Chapter 16 – IP Security

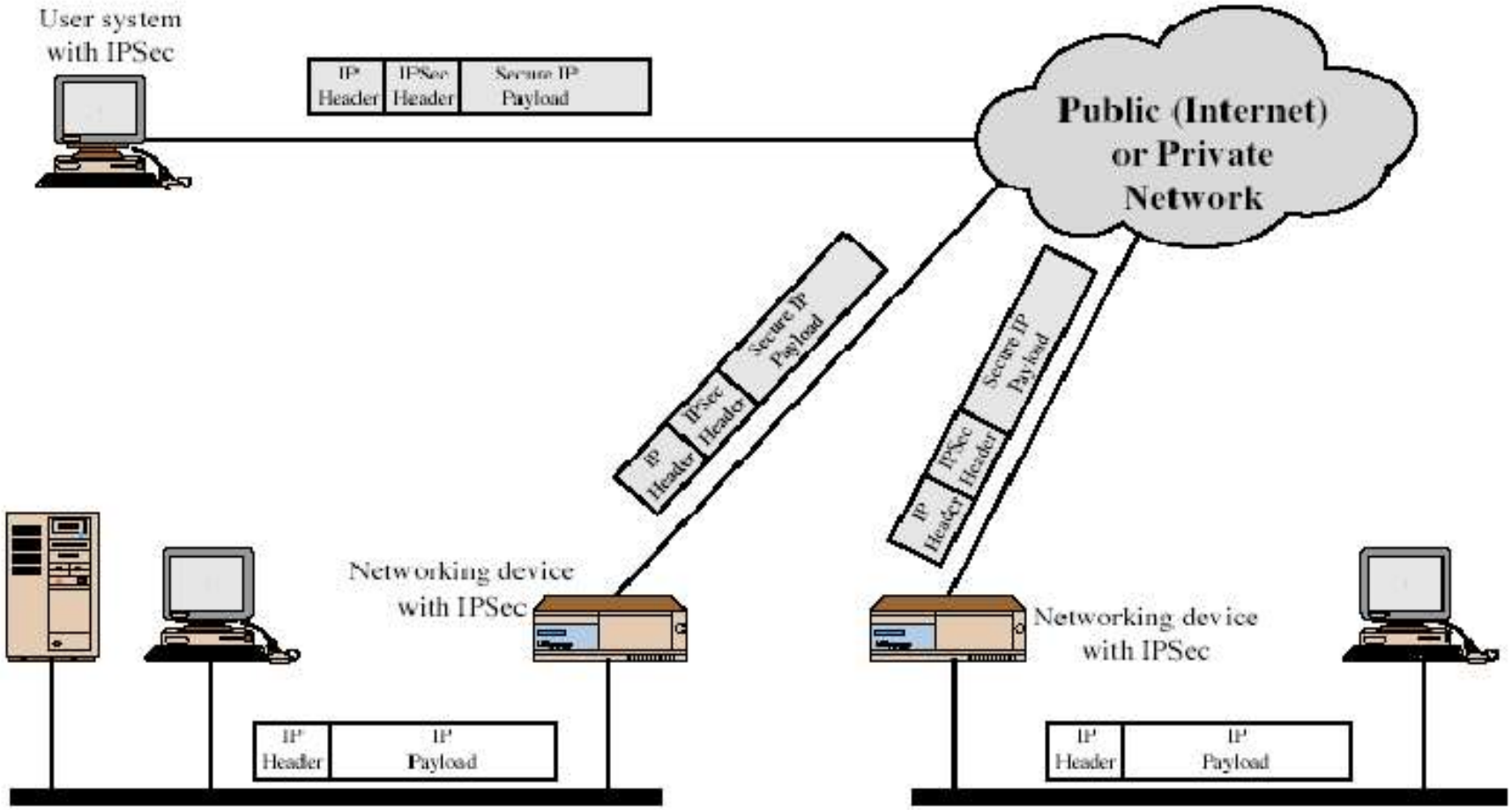
If a secret piece of news is divulged by a spy before the time is ripe, he must be put to death, together with the man to whom the secret was told.

—*The Art of War*, Sun Tzu

IP Security

- have considered some application specific security mechanisms
  - eg. S/MIME, PGP, Kerberos, SSL/HTTPS
- however there are security concerns that cut across protocol layers
  - would like security implemented by the network for all applications

IPSec Uses


User system with IPSec
IP Header
IPSec Header
Secure IP Payload
Public (Internet) or Private Network
Networking device with IPSec
Networking device with IPSec
IP Header
IP Payload

IPSec

- general IP Security mechanisms
- provides
  - authentication
  - confidentiality
  - key management
- applicable to use over LANs, across public & private WANs, & for the Internet

Benefits of IPSec

- in a firewall/router provides strong security to all traffic crossing the perimeter
- is resistant to bypass
- is below transport layer, hence transparent to applications
- can be transparent to end users

IP Security Architecture

- specification is quite complex
- defined in numerous RFC's
  - incl. RFC 2401/2402/2406/2408
  - many others, grouped by category
- mandatory in IPv6, optional in IPv4

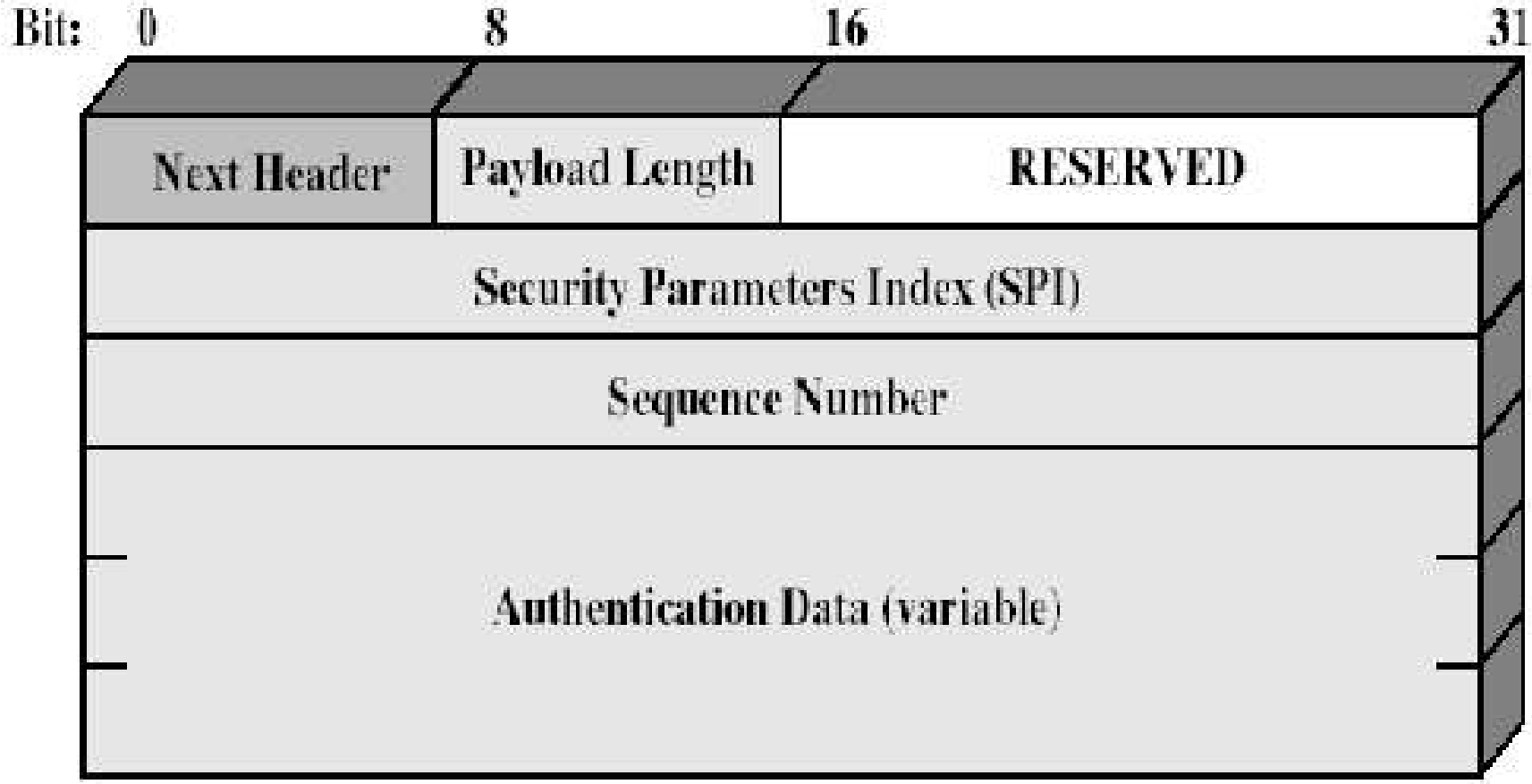
IPSec Protocols

- Authentication Header (AH)
  - Authentication
- Encapsulating Security Payload (ESP)
  - Confidentiality only
  - OR both

Security Associations

- a one-way relationship between sender & receiver that affords security for traffic flow
- defined by 3 parameters:
  - Security Parameters Index (SPI)
  - IP Destination Address
  - Security Protocol Identifier (AH or ESP?)
- has a number of other parameters
  - seq no, AH & EH info, lifetime etc
- have a database of Security Associations

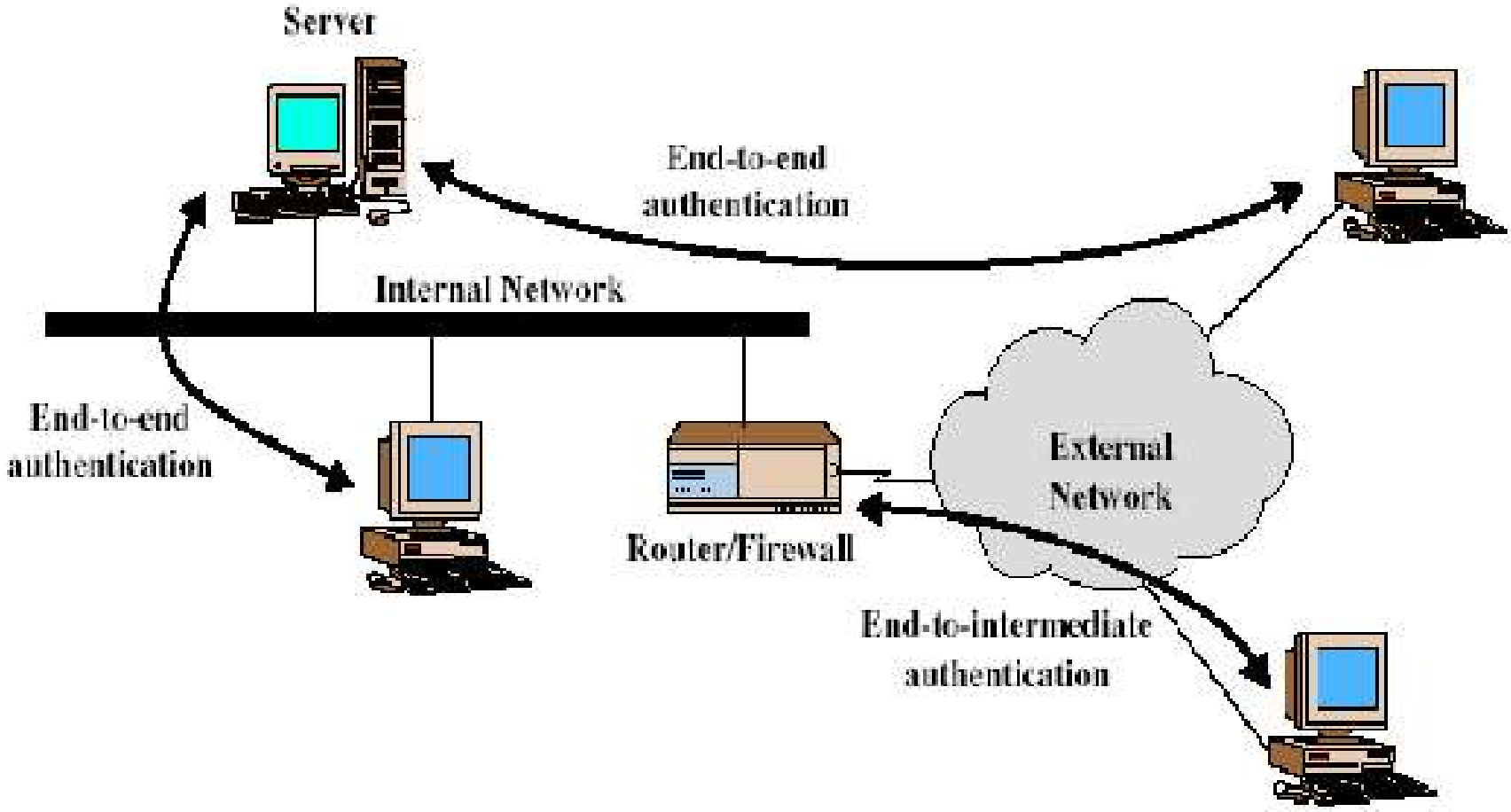
Authentication Header



Authentication Header (AH)

- provides support for data integrity & authentication of IP packets
  - end system/router can authenticate user/app
  - prevents replay attack by tracking sequence numbers
- based on use of a MAC
  - HMAC-MD5-96 or HMAC-SHA-1-96
- parties must share a secret key

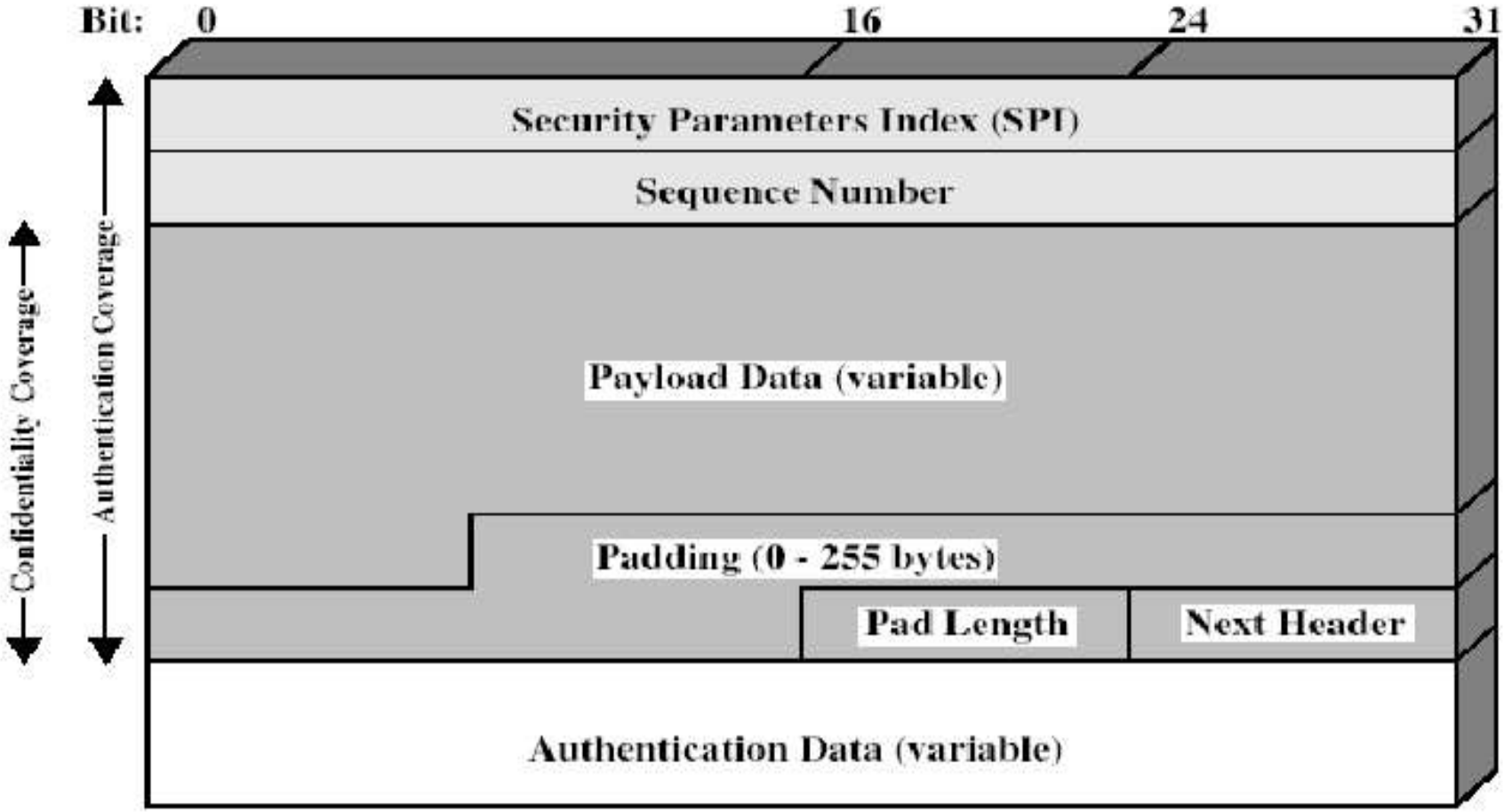
Transport & Tunnel Modes



Encapsulating Security Payload (ESP)

- provides message content confidentiality
- can optionally provide the same authentication services as AH
- supports range of ciphers, modes, padding
  - incl. DES, Triple-DES, RC5, IDEA, CAST etc
  - CBC most common

Encapsulating Security Payload



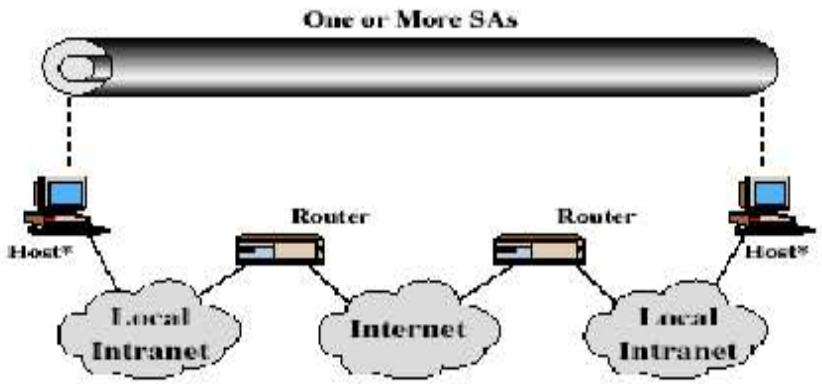
Transport vs Tunnel Mode ESP

- transport mode is used to encrypt & optionally authenticate IP data
  - data protected but header left in clear
  - can do traffic analysis but is efficient
  - good for ESP host to host traffic
- tunnel mode encrypts entire IP packet
  - add new header for next hop
  - good for VPNs, gateway to gateway security

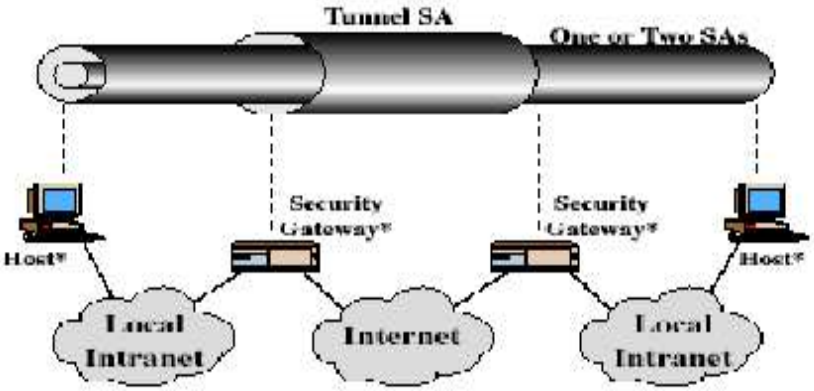
Combining Security Associations

- SA's can implement either AH or ESP
- to implement both need to combine SA's
  - form a security bundle

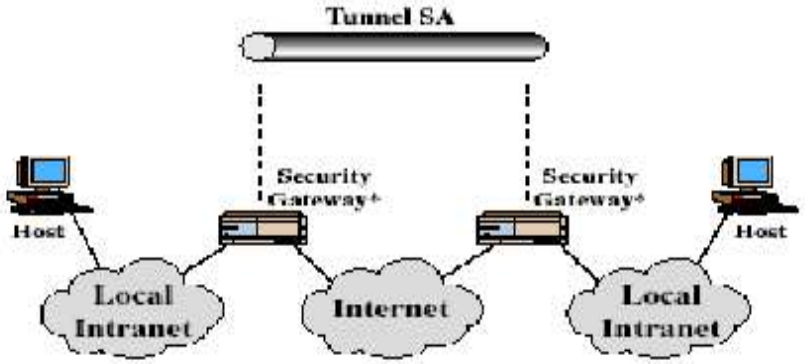
Combining Security Associations



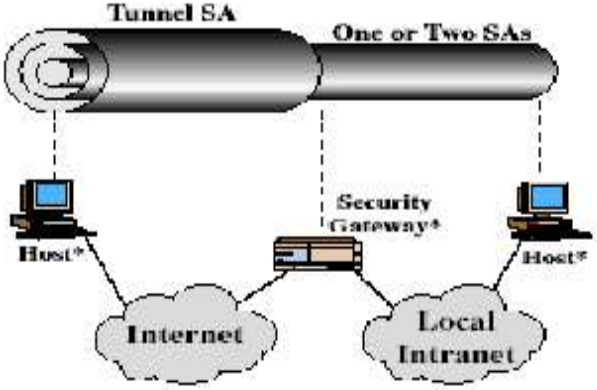
(a) Case 1



(c) Case 3



(b) Case 2



(d) Case 4

Summary

- have considered:
  - IPSec security framework
  - AH
  - ESP