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# **ATM Networks: An Overview**



**Raj Jain**

**Professor of Computer and Information Sciences**

**The Ohio State University**

**Columbus, OH 43210-1277**

**<http://www.cis.ohio-state.edu/~jain/>**

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ATM vs Phone Networks and Data Networks

ATM Protocol Layers

Cell Header Format, AALs

Physical Media

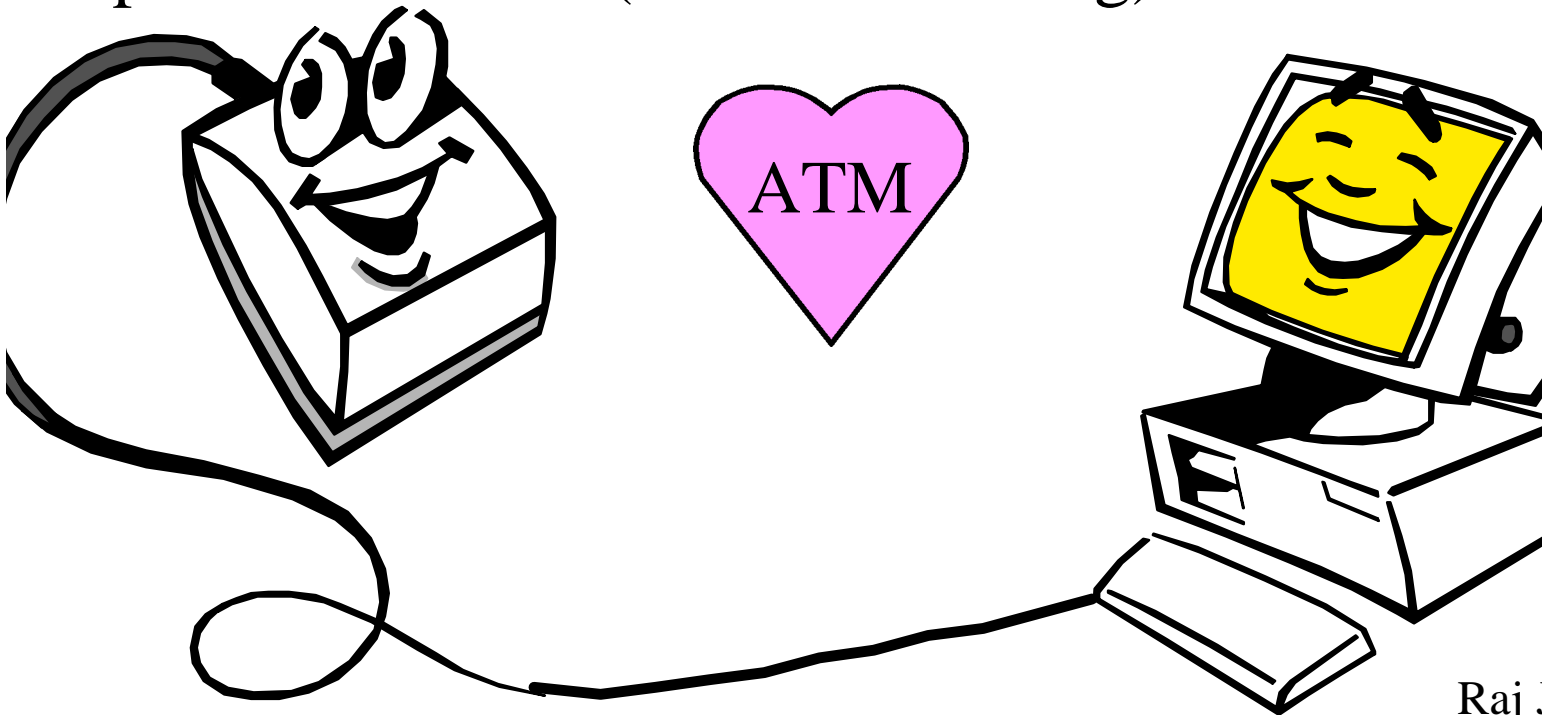
Traffic Management: ABR, UBR, GFR

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# 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.

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# 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.

Routing: Path based on quality of service (QoS)

Switching: In IP, each packet is addressed and processed individually.

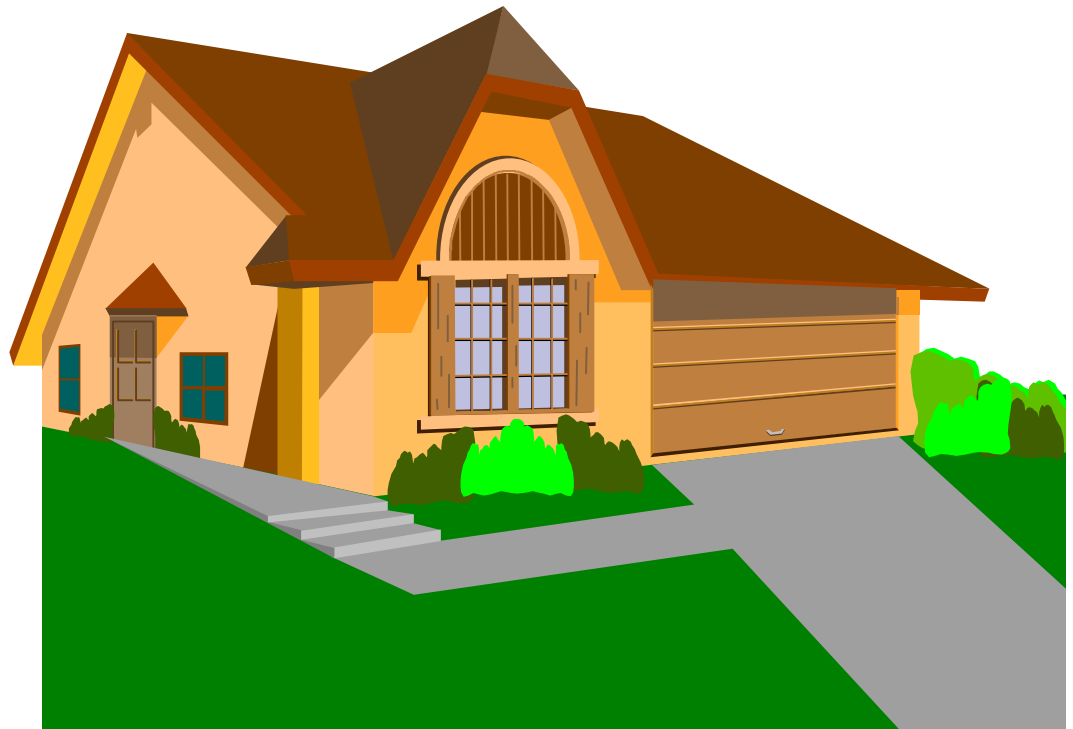
Traffic Management: Loss based in IP.

ATM has 1996 traffic management technology. Required for high-speed and variable demands.

Cells: Fixed size or small size is not important

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# Old House vs New House



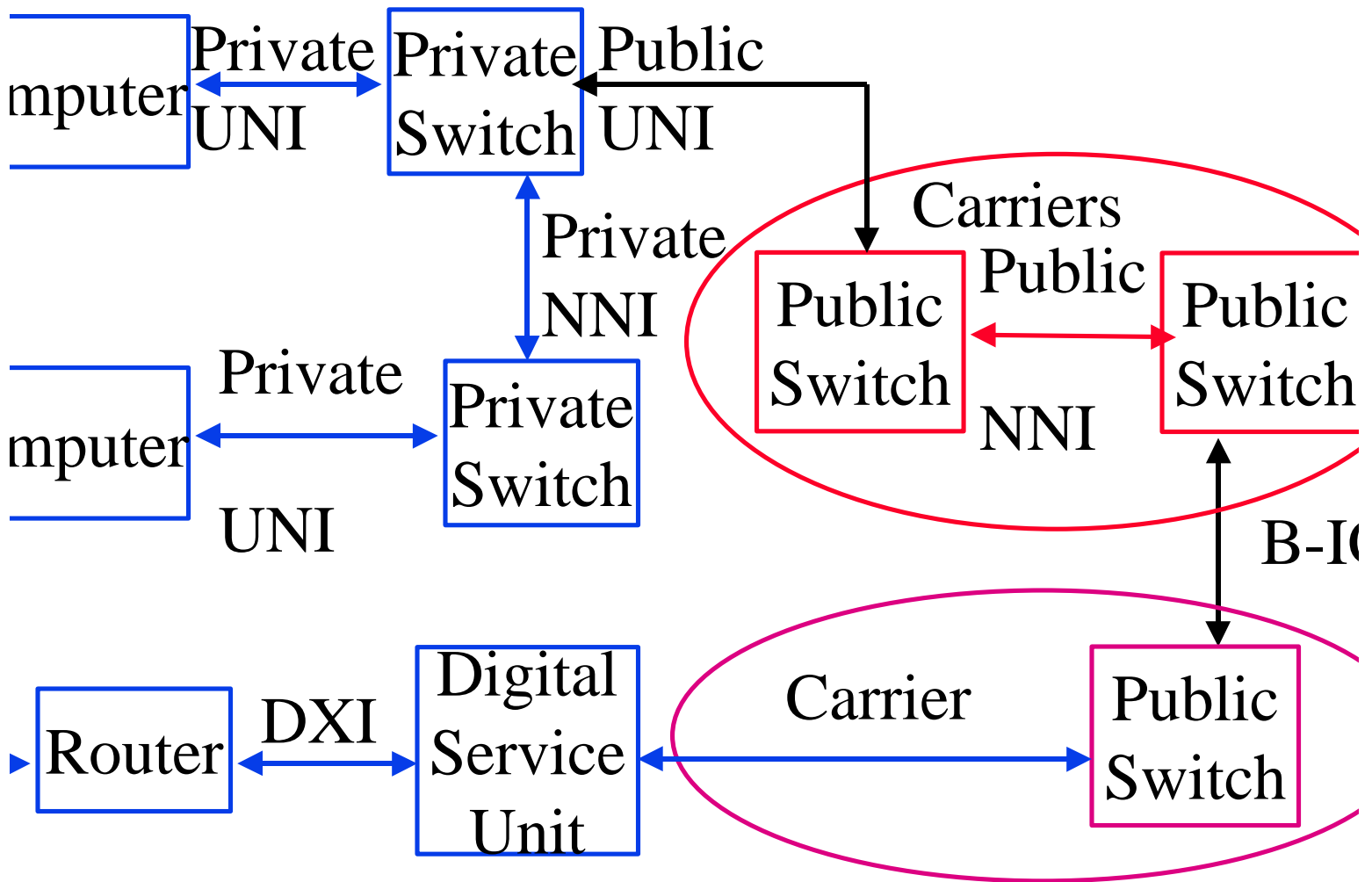
New needs:

Solution 1: Fix the old house (cheaper initially)

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

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# ATM Interfaces



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# 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)
    - ⇒ Broadband Inter-Carrier Interface (B-ICI)

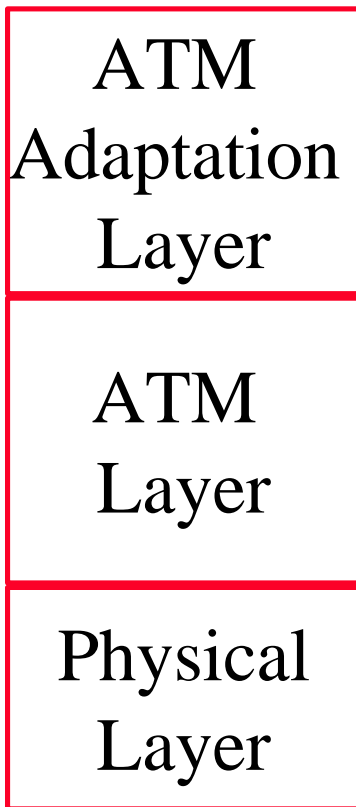
Data Exchange Interface (DXI)

Between routers and ATM Digital Service Units (DSUs)

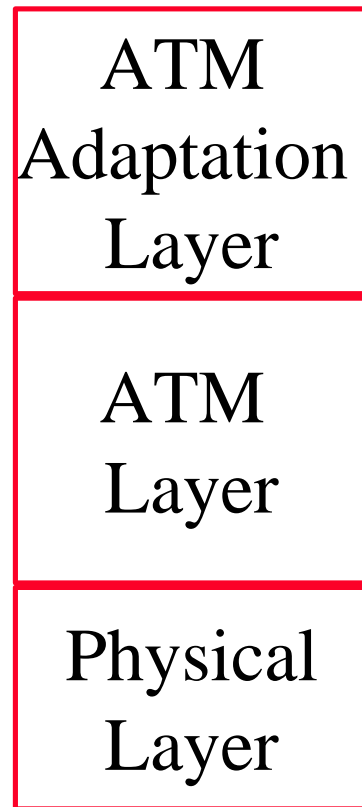
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# Protocol Layers

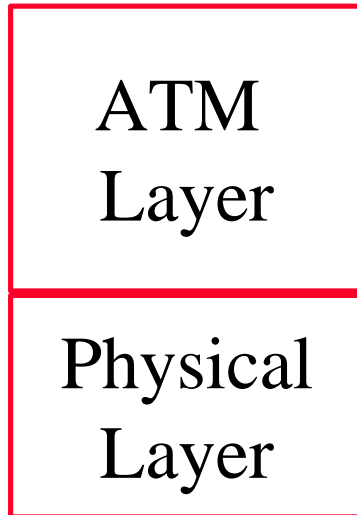
End System



End System



Switch



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# 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

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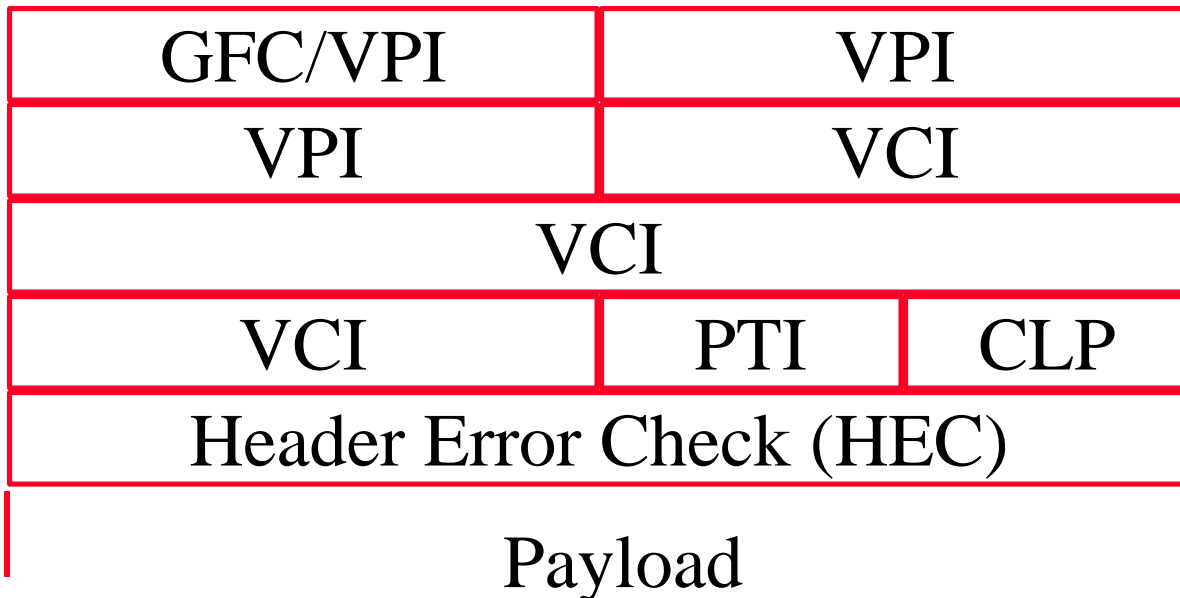
# Cell Header Format

GFC = Generic Flow Control

- (Was used in UNI but not in NNI)

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

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



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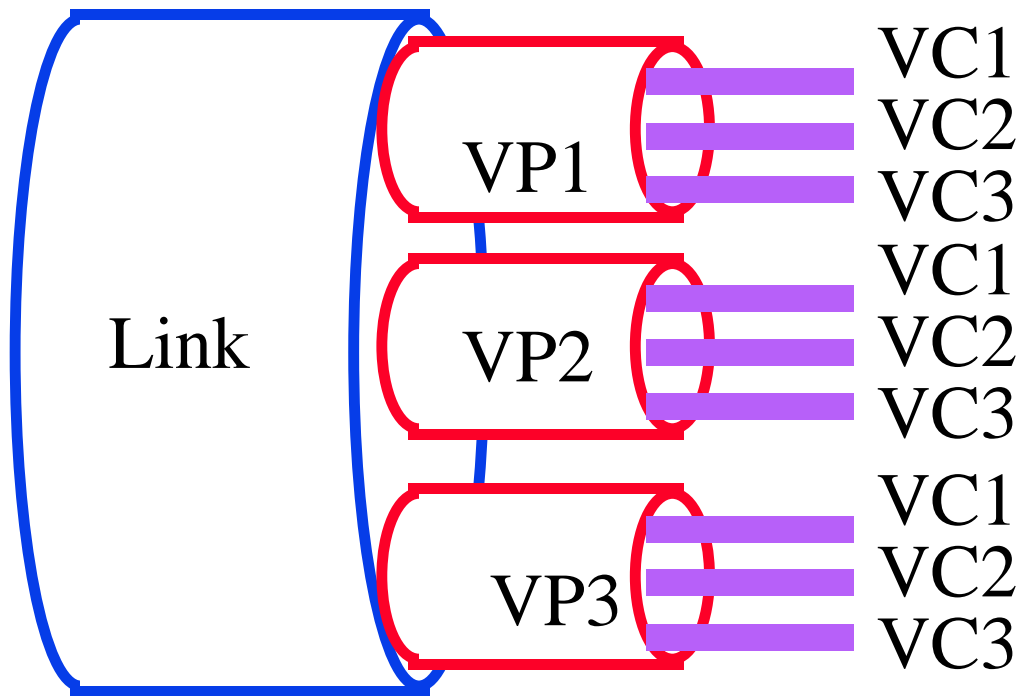
# Path vs Channels

24/28-bit connection identifier

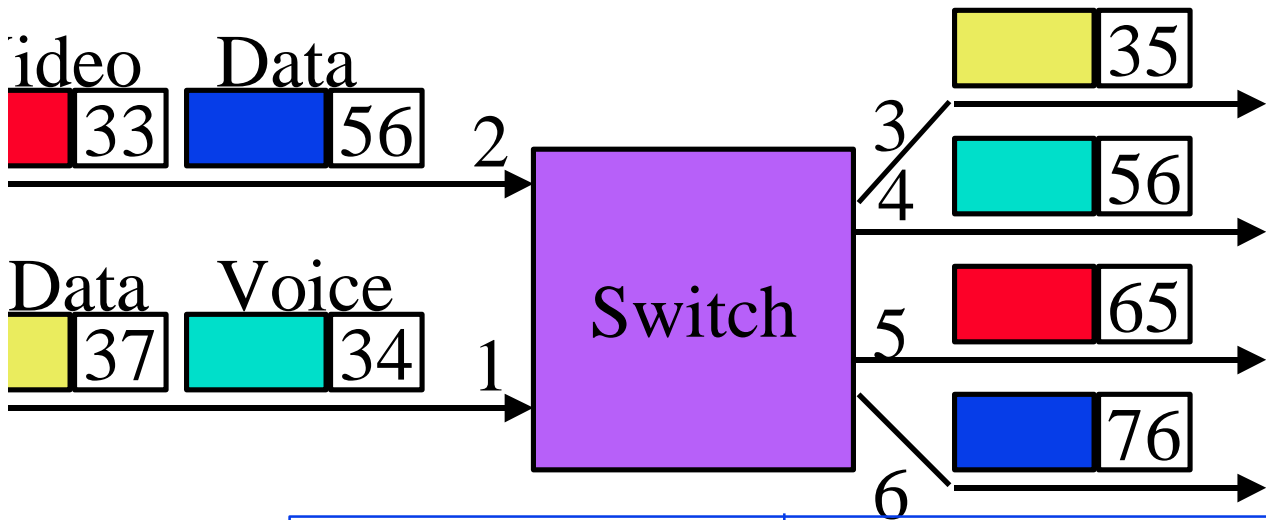
First 8/12 bits: Virtual Path,

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

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# 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

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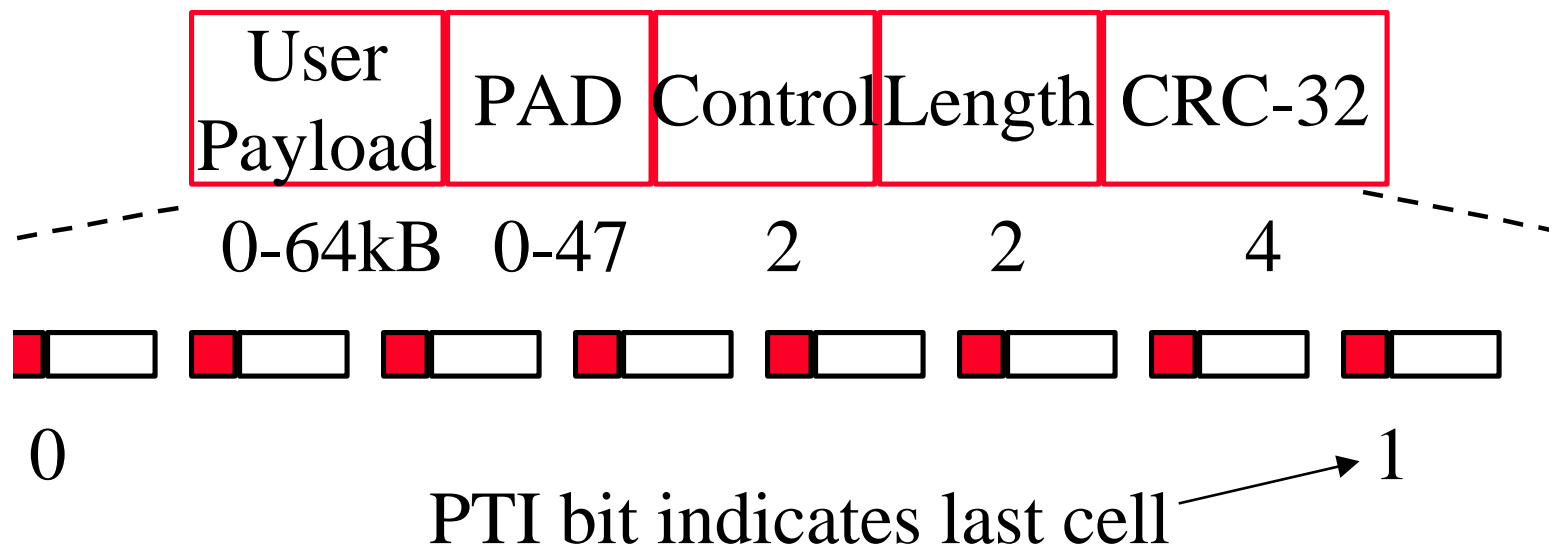
# AAL 5

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



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# AAL2

ideal for low bit rate voice

variable/constant rate voice

Multiple users per VC

Compression and Silence suppression

idle channel suppression



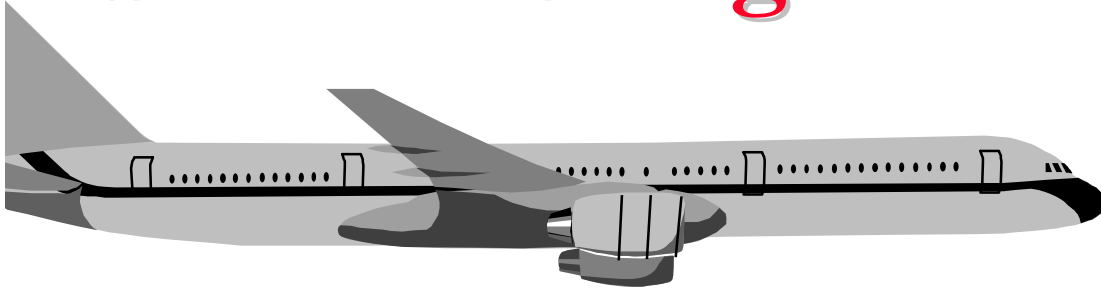
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# Physical Media

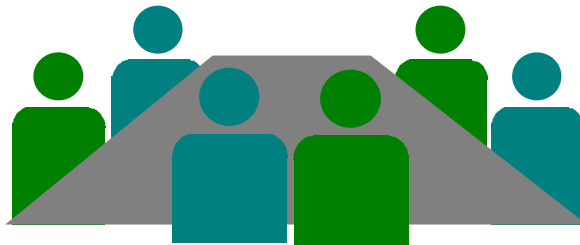
- Multimode Fiber: 100 Mbps using 4b/5b, 155 Mbps SONET STS-3c, 155 Mbps 8b/10b
- Single-mode Fiber: 155 Mbps STS-3c, 622 Mbps
- Plastic Optical Fiber: 155 Mbps
- Shielded Twisted Pair (STP): 155 Mbps 8b/10b
- Coax: 45 Mbps, DS3, 155 Mbps
- Unshielded Twisted Pair (UTP)
  - UTP-3 (phone wire) at 25.6,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

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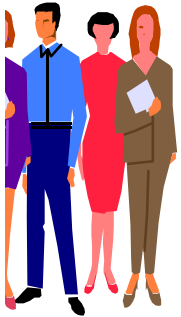
# Service Categories



Standby



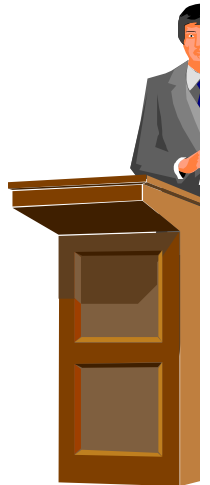
Guaranteed



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.

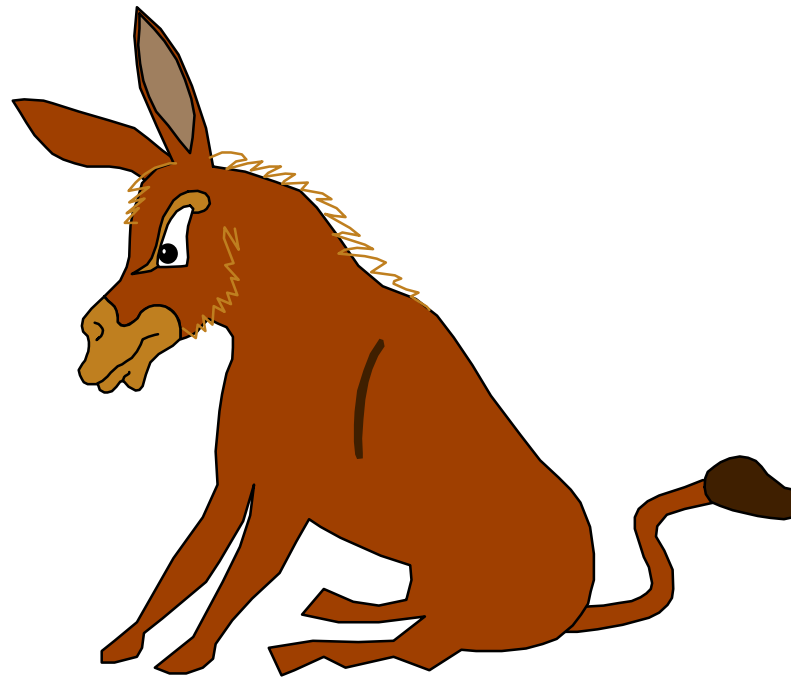
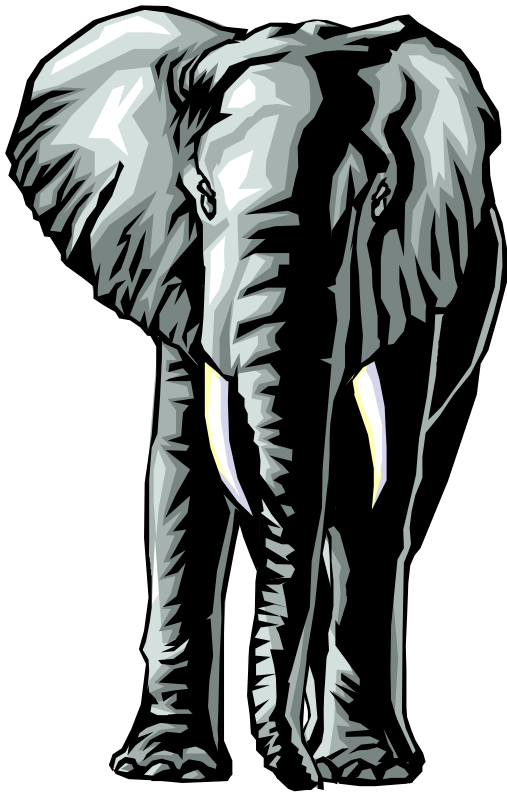
- **rt-VBR** (Real-time): Conferencing.

  - Max delay guaranteed.

- **nrt-VBR** (non-real time): Stored video.

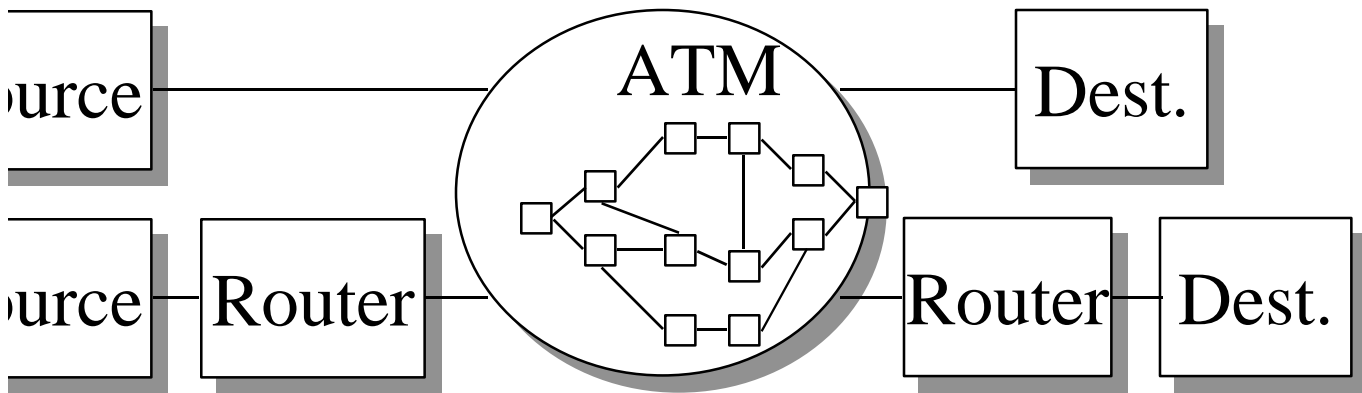
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# ABR or UBR?



intelligent transport or not?

# ABR vs UBR for TCP/IP



## ABR

Queue in the source  
 Pushes congestion to edges  
 Good if end-to-end ATM  
 Good for the provider

## UBR

Queue in the network  
 No backpressure  
 Same end-to-end or backbo  
 Generally unfair  
 Simple for user

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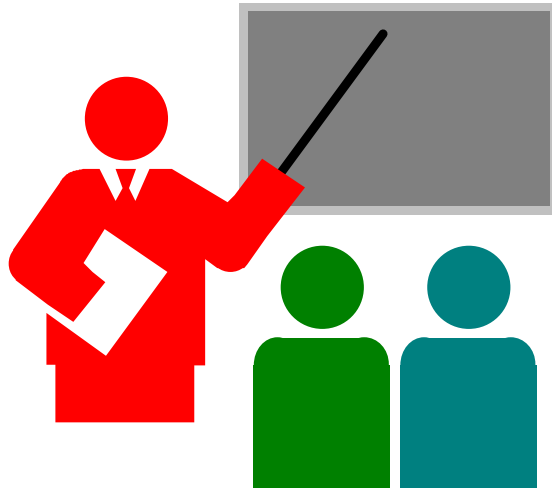
# Guaranteed Frame Rate (GFR)

UBR with minimum cell rate (MCR)  $\Rightarrow$  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.

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# 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

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# ATM : Key References

See [http://www.cis.ohio-state.edu/~jain/refs/atm\\_refs.htm](http://www.cis.ohio-state.edu/~jain/refs/atm_refs.htm)

J. Sackett and C. Y. Metz, “ATM and Multiprotocol Networking,” McGraw-Hill, 1997 (Technical).

ATM Forum specs are available at

<http://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/>