COMP522
Identification and authentication

CNS, Section 2.4
WSPC, Chapter 6

Identification, authentication, authorisation

- Three closely related concepts:

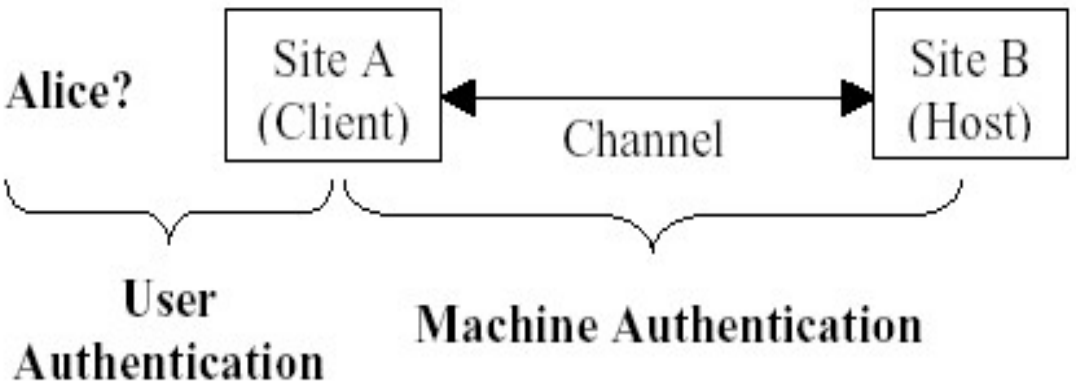
- **Identification:** associating an identity with a subject ("Who are you?")
- **Authentication:** establishing the validity of something, such as an identity ("Are you indeed the entity you claim you are?")
- **Authorisation:** associating rights or capabilities with a subject ("What rights (authority) do you have?")

Authentication

- **Authentication** is the process of verifying the identity of a user, device, or other entity in a computer system, often as a prerequisite to allowing access to resources in the system
- Authentication is used for the purpose of performing **trusted communications** between parties for computing and telecommunications applications.

Authentication

- **Machine-by-machine** authentication
- **Human-by-machine** authentication (user authentication)



(Picture by Lawrence O'Gorman, Proc. of IEEE , Dec 2003)

User vs Machine authentication

- User authentication is much less secure(mathematically) than machine authentication, but a good security guard can prove invaluable.

- Example:
  - encryption algorithm in AES standard uses the keys up to 256 bits long;
  - a 256-bit key is too long for most humans to remember, so in practice this key is stored in a computer file protected by a more memorable password;
  - Here is the problem: human tend to choose an easily guessable password
- In many cases humans are “weakest links” of otherwise secure systems

Authentication techniques

- Authentication techniques can be based on

- Passwords (knowledge-based, “what you know”)
- Tokens (object-based, “what you have”)
- Biometrics (ID-based, “who you are”)

Password-based techniques

- **Password:** a word,a phrase, or personal identification number that is kept as a secret and is used for authentication;
- Very popular and for many purposes adequate techniques, which don’t need a special hardware;
- The main problem:
  - short memorable password can be guessed or searched by by attacker;
  - Long and random password is difficult to remember

Other problems with passwords

- Before one can use a computer system, or a service, one needs a password
- Passwords may be intercepted on its way to the system
- Passwords may be forgotten
- Passwords may be passed to other people
- Passwords can be guessed (or forced)

- Although these problems can be dealt with, there is no absolute solution

Token-based authentication

- **Physical token** (identity token, security token) is physical device which perform or help authentication, such as:
  - Door key
  - Magnetic, or radio-frequency based access cards
  - Bankcard
  - Smartcard
  - Etc

- Authentication is based on what you have

Types of tokens

- This can be a secure storage device containing
- passwords, such as a bankcard, remote garage door opener, or smart card.

- This can also be an active device that yields *one-time passcodes (machine generated passwords)*, either
  - *time-synchronous*
  - or *challenge-response*

Problems with tokens

- The token doesn’t really “prove” who an owner of the token is – anybody who has possession of the token can gain access
- If the token is lost, the owner can not have an access, despite his/her identity has not changed
- Some tokens may be easily copied or forged

Multi-factor authentication techniques

- To increase security In some applications tokens are combined with other means of identification, such a passwords (PINs).
- **Examples**:
  - banking cards as tokens, and PINs as passwords
  - Mobile phone two-factor authentication:
    - password +
    - one time passcode sent by SMS/or Voice (proof of ownership of mobile phone)

New type of attacks – Side Channel

- Cache attack — attacks based on attacker's ability to monitor cache accesses made by the victim in a shared physical system as in virtualized environment or a type of cloud service.
- Timing attack — attacks based on measuring how much time various computations (such as, say, comparing an attacker's given password with the victim's unknown one) take to perform.
- Power-monitoring attack — attacks that make use of varying power consumption by the hardware during computation.

More side channel

- Electromagnetic attack — attacks based on leaked electromagnetic radiation, which can directly provide plaintexts and other information.
- Acoustic cryptanalysis — attacks that exploit sound produced during a computation (rather like power analysis).
- Differential fault analysis — in which secrets are discovered by introducing faults in a computation.
- Data remanence — in which sensitive data are read after supposedly having been deleted.

More information

- https://www.vusec.net/projects/anc/

- ASLR on the Line: Practical Cache Attacks on the MMU
- https://www.vusec.net/download/?t=papers/anc_ndss17.pdf

- Reverse Engineering Hardware Page Table Caches Using Side-Channel Attacks on the MMU
- https://www.vusec.net/download/?t=papers/revanc_ir-cs-77.pdf

Biometrics-based techniques

- A ***biometric*** is a feature measured from the human body that is distinguishing enough to be used for user authentication. (L.O'Gorman)
- Images of a person face, retina, or iris
- Fingerprints
- Footprints and gait (walking style)
- Voice patterns
- Handwriting characteristics
- Smell
- Hand geometry

What are biometrics?

- Security using characteristics
- Characteristics can be varied
- Physiological characteristics
  - Fingerprints, retina scans, vein thickness etc.
- Behavioural characteristics
  - Gait, keystroke dyanmic, signature

Biometrics

- **Advantages**

- Biometrics can’t readily be shared, copied, or stolen
- Biometrics (in normal circumstances) can ‘t be lost
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- **Disadvantages**

- Complicated technology
- Specialized hardware
- High-cost (yet, it has been going down)
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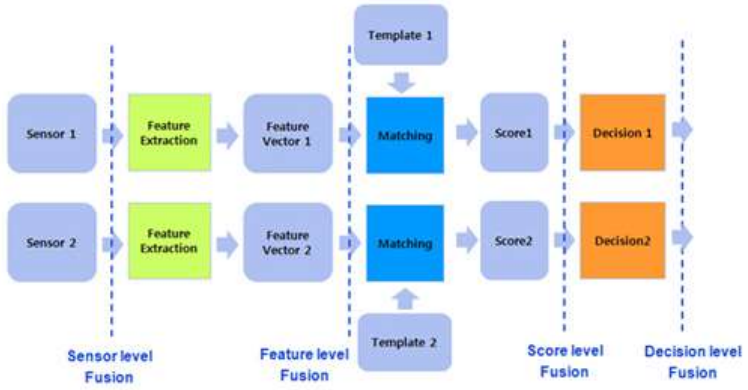
Problems with biometrics

- Certain level of
  - False positives, and
  - False negatives
- To deal with this problem one may combine biometric technique with password- or token-based techniques
- If measuring equipment is not specially protected, the equipment is vulnerable to sabotage and fraud.

Multi-modal Architecture

- Two or more biometrics
- Promotes fusion
  - Different levels of fusion
- Promotes universality
- Very secure technique
- Can minimise impacts of entropy



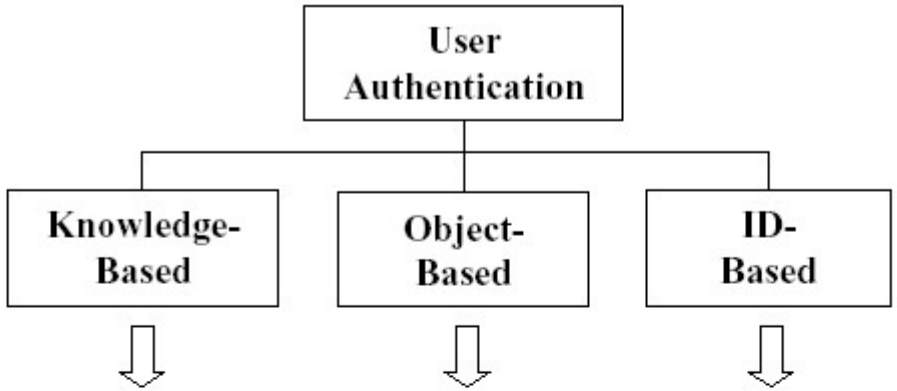
Recent advances: authentication by brainwaves

- John Chuang et al.

"I think, therefore I am: Usability and Security of Authentication Using Brainwaves", a 2013 paper available at

people.ischool.berkeley.edu/~chuang/pubs/usec13.pdf

User authentication



Commonly Referred to as:		Password, Secret	Token	Biometric
Support Authentication by:		Secrecy or obscurity	Possession	Uniqueness and personalization
Security Defense:		Closely kept	Closely held	Forge-resistant
Example	**Traditional:**	Combination lock	Metal key	Driver's license
	Digital:	Computer password	Key-less car entry	Fingerprint
Security Drawback:		Less secret with each use	Insecure if lost	Difficult to replace