

Warmup:
What adversary might this successfully protect against?



CSE 484

Computer Security and Privacy

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Logistics

- Canvas is up, assignments are not
- Panopto recording *does not have slides*
 - (thanks HDCP!)
 - Trying something different this time
- HW1 will be out this week, primarily writing assignment
- (584 only) research readings start next week
- OH start next week
- Section starts *tomorrow*



Lea Kissner ✓

@LeaKissner



I was just asked what the differences are between the fields of privacy, security, and health/trust&safety. Here's my best shot -- do you have better?

Security: our products/systems behave how they're supposed to, even in the presence of adversaries

10:37 AM · Sep 14, 2022 · Twitter for Android



Lea Kissner ✓

@LeaKissner



Privacy: our products/systems behave respectfully towards the people who use and are affected by them

T&S: users interact respectfully with each other through our products/systems

10:37 AM · Sep 14, 2022 · Twitter for Android

<https://twitter.com/LeaKissner/status/1570104506477867008>

THREAT MODELING

Threat Modeling (Security Reviews)

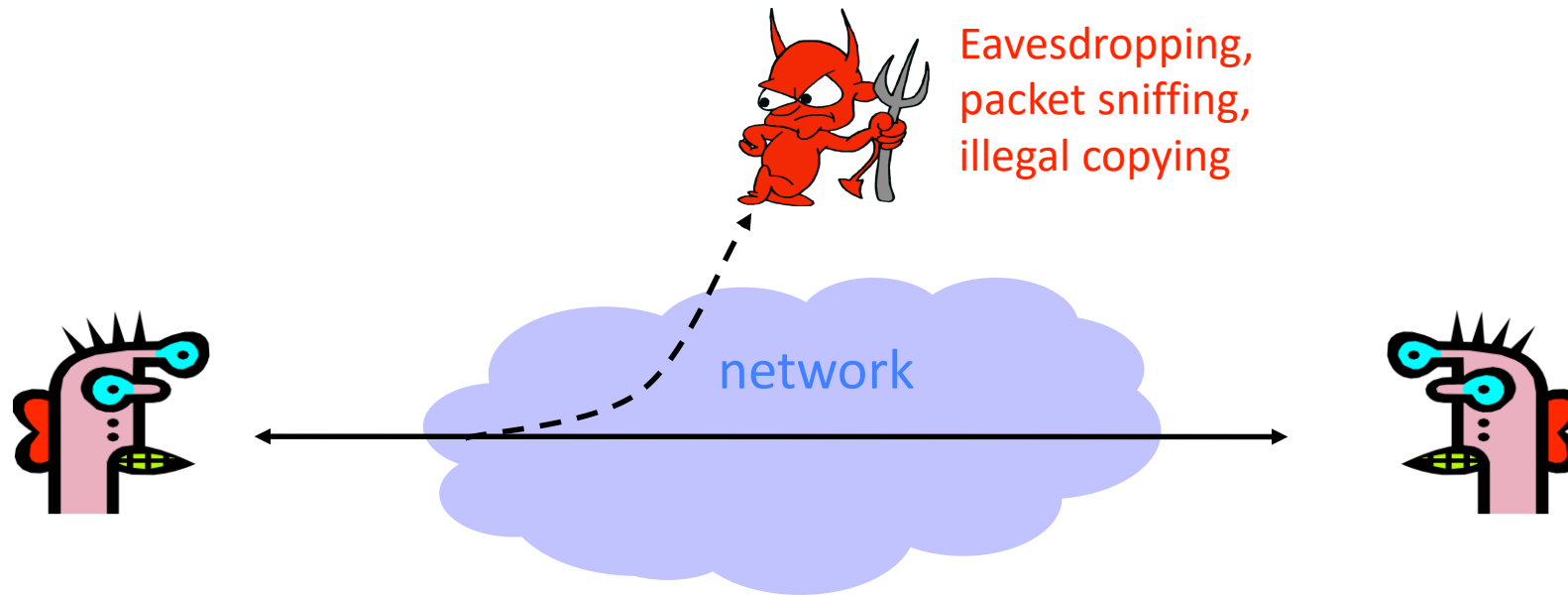
- **Assets**: What are we trying to protect? How valuable are those assets?
- **Adversaries**: Who might try to attack, and why?
- **Vulnerabilities**: How might the system be weak?
- **Threats**: What actions might an adversary take to exploit vulnerabilities?
- **Risk**: How important are assets? How likely is exploit?
- **Possible Defenses**
- Not “traditional” threat modeling, but important (both in general, and to help better understand the system prior to threat modeling):
 - **Benefits**: Who might the system benefit, and how?
 - **Harms**: Who might the system harm, and how?

What's *Security*, Anyway?

- Common general security goals: “CIA”
 - Confidentiality
 - Integrity
 - Availability
- Or the extension: CPIAAU (Parkerian Hexad)
 - Control
 - Authenticity
 - Utility

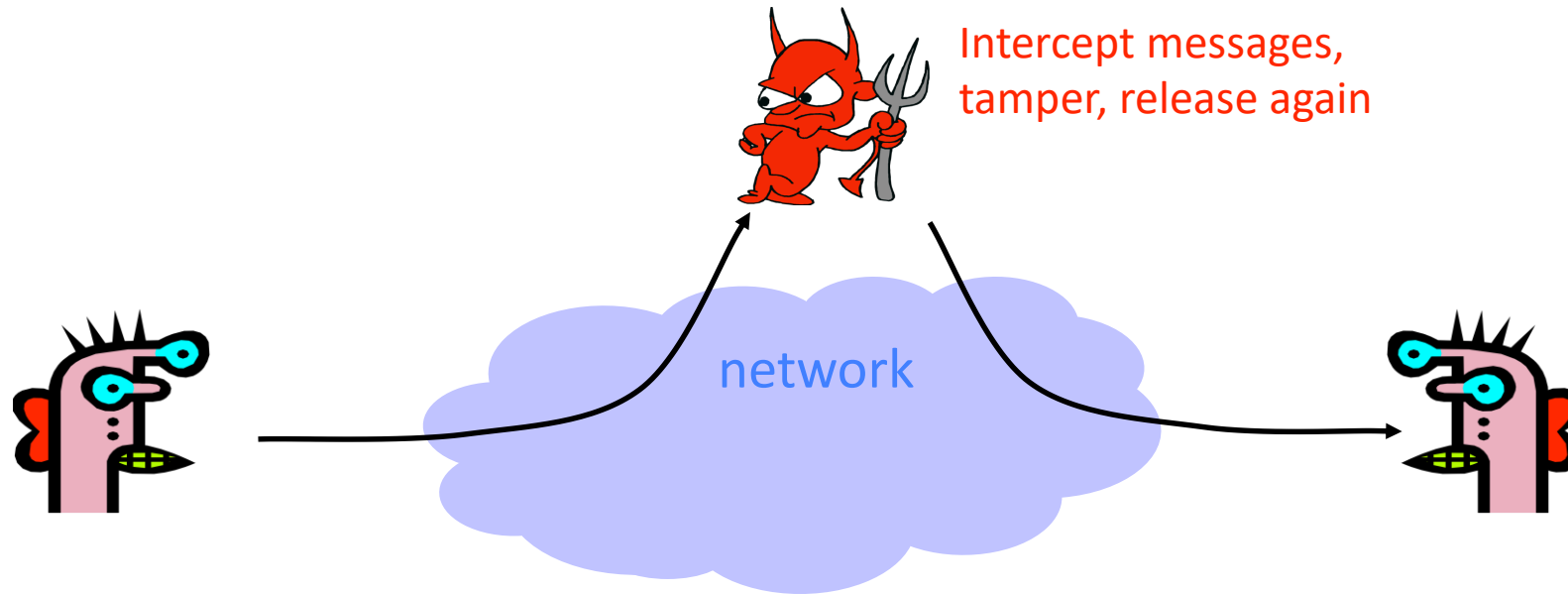
Confidentiality (Privacy)

- Confidentiality is **concealment of information**.



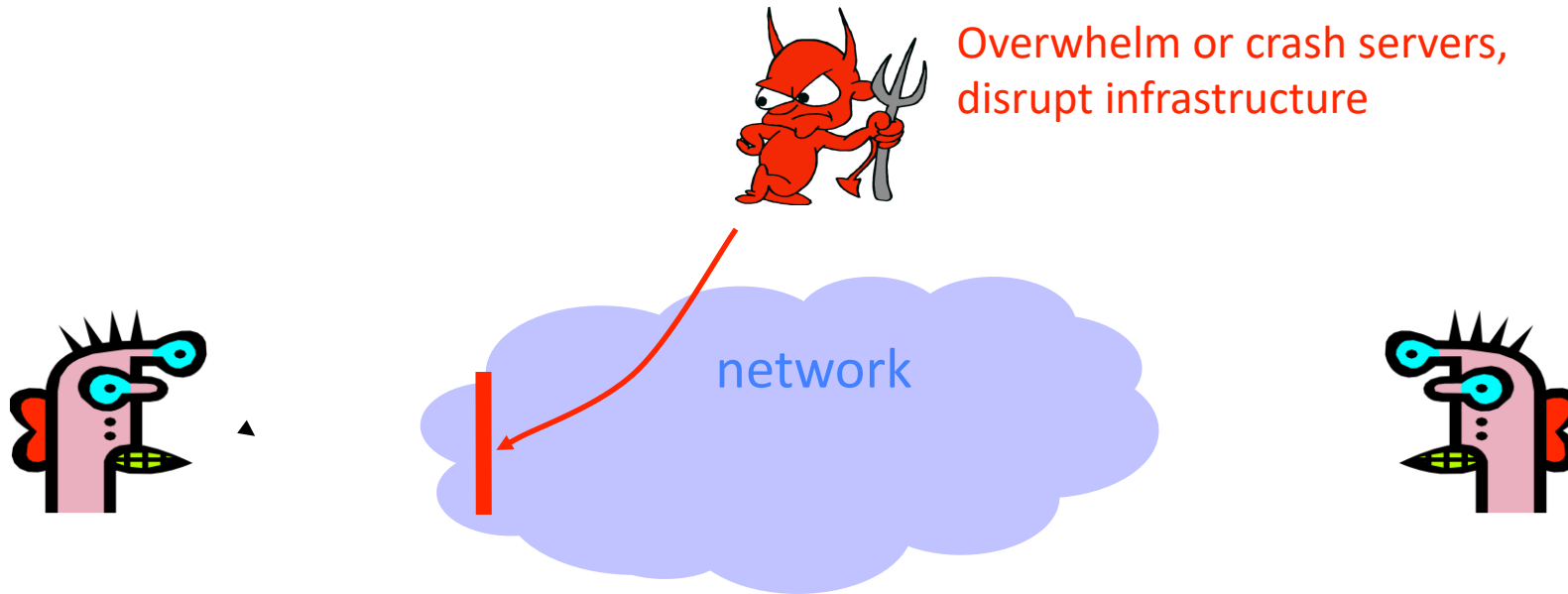
Integrity

- Integrity is prevention of unauthorized changes.



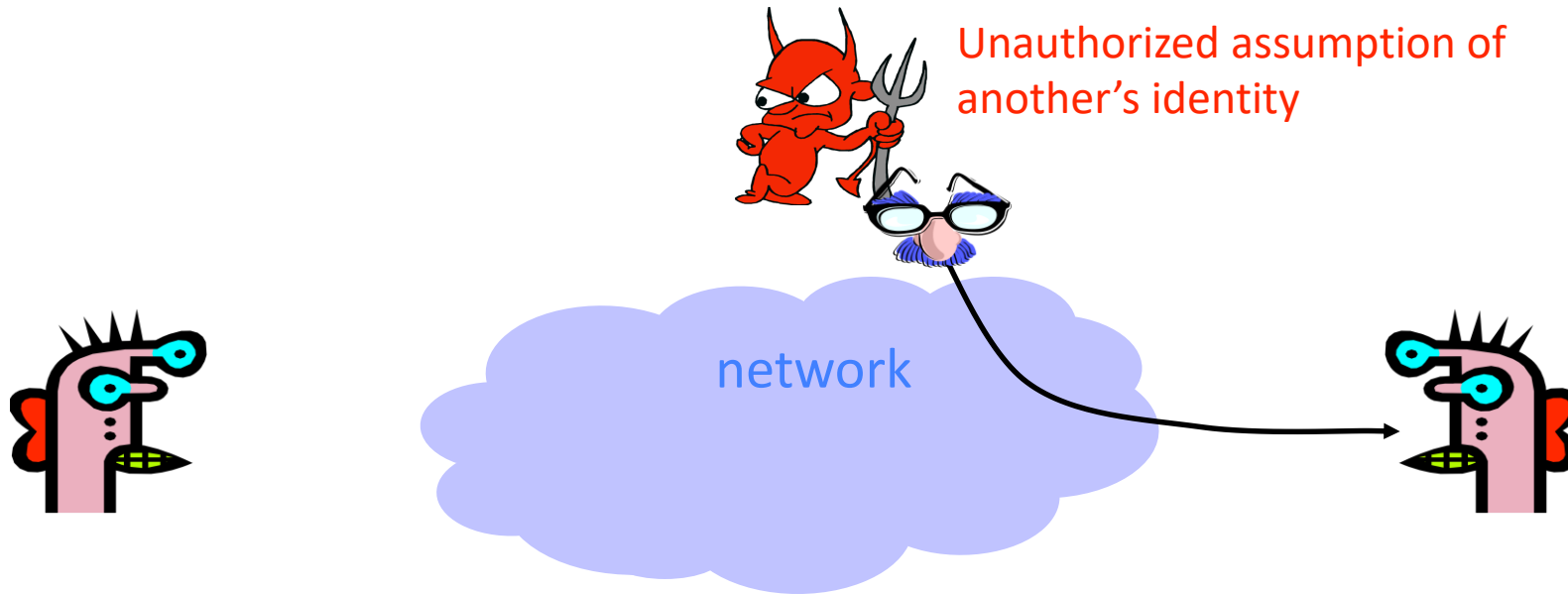
Availability

- Availability is **ability to use information or resources**.



Authenticity

- Authenticity is **knowing who you're talking to.**

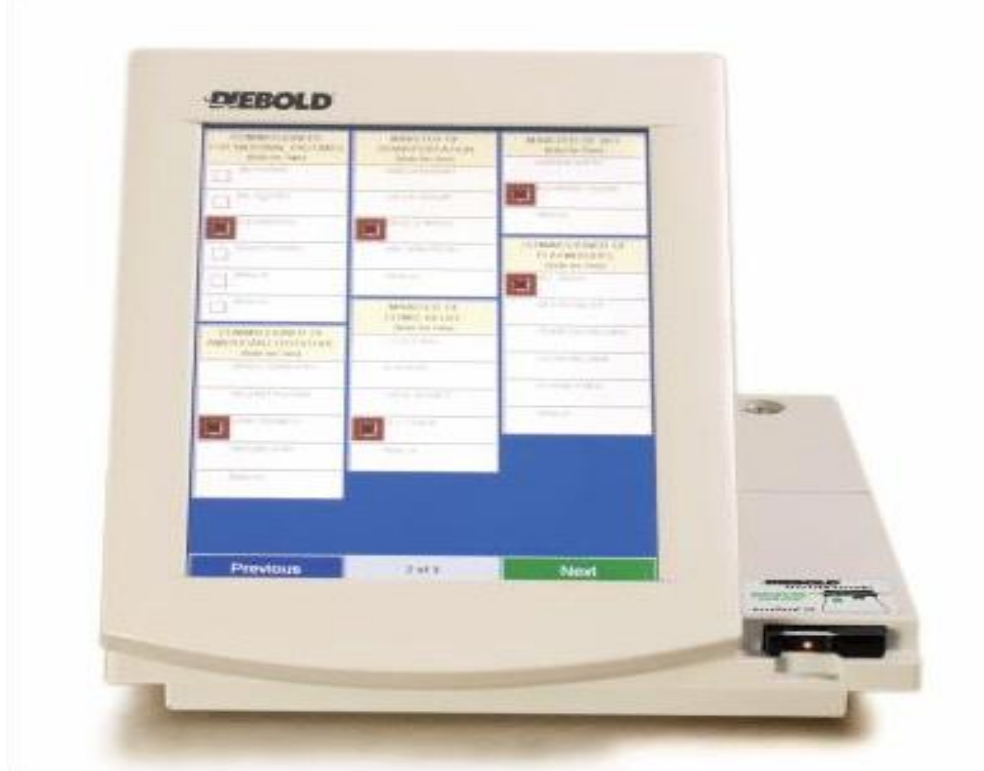


Threat Modeling

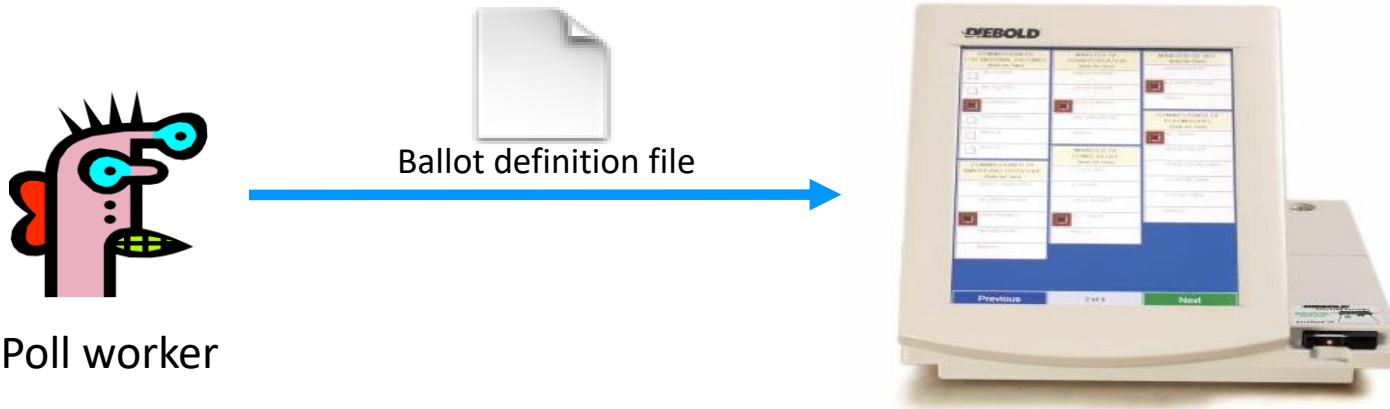
- There's no such thing as perfect security
 - But, attackers have limited resources
 - **Make them pay unacceptable costs / take on unacceptable risks to succeed!**
- Defining security per context: identify assets, adversaries, motivations, threats, vulnerabilities, risk, possible defenses

Threat Modeling Example: Electronic Voting

- Popular replacement to traditional paper ballots

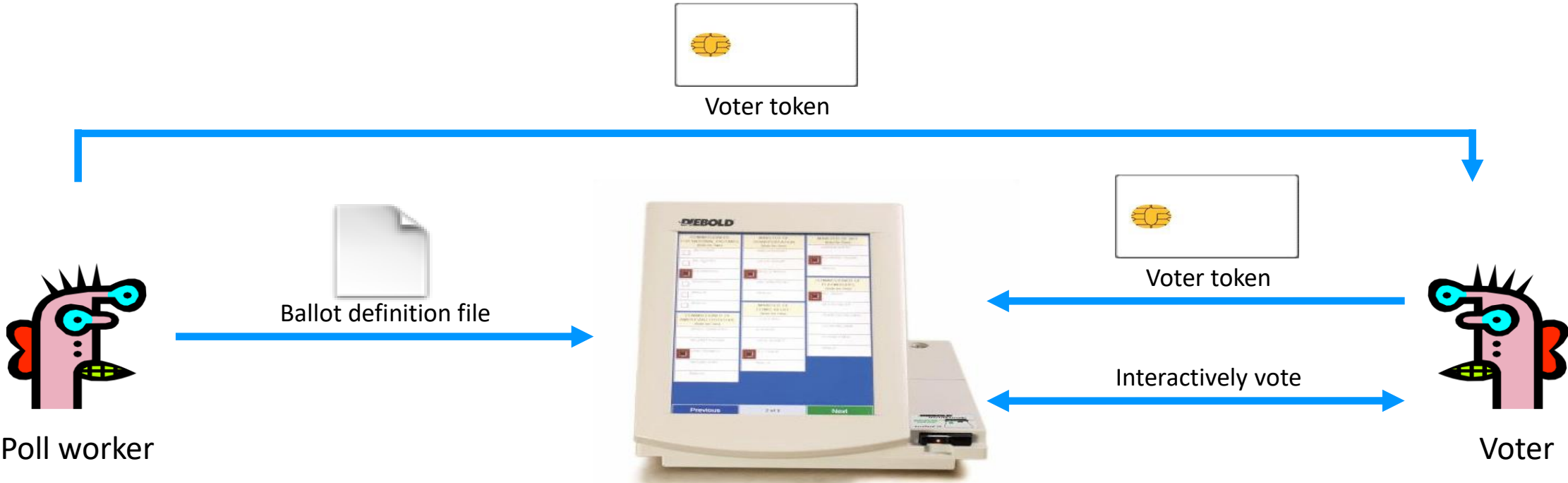


Pre-Election



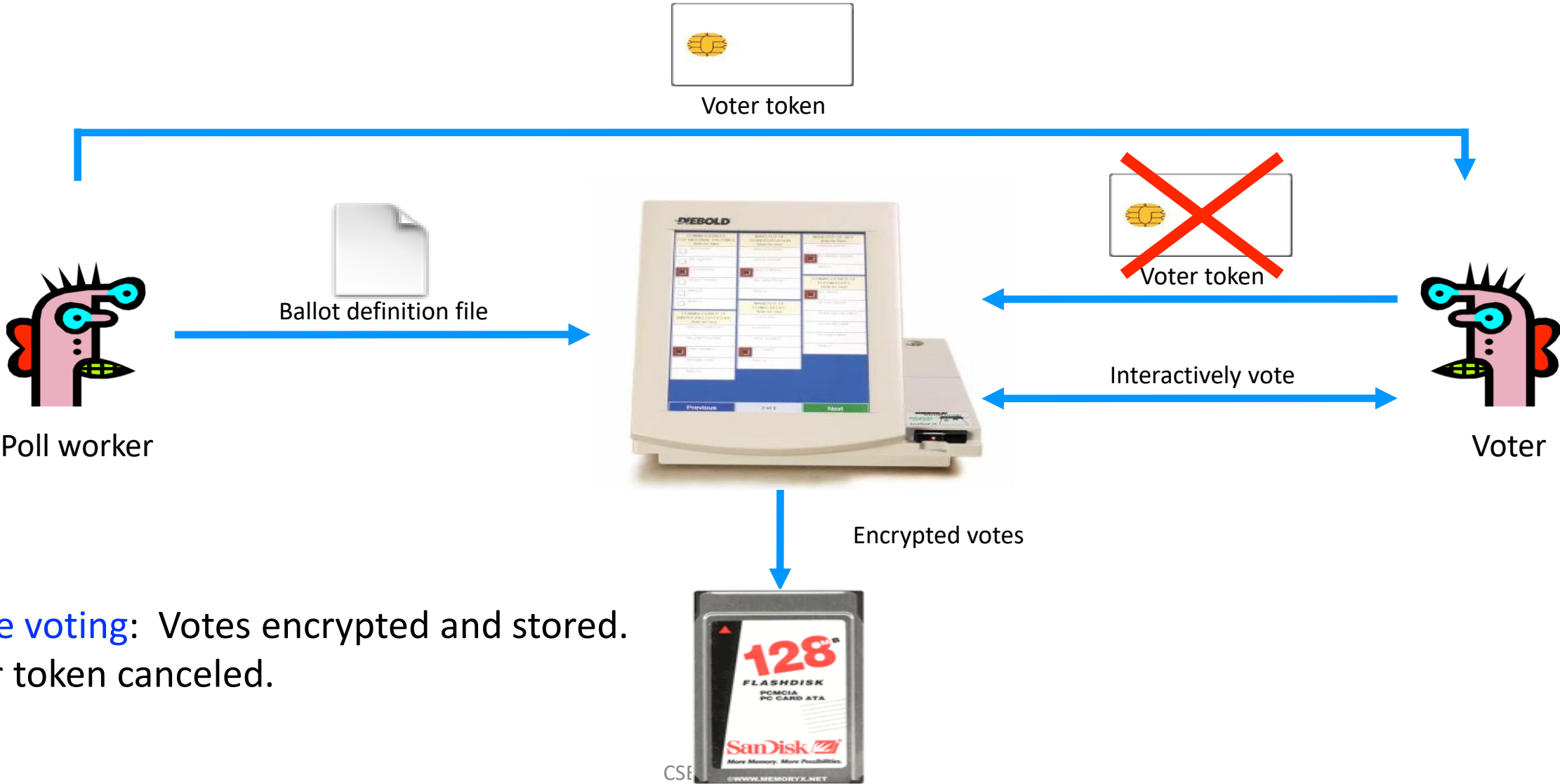
Pre-election: Poll workers load “ballot definition files” on voting machine.

Active Voting



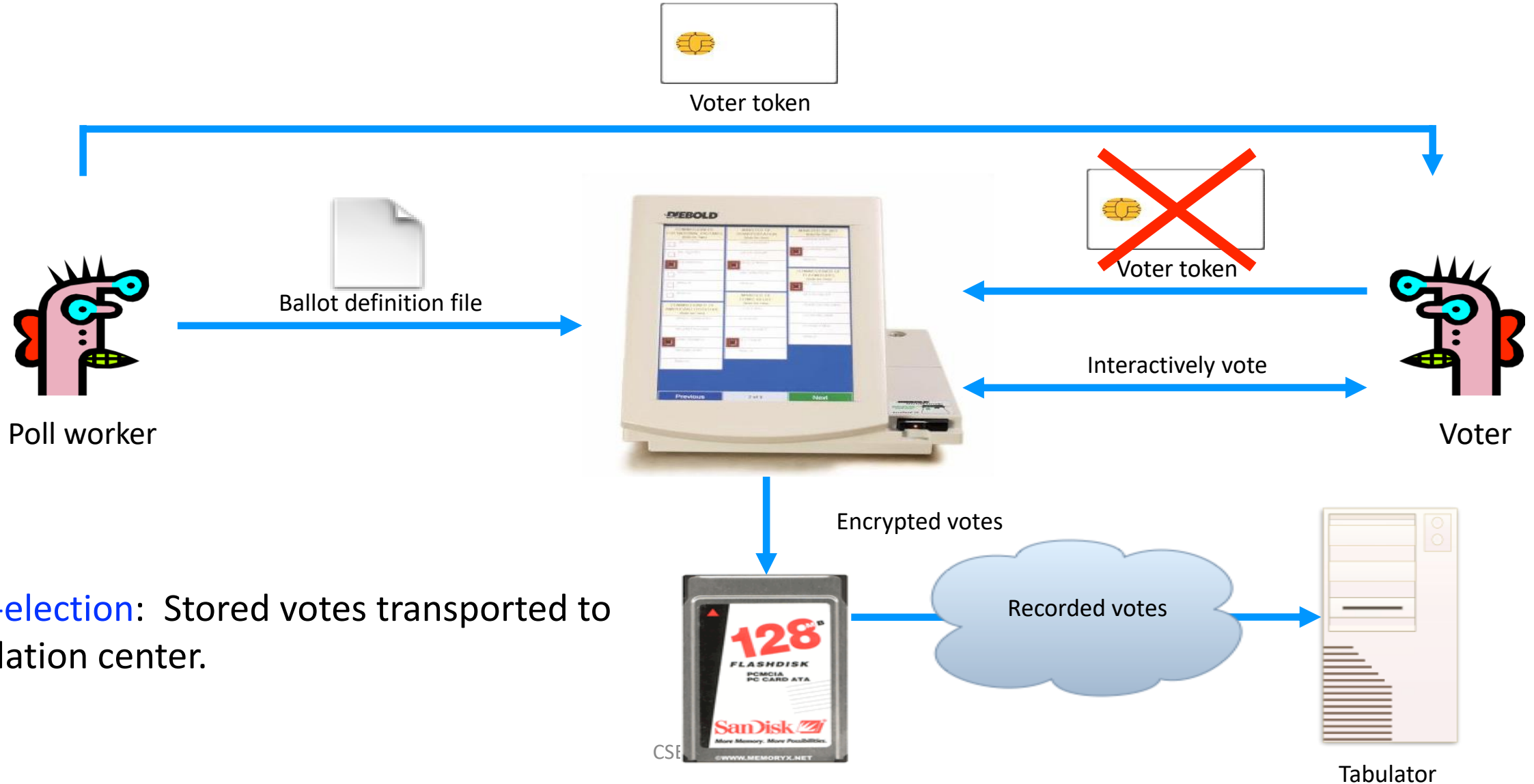
Active voting: Voters obtain **single-use** tokens from poll workers. Voters use tokens to **activate machines** and vote.

Active Voting



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

Post-Election



Post-election: Stored votes transported to tabulation center.

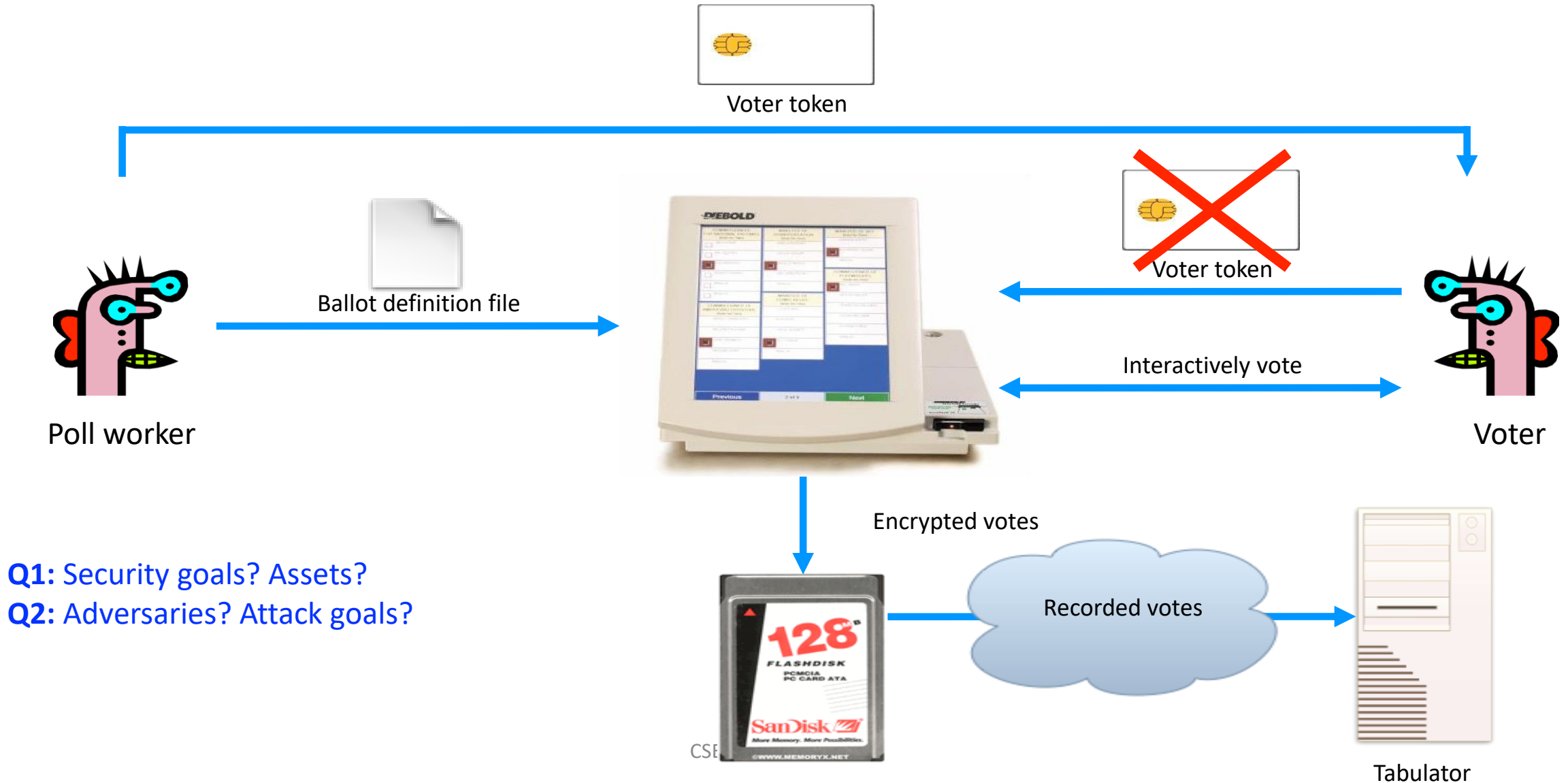
Threat modeling

- Polleverywhere
- Fill out the questions while discussing with your neighbors
 - 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

Security and E-Voting (Simplified)

- Functionality goals:
 - Easy to use, reduce mistakes/confusion, make voting more accessible
- Security goals:

Can You Spot Any Potential Issues?



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 they wanted.

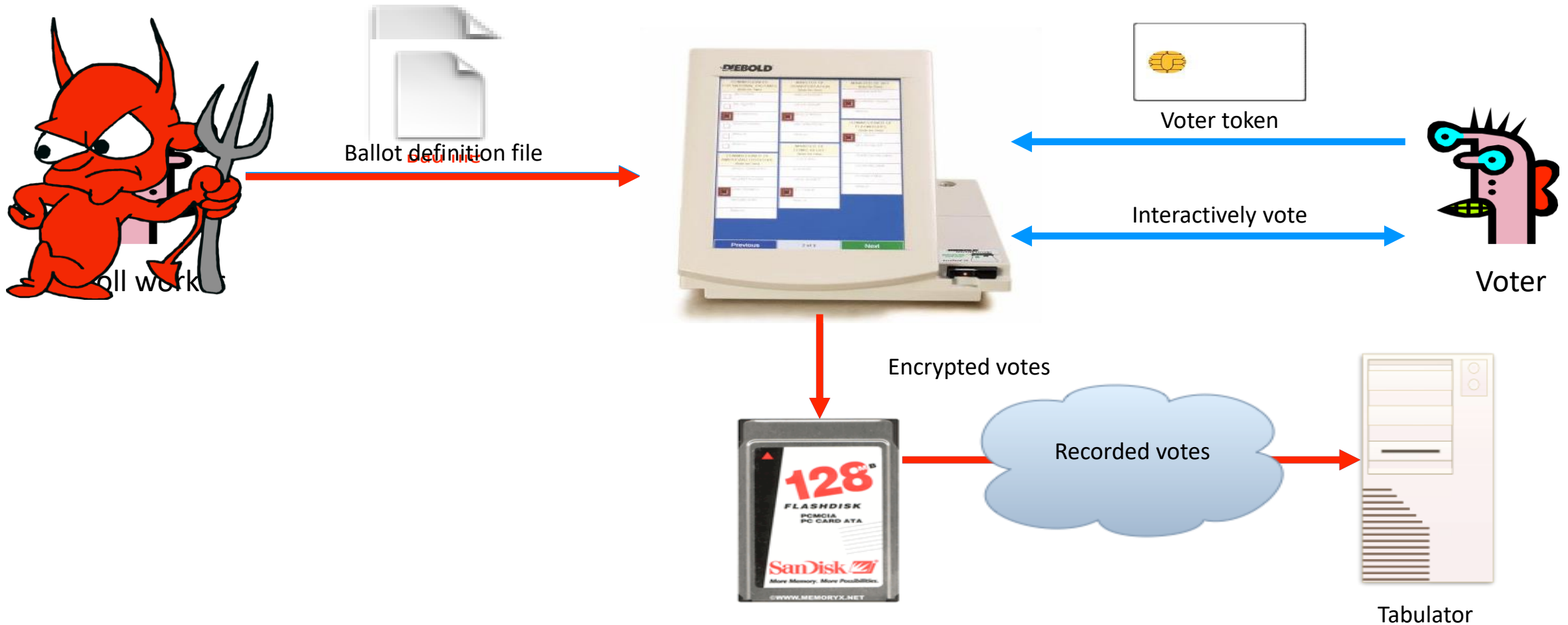


KEYS TO THE KINGDOM

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.

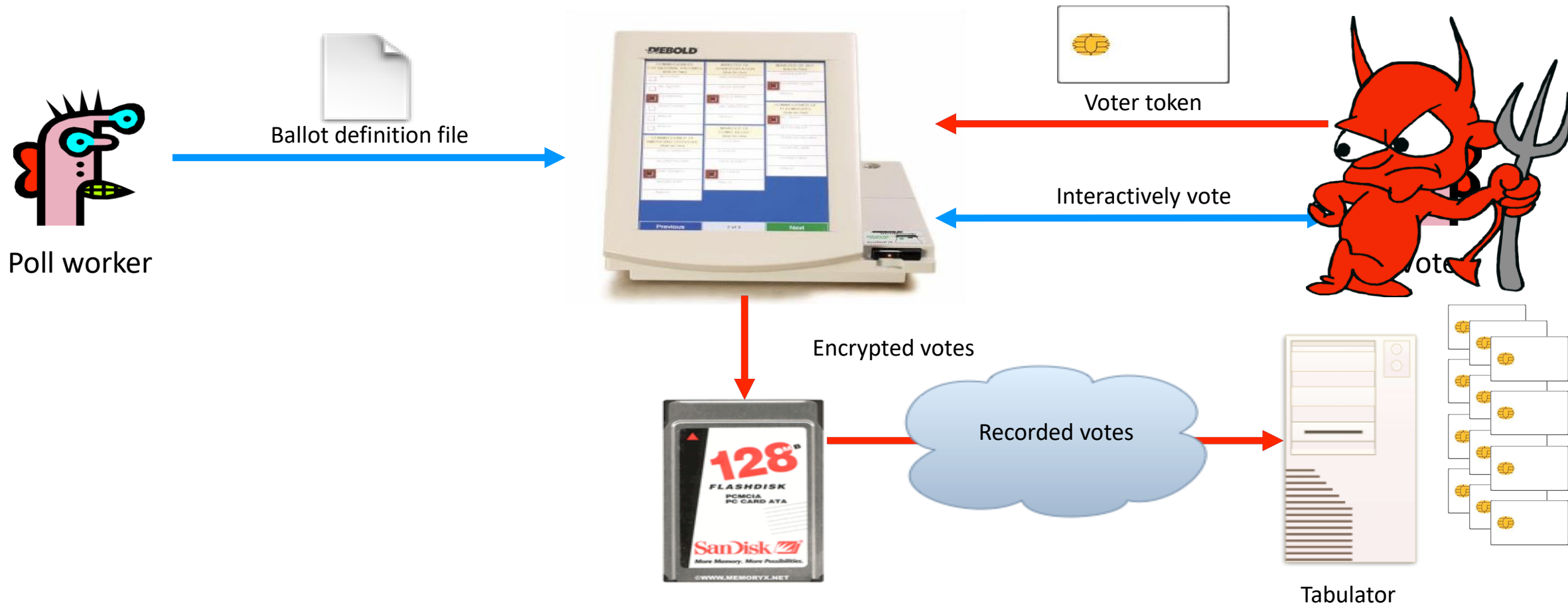
Problem: Ballot definition files are not authenticated.

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



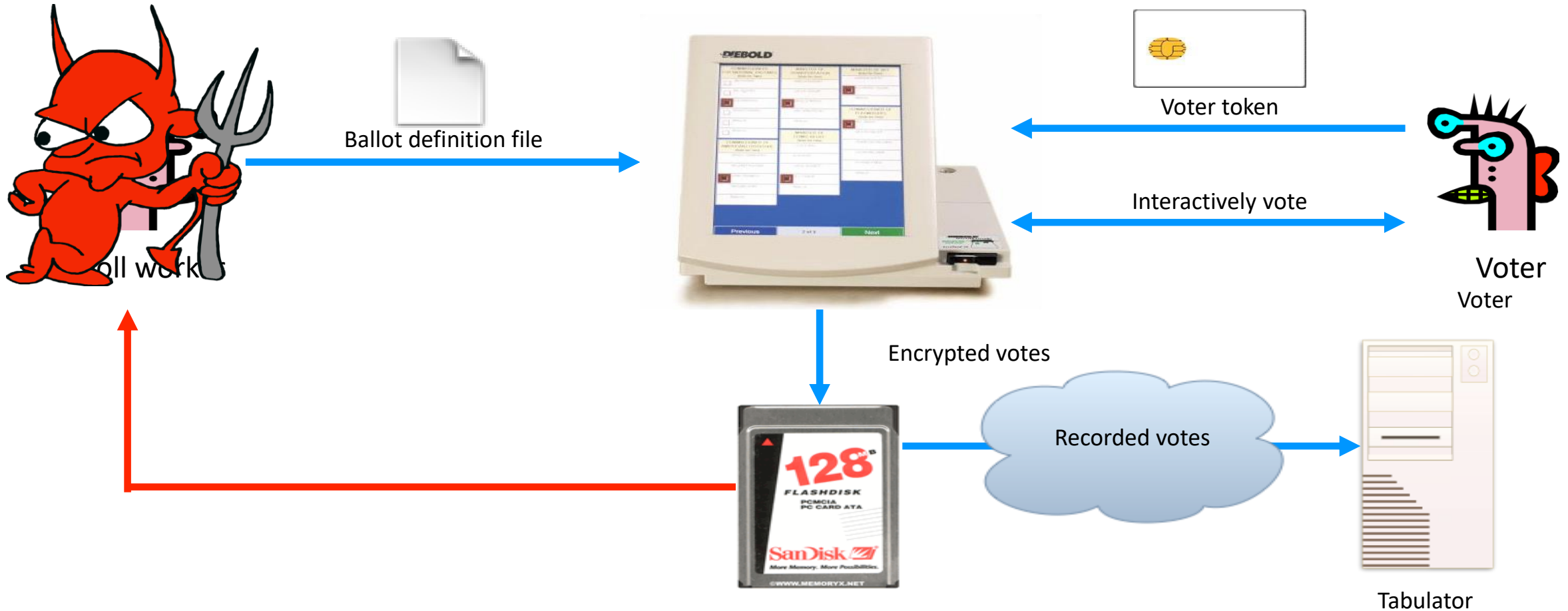
Problem: Smartcards can perform cryptographic operations. But there is **no authentication** from voter token to terminal.

Example attack: A regular voter could make their own voter token and **vote multiple times**.



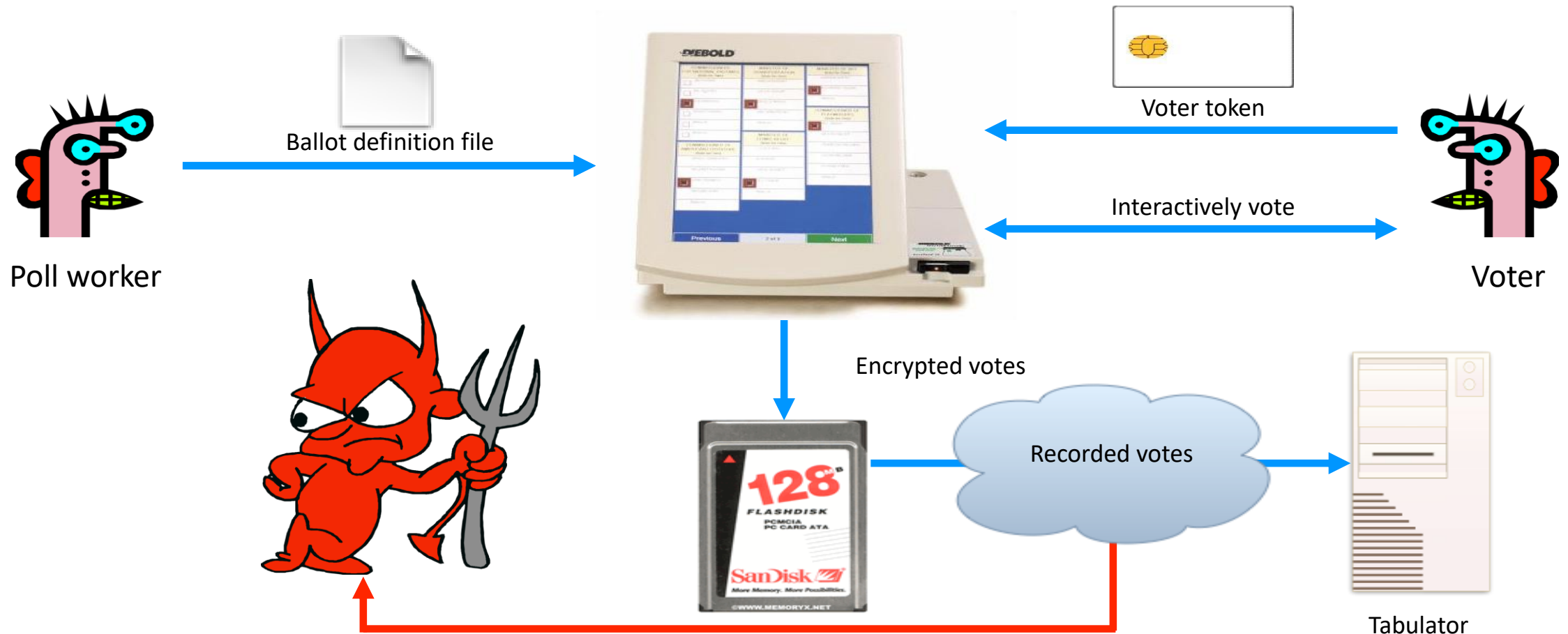
Problem: Encryption key (“F2654hD4”) hard-coded into the software since (at least) 1998. Votes stored in the order cast.

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 to the tabulator.

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



TOWARDS DEFENSES

Approaches to Security

- Prevention
 - Stop an attack
- Detection
 - Detect an ongoing or past attack
- Response and Resilience
 - Respond to / recover from attacks
- The threat of a response may be enough to deter some attackers

Whole System is Critical

- Securing a system involves a **whole-system view**
 - Cryptography
 - Implementation
 - People
 - Physical security
 - Everything in between
- This is because “security is only as strong as the weakest link,” and security can fail in many places
 - No reason to attack the strongest part of a system if you can walk right around it.

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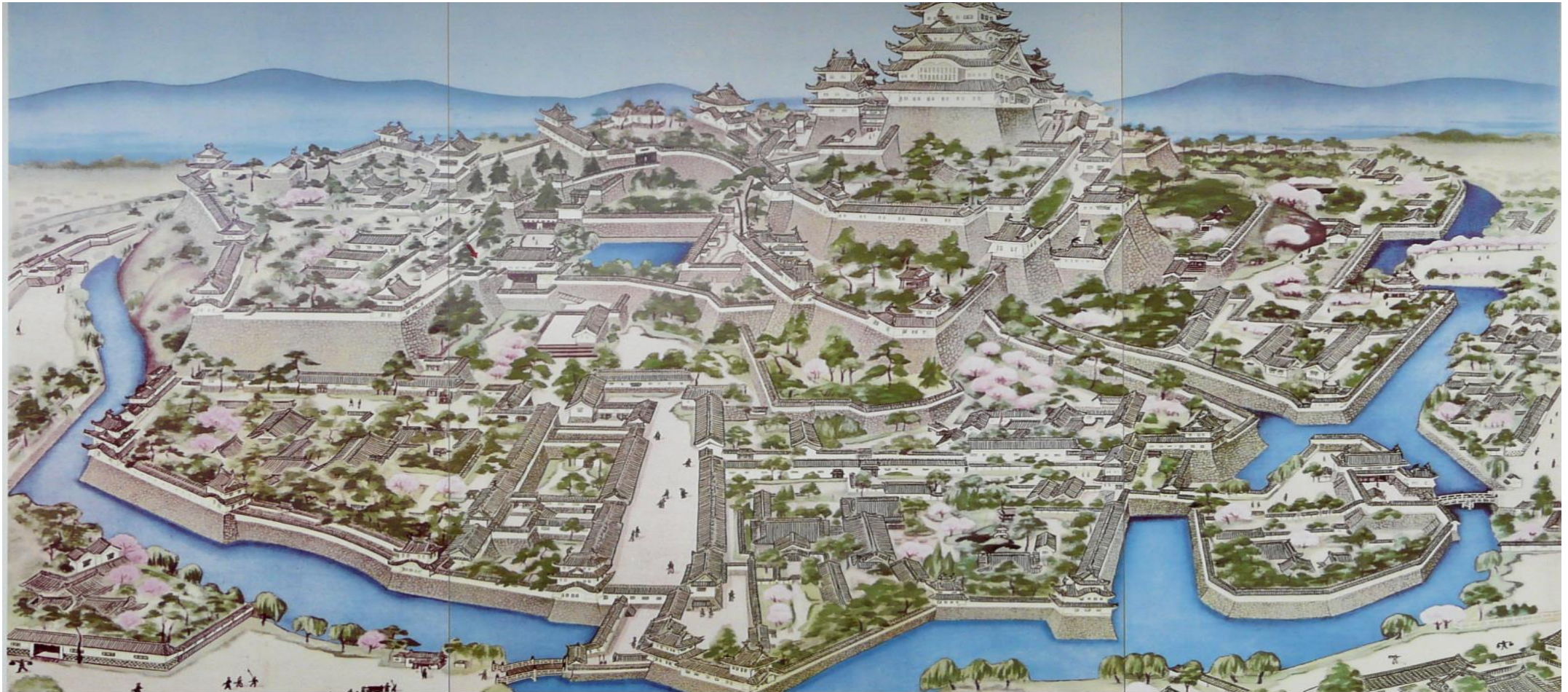
Asymmetric advantages in security

Defender's Asymmetric Advantage



- The attacker only succeeds while undetected
- Defender is on 'home turf'
- Defender has (hopefully) more resources than the attacker
- If the defender can spot them one time, they win

Attacker's Asymmetric Advantage



Attacker's Asymmetric Advantage



- Attacker only needs to win one time, not all the time
- Attackers are professional attackers(maybe)
- Are those things about defenders true *in practice*?

Defender's Asymmetric Advantage?



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- Defender is on 'home turf'
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From Policy to Implementation

- After you've figured out what security means to your application, there are still challenges:
 - Requirements bugs and oversights
 - Incorrect or problematic goals
 - Design bugs and oversights
 - Poor use of cryptography
 - Poor sources of randomness
 - ...
 - Implementation bugs and oversights
 - Buffer overflow attacks
 - ...
 - Is the system **usable**?

Many Participants

- Many parties involved
 - System developers
 - Companies deploying the system
 - The end users
 - The adversaries (possibly one of the above)
- Different parties have different goals
 - System developers and companies may wish to optimize cost
 - End users may desire security, privacy, and usability
 - Side question: Do system developers / companies really understand the needs and values of all their users? Or all stakeholders who might be impacted by the system?
 - But the relationship between these goals is quite complex (e.g., will customers choose features or security?)

Better News

- There are a lot of defense mechanisms
 - We'll study some, but by no means all, in this course
- It's important to understand their limitations
 - “If you think cryptography will solve your problem, then you don't understand cryptography... and you don't understand your problem”
-- Bruce Schneier