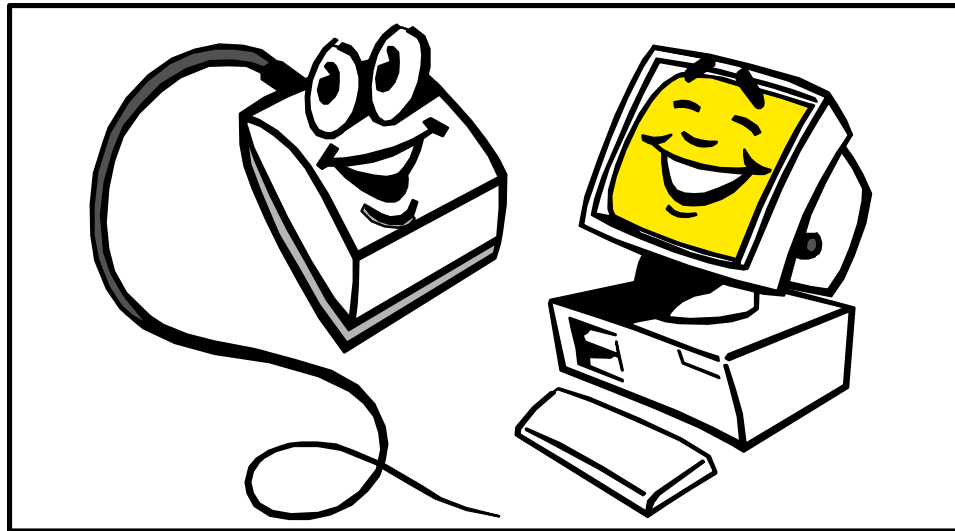


# ATM Networks



Raj Jain

Professor

Science

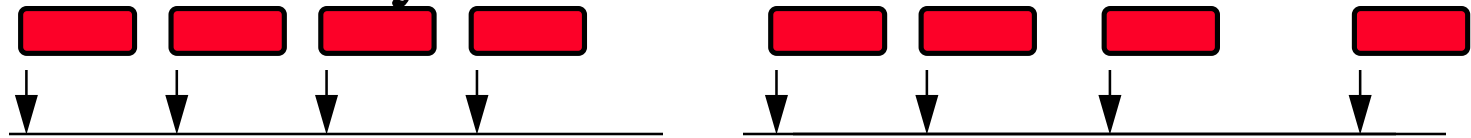
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- ❑ ATM: Overview
- ❑ ATM Protocol Layers
- ❑ Adaptation Layers
- ❑ LAN Emulation
- ❑ Network Interfaces

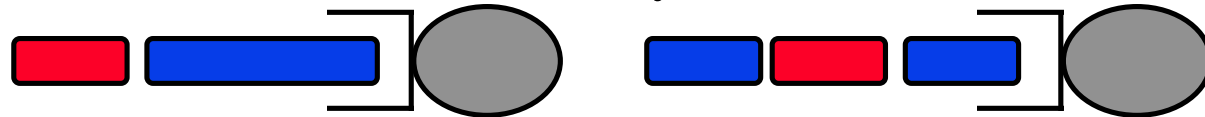
# ATM Networks: Overview

- STM = Synchronous Transfer Mode,  
ATM = Asynchronous Transfer Mode

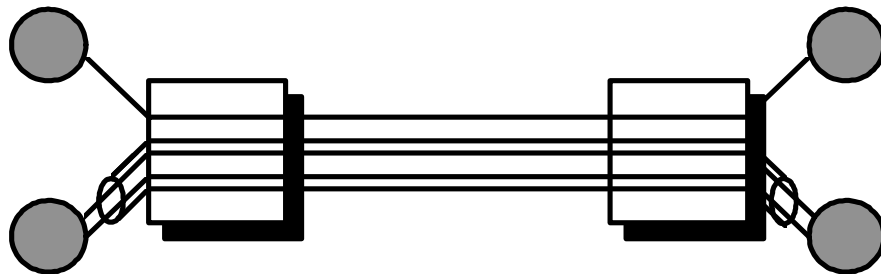


Allows any-speed and even variable rate connection

- ATM = Short fixed size 53-byte cells

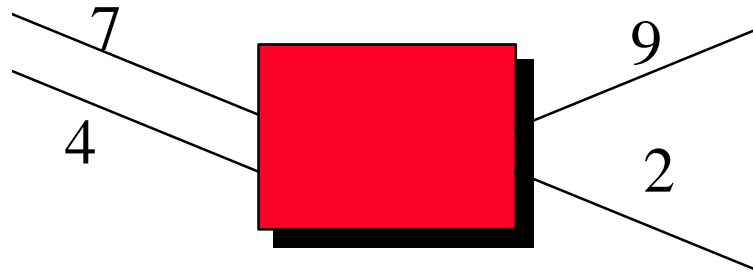


- Connection oriented  $\Rightarrow$  Virtual Channels (VC)



- ❑ Labels vs addresses

⇒ Better scalability in number of nodes

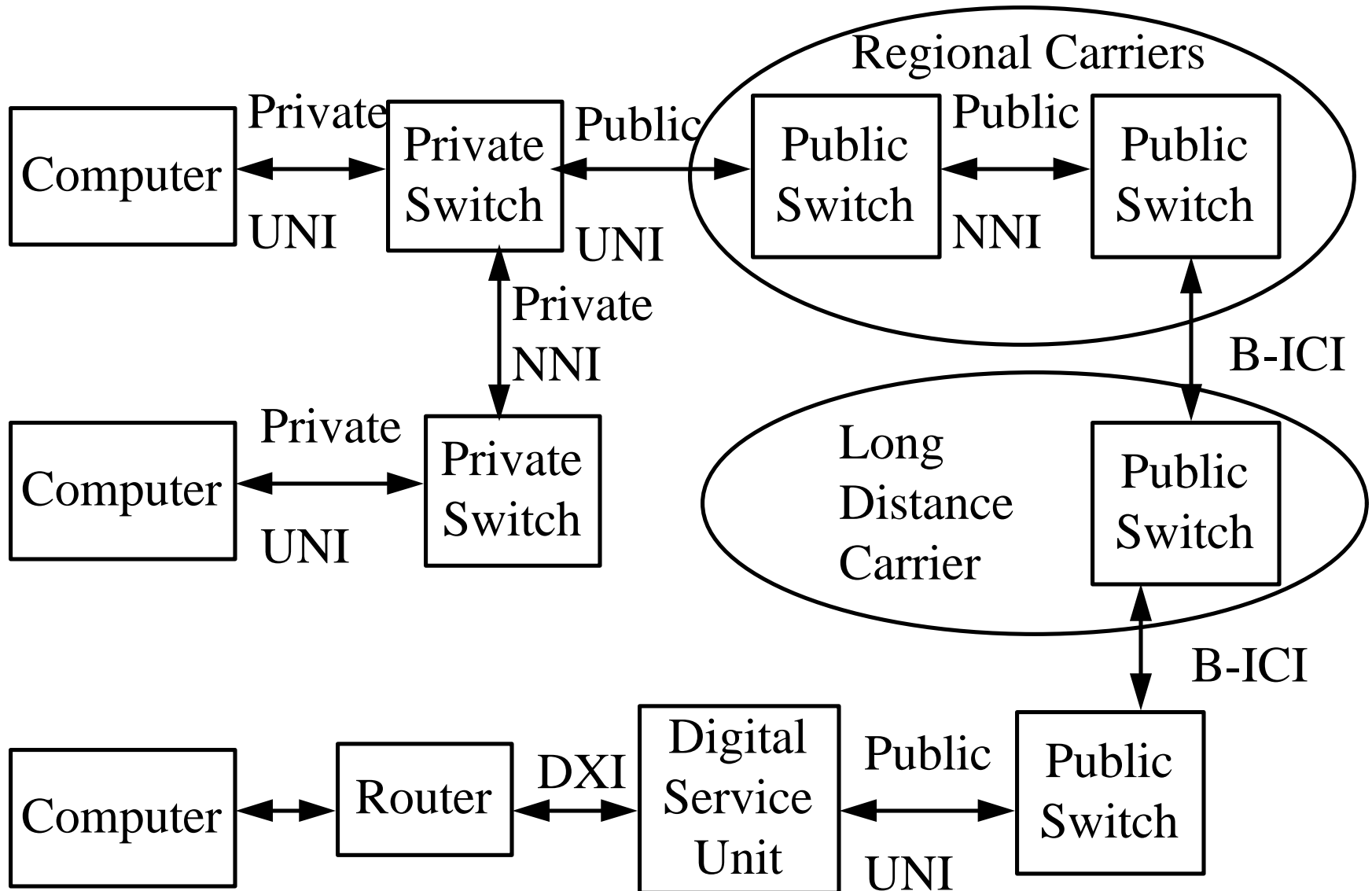


- ❑ Slotted system ⇒ Better scalability in distance-bandwidth
- ❑ Switches vs routers  
⇒ Cheaper due to fixed size, short address, simplicity
- ❑ Seamless ⇒ Same technology for LAN, MAN, WAN
- ❑ Data, voice, video integration
- ❑ Everyone else is doing it

# History of ATM

- ❑ 1980: Narrowband ISDN adopted
- ❑ Early 80's: Research on Fast Packets
- ❑ Mid 80's: B-ISDN Study Group formed
- ❑ 1988: ATM chosen for B-ISDN
- ❑ June 1989: 48+5 chosen (64+5 vs 32+4)
- ❑ October 1991: ATM Forum founded
- ❑ July 1992: UNI V2 released by ATM Forum
- ❑ 1993: UNI V3 and DXI V1
- ❑ 1994: B-ICI V1

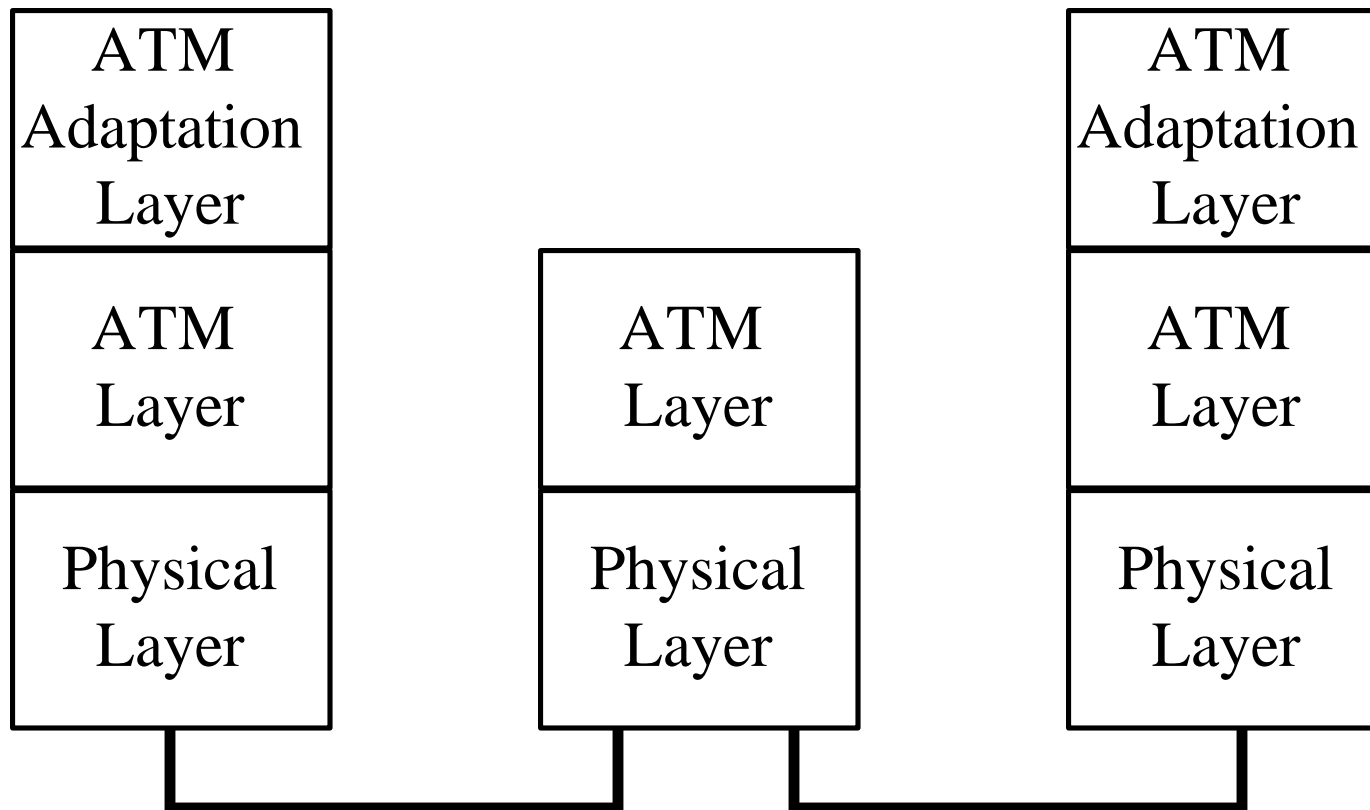
# ATM Network Interfaces



# ATM Network 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)  
⇒ Broadband Inter-Carrier Interface (B-ICI)
- ❑ Data Exchange Interface (DXI)  
Between packet routers and ATM Digital Service Units (DSU)

# Protocol Layers





# Protocol Layers

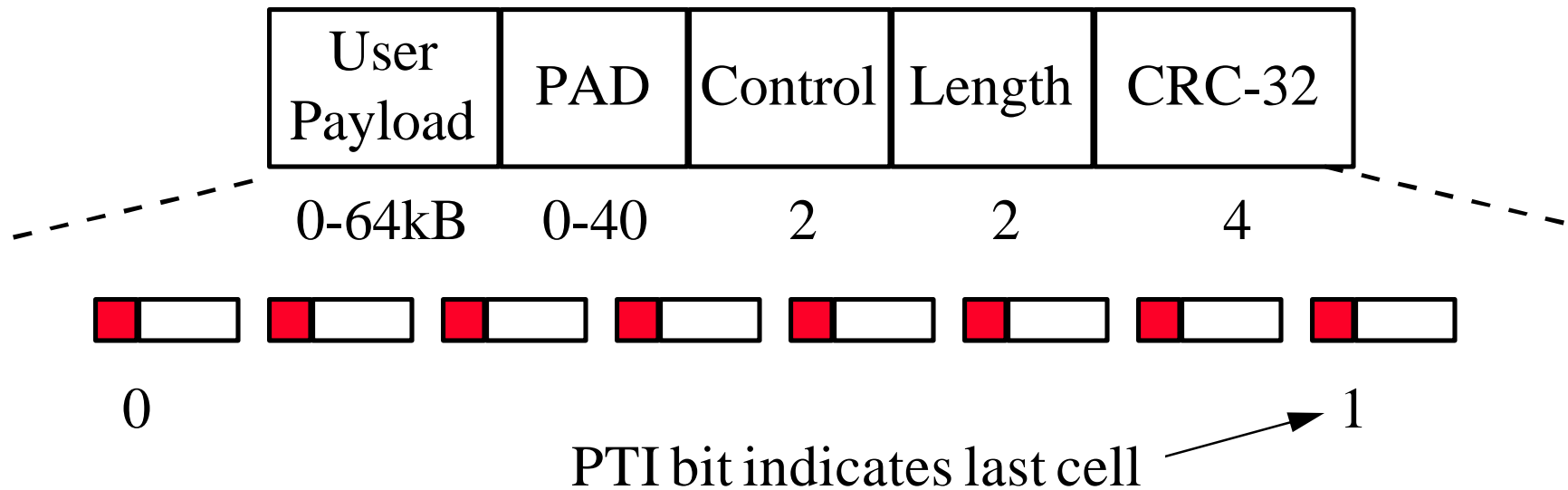
- The ATM Adaptation Layer
  - ◆ How to break application messages to cells
- The ATM Layer
  - ◆ Transmission/Switching/Reception
  - ◆ Congestion Control/Buffer management
  - ◆ Cell header generation/removal at source/destination
  - ◆ Reset connection identifiers for the next hop (at switch)
  - ◆ Cell address translation
  - ◆ Sequential delivery

# Original Classes of Traffic

	Class A	Class B	Class C	Class D
Time Synch	Required		Not Required	
Bit Rate	Constant	Variable		
Connection Mode	Connection oriented			Connect ionless
AAL	AAL 1	AAL 2	AAL 3/4/5	AAL 3/4/5
Examples	Circuit emulation	Compressed Video	Frame Relay	SMDS

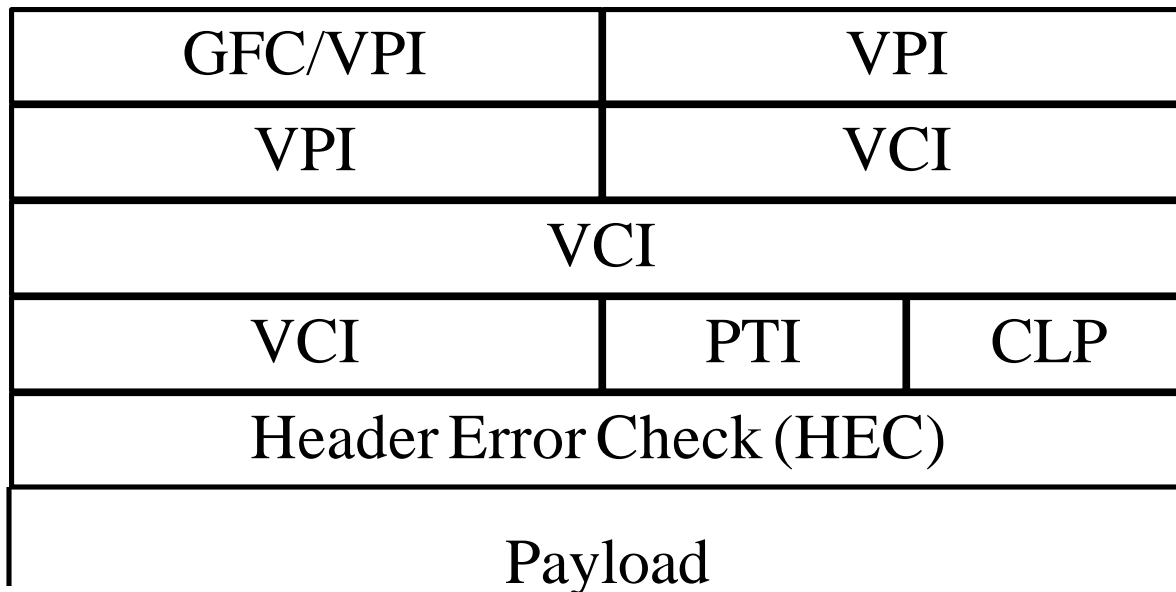
# AAL 5

- ❑ 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



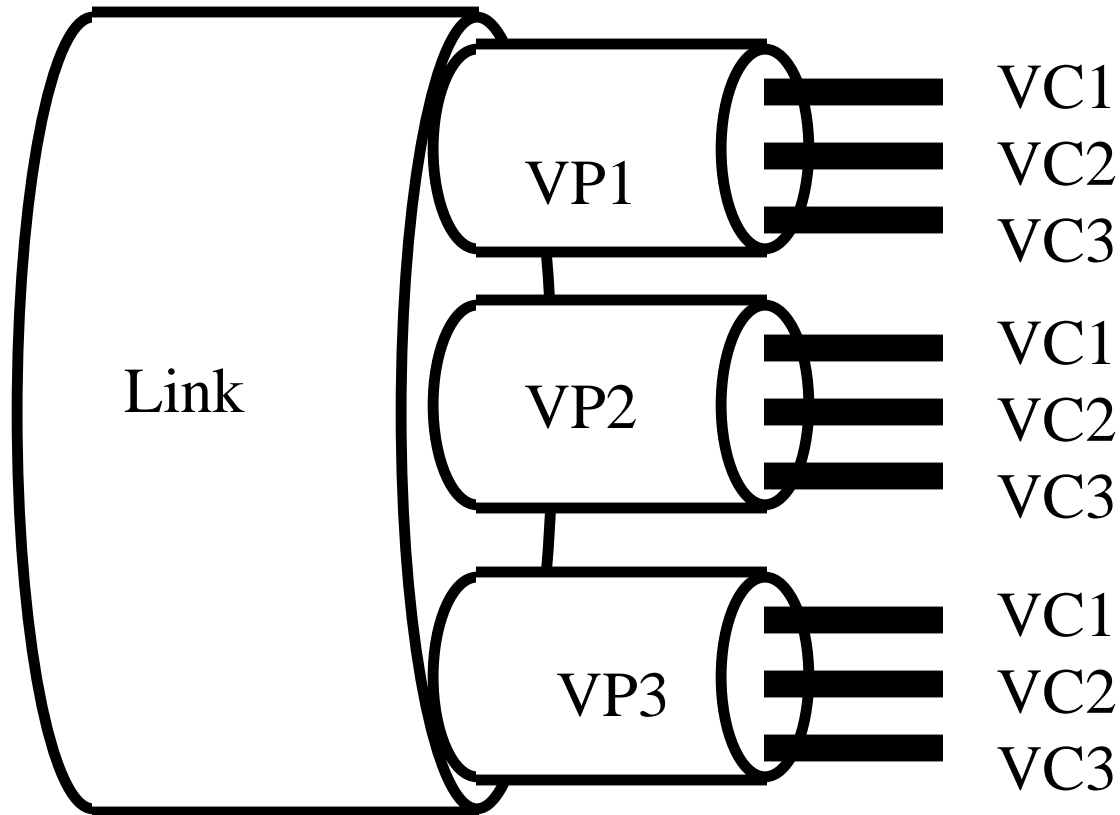
# ATM Cell Header Format

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

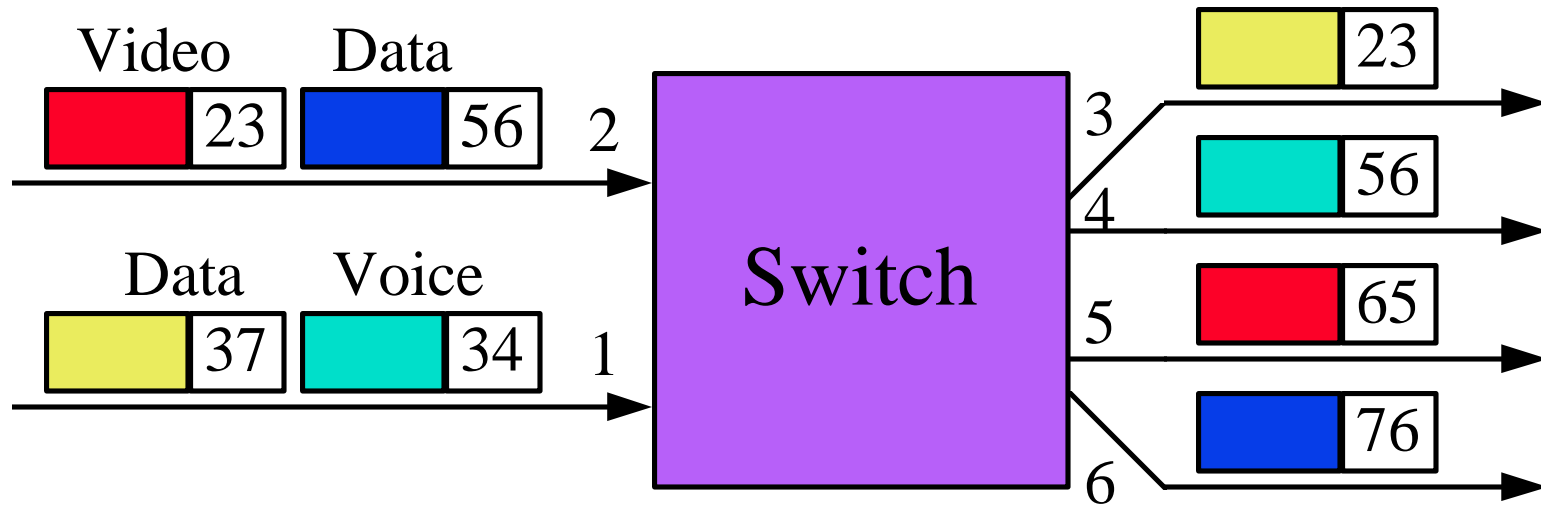


# Connection Identifiers

- ❑ Each cell contains a 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

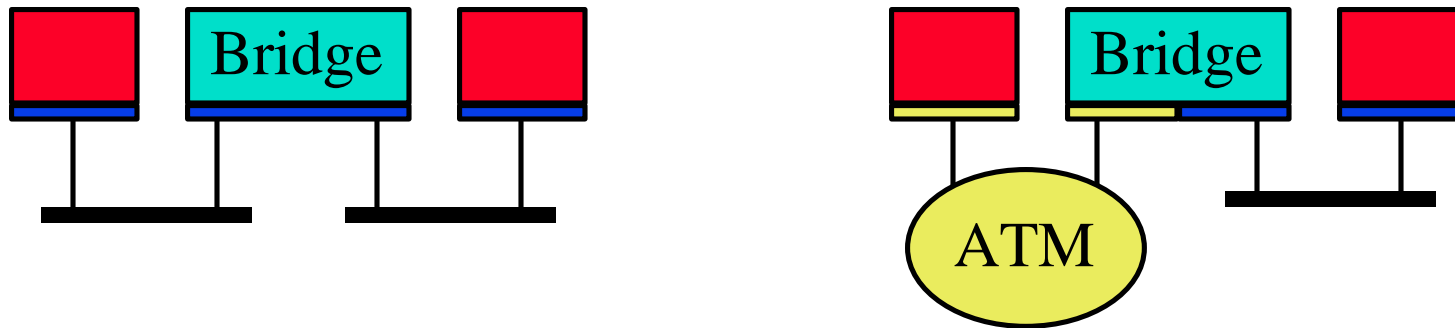


# VP/VC Assignment/Use



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

# 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

# Protocol Layers

ATM Host

Existing Applications	
IP	IPX
NDIS	ODI
LAN Emulation	
AAL5	
ATM	
Physical Layer	

LAN Host

Existing Applications	
IP	IPX
NDIS	ODI
Media Access Control	
Physical Layer	

ATM Switch

ATM	
Physical Layer	Physical Layer

ATM-LAN Bridge

Bridging	
LAN Emulation	Media Access Control
AAL5	
ATM	
Physical Layer	Physical Layer

- ❑ NDIS = Network Driver Interface Specification
- ❑ ODI = Open Datalink Interface



# Features

- ❑ One ATM LAN can be multiple 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
- ❑ Doesn't allow passive monitoring
- ❑ No token management (SMT), collisions, beacon frames

LE Header (2 Bytes)	Standard IEEE 802.3 or 802.5 Frame
---------------------	------------------------------------

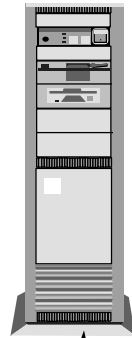
# LAN Emulation

1. Clients get recipient's address from LES and setup a VC.

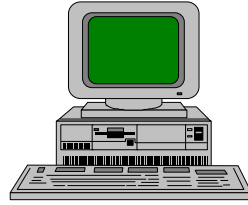
2. Clients send messages on the VC

3. Messages for ATM clients are delivered directly.

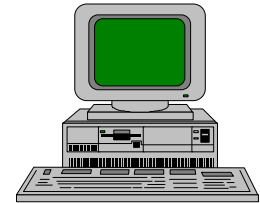
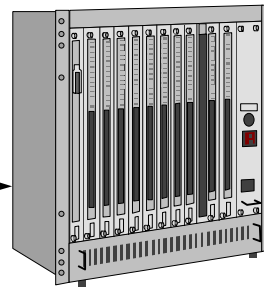
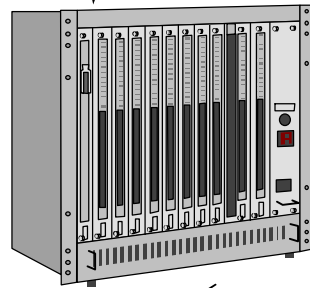
4. Messages for non-ATM clients are forwarded through a bridge



LAN Emulation Server (LES)



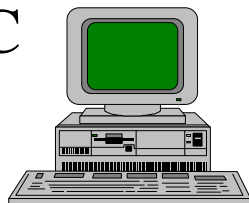
ATM Switches



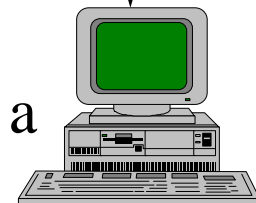
ATM client B



Bridge



Broadcast/Unknown Server (BUS)



Non-ATM client

Raj Jain

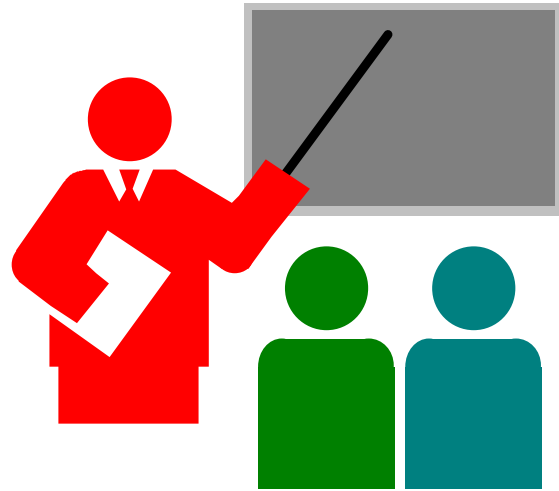
# Operation

- ❑ Initialization: Client gets Server's address from a well known ATM address
- ❑ Registration: Client sends a list of its MAC addresses to Server
- ❑ Address Resolution: Client sends ARP request to Server
  - ◆ Server, Clients, Bridges answer ARP
  - ◆ Client setups a direct connection
- ❑ Broadcast/Unknown Server (BUS):  
Forwards multicast traffic to all members

# Physical Media Dependent Layers (PMDs)

- ❑ Multimode Fiber: 100 Mbps using 4b/5b (TAXI), 155 Mbps SONET STS-3c, 155 Mbps 8b/10b
- ❑ Single-mode Fiber: 155 Mbps SONET STS-3c
- ❑ Shielded Twisted Pair (STP): 155 Mbps 8b/10b
- ❑ Coax: 45 Mbps, DS3
- ❑ Unshielded Twisted Pair (UTP)
  - ◆ UTP-3 (phone wire) at 51.84 Mbps, CAP-16 coding
  - ◆ UTP-5 (Data grade UTP) at 155 Mbps, NRZI coding

# Summary



- ❑ ATM Overview: History, Why and What
- ❑ Interfaces: PNNI, NNI, B-ICI, DXI
- ❑ Protocol Layers: AAL, ATM, Physical layers, Cell format
- ❑ LAN Emulation
- ❑ IP over ATM

# References

- ❑ R, Handel, M. Huber, and S. Schroder, *ATM Networks*, Addison-Wesley, 1994.
- ❑ D.E. McDysan and D.L. Spohn, *ATM: Theory and Applications*, McGraw-Hill, 1994
- ❑ L.G. Cuthbert and J-C Sapanel, *ATM: The broadband Telecommunication Solution* IEE 1993, London, 161 pp.
- ❑ David Benham, *ATM in Local Area Networks*, 11 April 1994, Hughes LAN Systems, (800)395-LANs, (415)966-7300.
- ❑ *Communications of ACM*, Special issue on ATM, February 1995
- ❑ *Presentation ATM Basics*, ATM Forum, Fax on demand (415)-688-4318, Document #5007, 8 pp.
- ❑ Computer based training (CBT) diskettes, ATM Forum

# References

- ❑ RFC 1577, “*Classical IP and ARP over ATM*” by M. Laubach, January 1994.
- ❑ RFC 1483, “*Multiprotocol Encapsulation over ATM Adaptation Layer 5*” by J. Heinanen, July 1993.
- ❑ *User-Network Interface Specifications, V3.0*, Prentice-Hall, September 10, 1993., (515)-284-6751
- ❑ From ATM Forum, (415)-578-6860
  - ◆ B-ICI V1.1
  - ◆ DXI V1
  - ◆ DS1 Phy V1.0
  - ◆ 52 Mb/s Category 3 UTP
  - ◆ 155 Mb/s Category 5 UTP

# Information Sources

- ATM Forum (415)578-6860 info@atmforum.com
  - ◆ <http://www.atmforum.com>
- Internet Engineering Task Force
  - ◆ IP over ATM: atm-request@hpl.hp.com
  - ◆ Routing over Large Clouds: rolc-request@nsc.com
  - ◆ atommib-request@thumper.bellcore.com
  - ◆ RFCs: mail-server@nisc.sri.com (Send Help in message)
  - ◆ Draft RFC's: Internet-Drafts@cnri.reston.va.us
- Internet News: cell-relay-request@indiana.edu
  - ◆ [comp.dcom.cell-relay@indiana.edu](mailto:comp.dcom.cell-relay@indiana.edu)
- International Telecommunications Union (ITU)