

# Problems on Network Layer & Fragmentation

## Question 1 (5 Marks):

a) Why do we send more than one packet while pinging? (2 Marks)

=> **One packet might get lost even if there is a connection between the devices. For this reason, 4 packets are sent by default while pinging. If there is a connection between the devices at least one of them will be replied back. Also, the average connectivity of the devices can be calculated using the packet loss percentage.**

b) Suppose Router R1 to R72 are connected in series. If R31 wants to ping and get response from all other routers but keep the TTL value same for all of the ping requests. What is the minimum value of TTL that can be set for the ping requests? (2 Marks)

=> **R31 to R1 = 31-1 = 30**

**R31 to R72 = 72-31 = 41**

**So, the minimum number of TTL to reach all the devices is 41.**

c) If a packet is fragmented, all the fragments are reassembled only at the final destination. Can you state a reason why they are not reassembled before reaching the final destination? (1 Mark)

=> **Fragments might take different paths to reach the destination. So, they might not be accumulated at the same place before reaching the destination.**

## Question 2 (10 Marks):

Suppose after fragmentation of the original packet, the fragment offset value of the second last fragment is 3024 and the initial byte number is 960. If the MTU of the network is 4043 and the size of the last fragment is 720 bytes including 171 bytes of header, answer the following questions.

a) Calculate the size of data in the last fragment. (2 Marks)

=> **Data in last fragment = 720-171 = 549 bytes**

b) What is the size of the original packet? (4 Marks)

**=>Data in each fragments except the last fragment =  $4043-171 = 3872$  bytes**

**Starting byte number of 2nd last fragment =  $3024*8 = 24192$**

**Data up to 2nd last fragment =  $24192-960 = 23232$  bytes**

**Data in 2nd last fragment = 3872 bytes**

**Data in last fragment = 549 bytes**

**Header size = 171 bytes**

**Size of original packet =  $23232 + 3872 + 549 + 171 = 27824$  bytes**

c) How many fragments have been created to send the data? (2 Marks)

**=> number of fragments =  $\text{ceil of } (27824-171)/(4043-171) = 8$**

d) What are the MF values of the first fragment and the last fragment? (2 Marks)

**=> For the first fragment, the value is 1. Because there are more fragments after this one.**

**For the last fragment, the value is 0. Because there aren't any more fragments after this one.**

## **Question 3 (15 Marks):**

The original packet has been divided into 9 fragments. The fragment offset value of the 4th fragment is 200 and the last byte number of the 6th fragment is 3039. Given that the last fragment size is half of network MTU and the header size is 132 bytes, answer the following questions.

a) What is the MTU of the network? (4 Marks)

**=> first byte number of the 4th fragment =  $200*8 = 1600$**

**First byte number of the 7th fragment =  $3039+1 = 3040$**

**Data in each fragment except the last one =  $(3040-1600)/(7-4) = 480$  bytes**

**MTU of the network =  $480 + 132 = 612$  bytes**

b) What is the data size of the last fragment? (3 Marks)

**=> last fragment size =  $612/2 = 306$  bytes**

**Data in last fragment =  $306 - 132 = 174$  bytes**

c) What is the size of the original packet? (2 Marks)

**=> size of the original packet =  $480*8 + 174 + 132 = 4146$  bytes**

d) What are the fragment offsets of the first and the last fragments? (4 Marks)

**=>fragment offset of the first fragment =  $200 - (4-1) * 480/8 = 20$**

**Fragment offset of the last fragment =  $20 + (9-1) * 480/8 = 500$**

e) If the size of MTU is doubled, will the size of data in a fragment be doubled too? Provide reasons (2 Marks)

**=> no, the size of data in a fragment will be more than double because even though the size of MTU is doubled, the header size remains the same.**

**Suppose, the MTU was initially 25 bytes and the header size is 10 bytes. So, data size is 15 bytes.**

**Now if the MTU is increased to 50 bytes. Data size =  $50-10 = 40$  bytes which is more than double the size of previous data size which is 15 bytes.**