Chapter 3: Network Layer

(The questions concern IPv4, unless otherwise stated.)

1. Explain the dotted decimal notation in IPv4.

2. What is network prefix and how is it represented in routing tables?

3. Why is the usefulness of network prefix?

4. What is subnet mask?

5. What are fixed length subnet mask and variable length subnet mask (VLSM)?

6. What is network ID and what is broadcast IP address? Explain their usefulness in Layer 3.

7. Take an IP address and a network mask. Find the network ID and the broadcast address.

8. Given a network ID and a network mask, compute the number of hosts/routers that can be connected on the given network.

9. Assuming that two routers have been connected by means of a point-to-point link, find the network mask for the subnet that comprises the two corresponding physical interfaces of the router. Ensure that you do not waste IP addresses.

10. What are public IP addresses and private IP addresses? Compare their advantages and disadvantages.

11. Show the structure of a routing table, and explain the meanings of “connected” entries and a “default” entry.

12. What are the two key functions of a router to realize multi-hop communication?

13. A router selects the next hop for an IP packet based on what two key pieces of information?

14. What is longest prefix matching?

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15. Explain the process of address matching performed by routers in terms of inputs, outcome, and the process.

16. What is the role of the ICMP protocol in the address matching process?

17. Show the details of the architecture of a typical router.

18. Explain the three kinds of switching fabrics.

19. What is decentralized switching in a router? Explain its advantage(s).

20. Explain why routers drop IP packets.

21. Explain the TTL and "Upper Layer" protocol fields in the IPv4 header.

22. Explain the 16-bit-ID, flags, and offset fields in the IPv4 header.

23. What is the rationale for letting routers segment long IPv4 packets into smaller packets?

24. What fields in the IPv4 header support packet segmentation?

25. What is the length of the IPv4 header without options?

26. What kinds of information can be carried in the options field of an IPv4 header?

27. Explain the Internet checksum computation algorithm. Apply it to a given header.

28. Identify the four kinds of information obtained by a host computer from a DHCP server.

29. What is address aggregation? Explain it by means of an example. What is the advantage of address aggregation?

30. What is an Autonomous System in the Internet?

31. What does an Interior Gateway Protocol (IGP) do? Give two examples of IGP.

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32. What does an Exterior Gateway Protocol (EGP) do? Give an example of an actual EGP.

33. Explain the Distance Vector algorithm to compute shortest paths in an undirected graph.

34. Explain how the RIP protocol constructs a routing table.

35. What cost metric is used in the RIP protocol?

36. Explain the advantage(s) and disadvantage(s) of RIP.

37. Explain the *two-node* instability problem and how the *split-horizon* mechanism resolves it.

38. Explain the difference between *split-horizon* and *poisoned-reverse* mechanisms to solve the two-node instability problem.

39. Explain the OSPF protocol in a step-by-step manner.

40. Why do routing loops not form in an AS running the OSPF protocol?

41. Compare the RIP protocol with OSPF by identifying five comparison metrics.

42. How does BGP differ from OSPF?

43. Identify the key attributes of BGP.

44. What is policy-based routing (PBR) in BGP?

45. Explain the concepts of import policy and export policy, by means of examples.

46. Explain the mechanism(s) on the Internet to prevent IPv4 packets from being forwarded infinitely without ever reaching their destinations.

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47. Explain all the mechanisms on the Internet, as studied in class, to reduce the size of routing tables.