Security Analysis of the Diebold AccuVote-TS Voting Machine

EVT '07
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Presenter
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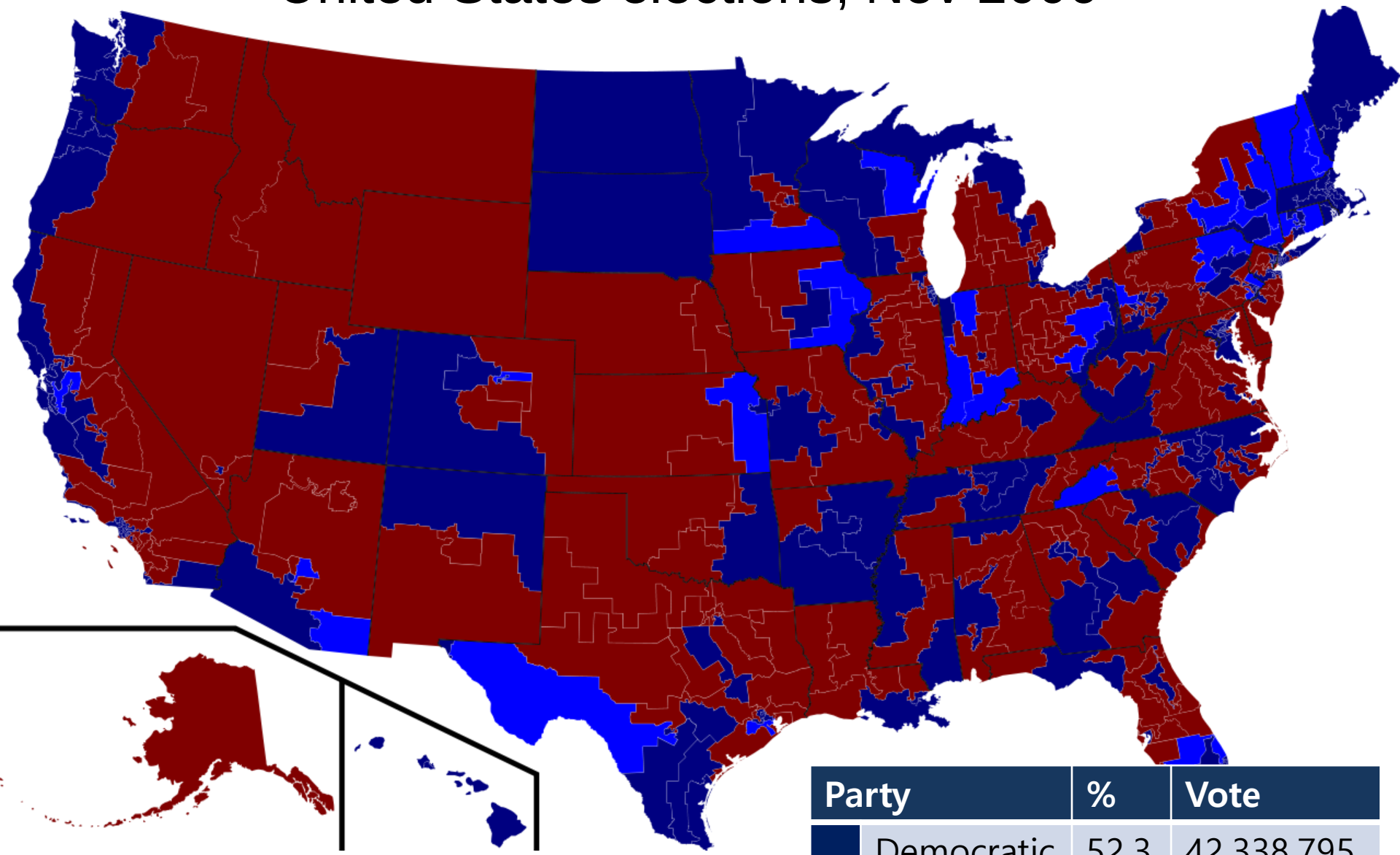
This file is originally written by Dawon Park and Donhwan Kwon,
Revised by Jinseob Jeong

United States elections, Nov 2006



Party	%	Vote
Democratic	52.3	42,338,795
Republican	44.3	35,857,334

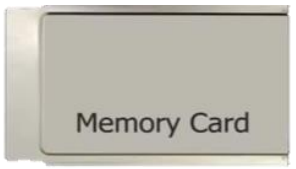
Voting

Paper-based Voting

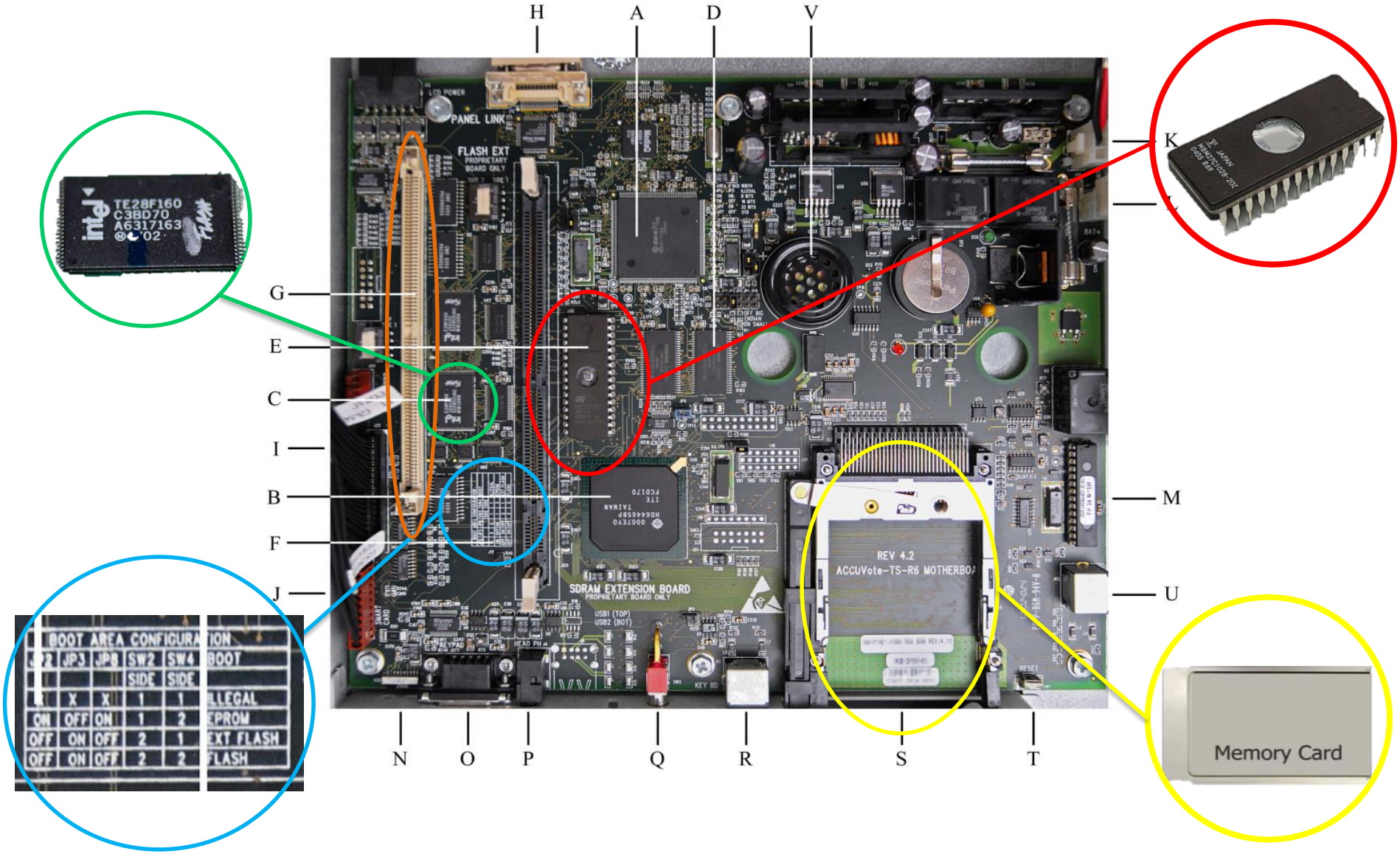
Electronic Voting

AccuVote-TS Voting Machine

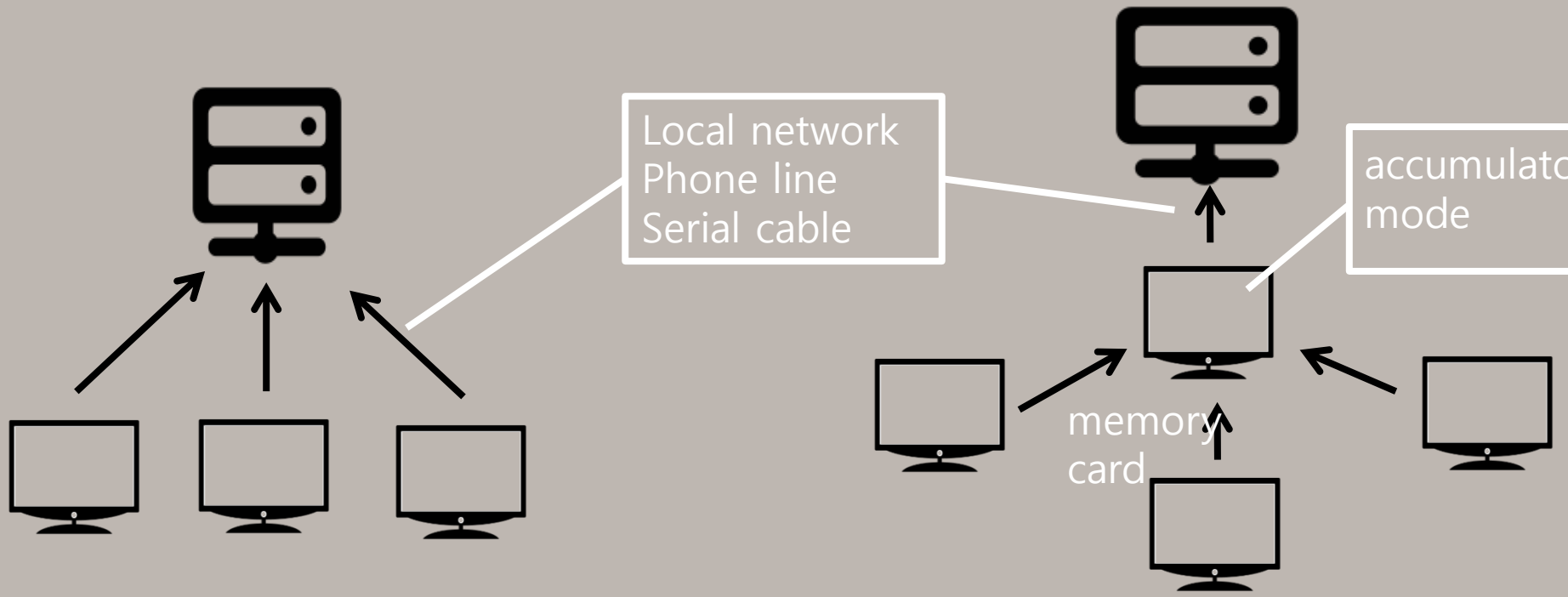
Software	Software
Windows CE	
Direct Recording Electronic (DRE)	



AccuVote-TS Voting Machine



AccuVote-TS Voting Machine



- Voter access card (valid -> invalid)

- **On-board Flash memory, Flash memory card**

- Local network
- **Accumulator mode**

Attacker's Goal

Attacker's Goal

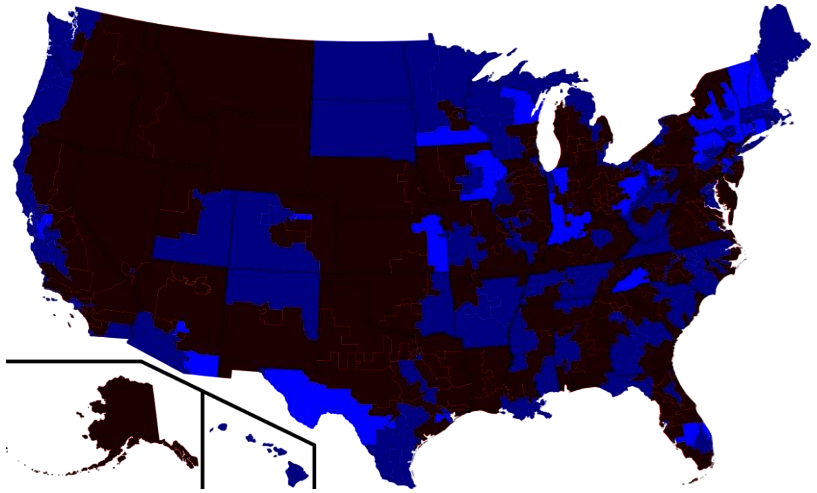
Vote Stealing

Party	%	Vote
Democratic	52.3	42,338,795
Republican	44.3	35,857,334

5% (4,048,777)

Party	%	Vote
Republican	49.3	39,906,111
Democratic	47.3	38,290,018

Denial of Service



Vulnerability

Direct Installation

- Easy to physically access to the motherboard
  - EPROM chip, removable memory card, power button
- Source of bootloader code is changeable
  - EPROM chip / On-board flash memory / Memory card
- Not verify authenticity of files
  - fboot.nb0, nk.bin, EraseFFX.bsq, explorer.glb, .ins file

Spreading Virus

- Removable memory card can spread out virus
  - Used for multiple machine, rewritable memory

Attack Scenario – installing malware

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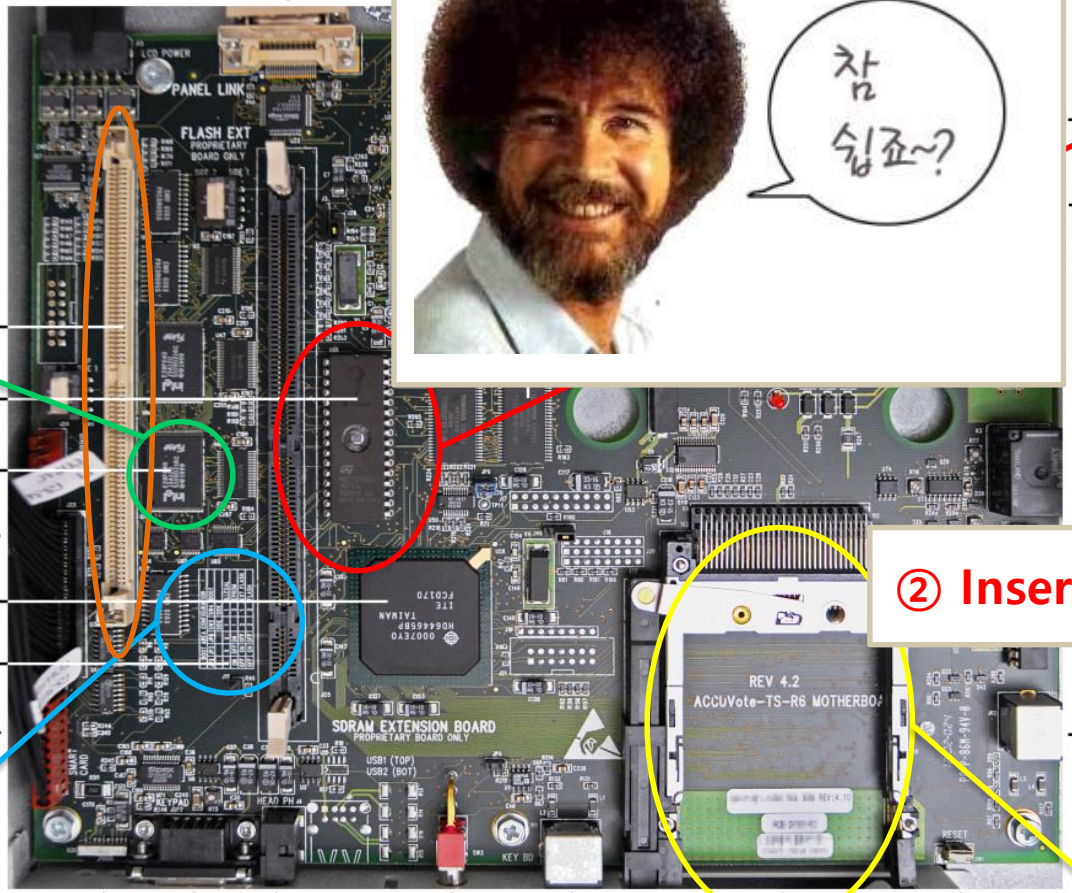
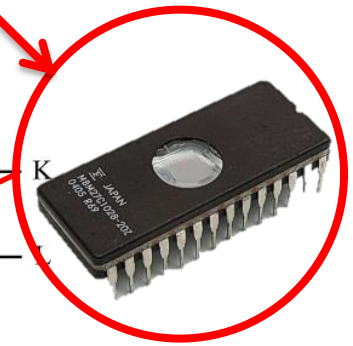


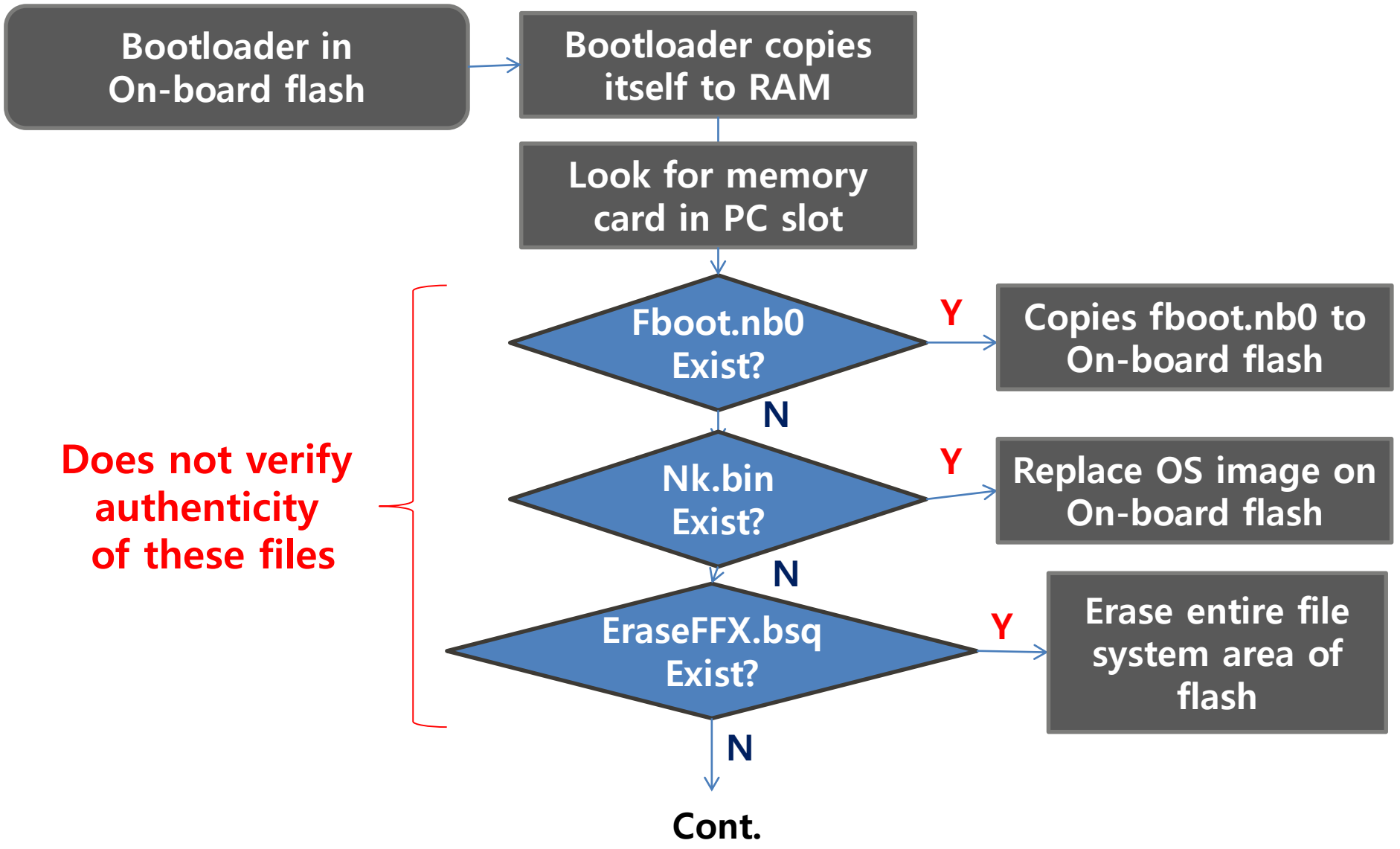
① Replace EPROM chip



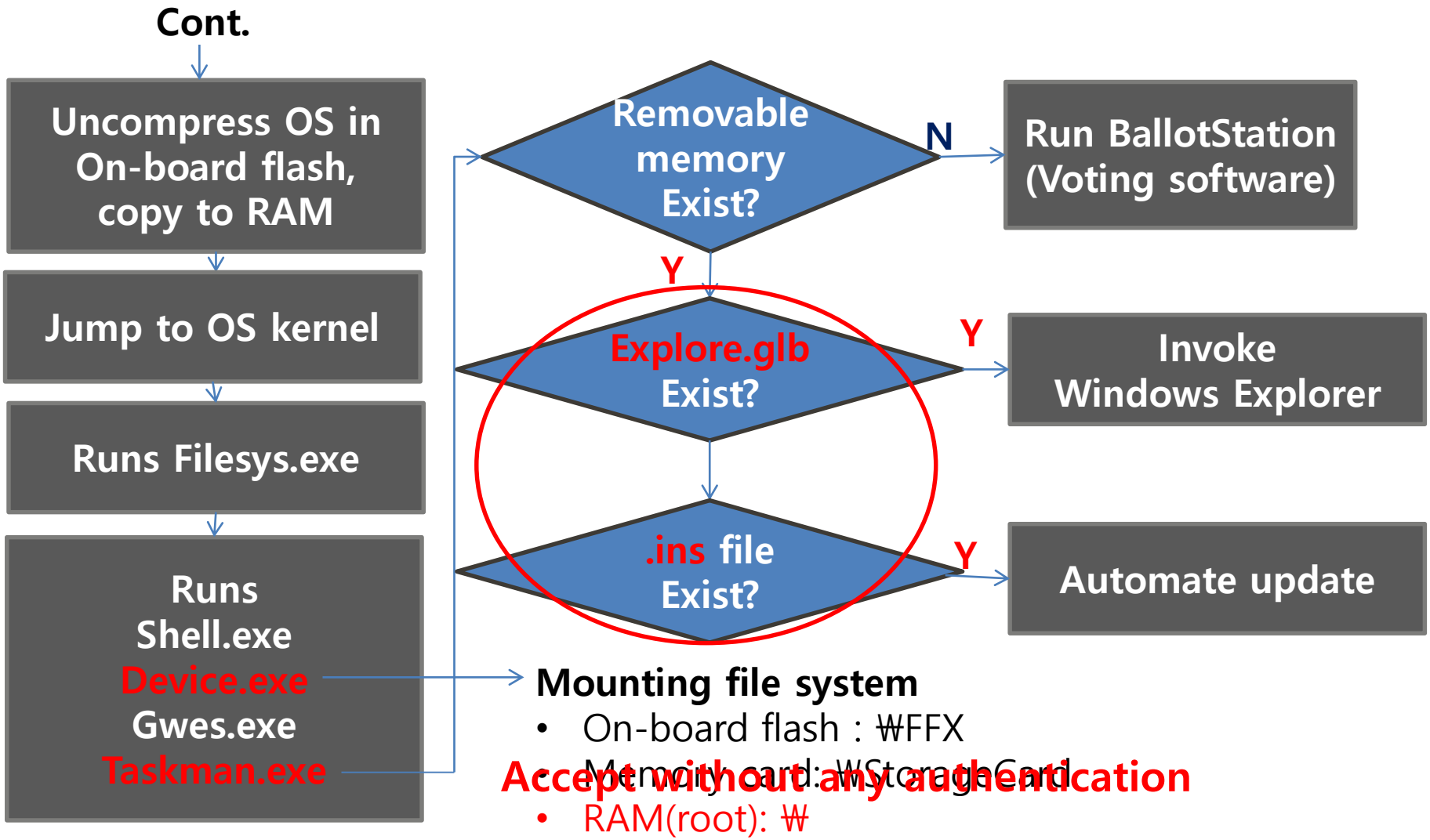
② Insert Memory Card

Determine source of bootloader code

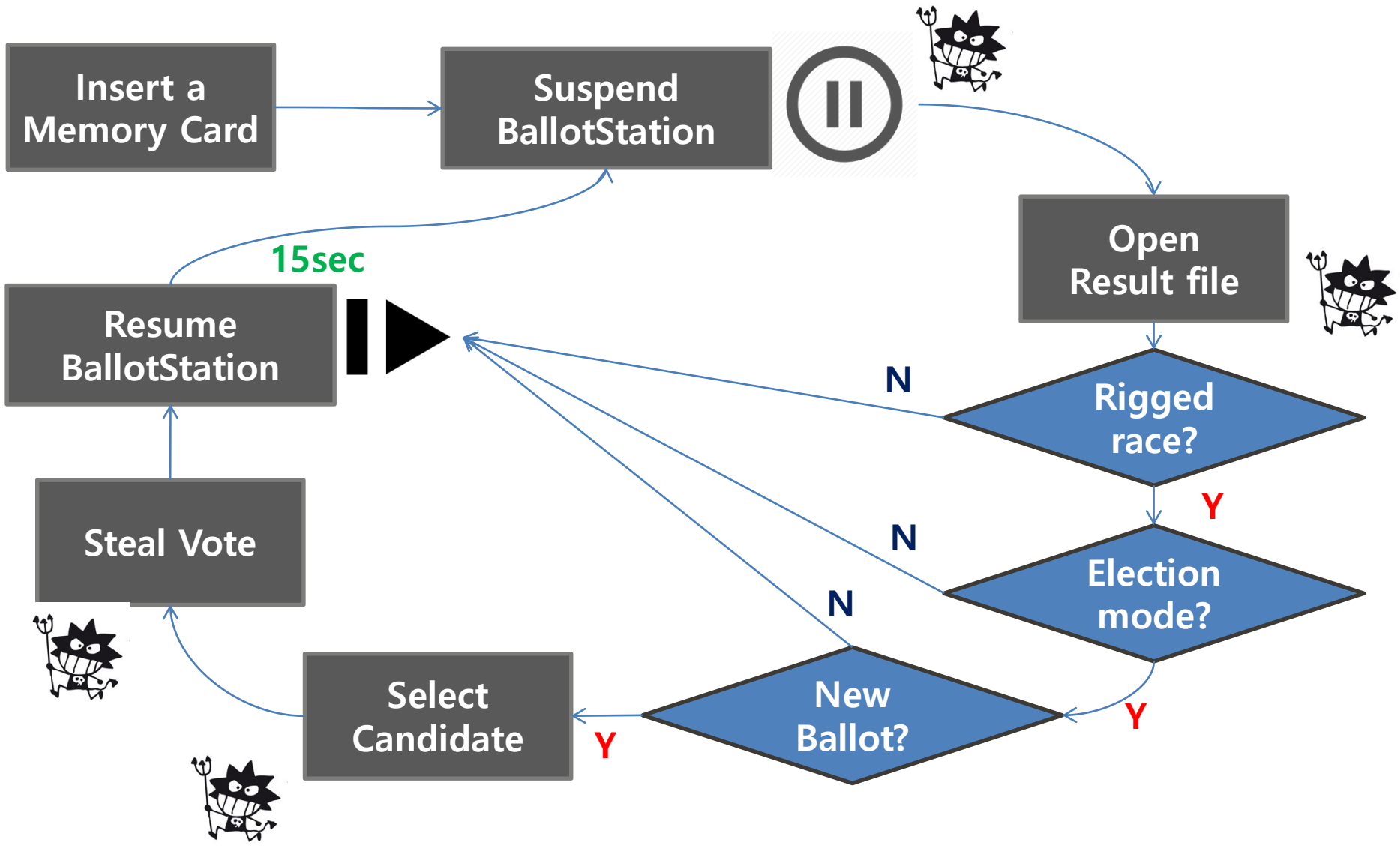
Attack Scenario – installing malware



Attack Scenario – installing malware



Attack Scenario – stealing vote



Mitigation

- S/W & H/W modification
  - Code signing & signature verification
  - Person confirm for software updates
  - Not use rewritable storage -> tamper-proof logs, records
- Physical access control : broken seal cause DoS
- Parallel testing : simulation pattern, secret knock
- Effective certification system : Strong Certifica
- Software independent design : printout paper

Conclusion

- H/W & S/W encompassing study of a widely used DRE
- Demonstration of vote-stealing and virus spreading
- Warning for large scale fraud
- Proving H/W architecture limitation of the target

Limitation & Future work

- General attack idea -> Attack through network
- Malicious action of voters : copy card or re-enable invalid card
- Physical access is not so easy during voting

Another Story – Diebold

`02 `03 `03

Diebold Election Systems to Become Premier Election Solutions

Increased Operational Independence, Concentrated Focus on Elections Systems

Industry Will Strengthen Premier's Competitive Advantage

Aug 16, 2007, 01:00 ET from Premier Election Solutions, Inc.

None of them

Diebold CEO resigns after reports of fraud litigation, internal woes

John Byrne

Harri Hursti
- **Hardware & compiled boot-loader**
- Problems with software update

Feldman, Halderman, Felten
- Reverse engineer hardware & software
- Confirmed earlier studies by **demo**

Another Story – Diebold

`07

David Wagner, California
- **TTBR(Top to Bottom Review)**
- "Deep architectural flaws"
- Buffer overflow, weak cryptography

`07

Ohio
- Project EVEREST
- "Yet more vulnerabilities"

`09

Election Systems & Software
Take over

`10

Dominion Voting System
Take over

Electronic voting in Korea

Secure?

OOO 당, 왜그러나 또 '선거 조작?'… '1번이 ooo 선장' 괴문자 파문

K-보팅 주소도 그대로 노출됐다. 비밀 보장을 위해 각 유권자에게 알파벳 6자리로 된 고유번호와 보안코드가 제공됐음에도 특정인의 비밀코드가 고스란히 노출돼 클릭하면 자동 연결된다.

'나가수' 뽑은 선관위 전자투표 보안기술 엉터리

Thanks