Key Management/ Infrastructures

Security 07

Basic problem

- Cryptographic security: must be some keys that are not cryptographically protected.
- Must find other ways to protect these keys.

How can the system identify you?

- Passwords
  - Something you *know*
- Hardware
  - Something you *have*
- Biometrics
  - Something you *are*

Password

- A sequence of characters known to only user and system, fx
  - QWERTY
  - 8676
  - Cis#1isT$

Attacks/aspects

Aspects	Attacks
Choice of password	Guess password
Use of password	Steal password while it is used
Storage by owner	Steal password from owner
Storage by system	Steal from system

Choice of password

- Keyspace: long passwords = many possibilities
  - 4-digit PIN-code: 10.000 possibilities
  - Unix password: $\approx 2^{52}$
- Practical limit
  - Max remember 12 characters under pressure

Passphrases

- Length not enough – quality matters
- Passphrases:
  - Course in security number 1 is Top-dollar
  - Cis#1isT$
- As hard to guess as random passwords!
- If users don't do as they are told? - Programs rejecting bad passwords. Or programs that help estimate quality.

Guessing a password

- Simply attempt to log on until you succeed.
- After 3 attempts, block account

✂☺ ☹ ?!

  - Good if attacker wants to log in
  - Bad if purpose is denial of service.
  - Better with delays after failed attempts.

Steal password under transmission

- Look over the shoulder
  - Physically – or electronically: Spyware
- Fake hardware
- Network eavesdropping

- Solutions involve
  - Cryptography
  - Hardware
  - Biometrics

Steal password from user

- If it's written down?
  - Piece of paper in dust bin
- Devices for remembering PIN-codes can help
- BUT: Social engineering…

Social engineering

- 336 students were asked by mail to send back their passwords to validate the password database
- 138 returned their passwords!!
- A few changed their passwords, but no one reported to the system administrator
- Passwords for chocolate ?!

More (less?) sophisticated methods:

- Call the company *Naive software solutions*: ”I’m security administrator at IBM, the software you delivered has a problem, I need your password…”
- Phising: send mails leading people to fake web pages: we need to validate your account, click here – and enter your password..

Social engineering – defenses?

- One of the most effective ways to break into systems
- Information and education
- Technology: make sure it takes more than you can steal by phising..
  - Hardware
  - Biometrics

Stealing passwords from systemet

- Password-database in cleartext ☹
- Better method: store a complicated function of password and not the password itself.
- No guarantee: with badly chosen passwords, this may also fail.

Password-DB by one-way functions

- Table with entries:
  - U, user
  - *f*(*password of U*)
- Where f is a function that is easy to compute but hard to invert.

- No immediate information on passwords in table. Nevertheless, an entered password can be checked.

Dictionary attack

- One-way function is known

- Take a table of likely passwords.
- For each pw in table, compute $f(pw)$ until match is found

- Up to 25% succes-rate in practice
  - Better choice of passwords - passphrases

Passwords - overview

Aspect	Attack	Defense
Choice	Guess	Passphrases
	Dictionary	Help to choose
Usage	Spyware, eavesdropping, …	Training
		Hardware, biometrics, crypto
User storage	Social engineering	Training
System storage	”Steal DB”	One-way functions
	Dictionary	Better choice of pw

Hardware

- Not just: prevent exposure of keys.
- But also: Make sure your key exists in only one copy
  - easy to copy files, or magnetic stripe cards
  - If copying hard, or takes time, better chance that theft is detected
- Means hardware can be useful even if break-in possible

Chip-card

- Cards with computer on board
  - CPU, RAM, I/O, even RSA co-processor
- Fx the new DanKort, SIM-cards for mobile phones …
- Physical intrusion not impossible, but hard..

Always necessary to break in? – Analysis of current usage

- Naiv implementation pf RSA-encryption
  - Scan bits in key one by one:
    - If 0, one set of instructions
    - If 1, another
  - *Very* big difference in current usage of the two
  - Measure current usage, plot => private-key in cleartext!

Tamper resistance

- American standard: FIPS

- Must detect
  - Cooling
  - Shaking
  - Explosion
  - Magnetic fields
  - …

An example IBM 4758

- Evaluated to max FIPS-level
- Used by many banks
- No known attacks on physical protections – but attacks on API previously

Authenticity – again(!)

- Scenario:
  - RSA private-key in IBM4758, can only be accessed with smart card and PIN code.

- Via software you download (applet) you instruct system to sign document.
- But what is actually signed?!

Hardware - overview

- Protection
  - tamper-proof – or:
  - tamper -evident.
- Attacks
  - Bad API's
  - Unforseen sideeffect
  - Control over both hard- and software?

Biometrics

- Traditionally:
  - Man-man
  - Based on signatures, photos, etc.
- Here:
  - Man-machine
  - Based on measurement of physical characteristics

BornholmsTrafikken

General Solution

- Function from individual to data
  - Based on particular biological characteristics
  - Database on these
- Identifikation:
  - Measure
  - (Re-)calculate function
  - Compare to database

False negatives and positives

- False negative: rejected, even though you are a legal user
- False positive: approved, although you shouldn't be.
- Cannot be completely avoided. What is acceptable is decided by application.

Technology

- Iris-scanning
- Fingerprint
- Face shape
- Handgeometry
- Speach
- …

- Often the first two are best

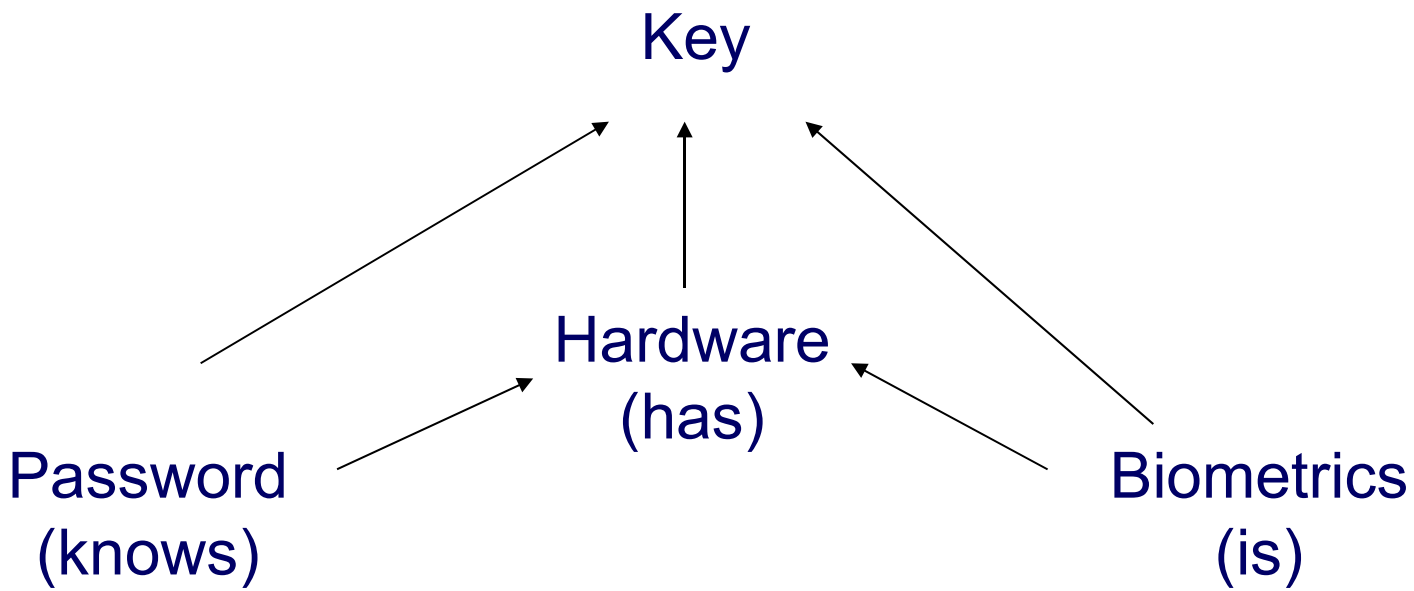
Pro's and Con's

- You always bring yourself

- But: Anonymity, privacy
- May be other ways to get in than by imitating the physical characteristics
- Natural physical change of user.

- Note: Your fingerprint is not a signature! Biometrics good for access control to your signature key, but cannot replace it

Key management - overview



A remaining question

Have seen ways for system to **identify who** wants access to something (here a key)

Must prevent access without being approved by system

Need ways to ”lock up” the ressource..

Two ways to ”lock it up”

- If secure hardware around, easy
- If not, must go back to crypto
- Ex: key to be protected by password without hardware security – must encrypt key under password
- Problem: can test all passwords. Solution: slow the process down.