CHAPTER 20

Network Layer: Internet Protocol

Solutions to Selected Exercises

11. 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*** field may also change to reflect the fragmentation. If options are present and fragmentation occurs, the ***header length*** field of the base header may also change to reflect whether or not the option was included in the fragments.

13. **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

14. 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.

15. 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. This field has a value of exactly 5 when there are no options included in the header.

18. The datagram must contain 16 bytes of data:
    36 byte total length – (5 HLEN field · 4) = 36 – 20 = **16 bytes**

19. Since there is no option information, the header length is 20, which means that the value of HLEN field is **5** or **0101** in binary. The value of total length is 1024 + 20 or **1044** (00000100 **00010100** in binary).

23. Errata: in the command, the fields **Checksum** and **Flags and Fragmentation** are inverted.
    Let us first find the value of header fields before answering the questions: **VER** = 0x4 = **4**
    HLEN = 0x5 = 5 → 5 · 4 = **20**
    Service = 0x00 = **0**
    Total Length = 0x0054 = **84**
    Identification = 0x0003 = **3**
    Flags and Fragmentation = 0x0000 → D = **0** M= **0** offset = **0** **Time to live** = 0x20 = **32**
    Protocol = 0x06 = **6**
    Checksum = 0x5850
    Source Address: 0x7C4E0302 = **124.78.3.2** **Destination Address:** 0xB40E0F02 = **180.14.15.2**

    We can then answer the questions:
    1. If we calculate the checksum, we get 0x0000. ***The packet is not corrupted.***

2. Since the length of the header is 20 bytes, ***there are no options.***
3. Since $M = 0$ and *offset* = 0, ***the packet is not fragmented.***
4. The total length is 84. ***Data size is 64 bytes (84 –***20).
5. Since the value of *time to live* = 32, ***the packet may visit up to 32 more routers.***
6. ***The identification number of the packet is 3.***
7. ***The type of service is normal.***

CHAPTER 29

Multimedia

Solutions to Review Questions and Exercises

11.

a. **3 s** in the buffer. Four seconds were lost between 00.00.11 and 00.00.15.
b. **3 s** in the buffer.
c. **3 s** in the buffer.
d. **1 s** in the buffer. Two seconds were lost between 00.00.25 and 00.00.27.

12. ***TCP*** is not suitable for real-time traffic because it has no provision for timestamping, it does not support multicasting, and, most importantly, it retransmits lost or corrupted packets. ***RTP*** is a protocol designed to handle real-time traffic. RTP handles timestamping, sequencing, and mixing. There is no retransmission when RTP is used with UDP.

13. We can say that ***UDP*** plus ***RTP*** is more suitable than ***TCP*** for multimedia communication. The combination uses the appropriate features of UDP, such as times- tamp, multicasting, and lack of retransmission, and appropriate features of ***RTP*** such as error control.

14. ***RTCP*** is a control protocol that handles messages that control the flow and quality of data. It also allows recipient feedback. TCP allows for these types of messages, so it doesn't need RTCP.