X.25

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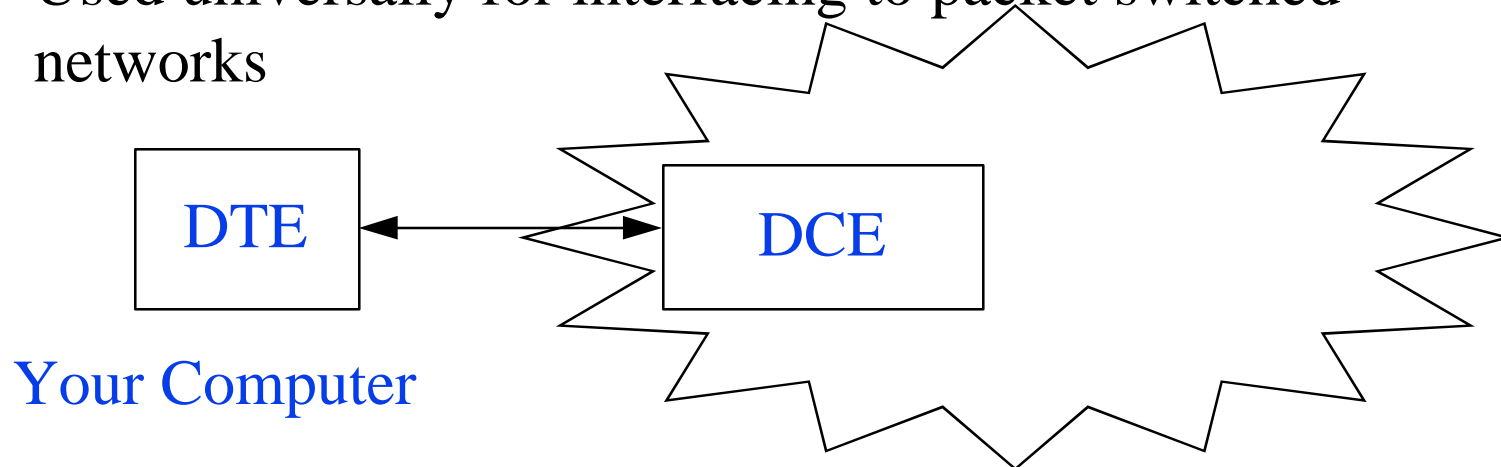
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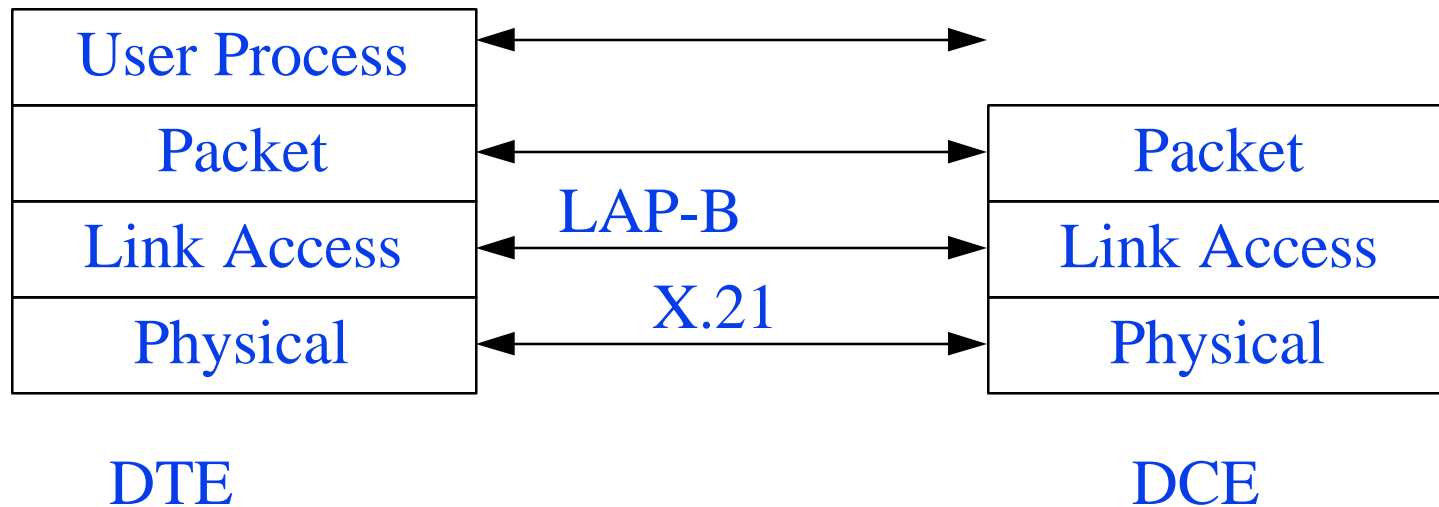http://www.cse.wustl.edu/~jain/

Overview

- Protocol layers
- Packet types and format
- Virtual call
- Multiplexing
- Flow, error control, segmentation, and reassembly

X.25

❑ First packet switching interface.

❑ Issued in 1976 and revised in 1980, 1984, 1988, and 1992.

❑ Data Terminal Equipment (DTE) to Data Communication Equipment (DCE) interface $\Rightarrow$ User to network interface (UNI)

❑ Used universally for interfacing to packet switched networks

DTE ← → DCE

Your Computer

X.25 Protocol Layers

User Process		Packet
Packet		Link Access
Link Access	**LAP-B**	Physical
Physical	**X.21**	

DTE   DCE
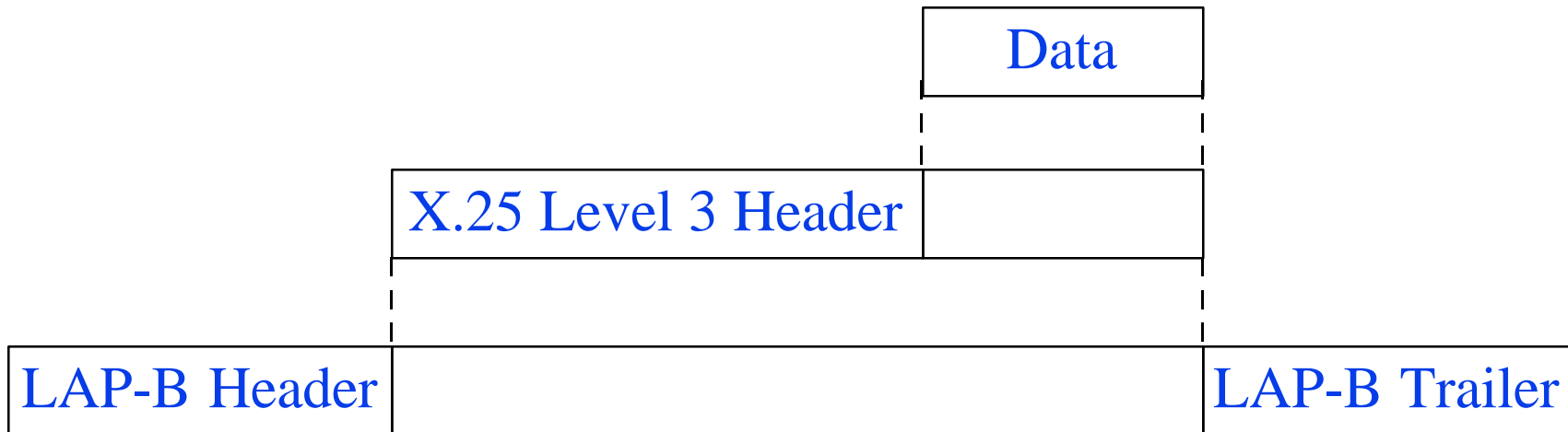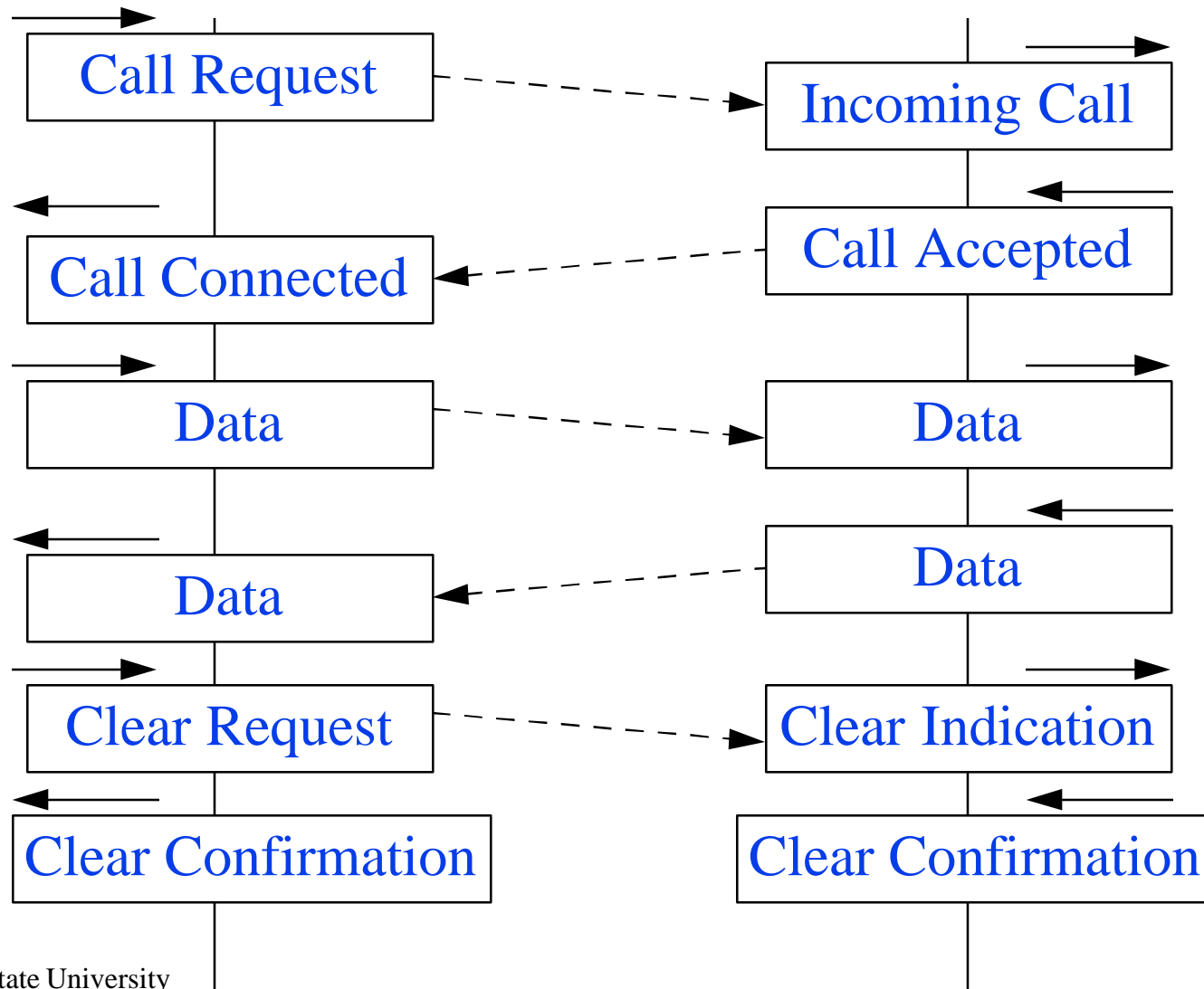
- ❑ X.21 often replaced by EIA-232 (RS-232C)
- ❑ LAP-B = Link access procedure - Balanced
- ❑ Packet layer = Connection-oriented transport over virtual circuits

Virtual circuit service

❑ Virtual call = Switched virtual circuit (SVC)

❑ Permanent virtual circuit (PVC)

❑ X.25 Packets

❑ Data is broken into blocks

❑ 3- or 4-byte header

		Data
	X.25 Level 3 Header	
LAP-B Header		LAP-B Trailer

Events

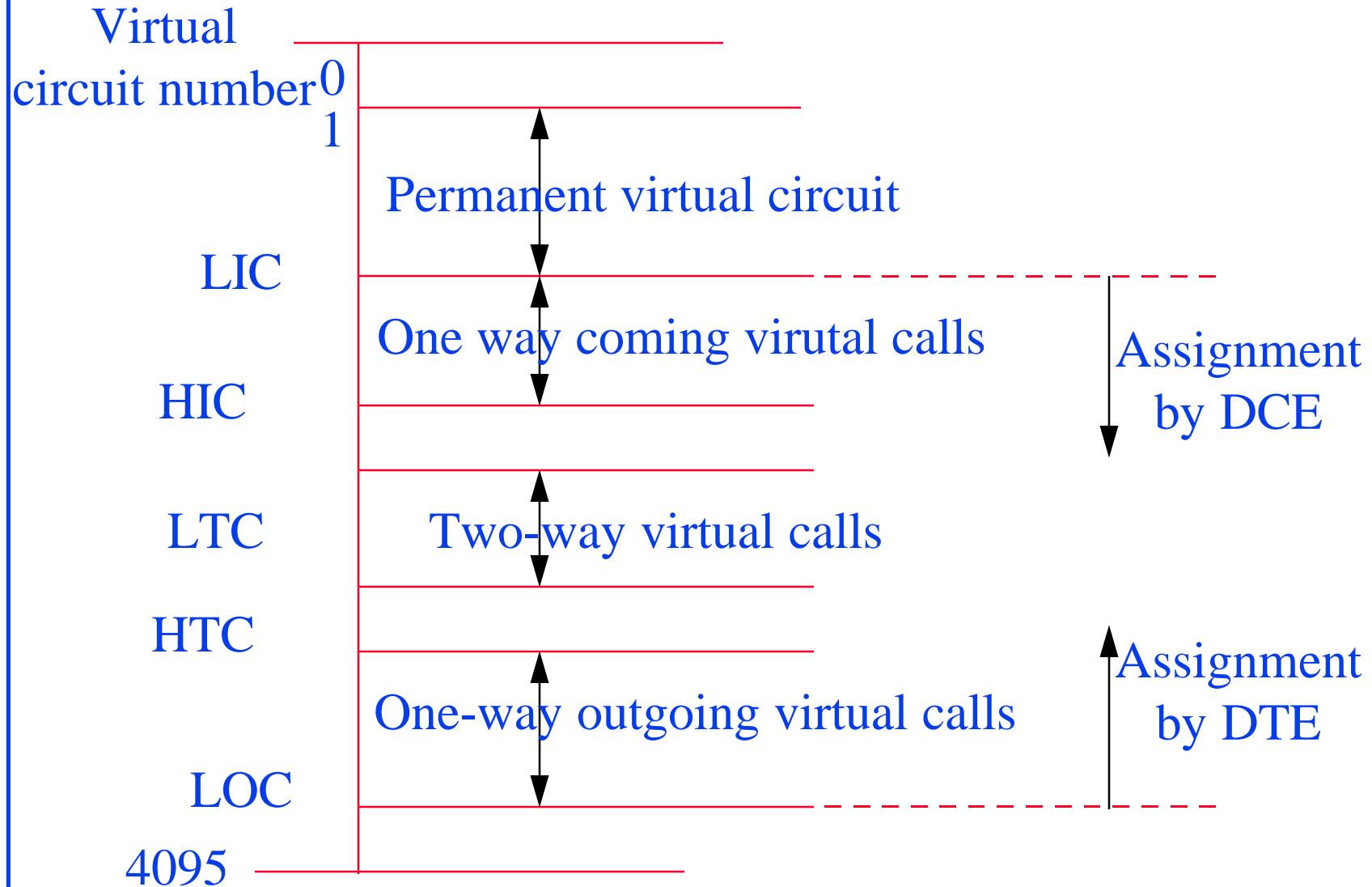|	
Call Request	Incoming Call
Call Connected	Call Accepted
Data	Data
Data	Data
Clear Request	Clear Indication
Clear Confirmation	Clear Confirmation

Multiplexing

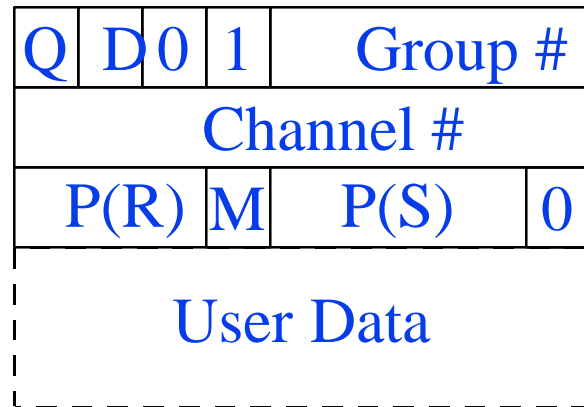❑ Allows up to 4095 simultaneous VCs over one physical DTE-DCE link

❑ All VCs are full-duplex (bi-directional)

❑ Each packet contains a 12-bit VC number = 4-bit group + 8-bit channel

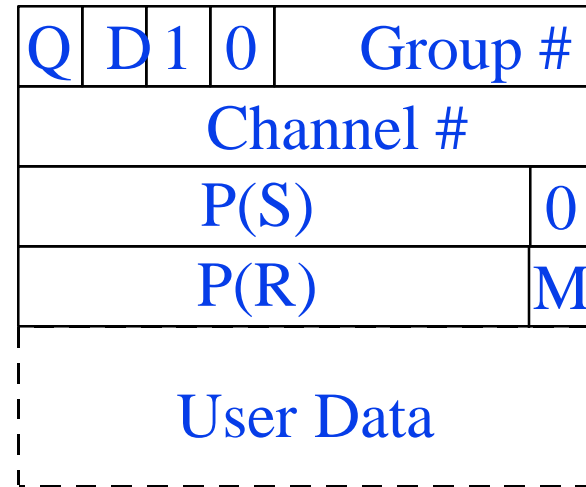# VC Number Assignment

Virtual circuit number 0

1

Permanent virtual circuit

LIC

One way coming virutal calls

HIC

Two-way virtual calls

LTC

HTC

One-way outgoing virtual calls

LOC

4095

Assignment by DCE

Assignment by DTE

Packet Format

Q	D	0	1	Group #

Channel #

P(R)	M	P(S)	0

User Data

Data packet w 3-bit seq

Q	D	1	0	Group #

Channel #

P(S)	0

P(R)	M

User Data

Data packet w 7-bit seq

❑ Q bit not defined. Allows users to have two classes of packets.

❑ M and D bits used for segmentation and acknowledgment

Packet Format (Contd)

0	0	0	1	Group #
Channel #				
Packet Type				1
Additional Information				

Control packet w 3-bit seq

0	0	1	0	Group #
Channel #				
Packet Type				1
Additional Information				

Control packet w 7-bit seq

0	0	0	1	Group #
Channel #				
P(R)	Packet Type			1

RR, RNR, and REJ packet
with 3-bit sequence numbers

0	0	1	0	Group #
Channel #				
Packet Type				1
P(R)				0

RR, RNR, and REJ packet
with 7-bit sequence numbers

Flow and Error Control

- Link Access Protocol - Balanced (LAPB)
- Balanced $\Rightarrow$ Both stations combined
- 3- or 7-bit sequence numbers
- 3-4th bits of X.25 header =
  01 $\Rightarrow$ 3-bit sequence number
  10 $\Rightarrow$ 7-bit sequence number
- Each VC has separate sequence number
- D=0 packets are acked by local DCE
- D=1 packets are acked by remote DTE (end-to-end ack)

Segmentation and Acknowledgment

- ❑ X.25 allows segmenting large packets into smaller packets inside the network

- ❑ A Packet: First and intermediate blocks

- ❑ B Packet: Last block

- ❑ M = 1 ⟹ Additional segments to follow

- ❑ D = 1 ⟹ end-to-end acknowledgment required from receiving DTE to sending DTE

- ❑ M = 1 and D = 0 ⟹ A packet

- ❑ All others ⟹ B packet

- ❑ Segments can be further segmented or combined inside the network

X.25 Packet Sequences

EXAMPLE PACKET SEQUENCES

Original seq.			Combined seq.		
Pkt type	M	D	Pkt type	M	D
A	1	0			
A	1	0	A	1	0
A	1	0			
A	1	0	A	1	0
A	1	0			
B	0	1	B	0	1

Segmented seq

B	0	0	A	1	0
			B	0	0

X.25 Packet Sequences (Contd)

EXAMPLE PACKET SEQUENCES
WITH INTERMEDIATE E-E ACK

Pkt type	M	D	
A	1	0	
A	1	0	*
A	1	0	
B	1	1	
A	1	0	
A	1	0	*
B	1	1	
A	1	0	
A	1	0	*
A	1	0	
B	0	1	

end of sequence

* Groups of packets that can be combined

Summary
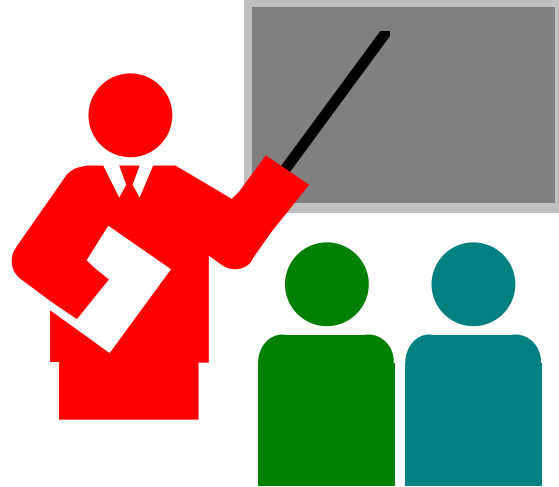
- X.21, LAPB
- PVC and virtual call
- VC numbers
- A and B packets
- M and D bits