CSE 484 / CSE M 584 (Autumn 2011)

Introduction Continued (Day 2)

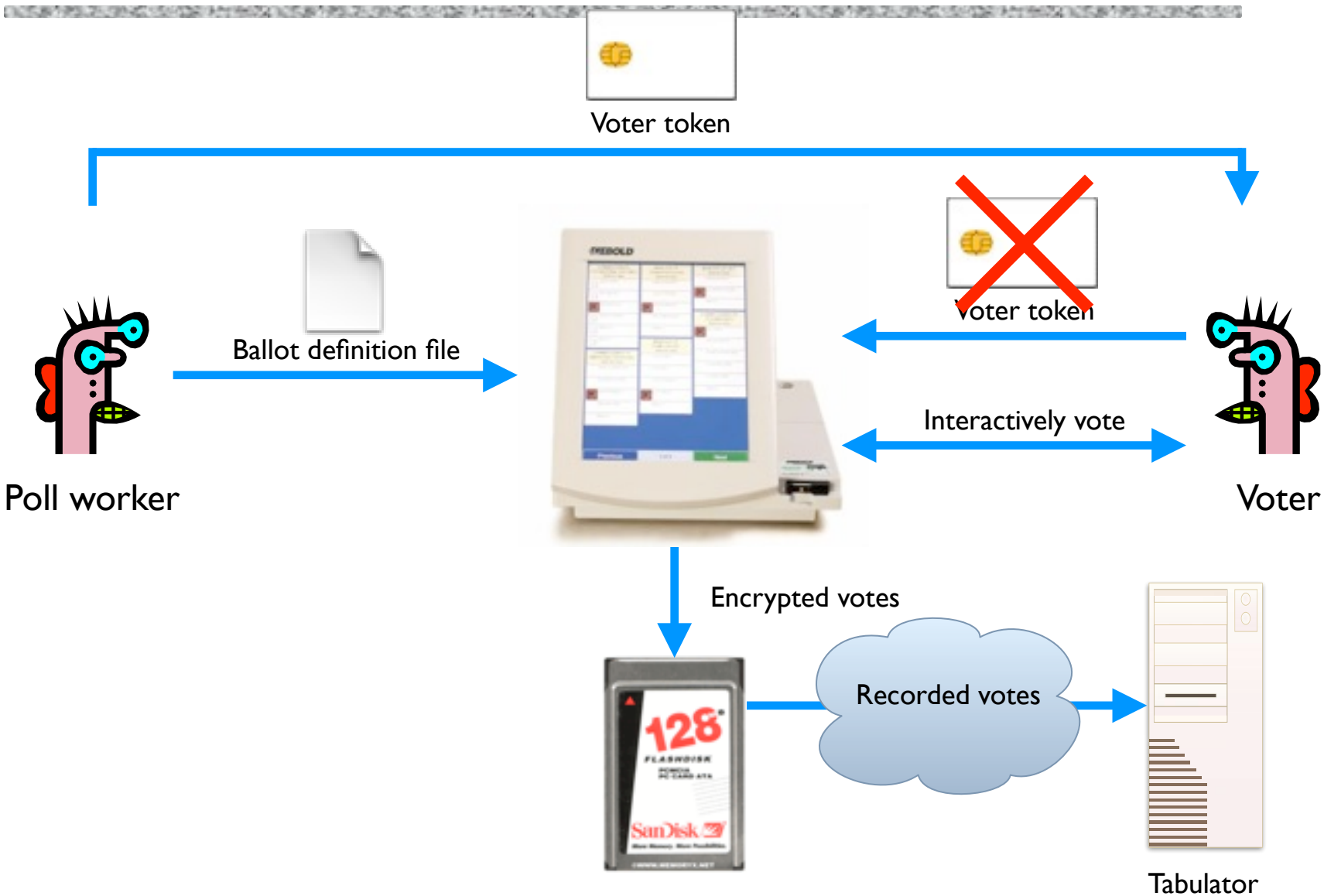
Daniel Halperin
Tadayoshi Kohno

Thanks to Dan Boneh, Dieter Gollmann, John Manferdelli, John Mitchell, Vitaly Shmatikov, Bennet Yee, and many others for sample slides and materials ...

Administrivia

- **HW #0**: Ethics statement on Catalyst (41 accepts as of 2pm today)
- **Forums** are open for business
- **Read Chapter 1** of the book over the next week or so
- **Lab #1** will be posted on Monday (Due Oct. 21)
- 584 M students: **First research paper** to review will be posted this afternoon

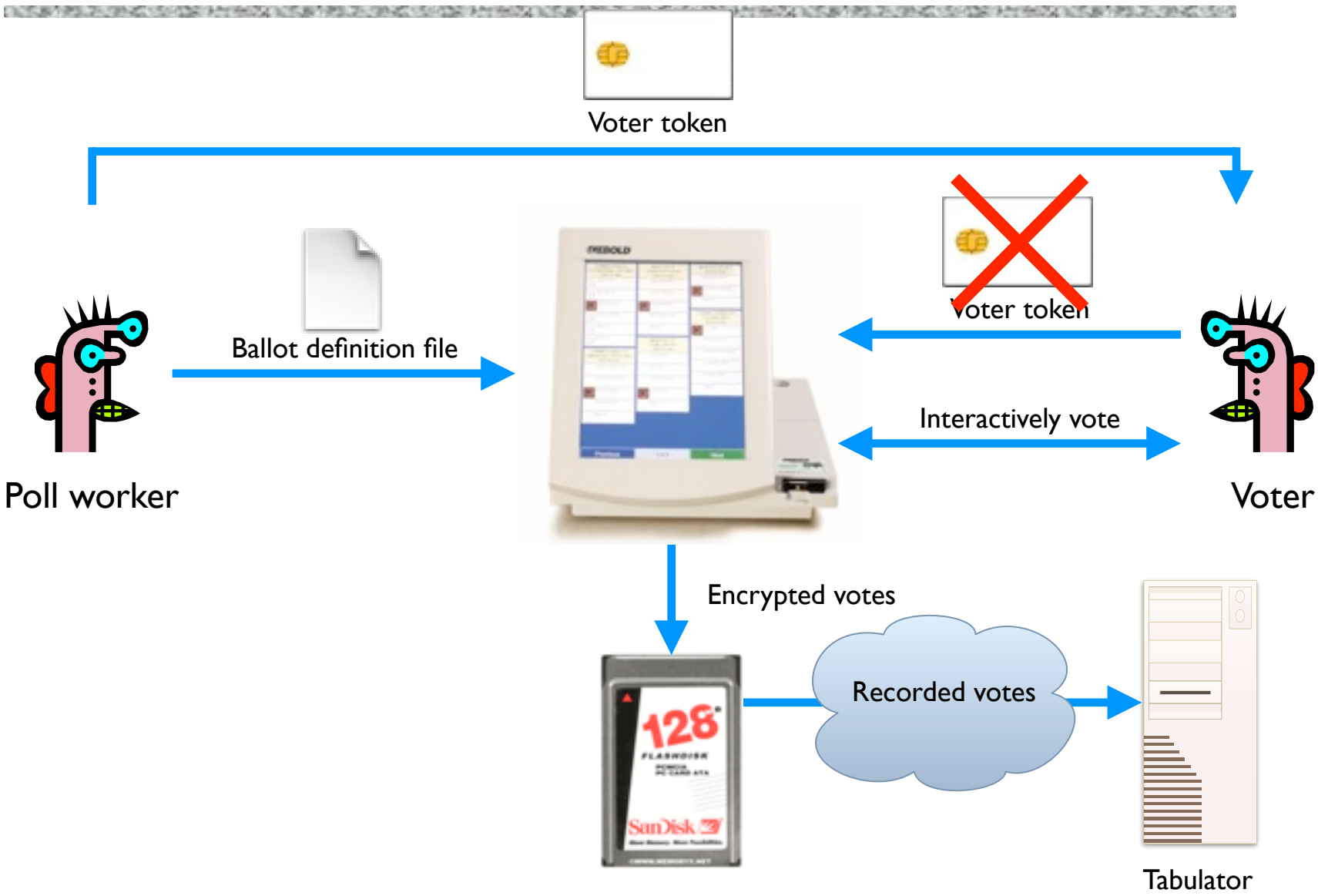
Post-Election



Security and E-Voting (Simplified)

- Functionality goals:
  - Easy to use
  - People should be able to cast votes easily, in their own language or with headphones for accessibility
- Security goals:
  - Adversary should not be able to tamper with the election outcome
    - By changing votes
    - By denying voters the right to vote
  - Is it OK if an adversary can do the above, assuming you can catch him or her or them?
  - Adversary should not be able to figure out how voters vote

Can You Spot Any Potential Issues?



Potential Adversaries

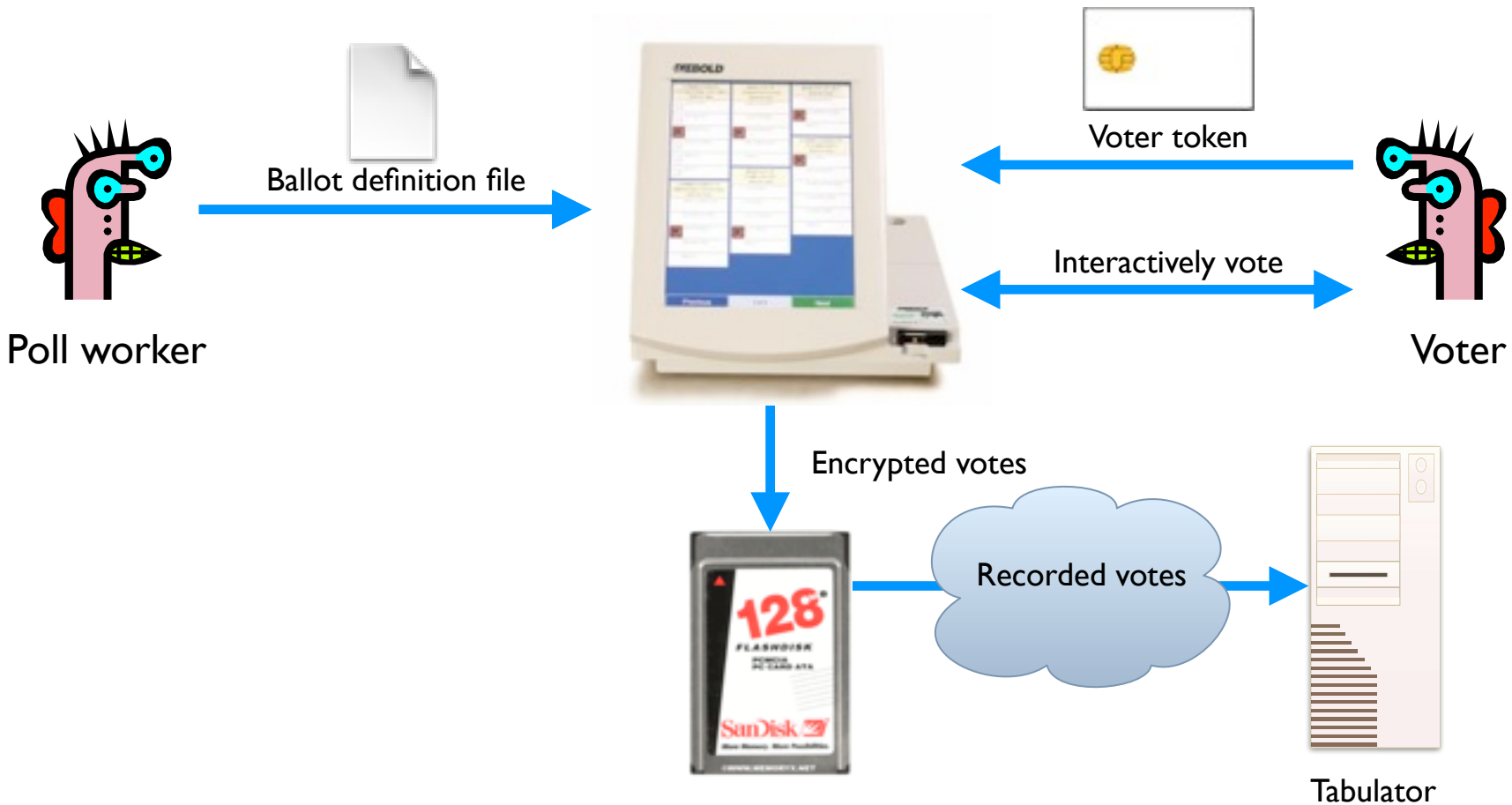
- Voters
- Election officials
- Employees of voting machine manufacturer
  - Software/hardware engineers
  - Maintenance people
- Other engineers
  - Makers of hardware
  - Makers of underlying software or add-on components
  - Makers of compiler
- ...
- Or any combination of the above

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.

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."



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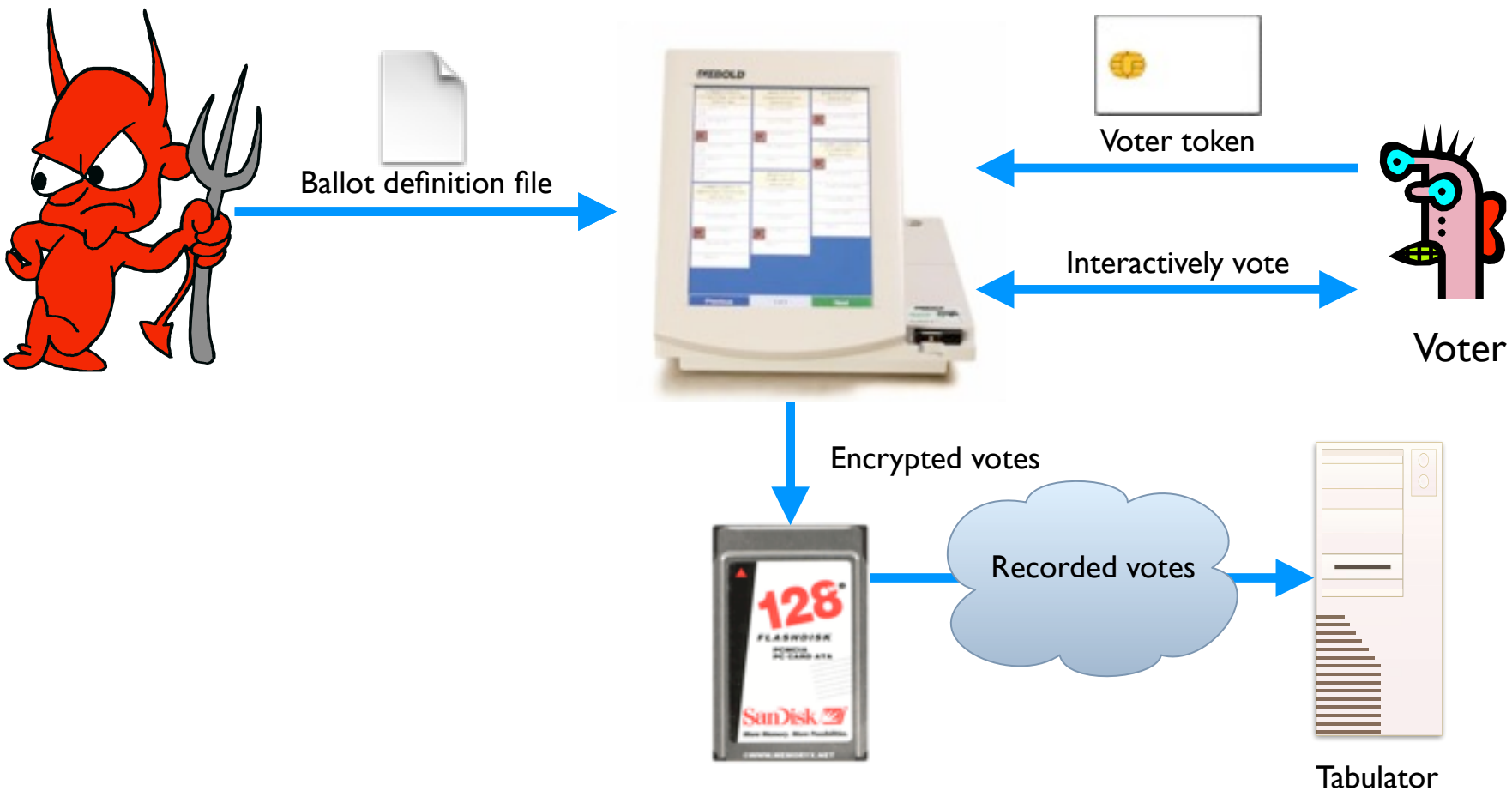

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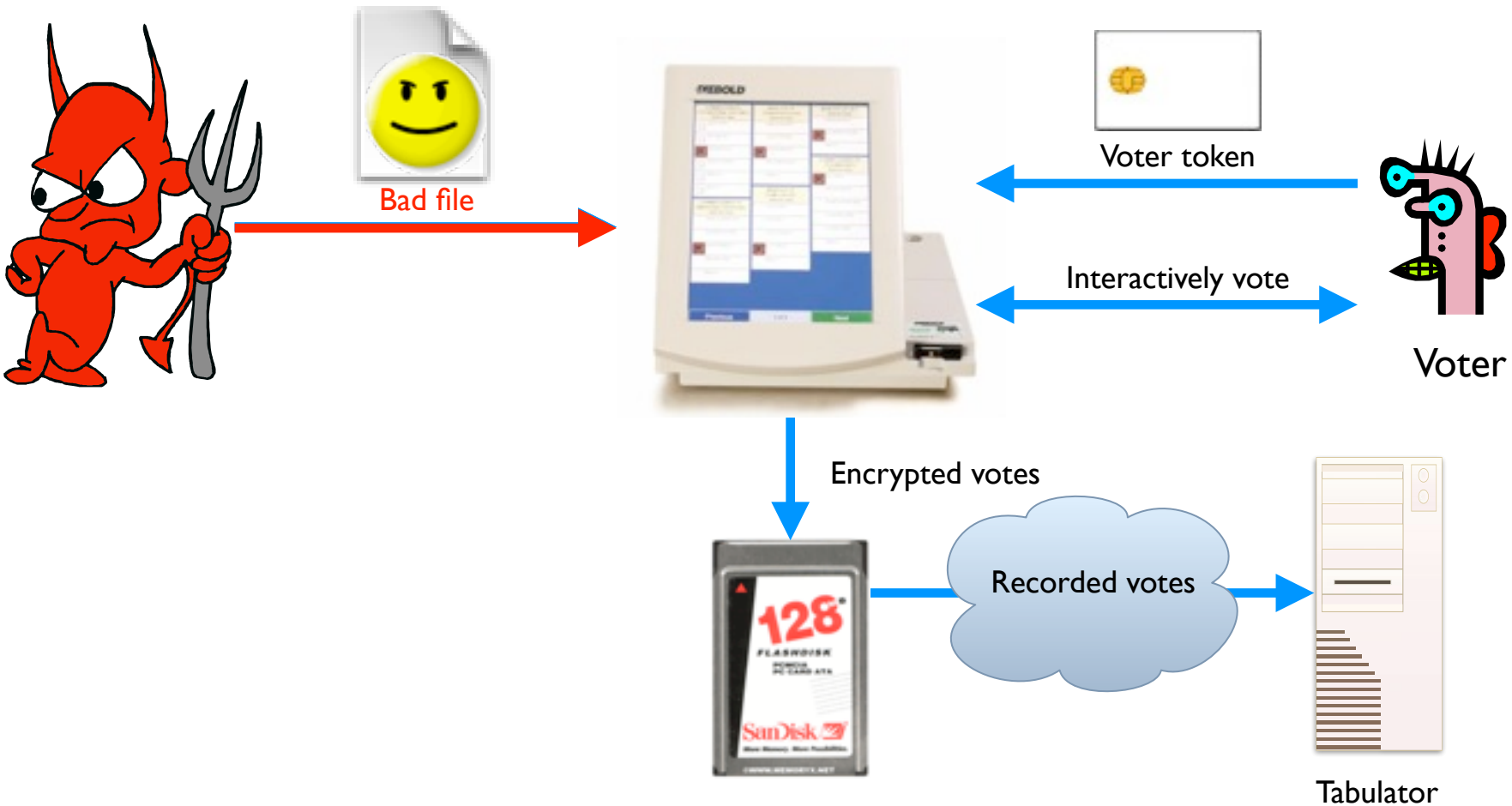

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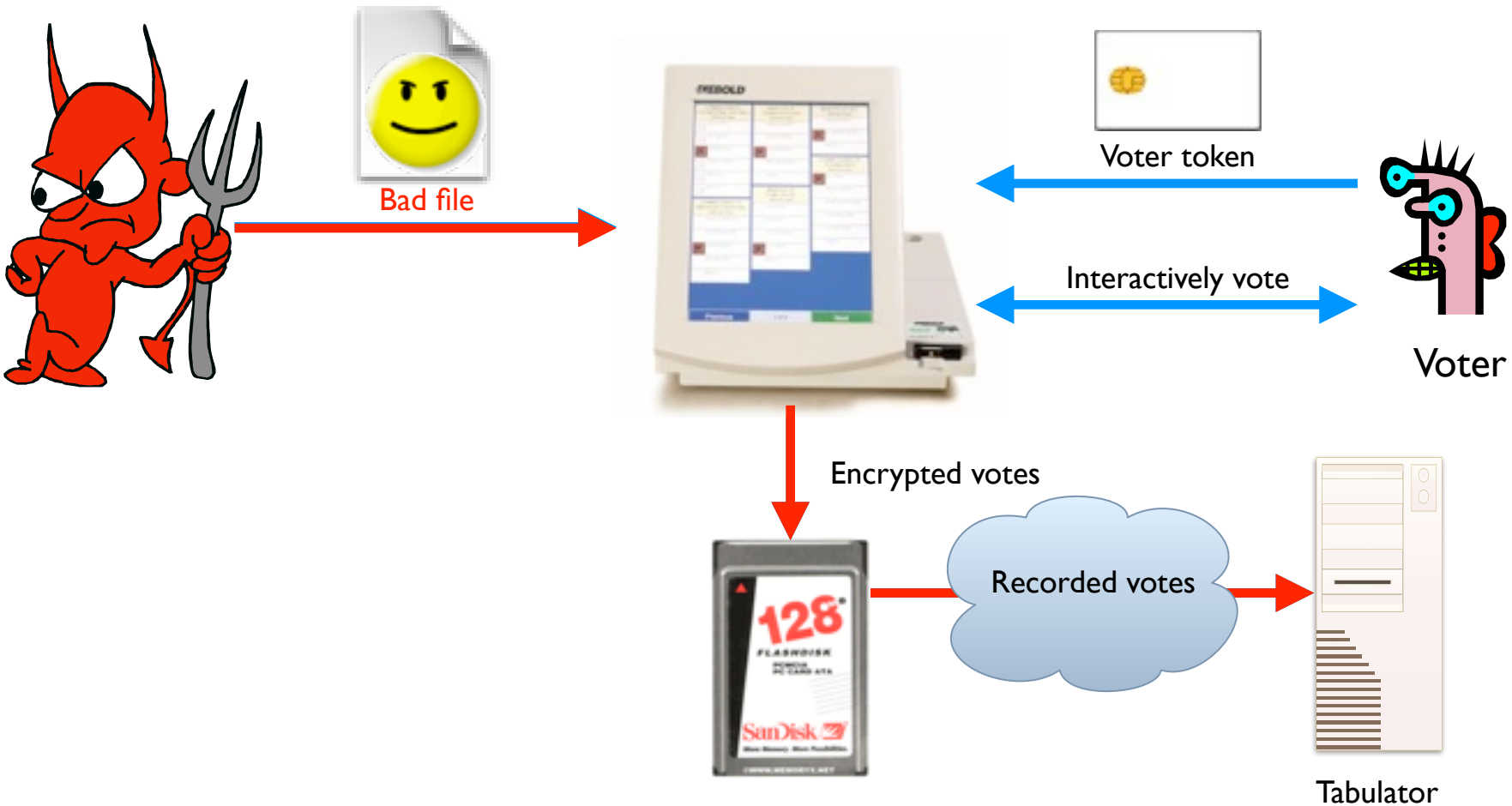

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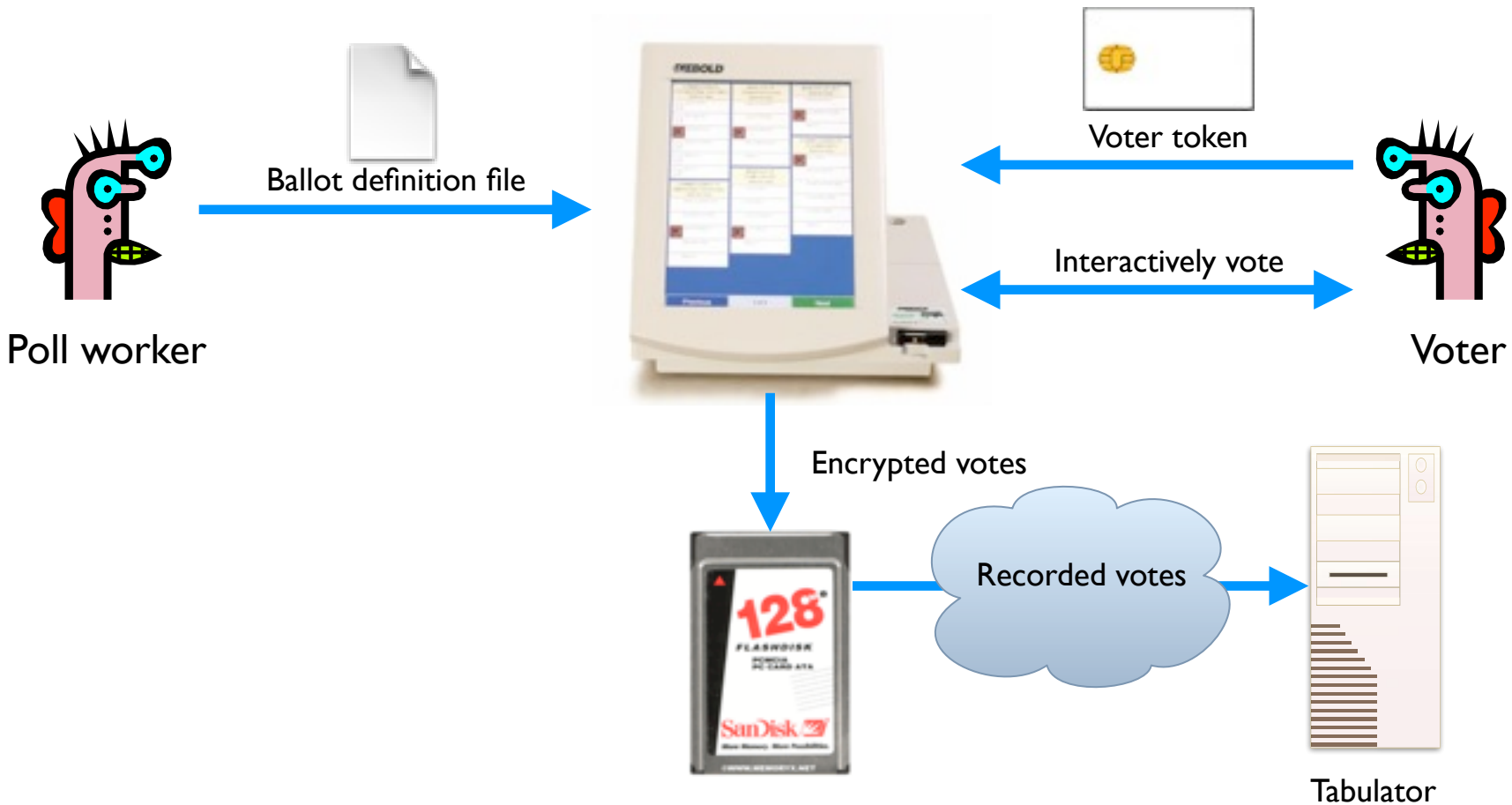
Example attack: A regular voter could make his or her own voter token and vote multiple times.



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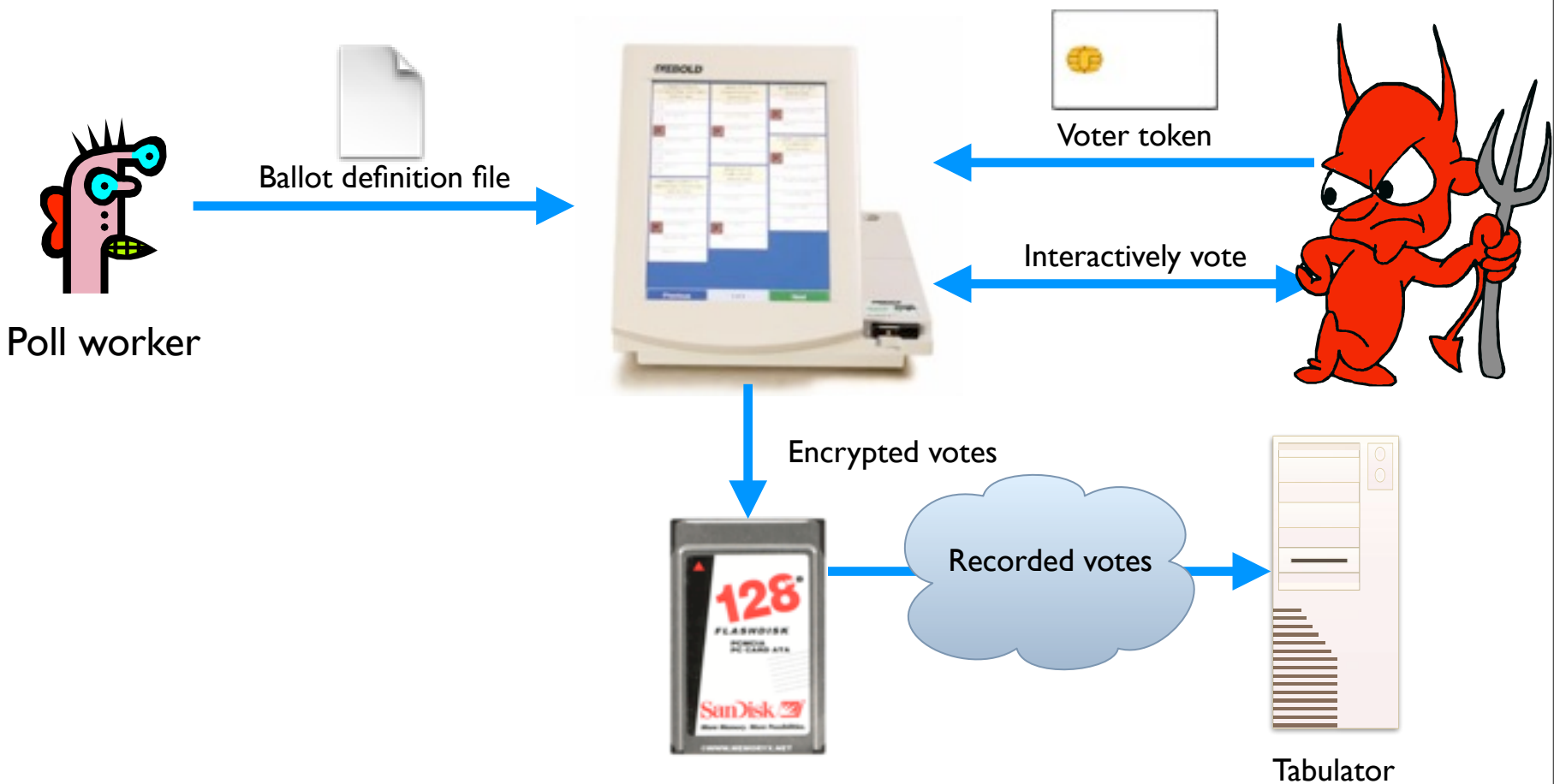

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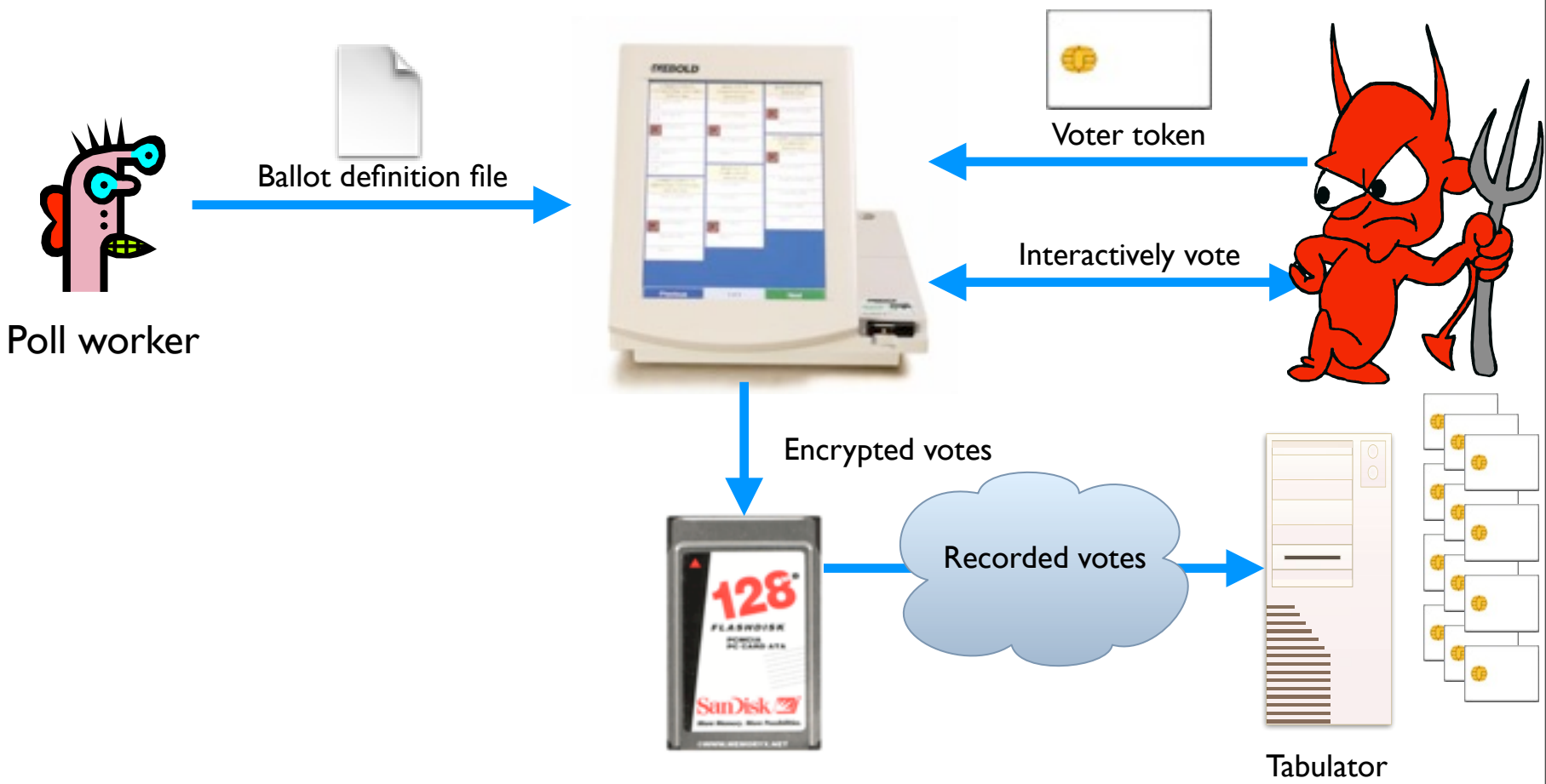

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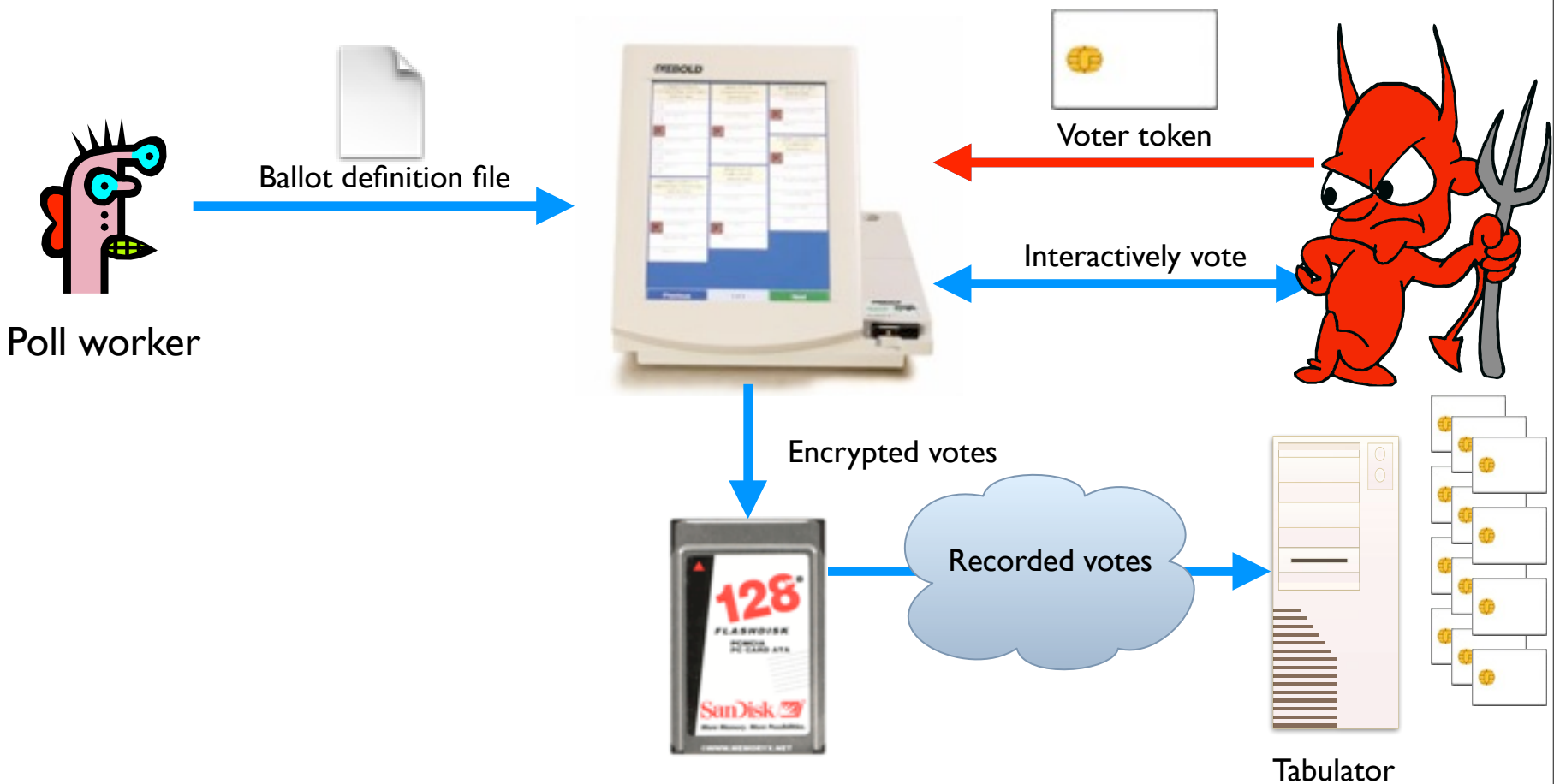

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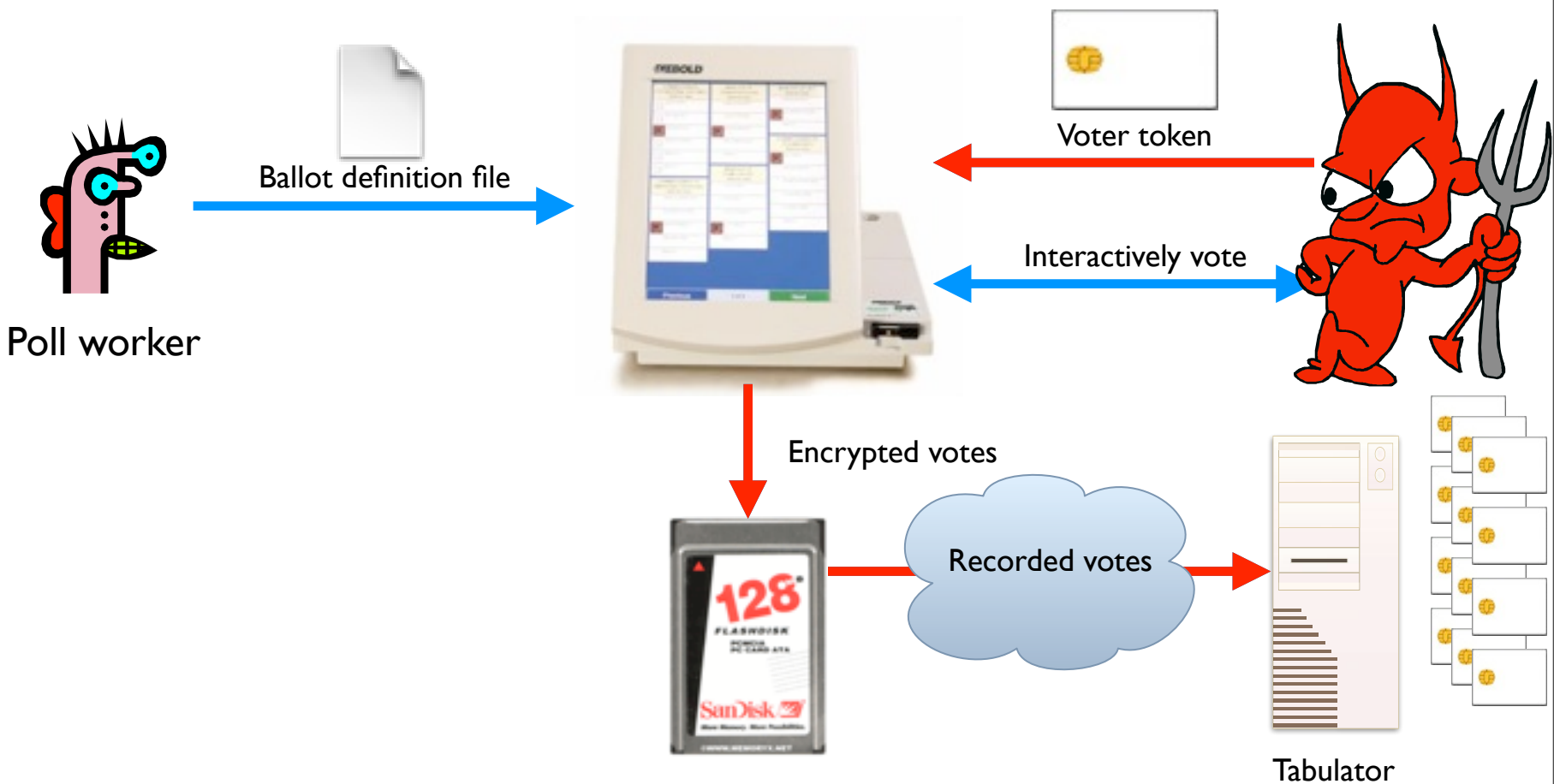

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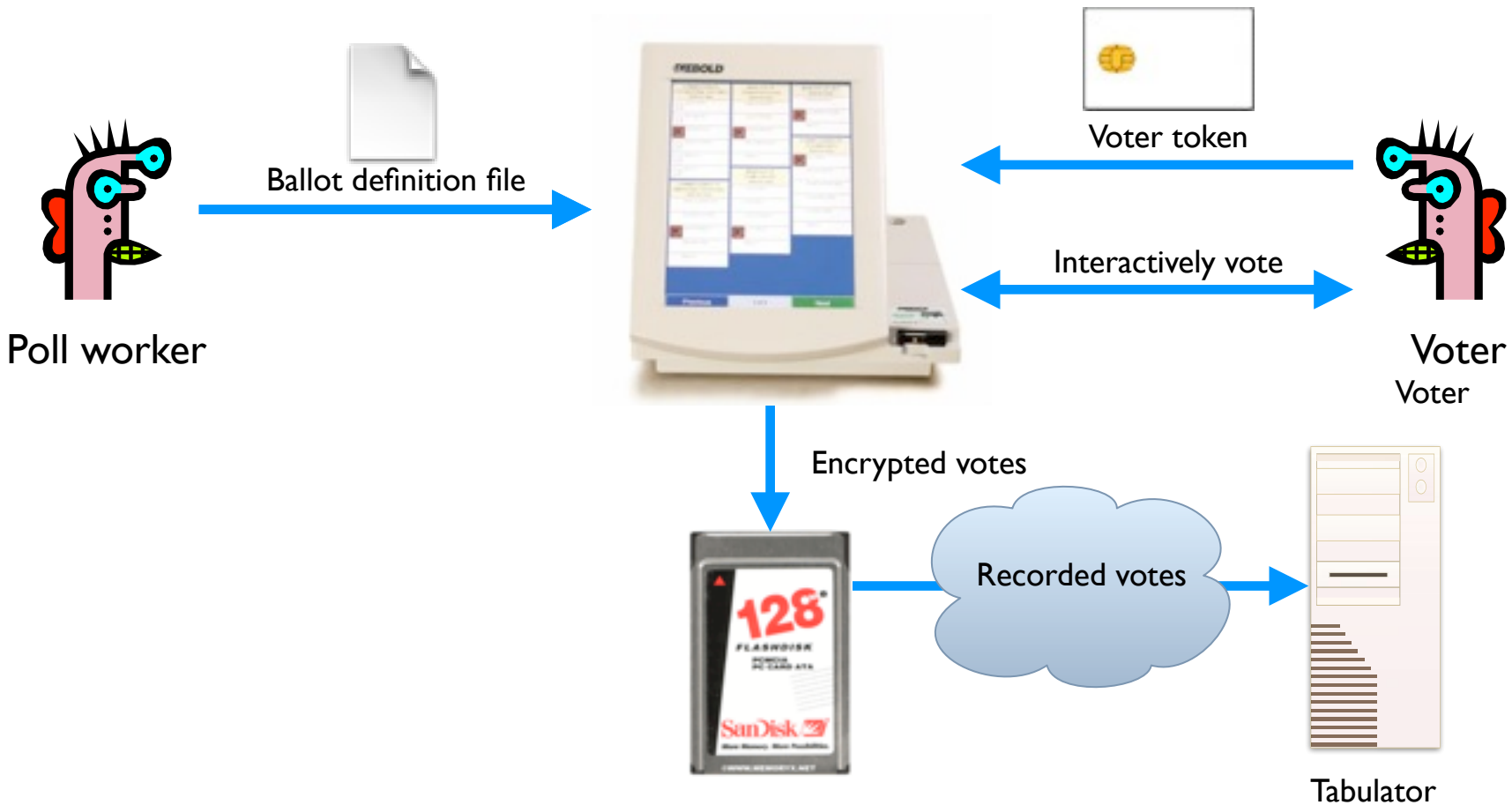
Example attack: A poll worker could determine how voters vote.



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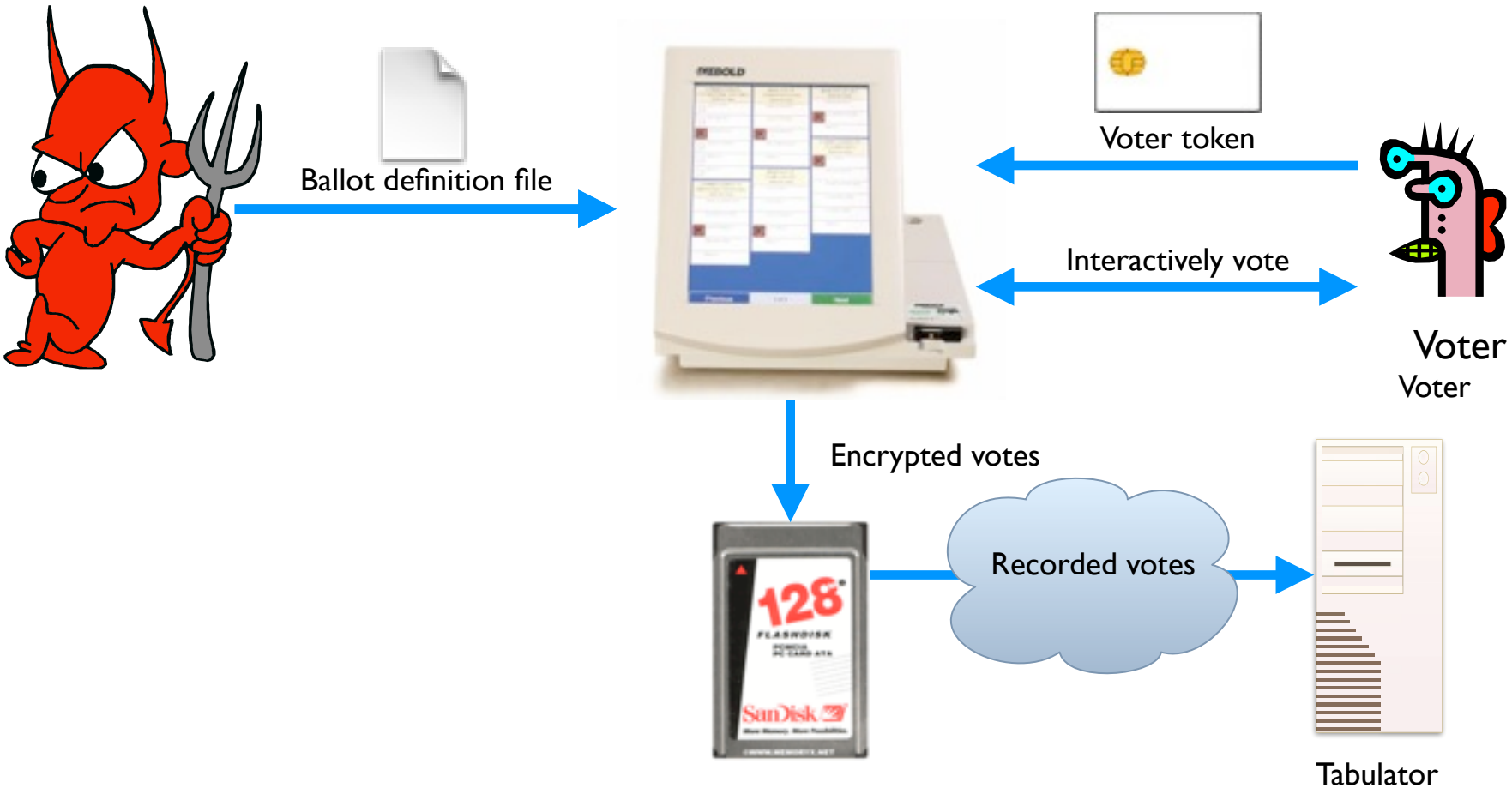

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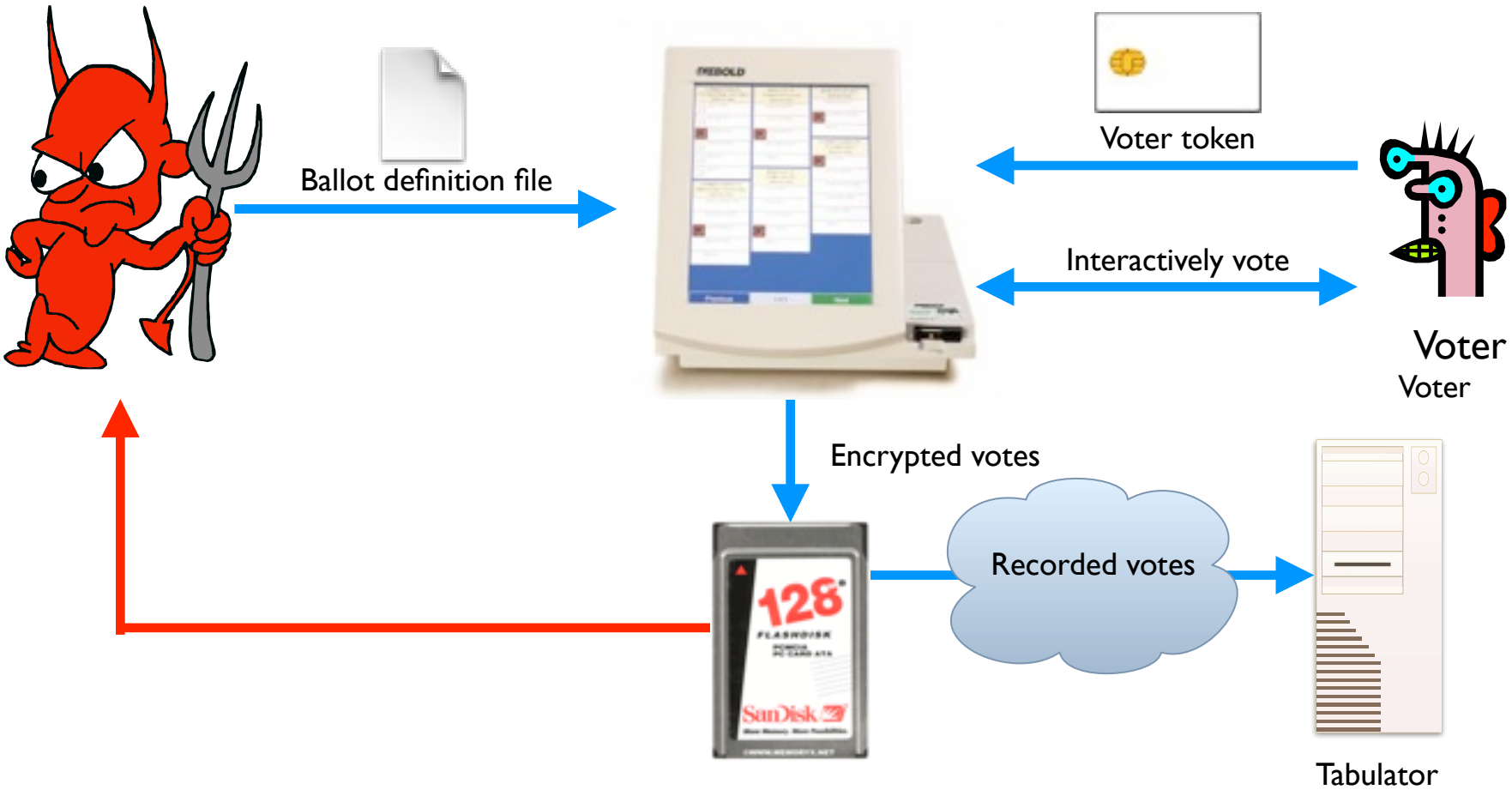

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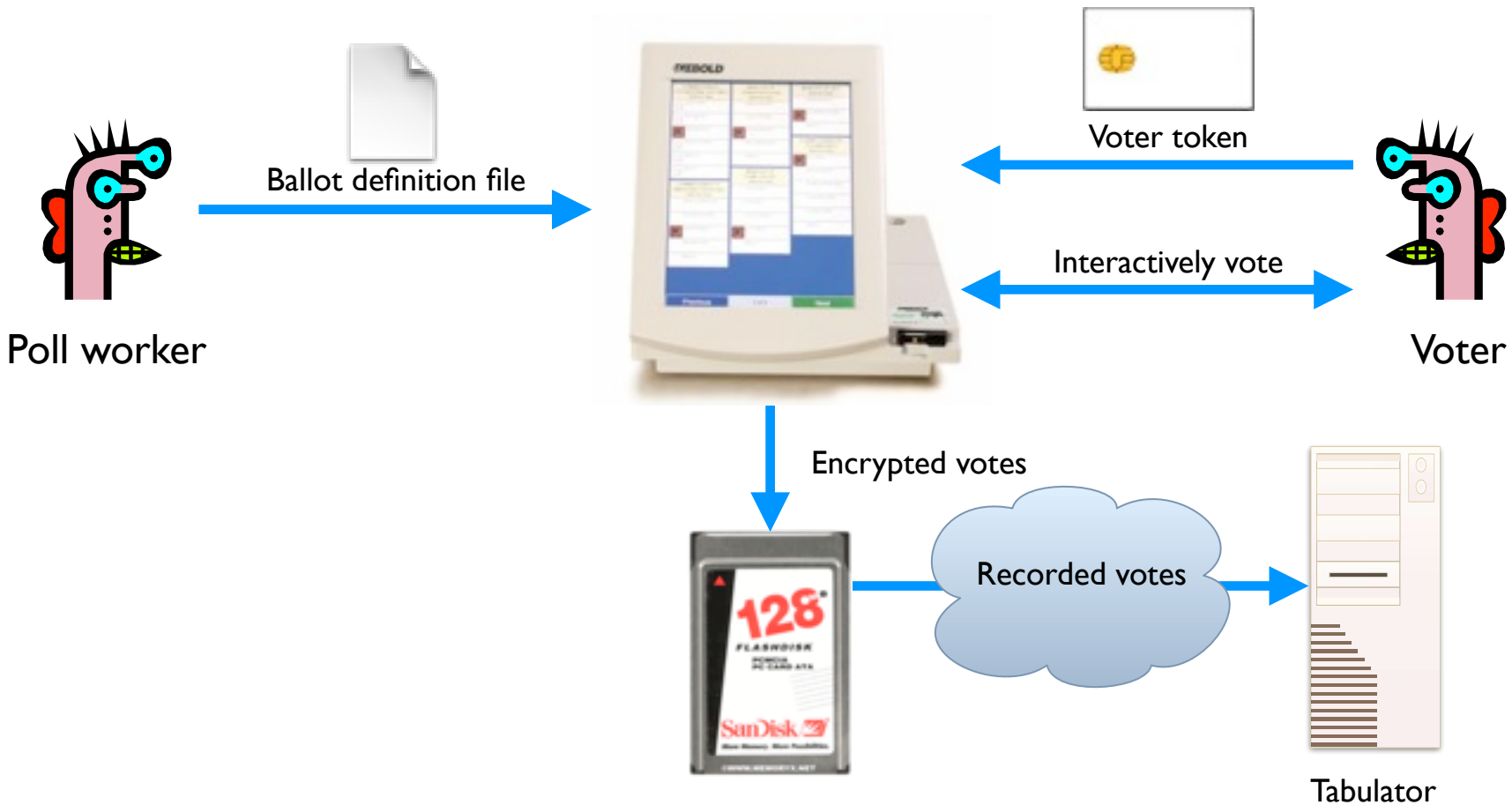

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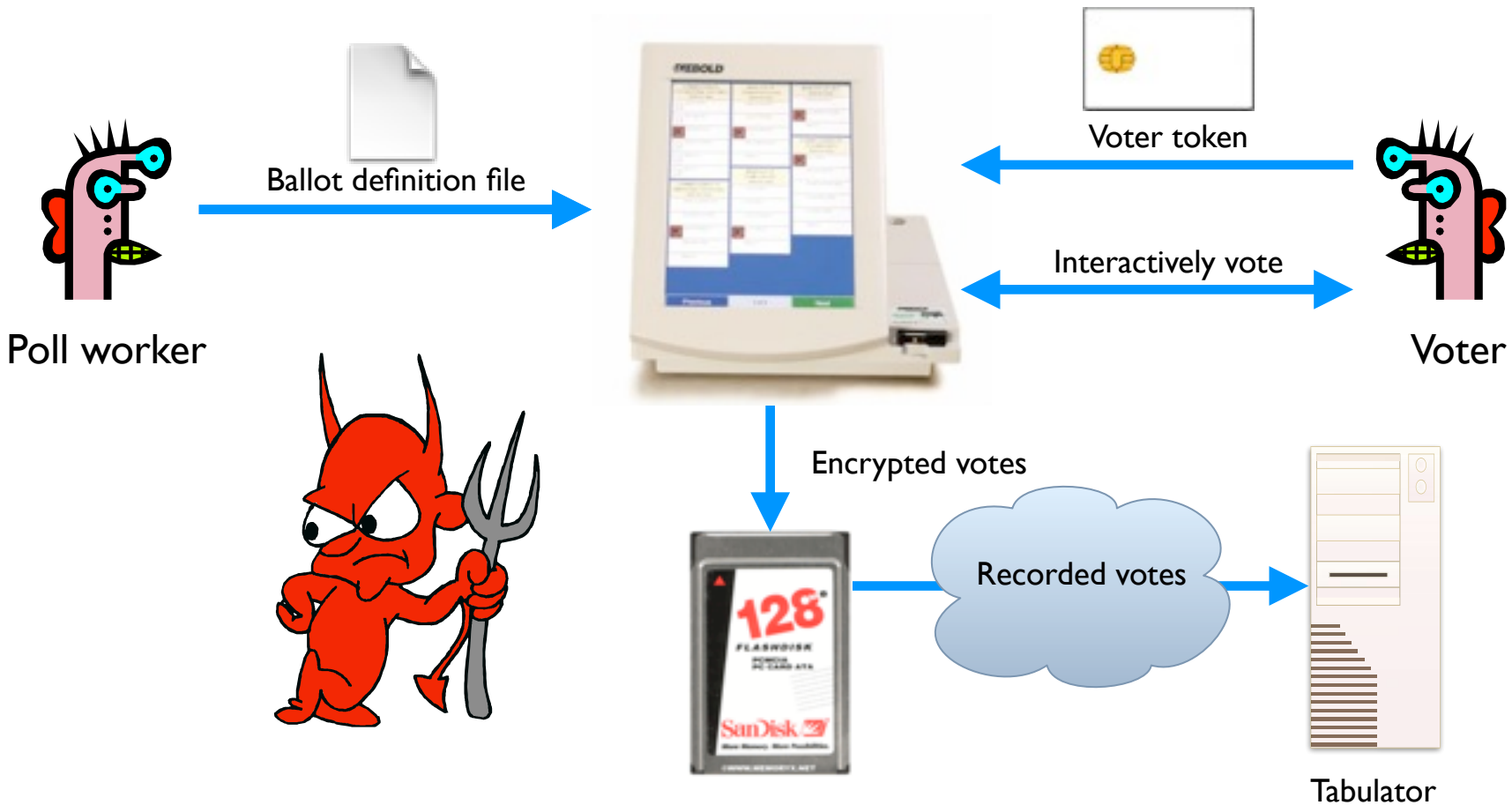

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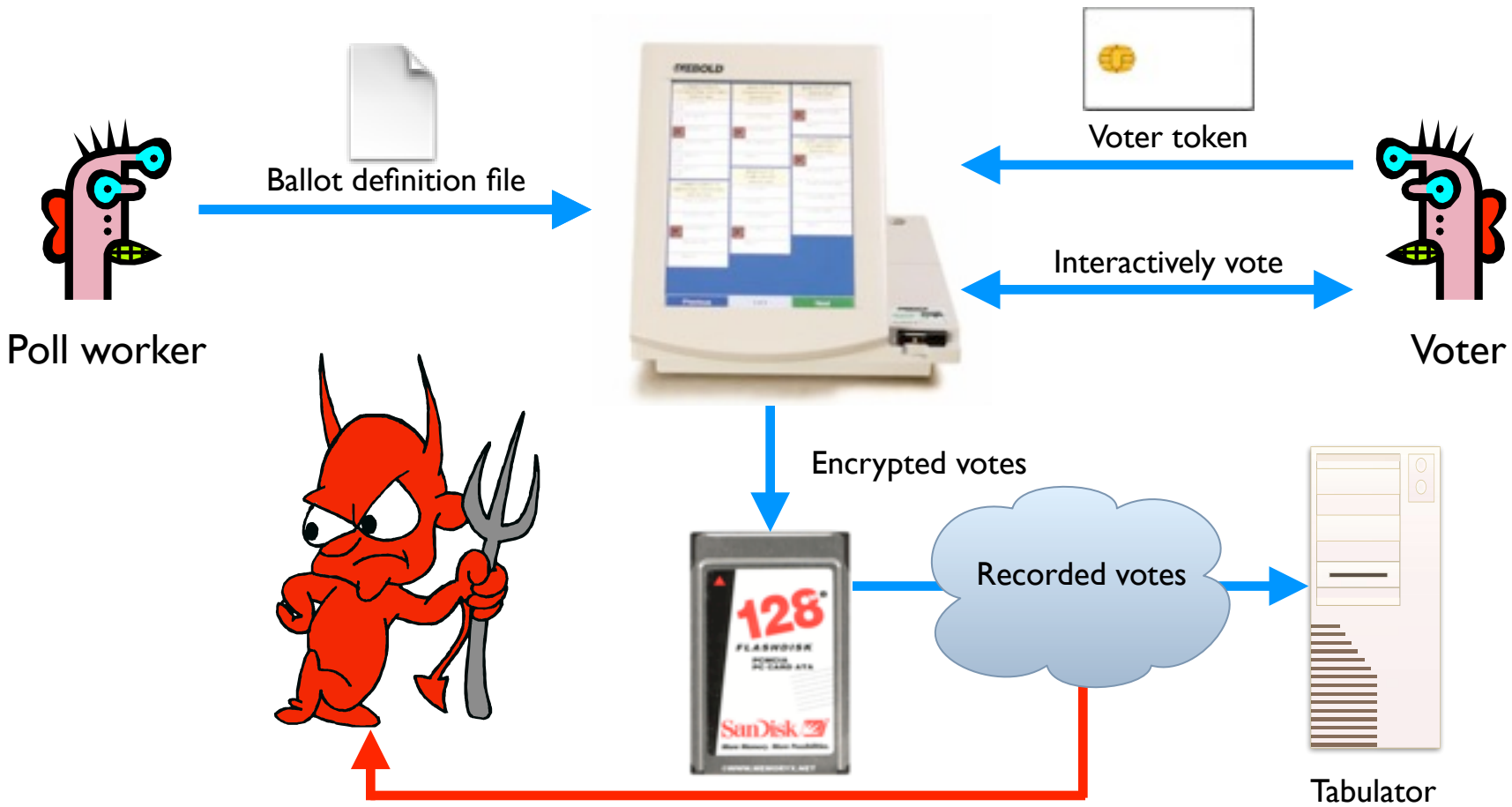


Security not just for PCs

mobile sensing platforms

RFID

EEG Gaming

large displays

ambient displays

smart phones

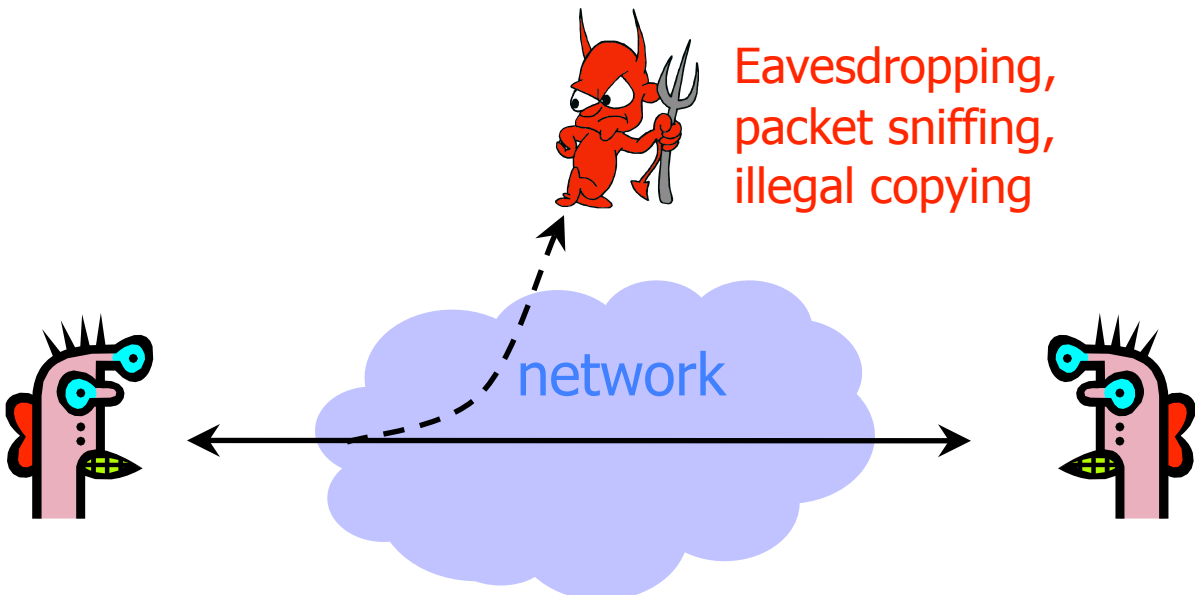
wearables

health displays

Security Goals

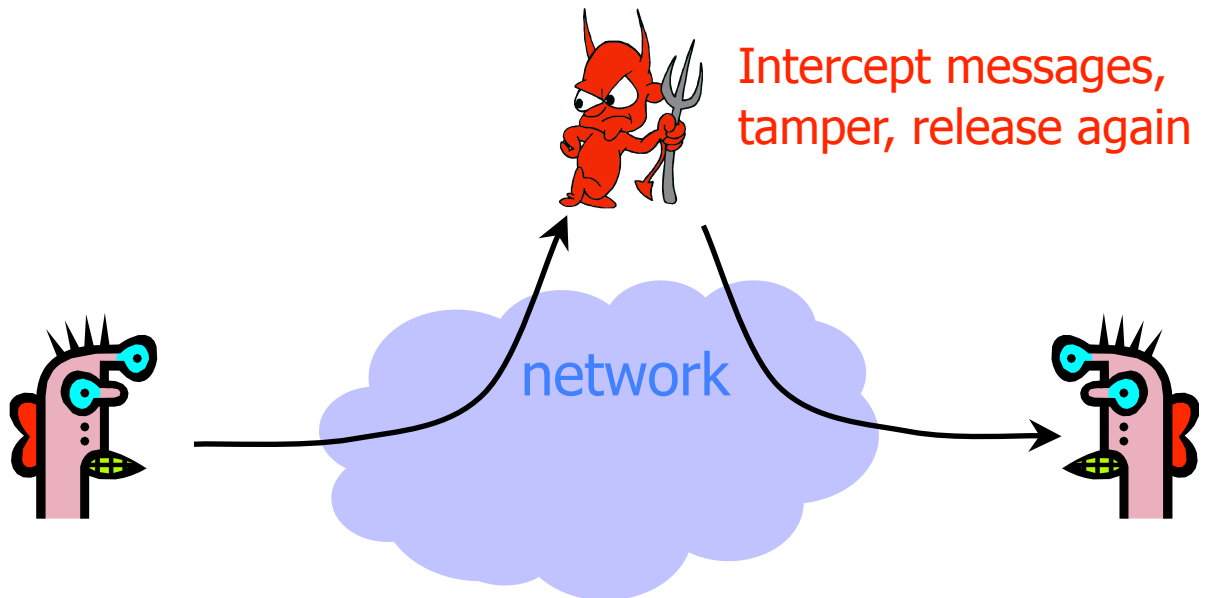
Confidentiality (Privacy)

- Confidentiality is concealment of information



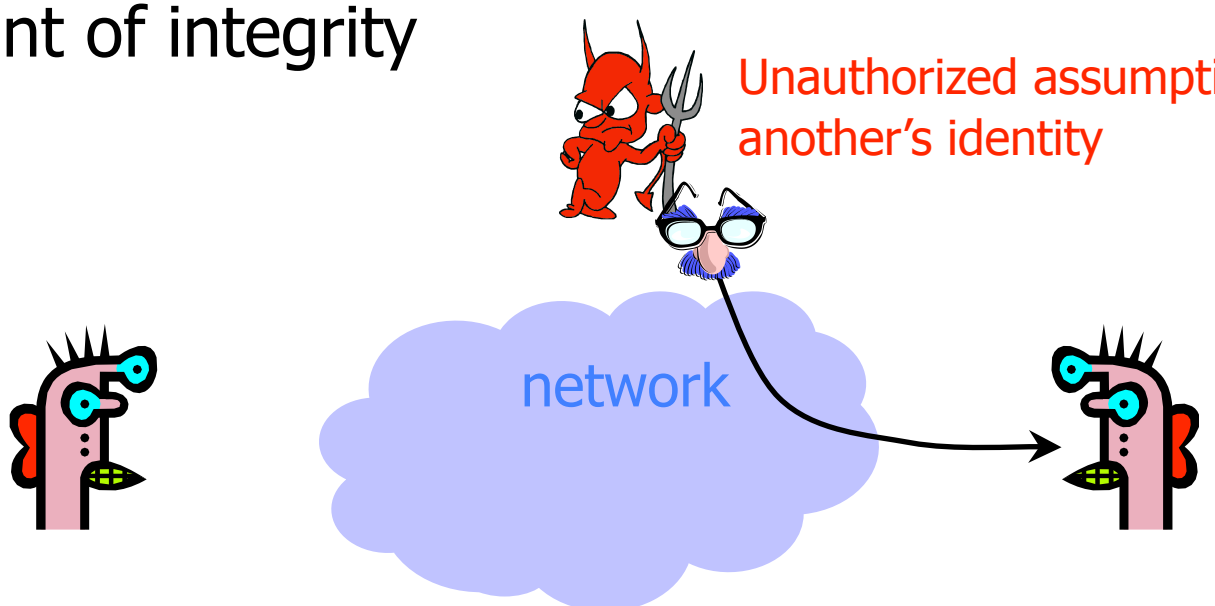
Integrity

- Integrity is prevention of unauthorized changes



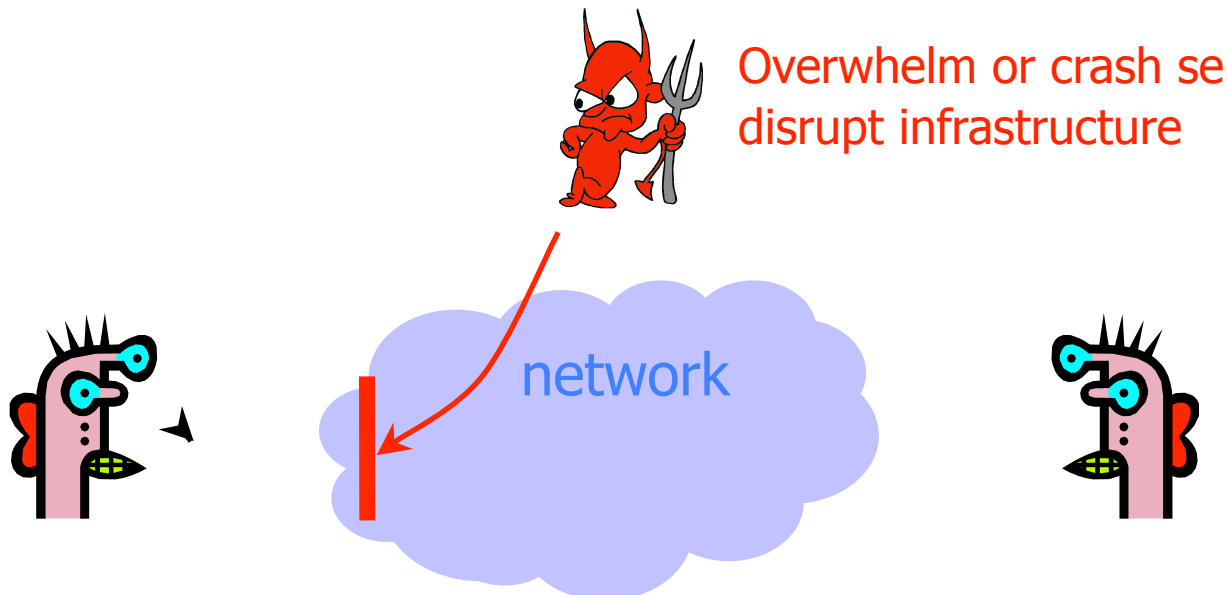
Authenticity

- Authenticity is identification and assurance of origin of information
- Variant of integrity



Availability

- Availability is ability to use information or resources desired



Security of a system

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.
  - (Still important to strengthen more than the weakest link)

Analyzing the Security of a System

- First thing: Summarize the system as clearly and concisely as possible
  - Critical step. If you can't summarize the system clearly and concisely, how can you analyze it's security?
  - Summary can be hierarchical
- Next steps:
  - Identify the assets: What do you wish to protect?
  - Identify the adversaries and threats
  - Identify vulnerabilities: Weaknesses in the system
  - Calculate the risks

Assets

- Need to know what you are protecting!
  - Hardware: Laptops, servers, routers, PDAs, phones, ...
  - Software: Applications, operating systems, database systems, source code, object code, ...
  - Data and information: Data for running and planning your business, design documents, data about your customers, data about your identity
  - Reputation, brand name
  - Responsiveness
- Assets should have an associated value (e.g., cost to replace hardware, cost to reputation, how important to business operation)

Adversaries

- National governments
- Terrorists
- Thieves
- Business competitors
- Your supplier
- Your consumer
- The New York Times
- Your family members (parents, children)
- Your friends
- Your ex-friends
- ...

Threats

- Threats are actions by adversaries who try to exploit vulnerabilities to damage assets
  - Spoofing identities: Attacker pretends to be someone else
  - Tampering with data: Change outcome of election
  - Crash machines: Attacker makes voting machines unavailable on election day
  - Elevation of privilege: Regular voter becomes admin
- Specific threats depend on environmental conditions, enforcement mechanisms, etc
  - You must have a clear, simple, accurate understanding of how the system works!

Threats

- Several ways to classify threats
  - By damage done to the assets
    - Confidentiality, Integrity, Availability
  - By the source of attacks
    - (Type of) insider
    - (Type of) outsider
    - Local attacker
    - Remote attacker
    - Attacker resources
  - By the actions
    - Interception
    - Interruption
    - Modification
    - Fabrication

Vulnerabilities

- Weaknesses of a system that could be exploited to cause damage
  - Accounts with system privileges where the default password has not been changed (Diebold: 1111)
  - Programs with unnecessary privileges
  - Programs with implementation flaws
  - Problems with cryptography
  - Weak firewall configurations that allow access to vulnerable services
  - ...
- Sources for vulnerability updates: CERT, SANS, Bugtraq, the news, ...

Risks Analyses: Lots of Options

- Quantitative risk analysis
  - Example: Risk = Asset × Threat × Vulnerability
  - Monetary value to assets
  - Threats and vulnerabilities are probabilities
  - (Yes: Difficult to assign these costs and probabilities)
- Qualitative risk analysis
  - Assets: Critical, very important, important, not important
  - Vulnerabilities: Has to be fixed soon, should be fixed, fix if convenient
  - Threats: Very likely, likely, unlikely, very unlikely

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Risk Impact

Probability

Risks Analyses: Lots of Options

Risk Exposure Risk Impact

- Quantitative risk analysis

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Helpful Tables

Asset	Confidentiality	Integrity	Availability
Hardware			
Software			
Data			
People			
…			

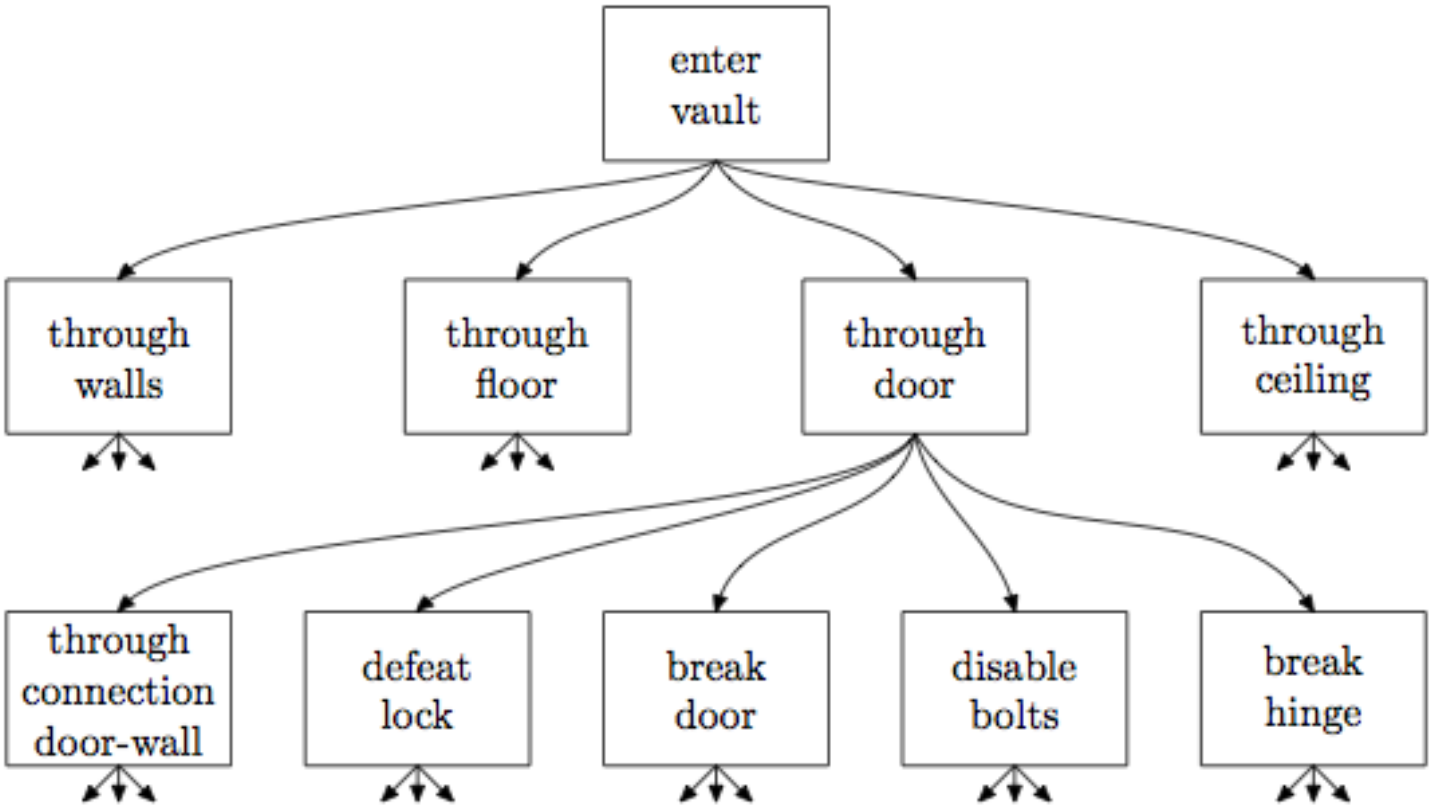
Helpful Tables

	Voter	Election official	...
Privacy of vote			
Integrity of vote			
Availability of voting system			
Confidence in election			
...			

Helpful Tables

	Create New Voter Cards	Decrypt voting record	...
Privacy of vote			
Integrity of vote			
Availability of voting system			
Confidence in election			
...			

Attack Trees



Security is Subtle

- Security attacks can be subtle
- Can't provably and accurately identify / quantify all risks, vulnerabilities, threats.
- So need to think careful!
  - And keep the whole system in mind
- Phishing one example
  - If attacker can trick user into entering private information, then no protection mechanism will help
  - (So research tries to focus on helping users not be tricked)

On Modularity and Complexity

- Modular design may increase vulnerability
  - Abstraction is difficult to achieve in security: what if the adversary operates below your level of abstraction?
- Modular design may increase security: small TCB (trusted computing base)
- Complexity may increase vulnerability

Conclusions

Bad News

- Security often not a primary consideration
  - Performance and usability take precedence
- Feature-rich systems may be poorly understood
  - Higher-level protocols make mistaken assumptions
- Implementations are buggy
  - Buffer overflows, XSS vulnerabilities, ...
- Networks are more open and accessible than ever
  - Increased exposure, easier to cover tracks
- No matter what technical mechanisms you have, people may circumvent them
  - Phishing, impersonation, write down passwords, ...
- Attackers may be very powerful
  - ISPs, governments, ...
    - –

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
  - Security is not a binary property
  - Many security holes are based on misunderstanding
- Security awareness and user "buy-in" help

Course and Assignments

Tentative Syllabus

- Thinking about security; the "big picture"
  - The hardest part: Getting the "security mindset"
- Software security (including buffer overflow attacks)
- Web security (including XSS attacks)
- Cryptography
- Network security
- Botnets and malware
- The users (including usability)
- Anonymity

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Field broad. All parts interconnected, so we will "bounce" around in a methodical way

Forum

- Help you develop the "security mindset"
- Best way to learn a foreign language: move to that country and immerse yourself in the language.
- Same thing applies to "security thinking"
- Forum: opportunity to think about security on a regular basis -- outside of class
  - Current events
  - New product announcements
  - Security in your everyday life

Current Events

- Important for computer security practitioners (and all computer scientists) to be able to
  - Reflect on the broader context of technology
  - Guide future development of technology
  - Guide future policy
- For the course blog
  - Summarize current event
  - Discuss why event arose
  - Reflect on what could have been done prior to the event arising (to prevent, deter, or change consequences)
  - Describe broader issues surrounding current event (ethical, societal)
  - How should people respond to the event (policy makers, the public, companes, etc.)

Current Events
(last few days on Slashdot)

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(last few days on Slashdot)

Man-In-the-Middle Remote Attack On Diebold Voting Machines

Posted by **Soulskill** on Wednesday September 28, @05:20AM
from the some-things-never-change dept.

An anonymous reader tips news of a vulnerability discovered in the Diebold Accuvote voting system, which could be used to alter voting results without leaving evidence of tampering. Quoting Salon:

> "[T]he Argonne team's attack required no modification, reprogramming, or even knowledge, of the voting machine's proprietary source code. ... The team's video demonstrates how inserting the inexpensive electronic device into the voting machine can offer a "bad guy" virtually complete control over the machine. A cheap remote control unit can enable access to the voting machine from up to half a mile away. ... The video shows three different types of attack, each demonstrating how the intrusion developed by the team allows them to take complete control of the Diebold touch-screen voting machine. They were able to demonstrate a similar attack on a DRE system made by Sequoia Voting Systems as well."

Current Events
(last few days on Slashdot)

Man-In-the-Middle Remote Attack On Diebold Voting Machines

Posted by **Soulskill** on Wednesday September 28, @05:20AM
from

Microsoft Disables Kelihos Botnet

Posted by **Unknown Lamer** on Tuesday September 27, @03:55PM
from the i'm-down-to-20k-viagra-offers-per-day dept.

An
voti
tam

Trailrunner7 writes with an excerpt from an article in Threatpost:

> "Continuing its legal assault on botnet operators and the hosting companies that the criminals use for their activities, Microsoft has announced new actions against a group of people it contends are responsible for the operation of the Kelihos botnet. The company has also helped to take down the botnet itself and says that Kelihos's operators were using it not only to send out spam and steal personal information but also for some more nefarious purposes."

demonstrate a similar attack on a DRE system made by Sequoia Voting Systems as well."

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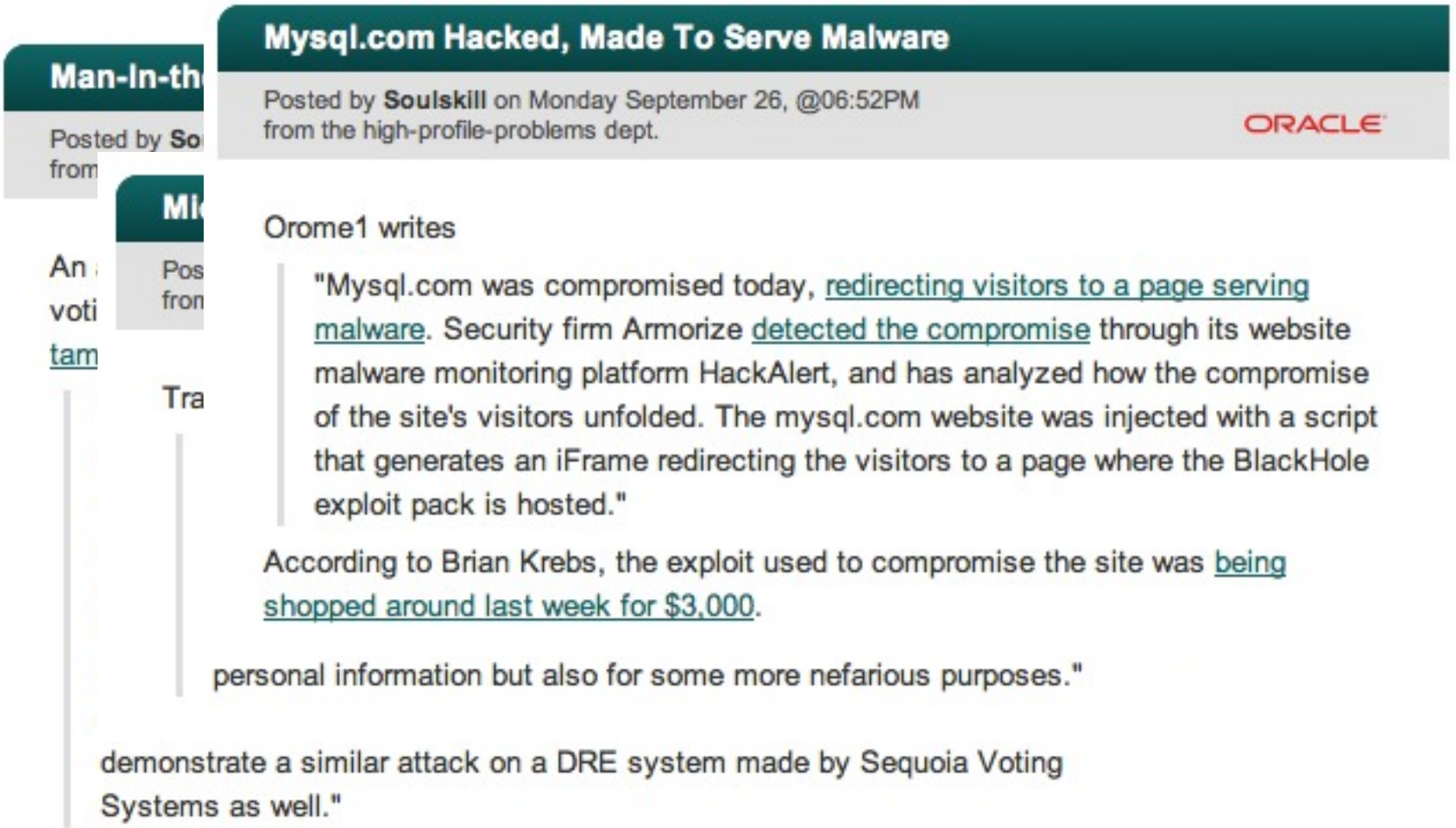

Mysql.com Hacked, Made To Serve Malware

Posted by **Soulskill** on Monday September 26, @06:52PM
from the high-profile-problems dept.

ORACLE

Orome1 writes

> "Mysql.com was compromised today, redirecting visitors to a page serving malware. Security firm Armorize detected the compromise through its website malware monitoring platform HackAlert, and has analyzed how the compromise of the site's visitors unfolded. The mysql.com website was injected with a script that generates an iFrame redirecting the visitors to a page where the BlackHole exploit pack is hosted."

According to Brian Krebs, the exploit used to compromise the site was being shopped around last week for $3,000.

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Current Events
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Microsoft Security Products Flag Google Chrome As a Virus

Posted by **Soulskill** on Friday September 30, @01:53PM
from the if-it-quacks-like-a-horse dept.

New submitter maeltor writes

> "Reports poured in this morning that Microsoft's security products, namely Microsoft Security Essentials and Forefront Client Security, were flagging Google Chrome as a virus (PWS:Win32/Zbot) and removing the browser if users chose to clean and reboot their machines. Users reported that the only way to mitigate the problem was to set MSE and Forefront to 'always allow' Zbot, which is generally considered to be a bad idea."

A Google employee in the above support thread notes that Microsoft has now pushed another update to resolve the issue. "On September 30th, 2011, an incorrect detection for PWS:Win32/Zbot was identified. On September 30th, 2011, Microsoft released an update that addresses the issue. Signature versions 1.113.672.0 and higher include this update."

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Analyzing Data Retention By Wireless Carriers

Posted by **Soulskill** on Friday September 30, @03:16PM
from the privacy-on-a-timetable dept.

adeelarshad82 writes

> "How long does your cell phone carrier retain information about your calls, text messages, and data use? According to data gathered by the Department of Justice, it can be as little as a few days or up to seven years, depending on your provider. The data was made public after the American Civil Liberties Union filed a Freedom of Information Act request related to an investigation into cell phone location tracking by police."

Current Events
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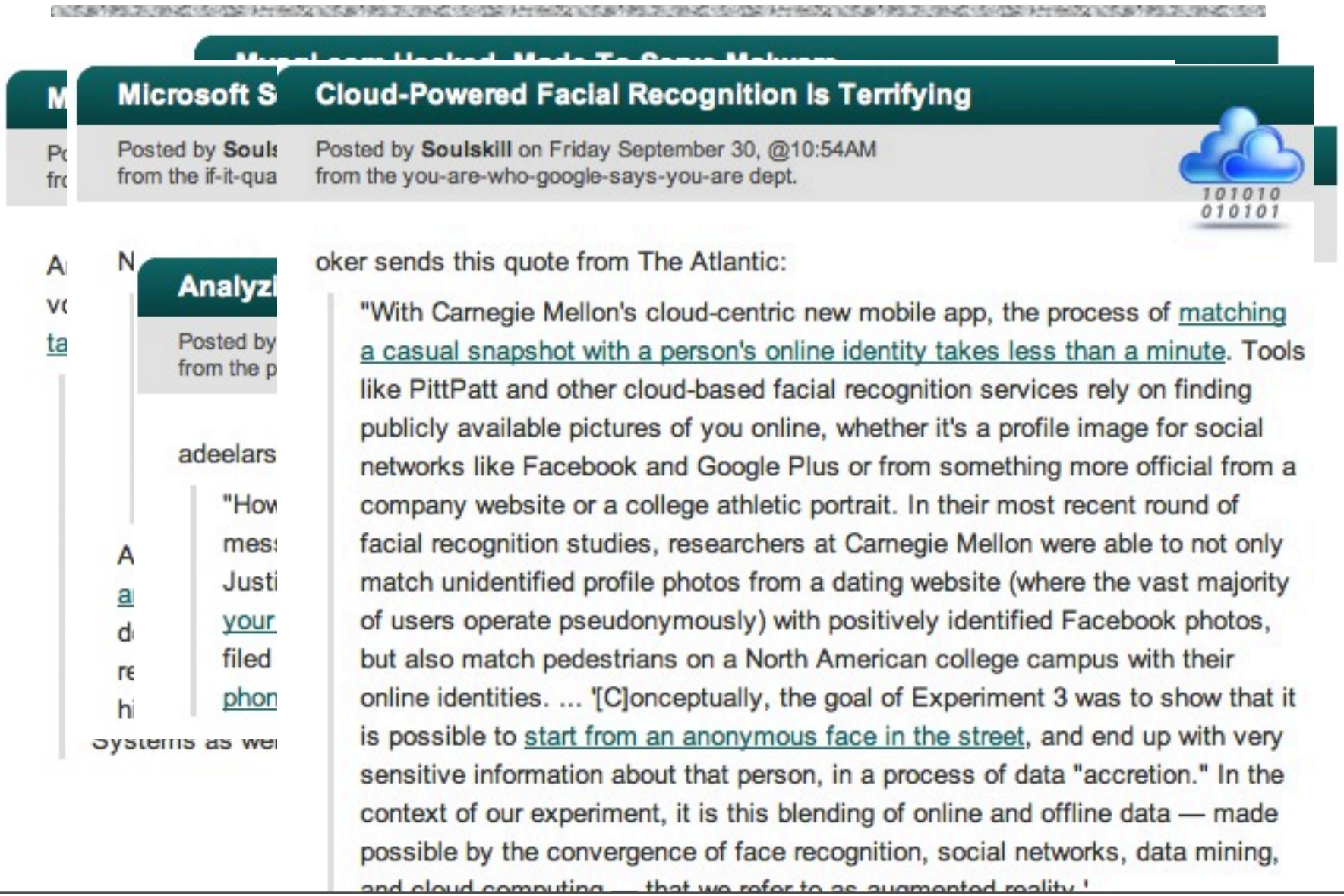

Security Reviews

- Summary of system/product
- Assets
- Adversaries and threats
- Potential weaknesses (OK to speculate, but make it clear that you are speculating)
- Potential defenses
- Risks
- Conclusions

Security in your life

- Take and share security-related photos (anecdotes, videos, audio, etc.) on the forum
- Explain what you were capturing and how it relates to security

- *__Stay within legal limits__*---for instance, Washington State is a "2-Party State", which means you can't record communications without both sides' consent/notification.
  (All-party for multi-way communications)