DATA LINK CONTROL (DLC)

DLC SERVICES

Data link control functions include framing and flow and error control.

1. **Framing**
    - Data transmission in the physical layer means moving bits in the form of a signal from the source to the destination.
    - The physical layer provides bit synchronization to ensure that the sender and receiver use the same bit duration and timing.
    - The data- link layer, on the other hand, needs to pack bits into frames, so that each frame is distinguishable from another.
    - Framming in the data- link layer separates a message from one source to a destination by adding a sender address and a destination address. The destination address defines where the packet is to go; the sender address helps the recipient acknowledge the receipt.

Frame size

- Frames can be fixed or variable size. In fixed size framing, there is no need for defining the boundaries of the frames; The size itself can be used as a delimiter. In variable size framing, prevalent in local – area networks. In variable size framing, we need a way to define the end of one frame and the beginning of the next.

Character-Oriented Framming

- In character- oriented (or byte -oriented) framing, data to be carried are 8-bit characters from a coding system such as ASCII. The header, which normally carries the source and destination addresses and other control information, and the trailer, which carries error detection redundant bits.

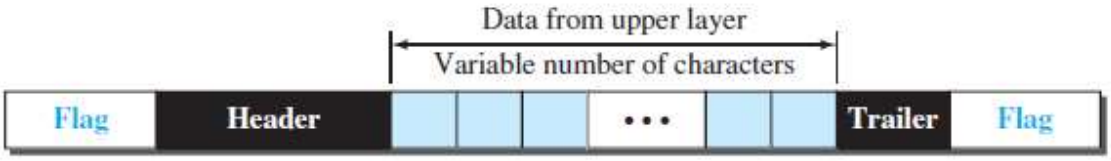

Fig1 : A frame in a character-oriented protocol.

- In byte stuffing (or character stuffing), a special byte is added to the data section of the frame when there is a character with the same pattern as the flag.
- The data section is stuffed with an extra byte.
- The byte is usually called the escape character (ESC) and has a predefined bit pattern.
- Whenever the receiver encounters the ESC character, it removes it from the data section and treats the next character as data, not as a delimiting flag.
- Fig 2 shows the situation.

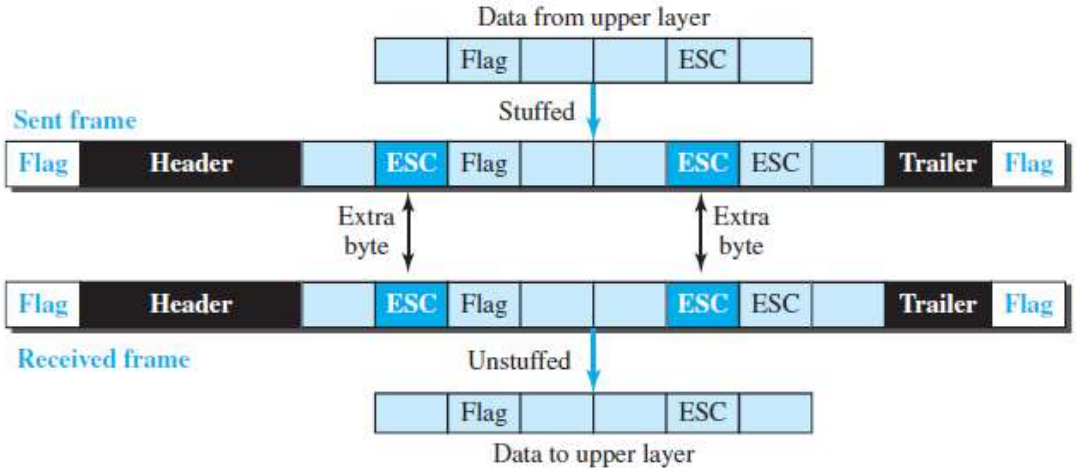

Fig 2: Byte stuffing and unstuffing

- Byte stuffing is the process of adding one extra byte whenever there is a flag or escape character in the text.

Bit Oriented Framming

- In bit-oriented framing, in addition to headers we still need a delimiter to separate one frame from the other.
- Most protocols use a especial 8 bit pattern flag, 01111110, as the delimeter to define the begining and end of the frame, as shown in fig3

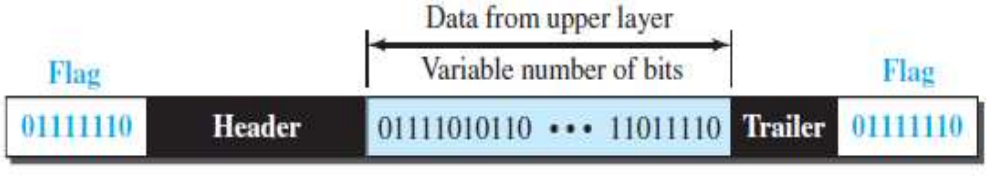

Fig 3: A frame in a bit-oriented protocol

- This flag can create the same type of problem, to prevent the pattern from looking like a flag.

- The stragery is called bit stuffing.
- Bit stuffing is the process of adding one extra 0 whenever five consecutive 1s follow 0 in the data, so that the receiver does not mistake the pattern 01111110 for a flag.

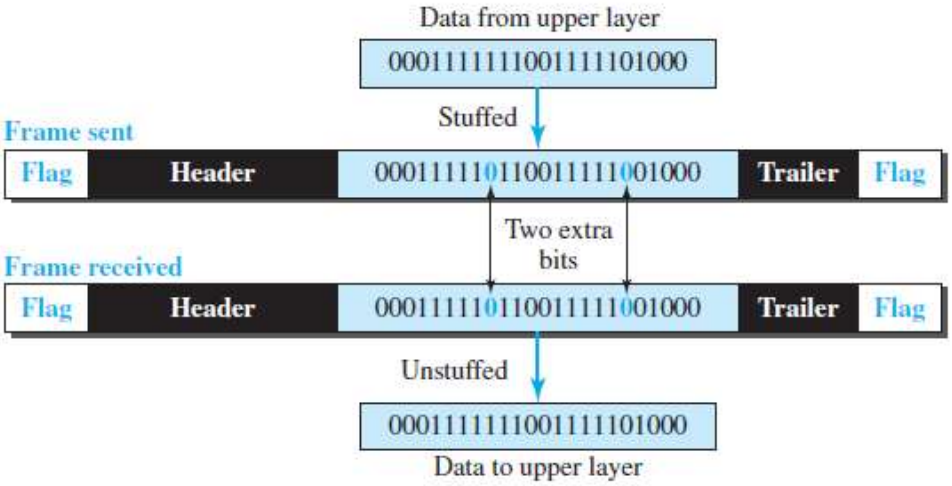

Fig 4: Bit stuffing and unstuffing

2. Flow and Error Control

- One of the responsibilities of the data-link control sublayer is flow and error control at the data- link layer.

Flow Control

- Whenever an entity produces items and another entity consumes them, there should be a balance between production and consumption rates.
- If the items are produced faster than they can be consumed, the consumer can be overwhelmed and may need to discard some items.
- We need to prevent losing the data items at the consumer site for that flow control is needed

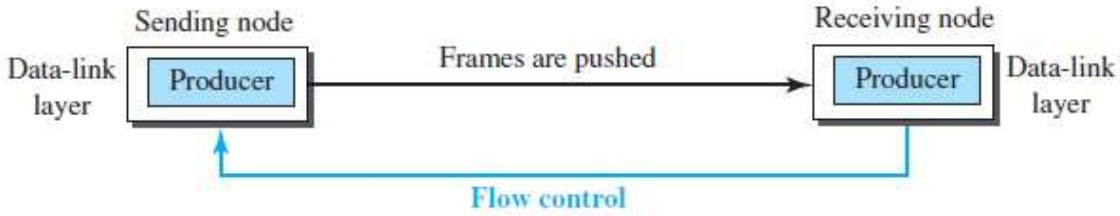

Fig 5: Flow control at the data-link layer

- The figure shows that the data-link layer at the sending node tries to push frames toward the data-link layer at the receiving node.

- If the receiving node cannot process and deliver the packet to its network at the same rate that the frame arrive, it becomes overwhelmed with frames.
- Flow control in this case can be feedback from the receiving node to the sending node to stop or slow down pushing frames.

Buffers:

- Although flow control can be implemented in several ways, one of the solutions is normally to use two buffers; one at the sending data-link layer and the other at the receiving data-link layer.
- A buffer is a set of memory locations that can hold packets at the sender and receiver.
- The flow control communication can occur by sending signals from the consumer to the producer.
- When the buffer of the receiving data –link layer is full, it informs the sending data –link layer to stop pushing frames.

Error Control:

- We need to implement error control at the data-link layer to prevent the receiving node from delivering corrupted packets to its network layer. Error control at the data-link layer is normally very simple and implemented using one of the following two methods.
    - In the first method, if the frame is corrupted, it is silently discarded; if it is not corrupted, the packet is delivered to the network layer. This method is used mostly in wired LANs such as Ethernet.
    - In the second method, if the frame is corrupted, it is silently discarded; if it is not corrupted, an acknowledgment is sent (for the purpose of both flow and error control) to the sender.

Combination of flow and Error Control

- Flow and error control can be combined, In a simple situation, the acknowledgment that is sent for flow control can also be used for error control to tell the sender the packet has arrived uncorrupted.

Connectionless and connection-oriented

A DLC protocol can be either connectionless or connection oriented.

Connectionless Protocol:

- In a connectionless protocol, frames are sent from one node to the next without any relationship between the frames; each frame is independent.

- Note that the term connectionless here does not mean that there is no physical connection between the nodes; it means that there is no connection between frames.
- The frames are not numbered and there is no sense of ordering.
- Most of the data-link protocols for LANs are connectionless protocols.

Connection-Oriented Protocols:

- In a connection-oriented protocol, a logical connection should first be established between the two nodes.(setup phase)
- After all frames that are somehow related to each other are transmitted, the logical connection is terminated.(transfer phase)
- In this type of communication, the frames are numbered and sent in order.
- If they are not received in order, the receiver needs to wait until all frames belonging to the same set are received and then deliver them in order to the network layer.