UNIVERSITY INSTITUTE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Bachelor of Computer Science

5th Semester

Computer Networks(**23CST-302/ 23ITT-302**)

Unit No. 1   **Chapter No. 3**   **Lecture No.16**

Topic : DLL-   Design issues of DLL

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Learning Objectives & Outcomes

Learning Objective

To understand the concepts of Flow Control & Error Control of Data link layer

Learning Outcome

Students will be able to learn design issues of Data Link layer that includes Services Provided to the Network Layer, Framing, Error Control & Flow Control

Data Link Layer

The data link layer uses the services of the physical layer to send and receive bits over communication channels. It has a number of functions, including:
1. Providing a well-defined service interface to the network layer.
2. Framing
3. Dealing with transmission errors. (Error Control)
4. Regulating the flow of data so that slow receivers are not swamped by fast senders.(Flow Control)

Data Link layer function

To accomplish these goals,
- The data link layer takes the packets it gets from the network layer and encapsulates them into frames for transmission.
- Each frame contains a frame header, a payload field for holding the packet, and a frame trailer, as illustrated in Fig. 2.1
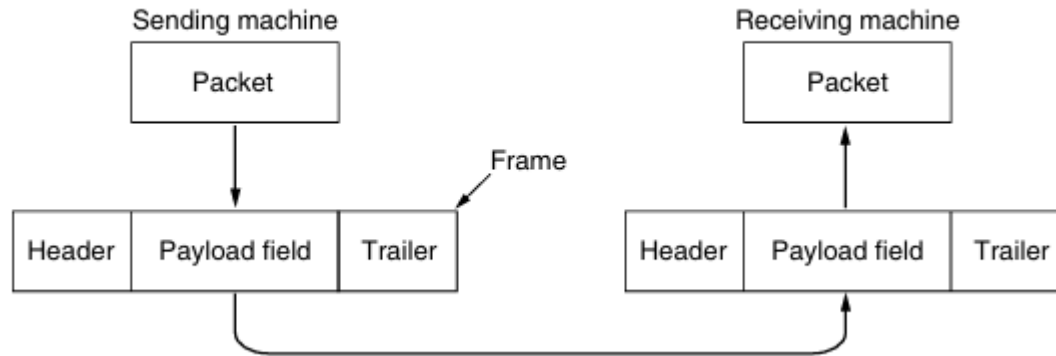

Fig 2.1   DLL Frame

Data Link Layer (Design Issues)

Various Design issues are:

1. **Providing services to the network layer**

2. **Framing**

3. **Error Control**

4. **Flow Control**

DLL Design Issues

1. Providing services to the network layer:

   a) Unacknowledged connectionless service.

       Appropriate for low error rate and real-time traffic. Ex: Ethernet

   b) Acknowledged connectionless service.

       Useful in unreliable channels, WiFi. Ack/Timer/Resend

   c) Acknowledged connection-oriented service.

       Guarantee frames are received exactly once and in the right order.

       Appropriate over long, unreliable links such as a satellite channel or

       a long- distance telephone circuit.

DLL Design Issues

2. Framing: Frames are the streams of bits received from the network layer into manageable data units. This division of stream of bits is done by Data Link Layer.
A good design must make it easy for a receiver to find the start of new frames while using little of the channel bandwidth.There are four methods:

a) **Byte count**-a field in the header to specify the number of bytes in the frame.
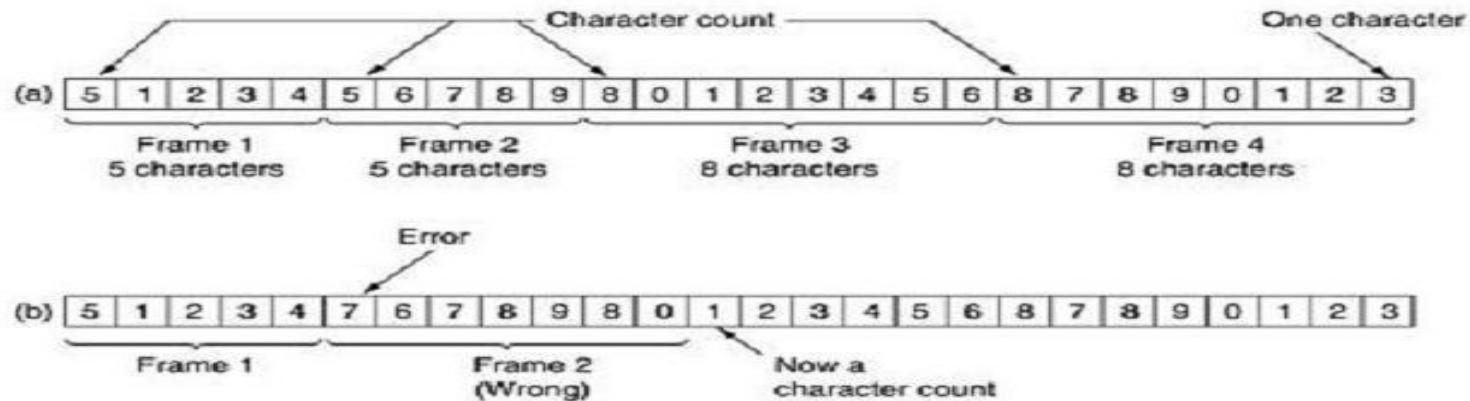

Fig. 2.2 Byte Count

DLL Design Issues

b) Flag bytes with byte stuffing-the same byte, called a flag byte, is used as both the starting and ending delimiter. The data link layer on the receiving end re moves the escape bytes before giving the data to the network layer. This technique is called byte stuffing.
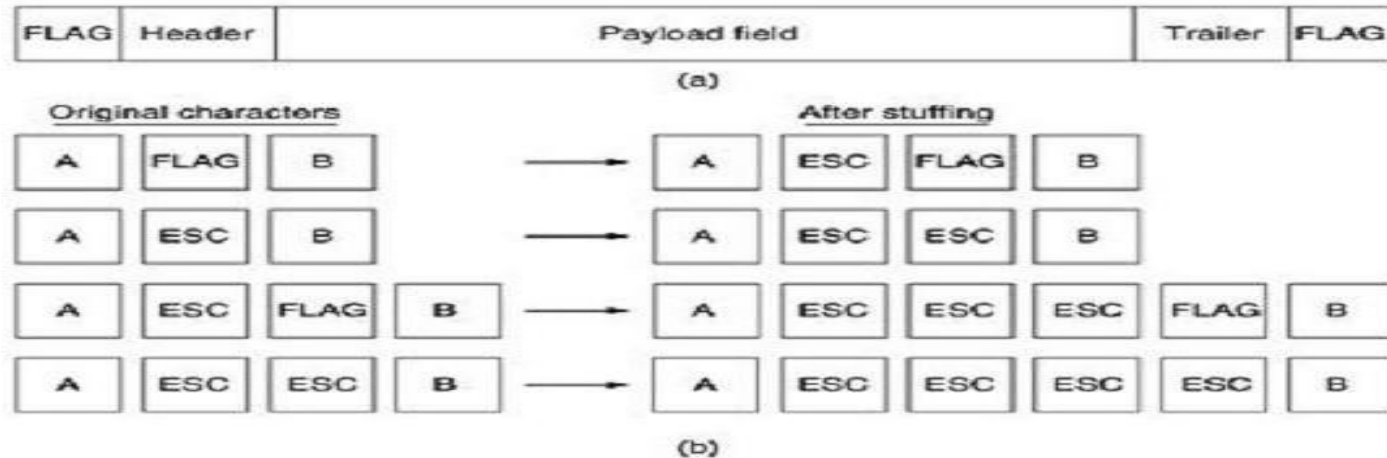

Fig. 2.3 a) A frame delimited by flag bytes (b) Four examples of byte sequences before and after byte stuffing

DLL Design Issues

c) Flag bits with bit stuffing- Each frame begins and ends with a special bit pattern
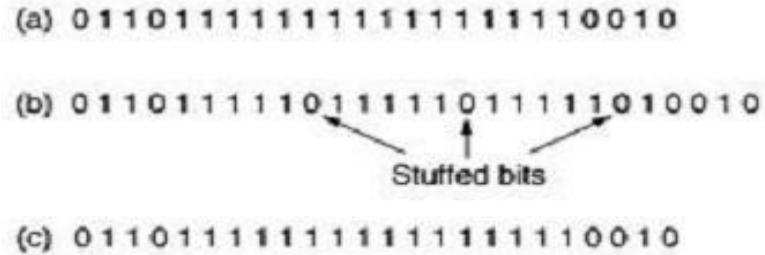

Fig 2.4 :Bit stuffing. (a) The original data. (b) The data as they appear on the line.(c) The data as they are stored in the receiver's memory after destuffing

d) Physical layer coding violations-Some reserved signals to indicate the start and end of frames. In effect, we are using ''coding violations'' to delimit frames.
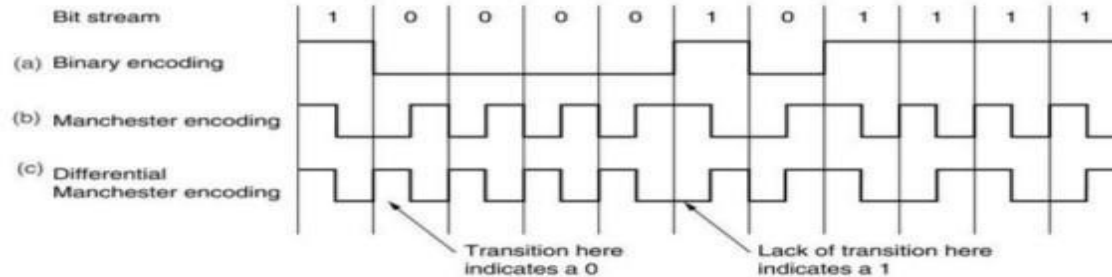
DLL Design Issues

Fig. 2.5 Binary/Manchester Encoding

3. Physical Addressing: The Data Link layer adds a header to the frame in order to define physical address of the sender or receiver of the frame, if the frames are to be distributed to different systems on the network.

DLL Design Issues

4. Flow Control: A receiving node can receive the frames at a faster rate than it can process the frame. Without flow control, the receiver's buffer can overflow, and frames can get lost. To overcome this problem, the data link layer uses the flow control to prevent the sending node on one side of the link from overwhelming the receiving node on another side of the link. This prevents traffic jam at the receiver side.Ways for Flow Control are:

a) **Feedback-based flow control:** The receiver sends back information to the sender giving it permission to send more data, or at least telling the sender how the receiver is doing.

b) **Rate-based flow control:** The protocol has a built-in mechanism that limits the rate at which senders may transmit data, without using feedback from the receiver.

DLL Design Issues

5. i)Error Control: Error control is achieved by adding a trailer at the end of the frame. Duplication of frames are also prevented by using this mechanism. Data Link Layers adds mechanism to prevent duplication of frames.
ii) Error detection: Errors can be introduced by signal attenuation and noise. Data Link Layer protocol provides a mechanism to detect one or more errors. This is achieved by adding error detection bits in the frame and then receiving node can perform an error check.
iii)Error correction: Error correction is similar to the Error detection, except that receiving node not only detects the errors but also determine where the errors have occurred in the frame.

Summary of the Lecture

The data link layer faces several key design issues to ensure reliable communication over a physical link.

- It must define how to **frame data** so the receiver can identify the start and end of each frame.
- It also needs effective **error control** mechanisms to detect and correct transmission errors.
- **Flow** control is important to prevent faster senders from overwhelming slower receivers.
- Finally, when multiple devices share the same medium, the data link layer must manage **access control** to avoid collisions and ensure fair usage.

Next Lecture

- Error Detection & Correction

FAQ's

Q1: What is the main purpose of framing in the data link layer?

Q2: How does the data link layer handle errors during transmission? Q3:

Q3: Why is flow control necessary in the data link layer?

Q4: What methods are used to control access in shared communication
   media?

Q5: How does the data link layer identify devices on the same network?

References/ Articles/ Videos

References

- Computer Networks, Tanenbaum, Andrew, Fifth Edition, PHI.
- Data Communication and Networking, Behrouz A. Forouzan, Fourth Edition.Larry

Videos

[1] https://www.youtube.com/watch?v=oQ96ceboZuo

[2] https://www.youtube.com/watch?v=2U6kPu0dfqI

Relevant learning resources

- NPTEL CN COURSE
- https://www.coursera.org/learn/introduction-to-networking-nvidia

Class-Wise Feedback

Thank You

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