Subject: Computer networks
Topic: Address mapping
Name of the teacher: Lisna Thomas
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ADDRESS MAPPING

21-1 ADDRESS MAPPING

The delivery of a packet to a host or a router requires two levels of addressing: logical and physical. We need to be able to map a logical address to its corresponding physical address and vice versa. This can be done by using either static or dynamic mapping.

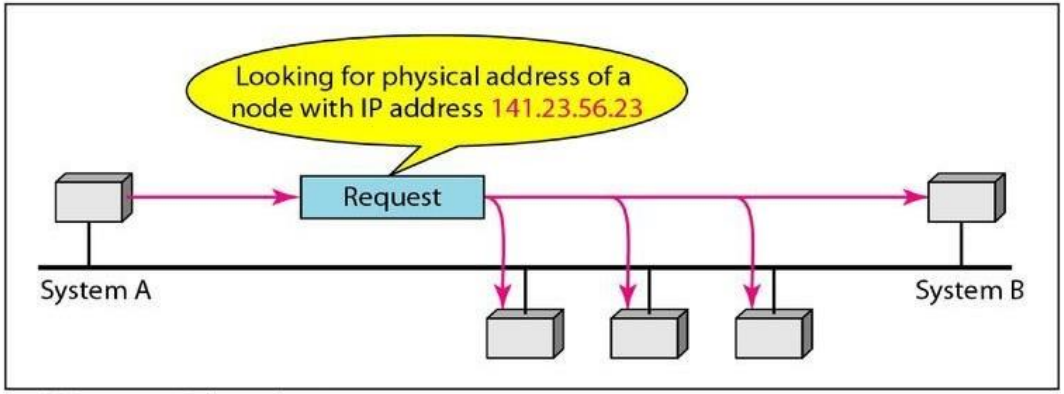
Protocols Used for Mapping

- Address Resolution Protocol (ARP)
- Reverse Address Resolution Protocol (RARP)
- Bootstrap Protocol (BOOTP)
- Dynamic Host Configuration Protocol (DHCP)

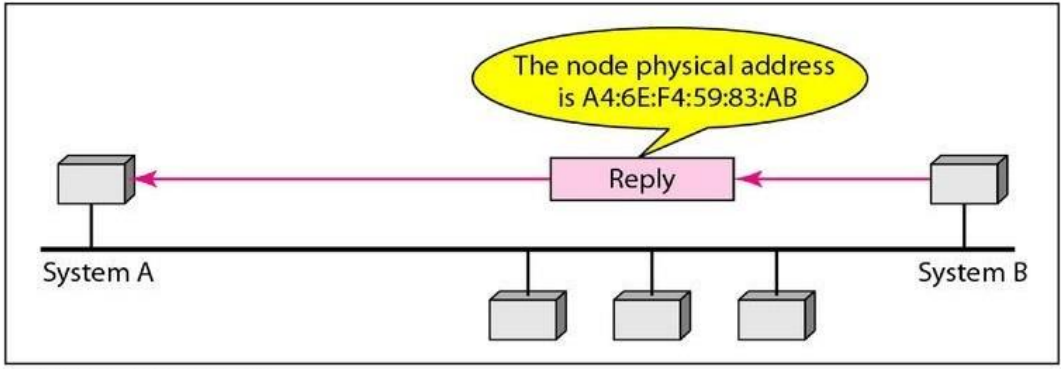
Address Resolution Protocol

- Internet is made of a combination of physical networks connected by internetworking devices such as routers
- Hosts and routers are recognized at the network level by their logical IP addresses
- Packets pass through physical networks to reach these hosts and routers
- At the physical level, the hosts and routers are recognized by their physical addresses
- ARP is the protocol used to map IP address to MAC address.
- View ARP cache (Command prompt): arp –a, arp /?

ARP operation



a. ARP request is broadcast

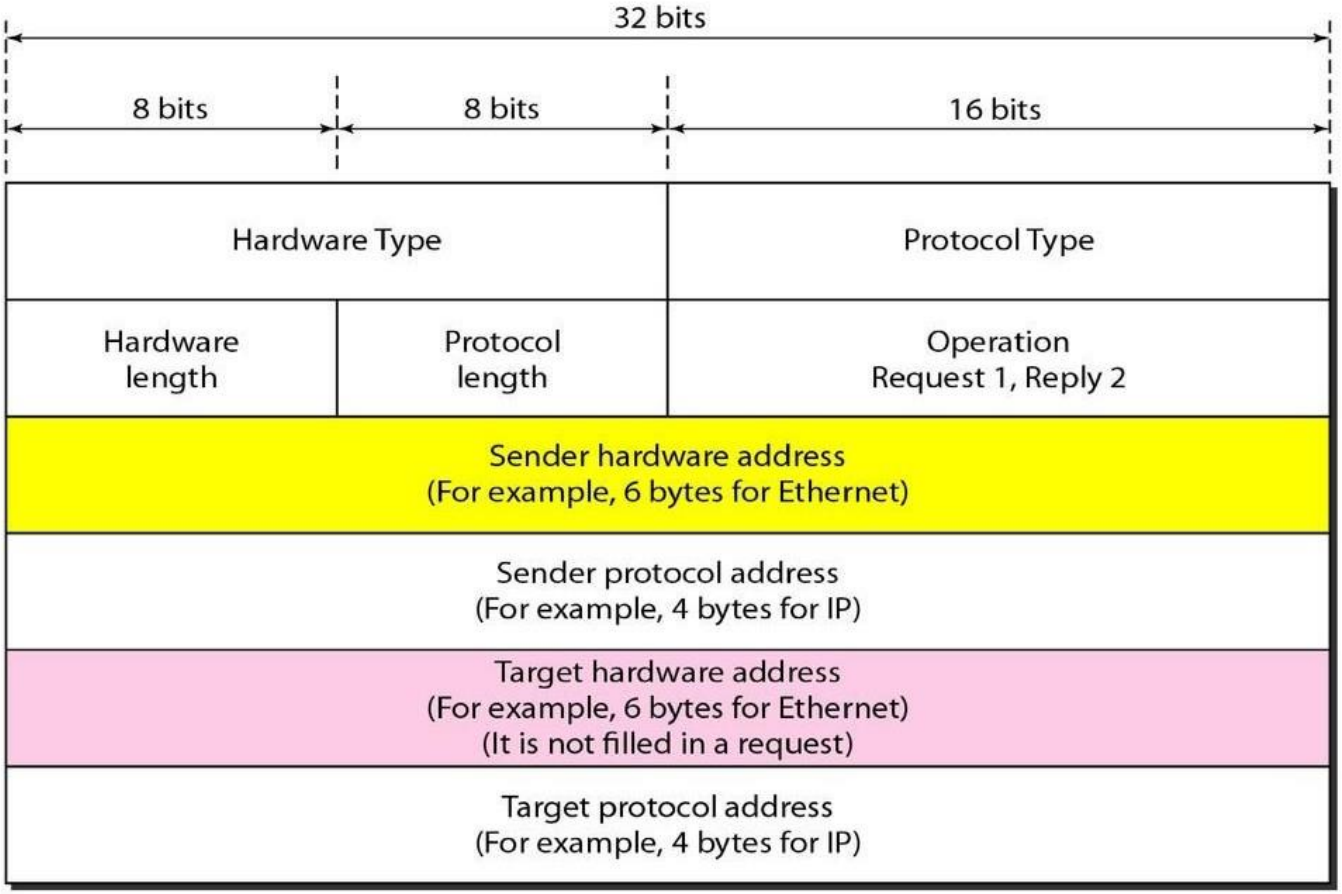


b. ARP reply is unicast

Performance: Cache Memory

- Using ARP is inefficient if system A needs to broadcast an ARP request for each IP packet it needs to send to system B
- ARP can be useful if the ARP reply is cached (kept in cache memory)
- A system that receives ARP reply stores the mapping in cache memory and keep it for 20 to 30 minutes unless there is no space in the cache.

ARP PACKET FORMAT



ARP Packet

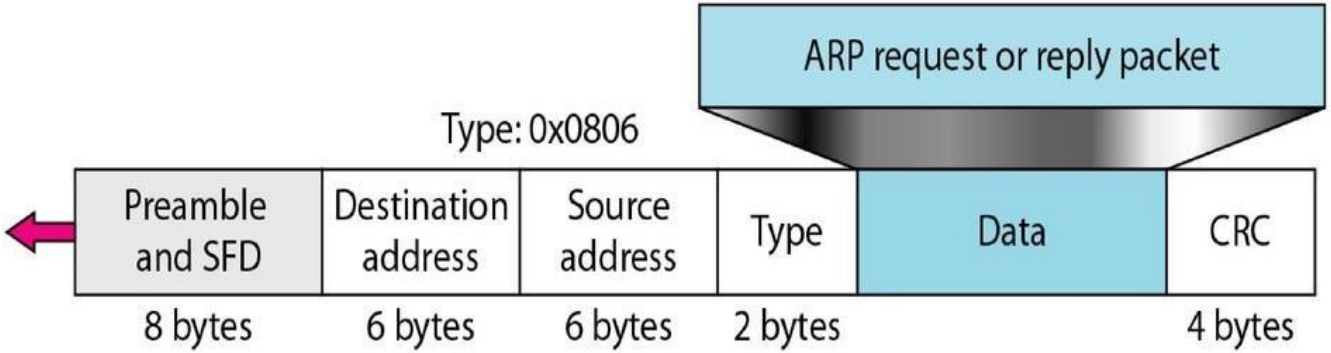
- **Hardware type:** define the type of the network on which ARP is running. Ethernet is given type 1.
- **Protocol Type:** define the protocol. 0800 for IPv4
- **Hardware length:** define the length of the physical address in bytes. Ethernet the value is 6.
- **Protocol Length:** define the length of the logical address in bytes. For IPv4 protocol the value is 4.
- **Operation:** define the type of packets. ARP request (1) or ARP reply (2).
- **Sender hardware address:** the physical address of the sender.
- **Sender protocol address:** the IP address of the sender
- **Target hardware address:** the physical address of the receiver.
- **Target protocol address:** the IP address of the receiver.

Encapsulation

- Data is encapsulated with protocol information at each layer when it is transmitted across a network. As data moves through the layers, communication occurs within the peer layer before moving to the next layer.
- One important piece of information to keep in mind is that data flows two ways in the OSI model, DOWN (data encapsulation) and UP (data decapsulation).
- An ARP packet is encapsulated directly into a data link frame.
- Next slide shows you an ARP packet is encapsulated in an Ethernet frame.

Encapsulation of ARP Packet

The type field indicates that the data carried by the frame is an ARP Packet

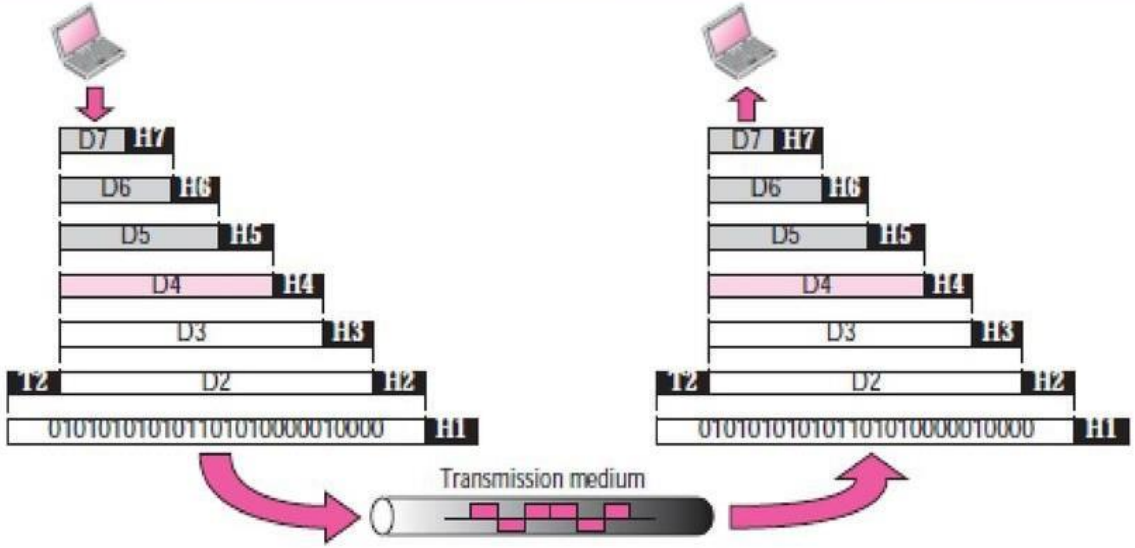


Encapsulation

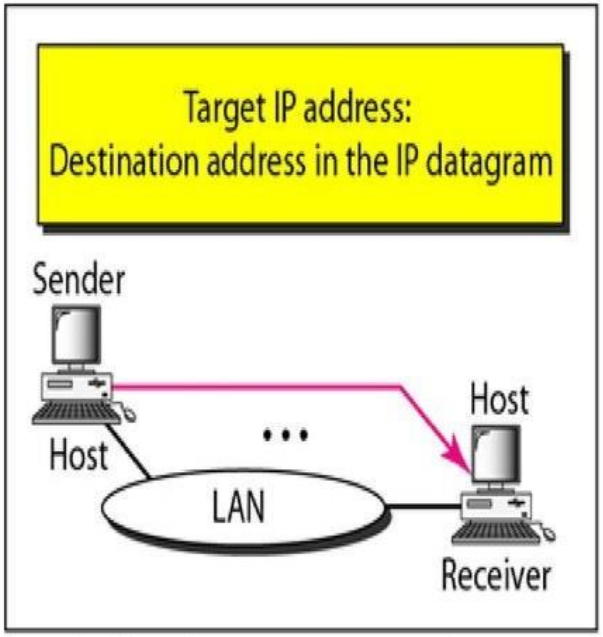
- A packet at level 7 is encapsulated in the packet at level 6. The whole packet at level 6 is encapsulated in a packet at level 5, and so on.
- The data part of a packet at level N is carrying the whole packet (data and overhead) from level $N - 1$.
- The concept is called encapsulation because level N is not aware what part of the encapsulated packet is data and what part is the header or trailer.

Encapsulation

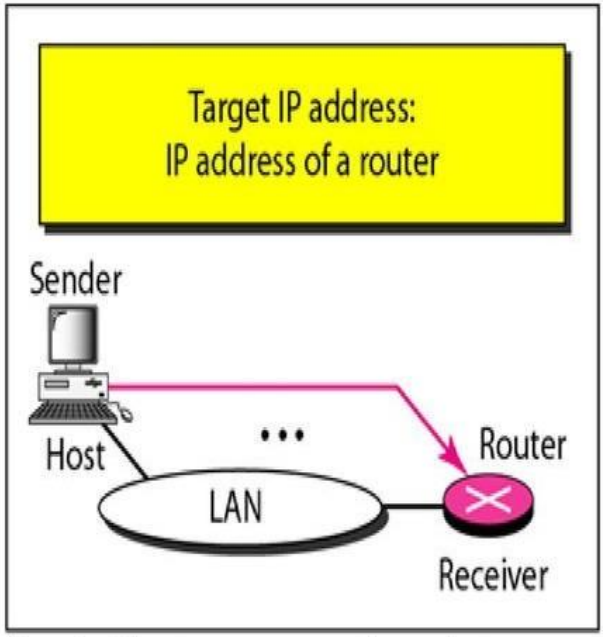
Figure 2.5 *An exchange using the OSI model*



ARP FOUR CASES

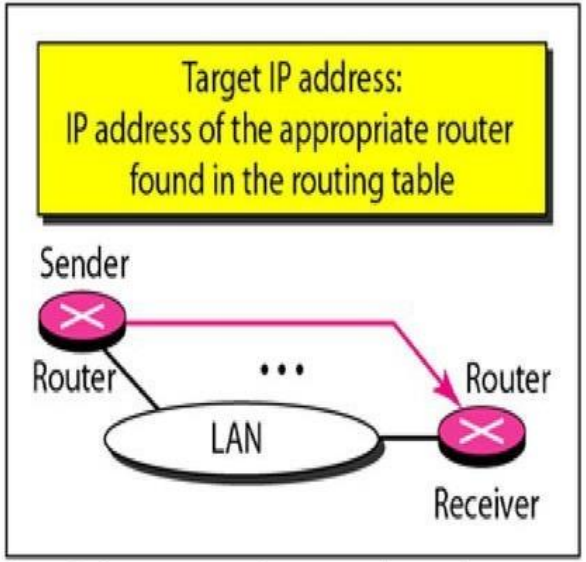


Case 1. A host has a packet to send to another host on the same network.

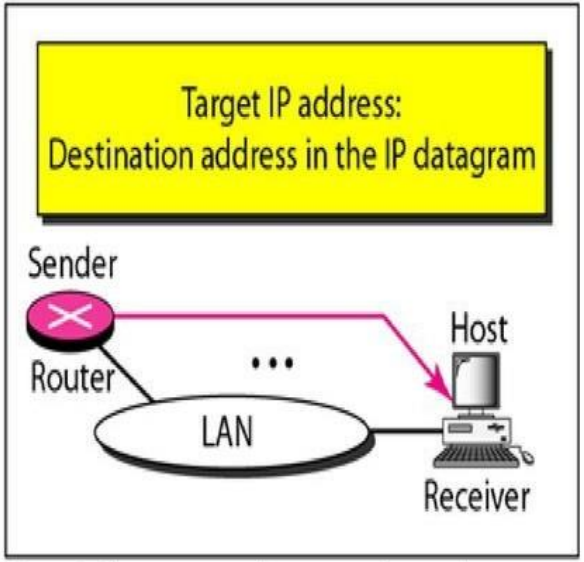


Case 2. A host wants to send a packet to another host on another network. It must first be delivered to a router.

ARP FOUR CASES



Case 3. A router receives a packet to be sent to a host on another network. It must first be delivered to the appropriate router.



Case 4. A router receives a packet to be sent to a host on the same network.

Note

An ARP request is broadcast; an ARP reply is unicast.

Reverse Address Resolution Protocol (RARP)

- Finds the logical address for a machine that knows only its physical address.
- To create an IP datagram, a host or a router needs to know its own IP address or addresses.
- A RARP request is created and broadcast on the local network.
- The requesting machine must be running a RARP client program; the responding machine must be running a RARP server program.
- There is a serious problem with RARP: Broadcasting is done at the data link layer.
- This means that if an administrator has several networks or several subnets, it needs to assign a RARP server for each network or subnet.