**DATA LINK LAYER**

**I. Introduction to data link layer:**

Networks use physical components connected by various media. Data needs assistance to travel across different media types, similar to how a golf ball travels differently through air versus water. The data link layer provides this necessary assistance, adapting to various factors to ensure successful data delivery.

- Connects upper-layer processes to the physical layer

- Places data on and receives data from the network.

- Provides data delivery between ethernet devices

**II. Purpose of data link layer:**

- The Data Link Layer (Layer 2) of the OSI model is responsible for communication between network interface cards (NICs). Its key functions include:

* **Media Access:** Provides a way for upper layers to interact with the network media, regardless of the specific type.
* **Encapsulation:** Takes Layer 3 packets (like IPv4 or IPv6) and wraps them into Layer 2 frames.
* **Media Control:** Manages how data is sent and received on the network media.
* **Frame Exchange:** Handles the transmission of frames between devices.
* **Decapsulation & Routing:** Receives frames, extracts the Layer 3 packets, and directs them to the correct upper-layer protocol.
* **Error Detection:** Detects and discards corrupted frames.

- A network node is any device (like a laptop, phone, or switch) that handles data in a network. The Data Link Layer is crucial because it shields higher-level protocols (like IP) from the complexities of different network media.

- Without it, IP would need to know how to work with every single type of network connection. The Data Link Layer takes a Layer 3 packet (like an IP packet) and adds Layer 2 information (like source and destination MAC addresses for Ethernet) before passing it down to the Physical Layer for transmission. This simplifies network design and allows IP to remain independent of the underlying physical media.

**III. IEEE 802 LAN/MAN Data Link Sublayers:**

IEEE 802 LAN/MAN standards define how devices connect in local and metropolitan networks (like Ethernet and Wi-Fi). The data link layer has two sublayers:

* **LLC (Logical Link Control)**: **Talks to network software and hardware**, identifies which **network protocol (like IPv4 or IPv6) is being used**.
* A screen shot of a computer

  AI-generated content may be incorrect.**MAC (Media Access Control)**: **Hardware-based, handles data packaging, network access, addressing, and works with the physical layer**

- **LLC:** Adds control info to network protocol data (like IPv4/6) for delivery.

- **MAC:** Controls hardware (NIC) for sending/receiving data. It handles:

* **Framing:** Marks the start/end of data.
* **Addressing:** Source/destination info.
* **Error Detection:** Checks for transmission problems.
* **Media Access:** Manages shared network communication (not needed for full-duplex).

**III. Providing Access to Media:**

Networks vary (e.g., busy Ethernet LAN vs. simple serial link). The MAC sublayer handles media access for shared mediums (like Ethernet), but isn't needed for direct connections. Routers move packets between networks, each with potentially different link characteristics. They perform these Layer 2 functions:

1. Receive: Accept a frame from a medium (e.g., Ethernet).
2. De-encapsulate: Remove the frame's header/trailer to get the original network packet.
3. Re-encapsulate: Add a *new* frame header/trailer appropriate for the *next* network segment (e.g., serial link).
4. Forward: Send the new frame onto the next medium.

A diagram of a connection between a lan trailer

AI-generated content may be incorrect.So, a router essentially translates frames between different network types as a packet travels through the internetwork.

A person sitting at a computer

AI-generated content may be incorrect.

**IV. Data Link Layer Standards:**

* TCP/IP's Top Layers: The IETF (Internet Engineering Task Force) makes the rules for how the upper layers of TCP/IP (like how applications talk to each other) work.
* Data Link Layer is Different: But the IETF *doesn't* define the Data Link Layer (how devices physically connect).
* Who Makes the Rules? Other groups handle that:
  + IEEE: Think Ethernet, Wi-Fi.
  + ITU: Telecommunications standards.
  + ISO: A big standards organization.
  + ANSI: American standards.

Basically, different organizations set the standards for the lower, more hardware-focused layers of networking.

- The media access control method used depends on **Topology and Media Sharing**

- The MAC sublayer controls how devices access and use the network medium to send and receive frames. It's like traffic control for network communication.

- **IEEE** organization defines standards for the network access layer (i.e., the OSI physical and data link layers)?

**V. Frame formatting:**

- Network layer packets are encapsulated into frames

A diagram of a network layer

AI-generated content may be incorrect.- They are given a header and trailer to create a PDU(Protocol Data Unit)

Components of the HEADER:

- Start Frame (8 bytes)

- Address (12 bytes)

- Type/Length (2 bytes)

Components of the TRAILER:

- FCS (Frame Check Sequence)

- Stop Frame when field length is not used (Optional)

**VI. Logical Link Control Sub-Layer:**

- Prepares data for transmission

- Frames the network layer packet

- Identifies network layer protocols

**VII. Media Access Control Sub-layer:**

- Addresses the frame

- Marks the beginning and end of a frame

- Access to physical hardware.

=> For Youtube link: https://www.youtube.com/watch?v=pi7mMjiixiY