# Network Security Contd

COMP90007
Internet Technologies

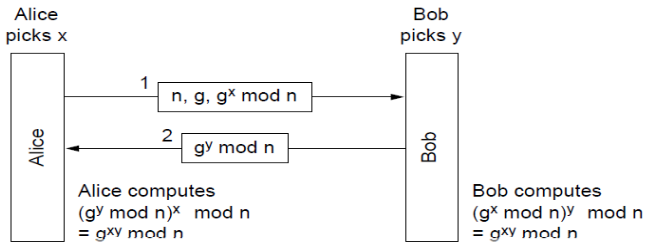


## Authentication

- **Authentication is a primary tenet** of network security
- However, **authentication process itself needs to be secure** also
- A fundamental principle: **minimise the use of permanent keys in establishment of secure connections** (the less packets are exchanged using such keys, the less exposure to potential attackers)
- Four methods in common use:
  - Shared keys
  - Key distribution
  - Kerberos
  - Public keys

## Authentication Based on a Shared Secret Key

- How to create a key with Diffie-Hellman key exchange:




Shared secret

Shared secret

Is there a way to break this?

Still open to man-in-the-middle attack!



## Authentication Using a Key Distribution Center

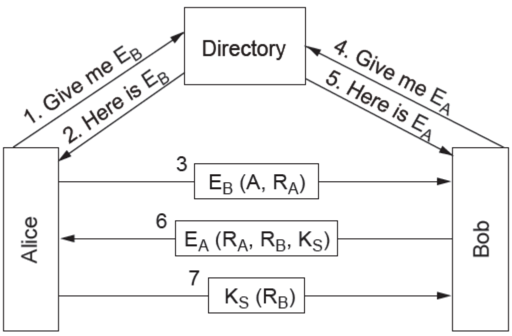
- In this method, **<u>a trusted intermediary is used</u>** to facilitate
- Users each share a key with a central key distribution centre, and authenticate to the KDC directly
- The KDC acts as a relay between the two parties
- There are issues here as well:
  - Open to **<u>replay-attack</u>**
- Solutions exist to patch the KDC mechanism
  - E.g. timestamps

# Authentication Using Kerberos

- Similar to KDC a popular protocol emerged and in frequent use today: Kerberos
- In this method, a multi-component system is required
  - Authentication Server
  - Ticket Granting Server (TGS)
  - Recipient
- Authentication is managed centrally, and then **party to party communication is facilitated by single use tickets**
- Still disadvantages remains: Does not scale to large numbers; different businesses need to trust each other's TGSs…



# Authentication Using Public Key Cryptography



## IPSec

- Where to put security?
  - Some say application layer: but users may not want such things
  - Some say lower layers: but not as strong as having it at app layer
  - Outcome is **security can/should be in multiple layers**
- One can put security at application level but also…
- **IPSec (RFC 2401,..) puts it at the network** level as well
- In the IPSec model, **encryption is compulsory, but a null encryption algorithm can be used** between points
- The main IPSec framework features are **secrecy, data integrity, and replay** attack protection
- The IPSec framework allows multiple algorithms and multiple levels of granularity, connection-oriented (**connections are named as SA's security associations**)



## IPSec Implementation

- IPSec has two main implementation components
  - Things being added to packets in transit
  - ISAKMP key management: Internet Security Association and Key Management Protocol for establishing keys
- IPSec has 2 modes
  - Transport mode - uses header insertion after IP Header
  - Tunnel mode - uses packet encapsulation

# Virtual Private Networks

- Unlike a physical network based on leased lines between locations for which secure transit is required
- A Virtual Private Network (VPN) is **a virtual layer on top of an IP network which provides a secure end-to-end connection** over public infrastructure
- A common VPN implementation model:
  - **Use a firewall at each end of a connection**
  - Setup a **SA to create an IPSec tunnel between the two end points**
- Communication on this infrastructure is **transparent to end users**

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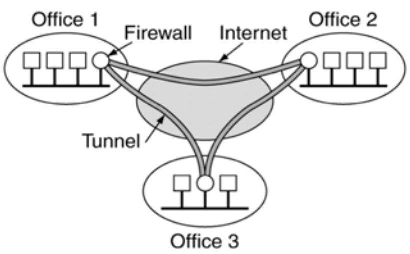
# VPN

A virtual private network

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## Firewalls

- While IPSec ensures security in transit, a **firewall ensures security at the network perimeter**
- Firewalls are positioned at the network boundary, and **provide a controlled series of routes between the internal and external networks**
- Three characteristics of firewalls
  - All inbound and outbound traffic must transit the firewall
  - Only authorised traffic must pass through the firewall
  - Firewalls should be immune to penetration themselves

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## Firewall Scope

- Check packets for "bad" packets
  - Administrators can **write rules for this**, e.g., distinguish regular HTTP from P2P related HTTP
- **Not everything is inside the wall**
- Web servers and email servers etc **need to be exposed to allow more open communication**
  - Best firewall is NOT disconnecting everything from the Internet
- Through **further rules packets go in-between this gray area and the LAN**
- Firewalls dont provide protection against inhouse threats
- Applications can still distribute viruses (via bad attachments for example)

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## Wireless Security Context

- Wired networks are relatively easy to secure because they require physical access to intercept traffic
- Wireless networks are more difficult to secure because of **omnidirectional signal propagation**
- Additionally by default **most wireless network equipment operates in an insecure and promiscuous manner**
- 802.11 has a native secure protocol, **Wired Equivalency Protocol** (WEP), which is a 40-bit encryption based on RC4 algorithm

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## Wireless Security Issues

- Two inherent insecurities
  - 40 bit encryption is breakable with low-moderate computational resources
  - RC4 re-uses keys, so capturing a small volume of encrypted traffic will guarantee key identification
- Given these constraints, how can wireless networks be secured?

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## Securing Wireless

- Additional encryption (128bit WEP)
  - Increased security through longer key lengths
- MAC Address Filtering
  - Only allow specified MAC interfaces to establish connections
- …
- WPA2 (WiFi Protected Access 2)
- …
- Multilayered security
  - Use a VPN over wireless