A Security Flaw in the Verification Code Mechanism of the Norwegian Internet Voting System

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Outline

1. Introduction
   - Problem Space
   - Properties of the Norwegian E-Voting Protocol
   - Implementation
2. Attack
   - Controlling the SMS-Channel: Network-Layer
   - Controlling the SMS-Channel: Application-Layer
   - Adversarial Communication
   - Adversarial Infection
   - Counter Meassurements
3. Conclusion

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Why This Talk?

The Norwegian E-Voting System...

- ...allows vote updating
- ...uses SMS as out-of-band post channel
- ...allows smart-phone as trusted device
- ...faces a secure platform problem
- ...cannot provide the required vote integrity by verification code
- ...can be fixed!

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Adversary Model and Trust Assumptions

The Norwegian E-Voting System...

- ...assumes server side to be honest
- ...accepts a malicious browser (MITB)
  - *cannot guarantee privacy (at the voter side)*

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The Norwegian E-Voting System...

- ...creates voter-individual and candidate based verification code (at the server side)
- ...sends verification codes to the voter via out-of-band channels
- ...provides vote integrity, vote and [illegible]

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  - pre-channel: postal mail (secure printing)
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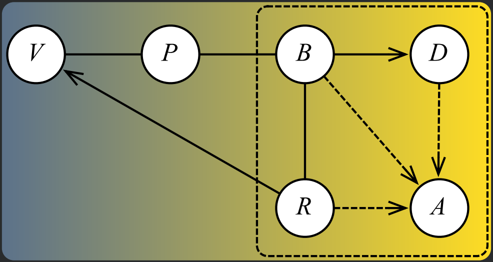

Verification Code: Recoginizing an Attack

If...

- ...correct receipt appears after the vote: Good
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Speciality

The Norwegian E-Voting System...

...allows vote updating!

Out-of-Band Post-Channel

The Norwegian E-Voting System...

...uses SMS-channel

Enhanced Adversary model

Man in the...

...*B*rowser & *S*MS-Channel

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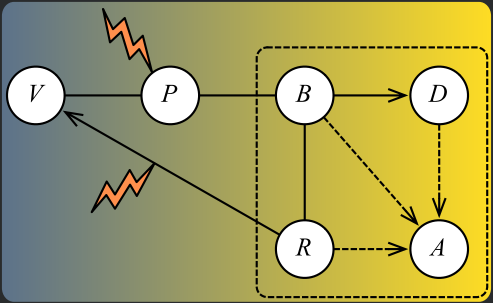
SMS-Channel: No more Out-of-Band

MIT(B + S) + Vote-Updating $\mapsto$ Compromized System



Fake GSM Base Transceiver *Dedicated Hardware*

IMSI-catcher: Demonstrated live @ Defcon 2010

- Hardware: 1500$ (off-the-shelf HW)
- Software: 0$ (Open Source)
- Trick: Proxy GSM-network ↔ GSM-phone
- Range: ≈ 35km

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Malicious Browser (MITB) & Fake GSM Base Transceiver (MITS) *Dedicated Hardware*

Logic

- MITB informs MITS to withold every second SMS:

  receipt generator $\mapsto$ voter's phone

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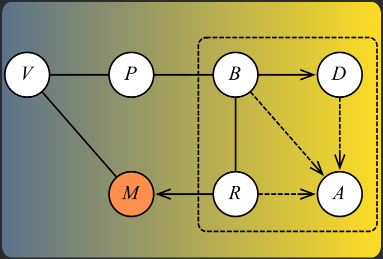
Statement

Introduction of smart-phone technology results in a new environment with strong impact on the security model

The Norwegian E-Voting System...

Introduction of Smart-Phone Technology to the Norwegian System



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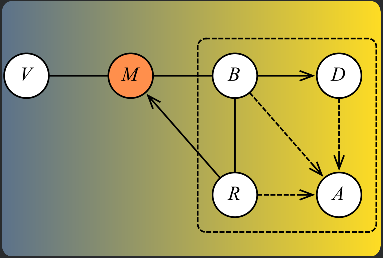

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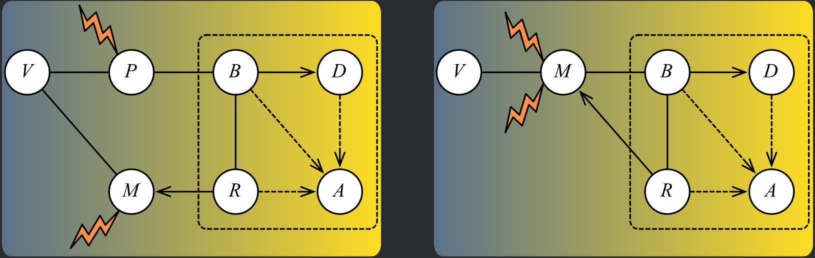

Malicious Browser & SMS-App

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**Web-Buddy (MITB) & SMS-Buddy (MITS)
Demonstrated live @ SIC [1] 2013**

- Hardware: 0$ (Voter's device)
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- Task: Proxy smart-phone → voter
- Range: [illegible]

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'Silent-Channel' communication

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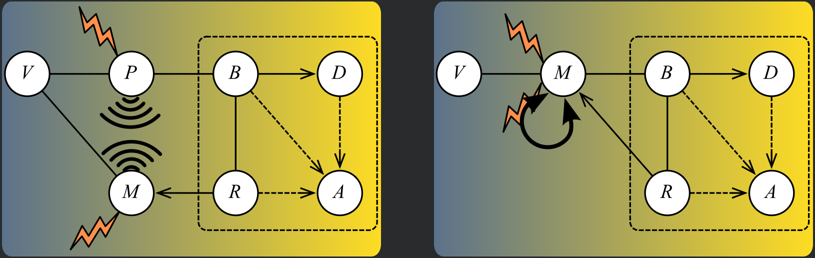

Channel: SMS-App ↔ Browser

How They Communicate

None SMS-App is programmed to block every second SMS from receipt generator

Implementation available

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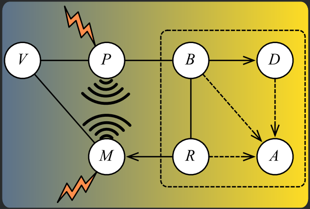

Internet-SMS-Gateway: MITB only allowed to use the internet

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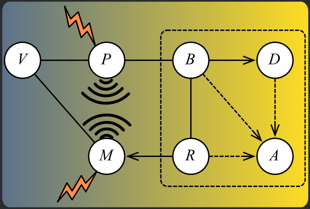

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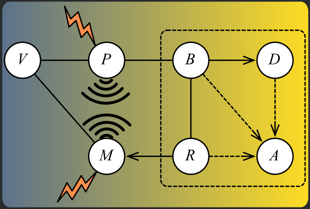

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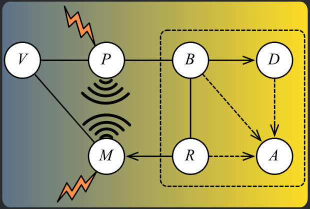

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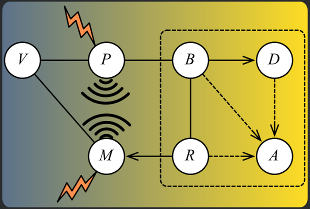

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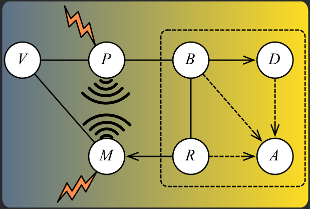

Ultra-Sonic MITS broadcasts via loudspeaker
MITB listens via microphone

Proof of Concept available

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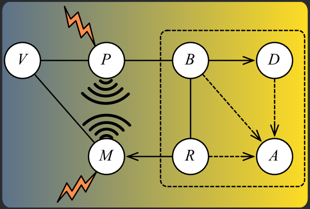

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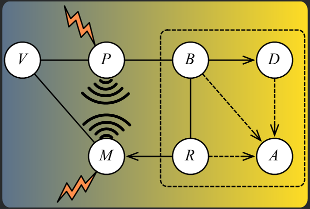

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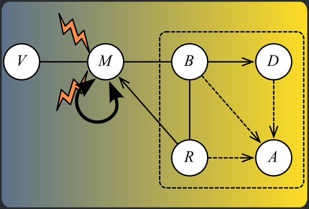

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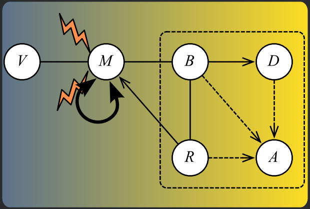

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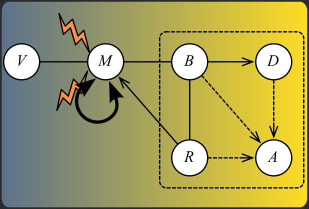

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Assumption: The browser is already infected

Social Engineering SMS-App is designed to guard privacy! No additional permissions needed!
Browser keeps 'nagging'

Cloud-Based After user has logged into cloud (Google-Play-Store / Apple-App-Store / ...)
Browser directly downloads SMS-App

Implementations and success-stories available (Eurograbber et al)

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How to Void this Attack on the Norwegian E-Voting System

One Vote only...

Per Voting Session MinID used to authenticate and authorize voter. Equal to e-banking mTAN.
This is no real solution, as Web-Buddy and SMS-Buddy are designed to break e-banking mTAN → attacking MinID

[illegible] No vote updating → no successful attack

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How to Void this Attack on the Norwegian E-Voting System

One Vote only...

Per Voting-Session — MinID used to authenticate and authorize voter. Equal to e-banking mTAN.
This is no real solution, as Web-Buddy and SMS-Buddy are designed to break e-banking mTAN $\mapsto$ attacking MinID

! — No vote updating ... no successful attack.

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Dedicated Hardware Device

SMS-Receiver: A must, if MinID alike infrastructure shall remain.
However, Fake GSM-Attack still possible.

Trusted Hardware Token: Secure Display, Secure Keyboard. Messages E2E encrypted (over the Internet).

Implementation available: ZTIC(IBM UBS)
Cronto-Device (Steven Murdoch)

Success-Story available: E-Banking (UBS)

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Smart-Phones Do Not Provide any Out-of-Band Channel

Stop using smart-phones as trusted device

Your system will be grounded by a *script kiddie*

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