

# IP over ATM

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ciences

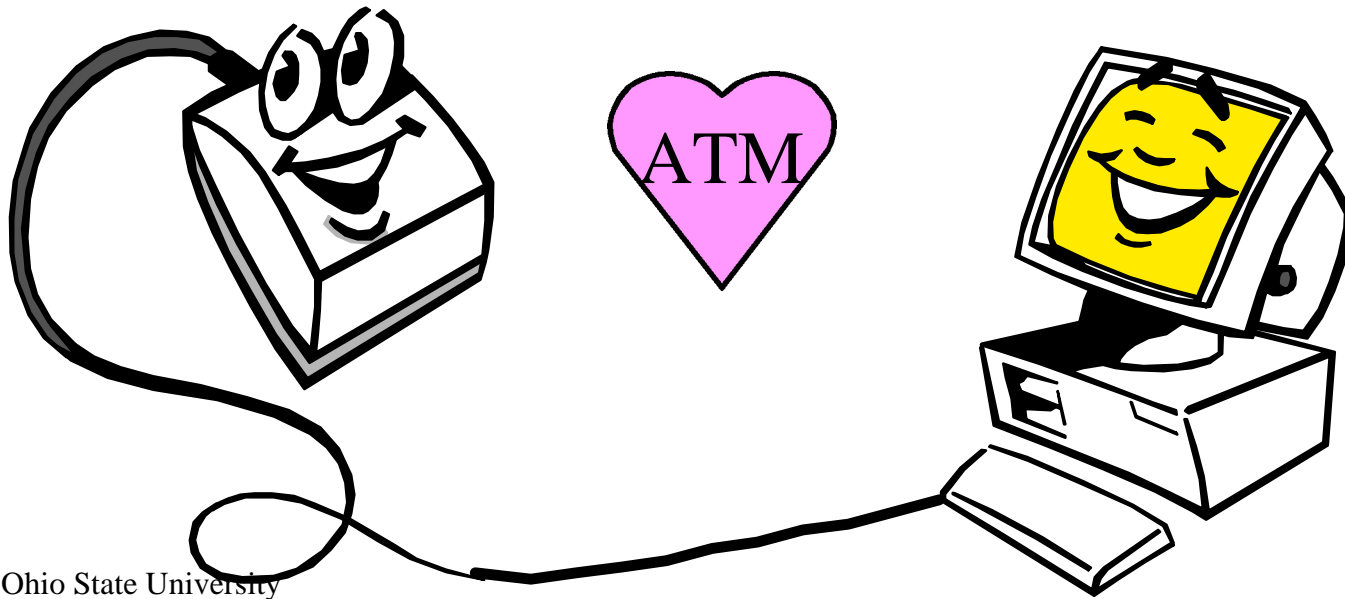
[http://www.cis.ohio-state.edu/~jain/talks/atm\\_ip.htm](http://www.cis.ohio-state.edu/~jain/talks/atm_ip.htm)



- ❑ Key Features of ATM
- ❑ LAN Emulation
- ❑ Classical IP over ATM
- ❑ Multicast Address Resolution (MARS)
- ❑ Next Hop Resolution Protocol (NHRP)
- ❑ Multiprotocol over ATM(MPOA)
- ❑ IP Switching

# What is ATM?

- ❑ Asynchronous Transfer Mode
- ❑ ATM Net = Data Net + Phone Net
- ❑ Combination of Internet method of communication (packet switching) and phone companies' method (circuit switching)



# ATM: Key Features

- Fixed Size Cells: 48B payload + 5B header

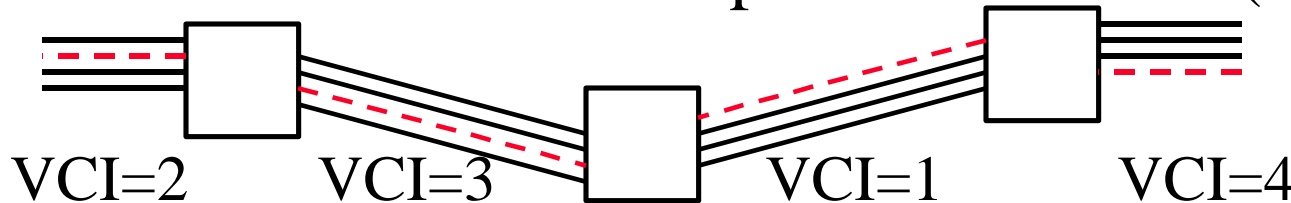


Non-ATM Networks



ATM Networks

- Connection Oriented: Dial-up virtual circuits (VCs)

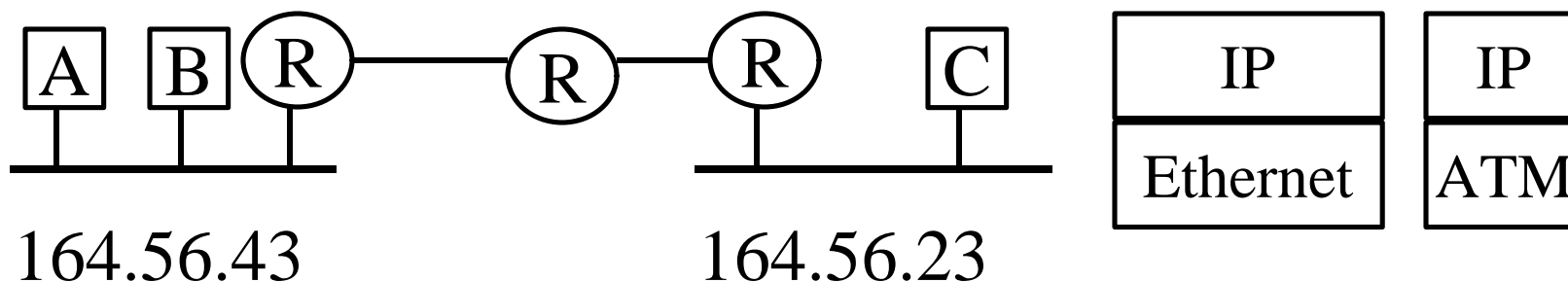


- Switching: VC Id is used as index. No address lookup.
- Signaling: Declare the traffic and performance
- Quality of Service: Path depends upon delay/throughput
- Traffic Management: Feedback based. Not loss.

# IP Forwarding: Fundamentals

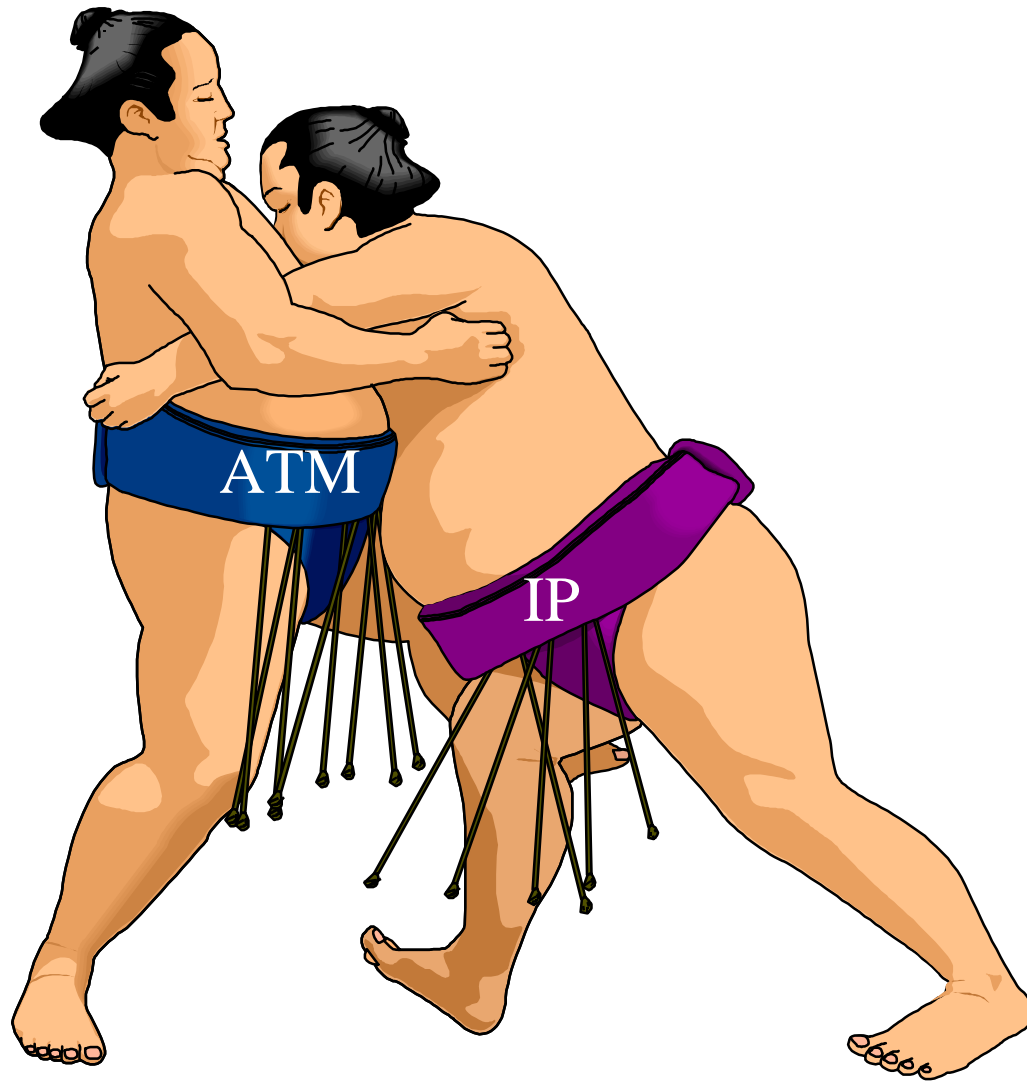
To: 164.56.23.34

From: 164.56.43.96



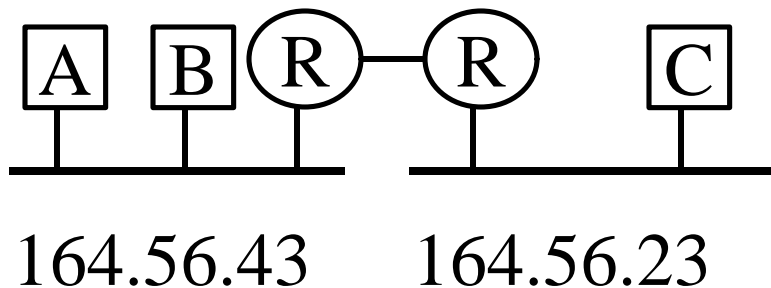
- ❑ All IP nodes have a 32-bit IP address
- ❑ IP routers forward the packets towards the destination subnet
- ❑ On the same subnet, routers are not required.
- ❑ On the destination subnet, IP address is translated to LAN address.

# IP Over ATM

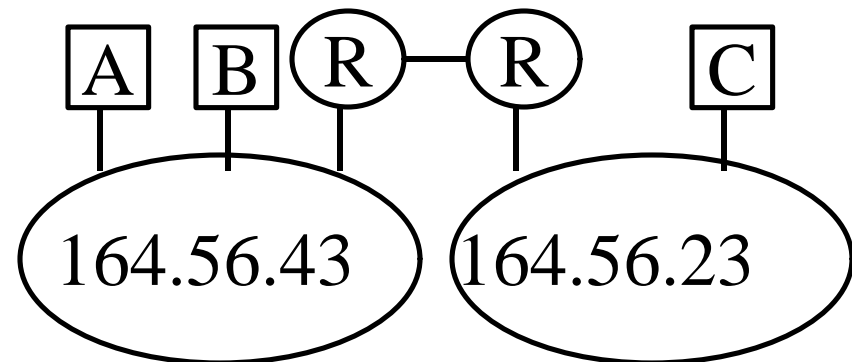


# IP over ATM via LAN Emulation

- Make ATM layer look exactly like Ethernet layer  
IP layer runs on ATM as it is running on Ethernet  
⇒ LAN emulation



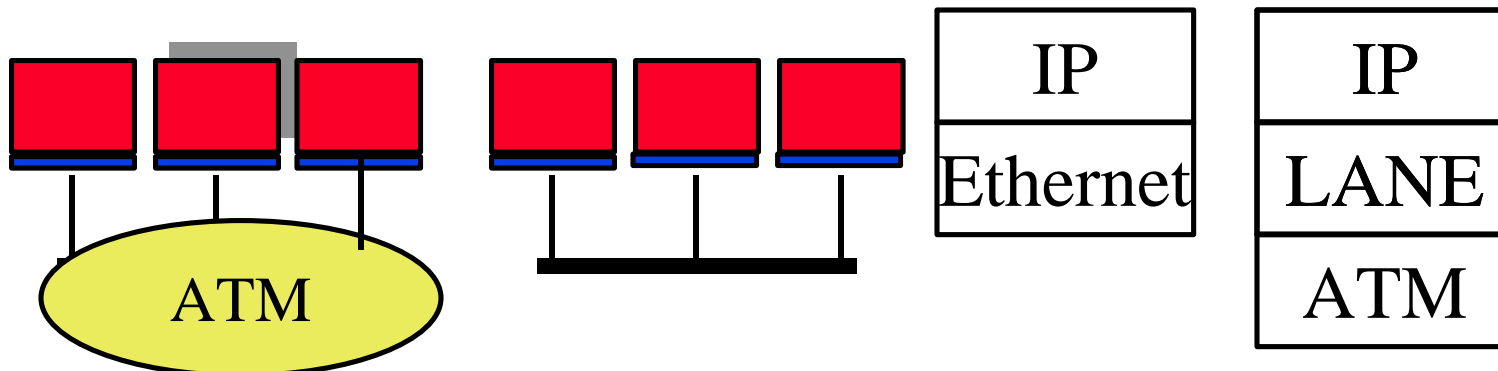
Ethernet-based LAN



ATM LAN

- IP Addresses: 164.56.23.34  
Ethernet Addresses: AA-23-56-34-C4-56  
ATM : 47.0000 1 614 999 2345.00.00.AA....

# LAN Emulation

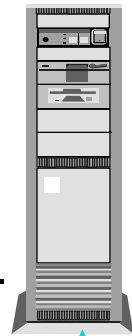


- ❑ LAN Emulation driver replaces Ethernet driver and passes the networking layer packets to ATM driver.
- ❑ Each ATM host is assigned an Ethernet address.
- ❑ LAN Emulation Server translates Ethernet addresses to ATM addresses
- ❑ Hosts set up a VC and exchange packets
- ❑ All software that runs on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

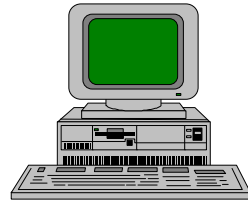


# LAN Emulation

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

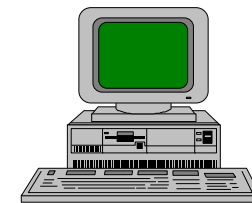
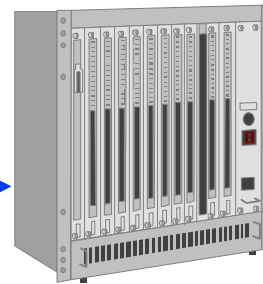
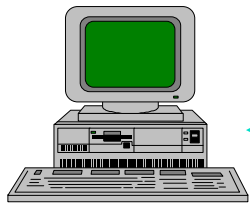


LAN Emulation Server



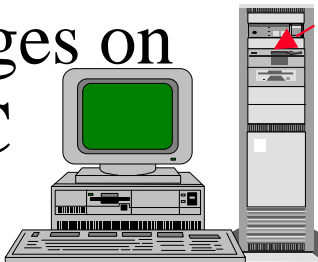
3. Messages for ATM clients are delivered directly.

Switches

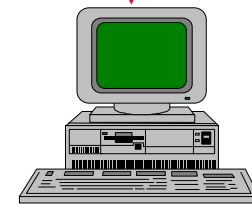


ATM client B  
Bridge

2. Client sends messages on the VC



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

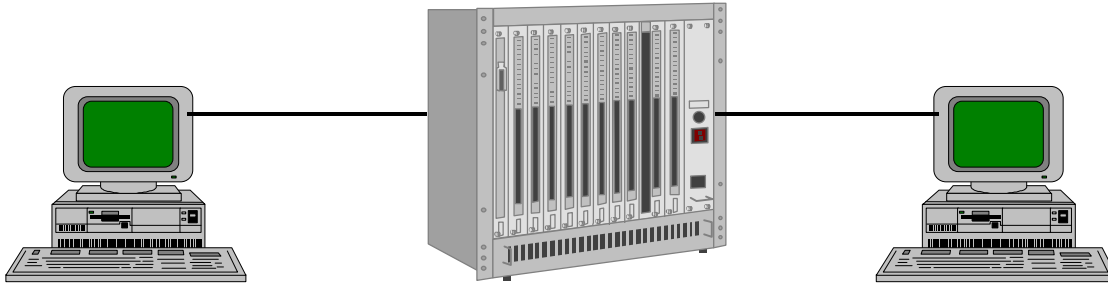


Broadcast/Unknown Server (BUS)

Non-ATM client

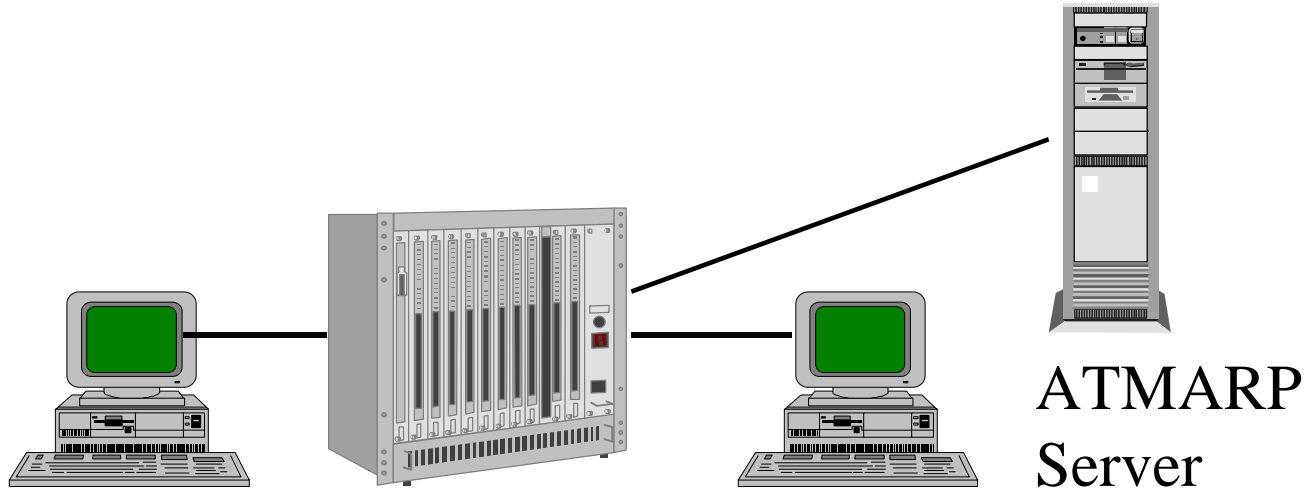
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# IP Over ATM: Issues



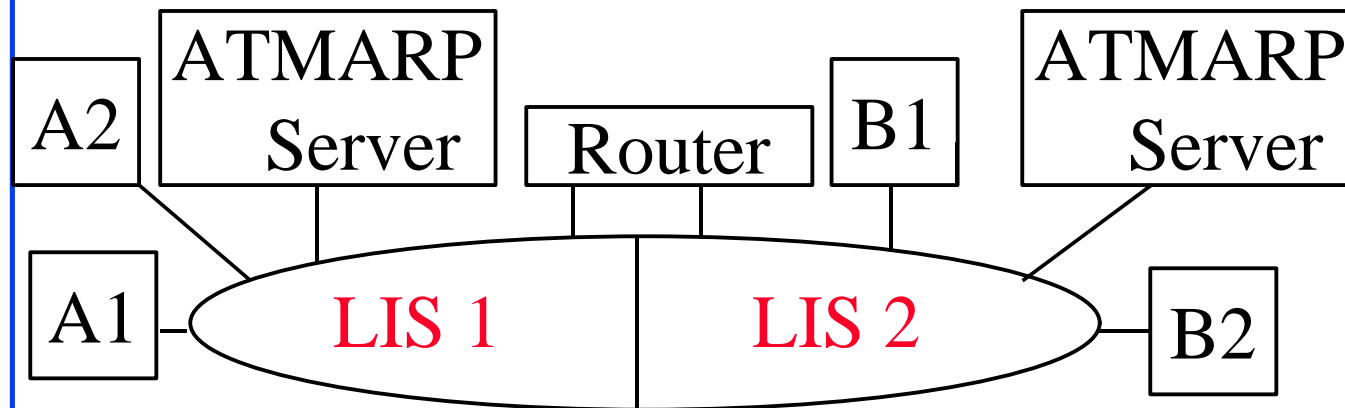
1. How to find ATM addresses from IP addresses  
Address resolution [RFC1577]
2. How to handle multicast? [MARS, RFC 2022]
3. How do we go through  $n$  subnets on a large ATM network? [NHRP]

# 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



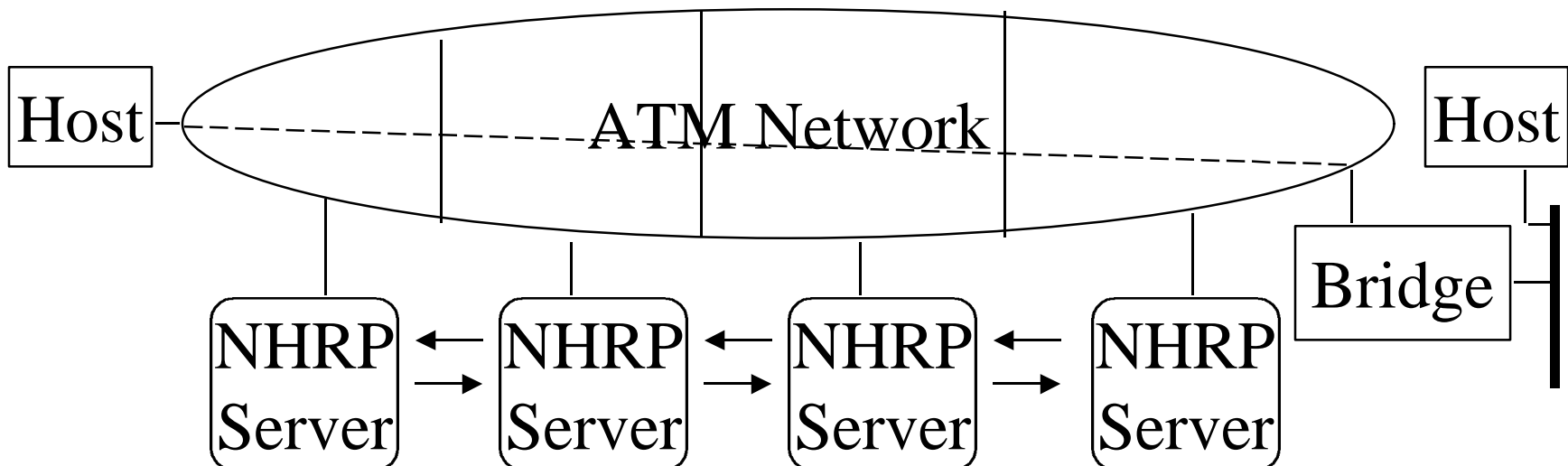
- ❑ ATM stations are divided into Logical IP Subnets (LIS)
- ❑ ATMARP server translates IP addresses to ATM addresses.
- ❑ Each LIS has an ATMARP server for resolution
- ❑ IP stations set up a direct VC with the destination or the router and exchange packets.

# 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

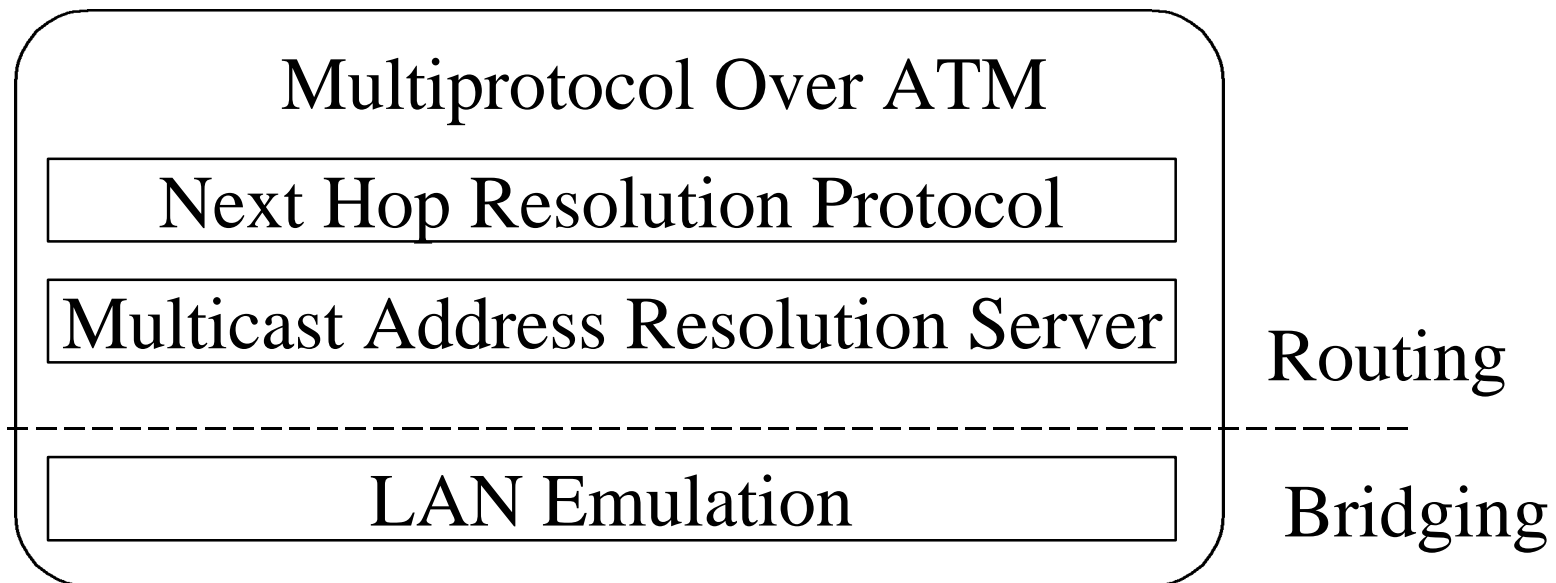
# Next Hop Resolution Protocol

- ❑ 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.



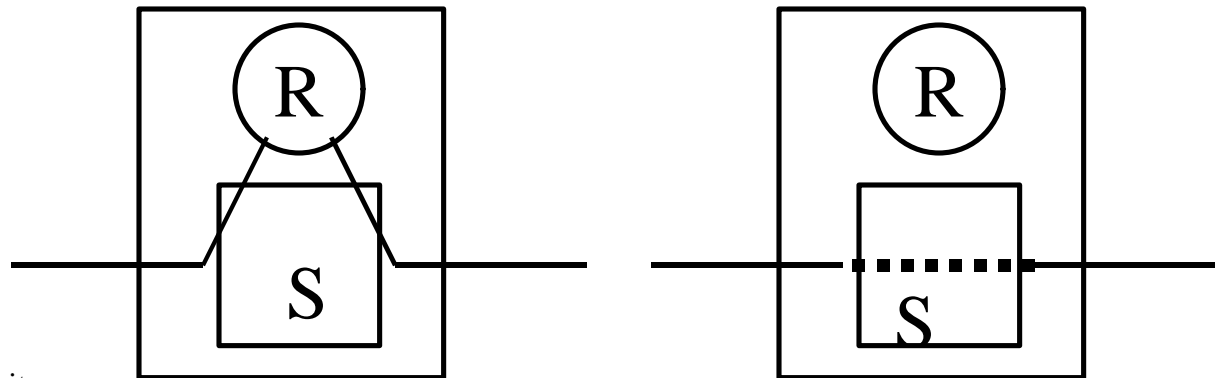
# Multiprotocol Over ATM

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



# IP Switching

- ❑ Developed by Ipsilon
- ❑ Routing software in every ATM switch in the network
- ❑ Initially, packets are reassembled by the routing software and forwarded to the next hop
- ❑ Long term flows are transferred to separate VCs. Mapping of VCIs in the switch  $\Rightarrow$  No reassembly





# IP Switching (Cont)

- ❑ Flow-oriented traffic: FTP, Telnet, HTTP, Multimedia
- ❑ Short-lived Traffic: DNS query, SMTP, NTP, SNMP, request-response  
Ipsilon claimed that 80% of packets and 90% of bytes are flow-oriented.
- ❑ Ipsilon claimed their Generic Switch Management Protocol (GSMP) to be 2000 lines, and Ipsilon Flow Management Protocol (IFMP) to be only 10,000 lines of code
- ❑ Runs as added software on an ATM switch
- ❑ Implemented by several vendors

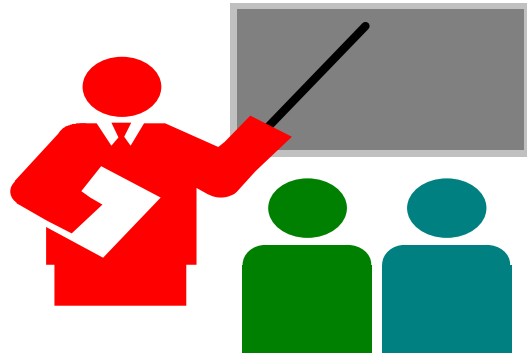
# Before



**After**



# Summary



- ❑ LANE allows current applications to run on ATM
- ❑ Classical IP allows ARP using ATMARP servers
- ❑ MARS allows IP multicasts on ATM
- ❑ NHRP removes the need for routing in an ATM net
- ❑ MPOA combines LANE and NHRP
- ❑ IP Switching automatically set up VCs for long-lived flows.

# References

- ❑ LAN Emulation and IP over ATM References, [http://www.cis.ohio-state.edu/~jain/refs/ipoa\\_ref.htm](http://www.cis.ohio-state.edu/~jain/refs/ipoa_ref.htm)
- ❑ A Survey of IP over ATM, [http://www.cis.ohio-state.edu/~jain/cis788-97/ip\\_over\\_atm/index.htm](http://www.cis.ohio-state.edu/~jain/cis788-97/ip_over_atm/index.htm)
- ❑ IP QoS over ATM (Intserv, Diffserv, RSVP and MPLS over ATM), [http://www.cis.ohio-state.edu/~jain/cis788-99/ip\\_qos\\_atm/index.html](http://www.cis.ohio-state.edu/~jain/cis788-99/ip_qos_atm/index.html)
- ❑ The Performance of TCP Over ATM ABR and UBR Services, [http://www.cis.ohio-state.edu/~jain/cis788-97/tcp\\_over\\_atm/index.htm](http://www.cis.ohio-state.edu/~jain/cis788-97/tcp_over_atm/index.htm)

# Thank You!

