COMP9332 Network Routing and Switching
Self-assessed Tutorial for Multicast

Solve the following questions from Chapter 10 of Forouzan (3rd Edition, , pages 252-254, attached below):

3, 19, 20, 21, 26, 27.

Solve the following questions from Chapter 15 of Forouzan (3rd Ed., page 455, attached below):

4, 5, 6, and 7.

- A host maintains a list of processes that have membership in a group.
- A router maintains a list of groupids that shows group membership for each interface.
- A router or host sends a membership report to join a group.
- A router or host sends a leave report to leave a group.
- A router sends a general query message to monitor group membership.
- 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.
- An IGMP package can consist of a host group table, a set of timers, and four software modules: an input module, an output module, a group-joining module, and a group-leaving module.

10.8 PRACTICE SET

Exercises

1. Why is there no need for the IGMP message to travel outside its own network?
2. A multicast router list contains four groups (W, X, Y, and Z). There are three hosts on the LAN. Host A has three loyal members belonging to group W and one loyal member belonging to group X. Host B has two loyal members belonging to group W and one loyal member belonging to group Y. Host C has no processes belonging to any group. Show the IGMP messages involved in monitoring.
3. A multicast address for a group is 231.24.60.9. What is its 48-bit Ethernet address for a LAN using TCP/IP?
4. If a router has 20 entries in its group table, should it send 20 different queries periodically or just one? Explain your answer.
5. If a host wants to continue membership in five groups, should it send five different membership report messages or just one?
6. A router with IP address 202.45.33.21 and physical Ethernet address 23:4A:45:12:EC:D1 sends an IGMP general query message. Show all of the entries in the message.
7. Encapsulate the message of Exercise 6 in an IP packet. Fill in all the fields.
8. Encapsulate the message of Exercise 7 in an Ethernet frame. Fill in all the fields.
9. A host with IP address 124.15.13.1 and physical Ethernet address 4A:22:45:12:E1:E2 sends an IGMP membership report message about groupid 228.45.23.11. Show all of the entries in the message.
0. Encapsulate the message of Exercise 9 in an IP packet. Fill in all the fields.
1. Encapsulate the message of Exercise 10 in an Ethernet frame. Fill in all the fields.
2. 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 of 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?
13. What if the router in Exercise 12 cannot find the groupid in its table?
14. Redo Exercise 12 with a physical network that does not support physical multicast addressing.
15. A host with IP 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? If so, show the packet fields.
16. A host with IP 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? Show the fields.
17. A host with IP address 186.4.77.9 receives a request from a process to join a group with groupid 230.44.101.34. When the host checks its group table, it does not find an entry for this groupid. What action should the host take? Should it send any messages? If so, show the packet field.
18. Redo Exercise 17 with the host finding an entry in its table.
19. A router with IP address 184.4.7.9 receives a report from a host that wants to join a group with groupid 232.54.10.34. When the router checks its group table, it does not find an entry for this groupid. What action should the router take? Should it send any messages? If so, show the packet fields.
20. Redo Exercise 19 with the router finding an entry in its table.
21. A router sends a query and receives only three reports about groupids 225.4.6.7, 225.32.56.8, and 226.34.12.9. When it checks its routing table, it finds five entries: 225.4.6.7, 225.11.6.8, 226.34.12.9, 226.23.22.67, and 229.12.4.89. What action should be taken?
22. The contents of an IGMP message in hexadecimal notation are:

    11 00 EE FF 00 00 00 00

    Answer the following questions:
    a. What is the type?
    b. What is the checksum?
    c. What is the groupid?
23. The contents of an IGMP message in hexadecimal notation are:

    16 00 F9 C0 E1 2A 13 14

    Answer the following questions:
    a. What is the type?
    b. What is the checksum?
    c. What is the groupid?

24. Is there an error in the following hexadecimal representation of an IGMP message?

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11 00 A0 11 E1 2A 13 14
```

25. Is there an error in the following hexadecimal representation of an IGMP message?

```
17 00 A0 11 00 00 00 00
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✓ 26. How many multicast addresses can be supported for the IP protocol in Ethernet?

✓ 27. How many multicast addresses can be supported by the IP protocol?

28. What is the size of address space lost when we transform a multicast IP address to an Ethernet multicast address?

29. Change the following IP 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

30. Modify the IGMP package in the text to be also applicable to a router.

31. Do some research on IGMPv1. What is the size of the type field? Is there any field in the first version that is not in the second? Are versions 1 and 2 compatible? If a router supporting version 2 receives a message in version 1, what can the router do? If a router supporting version 1 receives a message in version 2, what can the router do?

32. Use *netstat* to find if your server supports multicast addressing.

33. Find the RFCs related to IGMP protocols.

- Reverse path broadcasting (RPB) creates a shortest path broadcast tree from the source to each destination. It guarantees that each destination receives one and only one copy of the packet.
- Reverse path multicasting (RPM) adds pruning and grafting to RPB to create a multicast shortest path tree that supports dynamic membership changes.
- DVMRP is a multicast routing protocol that uses the distance routing protocol to create a source-based tree.
- The Core-Based Tree (CBT) protocol is a multicast routing protocol that uses a router as the root of the tree.
- PIM-DM is a source-based tree routing protocol that uses RPF and pruning/grafting strategies to handle multicasting.
- PIM-SM is a group-shared tree routing protocol that is similar to CBT and uses a rendezvous router as the source of the tree.
- For multicasting between two noncontiguous multicast routers, we make a multicast backbone (MBONE) to enable tunneling.

15.11 PRACTICE SET

Exercises

1. In Figure 15.4, find the unicast routing tables for routers R2, R3, and R4. Show the shortest path trees.
2. In Figure 15.5, find the multicast routing tables for routers R2, R3, and R4.
3. A router using DVMRP receives a packet with source address 10.14.17.2 from interface 2. If the router forwards the packet, what are the contents of the entry related to this address in the unicast routing table?
4. Router A sends a unicast RIP update packet to router B that says 134.23.0.0/16 is 7 hops away. Network B sends an update packet to router A that says 13.23.0.0/16 is 4 hops away. If these two routers are connected to the same network, which one is the designated parent router?
5. Does RPF actually create a shortest path tree? Explain.
6. Does RPB actually create a shortest path tree? Explain. What are the leaves of the tree?
7. Does RPM actually create a shortest path tree? Explain. What are the leaves of the tree?

Research Activities

8. Find the format of the DVMRP prune message. What is the format of the graft message?
9. For MOSPF find the format of the group-membership-LSA packet that associates a network with a group.