

### Solution of Homework III

1.

$$(b) \sum_{i=1}^Q \left( \frac{(L+3h)}{R_i} + D_i \right)$$

(c) Because there is no store-and-forward delays at the links, the total delay is

$$t_s + \frac{2h+L}{R}$$

2. Converting time is

$$\frac{48 \times 8}{32 \times 10^3} \text{sec} = 12 \text{msec}$$

The time required to transmit the packet is

$$\frac{48 \times 8}{1 \times 10^6} \text{sec} = 384 \mu\text{sec}$$

Propagation delay = 2 msec.

The delay until decoding is

$$12 \text{msec} + 384 \mu\text{sec} + 2 \text{msec} = 14.384 \text{msec}$$

3.

a)  $\frac{7.5 \times 10^6}{1.5 \times 10^6} \text{sec} = 5 \text{sec}$ . With store-and-forward switching, the total time to move message from source host to destination host = 5 sec  $\times$  3 hops = 15 sec

b) Time to send 1<sup>st</sup> packet from source host to first packet switch =  $\frac{1.5 \times 10^3}{1.5 \times 10^6}$  sec = 1 msec. Time at which 2<sup>nd</sup> packet is received at the first switch = time at which 1<sup>st</sup> packet is received at the second switch = 2  $\times$  1 msec = 2 msec

c) Time at which 1<sup>st</sup> packet is received at the destination host = 1 msec  $\times$  3 hops = 3 msec. After this, every 1msec one packet will be received; thus time at which last (5000<sup>th</sup>) packet is received = 3 msec + 4999  $\times$  1 msec = 5.002 sec.

It can be seen that delay in using message segmentation is significantly less (almost 1/3<sup>rd</sup>).

d) Drawbacks:

- i. packets have to be put in sequence at the destination.
- ii. Message segmentation results in many smaller packets. Since header size is usually the same for all packets regardless of

their size, with message segmentation the total amount of header bytes is more.

4.

The total amount of time to get the IP address is

$$RRT_1 + RRT_2 + \dots + RRT_n.$$

Once the IP address is known,  $RRT_0$  elapses to set up the TCP connection and another  $RRT_0$  elapses to request and receive the small object. The total response time is

$$2RRT_0 + RRT_1 + RRT_2 + \dots + RRT_n$$

5. Because the location of referenced objects is parsed from received HTML file, the elapsed time for HTML file can not be ignored.

- (a)  $RRT_1 + RRT_2 + \dots + RRT_n + 2 RRT_0 + 3 \times 2 RRT_0$   
 $= 8RRT_0 + RRT_1 + RRT_2 + \dots + RRT_n$
- (b)  $RRT_1 + RRT_2 + \dots + RRT_n + 2 RRT_0 + 2 RRT_0$   
 $= 4RRT_0 + RRT_1 + RRT_2 + \dots + RRT_n$
- (b)  $RRT_1 + RRT_2 + \dots + RRT_n + 2 RRT_0 + RRT_0$   
 $= 3RRT_0 + RRT_1 + RRT_2 + \dots + RRT_n$