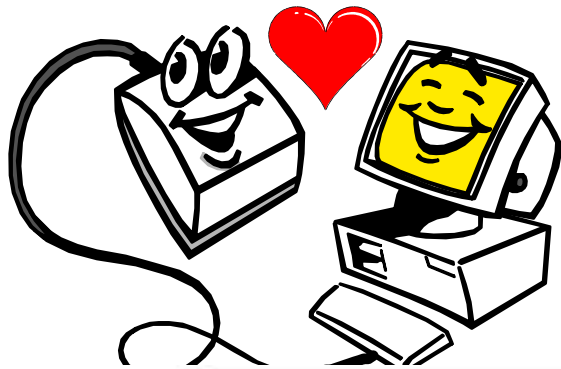


ATM Networks: An Overview



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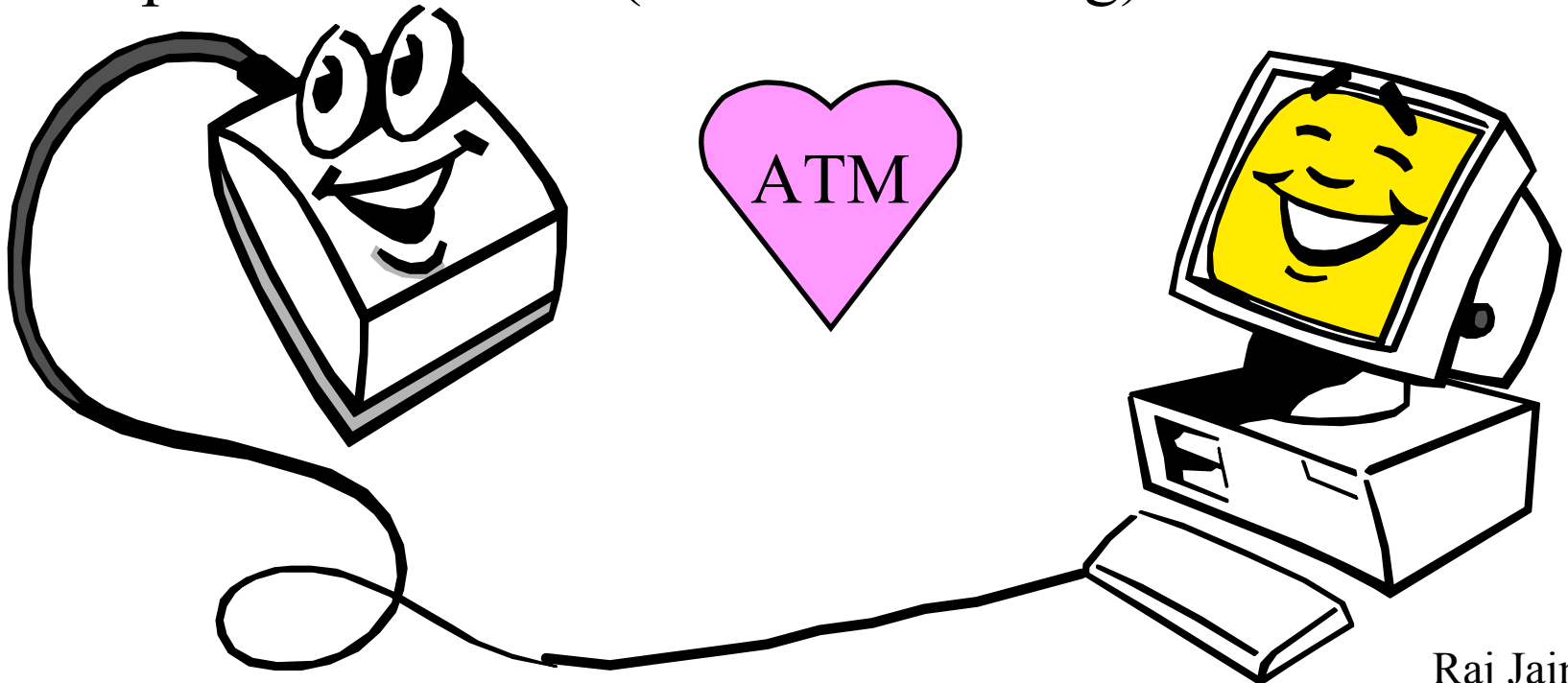
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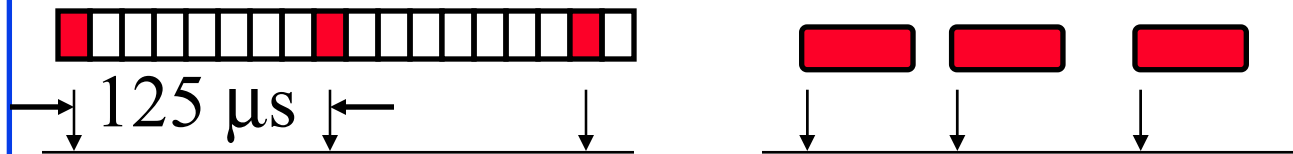
- ❑ ATM vs Phone Networks and Data Networks
- ❑ ATM Protocol Layers
- ❑ Cell Header Format, AALs
- ❑ Physical Media
- ❑ Traffic Management: ABR, UBR, GFR

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

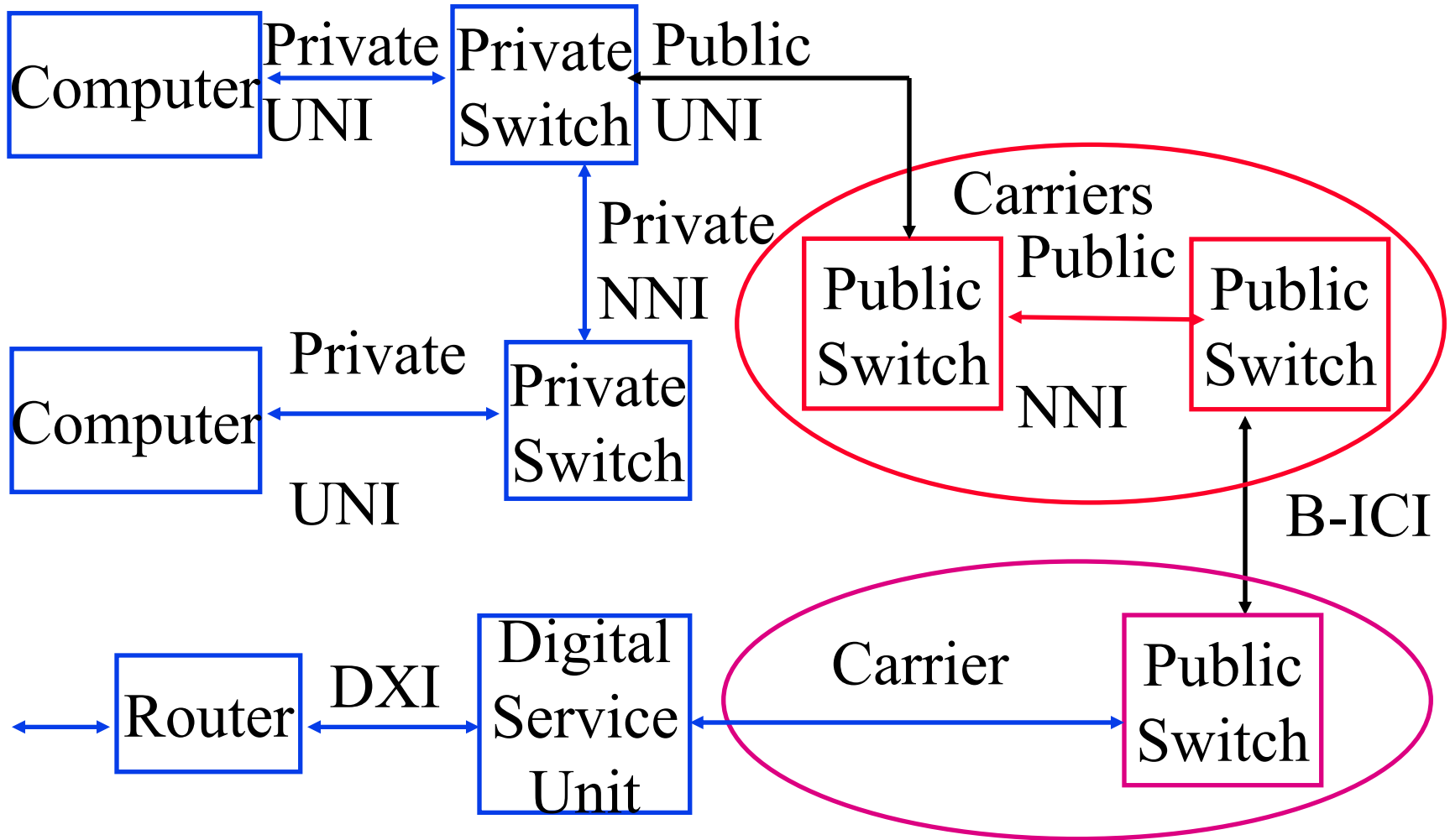


- ❑ Current phone networks are synchronous (periodic).
ATM = Asynchronous Transfer Mode
- ❑ Phone networks use circuit switching.
ATM networks use “Packet” Switching
- ❑ In phone networks, all rates are multiple of 8 kbps.
With ATM service, you can get any rate.
You can vary your rate with time.
- ❑ 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

ATM Interfaces

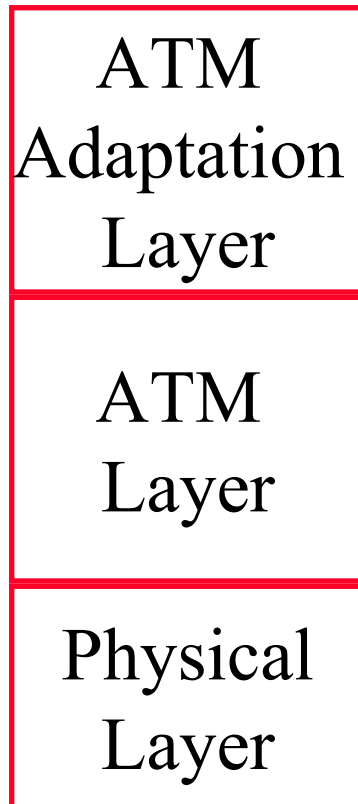


ATM Interfaces

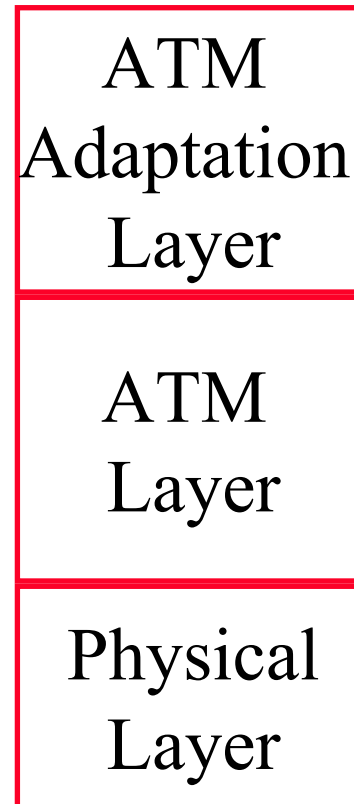
- ❑ User to Network Interface (UNI):
Public UNI, Private UNI
- ❑ Network to Node Interface (NNI):
 - Private NNI (P-NNI)
 - Public NNI = Inter-Switching System Interface (ISSI)
Intra-LATA ISSI (Regional Bell Operating Co)
 - Inter-LATA ISSI (Inter-exchange Carriers)
⇒ Broadband Inter-Carrier Interface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

Protocol Layers

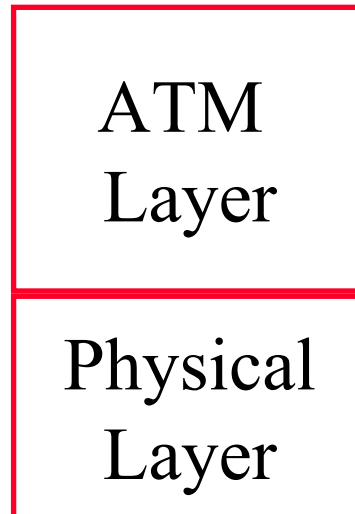
End System



End System



Switch

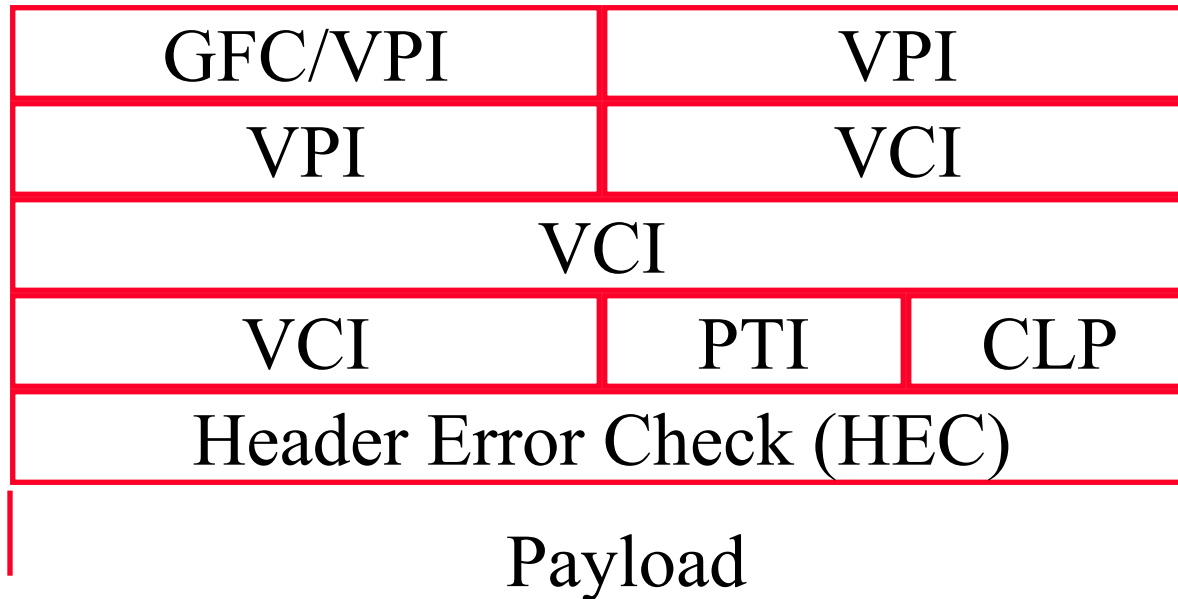


Protocol Layers

- ❑ 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

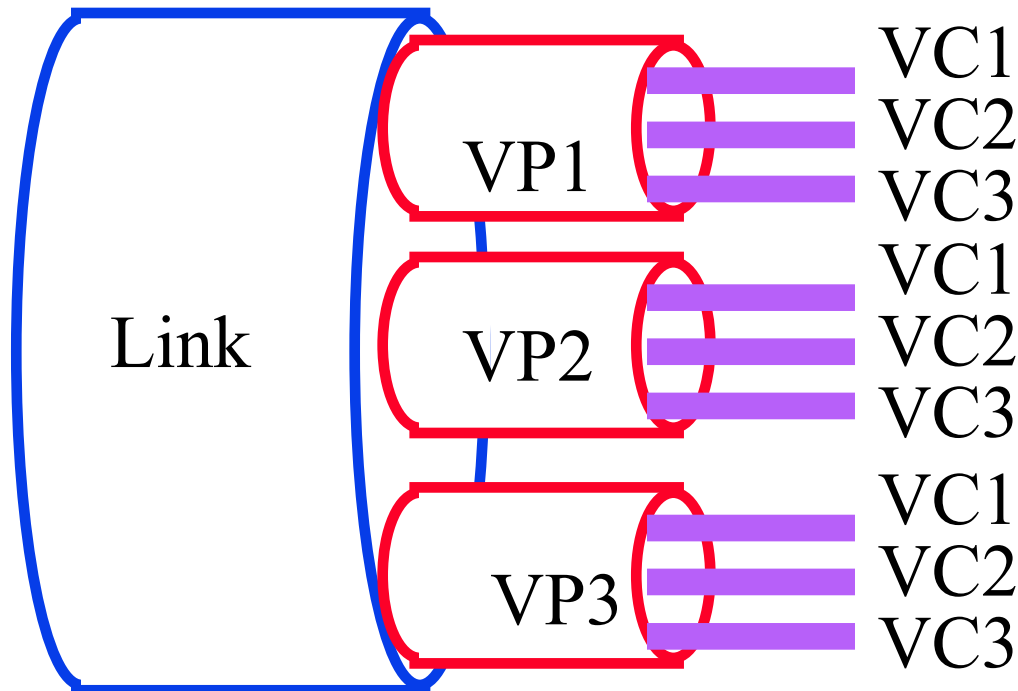
Cell Header Format

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

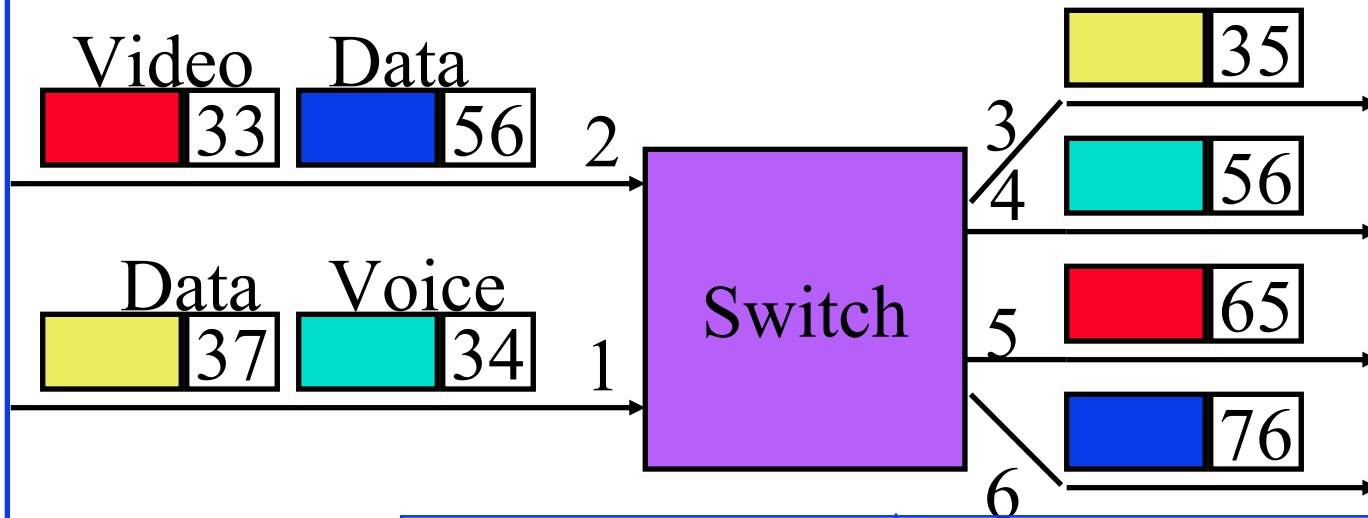


Path vs Channels

- 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



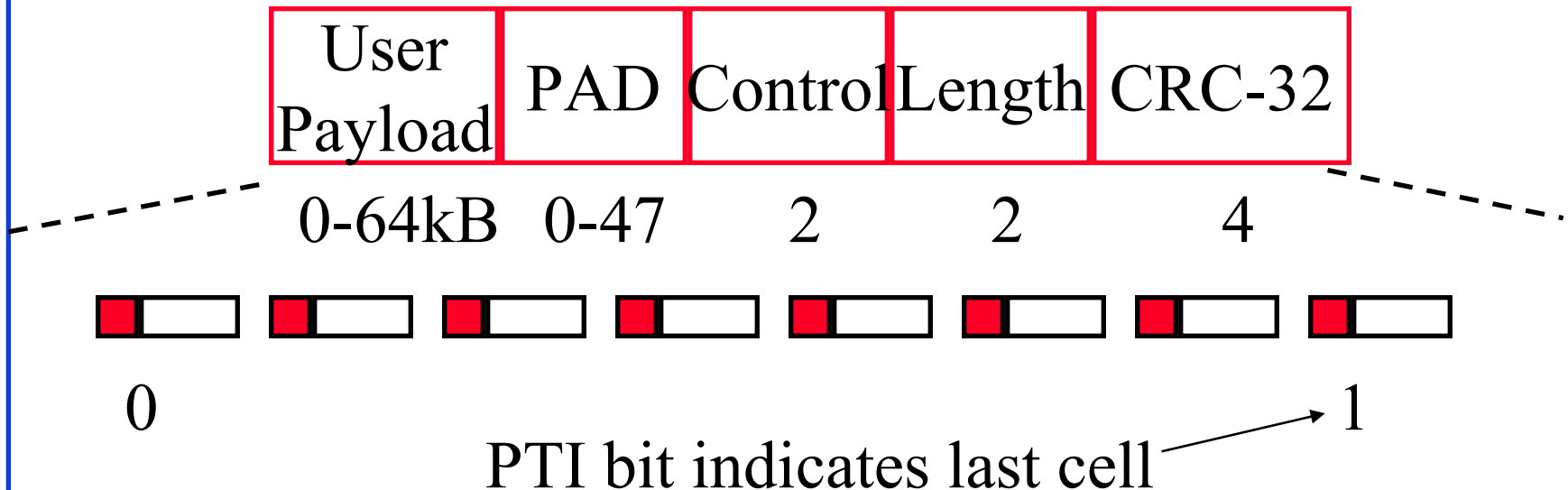
In		Out	
Port	VPI/VCI	Port	VPI/VCI
1	1/37	3	1/35
1	3/34	4	2/56
2	5/33	5	4/65
2	2/56	6	4/76

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, $n \times T1$

Service Categories



Standby



Guaranteed



Joy Riders

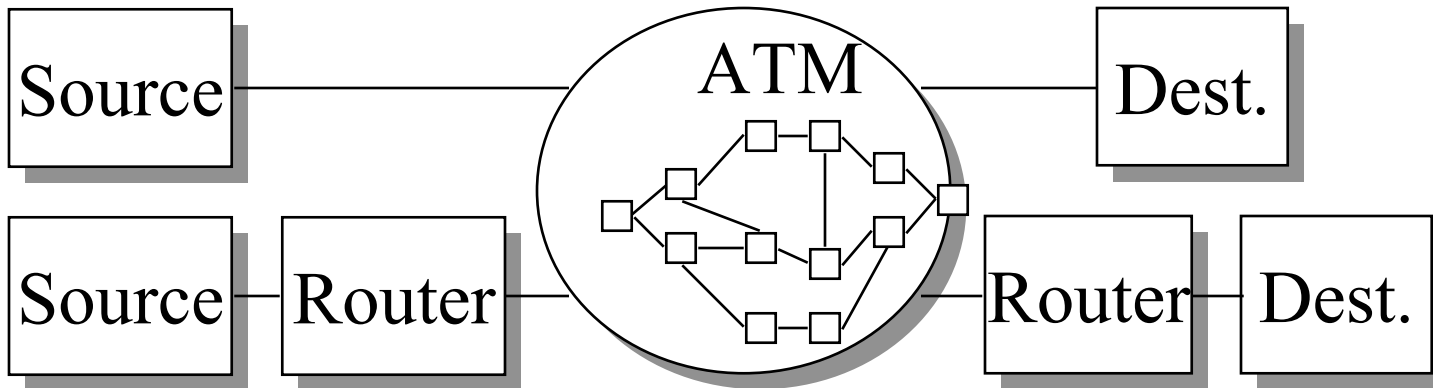


Confirmed

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 vs UBR for TCP/IP



ABR

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

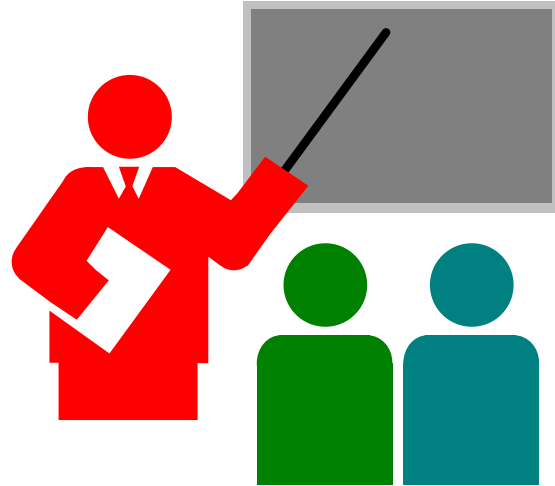
UBR

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

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.

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