- A delayed response strategy prevents unnecessary traffic on a LAN.
- The IGMP message is encapsulated in an IP datagram.
- Most LANs, including Ethernet, support physical multicast addressing.
- WANs that do not support physical multicast addressing can use a process called tunneling to send multicast packets.
- BOOTP and Dynamic Host Configuration Protocol (DHCP) are client/server applications that deliver vital network information to either diskless computers or computers at first boot.
- A BOOTP request is encapsulated in a UDP user datagram.
- BOOTP, a static configuration protocol, uses a table that maps IP addresses to physical addresses.
- A relay agent is a router that helps send local BOOTP requests to remote servers.
- DHCP is a dynamic configuration protocol with two databases: One is similar to BOOTP, and the other is a pool of IP addresses available for temporary assignment.
- The DHCP server issues a lease for an IP address to a client for a specific time.
- ICMPv6, like version 4, reports errors, handles group memberships, updates specific router and host tables, and checks the viability of a host.

21.8 PRACTICE SET

Review Questions

1. Is the size of the ARP packet fixed? Explain.
2. What is the size of an ARP packet when the protocol is IPv4 and the hardware is Ethernet?
3. What is the size of an Ethernet frame carrying an ARP packet in Question 2?
4. What is the broadcast address for Ethernet?
5. Why is there a restriction on the generation of an ICMPv4 message in response to a failed ICMPv4 error message?
6. What is the purpose of including the IPv4 header and the first 8 bytes of datagram data in the error-reporting ICMPv4 messages?
7. Give an example of a situation in which a host would never receive a redirection message.
8. What is the minimum size of an ICMPv4 packet? What is the maximum size of an ICMPv4 packet?
9. What is the minimum size of an IPv4 packet that carries an ICMPv4 packet? What is the maximum size?
10. How can we determine if an IPv4 packet is carrying an ICMPv4 packet?
11. What is the minimum size of an Ethernet frame that carries an IPv4 packet which in turn carries an ICMPv4 packet? What is the maximum size?
12. Why is there no need for the ICMPv4 message to travel outside its own network?

Exercises

13. A router with IPv4 address 125.45.23.12 and Ethernet physical address 23:45:AB:4F:67:CD has received a packet for a host destination with IP address 125.11.78.10. Show the entries in the ARP request packet sent by the router. Assume no subnetting.
14. Show the entries in the ARP packet sent in response to Exercise 13.
15. Encapsulate the result of Exercise 13 in a data link frame. Fill in all the fields.
16. Encapsulate the result of Exercise 14 in a data link frame. Fill in all the fields.
17. Host A sends a datagram to host B. Host B never receives the datagram, and host A never receives notification of failure. Give two different explanations of what might have happened.
18. Calculate the checksum for the following ICMP packet:
    Type: Echo Request Identifier: 123 Sequence number: 25 Message: Hello
19. A router receives an IPv4 packet with source IP address 130.45.3.3 and destination IP address 201.23.4.6. The router cannot find the destination IP address in its routing table. Which ICMPv4 message should be sent?
20. TCP receives a segment with destination port address 234. TCP checks and cannot find an open port for this destination. Which ICMPv4 message should be sent?
21. A multicast address for a group is 231.24.60.9. What is its 48-bit Ethernet address for a LAN using TCPIIP?
22. If a router has 20 entries in its group table, should it send 20 different queries periodically or just one? Explain your answer.
23. If a host wants to continue membership in five groups, should it send five different membership report messages or just one?
24. A router on an Ethernet network has received a multicast IP packet with groupid 226.17.18.4. When the host checks its multicast group table, it finds this address. Show how the router sends this packet to the recipients by encapsulating the IP packet in an Ethernet frame. Show all the entries of the Ethernet frame. The outgoing IP address of the router is 185.23.5.6, and its outgoing physical address is 4A224512E1E2. Does the router need the services of ARP?
25. A host with IPv4 address 114.45.7.9 receives an IGMP query. When it checks its group table, it finds no entries. What action should the host take? Should it send any messages?
26. A host with IPv4 address 222.5.7.19 receives an IGMP query. When it checks its routing table, it finds two entries in its table: 227.4.3.7 and 229.45.6.23. What action should the host take? Should it send any messages? If so, what type and how many?
27. How many multicast addresses can be supported for the IPv4 protocol in Ethernet? How many multicast addresses can be supported by the IPv4 protocol? What is the size of address space lost when we transform a multicast IPv4 address to an Ethernet multicast address?
28. Change the following IPv4 multicast addresses to Ethernet multicast addresses. How many of them specify the same Ethernet address?

a. 224.18.72.8
b. 235.18.72.8
c. 237.18.6.88
d. 224.88.12.8

Research Activities

29. Use the *ping* program to test your own computer (loopback).
30. Use the *ping* program to test a host inside the United States.
31. Use the *ping* program to test a host outside the United States.
32. Use *traceroute* (or *tracert)* to find the route from your computer to a computer in a college or university.
33. Use *netstat* to find out if your server supports multicast addressing.
34. DHCP uses several messages such as DHCPREQUEST, DHCPDECLINE, DHCPACK, DHCPNACK, and DHCPRELEASE. Find the purpose of these messages.