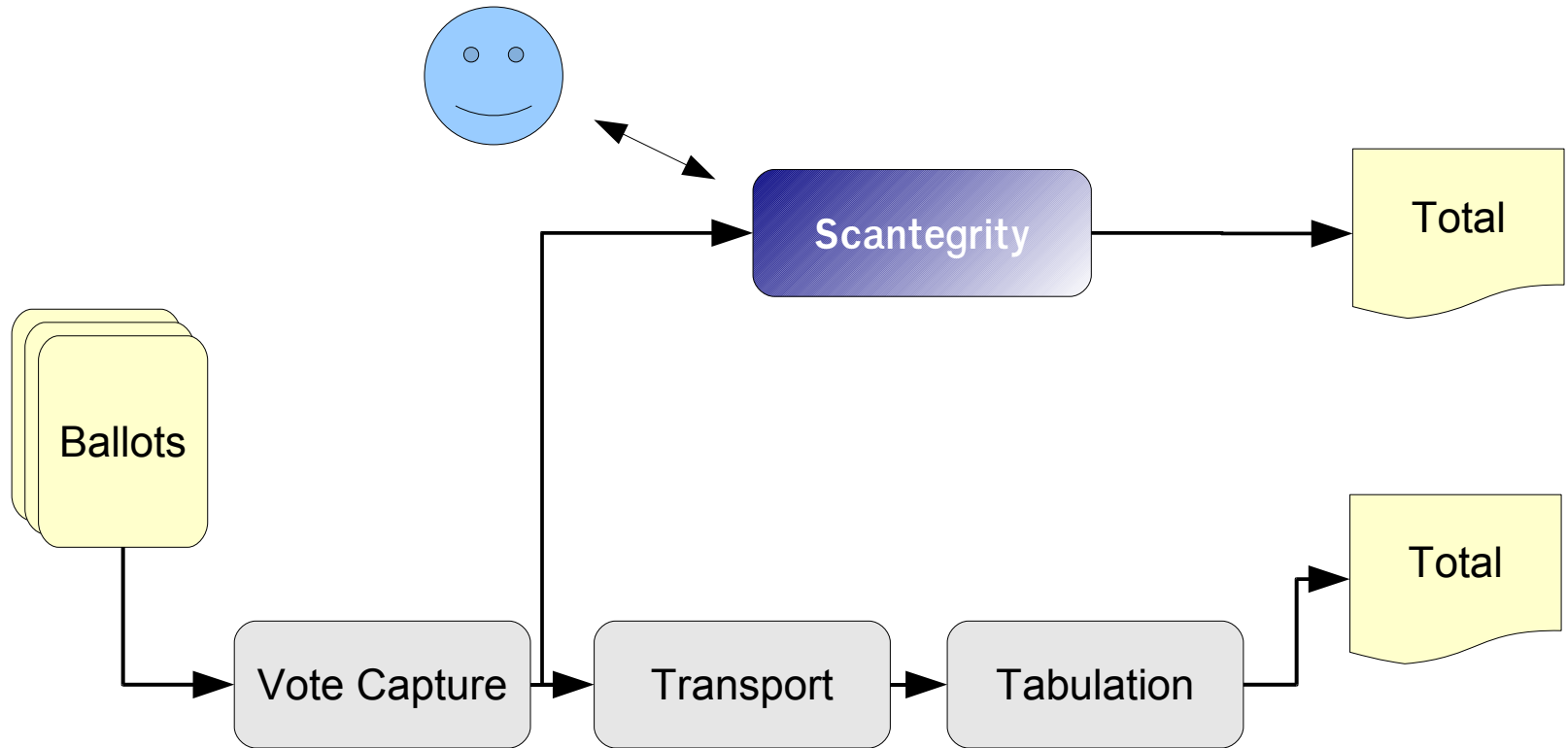


Punchscan



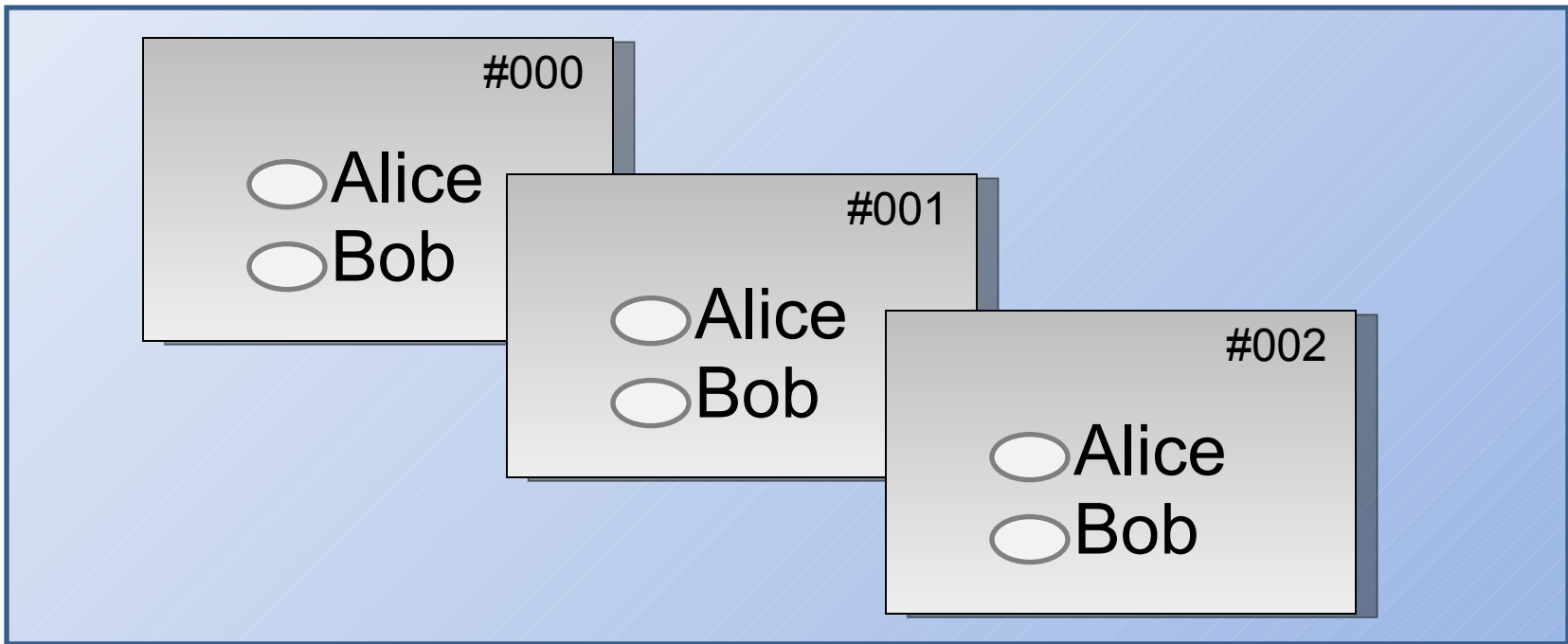
Scantegrity II

The process is the same

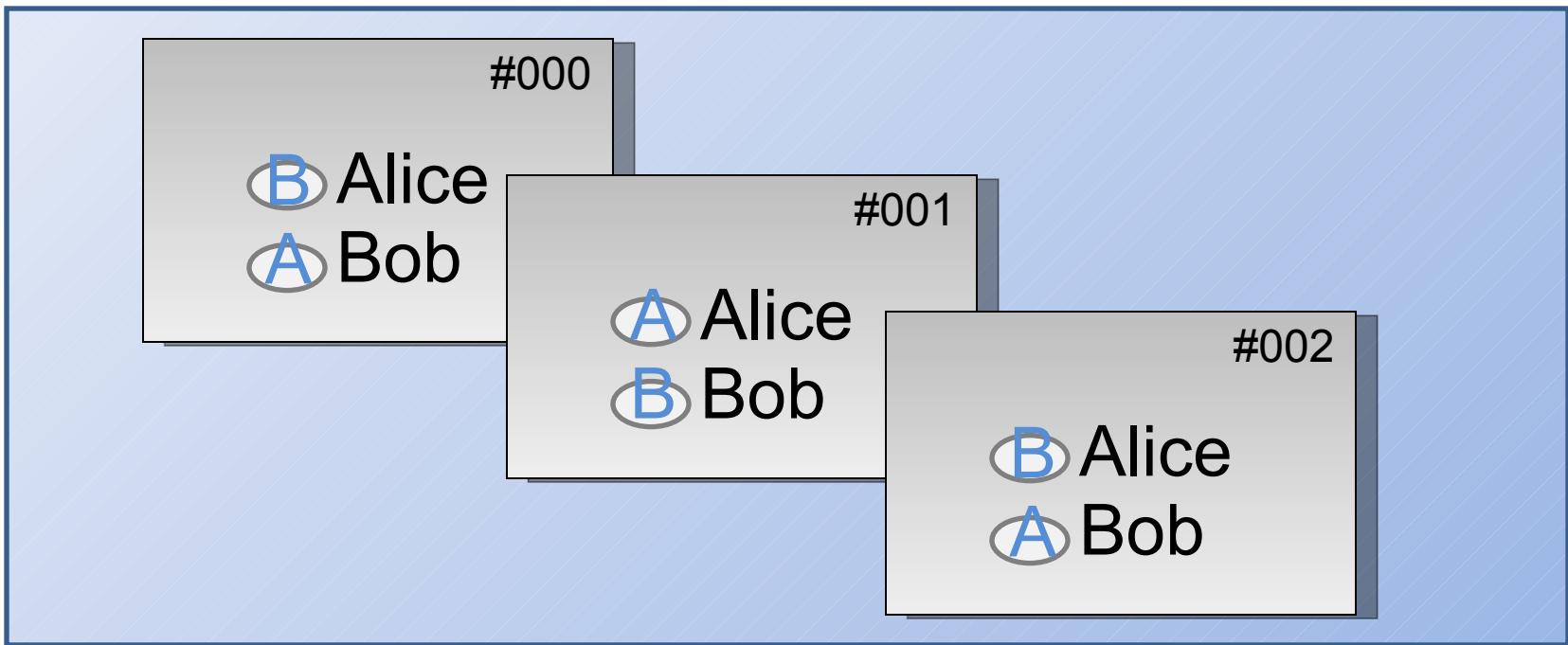


Simple adoption

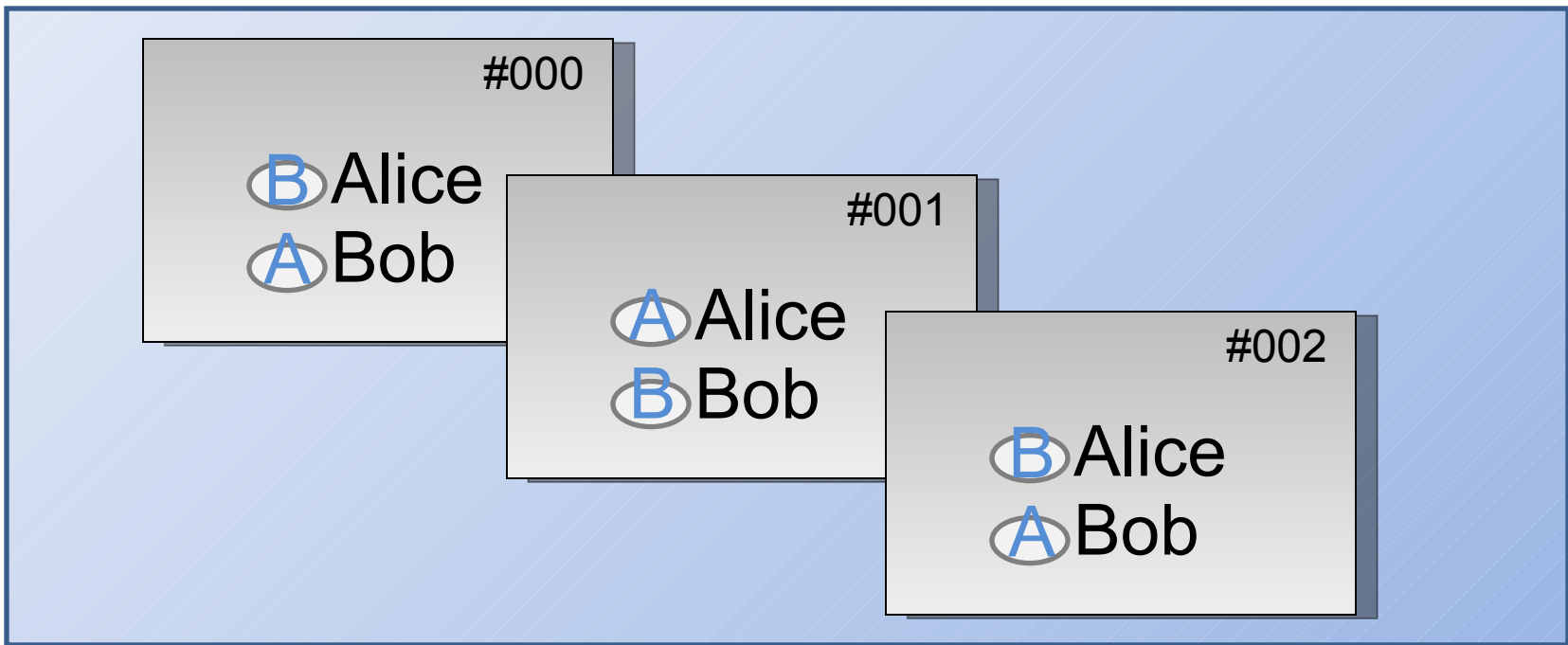
- ▶ Optical scan is most widely used platform
- ▶ Secures existing optical scan and tabulation equipment
- ▶ Maintains established election procedures
- ▶ Value added features are opt-in



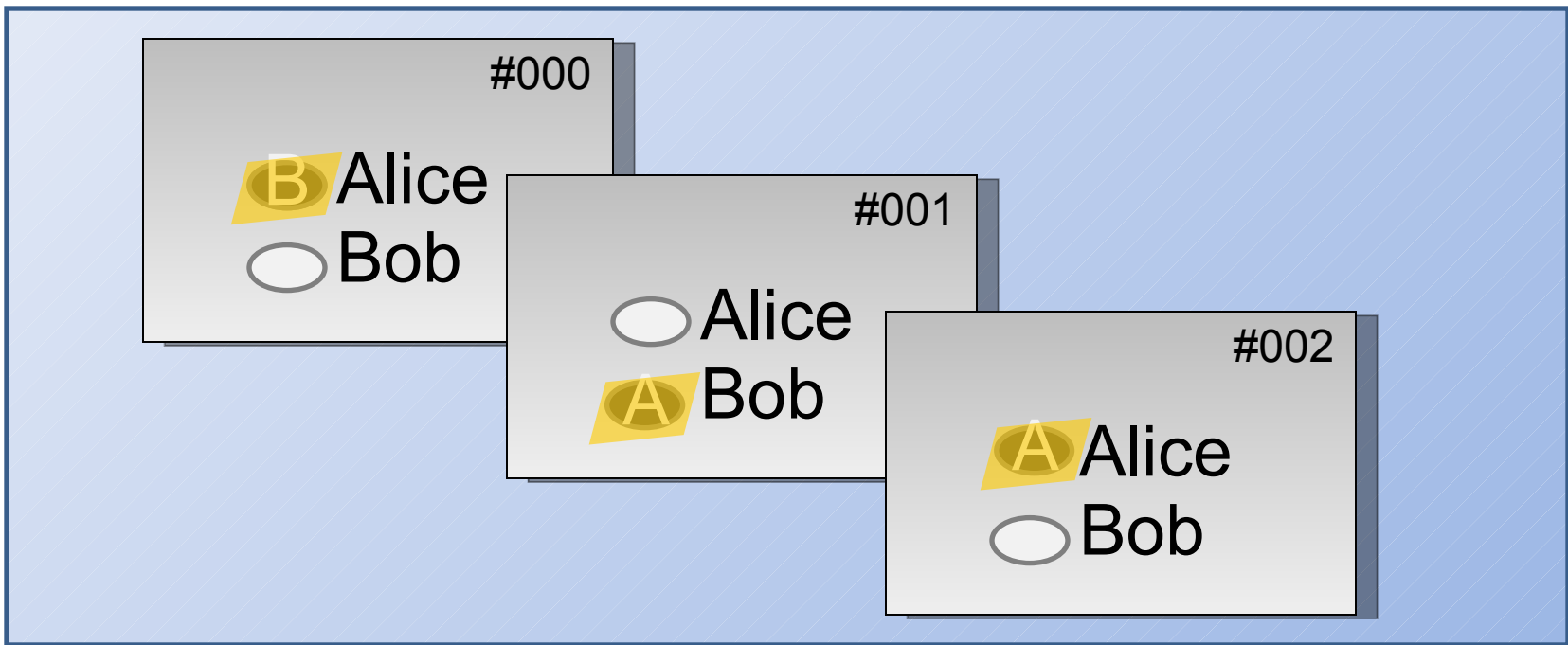
- Regular optical scan ballot



- 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

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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

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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

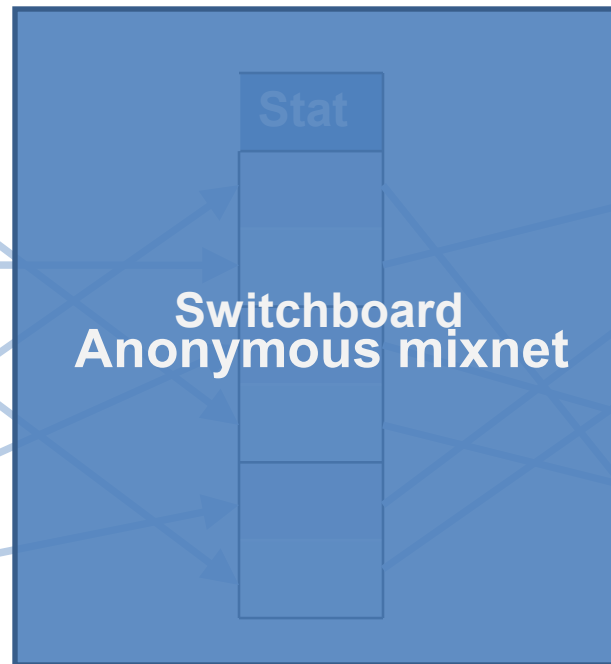
Ok, so they got the codes right, so what?

Tags

Strings

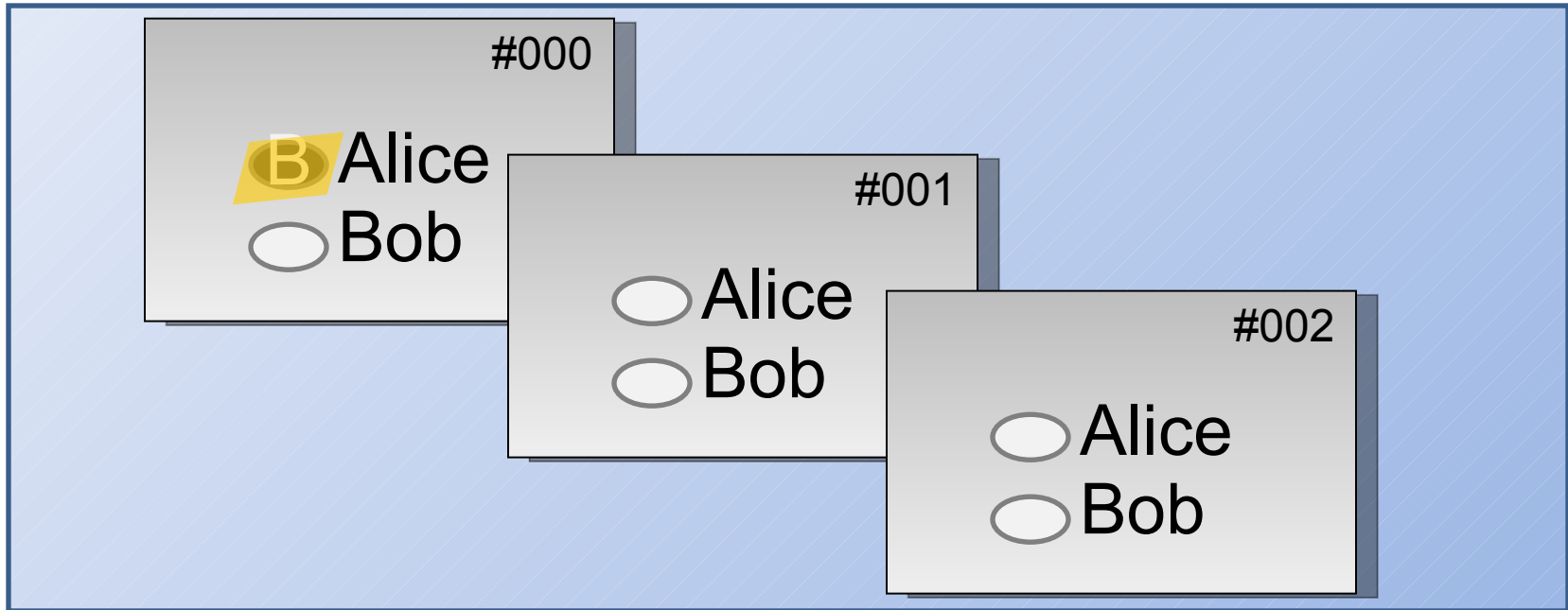
Teapot

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

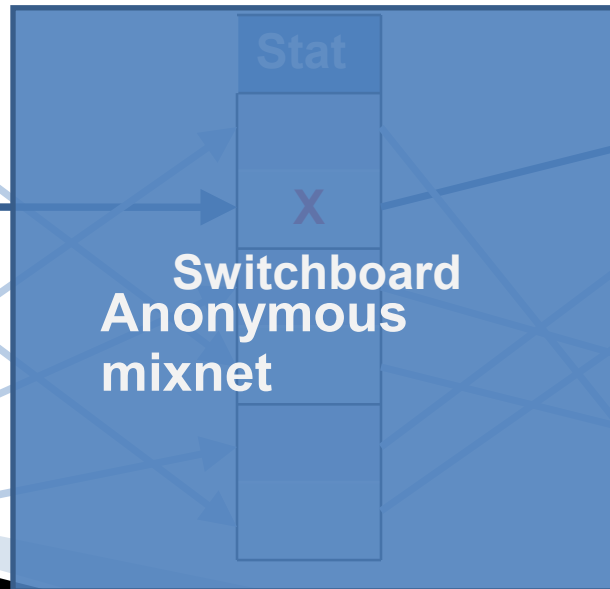


State	Candidate
	Alice
	Alice
	Alice
	Bob
	Bob
	Bob

A peek under the hood



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



State	Candidate
X	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