UNIT 8

8-1. Define *data-link protocol.*

Anwer:- A *data-link protocol* is a set of rules implementing and governing an orderly exchange of data between layer two devices, such as line control units and front-end process ors. Protocols outline precise character sequences that ensure an orderly exchange of data between two layer two devices, such as line control units and front-end processors.

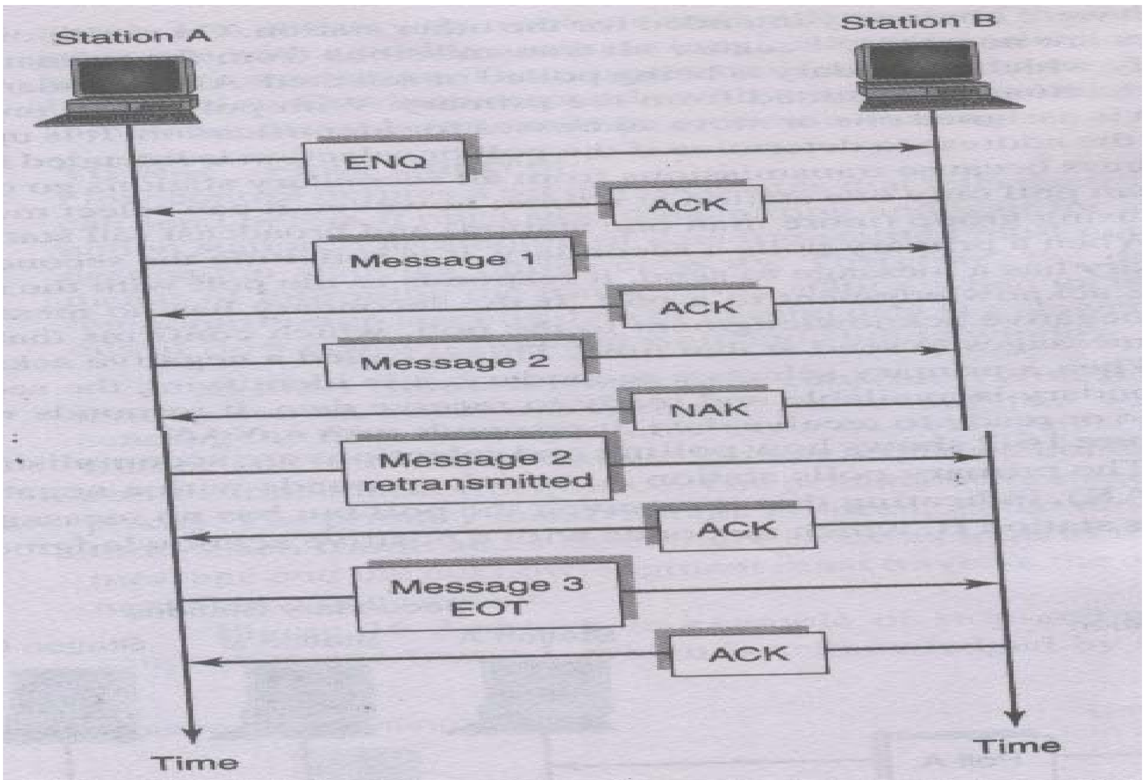
8-2. List and describe the three data-link protocol functions.

Answer:- Data-link protocol *functions* include line discipline, flow control, and error control. *Line discipline* coordinates hop-to-hop data delivery where a hop is a computer, a network controller, or some type of network-connecting device, such as a router. *Line discipline* determines which device is transmitting and which is receiving at any point in time. *Flow control* coordinates the rate at which data is transported over a link and generally provides an acknowledgment mechanism that ensures that data is received at the destination. *Error control* specifies a means of detecting and correcting transmission errors.

8-3. Briefly describe the *ENQ/ACK line discipline.*

Answer:- line discipline is coordinating half-duplex transmission on a data communications network. There are two fundamental ways that line discipline is accomplished in data communications network: *enquiry/acknowledgment* (ENQ/ACK) and *poll/select.*

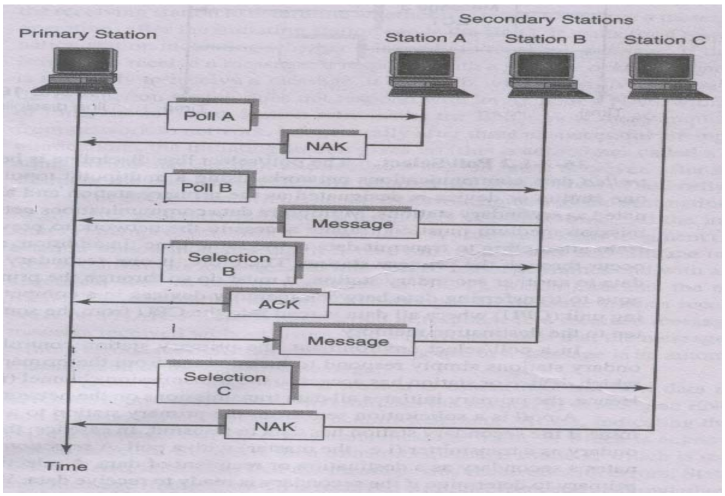
ENQ/ACK:- Figure shows how a session is established and how data is transferred using ENQ/ACK procedures.



Station A initiates the session by sending an ENQ to station B. Stat ion B responds with a positive acknowledgment (ACK), indicating that it is ready to receive a message. Station A transmits message frame I, which is acknowledged by station I B with an ACK. Station A then transmits message frame 2, which is rejected by station B with a NAK, indicating that the message was received with errors. Station A then retransmits message frame 2, which is received without errors and acknowledged by station B with an ACK.

8-4. Briefly describe the *poll/select line discipline.*

Answer:- Figure shows how polling and selections are accomplished using poll/select procedures.

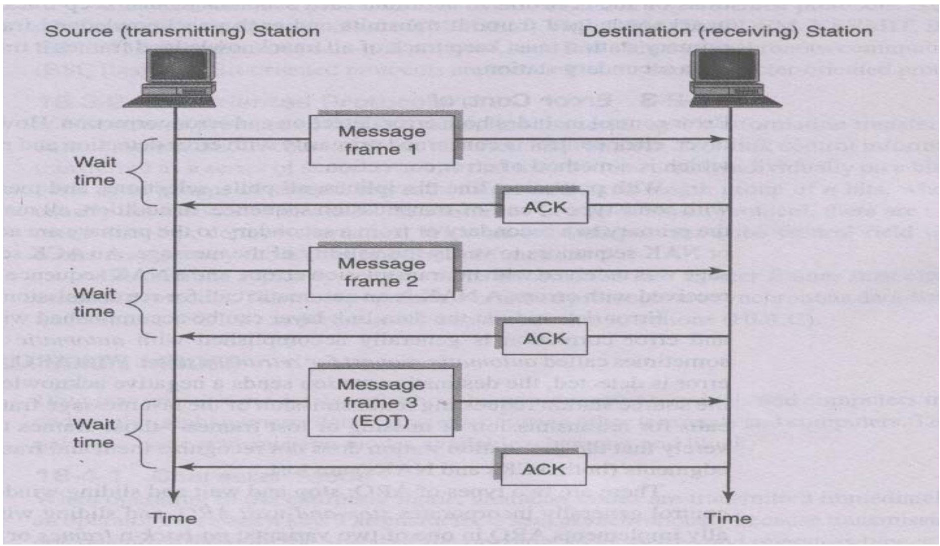


The primary polls station A, which responds with a negative acknowledgment to a poll (NAK), indicating that it received the poll but has no message to send. Then the primary polls station B, which responds with a positive acknowledgment to a poll (i.e., a message). The primary then selects station B to see if it ready to receive a message. Station B responds with a positive acknowledgment to the selection (ACK), indicating that it is ready to receive a message. The primary transmits the message to station B. The primary then selects station C, which responds with a negative acknowledgment to the selection (NAK), indicating that it is not ready to receive a message.

8-5. Briefly describe the *stop and-wait method* of flow control.

Answer:- Flow control defines a set of procedures that tells the transmitting station how much data it can send before it must stop transmitting and wait for an acknowledgment from the destination station. The amount of data transmitted must not exceed the storage capacity of the destination station's buffer capacity. Therefore, the destination station must have some means of informing the transmitting station when its buffers are nearly at capacity and to temporarily stop sending data or to send data at a slower rate. There are two common methods of flow control: stop and wait and sliding window.

Stop-and-wait flow control:- Figure shows an example of stop-and-wait flow control.



The source station sends message frame 1, which is acknowledged by the destination station. After stopping transmission and waiting for the acknowledgment, the source station transmits the next frame (message frame 2). After sending the second frame, there is another lapse in time while the destination station acknowledges reception of frame 2. The time it takes the source station to transport three frames equates to at least three times as long as it would have taken to send the message in one long frame.

8-6. Briefly describe the *sliding window method* of flow control.

Answer:- With *sliding window* flow control, a source station can transmit several frames in succession before receiving an acknowledgment. There is only one acknowledgment for several transmitted frames, thus reducing the - transmission time considerably over the stop-and-wait technique.

The term *sliding window* refers to imaginary boxes at the source and destination stations with the capacity of holding several frames of data. Message frames can be acknowledged any time before the window is filled with data. To keep track of which frames have been acknowledged and which have not, sliding window procedures require a modulo-n, numbering scheme where each transmitted frame is identified with a unique sequence number between 0 and *n* -1. With a three-bit binary numbering scheme, there are eight numbers possible (0, 1, 2, 3,4, *5,* 6, and 7), and, therefore, the windows must have the *ca*pacity of holding *n-1* (seven) frames of data.

8-7. Briefly describe how the *XMODEM protocol* works.

Answer:- XMODEM specifies a half-duplex stop-and-wait protocol using a data frame comprised of four fields. The frame format for XMODEM contains four fields, as shown in Figure.

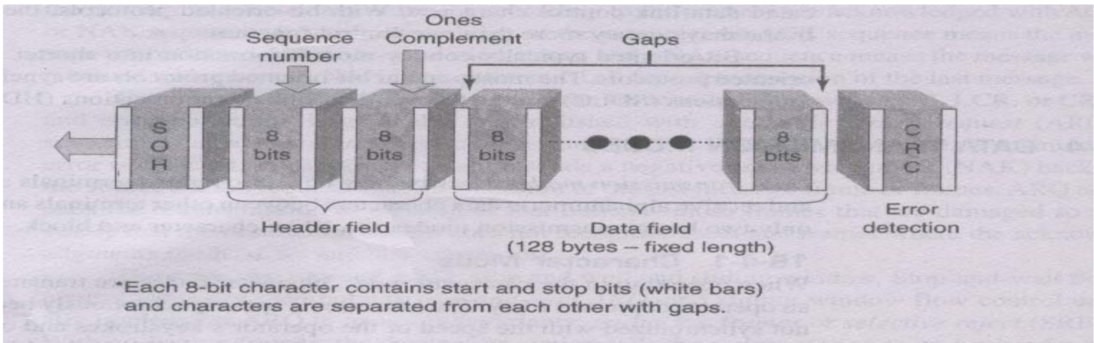


FIGURE 16-4 XMODEM frame format

The four fields for XMODEM are the SOH field, header field, data field, and error- detection field. The first field of an XMODEM frame is simply a one-byte start-of-heading (SOH) field. SOH is a data-link control character indicating the beginning of the header. SOH simply indicates that the next byte is the first byte of the header. The second field is a two- byte sequence that is the actual header for the frame. The first header byte is called the *sequence number,* as it contains the number of the current frame being transmitted. The second header byte is simply the 2-s complement of the first byte, which is used to verify the validity of the first header byte (this is sometimes called *complementary redundancy).* The next field is the information field, which contains the actual user data. The information field has a maximum capacity of 128 bytes (e.g., 128 ASCII characters). The last field of the frame is an eight-bit frame check sequence (CRC-8) that is used for error detection.

YMODEM:-
YMODEM is a protocol similar to XMODEM except with the following exceptions:

1. The information field has a maximum capacity of 1024 bytes.
2. Two CAN characters are required to abort a transmission.
3. ITU-T-CRC 16 is used to calculate the frame check sequence.
4. Multiple frames can be sent in succession and then acknowledged with a single ACK or NAK character.

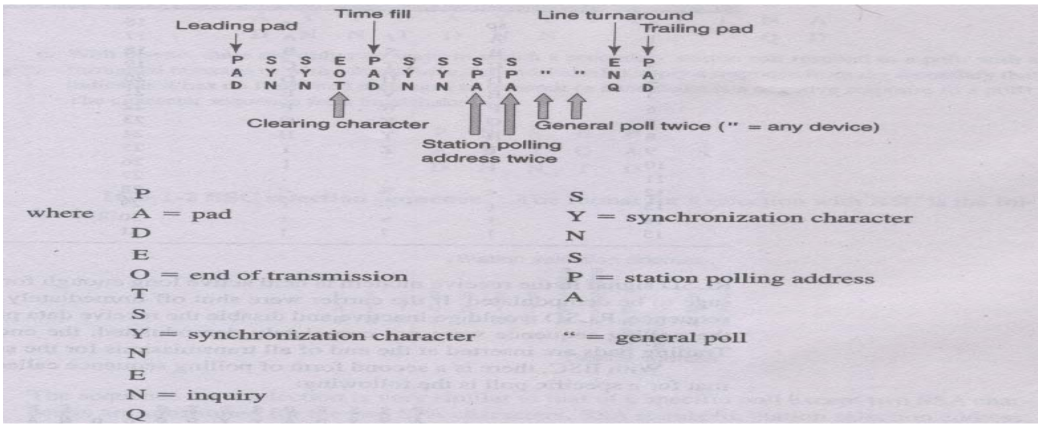
ZMODEM:-
ZMODEM is a newer protocol that simply combines the features of XMODEM and YMODEM.

8-8. Briefly describe the *polling sequence* for *BSC,* including the difference between a general and specific poll.

Answer:- BSC polling sequences.

There are two polling formats used with bisync: General and Specific.

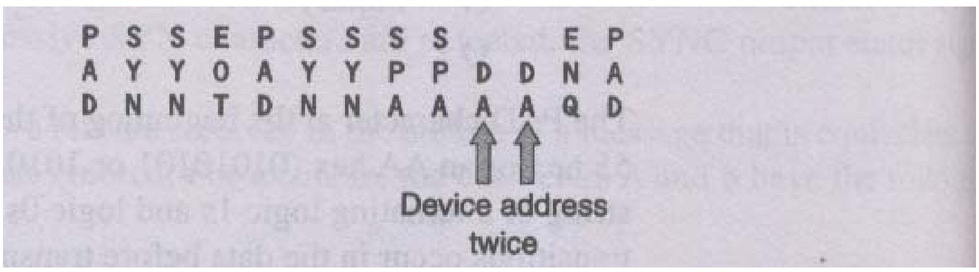
The format for a general poll is the following:



The PAD character at the beginning of the sequence is called *a leading pad* and is either a *55* hex or an AA hex (01010101 or 10101010). The purpose of the leading pad is to ensure that transitions occur in the data before transmission of the actual message. The transitions are needed for clock recovery in the receive modem to maintain bit synchronization. Immediately following the leading pad are two SYN characters that establish character synchronization. The EOT character is again used as a clearing character that places all secondary stations into the line-monitoring mode. The PAD character immediately following the second SYN character is simply a string of successive logic is that serves as a time fill, giving each of the secondary stations time to clear. The number of logic is transmitted during this time fill may not be a multiple of eight bits. Consequently, the two SYN characters are repeated to reestablish character synchronization. Two station polling address (SPA) characters are transmitted for error detection (character redundancy). A secondary will not recognize or respond to a poll unless its SPA appears twice in succession. The two quotation marks signify that the poll is a general poll for any device at that station that has a formatted message to send. If two or more devices have messages to transmit when a general poll is received, the station controller determines which device's message is transmitted. This allows the controller to prioritize the devices at the station. The enquiry (ENQ) character is sometimes called a *format* or *line turnaround* character because it simply completes the polling sequence and initiates a line turnaround (i.e., the secondary station identified by the SPA is designated the master and must respond to the poll).

The PAD character at the end of the polling sequence is called a *trailing pad* and is simply a 7F (DEL, or delete character). The purpose of the trailing pad is to ensure that the RLSD signal in the receive modem is held active long enough for the entire received message to be demodulated. If the carrier were shut off immediately at the end of the polling sequence, RLSD would go inactive and disable the receive data pin. If the last character the polling sequence were not completely demodulated, the end of it would be cut off. Trailing pads are inserted at the end of all transmissions for the same purpose.

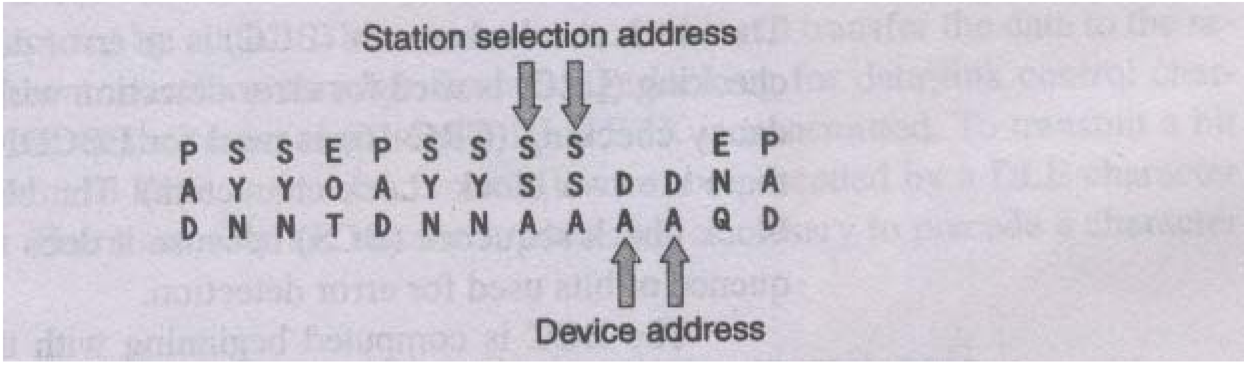
With BSC, there is a second form of polling sequence called a *specific poll.* The mat for a specific po11 is the following:



The character sequence for a specific poll is similar to a general poll except that two device address (DA) characters are substituted for the two quotation marks. With a specific both the station and the device address are included. Therefore, a specific poll is an invitation for only one specific device at a given secondary station to transmit its message. Again two DA characters are transmitted for redundancy error detection.

8-9. Briefly describe the *selection sequence* for BSC.

Answer:- The format for a selection with BSC is the following:



The sequence for a selection is very similar to that of a specific poll except two SSA characters are substituted for the two SPA characters. SSA stands for station selection address. All selections are specific; they are for a specific device at a specific station.

8-10. What is the difference between a *command* and a *response* with SDLC?

There are two types of stations defined by SDLC: *primary stations* and *secondary stations.* There is only one primary station in an SDLC circuit that controls data exchange on the communications channel and issues *commands.* All the other stations on an SDLC circuit are secondary stations, which receive commands and return (transmit) *responses* to the primary station.

8-11. What are the three *transmission states* used with SDLC?

Answer:- There are three transmission states with SDLC: transient, idle, and active. The *transient state* exists before and after an initial transmission and after each line turnaround. A secondary station assumes that the circuit is in an idle state after 15 or more consecutive logic l s have been received. The *active state* exists whenever either the primary or one of the secondary stations is transmitting information or control signals.

8-12. What are the five fields used with SDLC?

Answer:- SDLC Frame Format
Figure 16-6 shows the frame format used with SDLC. Frames transmitted from the primary and secondary stations use exactly the same format. There are five *fields* included in an SDLC frame:

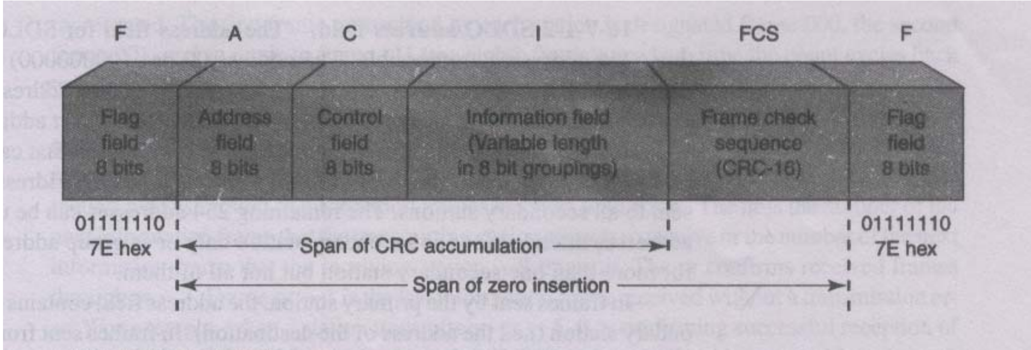


FIGURE 16-6 SDLC frame format

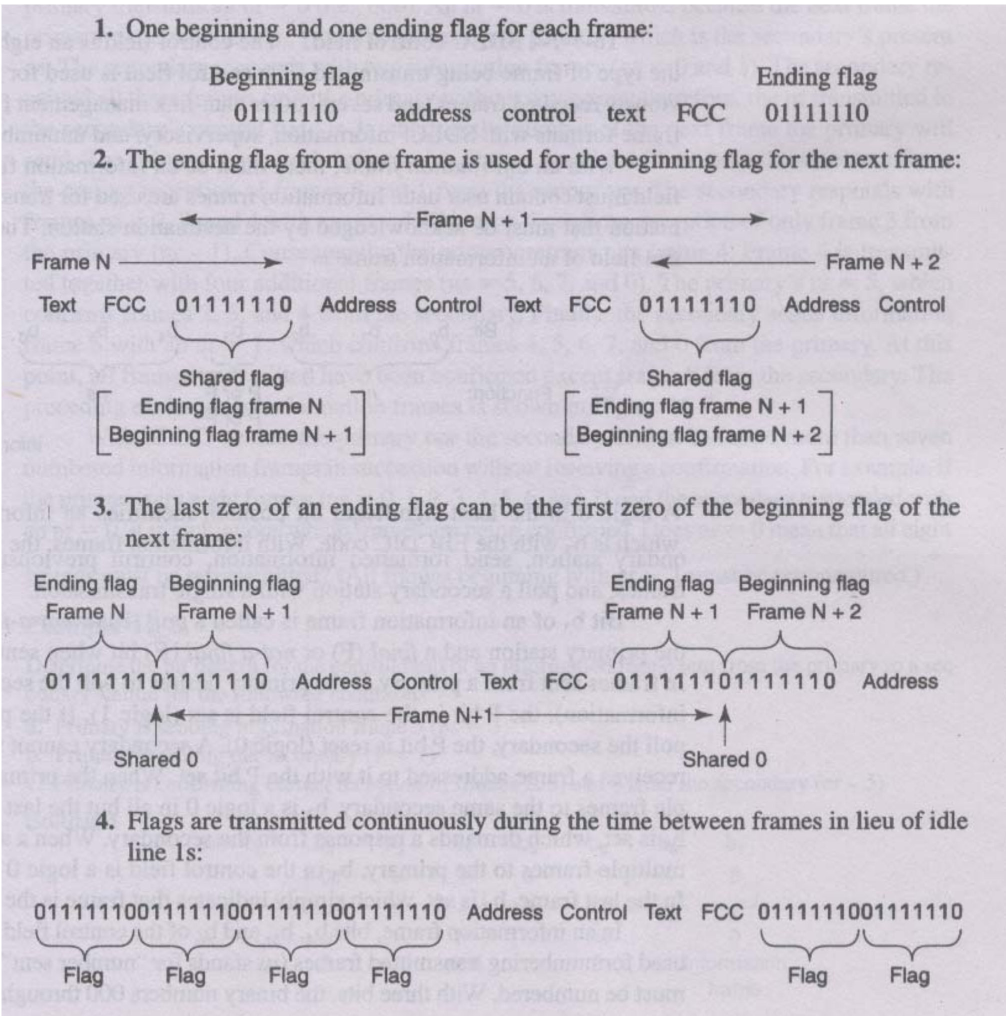
1. Flag field
2. Address field
3. Control field
4. Information (or text) field
5. Frame check character (FCC) field

8-13. What is the *delimiting sequence* used with SDLC?

Answer:-

SDLC flag field:- There are two *flag fields* per frame, each with a minimum length of one byte. The two flag fields are the *beginning flag* and the *ending flag.* Flags are used for the *delimiting sequence* for the frame and to achieve *frame and charac*ter *synchronization.* The delimiting sequence sets the limits of the frame (i.e., when the frame begins and when it ends). The flag is used with SDLC in a manner similar to the way SYN characters are used with bisync—to achieve character synchronization. The bit sequence for a flag is 01111110 (7E hex), which is the character "=" in the EBCDIC code.

There are several variations to how flags are used with SDLC:



8-14.Write short notes on SDLC address field and information field.

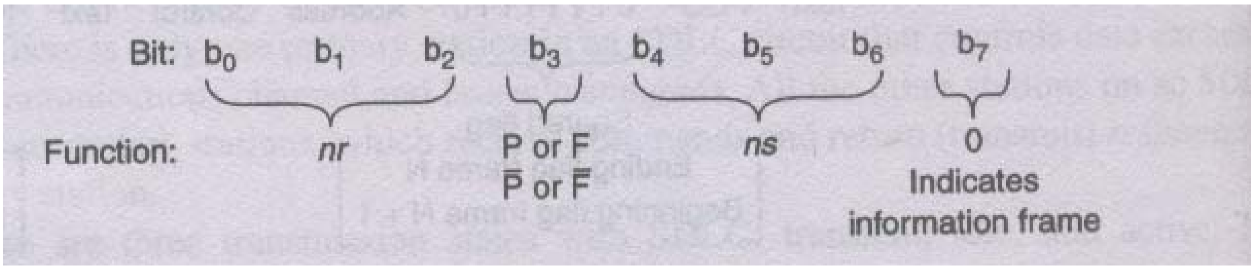
Answer:-SDLC address field:-The address field for SDLC contains eight b. thus, 256 addresses are possible. The address 00 hex (00000000) is called the *null ad*dress and is never-assigned to a secondary station. The null address is used for network testing. The address FF hex (11111111) is called the *broadcast* address and is common to all secondary stations. The primary station is the only station that can transmit the broad cast address. When a frame is transmitted with the broadcast address, it is simultaneous, sent to all secondary stations. The remaining 254 addresses can be used as unique static addresses intended for one secondary station only or as group addresses that are intended for more than one secondary station but not all of them.

In frames sent by the primary station, the address field contains the address of the secondary station (i.e., the address of the destination). In frames sent from a secondary s the address field contains the address of the secondary (i.e., the address of the station sing the message). The primary station has no address because all transmissions from secondary stations go to the primary station. SDLC Information field:- All information transmitted in an SDLC frame must be in the information field (I field), and the number of bits in the information field must be a multiple of eight. An information field is not allowed with all SDLC frames; however, the data within an information field can be user information or control information.

8-15. What is the information frame format used with SDLC? What are the purposes of the ns and *nr* bit sequences?

Answer:- SDLC control field:- The control field is an eight-bit field that identifies the type of frame being transmitted. The control field is used for polling, confirming previously received frames, and several other data-link management functions. There are three frame formats with SDLC: information, supervisory, and unnumbered.

With an *information frame,* there must be an information field, and the information field must contain user data. Information frames are used for transmitting sequenced information that must be acknowledged by the destination station. The bit pattern for the control field of an information frame is



A logic 0 in the least-significant bit position identifies an information frame (I which is b7 with the EBCDIC code. With information frames, the primary can select a secondary station, send formatted information, confirm previously received information frames, and poll a secondary station with a single transmission. b3 of an information frame is called a poll (P) or *not-a-poll* (P¯) bit when sent by the primary station and a *final* (F) or *not-a final* (F¯) bit when sent by a secondary station. In frames sent from a primary, if the primary desires to poll the secondary (i.e., solicit it for information), the P bit in the control field is set (logic 1). If the primary does not wish to poll the secondary, the P bit is reset (logic 0).

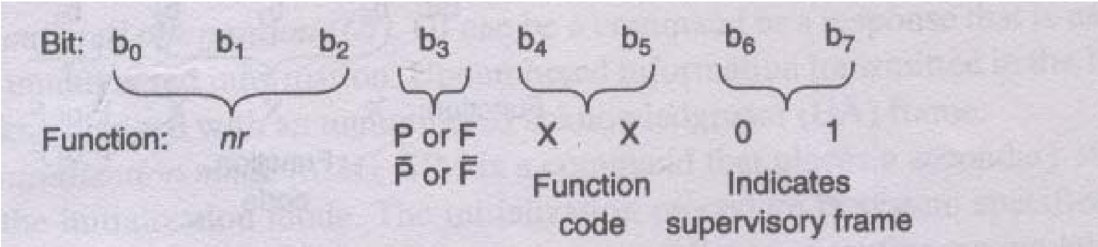
A secondary cannot transmit frames unless it receives a frame addressed to it with the P bit set. When the primary is transmitting multiple frames to the same secondary, b3 is logic 0 in all but the last frame. In the last frame, b3 is set, which demands a response from the secondary. When a secondary is transmitting multiple frames to the primary, b3 in the control field is logic 0 in all but the last frame. In the last frame, b3 is set, which simply indicates that frame is the last one in the sequence.

In an information frame, bits b4, b5, and b6 of the control field are the ns bits, which are used for numbering transmitted frames *(ns* stands for "number sent"). All information frames must be numbered. With three bits, the binary numbers 000 through 111(0 through 7) can be represented. The first frame transmitted by each station is designated frame 000. The second frame 001, and soon up to frame 111 (the eighth frame), at which time the count cycles back to 000 and repeats.

In an information frame, bits b0, b1, and b2 in the control field are the nr bits, which are used to indicate the status of previously received information frames *(nr* stands for "number received"). The nr bits are used to confirm frames received without errors and to automatically request retransmission of information frames received with errors. The nr is the number of the next information frame that the transmitting station expects to receive or the number of the next information frame that the receiving station will transmit. The nr confirms received frames through nr-1. Frame nr-1 is the last information frame received without a transmission error.

8-16. What is the supervisory frame format used with SDLC?

Answer:- With *supervisory frames,* an information field is not allowed. Consequently, supervisory frames cannot be used to transfer numbered information; however, they can be used to assist in the transfer of information. Supervisory frames can be used to confirm previously received information frames, convey ready or busy conditions, and for a primary to poll a secondary station when the primary does not have any numbered information to send to the secondary. The bit pattern for the control field of a supervisory frame is



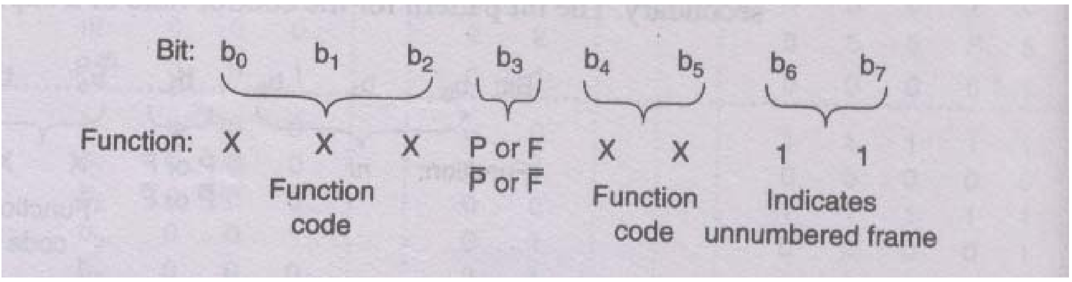
A supervisory frame is identified with a 01 in bit positions b6 and b7respectively, of the control field. With the supervisory format, bit b3 is again the poll/not-a-poll or final/not-a-final bit, and b0, b1, and b2 are the nr bits. Therefore, supervisory frames can be used by a primary to poll a secondary, and both the primary and the secondary stations can use supervisory frames to confirm previously received information frames. Bits b4 and b5 in a supervisory are used either to indicate the receive status of the station transmitting the frame or to request transmission or retransmission of sequenced information frames. With two bits, there are four combinations possible. The four combinations and their functions are the following:

b_4	b_5	Receive Status
0	0	Ready to receive (RR)
0	1	Ready not to receive (RNR)
1	0	Reject (REJ)
1	1	Not used with SDLC

When a primary station sends a supervisory frame with the P bit set and a status of ready to receive, it is equivalent to a general poll. Primary stations can use supervisory frames for polling and also to confirm previously received information frames without sending any information. A secondary uses the supervisory format for confirming previously received information frames and for reporting its receive status to the primary. If a secondary sends a supervisory frame with RNR status, the primary cannot send it numbered information frames until that status is cleared. RNR is cleared when a secondary sends an information frame with the F bit = 1 or a supervisory frame indicating RR or REJ with the F bit = 0. The REJ command/response is used to confirm information frames through nr -1 and to request transmission of numbered information frames beg inning with the frame number identified in the REJ frame. An information field is prohibited with a supervisory frame, and the REJ command/response is used only with full duplex operation.

8-17. What is the unnumbered frame format used with SDLC?

Answer:- An *unnumbered frame* is identified by making bits b6 and b7 in the control field both logic 1s. The bit pattern for the control field of an unnumbered frame is



With an unnumbered *frame,* bit b3 is again either the poll/not-a-poll or final/not-a-final bit. There are five X bits (b0, b1, b2, b4, and b5) included in the control field of an unnumbered frame and are used for various unnumbered commands and responses. With five bits available, there are 32 unnumbered commands/responses possible. The control field in unnumbered frame sent from a primary station is called a *command,* and the control field in an unnumbered frame sent from a secondary station is called a *response.* With unnumbered frames, there are neither ns nor nr bits included in the control field. Therefore, numbered formation frames cannot be sent or confirmed with the unnumbered format. Unnumbered frames are used to send network control and status information.

8-18. Explain SDLC loop configuration. What is the *go-ahead sequence?* The *turnaround sequence?*

Answer:- SDLC loop configuration is summarized here:

1. Primary transmits sequential frames to one or more secondary stations.

2. Each transmitted frame contains a secondary station's address.

3. After a primary has completed transmitting, it follows the last flag of the frame with eight consecutive logic zeros (turnaround sequence) followed by continuous logic ones (go-ahead sequence -0111111111 ————).

4. The turnaround sequence alerts secondary stations of the end of the transmissions.

5. Each secondary, in turn, decodes the address field of each frame and removes frames addressed to them.

6. Secondary stations serve as repeaters for any down-line secondary stations.

7. Secondary stations cannot transmit frames of their own unless they receive a frame with the P bit set.

8. The *first* secondary station that receives a frame addressed to it with the P bit set changes the seventh logic one in the go-ahead sequence to a logic zero, thus creating a flag. The flag becomes the beginning flag for the secondary station's response frames.

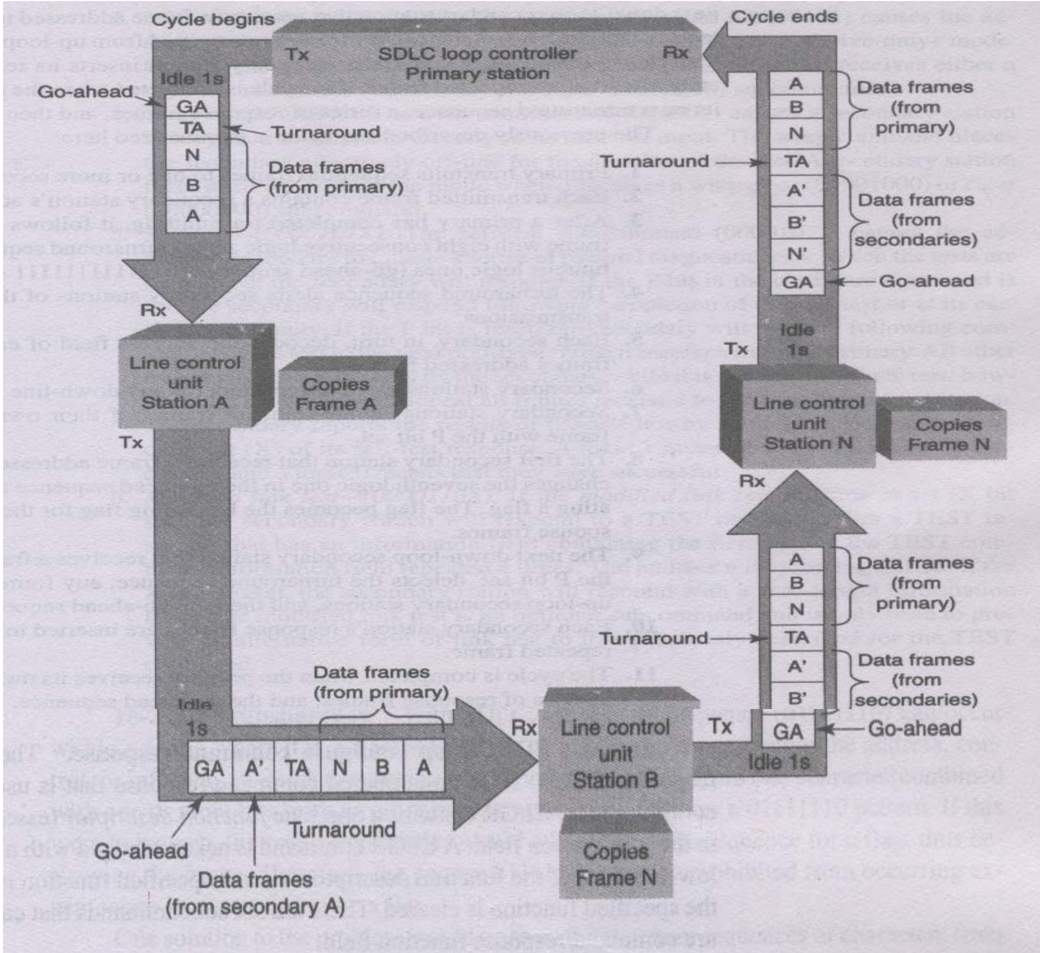


FIGURE 16-8 SDLC loop configuration

9. The next down-loop secondary station that receives a frame addressed to it with the P bit set, detects the turnaround sequence, any frames transmitted by other up-loop secondary stations, and then the go-ahead sequence.

10. Each secondary station's response frames are inserted immediately after the repeated frame.

11. The cycle is completed when the primary receives its own turnaround sequence, a series of response frames, and the go-ahead sequence.

8-19. list and describe the HDLC *operational modes.*

Answer:-
HDLC has two operational modes not specified in SDLC: asynchronous response mode and asynchronous disconnect mode:

1. *Asynchronous response mode (ARM:-.* With the ARM, secondary stations are allowed to send unsolicited responses. To transmit, a secondary does not need to have received a frame from the

primary with the P bit set. However, if a secondary receives a frame with the P bit set, it must respond with a frame with the F bit set.

2. *Asynchronous disconnect mode (ADM):-*. An ADM is identical to the normal disconnect mode except that the secondary can initiate a DM or RIM response at any time.

8-20.Explain ISO 4335 standard control field of HDLC.

Answer:- Control field:- With HDLC, the control field can be extended to 16 bits. Seven bits are for the ns, and seven bits are for the nr. Therefore, with the extended control format, there can be a maximum of 127 outstanding (unconfirmed) frames at any given time. In essence, a primary station can send 126 successive information frames to a secondary station with the P bit = 0 before it would have to send a frame with the P bit 1.

With HDLC, the supervisory format includes a fourth status condition: *selective* re*ject* (SREJ). SREJ is identified by two logic 1s in bit positions b4 and b5 of a supervisory control field. With SREJ, a single frame can be rejected. A SREJ calls for the retransmission of only one frame identified by the three-bit nr code. A REJ calls for the retransmission of all frames beginning with frames identified by the three-bit nr code.