CHAPTER 9

ICMP

9.1 MULTIPLE-CHOICE QUESTIONS

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

9.2 EXERCISES

20.

a. The original message or the reply may have been lost or corrupted in transit.

b. Host B may be unreachable for some reason.

c. There may have been a problem with how the original message was generated (for example, a parameter problem).

d. The time to live field may have reached zero on its way to host B.

e. The original datagram may have been dropped due to congestion.

21. Hostid: 27 Class: C

22. This restriction prevents ICMP packets from flooding the network. Without this restriction an endless flow of ICMP packets could be created.

23. It could happen that host B is unreachable, for some reason. The error message could then be lost on its way back to host A. It could also happen that host A is on an isolated network that does not contain host B or any router.

24. The IP header is included because it contains the IP address of the original source. The first 8 bytes of the data are included because they contain the first section of the TCP or UDP header which contains information about the port numbers (TCP and UDP) and sequence number (TCP). This information will allow the source to identify the problem datagram.

25. The maximum value is 59 because the pointer points to a byte somewhere in the error data that consists of the original IP header (a maximum of 60 bytes). An off-

set of 0 would point to the first byte, so an offset of 59 would point to the 60th byte.

26. A host would never receive a redirection message if there is only one router that connects the local network with the outside world.

27. See Table 9.1.

Table 9.1 *Solution to Exercise 27*

Category	*Type*	*Code*	*NonDest. host*	*Router*	*Destin. host*
Error	Destination unreachable	0		X	
		1		X	
		2			X
		3			X
		4		X	
		5		X	
		6		X	
		7		X	
		8		X	
		9		X	
		10		X	
		11		X	
		12		X	
		13		X	
		14		X	
		15		X	
	Source quench	0		X	X
	Time exceeded	0		X	
		1			X
	Parameter problem	0		X	X
	Redirection	0		X	
Query	Echo request	0	X	X	X
	Echo reply	0	X	X	X
	Timestamp request	0	X		
	Timestamp reply	0			X
	Addr. mask request	0	X		
	Addr. mask reply	0			X
	Router solicitation	0	X		
	Router advertisement	0		X	

28. The calculated sending time can be negative if the sending station's clock is running ahead of the receiving station's clock by more than the transmission time between the two. In this case, the calculation

$$\text{sending time} = \text{receive timestamp} - \text{original timestamp}$$

results in a negative number. Likewise, the receiving time can be negative if the receiving station's clock is running ahead of the requesting stations's clock by more than the transmission time. Then the calculation

$$\text{receiving time} = \text{time packet is returned} - \text{transmit timestamp}$$

results in a negative number. The round trip time will never have a negative value because the calculation

$$\text{round trip time} = \text{sending time} + \text{receiving time}$$

includes the difference between the 2 clocks twice: once as a positive difference and once as a negative difference, thereby canceling any error in the calculation. The round trip time will, therefore, always be the correct positive number of milliseconds taken for the complete round trip.

29. The one way time is not the round trip divided by 2 because the request packet may have traveled by a different route than the response packet. In this case, the transmission time in one direction may be different than the transmission time in the other direction.
30. The minimum size of an ICMP packet is 8 bytes (router solicitation packet). The largest of the ICMP packets is the router advertisement packet with up to 255 listings. The maximum size is then:

$$255 \text{ listings} \times 8 \text{ bytes/listing} + 8 \text{ bytes for the ICMP header} = 2048 \text{ bytes}$$

31. The minimum size of an IP packet that carries an ICMP packet would be 28 bytes (a 20 byte IP header + an 8 byte router solicitation packet). The maximum size would be 2068 bytes (a 20 byte IP header + a 2048 byte router advertisement packet).
32. The minimum size would be 64 bytes if we do not consider the preamble and SFD fields, which are added at the physical layer. The maximum size would be 1516 bytes, again not considering the preamble and SFD fields. Although the maximum size of an ICMP packet can be much more than 1500 bytes (for a router advertisement packet), the Ethernet can carry only 1500 bytes of it.
33. The value of the protocol field of an IP packet carrying an ICMP packet is 1.
34. See Figure 9.1. The checksum is 1101001110011001.
35. See Figure 9.2.
36. See Figure 9.3
37. The type in this message is 3, which means it is a destination unreachable message. The code in this message is 3, which means that the target port is unreachable. The purpose of this message is to inform the sender that the target application of the data that was sent is not available on the destination host at this time.
38. The type in this message is 5, which means it is a redirection message. The code in this message is 0, which means that the message is a redirection for the network specific route. The value of the last 4 bytes is 17.11.3.2, which is the IP address of another router on the network. The purpose of this message is to inform the sender

Figure 9.1 *Exercise 34*

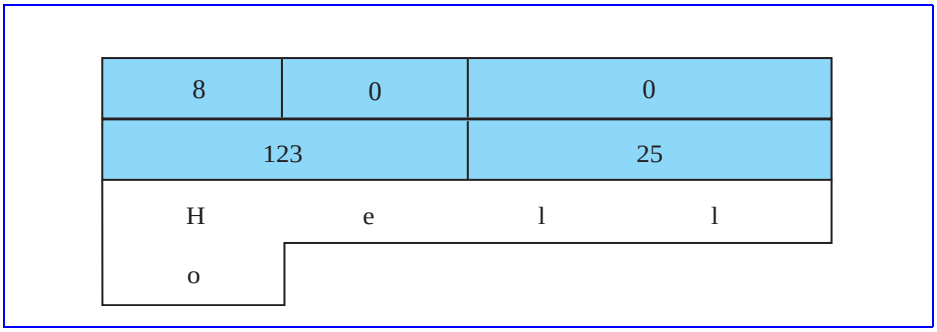
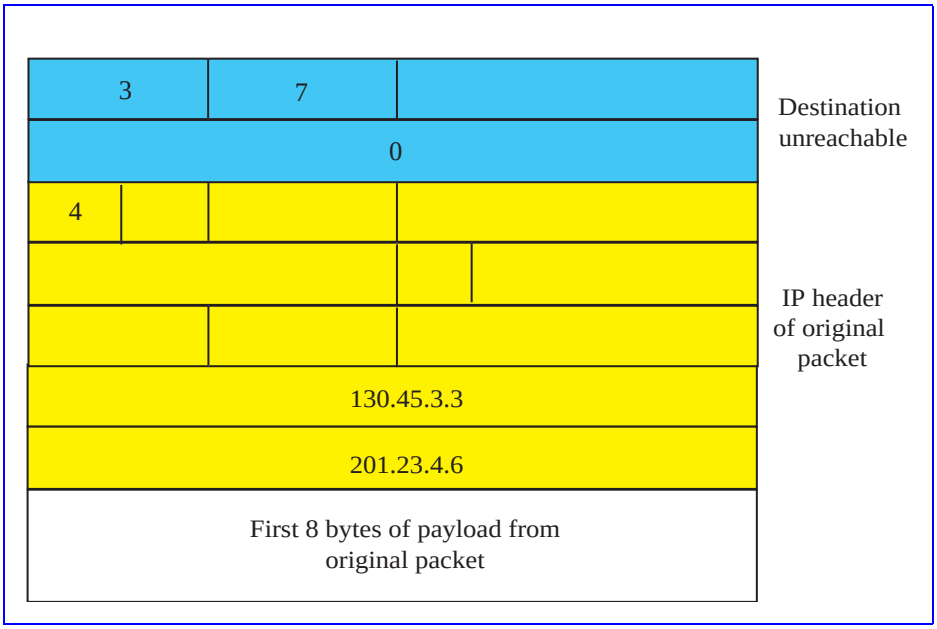


Figure 9.2 *Exercise 35*



that any data being sent to the original destination should be sent to the router with IP address of 17.11.3.2.

39. See Figure 9.4
40. See Figure 9.5
41. 7005 milliseconds
42. Sending time = 13,562,000 – 13,560,000 = 2,000 milliseconds
    Receiving time = 13,567,000 – 13,564,300 = 2,700 milliseconds
    Round trip time = 2,000 + 2,700 = 4,700 milliseconds
    Difference in clocks = 13,562,000 – (13,560,000 + (4,700 / 2)) = –350 milliseconds, which means that the sending clock is 350 milliseconds ahead of the

Figure 9.3 *Exercise 36*

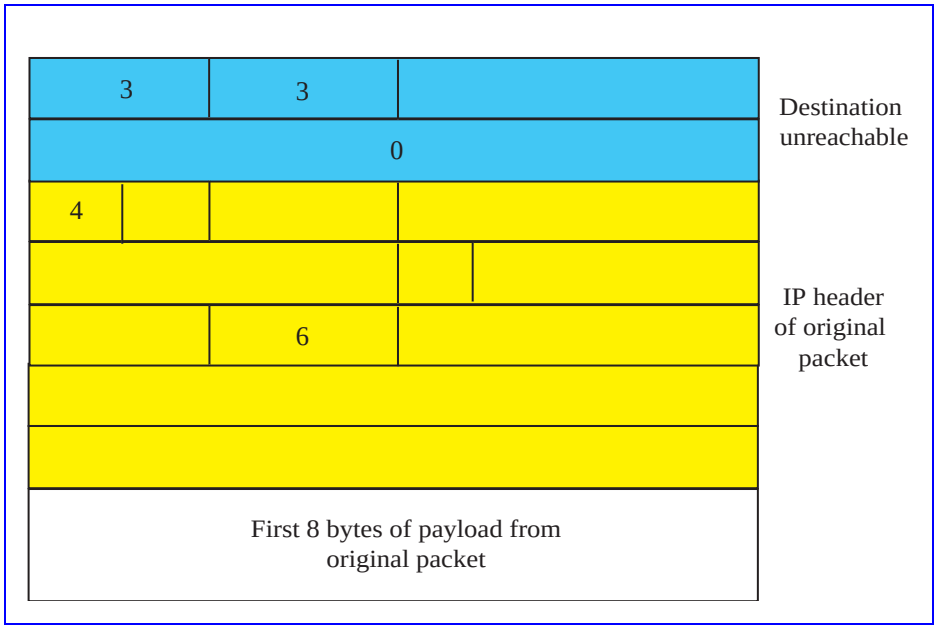
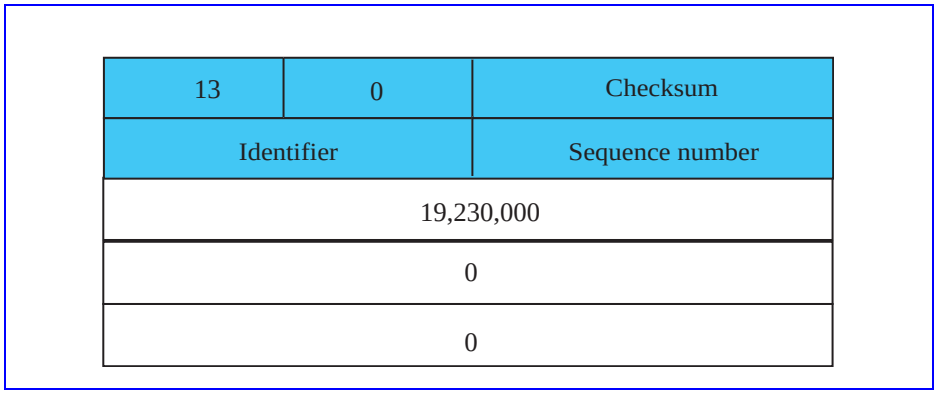


Figure 9.4 *Exercise 39*



receiving clock. This assumes that the one way transmission time is one half of the round trip transmission time.

43. 26.9 milliseconds (assuming the message travels at the speed of light).

Figure 9.5 *Exercise 40*