LAN Emulation, IP Over ATM and MPOA

Raj Jain

Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/

Overview

❑ LAN Emulation

❑ Classical IP over ATM

❑ Next Hop Resolution Protocol (NHRP)

❑ Multiprotocol over ATM(MPOA)

LAN Emulation: Features

❑ One ATM LAN can be *n* virtual LANs

❑ Logical subnets interconnected via routers

❑ Need drivers in hosts to support each LAN

❑ Only IEEE 802.3 and IEEE 802.5 frame formats supported. (FDDI can be easily done.)

❑ Doesn't allow passive monitoring

❑ No token management (SMT), collisions, beacon frames.

❑ Allows larger frames.

| LE Header (2 Bytes)	IEEE 802.3 or 802.5 Frame

LAN Emulation

IP
Ethernet

| IP |
|----|
| LANE |
| ATM |

ATM
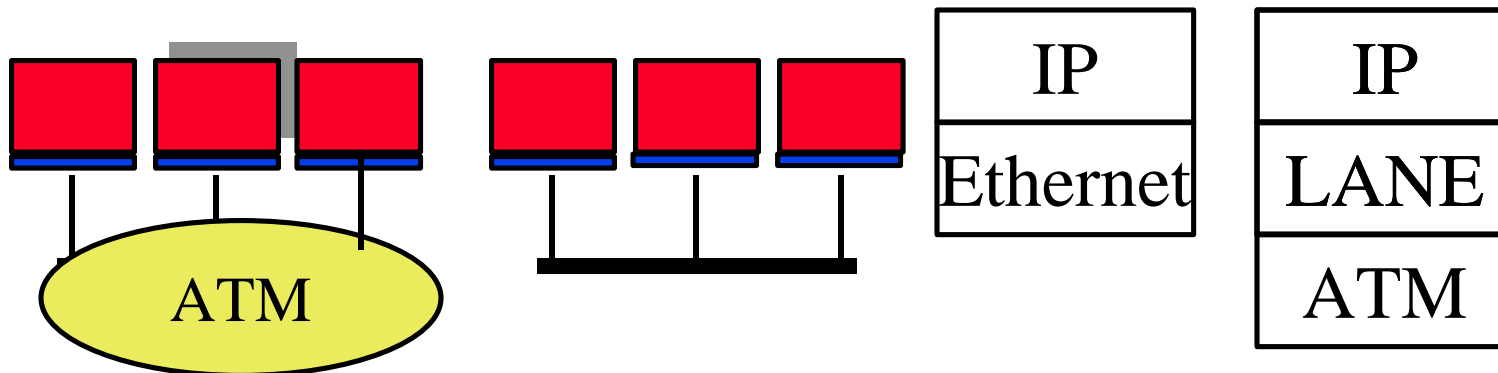
- ❑ LAN Emulation driver replaces Ethernet driver and passes the networking layer packets to ATM driver.

- ❑ Each ATM host is assigned an Ethernet address.

- ❑ LAN Emulation Server translates Ethernet addresses to ATM addresses

- ❑ Hosts set up a VC and exchange packets

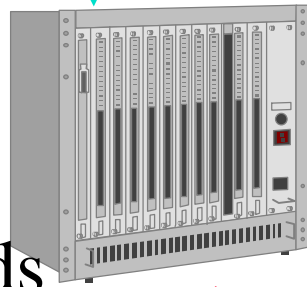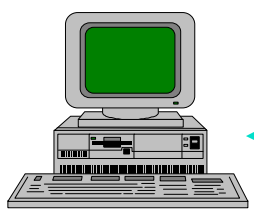- ❑ All software that runs on Ethernet can run on LANE

LAN Emulation

1. Client gets recipient's address from LES and sets-up a VC.
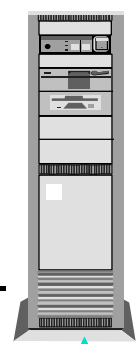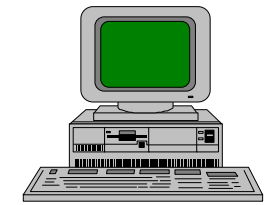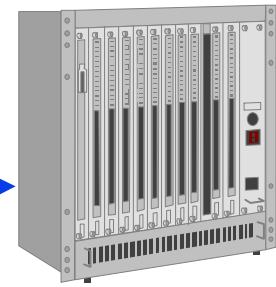
LAN Emulation Server
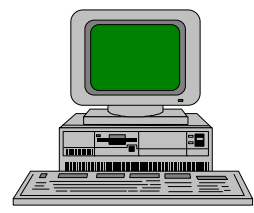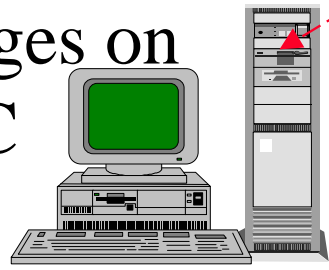
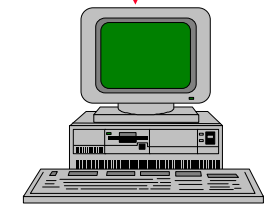3. Messages for ATM clients are delivered directly.

Switches

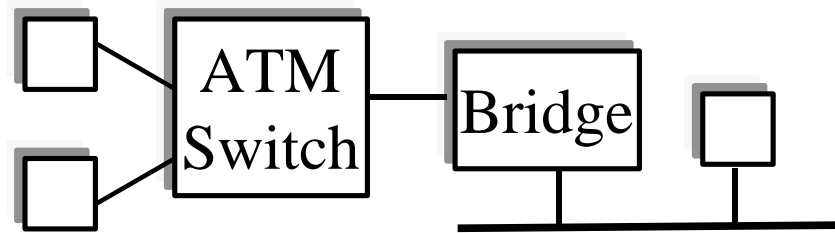2. Client sends messages on the VC

ATM client B Bridge

4. Messages for non-ATM clients are forwarded through bridges

Broadcast/Unknown Server (BUS)

Non-ATM client

Protocol Layers

ATM Host

Applica-tions	
IP	IPX
NDIS	ODI
LAN Emulation	
AAL5	
ATM	
Physical Layer	

ATM Switch

ATM	
Phy Layer	Phy Layer

ATM-LAN Bridge

Bridging		
LAN Emulation		Media Access Control
AAL5		
ATM		
Phy Layer		Phy Layer

LAN Host

Applica-tions	
IP	IPX
NDIS	ODI
Media Access Control	
Physical Layer	

Protocol Layers (Cont)

- NDIS = Network Driver Interface Specification
- ODI = Open Datalink Interface
- IPX = NetWare Internetworking Protocol
- **LAN Emulation Software**:
  - LAN Emulation Clients in each host
  - LAN Emulation Servers
    - LAN Emulation Configuration server (LECS)
    - LAN Emulation Server (LES)
    - Broadcast and unknown server (BUS)

Operation

❑ Initialization:

  ❍ Client gets address of LAN Emulation Configuration Server (LECS) from its switch, uses well-known LECS address, or well known LECS PVC

 ❍ Client gets Server's address from LECS

❑ Registration:

  ❍ Client sends a list of its MAC addresses to Server.

 ❍ Declares whether it wants ARP requests.

Operation (Cont)

❑ Address Resolution:

  ○ Client sends ARP request to Server.

  ○ Unresolved requests sent to clients, bridges.

  ○ Server, Clients, Bridges answer ARP

  ○ Client setups a direct connection

❑ Broadcast/Unknown Server (BUS):

  ○ Forwards multicast traffic to all members

  ○ Clients can also send unicast frames for unknown addresses
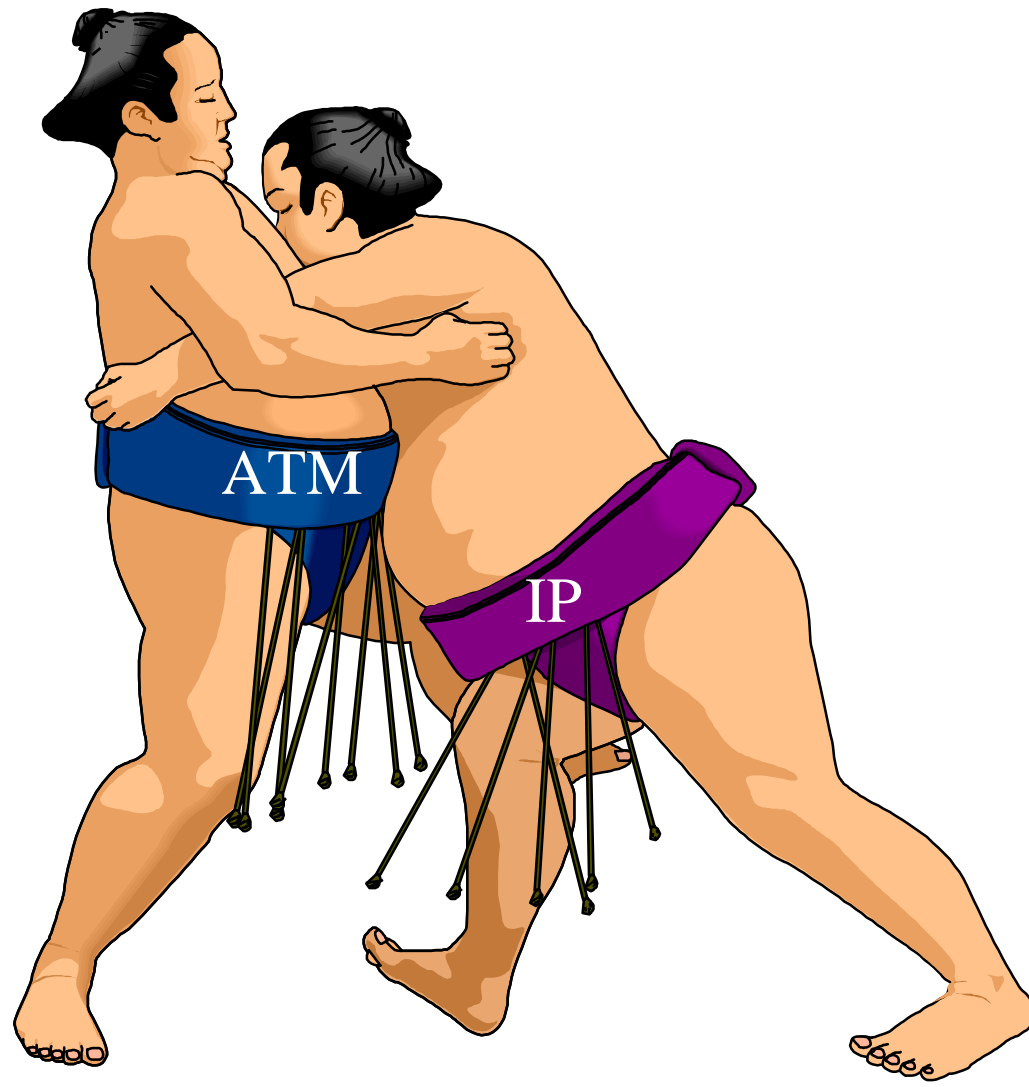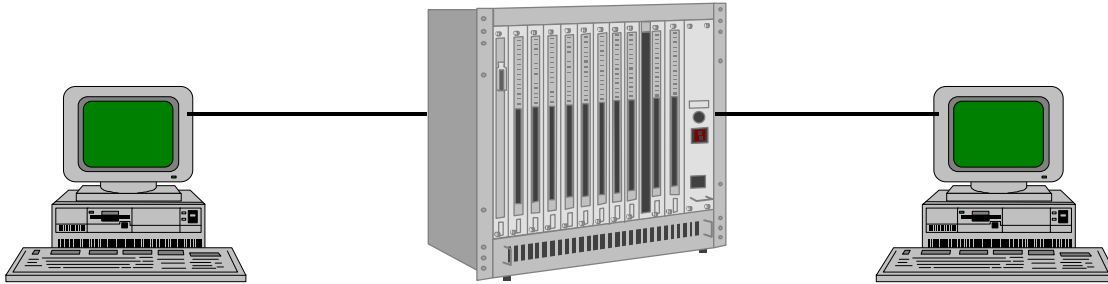
ATM Virtual LANs

❑ Physical View

Router

A1

A2

LANE Server A

ATM Switch

LANE Server B

B1

B2

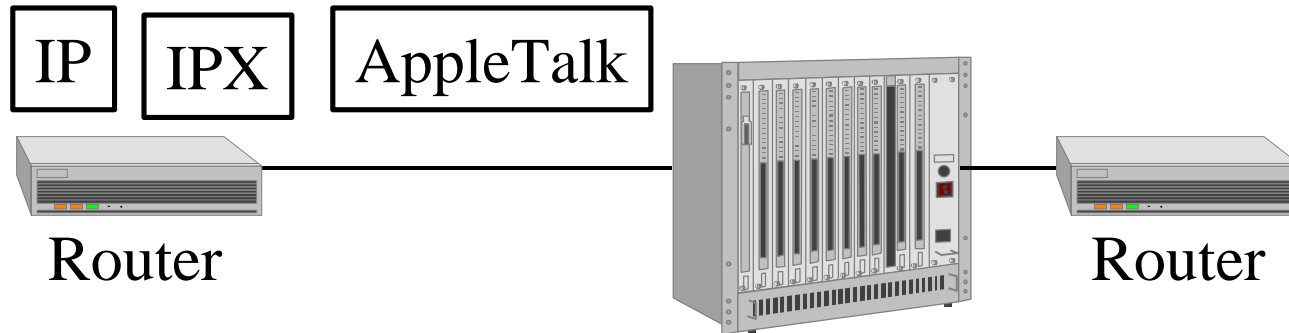❑ Logical View

A1

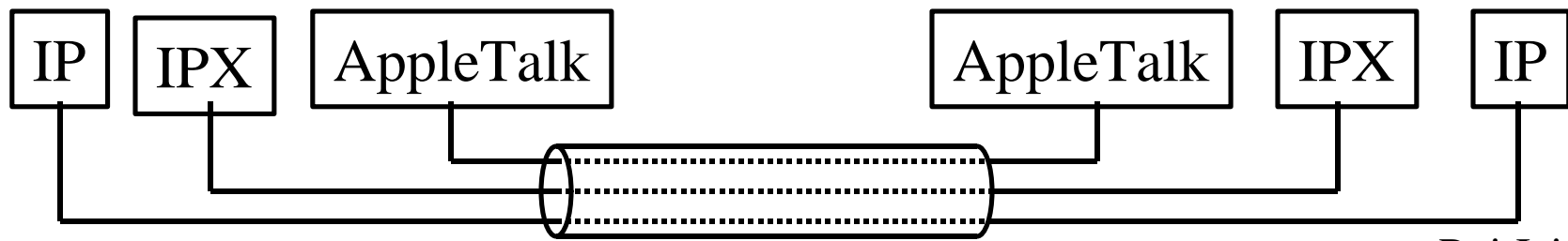B1

Router

A2

B2
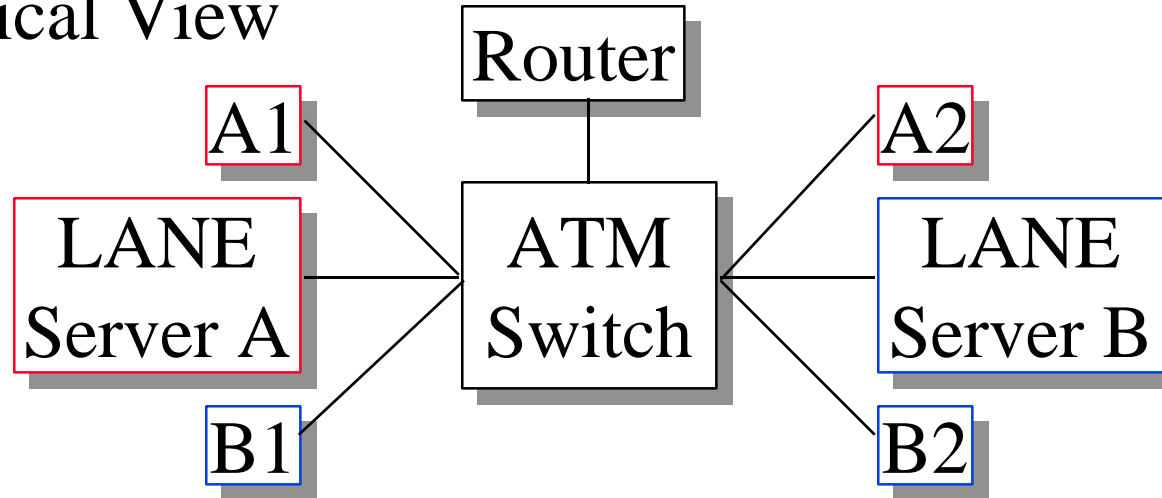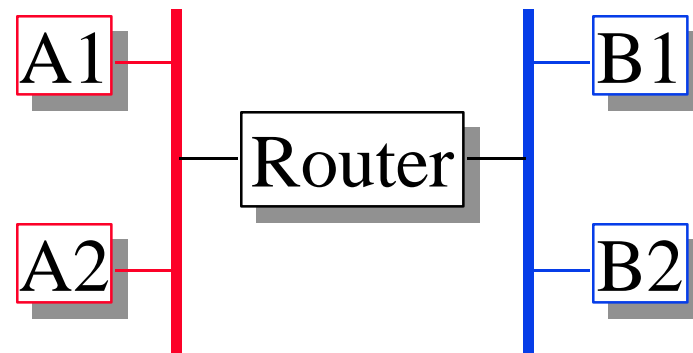
IP Over ATM

IP Over ATM: Issues

❑ How many VC's do we need for n protocols?

❍ Packet encapsulation [RFC1483]

❑ How to find ATM addresses from IP addresses

❍ Address resolution [RFC1577]

❑ How to handle multicast? [MARS, RFC 2022]

❑ How do we go through n subnets on a large ATM network? [NHRP]

Packet Encapsulation [RFC1483]

IP   IPX   AppleTalk

Router   Router
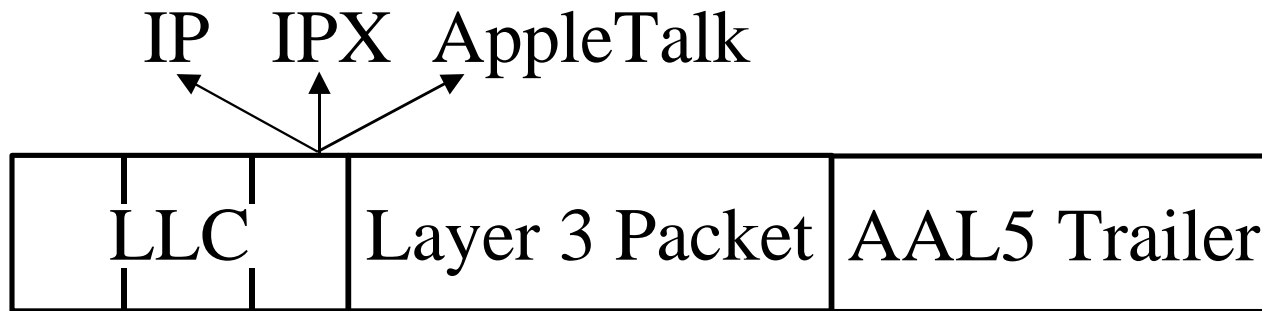
❑ **Question**: Given an ATM link between two routers, how many VC's should we setup?

❑ **Answer 1**: One VC per Layer 3 protocol. Null Encapsulation: No sharing. VC based multiplexing.

IP   IPX   AppleTalk   AppleTalk   IPX   IP

Encapsulation (Cont)

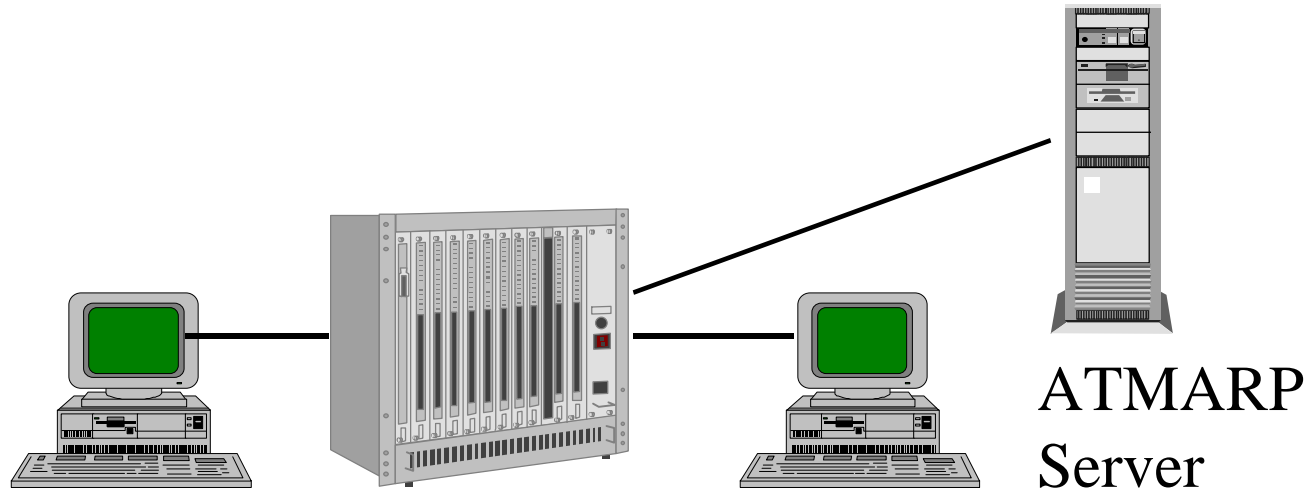IP   IPX AppleTalk

|	LLC		Layer 3 Packet	AAL5 Trailer

- **Answer 2**: Share a VC using Logical Link Control (LLC) Subnetwork Access Protocol (SNAP). LLC Encapsulation

- Protocol Types: 0x0800 = IP, 0x0806 = ARP, 0x809B = AppleTalk, 0x8137 = IPX

Address Resolution

ATMARP
Server

- ❑ IP address: 123.145.134.65
  ATM address: 47.0000 <u>1 614 999 2345</u>.00.00.AA....

- ❑ Issue: IP Address ⟺ ATM Address translation

  - ❍ Address Resolution Protocol (ARP)

  - ❍ Inverse ATM ARP: VC ⟹ IP Address

- ❑ Solution: ATMARP servers

Classical IP Over ATM

A2 ATMARP Server Router B1 ATMARP Server

A1 LIS 1 LIS 2 B2
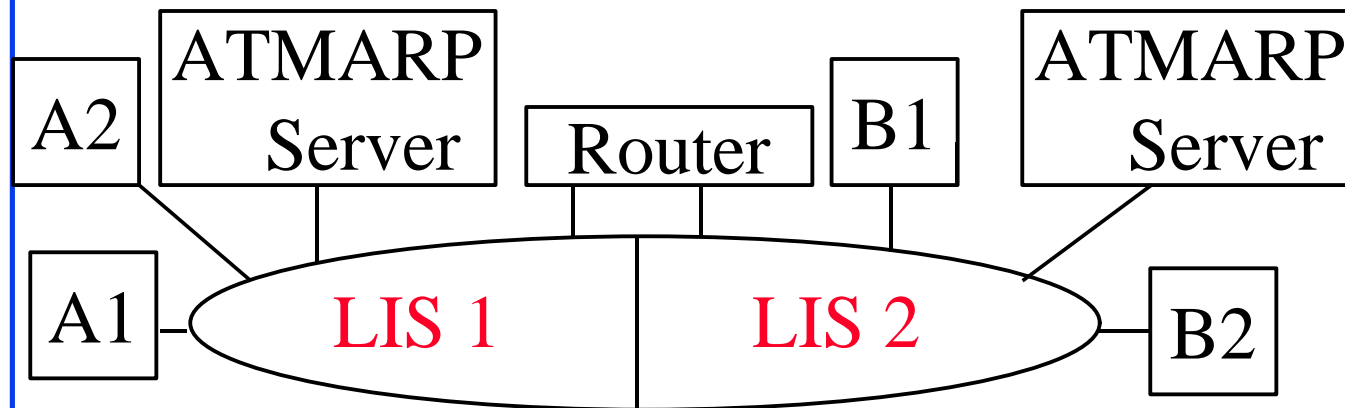
- ❑ ATM stations are divided in to Logical IP Subnets (LIS)

- ❑ ATMARP server translates IP addresses to ATM addresses.

- ❑ Each LIS has an ATMARP server for resolution

- ❑ IP stations set up a direct VC with the destination or the router and exchange packets.

IP Multicast over ATM

- ❑ Multicast Address Resolution Servers (MARS)

- ❑ Internet Group Multicast Protocol (IGMP)

- ❑ Multicast group members send IGMP join/leave messages to MARS

- ❑ Hosts wishing to send a multicast send a resolution request to MARS

- ❑ MARS returns the list of addresses

- ❑ MARS distributes membership update information to all cluster members

Next Hop Resolution Protocol

❑ Routers assemble packets ⇒ Slow

❑ NHRP servers can provide ATM address for the edge device to any IP host

❑ Can avoid routers if both source and destination are on the same ATM network.
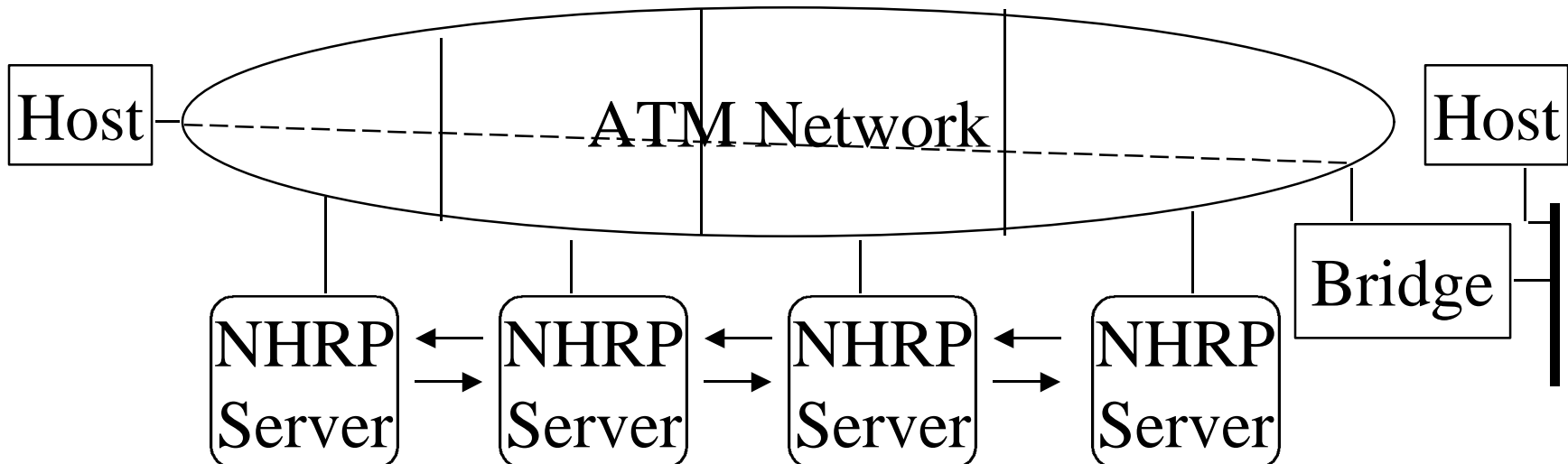
Multiprotocol Over ATM

❑ MPOA= LANE + "NHRP+"

❑ Extension of LANE

❑ Uses NHRP to find the shortcut to the next hop

❑ No routing (reassembly) in the ATM network

Multiprotocol Over ATM

Next Hop Resolution Protocol

Multicast Address Resolution Server

Routing

LAN Emulation

Bridging
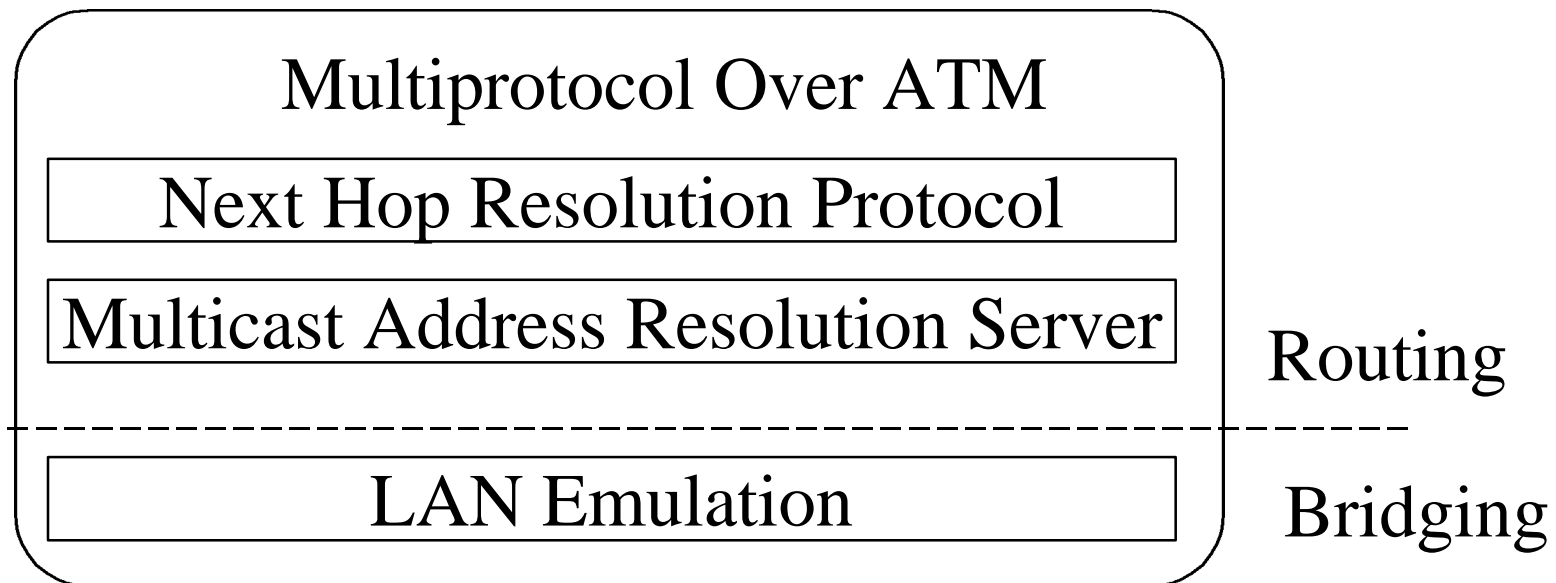
MPOA (Cont)

❑ LANE operates at layer 2

❑ RFC 1577 operates at layer 3

❑ MPOA operates at both layer 2 and layer 3
$\Rightarrow$ MPOA can handle non-routable as well as routable protocols

❑ Layer 3 protocol runs directly over ATM
$\Rightarrow$ Can use ATM QoS

❑ MPOA uses LANE for its layer 2 forwarding
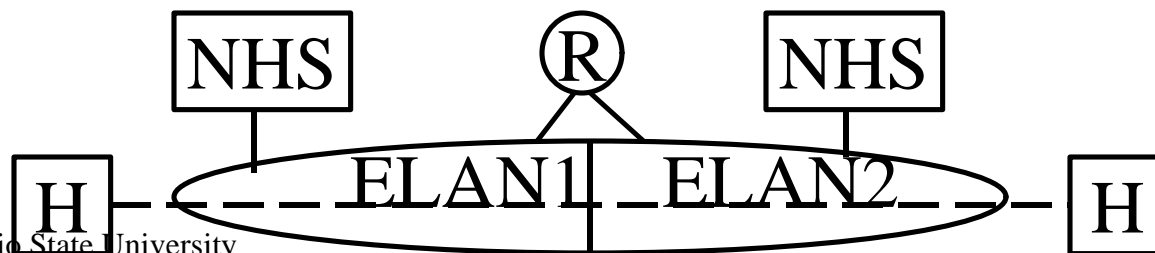
Summary
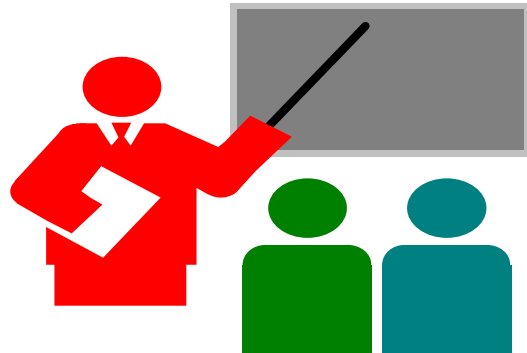
- LANE allows current applications to run on ATM
- Classical IP allows ARP using ATMARP servers
- NHRP removes the need for routing in an ATM net
- MPOA combines LANE and NHRP

Homework

❑ Read Chapter Chapters 19 and 20.1-20.5 of McDysan and Spohn