CHAPTER 8

Internet Protocol (IP)

8.1 MULTIPLE-CHOICE QUESTIONS

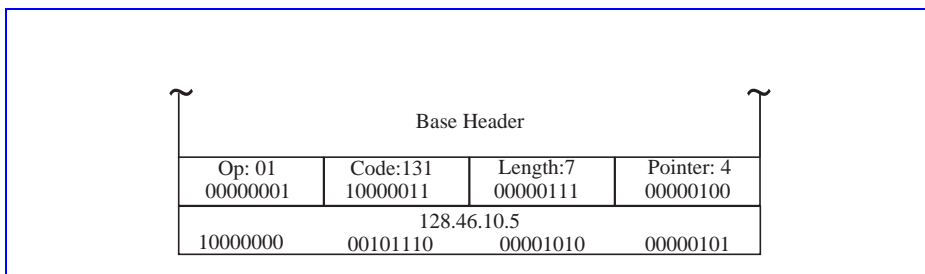|									
1. b	2. d	3. d	4. a	5. d	6. c	7. d	8. d	9. d	10. a
11. d	12. b	13. d	14. d	15. d	16. c	17. a	18. b	19. d	20. b
21. a	22. d	23. c	24. d						

8.2 EXERCISES

25. If no fragmentation occurs at the router, then the only field to change in the base header is the time to live field. If any of the multiple-byte options are present, then there will be changes in the option headers as well (to record the route and/or timestamp). If fragmentation does occur, the total length field will change to reflect the total length of each datagram. The more fragment bit of the flags field and the fragmentation offset fields may also change to reflect the fragmentation. If options are present and fragmentation occurs, the HLEN field of the base header may also change to reflect whether or not the option was included in the fragments.

26. (0110)

27. Advantages of a large MTU:
Good for transferring large amounts of data over long distances
No fragmentation necessary; faster delivery and no reassembly
Fewer lost datagrams
More efficient (less overhead)

Advantages of a small MTU:
Good for transferring time-sensitive data such as audio or video
Better suited for multiplexing

28. The first byte number can be calculated from the offset itself. If the offset is 120, that means that 120×8 or 960 bytes (bytes 0 through 959) were sent before this fragment. The first byte number is therefore 960. The last byte number can be calculated by adding the total length field and subtracting one.

29. In this case, we use a Loose Source Route option with only one entry. See Figure 8.1.

Figure 8.1   *Exercise 29*

Base Header			
Op: 01 00000001	Code:131 10000011	Length:7 00000111	Pointer: 4 00000100
128.46.10.5			
10000000	00101110	00001010	00000101

30. Only 4 routers can be recorded if the flags field has a value of 1. The maximum length of the options field is 40 bytes (60 byte maximum header length – 20 byte base header = 40 bytes of options allowed). The option header takes up 4 bytes leaving 36 bytes. Each of the entries takes up 8 bytes: 4 bytes for the outgoing IP address and 4 bytes for the timestamp. This means that 4 timestamps can be recorded and the total header length will then be 56 bytes.

31. The value of the header length field of an IP packet can never be less than 5 because every IP datagram must have at least a base header that has a fixed size of 20 bytes. The value of HLEN field, when multiplied by 4, gives the number of bytes contained in the header. Therefore the minimum value of this field is 5 ($5 \times 4 = 20$). This field has a value of exactly 5 when there are no options included in the header.

32. If the value of the HLEN field is 7, there are 28 bytes included in the header ($7 \times 4 = 28$). There are 20 bytes in the base header, so the total number of option bytes must be 8.

33. If the size of the option field is 20 bytes, then the total length of the header is 40 bytes (20 byte base header + 20 bytes of options = 40 bytes). The HLEN field will be the total number of bytes in the header divided by 4, in this case 10 (1010 in binary).

34. The datagram must contain 16 bytes of data:

    36 byte total length – (5 HLEN field $\times$ 4) = $36 - 20 = 16$

35. HLEN field: 5 (0101)

    Total length field: 1044 (00000100 00010100)

36. 1123

37. If the fragmentation offset is 0 and the more fragment bit is off, this is not a fragment.

38. Since the fragmentation offset field shows the offset from the beginning of the original datagram in multiples of 8 bytes, an offset of 100 indicates that there were 800 bytes of data sent before the data in this fragment.

39. There are no options. The packet is not fragmented. The packet carries 64 bytes of data and a 20 byte header. The checksum is not used. The packet may visit up to 32 more routers. The identification number of the packet is 3 (decimal). The type of service is normal.

40. 1600 is the fist byte; 1779 is the last byte. This is the last fragment.