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

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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.

2. Client sends messages on the VC

3. Messages for ATM clients are delivered directly.

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

Broadcast/Unknown Server (BUS) Non-ATM client

ATM client B Bridge

LAN Emulation Server

Switches
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 ⇒ 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
  - LANE Server A
  - LANE Server B
  - ATM Switch
  - Router

- Logical View
  - LANE Server A
  - LANE Server B
  - ATM Switch
  - Router
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

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

Hosts

- CIF Attachment Device

CIF-AD

ATM

Shim

Ethernet

Phy

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CIF Frame Format

```
48b   48b   16b   32b
Dest. Addr. Src. Addr. Type Payload CRC
```

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

```
4b  8b  16b  4b  8b
GFC VPI VCI PTI/CLP HEC
```

CIF Header

ATM Cell payloads (48 Bytes)
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]
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.
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
IP address: 123.145.134.65
ATM address: 47.0000 1614 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 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 → Server cache synchronization protocol (SCSP)
- RFC 1577 allows one MTU size per LIS. Different MTU sizes for each VC. Use path MTU discovery.
- 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](http://www.cis.ohio-state.edu/~jain/refs/atm.refs.htm)


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,”

- "Classical IP and ARP over ATM",
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