CHAPTER 27

Next Generation: IPv6 and ICMPv6

Exercises

1.

a. 2340:1ABC:119A:A000::0

b. 0:AA::119A:A231

c. 2340::119A:A001:0

d. 0:0:0:2340::0

2.

a. **0000:0000:0000:0000:0000:0000:0000:0000**

b. **0000:00AA:0000:0000:0000:0000:0000:0000**

c. 0000:1234:0000:0000:0000:0000:0000:0003

d. 0123:0000:0000:0000:0000:0000:0001:0002

3.

a. Link local address

b. Site local address

c. Multicast address (permanent, link local)

d. Loopback address

4.

a. Unspecified address

b. Mapped address

c. Provider based address with the address registered through INTERNIC (North American registry).

d. Provider based address with the address registered through RIPNIC (European registry).

e. Provider based address with the address registered through APNIC (Asian/ Pacific registry).

5. **58ABC1**

6. **0000:0000:0000:0000:0000:0000::8106:0C22 or 0::8106:C22**

7. **0000:0000:0000:0000:0000:FFFF:8106:0C22 or 0::FFFF:8106:C22**

8. **0000:0000:0000:0000:0000:0000:0000:0001 or 0::1**

9. **FE80:0000:0000:0000:0000:0000:0000:0123 or FE80::123**

10. **FEC0:0000:0000:0000:0000:0000:0000:0123 or FEC0::123**

11. **FF02**: < Group ID >

12. **FF01**: Permanent node local
    FF02: Permanent link local
    FF05: Permanent site local
    FF08: Permanent organization local
    FF0E: Permanent global
    FF11: Transient node local
    FF12: Transient link local
    FF15: Transient site local
    FF18: Transient organization local
    FF1E: Transient global

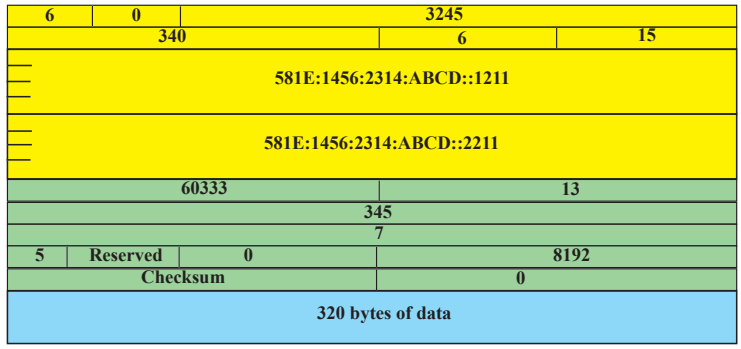
13. The node identifier is **0000:0000:1211**. Assuming a 32-bit subnet identifier, the subnet address is **581E:1456:2314:ABCD:0000** where **ABCD:0000** is the subnet identifier.

14. The provider prefix is the type identifier plus registry identifier plus provider identifier (3 + 5 + 16 = 24 bits). This is the first 24/4 = 6 hex digits. The provider prefix is **581E:14**

15. **581E:1456:2314:0000:ABCD:0000:0001:XXXX**
    through **581E:1456:2314:0000:ABCD:0000:00C8:XXXX**
    where **XXXX** is the node identifier.

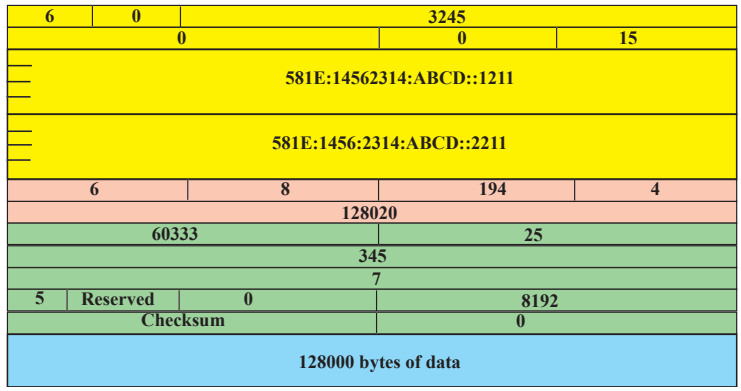
16. See Figure 27.1.

Figure 27.1 *Exercise 16*



17. See Figure 27.2.

Figure 27.2 *Exercise 17*



18. The types of ICMP messages that contain part of the original IP datagram are all 5 of the error reporting types (destination unreachable, packet too big, time exceeded, parameter problem, and redirection). The IP header and first 8 bytes of data are included because this data contains all of the information needed for the source of the datagram to identify the packet in question, including the destination address and the source and destination port addresses.

19. The destination unreachable message for IPv6 is almost identical to that of IPv4 with 2 exceptions: the type is type 3 in IPv4 and type 1 in IPv6 and there are far fewer possible codes in IPv6 than there were in IPv4 (5 as opposed to 16 in IPv4).

20. The time exceeded message for IPv6 is identical to that of IPv4 except that the type is now type 3 instead of type 11 for IPv4.

21. In the parameter problem message, the type is type 4 in IPv6 and type 12 in IPv4. In IPv4, the code could be either 0 for an error or ambiguity in one of the header fields or 1 if a required part of an option is missing. In IPv6, code 0 means the same thing as in IPv4, code 1 now means that there is an unrecognizable extension header, and code 2 means there was an unrecognizable option. The pointer field still points to where the problem was but was extended to 4 bytes in IPv6.

22. In the redirection message, the type changes from type 5 in IPv4 to type 137 in IPv6, there is only code 0 in IPv6, the address section has been expanded to accommodate the size of the larger addresses and to include the original destination address, and an extension header has been added to inform the source of the physical address of the target router.

23. The echo request and reply messages are almost identical in both versions, except the type field contains either 8 for a request or 0 for a reply in IPv4, while the type field contains either 128 for a request or 129 for a reply in IPv6.

24. In the router solicitation message, the type is 10 in IPv4 and 133 in IPv6. The code and checksum fields are unchanged, the identifier and sequence number fields of IPv4 have been eliminated, and an option to inform the responding router of the host's physical address has been added in IPv6. In the router advertisement message, the type of 9 was used in IPv4 while the type of 134 is used in IPv6. In IPv6, the router only announces itself instead of all of the routers on the network, so the number of addresses field and the address entry size field have been eliminated. Options have been added that allow the router to advertise its physical address, its MTU size, and its valid and preferred lifetime.

25. The format for the neighbor solicitation and advertisement messages are completely different in IPv6 than they are in ARP. The ARP packet included hardware type, protocol type, hardware length, protocol length, operation (request or reply) fields and fields for the source and target hardware and protocol addresses. In ICMPv6, the messages include a type field (135 for solicitation and 136 for advertisement), a code of 0, a checksum, and a field to specify the sender's IP address. An option may also be used to indicate the physical address of the sender for the convenience of the receiver.

26. The version field of IGMP was eliminated. IGMP had 2 possible types: type 1 for a query and type 2 for a report. ICMPv6 uses type 130 for a query, type 131 for a report, with a third type added, type 132, for a termination message. ICMPv6 messages have a code field that is always 0. The query message in ICMPv6 has a maximum response delay field and a larger address field to accommodate the longer addresses of IPv6.

27. The IPv4 compatible address is used when one host using IPv6 wants to send a message to another host using IPv6, but the message must travel through a region where the networks still use IPv4. The IPv4 mapped address is used when one host using IPv6 wants to send a message to a host that is still using IPv4 and the message must travel through mostly IPv6 networks.

28. **0000:0000:0000:0000:0000:0000:77FE:FEFE or 0::77FE:FEFE**

29. **0000:0000:0000:0000:0000:FFFF:77FE:FEFE or 0::FFFF:77FE:FEFE**

30. $(2^{128} - 2^{32})$ more addresses

31. This is because any IPv6 address starting with ***11111111*** is a multicast address.