

Legacy Protocols Over ATM: Part II

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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.



- ❑ 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.
⇒ 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

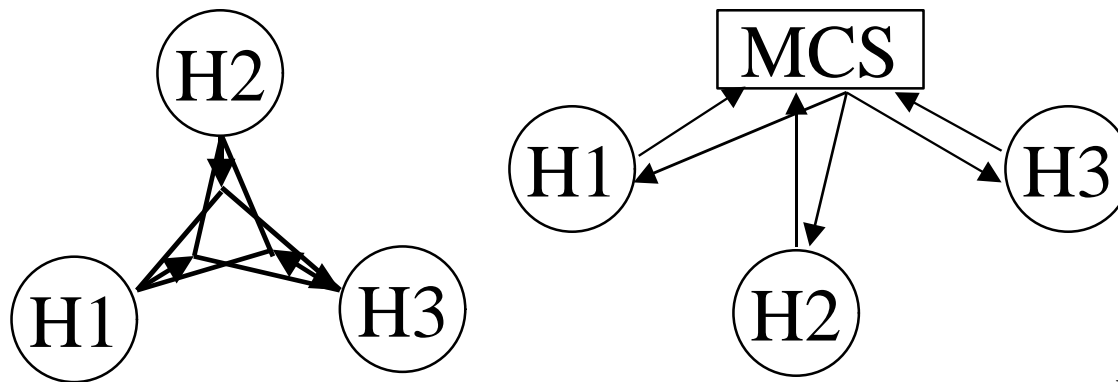
- ❑ Need to resolve IP multicast address to ATM address list
- ❑ Multicast Address Resolution Servers (MARS)
- ❑ Each MARS serves a cluster (LIS) of IP hosts
- ❑ Each LIS contains only one cluster
- ❑ Old LIS members not using MARS are not in the cluster
- ❑ Internet Group Multicast Protocol (IGMP)
-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

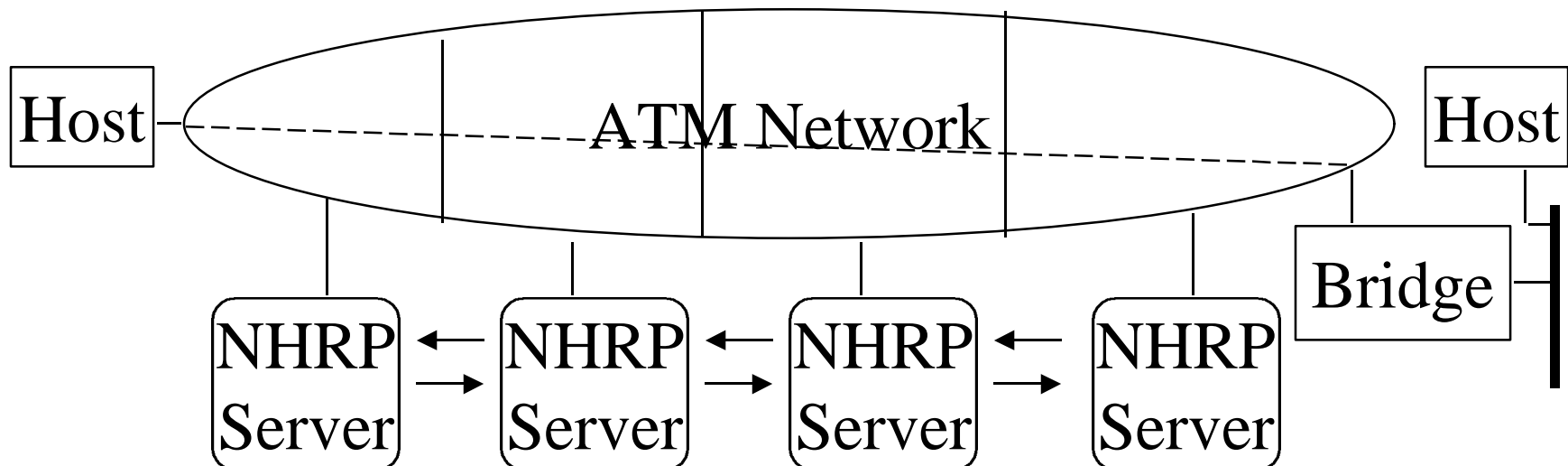


MCS (Cont)

- ❑ 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

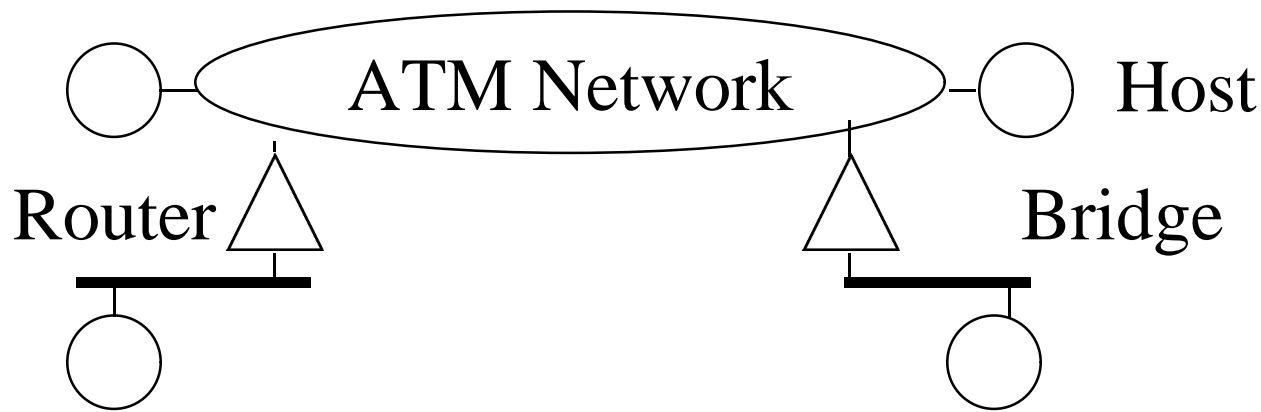


- ❑ Provides the next hop towards the destination.
- ❑ Developed by Routing over Large Clouds (ROLC) group
- ❑ Hosts are configured with the address of server
- ❑ NHRP servers cache the results
- ❑ NHRP replies can be non-authoritative or authoritative
- ❑ NHRP requests can be non-authoritative or authoritative
- ❑ 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

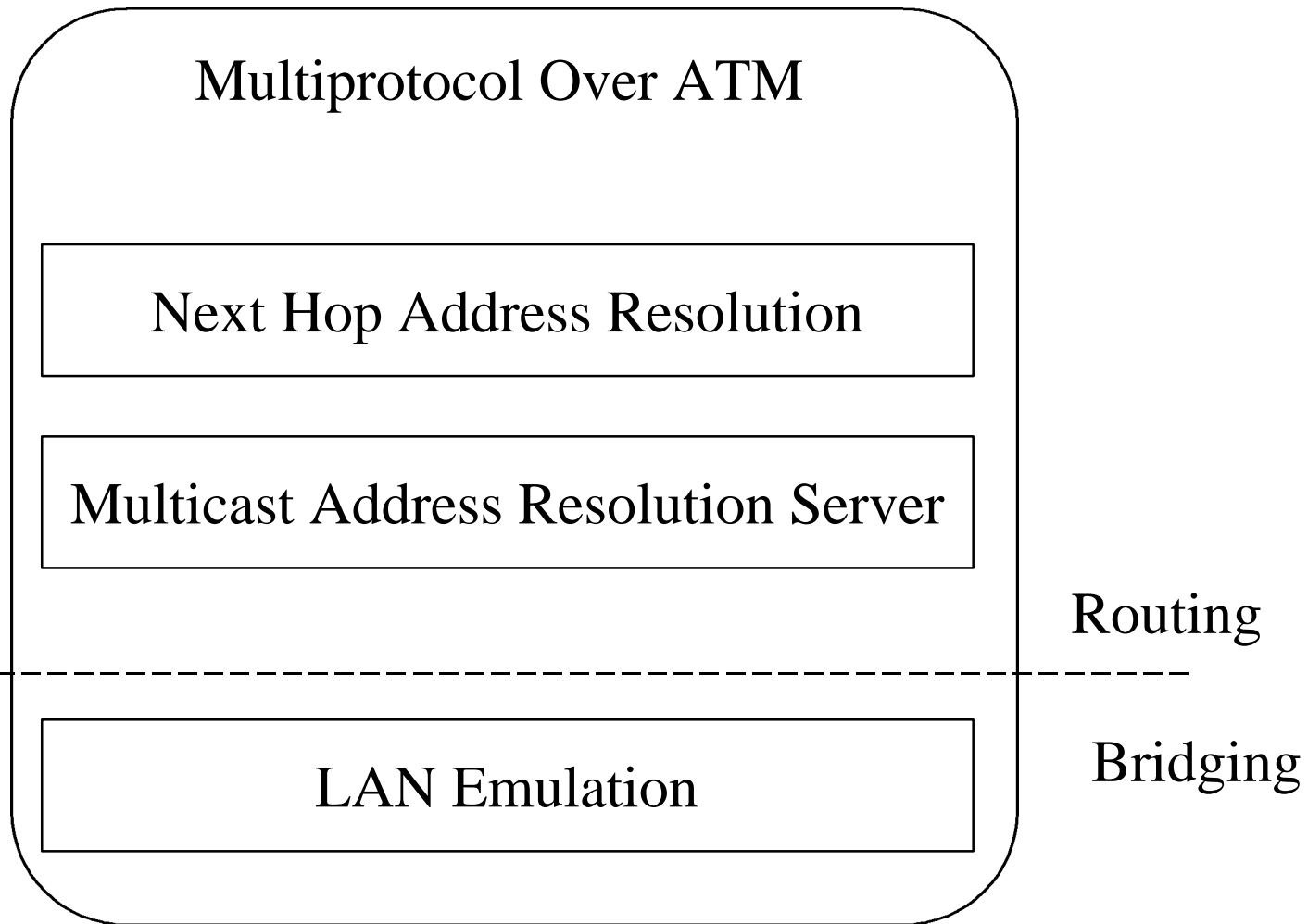
Multiprotocol Over ATM

- ❑ 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

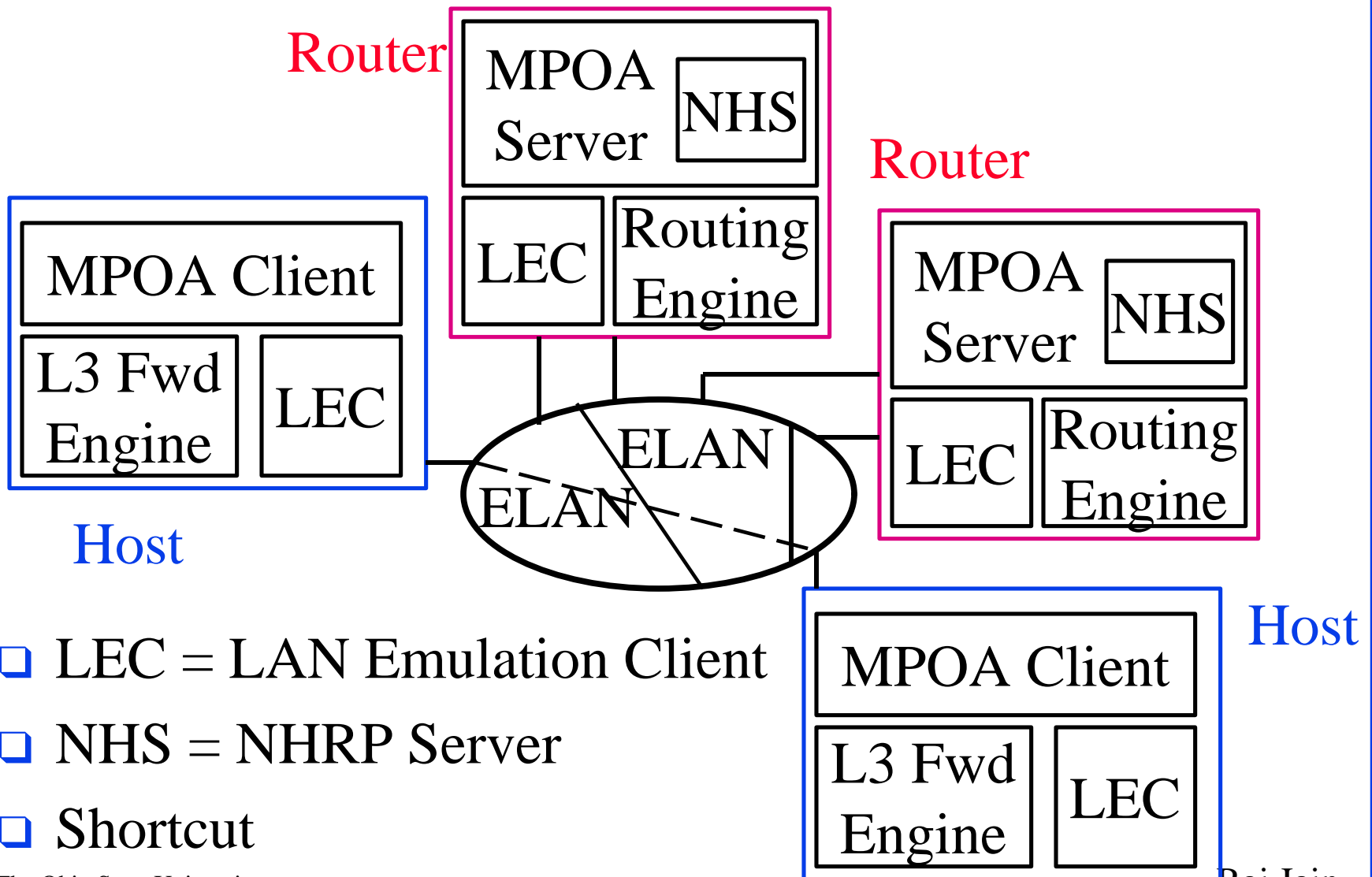


- ❑ Layer 3 protocol runs directly over ATM
⇒ Can use ATM QoS
- ❑ LANE operates at layer 2
- ❑ RFC 1577 operates at layer 3
- ❑ MPOA operates at both layer 2 and layer 3
⇒ MPOA can handle non-routable as well as routable protocols
- ❑ MPOA uses LANE for its layer 2 forwarding
- ❑ Multiprotocol = Unified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

Simplified Protocol Stack



MPOA Components

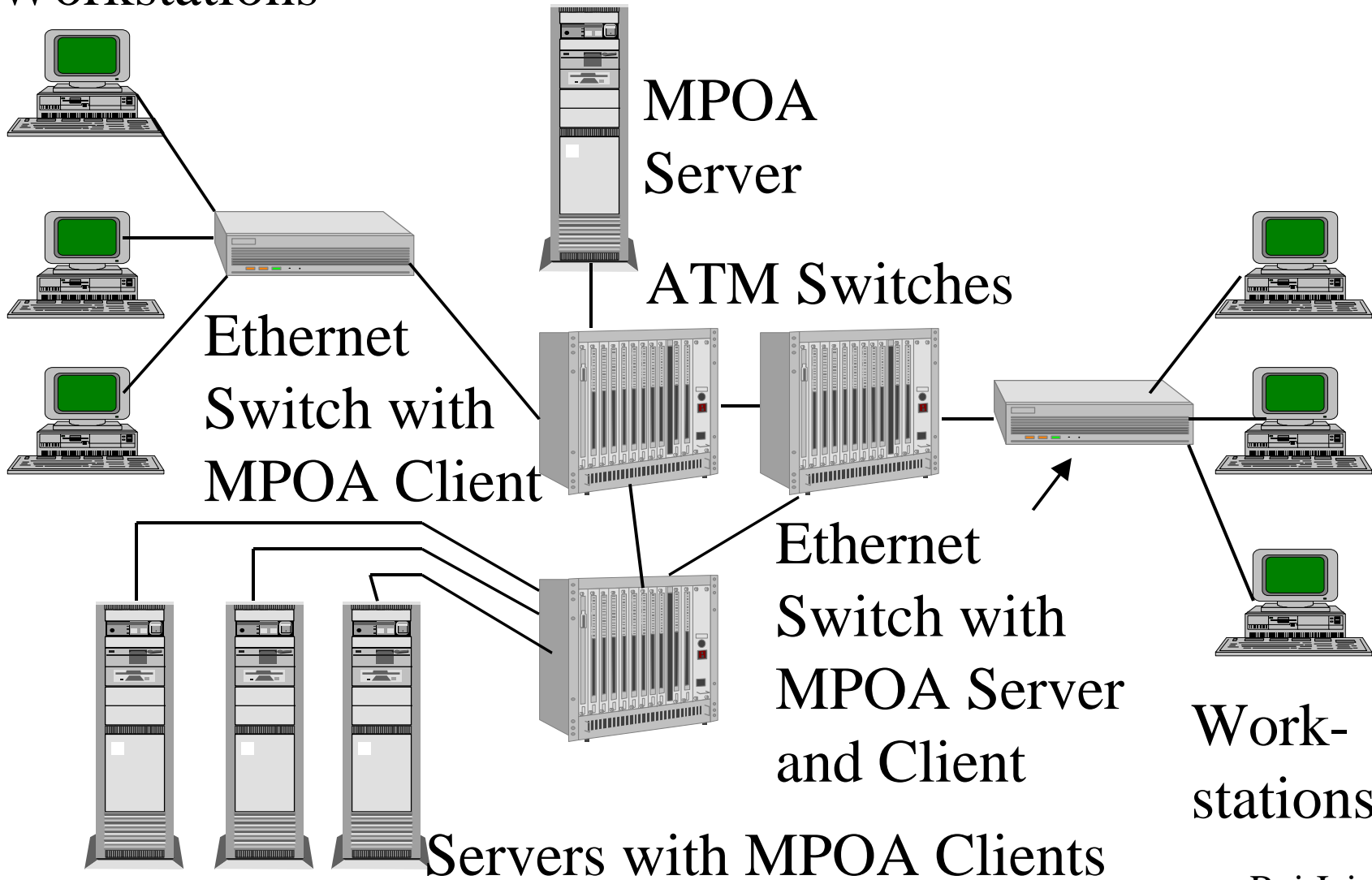


- ❑ LEC = LAN Emulation Client
- ❑ NHS = NHRP Server
- ❑ Shortcut

- ❑ 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

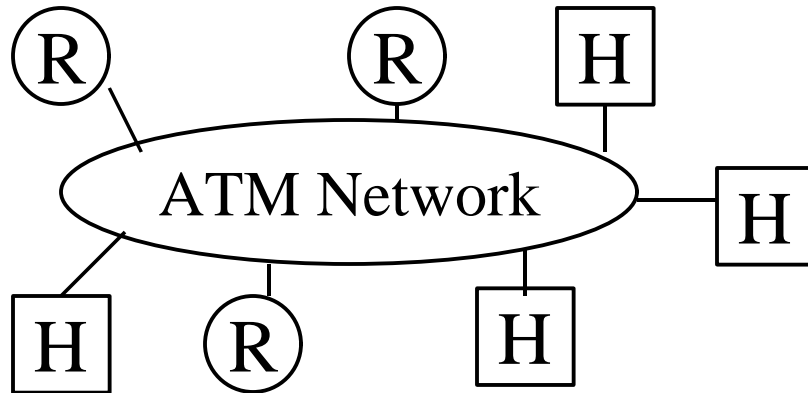
Sample MPOA Network

Workstations

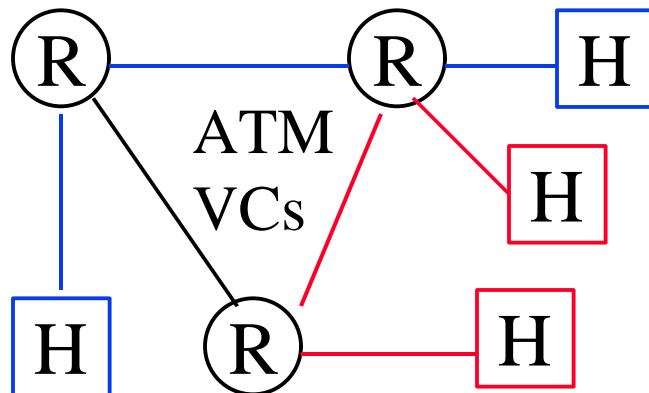


IP Switching

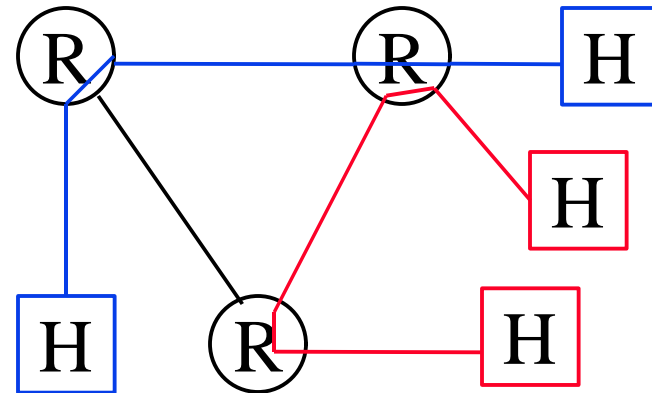
1. Original ATM Network



2. VCs at every hop



3. Short-circuit VCs



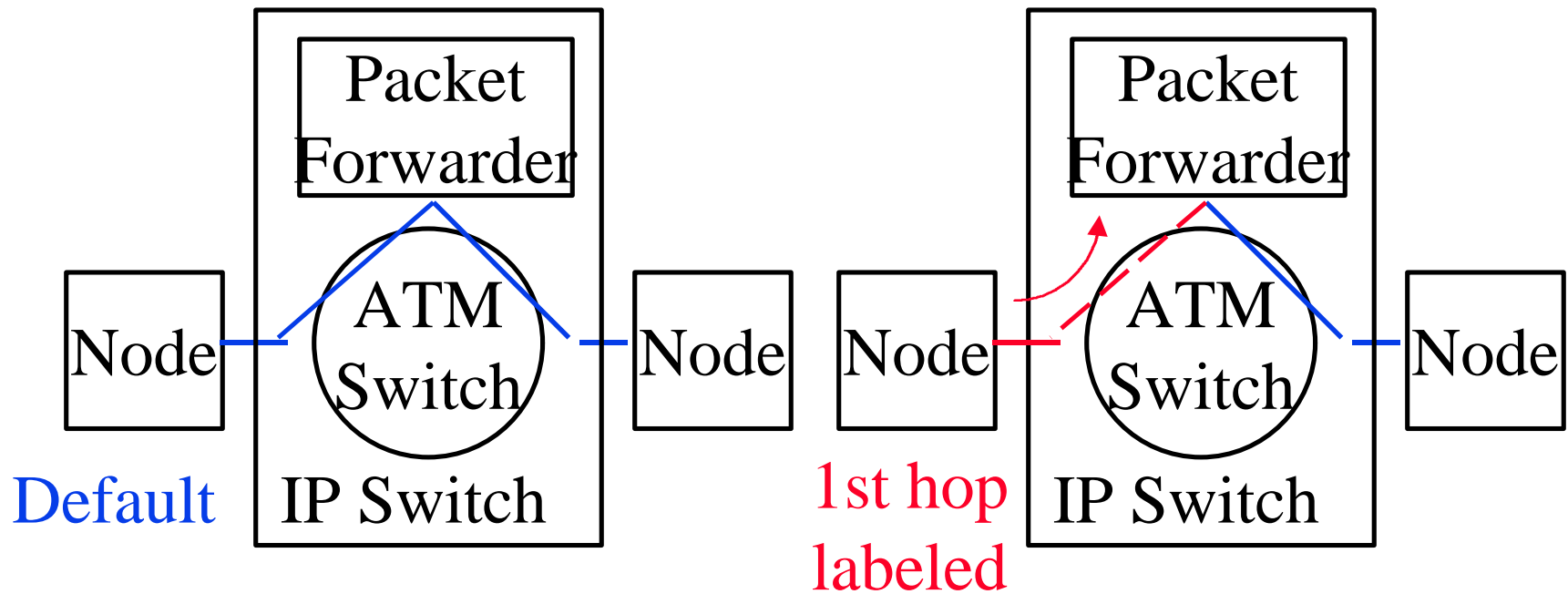
IP Switching

- ❑ 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

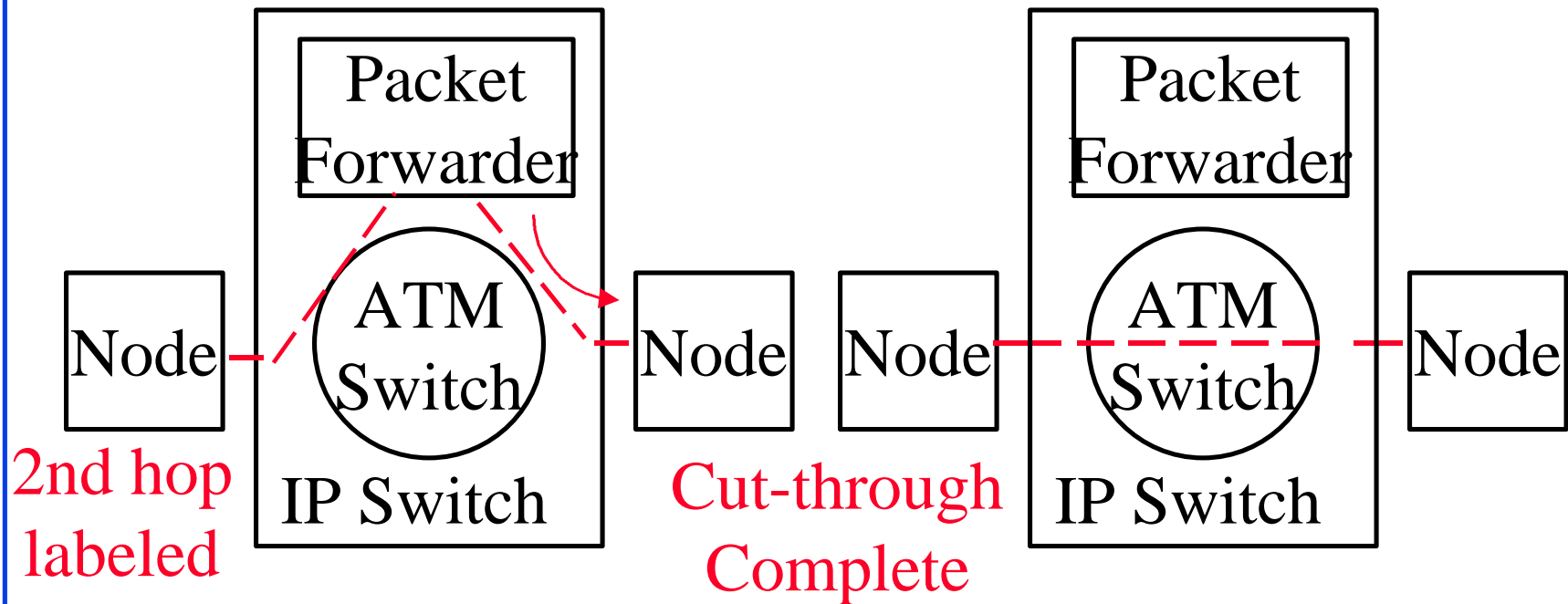
IP Switching (Cont)

- ❑ 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



IP Switching: Steps 3, 4



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

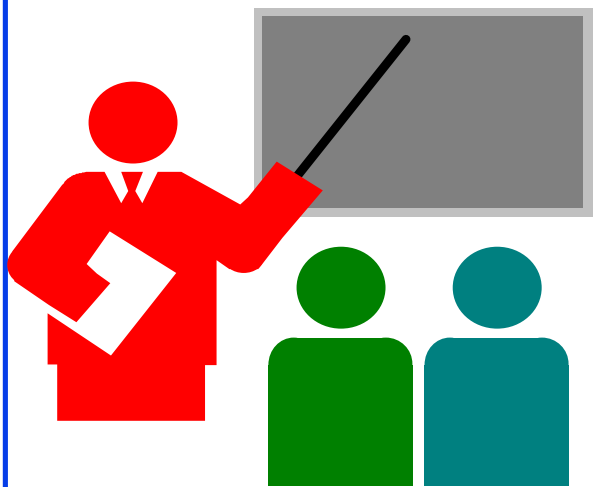
- ❑ VCI field is used as ID.
VPI/VCI change at switch
 - ⇒ Must run on **every** ATM switch
 - ⇒ non-IP switches not allowed between IP switches
 - ⇒ Subnets limited to one switch
- ❑ Cannot support VLANs
- ❑ Scalability: Number of VC \geq Number of flows.
 - ⇒ **VC Explosion**
1000 setups/sec.
- ❑ Quality of service determined implicitly by the flow class or by RSVP

Issues (Cont)

- ❑ ATM only
- ❑ Connection setup on demand
⇒ 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)
- ⇒ 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.