ATM Networks: An Overview

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Pr ences

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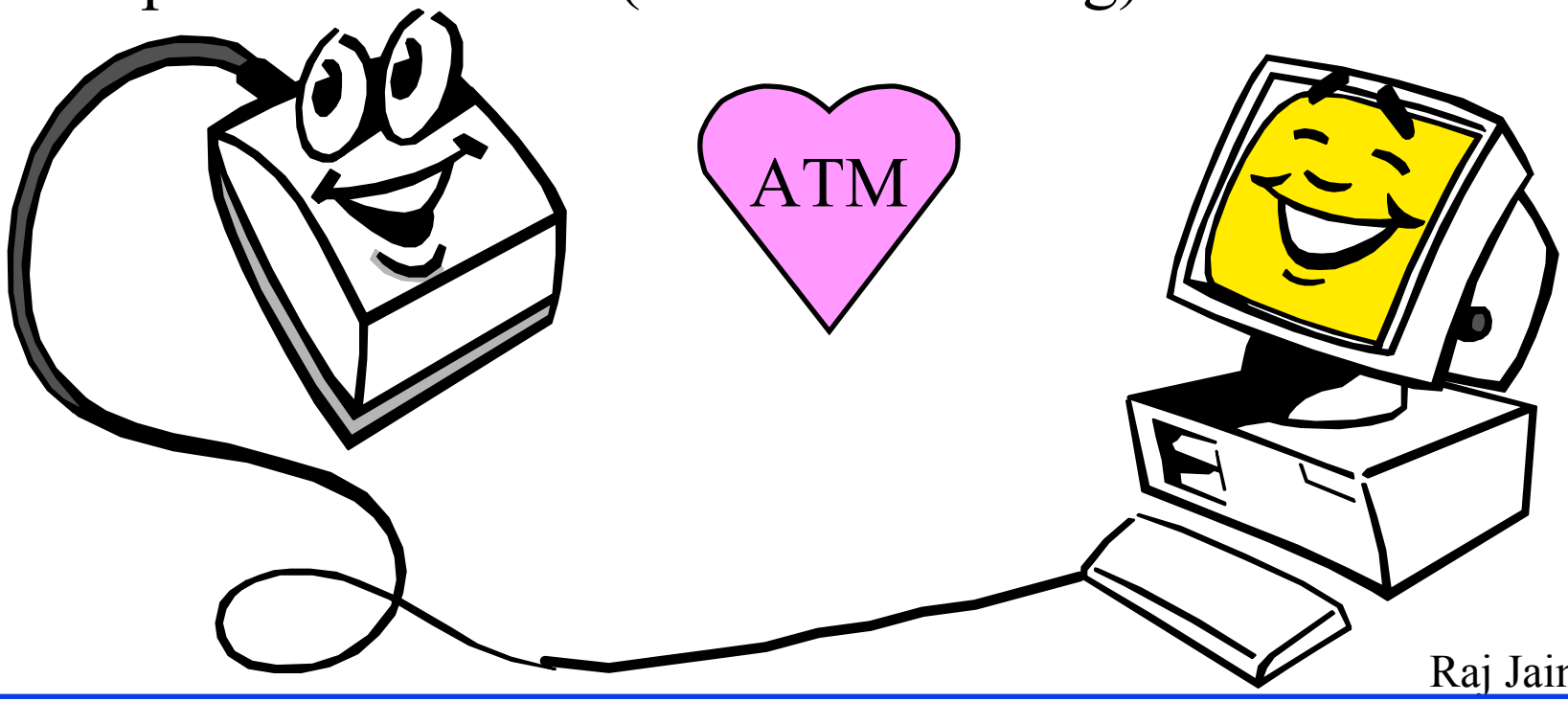
Overview

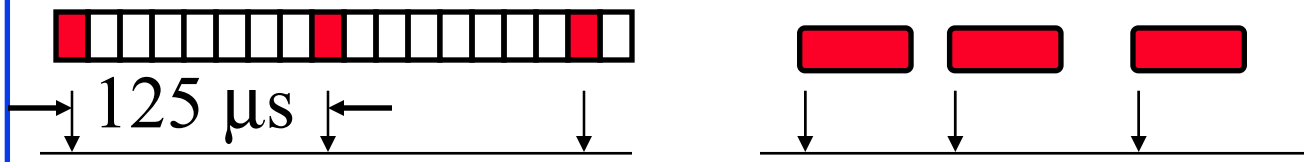
- ATM vs Phone Networks and Data Networks
- ATM Protocol Layers
- Cell Header Format, AALs
- Physical Media
- Traffic Management: ABR, UBR, GFR

ATM

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



ATM vs Phone Networks

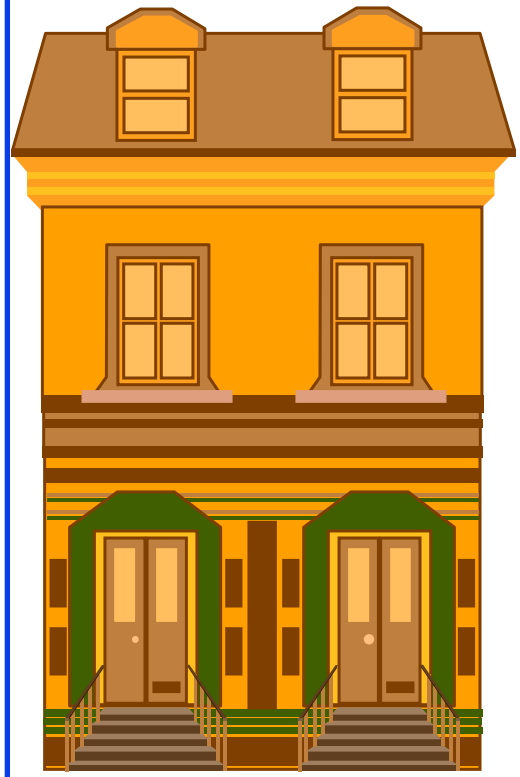


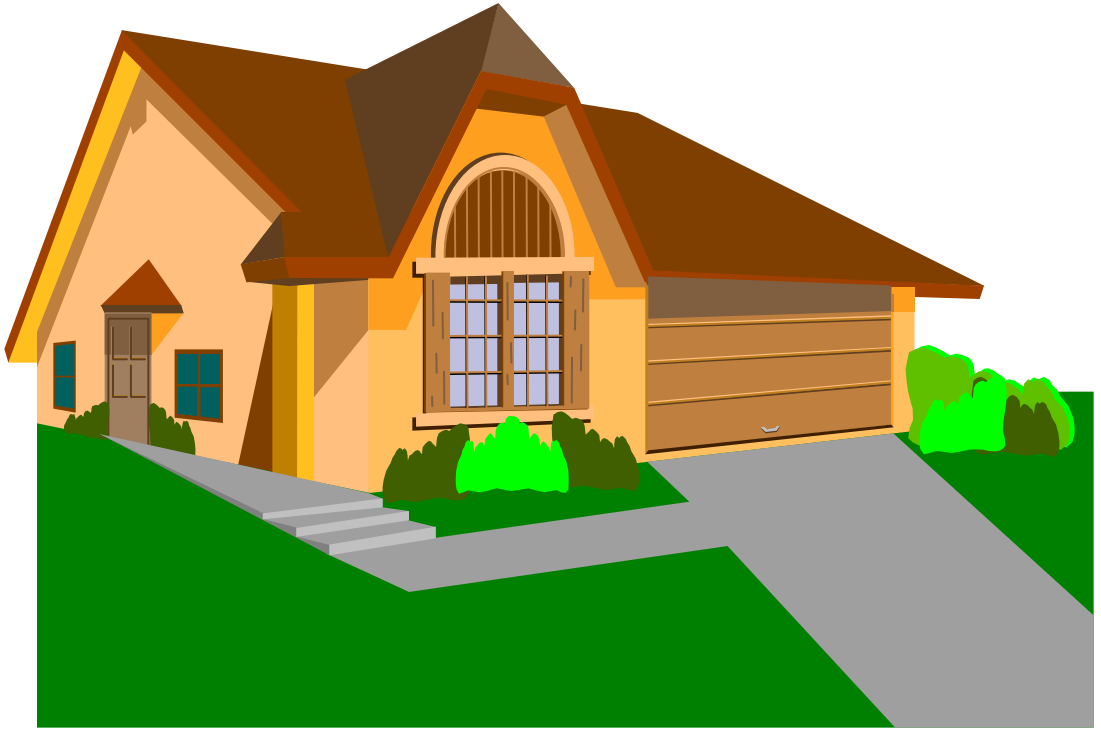
- Current phone networks are synchronous (periodic).
  ATM = Asynchronous Transfer Mode
- Phone networks use circuit switching.
  ATM networks use "Packet" Switching
- In phone networks, all rates are multiple of 8 kbps.
  With ATM service, you can get any rate.
  You can vary your rate with time.
-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

ATM vs Data Networks

- Signaling: Internet Protocol (IP) is connectionless.
  You cannot reserve bandwidth in advance.
  ATM is connection-oriented.
  You declare your needs before using the network.
- PNNI: Path based on quality of service (QoS)
- Switching: In IP, each packet is addressed and processed individually.
- Traffic Management: Loss based in IP.
  ATM has 1996 traffic management technology.
  Required for high-speed and variable demands.
- Cells: Fixed size or small size is not important

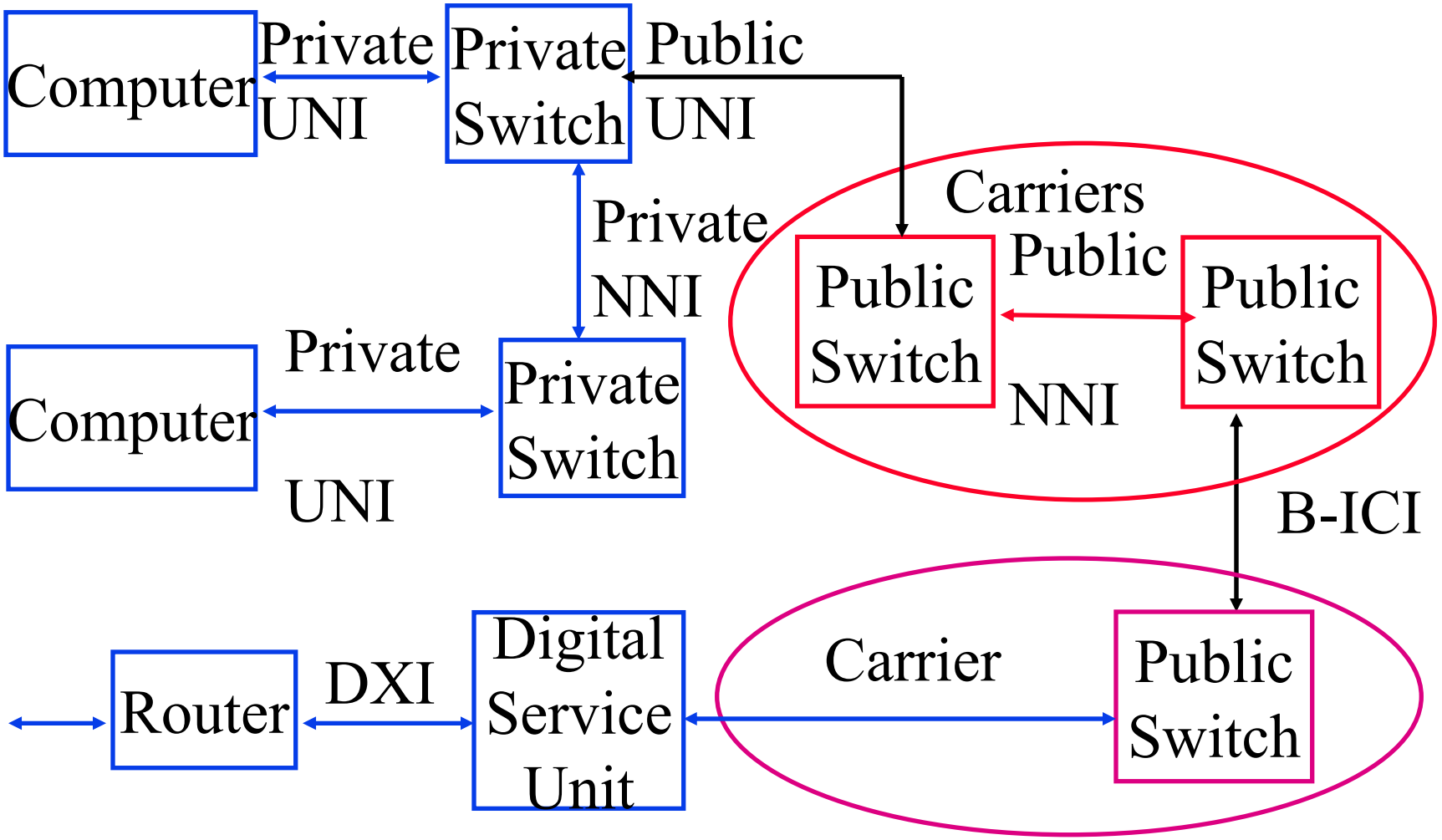
Old House vs New House





- New needs:
  Solution 1: Fix the old house (cheaper initially)
  Solution 2: Buy a new house (pays off over a long run)

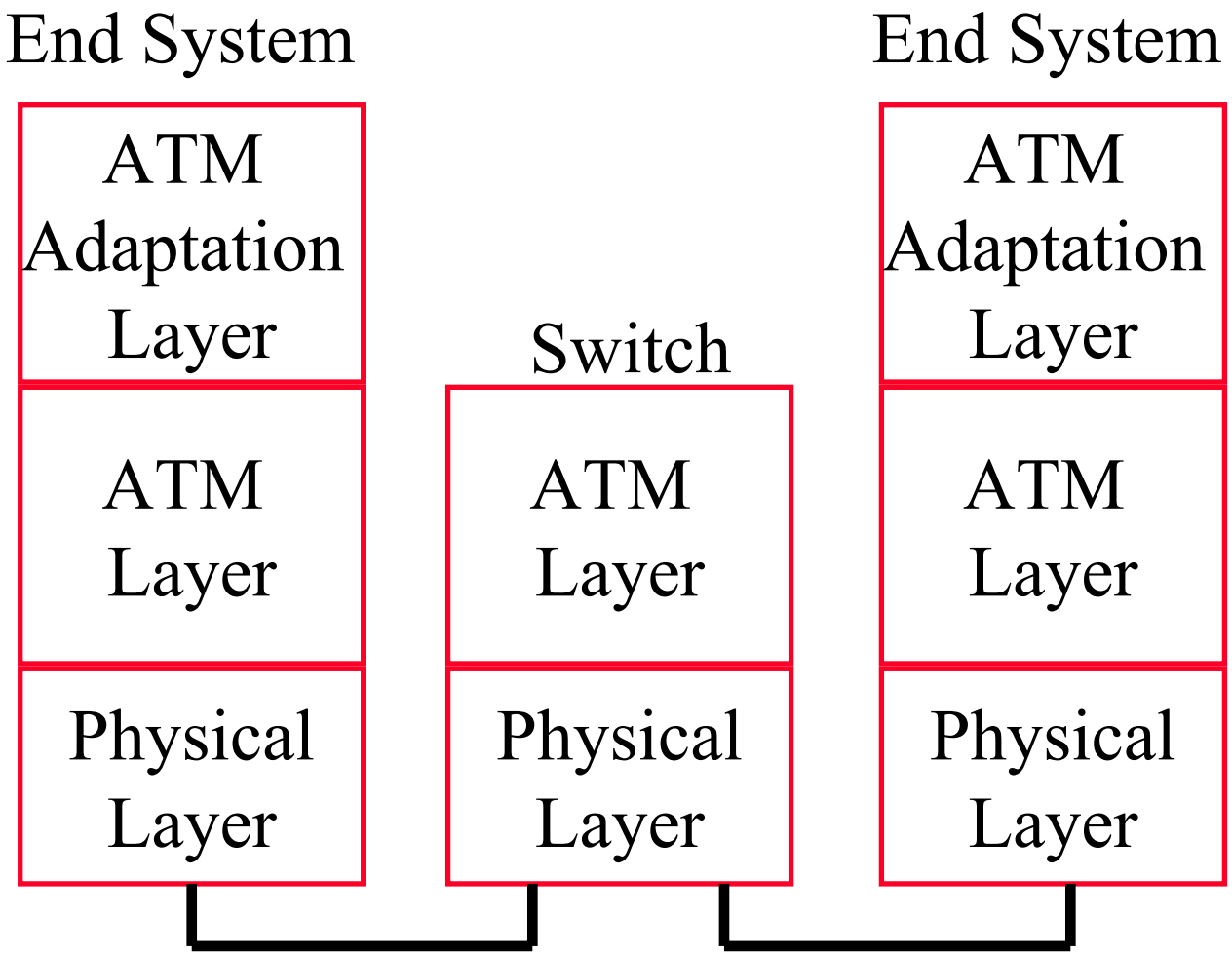
ATM Interfaces



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

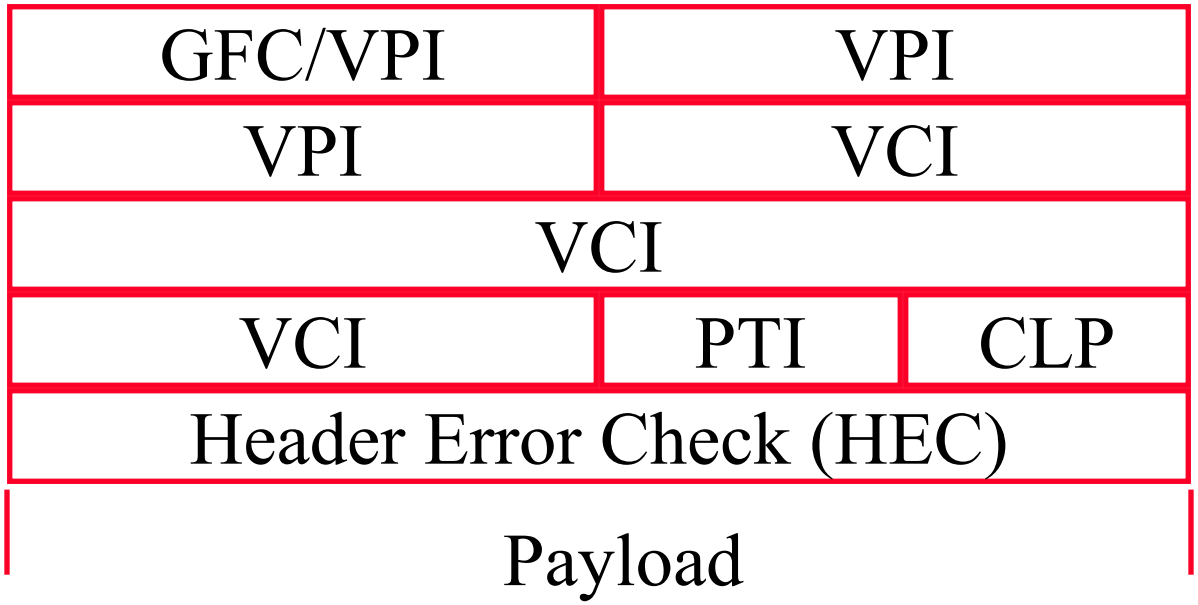


Protocol Layers

- 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

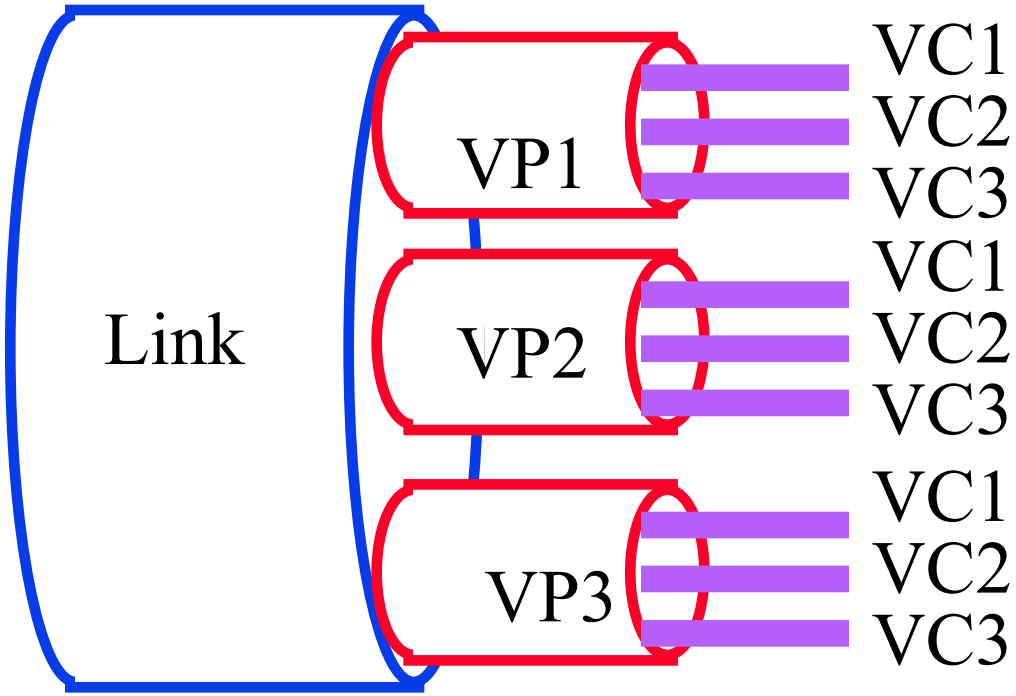
Cell Header Format

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

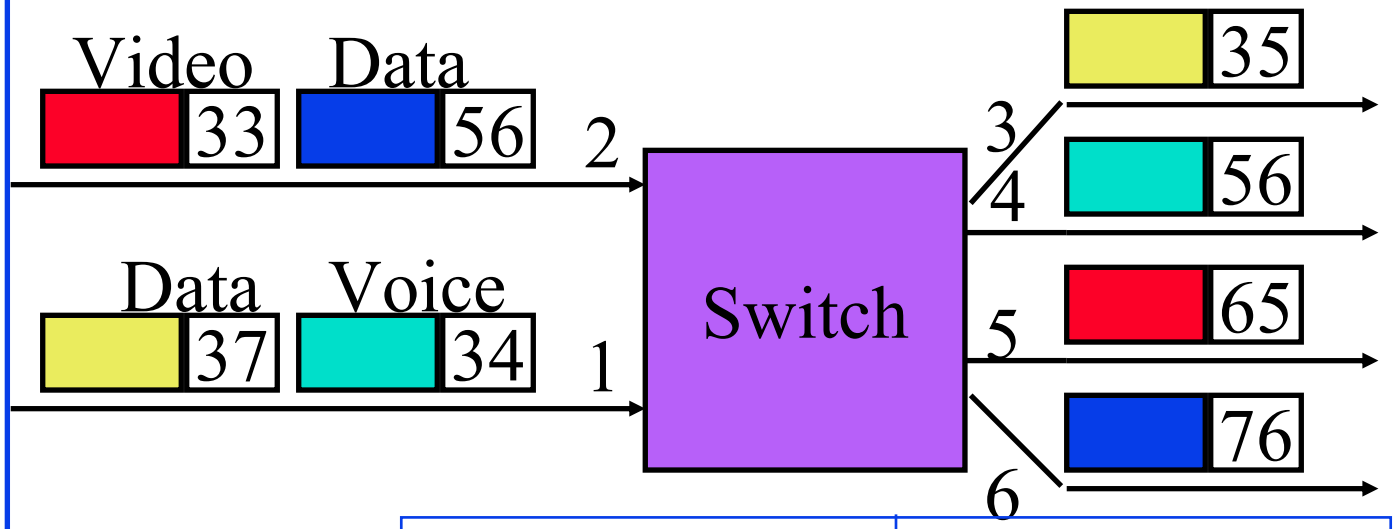


Path vs Channels

- 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



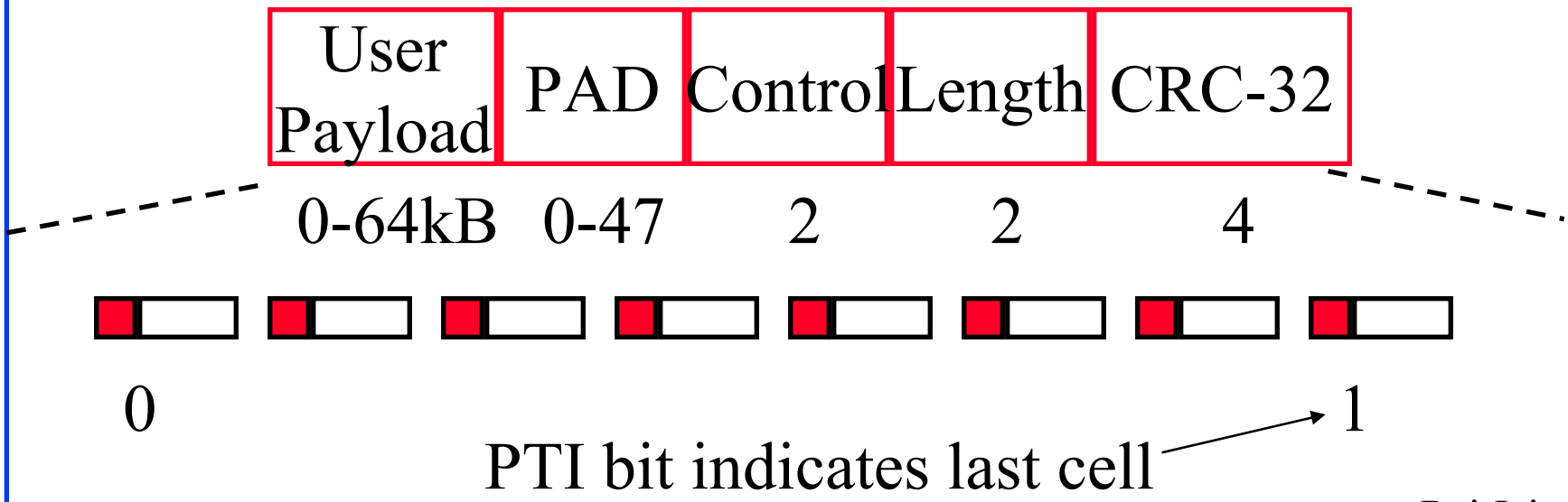
In		Out	
Port	VPI/VCI	Port	VPI/VCI
1	1/37	3	1/35
1	3/34	4	2/56
2	5/33	5	4/65
2	2/56	6	4/76

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

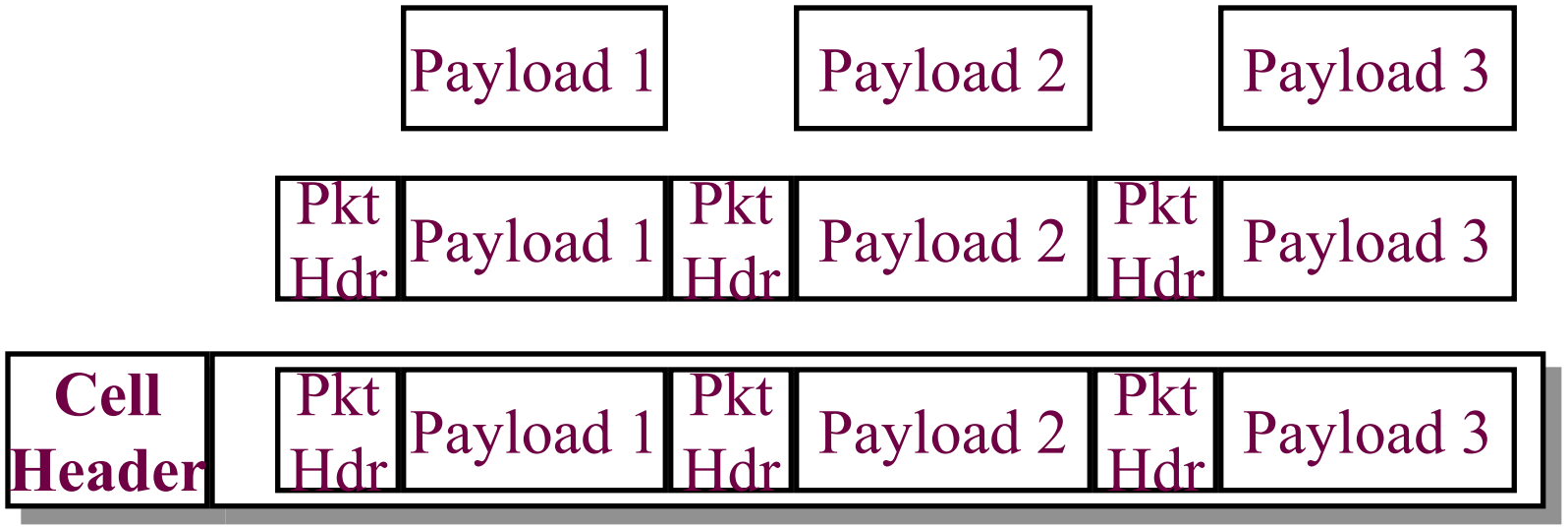
AAL 5

- 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



AAL2

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



Physical Media

- 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
- Plastic Optical Fiber: 155 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, 51.84, 155 Mbps
  - UTP-5 (Data grade UTP) at 155 Mbps
- DS1, DS3, STS-3c, STM-1, E1, E3, J2, n × T1

Service Categories

Standby

Guaranteed

Joy Riders

Confirmed

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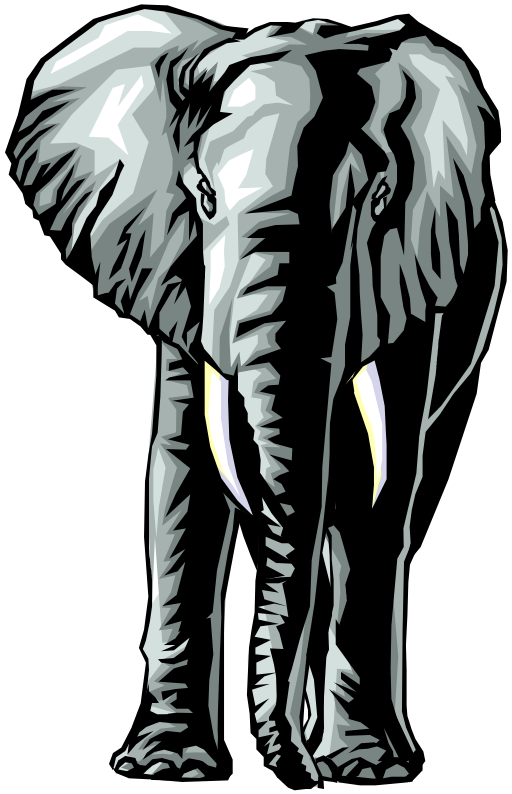
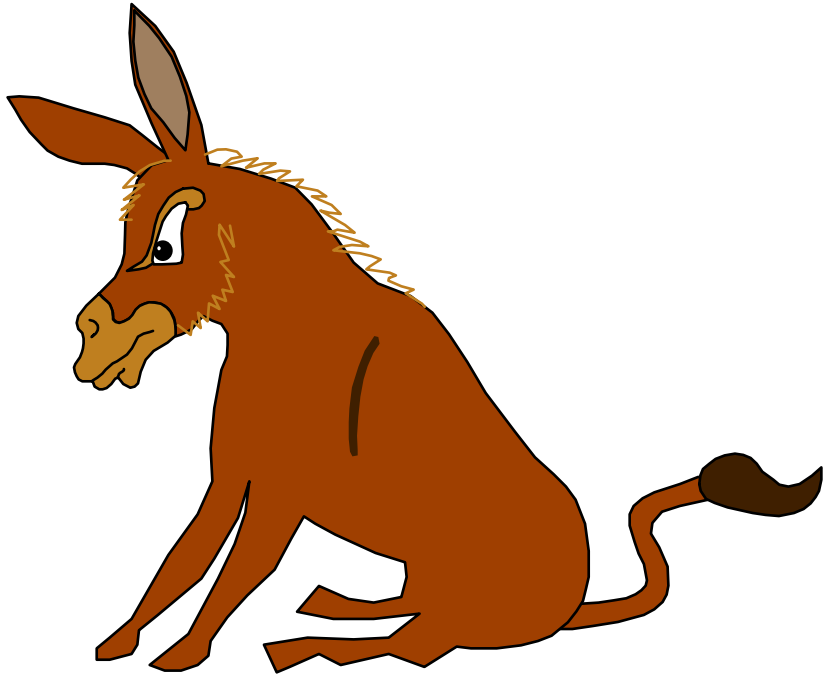
Service Categories

- ABR (Available bit rate):
  Source follows network feedback.
  Max throughput with minimum 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 guaranteed.
  - nrt-VBR (non-real time): Stored video.

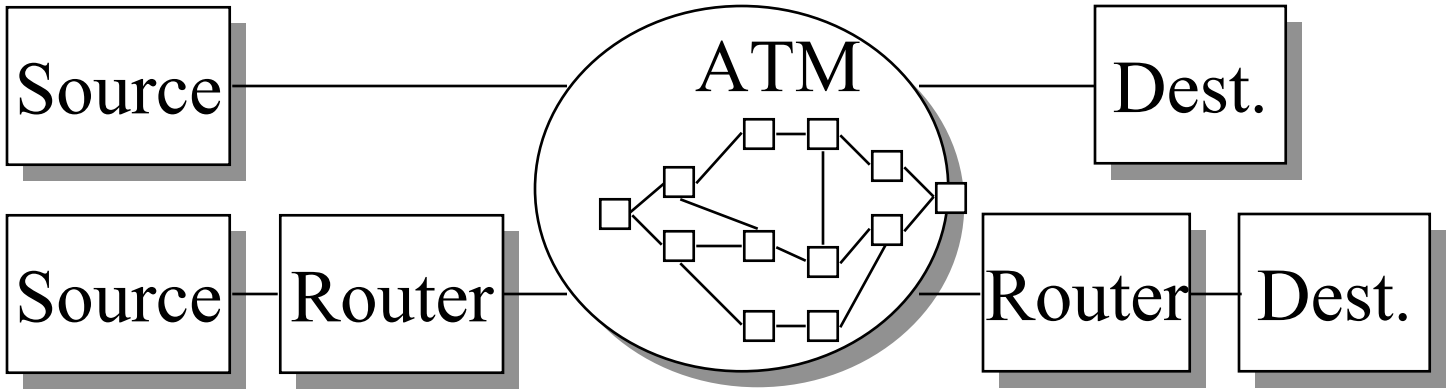
ABR or UBR?





- Intelligent transport or not?

ABR vs UBR for TCP/IP

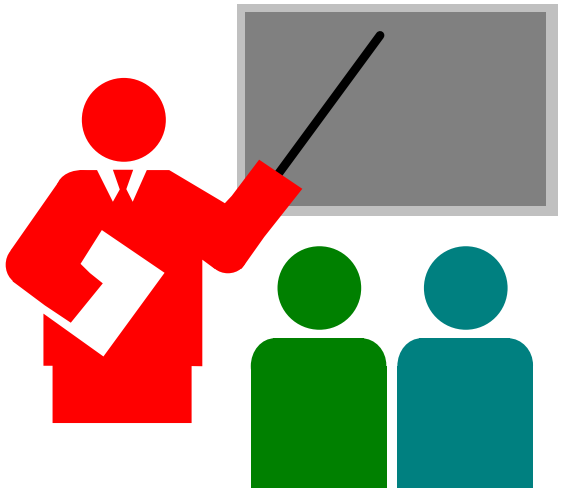


ABR	UBR
Queue in the source	Queue in the network
Pushes congestion to edges	No backpressure
Good if end-to-end ATM	Same end-to-end or backbone
Fair	Generally unfair
Good for the provider	Simple for user

Guaranteed Frame Rate (GFR)

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

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, GFR

ATM : Key References

- See http://www.cis.ohio-state.edu/~jain/refs/atm_refs.htm
- G. Sackett and C. Y. Metz, "ATM and Multiprotocol Networking," McGraw-Hill, 1997 (Technical).
- ATM Forum specs are available at ftp://ftp.atmforum.com/pub/approved-specs/
- R. Jain, "ATM Networks: Issues and Challenges head," NetWorld+Interop Engineering Conference, March 1995. Available on http://www.cis.ohio-state.edu/~jain/