CSE 484 / CSE M 584: Computer Security and Privacy

Autumn 2020

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Announcements

- Things Due:
  - Ethics form: Due next Wednesday (10/7)
  - Homework #1: Due next Friday (10/9)
  - Form for help with creating groups was sent out to course email list

- Any logistics questions at this point?

THREAT MODELING

Threat Modeling

- There's no such thing as perfect security
  - But, attackers have limited resources
  - **Make them pay unacceptable costs to succeed!**
- Defining security per context: identify assets, adversaries, motivations, threats, vulnerabilities, risk, possible defenses

Threat Modeling (Security Reviews)

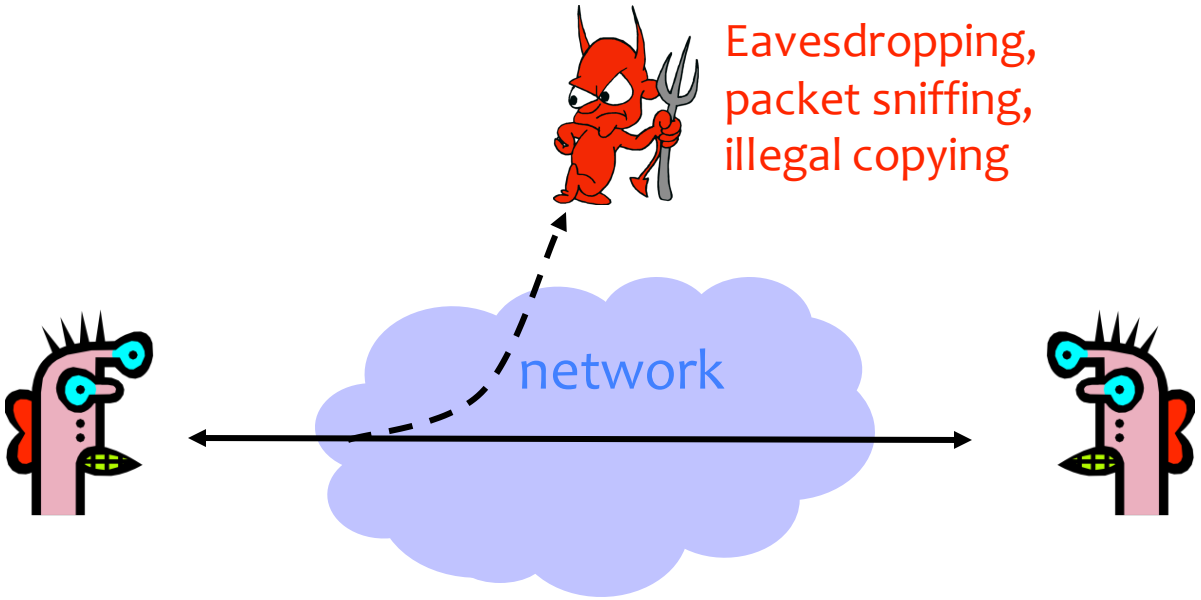
- Assets: What are we trying to protect? How valuable are those assets?
- Adversaries: Who might try to attack, and why?
- Vulnerabilities: How might the system be weak?
- Threats: What actions might an adversary take to exploit vulnerabilities?
- Risk: How important are assets? How likely is exploit?
- Possible Defenses

What's *Security*, Anyway?

- Common general security goals: "CIA"
  - Confidentiality
  - Integrity
  - Authenticity
  - Availability

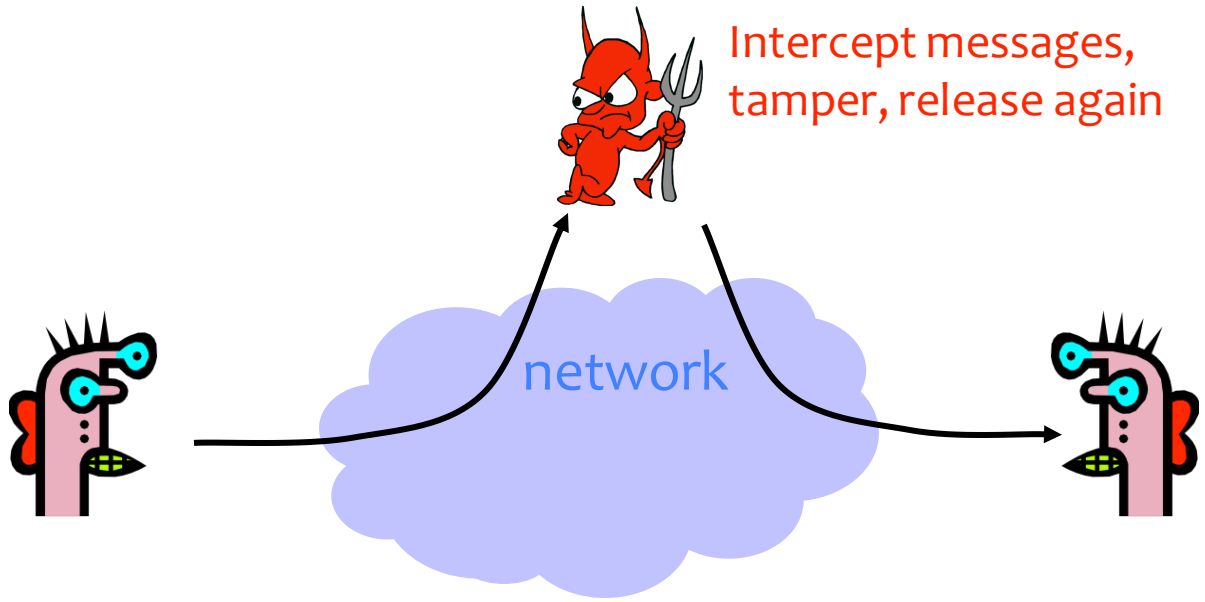
Confidentiality (Privacy)

- Confidentiality is concealment of information.



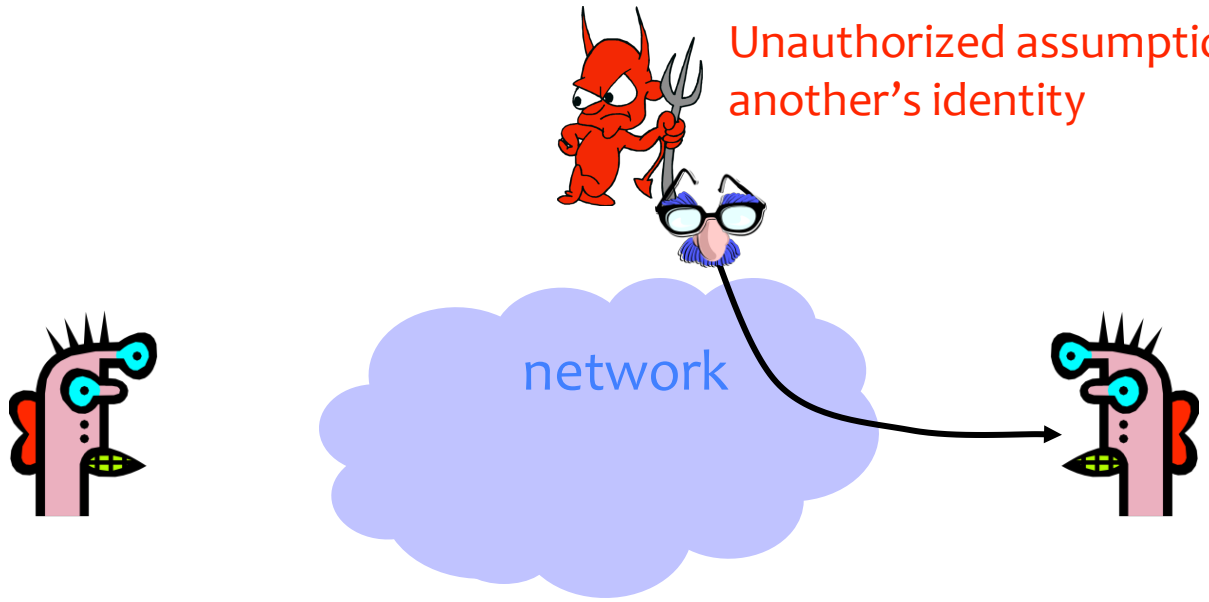
Integrity

- Integrity is prevention of unauthorized changes.



Authenticity

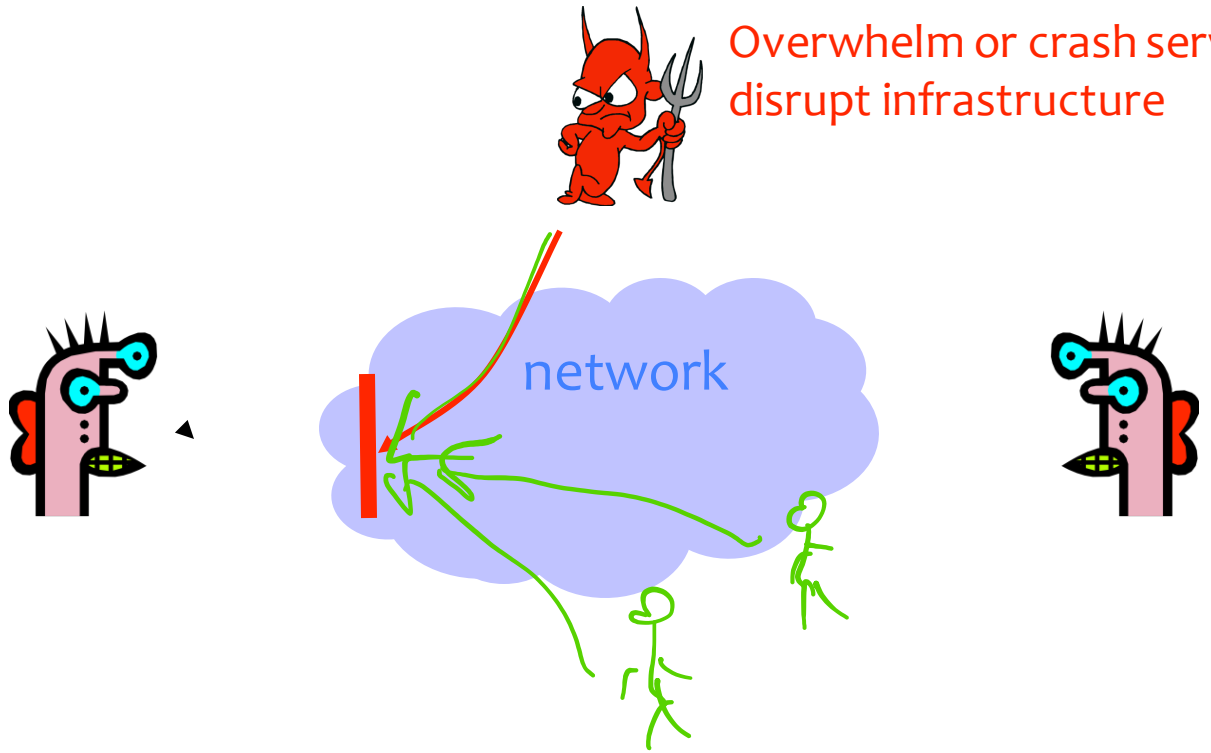
- Authenticity is knowing who you're talking to.



Availability

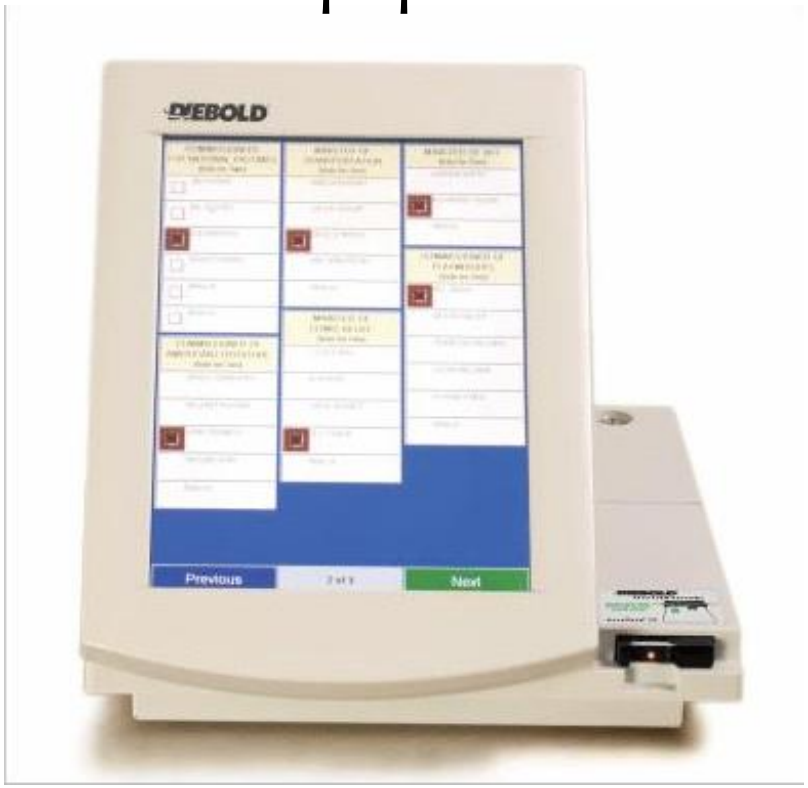
denial of service attack (DoS)
DDOS ↑ distributed

- Availability is ability to use information or resources.

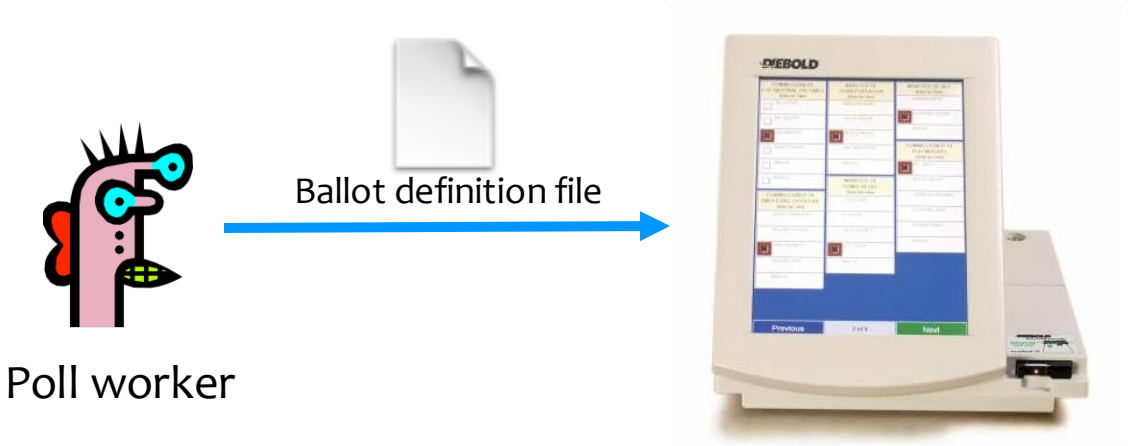


Threat Modeling Example: Electronic Voting

- Popular replacement to traditional paper ballots

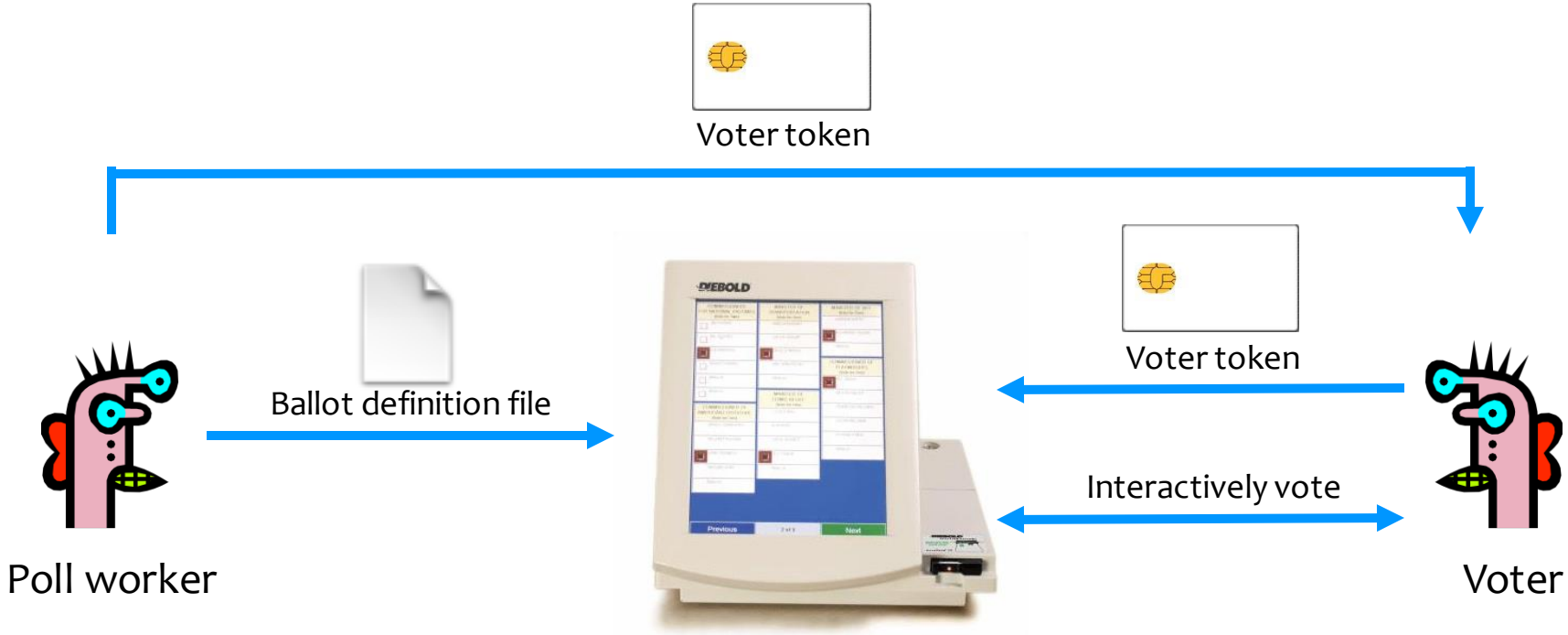


Pre-Election



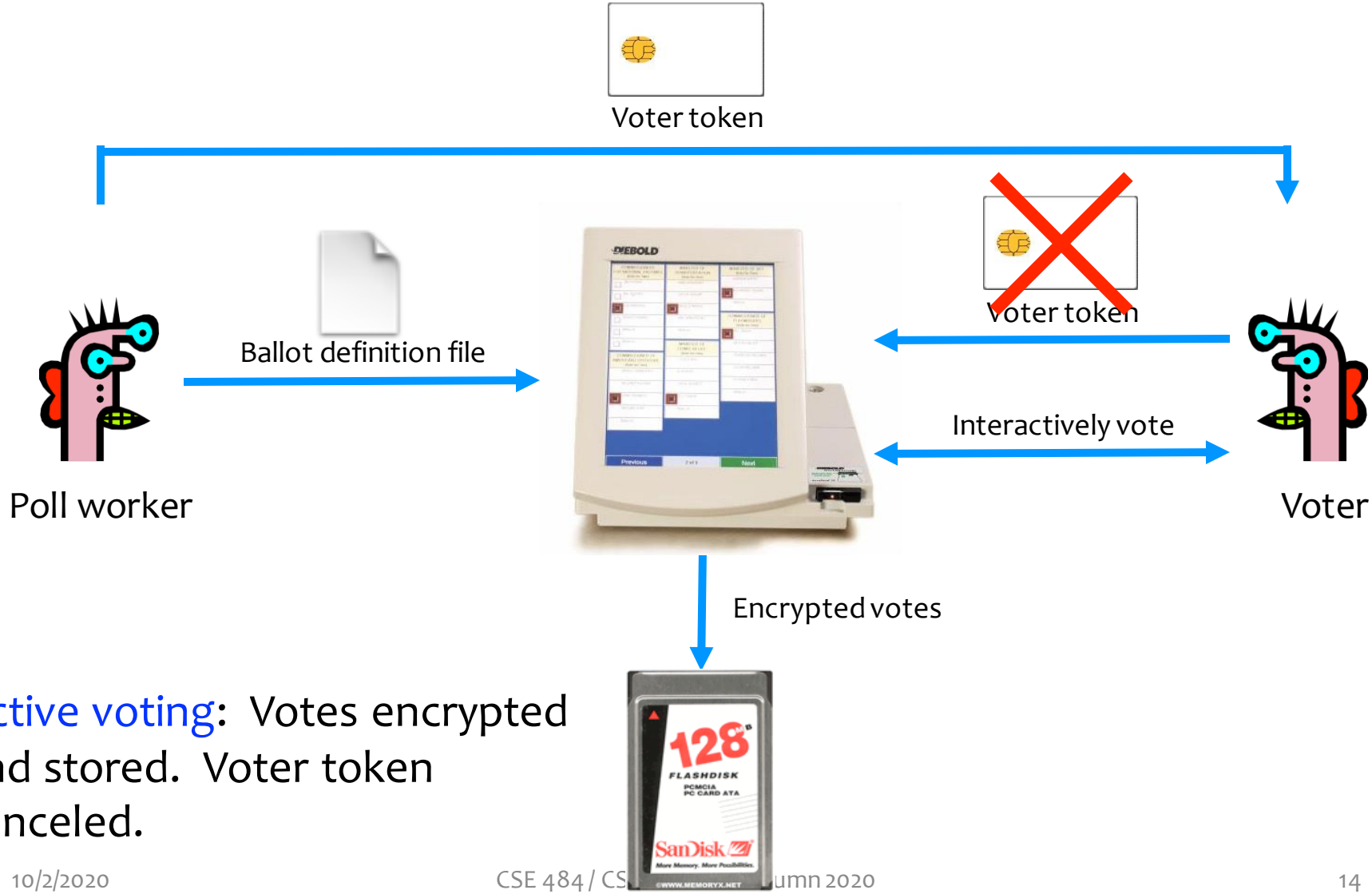
Pre-election: Poll workers load "ballot definition files" on voting machine.

Active Voting



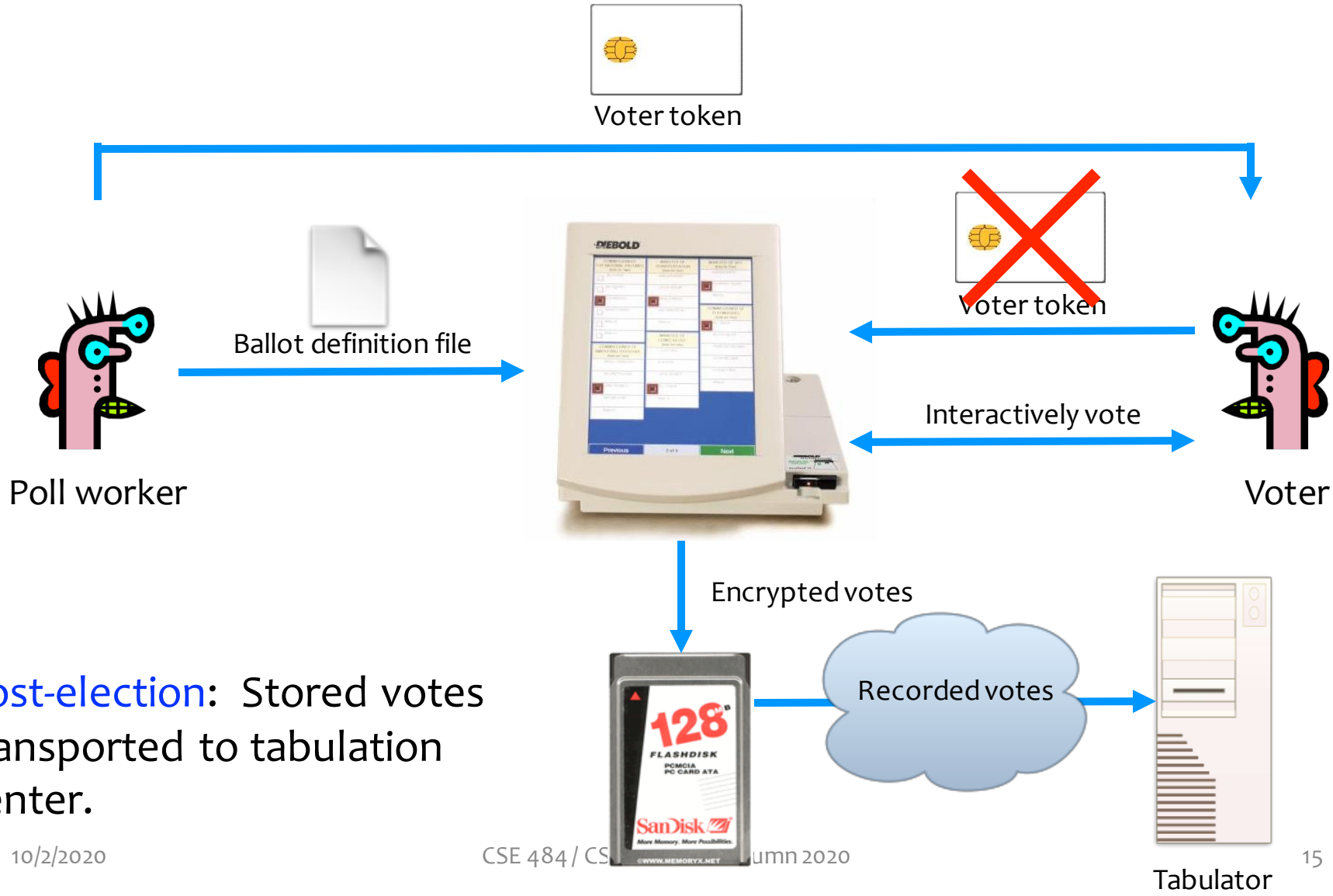
Active voting: Voters obtain single-use tokens from poll workers. Voters use tokens to activate machines and vote.

Active Voting



Active voting: Votes encrypted and stored. Voter token canceled.

Post-Election



Post-election: Stored votes transported to tabulation center.

In-Class "Worksheet" Experiment

- Go to Canvas -> Quizzes -> "In-Class Activity – Oct 2"

  (I will also always post the link in the chat.)
- Fill out the questions while discussing with your breakout group
  - Everyone should submit their own
  - **No need for polish or complete sentences** – jot things down as you would on a piece of paper while chatting in class

Can You Spot Any Potential Issues?

Q1: Security goals? Assets?
Q2: Adversaries? Attack goals?

Security and E-Voting (Simplified)

- Functionality goals:
  - Easy to use, reduce mistakes/confusion
- Security goals:
  - correct person's vote is counted
  - authenticity
  - confidentiality of vote — avoid retaliation, vote coercion
  - availability
  - bribery
  - physical safety
  - integrity of process, confidence in reported outcome

Security and E-Voting (Simplified)

- Functionality goals:
  - Easy to use, reduce mistakes/confusion
- Security goals:
  - Adversary should not be able to tamper with the election outcome
    - By changing votes (**integrity**)
    - By voting on behalf of someone (**authenticity**)
    - By denying voters the right to vote (**availability**)
  - Adversary should not be able to figure out how voters vote (**confidentiality**)

Potential Adversaries

foreign govts

political opponents

private companies

revolutionaries

sow chaos

bored teenagers

malicious pen testers

Potential Adversaries

- Voters
- Election officials
- Employees of voting machine manufacturer
  - Software/hardware engineers
  - Maintenance people
- Other engineers
  - Makers of hardware
  - Makers of underlying software or add-on components
  - Makers of compiler
- …
- Or any combination of the above

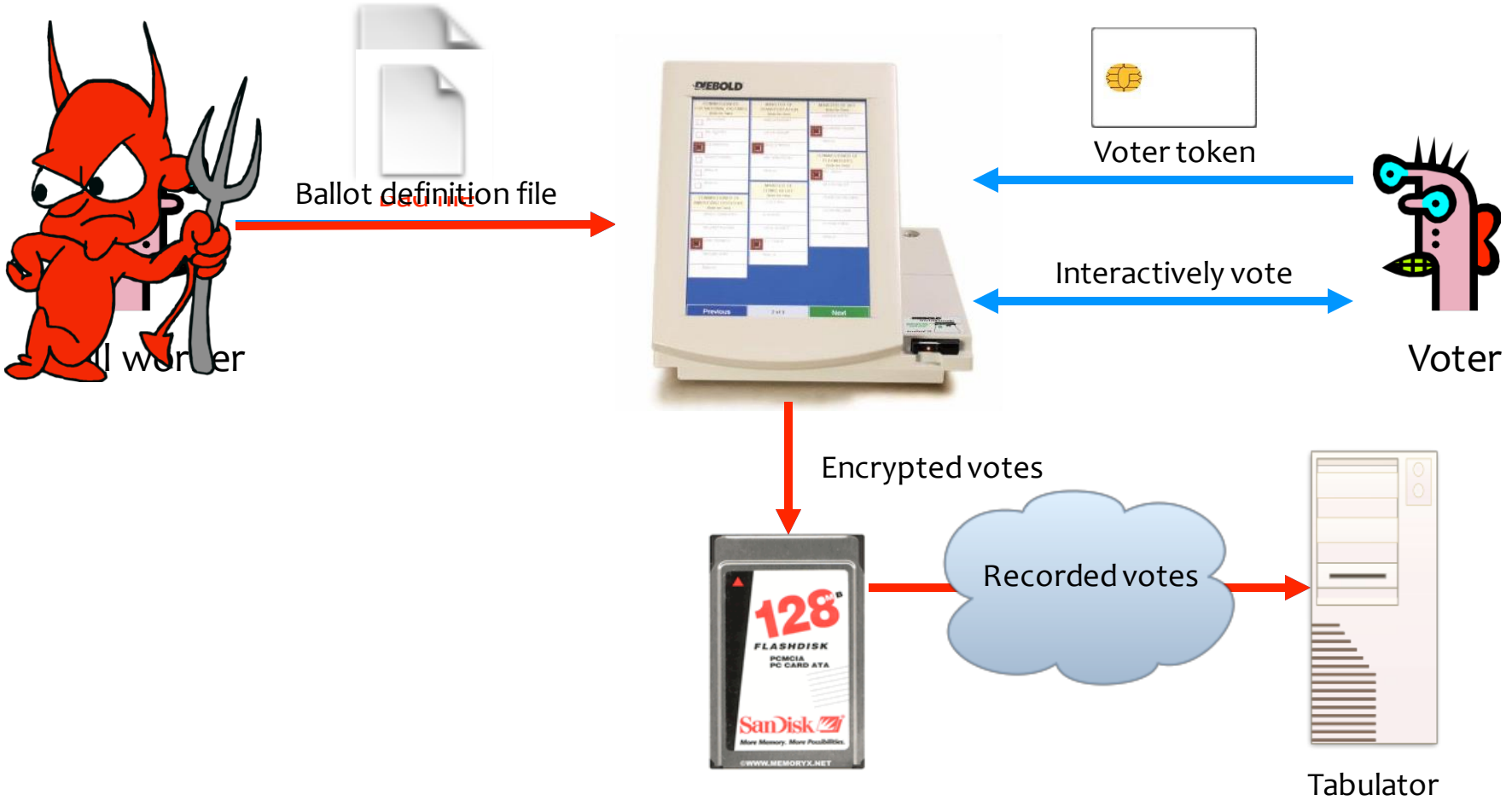
What Software is Running?

Problem: An adversary (e.g., a poll worker, software developer, or company representative) able to control the software or the underlying hardware could do whatever he or she wanted.


KEYS TO THE KINGDOM
Photo taken from Diebold's online store. The keys that open every Diebold touch-screen voting machine. Working copies have been made from the photo.

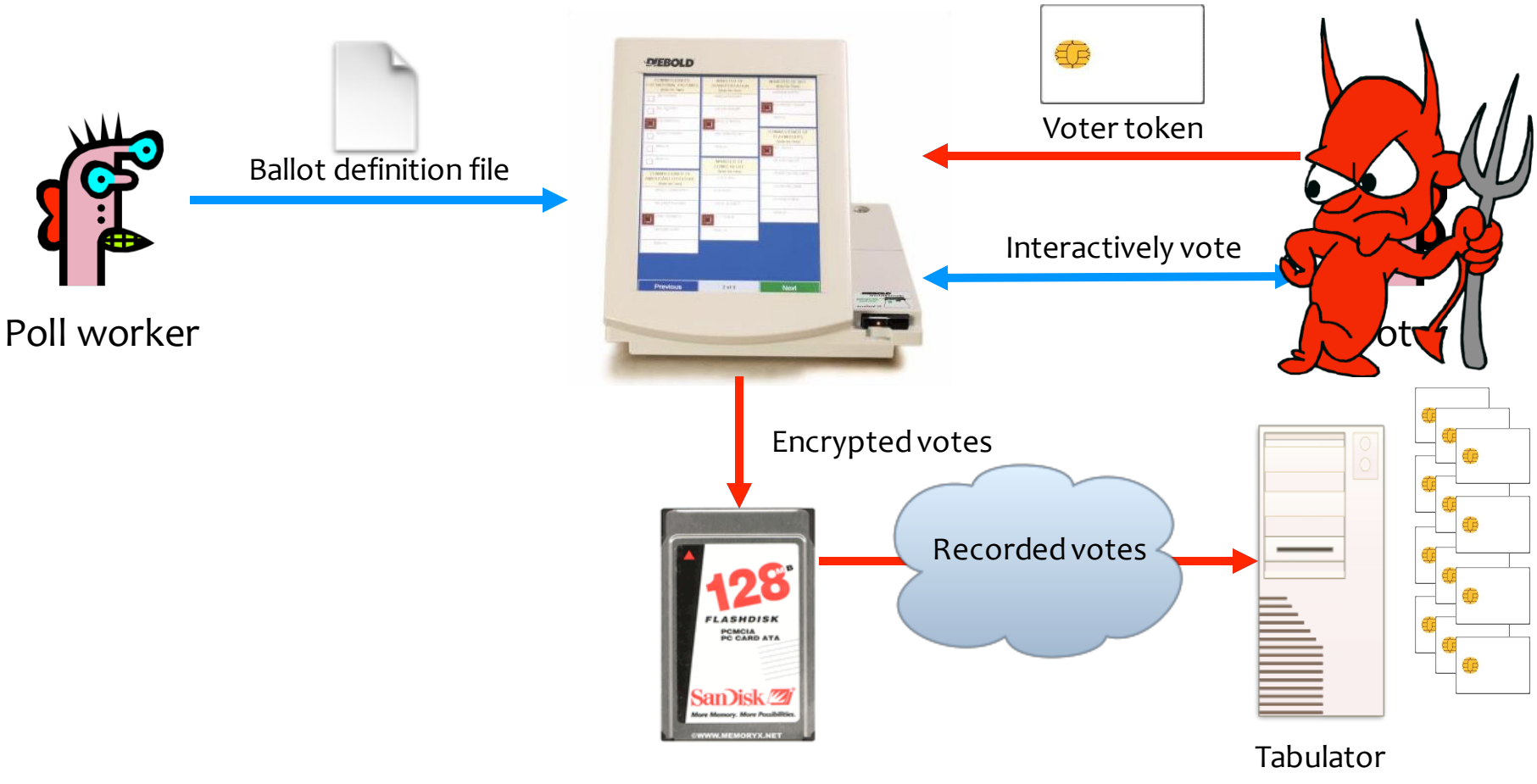
Problem: Ballot definition files are not authenticated.

Example attack: A malicious poll worker could modify ballot definition files so that votes cast for "Mickey Mouse" are recorded for "Donald Duck."



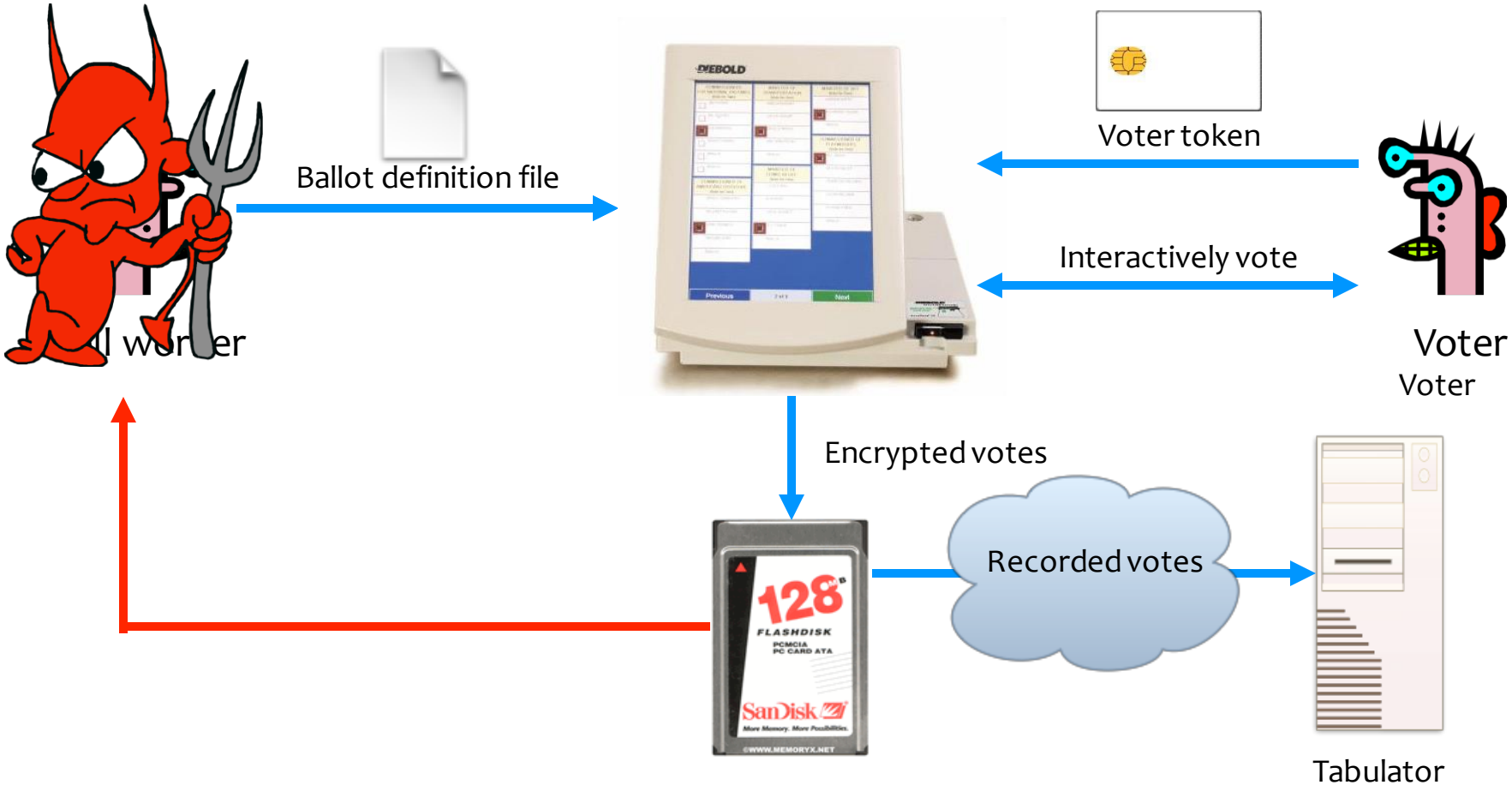
Problem: Smartcards can perform cryptographic operations. But there is no authentication from voter token to terminal.

Example attack: A regular voter could make his or her own voter token and vote multiple times.



Problem: Encryption key ("F2654hD4") hard-coded into the software since (at least) 1998. Votes stored in the order cast.

Example attack: A poll worker could determine how voters vote.



Problem: When votes transmitted to tabulator over the Internet or a dialup connection, they are decrypted first; the cleartext results are sent the the tabulator.

Example attack: A sophisticated outsider could determine how voters vote.