

# X.25

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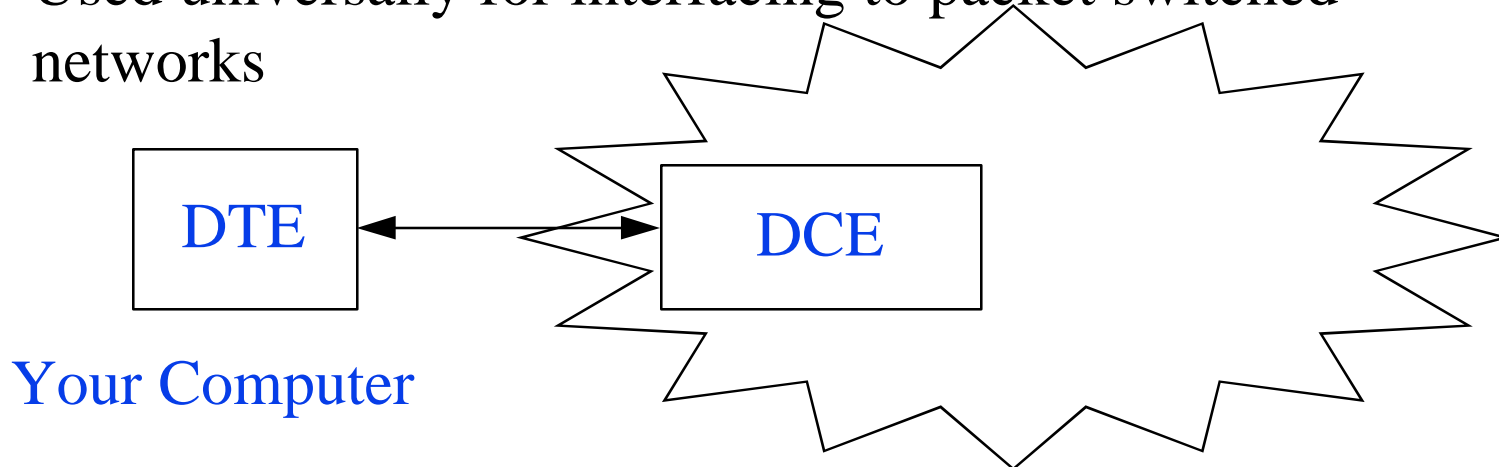
<http://www.cis.ohio-state.edu/~jain/>



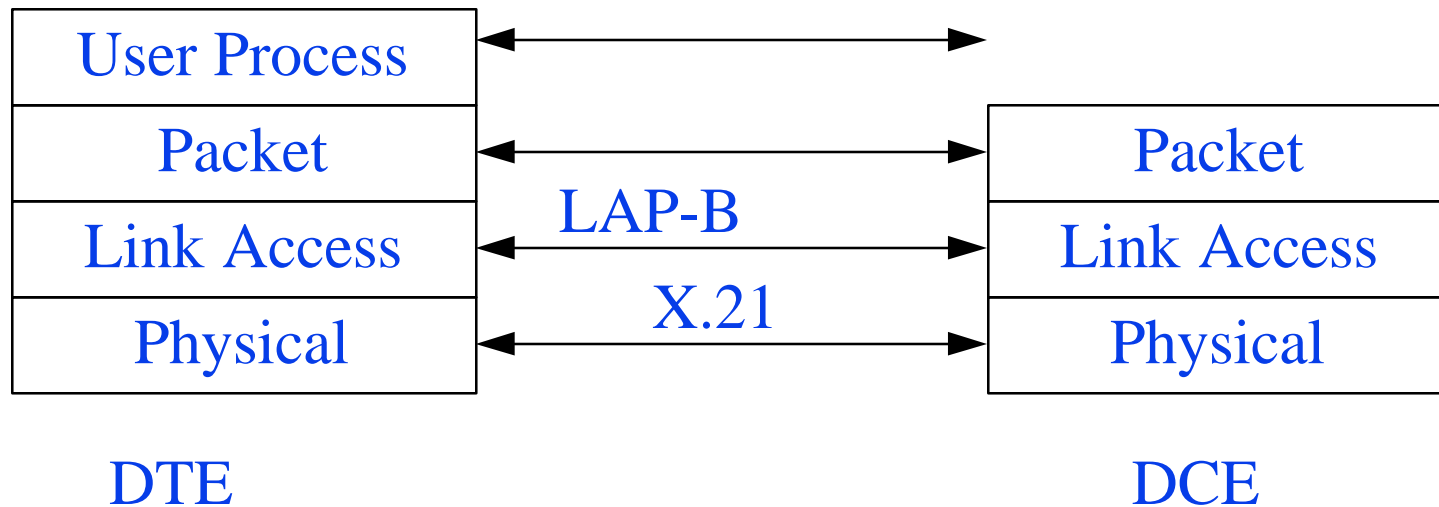
- ❑ Protocol layers
- ❑ Packet types and format
- ❑ Virtual call
- ❑ Multiplexing
- ❑ Flow, error control, segmentation, and reassembly

# 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



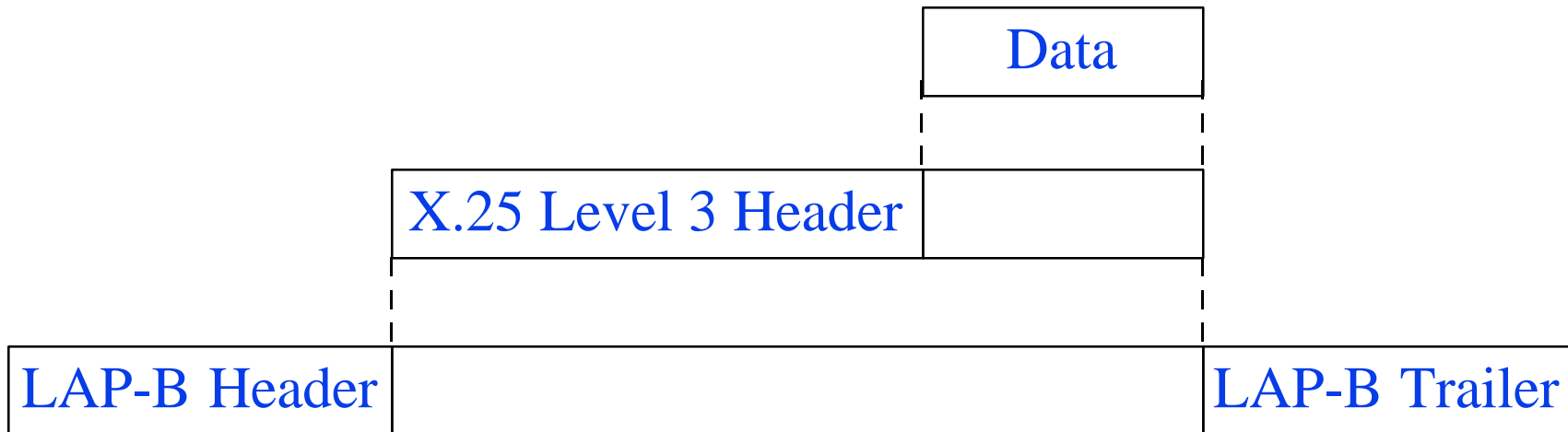
# X.25 Protocol Layers



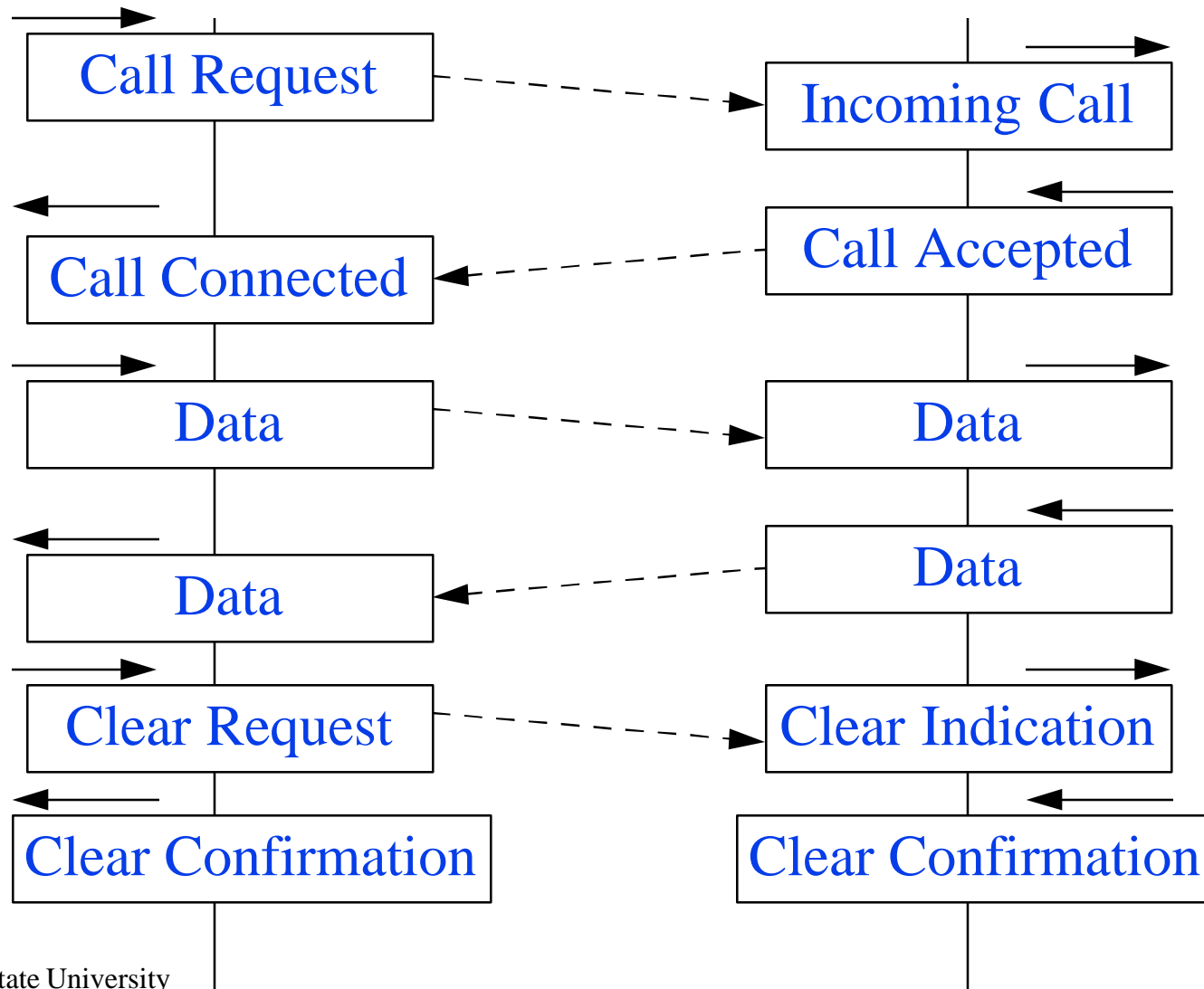
- ❑ X.21 often replaced by EIA-232 (RS-232C)
- ❑ LAP-B = Link access procedure - Balanced
- ❑ Packet layer = Connection-oriented transport over virtual circuits

# 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



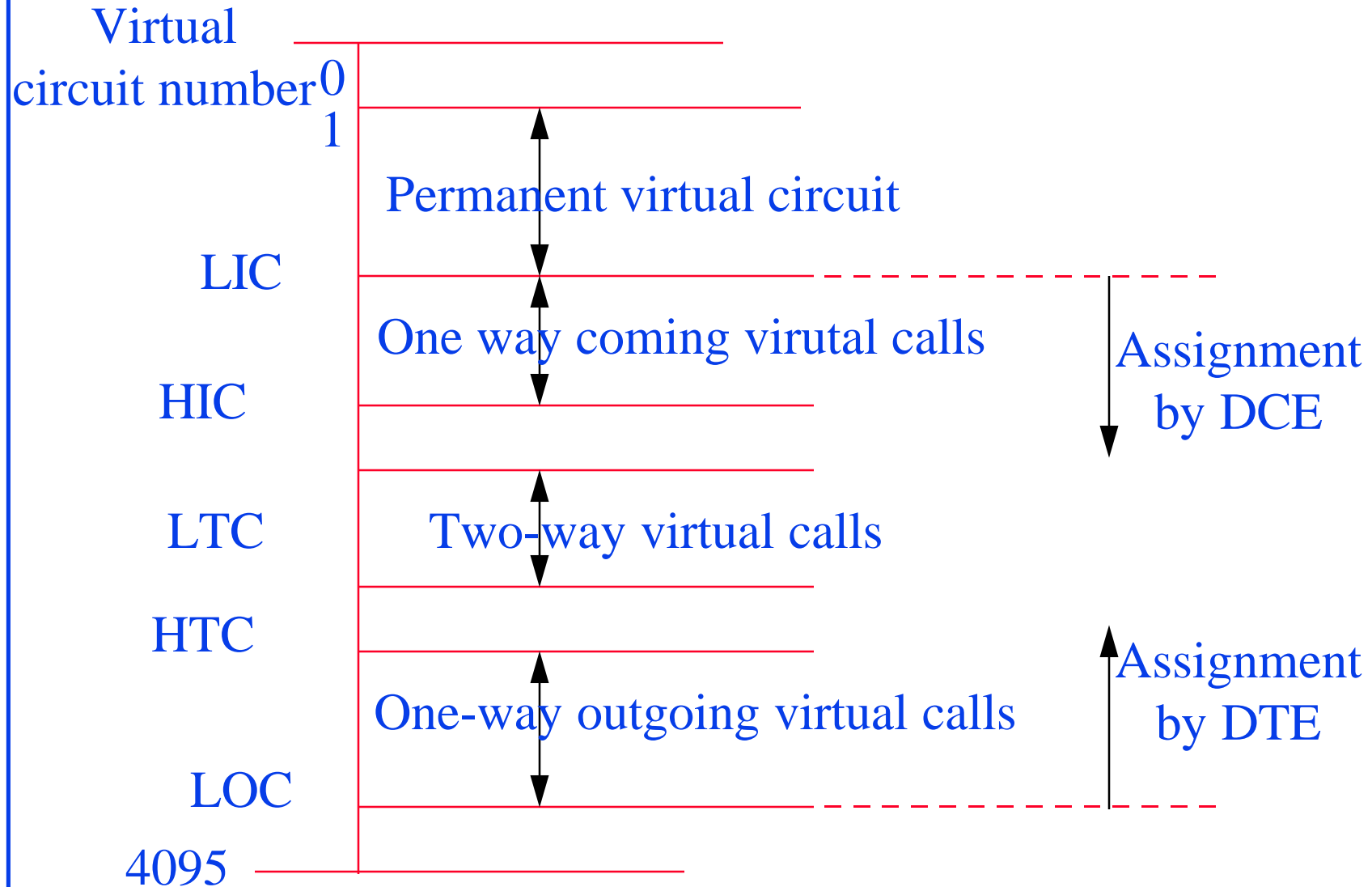
# Events



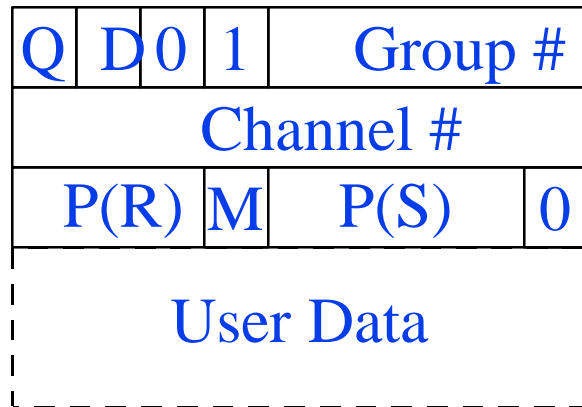
# Multiplexing

- ❑ 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

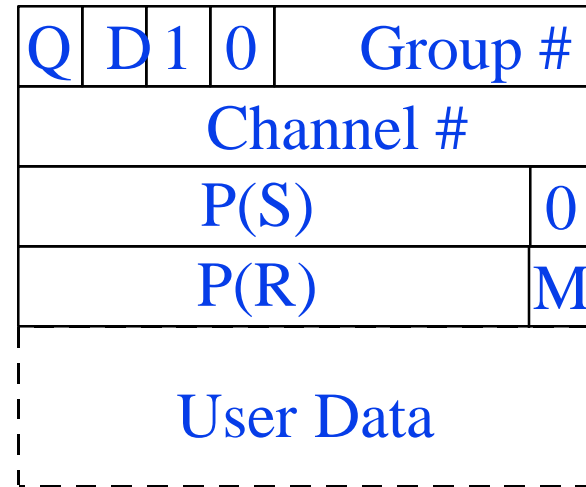
# VC Number Assignment



# Packet Format



Data packet w 3-bit seq



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
- ❑  $M = 1 \Rightarrow$  Additional segments to follow
- ❑  $D = 1 \Rightarrow$  end-to-end acknowledgment required from receiving DTE to sending DTE
- ❑  $M = 1$  and  $D = 0 \Rightarrow$  A packet
- ❑ All others  $\Rightarrow$  B packet
- ❑ Segments can be further segmented or combined inside the network

# X.25 Packet Sequences

## EXAMPLE PACKET SEQUENCES

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

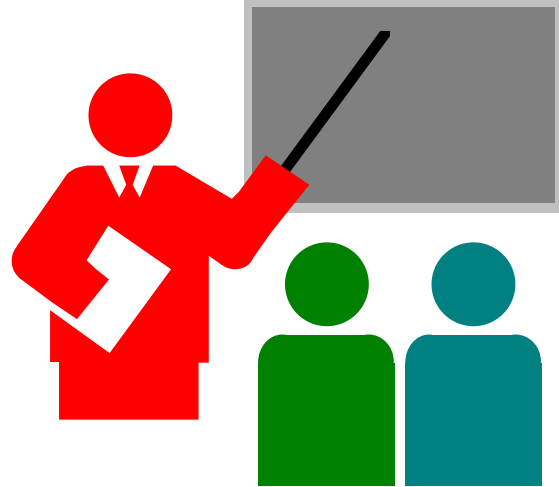
## EXAMPLE PACKET SEQUENCES WITH INTERMEDIATE E-E ACK

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