# ATM Networks: An Overview


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# MBone Instructions

- Handouts for the class are available on-line: http://www.ci.s.ohio-state.edu/~jain/cis788-97/index.html
- The schedule keeps changing. Please always check current schedule at: http://www.ci.s.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)

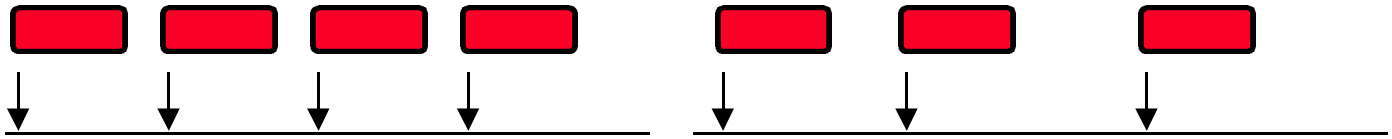
- Please email your positive and negative feedback about the quality of the reception as well as the content with a subject field of "Feedback" to mbone@netlab.ohio-state.edu
- If you are not able to receive the program due to some technical difficulties, please email "Feedback" to mbone@netlab.ohio-state.edu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

# Overview

- ATM: Overview
- ATM Protocol Layers
- Network Interfaces
- Adaptation Layers
- Physical Layers

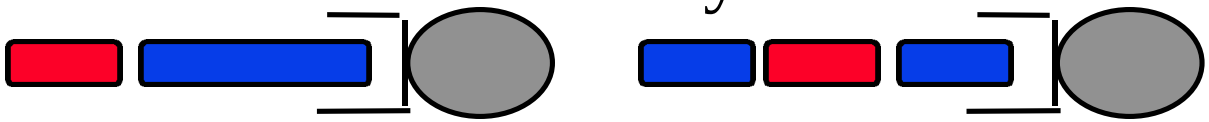
# ATM Nets: Key Features

1. STM = Synchronous Transfer Mode,
   ATM = Asynchronous Transfer Mode

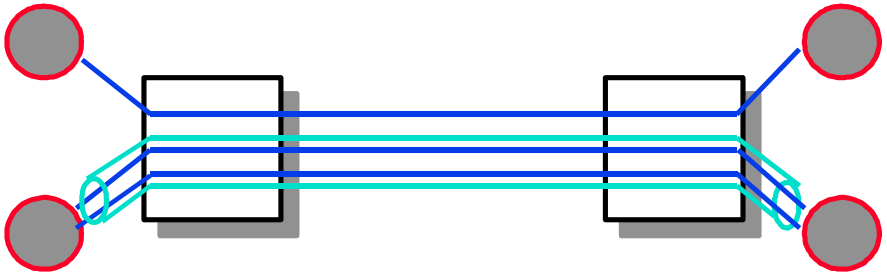


2. Allows any-speed and even variable rate connection

3. ATM = Short fixed size 53-byte cells

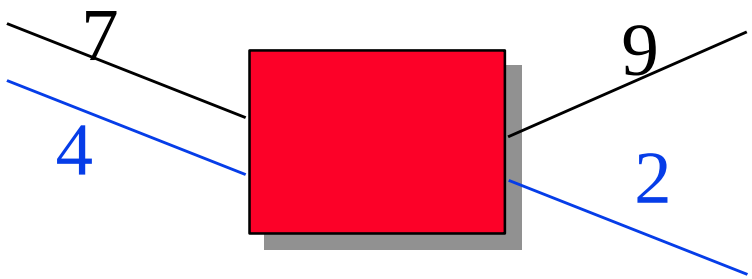


4. Connection oriented ⇒ Virtual Channels (VC)



**5**. Labels vs addresses

⇒ Better scalability in number of nodes




**6**. Switches vs routers

⇒ Faster due to fixed size, short address, simplicity

**7**. Data, voice, video integration

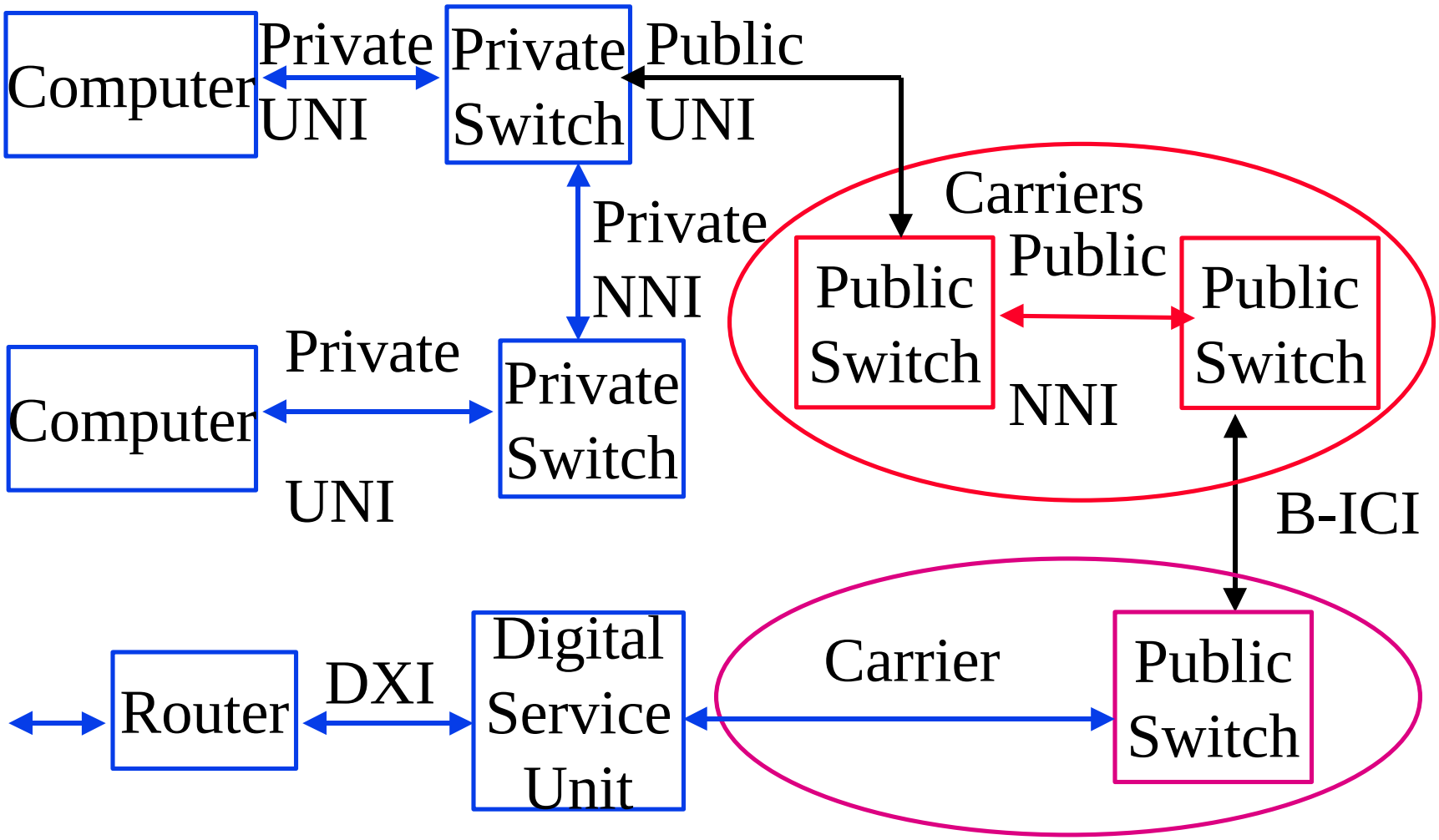
**8**. Seamless ⇒ Same technology for LAN, WAN,

# Two Approaches

| | Computer | Telecom |
|---|---|---|
| Traffic | Data | Voice |
| Switching | Packet | Circuit |
| Arrivals | Bursty | Periodic |
| Quality of Service | Best effort | Guaranteed |
| Delay Variation | Not critical | Critical |
| Resource Alloc | Shared | Dedicated |
| Connections | Connectionless | Connection-oriented |

- ATM = Computer + Telecom

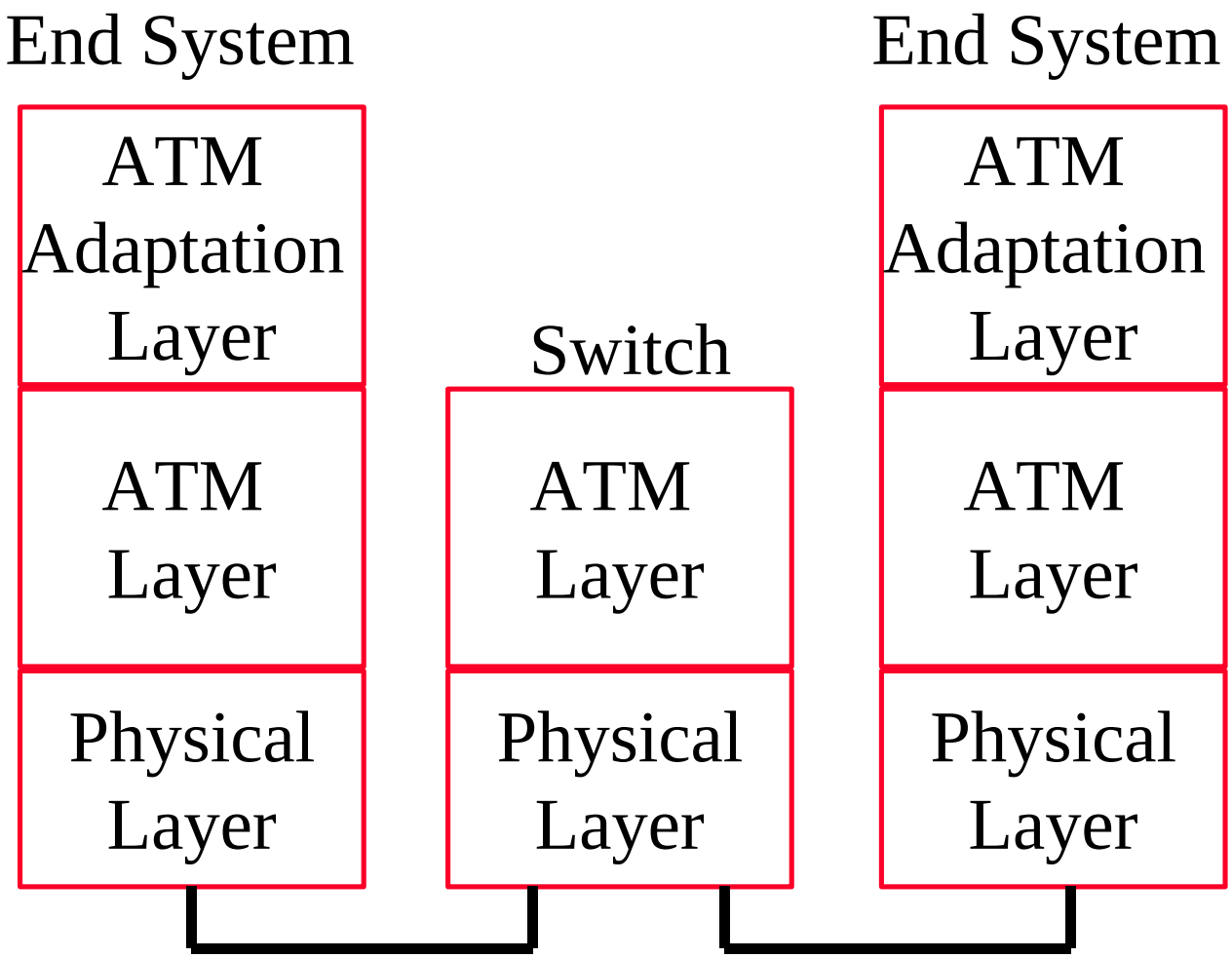
# ATM Interfaces



# ATM Interfaces

- User to Network Interface (UNI):
  Public UNI, Private UNI
- Network to Node Interface (NNI):
  - Private NNI (P-NNI)
  - Public NNI =Inter-Switching System Interface (ISSI)
    Intra-LATA ISSI (Regional Bell Operating Co)
  - Inter-LATA ISSI (Inter-exchange Carriers)
    $\Rightarrow$ Broadband Inter-Carrier Interface (B-ICI)
- Data Exchange Interface (DXI)
  Between routers and ATM Digital Service Units (DSU)

# Protocol Layers

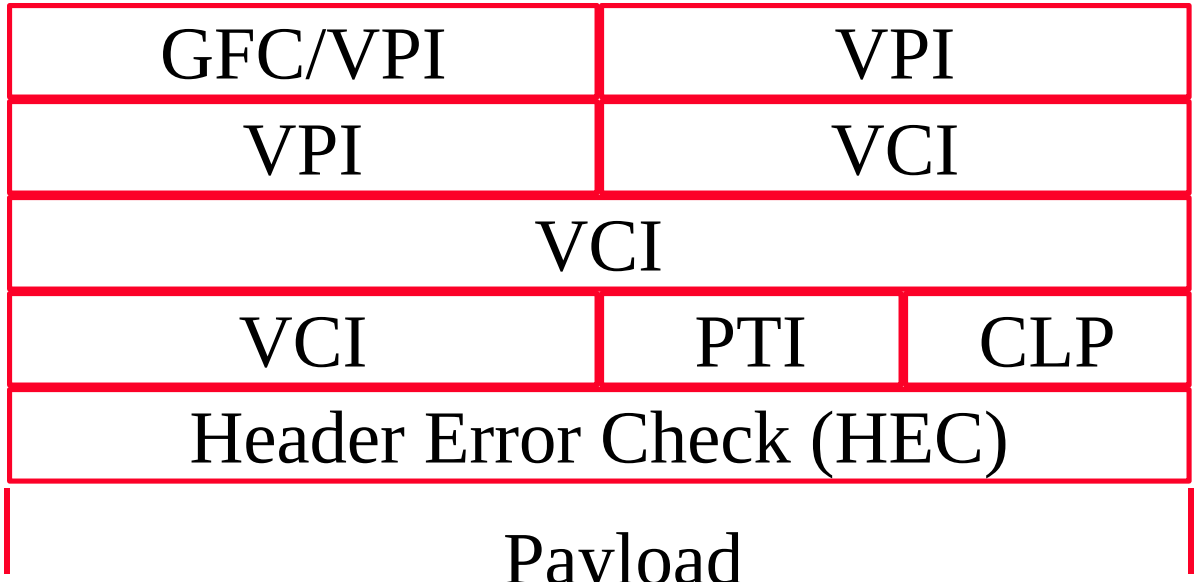


# Protocol Layers

- The ATM Adaptation Layer
  - How to break messages to cells
- The ATM Layer
  - Transmission/Switching/Reception
  - Congestion Control/Buffer management
  - Cell header generation/removal at source/destination
  - Cell address translation
  - Sequential delivery

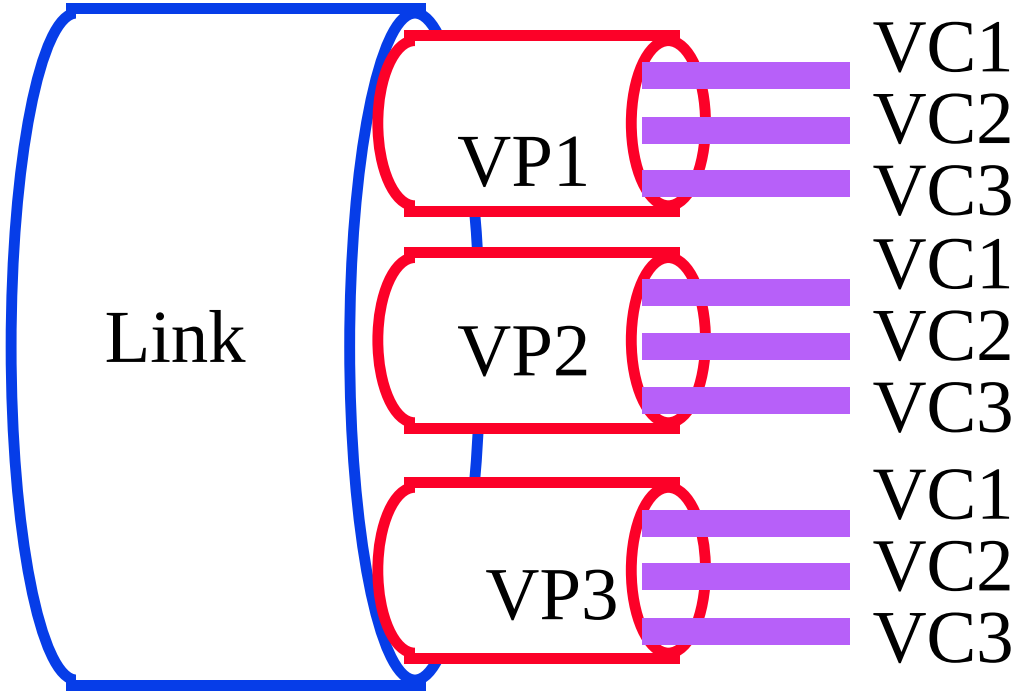
# Cell Header Format

- GFC = Generic Flow Control
  - (Was used in UNI but not in NNI)
- VPI/VCI = 0/0 ⇒ Idle cell; 0/n ⇒ Signaling
- HEC: $1 + x + x^2 + x^8$

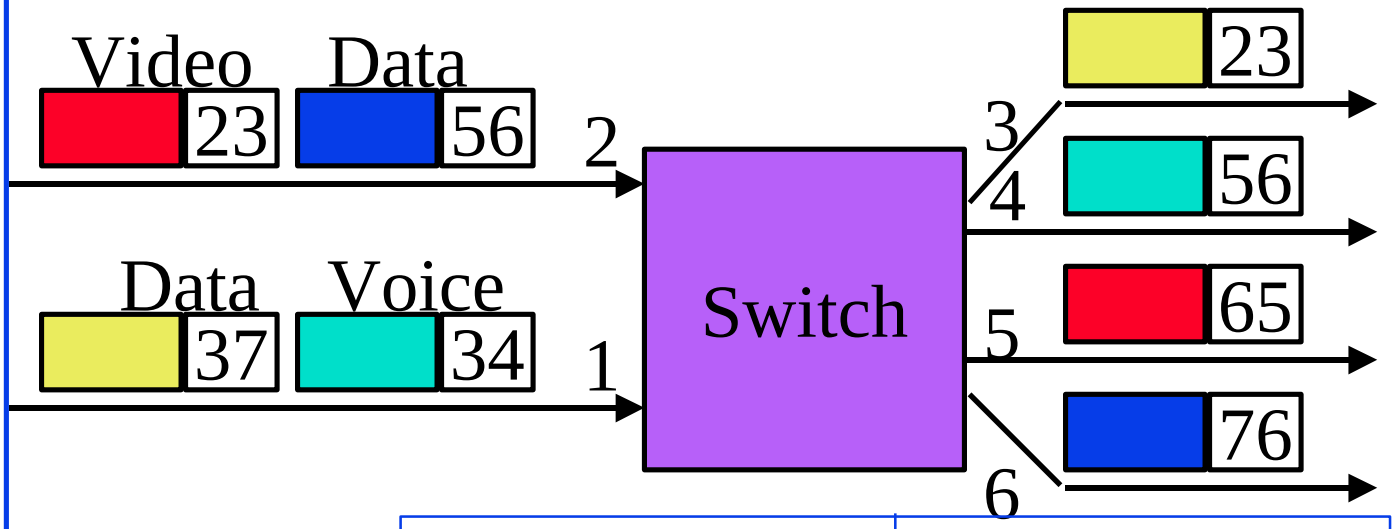


# Path vs Channels

- 24/28-bit connection identifier
  First 8/12 bits: Virtual Path,
  Last 16 bits: Virtual Circuit
- VP service allows new VC's w/o orders to carriers



# VP/VC Assignment/Use



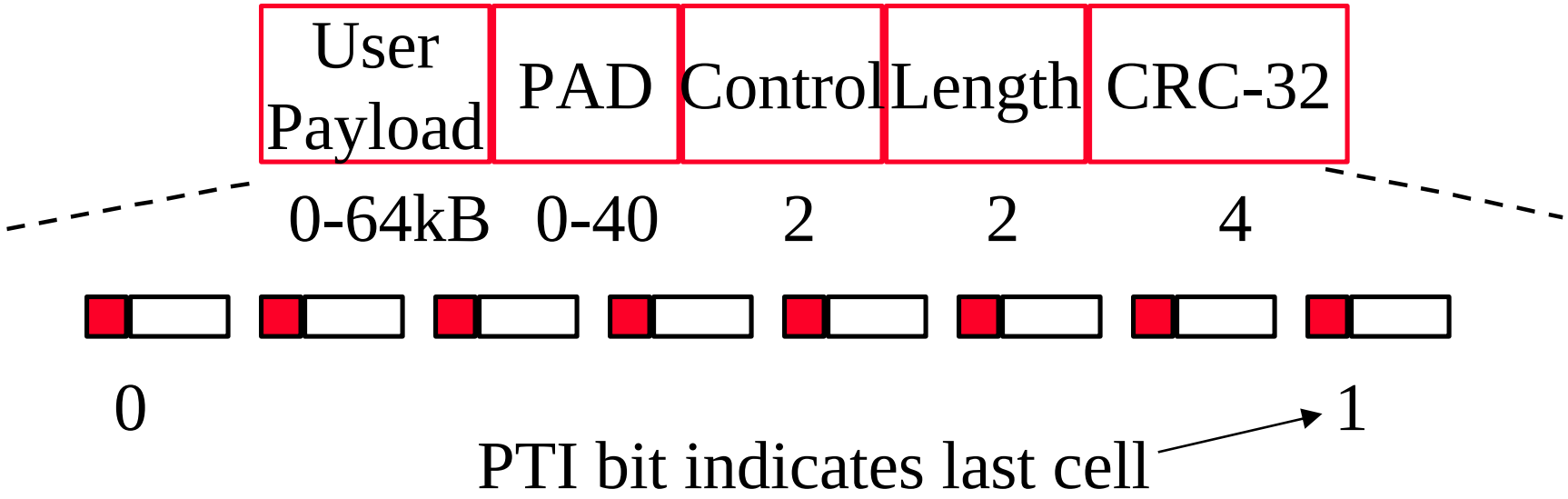

| In | | Out | |
|---|---|---|---|
| Port | VPI/VCI | Port | VPI/VCI |
| 1 | 0/37 | 3 | 1/23 |
| 1 | 0/34 | 4 | 0/56 |
| 2 | 0/23 | 5 | 0/65 |
| 2 | 0/56 | 6 | 4/76 |

# Original Classes of Traffic

| | Class A | Class B | Class C | Class D |
|---|---|---|---|---|
| Time Sync | Required | Required | Not Required | Not Required |
| Bit Rate | Constant | Variable | Variable | Variable |
| Connection | Connection Oriented | Connection Oriented | Connection Oriented | Connection less |
| AAL | AAL1 | AAL2 | AAL3 | AAL4 |
| Examples | Circuit Emulation | Compressed Video | Frame Relay | SMDS |

# AAL 5

- Designed for data traffic
- Less overhead bits than AAL 3/4
  Simple and Efficient AAL (SEAL)
- No per cell length field, No per cell CRC



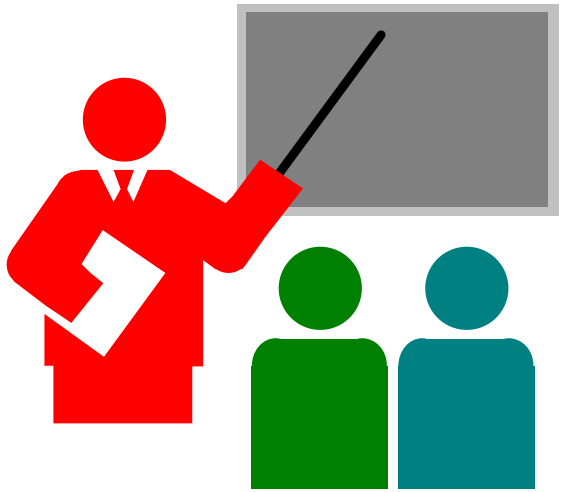
# Classes of Service

- ABR (Available bit rate): Follows feedback
  Network gives max throughput with min loss.
- UBR (Unspecified bit rate):
  User sends whenever it wants. No feedback. No guarantee. Cells may be dropped during congestion.
- CBR (Constant bit rate): User declares required rate.
  Throughput, delay and delay variation guaranteed.
- VBR (Variable bit rate): Declare avg and max rate.
  - rt-VBR (Real-time): Conferencing.
    Max delay and delay variation guaranteed.
  - nrt-VBR (non-real time): Stored video.

# Physical Media Dependent Layers

- Multimode Fiber: 100 Mbps using 4b/5b, 155 Mbps SONET STS-3c, 155 Mbps 8b/10b
- Single-mode Fiber: 155 Mbps STS-3c, 622 Mbps
- Shielded Twisted Pair (STP): 155 Mbps 8b/10b
- Coax: 45 Mbps, DS3, 155 Mbps
- Unshielded Twisted Pair (UTP)
  - UTP-3 (phone wire) at 25.6 Mbps, 51.84 Mbps
  - UTP-5 (Data grade UTP) at 155 Mbps
- DS1, DS3, STS-3c, STM-1, E1, E3, J2, n × T1

# Summary



- ATM Overview: History, Why and What
- Protocol Layers: AAL, ATM, Physical layers, Cell format
- Interfaces: PNNI, NNI, B-ICI, DXI
- ABR, CBR, VBR, UBR

# ATM : Key References

- H. Dutton and Peter Lenhard, “Asynchro-nous Transfer Mode (ATM) Technical Overview,” 2nd Ed., Prentice Hall, 1995.
- S. Siu and R. Jain, "A brief overview of ATM: Protocol Layers, LAN Emulation and Traffic Management" Computer Communications Review (ACM SIGCOMM), April 1995. Available at http://www.cis.ohio-state.edu/~jain/
- ATM Forum specs are available at ftp://ftp.atmforum.com/pub/approved-specs/

# References (Cont)

- A very detailed list of references including books is available at http://www.cis.ohio-state.edu/~jain/refs/atm_refs.htm

# 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
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- Mike Douglas, OSU/UTS
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