CNL
Communications & Networking
Laboratory

ECE 462 – Data and Computer Communications

Lecture 13A: HDLC and PPP

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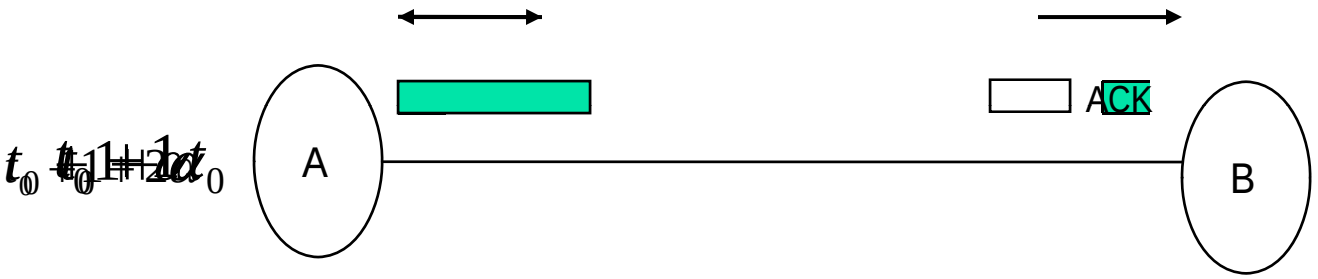
Outline

- Summary of throughput Analysis (what we have seen so far)
- DLC and its Efficiency
- Illustration of Window Concept
- Maximum Window Size
- Error Recovery Scenarios
- Error Recovery Analysis

Stop and Wait Link Utilization (1)



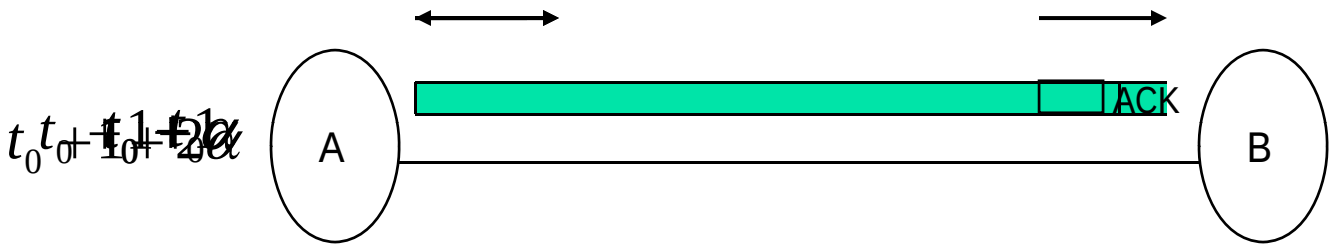
$\alpha > 1$

Effect of $\alpha = t_P / t_I$

Frame Tx time $(t_I) = 1$

Prop Time (t_P)

Stop and Wait Link Utilization (2)



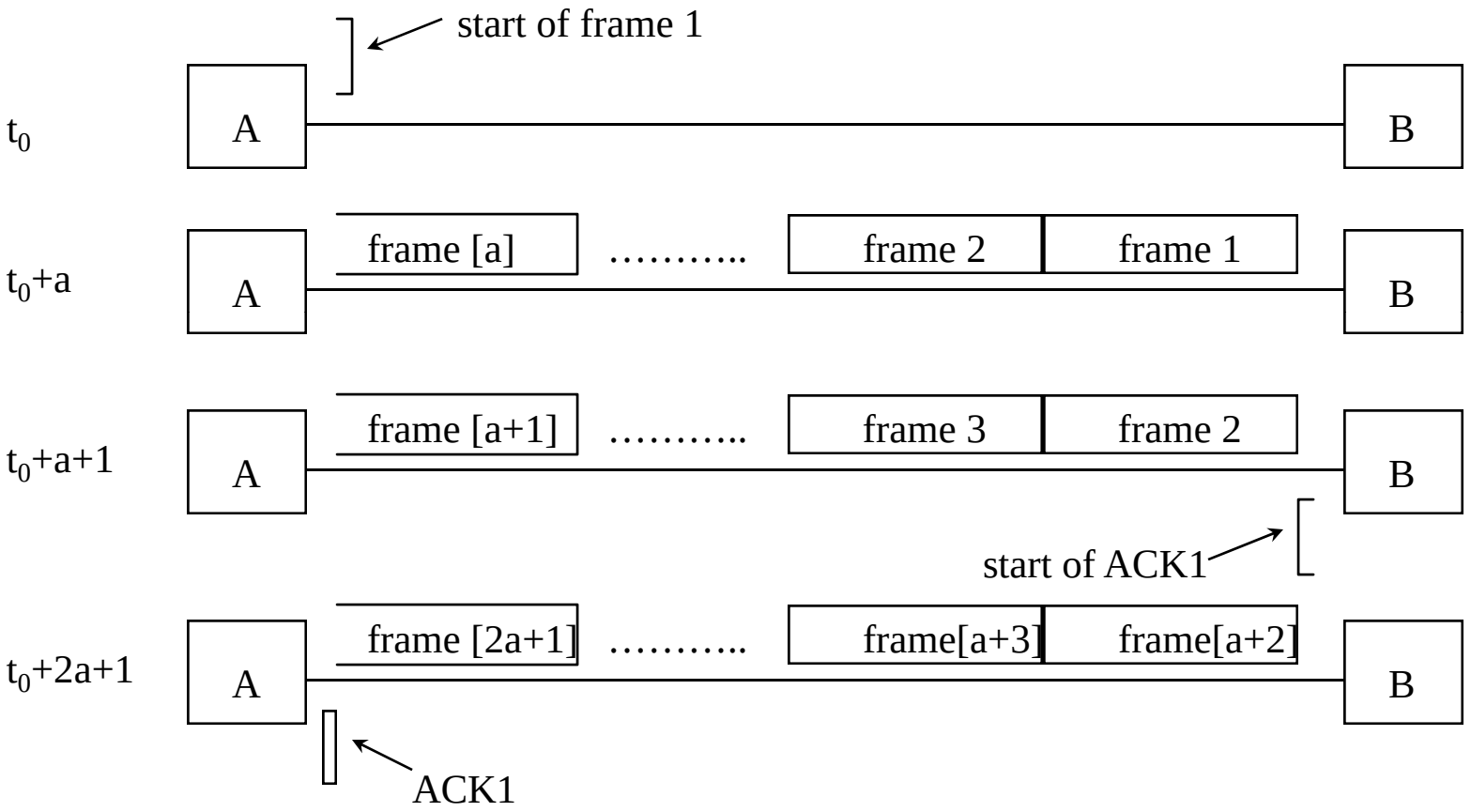
$\alpha < 1$

Effect of $\alpha = t_P / t_I$

Frame Tx time $(t_I) = 1$

Prop Time (t_P)

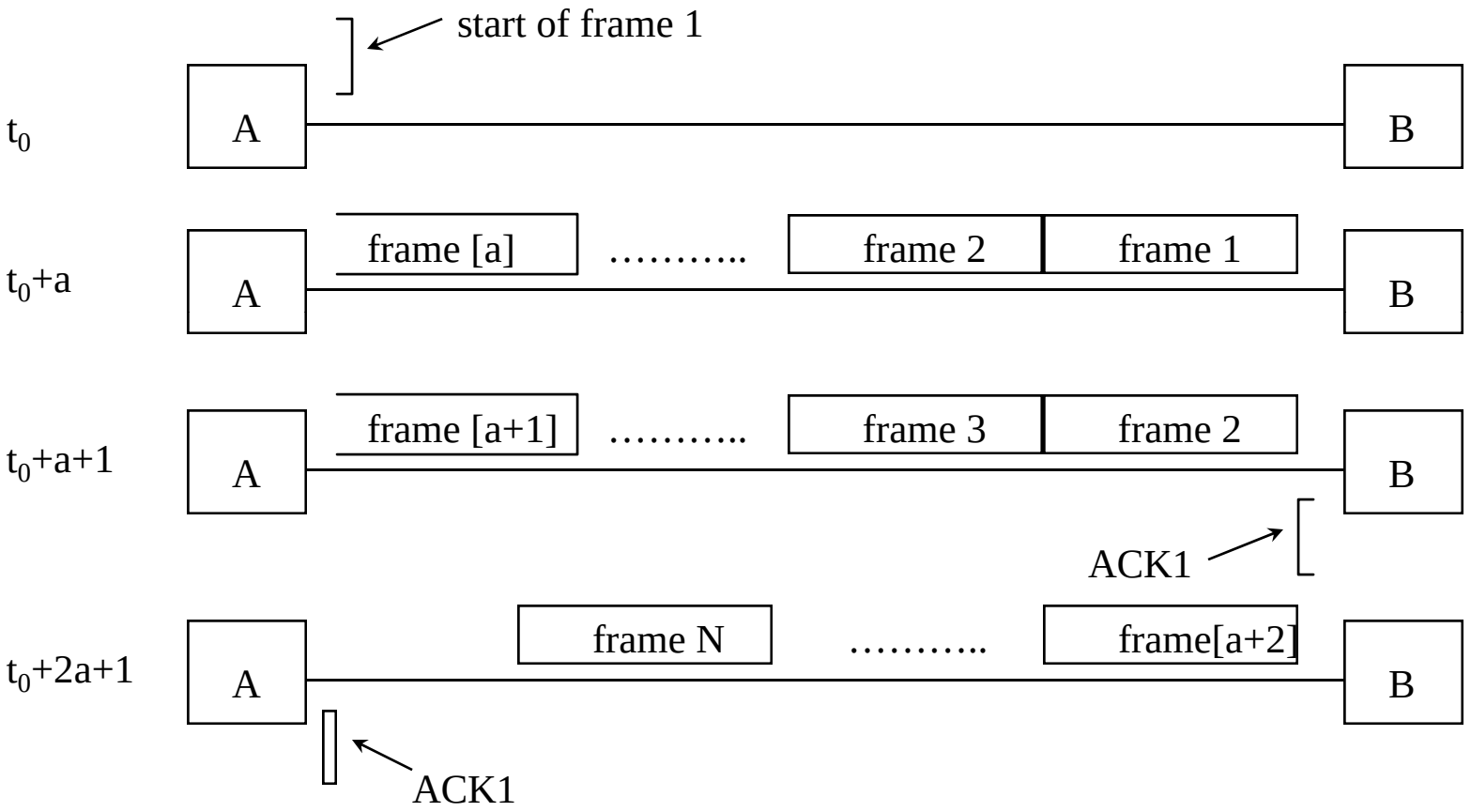
Timing of a sliding-window protocol



(a) N > 2a+1

[X] = smallest integer greater than or equal to X

Timing of a sliding-window protocol



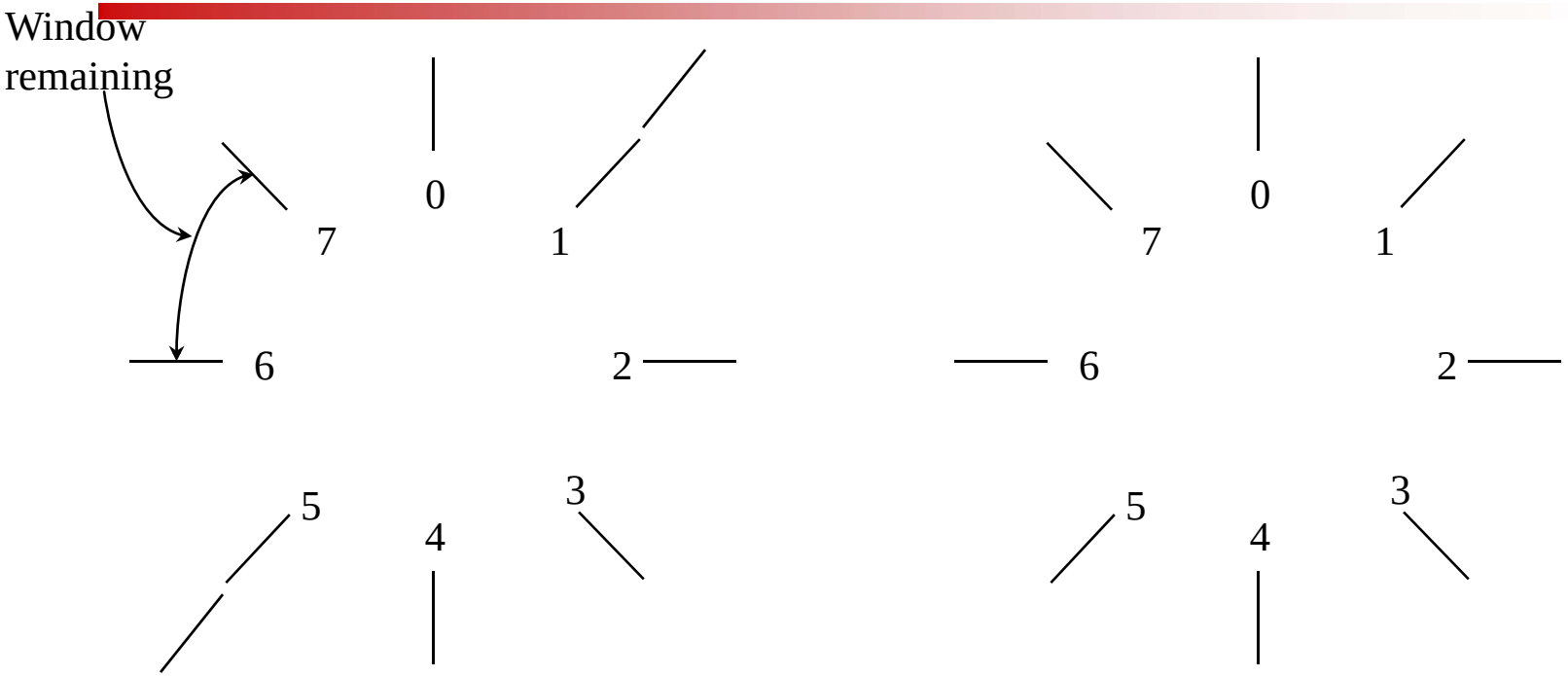
(b) N < 2a+1

[X] = smallest integer greater than or equal to X

Sequence Numbering

- Each frame is sequentially numbered (0 to 7) and after reaching 7 it cycles through the range 0 to 7 (i.e., modulo 8).
- The maximum number of unacknowledged frames at any given time never exceeds 7, (i.e. modulus minus one).
- Sequence numbering is used both at the transmit and receive points.
- Can be represented by window concept.
- Used for lost, errored and mis-sequenced frames.

Window Concept



(a) (b)

Sequence number and window concept
a. Prior to ack arrival
b. Ack with N(R)=3 arrives

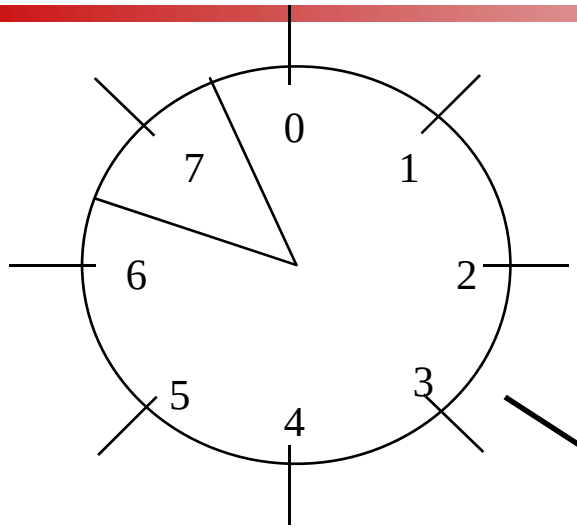
Window Concept

- Illustration of the window concept using modulo 8
- Suppose A transmits frame0, frame1, frame2
- A shrinks its window with transmission of each frame
- A can transmit a total of 7 frames
- Therefore, A is represented by a window that is open to transmit 4 additional frames

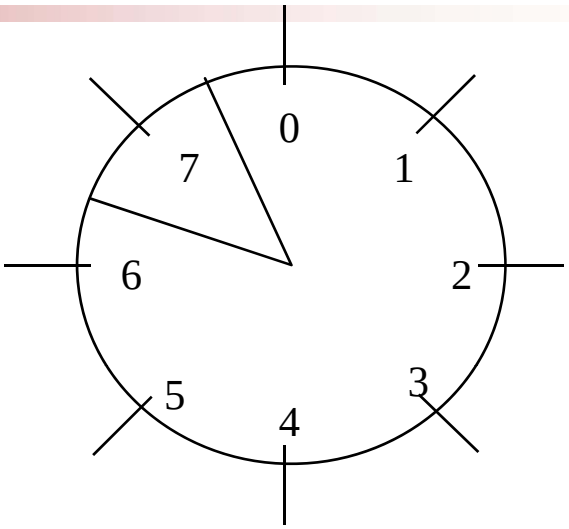
A can transmit 4 frames

Consider two stations A and B, each having a window of seven frames :

A

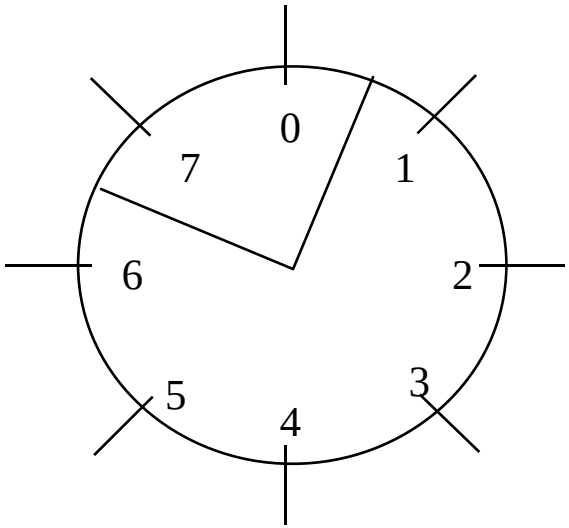


B



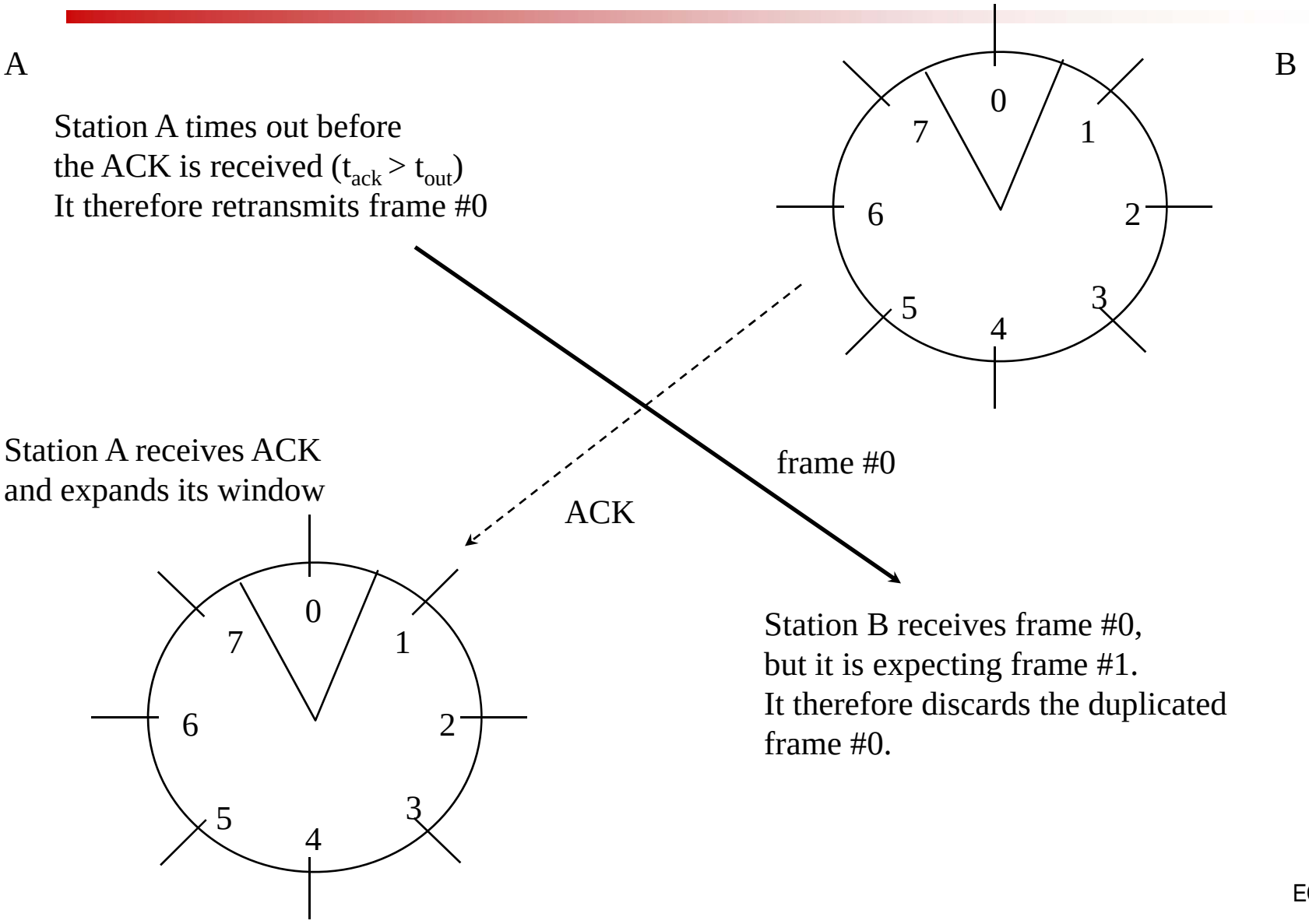
A sends frame #0 and
shrinks its window accordingly

frame #0



Station B receives frame #0,
acknowledges it and adjusts its window

Consider two stations A and B, each having a window of seven frames :

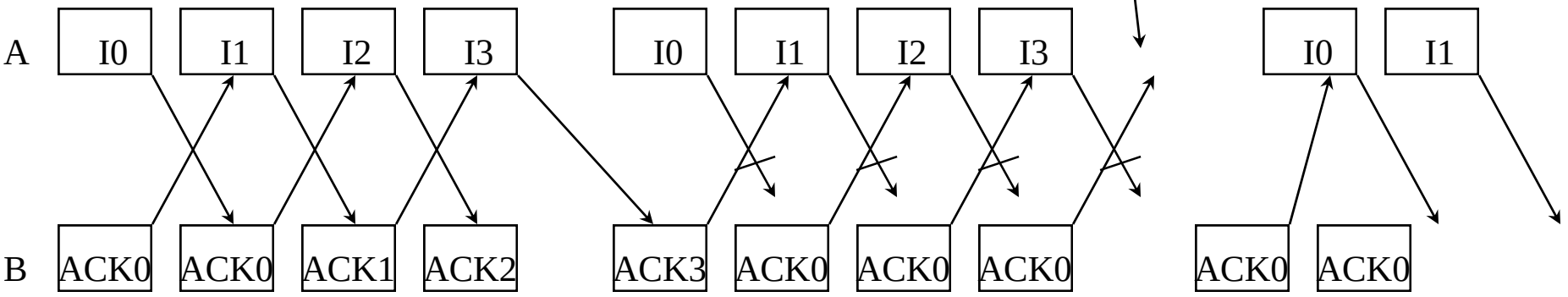


Maximum Window Size in Go-Back N Protocol

Consider Modulus 4
Then seq no are: 0, 1, 2,..Max Seq No (= 3)
Suppose Window Size = Max Seq No + 1

A will presume that all the previous frames have been received correctly by B and Will send new frames.

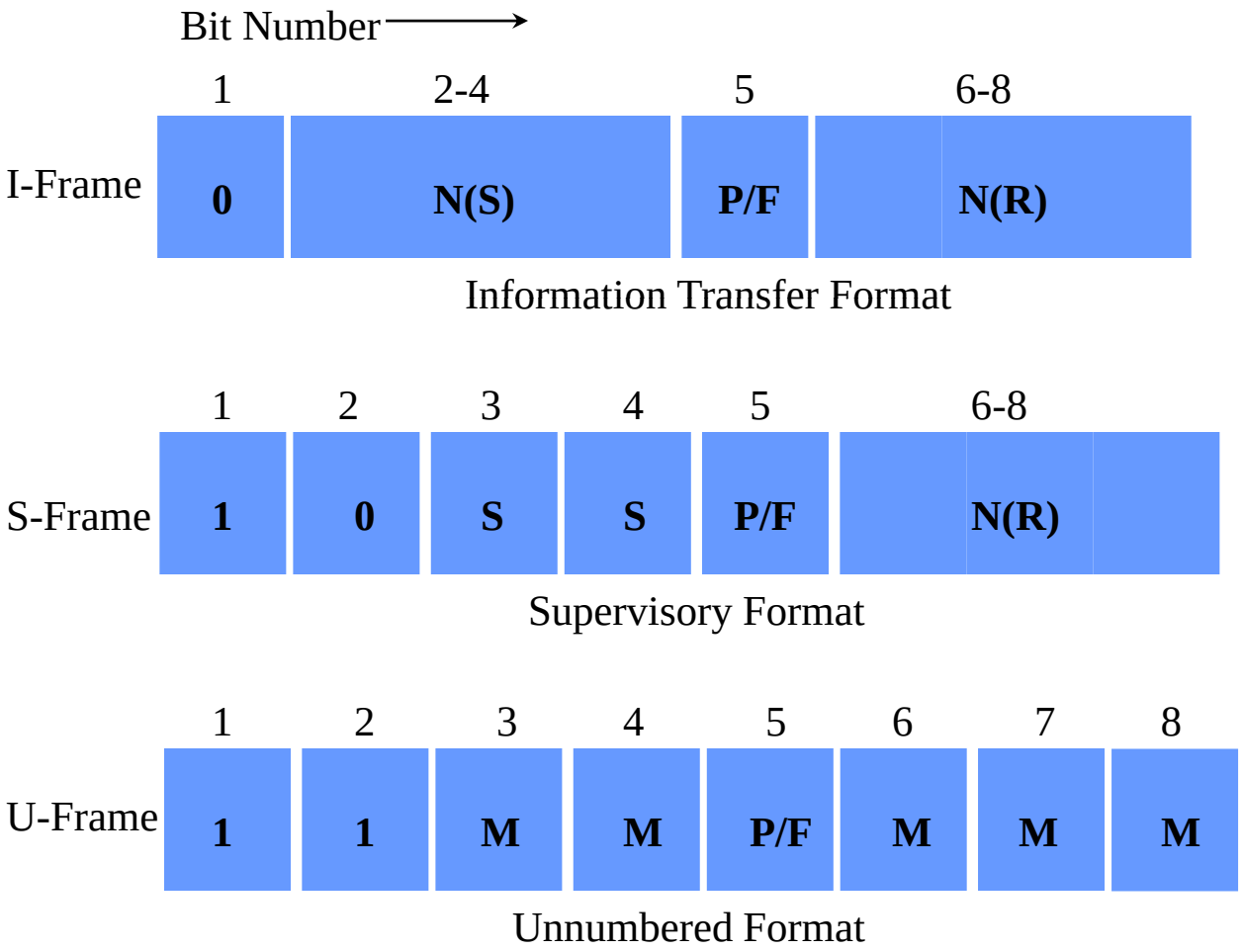
Invalid transmission occurs



Therefore, the MAX window size must be restricted to Max Seq No

HDLC Frame Format

Frame Types and Their Control Field Format



Detailed Control Fields of Frames

1. Information (**I**) Frames for transferring information

N(R)	P/F	N(S)	0

→ first bit to be transmitted

2. Supervisory (**S**) Frames to acknowledge I frames, request retransmission of I frames, and to communicate status (busy, ready)

Receive Ready **(RR)**	N(R)	P/F	00	01
Reject (**REJ)**	N(R)	P/F	01	01
Receive Not Ready (**RNR**)	N(R)	P/F	10	01
Selective Reject (**SREJ**)	N(R)	P/F	11	01

3. Unnumbered (**U**) Frames to issue commends and responses

Type	P/F	Type	11

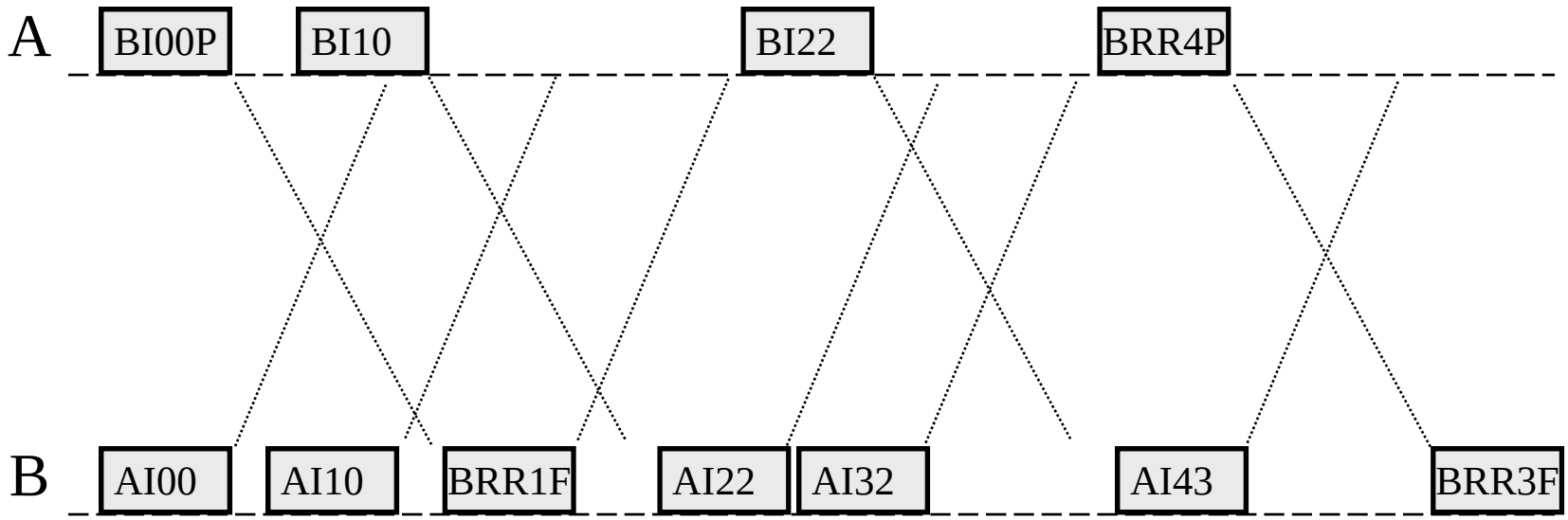
Unnumbered format commands

Control Field Bits	Mnemonic	Name
1 0 0 P 0 0 1 1	SNRM	Set Normal Response Mode
0 0 0 P 1 1 1 1	SARM	Set Asynchronous Response Mode
0 0 1 P 1 1 1 1	SABM	Set Asynchronous Balanced Mode
1 1 0 P 1 1 1 1	SNRME	Set Normal Response Mode Extended
0 1 0 P 1 1 1 1	SARME	Set Asynchronous Response Mode Extended
0 1 1 P 1 1 1 1	SABME	Set Asynchronous Balanced Mode Extended
0 0 0 P 0 1 1 1	SIM	Set Initialization Mode
0 1 0 P 0 0 1 1	DISC	Disconnect
0 0 0 P 0 0 1 1	UI	Unnumbered Information
0 0 1 P 0 0 1 1	UP	Unnumbered Poll
1 0 0 P 1 1 1 1	RSET	Reset
1 0 1 P 1 1 1 1	XID	Exchange Identification
Unumbered format responses		
0 1 1 F 0 0 1 1	UA	Unnumbered Acknowledgement
0 0 0 F 1 1 1 1	DM	Disconnected Mode
0 0 0 F 0 1 1 1	RIM	Request Initialization Mode
0 0 0 F 0 0 1 1	UI	Unnumbered Information
1 0 0 F 0 1 1 1	FRMR	Frame Reject
1 0 1 F 1 1 1 1	XID	Exchange Identification
0 1 0 F 0 0 1 1	RD	Request Disconnect

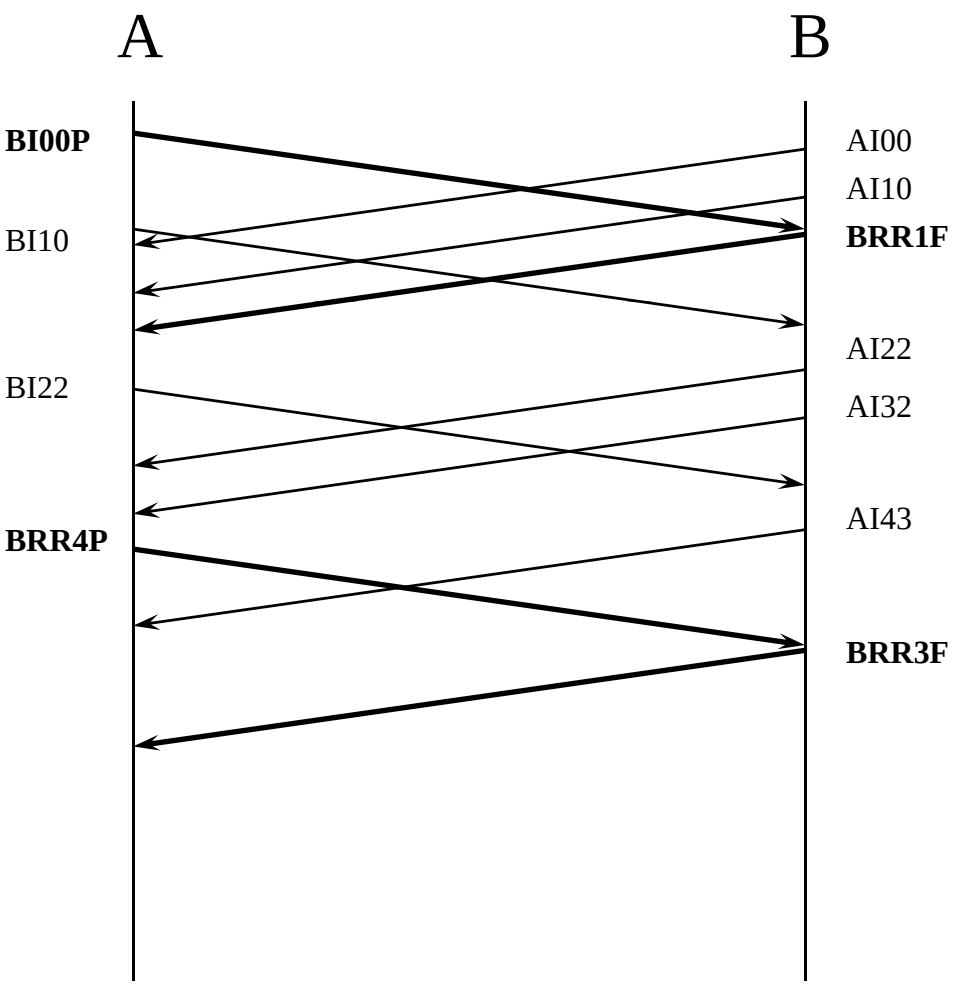
HDLC Modes of Operation

- NRM (Normal Response Mode)
  - Used in a centralized control environment (Roll-call polling), One primary and several secondary station in a multi-hop configuration
- ARM (Asynchronous Response Mode)
  - Similar to NRM but no primary command needed for the secondary station
- ABM (Asynchronous Balanced Mode)
  - For point-to-point link transmission, LAPB of X.25

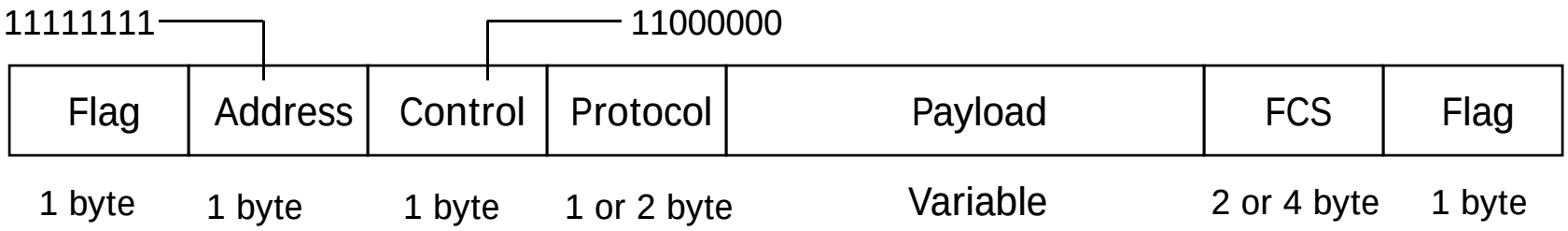
LAPB Protocol Operation



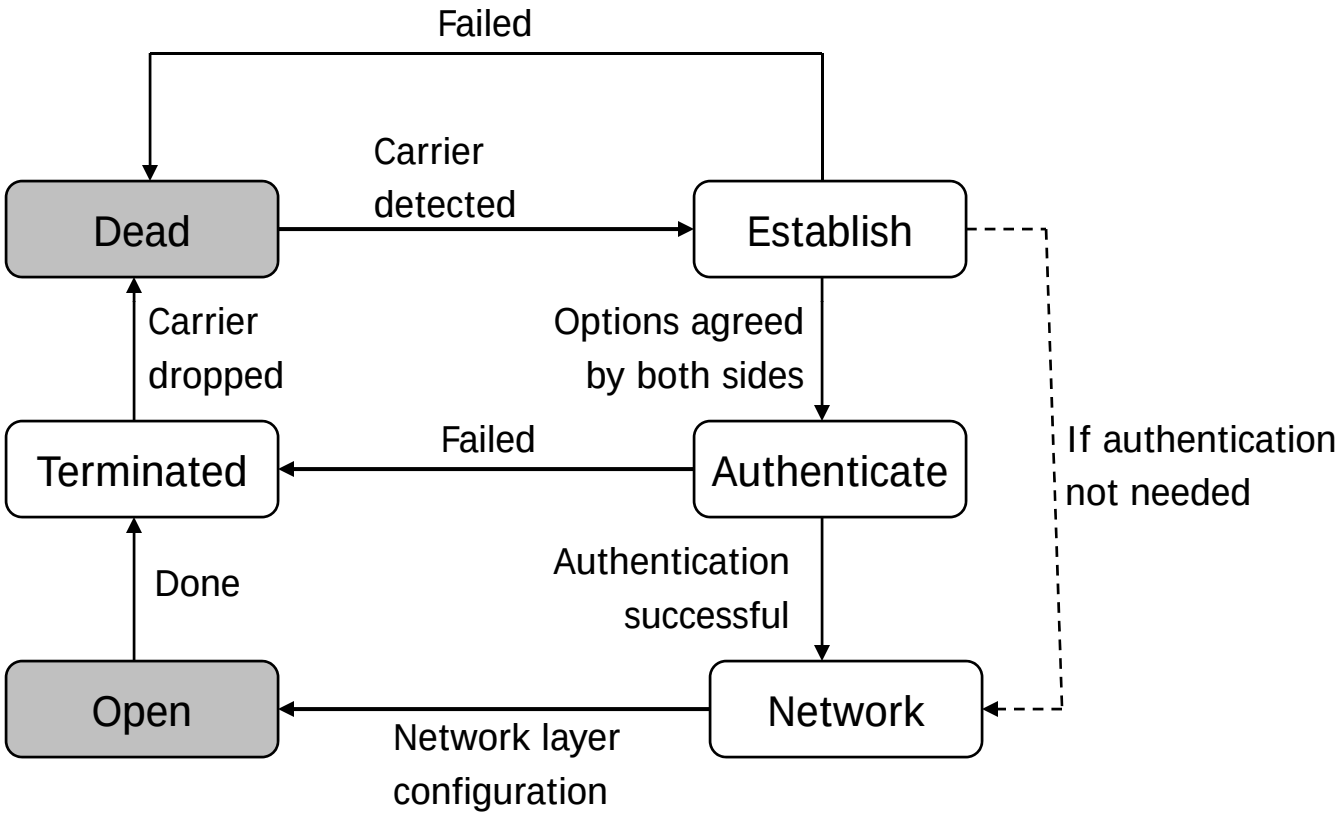
LAPB Operation- No Errors



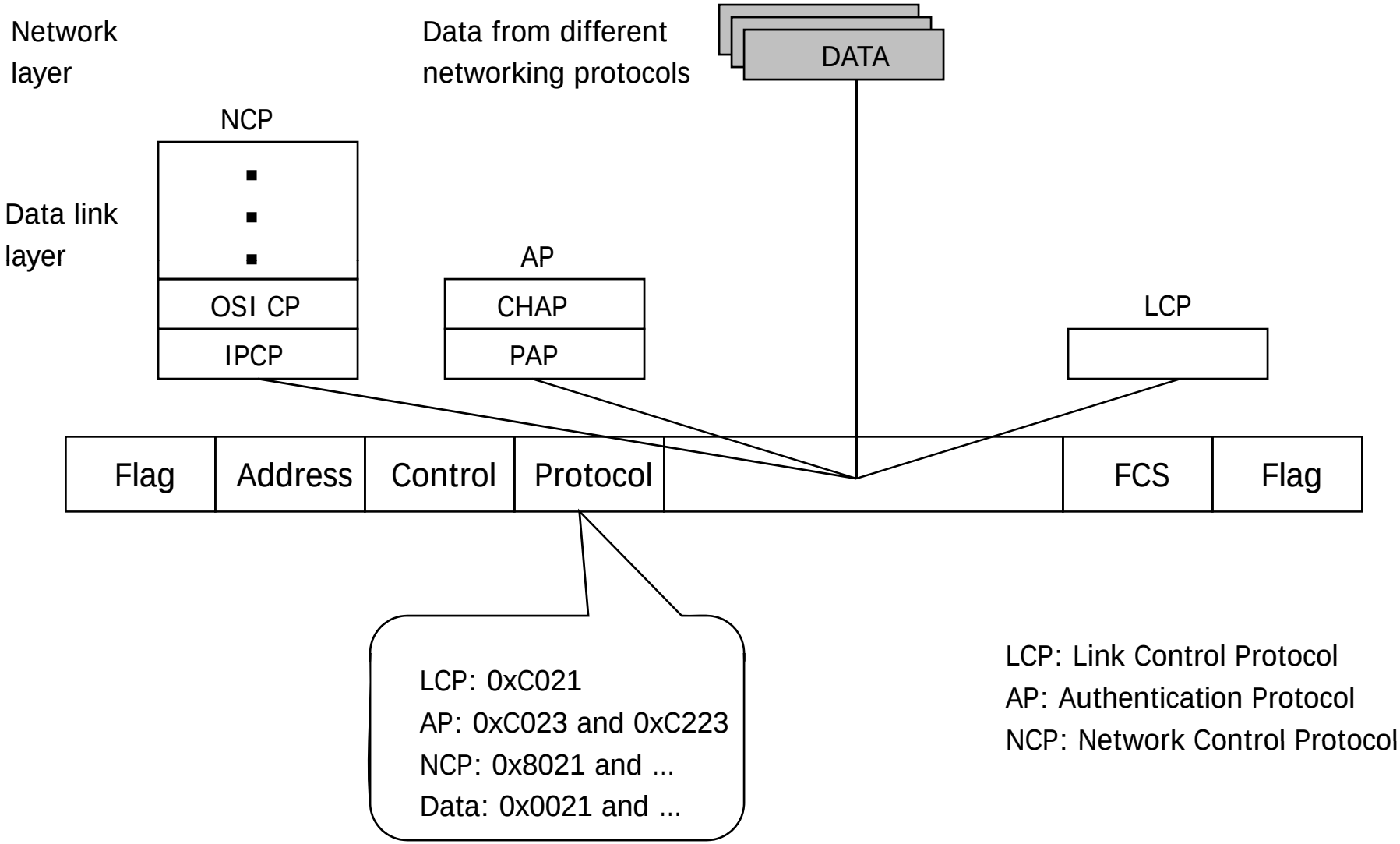
PPP frame format



Transition Phases



Multiplexing in PPP



Multilink PPP