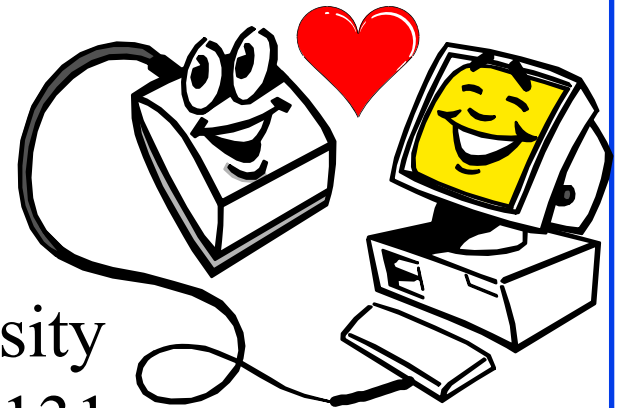


# ATM Networks: An Overview

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These slides are available on-line at:

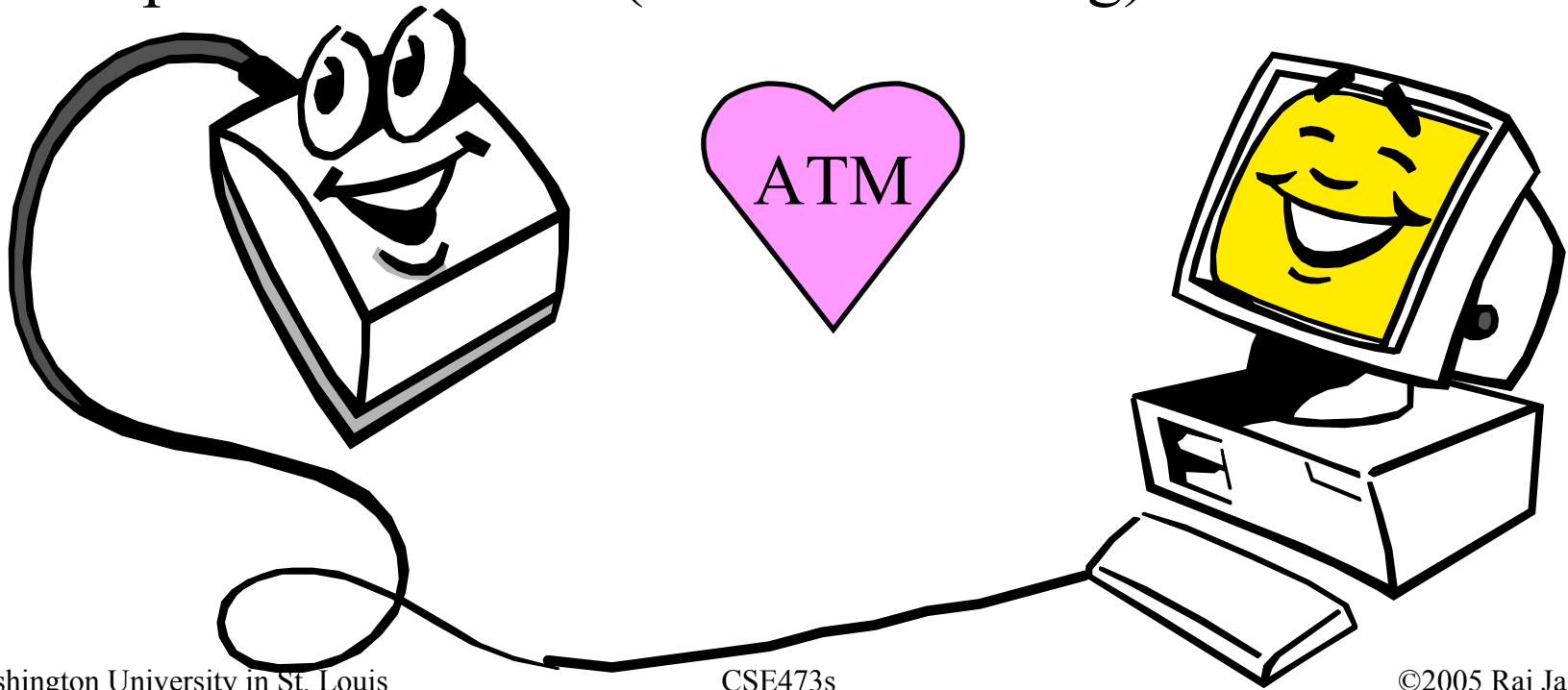
<http://www.cse.wustl.edu/~jain/cse473-05/>



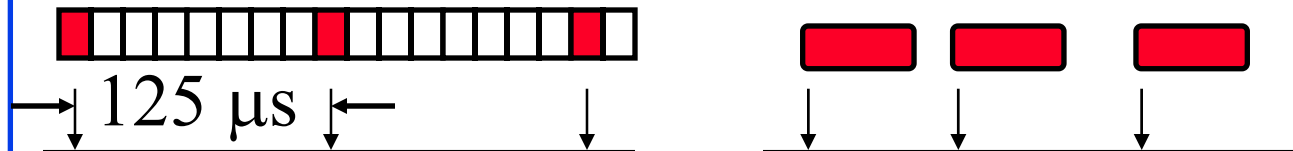
- q ATM vs Phone Networks and Data Networks
- q ATM Protocol Layers
- q Cell Header Format, AALs
- q Physical Media
- q Service Classes: CBR, VBR, ABR, UBR, GFR

# ATM

- q ATM Net = Data Net + Phone Net
- q Combination of Internet method of communication (packet switching) and phone companies' method (circuit switching)



# ATM vs Phone Networks

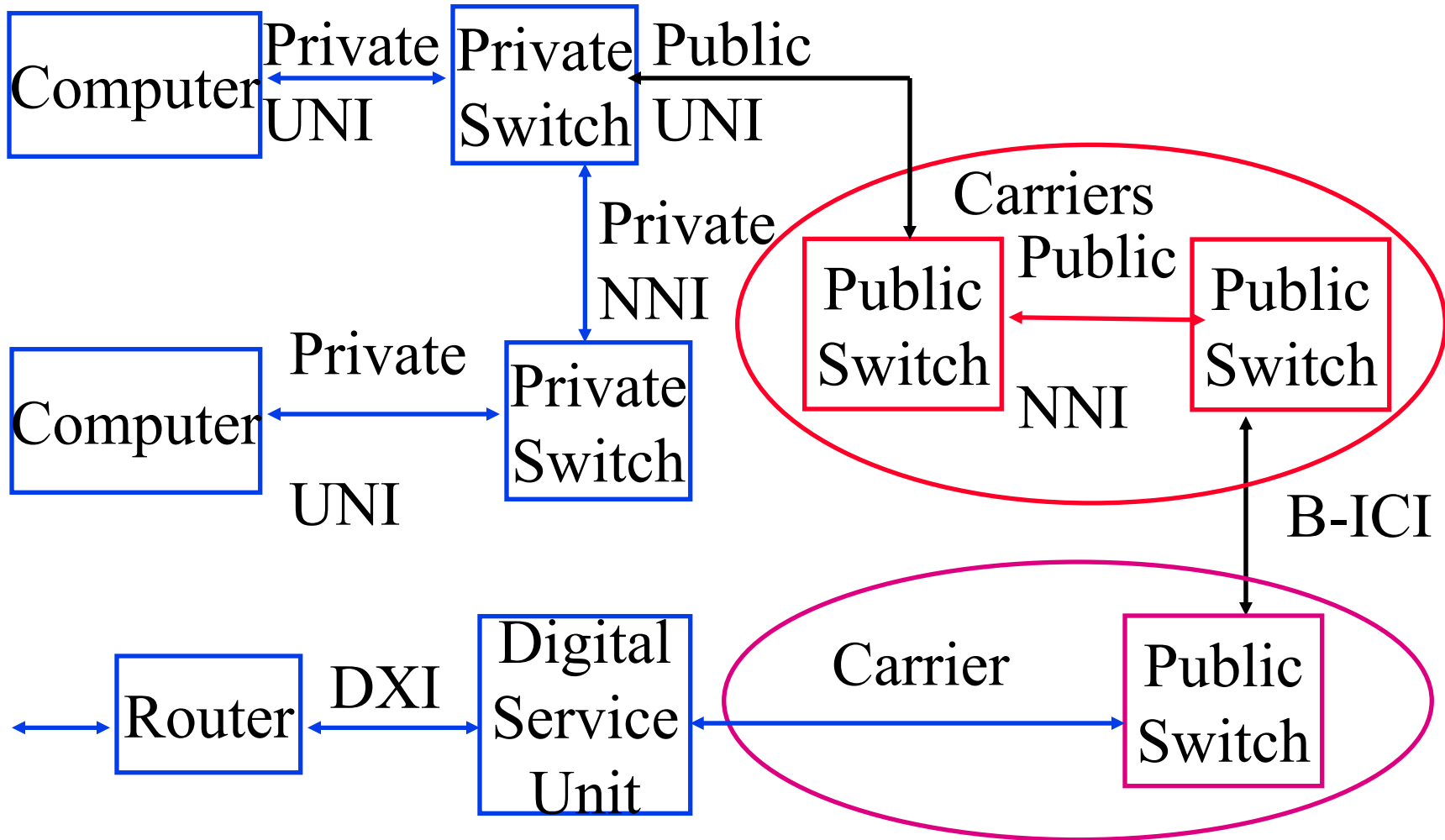


- q Legacy phone networks are synchronous (periodic).  
ATM = Asynchronous Transfer Mode
- q Phone networks use circuit switching.  
ATM networks use “Packet” Switching
- q In phone networks, all rates are multiple of 8 kbps.  
With ATM service, you can get any rate.  
You can vary your rate with time.
- q With current phone networks, all high speed circuits are manually setup. ATM allows automated setup.

# ATM vs Data Networks

- q Signaling: Internet Protocol (IP) was connectionless. You could not reserve bandwidth in advance. ATM is connection-oriented. You declare your needs before using the network.
- q PNNI: Path based on quality of service (QoS)
- q Switching: In IP, each packet is addressed and processed individually.
- q Traffic Management: Loss based in IP. ATM has newer traffic management technology. Required for high-speed and variable demands.
- q Cells: Fixed size or small size. Not important

# ATM Interfaces

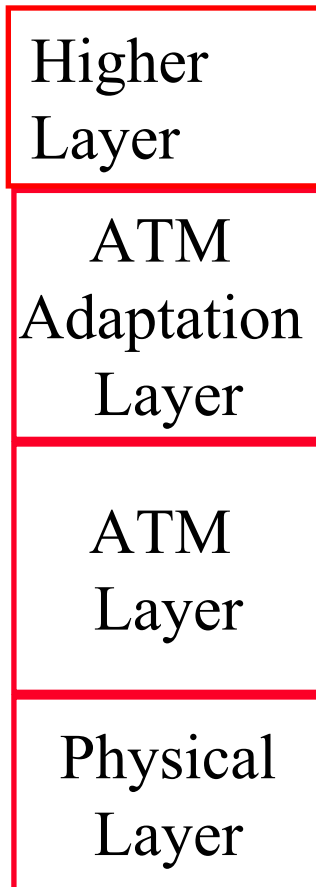


# ATM Interfaces

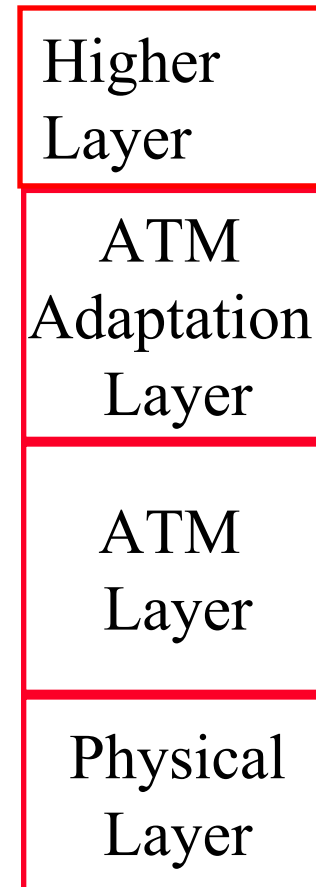
- q User to Network Interface (UNI):  
Public UNI, Private UNI
- q Network to Node Interface (NNI):
  - q Private NNI (P-NNI)
  - q Public NNI = Inter-Switching System Interface (ISSI)  
Intra-LATA ISSI (Regional Bell Operating Co)
  - q Inter-LATA ISSI (Inter-exchange Carriers)  
⇒ Broadband Inter-Carrier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

# Protocol Layers

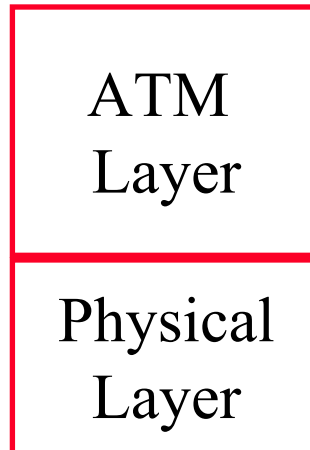
End System



End System



Switch

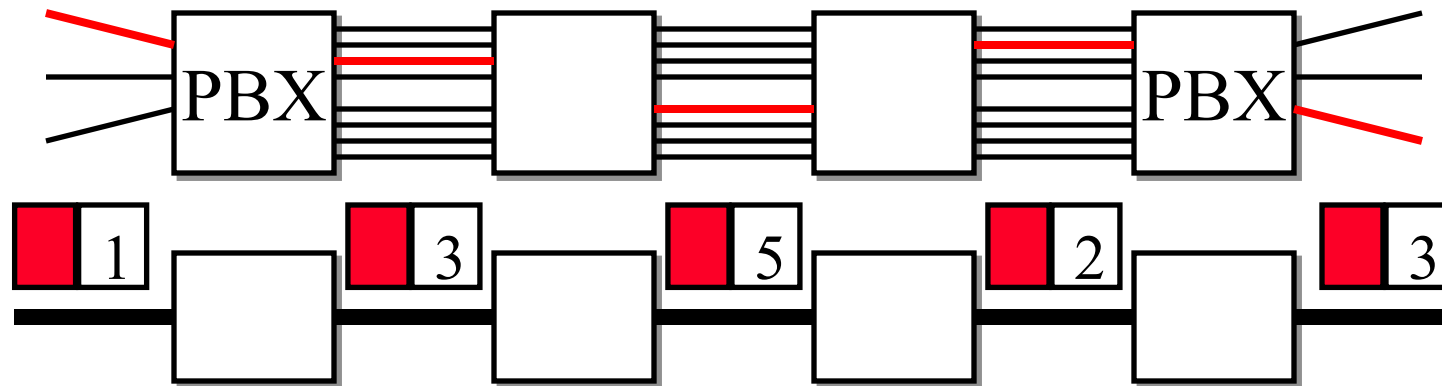




# Protocol Layers

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

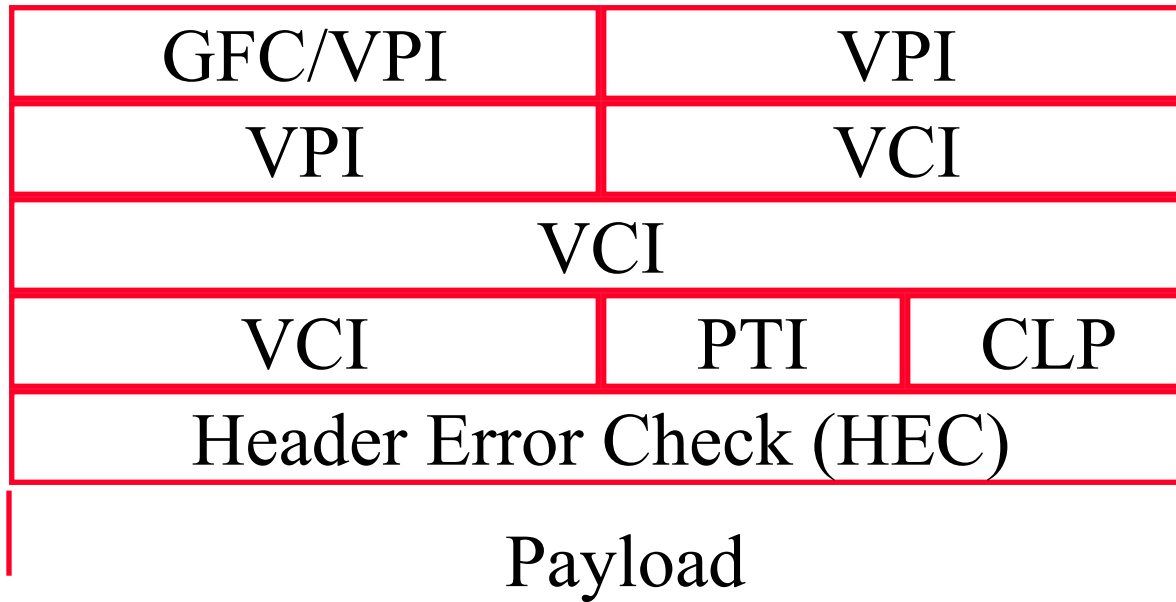
## Virtual Circuit Numbers



- q Each cell has a circuit number
- q Circuit number determines the cell's queuing and forwarding
- q Circuits have to be set up before use
- q Circuits are called Virtual Circuits (VCs)

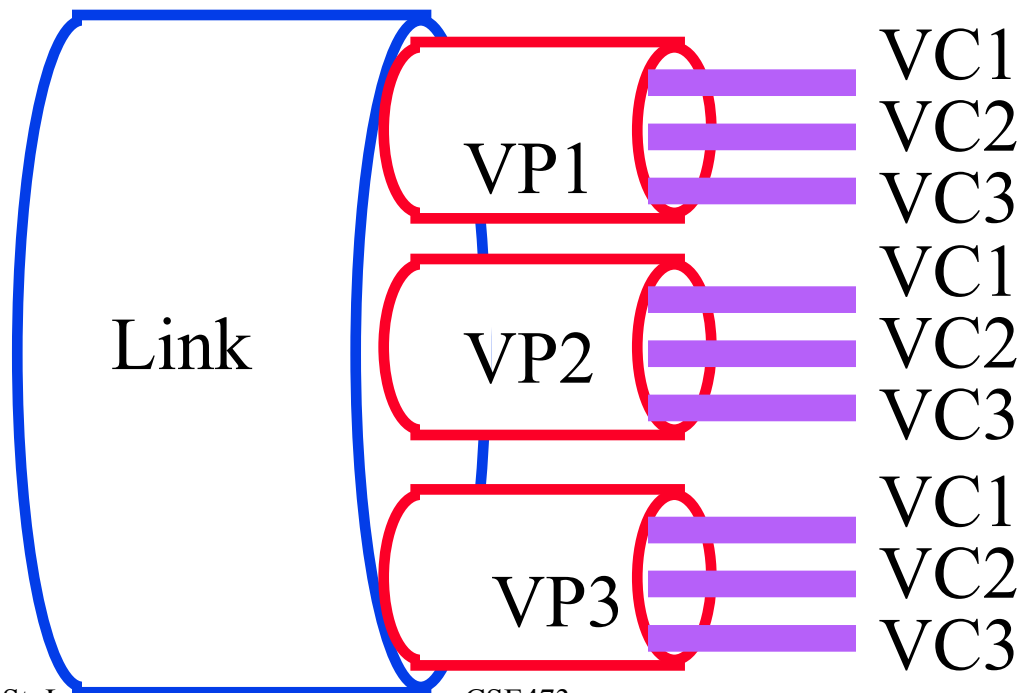
# Cell Header Format

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

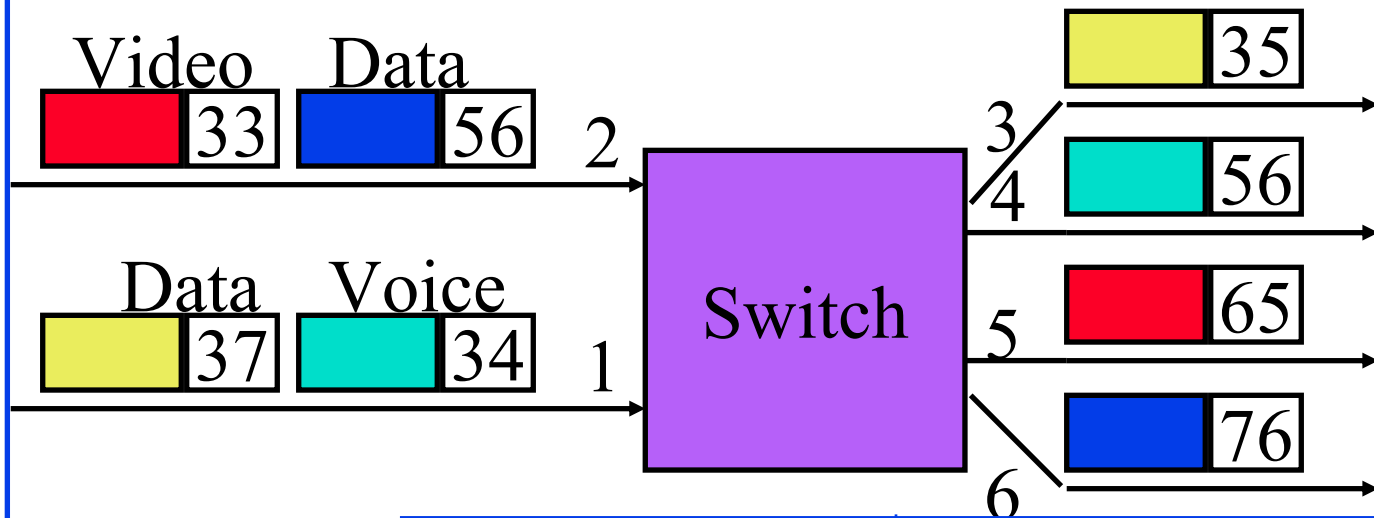


# Path vs Channels

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



# VP/VC Assignment/Use

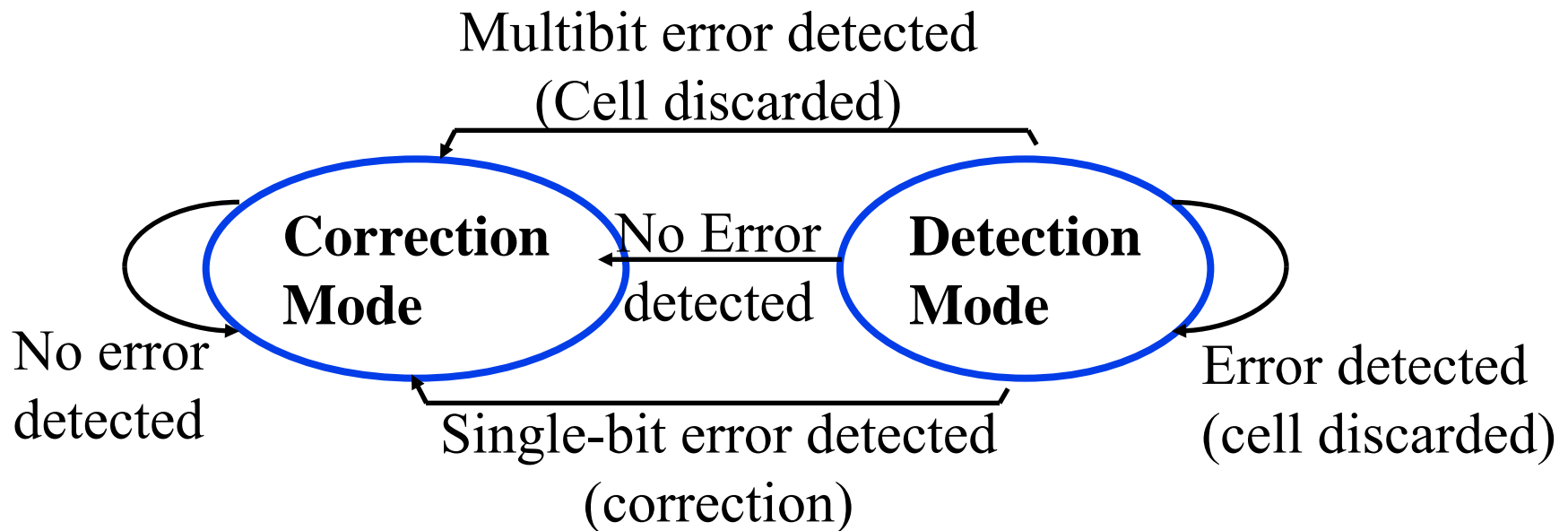


In		Out	
Port	VPI/VCI	Port	VPI/VCI
1	0/37	3	1/35
1	0/34	4	0/56
2	0/33	5	0/65
2	0/56	6	4/76

# Header Error Control

- q 8 bit error control field
- q Calculated on remaining 32 bits of header
- q Allows some error correction

# HEC Operation at Receiver



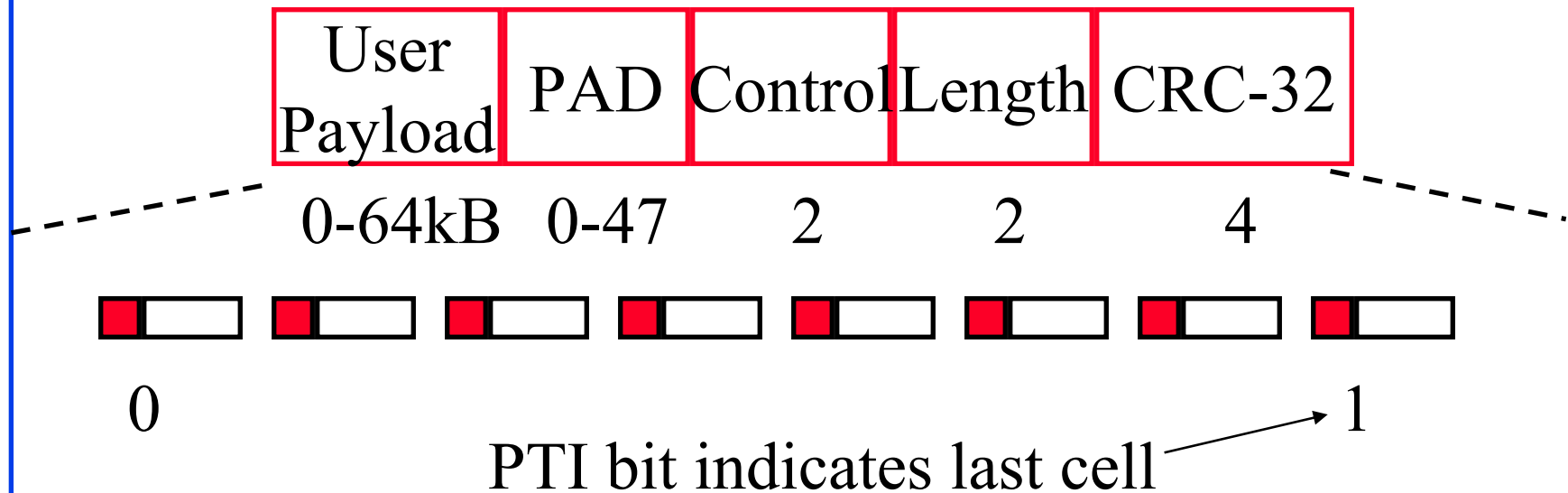
# Original Classes of Traffic

	Class A	Class B	Class C	Class D
Time Sync	Yes	Yes	No	No
Bit Rate	Constant	Variable	Variable	Variable
Connection -Oriented	Yes	Yes	Yes	No
Examples	Circuit Emulation	Comp. Video	Frame Relay	SMDS
AAL	AAL1	AAL2	AAL3	AAL4



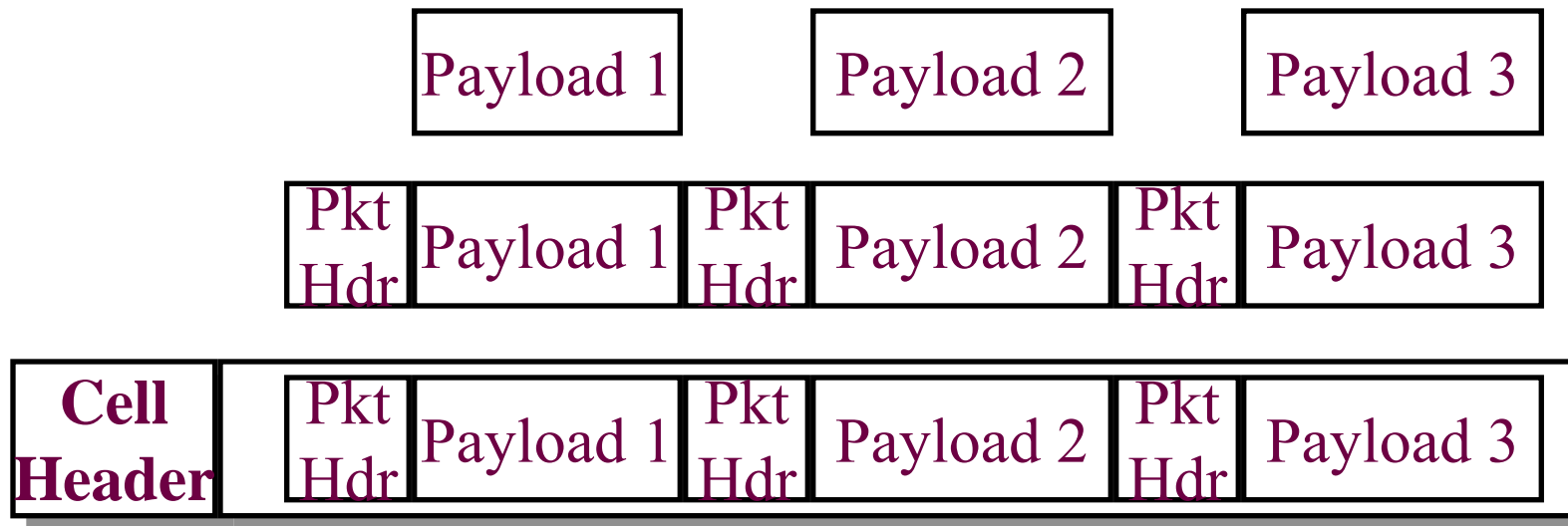
# AAL 5

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



# AAL2

- q Ideal for low bit rate voice
- q Variable/constant rate voice
- q Multiple users per VC
- q Compression and Silence suppression
- q Idle channel suppression



# Physical Media

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

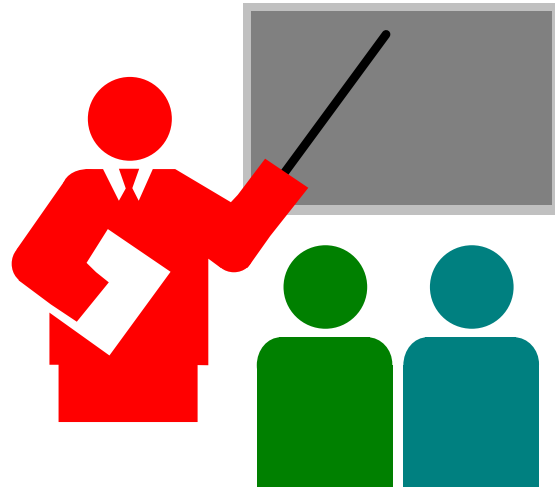
# Classes of Service

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

# Guaranteed Frame Rate (GFR)

- q UBR with minimum cell rate (MCR)  $\Rightarrow$  UBR+
- q Frame based service
  - q Complete frames are accepted or discarded in the switch
  - q Traffic shaping is frame based.  
All cells of the frame have the same cell loss priority (CLP)
  - q All frames below MCR are given CLP =0 service.  
All frames above MCR are given best effort (CLP =1) service.

# Summary



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

# Reading Assignment

- q Read Chapter 11 of Stallings' 7<sup>th</sup> edition  
Try to answer Review Questions 11.3-11.10 (There is no need to submit)