
CHAPTER 7

Internet Protocol Version 4 (IPv4)

Exercises

1. 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 time-stamp). 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.

3.

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)

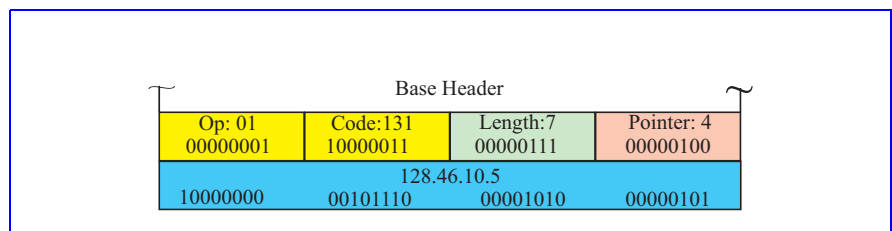
Advantages of a small MTU:

Good for transferring time-sensitive data such as audio or video

Better suited for multiplexing

5. In this case, we use a Loose Source Route option with only one entry as shown in Figure 7.E5.

Figure 7.E5 *Solution to Exercise 5*



7. 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.
9. If the size of the option field is 20 bytes, then the total length of the header is 40 bytes (20 byte base header plus 20 bytes of options). The HLEN field will be the total number of bytes in the header divided by 4, in this case ten (1010 in binary).

11. HLEN field: **5 = (0101)₂**

Total length field: 1044 = (00000100 00010100)₂

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

15.

- a. There are no options.
- b. The packet is not fragmented.
- c. The packet carries 64 bytes of data.
- d. The header is 20 bytes long.
- e. The checksum is not used.
- f. The packet may visit up to 32 more routers.
- g. The identification number of the packet is 3 (decimal). The type of service is normal.