ATM Networks: An Overview

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These Slides are available on-line at:

http://www.cis.ohio-state.edu/~jain/cis788-99/

ATM vs Phone Networks and Data Networks

ATM Protocol Layers

Cell Header Format, AALs

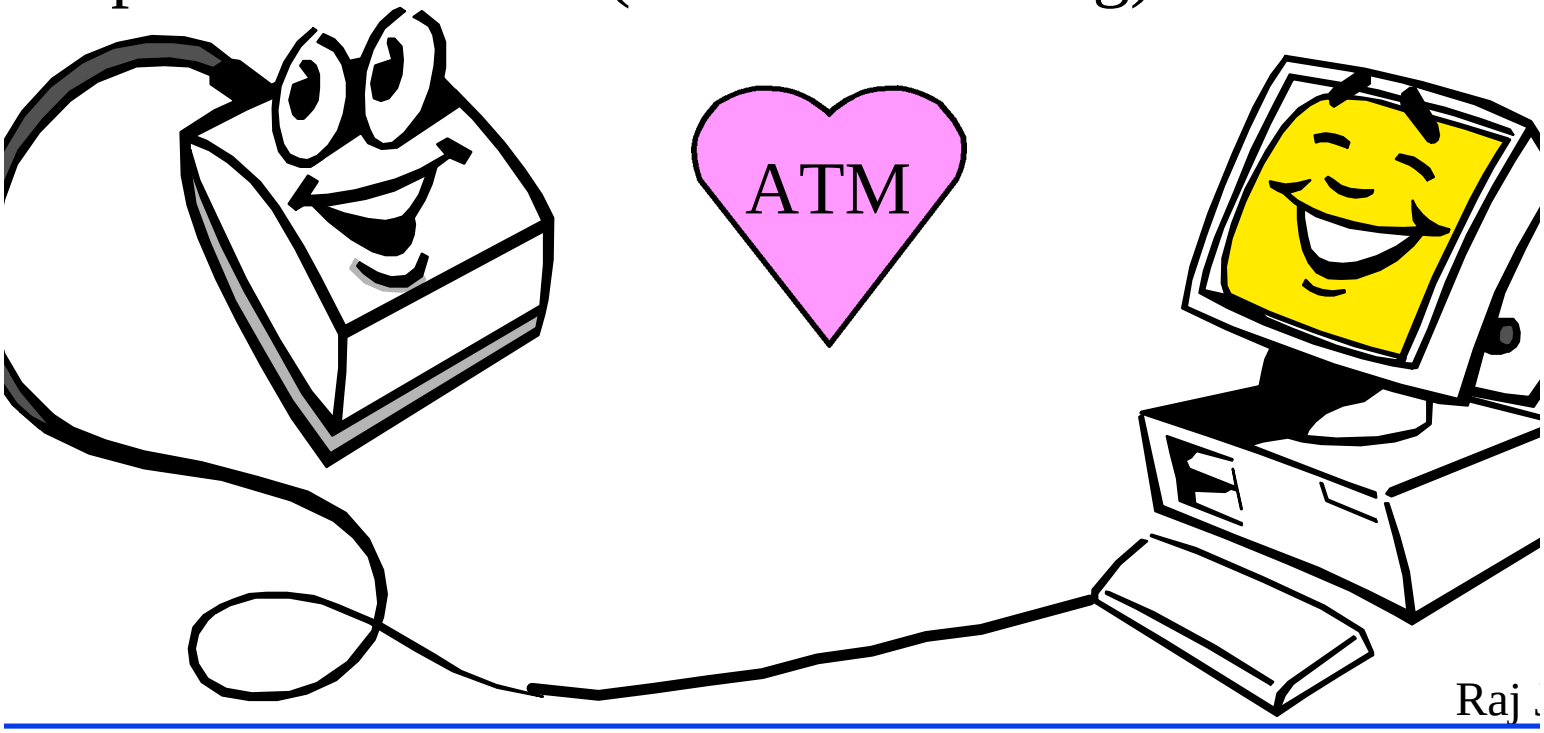
Physical Media

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)



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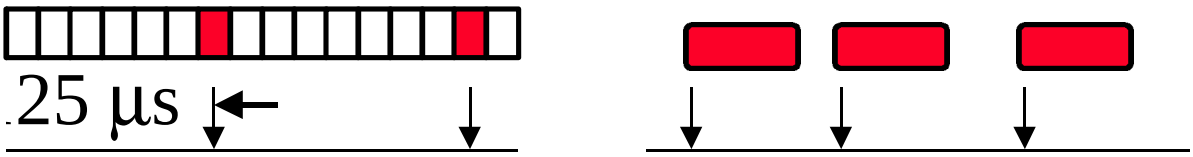
ATM vs Phone Networks



- 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.

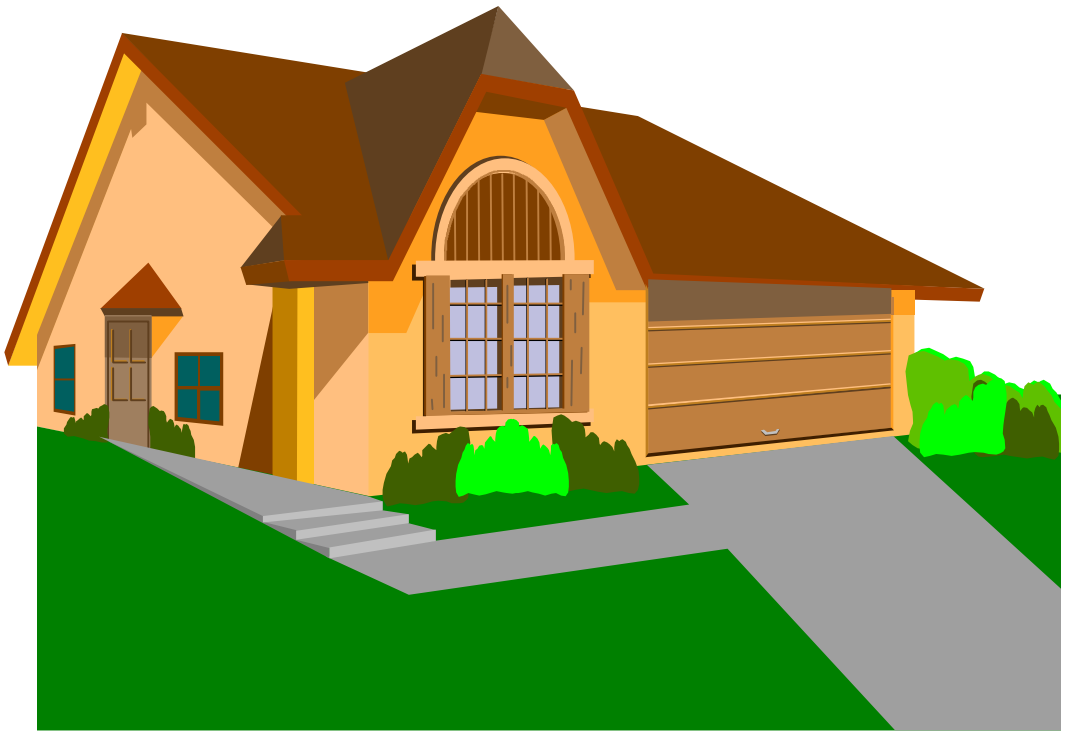
PNNI: Path based on quality of service (QoS)

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

ld House vs New House

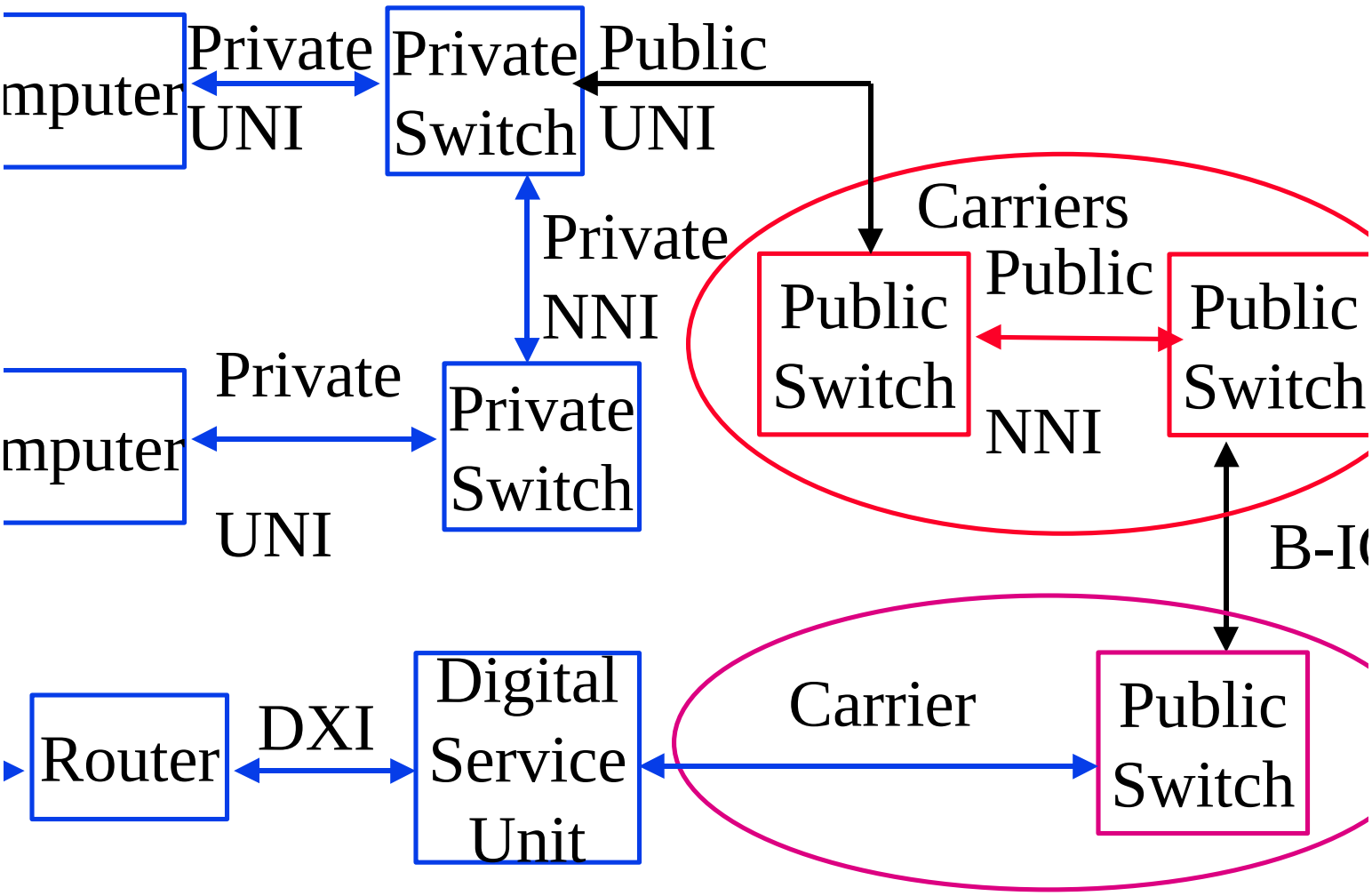


New needs:

Solution 1: Fix the old house (cheaper initially)

Solution 2: Buy a new house (pays off over a long ru

ATM Interfaces



ATM Interfaces

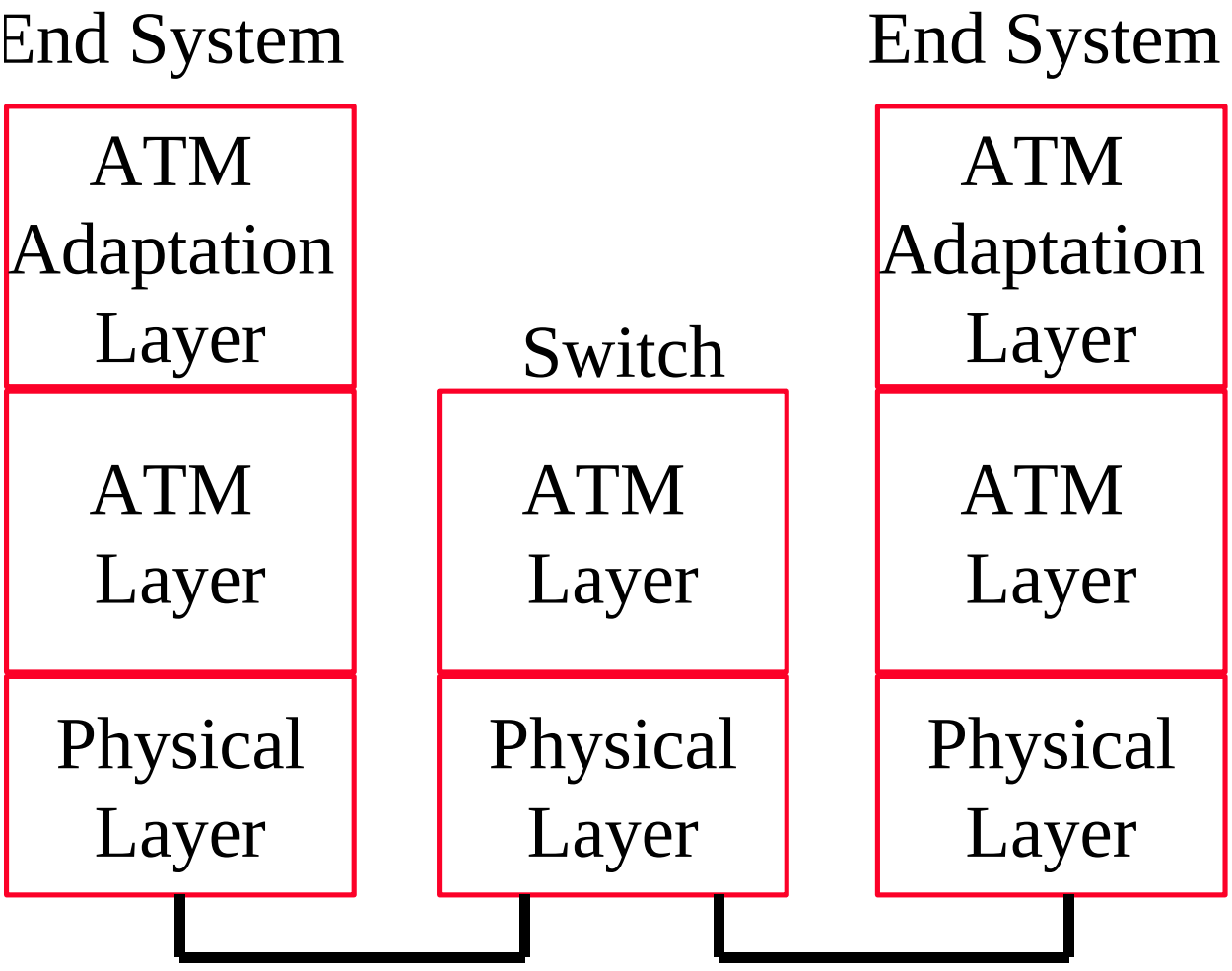
User to Network Interface (UNI):
Public UNI, Private UNI

Network to Node Interface (NNI):

- Private NNI (P-NNI)
- Public NNI =Inter-Switching System Interface (IS
  Intra-LATA ISSI (Regional Bell Operating Co)
- Inter-LATA ISSI (Inter-exchange Carriers)
  ⇒ Broadband Inter-Carrier Interface (B-ICI)

Data Exchange Interface (DXI)
Between routers and ATM Digital Service Units (DS

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

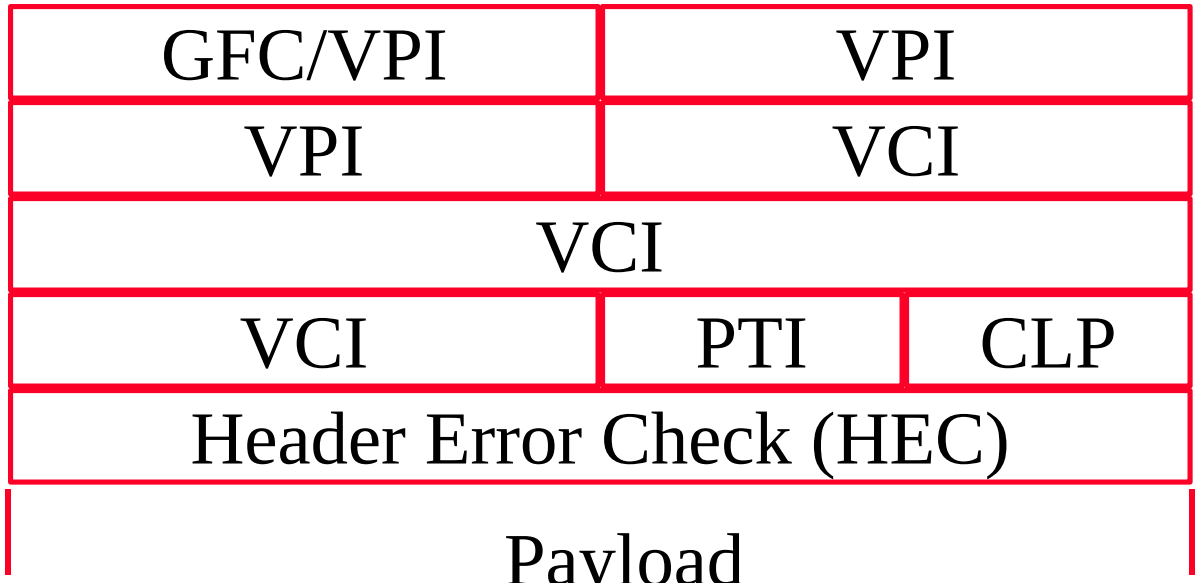
Cell Header Format

GFC = Generic Flow Control

- (Was used in UNI but not in NNI)

VPI/VCI = 0/0 ⇒ Idle cell; 0/n ⇒ Signaling

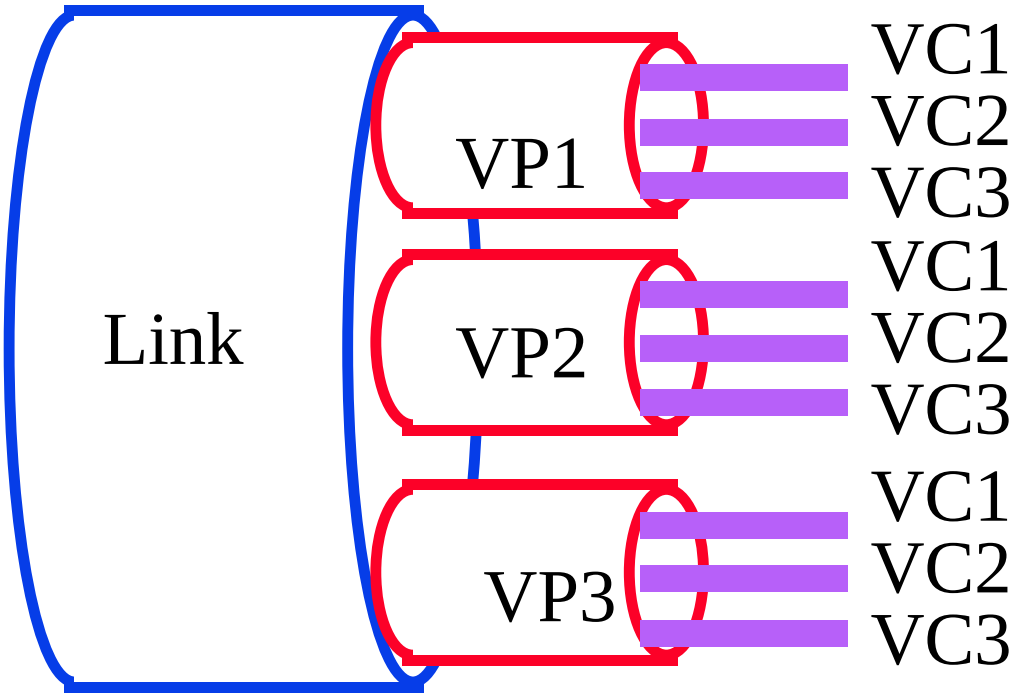
HEC: $1 + x + x^2 + x^8$



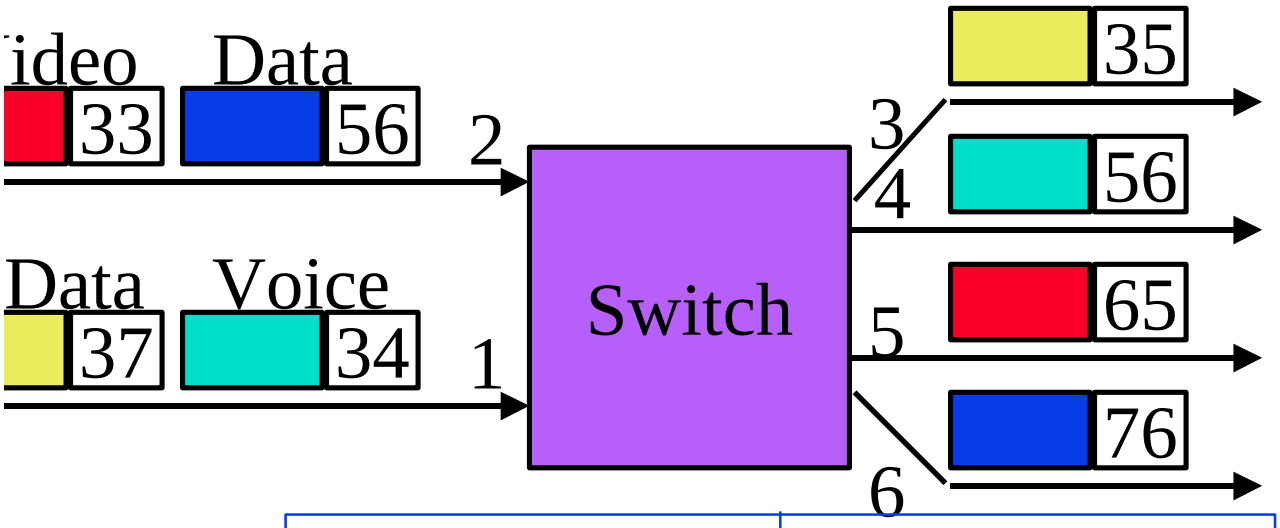
Path vs Channels

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



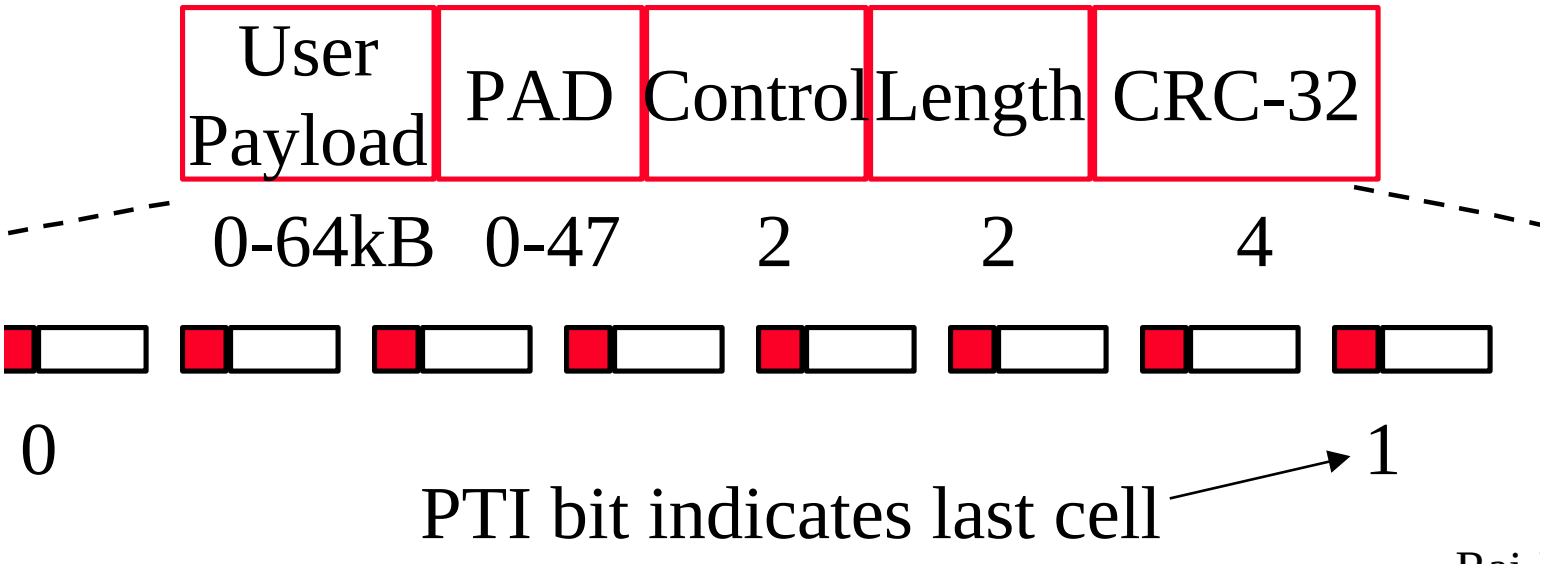
In		Out	
Port	VPI/VCI	Port	VPI/VCI
1	1/37	3	1/35
1	3/34	4	2/56
2	5/33	5	4/65
2	2/56	6	4/76

Original Classes of Traffic

	Class A	Class B	Class C	Class D
ime Sync	Yes	Yes	No	No
it Rate	Constant	Variable	Variable	Variabl
onnection Oriented	Yes	Yes	Yes	No
xamples	Circuit Emulation	Comp. Video	Frame Relay	SMDS
AL	AAL1	AAL2	AAL3	AAL4

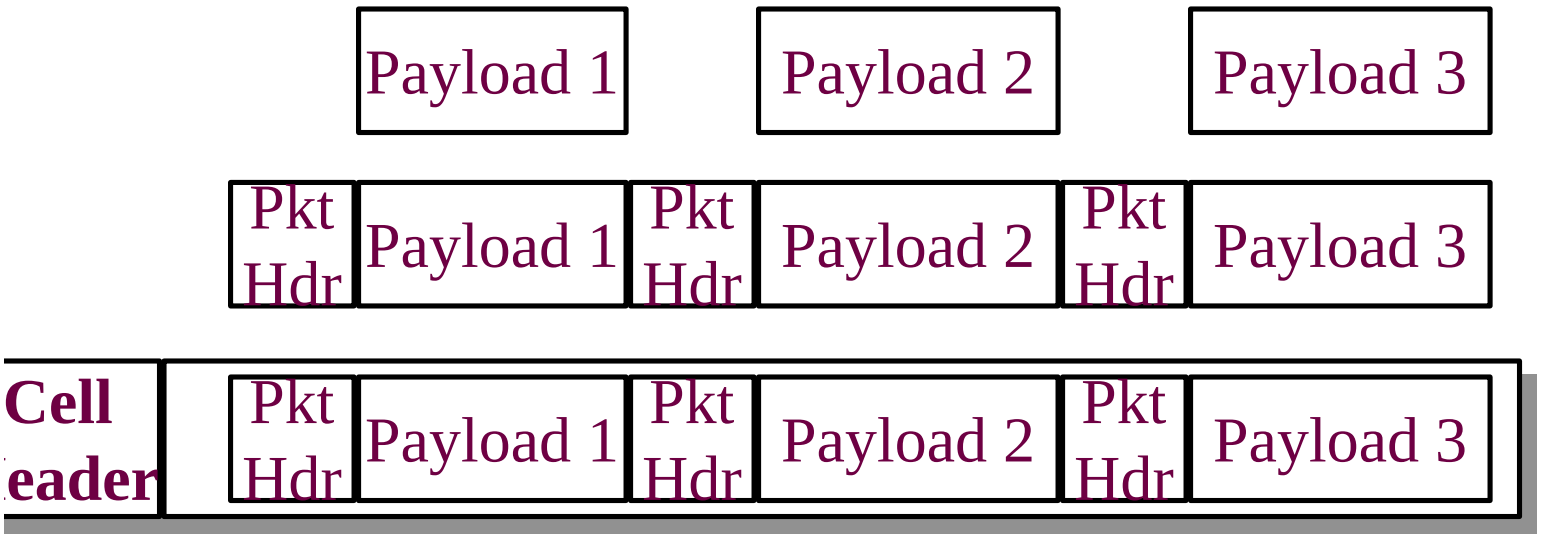
AAL 5

- 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

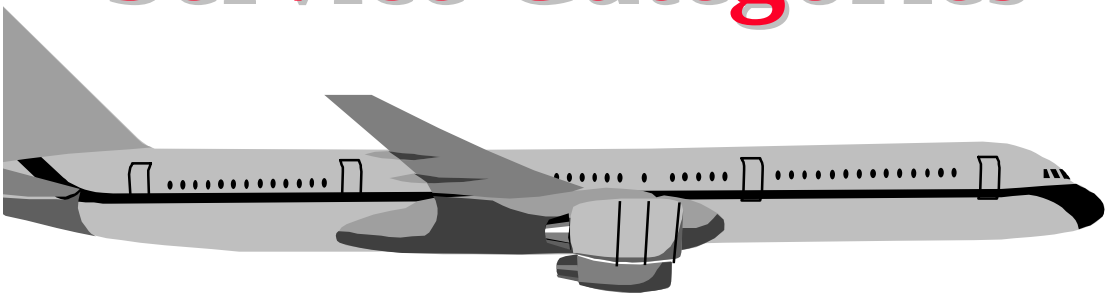
- Ideal for low bit rate voice
- Variable/constant rate voice
- Multiple users per VC
- Compression and Silence suppression
- Idle channel suppression



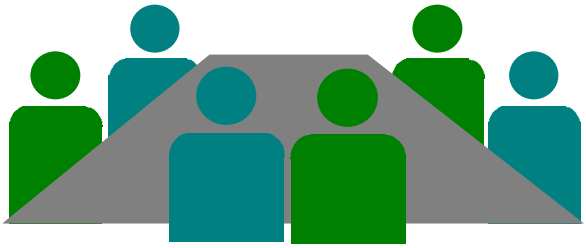
Physical Media

- 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

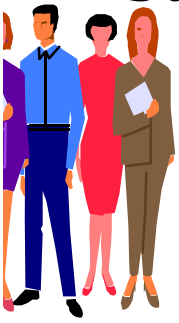
Service Categories



Standby



Guaranteed



Riders

Confirmed

Raj

Service Categories

ABR (Available bit rate):
Source follows network feedback.
Max throughput with minimum loss.

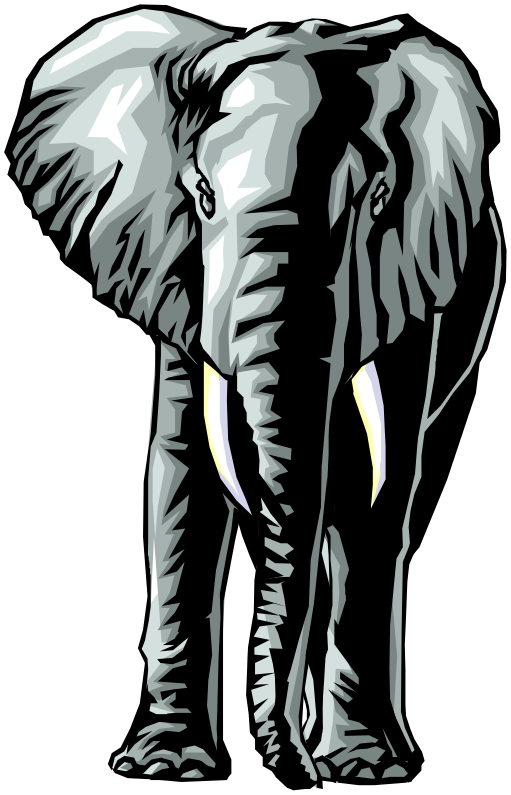
UBR (Unspecified bit rate):
User sends whenever it wants. No feedback. No guarantee. Cells may be dropped during congestion

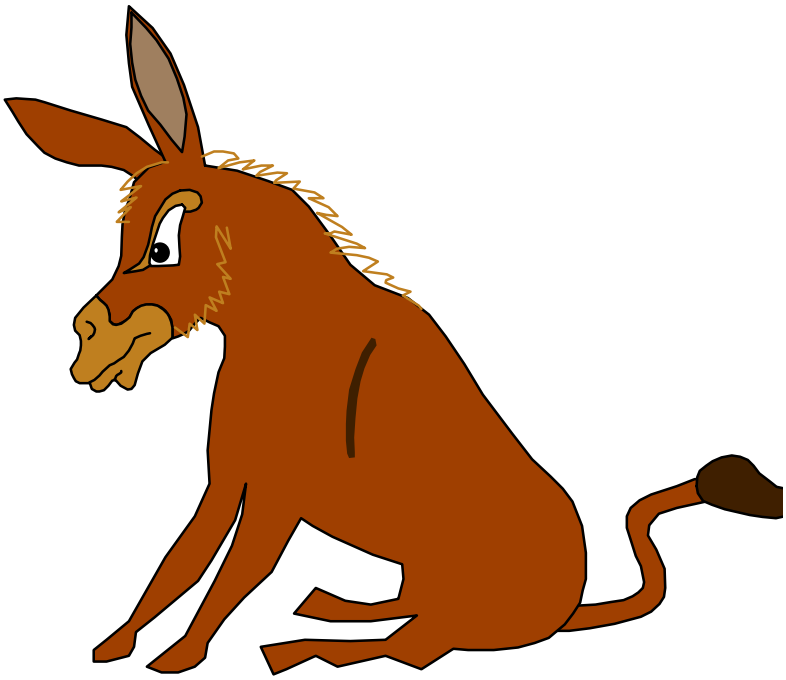
CBR (Constant bit rate): User declares required rat
Throughput, delay and delay variation guaranteed.

VBR (Variable bit rate): Declare avg and max rate.

- rt-VBR (Real-time): Conferencing.
  Max delay guaranteed.
- nrt-VBR (non-real time): Stored video.

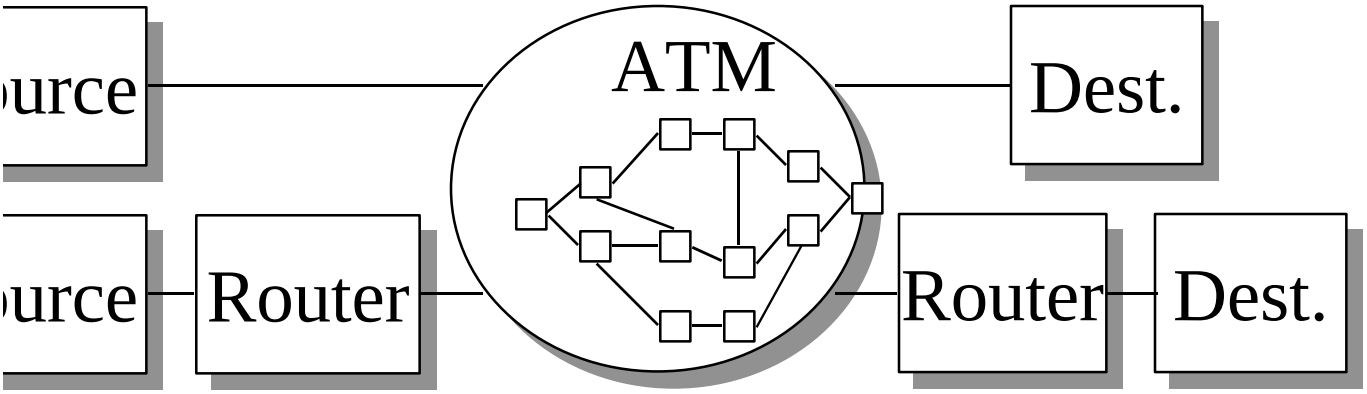
ABR or UBR?





ntelligent transport or not?

ABR vs UBR for TCP/IP



ABR	UBR
eue in the source	Queue in the network
hes congestion to edges	No backpressure
od if end-to-end ATM	Same end-to-end or backb
	Generally unfair
od for the provider	Simple for user

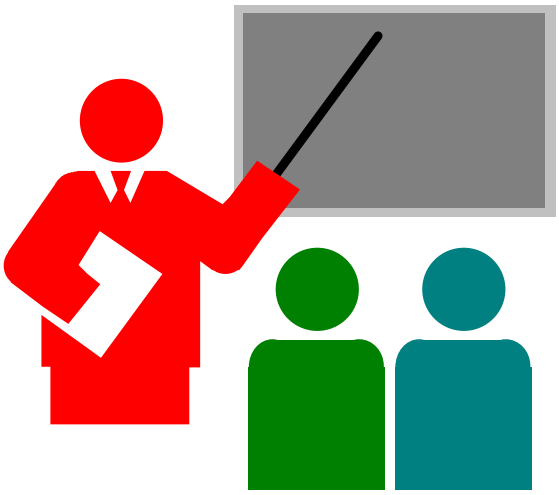
Guaranteed Frame Rate (GFR)

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 Multiprotoco 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 ahead," NetWorld+Interop Engineering Conference, March 1995. Available on http://www.cis.ohio-state.edu/~jain/