

Legacy Protocols Over ATM: Part I

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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>
- ❑ The schedule keeps changing. Please always check current schedule at:
<http://www.cis.ohio-state.edu/~jain/cis788-97/schedule.html>
- ❑ We would like to know how many people are attending. Please send an email after the class with the subject word “**Attended #**” to mbone@netlab.ohio-state.edu. # is the number of people attending.

Instructions (Cont)

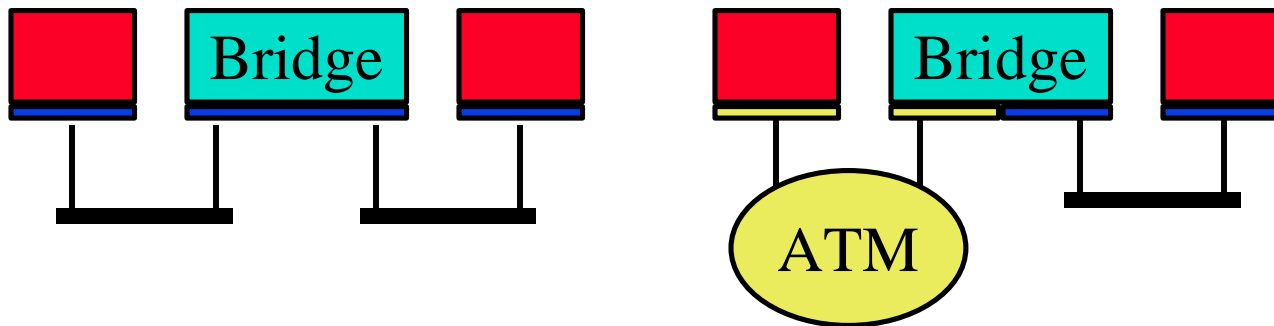
- ❑ Please email your positive and negative feedback about the quality of the reception as well as the content with a subject field of “**Feedback**” to mbone@netlab.ohio-state.edu
- ❑ If you are not able to receive the program due to some technical difficulties, please email “**Feedback**” to mbone@netlab.ohio-state.edu
- ❑ Please email technical questions with the subject field “**Question**” to mbone@netlab.ohio-state.edu. We will try to answer selected questions live.



- ❑ LAN Emulation (LANE)
- ❑ LANE V2.0
- ❑ Cells in Frames
- ❑ IP Over ATM - partly

Note: IP Multicast (MARS) and Multiple-subnet technologies (NHRP, MPOA, IP switching) will be covered in the next lecture.

LAN Emulation



- ❑ Problem: Need new networking s/w for ATM
- ❑ Solution: Let ATM network appear as a virtual LAN
- ❑ LAN emulation implemented as a device driver below the network layer

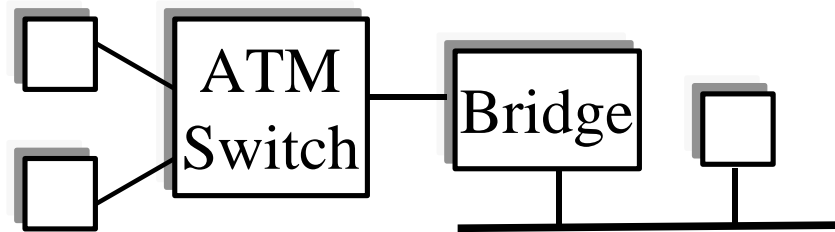
Features

- ❑ 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

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

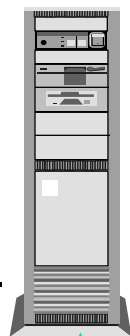
LAN Host	
Applications	
IP	IPX
NDIS	ODI
Media Access Control	
Physical Layer	

Protocol Layers (Cont)

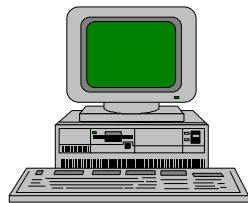
- ❑ NDIS = Network Driver Interface Specification
- ❑ ODI = Open Datalink Interface
- ❑ IPX = NetWare Internetworking Protocol
- ❑ **LAN Emulation Software:**
 - ❑ LAN Emulation Clients in each host
 - ❑ LAN Emulation Servers
 - ❑ LAN Emulation Configuration server (LECS)
 - ❑ LAN Emulation Server (LES)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

LAN Emulation

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

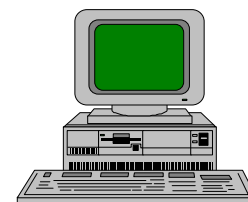
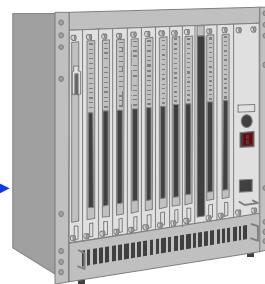
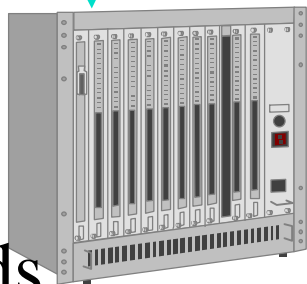
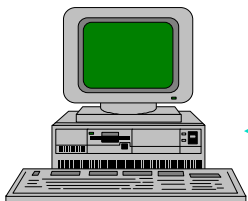


LAN Emulation Server



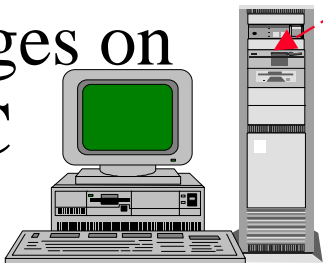
3. Messages for ATM clients are delivered directly.

Switches

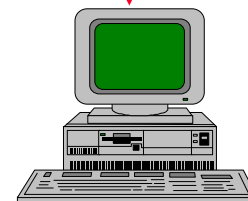
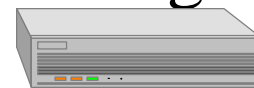


ATM client B
Bridge

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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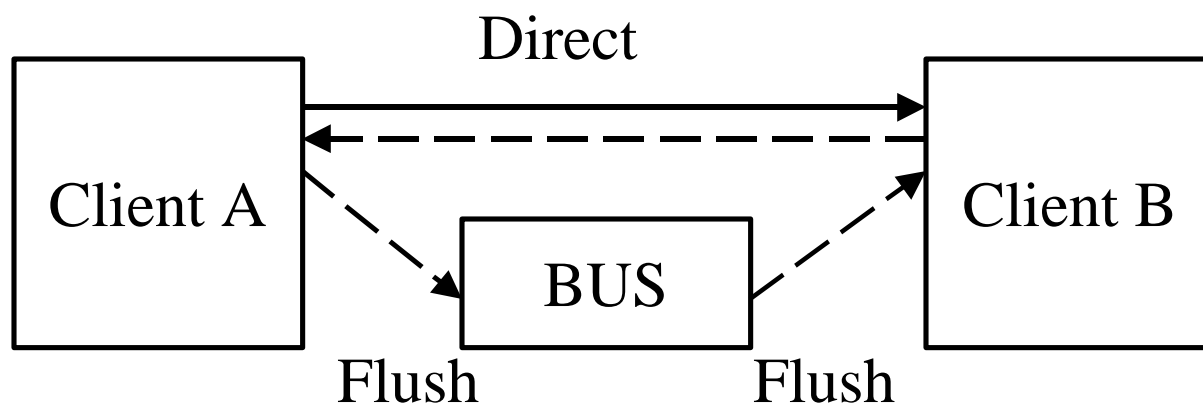
Operation

- 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

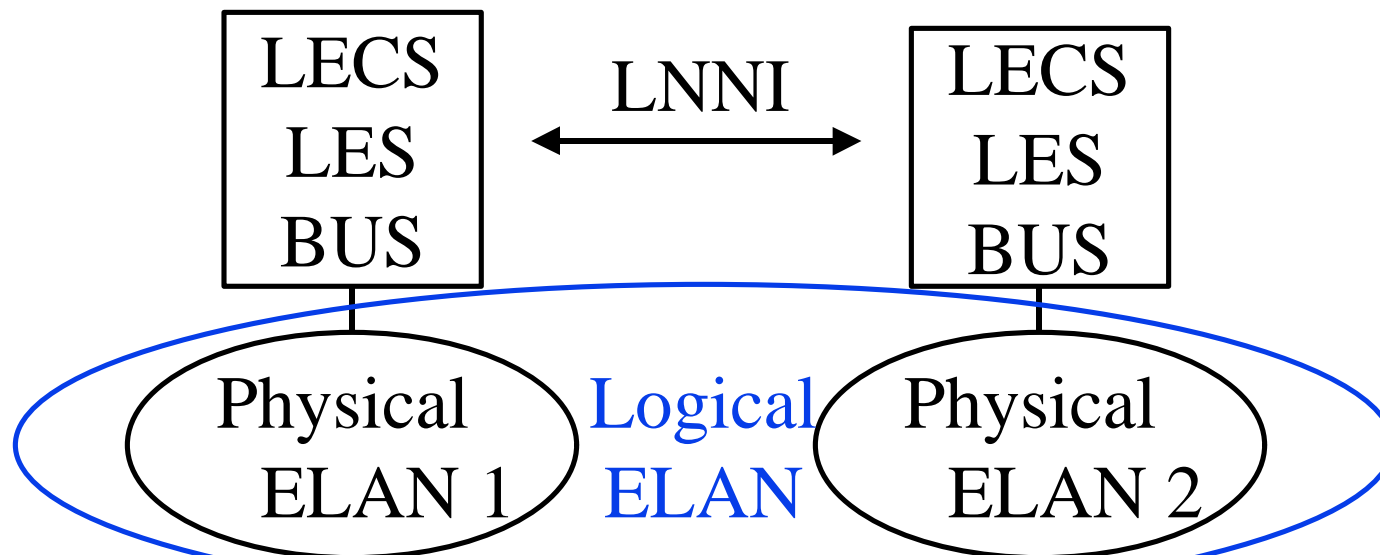
Flush Protocol



- ❑ Clients can send unicast packets via BUS while trying to resolve the address \Rightarrow Out-of-order arrivals
- ❑ When the direct VCC is setup, clients send a “Flush message” to destination. Destination returns it to source. Source can then send packets on direct VC.

LANE v2.0

- Allows multiple LE Servers:
LES, BUS, and LECS on a single ELAN
- LAN Emulation network-to-network interface (LNNI): Specifies interfaces for communication between the LE server entities.



LANE v2.0 (Cont)

- ❑ Server cache synchronization protocol
- ❑ Changes to LAN Emulation

User-to-network Interface (LUNI):

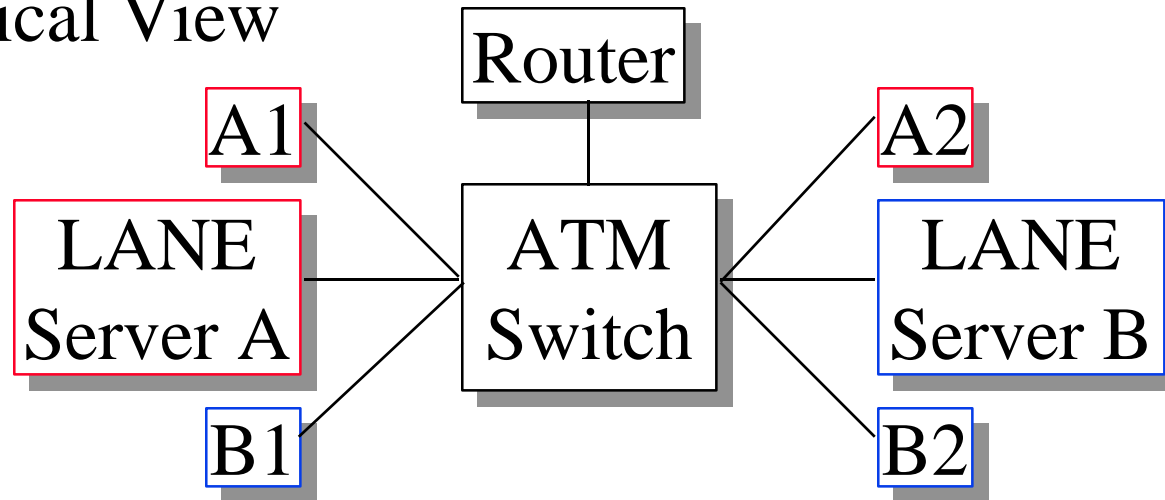
- Quality of service (8 global classes)
- Enhanced support for PVC
- LLC multiplexing
- Support for ABR
- Enhanced multicast support

Multicast trees (VCs) different from broadcast tree

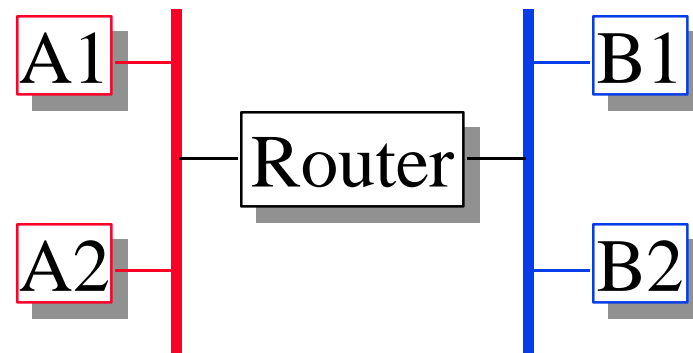
- ❑ Status: LUNI 2.0 was in straw ballot in April 97

ATM Virtual LANs

Physical View

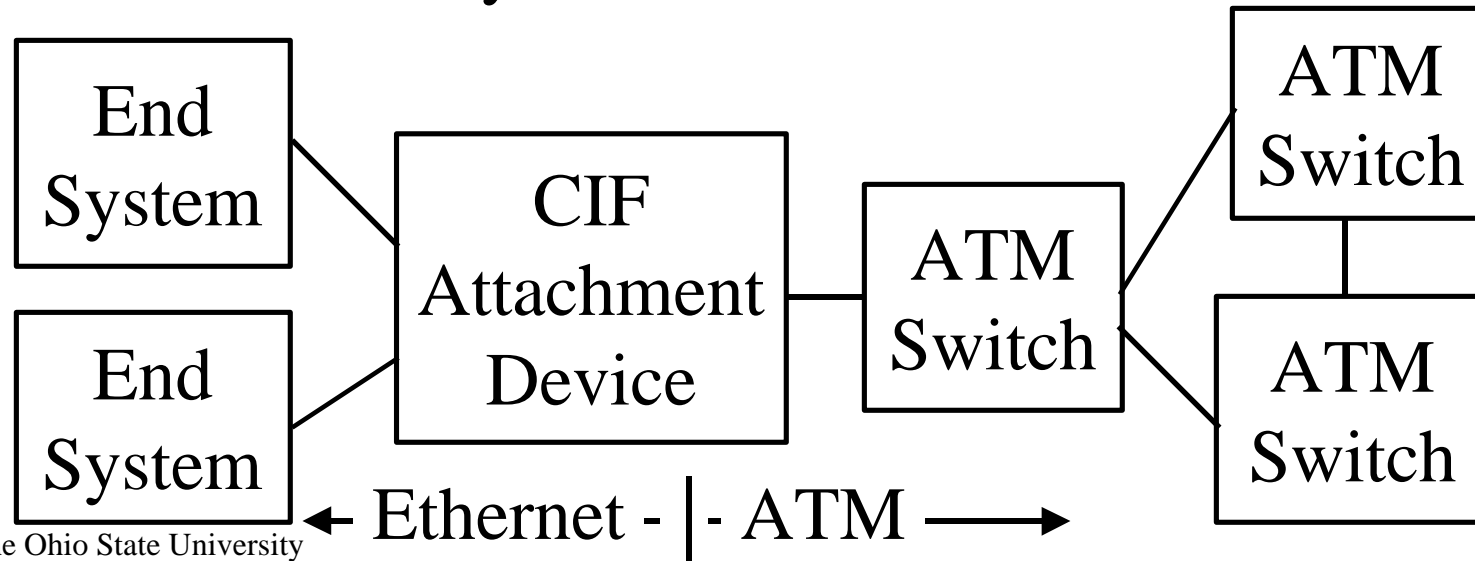


Logical View

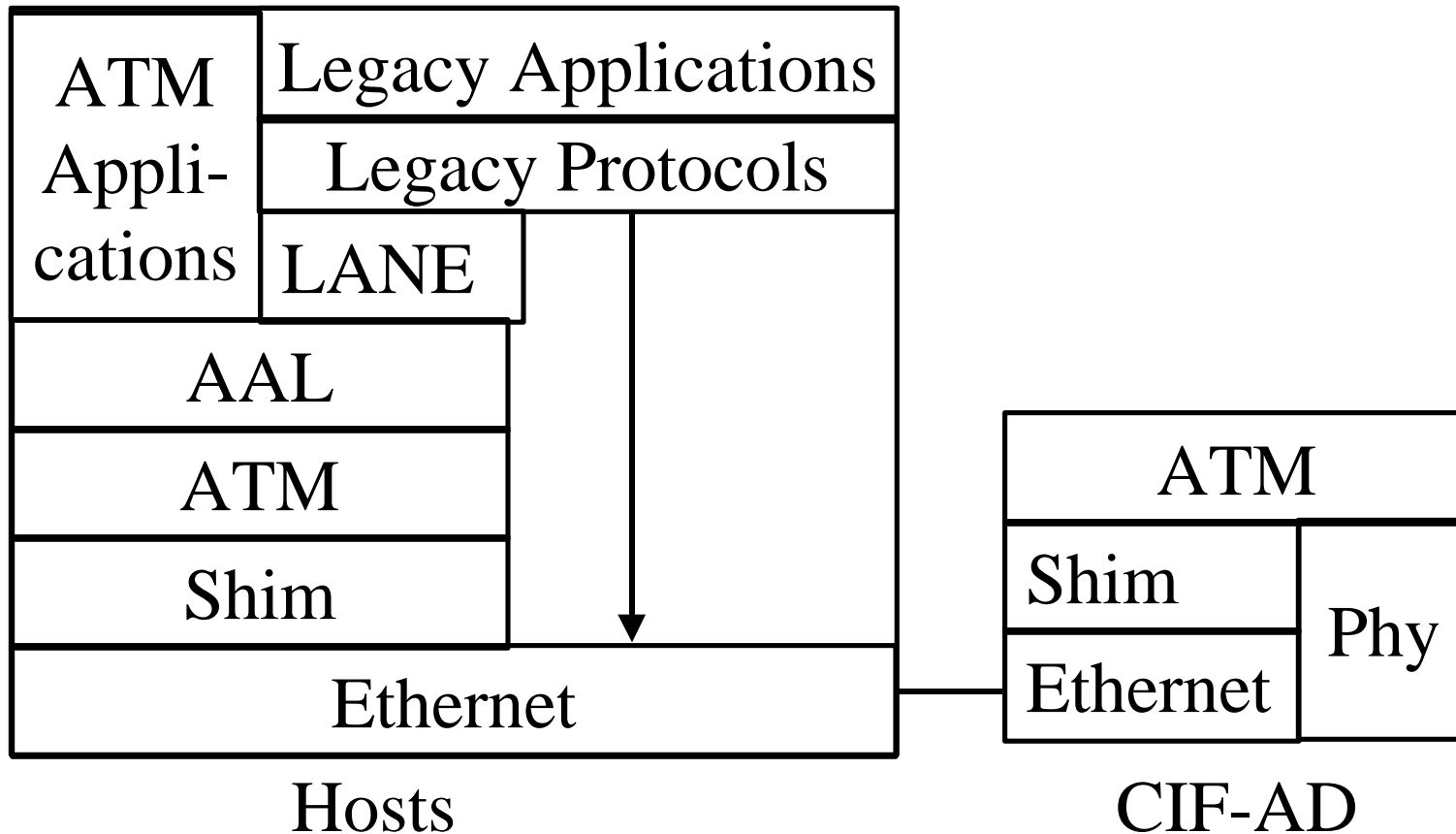


ATM Emulation: Cells in Frames

- ❑ **Fact:** All hosts have Ethernet cards.
Will not be replaced anytime soon.
- ❑ **Problem:** How to support ATM applications on such hosts?
- ❑ **Solution:** Carry ATM cells in Ethernet Frames

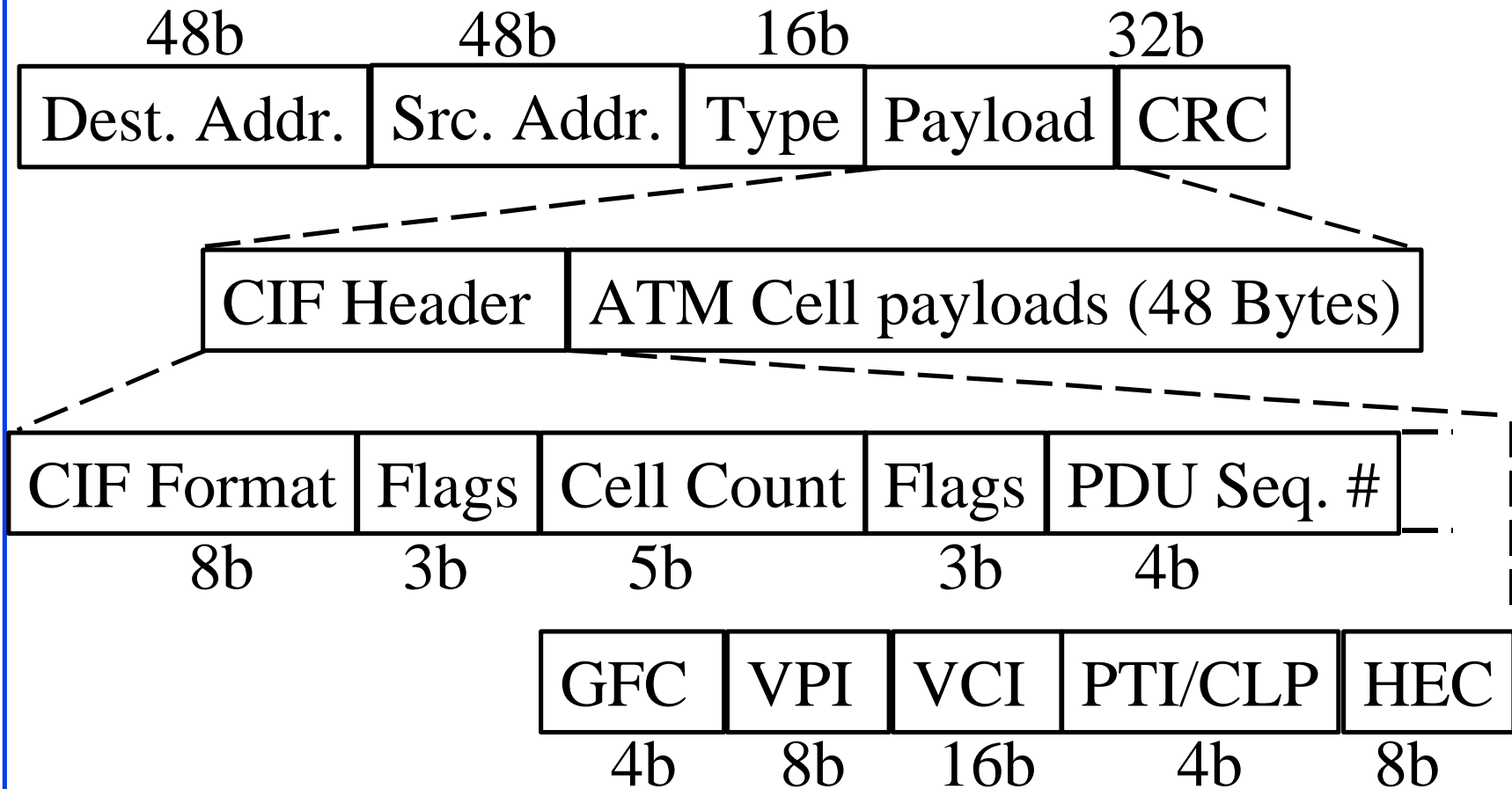


CIF Protocol Stack

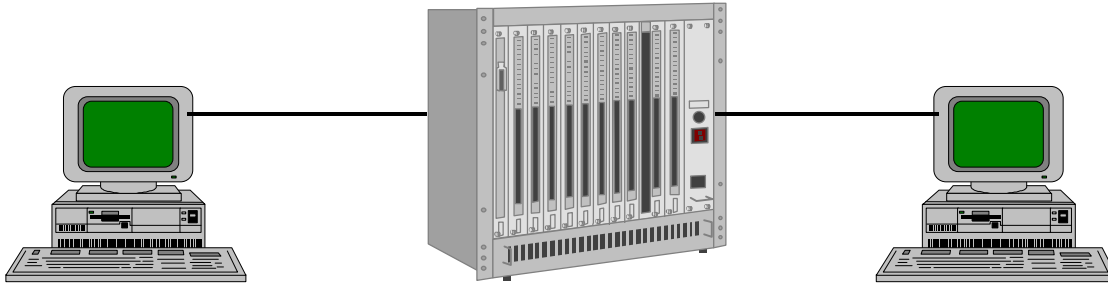


□ CIF Attachment Device

CIF Frame Format

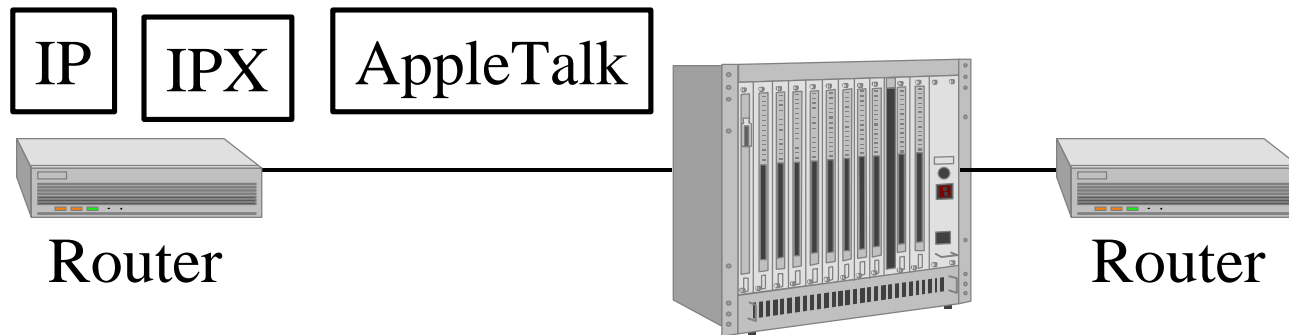


IP Over ATM: Issues

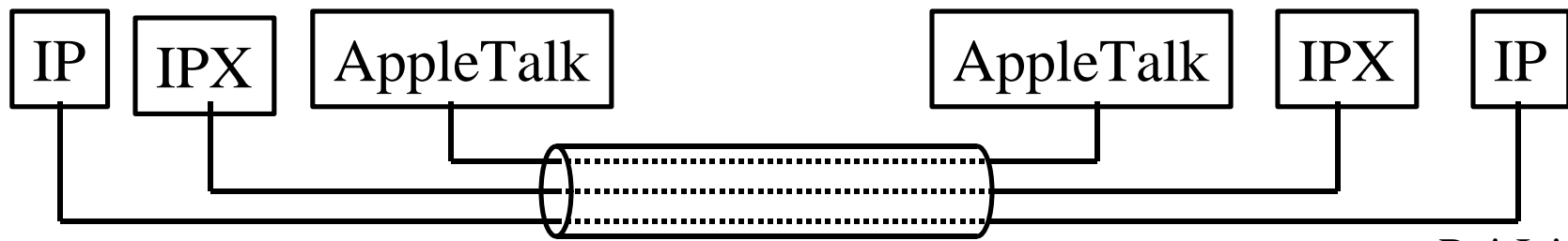


- ❑ How many VC's do we need for n protocols?
 - Packet encapsulation [RFC1483]
- ❑ How to find ATM addresses from IP addresses
 - Address resolution [RFC1577]
- ❑ How to handle multicast? [MARS, RFC 2022]
- ❑ How do we go through n subnets on a large ATM network? [NHRP]

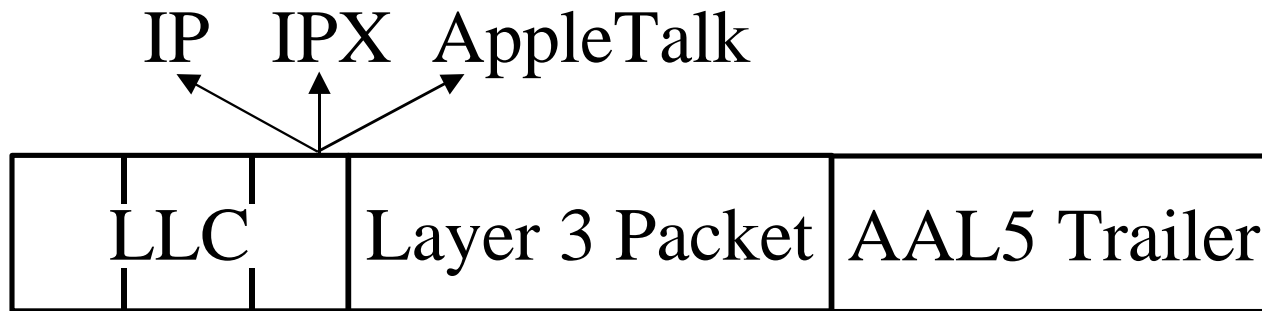
Packet Encapsulation [RFC1483]



- ❑ **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.

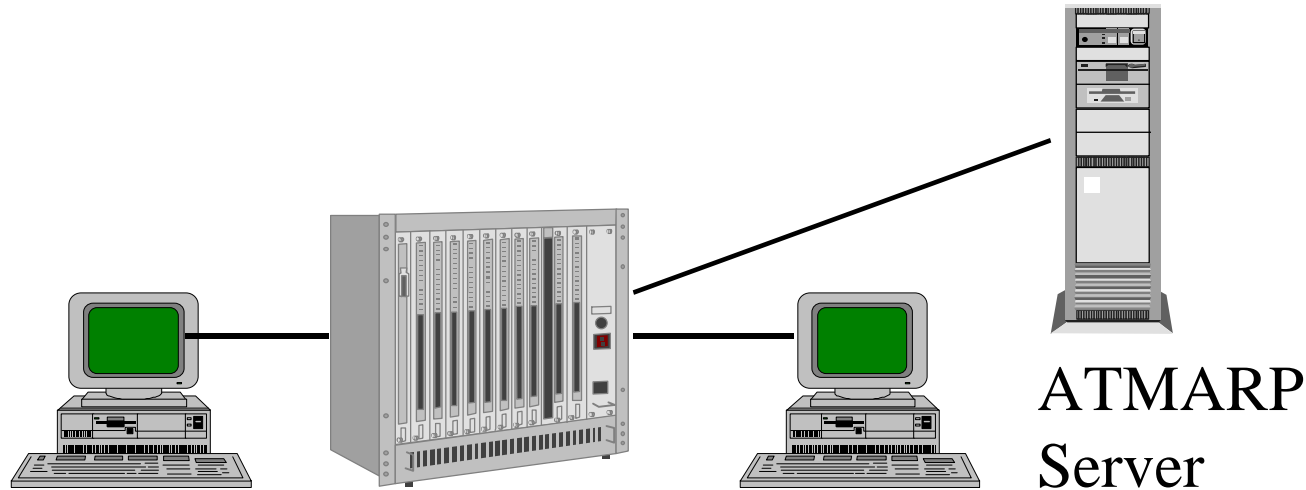


Encapsulation (Cont)



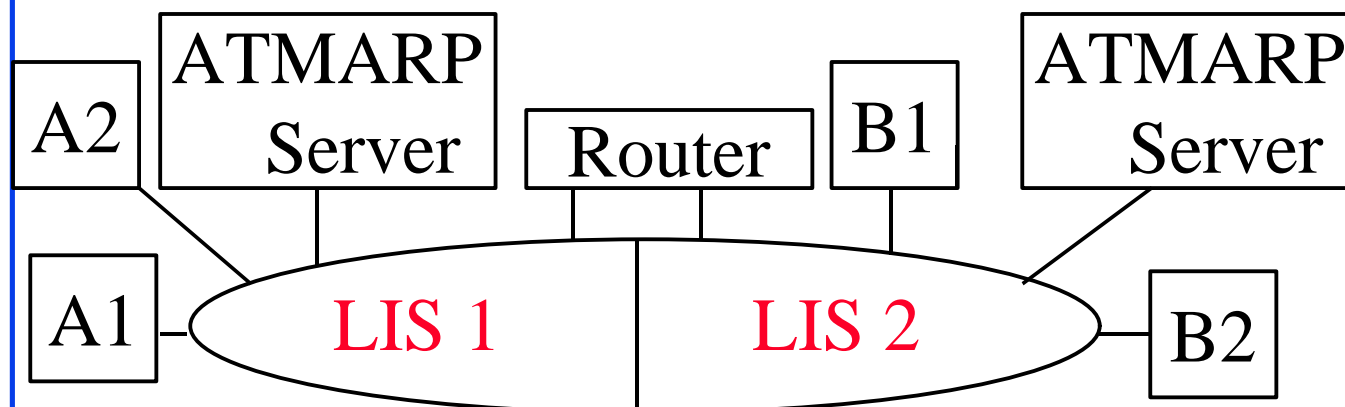
- ❑ **Answer 2:** Share a VC using Logical Link Control (LLC) Subnetwork Access Protocol (SNAP). LLC Encapsulation
- ❑ Protocol Types: 0x0800 = IP, 0x0806 = ARP, 0x809B = AppleTalk, 0x8137 = IPX

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

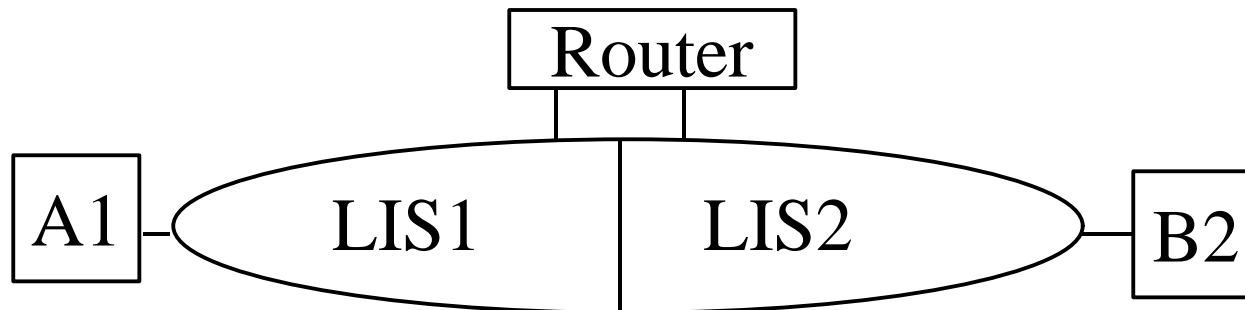
ARP Over ATM



- ❑ ATM stations are divided into Logical IP Subnets (LIS)
- ❑ Each LIS has an ATMARP server for resolution
- ❑ Clients are configured with server's ATM address
- ❑ Clients register at startup and periodically

IPOA (Cont)

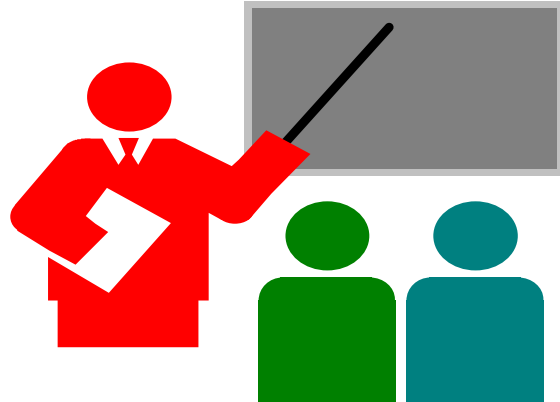
- ❑ Clients ask ATMARP server for destination's ATM address
- ❑ Server does not broadcast unresolved ARP requests
- ❑ Clients within the same LIS use direct VCs
- ❑ All traffic between LIS passes through a router



Enhancements to IPOA

- ❑ RFC 1577 allows only one ARP server per LIS
- ❑ Multiple servers \Rightarrow Server cache synchronization protocol (SCSP)
- ❑ RFC 1577 allows one MTU size per LIS. Different MTU sizes for each VC. Use path MTU discovery.
- ❑ Internet draft "Classical IP and ARP over ATM", 4/22/97, <http://www.internic.net/internet-drafts/draft-ietf-ion-classic2-02.txt>

Summary



- ❑ LANE allows current applications to run on ATM
- ❑ LANE V2 allows multiple servers \Rightarrow Bigger ELANs
- ❑ CIF allows ATM applications to run on Ethernet/Token ring hosts
- ❑ Classical IP allows ARP using ATMARP servers

Legacy Protocols over ATM I: Key References

- ❑ For a detailed list of references, see http://www.cis.ohio-state.edu/~jain/refs/atm_refs.htm
- ❑ G. Sackett and C. Metz, “ATM and Multiprotocol Networking,” McGraw-Hill, 1996.
- ❑ B. Dorling, et al, “Internetworking over ATM,” Prentice-Hall, 1996, 260 pp.
- ❑ D. Minoli and A. Alles, “LAN, ATM, and LAN Emulation Technologies,” Artech House, 1996.

References (Cont)

- ❑ S. W. Brim, "Cells In Frames Version 1.0: Specification, Analysis, and Discussion," <http://cif.cornell.edu/specs/v1.0/CIF-baseline.html>
- ❑ RFC 1483, "Multiprotocol Encapsulation over ATM Adaptation Layer 5," July 1993
- ❑ RFC 1577, "Classical IP and ARP over ATM," 1/20/94. Update in <http://www.internic.net/internet-drafts/draft-ietf-ion-classic2-01.txt>, 11/26/1996.
- ❑ "Classical IP and ARP over ATM", 04/22/1997, <http://www.internic.net/internet-drafts/draft-ietf-ion-classic2-02.txt>

Current Schedule

6/24/97 Course Overview

6/26/97 Networking Trends and their impact

7/1/97 ATM - Introduction

7/3/97 LAN Emulation and ATM Emulation

7/8/97 IP Switching

7/10/97 Virtual LANs and LAN Switching

7/15/97 Quiz 1 (No Mbone transmission)

7/17/97 Gigabit Ethernet

7/22/97 **No Class**

Schedule (Cont)

7/24/97 Multimedia: Compression Standards

7/29/97 Multimedia over IP: RSVP, RTP

7/31/97 Quiz 2 (No MBone transmission)

8/5/97 Wireless LANs and WANs

8/7/97 Residential broadband: Cable Modems, xDSL

8/12/97 Mobile Networking: Mobile IP, Wireless ATM

8/14/97 IPng - IP Next Generation (IPng)

8/19/97 Quiz 3 (No MBone transmission)

8/21/97 Graduating Seniors' grades due

Credits

This MBone transmission was made possible by:

- ❑ Mark Fullmer, OSU/UTS
- ❑ Mike Iverson, OSU/UTS
- ❑ Bob Dixon, OSU/UTS
- ❑ Mike Douglas, OSU/UTS
- ❑ Jayaraman Iyer, OSU/CIS
- ❑ Sohail Munir, OSU/CIS