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# What are Links and Nodes in a Network?

## Node

•A link refers to the physical or logical communication path between two or more nodes in a network.
•It enables data transfer and connectivity, forming the backbone of network infrastructure.
•**Types of Links:**
- **Wired Links:** Use physical cables such as Ethernet cables, fiber optics, or coaxial cables.
- **Wireless Links:** Use radio signals, microwaves, or infrared technology, such as Wi-Fi and Bluetooth.

•**Importance of Links:**
- Ensure uninterrupted data transmission.
- Influence the speed and efficiency of a network.
- Determine the topology and architecture of a network.

## Link

•A node is any active electronic device capable of sending, receiving, or forwarding information within a network.
•**Types of Nodes:**
- **End Nodes:** Devices like computers, mobile phones, and IoT devices that generate and consume data.
- **Intermediate Nodes:** Devices such as routers, switches, and gateways that facilitate data transfer.

•**Role of Nodes in a Network:**
- Store, process, and transmit data.
- Enable communication between different network devices.
- Manage routing, switching, and network security functions.

# OSI Reference Model: A Quick Recap

1. **Physical Layer**
   Manages physical connections (cables, signals, transmission rates).
2. **Data Link Layer**
   Ensures reliable node-to-node data transfer and error detection.
3. **Network Layer**
   Handles logical addressing and routing of data packets
4. **Transport Layer**
   Provides end-to-end communication, flow control, and error handling.
5. **Session Layer**
   Manages and controls communication sessions.
6. **Presentation Layer**
   Converts data formats and encrypts/decrypts information.
7. **Application Layer**
   Interfaces directly with user applications for network access.

# Data Link Layer: Role and Responsibilities

•The **Data Link Layer (Layer 2)** is responsible for direct, reliable communication between two connected network devices.

•**Key Functions:**

- **Framing:** Divides data into small, manageable units called frames for transmission.
- **Error Detection & Correction:** Identifies and rectifies errors using techniques like **Cyclic Redundancy Check (CRC)** and **Hamming Code**.
- **Flow Control:** Prevents data overflow by synchronizing sender and receiver speeds.
- **Media Access Control (MAC):** Determines which device can transmit data at a given time to avoid collisions.

•**Importance of Data Link Layer:**

- Ensures smooth, error-free data transfer within a local network.
- Bridges the gap between the physical layer and network layer.
- Facilitates MAC addressing, which uniquely identifies devices in a network.

# Network Layer: Role and Responsibilities

- The **Network Layer (Layer 3)** is responsible for ensuring that data packets are delivered from the source to the destination across multiple networks.
- **Key Functions:**
  - **Logical Addressing:** Uses IP addresses to identify and differentiate devices.
  - **Routing:** Determines the best path for data transmission based on routing algorithms like **Dijkstra's Algorithm** and **Bellman-Ford Algorithm**.
  - **Packet Forwarding:** Moves data packets across networks based on routing tables.
  - **Congestion Control:** Prevents traffic overload and ensures efficient data flow.

- **Importance of Network Layer:**
  - Enables global communication by ensuring proper routing of data.
  - Provides scalability for large networks.
  - Manages Quality of Service (QoS) for optimized data delivery.

# Data Link Layer vs. Network Layer: Key Differences

| Data Link Layer | Network Layer |
| --- | --- |
| Transfers data between directly connected devices. | Transfers data between different networks. |
| Uses MAC addresses to identify devices. | Uses IP addresses to identify devices. |
| Works with frames. | Works with packets. |
| Example protocols: Ethernet, Wi-Fi. | Example protocol: IP (Internet Protocol). |
| Detects and corrects errors in transmission. | Focuses on routing and forwarding data. |

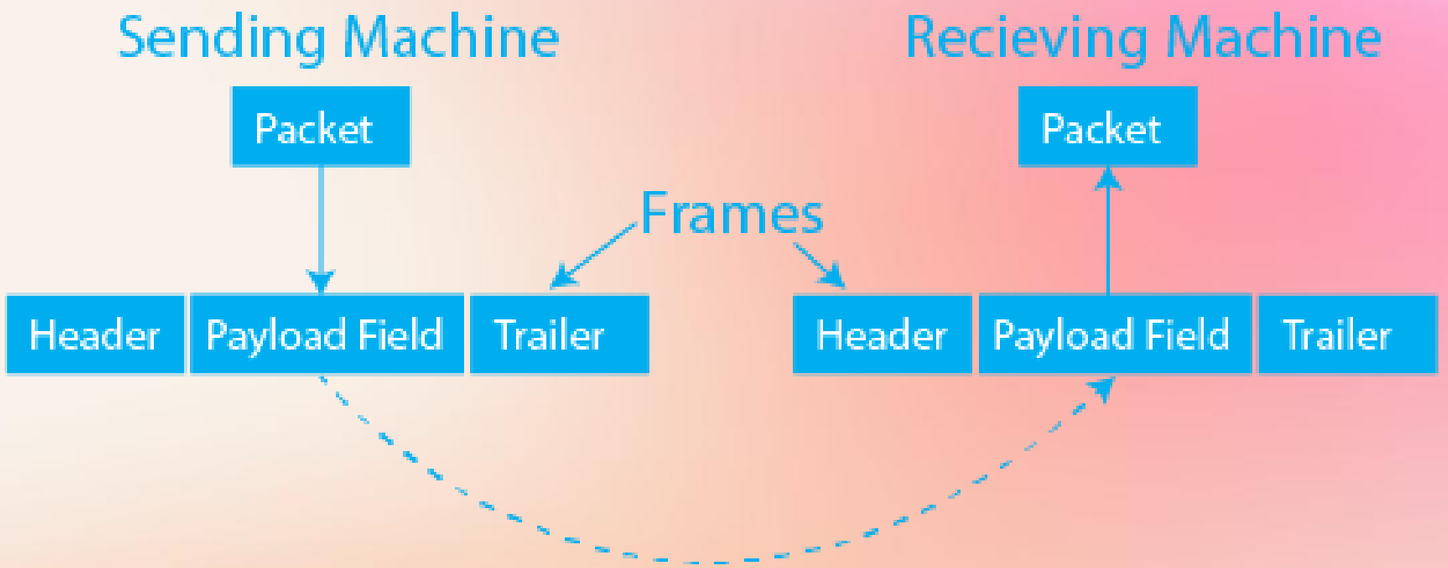
# Framing:

•**Framing** is the process of dividing data into small, manageable units called **frames** for transmission over a network.
•Each frame consists of three main parts:

1. **Header:** Contains source and destination MAC addresses, frame type, and control information.
2. **Payload:** The actual data being transmitted.
3. **Trailer:** Includes error detection and correction mechanisms.

•**Types of Framing Techniques:**

- •**Character Count Framing:** Uses a field in the header to specify the frame length.
- •**Byte-Oriented Framing:** Uses special characters like **STX (Start of Text)** and **ETX (End of Text)**.
- •**Bit Stuffing:** Inserts extra bits into the data stream to differentiate actual data from control information.
- •**Byte Stuffing:** Similar to bit stuffing but operates at the byte level.




## Importance of Framing

- Ensures that data is transmitted in an organized and error-free manner.
- Prevents data loss and corruption during transmission.
- Helps in synchronization between sender and receiver, avoiding misinterpretation of data.
- Plays a crucial role in **error detection** and **flow control mechanisms**.

# Summary:

•**Key Takeaways:**

- **Links & Nodes:** Fundamental elements enabling network communication.
- **Data Link Layer:** Ensures reliable, node-to-node communication with error detection and framing.
- **Network Layer:** Manages logical addressing, routing, and packet forwarding.
- **Framing:** Essential for structuring data into frames for smooth transmission.

**Thank you! Any questions?**