

Q.1 Define Data Link Layer. Give its introduction.

Ans: Data link layer is the second layer of OSI model.

- This layer is the most complicated and has complex functionalities and liabilities.
- It hides the details of underlying hardware and represents itself to upper layers as the medium of communication.
- It works between two hosts which are directly connected in some sense.
- This direct connection could be point-to-point or broadcast.
- Systems on broadcast network are said to be on same link.
- The work of data link layer gets more complicated when it is dealing with multiple hosts or single collision domain.
- It is responsible for converting data stream to signals bit by bit and to send that over the underlying hardware.
- At receiving end, Data link layer picks up data from hardware which are in the form of electrical signals, assemble them in a recognizable frame format, and handle over to upper layers.

- 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.

Q.2) Explain Data Link Layer Services in detail.

Ans The services of Data Link Layer is explained below:

- 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's end, data link layer picks up signals from hardware and assembles them into frames
- 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.

- Synchronization: when data link frames are sent on the link, both machines must be synchronized in order to transfer to take place.
- 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 errors reporting mechanism to the sender.
- 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.
- 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.

Q.3] Write about Errors Detection and Errors correction in detail.

Ans First of all errors is a ~~code~~ condition when the output information does not match with the input information.

- During transmission, digital signals suffer from noise that can introduce errors in the binary bits travelling from one system to other.
- That means a 0 bit may change to 1 or a 1 bit may change to 0.

- Errors-Detection codes:

- Whenever a message is transmitted, it may get scrambled by noise or data may get corrupted.
- To avoid this, we use - errors-detecting codes which are additional data added to a given digital message to help us detect if an error occurred during transmission of the message.
- A simple example of error-detecting code is parity check.

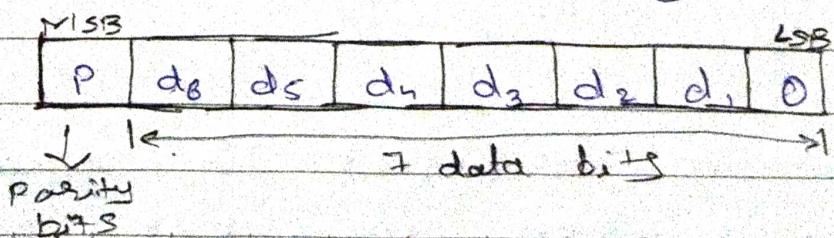
- Errors - Correction codes:

- Here, Parity check has a simple way to detect errors along with a sophisticated mechanism to determine the corrupt bit.

location.

Once the corrupt bit is located, its value is reverted (from 0 to 1 or 1 to 0) to get the original message.

- How to detect and correct errors?
- To detect and correct the errors, additional bits are added to the data bits at the time of transmission.
- The additional bits are called parity bits. They allow detection or correction of the errors.
- The data bits along with the parity bits form a code word.
- Parity checking of Error Detection.
- It is the simplest technique for detecting and correcting errors.
- The MSB of an 8-bits word is used as the parity bit and the remaining 7 bits are used as data or message bits.
- The parity of 8-bits transmitted word can be either even parity or odd parity.



- Even Parity :- It means the number of 1's in the given word including the parity bit should be even (2, 4, 6, ...)
- Odd Parity :- It means the number of 1's in the given word including the parity bit should be odd (1, 3, 5, ...)

=> There are also other techniques of errors detection like:

- checksum Method
- Cyclic Redundancy Check

Q.4) Explain Multiple Access Links and Protocols in detail.

Ans There are two type of network links:

- A point-to-point link consists of a single sender at one end of the link and a single receiver at the other end of the link.
- A broadcast link, can have multiple sending and receiving nodes all connected to the same, single shared broadcast channel.
- The term broadcast is used here because, when any one node transmits

a frame, the channel broadcasts the frame and each of the other nodes receives a copy.

- Multiple Access Protocols

- Categories of Multiple Access Protocols:

1. Channel Partitioning Protocols.

- Divide channel into smaller "pieces"!
(time slots, frequency, code)
- Allocate piece to node for exclusive use
- Examples of channel partitioning protocols
 - TDMA: Time Division Multiple Access
 - FDMA: Frequency Division Multiple Access
 - CDMA: Code Division Multiple Access

2. Random Access Protocols

- channel is not divided and allow collisions.
- "Recover" from collisions
- Examples of random access MAC (Medium Access Control) protocols
 - Pure ALOHA
 - Slotted ALOHA
 - CSMA, CSMA/CD, CSMA/CA

3. Taking-turns protocols

- Nodes take turns but nodes with more

to send can take longer turns.

Examples of taking -turn protocols

- Polling
- Token passing.