

18ECC303J – Computer Communication Networks

Course Credit: 4

Theory : 9 Hours

- 1. Behrouz A. Fehrouzan, "Data communication & Networking", Mc-Graw Hill, 5th Edition Reprint, 2014.
- 2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education India, 5th Edition, 2013.
- 3. William Stallings, "Data & Computer Communication", Pearson Education India, 10th Edition, 2014.

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Unit-2: OSI Lower Layers



- OSI Network models
- > Layered Architecture
- Data Link Layer Introduction
- ➤ Link Layer Addressing
- > Error detection and Correction
- ➤ Data Link control LLC
- ➤ Data Link control MAC
- > Flow and Error Control Protocol
- > ARQ Schemes
- > HDLC protocol

Unit 2 –Week 6



Session 16

High level Data Link Control (HDLC) Protocol

HDLC

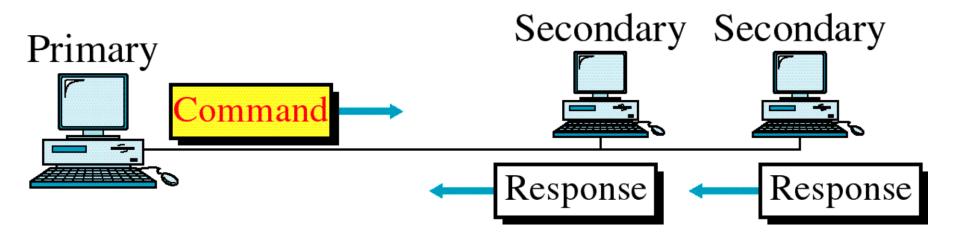


- High-level Data Link Control (HDLC)
- All bit oriented protocols are related to High-level Data Link Control
- It is published by ISO.
- HDLC supports both half duplex and full duplex modes in point to point and multipoint configurations
- is a bit-oriented protocol. It implements ARQ mechanisms

HDLC Configuration



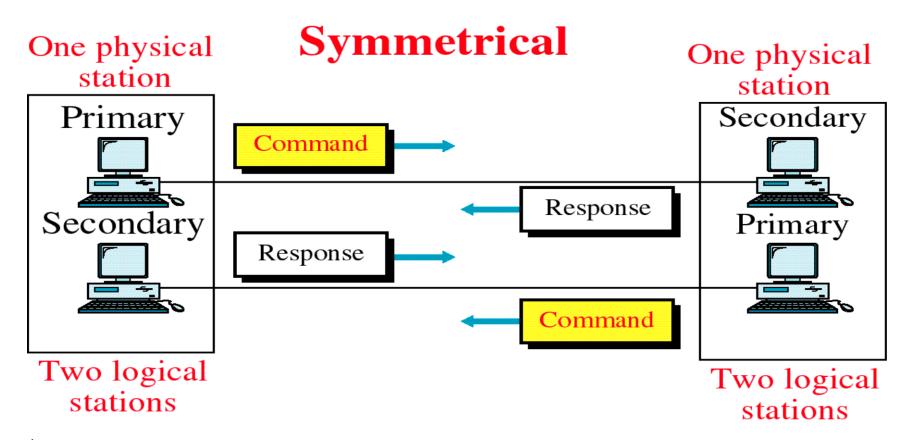
Unbalanced



- ➤ In this one device is primary and other is secondary
- > If it is point to point only two devices are involved
- ➤ If it is multipoint one primary controlling several secondary's.

HDLC Configuration

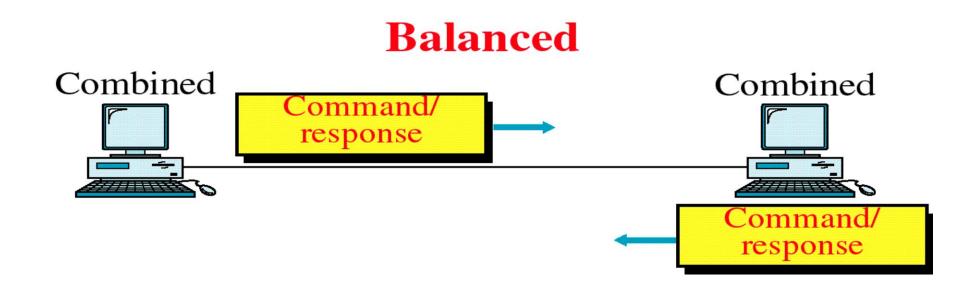




- Each physical station on a link consists of two logical stations
- ➤ One primary and the other a secondary
- ➤ Separate lines link the Primary of one physical station to secondary aspect of another physical station.

HDLC Configuration





- In balanced types both the point to point topology are of combined type.
- > Stations are link by a single line
- That is controlled by either station

HDLC MODES



 HDLC supports three modes of communication between station

- > Normal Response Mode (NRM)
- > Asynchronous Response Mode (ARM)
- > Asynchronous Balanced Mode (ABM)

HDLC MODES



Normal Response Mode (NRM)

- Refers to standard Primary Secondary relationship
- In this mode, secondary device must have permission from the primary device before transmitting
- Once permission has been granted, the secondary may initiate a response transmission of one or more frames containing data.

Asynchronous Response Mode (ARM)

- Refers to standard Primary Secondary relationship
- In this mode, secondary device may initiate transmission without permission from the primary whenever the channel is idle.
- All transmissions from a secondary must be made to the primary for relay to a final destination

Asynchronous Balanced Mode (ABM)

- In this mode, all stations are equal
- Only combined stations connected in point to point are used.
- Either combined station may initiate transmission with the other combined station without permission.



HDLC defines three types of frames:

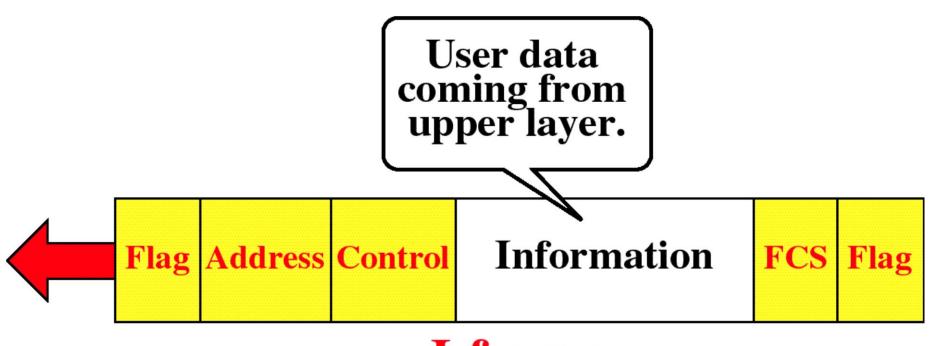
Information frames (I-frames)

Supervisory frames (S-frames)

Unnumbered frames (U-frames)

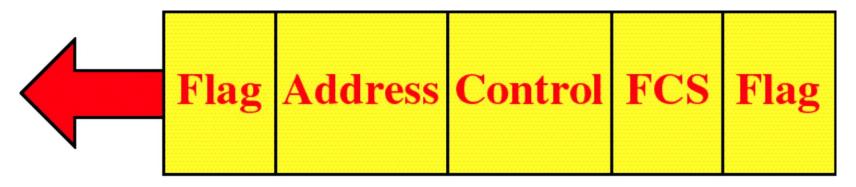
- Each type of frame works as an envelope for the transmission of a different types of message
- ➤ I-frames are used to transport user data and control information relating to user data
- > S-frames are used only to transport control information.
- > U-frames are reserved for system management.
- ➤ Information carried by U-frames is intended for managing the link itself.





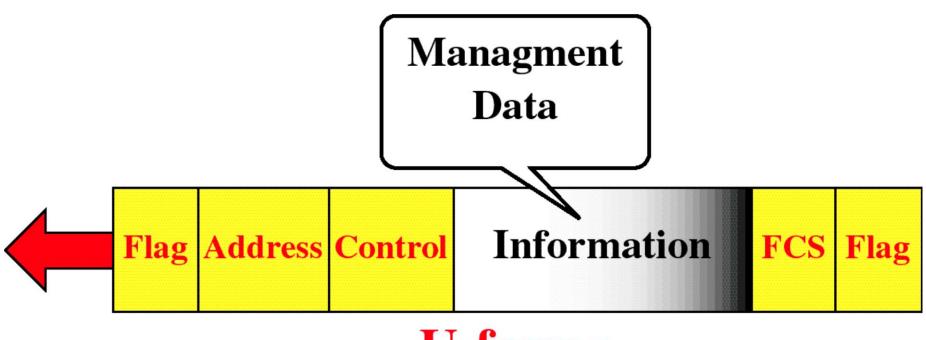
I-frame





S-frame





U-frame

HDLC Frame Fields

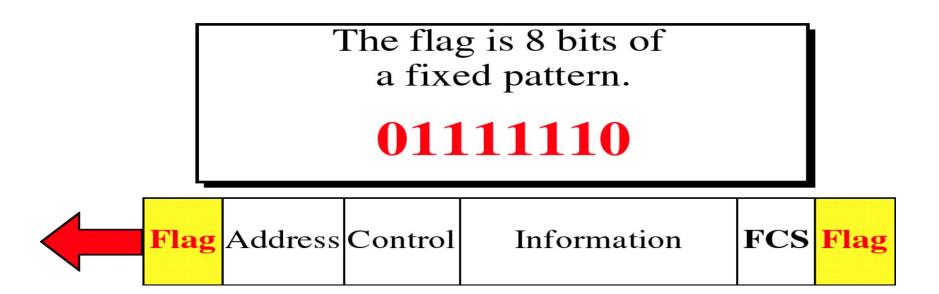


Each frame in HDLC contains the following six fields

- Beginning flag field
- > Address field
- > Control field
- > Information field
- > Frame check sequence (FCS) field
- > Ending Flag field

HDLC Flag Field





Flag

- ➤ It is an 8-bit sequence with the bit pattern 01111110 that identifies the beginning and end of a frame.
- > It serves as a synchronization pattern for the receiver.

Bit Stuffing and removal



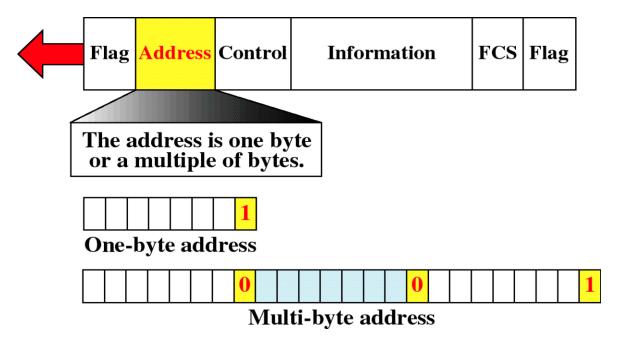
- > HDLC uses a process called bit stuffing
- > Sender wants to transmit a bit sequence having more than five consecutive 1s. It inserts one redundant 0 after the fifth 1

For example 0111111111000 becomes 01111110111000

- ➤ It indicates the receiver that the current sequence is not a flag, its data
- ➤ Once the receiver has seen the stuffed 0, it is dropped from the data and the original bit stream is restored.
- ➤ Bit stuffing is the process of adding one extra 0 whenever there are five consecutive 1s in the data
- > So that receiver does not mistake the data for a flag.

HDLC Address Field

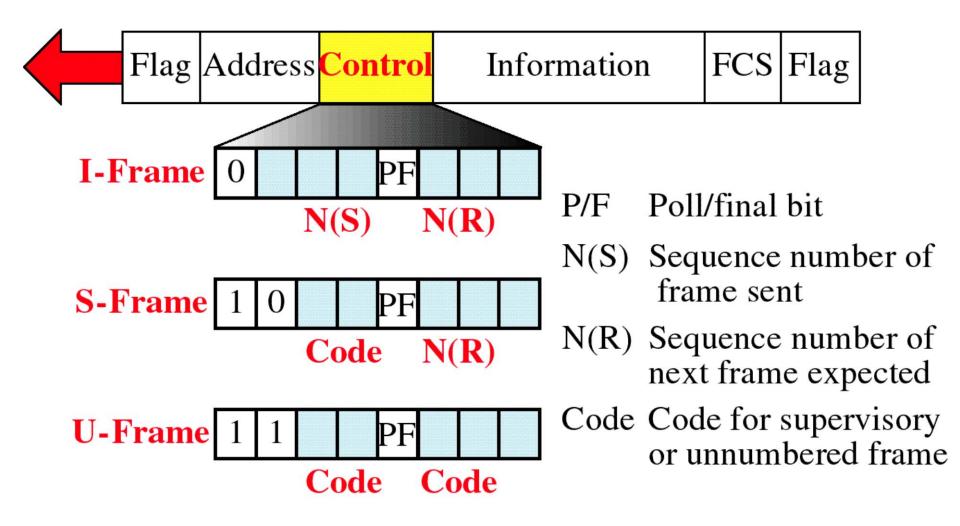




- ➤ It contains address of the secondary station.
- ➤ If a primary station created the frame, it contains a *to* address.
- ➤ If a secondary creates the frame, it contains a *from* address.
- An address field can be 1 byte or several bytes, depending on the network.
- ➤ If the address is only one byte, the last bit is always 1.
- ➤ If the address is more than one byte, all bytes but last one will end with 0; and only the last will end with 1.

HDLC Control Field





HDLC Control Field



- Control field is a one or two byte segment of the frame
- It is used for flow management
- It differ depending on frame type
- If the first bit is 0 the frame is an I Frame
- If the first bit is 1 and second bit is 0 the frame is an S- Frame
- If the both first and second bits are 1s the frame is a U frame.
- All three types of frames contain a bit called the Poll/Final (P/F) bit

Control Field of I-frame



- An I frame contains two 3 bit flow [N(S)] and error control sequence [N(R)], either side of P/F bit
- \triangleright N(S) Number of frame being sent
- \triangleright N(R) Number of frame expected in return in a two way exchange
- \triangleright N(R) is the acknowledgement field
- \triangleright If the last frame is was error free N(R) number will be that of the next frame in the sequence
- ➤ If the last frame was not received correctly
- > N(R) number will be number of the damaged frame indicating the need for its retransmission

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Control Field of S-Frame

- Control field of S Frame contains an N(R) field but not N(S) field
- S- Frames are used to return N(R) when the receiver does not have data of its own to send
- ACK is contained in the control field of an I Frame
- S- Frame do not transmit data and so do not require N(S) field
- Two bits proceeding the P/F bit are sued to carry coded flow and error control information

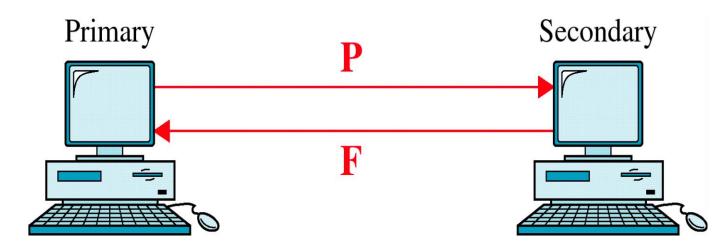
Control Field of U-Frame

- U Frames have neither N(S) or N(R)
- It is not designed for user data exchange of ACL
- It have two code field one two bits and other three bits either side of P/F bit
- These codes are used to identify the type of U frame and its functions

Poll / Final

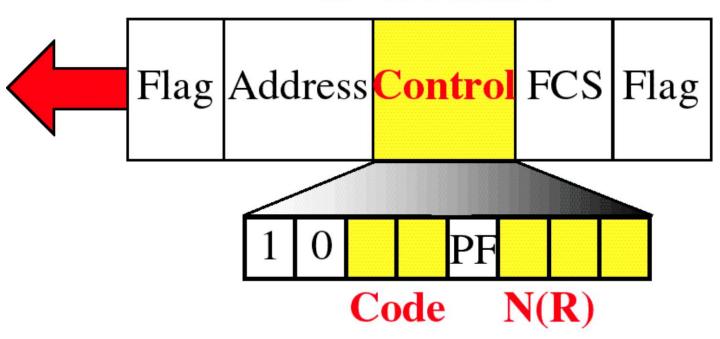


- P/F field is a single bit with a dual purpose
- When it is set (bit = 1) mean Poll or Final
- Poll → means when the frame is sent by a primary station to secondary
- The address field contains the address of the receiver
- Final \rightarrow means when the frame is send by a secondary to a primary
- When the address field contains the address of the sender



S-Frame





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

Types of S-Frames



Receive ready (RR): If the value of code is 00, it is an RR S-frame. This kind of frame acknowledges the receipt of a safe frame or group of frames.

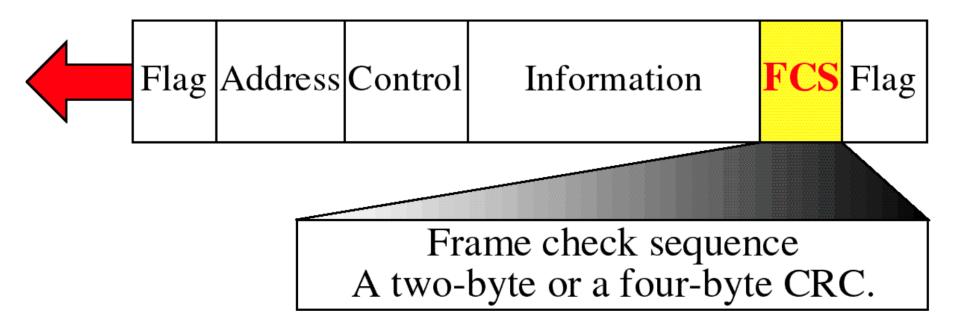
Receive not ready (RNR): If the value of code is 10, it is an RNR S-frame. It acknowledges the receipt of a frame(s), and announces that the receiver is busy and cannot receive more frames. It acts as a congestion control mechanism.

Reject (**REJ**): If the value of the code subfield is 01, it is a REJ S-frame. This is a NAK frame used in *Go-Back-N* ARQ to inform the sender, before the sender time expires, that the last frame is lost or damaged.

Selective reject (**SREJ**): If the value of the code subfield is 11, it is an SREJ S-frame. This is a NAK frame used in Selective Repeat ARQ.

HDLC FCS Field

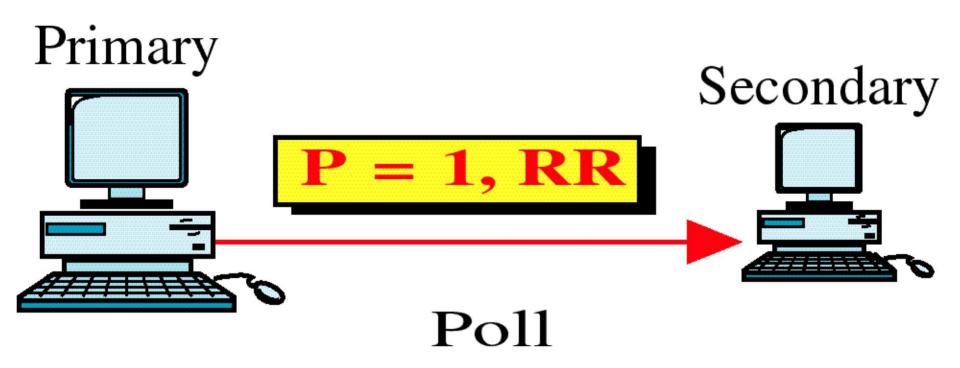




➤ It is HDLC's Error detection field

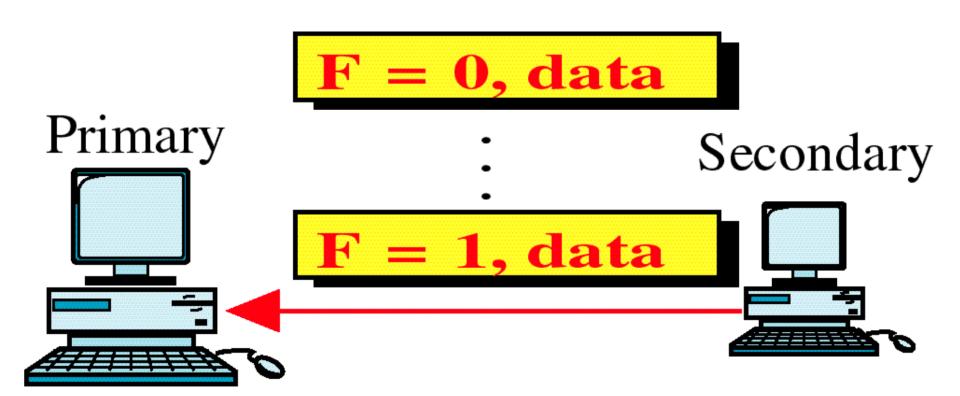


Use of P/F Field









Positive response to poll



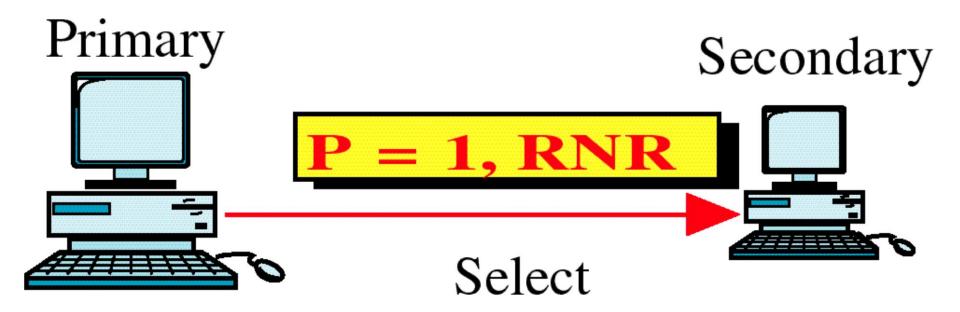




Negative response to poll



Use of P/F Field



Use of P/F Field





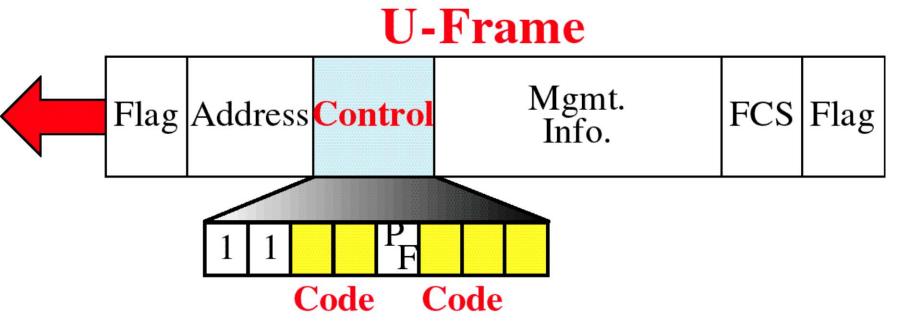
Positive response to select



Negative response to select



U-Frame Control Field



- Unnumbered frames are used to exchange session management and control information between connected devices.
- ➤ U-frame codes are divided into two sections: a 2-bit and 3-bit before and after the P/F bit, i.e 32 different types of U-frames.

U-frame Control Field



Control field for U-frame

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