

# Chapter 10

## *Internet Group Management Protocol*

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### Objectives

*Upon completion you will be able to:*

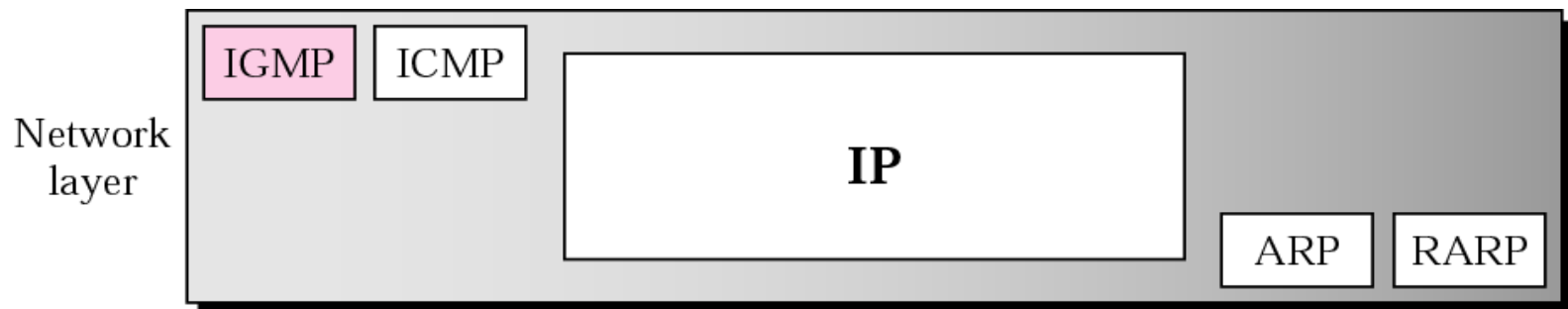
- *Know the purpose of IGMP*
- *Know the types of IGMP messages*
- *Understand how a member joins a group and leaves a group*
- *Understand membership monitoring*
- *Understand how an IGMP message is encapsulated*
- *Understand the interactions of the modules of an IGMP package*

IP protocol has two types of communication: Unicasting and Multicasting.

**Multicasting:** Sending the same message to a large number of receivers simultaneously. i.e. One-to-many communication.

**Ex.** Distance Learning, Video-on-demand, Stock prices, etc.

**Figure 10.1** *Position of IGMP in the network layer*



# 10.1 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.***

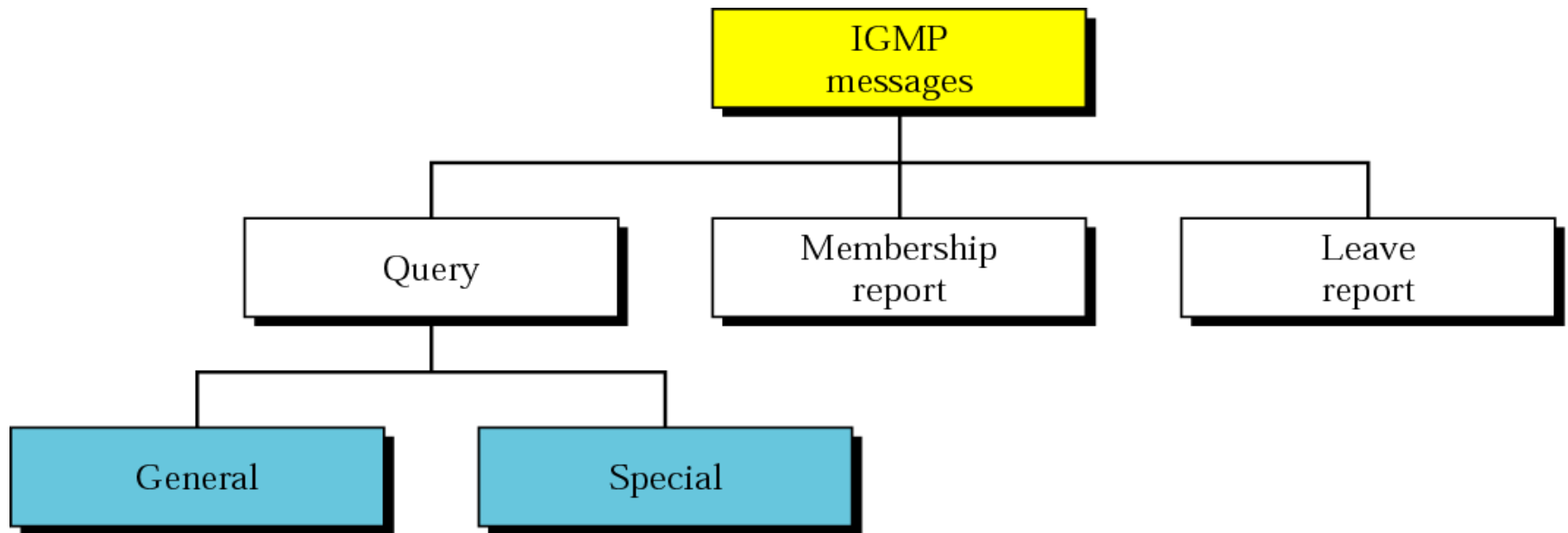
## 10.2 IGMP MESSAGES

*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.*

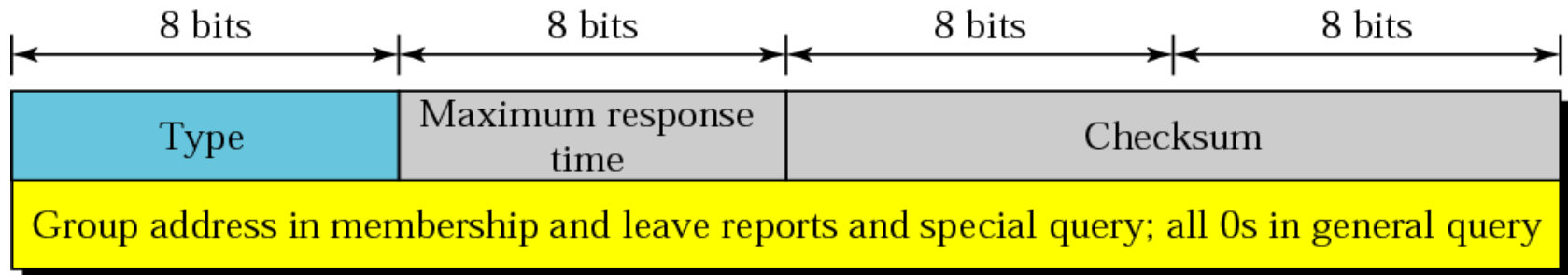
***The topics discussed in this section include:***

***Message Format***

**Figure 10.2** *IGMP message types*



## IGMP message format



**Type:** Type of message

**Max. Response time:** Defines amount of time in which query must be answered. Value is  $10^{\text{th}}$  of a second.

**Checksum:** Calculated over 8-byte message.

**Group Address:** 0 for general query message. Value defines groupid in special query, membership report, and leave report message.



***Table 10.1 IGMP type field***

<i>Type</i>	<i>Value</i>
General or Special Query	0x11 or 00010001
Membership Report	0x16 or 00010110
Leave Report	0x17 or 00010111

## 10.3 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.*

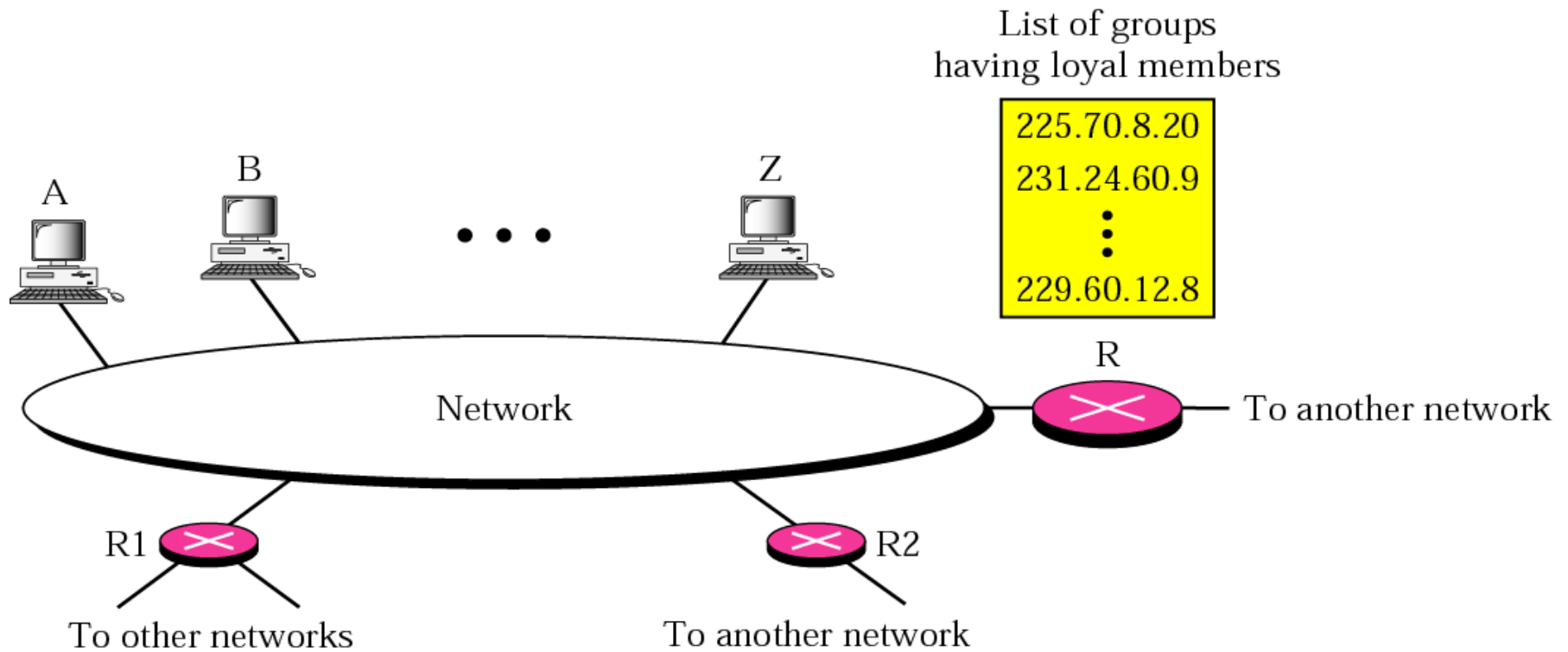
***The topics discussed in this section include:***

*Joining a Group*

*Leaving a Group*

*Monitoring Membership*

**Figure 10.4** *IGMP operation*





## Joining a Group

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A host or router can join a group.

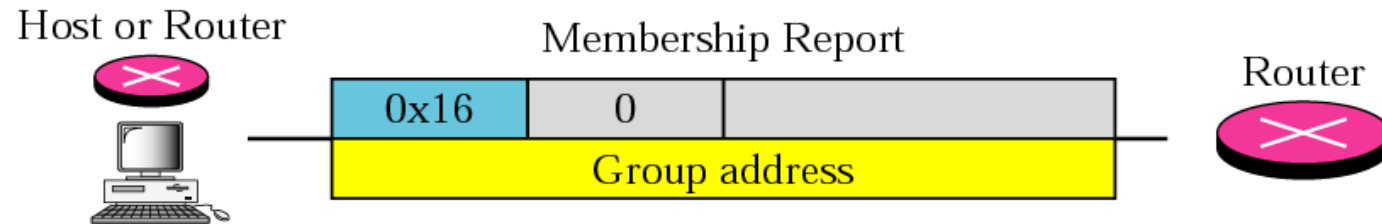
Host maintains the list of processes that have membership in a group.

Router also maintains a list of groupids that shows membership for the networks connected to each interface.

Membership report is sent out of all interfaces except the one from which the new interest comes.

See Fig.

**Figure 10.5** *Membership report*





Note:

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

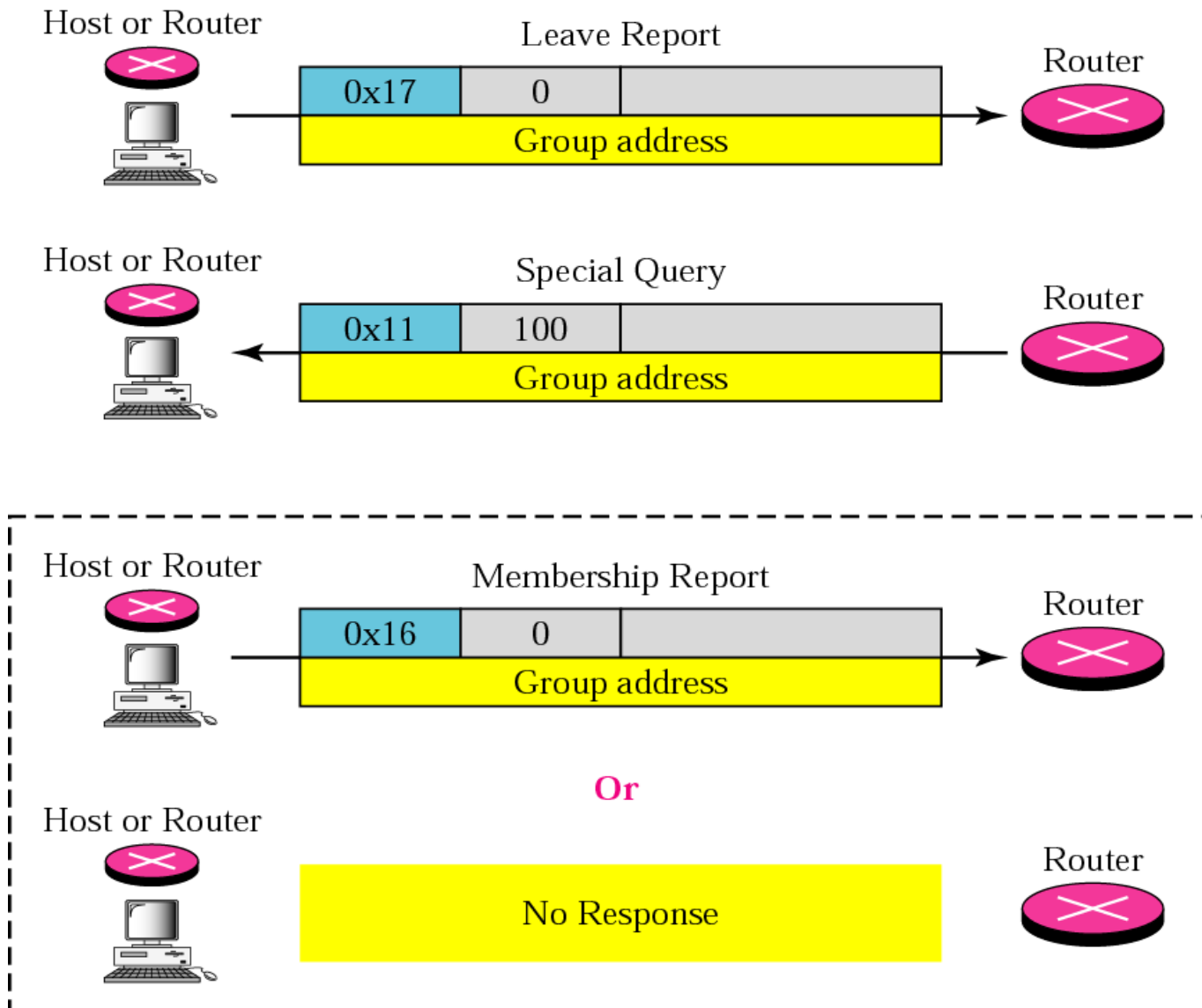
When a host sees that no process is interested in specific group, it sends a leave report.

When router receives leave report, it sends a special query message and inserts the groupid related to that group.

Router allows specified time for any host or router to respond.

If router does not receive any interest i.e. Membership report, it purges the group from its list.

**Figure 10.6** *Leave report*







Note:

*The general query message does not define a particular group.*

A multicast router is responsible for monitoring all hosts or routers in a LAN to see if they want to continue their membership in a group.

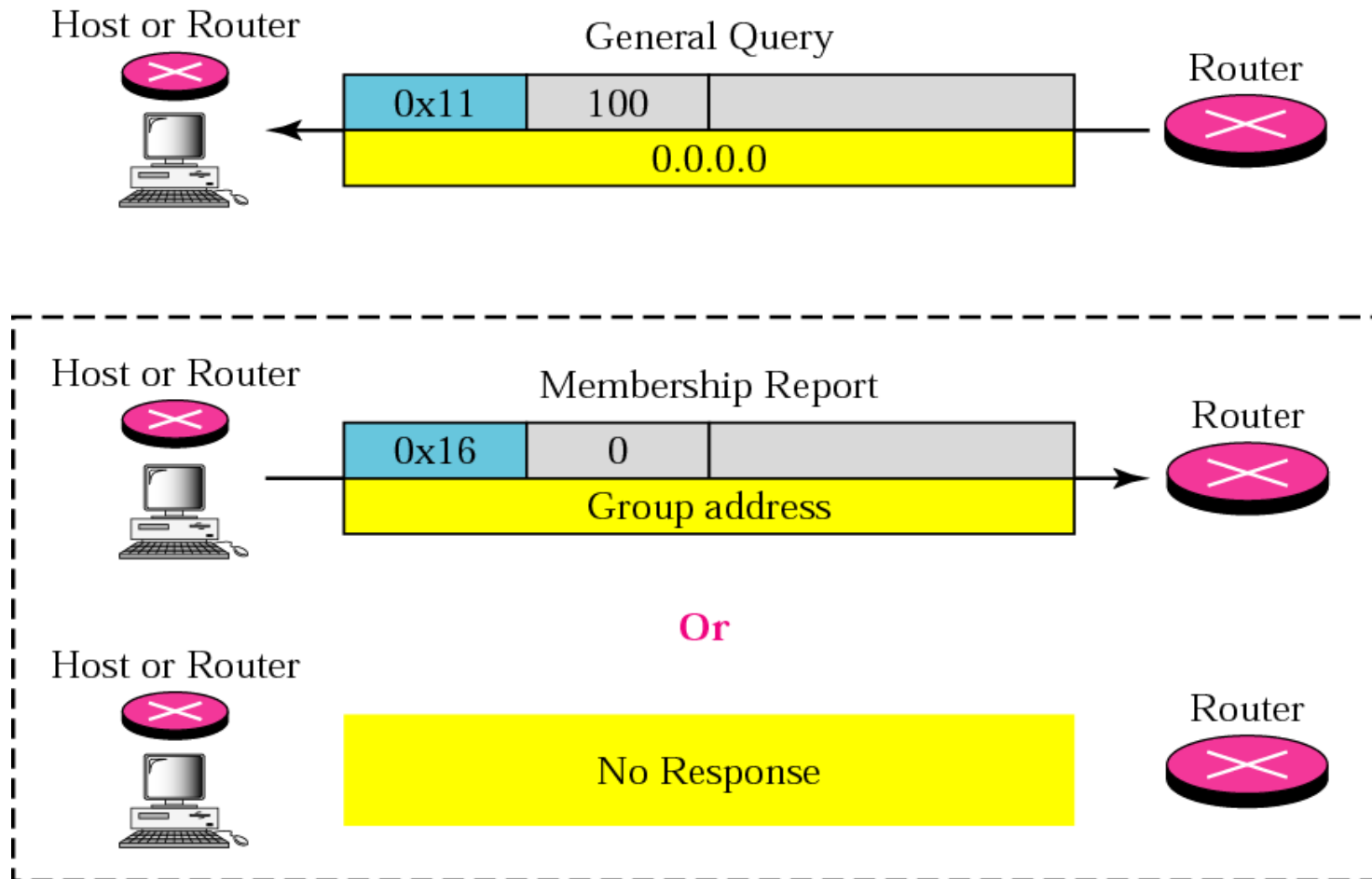
Router periodically sends a general query message with group address field 0.0.0.0.

Router expects answer for each group in its group list.

If more than one host is interested in membership, only one responds to save traffic.

See fig.

**Figure 10.7** *General query message*





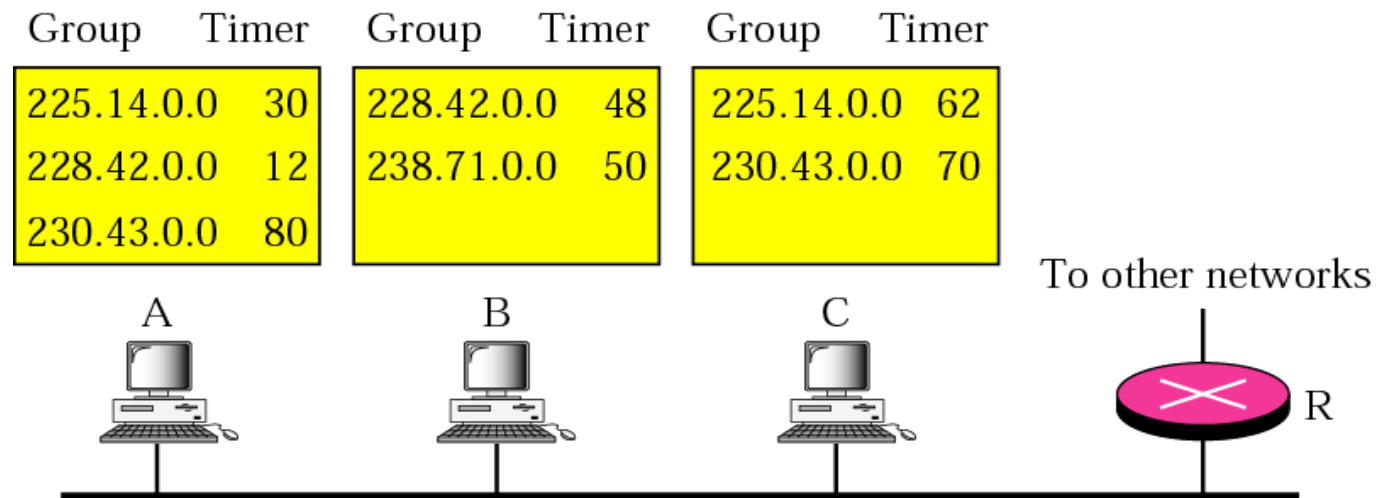
## ***Example 1***

*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 timer for 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.*

## 10.4 ENCAPSULATION

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

***The topics discussed in this section include:***

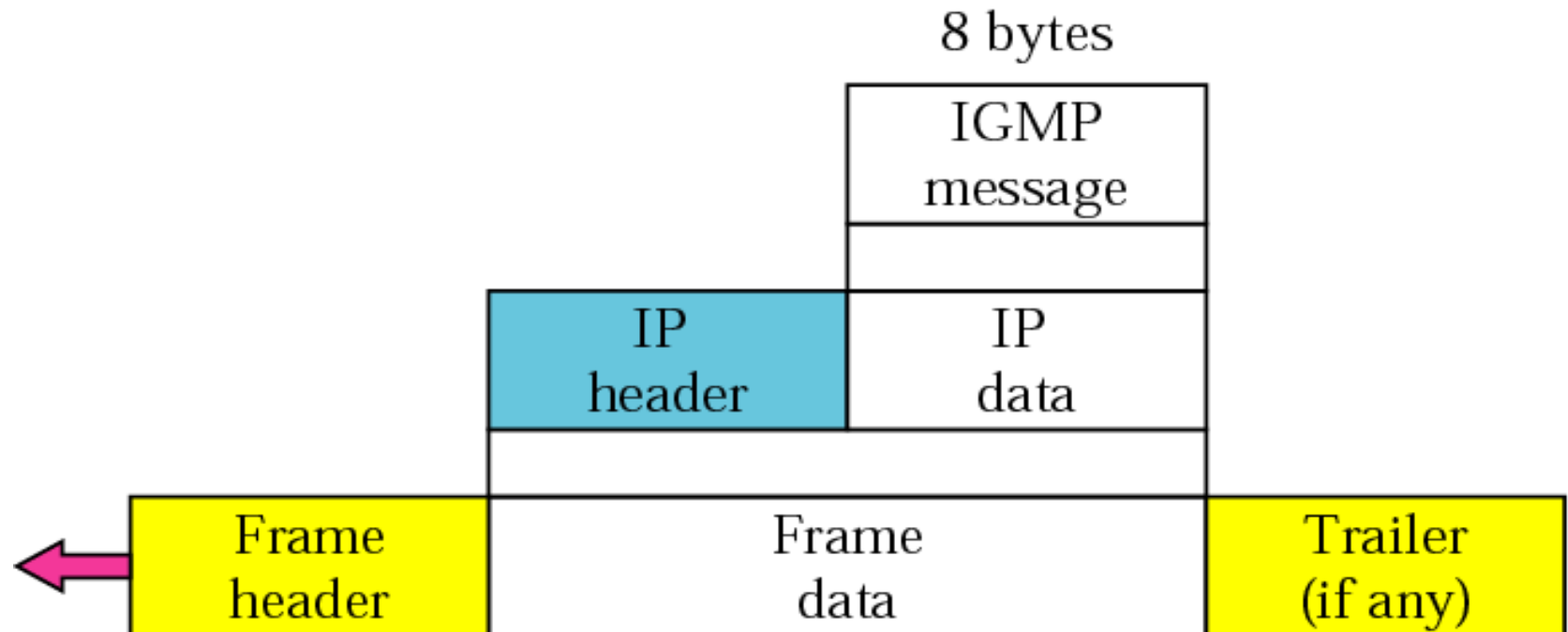
*IP Layer*

*Data Link Layer*

*Netstat Utility*



**Figure 10.9** *Encapsulation of IGMP packet*





Note:

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



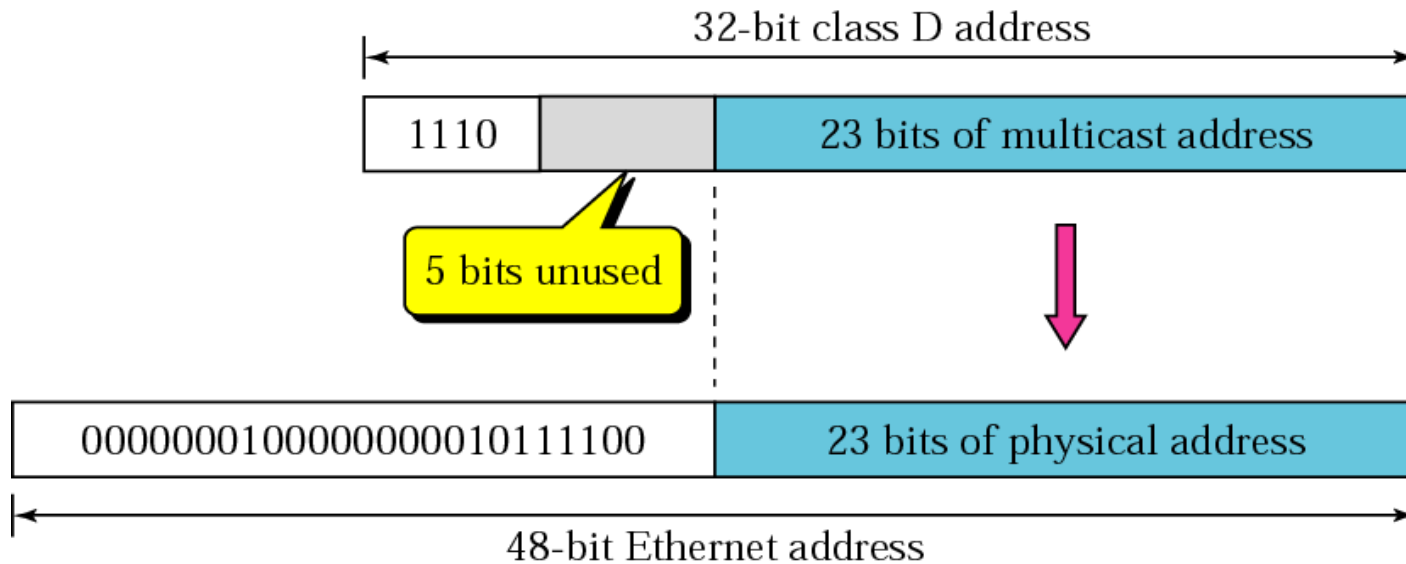
Note:

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

***Table 10.2 Destination IP addresses***

<i>Type</i>	<i>IP Destination Address</i>
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

**Figure 10.10** *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***

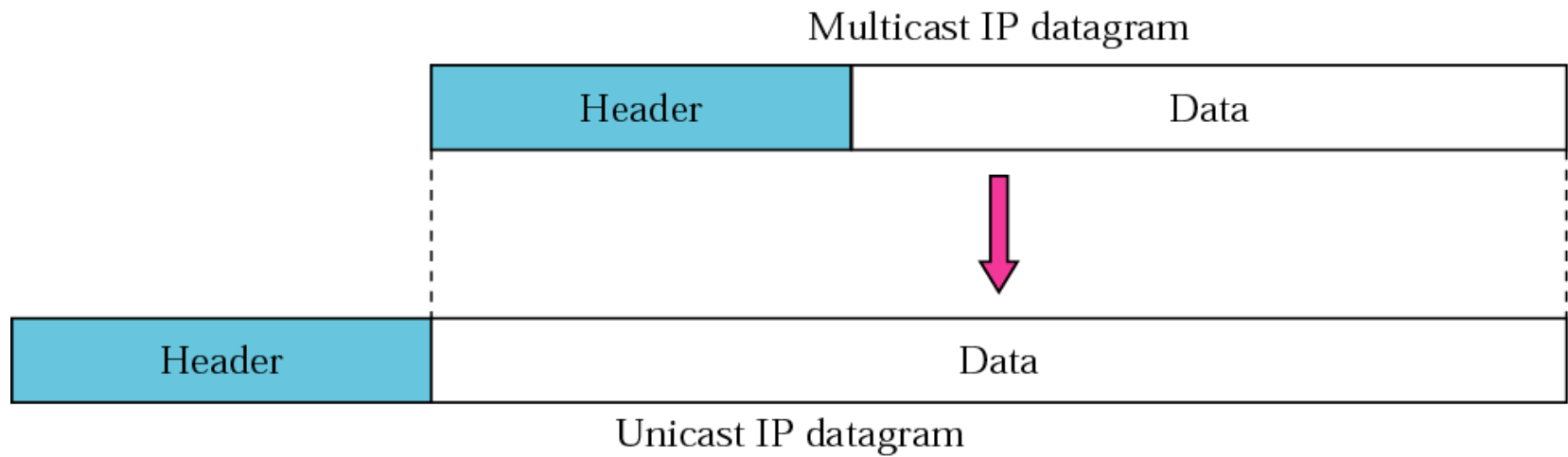
***a.*** *The right-most three bytes in hexadecimal are D4:18:09. We need to subtract 8 from the leftmost digit, resulting in 54:18:09..*

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

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



**Figure 10.11** *Tunneling*





## Example 4

We use **netstat** with three options, **-n**, **-r**, and **-a**. The **-n** option gives the numeric versions of IP addresses, the **-r** option gives the routing table, and the **-a** option gives all addresses (unicast and multicast). Note that we show only the fields relative to our discussion.

```
$ netstat -nra
```

*Kernel IP routing table*

<i>Destination</i>	<i>Gateway</i>	<i>Mask</i>	<i>Flags</i>	<i>Iface</i>
153.18.16.0	0.0.0.0	255.255.240.0	U	eth0
169.254.0.0	0.0.0.0	255.255.0.0	U	eth0
127.0.0.0	0.0.0.0	255.0.0.0	U	lo
<b>224.0.0.0</b>	<b>0.0.0.0</b>	<b>224.0.0.0</b>	<b>U</b>	<b>eth0</b>
0.0.0.0	153.18.31.254	0.0.0.0	UG	eth0

*Any packet with a multicast address from 224.0.0.0 to 239.255.255.255 is masked and delivered to the Ethernet interface.*

## 10.5 IGMP PACKAGE

*We can show how IGMP can handle the sending and receiving of IGMP packets through our simplified version of an IGMP package. In our design an IGMP package involves a group table, a set of timers, and four software modules.*

***The topics discussed in this section include:***

***Group Table***

***Timers***

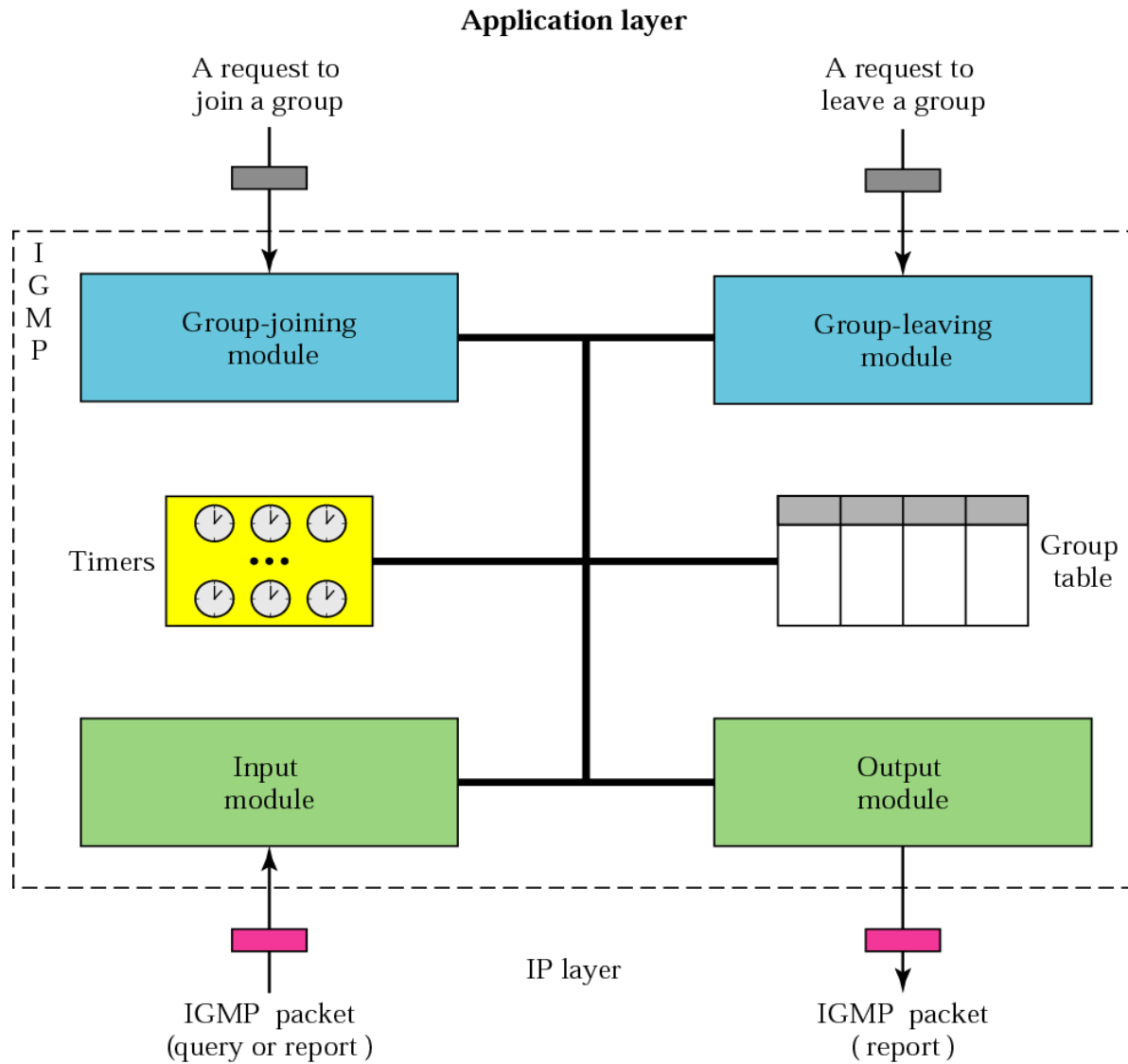
***Group-Joining Module***

***Group-Leaving Module***

***Input Module***

***Output Module***

**Figure 10.12** *IGMP package*





**Figure 10.13** *Group table*

State	Interface No.	Group Address	Reference Count
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....