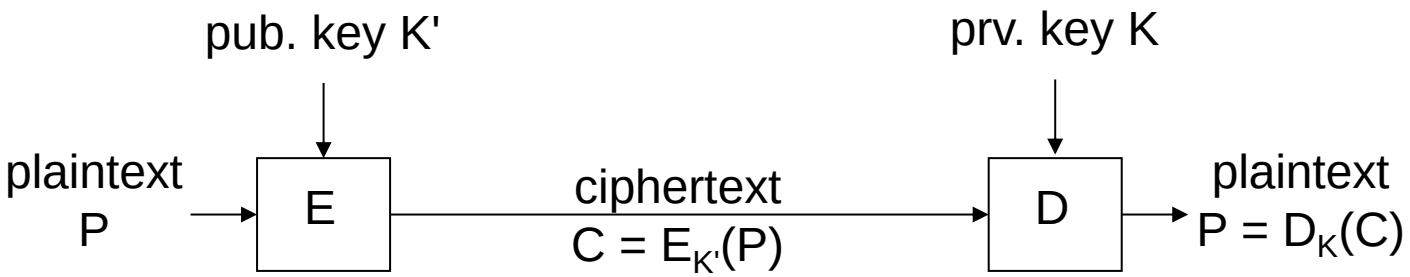
Key Distribution

BİL 448/548

Internet Security Protocols

Ali Aydın Selçuk

Public Key Cryptography



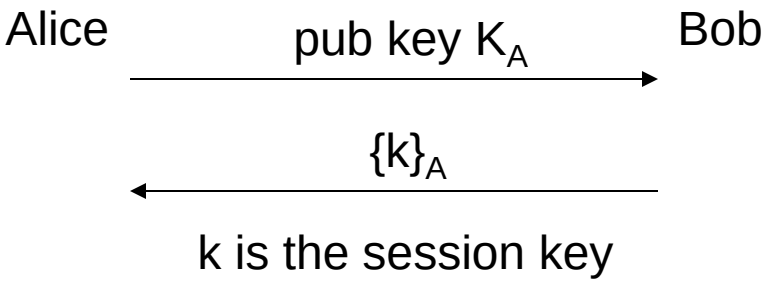
- Simple PKC solves key dist. problem against passive attackers (i.e., an attacker that just eavesdrops).
- Active attackers can send a fake public key & become a “man in the middle” (MitM).

Notation:

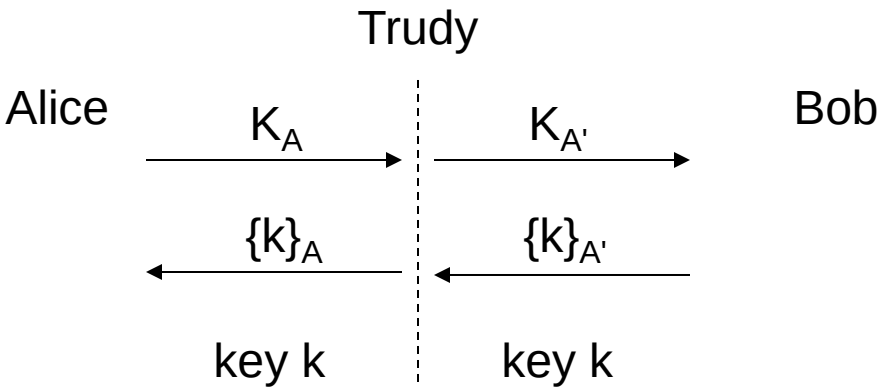
- $\{M\}_X$: message M enc. with the pub. key of X
- $[M]_X$: message M signed with the prv. key of X

MitM Attack against RSA

Normal op:

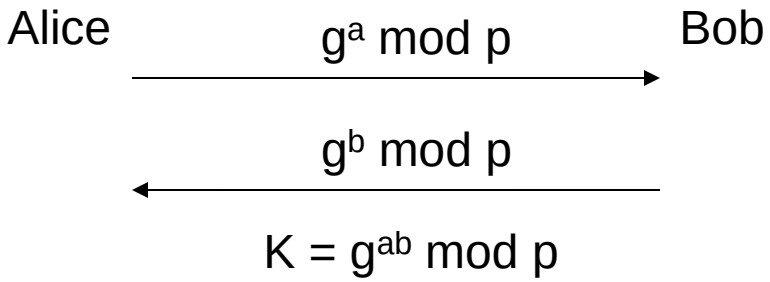


MitM attack:

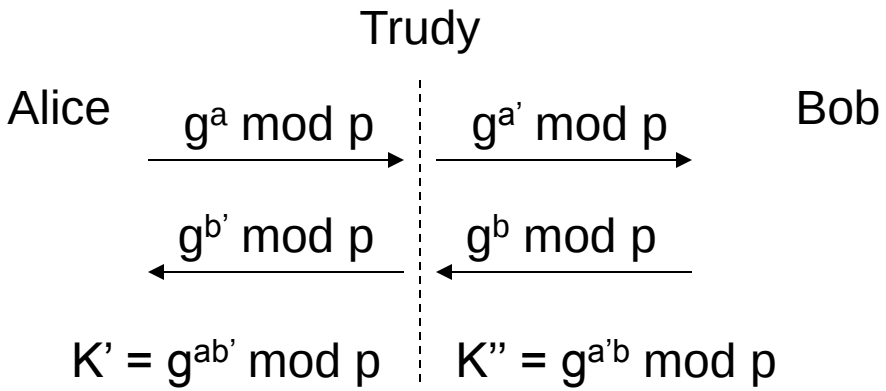


MitM Attack against DH

Normal op:



MitM attack:



Trusted Third Parties

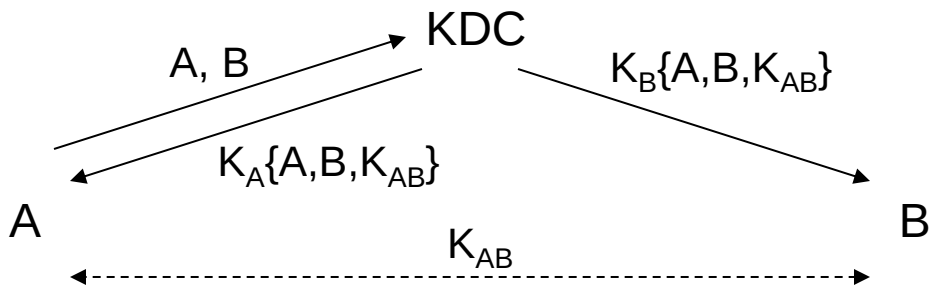
- Solution against active attackers: “Trusted Third Parties” (TTPs)
- Symmetric key solution: KDC
  - Everyone registers with the KDC, shares a secret key.
  - When A & B want to communicate, they contact the KDC & obtain a session key.
- Public key solution: CA
  - Everyone registers with the CA, obtains a “certificate” for his/her public key.
  - Certificate: A document signed by the CA, including the ID and the public key of the subject.
  - People obtain each other’s certificates thru a repository, a webpage, or at the beginning of the protocol,
  - and use the certified public keys in the protocols.

KDC vs. CA

- KDC
  - faster (being based on symmetric keys)
  - has to be online
- CA
  - doesn’t have to be online
  - if crashes, doesn’t disable the network
  - much simpler
  - scales better
  - certificates are not disclosure-sensitive
  - a compromised CA can’t decrypt conversations
- KDCs are preferred for LANs, CAs for WANs (e.g., the Internet).

Key Distribution with KDC

A simple protocol:



K_A, K_B: Long-term secret keys of Alice, Bob.
$K_A\{m\}$: Encryption of m with K_A.

Better ways of doing it:

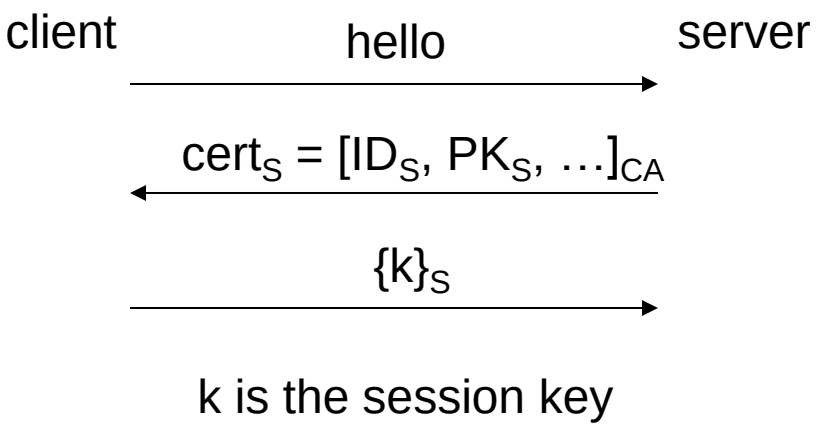
- Needham-Schroeder protocol
- “Kerberos”

Key Distribution with CA

A simple protocol:

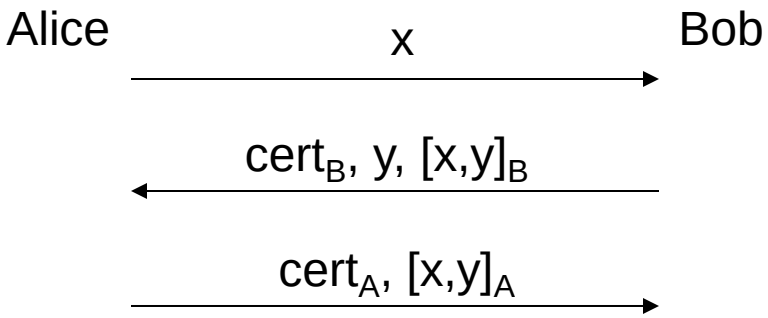
- certificates are obtained in advance
- session key is transported with public key encryption

~ SSL key exchange:



DH with Certificates

- STS Protocol: Authenticated DH protocol; basis for many real-life app's.
- Certified PKs are used for signing the public DH parameters. A slightly simplified version:



where $x = g^a \bmod p$, $y = g^b \bmod p$, $k = g^{ab} \bmod p$.

- Feature: "Perfect forward secrecy"