Kerberos

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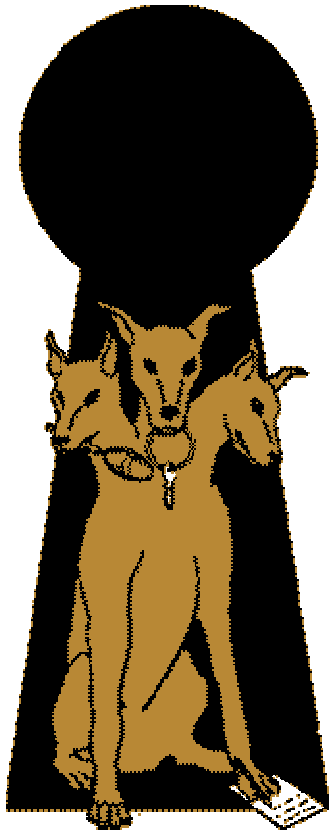
Kerberos

- Kerberos is a network authentication protocol. Requirements:
  - Security
  - Reliability
  - Transparency
  - Scalability
- Cryptographic authentication for distributed systems
- Based on symmetric-key authentication with KDC
- Developed at MIT: two versions: Version 4 and Version 5 (specified as RFC1510)
  - http://web.mit.edu/kerberos/www

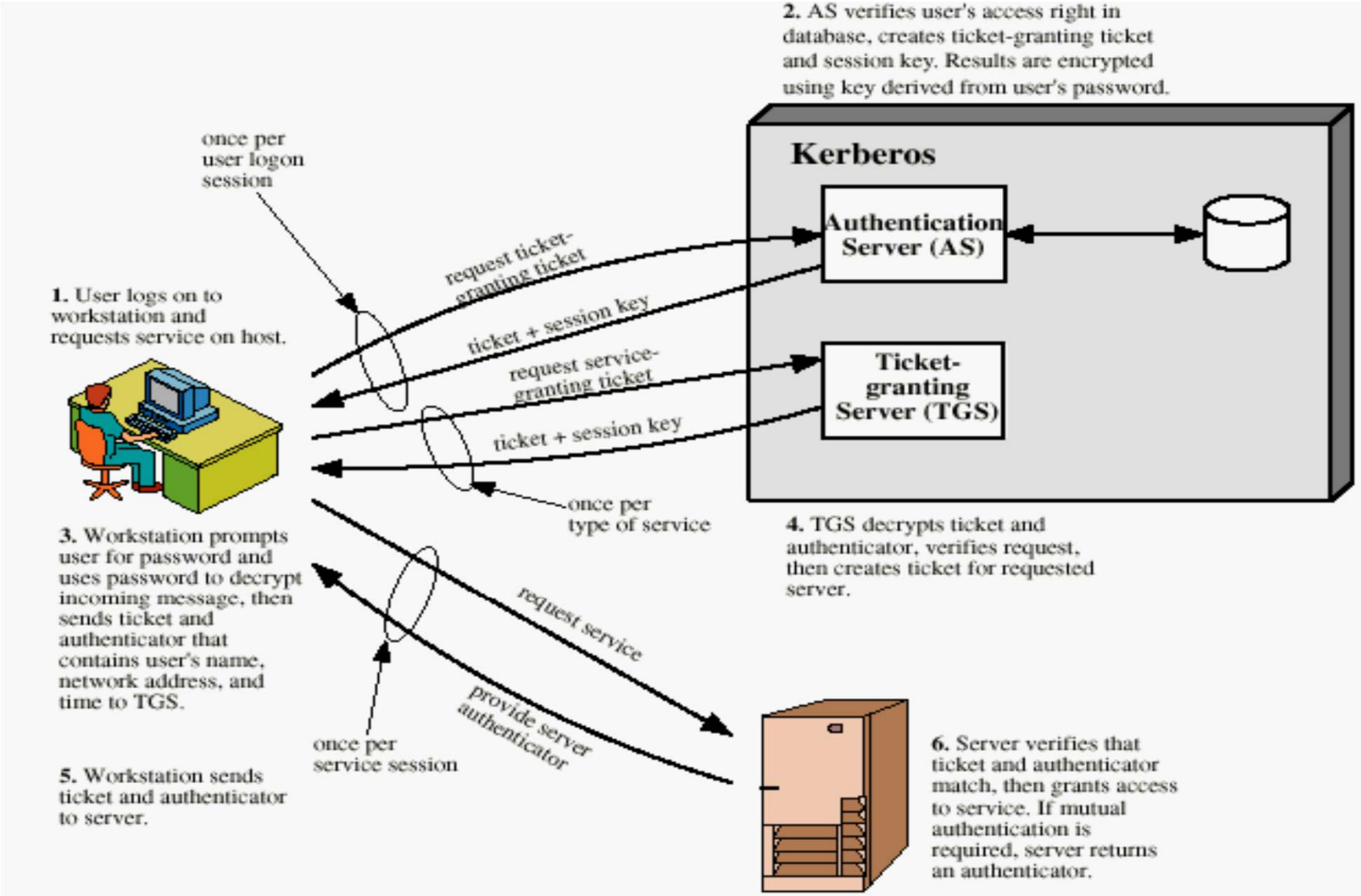


Kerberos

- Advantages:
  - secure authentication
  - single sign-on
  - secure data flow

- Applications benefiting from Kerberos:
  - telnet, ftp
  - BSD rtools (rlogin, rsh, rcp)
  - NFS
  - Others (pine, eudora, etc.)

Overview of Kerberos



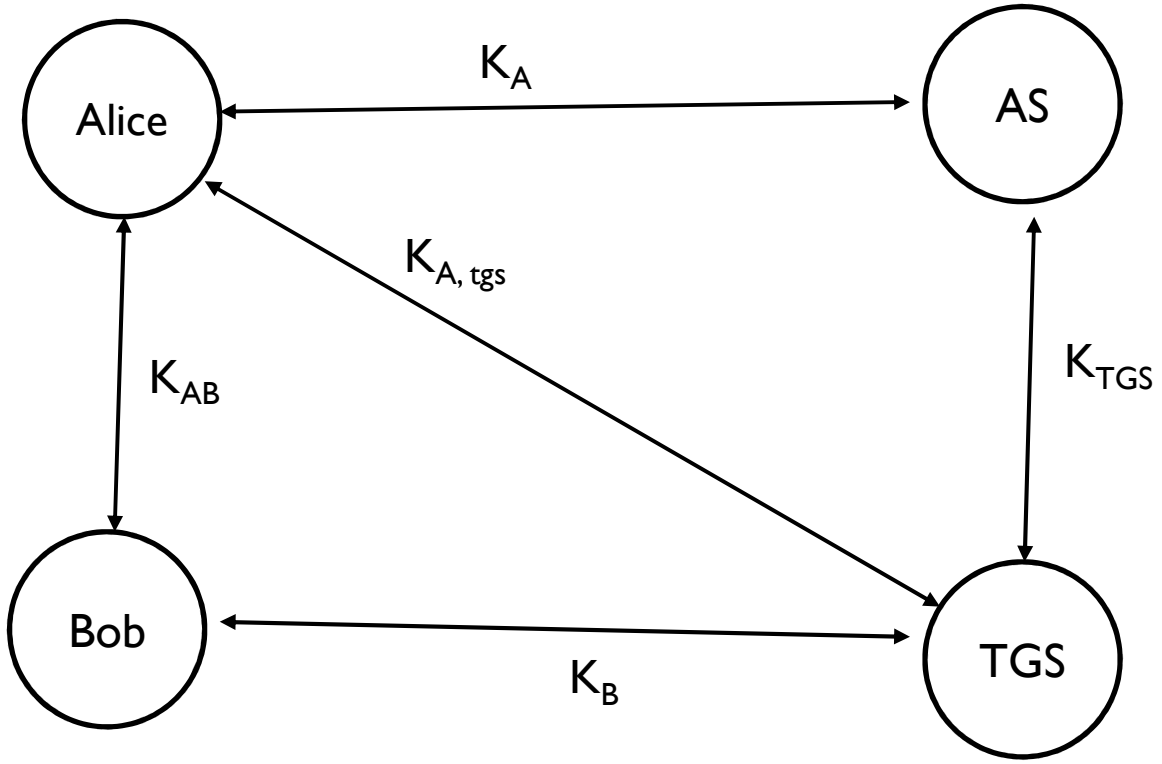
Protocol Design Motivations

- AS knows passwords for all clients
- AS distributes keys Client-TGS
- TGS distributes keys Client-Server
- Lifetime validity for tickets, include a time validity
- Freshness of messages to prevent replay attacks: use sequence numbers, timestamp or random numbers

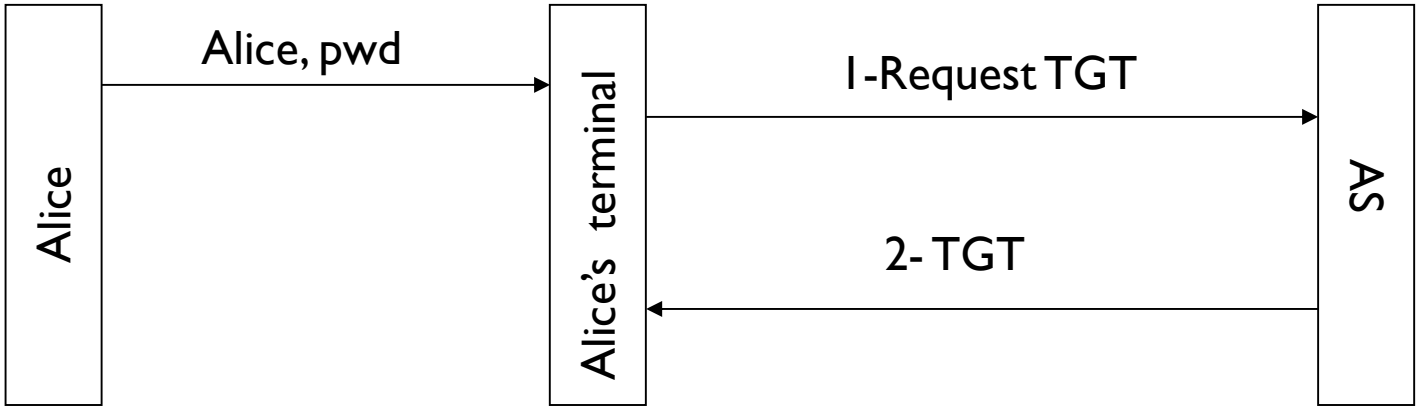
Kerberos Keys

- Each principal shares a "master key" with KDC
  - K_A: Alice's master key. Used for initial authentication
- K_{TGS}: The key known by AS and the TGS.
- $K_{A, tgs}$: The key shared between the TGS and Alice
- Ticket Granting Tickets (TGT):
  - issued to Alice by AS after login
  - encrypted with K_{TGS}
  - used to obtain session key $K_{A,tgs}$

Key Relation in Kerberos



Logging into the Network



1- Alice $\rightarrow$ AS: $ID_A \,||\, ID_{tgs} \,||\, TS_1$

2- AS $\rightarrow$ Alice: $E_{K_A}[K_{A,tgs} || ID_{tgs} || TS_2 || Lifetime_2 || Ticket_{tgs}]$

$Ticket_{tgs} = E_{K_{tgs}}[K_{A,tgs} || ID_A || AD_A || ID_{tgs} || TS_2 || Lifetime_2]$

ID_{tgs} denotes the identifier of the Ticket Granting Server (TGS)

$K_{A,tgs}$ is the key shared by the TGS and Alice

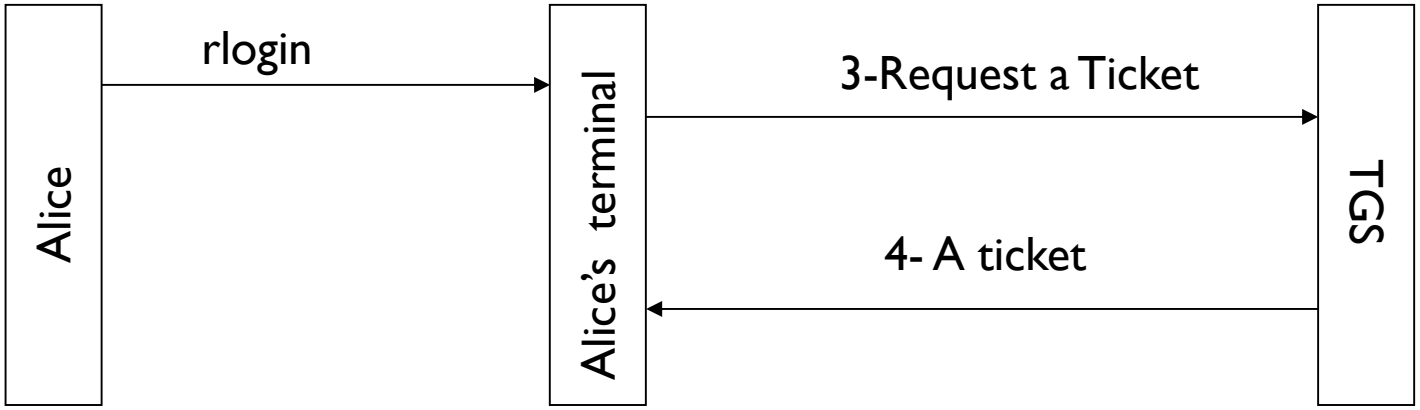
K_{tgs} key known by AS and the TGS

Logging into the Network

The workstation,

- converts Alice's password into a DES key
- when receives the credentials from the server, decrypts them using this DES key
- if decrypts correctly, authentication is successful
- discards Alice's master key; retains the TGT.
- TGT contains all the information TGS needs about Alice's session; hence TGS can work without remembering any volatile data.

Obtaining a Ticket from TGS



3- Alice → TGS: $ID_B \;||\; Ticket_{tgs} \;||\; Authenticator_A$

4- TGS → Alice: $E_{K_{A,tgs}} [\, K_{AB} \;||\; ID_B \;||\; TS_4 \;||\; Ticket_B \,]$

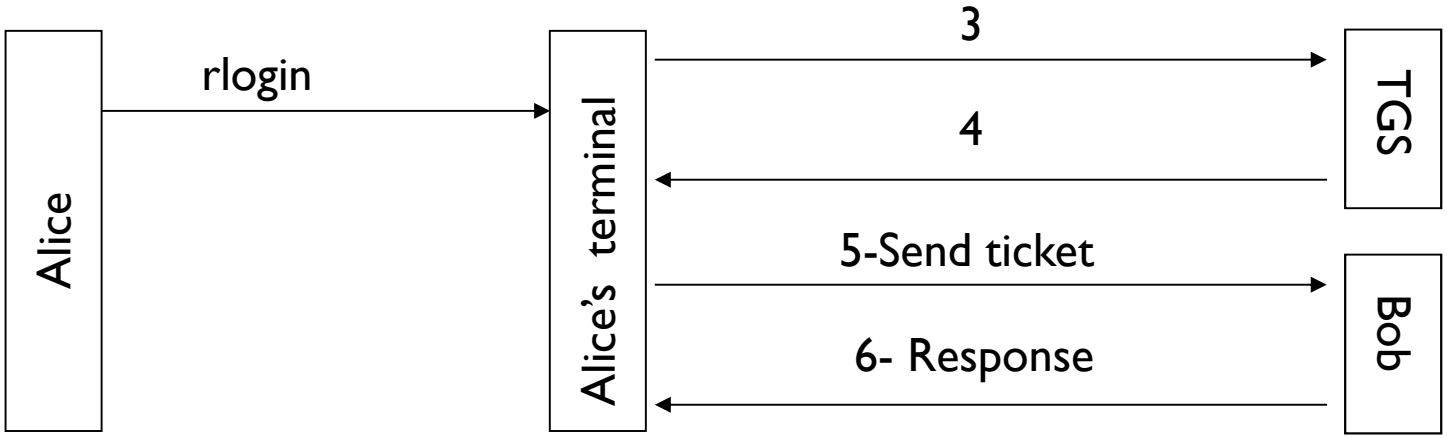
$Authenticator_A = E_{K_{A,\,tgs}} [\, ID_A \;||\; AD_A \;||\; TS_3 \,]$

$Ticket_{tgs} = E_{K_{tgs}} [K_{A,tgs} \;||\; ID_A \;||\; AD_A \;||\; ID_{tgs} \;||\; TS_2 \;||\; Lifetime_2]$

$Ticket_B = E_{K_B} [\, K_{AB} \;||\; ID_A \;||\; AD_A \;||\; ID_B \;||\; TS_4 \;||\; Lifetime_4 \,]$

K_B is the key shared by the TGS and server B

Client-Server Authentication Exchange



5- Alice → Bob: $Ticket_B \,||\, Authenticator_A$

6- Bob → Alice: $E_{K_{AB}} [TS_5 + 1]$

$Ticket_B = E_{K_B} [K_{AB} \,||\, ID_A \,||\, AD_A \,||\, ID_B \,||\, TS_4 \,||\, Lifetime_4]$

$Authenticator_A = E_{K_{AB}} [ID_A \,||\, AD_A \,||\, TS_5]$