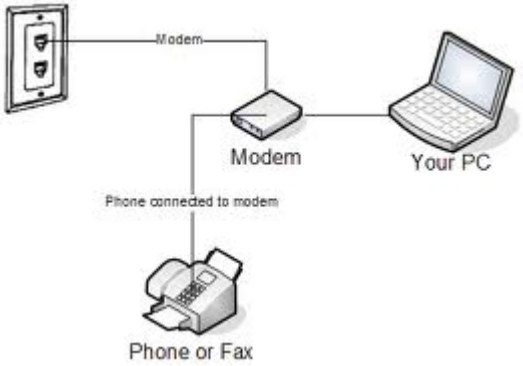
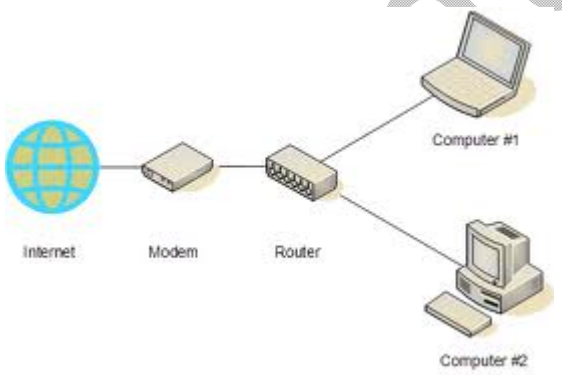
## Unit-3

### Data communication components: -

### Modems: -

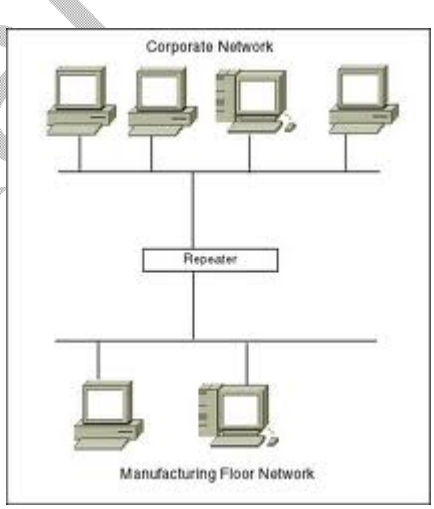
- There are two types of modems are available. [1] Internal modem [2] External modem.
- Internal modem, which are installed inside the computer.
- External modem, which are connected to the computer with serial or USB port.
- The modems are connected to the personal computers to access internet.
- Modem stands for modulator-demodulator.
- A modulator converts digital signals into analog signals.
- A demodulator converts analog signals into digital signals.
- A modem is a device or program that enables a computer to transmit data over telephone line.
- The new personal computers came with 56 Kbps modem as internal modems.
- By using a modem we can transmit several kinds of data like audio, video, picture etc...
- The term modem is refers to the two functional entities that make the device: a signal modulator and a signal demodulator.




### Repeaters: -

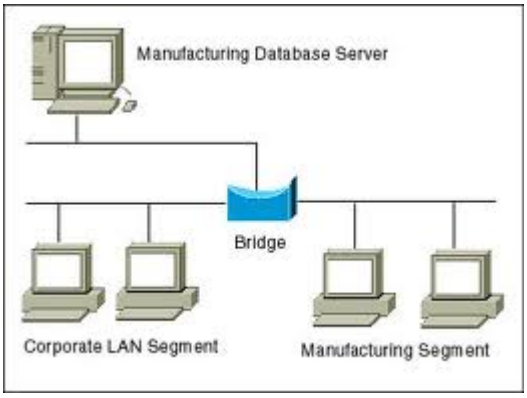
- A repeater is also known as regenerator.
- A repeater is an electronic device that operates on only physical layer of OSI model.
- Signals that carry information within a network can travel a fixed distance.
- A repeater installed on a link.
- A repeater receives the signals before it become weak or corrupted.
- A repeater regenerates the original bit patterns, and puts the refreshed copy back onto the link.
- A repeater allows us to extend only the physical length of a network.
- The repeater does not change the functionality of the network.




### Bridges: -

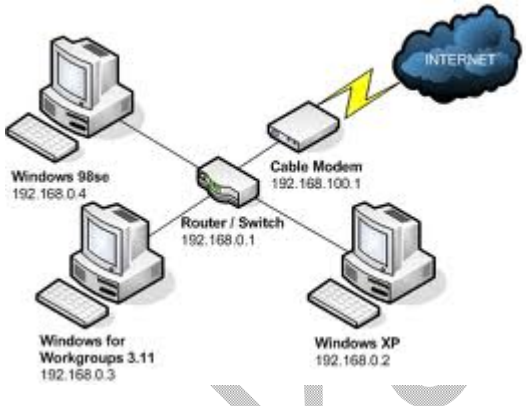
- Bridges operate in the both physical and the data link layers of OSI model.
- Bridges can divide a large network into smaller segment.
- They can also relay frames between two separate LANs.
- Bridges contain logic that keeps the network traffic separate for different segments.
- In this way, bridges filter the network traffic.
- By this way bridges control the congestion.
- Bridges can also provide the security for network traffic.
- When data frame enters in bridge, the bridge regenerates the signals.

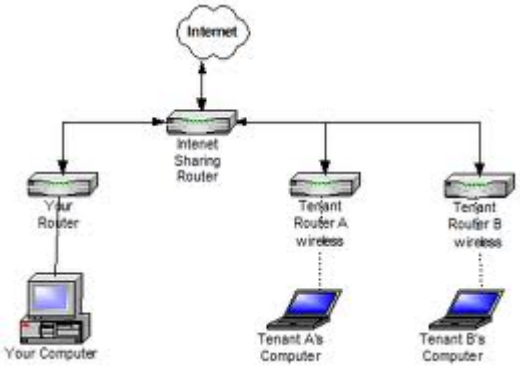
- As a bridge encounters a packet, it reads the address and compares that address with a table of all the stations on both segments.
- When its finds a match, it discovers to witch segment the station belongs and relay the packet only to that segment.




**Routers: -**

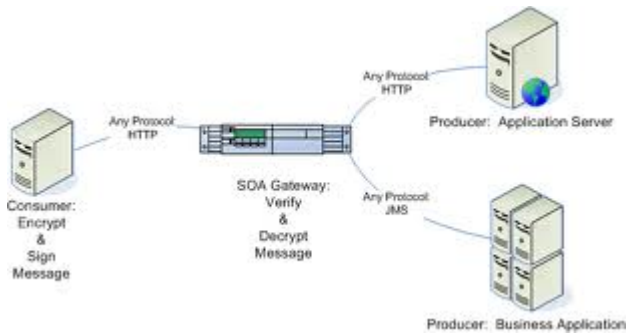
- The routers are access on network layer.
- Routers are hardware device which is capable for performing specific task.
- Routers are used to determines which path is suitable form several paths for data transmission.
- Routers can also operate in the physical, data link layers of OSI model.
- Routes relay packets among multiple interconnected networks.
- They route the packets from one network to another network.
- A packet sent from a station on one network to a station on a neighbouring network.
- Router forwards the packet to the next router on the path, and so on, until the destination is reached.
- Router act like station on a network.



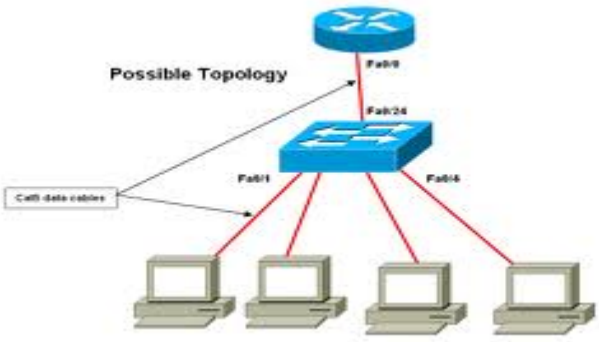

**Gateways: -**

- Gateways are operates in all seven layers of OSI model.
- A gateway is a protocol converter.
- A gateway can accept a packet formatted for one protocol and convert it to a packet formatted for another protocol.
- A gateway is generally software which is installed within a router.
- In some case, the only modifications necessary are the header and trailer of the packet.
- In the other case, the gateway must adjust the data rate, size, and format.



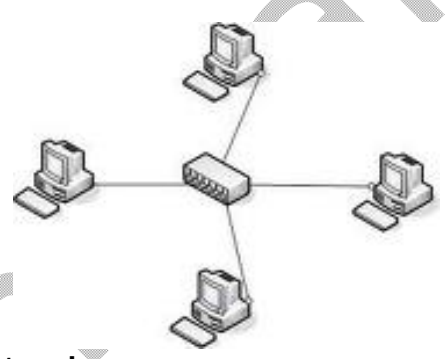
**Switches: -**

- A switch is a device that provides bridging functionality with higher efficiency.
- A switch may act as multiport bridge.
- Switches are used to connect a devices or segments in a LAN.
- The switch has a buffer for each link which it is connected.
- When switch receives a packet, it stores the packet in the buffer of the receiving link.
- Then checks the address to find the out-going link.
- If the out-going link is free, the switch sends the frame to that particular link.
- Switches are wok on two basic strategies. [1] Store-and-forward [2] Cut-through.
- A store-and-forward switch stores the frame in the input buffer the whole packet has arrived.
- A cut-through switch forwards the packet to the output buffer as soon as the destination address is found.




**Hubs: -**

- A hub is a small and simple device that joins multiple computers together.
- Hubs are operating in data link layer of OSI model.
- The hub can be found in many home and small business network.
- Hub is a central device of a network and every computer in a network is directly connected with the hub.
- Hub broadcasts the data to its every port.
- If the hub fails to work, the communication between the computers stops till the hub again starts work.
- Some years ago, hubs offered only 10 Mbps speed.
- Newer types of hubs offer 100 Mbps speed.



**Data link protocols: -**

- The protocol refers to a set of rules for communication.
- A data link protocol is a set of specifications used to implement the data link layer.
- The data link protocols can be divided into two groups:
  1. Asynchronous protocols
  2. synchronous protocols

**Asynchronous protocols: -**

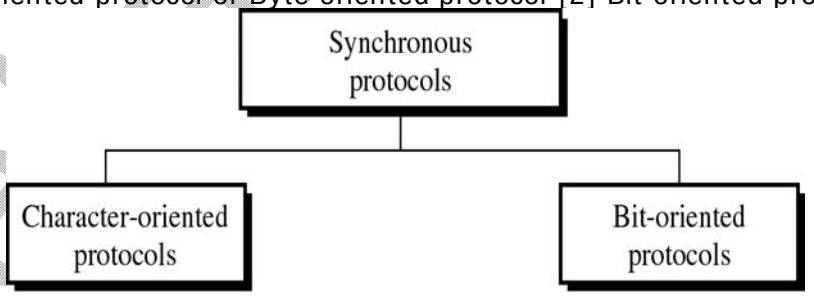
- A number of asynchronous protocols have been developed over the last years.
- These protocols are used in mainly modems.
- Asynchronous protocols are as under.
  1. XMODEM
  2. YMODEM
  3. ZMODEM
  4. BLAST

5. Kermit

- Asynchronous protocols are simple, easy to implement.
- In asynchronous transmission a data unit is transmitted with no timing coordination between sender and receiver.
- **XMODEM: -**
  1. In 1979 Ward Christiansen designed a file transfer protocol for telephone-line-communication.
  2. This protocol is known as XMODEM.
  3. This protocol is half-duplex and stop-and-wait protocol.
  4. The first field is a one byte start of header (SOH).
  5. The last field CRC checks for error in data field only.
- **YMODEM: -**
  1. YMODEM is similar to the XMODEM.
  2. YMODEM has 1024 byte data unit.
  3. It has two CAN to cancel the transmission.
  4. It also provides the error checking.
  5. By using YMODEM we send the multiple files at a same time.
- **ZMODEM: -**
  1. ZMODEM is a newer protocol.
  2. It combines the future of both XMODEM and YMODEM.
- **BLAST: -**
  1. The full form is **B**locked **A**synchronous **T**ransmission.
  2. The BLAST is more power full than XMODEM.
  3. It provides the fill-duplex floe control.
  4. BLAST can provide the sliding window flow control.
  5. It allows the transfer of data and binary files.
- **Kermit: -**
  1. Kermit is designed at Columbia University.
  2. The most widely used asynchronous protocol.
  3. The file transfer protocol is similar in the operation to XMOEM, with sender waiting for an acknowledgement before it starts transmission.
  4. Kermit allows the transmission of control character as text.

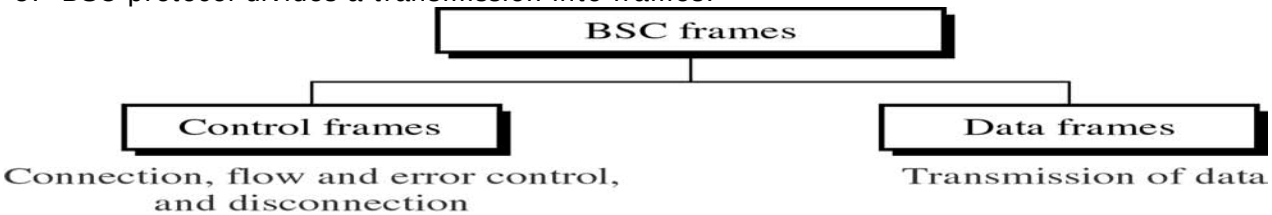
**Synchronous protocols: -**

- The speed of synchronous transmission makes it a better choice over asynchronous transmission, for LAN, MAN, and WAN.
- Synchronous protocols can be divided into two classes.
- [1] Character oriented protocol or Byte oriented protocol [2] Bit oriented protocol.

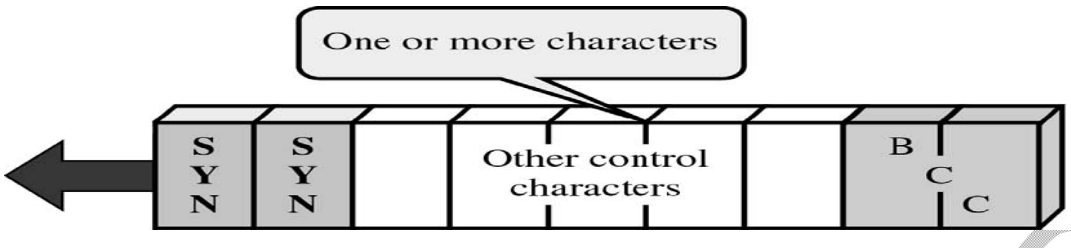


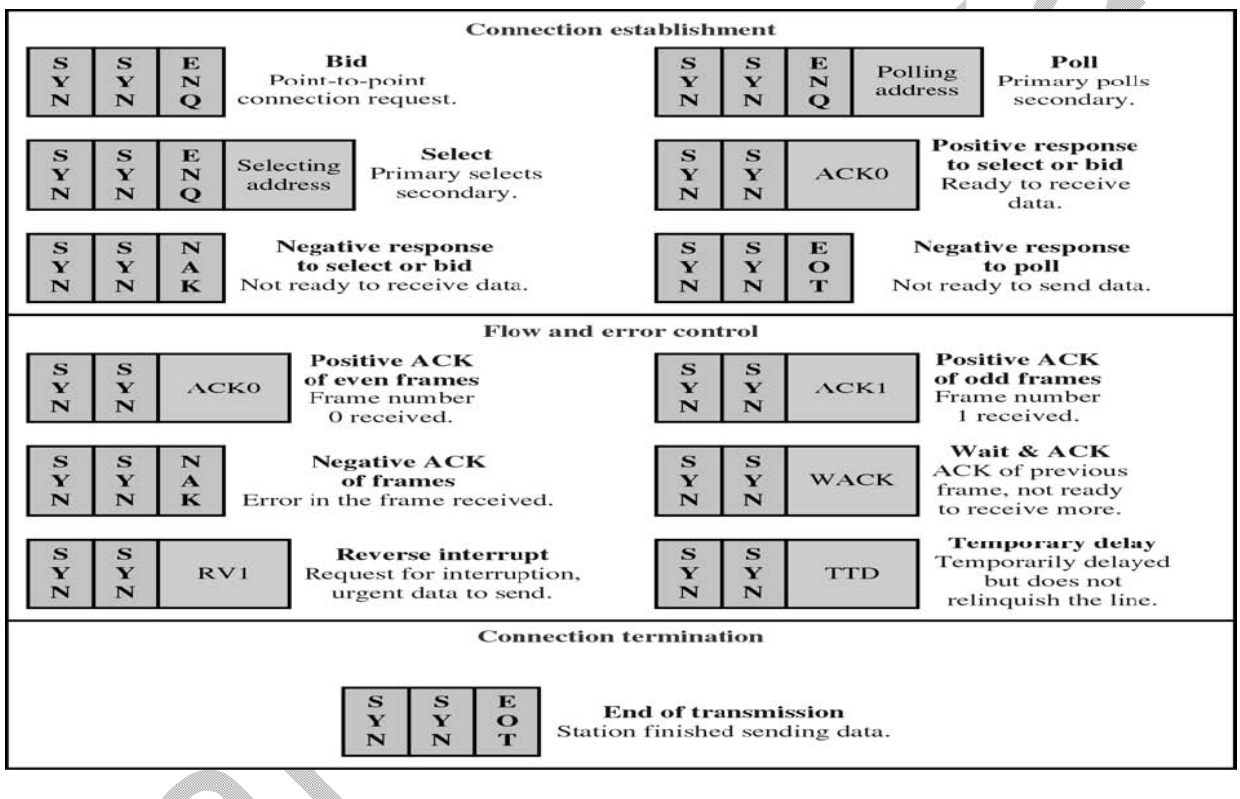

**Character oriented protocol: -**

- Character oriented protocol is also known as Byte oriented protocol.
- These protocols interpret a transmission frame, each usually composed of one byte.
- All control information is in the form of an existing character encoding system.
- **Binary synchronous communication (BSC):**
  1. BSC is developed by IBM in 1964.
  2. It is used in both point-to-point and multiple communications.
  3. It supports half-duplex transmission using stop-and-wait flow control.
  4. It does not support full-duplex transmission or sliding window protocol.
  5. BSC protocol divides a transmission into frames.

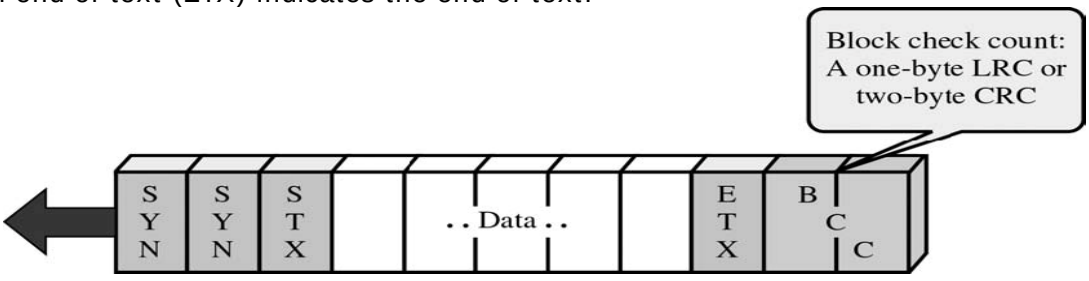


- **Control frames:**
  1. If a frame is used for control purpose, it is called control frame.
  2. Control frame are used to exchange information between communicating devices.
  3. For example: to create a connection, to control the flow, to request error correction etc…
  4. A control frame is used by one device to send command to get information from another device.
  5. A control frame contains control character but no data.
  6. It carries information specific to the functioning of the data link layer itself.
  7. Control frame serve three purposes: [1] Establishing connections [2] Maintaining flow and error control [3] Terminating connection.

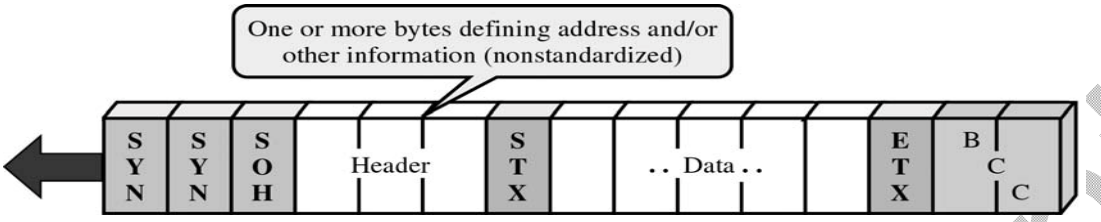



- **Data frames:**
  1. If a frame contains messages, it is called a data frame.
  2. Data frames are used to transmit the information.
  3. Following figure shows the format of simple data frame.
  4. Arrow shows the direction of transmission.
  5. The frame begins with two or more synchronous (SYN) character.
  6. After the two synchronous characters, comes a start of text (STX) character.
  7. This character gives a signal to the receiver that control information is ending and next byte will be data.
  8. Data or text can consist of number of character.
  9. An end of text (ETX) indicates the end of text.

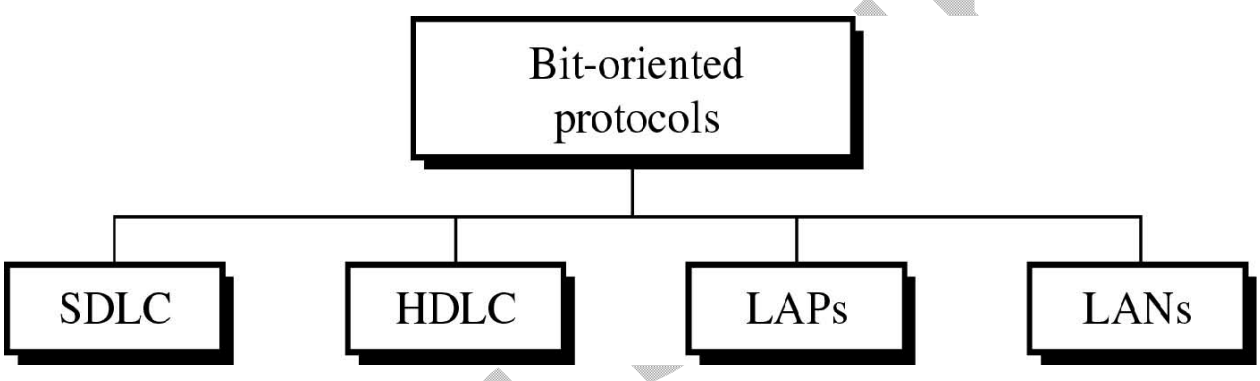


- **Data frame with header:**
  1. A frame as simple as above is used.
  2. Usually we need to include the address of receiving device, the address of sending device and the identity number of the frame (0 or 1) for stop-and-wait flow control.
  3. All the information is included in a field header.
  4. Header begins with start of the herder (SOH).
  5. The next fields are SYN and STX character.
  6. Every thing after received after the SOH field but before STX character is the header information.

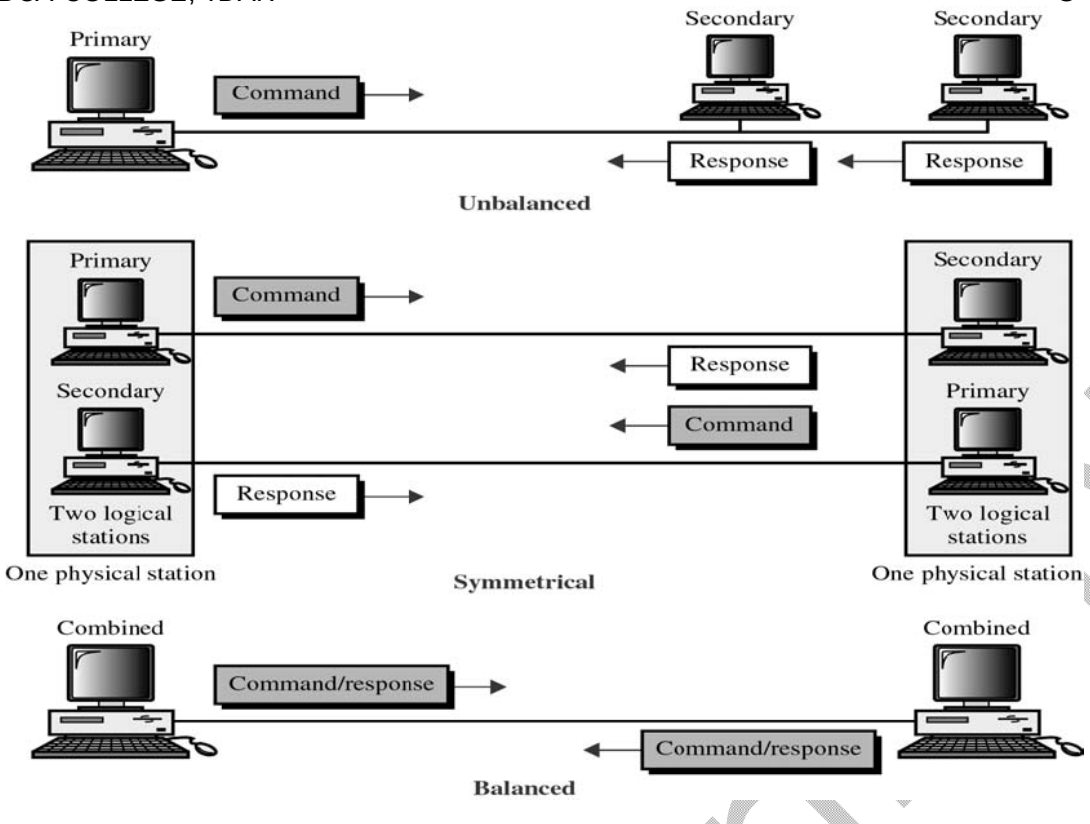



**Bit oriented protocols: -**

- In character oriented protocol, bits are grouped into predefined patterns forming characters.
- But in bit oriented protocols can pack more information into shorter frames.



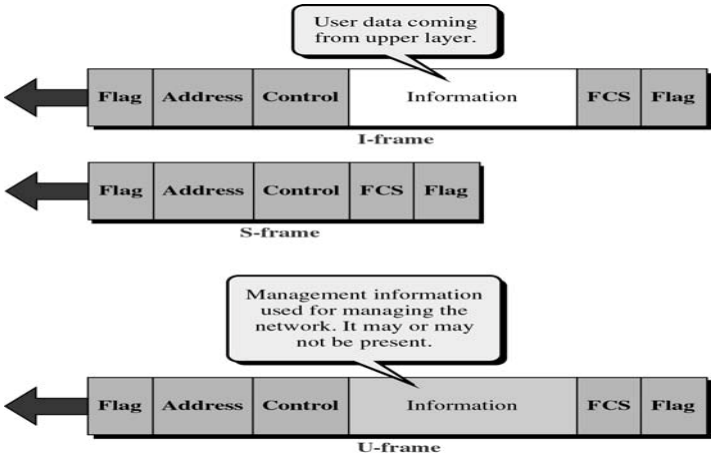

- A lot of bit oriented protocols have been developed over the years.
- One of these HDLC is the design of the ISO and has become the basis for all bit oriented protocols in use today.
- In 1975, IBM gave synchronous data link control (SDLC).
- In 1979, ISO provide high level data link control (HDLC).
- **High level data link control (HDLC):**
  1. HDLC is a bit oriented data link protocol.
  2. It is designed for full-duplex and half-duplex.
  3. It is point-to-point and multipoint links.
  4. HDLC can be characterized by: Station Type, Configurations, and Response Modes.
  5. **Station Type (1): -** HDLC differentiates between 3 types of stations. [1] Primary station [2] Secondary station [3] Combined station.
  6. **Primary station:** - Primary station works in the same ways as primary devices. The primary is a device in point-to-point or multipoint line configuration that has complete control of the link.
  7. **Secondary station:** - The primary sends command to the secondary stations. A primary issues commands and secondary issues responses.
  8. **Combined station: -** A combined station can both command and respond. A combined station is one of a set of connected peer devices programmed to behave either as a primary or as a secondary depending on the nature and the direction of the transmission.
  9. **Unbalanced configuration:** - It is also called master/slave configuration. One device is a primary and other are secondary. Unbalanced configuration can be point to point if only two devices are involved.
  10. **Symmetrical configuration: -** Each physical station on a link consists of two logical stations, one a primary and other is secondary. Separate lines link the primary aspects of one physical station to the secondary aspect of another physical station.
  11. **Balanced configuration:** -Both stations in a point-to-point topology are of combined type. HDLC does not support balanced multipoint.




- **Modes:**
  1. A mode in HDLC is the relationship between two devices involved in an exchange.
  2. The mode describes who controls the link.
  3. HDLC supports 3 modes of communication between stations: [1] Normal Response Mode (NRM) [2] Asynchronous response Mode (ARM) [3] Asynchronous Balanced Mode (ABM).
  4. **Normal response mode (NRM): -** Refers to the standards primary-secondary relationship. Secondary device must have permission from primary device before transmitting. Once permission has granted, the secondary may initiate a response transmission of one or more frames containing data.
  5. **Asynchronous response mode (ARM):** - A secondary may initiate a transmission before permission from the primary whenever the channel is idle. ARM does not alter the primary secondary relationship in any other way. All transmissions from the primary still go to the secondary and then relayed to the other devices.
  6. **Asynchronous balanced mode (ABM):** - All stations are equal and therefore only combined stations connected in point-to-point are used. Either combined station may initiate transmission with the other combined station before permission.

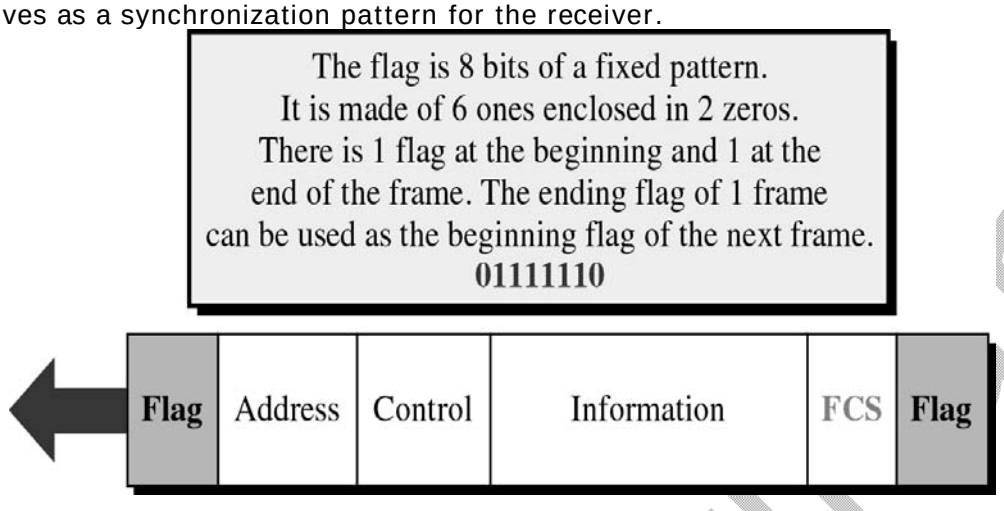
| | NRM | ARM | ABM |
|---|---|---|---|
| **Station type** | Primary & secondary | Primary & secondary | Combined |
| **Initiator** | Primary | Either | Any |

- **HDLC frames: -**

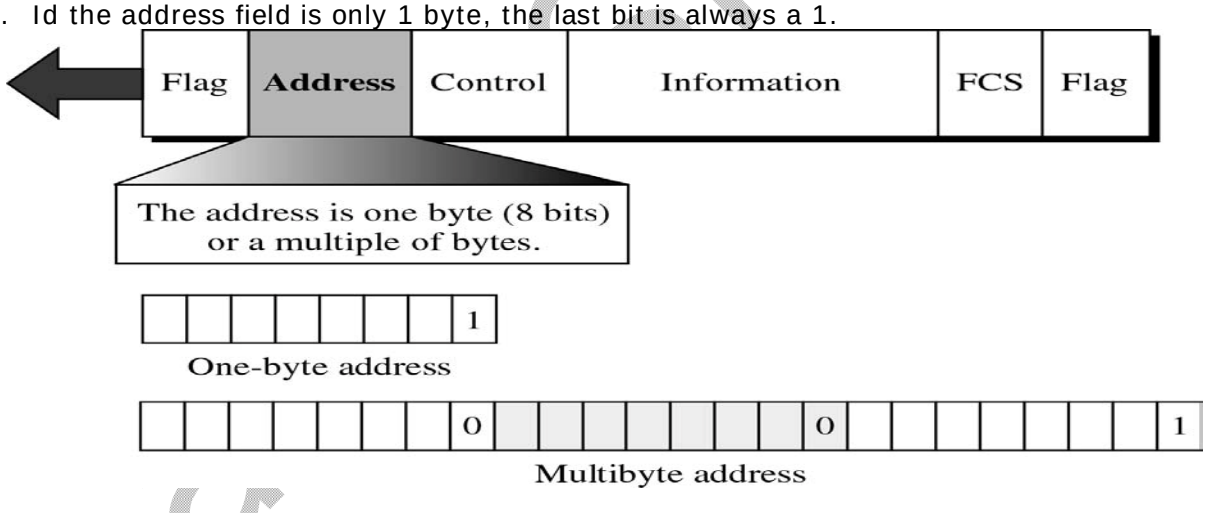


1. **Information frames (I-frames): -** I-frames are used to transport user data and control information relating to user data.
2. **Supervisory frames (S-frames): -** S-fames are used only to transport control information.
3. **Unnumbered frames (U-**frames): - U-frames are reserved for system management.

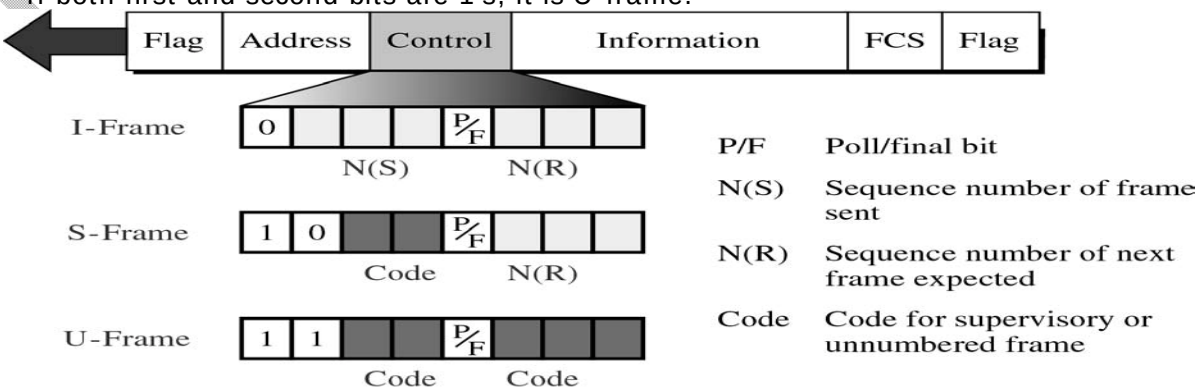
- **Flag field: -**
  1. The flag field of an HDLC frame is an 8 bit sequence with a bit pattern 01111110 that identifies both the beginning and the ending of the of a frame.
  2. It serves as a synchronization pattern for the receiver.




- **HDLC address field: -**
  1. The second field of HDLC frame contains the address of the secondary station that either the originator or the destination of the frame.
  2. If the primary station creates frame it includes a 'To' address and if a secondary creates the frame, it contains a 'From' address.
  3. Can be of one byte or several bytes depending upon the network.
  4. Id the address field is only 1 byte, the last bit is always a 1.




- **HDLC control field: -**
  1. A control field is a one or two byte segment of the frame used for flow management.
  2. The two byte case is called the extended mode.
  3. If the control field is a 0, the frame is I-frame.
  4. If the first bit is 1 and the second bit is a 0, it is S-frame.
  5. If both first and second bits are 1's, it is U-frame.



- **Link access procedures: -**
  1. LAPB: - Link access procedure, balanced.
  2. LAPD: - Link access procedure for D-channel.
  3. LAPM: - Link access procedure for moems.