Hardware Security

The (slightly) more tactile side of security

Overview of Today's Lecture:

- Hardware vs. Software Security
- Attacks, Threats and Attackers
- Security Categories
- Examples

Hardware Security vs. Security So Far:

- Different Landscape
  - Threats
  - Attackers
  - Attacks

- As important as software/network security

Threat Vectors:

- *Interception*

  - Gain access to information without interfering with system

- *Interruption*

  - Prevention of system functionality

- *Modification*

  - Invasive tampering

- *Fabrication*

  - Counterfeiting

Attackers:

Class 0 – Script Kiddies

Class I – Clever Outsider

- Intelligent, limited knowledge of target
- Usually through a known weakness

Class II – Knowledgeable Insider

- High-tech expertise
- Advanced tools and instruments

Class III – Funded Organisation

- Specialists with lots of funding
- Most advanced tools and analysis

Attacks:

- *Insider Attack*
  - e.g. Laid-off employee
- *Lunchtime Attack*
  - Performed during a small window of opportunity
  - e.g. during coffee break
- *Focused Attack*
  - Plenty of time, money and resources

Attacks:

- *Invasive Attacks*
  - e.g. Hardware reverse engineering
- *Semi-invasive Attacks*
  - e.g. Heating
- *Non-Invasive Attacks*
  - e.g. EM radiation observation

Security Categories:

- Physical
- Logical
- Environmental
- Operational

Physical Security:

Tampering

"An (physical) interference of a harmful nature"

Tamper Mechanisms:

- Strive to prevent an attempt by an attacker to perform unauthorised physical or electronic action

Tamper Mechanisms:

- *Tamper Resistance*
  - Special materials
- *Tamper Evidence*
  - Visible evidence left behind after tampering
- *Tamper Detection*
  - Hardware is aware of tampering
- *Tamper Response*
  - Countermeasures upon detection

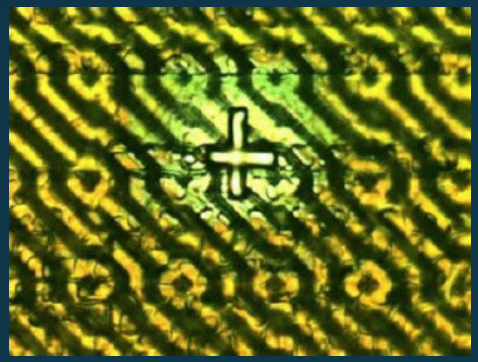
Physical Attacks:

- *Invasive*
  - Direct access to embedded components (e.g. cpu)
  - Micro probing, reverse engineering, memory readout techniques (e.g. freezing)
  - Require lot of time, knowledge and resources
- *Semi-invasive (integrated chip cards)*
  - UV lights, x-rays, laser, EM field, heating
  - Optical fault induction (SRAM illumination)
  - Low cost, easy reproduction on same target

Physical Attacks:

Micro-probing station:

Modified Circuit:



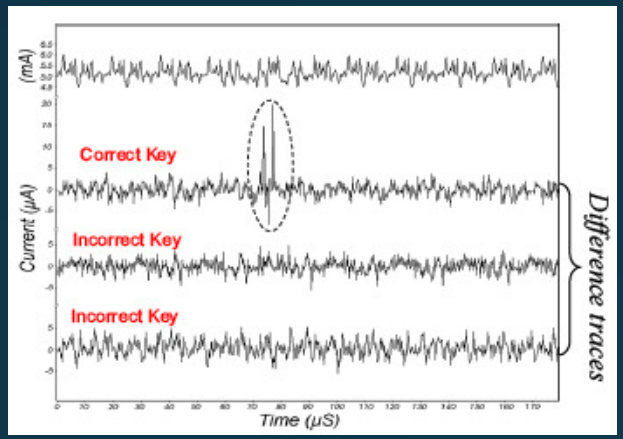
Source: Cambridge Security Lab

Logical Security:

- Access Control
- Cryptographic Algorithms
- Cryptographic Protocols

Logical Attacks:

- Non-Invasive
- No Physical Damage
- *Monitoring/Eavesdropping*
  - TEMPEST attacks
  - Side Channel Attacks
    - Timing Analysis
    - Power Analysis
    - Fault Analysis



Logical Attacks:

- *Software Attacks – API*
  - No specialised equipment needed
  - Very fast

  Issues:
  - Integrity of keys
  - Function parameter checking
  - Security policy enforcement

Environmental Security:

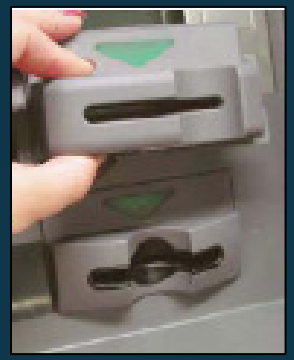
- Device itself is the asset
- Goal – limit attacker's possibilities by creating layers of hindrance (e.g. access)
- Administrative controls should be part of security policy

Operational Security:

- Security risks related to operation of hardware
- Closely related to last week's lecture
- Example: ATMs

  User's knowledge of:

  - Real vs. Fake card reader
  - Keypad operation
  - PIN Safeguarding
  - Latest attacks



Hardware Security Modules:

- For secure generation and storage of crypto information
- Often physically tamper resistant
- Sometimes have H/W cryptographic acceleration
- Sometimes have special “trusted” peripherals

  (e.g. card readers, key pads, etc..)

Example: Banks

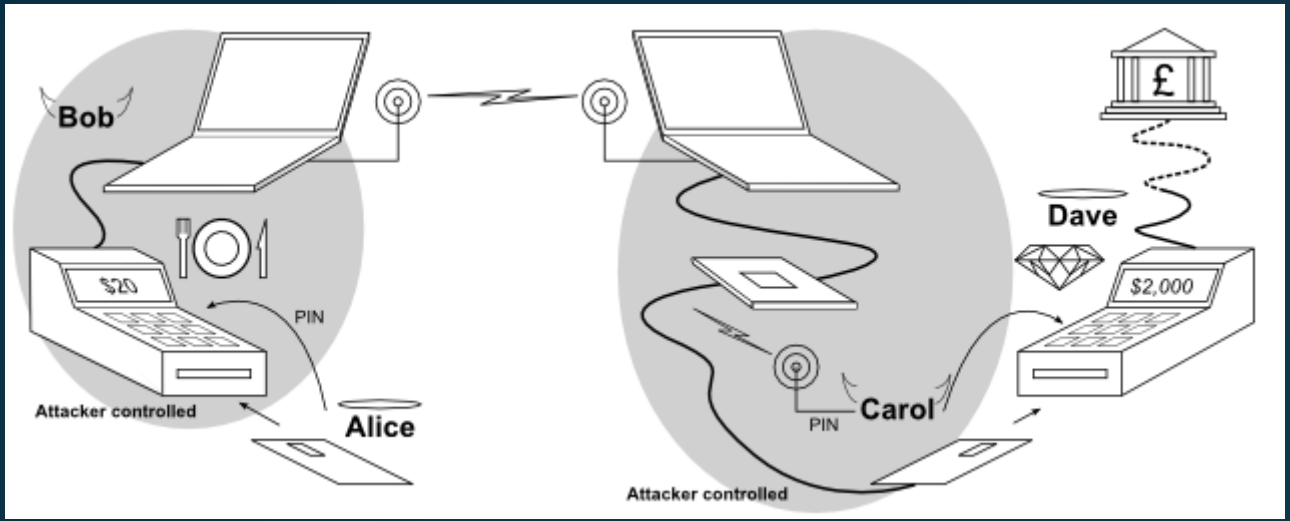
- ATMs
- Pre-payment electricity meters

Examples:

- Credit Cards
  - Magnetic Stripes
  - Chip & PIN
  - RFID (Radio Frequency Identification)

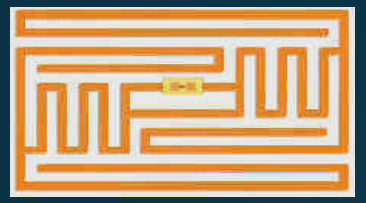
Examples:

Chip & PIN relay attack:



Source: Cambridge Security Lab

Examples:



RFID – Radio Frequency Identification

- Originally developed as the “Barcode of the future”
- Now used as
  - Inventory control
  - Logistics and supply chain management
  - Physical access cards
  - Payment
    - Motorway charges
    - Gas stations
    - Small items in shop

Examples:

Future:

- Embedded in all kinds of devices
- From clothing, to all products we buy

e.g. Milk that will tell fridge when it is expired

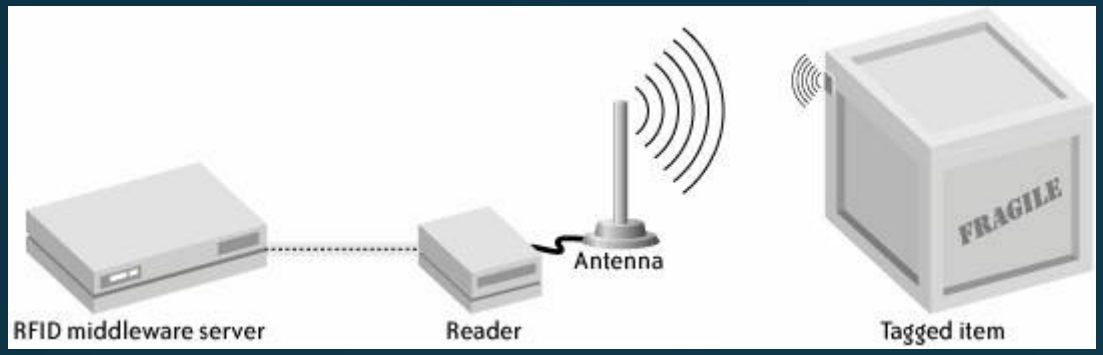
Issues:

- Privacy
- Security – RFID was not designed with security in mind!!

Examples:

- Susceptible to Power Analysis attacks
- Can be susceptible to Cloning attacks
- Susceptible to Relay attacks

"Is your cat infected with a computer virus?"



Remember:

- H/W security as important as other security aspects
- H/W security devices do not solve security
- Many attacks exist
- Many more problems are on the way
- Because – Security added as an afterthought