

# **LAN Emulation, IP Over ATM and MPOA**

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These slides are available at

<http://www.cis.ohio-state.edu/~jain/cis777-00/>



- ❑ LAN Emulation
- ❑ Classical IP over ATM
- ❑ Next Hop Resolution Protocol (NHRP)
- ❑ Multiprotocol over ATM(MPOA)

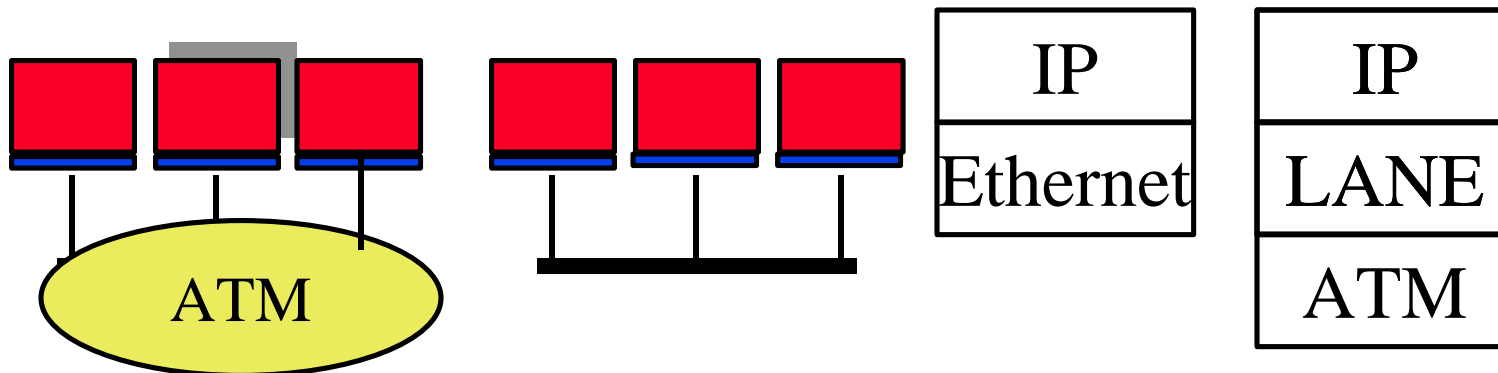
# LAN Emulation: Features

- ❑ 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

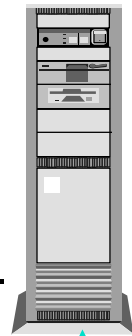
# LAN Emulation



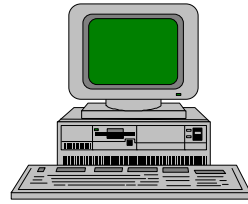
- ❑ LAN Emulation driver replaces Ethernet driver and passes the networking layer packets to ATM driver.
- ❑ Each ATM host is assigned an Ethernet address.
- ❑ LAN Emulation Server translates Ethernet addresses to ATM addresses
- ❑ Hosts set up a VC and exchange packets
- ❑ All software that runs on Ethernet can run on LANE

# LAN Emulation

1. Client gets recipient's address from LES and sets-up a VC.

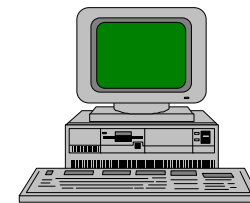
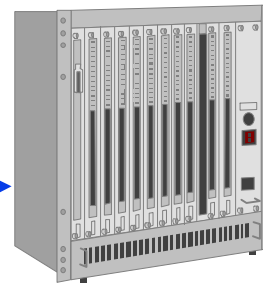
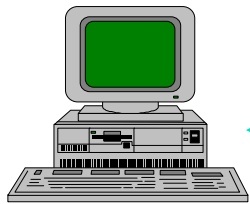


LAN Emulation Server



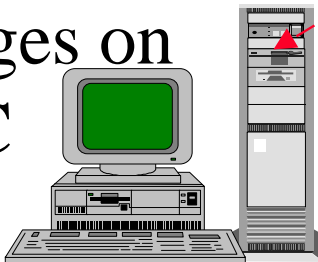
3. Messages for ATM clients are delivered directly.

Switches

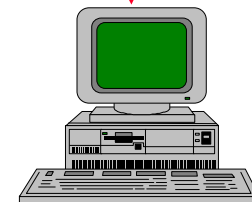
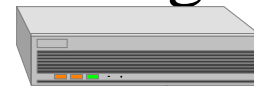


ATM client B  
Bridge

2. Client sends messages on the VC



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

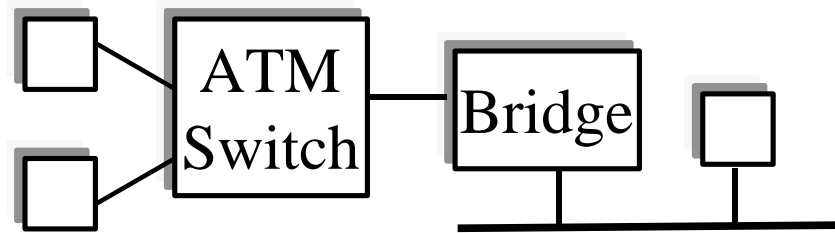


Broadcast/Unknown Server (BUS)

Non-ATM client

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# Protocol Layers



ATM Host

Applications	
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

Applications	
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.

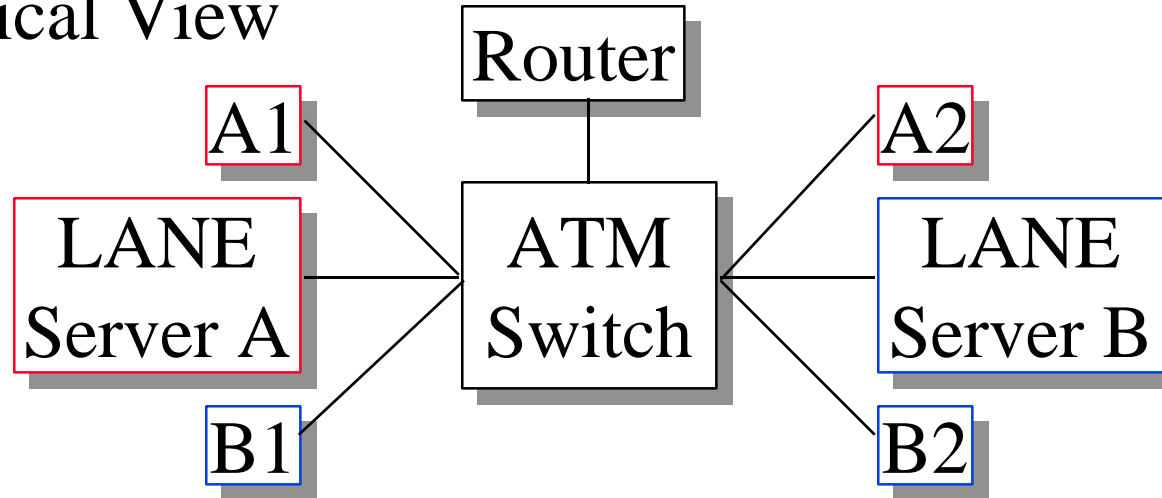


# Operation (Cont)

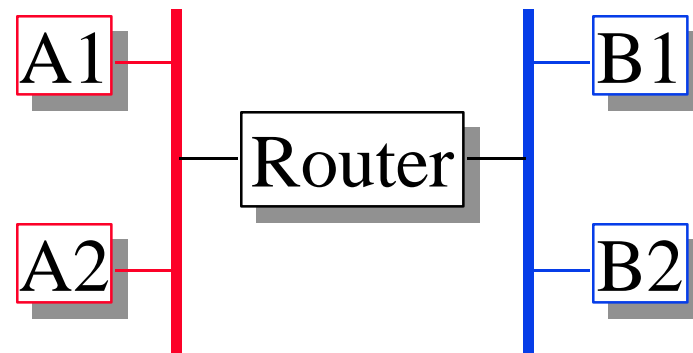
- Address Resolution:
  - Client sends ARP request to Server.
  - Unresolved requests sent to clients, bridges.
  - Server, Clients, Bridges answer ARP
  - Client setups a direct connection
- Broadcast/Unknown Server (BUS):
  - Forwards multicast traffic to all members
  - Clients can also send unicast frames for unknown addresses

# ATM Virtual LANs

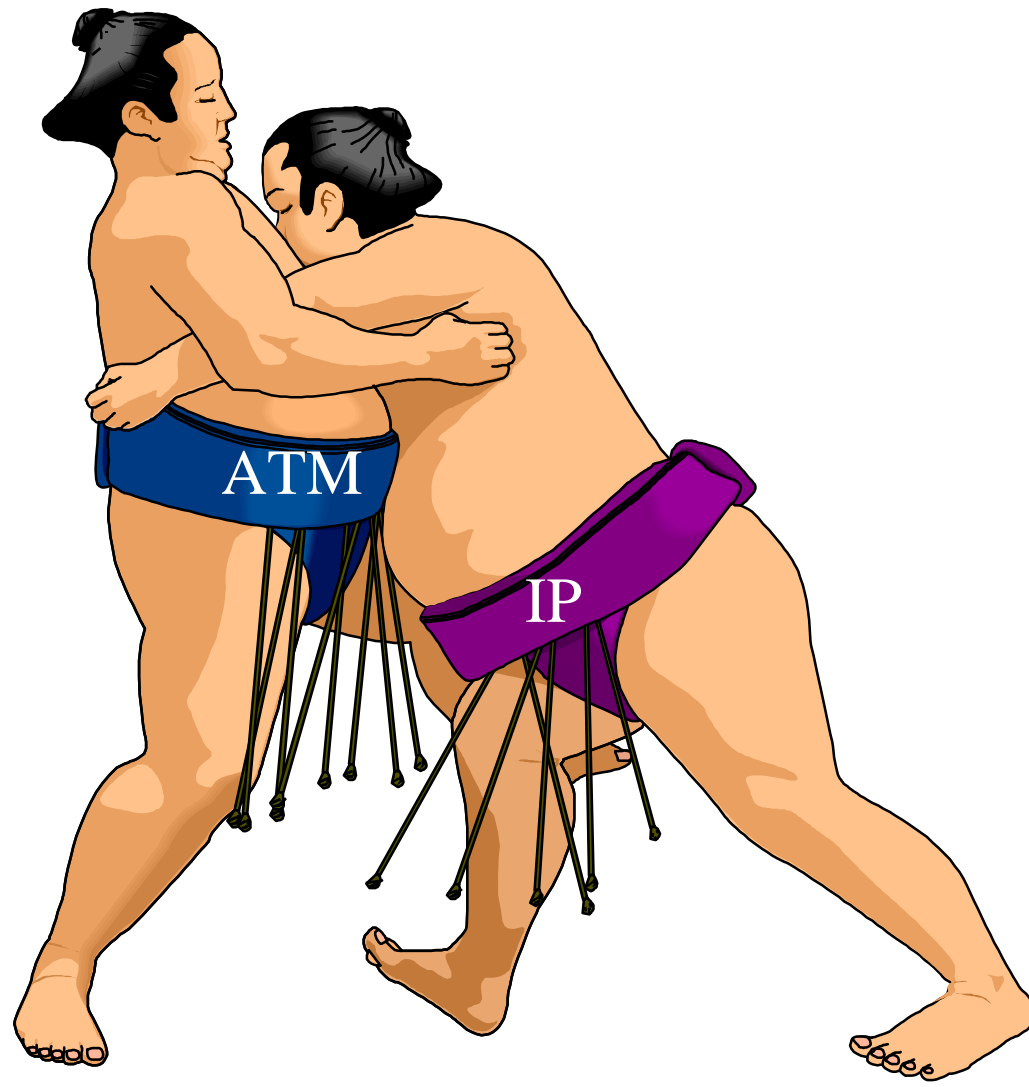
## Physical View



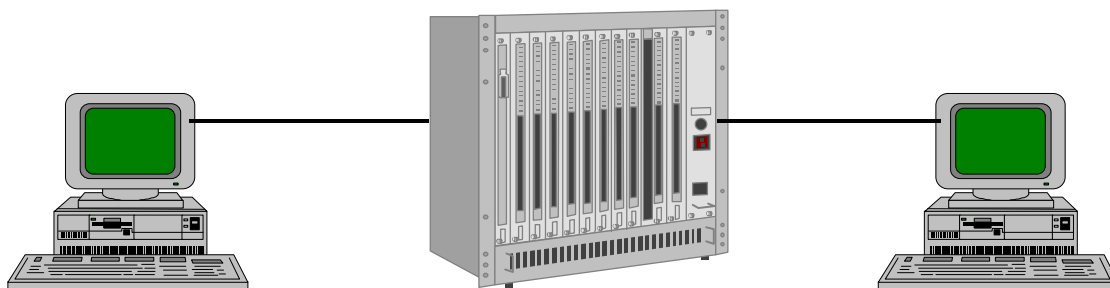
## Logical View



# IP Over ATM

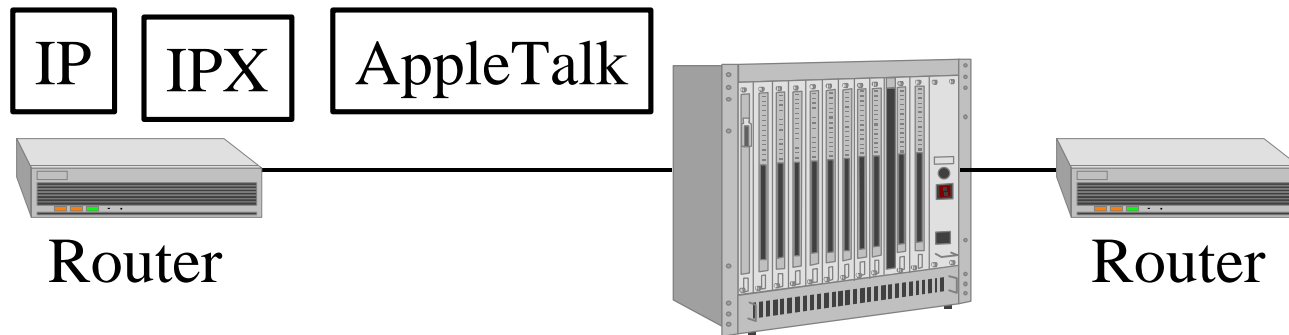


# IP Over ATM: Issues

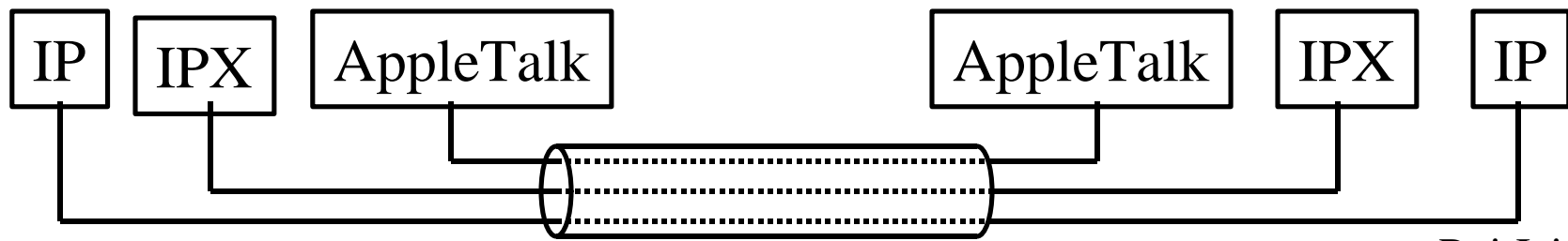


- ❑ How many VC's do we need for  $n$  protocols?
  - Packet encapsulation [RFC1483]
- ❑ How to find ATM addresses from IP addresses
  - Address resolution [RFC1577]
- ❑ How to handle multicast? [MARS, RFC 2022]
- ❑ How do we go through  $n$  subnets on a large ATM network? [NHRP]

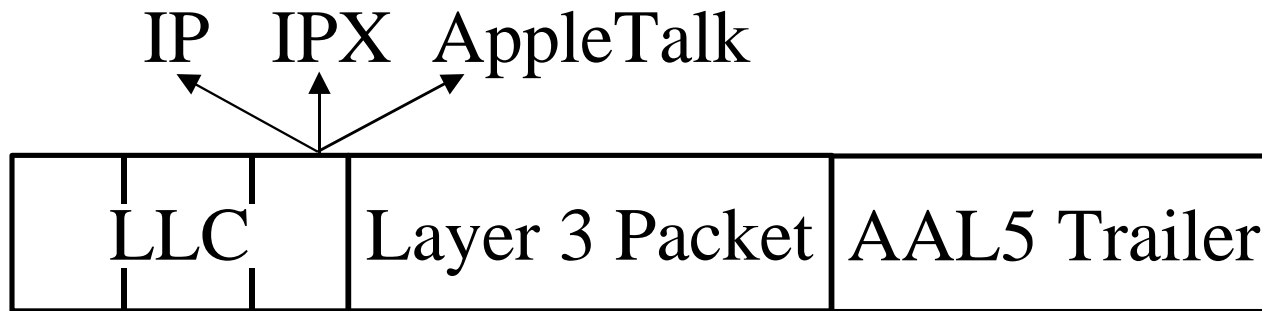
# Packet Encapsulation [RFC1483]



- ❑ **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.

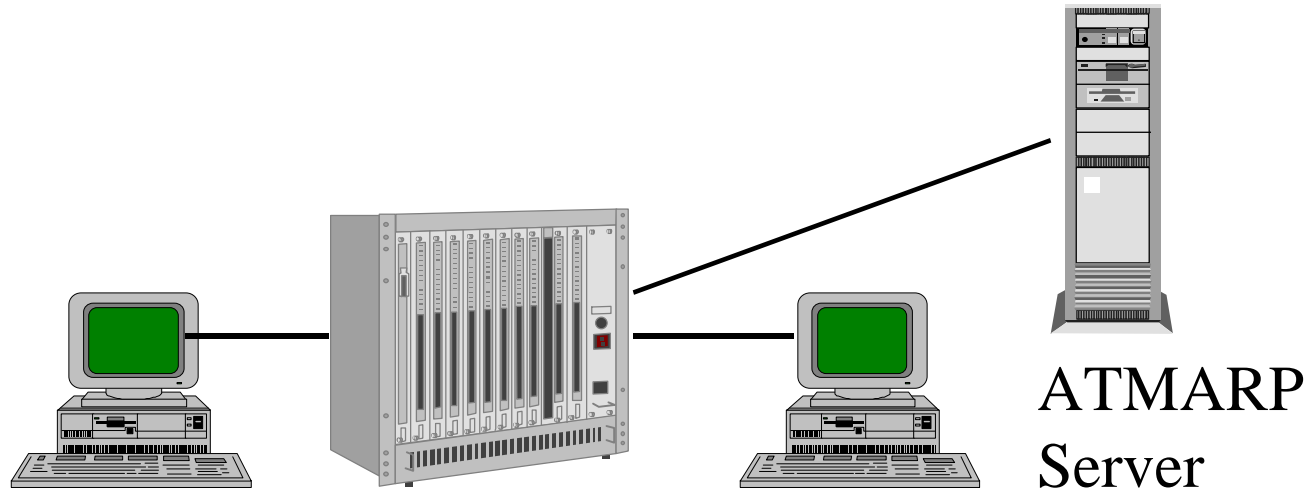


# Encapsulation (Cont)



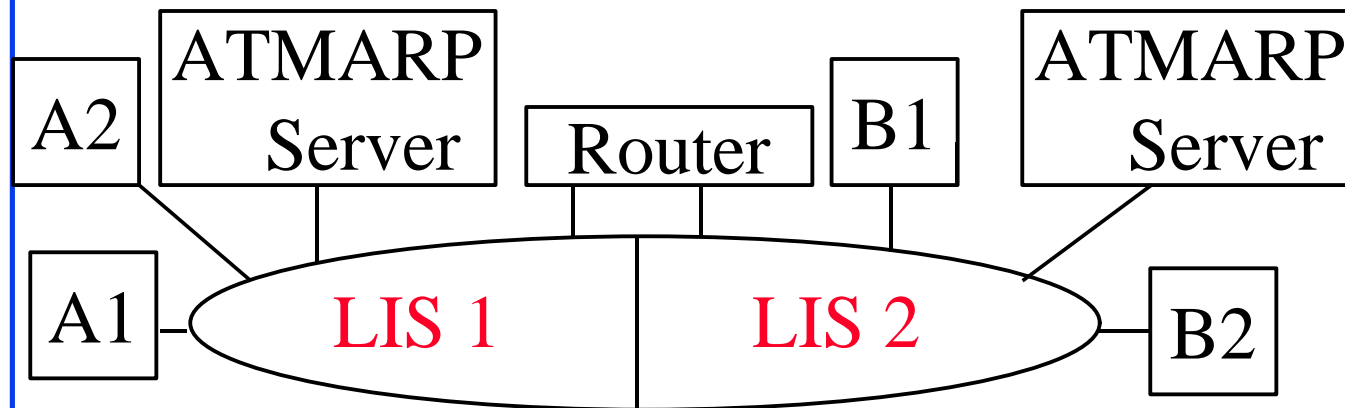
- ❑ **Answer 2:** Share a VC using Logical Link Control (LLC) Subnetwork Access Protocol (SNAP). LLC Encapsulation
- ❑ Protocol Types: 0x0800 = IP, 0x0806 = ARP, 0x809B = AppleTalk, 0x8137 = IPX

# Address Resolution



- ❑ IP address: 123.145.134.65  
ATM address: 47.0000 1 614 999 2345.00.00.AA....
- ❑ Issue: IP Address  $\Leftrightarrow$  ATM Address translation
  - Address Resolution Protocol (ARP)
  - Inverse ATM ARP: VC  $\Rightarrow$  IP Address
- ❑ Solution: ATMARP servers

# Classical IP Over ATM



- ❑ 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.

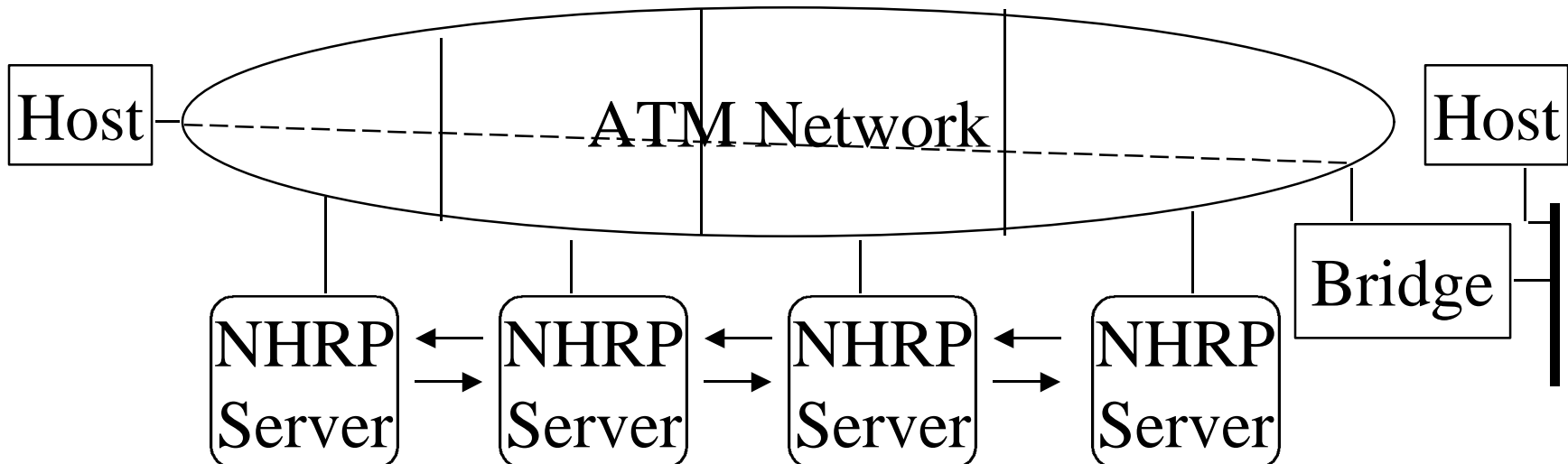


# IP Multicast over ATM

- ❑ 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

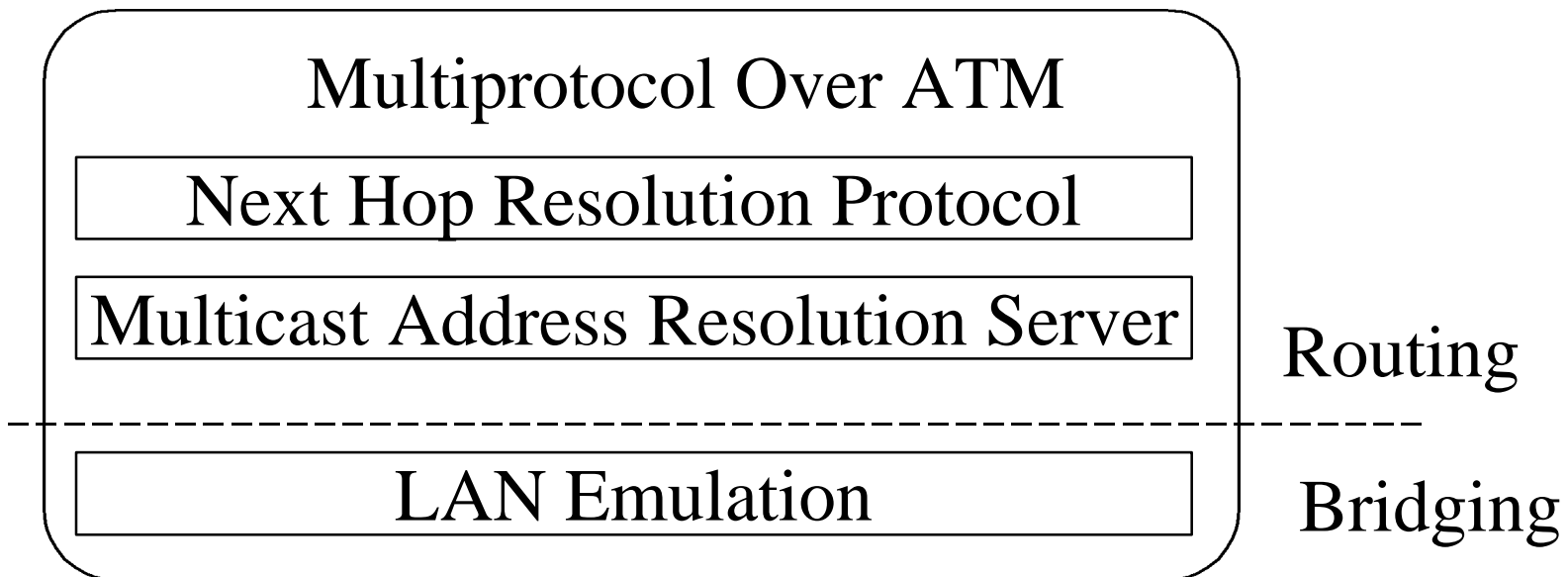
# Next Hop Resolution Protocol

- ❑ Routers assemble packets  $\Rightarrow$  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.



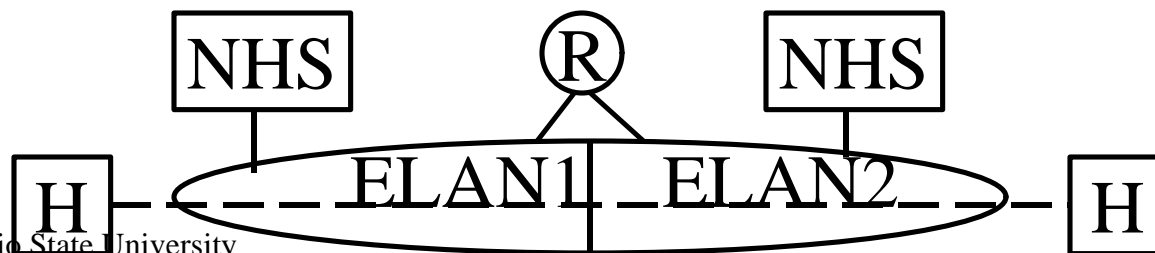
# Multiprotocol Over ATM

- ❑ MPOA= LANE + “NHRP+”
- ❑ Extension of LANE
- ❑ Uses NHRP to find the shortcut to the next hop
- ❑ No routing (reassembly) in the ATM network

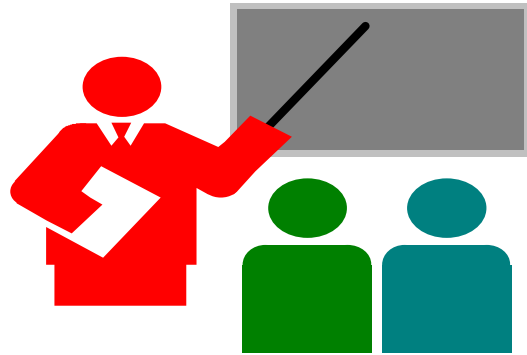


# MPOA (Cont)

- ❑ LANE operates at layer 2
- ❑ RFC 1577 operates at layer 3
- ❑ MPOA operates at both layer 2 and layer 3
  - ⇒ MPOA can handle non-routable as well as routable protocols
- ❑ Layer 3 protocol runs directly over ATM
  - ⇒ 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