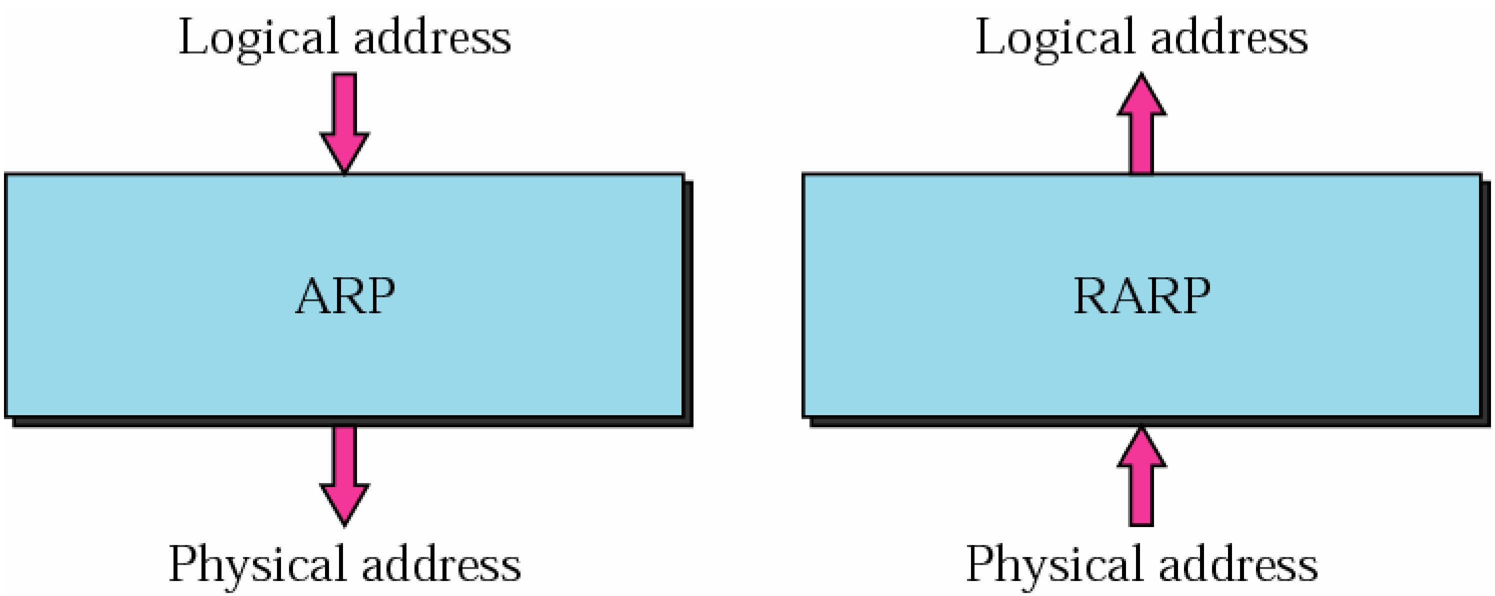
Chapter 7

ARP and RARP

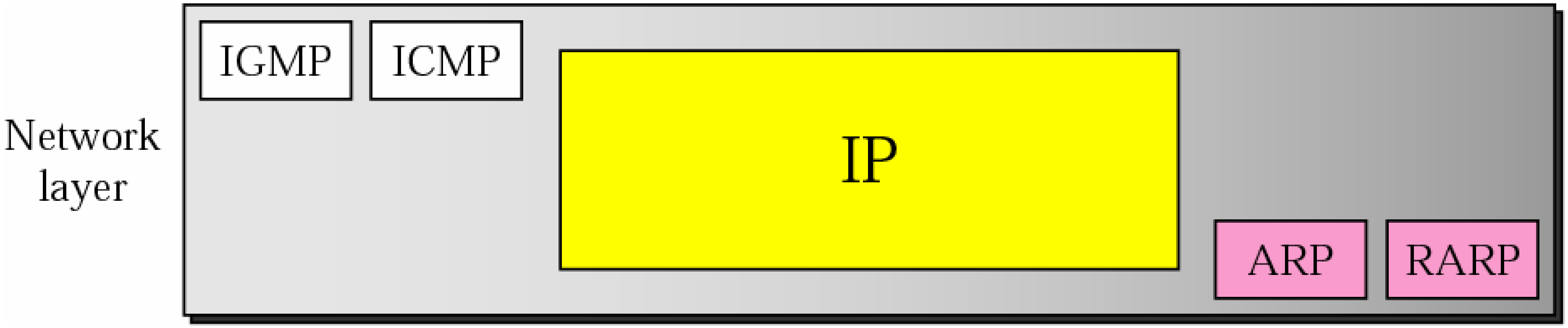
CONTENTS

- **ARP**
- **ARP PACKAGE**
- **RARP**

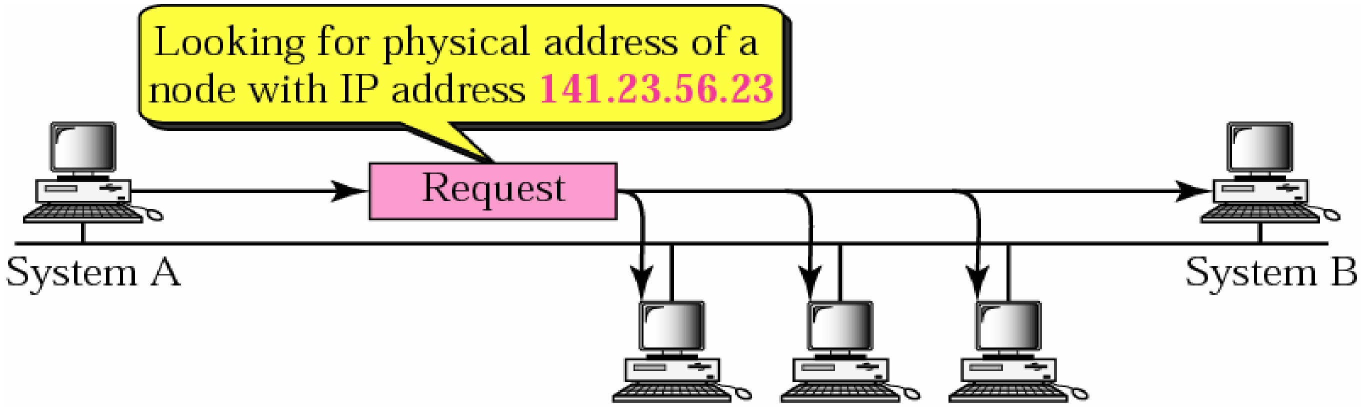
ARP and RARP


Logical address
ARP
Physical address
Logical address
RARP
Physical address

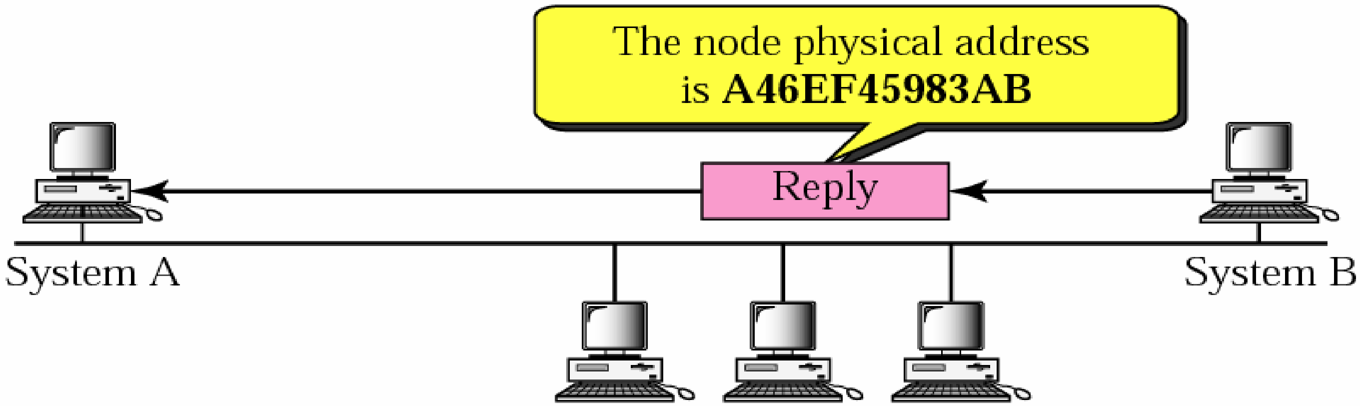
Position of ARP and RARP in TCP/IP protocol suite



7.1 ARP



a. ARP request is broadcast

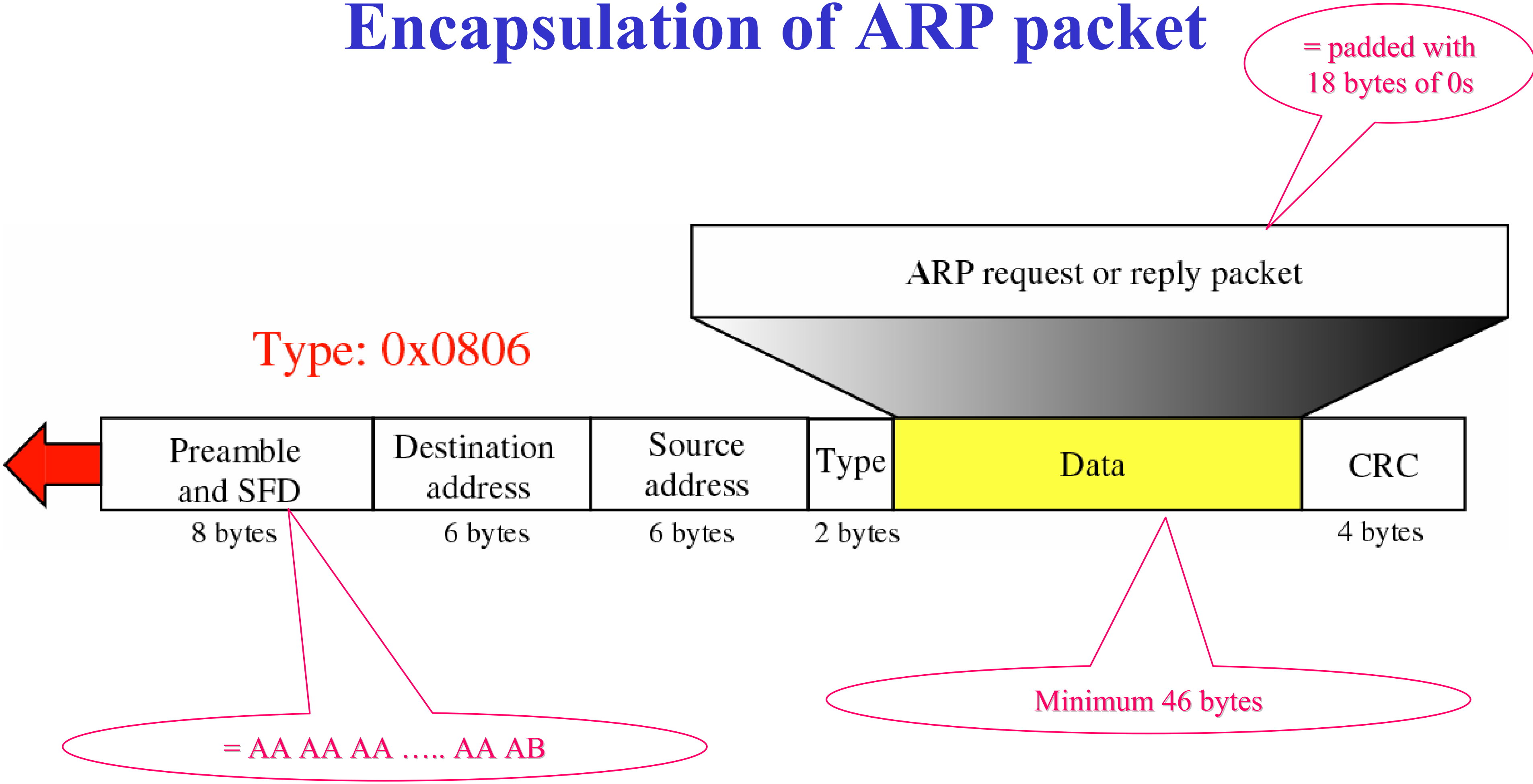


b. ARP reply is unicast

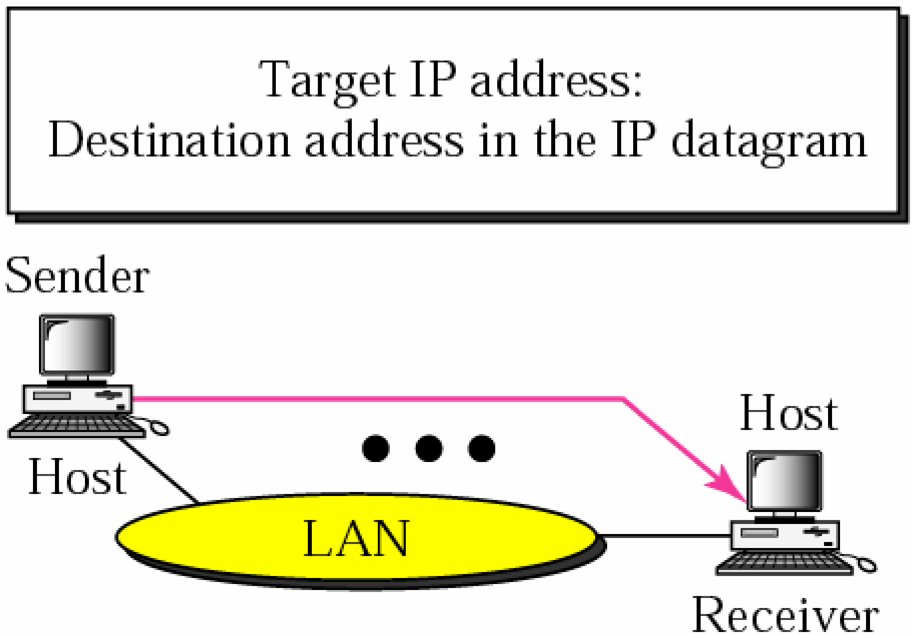
ARP packet

Hardware Type = 1 for Ethernet		Protocol Type = 0x0800 in IPv4	
Hardware length	Protocol length	Operation Request 1, Reply 2	
Sender hardware address (For example, 6 bytes for Ethernet)			
Sender protocol address (For example, 4 bytes for IP)			
Target hardware address (For example, 6 bytes for Ethernet) (It is not filled in a request)			
Target protocol address (For example, 4 bytes for IP)			

Encapsulation of ARP packet

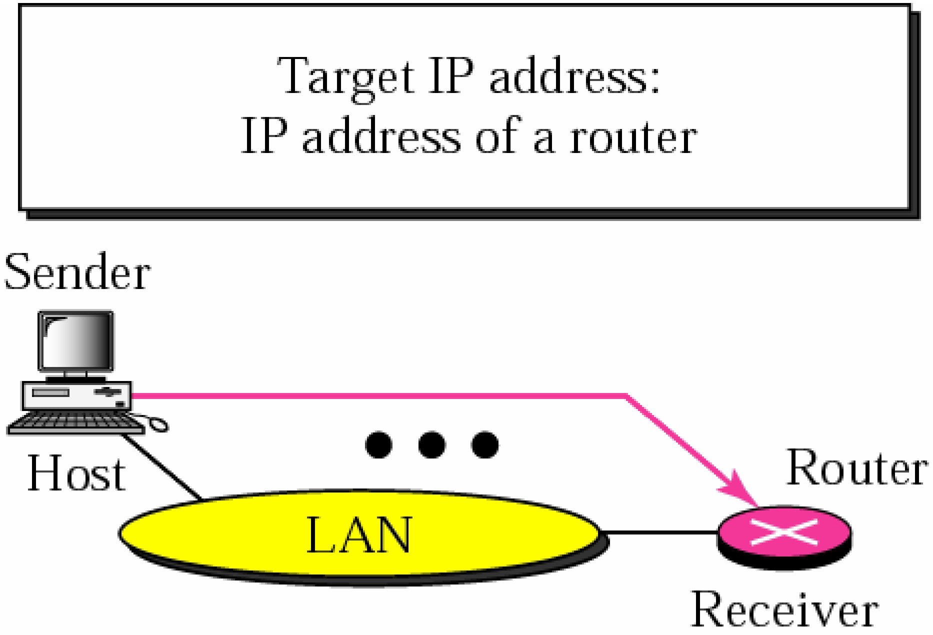


Four cases using ARP
Case 1



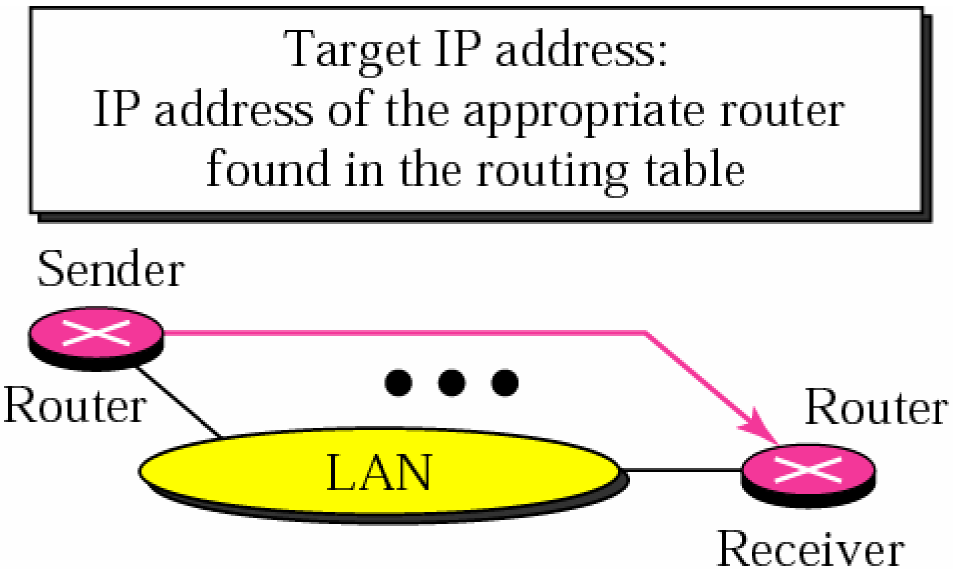
Case 1. A host has a packet to send to another host on the same network.

Four cases using ARP
Case 2



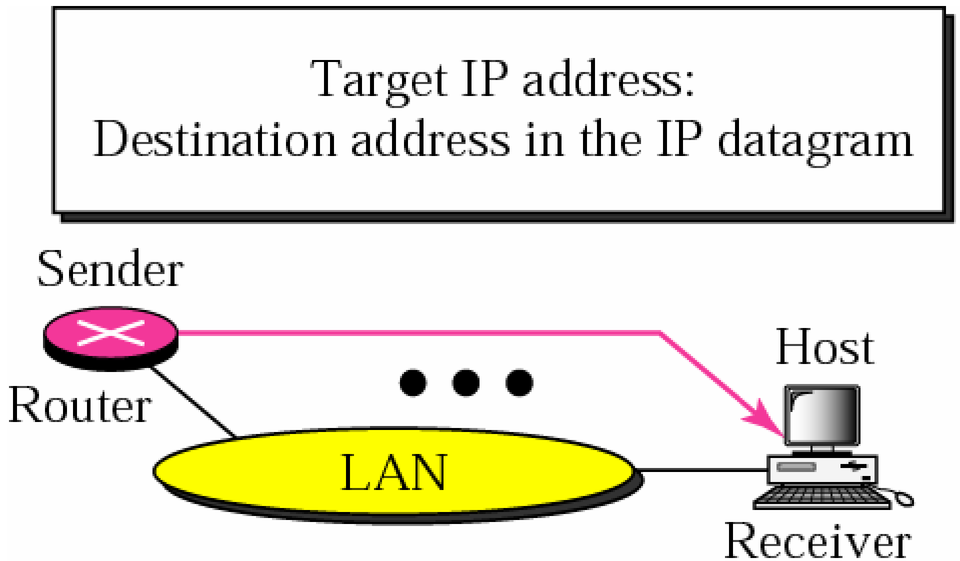
Case 2. A host wants to send a packet to another host on another network.
It must first be delivered to a router.

Four cases using ARP
Case 3



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.

Four cases using ARP
Case 4



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

Note

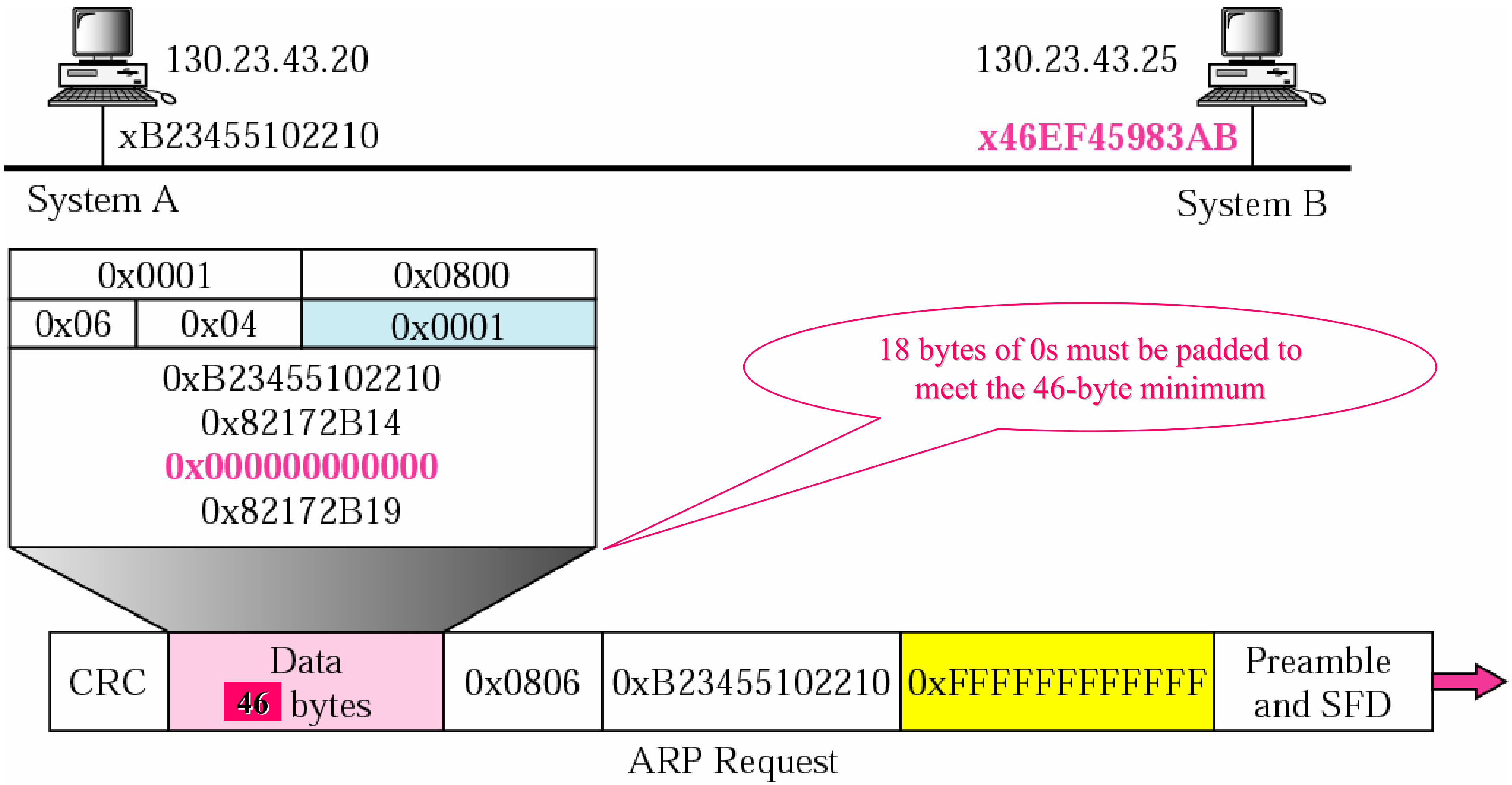
An ARP request is broadcast;

an ARP reply is unicast.

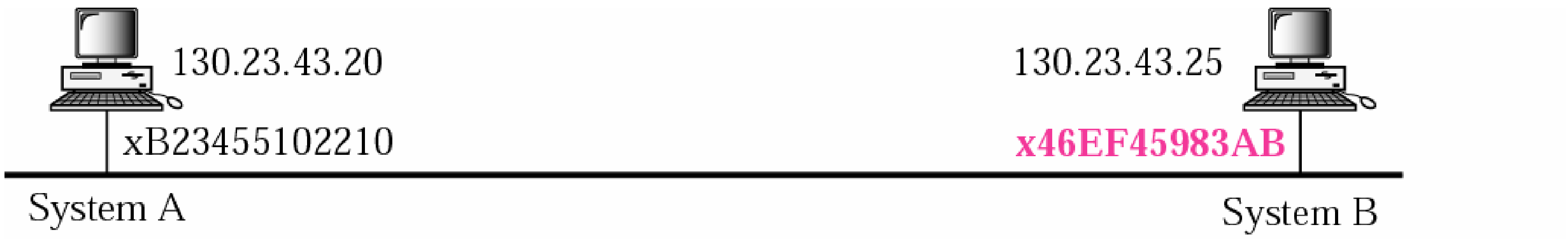
Example 1

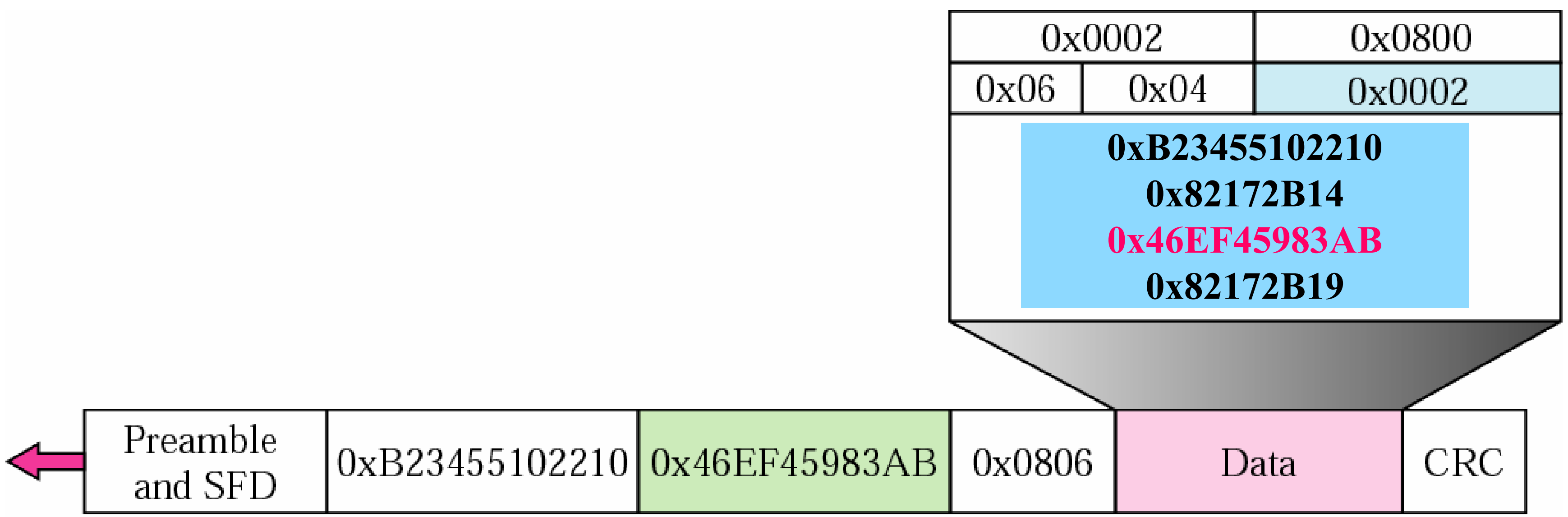
A host with IP address 130.23.43.20 and physical address 0xB23455102210 has a packet to send to another host with IP address 130.23.43.25 and physical address 0xA46EF45983AB. The two hosts are on the same Ethernet network. Show the ARP request and reply packets encapsulated in Ethernet frames.

Example 1: ARP Request



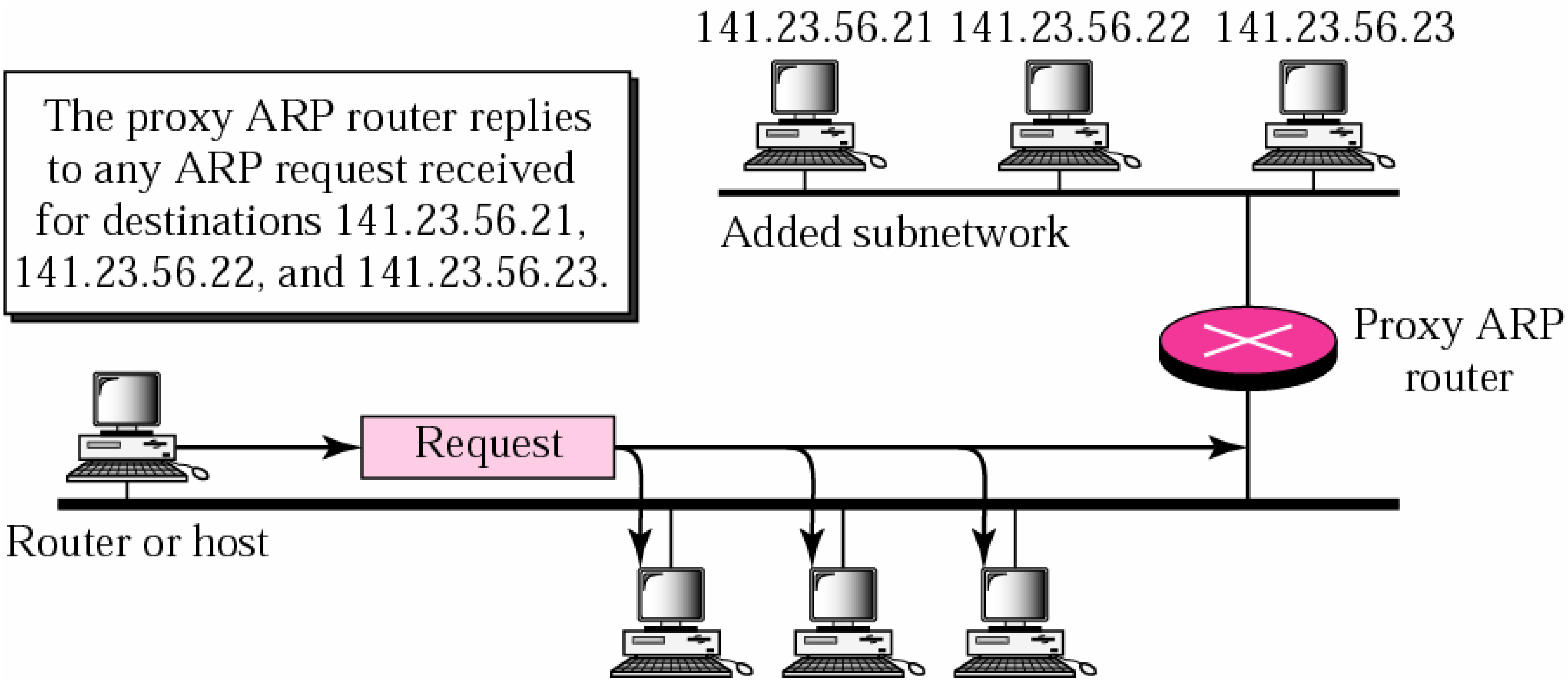
Example 1: ARP Reply





ARP Reply (from B to A)

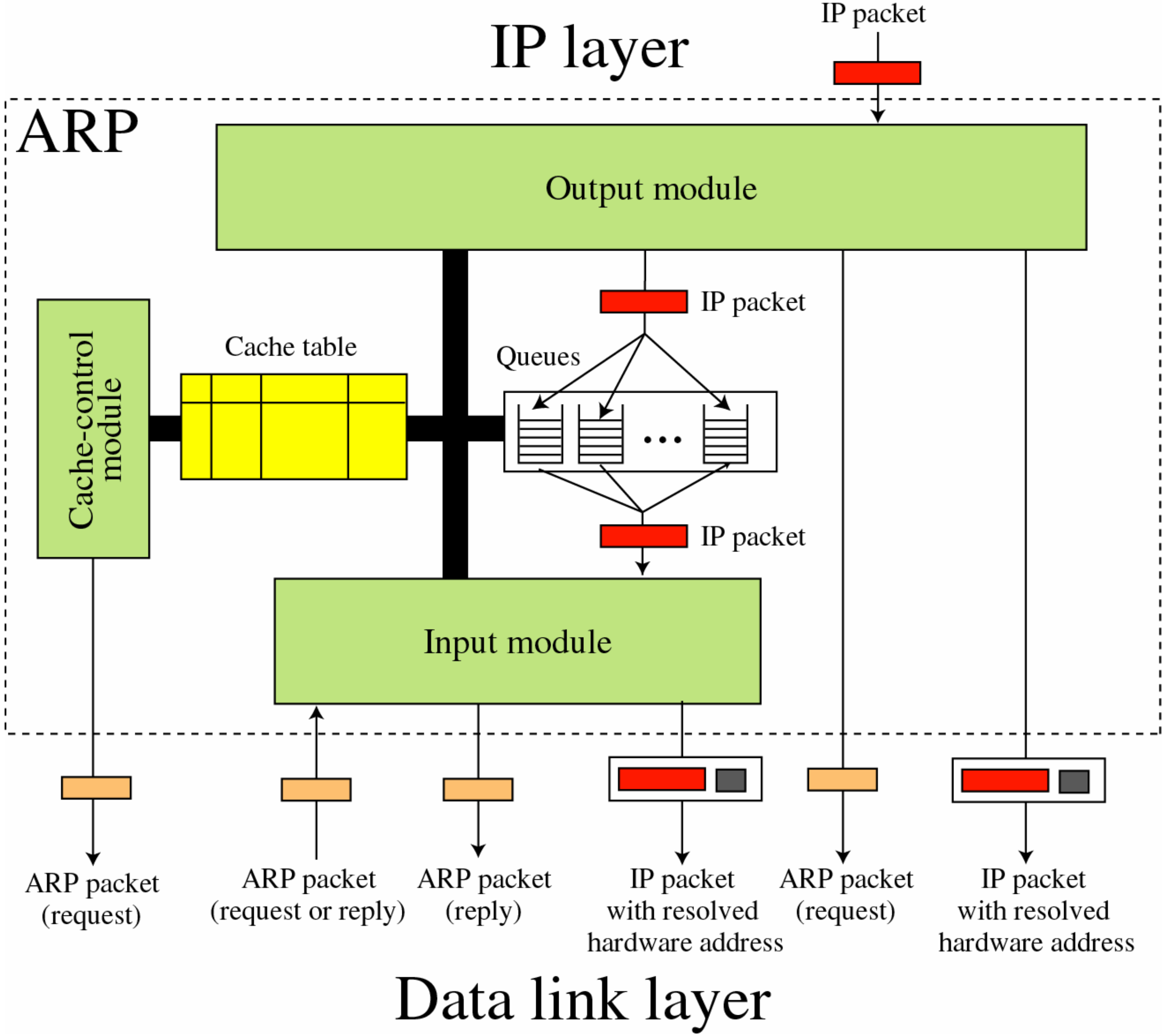
Proxy ARP


141.23.56.21
141.23.56.22
141.23.56.23
The proxy ARP router replies to any ARP request received for destinations 141.23.56.21, 141.23.56.22, and 141.23.56.23.
Added subnetwork
Proxy ARP router
Request
Router or host

7.2

ARP PACKAGE

ARP Software Architecture



Cache Table Entry Format

- State: of this entry; **R**esolved, **P**ending, or **F**ree
- Hardware Type, Protocol type, Hardware length, Protocol length: Same as in the ARP packet.
- Interface number
- Queue number
- Attempts
- Time-Out
- Hardware address: of destination, remains empty until resolved.
- Protocol address: of the destination, initially known.

Original cache table

State	Queue	Attempt	Time-out	Protocol Addr.	Hardware Addr.
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
F					
R	9		60	19.1.7.82	4573E3242ACA
P	18	3		188.11.8.71	

Example 2

The ARP output module receives an IP datagram (from the IP layer) with the destination address 114.5.7.89. It checks the cache table and finds that an entry exists for this destination with the RESOLVED state (R in the table). It extracts the hardware address, which is 457342ACAE32, and sends the packet and the address to the data link layer for transmission. The cache table remains the same.

Example 3

Twenty seconds later, the ARP output module receives an IP datagram (from the IP layer) with the destination address 116.1.7.22. It checks the cache table and does not find this destination in the table. The module adds an entry to the table with the state PENDING and the Attempt value 1. It creates a new queue for this destination and enqueues the packet. It then sends an ARP request to the data link layer for this destination.

Cache table for Example 3

State	*Queue*	*Attempt*	*Time-out*	*Protocol Addr.*	*Hardware Addr.*
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
P	**23**	**1**		**116.1.7.22**	
R	9		60	19.1.7.82	4573E3242ACA
P	18	3		188.11.8.71	

Example 4

Fifteen seconds later, the ARP input module receives an ARP packet with target protocol (IP) address 188.11.8.71. The module checks the table and finds this address. It changes the state of the entry to RESOLVED and sets the time-out value to 900. The module then adds the target hardware address (E34573242ACA) to the entry. Now it accesses queue 18 and sends all the packets in this queue, one by one, to the data link layer.

Cache table for Example 4

State	*Queue*	*Attempt*	*Time-out*	*Protocol Addr.*	*Hardware Addr.*
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
P	**23**	**1**		**116.1.7.22**	
R	9		60	19.1.7.82	4573E3242ACA
R	18			188.11.8.71	E34573242ACA

Example 5

Twenty-five seconds later, the cache-control module updates every entry. The time-out values for the first three resolved entries are decremented by 60. The time-out value for the last resolved entry is decremented by 25. The state of the next-to-the last entry is changed to FREE because the time-out is zero. For each of the **four pending** entries, the value of the attempts field is incremented by one. After incrementing, the attempts value for one entry (the one with IP protocol address 201.11.56.7) is more than the maximum; the state is changed to FREE, the queue is deleted.

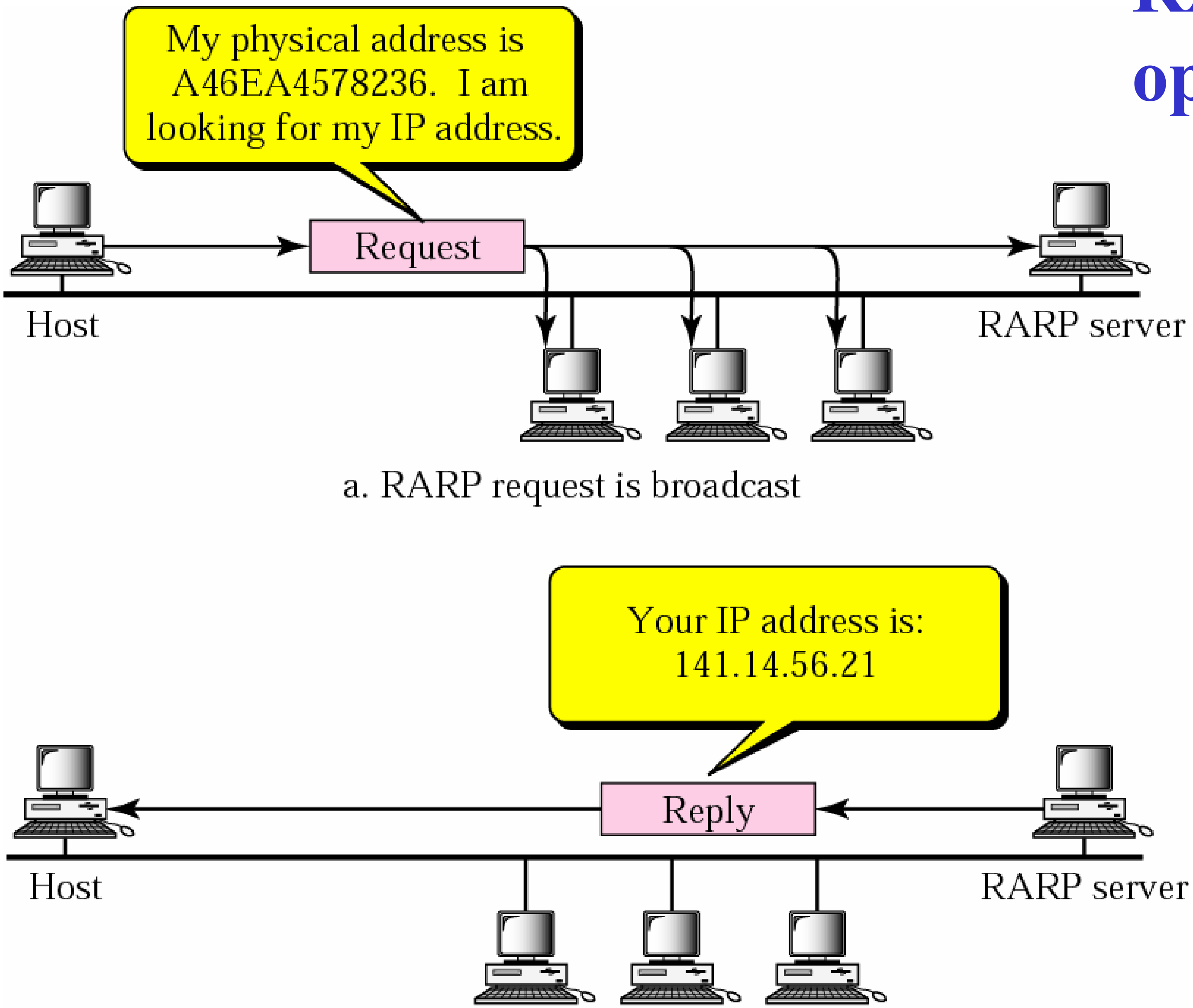
Cache table for Example 5

State	*Queue*	*Attempt*	*Time-out*	*Protocol Addr.*	*Hardware Addr.*
R	5		840	180.3.6.1	ACAE32457342
P	2	3		129.34.4.8	
F					
R	8		390	114.5.7.89	457342ACAE32
P	12	2		220.55.5.7	
P	**23**	**2**		**116.1.7.22**	
F					
R	18		874	188.11.8.71	E34573242ACA

7.3

RARP

RARP operation



a. RARP request is broadcast

b. RARP reply is unicast

Note

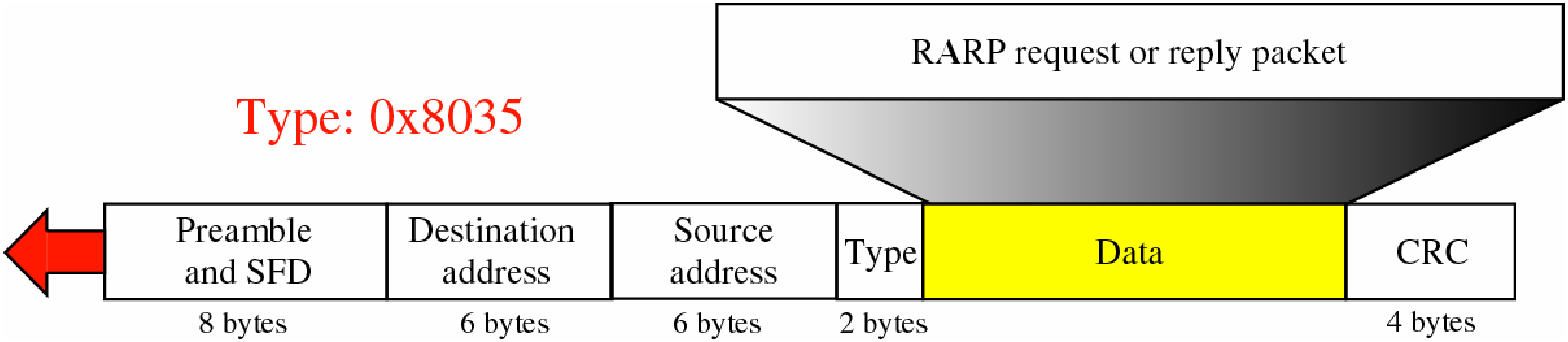
The RARP request packets are broadcast; the RARP reply packets are unicast.

Figure 7-11

RARP packet

<table>
<tr><td colspan="2">Hardware type</td><td colspan="2">Protocol type</td></tr>
<tr><td>Hardware length</td><td>Protocol length</td><td colspan="2">Operation
Request 3, Reply 4</td></tr>
<tr><td colspan="4">Sender hardware address
(For example, 6 bytes for Ethernet)</td></tr>
<tr><td colspan="4">Sender protocol address
(For example, 4 bytes for IP)
(It is not filled for request)</td></tr>
<tr><td colspan="4">Target hardware address
(For example, 6 bytes for Ethernet)
(It is not filled for request)</td></tr>
<tr><td colspan="4">Target protocol address
(For example, 4 bytes for IP)
(It is not filled for request)</td></tr>
</table>

Encapsulation of RARP packet



Alternative Solutions to RARP

When a diskless computer is booted, it needs more information in addition to its IP address. It needs to know its subnet mask, the IP address of a router, and the IP address of a name server. RARP cannot provide this extra information. New protocols have been developed to provide this information. In Chapter 17 we discuss two protocols, BOOTP and DHCP, that can be used instead of RARP.