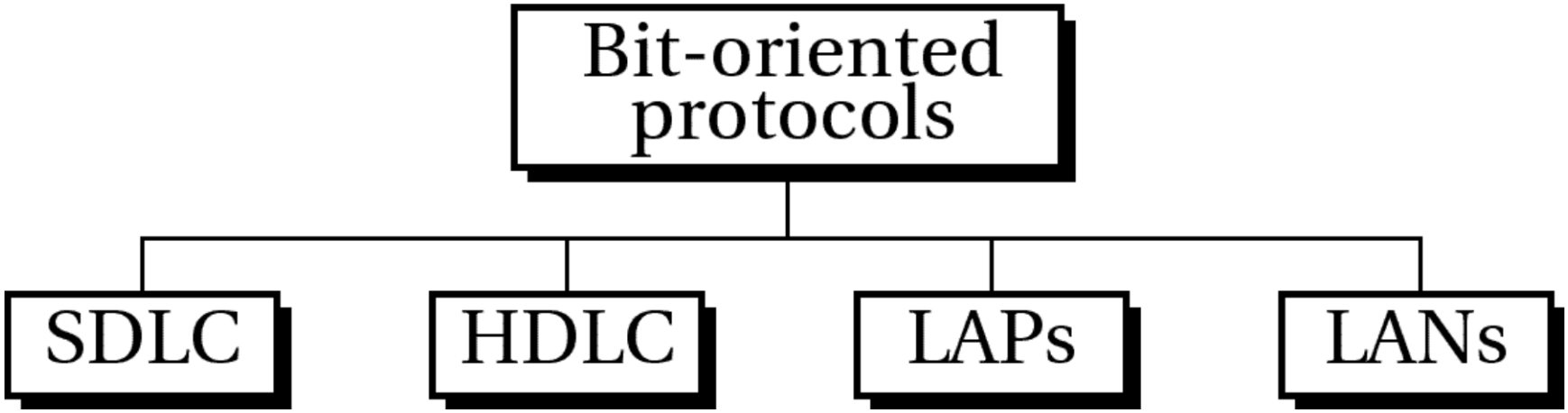
Bit-oriented protocols

HDLC, Project 802, Ethernet



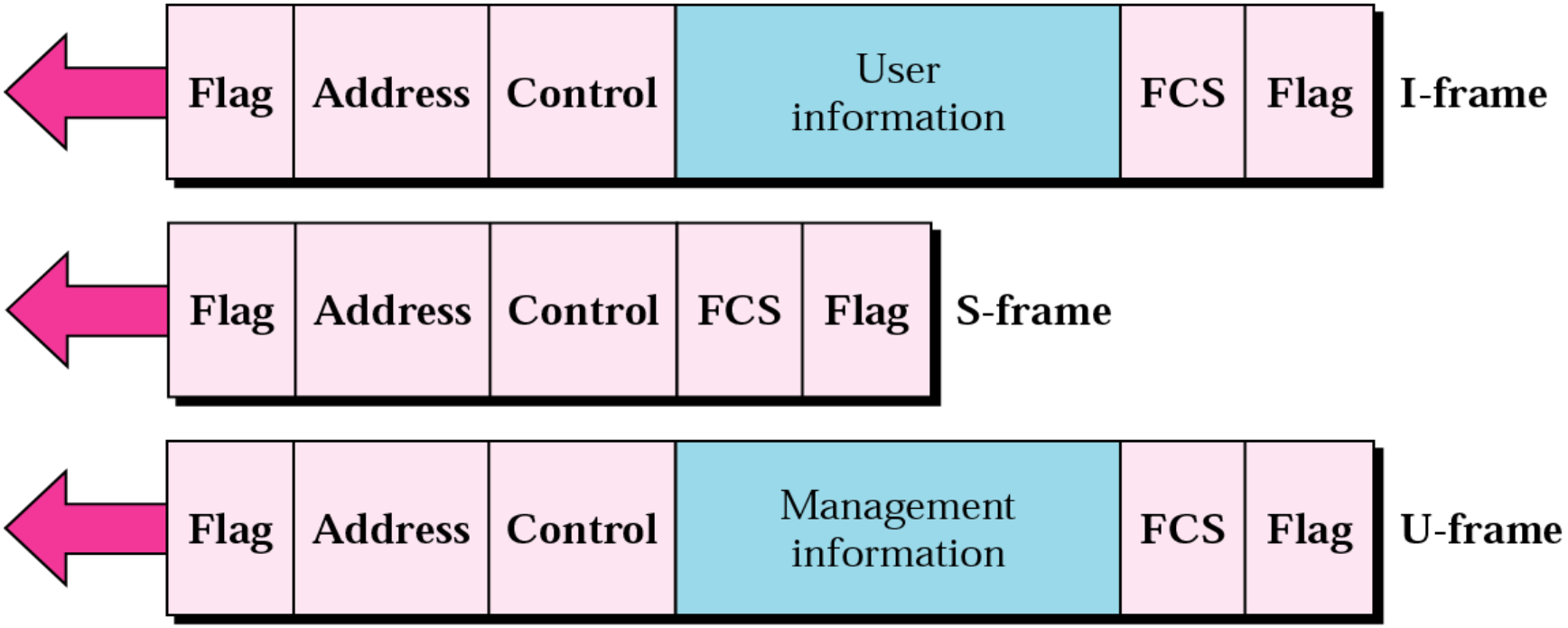
HDLC : *High-level Data Link Control*

1. It is a bit-oriented data link protocol
2. Designed to support both half duplex and full duplex communication over point-to-point and multipoint links.
3. It implements the ARQ mechanisms.
4. The HDLC protocol embeds information in a data frame that allows devices to control data flow and correct errors

HDLC : *High-level Data Link Control*

- Each piece of data is encapsulated in an HDLC frame by adding a trailer and a header.
- **The header** contains an HDLC address and an HDLC control field.
- **The trailer** is found at the end of the frame, and contains a (CRC) which detects any errors which may occur during transmission.
- The frames are separated by HDLC flag sequences which are transmitted between each frame and whenever there is no data to be transmitted.

HDLC frame types



HDLC *Frame Fields*

Flag field

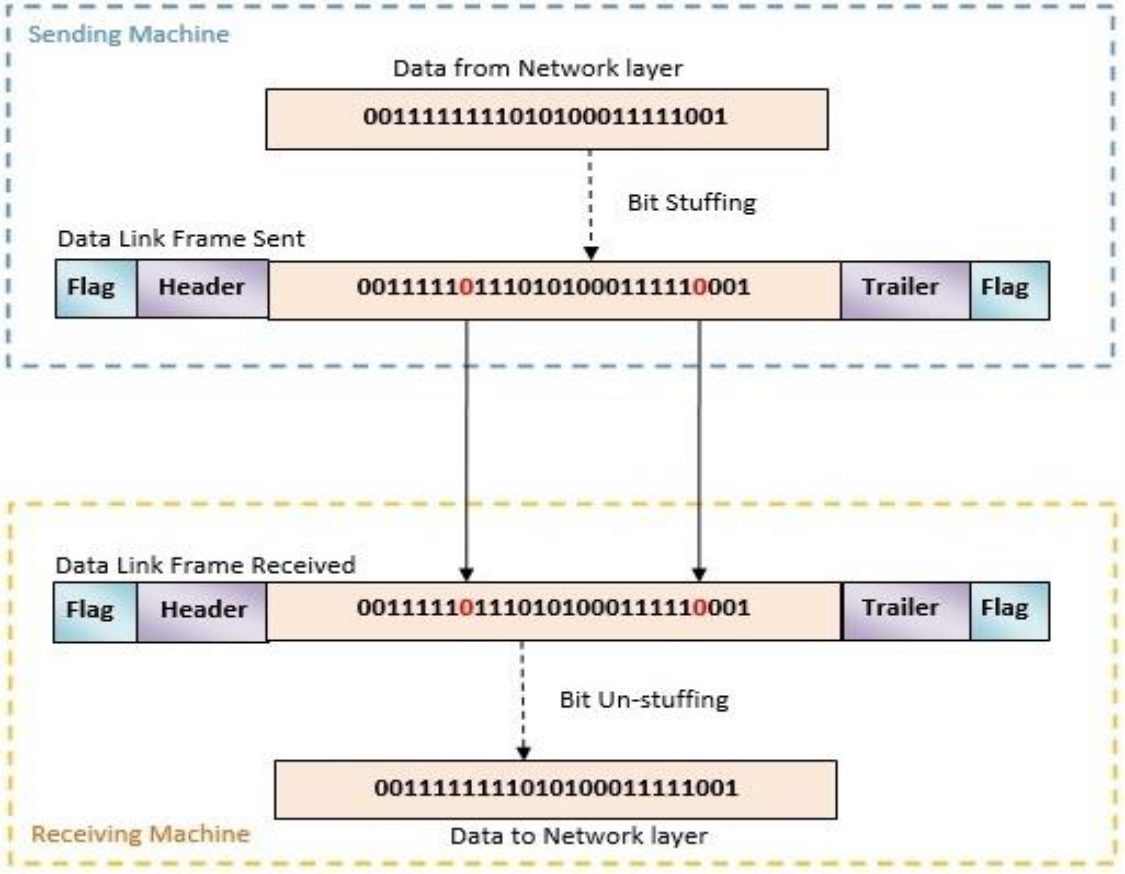
- is 8 bits of a fixed pattern (0111 1110).
- There is one flag at the beginning and one at the end frame.
- The ending flag of one Frame can be used as the beginning flag of the next frame.
- To guarantee that the flag does not appear anywhere else in the frame
- HDLC uses a process called **Bit Stuffing**.
- Every time a sender wants to transmit a bit sequence having more than 6 consecutive 1's, it inserts 1 redundant 0 after the 5_{th} 1

Exceptions:

- When the **bit sequence** is really a **flag.**
- when **transmission** is being **aborted.**
- when the **channel** is being put into **idle.**

Bit Stuffing

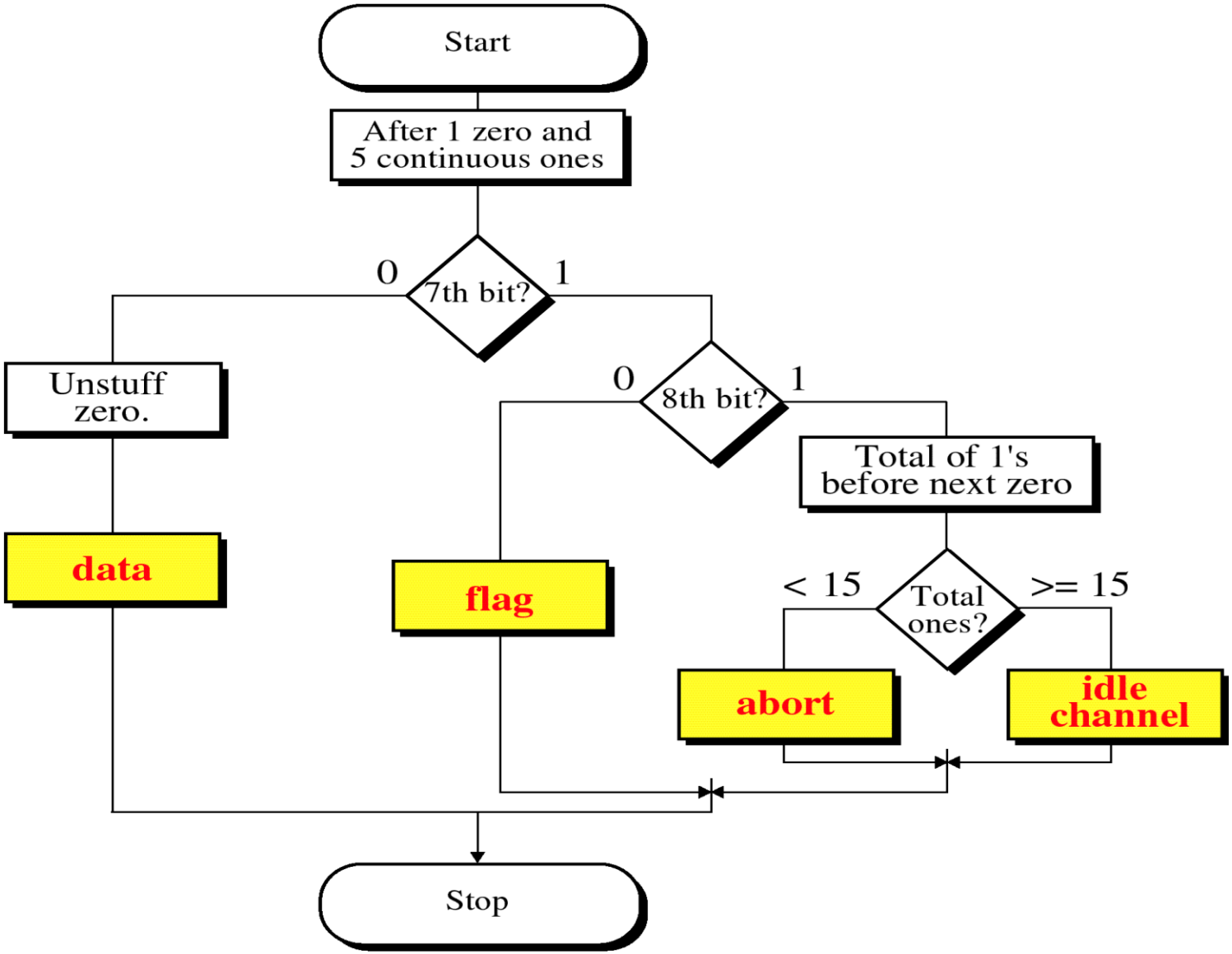
- The process of adding one extra zero whenever there are 5 consecutive 1's in the data, so that the receiver doesn't mistake the data for a flag.



How does the receiver identify a stuffed bit?

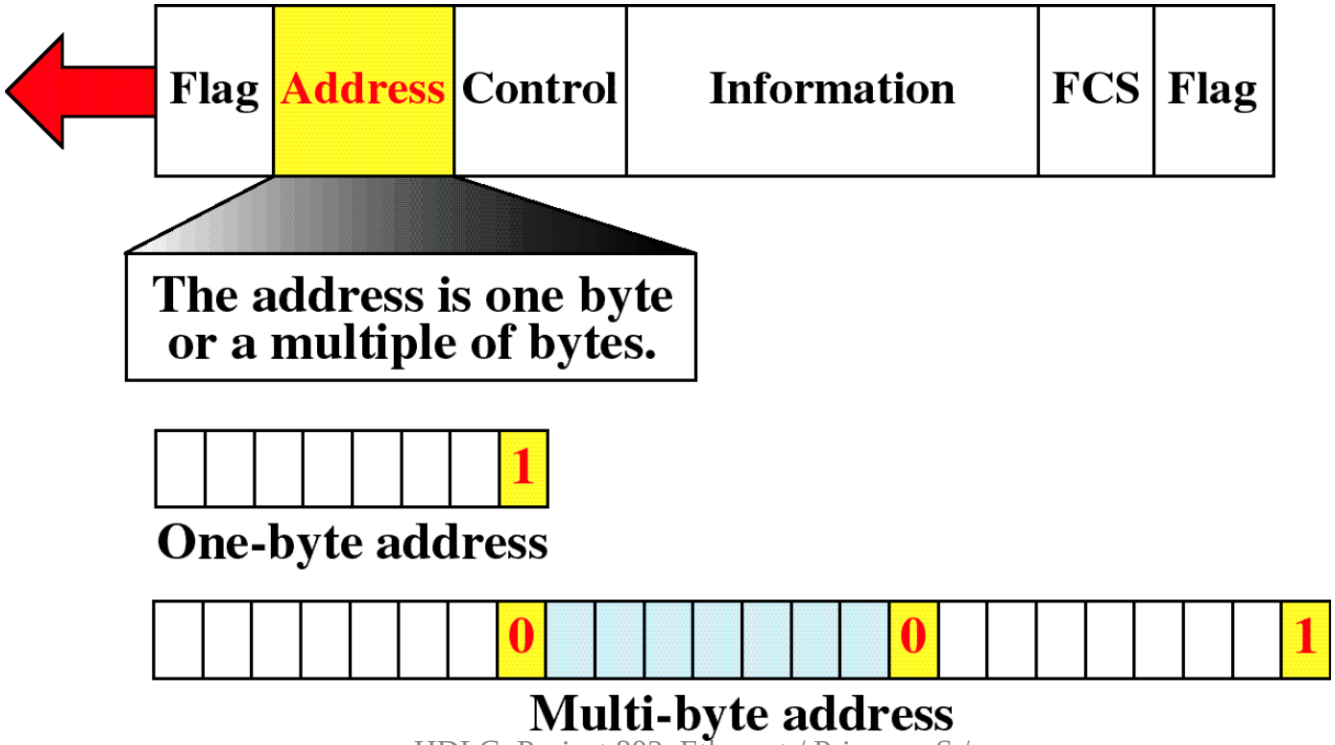
- Receiver reads incoming bits and counts 1's.
- When number of consecutive 1s **after** a zero is 5, it checks the next bit (7^{th} bit).
- If **7^{th} bit = zero** ➔ receiver recognizes it as a **stuffed bit**, discard it and resets the counter.
- If the **7^{th} bit = 1** ➔ then the receiver checks the 8^{th} bit; If the **8^{th} bit = 0**, the sequence is recognized as a **flag**.

How does the receiver identify a stuffed bit?

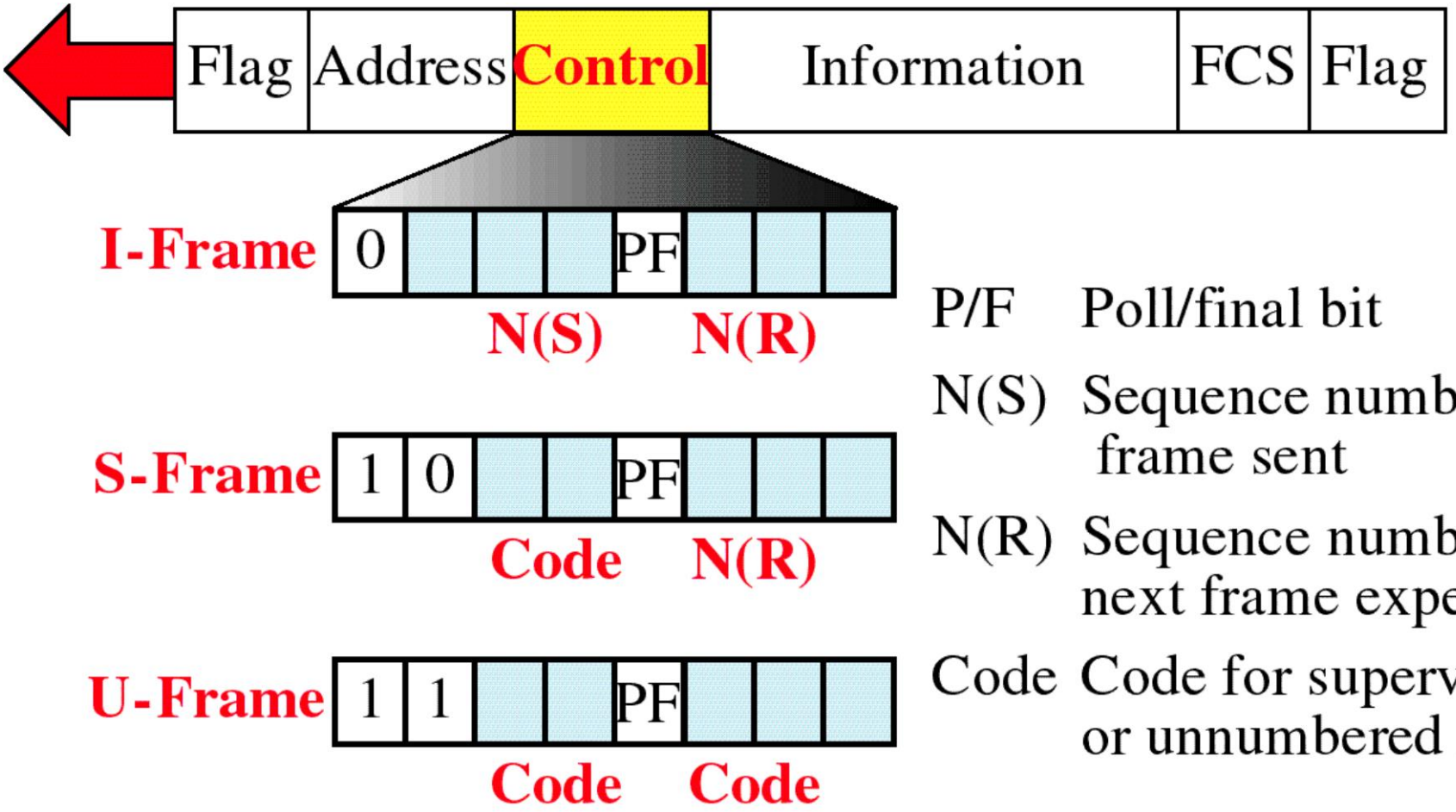


Address field

- Address field is one byte or more
- If the address is more than one byte, all bytes will end with 0,except the last one



HDLC Control Field



P/F Poll/final bit

N(S) Sequence number of frame sent

N(R) Sequence number of next frame expected

Code Code for supervisory or unnumbered frame

Control Field

- all three types contain a bit called (Poll/Final) P/F bit

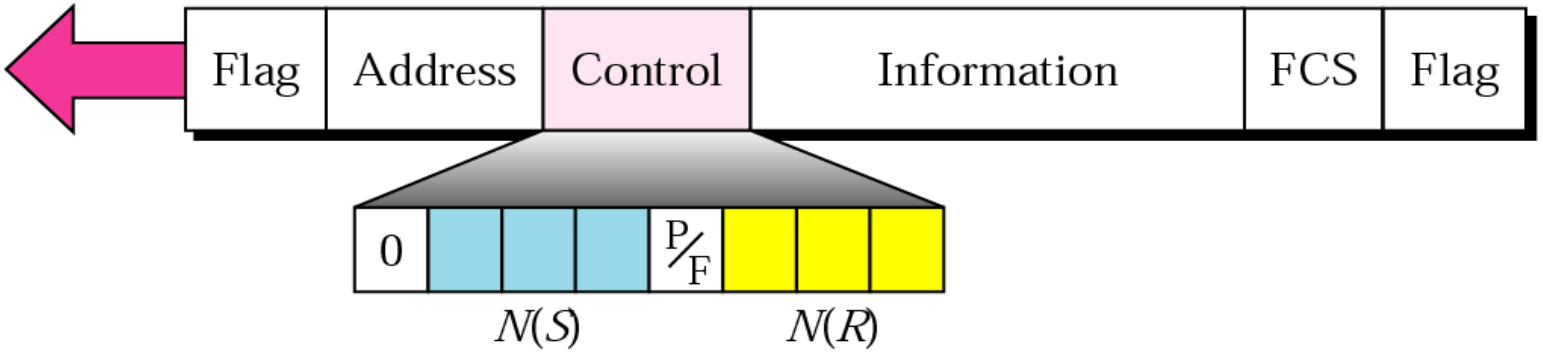
I-Frame

- **N(S)** : sequence # of the **sent frame**
- **N(R)** : sequence # of frame **expected in return**
  - ➔ **N(R)** is ACK field
- If last frame received is error free

  ➔ N(R) number will be the next frame in sequence
- If the frame was not received correctly

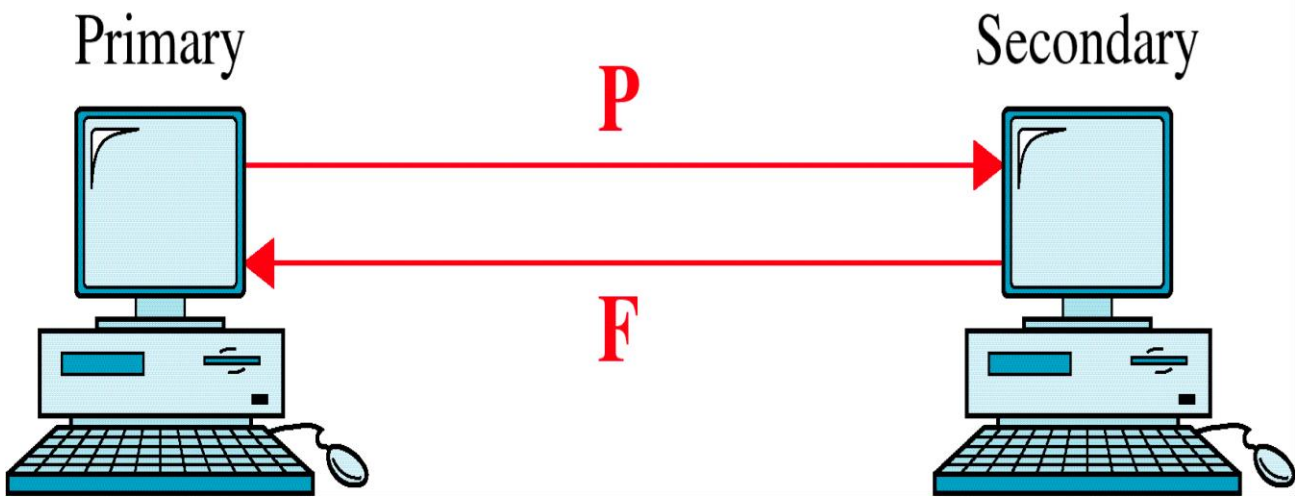
  ➔ N(R) number will be the number of damaged frame indicating the need for retransmission

I *frame*

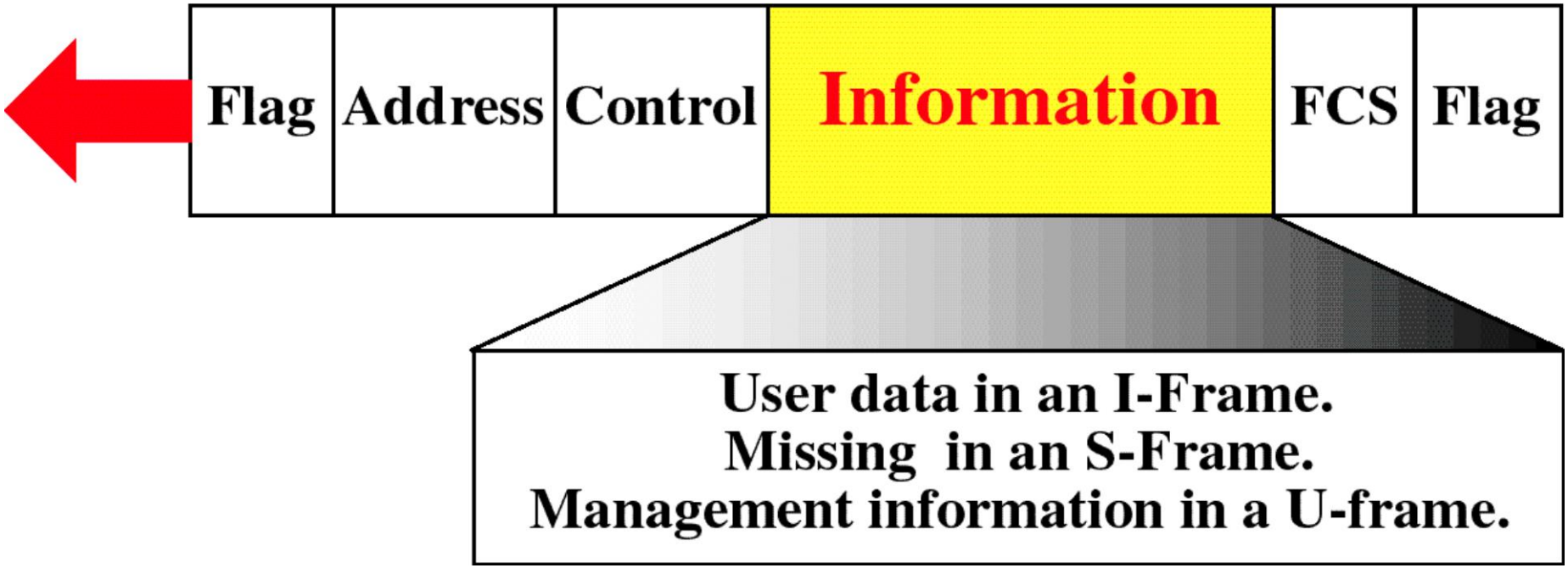


Poll/Final

- P/F = 1 ➔POLL or Final
  - **Poll** if frame is sent by the primary
  - **Final** if frame is sent by the secondary



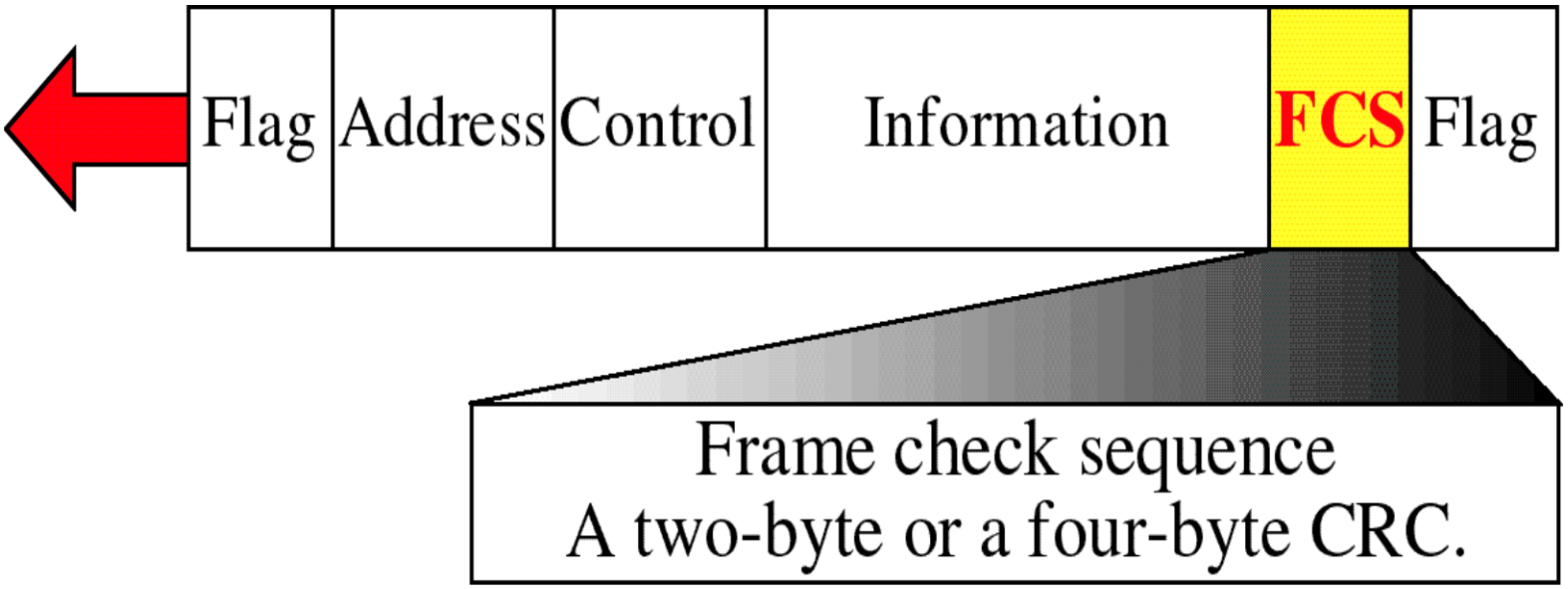
Information Field



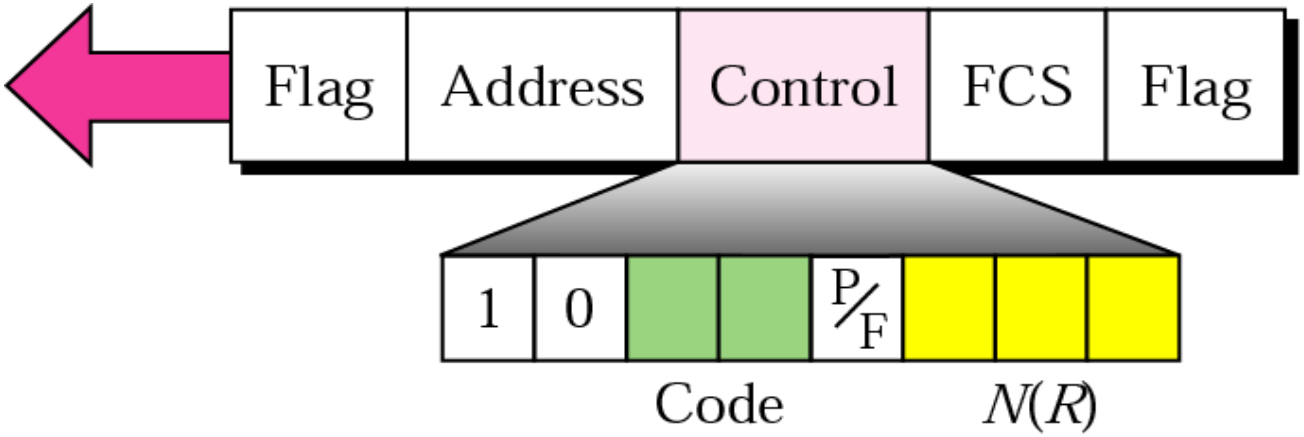
Information Field

- Contains **user data** in **I**-frame and **network management information** in a **U**-frame.
- It is possible to include flow and error control information in an I-frame that also contains data.
- In 2-way exchange of data (1/2 or full-duplex), the 2nd station can ACK receipt of data from the 1st station in the control field of its own data frame rather than sending a separate frame just for ACK.
- Combining data to be sent & ACK of the frame received in one single frame is called **PIGGYBACKING**.

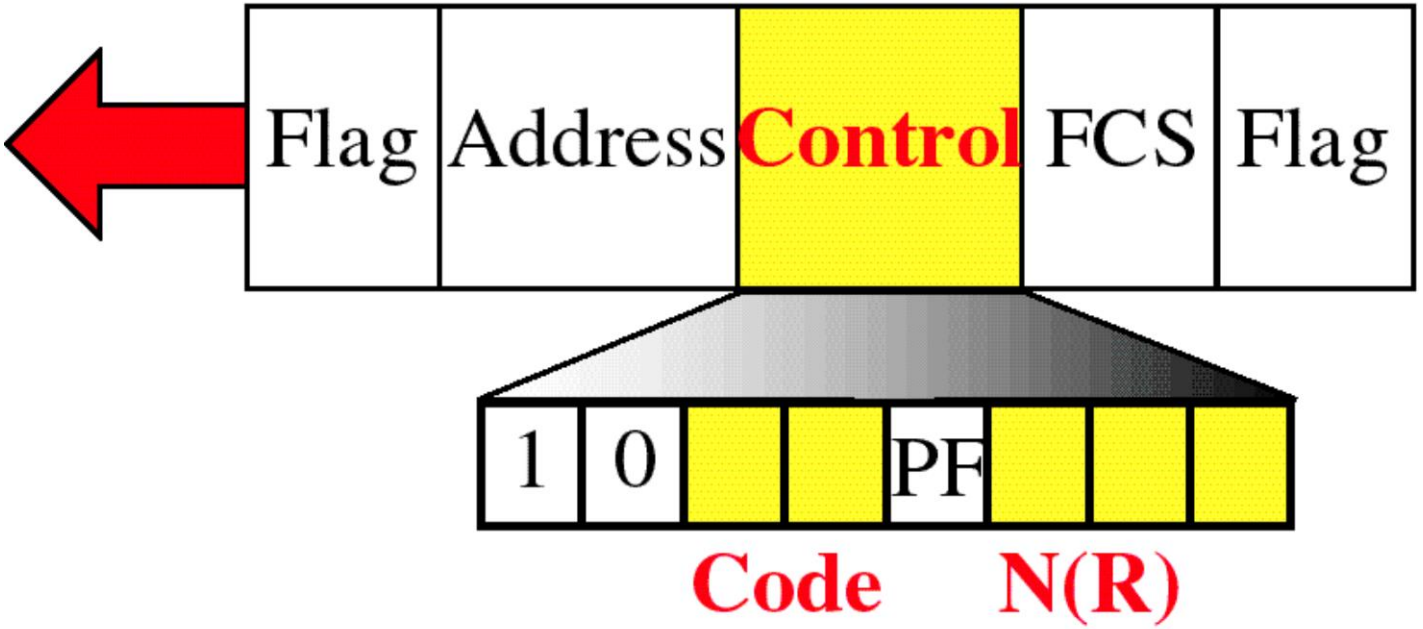
HDLC FCS Field



S-frame control field in HDLC



S-Frame



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

- **Receive Ready (RR)**
  - Positive ACK of a received I- frame
- **Receive Not Ready (RNR)**
  - Is RR frame with additional duties
  - It Ack the receipt of a frame and announces that the receiver is busy
- **Reject (REJ)**
  - This is a NAK frame that can be used in Go-back-n
- **Selective reject (SREJ)**
  - This is a NAK frame used in Selective Repeat ARQ

Project 802

- A Local area Network is the data communication system that allows a number of independent devices to communicate directly with each other in a limited geographical area.
- LANs are dominated by four architecture:
  - Ethernet
  - Token Bus
  - Token Ring
  - Fiber distributed data interface
- Token Bus, Token Ring and Ethernet are standards of IEEE and a part of project 802.

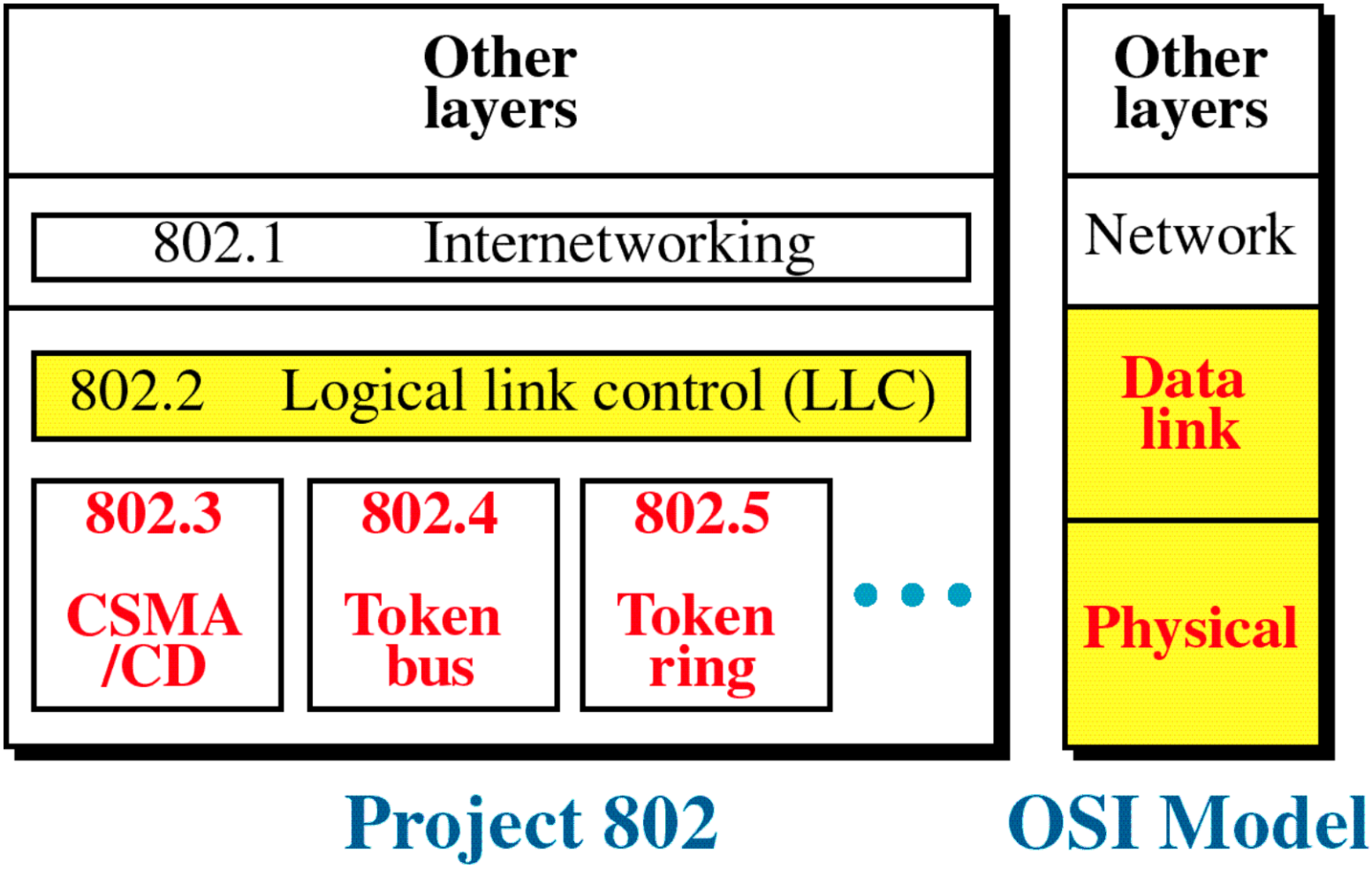
Project 802

- The computer society of the IEEE started a project, called 802 to set up standards to enable intercommunication between equipment from a variety of manufacturers.
- Project 802 does not seek to replace any part of the OSI model.
- The IEEE has subdivided the data link layer into sub layers:
  - Logical link control(LLC)
  - Medium access control(MAC)

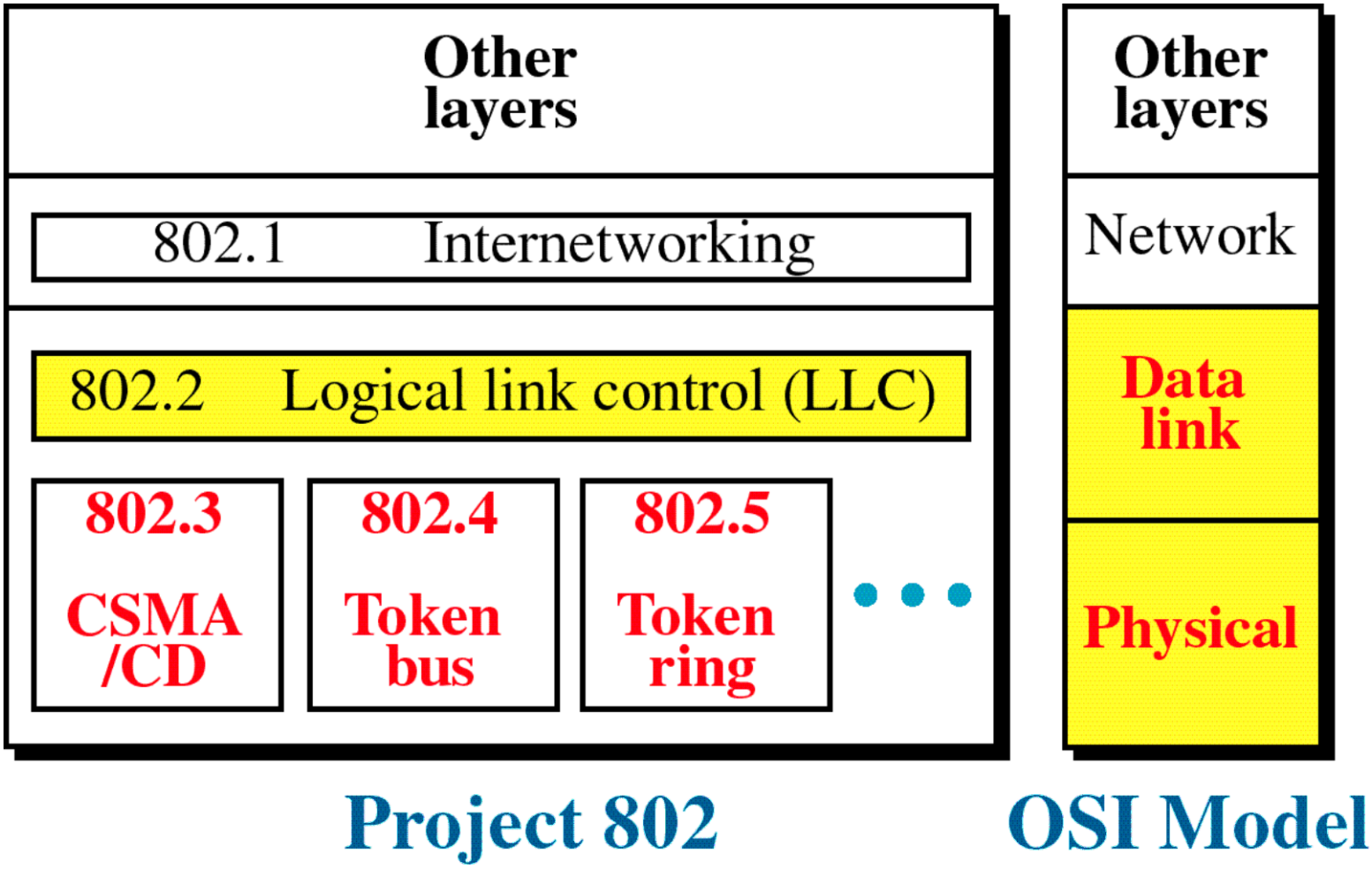
Project 802

- Each sub division is identified by a number:
  - 802.1 (Internetworking)
    - Standards for LAN
  - 802.2 (LLC)
    - Frame(Logical address, control information and data)
    - Consist PDU
  - 802.3 (MAC)
    - Resolve the contention
    - Synchronization, Flag, flow/error control, Physical address
  - 802.4 (Token Bus)
  - 802.5 (Token Ring)

Project 802


Other layers
802.1 Internetworking
802.2 Logical link control (LLC)
802.3 CSMA /CD
802.4 Token bus
802.5 Token ring
Other layers
Network
Data link
Physical
Project 802
OSI Model

Project 802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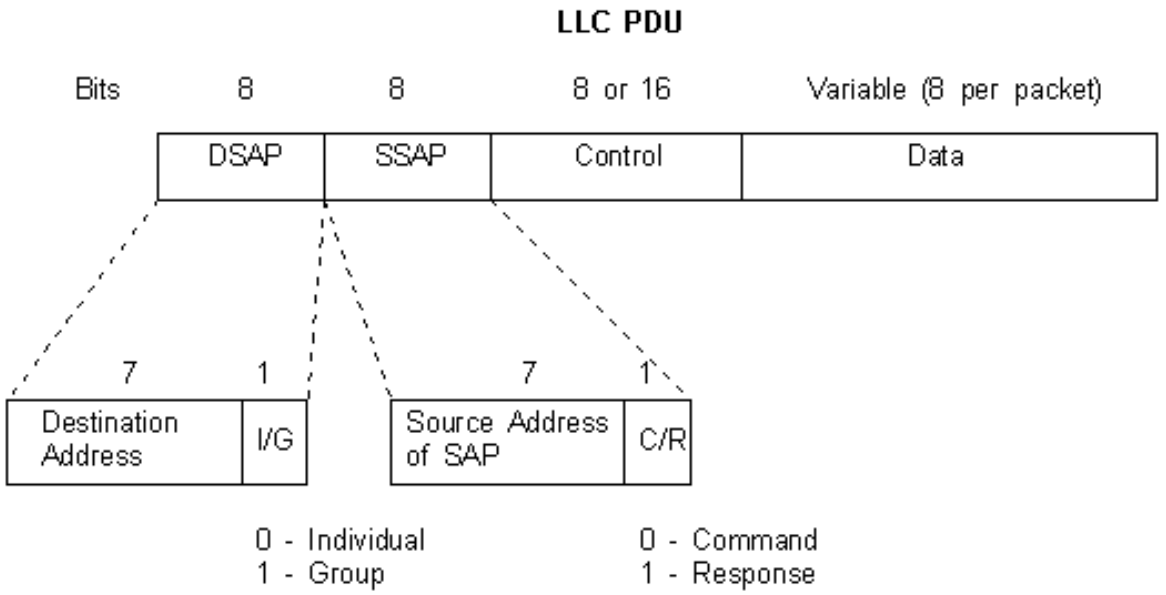
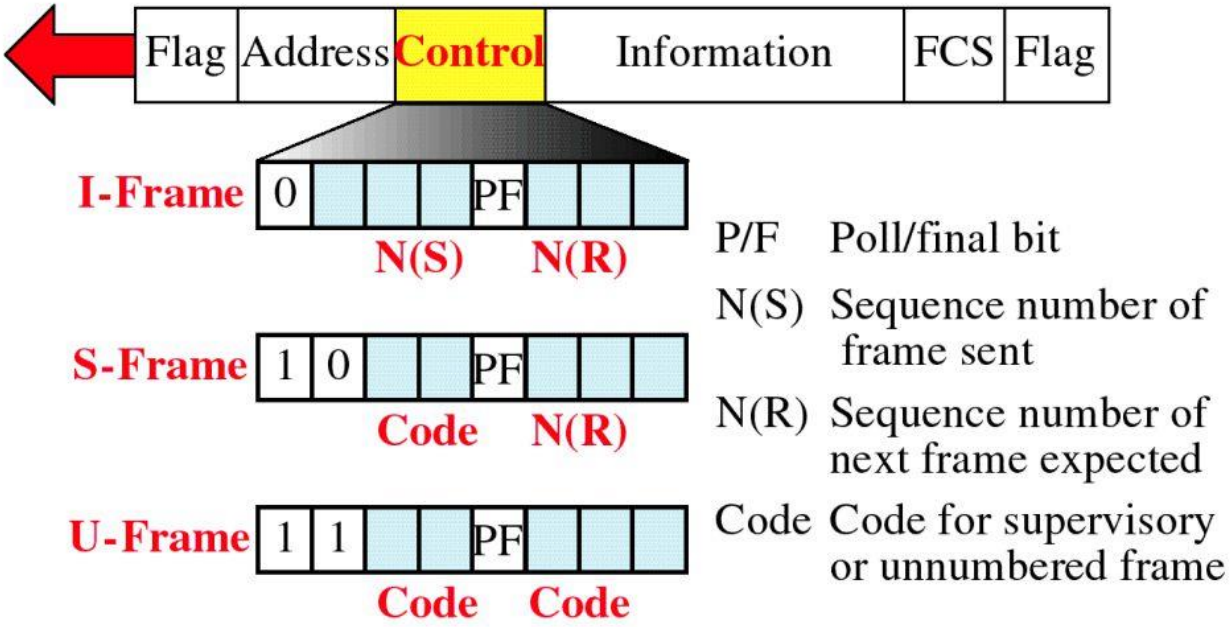
Project 802

- PDU(Protocol Data Units)



Project 802

HDLC Control Field



Code (S-frame) – carry coded flow and error control information
Code (U-frame) – identify the type of U-frame and its function

HDLC [High Level Data Link Control] :- It is a bit-oriented protocol for communication over point-to point and multipoint links.

Transfer Modes:-

Normal Response Mode (NRM)

↳ Station Config. is Unbalanced.

* One Primary station
  ↳ Send Commands.
* Multiple Secondary Station
  ↳ Respond

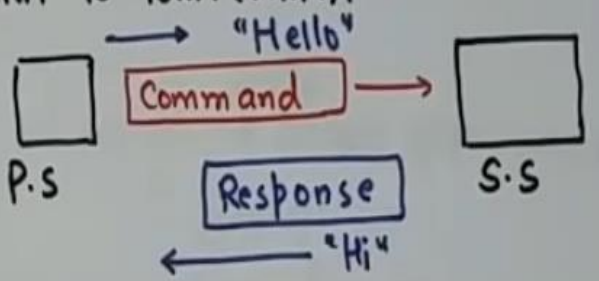
→ Point to point and Point to multipoint

Asynchronous Balanced Mode (ABM)

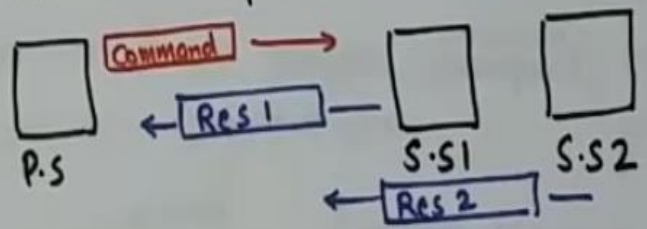
↳ Configuration is Balanced.

* Point to Point
* Each Station Can function as Primary & Secondary.

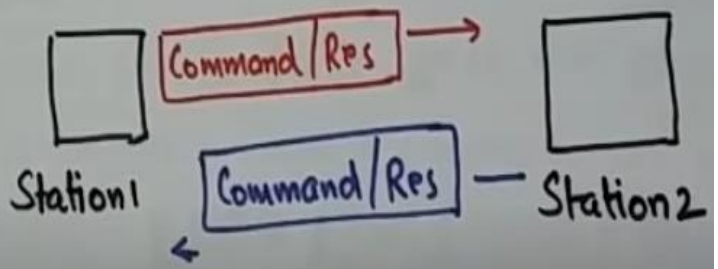
Point to Point (NRM):-



Point to Multipoint (NRM):-

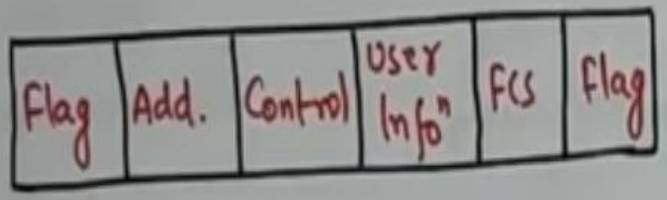


Point to Point (ABM):-

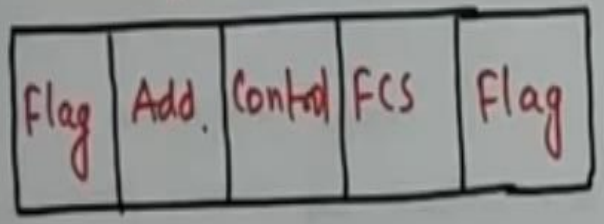


Types of Frames in HDLC:- There are three types of frames supported by HDLC.

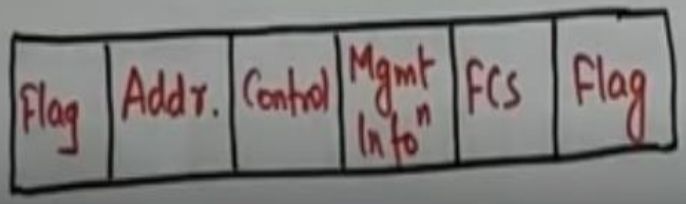
i) Information (I) Frames:- Transport → user data / → Control info"



ii) Supervisory (S) Frames:- Transport only Control Inf



iii) Unnumbered (U) Frames:- Reserved for System Mgmt.



Frame format of HDLC:- There are Six (6) (↳ upto) types of fields.

i) Flag → Beginning / End] of the Frame. | Serves as Synchronization pattern for receiver.

ii) Address → Contains the Address of the Station (Secondary)

P.S — 'to'

S.S — 'from'

iii) Control → used for Error and Flow Control.

iv) Information → User's data or Management Info".

v) FCS → Frome Check Sequence.
↳ HDLC Error detection field.