

CN1047 INTRODUCTION TO COMPUTER NETWORKING

CHAPTER 4

OSI MODEL – DATA LINK LAYER



Data Link Layer

- **Data Link Layer is second layer of OSI Layered Model.**
- **This layer is one of the most complicated layers and has complex functionalities and liabilities.**
- **Data link layer hides the details of underlying hardware and represents itself to upper layer as the medium to communicate.**

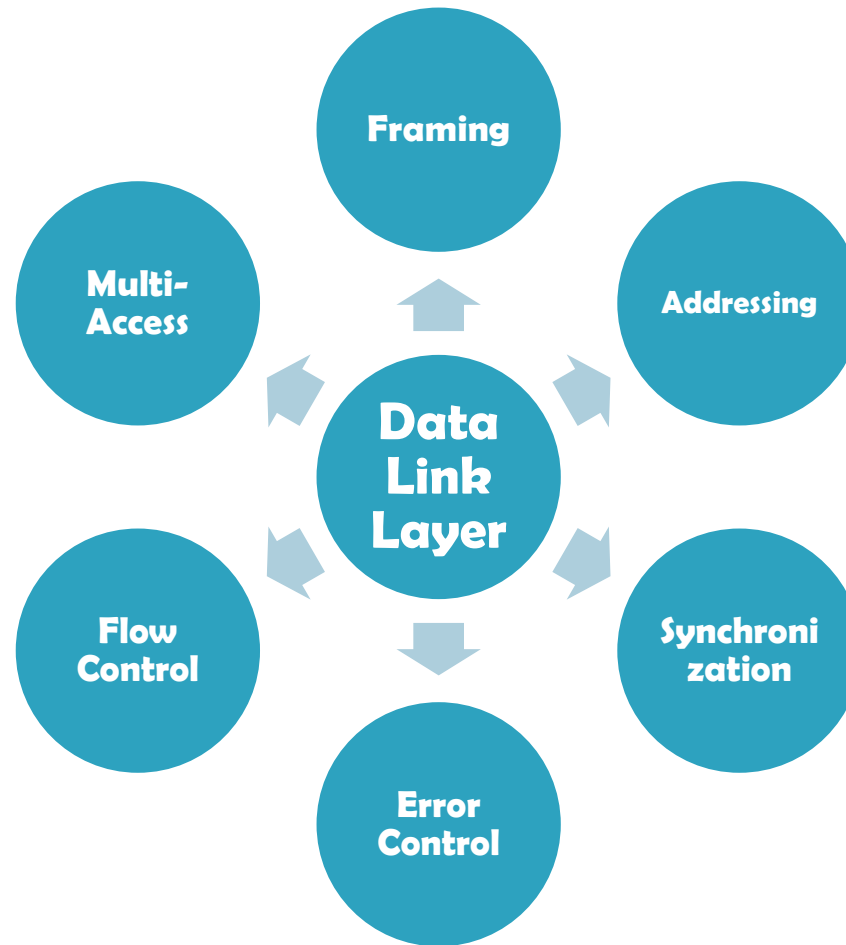
Data Link Layer

- ❑ **It takes raw transmission facility and transform it into a line free of transmission errors to network layer.**
- ❑ **It sends acknowledgement for received frames, retransmits frame it is not received by receiver and check for duplicate frames.**
- ❑ **It takes care of a slow receiver.**

Data Link Layer

- **Data link layer has two sub-layers:**
 - **Logical Link Control:** It deals with protocols, flow-control, and error control
 - **Media Access Control:** It deals with actual control of media

Functionality of Data-link Layer



Functionality of Data-link Layer

Framing

- ❑ **Data-link layer takes packets from Network Layer and encapsulates them into Frames.**
- ❑ **Then, it sends each frame bit-by-bit on the hardware.**
- ❑ **At receiver' end, data link layer picks up signals from hardware and assembles them into frames.**

Functionality of Data-link Layer

Addressing

- ❑ **Data-link layer provides layer-2 hardware addressing mechanism.**
- ❑ **Hardware address is assumed to be unique on the link.**
- ❑ **It is encoded into hardware at the time of manufacturing.**

Functionality of Data-link Layer

Synchronization

- **When data frames are sent on the link, both machines must be synchronized in order to transfer to take place.**

Functionality of Data-link Layer

Error Control

- ❑ **Sometimes signals may have encountered problem in transition and the bits are flipped.**
- ❑ **These errors are detected and attempted to recover actual data bits.**
- ❑ **It also provides error reporting mechanism to the sender.**

Functionality of Data-link Layer

Flow Control

- ❑ **Stations on same link may have different speed or capacity.**
- ❑ **Data-link layer ensures flow control that enables both machine to exchange data on same speed.**

Functionality of Data-link Layer

Multi-Access

- **When host on the shared link tries to transfer the data, it has a high probability of collision.**
- **Data-link layer provides mechanism such as CSMA/CD to equip capability of accessing a shared media among multiple Systems.**

Error Detection & Correction

- ❑ **There are many reasons such as noise, cross-talk etc., which may help data to get corrupted during transmission.**
- ❑ **The upper layers work on some generalized view of network architecture and are not aware of actual hardware data processing.**
- ❑ **Hence, the upper layers expect error-free transmission between the systems.**

Error Detection & Correction

Types of Errors

1. Single bit error

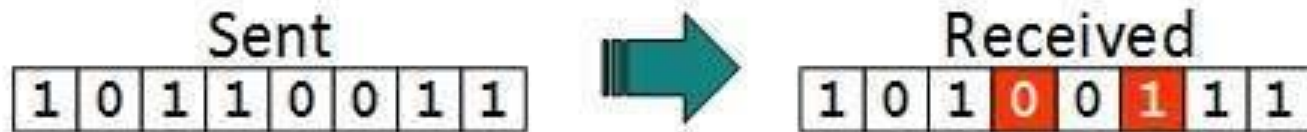


- In a frame, there is only one bit, anywhere though, which is corrupt.

Error Detection & Correction

Types of Errors

2. Multiple bits error



- **Frame is received with more than one bits in corrupted state.**

Error Detection & Correction

Types of Errors

3. Burst error



- **Frame contains more than 1 consecutive bits corrupted.**

Error Detection & Correction



- **Error control mechanism may involve two possible ways:**
 - **Error detection**
 - **Error correction**

Error Detection & Correction

Error Detection

- ❑ Errors in the received frames are detected by means of **Parity Check** and **Cyclic Redundancy Check (CRC)**.
- ❑ In both cases, few extra bits are sent along with actual data to confirm that bits received at other end are same as they were sent.
- ❑ If the counter-check at receiver' end fails, the bits are considered corrupted.

Error Detection & Correction

Error Detection



The receiver simply counts the number of 1s in a frame. If the count of 1s is even and even parity is used, the frame is considered to be not-corrupted and is accepted. If the count of 1s is odd and odd parity is used, the frame is still not corrupted.

Error Detection & Correction

Error Correction

- **In the digital world, error correction can be done in two ways:**
 - **Backward Error Correction**
 - **When the receiver detects an error in the data received, it requests back the sender to retransmit the data unit.**
 - **Forward Error Correction**
 - **When the receiver detects some error in the data received, it executes error-correcting code, which helps it to auto-recover and to correct some kinds of errors.**

Error Detection & Correction

Error Correction

- ❑ **The first one, Backward Error Correction, is simple and can only be efficiently used where retransmitting is not expensive. For example, fiber optics.**
- ❑ **But in case of wireless transmission retransmitting may cost too much.**
- ❑ **In the latter case, Forward Error Correction is used.**

Error Detection & Correction

Error Correction

- ❑ **To correct the error in data frame, the receiver must know exactly which bit in the frame is corrupted.**
- ❑ **To locate the bit in error, redundant bits are used as parity bits for error detection.**