Computer Security

Lecture 1

VULNERABILITIES, THREATS and PROTECTION MECHANISMS

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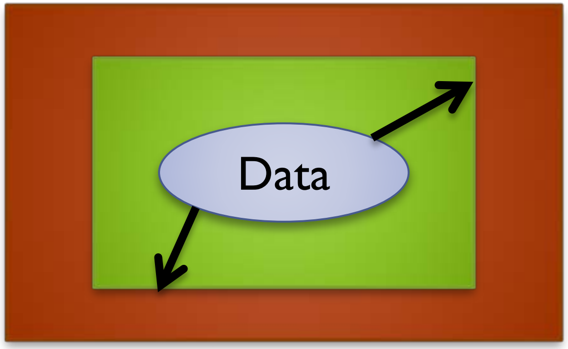
Terminology 1

- An ***attack*** is an intentional activity conducted or initiated by a human, attempting to cause a breach in a system or to compromise a system.
- A ***breach*** is the resulting violation of the security policy of a system.
- We use the term ***intrusion*** (or ***penetration***) to denote an attack and its corresponding breach.

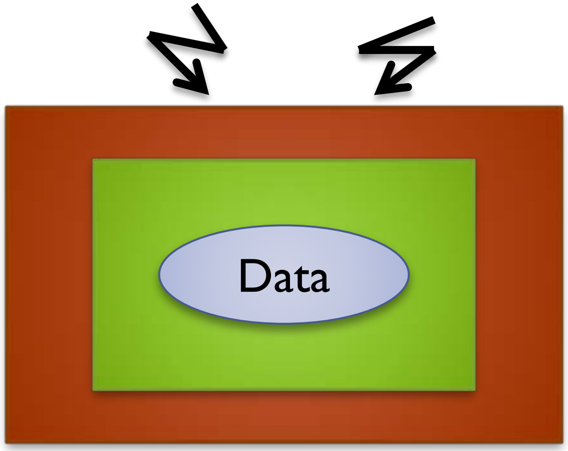
Terminology 2

- a ***vulnerability*** is a place in the system where it is open for attack (at least to some extent)
- a ***threat*** is something that can give undesired, negative consequences for the system
- a ***countermeasure*** or **protection** or **control** is a technique that will protect the system against attacks

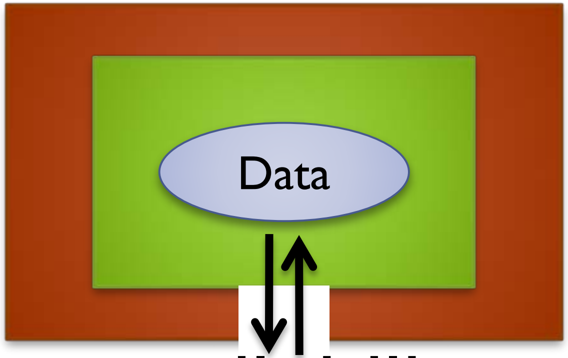
Security of Data – "CIA"



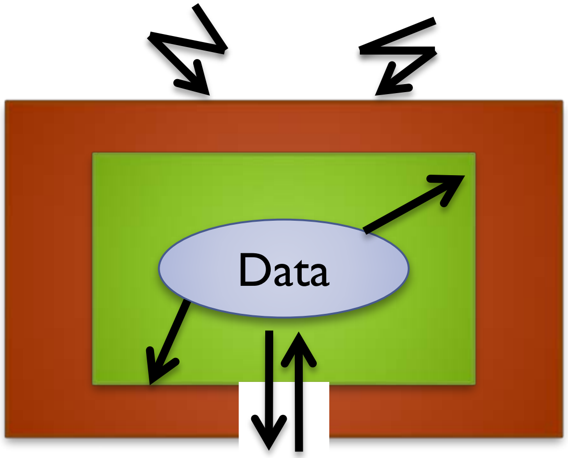
Confidentiality



Integrity



Availability



Secure Data

Many other definitions exist!

Examples of Security Problems

- intrusions, attacks
- eavesdropping (local, transmission, radiation, tempest)
- hardware, hardware errors
- software errors (bugs), software design methods!
- malicious software (virus, Trojan horses, COTS, etc)
- inadequate management, deficient configurations
- failure propagation, i.e. consequences of security problems in other systems
- ignorant users
- mistakes

Intruders

WHO ARE THE INTRUDERS?:

- “insiders” and “outsiders”
- outsiders are hackers, terrorists, thieves, enemy states, spy organisations, in principle almost anybody...

BUT WHO IS AN INSIDER?:

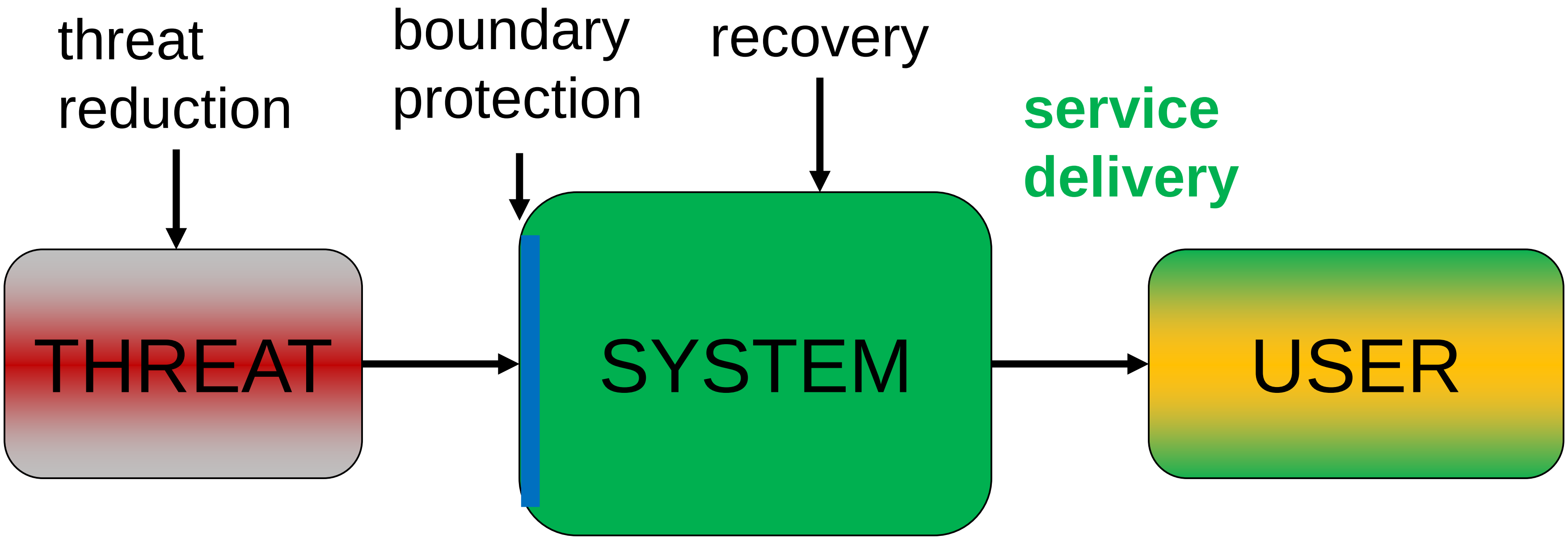
An **insider** is somebody who has *access to the system* to some extent

- the ordinary user
- the former user
- maintenance personnel (system administrator, etc)
- the designer!! (back doors, Trojan horses)

Network Security Attacks

- classify as **passive** or **active**
  - passive attacks are eavesdropping
    - release of message contents
    - traffic analysis
    - are hard to detect so aim to prevent
  - active attacks modify/fake data
    - masquerade
    - replay
    - modification
    - denial of service
    - hard to prevent so aim to detect

Computer Security – major defence lines

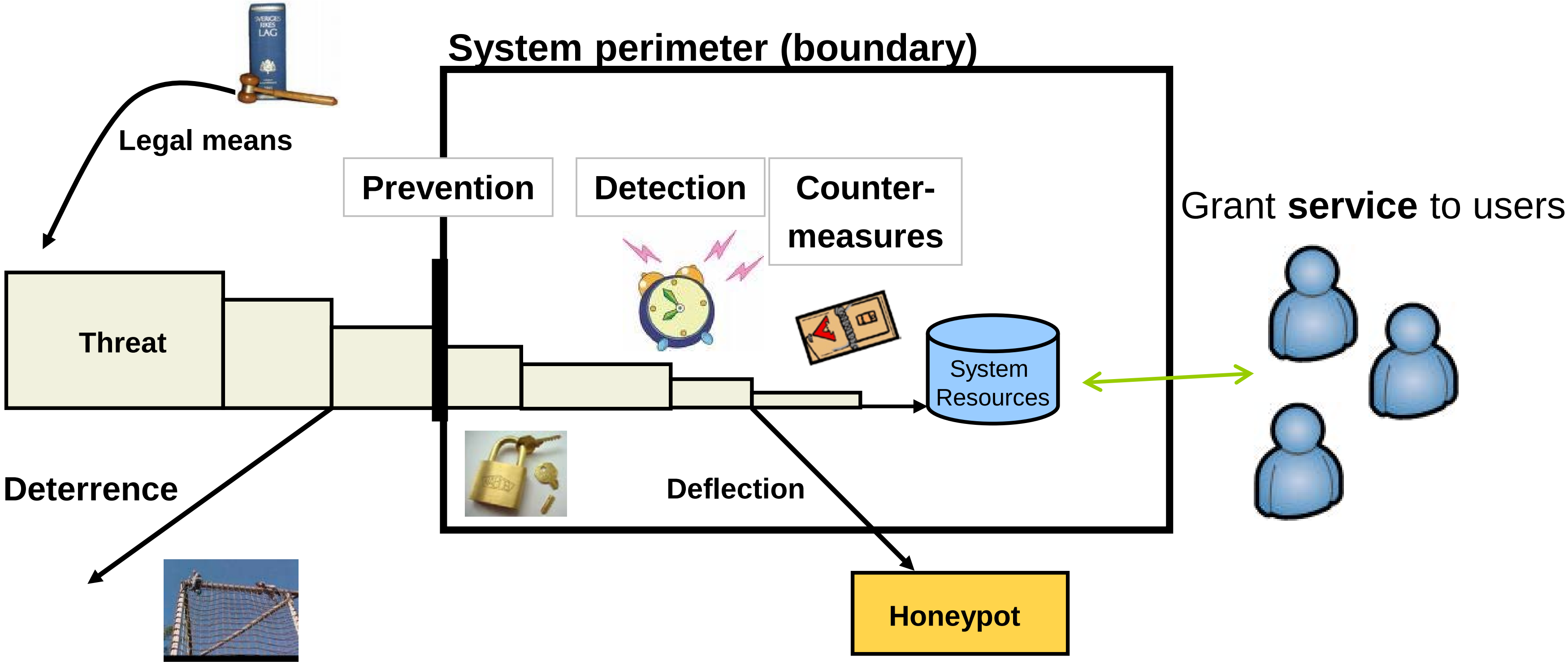


Security=Datasäkerhet

Examples of protection mechanisms

- **preventive protection:**
  - legal protection
  - reducing threats (e.g. “security check-ups”)
  - education / information / propaganda!
- **boundary protection mechanisms:**
  - shield cables
  - encryption
  - physical protection (e.g. locks)
  - access control
- **internal protection, recovery:**
  - (anti-)virus programs
  - supervision mechanisms (with response capabilities)
  - intrusion detection (with response capability)
  - encryption of stored data

Defence-in-depth(!) - should be applied



System perimeter (boundary)

Legal means

Prevention

Detection

Counter-measures

Grant **service** to users

Threat

System Resources

Deterrence

Deflection

Honeypot

Protection mechanisms principles

- technical measures:
  - access control; identification & authentication; system & communication protection; system & information integrity
- management controls and procedures
  - awareness & training; audit & accountability; certification, accreditation, & security assessments; contingency planning; maintenance; physical & environmental protection; planning; personnel security; risk assessment; systems & services acquisition
- overlapping technical and management:
  - configuration management; incident response; media protection

Ex of protection mechanisms

- protect the **hardware** (computers, servers, CDs, back-ups,
  modems, printers)
- use **authentication** (passwords, smartcards, etc)
- introduce **access controls** (read, write, execute, install)
- use **anti-virus programs**
- install a **firewall**. Configure it properly!
- **supervision** and **intrusion detection** mechanisms
- install **spam filtering** (whitelisting, blacklisting greylisting, etc)
- real sensitive networks and computers should be **isolated**

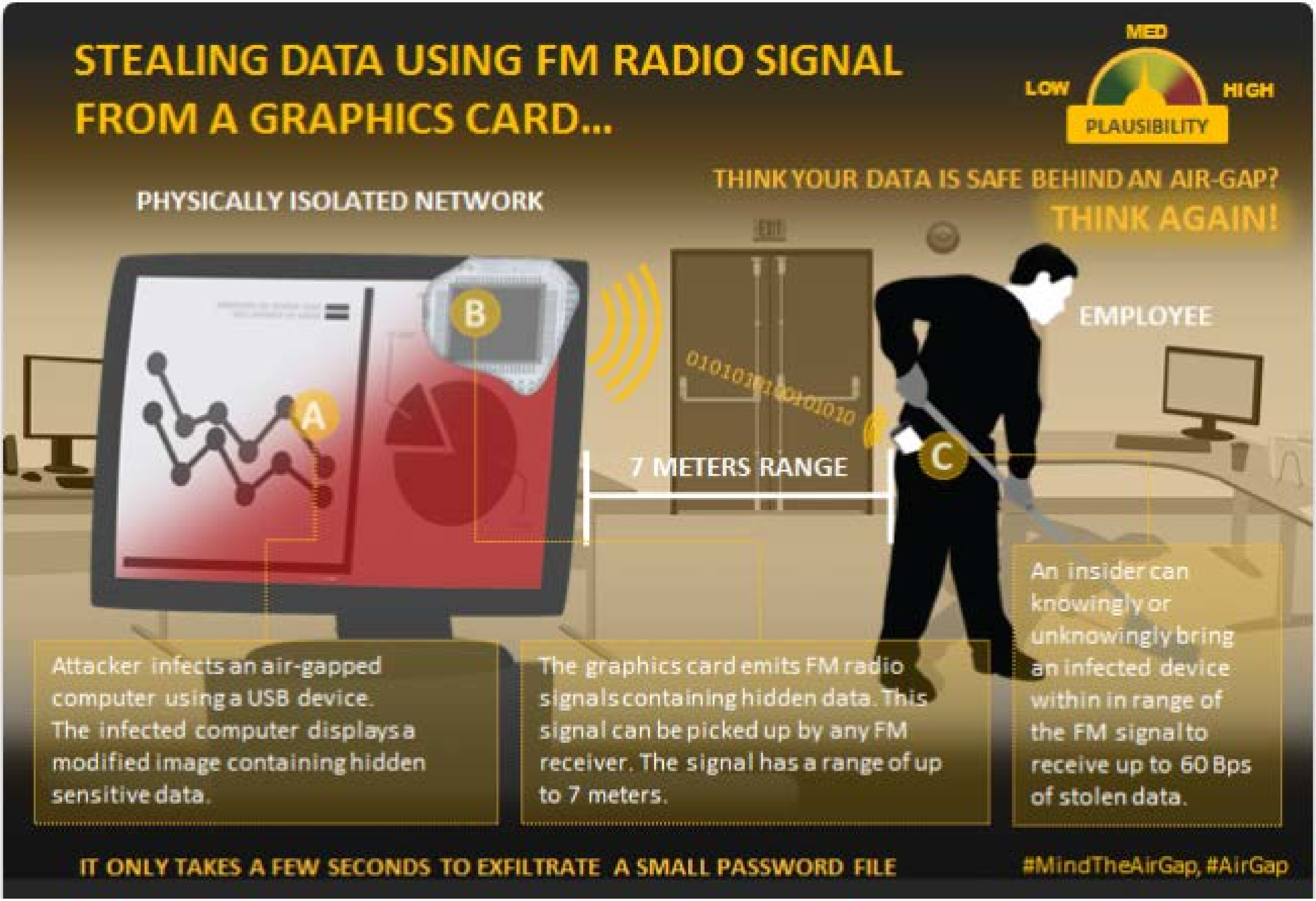
Equation Group

- Complex malware suite, been around since 2001
- Infects firmware → impossible to get rid of
- Designed to counter air-gapped systems
  - Transport info on USB:s

Air gap (1)

MIND THE AIR-GAP!
ARE AIR-GAPPED SYSTEMS STILL THE GOLD STANDARD OF SECURITY? WE LOOK AT THE PLAUSIBILITY OF SOME TECHNIQUES THAT HAVE THE POTENTIAL TO BREACH THAT GAP.
0111100010111010100110
THINK YOUR DATA IS SAFE BEHIND AN AIR-GAP?
THINK AGAIN!
#MindTheAirGap, #AirGap

https://www.symantec.com/connect/blogs/mind-gap-are-air-gapped-systems-safe-breaches



STEALING DATA USING FM RADIO SIGNAL FROM A GRAPHICS CARD...

THINK YOUR DATA IS SAFE BEHIND AN AIR-GAP? THINK AGAIN!

Attacker infects an air-gapped computer using a USB device. The infected computer displays a modified image containing hidden sensitive data.

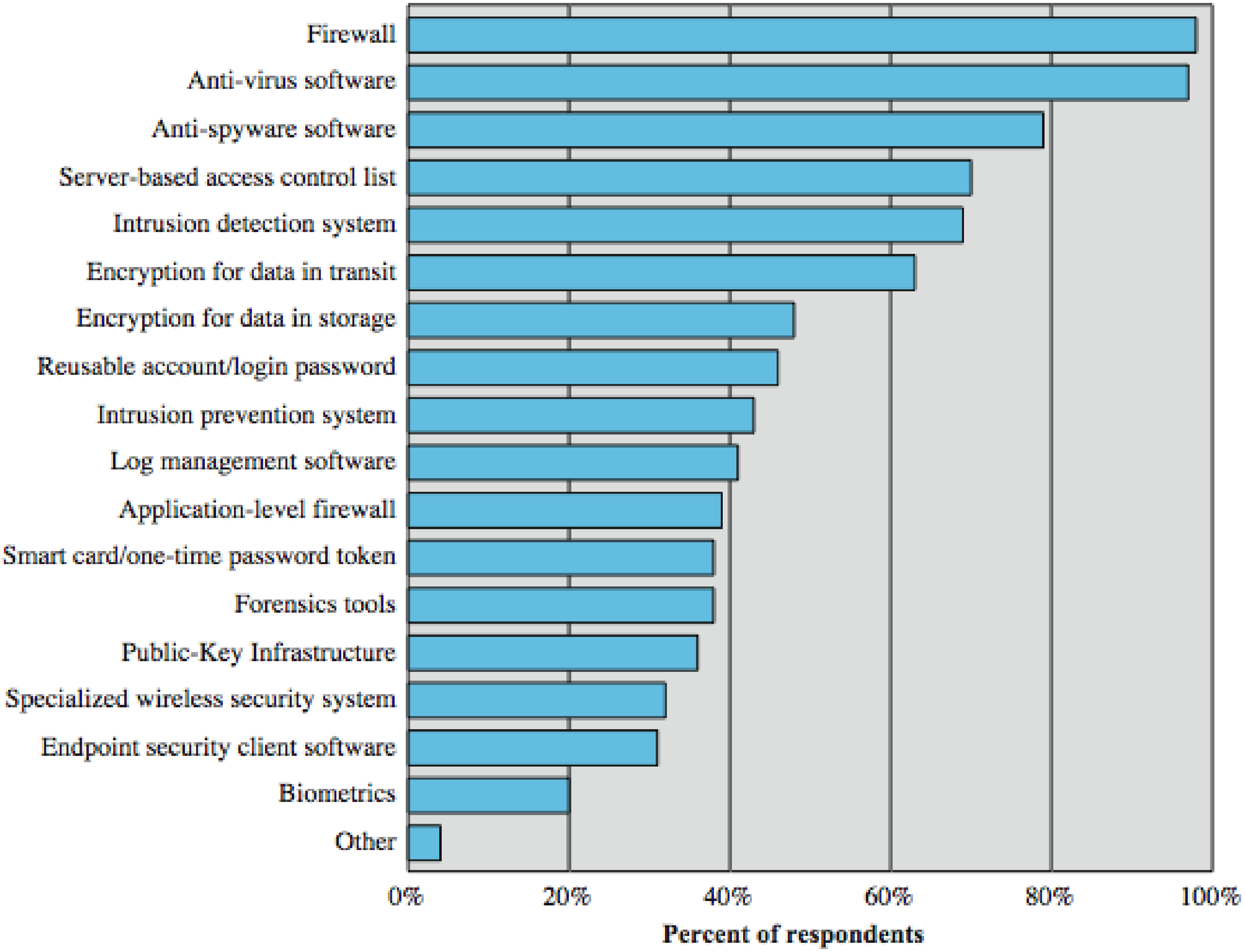
The graphics card emits FM radio signals containing hidden data. This signal can be picked up by any FM receiver. The signal has a range of up to 7 meters.

An insider can knowingly or unknowingly bring an infected device within in range of the FM signal to receive up to 60 Bps of stolen data.

IT ONLY TAKES A FEW SECONDS TO EXFILTRATE A SMALL PASSWORD FILE

https://www.symantec.com/connect/blogs/mind-gap-are-air-gapped-systems-safe-breaches

Security Technologies Used



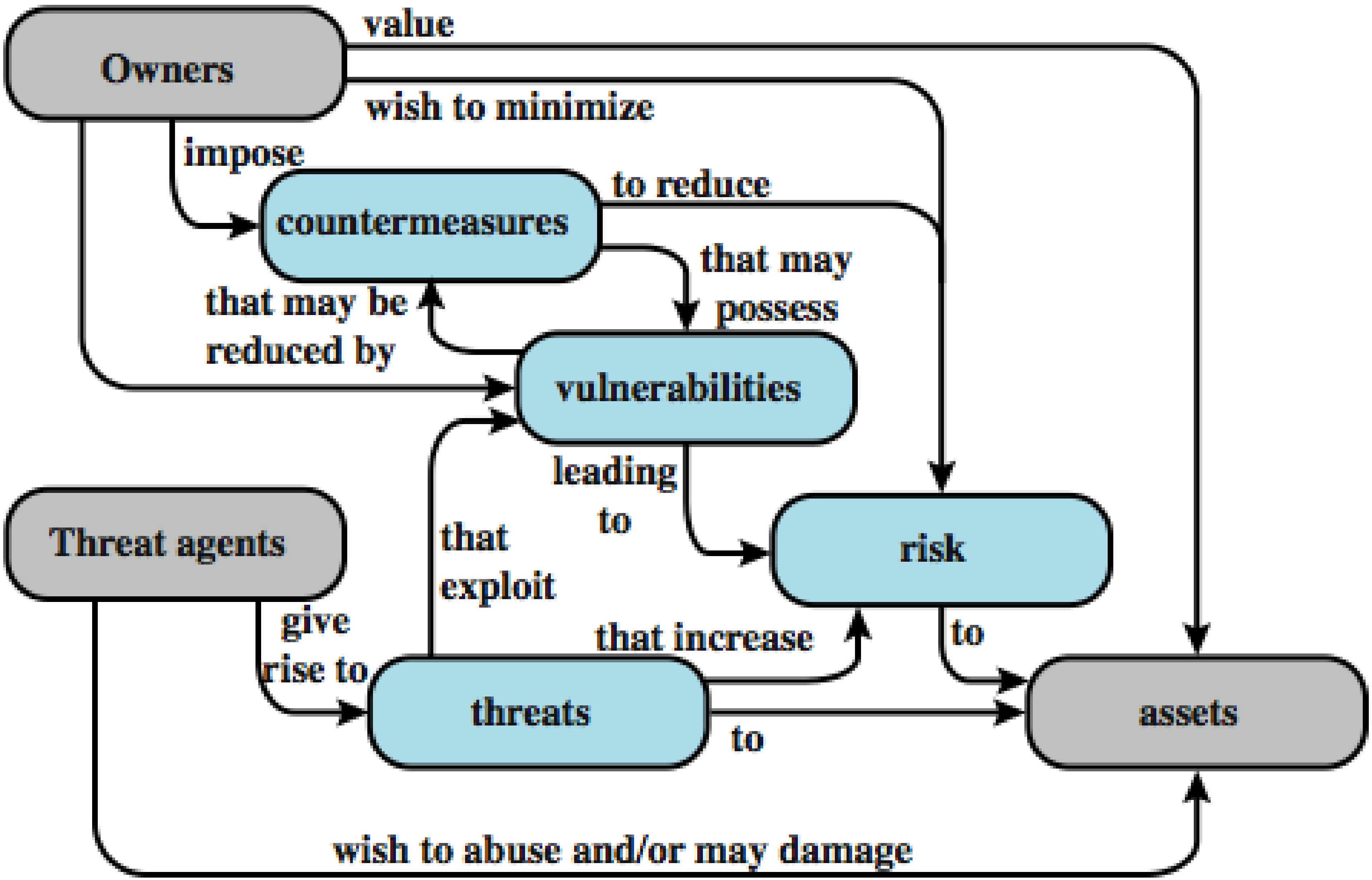
Source: Computer Security Institute/FBI 2006 Computer Crime and Security Survey

Information, methods and tools to enhance security

- know your system!
- update it continuously!
- supervise it
- make use of available security mechanisms
- alarm reports (CERT, OWASP, hacker-sites, ...)
- information about “patches”
- tools for analysis and intrusion detection
- educate the people!! (particularly the users)

....mostly for the system administrator

Security terminology flow chart

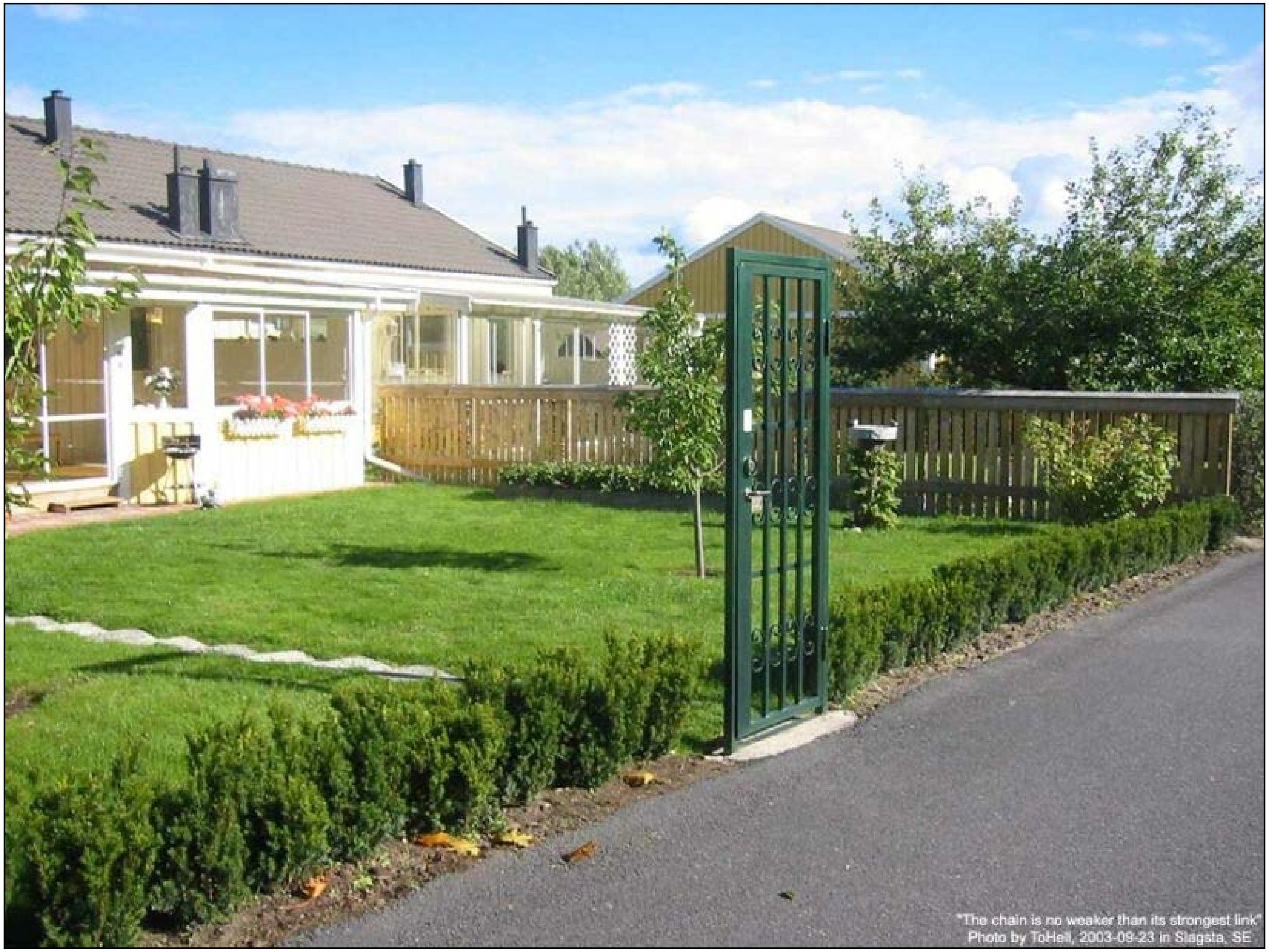


The Challenges of Computer Security

1. Security is not as simple as it may appear to the novice.
   - Possible to attack the security mechanism?
   - Security is not done in isolation from the rest of the system.
2. Security is a “chess game” between the attacker and the security administrator:
   - The attacker only needs to find a ***single*** vulnerability to penetrate the system, while the administrator needs to patch ***all*** holes to ensure system security.
3. Natural tendency to disregard security problems ***until*** a security failure occurs.
4. Security is a process ➔ constant monitoring, long-term perspective.
5. Security is often an afterthought – added after the system has been designed.
6. Some users think security is restricting them in their job.

See Stallings & Brown: Computer Security, Pearson 2008, ISBN: 978-0-13-513711-6, page 11

Security is the lack of insecurity!



"The chain is no weaker than its strongest link"
Photo by ToHell, 2003-09-23 in Slagsta, SE

General reflections

- Security is a **continuous process**.
  - there are no “free lunches”
  - the “biological” analogy (“several levels of protection”)
- You can not add security, only **reduce insecurity**
  - hacker’s vs owner’s perspective (at analysis)
- A computer system is **never 100% secure**
  - in particular not distributed systems
  - in any case you cannot verify security.
- Consider the **threats** and the **value** of what you protect:
  - **Principle of Adequate Protection:**
    Computer items must be protected only until they lose their value.
    They must be protected to a degree consistent with their value.