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.

Overview

❏ 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
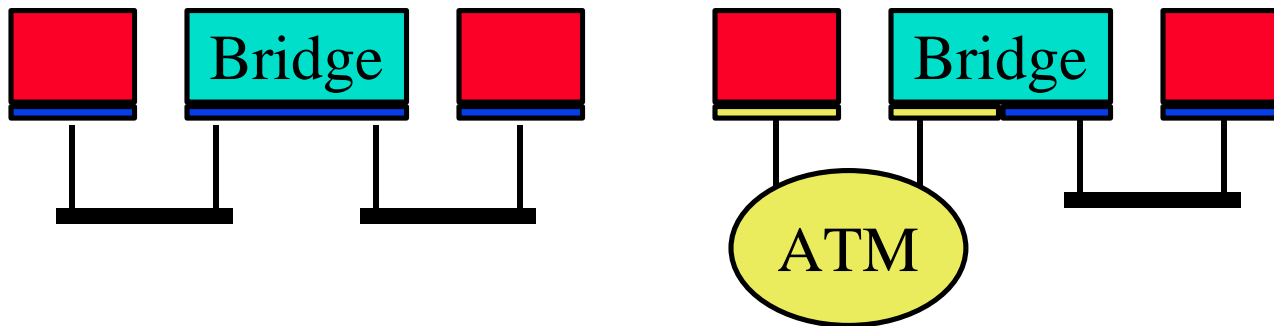
❏ Problem: Need new networking s/w for ATM

❏ 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
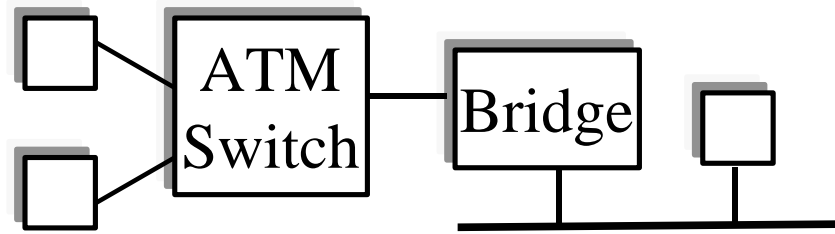
ATM Host

Applica-tions	
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

Applica-tions	
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

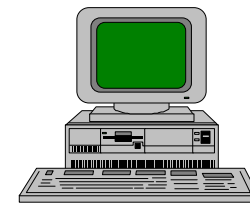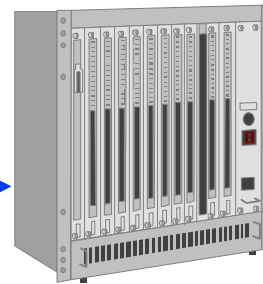1. Client gets recipient's address from LES and sets-up a VC.
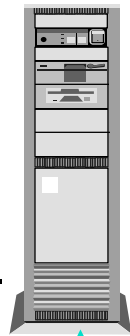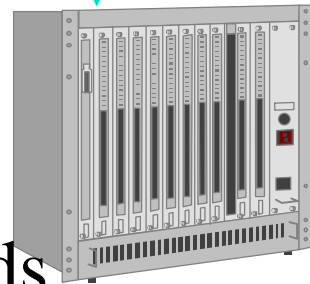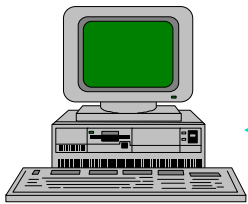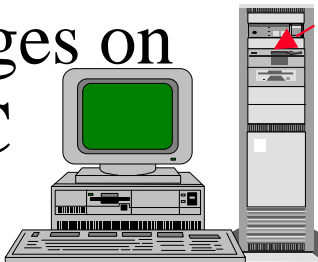
LAN Emulation Server
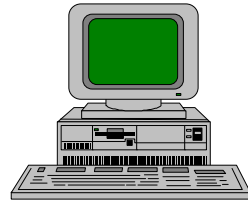
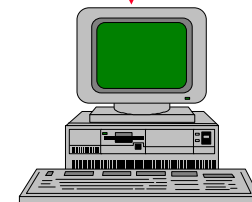3. Messages for ATM clients are delivered directly.

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

Direct

Client A

BUS

Client B

Flush   Flush
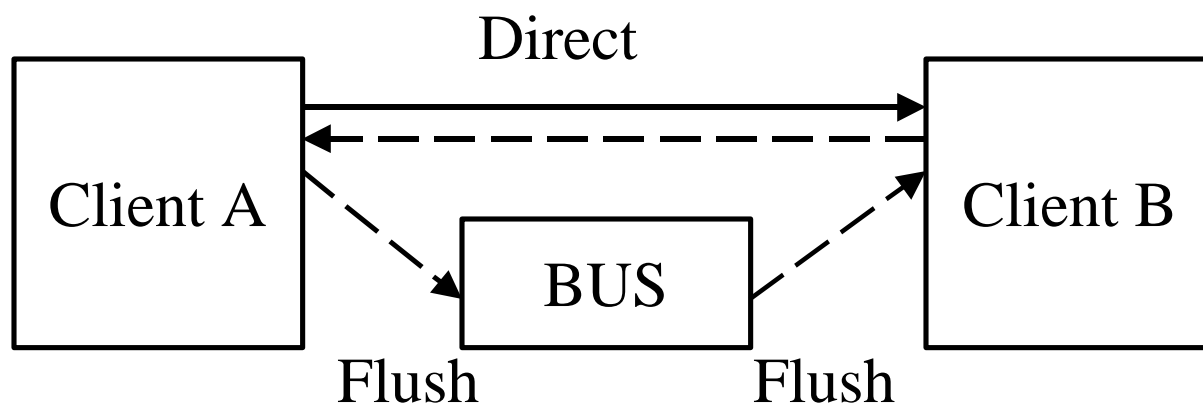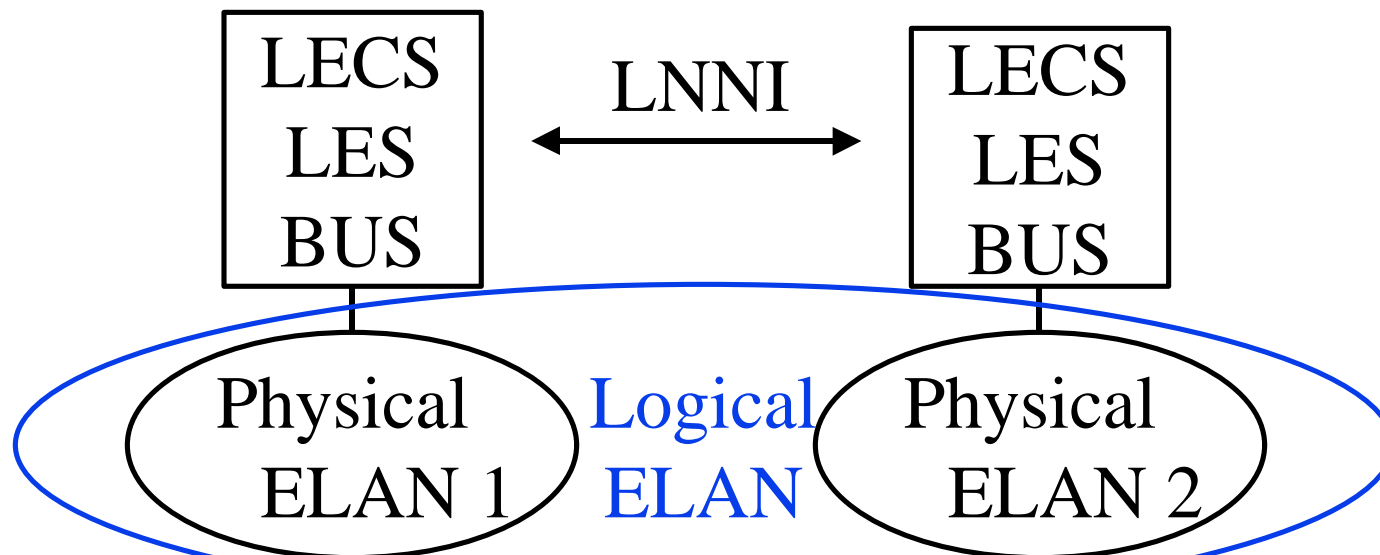
❑ Clients can send unicast packets via BUS while trying to resolve the address $\Rightarrow$ Out-of-order arrivals

❑ 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.

```
┌────────┐              ┌────────┐
│ LECS   │    LNNI      │ LECS   │
│ LES    │  ◄─────►     │ LES    │
│ BUS    │              │ BUS    │
└────────┘              └────────┘
```

Physical ELAN 1   Logical ELAN   Physical ELAN 2

LANE v2.0 (Cont)

❏ Server cache synchronization protocol

❏ Changes to LAN Emulation
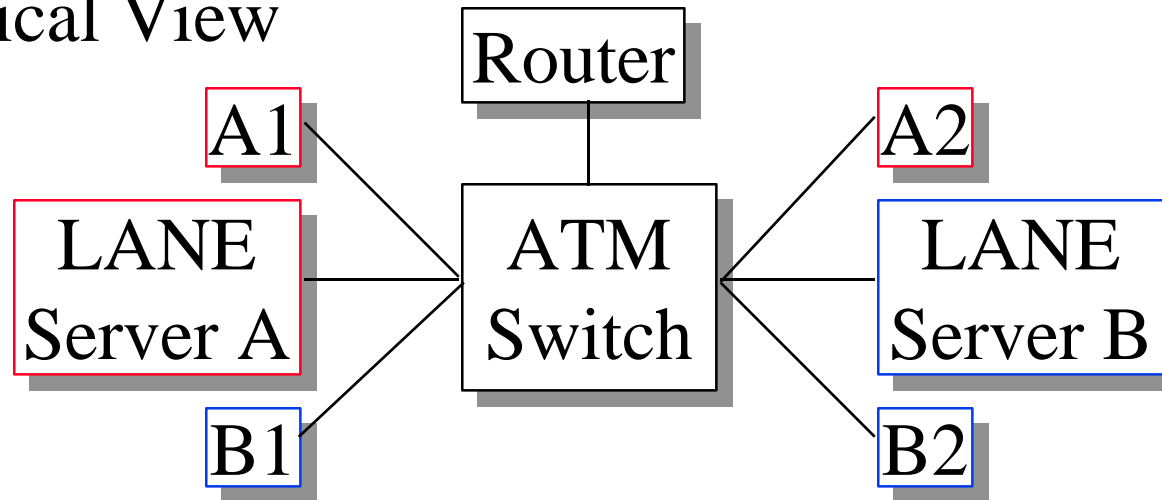 User-to-network Interface (LUNI):

  ❍ Quality of service (8 global classes)

  ❍ Enhanced support for PVC

  ❍ LLC multiplexing

  ❍ Support for ABR

  ❍ Enhanced multicast support
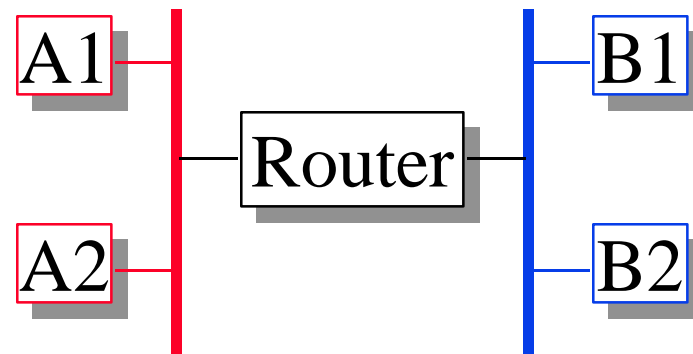   Multicast trees (VCs) different from broadcast tree

❏ Status: LUNI 2.0 was in straw ballot in April 97
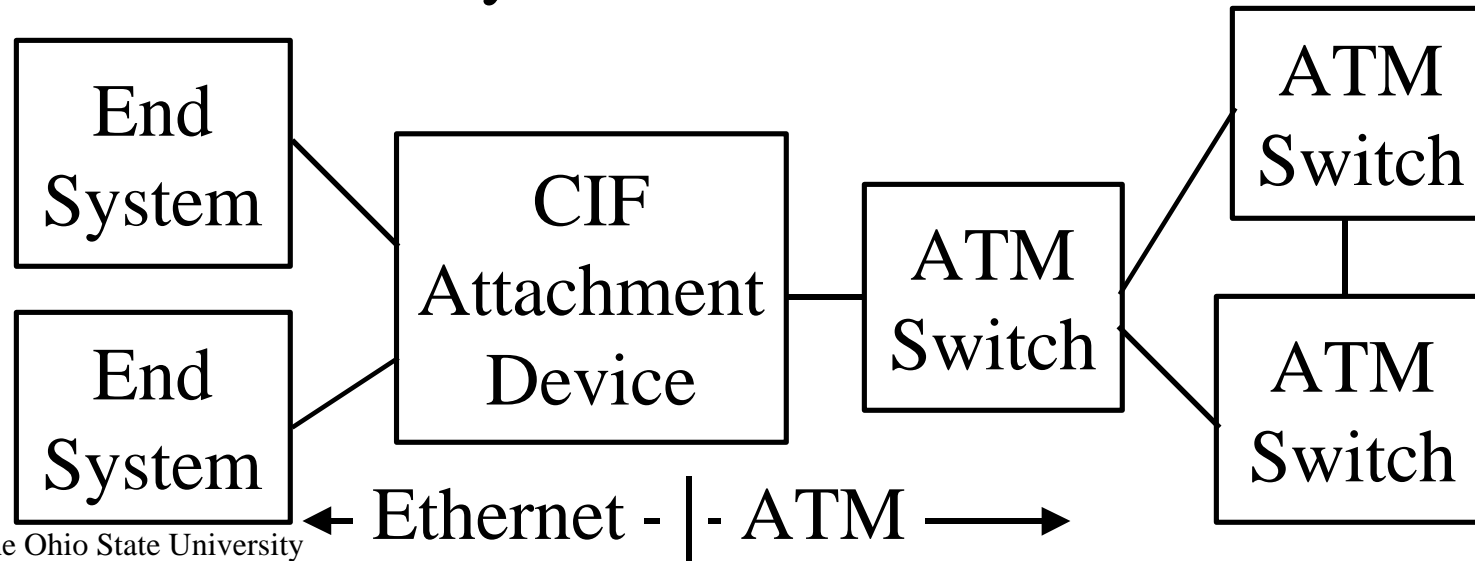
ATM Virtual LANs

❏ 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

End System

End System

CIF Attachment Device

ATM Switch

ATM Switch

ATM Switch

← Ethernet - | - ATM →

CIF Protocol Stack

ATM Appli-cations	Legacy Applications
	Legacy Protocols
	LANE
AAL	
ATM	
Shim	
Ethernet	

Hosts

ATM	
Shim	Phy
Ethernet	

CIF-AD
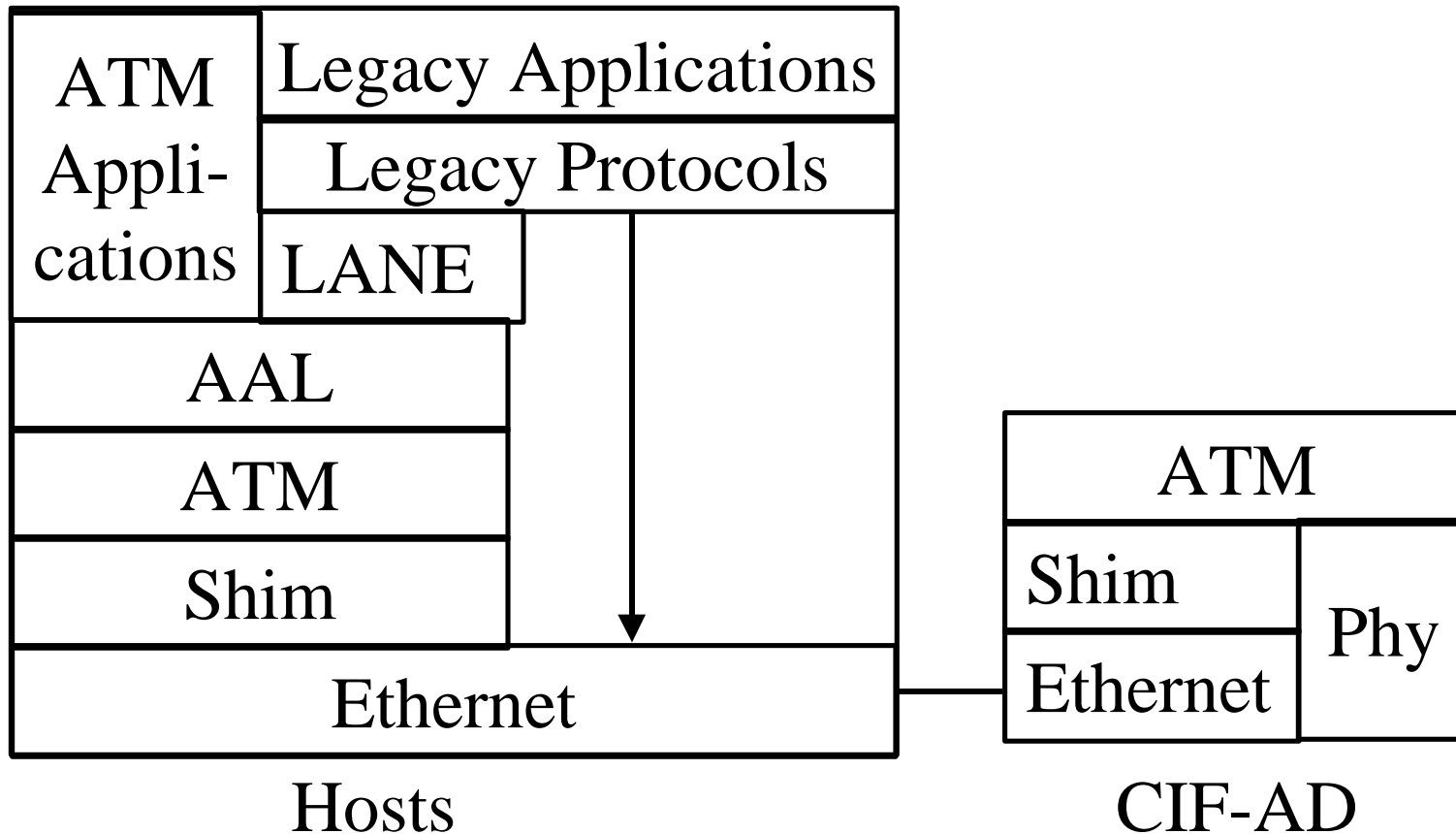
❑ CIF Attachment Device

CIF Frame Format

Dest. Addr. (48b)	Src. Addr. (48b)	Type (16b)	Payload (32b)	CRC

CIF Header	ATM Cell payloads (48 Bytes)

CIF Format (8b)	Flags (3b)	Cell Count (5b)	Flags (3b)	PDU Seq. # (4b)

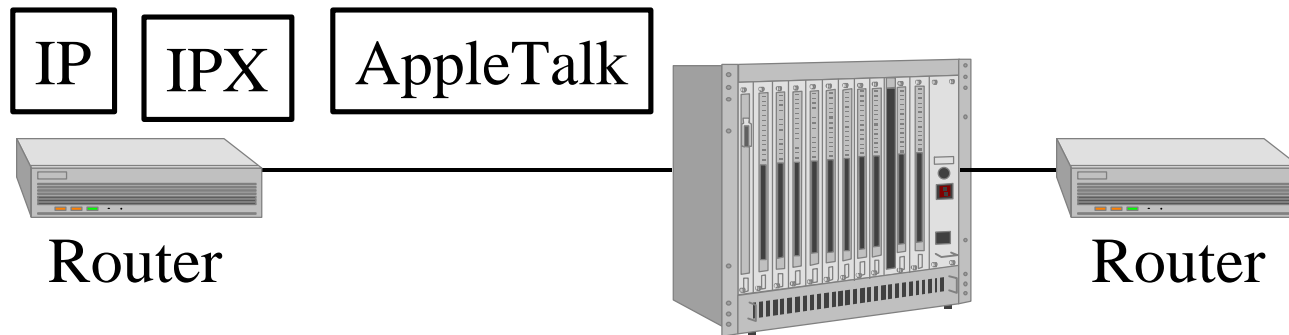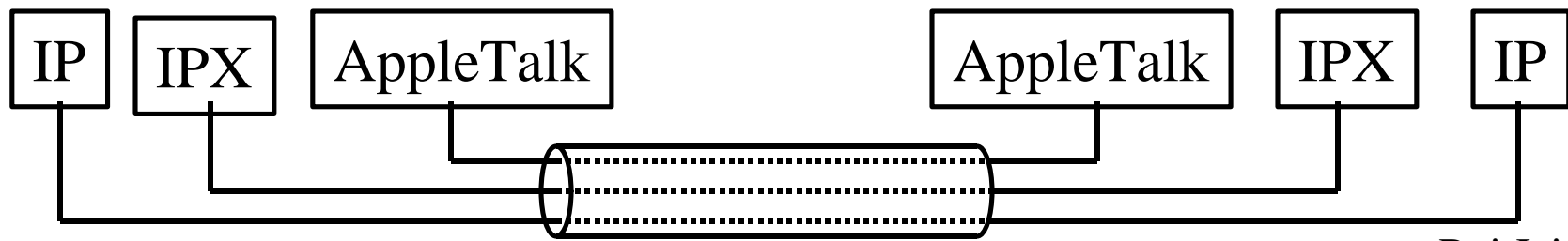| GFC (4b)	VPI (8b)	VCI (16b)	PTI/CLP (4b)	HEC (8b)
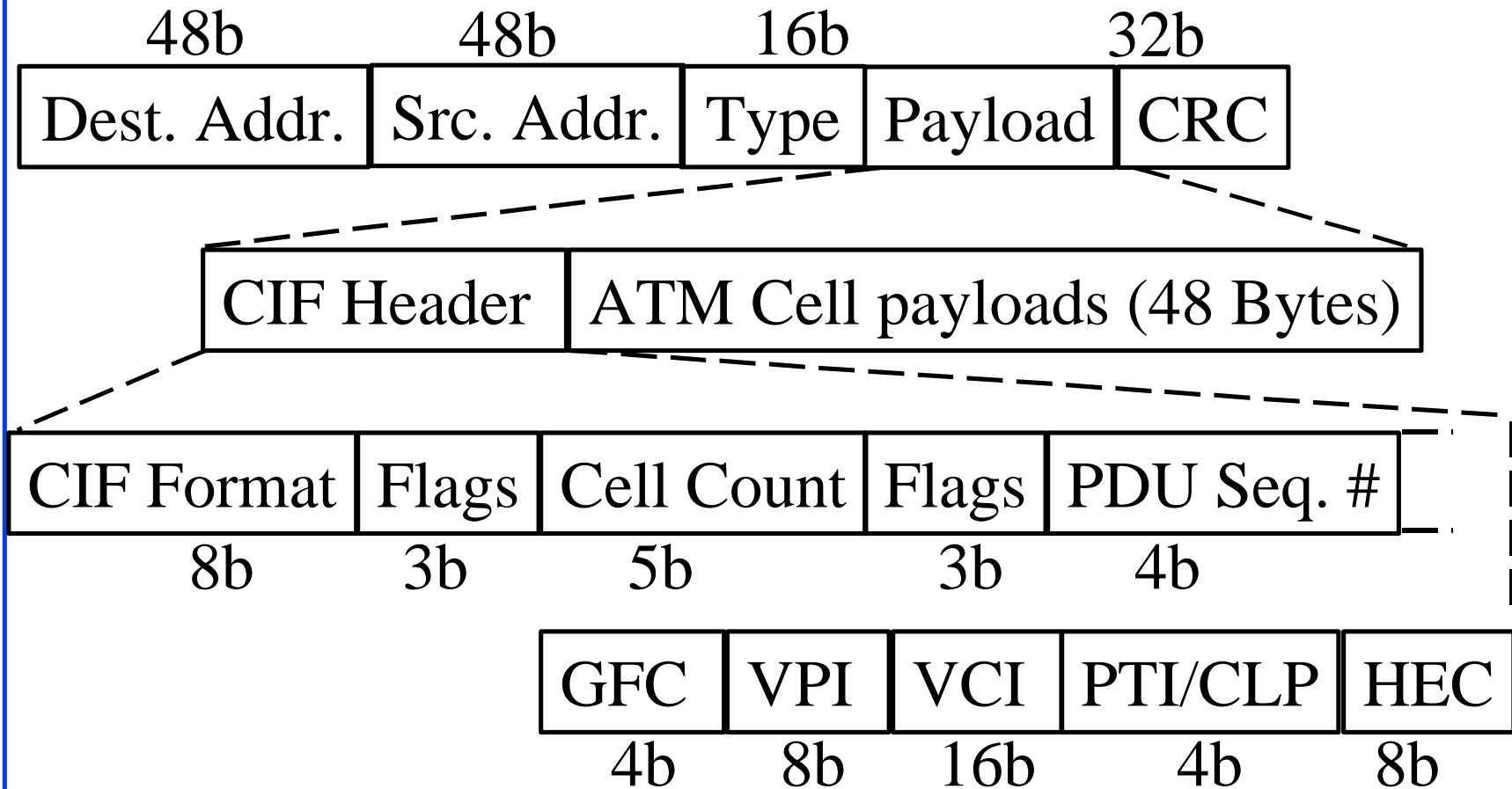
IP Over ATM: Issues
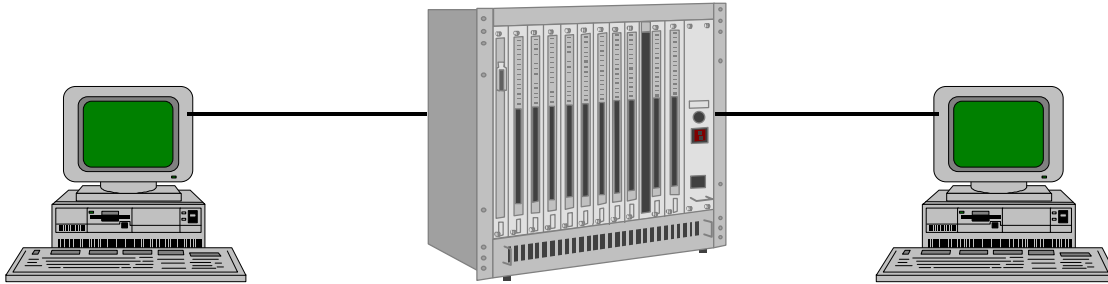
❑ How many VC's do we need for n protocols?

　❍ 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]

IP IPX AppleTalk

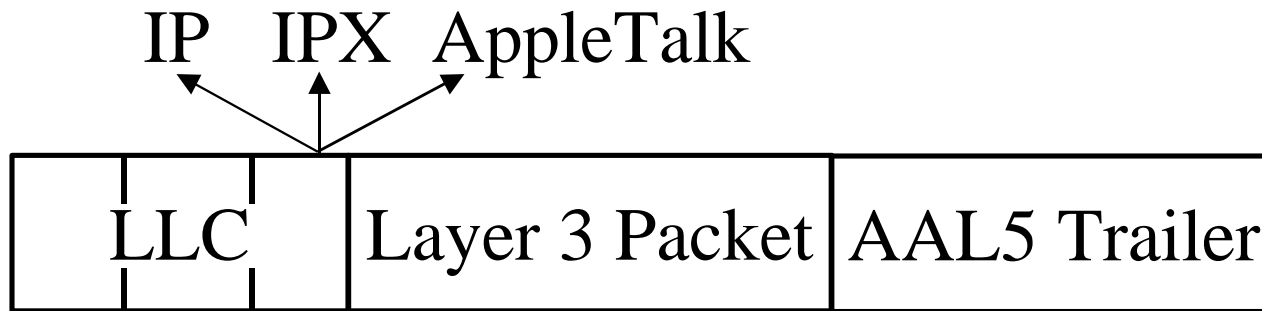Router   Router

❑ **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.

IP IPX AppleTalk   AppleTalk IPX IP

Encapsulation (Cont)

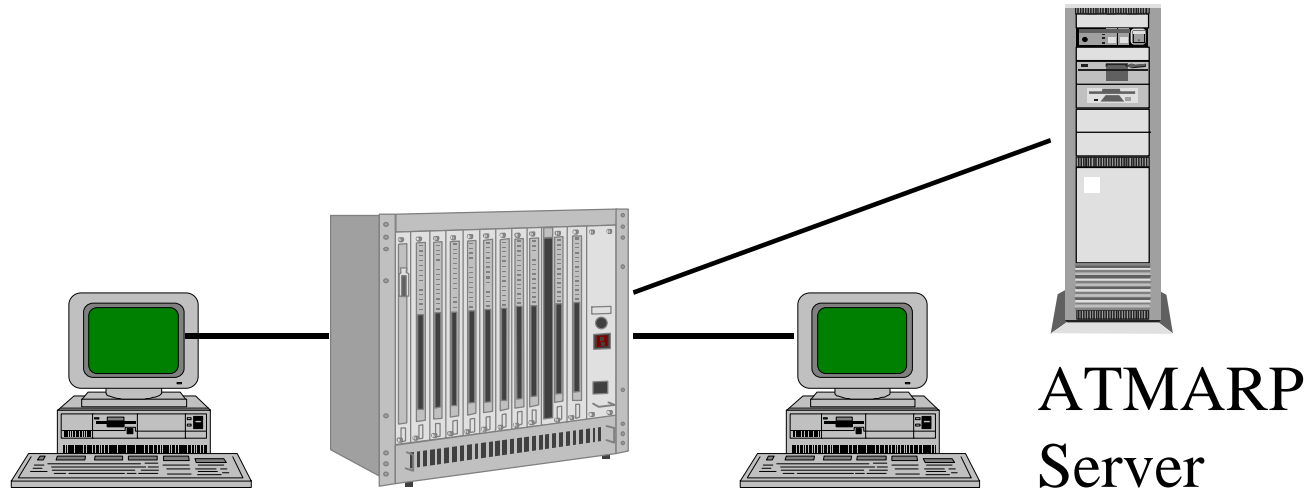IP   IPX   AppleTalk

	LLC		Layer 3 Packet	AAL5 Trailer

- ❏ **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

ATMARP
Server

❑ IP address: 123.145.134.65
ATM address: 47.0000 1 614 999 2345.00.00.AA....

❑ Issue: IP Address ⟺ ATM Address translation

  ❍ Address Resolution Protocol (ARP)

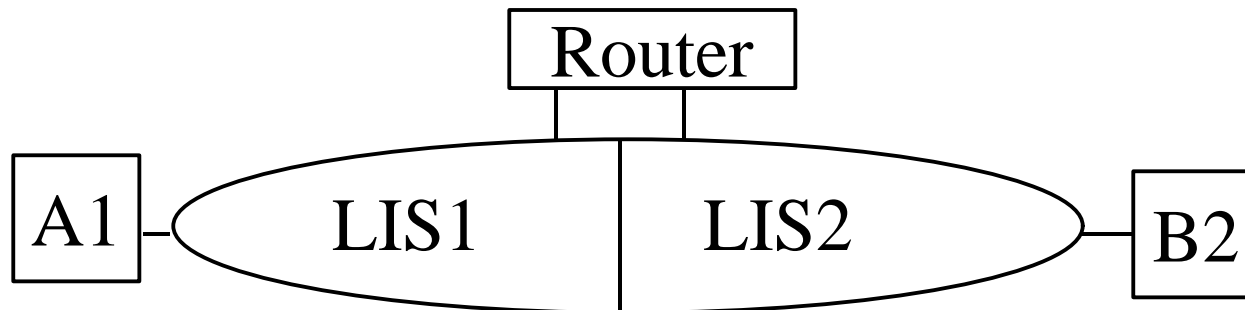 ❍ Inverse ATM ARP: VC ⟹ IP Address

❑ Solution: ATMARP servers

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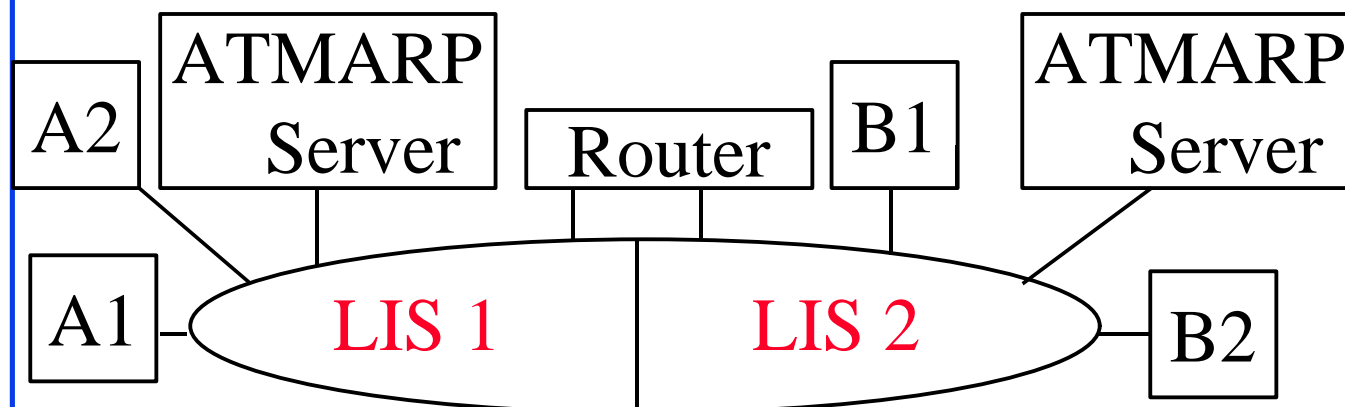
- ❑ ATM stations are divided in to Logical IP Subnets (LIS)
- ❑ Each LIS has an ATMARP server for resolution
- ❑ Clients are configured with server's ATM address
- ❑ Clients register at startup and periodically

IPOA (Cont)

❑ Clients ask ATMARP server for destination's ATM address

❑ Server does <u>not</u> broadcast unresolved ARP requests

❑ Clients within the same LIS use direct VCs

❑ All traffic between LIS passes through a router

```
                    ┌──────────┐
                    │  Router  │
                    └──┬────┬──┘
       ┌───┐        ╱   │    │   ╲        ┌───┐
       │A1 │───────( LIS1    │ LIS2 )─────│B2 │
       └───┘        ╲        │     ╱       └───┘
                         
```

Enhancements to IPOA

❑ RFC 1577 allows only one ARP server per LIS

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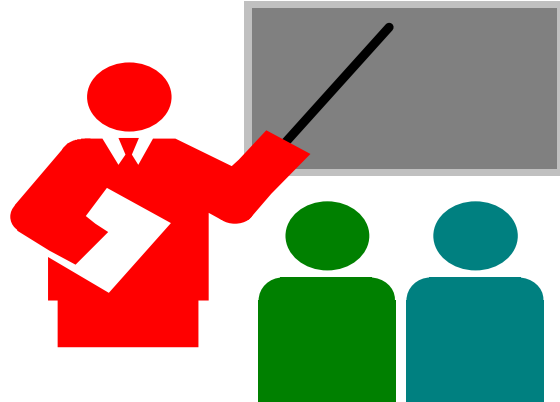
- ❑ LANE allows current applications to run on ATM
- ❑ LANE V2 allows multiple servers $\Rightarrow$ Bigger ELANs
- ❑ CIF allows ATM applications to run on Ethernet/Token ring hosts
- ❑ Classical IP allows ARP using ATMARP servers

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 Encaptulation 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