Overview of Authentication Systems

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Audio/Video recordings of this lecture are available at:
http://www.cse.wustl.edu/~jain/cse571-09/
Overview

- 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 ⇒ 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

- CIA’s KDC
  - $K_{KGB-CIA}$
- KGB’s KDC
  - $K_{KGB-CIA}$
  - $K_{CIA-KGB}$ (Alice from my domain wants to talk to you; use $K_{new}$)
  - $K_{Alice-Boris}$ (talk to Alice from CIA; use $K_{Alice-Boris}$)

Alice

- $K_{Alice}$ (use key $K_{new}$)
- let me talk to KGB’s KDC

CIA’s KDC

- CIA’s KDC generates $K_{new}$
- let me talk to Boris

KGB’s KDC

- KDC generates $K_{Alice-Boris}$
- $K_{Boris}$ (talk to Alice from CIA; use $K_{Alice-Boris}$)

Boris
KDCs in Multiple Trust Domains (Cont)

- Some pairs of KDCs have a secret key

- Issue: Every pair of KDC needs a shared key
  \[\Rightarrow\text{KDC hierarchy}\]

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  \[\Rightarrow\text{KDC hierarchy}\]
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
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.