Address Resolution Protocol (ARP)

OBJECTIVES:

- To make a distinction between logical address (IP address) and physical address (MAC address).
- To describe how the mapping of a logical address to a physical address can be static or dynamic.
- To show how the address resolution protocol (ARP) is used to dynamically map a logical address to a physical address.
- To show that the proxy ARP can be used to create a subnetting effect.

8-1 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. These can be done using either *static* or *dynamic* mapping.

8-2 ADDRESS MAPPING

- Anytime a host or a router has an IP datagram to send to another host or router, it has the **logical (IP)** address of the receiver.

- But the **IP datagram must be encapsulated in a frame to be able to pass through the physical network.** This means that the sender needs the **physical address** of the receiver.

- A mapping corresponds a logical address to a physical address.

- **ARP accepts a logical address from the IP protocol, maps the address to the corresponding physical address and pass it to the data link layer**.

Figure 8.1 *Position of ARP in TCP/IP protocol suite*

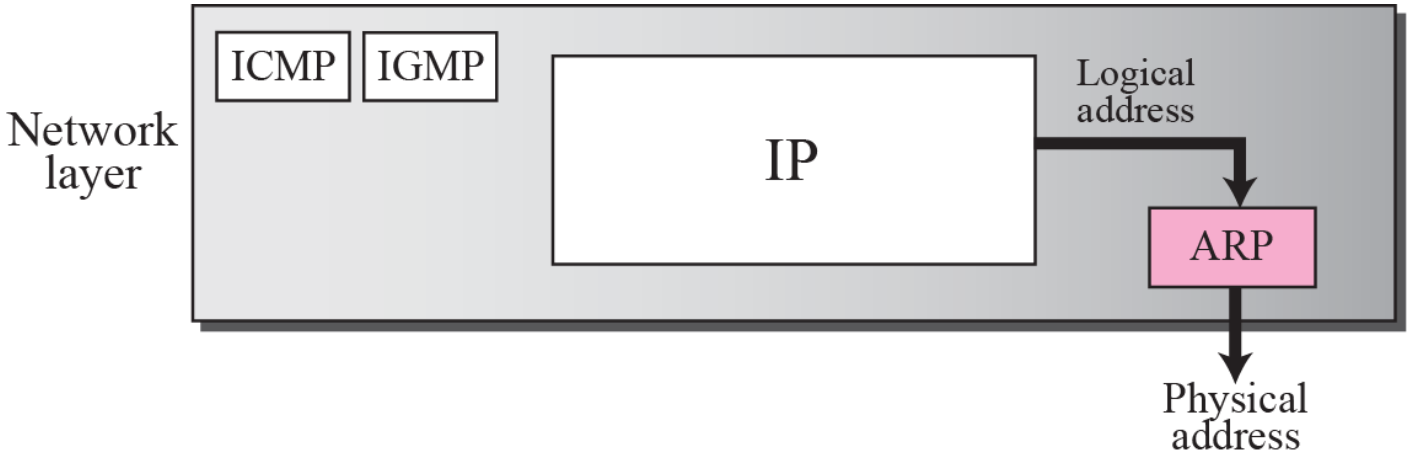
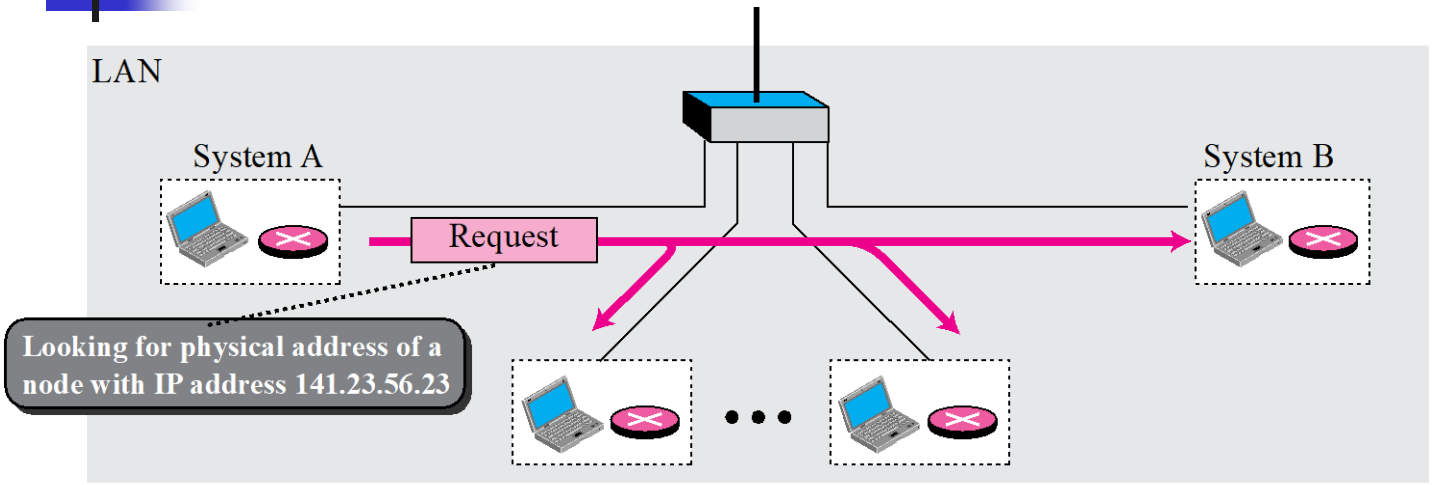
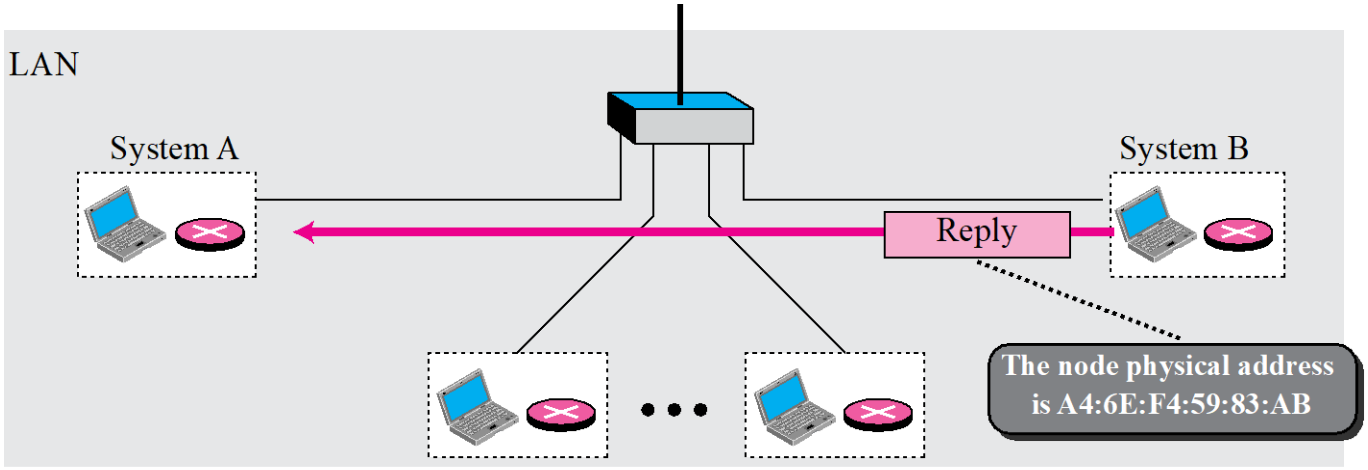


Figure 8.2 *ARP operation*

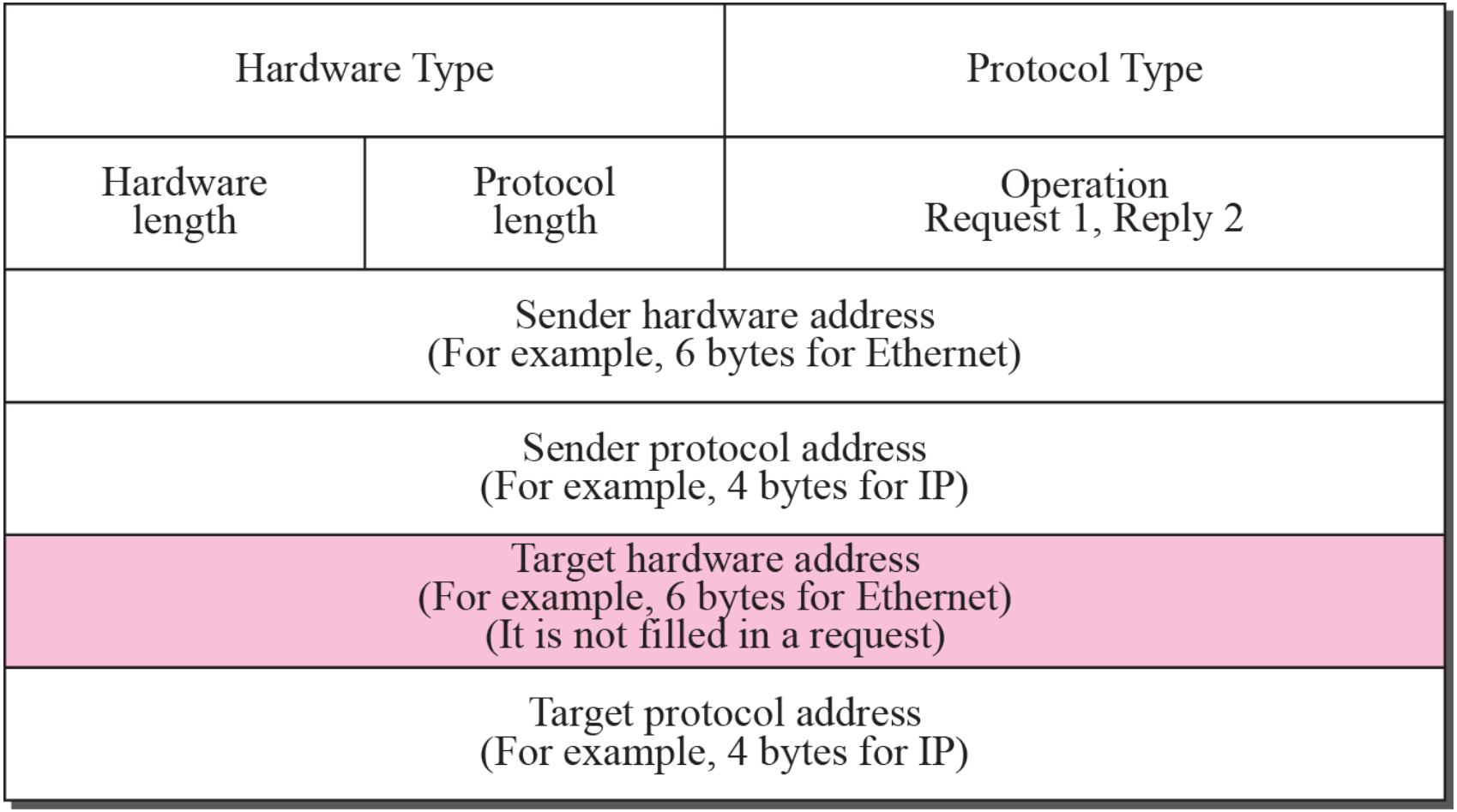


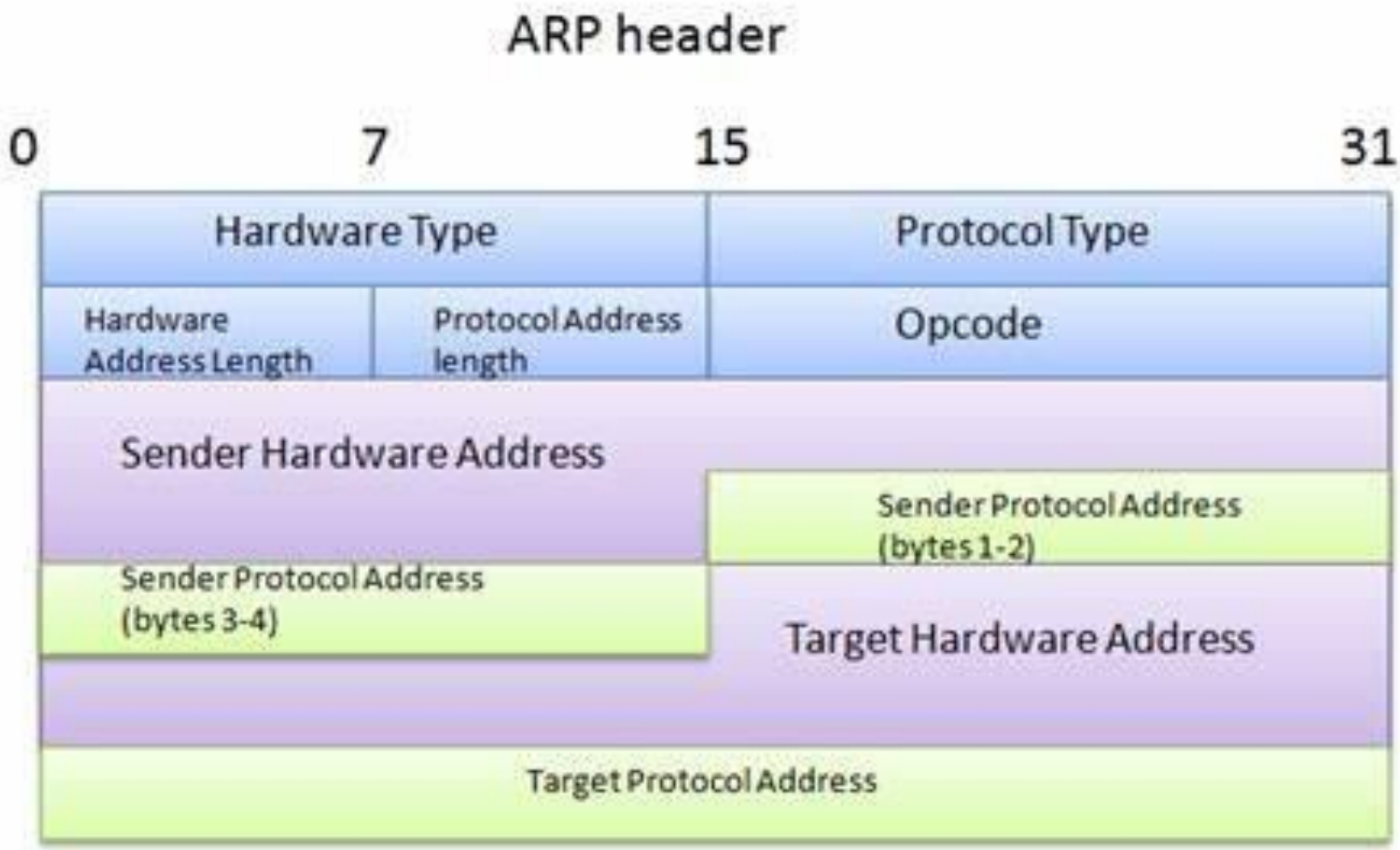
a. ARP request is broadcast



b. ARP reply is unicast

Figure 8.3 *ARP packet*

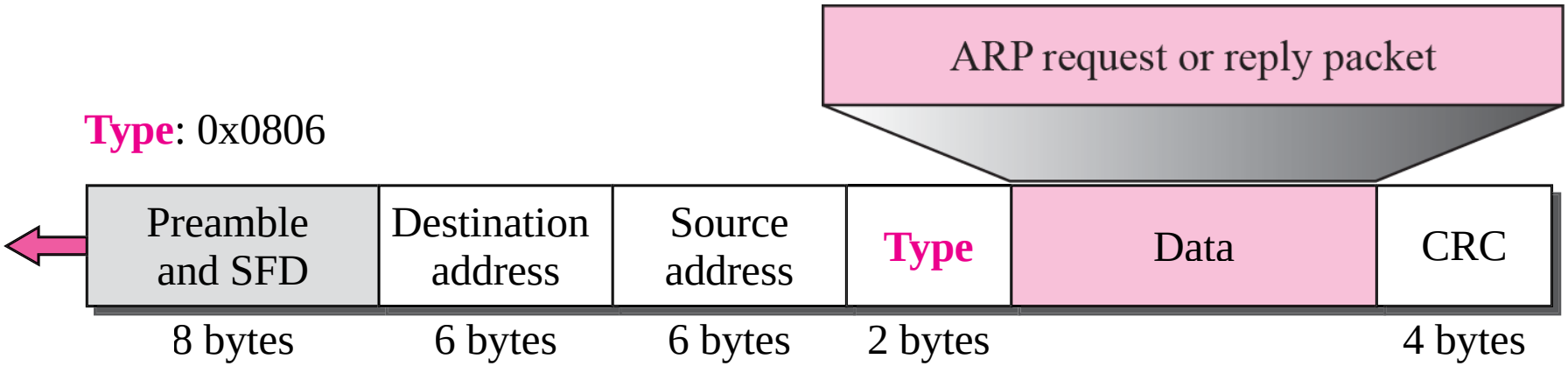



ARP header
0
7
15
31
Hardware Type
Protocol Type
Hardware Address Length
Protocol Address length
Opcode
Sender Hardware Address
Sender Protocol Address (bytes 1-2)
Sender Protocol Address (bytes 3-4)
Target Hardware Address
Target Protocol Address

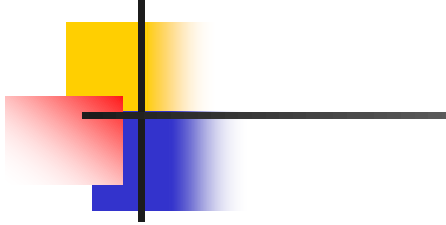
Packet Format:

- **Hardware Type:** This is a 16-bit field defining the type of the network on which ARP is running.For Ethernet, type is 1
- **Protocol Type:** Defines Network layer protocols. IPv4 protocol is $(0800)_{16}$.
- **Hardware length:** 8-bit field defining the length of the physical address in bytes. For Ethernet the value is 6.
- **Protocol Length:** 8-bit field defining the length of logical address in bytes. For the IPv4 protocol the value is 4.
- **Operation:** Request- 1, Reply- 2.

Figure 8.4 *Encapsulation of ARP packet*



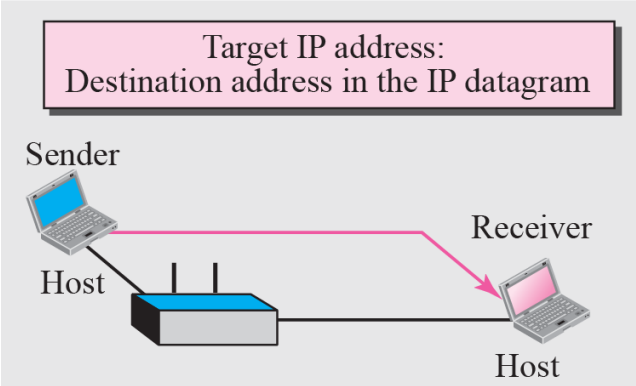
Ether Type	Protocol
0x0800	Internet Protocol version 4 (IPv4)
0x0806	Address Resolution Protocol (ARP)
0x8035	Reverse Address Resolution Protocol (RARP)



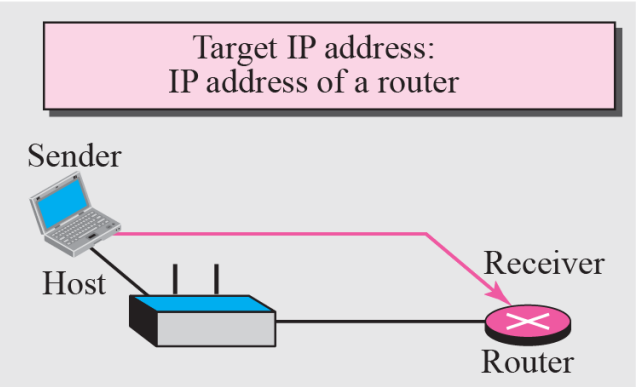
An ARP request is broadcast; an ARP reply is unicast.

Figure 8.5 *Four cases using ARP*

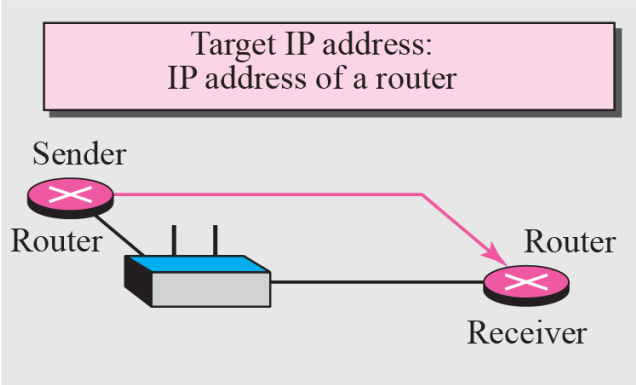
Case 1: A host has a packet to send to a host on the same network.



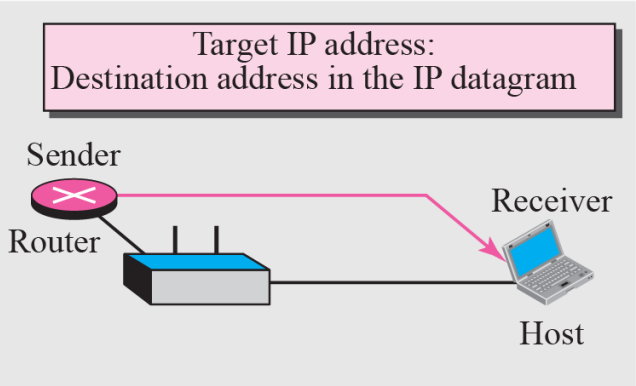
Case 2: A host has a packet to send to a host on another network.



Case 3: A router has a packet to send to a host on another network.



Case 4: A router has a packet to send to a host on the same network.



Example 8.1

A host with IP address 130.23.43.20 and physical address B2:34:55:10:22:10 has a packet to send to another host with IP address 130.23.43.25 and physical address A4:6E:F4:59:83:AB. The two hosts are on the same Ethernet network. Show the ARP request and reply packets encapsulated in Ethernet frames.

Solution

Figure 8.6 shows the ARP request and reply packets. Note that the ARP data field in this case is 28 bytes, and that the individual addresses do not fit in the 4-byte boundary. That is why we do not show the regular 4-byte boundaries for these addresses. Also note that the IP addresses are shown in hexadecimal.

Figure 8.6 *Example 8.1*

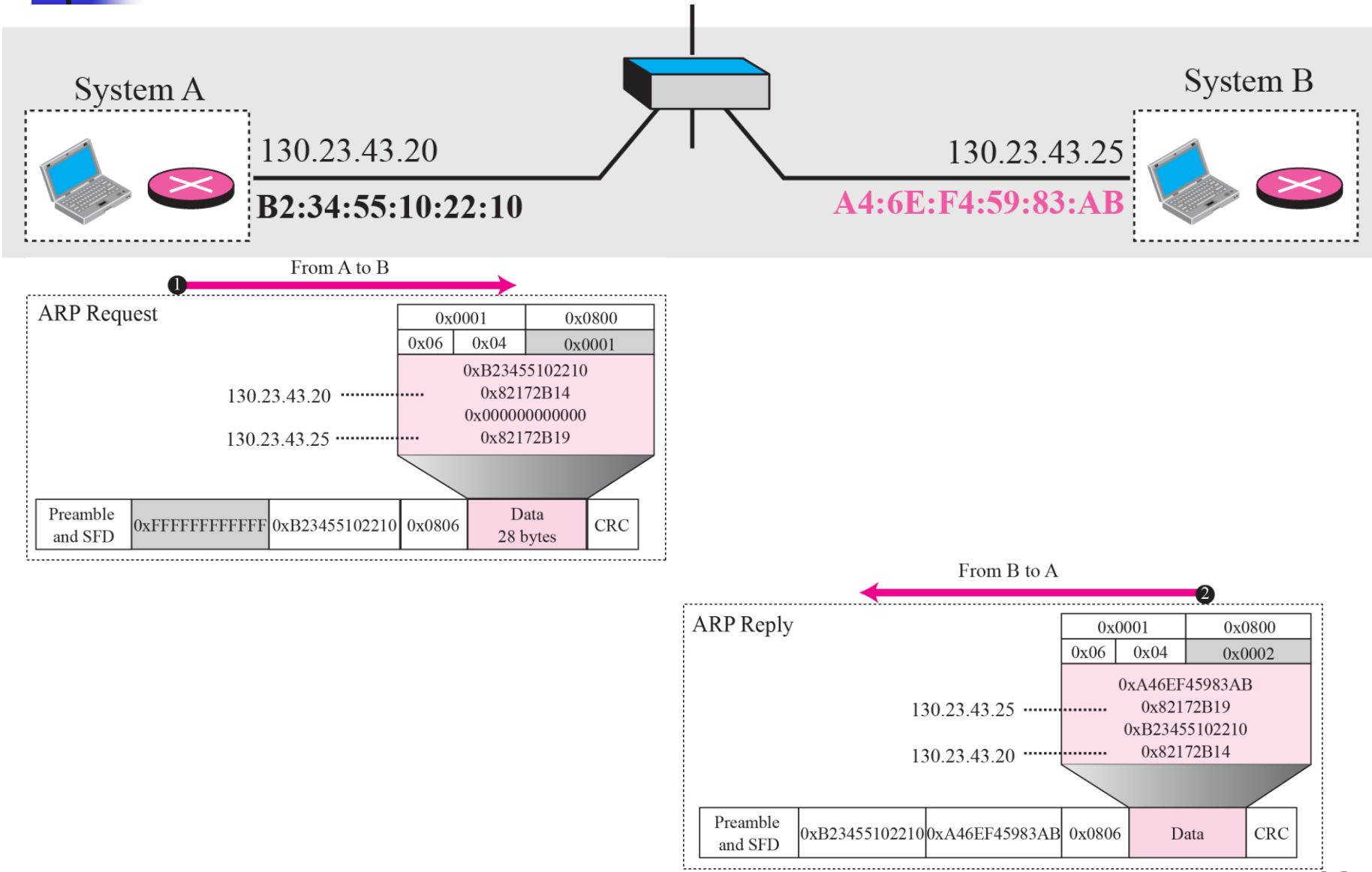
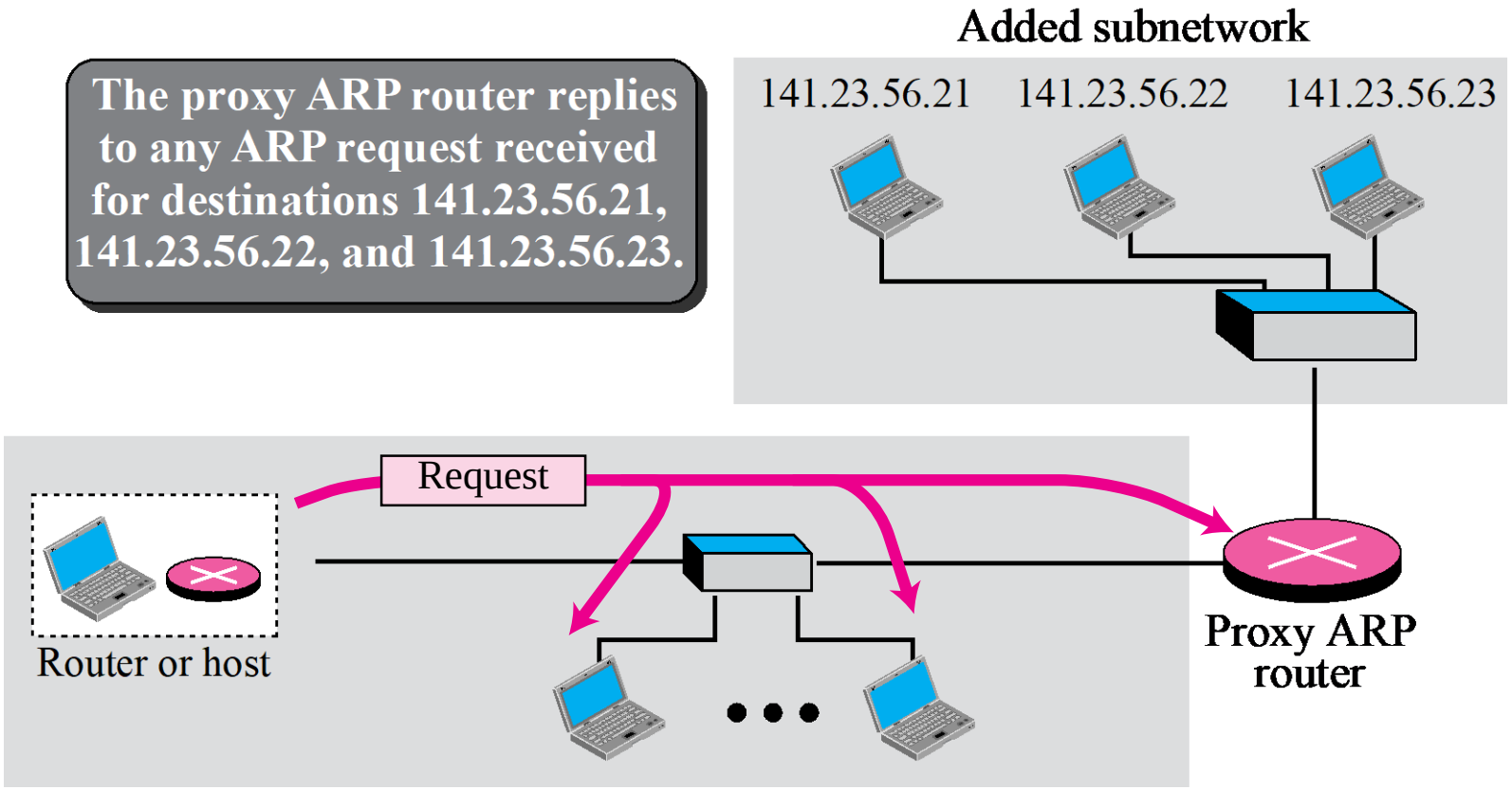


Figure 8.7 *Proxy ARP*



A router with IP address 195.5.2.12 and Ethernet physical address AA:25:AB:1F:67:CD has received a packet for a destination with IP address 185.11.78.10. When the router checks its routing table, it finds out the packet should be delivered to a router with IP address 195.5.2.6 and Ethernet physical address AD:34:5D:4F:67:CD.

a.) Show the entries in the ARP request packet sent by the router. Assume no subnetting.

b.) Show the entries in the ARP packet sent in response to part a.

c.) Encapsulate the packet made in part a in the data link layer. Fill in all the fields.

d.) Encapsulate the packet made in part b in a data link frame. Fill in all the fields.