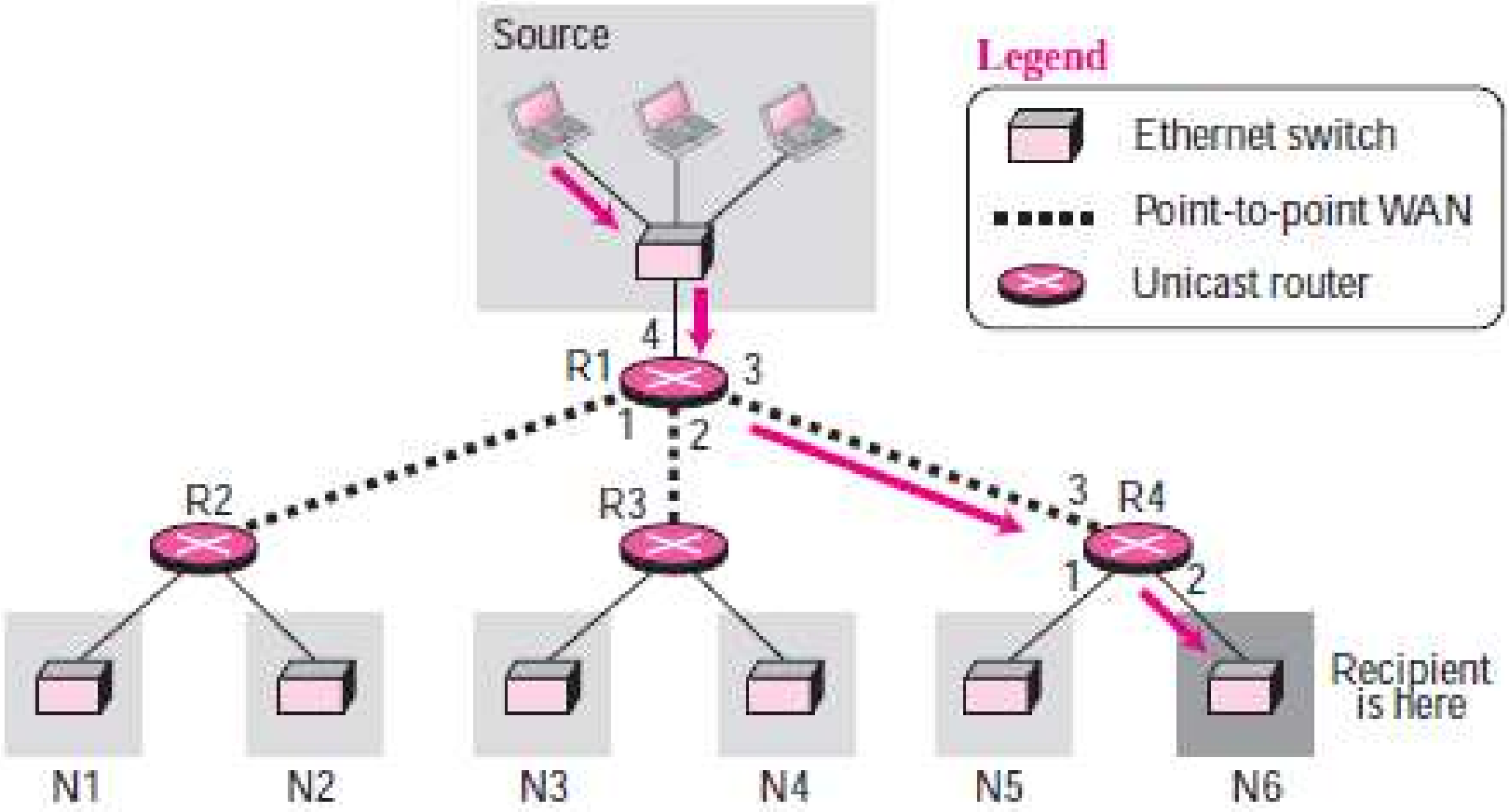
Internet Group Management Protocol

Objectives

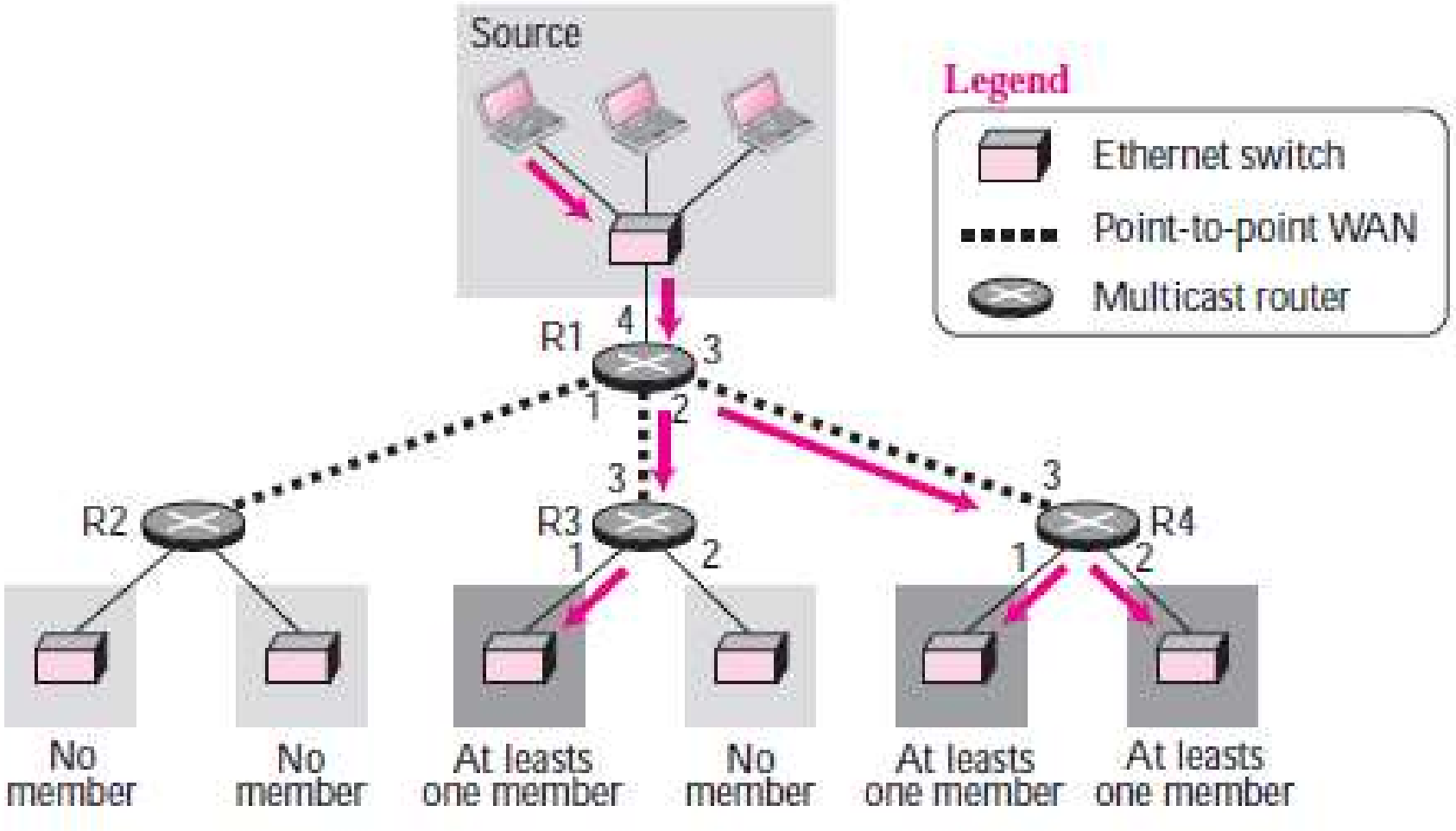
Upon completion you will be able to:

- ***Know the purpose of IGMP***
- ***Know the types of IGMP messages***
- ***Understand how a member joins a group and leaves a group***
- ***Understand membership monitoring***
- ***Understand how an IGMP message is encapsulated***
- ***Understand the interactions of the modules of an IGMP package***

UNICASTING

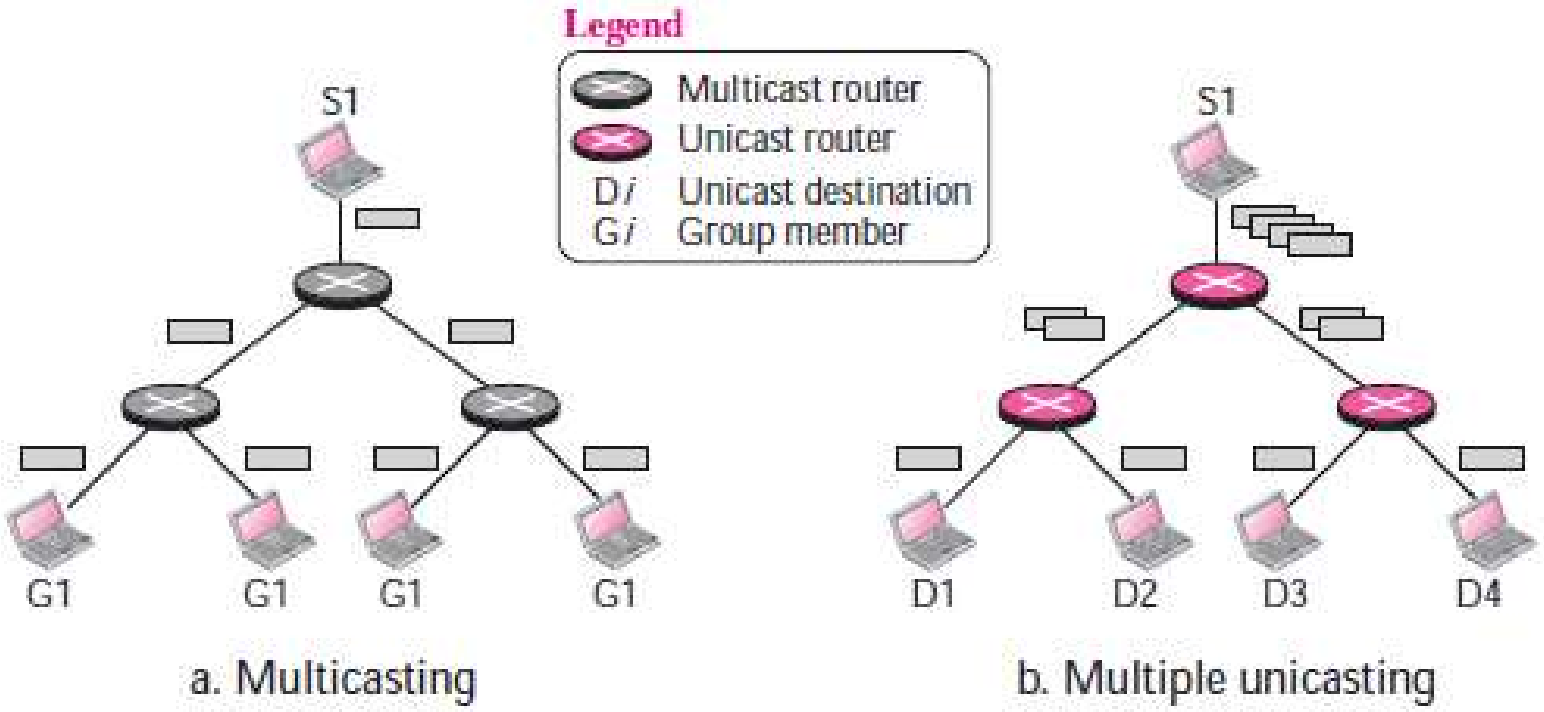

Source
Legend
Ethernet switch
Point-to-point WAN
Unicast router
R1
R2
R3
R4
4
3
1
2
3
1
2
Recipient is here
N1
N2
N3
N4
N5
N6

MULTICASTING



Difference b/w multicasting and multiple unicasting

- Multicasting starts with one single packet from the source that is duplicated by the routers. The destination address in each packet is the same for all duplicates
- In multiple unicasting, several packets start from the source with different destination address. For example, when a person sends an e-mail message to a group of people, this is multiple unicasting. The e-mail software creates replicas of the message, each with a different destination address, and sends them one by one.



Applications of Multicasting

- Teleconferencing
- Distance Learning
- Dissemination of News

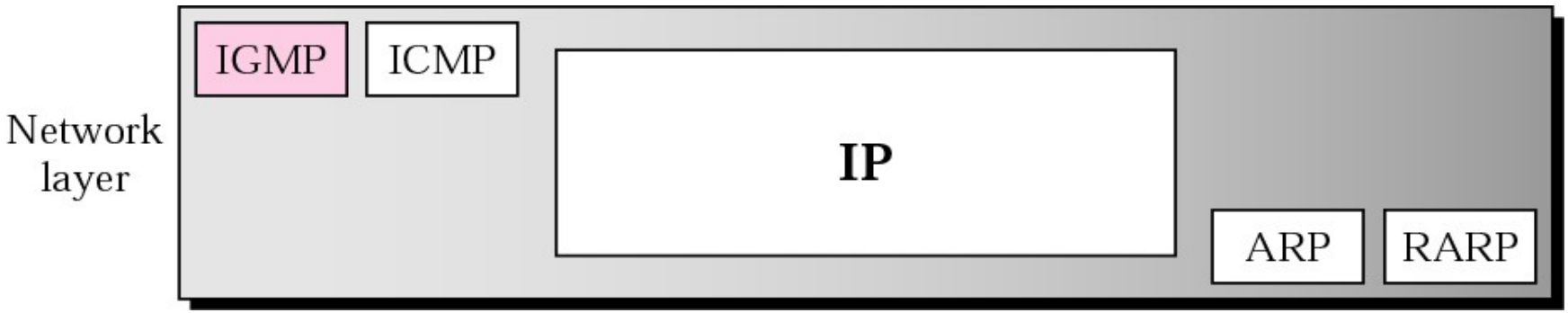
Multicast Address

- A multicast address is a destination address for a group of hosts that have joined a multicast group.
- A packet that uses a multicast address as a destination can reach all members of the group unless there are some filtering restriction by the receiver.
- **Multicast Address used in IPV4:** In classful addressing, multicast addresses occupied the only single block in class D. In classless addressing the same block has been used for this purpose.
- In other words, the block assigned for multicasting is 224.0.0.0/4. This means that the block has 2^28 = 268,435,456 addresses (224.0.0.0 to 239.255.255.255).

Internet Group Management Protocol (IGMP)

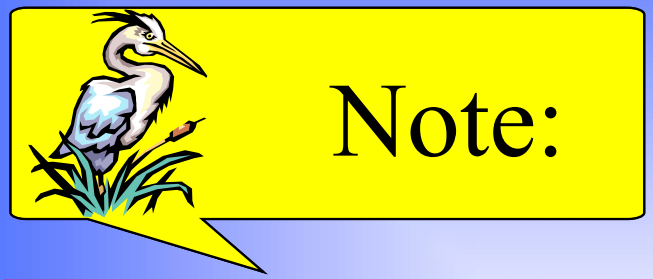
- Multicast communication means that a sender sends a message to a group of recipients that are members of the same group.
- Since one copy of the message is sent by the sender, but copied and forwarded by routers, each multicast router needs to know the list of groups that have at least one loyal member related to each interface.
- This means that the multicast routers need to collect information about members and share it with other multicast routers.
- Collection of this type of information is done at two levels: locally and globally.
- A multicast router connected to a network is responsible to collect this type of information locally; the information collected can be globally propagated to other routers.
- The first task is done by the IGMP protocol; the second task is done by the multicast routing protocols.

Position of IGMP in the network layer



GROUP MANAGEMENT

IGMP is a protocol that manages group membership. The IGMP protocol gives the multicast routers information about the membership status of hosts (routers) connected to the network. .



Note:

IGMP is a group management protocol. It helps a multicast router create and update a list of loyal members related to each router interface.

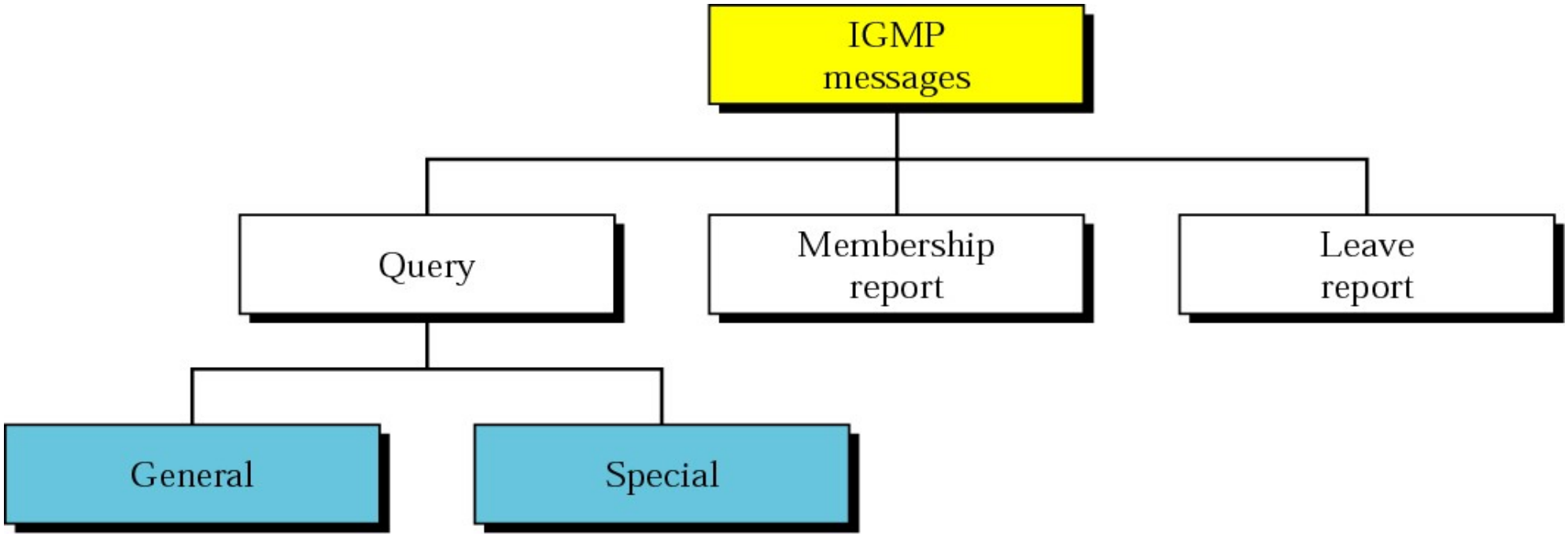
IGMP MESSAGES

IGMP has three types of messages: the query, the membership report, and the leave report. There are two types of query messages, general and special.

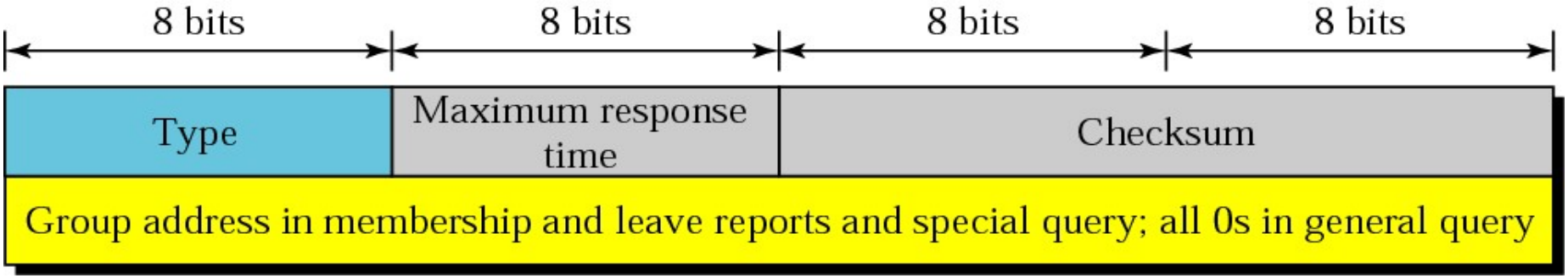
The topics discussed in this section include:

Message Format

IGMP message types



IGMP message format



IGMP type field

Type	*Value*
General or Special Query	0x11 or 00010001
Membership Report	0x16 or 00010110
Leave Report	0x17 or 00010111

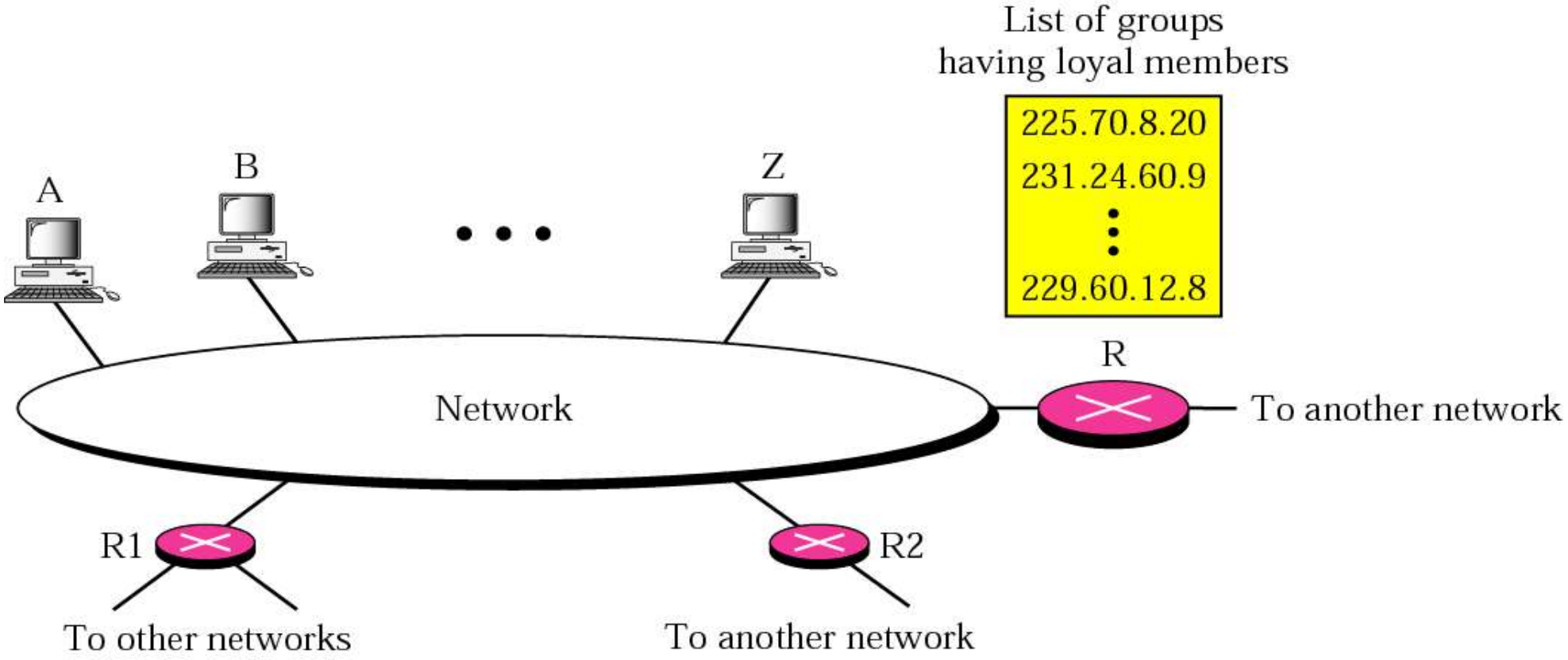
IGMP OPERATION

A multicast router connected to a network has a list of multicast addresses of the groups with at least one loyal member in that network. For each group, there is one router that has the duty of distributing the multicast packets destined for that group.

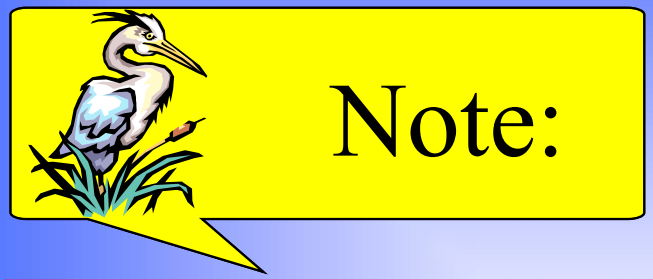
The topics discussed in this section include:

Joining a Group
Leaving a Group
Monitoring Membership

IGMP operation

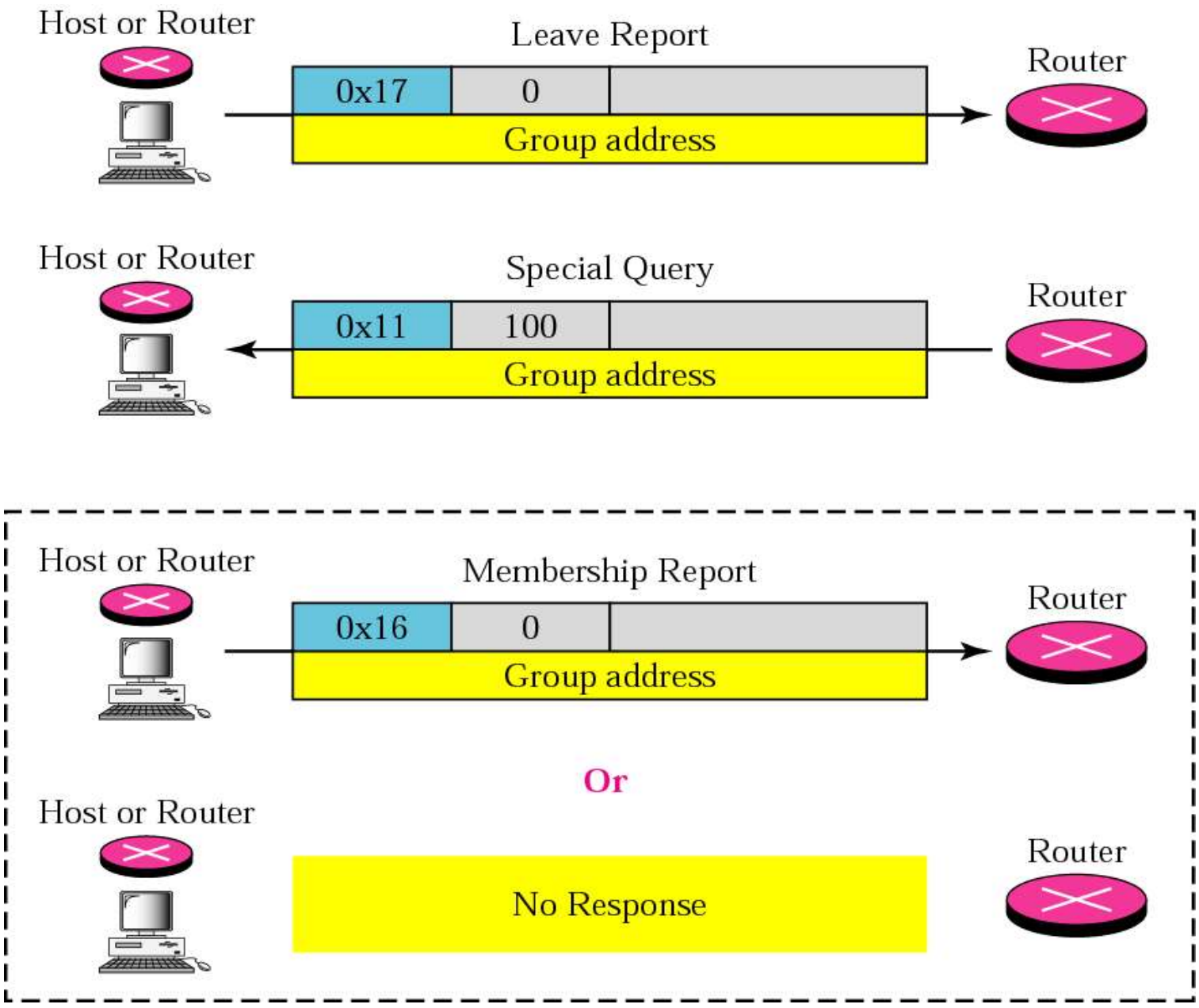


Membership report

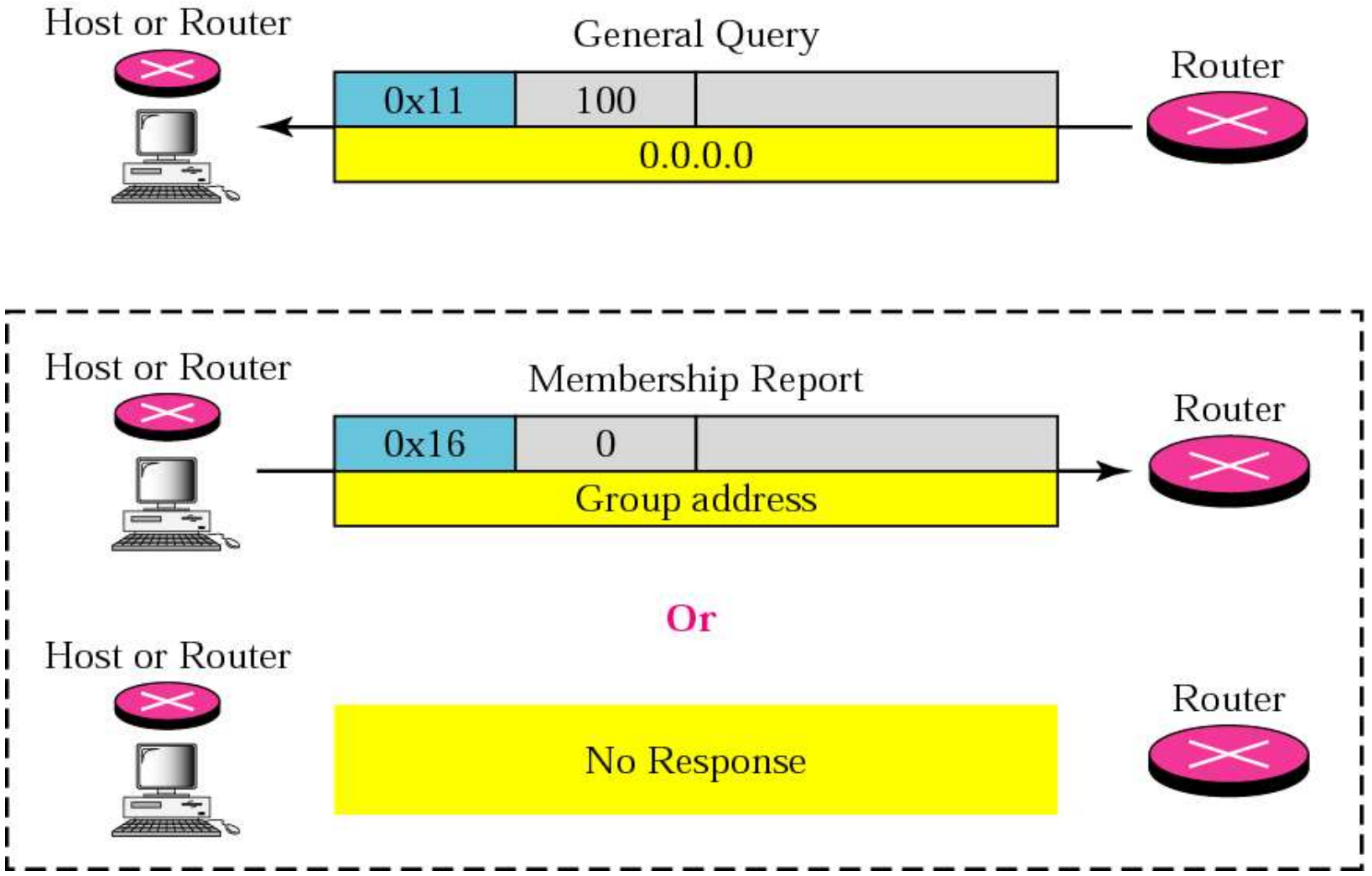


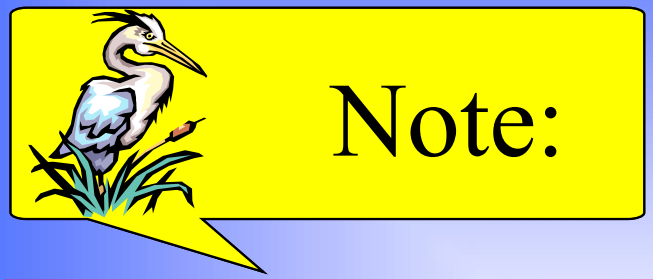
In IGMP, a membership report is sent twice, one after the other.

Leave report



General query message





The general query message does not define a particular group.

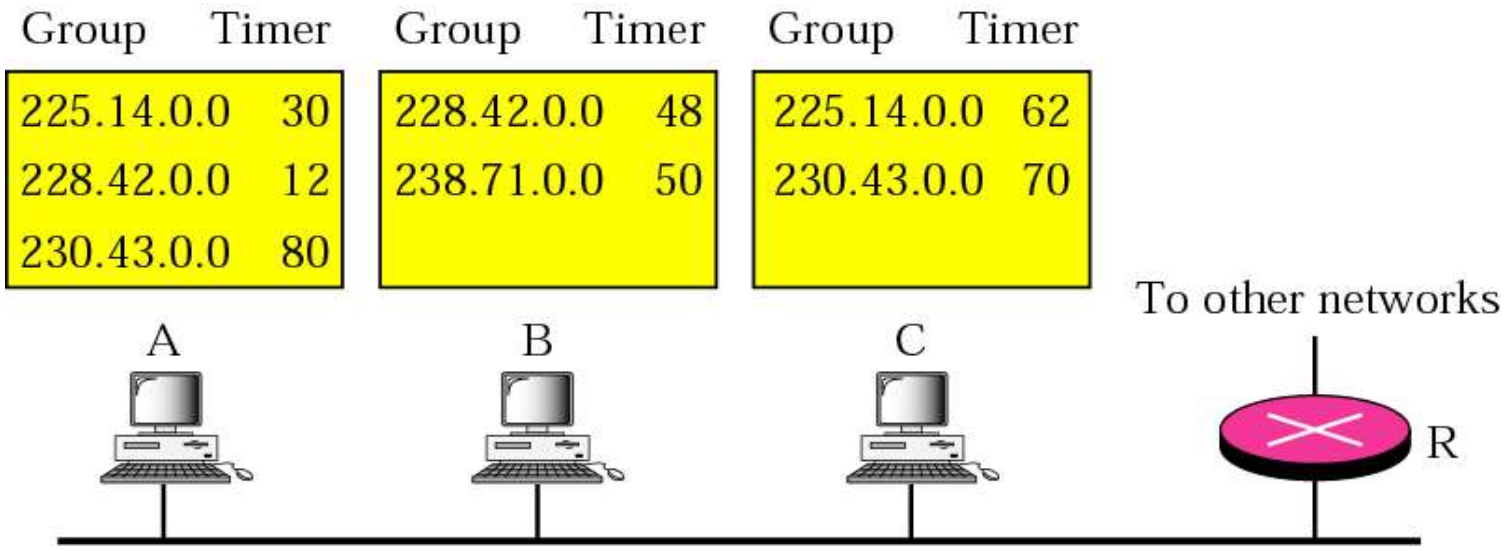
EXAMPLE 1

Imagine there are three hosts in a network as shown in Figure 10.8.

A query message was received at time 0; the random delay time (in tenths of seconds) for each group is shown next to the group address. Show the sequence of report messages.

See Next Slide

Figure 10.8 *Example 1*



EXAMPLE 1 (CONTINUED)

Solution

The events occur in this sequence:

a. **Time 12**: ***The timer for 228.42.0.0 in host A expires and a membership report is sent, which is received by the router and every host including host B which cancels its timer for 228.42.0.0.***

b. **Time 30:** ***The timer for 225.14.0.0 in host A expires and a membership report is sent, which is received by the router and every host including host C which cancels its timer for 225.14.0.0.***

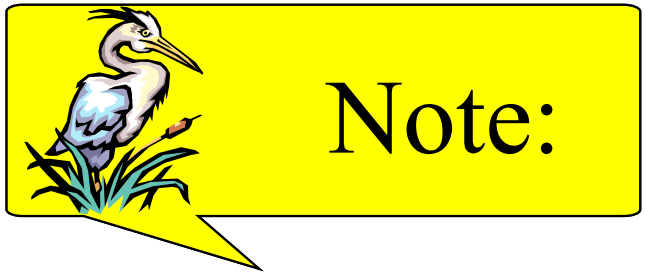
c. **Time 50:** ***The timer for 238.71.0.0 in host B expires and a membership report is sent, which is received by the router and every host.***

See Next Slide

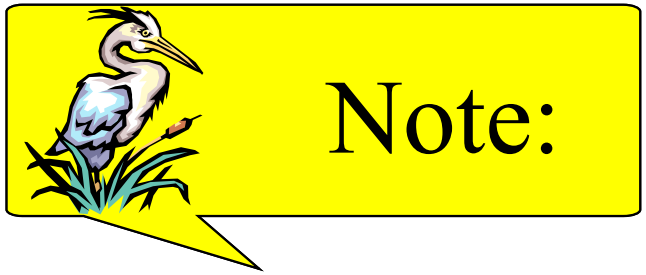
EXAMPLE 1 (CONTINUED)

d. **Time 70:** ***The timer for 230.43.0.0 in host C expires and a membership report is sent, which is received by the router and every host including host A which cancels its timerfor 230.43.0.0.***

Note that if each host had sent a report for every group in its list, there would have been seven reports; with this strategy only four reports are sent.



The IP packet that carries an IGMP packet has a value of 2 in its protocol field.



The IP packet that carries an IGMP packet has a value of 1 in its TTL field.

Destination IP addresses

Type	*IP Destination Address*
Query	224.0.0.1 All systems on this subnet
Membership Report	The multicast address of the group
Leave Report	224.0.0.2 All routers on this subnet

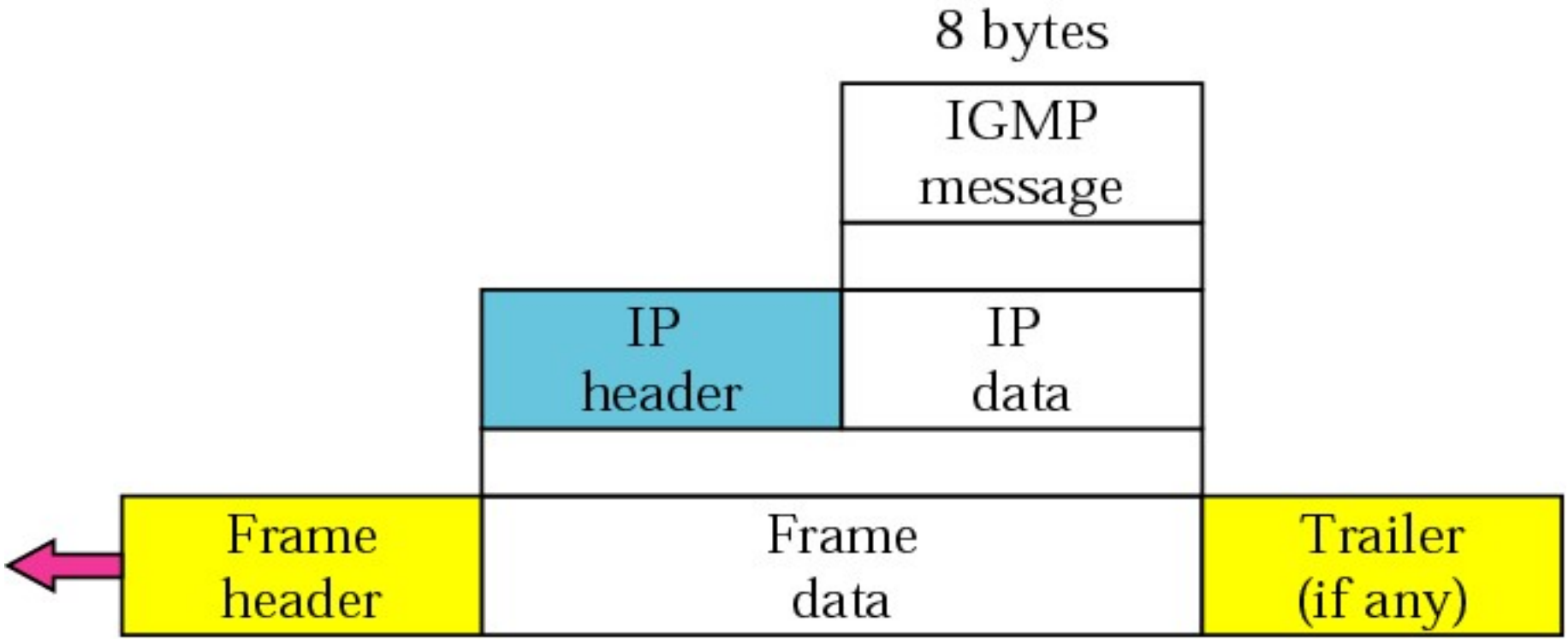
ENCAPSULATION

The IGMP message is encapsulated in an IP datagram, which is itself encapsulated in a frame.

The topics discussed in this section include:

IP Layer
Data Link Layer
Netstat Utility

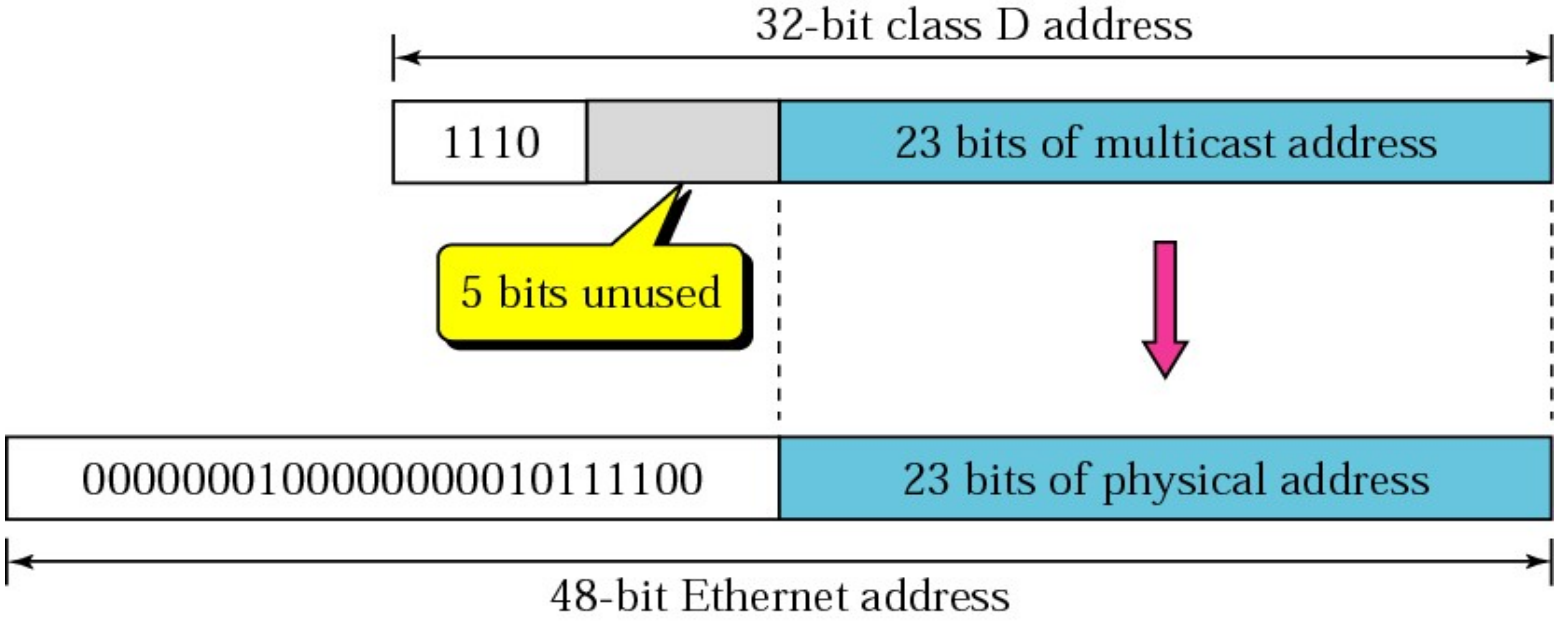
Encapsulation of IGMP packet

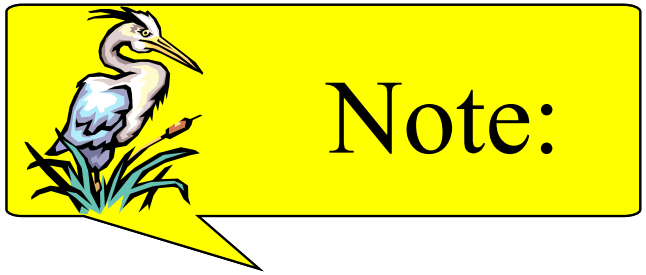


Delivery of Multicast Packets at Data Link Layer

- Because the IP packet has a multicast IP address, the ARP protocol cannot find the corresponding MAC (physical) address to forward the packet at the data link layer.
- What happens next depends on whether or not the underlying data link layer supports physical multicast addresses.
- Most LANs support physical multicast addressing. Ethernet is one of them.
- An Ethernet physical address (MAC address) is six octets (48 bits) long. If the first 25 bits in an Ethernet address are 00000001 00000000 01011110 0, this identifies a physical multicast address for the TCP/IP protocol.
- The remaining 23 bits can be used to define a group.
- To convert an IP multicast address into an Ethernet address, the multicast router extracts the least significant 23 bits of a multicast IP address and inserts them into a multicast Ethernet physical address

Mapping class D to Ethernet physical address





Note:

An Ethernet multicast physical address is in the range

01:00:5E:00:00:00

to

01:00:5E:7F:FF:FF.

EXAMPLE 2

Change the multicast IP address 230.43.14.7 to an Ethernet multicast physical

Solution

We can do this in two steps:

a. *We write the rightmost 23 bits of the IP address in hexadecimal. This can be done by changing the rightmost 3 bytes to hexadecimal and then subtracting 8 from the leftmost digit if it is greater than or equal to 8. In our example, the result is 2B:0E:07.*

b. *We add the result of part a to the starting Ethernet multicast address, which is (01:00:5E:00:00:00). The result is*

01:00:5E:2B:0E:07

EXAMPLE 3

Change the multicast IP address 238.212.24.9 to an Ethernet multicast address.

Solution

a. *The right-most three bytes in hexadecimal are D4:18:09. We need to subtract 8 from the leftmost digit, resulting in 54:18:09..*

b. *We add the result of part a to the Ethernet multicast starting address. The result is*

01:00:5E:54:18:09