Legacy Protocols Over ATM: Part II

Raj Jain

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

<u>http:</u>

MBone Instructions

❑ Handouts for the class are available on-line: http://www.cis.ohio-state.edu/~jain/cis788-97/index.html or http://www.netlab.ohio-state.edu/~jain/cis788-97/index.html

❑ The schedule keeps changing. Please always check current schedule at: http://www.cis.ohio-state.edu/~jain/cis788-97/schedule.html

Instructions (Cont)

❑ Please email your positive and negative
feedback about the quality of the reception
as well as the content with a subject field
of "Feedback" to mbone@netlab.ohio-state.edu

❑ If you are not able to receive the program due to some
technical difficulties, please email "Feedback" to
mbone@netlab.ohio-state.edu

❑ Please email technical questions with the subject field
"Question" to mbone@netlab.ohio-state.edu. We will
try to answer selected questions live.

Overview

- Multicast Address Resolution Servers (MARS)
- Next-Hop Resolution Protocol (NHRP)
- Multiprotocol over ATM (MPOA)
- IP Switching
  Note: Competing approaches such as tag, label switching, etc will be covered in the next lecture.

Disclaimer

❑ This technology is currently evolving.
$\Rightarrow$ All statements are subject to change.

❑ Features not in a scheme may be implemented later in that scheme.

❑ Problems claimed to be in a scheme may later not be a problem.

IP Multicast over ATM

- ❑ Need to resolve IP multicast address to ATM address list
- ❑ Multicast Address Resolution Servers (MARS)
- ❑ Each MARS serves a cluster (LIS) of IP hosts
- ❑ Each LIS contains only one cluster
- ❑ Old LIS members not using MARS are not in the cluster
- ❑ Internet Group Multicast Protocol (IGMP)
- ❑ Hosts are configured with MARS address

MARS (Cont)

- ❑ 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

- ❑ Senders do not need to be members of the multicast group

- ❑ All hosts are members of the 255.255.255.255 broadcast group

Multicast Server

❏ **VC Mesh**: Each hosts sets up a point-to-multipoint VC with all members of the group

❏ **Multicast Server** (MCS): Retransmits packets to multicast members on a point-to-multipoint VC or multiple point-to-point VCs.
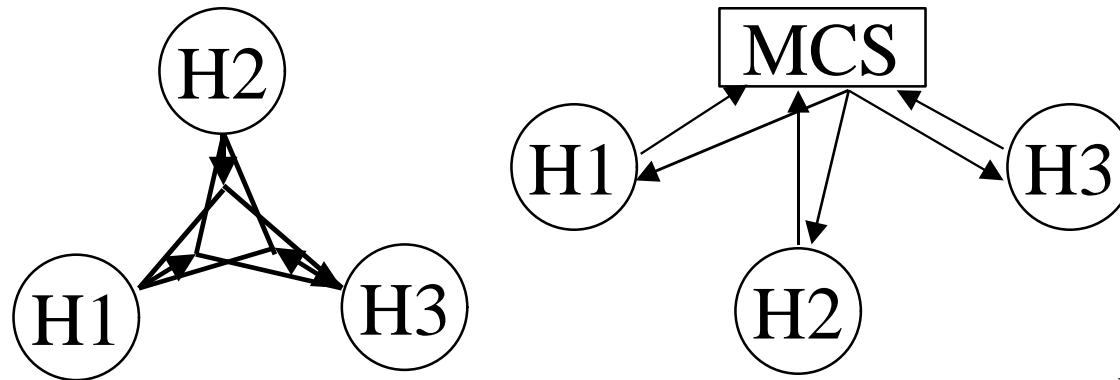
MCS (Cont)

❑ Each multicast group uses either VC mesh
  or multicast server (not both)

❑ MCS registers with MARS as a server for particular
  groups

❑ On ARP requests for those groups, MARS returns
  MCS's address

❑ On membership updates for those groups, MARS
  informs MCS

❑ MCS has to reassemble all frames before transmission

NHRP

❑ Problem with LANE and RFC 1577: Data needs to go through routers even if on the same ATM net

❑ Like going to the airport just to go to next block

❑ Solution: Next Hop Routing Protocol
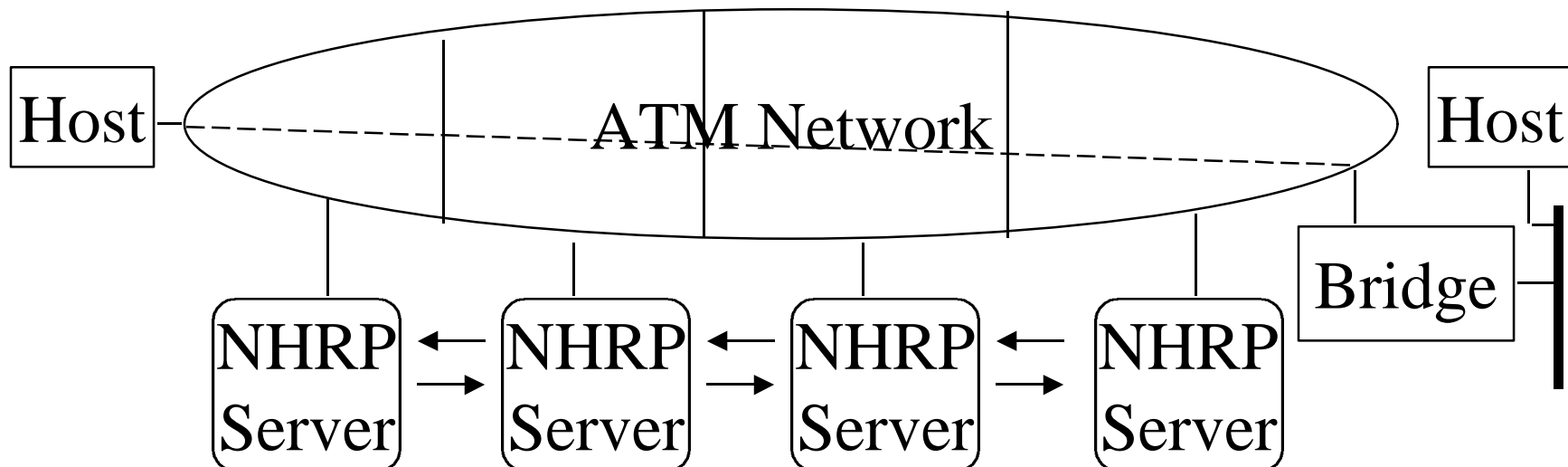
- ❑ Provides the next hop towards the destination.
- ❑ Developed by Routing over Large Clouds (ROLC) group
- ❑ Hosts are configured with the address of server
- ❑ NHRP servers cache the results
- ❑ NHRP replies can be non-authoritative or authoritative
- ❑ NHRP requests can be non-authoritative or authoritative
- ❑ Authoritative requests generally issued after failures.

- While waiting for NHRP shortcut, data may be forwarded along the routed path.
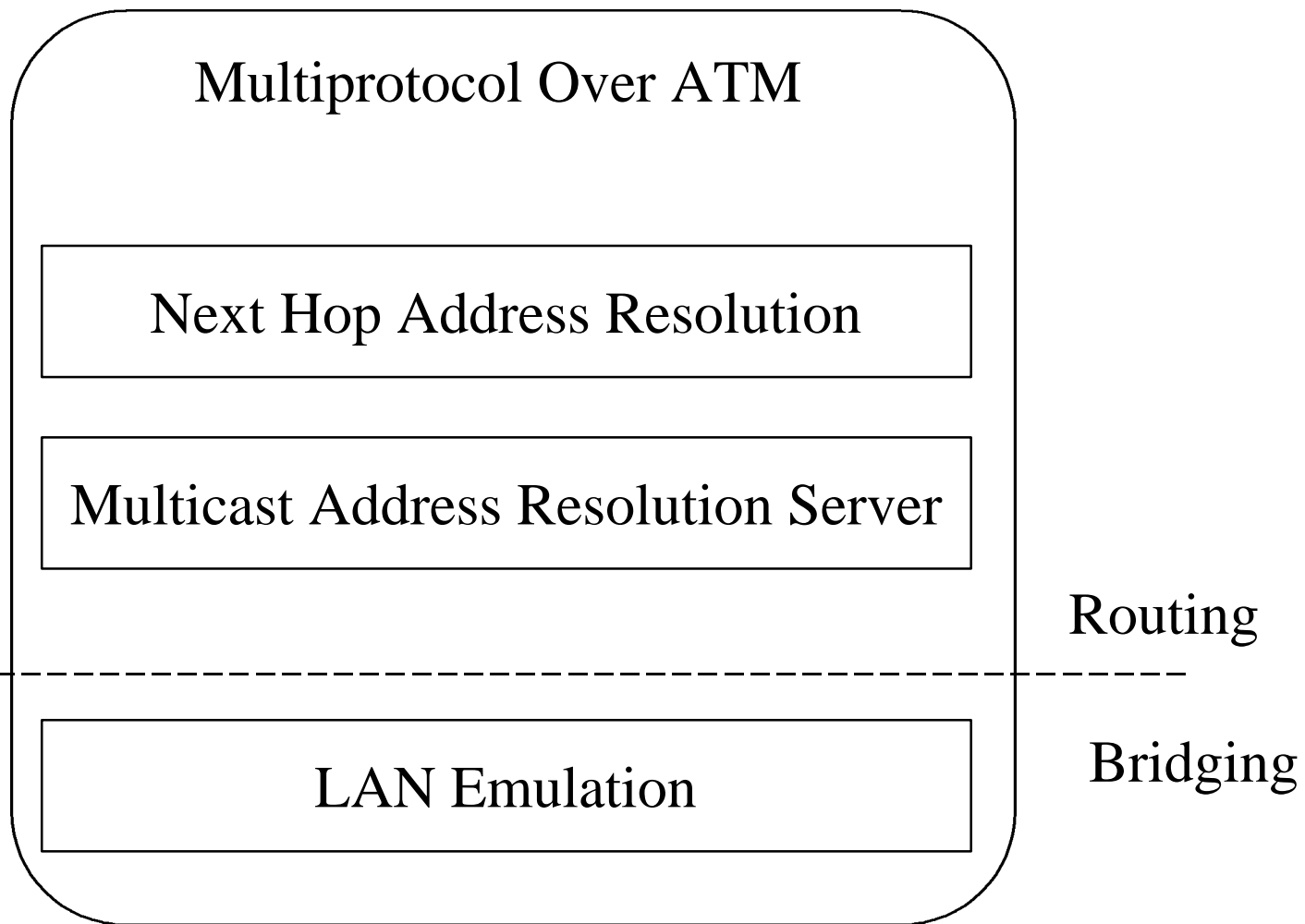- NHS learns about hosts via manual configuration or registration

Multiprotocol Over ATM

❑ MPOA is an extension of LANE.

❑ Both LANE and RFC 1577 need routers even in the same ATM network

❑ MPOA uses NHRP to provide direct layer 3 connectivity across an ATM fabric
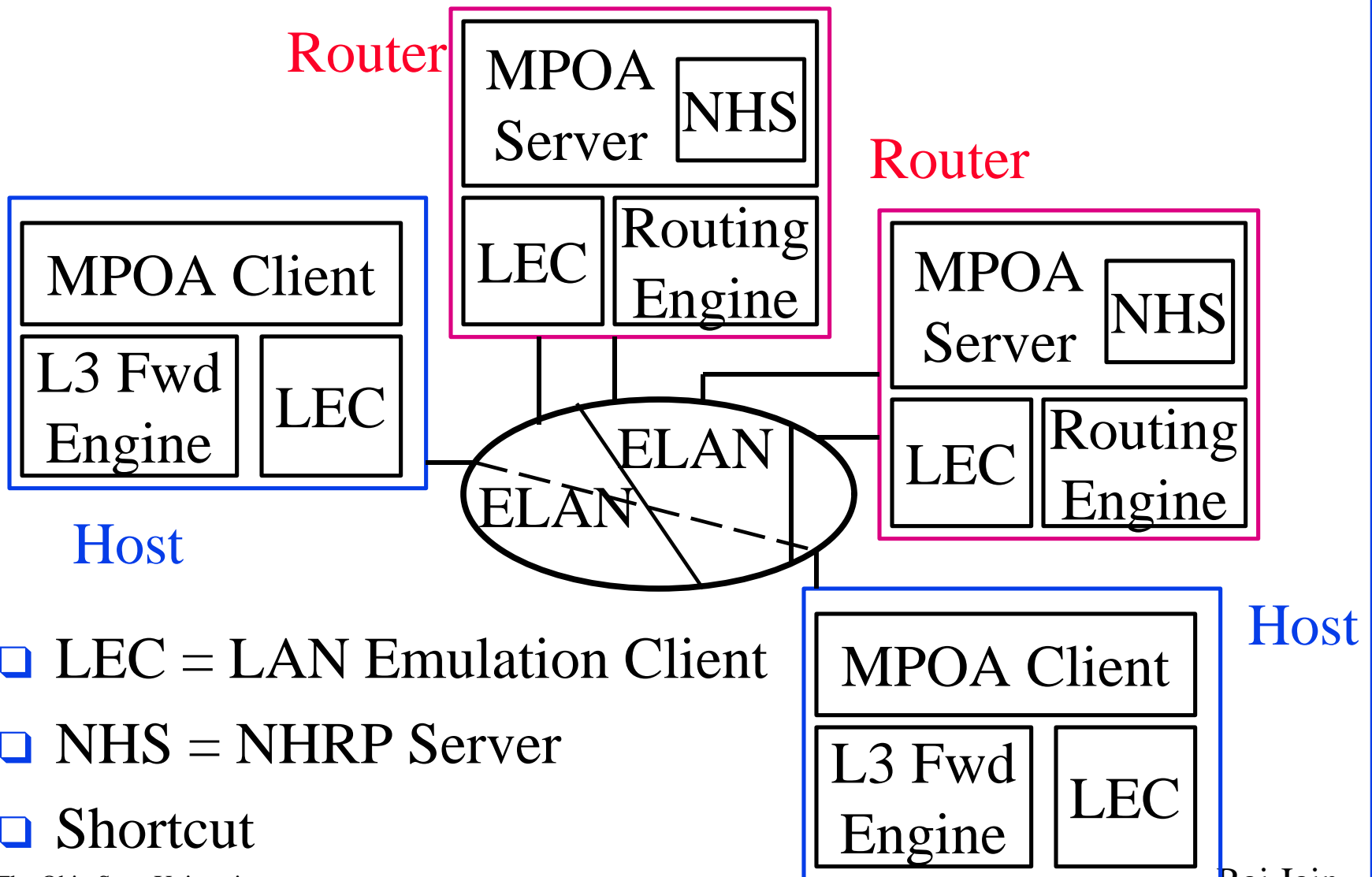
❑ Reduces the need for routers within ATM

ATM Network   Host

Router   Bridge
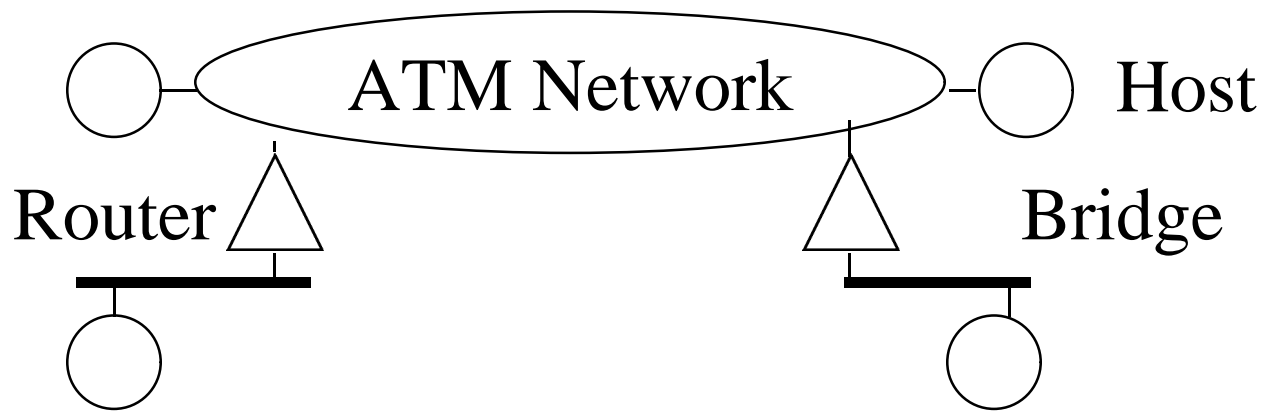
- ❏ Layer 3 protocol runs directly over ATM
  $\Rightarrow$ Can use ATM QoS
- ❏ LANE operates at layer 2
- ❏ RFC 1577 operates at layer 3
- ❏ MPOA operates at both layer 2 and layer 3
  $\Rightarrow$ MPOA can handle non-routable as well as routable protocols
- ❏ MPOA uses LANE for its layer 2 forwarding
- ❏ Multiprotocol = Unified approach for all layer 3 protocols over ATM

Simplified Protocol Stack

Multiprotocol Over ATM

Next Hop Address Resolution

Multicast Address Resolution Server

Routing

- -

LAN Emulation

Bridging

MPOA Components

Router

MPOA Server

NHS

LEC

Routing Engine

Router

MPOA Client

L3 Fwd Engine

LEC

Host

MPOA Server

NHS

LEC

Routing Engine

ELAN

ELAN

ELAN

Host

MPOA Client
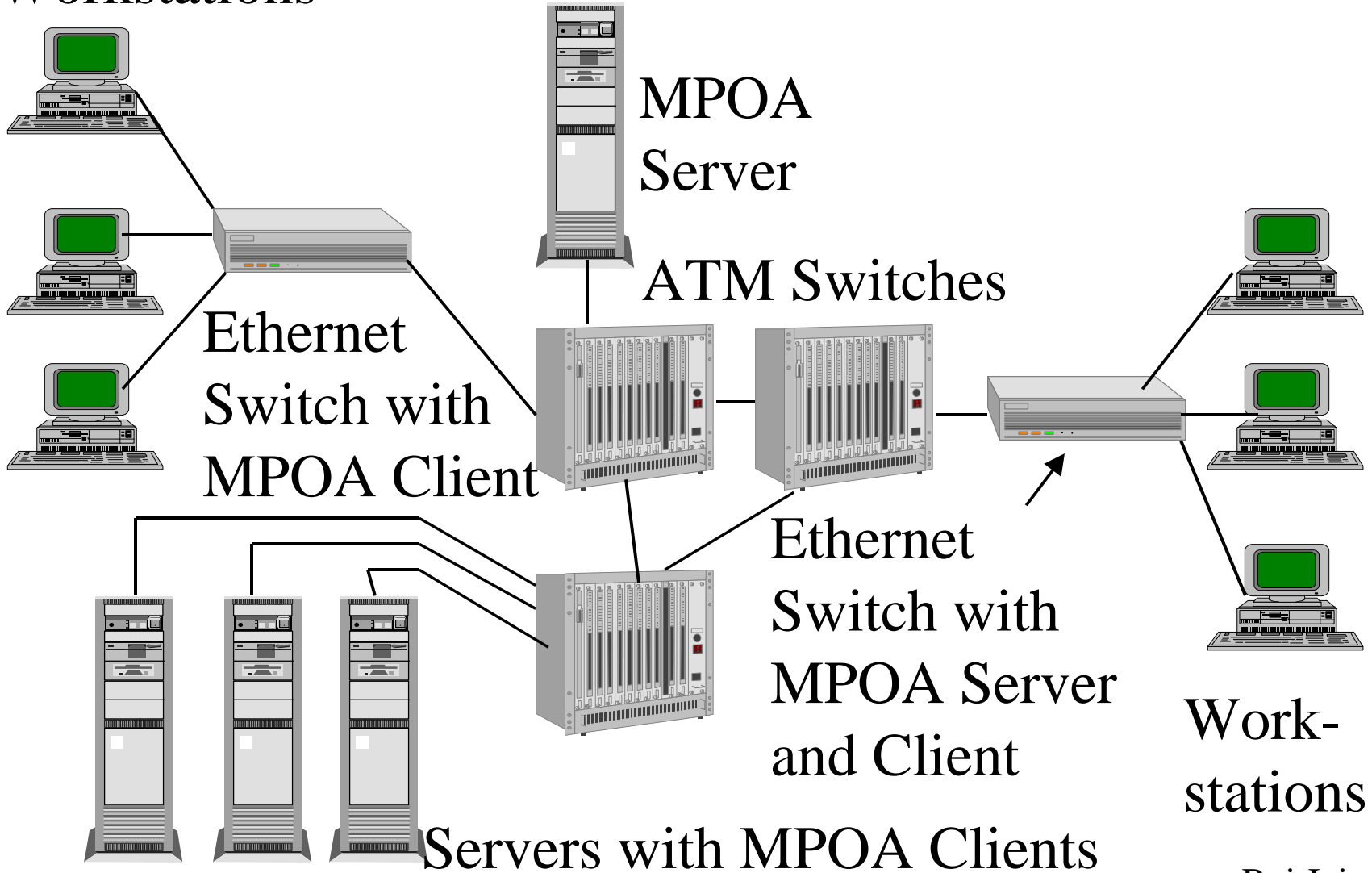
L3 Fwd Engine

LEC

❑ LEC = LAN Emulation Client

❑ NHS = NHRP Server

❑ Shortcut

- ❑ MPOA Client:
  - ❍ Sources and sinks shortcuts
  - ❍ Performs L3 forwarding
  - ❍ But does not run routing layer protocols
- ❑ MPC Server:
  - ❍ Provides L3 forwarding info to MPCs
  - ❍ Includes NHS and extensions
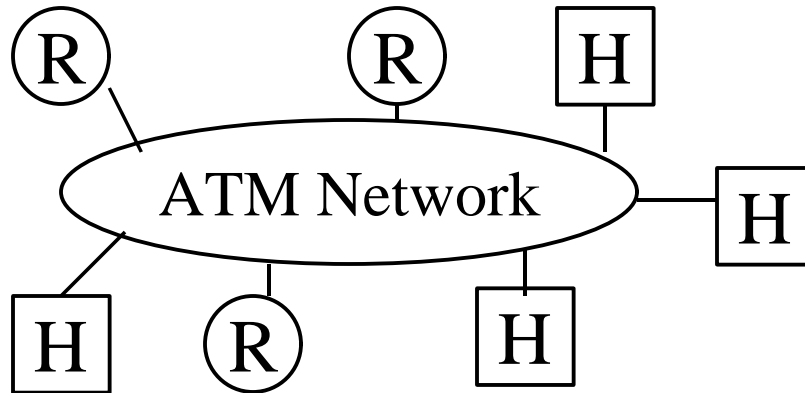- ❑ MPOA components use extensions to LANE ARP to discover each other
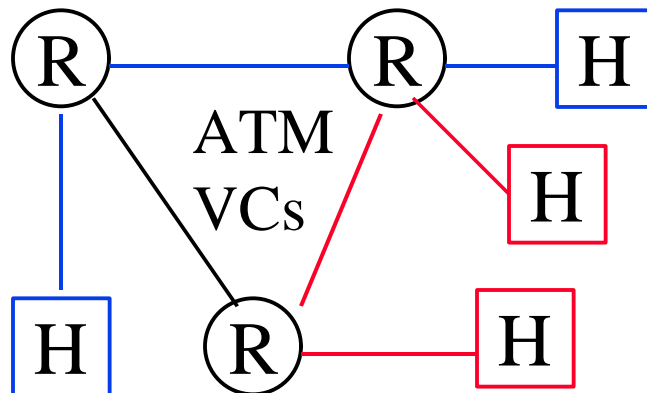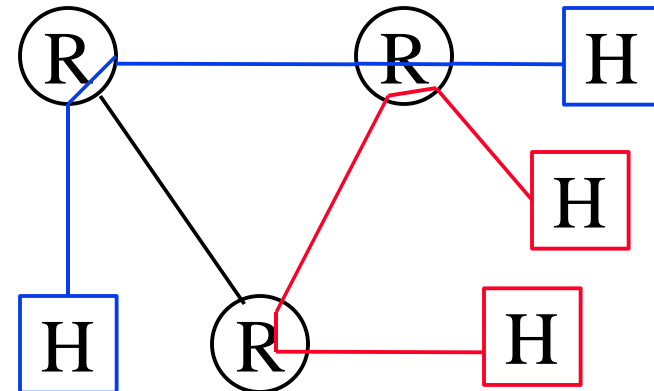
Sample MPOA Network

Workstations

MPOA
Server

ATM Switches

Ethernet
Switch with
MPOA Client

Ethernet
Switch with
MPOA Server
and Client

Work-
stations

Servers with MPOA Clients

IP Switching

1. Original ATM Network

2. VCs at every hop
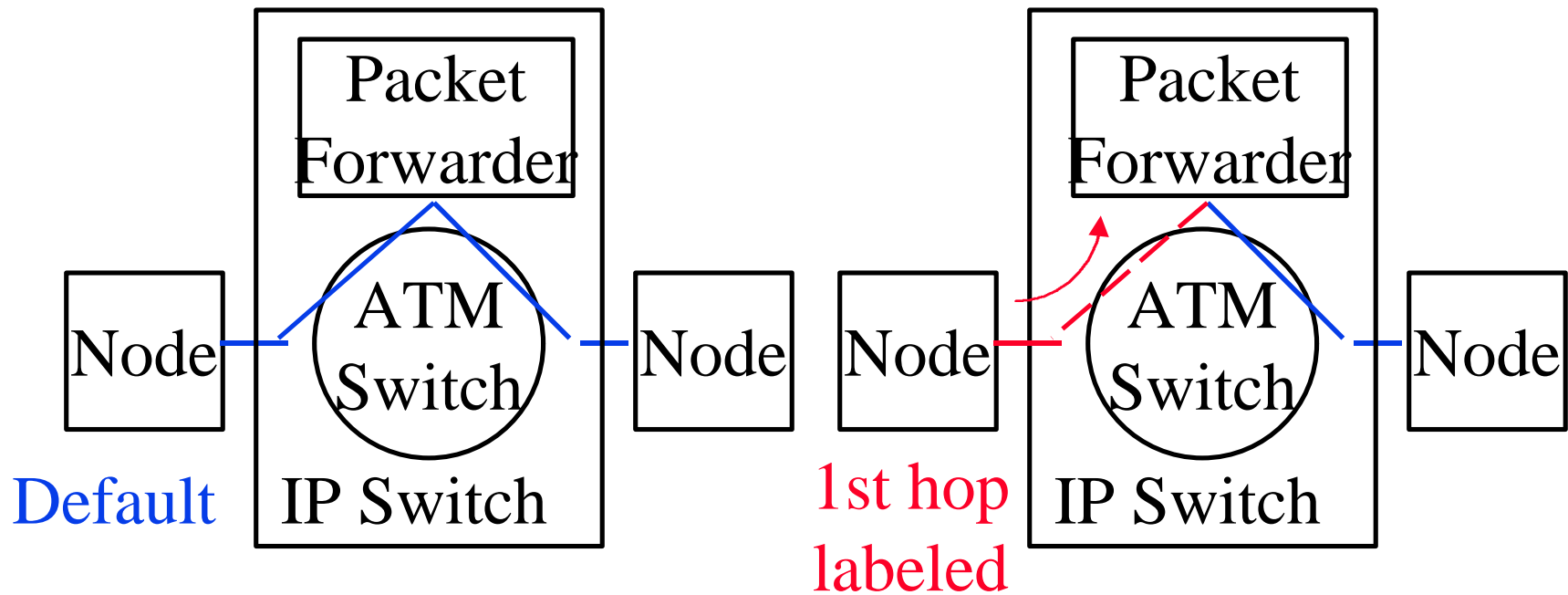

3. Short-circuit VCs

IP Switching

- ❏ Each ATM switch also has routing s/w

- ❏ Normally the packets are reassembled and forwarded in the router. Segmentation and reassembly in the forwarder.

- ❏ If a flow is deemed to be "flow oriented", previous node is told to set up a new VC. Forwarder uses cached info.

- ❏ Downstream nodes may also ask for a new VC. The switch then makes a mapping for cut-through
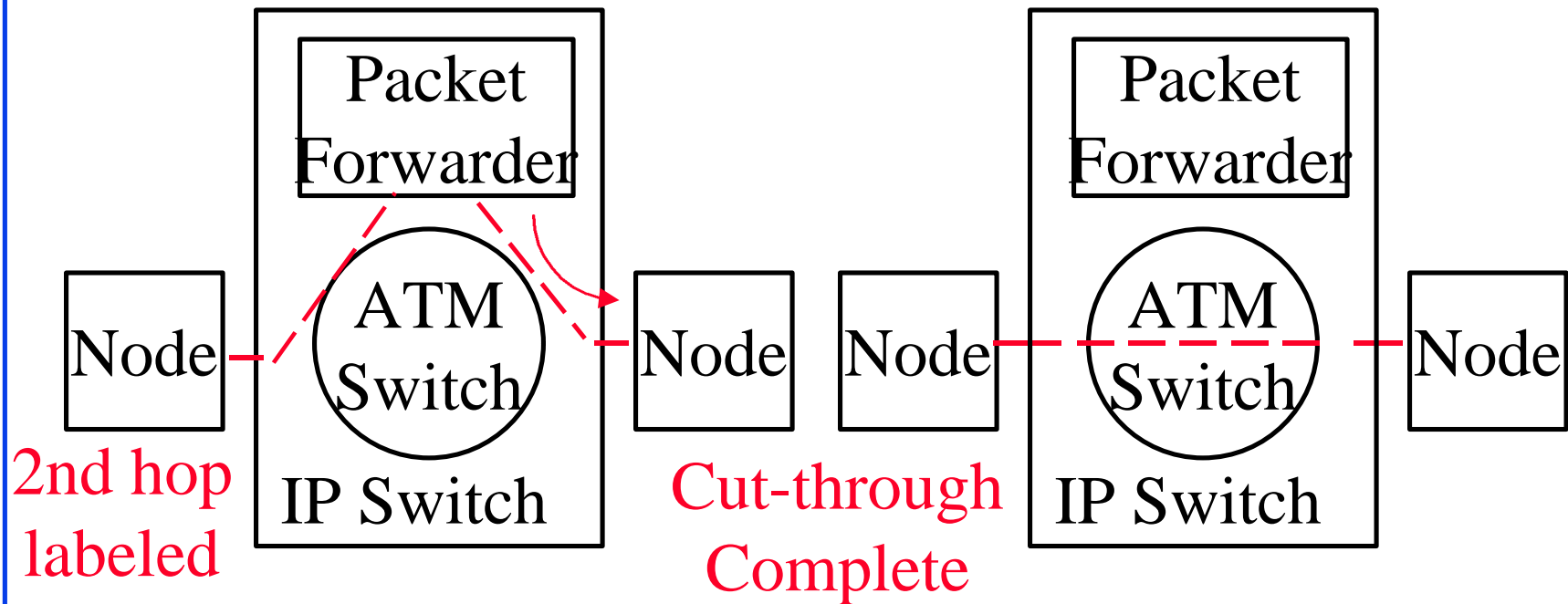
- ❏ Flow-oriented traffic: FTP, Telnet, HTTP, Multimedia

IP Switching (Cont)

- Short-lived Traffic: DNS query, SMTP, NTP, SNMP, request-response

- Ipsilon claims that 80% of packets and 90% of bytes are flow-oriented.

- Ipsilon Flow Management Protocol (IFMP)

- IP switching implemented as a s/w layer over an ATM switch

- Ipsilon claims their Generic Switch Management Protocol (GSMP) to be 2000 lines, and Ipsilon Flow Management Protocol (IFMP) to be only 10,000 lines of code

IP Switching: Steps 1-2

Default   IP Switch

1st hop labeled   IP Switch

Node   Packet Forwarder   ATM Switch   Node

IP Switching: Steps 3, 4

Packet Forwarder

ATM Switch

IP Switch

Node

Node

2nd hop labeled

Cut-through Complete

Packet Forwarder

ATM Switch

IP Switch

Node

Node

Node

Ipsilon's IP Switching: Features

❏ Runs as added software on an ATM switch

❏ Implemented by several vendors

❏ Multicast flows $\Rightarrow$ pt-mpt VC per source

❏ Routing bypassed $\Rightarrow$ Firewall bypassed

  ❍ Solution: IP fields are deleted before segmentation and added after assembly $\Rightarrow$ First packet has to go through firewall.

❏ Initially IP only. IPX supported via tunneling in IP.

Ipsilon's IP Switching: Issues

- ❏ VCI field is used as ID.
  VPI/VCI change at switch
  - ⟹ Must run on **every** ATM switch
  - ⟹ non-IP switches not allowed between IP switches
  - ⟹ Subnets limited to one switch

- ❏ Cannot support VLANs

- ❏ Scalability: Number of VC $\geq$ Number of flows.
  - ⟹ **VC Explosion**
  1000 setups/sec.

- ❏ Quality of service determined implicitly by the flow class or by RSVP

Issues (Cont)

❑ ATM only

❑ Connection setup on demand
  $\Rightarrow$ First packet is not switched

Other Competing Approaches

- ❑ Cisco: Tag Switching
- ❑ IBM: Aggregate Route Based IP Switching (ARIS)
- ❑ Toshiba: Cell-switched router
- ❑ Cabletron: Secure Fast Virtual Network
- ❑ 3Com: Fast IP
- ❑ Cascade: IP Navigator
- ❑ Bay Networks: Switch Node (packet-by-packet)

$\Rightarrow$ IETF: Multiprotocol label switching
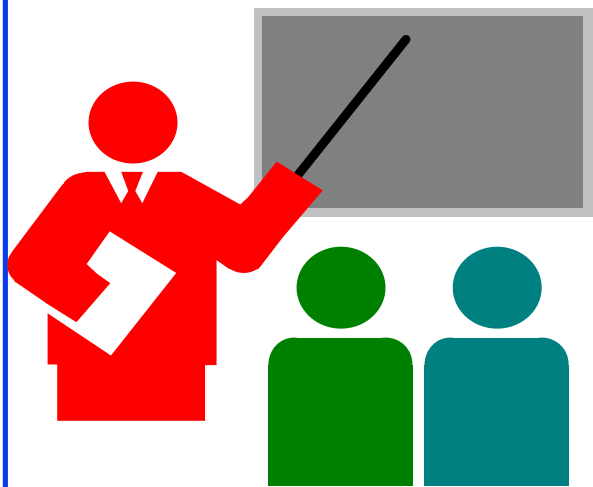
Summary

❏ MARS allows multicast address resolution within one subnet

❏ NHRP allows bypassing routers in a large ATM network

❏ MPOA extends LANE + MARS + NHRP

❏ Ipsilon's IP switch uses hop-by-hop VCs and bypasses routing for long flows

Key References

❑ See http://www.cis.ohio-state.edu/~jain/refs/atm_refs.htm for a detailed list of references.

❑ RFC 2022, "Support for Multicast over UNI 3.0/3.1 based ATM Network," 11/5/96.

❑ "NBMA Next Hop Resolution Protocol (NHRP)", http://www.internic.net/internet-drafts/draft-ietf-rolc-nhrp-10.txt, 10/1/1996.

❑ RFC 1954, "Transmission of flow labeled IPv4 on ATM datalinks Ipsilon V1.0," 5/22/96.