1.35.3. Data Link Layer

It is responsible for reliable node to node delivery of the data. It accepts packets from the network layer and forms frames and gives it to the physical layer as shown in figure 1.44.

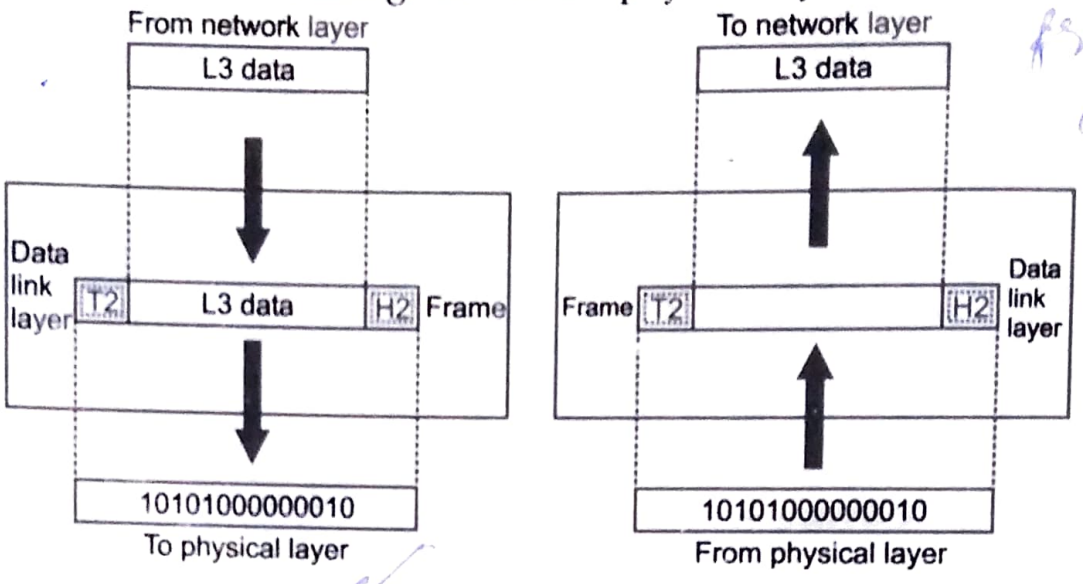


Fig. 1.44 Data link layer

Following are the functions of data link layer :

1. Framing

It divides the streams of bits received from the network layer into manageable data units called frames.

2. Physical Addressing

It adds a header to the frame to define the physical address of the sender and /or receiver of the frame.

3. Flow Control

It provides a flow control mechanism to avoid a fast transmitter from over-running a slow receiver by buffering the extra bits.

4. Error Control

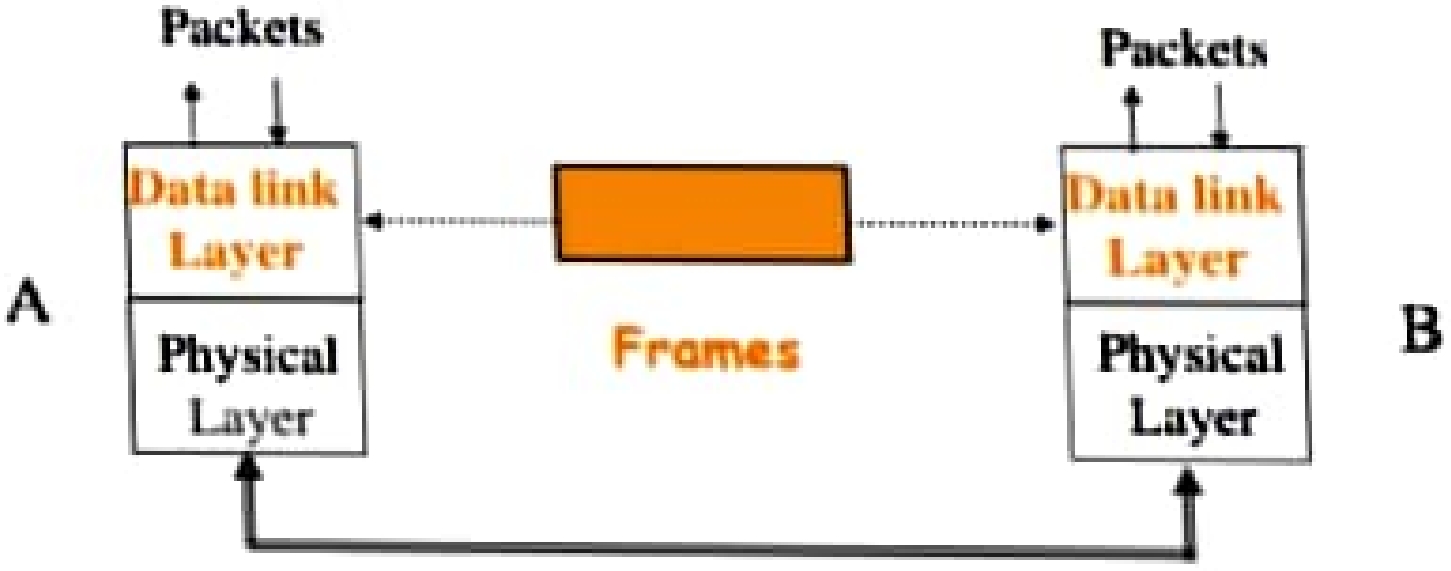
Error control is achieved by adding a trailer at the end of the frame. It also uses a mechanism to prevent duplication of frames.

5. Access Control

The data link layer protocol determines which of the devices has control over the link at any given time, when two or more devices are connected to the same link. The Institution of Electrical and Electronics Engineers (IEEE) felt the need to define the data link layer in more details, so they split it into two sub-layers.

(*i*) Logical Link Control (LLC)

It establishes and maintains links between the communicating device.


Packets
Packets
Data link Layer
Data link Layer
A
Physical Layer
Frames
Physical Layer
B

1. Logical Link Control (LLC)
2. Media Access Control (MAC)

The packet received from Network layer is further divided into frames depending on the frame size of NIC(Network Interface Card). DLL also encapsulates Sender and Receiver's MAC address in the header.

The Receiver's MAC address is obtained by placing an ARP(Address Resolution Protocol) request onto the wire asking "Who has that IP address?" and the destination host will reply with its MAC address.

The MAC addresses are used to establish logical link between two computers on the same LAN. Bridges, intelligent hubs and network interface cards are devices associated with the data link layer.

2. Data Link Layer (DLL) (Layer 2) :

The data link layer is responsible for the node to node delivery of the message. The main function of this layer is to make sure data transfer is error-free from one node to another, over the physical layer. When a packet arrives in a network, it is the responsibility of DLL to transmit it to the Host using its MAC address.
Data Link Layer is divided into two sub layers :

The functions of the data Link layer are :

1. **Framing:** Framing is a function of the data link layer. It provides a way for a sender to transmit a set of bits that are meaningful to the receiver. This can be accomplished by attaching special bit patterns to the beginning and end of the frame.
2. **Physical addressing:** After creating frames, Data link layer adds physical addresses (MAC address) of sender and/or receiver in the header of each frame.
3. **Error control:** Data link layer provides the mechanism of error control in which it detects and retransmits damaged or lost frames.

4. **Flow Control:** The data rate must be constant on both sides else the data may get corrupted thus , flow control coordinates that amount of data that can be sent before receiving acknowledgement.
5. **Access control:** When a single communication channel is shared by multiple devices, MAC sub-layer of data link layer helps to determine which device has control over the channel at a given time.

* *Packet in Data Link layer is referred as* ***Frame.***

Hardware address

The hardware address is also known as the data link layer address or layer 2 address or MAC (Media Access Control) address. From these terms, the term MAC address is commonly used to refer to the hardware address. Unlike the IP address or software address, this address can't be configured or managed. When you purchase a new NIC (Network Interface Card), or any device which has onboard NICs, it comes with a pre-configured MAC address.

A MAC address is 6 bytes (48 bits) long address in the binary numbers. MAC addresses are written in the hexadecimal format. The hexadecimal format uses the **base-16** to refer to numbers. If we divide the total available length (48 bits) in binary numbers by the base (base-16) that is used to write a number in hexadecimal format, we get the total digits of that number in the hexadecimal format. Thus, if we write a 6 bytes (48bits) long binary MAC address in hexadecimal format, we get a 12 digits long hexadecimal number.

For convenience and easier readability, when writing a MAC address in hexadecimal format, extra space or periods or colons are added after every two or four digits. For example, you can write a MAC address in the following ways.

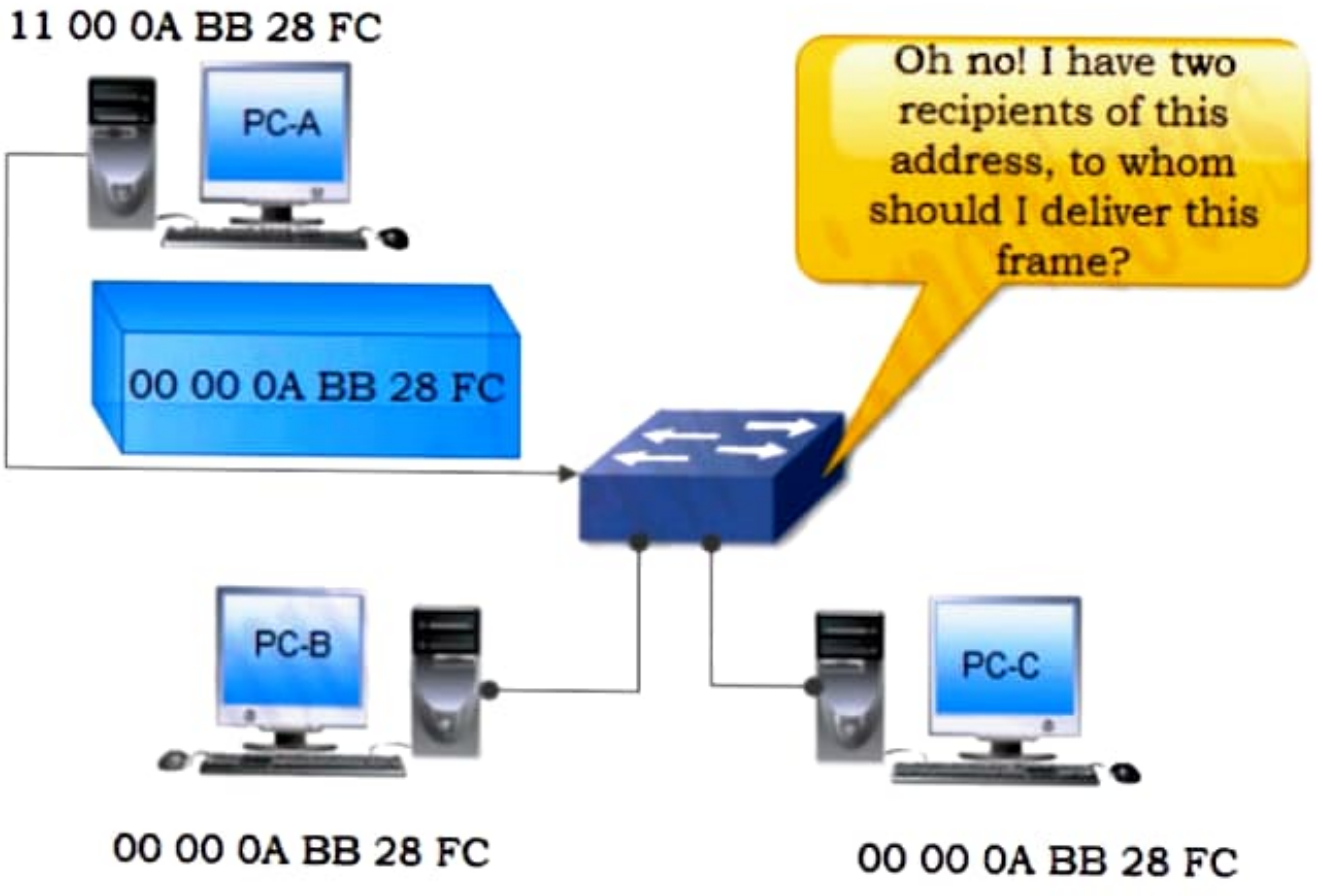
- Without any separator: - **00000ABB28FC**
- Extra space after every two digits: - **00 00 0A BB 28 FC**
- Extra space after every four digits: - **0000 0ABB 28FC**
- Colon after every two digits: - **00:00:0A:BB:28:FC**
- Colon after every four digits: - **0000:0ABB:28FC**
- Period after every two digits: - **00.00.0A.BB.28.FC**
- Period after every four digits: - **0000.0ABB.28FC**

No matter which style you use to write the MAC address, or an application or networking software uses to display the MAC address, a MAC address is always processed in binary numbers only. NIC converts hexadecimal numbers of the MAC address in binary numbers before processing and using it.

Suppose in a network three PCs; PC-A (11000ABB28FC), PC-B (00000ABB28FC) and PC-C (00000ABB28FC) are connected through a switch. NICs of PC-B and PC-C have the same MAC address 00000ABB28FC.

If PC-A sends a frame to the destination MAC address **00000ABB28FC**, the switch fails to deliver this frame as it has two recipients of this frame.

The following image shows this example.



A LAN network does not work unless each device in the LAN network has a unique MAC address.