Kerberos V4

Slide 1

Kerberos

- network authentication using Needham-Schroeder
- insecure network: listen, modify
- secret key
- *login session*: from login to logout
- Version 5: more complex, not just TCP/IP, greater functionality
- KDC + libraries (e.g., GSS API) ➠
  - telnet
  - rlogin, rcp, rsh, . . .
  - NFS

Slide 2

Tickets and Ticket-Granting Tickets

- users, resources: *principal* ➠ share masterkey with KDC
- KDC sends to A: $K_A\{K_{AB}\}$; ticket: $K_B\{K_{AB}, \text{Alice}\}$
- tickets expire in 21 hours
- thus: knowledge of K_{AB} proves identity + use for encryption
- *credentials:* K_{AB} and ticket
- password generates master key
- workstation asks for session key S_A (time-limited)
- *ticket-granting ticket* (TGT): $K_{\text{KDC}}\{S_A, \ldots\}$
- workstation forgets master key, uses TGT
- KDC: authentication server (AS) + ticket-granting server (TGS)

Slide 3

Configuration

- *KDC master key* encrypts KDC database, TGT
- DES-based
- principals need to remember pw (humans) or key (machines)

Slide 4

Logging In

- send username
- get credentials
- ask for password (minimum residency!)
- but: can do password-guessing by sending user name
- TGT ➠ state-less server (crashes, replication)

Slide 5

Communicating with Remote Node

`rlogin Bob`:

- authenticator = timestamp (Δ N-S)
- limit replay: allow skew of 5 min. ➠ time synchronization
- construct ticket to Bob

Slide 6

Replicated KDCs

- KDC: single PoF (in addition to NFS…)
- ➠ replication with master copy
- performance scaling: service location protocol?
- exchange master database in clear, protected by secure hash

Slide 7

Realms

- can't have single (replicated) KDC: need to limit trust
- limit compromise
- principal: name (service), instance (host, human role), realm
- each realm carries others as principals
- no chaining of realms: prevent rogue KDC impersonating everybody
- V4: DNS names

Slide 8

Key Version Numbers

- allow unsynchronized changes of master keys
- remember several versions of past keys
- replication ➠ new passwords may fail

Slide 9

Privacy and Integrity

- encrypt and protect (e.g., CBC with residue ➠ two passes)
- plain-text cipher block chaining (PCBC)
- CBC: $c_{n+1} = E(m_{n+1} \oplus c_n)$
- PCBC: $c_{n+1} = E(m_{n+1} \oplus m_n \oplus c_n)$
- corrupt c_i: all data $> i$ will be changed
- put recognizable string at end
- but: can swap two adjacent c_i's

Slide 10

Integrity

- DES CBC residue “too expensive”
- algorithm not documented (but not broken)
- hash over session key and message; transmit message, checksum
- may allow to get session key

Slide 11

Network Layer Addresses

- TGT, ticket contains Alice’s network layer address
- Bob checks connection
- ➠ Alice can’t hand off ticket to Ted
- ➠ can’t steal session key and use it from elsewhere
- ➠ prevent eavesdropping/replay within 5 min. window
- does not work with firewalls, mobile nodes
- does not support delegation
- addresses easily spoofable

Slide 12

Message Formats

timestamp: seconds since 1970-1-1; expires in 2038

D bit: direction to avoid reflection attack

lifetime: units of 5 minutes (21 hours)

5 ms timestamp: or sequence number

session key: 8 byte DES key

B bit: byteorder (little/big-endian)

Slide 13

Kerberos vs. NT4.0

Kerberos	NT 4.0
KDC	PDC (primary domain controller)
replicated KDC	BDC (backup domain controller)
realm	domain (= 1 PDC, $\geq$ 1 BDC)
interrealm auth.	trust between domains

Slide 14