

# ECE 428: Tutorial 5

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# **HDLC DATA LINK CONTROL**

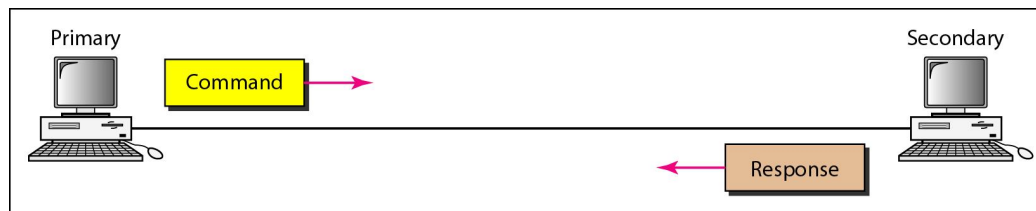
- High-level data link control gives the set of standards for operating
- a data link over bit synchronous physical layers.
- It is derived from SDLC (Synchronous Data Link Control) developed by IBM.
- It supports both Half-duplex and Full-duplex communication.

# HDLC Basics

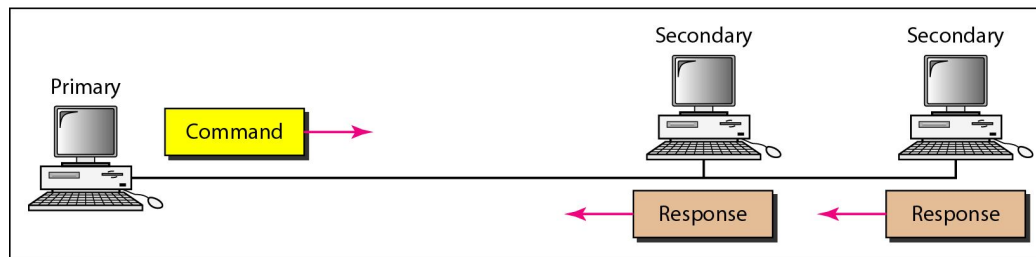
- Stations:
  - Primary: sends data, controls the link with commands
  - Secondary: receives data, responds to control messages
  - Combined: can issue both commands and responses
- Link configuration:
  - Unbalanced: one primary station, one or more secondary stations
  - Balanced: two combined stations

# HDLC

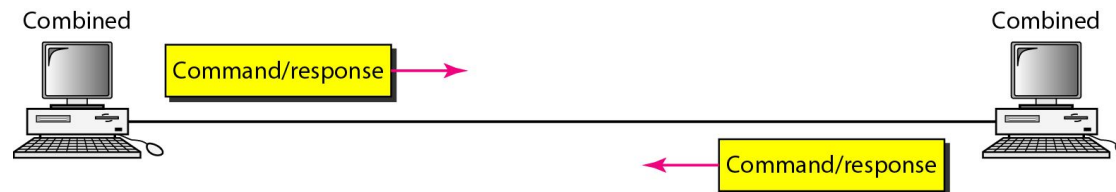
- Two common transfer mode: normal response mode (NRM) and asynchronous balanced mode (ABM)



a. Point-to-point

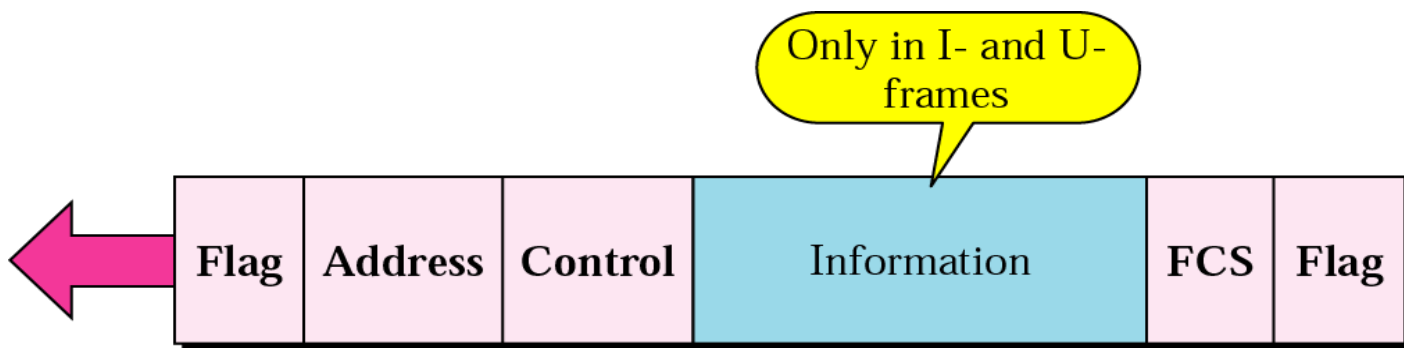


b. Multipoint



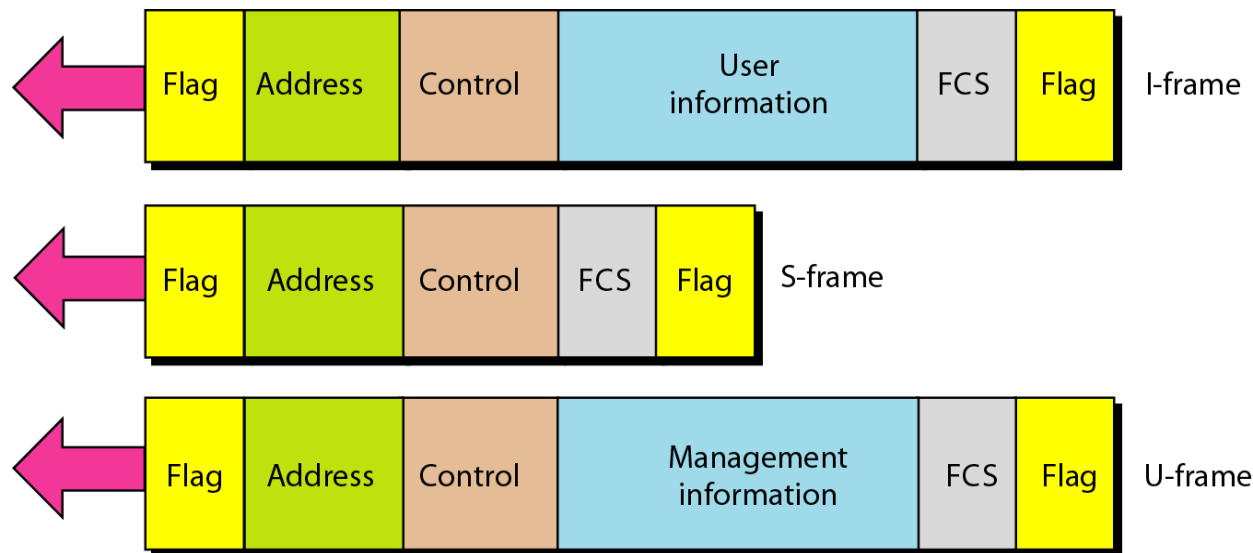
# High-level Data Link Control (HDLC)

- **Frame Format:** HDLC frames contains six fields
  - **Flag Field:** 8-bit contains 01111110 to identify the beginning and end of a frame and serves as a synchronization
  - **Address Field:** one or several byte long field contains address of either the originator or the destination of the frame. If primary creates the frame, it contains a to address. If a secondary creates the frame, it contains a from address.
  - **Control Field:** one or two byte long contains flow/error info.
  - **Information Field:** variable length field contains user's information from network layer or network management info.
  - **FCS Field:** frame-check-sequence is an error detection field contains 2 to 4 byte CRC data.



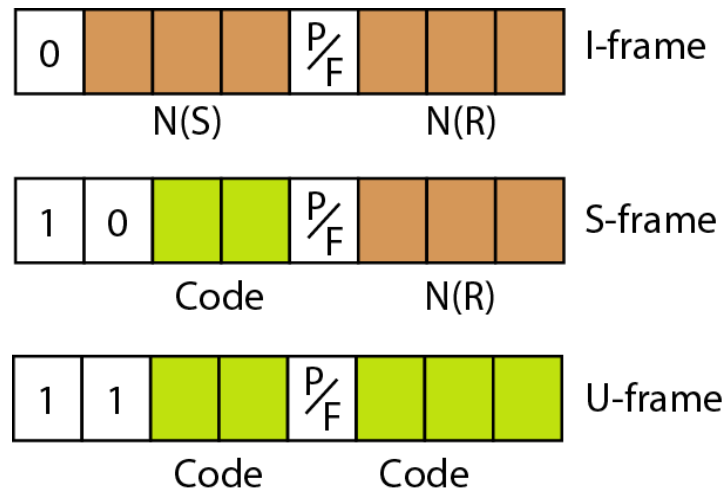
# HDLC: Frames

- I(information)-frames, S(supervisory)-frames, U(unnumbered frame)-frames
- Flag field: 01111110 to identify both the beginning and the end of a frame and serve as synchronization pattern for receiver
- FCS field: 2- or 4-byte ITU-T CRC for error detection



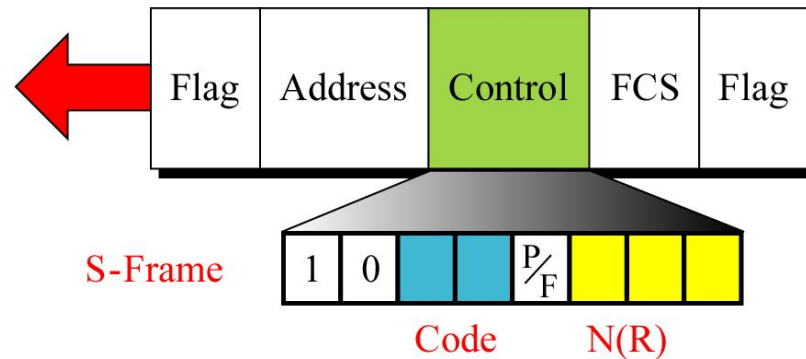
# HDLC: Frames

- Control Field: 1- or 2-byte segment of the frame used for flow and error control
- Determine the type of frame and define its functionality
- Control field for I-frame: P/F (poll/final bit for primary/secondary)



# HDLC: Frames

- Control field for S-frame
- Receive ready (RR), Receive not ready (RNR), Reject (REJ) Selective reject (SREJ)



Code	Command
<b>00</b>	<b>RR</b> Receive ready
<b>01</b>	<b>REJ</b> Reject
<b>10</b>	<b>RNR</b> Receive not ready
<b>11</b>	<b>SREJ</b> Selective-reject



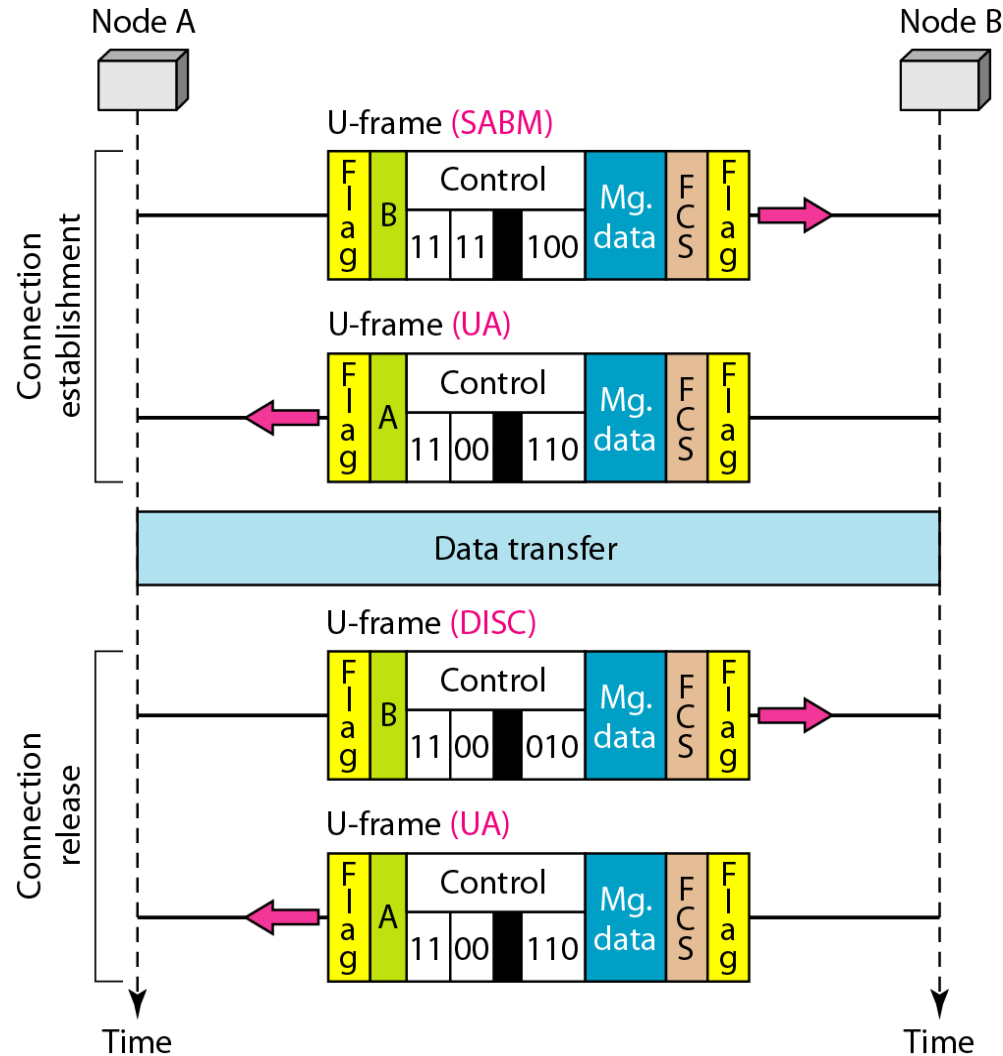
# HDLC: Frames

- Control field for U-frame

<i>Code</i>	<i>Command</i>	<i>Response</i>	<i>Meaning</i>
<b>00 001</b>	SNRM		Set normal response mode
<b>11 011</b>	SNRME		Set normal response mode, extended
<b>11 100</b>	SABM	<b>DM</b>	Set asynchronous balanced mode or <b>disconnect mode</b>
<b>11 110</b>	SABME		Set asynchronous balanced mode, extended
<b>00 000</b>	UI	<b>UI</b>	Unnumbered information
<b>00 110</b>		<b>UA</b>	<b>Unnumbered acknowledgment</b>
<b>00 010</b>	DISC	<b>RD</b>	Disconnect or <b>request disconnect</b>
<b>10 000</b>	SIM	<b>RIM</b>	Set initialization mode or <b>request information mode</b>
<b>00 100</b>	UP		Unnumbered poll
<b>11 001</b>	RSET		Reset
<b>11 101</b>	XID	<b>XID</b>	Exchange ID
<b>10 001</b>	FRMR	<b>FRMR</b>	Frame reject

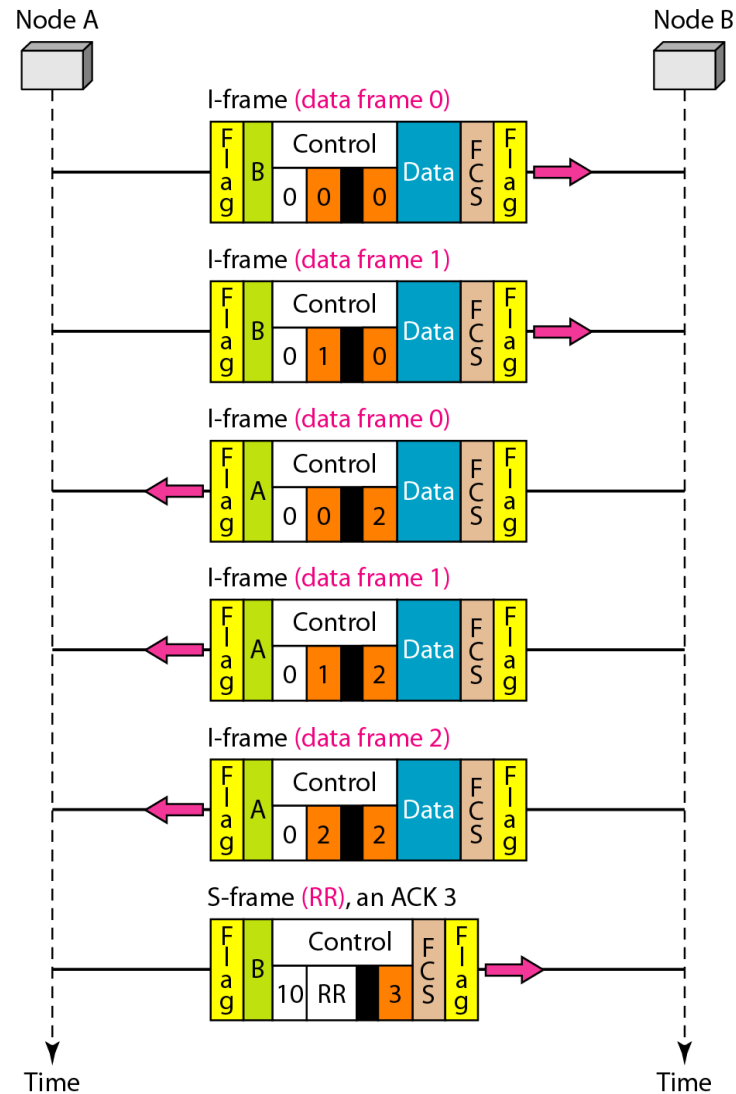
# HDLC: Example 1

- Connection and disconnection



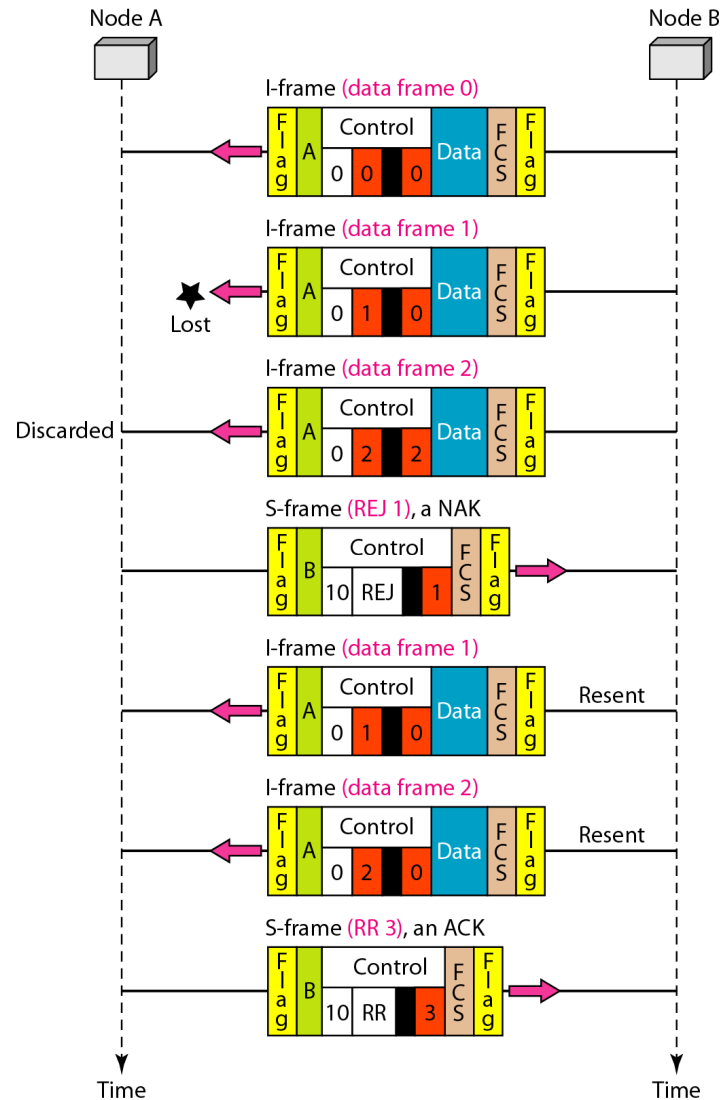
# HDLC: Example 2

- Piggybacking without error

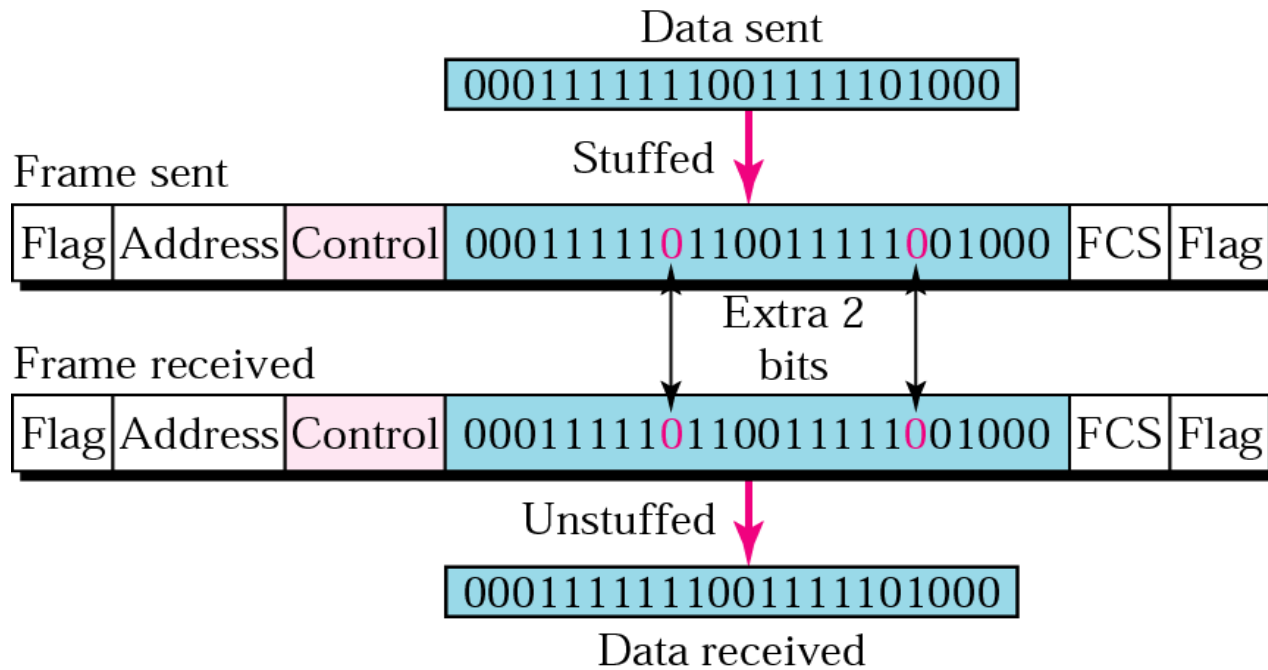


# HDLC: Example 3

- Piggybacking with error



# HDLC: Bit Stuffing and Unstuffing



# **POINT-TO-POINT PROTOCOL**

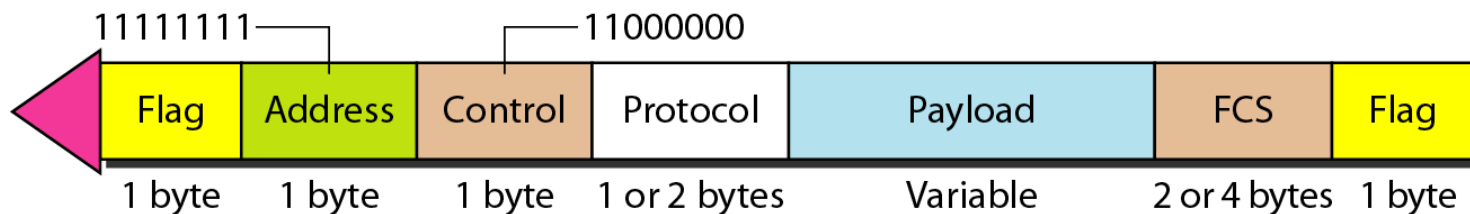
- **- PPP can be used as a data link control to connect two routers**
- **- It can be used to connect a personal computer to an internet service provider (ISP)**
- **-It can operate over asynchronous -links, bit asynchronous links**
- **- The PPP protocol uses HDLC –like frame format to encapsulate data grams over point-to-point links**

# Point-to-Point Protocol: *PPP*

- PPP defines/provides
  - the format of the frame to be exchanged between devices
  - how two devices negotiate the establishment of the link and the exchange of data
  - how network layer data are encapsulated in the data link frame
  - how two devices can authenticate each other
  - multiple network layer services
  - connection over multiple links
  - Network address configuration
- But, several services are missing for simplicity
  - no flow control, simple error control (detection and discard), no sophisticated addressing for multipoint configuration

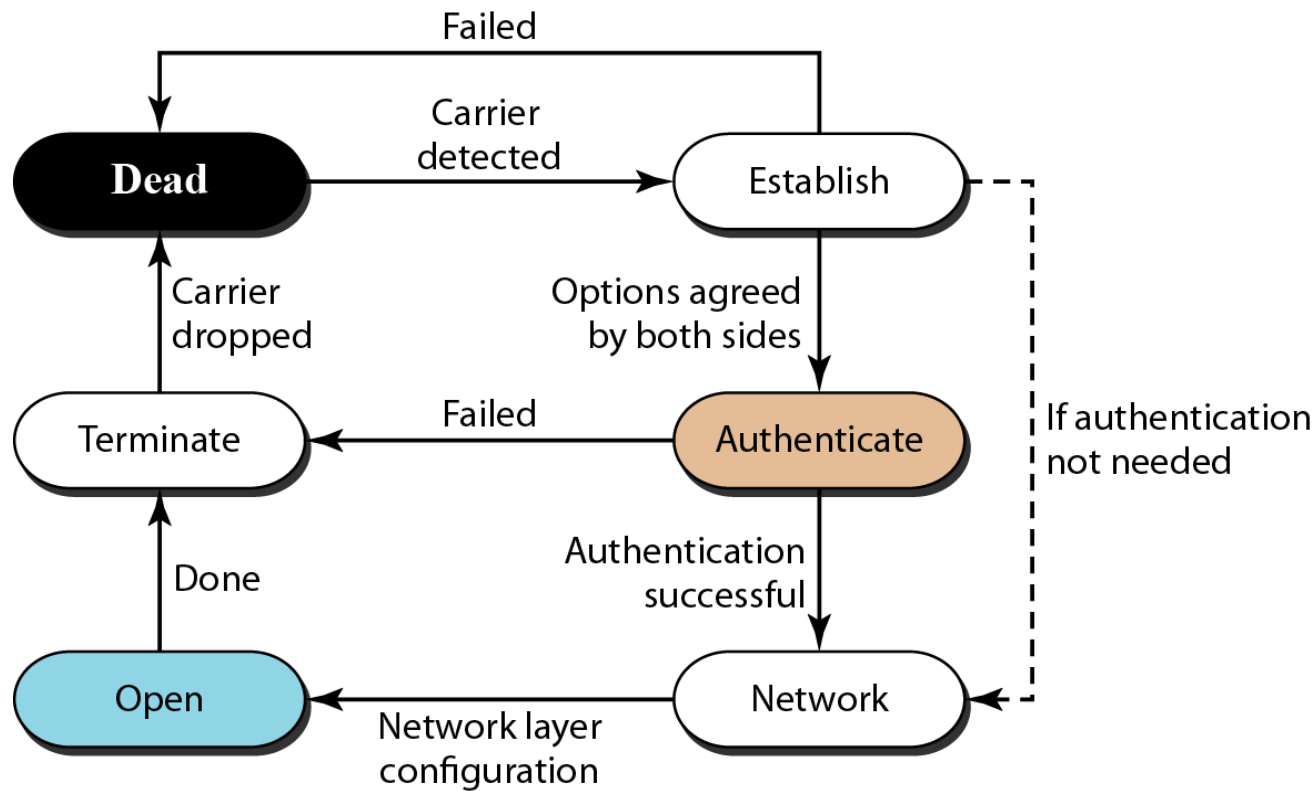
# PPP Frame

- Flag: 01111110 the same as HDLC, but it treated as a byte because of PPP is a byte-oriented protocol
- Address: 11111111 (broadcast address)
- Control: No need because PPP has no flow control and limited error control
- PPP is a byte-oriented protocol using byte stuffing with the escape byte 01111101



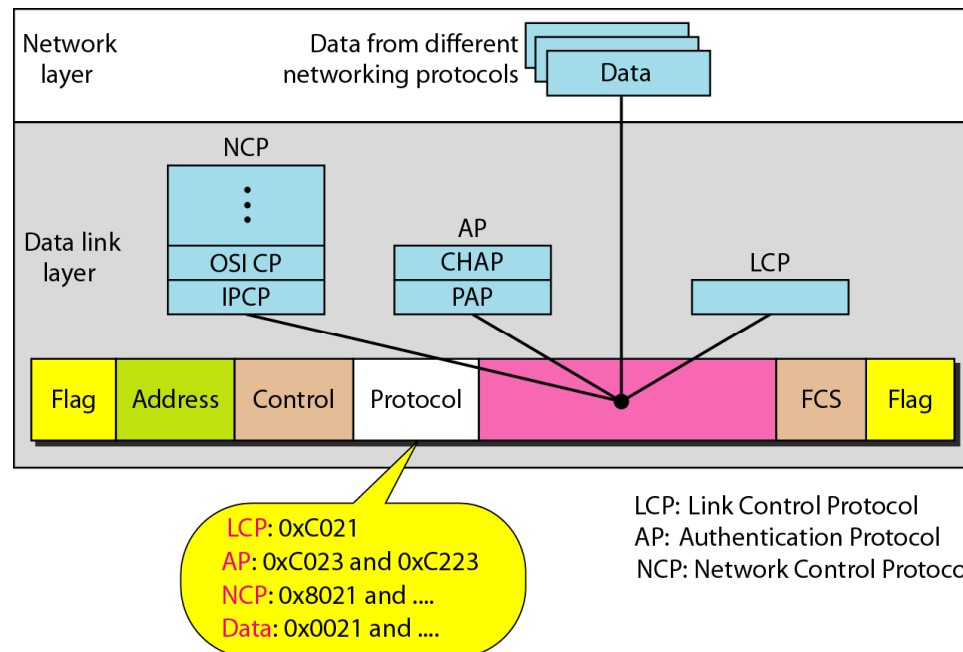


# PPP: Transition States

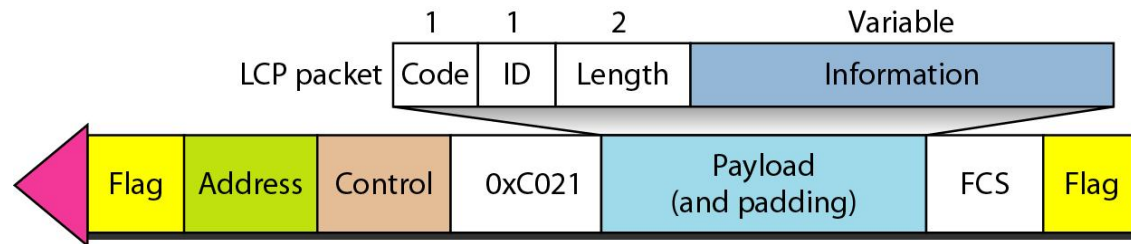


# PPP: Multiplexing

- PPP uses another set of other protocols to establish the link, authenticate the parties, and carry the network layer data
- Three sets of protocols defined for powerful PPP: LCP, two APs, several NCPs



# LCP: Encapsulated in a Frame



<i>Code</i>	<i>Packet Type</i>	<i>Description</i>
0x01	Configure-request	Contains the list of proposed options and their values
0x02	Configure-ack	Accepts all options proposed
0x03	Configure-nak	Announces that some options are not acceptable
0x04	Configure-reject	Announces that some options are not recognized
0x05	Terminate-request	Request to shut down the line
0x06	Terminate-ack	Accept the shutdown request
0x07	Code-reject	Announces an unknown code
0x08	Protocol-reject	Announces an unknown protocol
0x09	Echo-request	A type of hello message to check if the other end is alive
0x0A	Echo-reply	The response to the echo-request message
0x0B	Discard-request	A request to discard the packet

# LCP: Common Options

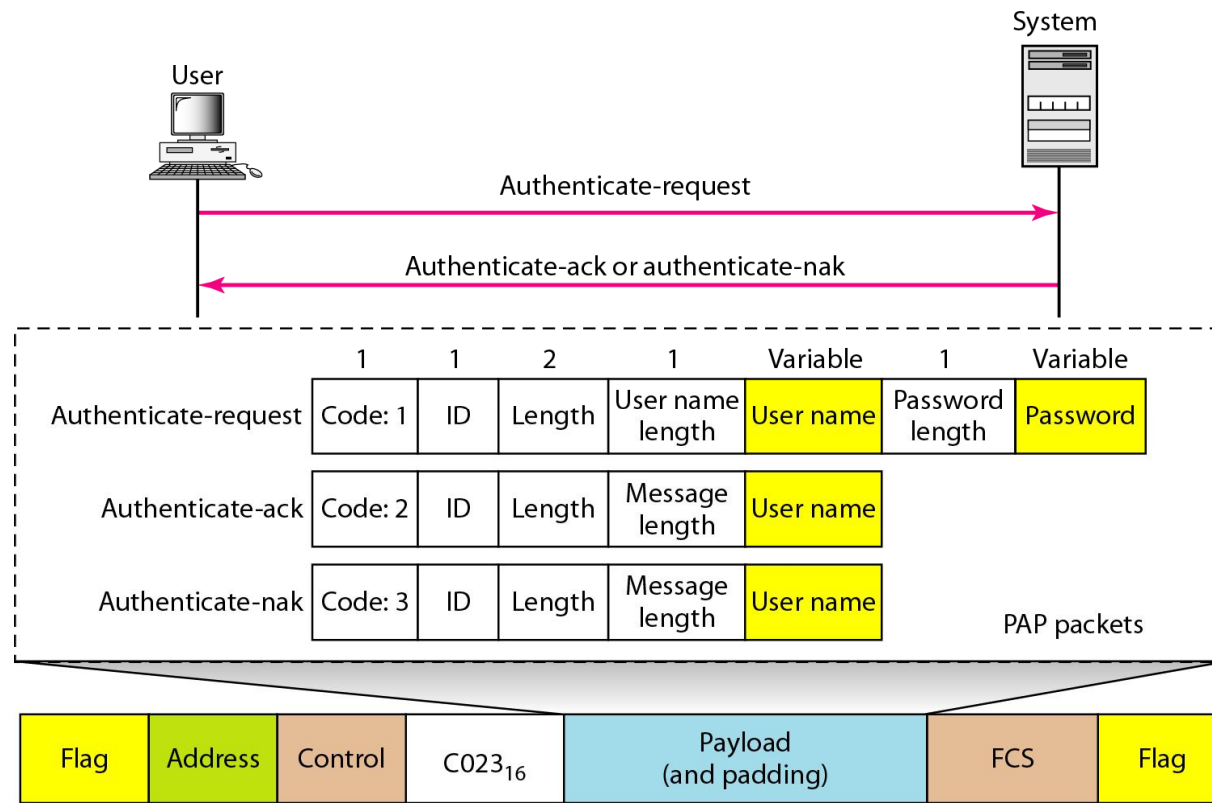
- Options are inserted in the information field of the configuration packets

<i>Option</i>	<i>Default</i>
Maximum receive unit (payload field size)	1500
Authentication protocol	None
Protocol field compression	Off
Address and control field compression	Off

# Authentication

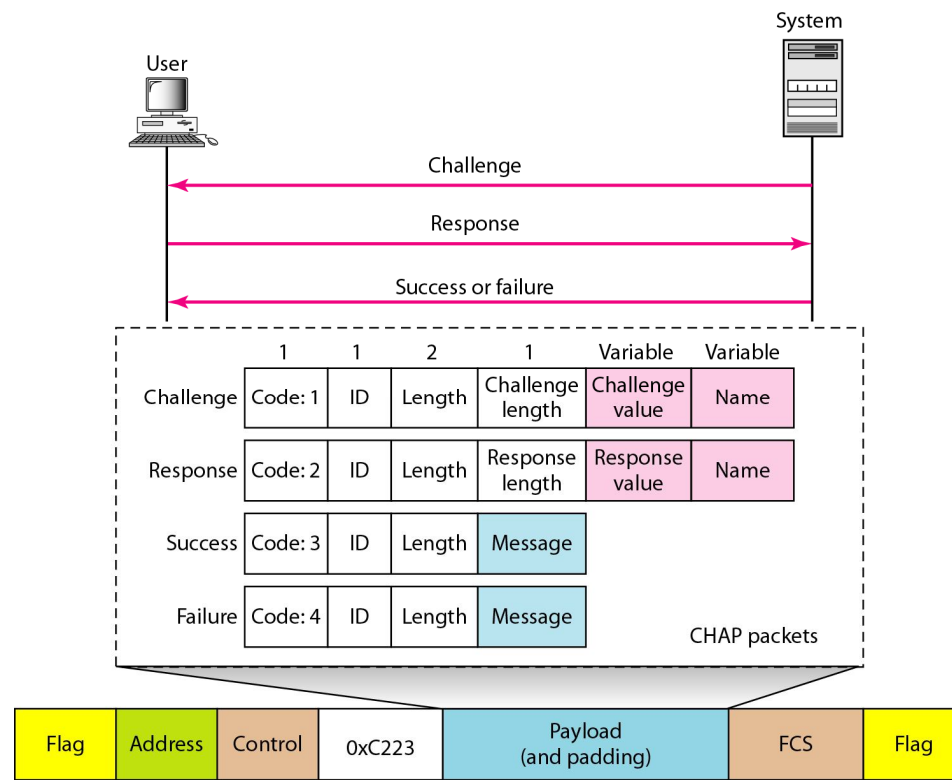
- Authentication means ***validating the identity of a user*** who needs to access
- PPP is designed for use over dial-up links  
⇒ User authentication is necessary
- PPP has two protocols for authentication
  - Password Authentication Protocol (PAP)
  - Challenge Handshake Authentication Protocol (CHAP)

# Password Authentication Protocol (PAP)



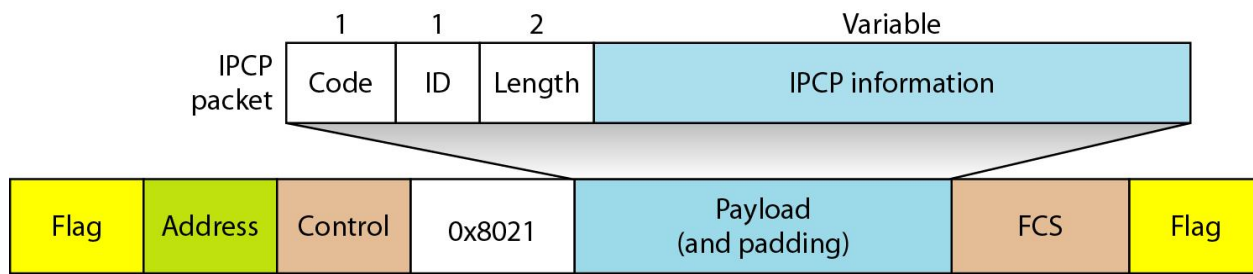
# Challenge Handshake Authentication Protocol (CHAP)

- Three-way hand-shaking authentication protocol with greater security than PAP



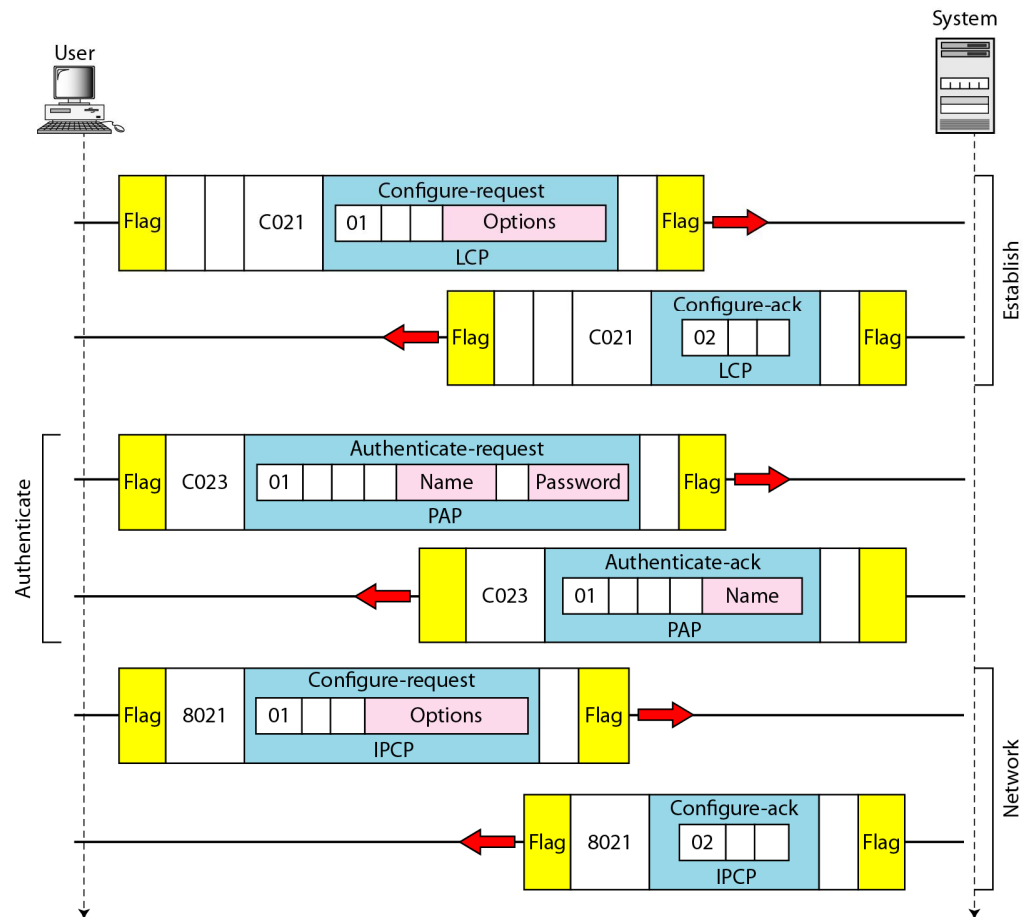
# Network Control Protocol: *NCP*

- PPP is a multiple-network layer protocol.
- It can carry a network data packet from protocols defined by the Internet, OSI, Xerox, DECnet, AppleTalk, Novel
- IPCP (IP Control Protocol)
  - Configures the link used to carry IP packets in the Internet





# Example (1)



# Example (2)

