

# Overview of Authentication Systems

Raj Jain  
Washington University in Saint Louis  
Saint Louis, MO 63130  
Jain@cse.wustl.edu

Audio/Video recordings of this lecture are available at:  
<http://www.cse.wustl.edu/~jain/cse571-07/>



- Passwords
- Address based authentication
- Key Distribution Center (KDC)
- Certification Authorities (CAs)
- Multiple Trust Domains
- Session Keys
- Delegation

## Passwords

- ❑ Do not store passwords in clear. Store hashes.
  - ⇒ Subject to offline attack
- ❑ Encrypt the hash storage.
  - ⇒ Where do you keep the master key?
- ❑ Do not transmit passwords in clear.
- ❑ Use password as a key to encrypt a challenge.
  - ⇒ Cryptographic Authentication

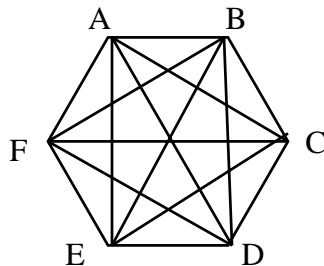
## Address based authentication

- ❑ /etc/hosts.equiv file in UNIX.
- ❑ John Smith can do on B whatever he is allowed to do on A.
  - ⇒ Users need to have the same name on all machines.
- ❑ Per user .rhosts files.
  - Lists <address, remote account name>
  - that can access this account.
- ❑ Issue: Attacker can gain access to all machines
- ❑ Attacker can change IP addresses of machines and can access remote resources of all users on that machine.
- ❑ Attacker can use source route <A, X, D> to send messages to D (from A).

## Machine vs. Person Authentication

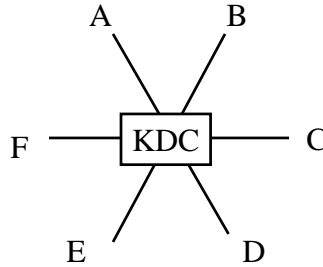
- ❑ Machines can store long secret keys.
- ❑ Person's password can be used to decrypt a long secret key or private key.

## Secret Keys for an N-System Network



- ❑ n system need  $n(n-1)/2$  pairs of secret keys
- ❑ Each system remembers  $n-1$  keys.
- ❑ If a new system comes in n new key are generated.
- ❑ If a system leaves,  $n-1$  keys are removed.

## Key Distribution Center (KDC)



- ❑ Each node is configured with KDC's key
- ❑ KDC has all the keys.
- ❑ KDC sends a key encrypted with A's key and B's key to A.
- ❑ Issues:
  - If KDC is compromised, all systems are compromised.
  - KDC is single point of failure or performance bottleneck.
  - KDC has to be on-line all the time.

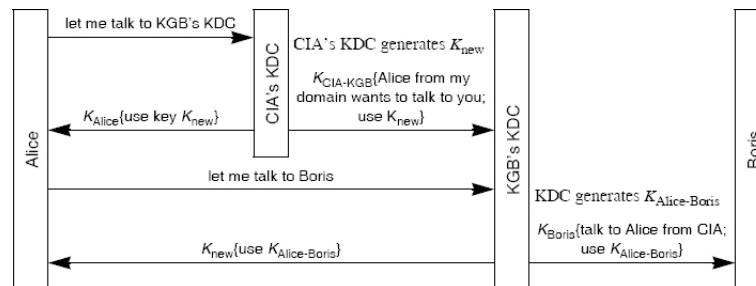
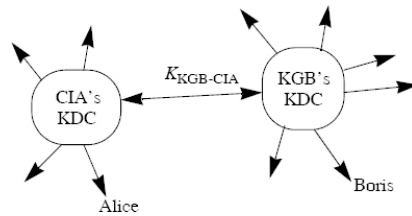
## Certification Authorities (CAs)

- ❑ Unsigned public keys can be tampered.
- ❑ Public Keys are signed by CAs  $\Rightarrow$  Certificates.
- ❑ Each system is configured with CA's public key.
- ❑ CA's don't have to be on-line.
- ❑ A compromised CA cannot decrypt conversations.

## Certificate Revocations Lists (CRL)

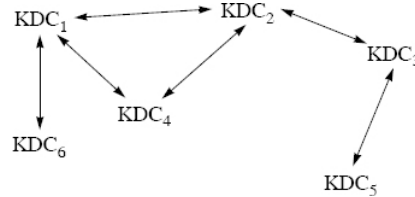
- ❑ The lists are published regularly.
- ❑ Certificates are checked in a recent CRL.
- ❑ Certificate contains user's name, public key, expiration time, a serial number, and CA's signature on the content.

## KDCs in Multiple Trust Domains

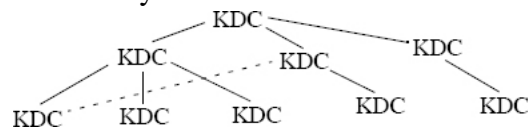


## KDCs in Multiple Trust Domains (Cont)

- Some pairs of KDCs have a secret key



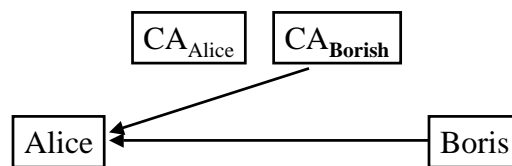
- Issue: Every pair of KDC needs a shared key  
⇒ KDC hierarchy



- Issue: Every pair of KDC needs a shared key  
⇒ KDC hierarchy

## CA's in Multiple Domains

- Each CA has a certificate from the other.
- Alice with Boris's certificate and Boris's CA's certificate issued by Alice's CA can authenticate Boris



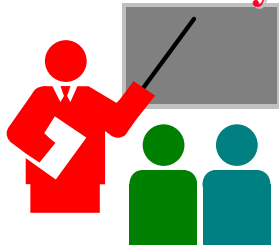
## Session Keys

- Public key is used to exchange a secret key.
- Each session should start with a new secret key.

## Delegation

- Authentication forwarding
- A signed message with time limit and details of privileges

## Summary



- ❑ Passwords should not be stored or transmitted in clear  
⇒ Use to generate keys
- ❑ Address based authentication is not safe.
- ❑ Key Distribution Center (KDC): Single point of failure
- ❑ Certification Authorities (CAs) sign public keys.
- ❑ Multiple Trust Domains: Hierarchy of KDCs or CAs

## Homework 9

- ❑ Read Chapter 9 of the textbook
- ❑ Submit answers to Exercise 9.3
- ❑ Extend the scenario in Section 9.7.4.1 Multiple KDC Domains to a chain of three KDCs. In other words assume that Alice wants to talk to Boris through a chain of three KDCs (Alice's KDC, A KDC that has shared keys with both Alice's KDC and Boris's KDC and finally, Boris's KDC). Give the sequence of events necessary to establish communication.