

# Data Link Layer, Part 1

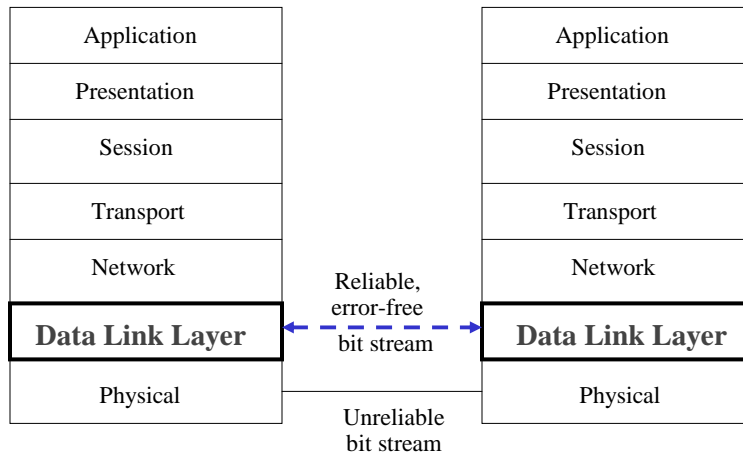
## Introduction

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## DLL in OSI Model



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## Functionalities of DLL

- Framing
  - how does a transmission unit start and end?
- Error detection/correction
- Flow control
- Reliability
  - actions in the presence of transmission errors

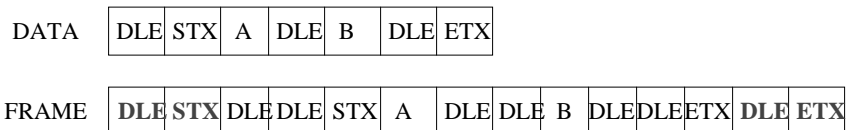
Not all these features are present in all DLL protocols

## Framing

- character-based framing
- bit-oriented framing
- violations of physical layer encoding

## Character–Oriented Framing

- ❑ DLE STX --- start of frame
- ❑ DLE ETX --- end of text
- ❑ SYN --- between frames
- ❑ What do we do if DLE appears in the frame?
  - at sending end, insert extra DLE before each DLE in data
  - at receiving end, extra ”stuffed” DLE’s are extracted
  - this is called **character stuffing**



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## Bit Oriented Framing

- ❑ Start – and stop-frame pattern: 0 1 1 1 1 1 1 0
- ❑ Bit Stuffing
  - sender inserts 0 after every sequence of five 1’s
  - when the receiver sees five 1’s followed by 0, extracts the 0
  - receiver recognizes the end of the frame when seeing six 1’s.
  - Example: 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0 1 1 1 0 0 0

**0111111011111010101111100011100001111110**

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## Violations of Physical Layer Encoding

- In some physical layer encoding methods, there are unused/illegal states in a bit period.
  - In the Manchester encoding, a legal bit period can be either HL or LH, but never HH and LL
- We can use “illegal bits” to represent the beginning and/or ending of frames.
  - Ethernet uses HH to mark the end of frames.