Lecture 11

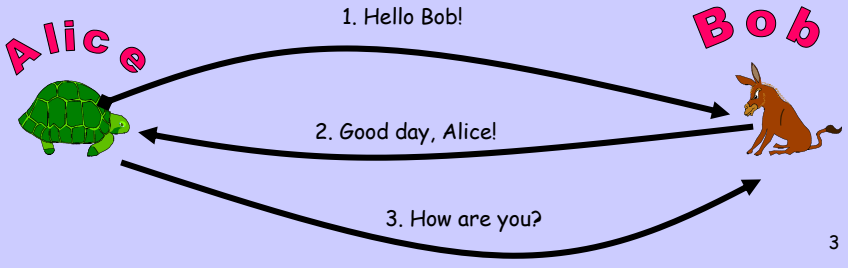
Authentication

Where are we now?

- We "know" a bit of the following:
  - Conventional cryptography
  - Hash functions and MACs
  - Public key cryptography
    - Encryption
    - Signatures
    - Identification (Fiat-Shamir) + Zero Knowledge
- And now what?
  - Protocols
    - Authentication/Identification
    - Key distribution

Secure Protocols

- A ***protocol*** is a set of rules for exchanging *messages* between 2 or more ***entities***
- A protocol has a number of ***rounds*** (>1) and a number of ***messages*** (>1)



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Secure Protocols

- A **message** is a unit of information send from one entity to another as part of a protocol
- A **round** is a basic unit of protocol time:
  1. *Wake up because of:*
     a) *Alarm clock*
     b) *Initial start or*
     c) *Receive message(s) from other(s)*
  2. *Compute something*
  3. *Send message(s) to others*
  4. *Repeat steps 2-3, if needed*
  5. *Wait for message(s) or sleep until alarm clock*

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What's a *secure* protocol?

- When acting honestly, *entities* (participants) achieve the stated **goal** of the protocol, e.g.:
  - A successfully authenticates to B,
  - A and B exchange a fresh session key
- Adversary can defeat this goal
  - e.g., by successfully impersonating A in an authentication protocol with B

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The Entities (2-party setting)

- **Alice** and **Bob**
  - want to mutually authenticate and/or share a key
- **Eve**, the adversary
  - passive or active
- In more complex protocols, **TTP**
  - 3rd party trusted by both Alice and Bob

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Definitions

- **Entity** authentication:
  - corroboration that an entity is the one claimed.
- **Unilateral** authentication:
  - entity authentication: providing one entity with assurance of the other's identity, but not vice versa
- **Mutual** authentication:
  - entity authentication which provides both entities with assurance of each other's identity

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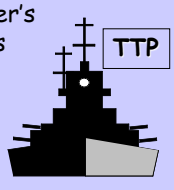
Purpose

Examples:

- Bank transactions, e.g., cash withdrawals
- Remote login
- File access
- P2P transaction

Has user's secrets



Send secret or prove knowing it?

Doesn't

Peer Or Server

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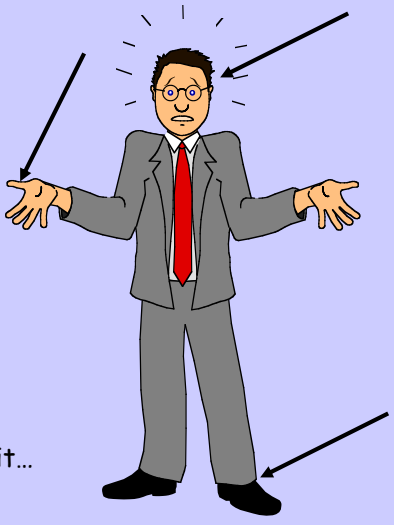
Basis for Authentication

- Something you **know** (a PIN, or password).
- Something you **have**:
  - A secure token, e.g., that generates a one-time password.
  - key embedded in a "secure area" on a computer, in browser software, etc.
  - a smartcard (which may contain keys and can perform cryptographic operations on behalf of a user).
- Something you **are** (a biometric).

Concrete Scenarios

- PIN-, PW-, Biometric-based schemes
  - Kerberos (covered later)
  - SecureID tokens
  - Iris/retina scanners
  - Thumbprint & Handprint
  - Handwriting acceleration & pressure
- Public Key Identification Schemes:
  - Fiat-Shamir, etc.
- Authentication protocols
  - conventional- and public key-based (covered later)

Human Failings



- Humans are notoriously unreliable
- Human memory is very volatile storage

What a human can remember:

- PIN (no more than 6-8 digits)
- Password (a word or a short phrase)
- Can a human do single-digit sums? Forget it…

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Biometrics

- Accuracy:
  - False acceptance rate.
  - False rejection rate.
- Retinal scanner, fingerprint reader, handprint reader, voiceprint, keystroke timing, signature (shape or pressure), etc.

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Fingerprints

- Vulnerability:
  - Dummy fingers and dead fingers
- Suitability and stability:
  - Not for people with high probability of damaged fingerprints (e.g., exema)
  - Not for kids who are still growing

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Voice Recognition

- Single phrase:
  - Can use tape recorder to fake
- Stability:
  - Background noise
  - Colds, vocal cord damage/strain, laughing gas ☺
  - Use with public phones

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Keystroke Timing

- Each person has a distinct typing timing and style
  - Hand/finger movements
- Suitability:
  - Best done for "local" authentication
    - Avoid network traffic delay

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(non-digital) Signatures

- Machines can't match human experts in recognizing shapes of signatures
- Add information on acceleration and/or pressure
  - Signing on a special electronic tablet

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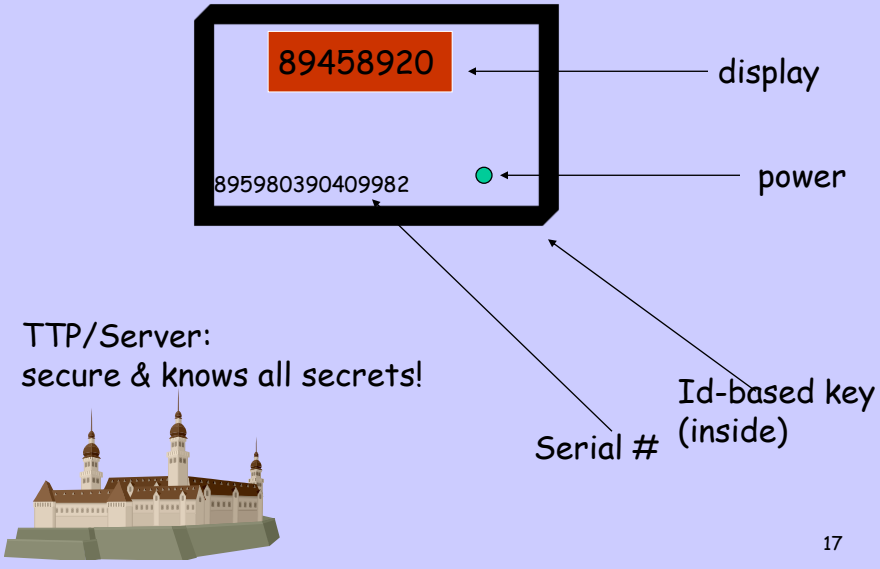
SecureID


89458920
display
power
895980390409982
TTP/Server:
secure & knows all secrets!
Id-based key
(inside)
Serial #

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