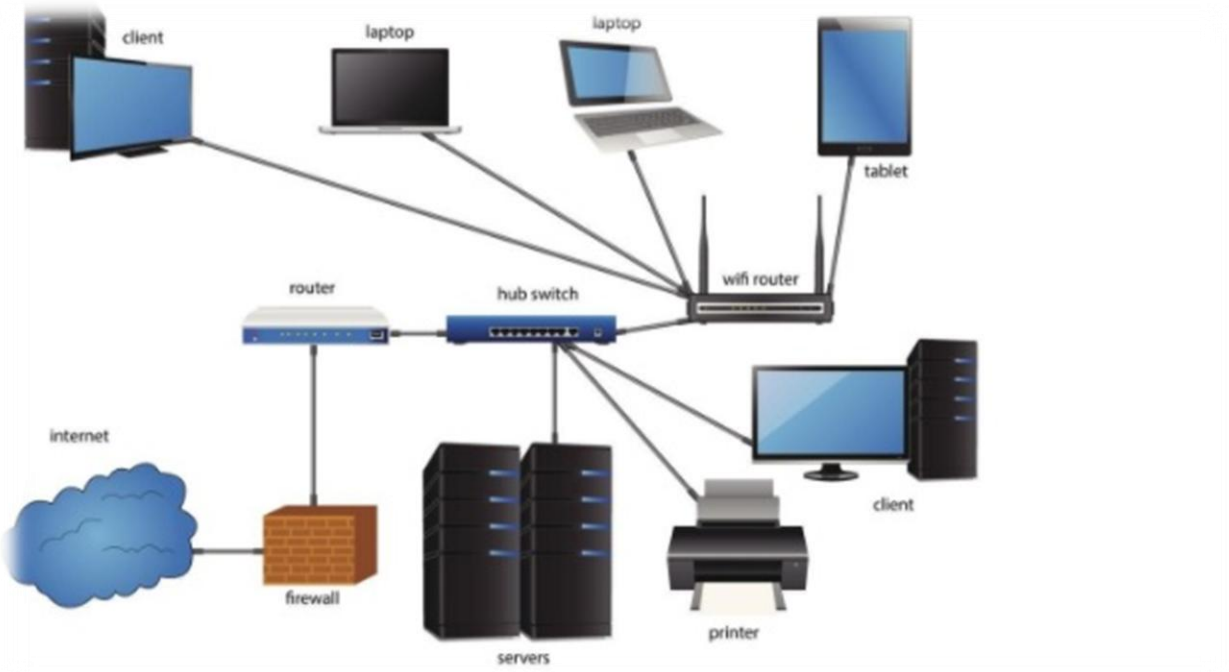
COMPUTER NETWORKS



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UNIT-II

HDLC and PPP

High-Level Data Link Control (HDLC)

- HDLC was defined by ISO for use on both point-to-point and multipoint data links.
- It supports full-duplex communication
- Other similar protocols are
  - Synchronous Data Link Control (SDLC) by IBM
  - Advanced Data Communication Control Procedure (ADCCP) by ANSI
  - Link Access Procedure, Balanced (LAP-B) by CCITT, as part of its X.25 packet-switched network standard

HDLC Overview

Broadly HDLC features are as follows:

- Reliable protocol
  - selective repeat or go-back-N
- Full-duplex communication
  - receive and transmit at the same time
- Bit-oriented protocol
  - use bits to stuff flags occurring in data
- Flow control
  - adjust window size based on receiver capability
- Uses physical layer clocking and synchronization to send and receive frames

HDLC Overview

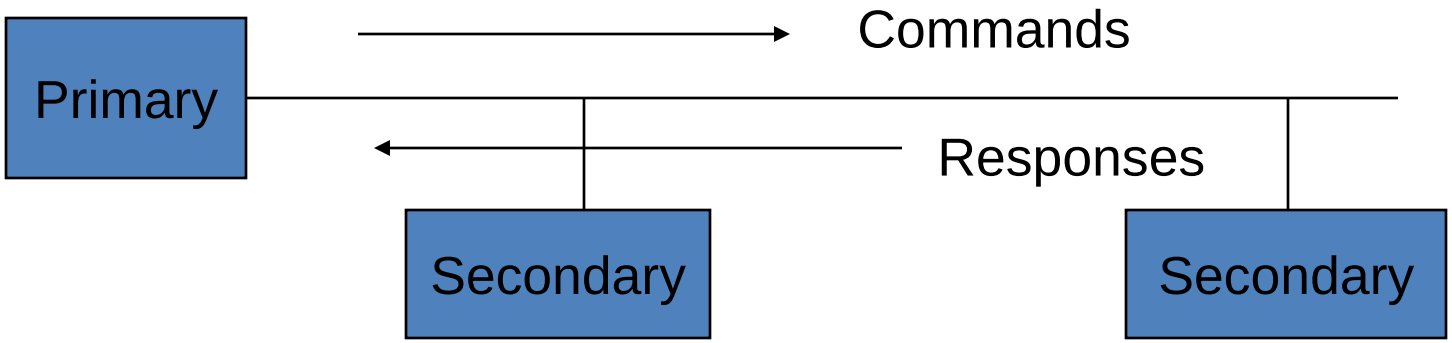
- Defines three types of stations
  - Primary
  - Secondary
  - Combined
- Defines three types of data transfer mode
  - Normal Response mode
  - Asynchronous Response mode
  - Asynchronous Balanced mode
- Three types of frames
  - Information
  - Supervisory
  - Unnumbered

HDLC

- The three stations are :
  - Primary station
    - Has the responsibility of controlling the operation of data flow the link.
    - Handles error recovery
    - Frames issued by the primary station are called *commands*.
  - Secondary station
    - Operates under the control of the primary station.
    - Frames issued by a secondary station are called *responses*.
    - The primary station maintains a separate logical link with each secondary station.
  - Combined station
    - Acts as both as primary and secondary station.
    - Does not rely on other for sending data

HDLC

Unbalanced Mode



Balanced mode

HDLC

- The three modes of data transfer operations are
  - Normal Response Mode (NRM)
    - Mainly used in terminal-mainframe networks. In this case,
    - Secondaries (terminals) can only transmit when specifically instructed by the primary station in response to a polling
    - Unbalanced configuration, good for multi-point links
  - Asynchronous Response Mode (ARM)
    - Same as NRM except that the secondaries can initiate transmissions without direct polling from the primary station
    - Reduces overhead as no frames need to be sent to allow secondary nodes to transmit
    - Transmission proceeds when channel is detected idle, used mostly in point-to-point-links
  - Asynchronous Balanced Mode (ABM)
    - Mainly used in point-to-point links, for communication between combined stations

Non-operational Modes

- Normal Disconnected Mode
- Asynchronous Disconnected Mode

Both the above modes mean that the secondary node is logically disconnected from the primary node

- Initialization Mode
  - A node negotiates transmission parameters with the other node E.g., flow control information
  - Parameters negotiated in this mode are used during any of the data transfer modes

Figure: High-level Data Link Control(HDFC)

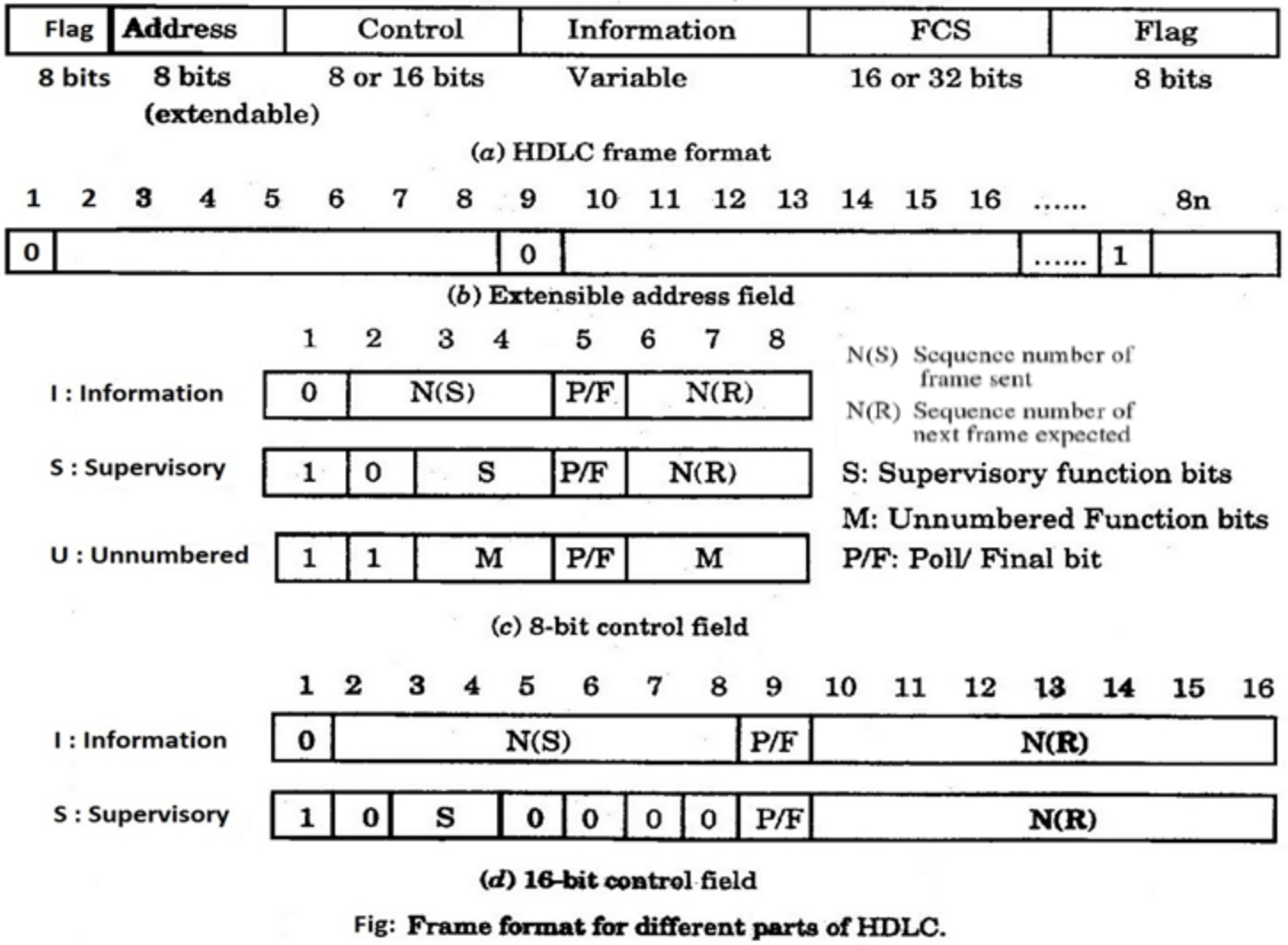


Fig: **Frame format for different parts of HDLC.**

HDLC

- Flag: 01111110- start and ending delimiter. Bits are stuffed for flags in data frames
- FCS: 16-bit CRC using generating polynomial

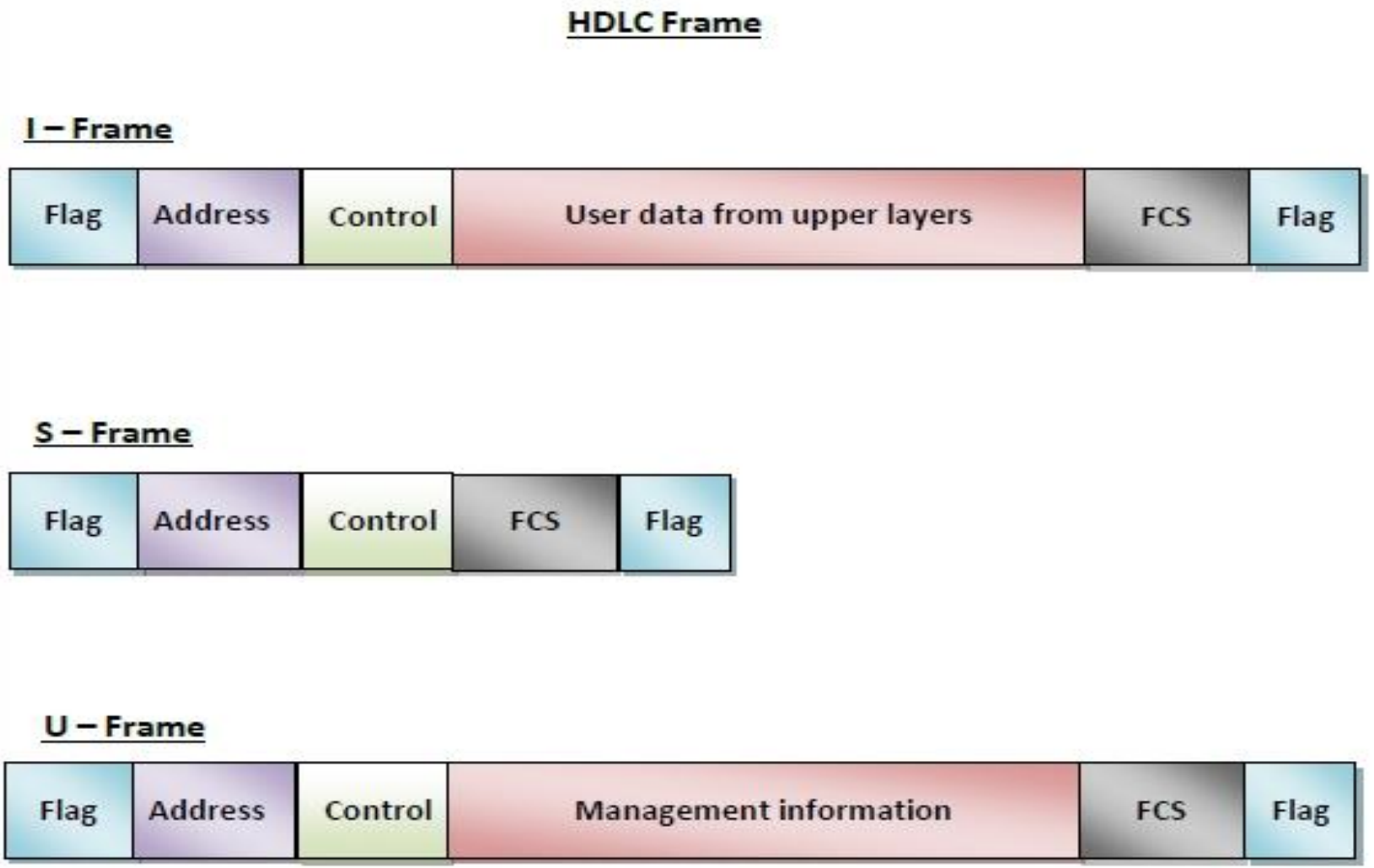
$$G(x) = x^{16} + x^{12} + x^5 + 1$$

- Address field:
  - mainly used in multipoint link configuration, and not used in point-to-point
  - In unbalanced configuration, every secondary is assigned a unique address. Contains address of secondary station in both command and response frames
  - In balanced mode, command frame has destination address and response frame has sending node's address
  - Group addresses are also possible. E.g., One command sent to all the secondaries
- In I-frames, N(S) is the sequence number of the frame being sent, and N(R) is the sequence number of the frame being expected.
- The P/F bit, known as the poll/final bit, is used with different meaning in different contexts.
  - It is used to indicate polling, to indicate the final I-frame, etc

HDLC

- There are three different classes of frames used in HDLC
  - Information frames, which carry actual information. Such frames can piggyback ACK in case of ABM
  - Supervisory frames, which are used for error and flow control purposes and hence contain send and receive sequence numbers
  - Unnumbered frames, used in link setup and disconnection, and hence do not contain ACK.

Figure: HDLC Cntd…



HDLC

- There are four different supervisory frames
  - SS=00, Receiver Ready (RR), and N(R) ACKs all frames received up to and including the one with sequence number N(R) - 1
  - SS=10, Receiver Not Ready (RNR), and N(R) has the same meaning as above
  - SS=01, Reject; all frames with sequence number N(R) or higher are rejected, which in turns ACKs frames with sequence number N(R) -1 or lower.
  - SS=11, Selective Reject; the receive rejects the frame with sequence number N(R)

HDLC

- The unnumbered frames can be grouped into the following categories:
  - Mode-setting commands and responses
  - Recovery commends and responses
  - Miscellaneous commands and responses

Point to Point Data Link Control

- One sender, one receiver, one link: easier than broadcast link:
  - No Media Access Control
  - No need for explicit MAC addressing
  - E.g., dialup link, ISDN line
- Popular point-to-point and high-level DLC protocols:
  - PPP (point-to-point protocol)
  - HDLC: High level data link control (Data link used to be considered “high layer” in protocol stack). HDLC is also used in multi-point links (one station many receivers)
- These protocols can often be run over other data link technologies providing best of both worlds
  - E.g., PPPoE, HDLC encapsulation by Ethernet

PPP Design Requirements

Functionality : (similar to link layer services + extra management functions)

- **Packet framing -** encapsulation of network-layer datagram in data link frame
- **Multi-protocol** - carry network layer data of any network layer protocol (not just IP) *at same time* ability to demultiplex upwards
- **Bit transparency -** must carry any bit pattern in the data field (even if underlying channel can't)
- **Error detection** - not correction

PPP Design Requirements (cont.)

The extra stuff:

- Connection liveness: detect, signal link failure to network layer
- Network layer address negotiation: endpoint can learn/configure each other's network address and other characteristics.
- Authentication: who are you (or at least whose account do I bill for your dial-in time?)
  - This information is used by traffic management software to control bandwidth to individual subscribers
- Management features: loopback detection

PPP non-requirements

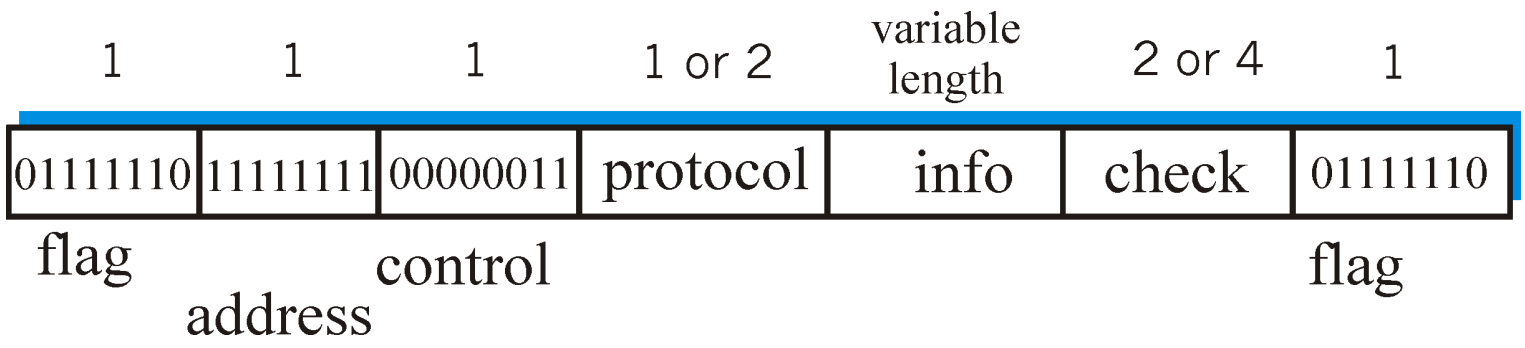
- No error correction/recovery

  (modems do one layer FEC, one layer packetization + retransmission “under the covers” anyway; other technologies are pretty reliable)
- No flow control
- Out of order delivery OK

Error recovery, flow control, data re-ordering all relegated to higher layers!

PPP Data Frame

- Flag: delimiter (framing)
- Address:
- Control:
- Protocol: upper layer protocol to which frame delivered (e.g., PPP-LCP, IP, IPCP, etc)



PPP Data Frame

- info: upper layer data being carried
- check: checksum for error detection