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Data Communication CS601 Lecture No 23

Lecture Prepared By

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CS601 Lecture No 23 Topic 129 to 134

Why LINK-LAYER ADDRESSING?

- **IP addresses are the identifiers at the network layer**
- **In Internet we cannot make a packet reach its destination using only IP addresses**

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- **Source and destination IP addresses define the two ends but cannot define which links the packet will take**

2.2 Link Layer Addressing

- A Link layer address is also called as **Link address or physical address or MAC address.**
- In a connectionless internetwork such as the Internet we cannot make a datagram reach its destination using only IP addresses. The reason is that each datagram in the Internet, from the same source host to the same destination host, may take a different path. The source and destination IP addresses define the two ends but cannot define which links the datagram should pass through.

2.2.1 Working Operation

- When a datagram passes from the network layer to the data link layer, then the datagram will be encapsulated in a frame and two data link addresses are added to the frame header.
- These addresses are changed every time the frames moves from one link to another.
- Each frame carries the same datagram with the same source and destination IP addresses.. The figure below demonstrates the concepts in a small internet:

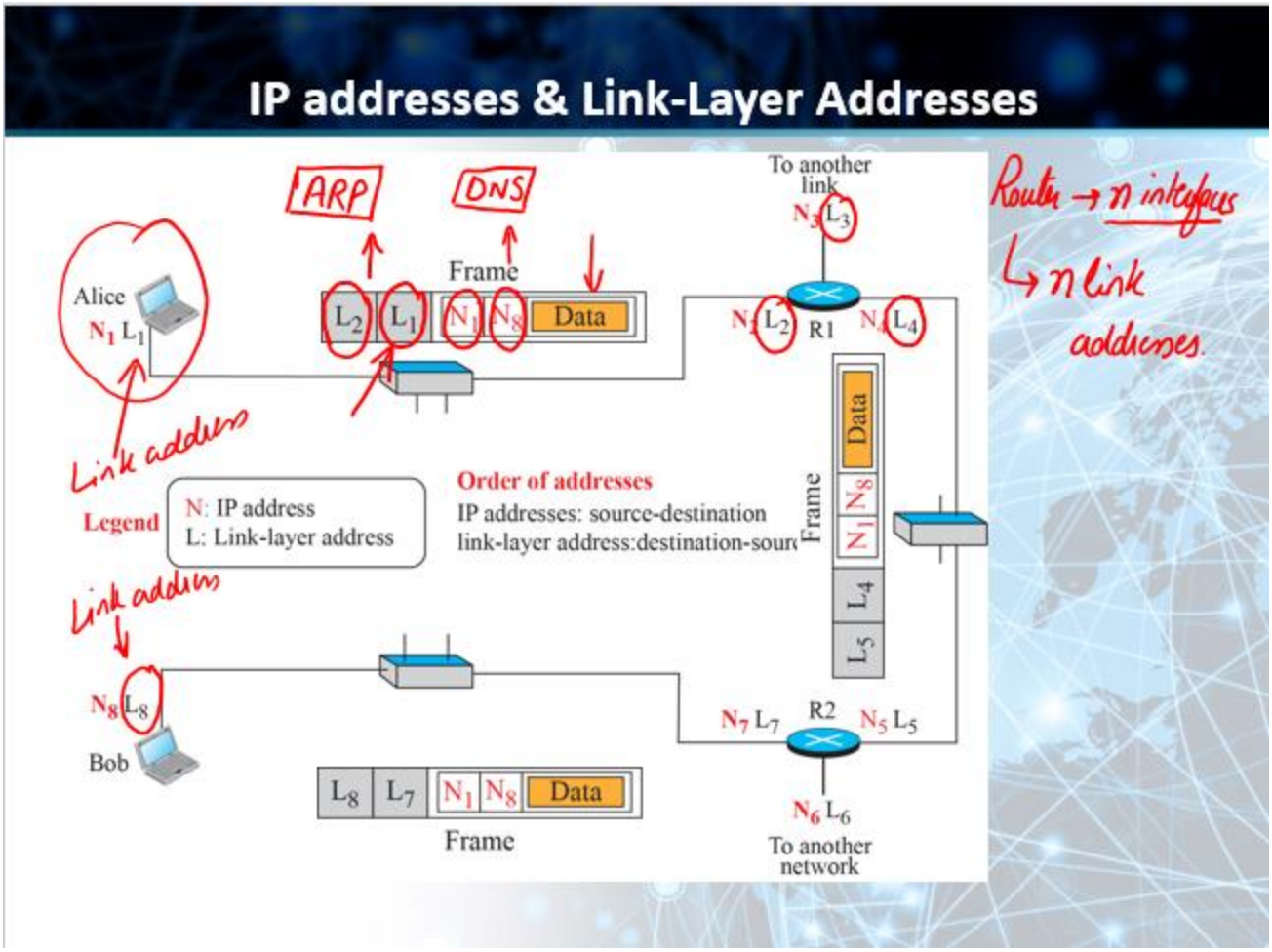
What is link layer addressing?

A link-layer address is called **a link address, called a physical address, and sometimes a MAC address**. Since a link is controlled at the data-link layer, the addresses need to belong to the data-link layer.

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Three Types of addresses

- **Some link-layer protocols define three types of addresses:**
- **Unicast**
- **Multicast**
- **Broadcast**

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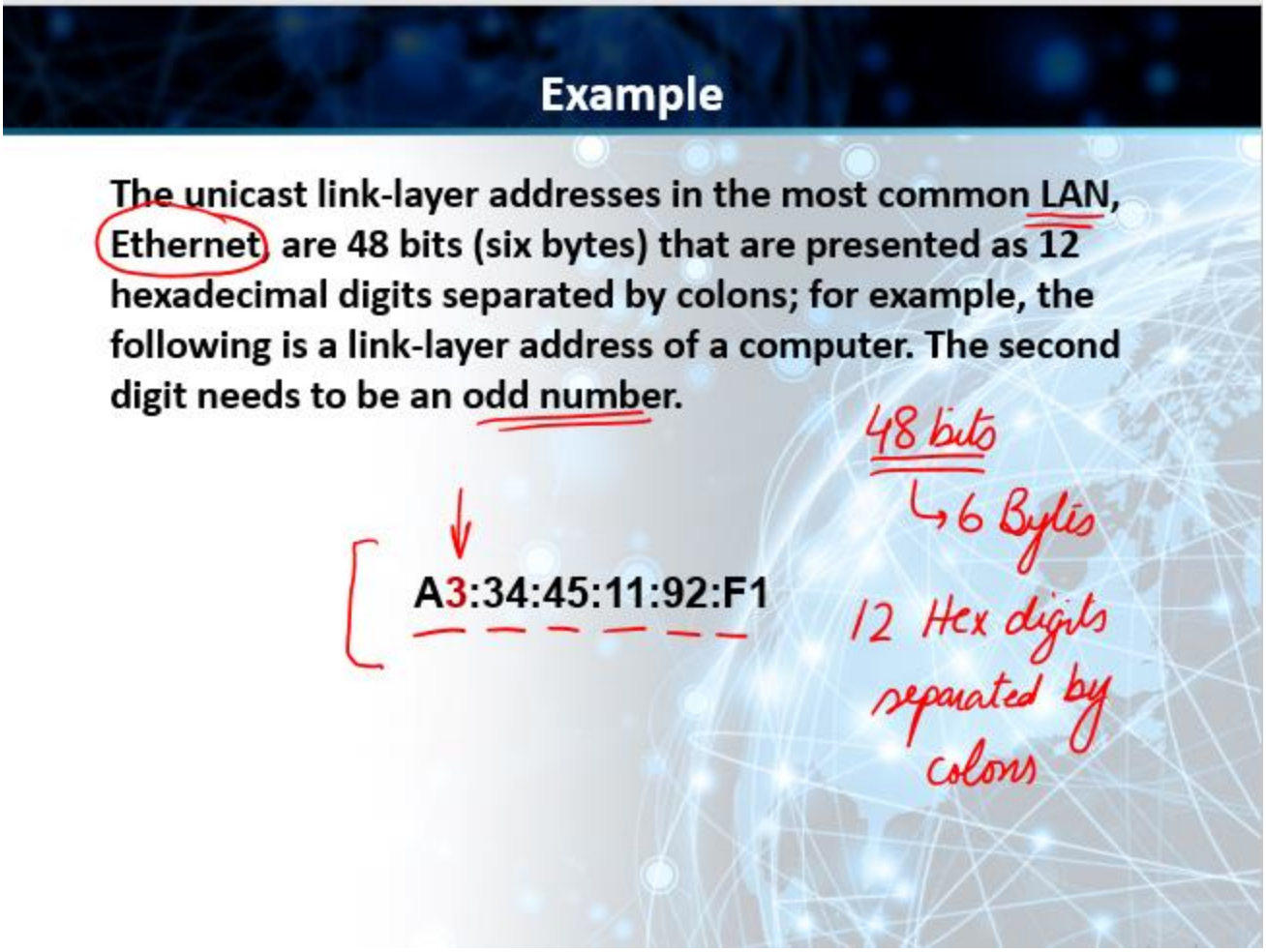
2.2.2 Types of Link layer Addresses

- Some link-layer protocols define three types of addresses: unicast, multicast, and broadcast.
- **Unicast:** Each host or each interface of a router is assigned a unicast address. Unicasting means one-to-one communication. A frame with a unicast address destination is destined only for one entity in the link.
- The unicast link-layer addresses in the most common LAN, Ethernet, are 48 bits (six bytes) that are presented as 12 hexadecimal digits separated by colons; for example, the following is a link-layer address of a computer. The second digit needs to be an odd number.
- A3:34:45:11:92:F1

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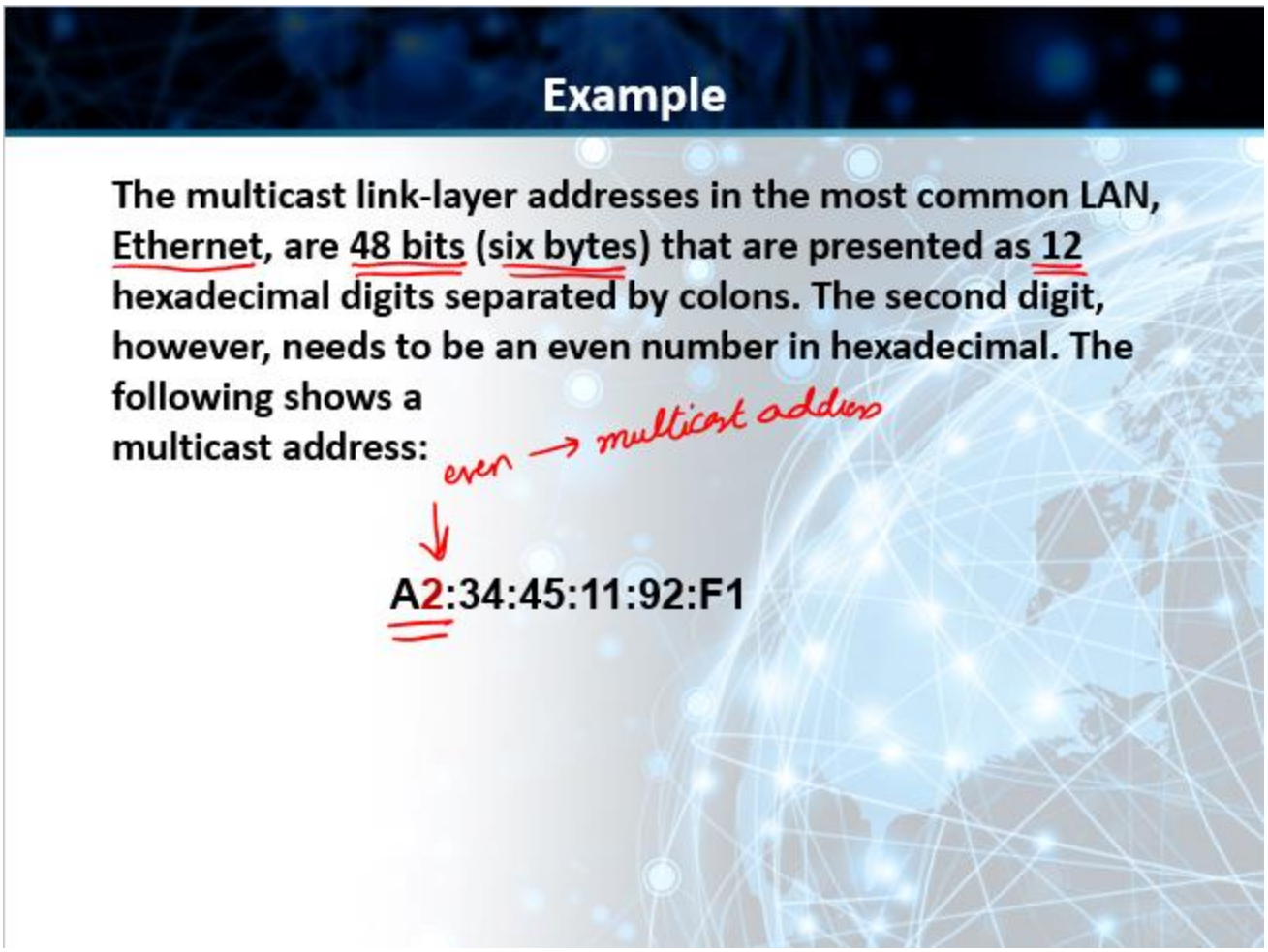
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- **Multicast**: one-to-many communication. However, the jurisdiction is local (inside the link).
- The multicast link-layer addresses in the most common LAN, Ethernet, are 48 bits (six bytes) that are presented as 12 hexadecimal digits separated by colons. The second digit, however, needs to be an even number in hexadecimal. The following shows a multicast address:
- A2:34:45:11:92:F1
- **Broadcast:** one-to-all communication. A frame with a destination broadcast address is sent to all entities in the link.
- The broadcast link-layer addresses in the most common LAN, Ethernet, are 48 bits, If all digits are Fs, then the address is broadcast all 1s, that are presented as 12 hexadecimal digits separated by colons. The following shows a broadcast address:
- FF:FF:FF:FF:FF:FF

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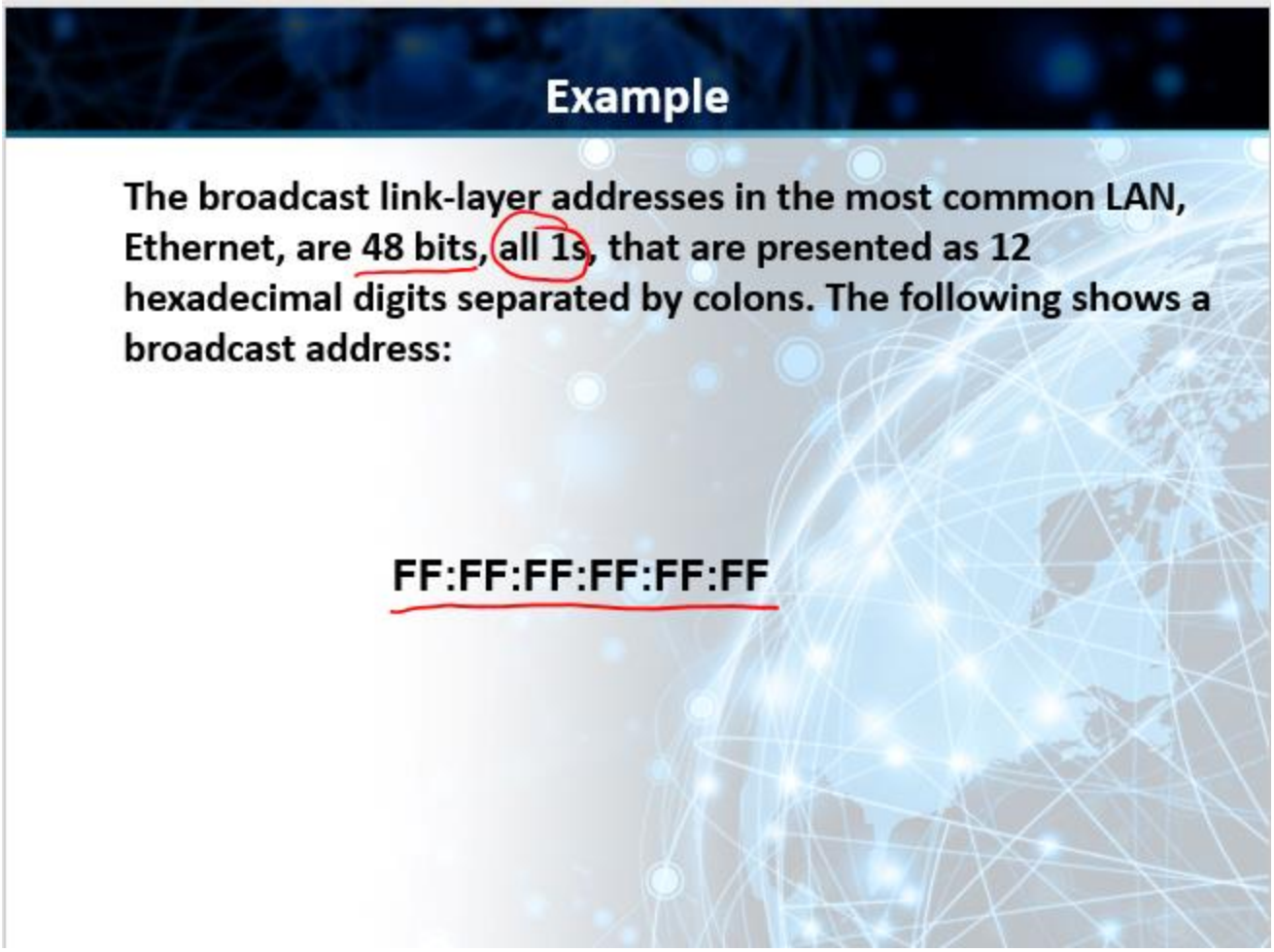
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Address Resolution Protocol (ARP)

- **Anytime a node has an IP packet to send to another node in a link, it has the IP address of the receiving node**
- **IP address of the next node is not helpful in moving a frame through a link; we need the link-layer address of the next node**

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ARP operation

- When a host or a router needs to find the link-layer address of another host or router in its network, A host or a router sends an ARP request packet that includes the link-layer and IP addresses of the sender and the IP address of the receiver. Because the sender does not know the link-layer address of the receiver, the query is broadcast over the link using the link-layer broadcast address.
- Every host or router on the network receives and processes the ARP request packet, but only the intended recipient recognizes its IP address and sends back an ARP response packet. The response packet contains the recipient's IP and link-layer addresses. The packet is unicast directly to the node that sent the request packet.

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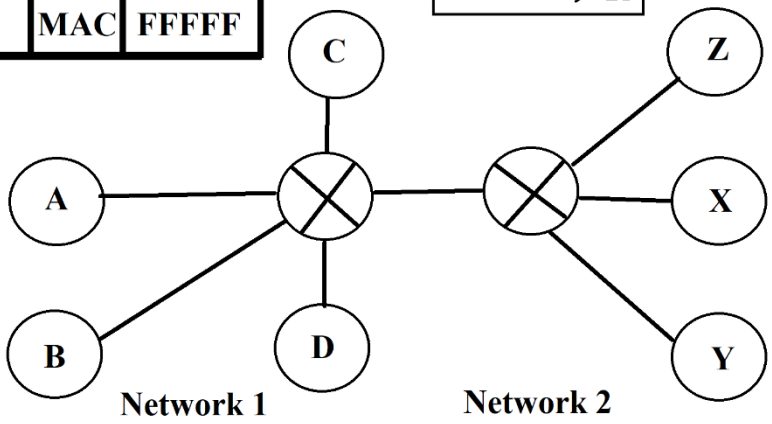
Address Resolution Protocol (ARP)

IP Adress ⟶ Logical

Mac Adress ⟶ Physical

H	H
H	R
R	H
R	R

IP	MAC	FFFFF



6	48	FFFFF OR 00000000

Hardware: LAN or WAN protocol

Protocol: Network-layer protocol

0	8	16	31
Hardware Type		Protocol Type	
Hardware length	Protocol length	Operation Request:1, Reply:2	
Source hardware address 6			
Source protocol address 48			
Destination hardware address (Empty in request) empty			
Destination protocol address			

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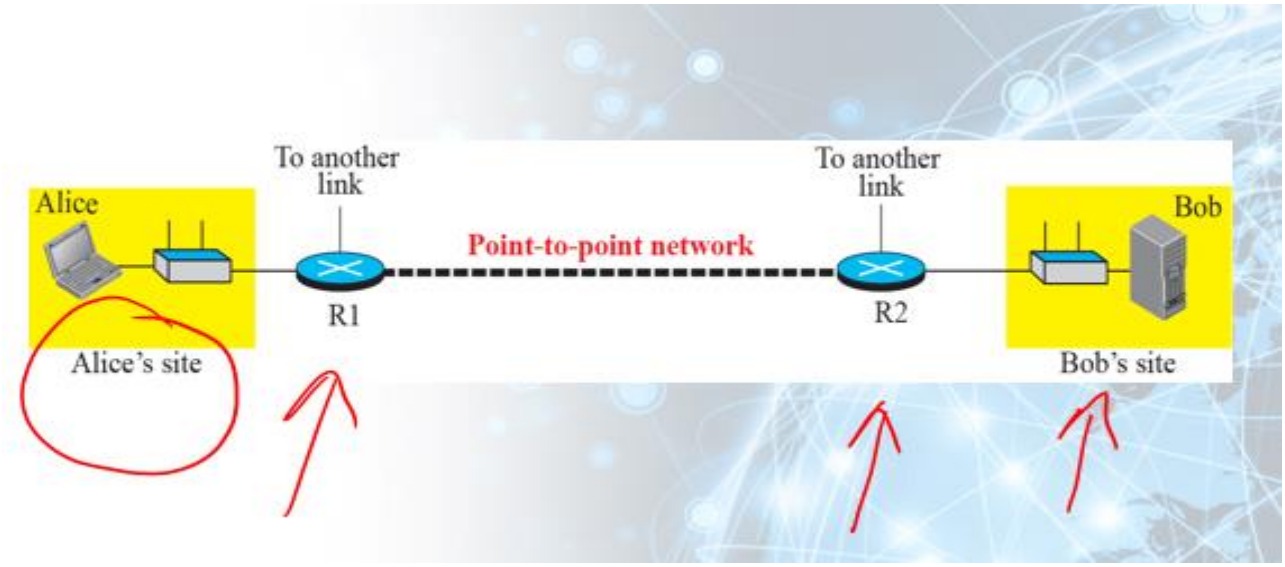
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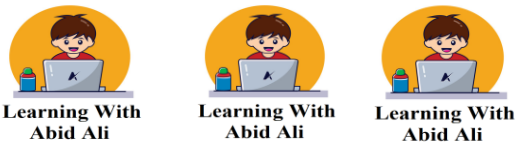
- **ARP packet**
- The hardware type field defines the type of the link-layer protocol; Ethernet is given the type 1.
- The protocol type field defines the network-layer protocol: IPv4 protocol is $(0800)_{16}$.
- Hardware Length defines the physical address length in bytes
- Protocol Length defines the logical address length in bytes
- The source hardware and source protocol addresses are variable-length fields defining the link-layer and network-layer addresses of the sender.
- The destination hardware address and destination protocol address fields define the receiver link-layer and network-layer addresses.
- An ARP packet is encapsulated directly into a data-link frame.

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