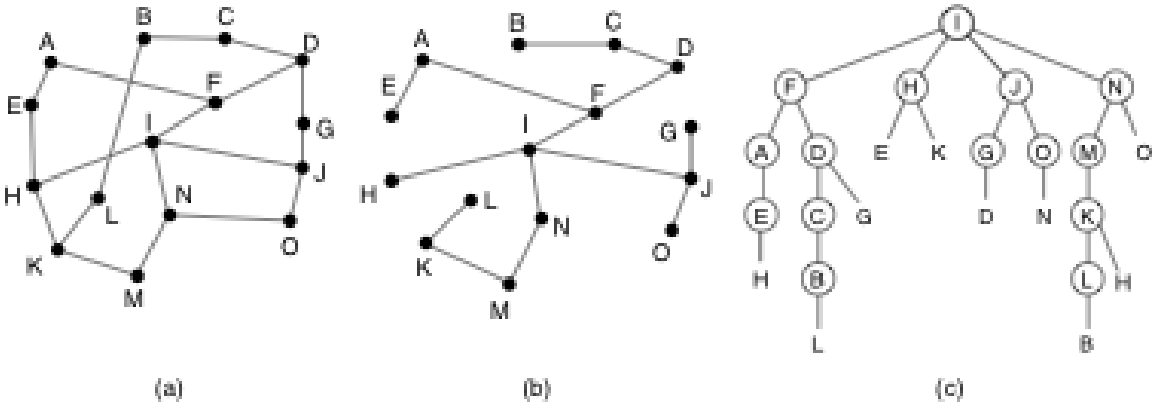
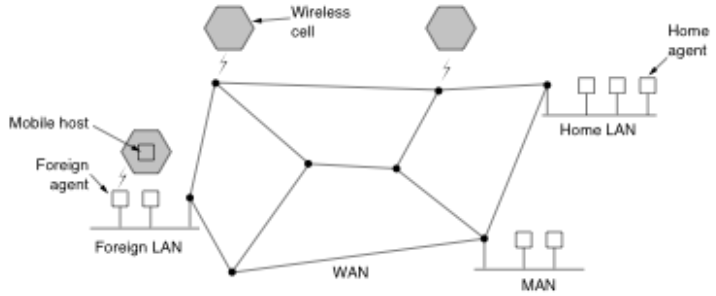
Lecture 20
Plan: Mobile routing and Internetwork routing

Review:
To do broadcast routing, we can

- flooding
- multicast routing (needs destination addressed in packet and regular routing table)
- spanning tree (routers need to know the spanning tree)
- reverse path routing (only a regular routing table is eough)



1. Routing for mobile hosts
Q:/ What is a mobile host?
A:/ migratory hosts which move from network to network, but not moving while connected or roaming hosts which maintain a connection while moving around
Q:/ How does the mobility of hosts affect routing?
A:/ How to find them?
Solution: Assume all hosts have a permanent home location (a LAN or a wireless cell) and a home address
When it moves, messages are still sent to its home address
Then through some mechanism, the messages will be delivered to its actual location.



Use two "agent" processes in each local area:

- The foreign agent, which acts as an agent for hosts who are visiting this area
- the home agent, which is the agent for a mobile host at its home location

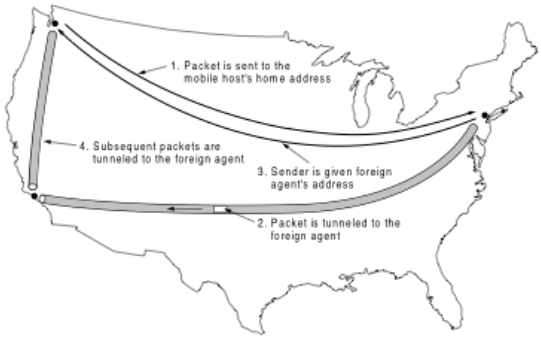
Then

- mobile host tries to register with the foreign agent (tell the foreign agent its home address, data link layer address, and some secret)

- foreign agent contacts the mobile host's home agent with the secret and the foreign agent's network address
- home agent tests the secret and agrees to allow the host to connect with the foreign agent
- mobile host registers with the foreign agent

Q:/How does the communication work?
A:/

- packet for the mobile host will be delivered to its home address
- home agent sends it to the foreign agent
- foreign agent sends it to the mobile host
- home agent notifies the sender to direct future communications to the foreign agent



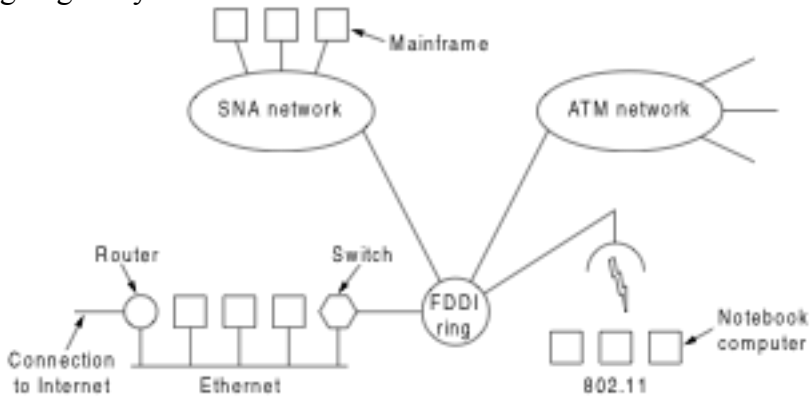
2. Internetworking issues in network layer

a. What is inter-networking?

A:/ Interconnecting different networks (with different protocols, etc.)That is, forming a network of networks.

b. Why do we have to discuss this topic?

A:/ In real life, many different networks exist and they are connected. They are probably not going away soon.



FDDI: fiber distributed data interface
SNA: system network architecture

c. How networks differ?

A:/

Item	Some Possibilities
Service offered	Connection oriented versus connectionless
Protocols	IP, IPX, SNA, ATM, MPLS, AppleTalk, etc.
Addressing	Flat (802) versus hierarchical (IP)
Multicasting	Present or absent (also broadcasting)
Packet size	Every network has its own maximum
Quality of service	Present or absent; many different kinds
Error handling	Reliable, ordered, and unordered delivery
Flow control	Sliding window, rate control, other, or none
Congestion control	Leaky bucket, token bucket, RED, choke packets, etc.
Security	Privacy rules, encryption, etc.
Parameters	Different timeouts, flow specifications, etc.
Accounting	By connect time, by packet, by byte, or not at all

MPLS: multi-protocol label switching

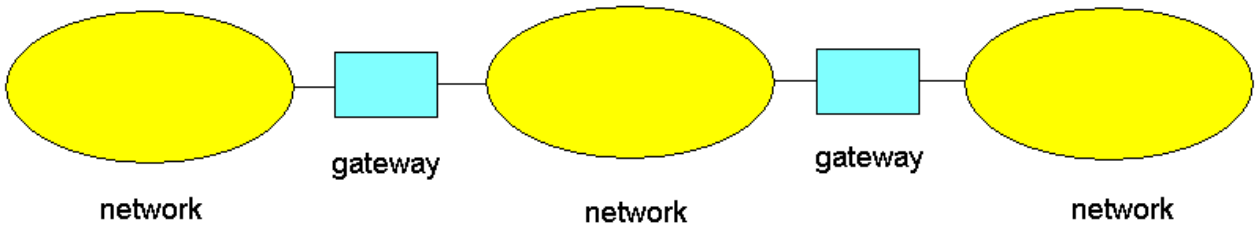
d. How to connect different networks

It can be done at the network layer by using a multiprotocol router.

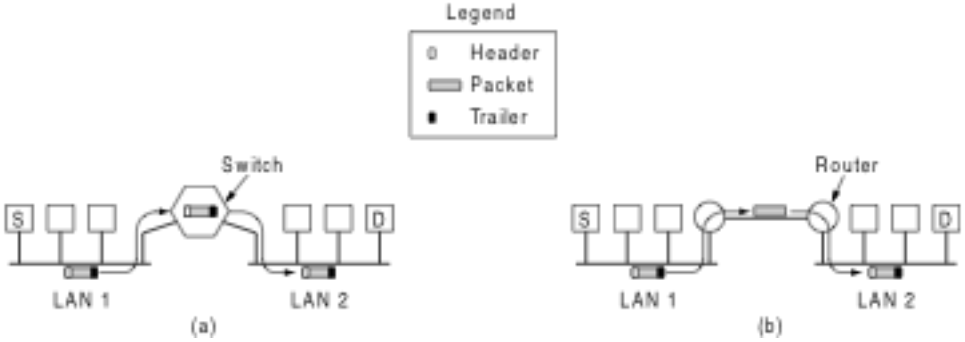
Gateway

A mulitprotocol router responsible for routing packets and translating between protocols. It is similar in function to a bridge.

"gateway" device connecting dissimilar networks



Difference between switching in the datalink layer and the network layer

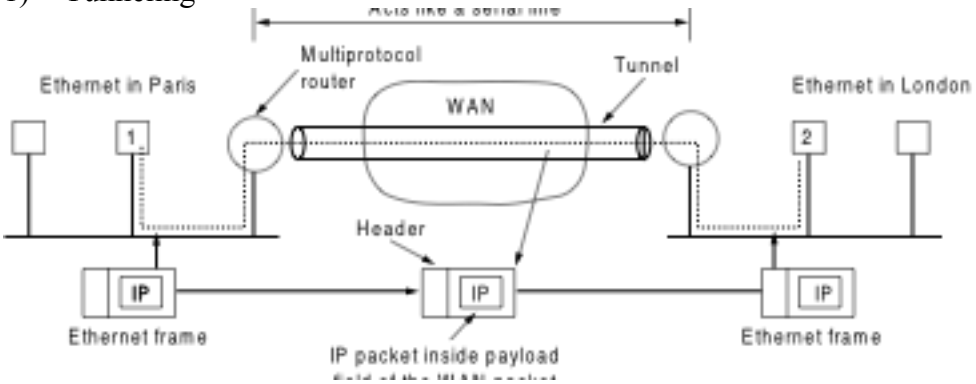


The main difference is the switch in (a) will basically translate the frame from LAN1 to LAN2 without looking at the payload the frame. In (b), the routers will examine the payload and then translate the frame format.

(a) uses MAC address to select a route. (b) uses the IP address

Issues

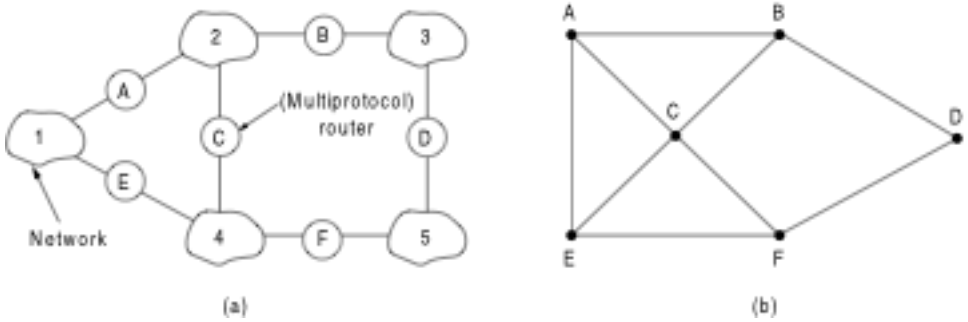
1) "Tunneling"



It allows communication between networks of same type, passing through a network of another type.

- Encapsulate a packet within the intermediate net's packet type.

2) Internetwork routing is essentially hierarchical



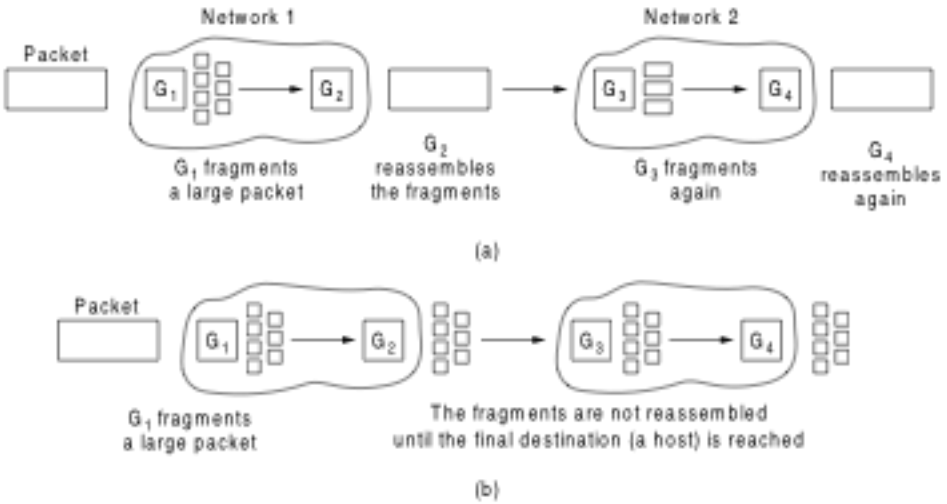
a) Networks are linked by gateways (multiprotocol routers)
b) Pass packet from gateway to gateway going on paths within networks.
   i) interior gateway protocol - within each network (independent of other networks -- "autonomous system")
   ii) exterior gateway protocol - between networks

3) Fragmentation

Q:/ Why?

A:/ there are limits on packet sizes (65515 bytes→ 64K for IP packets) and need to split packets when maximum sizes don't match, then reassemble later.

Q:/ When? Two choices:



i) Packets are reassembled at each gateway such as in ATM. It is called **transparent fragmentation.** In a of the above figure, the fragmentation is invisible for other networks.

   Q:/ Cons of this approach?

   A:/ All small packets must use the same route for the network to re-assemble the whole big packet

ii) Not until reaching final destination, as in IP.

   (1) This allows fragments to take different routes to the destination.

   (2) At the destination, all or nothing. If not all fragments arrive within time limit, datagram is discarded.