Authentication

- Verifying an identity
- People authentication
- Host authentication

Authentication vulnerabilities

- eavesdropping
- password database
- replay
- online/ offline guessing
- session maybe hijacked after authentication!

Authenticating people

Computer verifying who you are

- **what you know : password**
- **what you have : physical keys**
- **what you are : fingerprint *etc*.**

Best : at least two of the above

Authentication protocols

- **one-way**
  - **password**
  - **challenge/response**
  - **public-key**
- **two-way (mutual authentication)**
  - **trusted intermediary (Kerberos)**
  - **public-key**

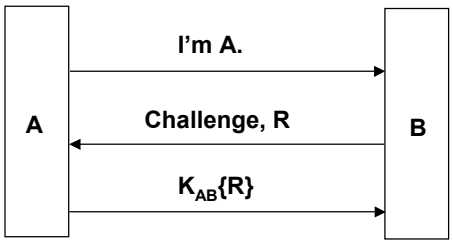
Authentication Systems

- Password-based authentication
  - Off-line vs On-line Password guessing
  - Storing user passwords
- Address-based authentication
  - etc/hosts.equiv, .rhosts (UNIX)
- Trusted Intermediaries
  - KDC (Key Distribution Center)
  - CA (Certification Authorities)
  - Multiple Trusted Intermediaries

Password authentication

- easy and popular
- Assuming
  - No eavesdropping
  - No bad guys
- Replacing clear password with cryptographic challenge/response

Shared secret(I)

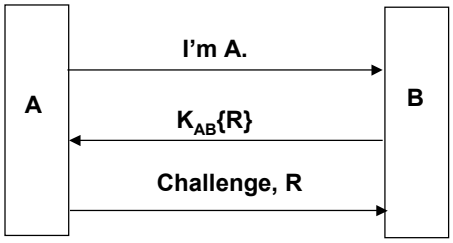


K_{AB} : Shared secret key between A and B.

Risks

- Not mutual authentication
- Off-line password guessing attack
- Some who reads B's database can later impersonate A.

Shared secret(II)



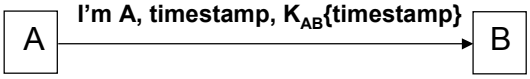
K_{AB} : Shared secret key between A and B.

Risks

If R is recognizable quantity,
password guessing attack is possible

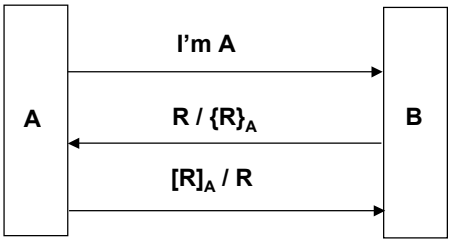
Shared secret(III)

B authenticates A based on synchronized clocks and a shared secret



B authenticates A based on high resolution time and a shared secret

Public Key



B authenticates A based on her public key signature.
B authenticates A if she can decrypt a message encrypted with her public key
$[R]_A$: A signs R with private key.

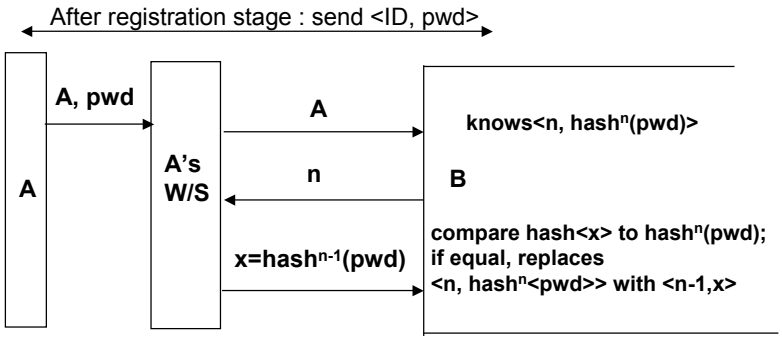
Risk : man-in-the middle attack

Lamport's hash(I)

- **A remembers passwd**
- **B has DB for eash user**
  - **username**
  - **n, an integer which decrements each time B authenticates the user. (Ex.) n=1000**
  - **$hash^n$(pwd) i.e., hash(hash..hash(pwd)…))**
- **Risks**
  - **password access in system DB**
  - **eavesdropping communication line**
  - **revelation of password by careless user**

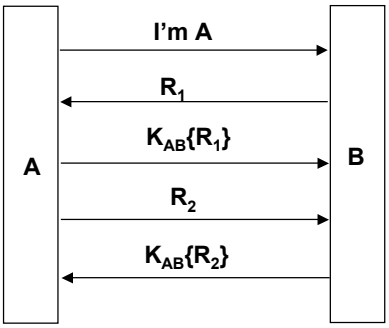
* L. Lamport, "Password Authentication with Insecure Channel",Comm. of the ACM, pp. 770-772, No.11, Vol.24, Nov., 1981

Lamport's hash(II)



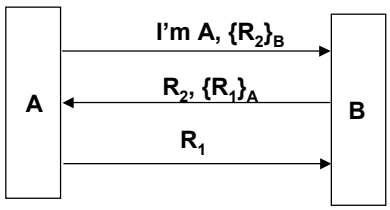
- Solving Encryption and integrity together : use password||salt instead of password only -> advance to S/KEY
- No mutual authentication

Mutual authentication(I)



- Mutual authentication based on shared secret, K_{AB}
- Risk of simplified 3-pass version (Protocol 9-9)
  - Man-in-the-middle attack (reflection attack)
  - password guessing

Mutual authentication(II)



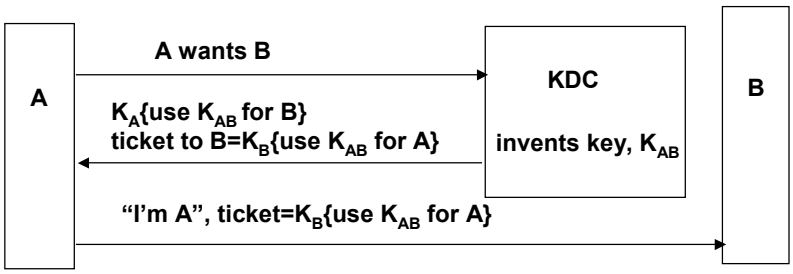
Mutual authentication with public keys
assuming that A and B know each other's public keys.

Mediated Authentication(I)

KDC operation (in principle)

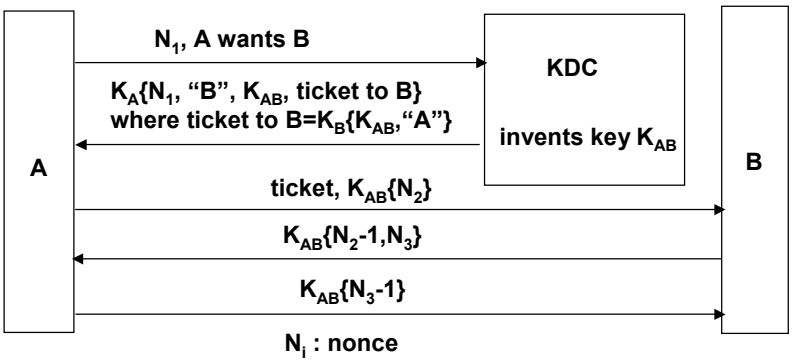
* anyone can impersonate A

Mediated Authentication(II)



KDC operation (in practice)

Needham-Schroeder



N_i : nonce

R.G.Needham and M.D. Schroeder, "Using encryption for authentication in large networks of computers", Comm. of the ACM, pp.993-999, Vol.21, No.12,Dec. 1978

Nonce

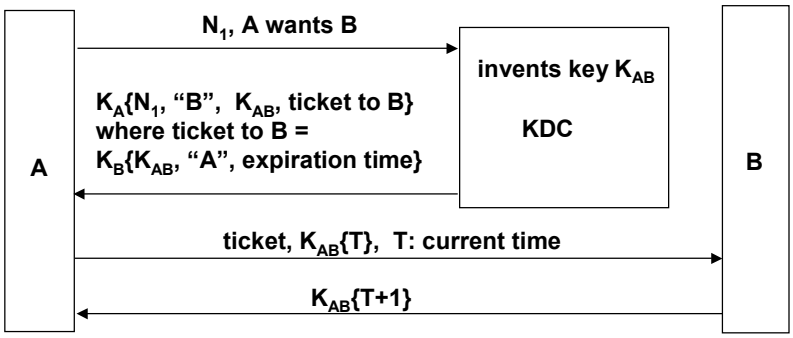
a number use only once

- timestamp
  - synchronized clocks
  - guessable
  - set clock back
- sequence number
  - guessable
  - requires state
- large random number

Others

- Extension of Needham-Schroeder
- Otway-Rees
- Bellovin-Meritt
- Kerberos

Kerberos



Performance of protocol

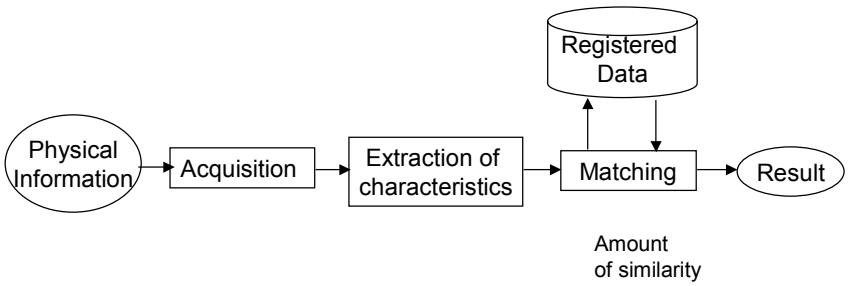
- No. of cryptographic operations using a private key
- No. of cryptographic operations using a public key
- No. of bytes encrypted or decrypted using a secret key
- No. of bytes to be cryptographically hashed
- No. of message transmitted

Bio Identification

(Def) B y Anil Jain (Michigan Univ) "*Biometrics deals with identification of individuals based on their biological or behavioral characteristics*"
By Biometric Consortium "*Automatically recognizing a person using distinguishing*"

Basic Characteristics
(1) Universality : every person should have the characteristics
(2) Uniqueness : no two person should be the same in terms of characteristics
(3) Permanence : the characteristics should be invariant with time
(4) Collectability : the characteristics can be measured quantitatively

Basic Configuration



Biometric Information

•Fingerprint
•Face
•Iris
•Eye
•Retinal
•Hand geometry
•Ear
•DNA

•Voice pattern
•Dynamic signature
•Key stroke
•Walking pattern

Comparison

Method	Information (Byte)	Processing time(sec.)	Prob. (%)*	Research grou[p
Finger print	200	2.5	p1=99.63 p2=99.97	FBI
Hand	4	2~3	p1=99.72	US Air force
Signature	50	2~3	p1=99 p2=98.5	U. of Nagoya NTT
Voice	600	12	p1=97 p2=98	IBM,NTT, Bell Lab
Face	100	2~3	p1=86 p2=100	NTT, Bell Lab
Iris	70	3	p1=87.6 p2=100	Identify

* p1: prob. of accepting correct person, p2: prob. of rejecting wrong person