SOLUTION ASSIGNMENT-04 5C & 5D

PART-01

REVIEW QUESTIONS

R11.

At time t_0, the sending host begins to transmit. At time $t_1 = \frac{L}{R_1}$, the sending host completes transmission, and the entire packet is received at the router (no propagation delay). Because the router has the entire packet at time t_1, it can begin to transmit the packet to the receiving host at time t_1.

At time $t_2 = t_1 + \frac{L}{R_2}$, the router completes transmission, and the entire packet is received at the receiving host (again, no propagation delay). Thus, the end-to-end delay is:

$$\frac{L}{R_1} + \frac{L}{R_2}$$

R17. The delay components are processing delays, transmission delays, propagation delays, and queuing delays. All of these delays are fixed, except for the queuing delays, which are variable.

R19.a) 500 kbps
b) 64 seconds
c) 100 kbps; 320 seconds

R23. The five layers in the Internet protocol stack, from top to bottom, are the application layer, transport layer, network layer, link layer, and physical layer. The **application layer** provides services directly to user applications, such as web browsing (HTTP) or email (SMTP). The **transport layer** ensures communication between processes on different hosts, offering reliability (TCP) or low-latency delivery (UDP). The **network layer** manages the routing and forwarding of packets across networks using logical addressing (e.g., IP). The **link layer** facilitates data transfer between neighboring devices, handling framing and error detection, with technologies like Ethernet or Wi-Fi. Finally, the **physical layer** oversees the actual transmission of bits over physical media, such as cables or wireless signals, defining hardware specifications and signaling methods. Together, these layers form a robust framework for reliable network communication.

PROBLEMS

Problem 6.

a) $d_{prop} = m/s$ seconds.

b) $d_{trans} = L/R$ seconds.

c) $d_{end-to-end} = (m/s + L/R)$ seconds.

d) The bit is just leaving Host A.

e) The first bit is in the link and has not reached Host B.

f) The first bit has reached Host B.

g) Want

$$m = \frac{L}{R}s = \frac{120}{56\times10^3}\left(2.5\times10^8\right) = 536\,\text{km}.$$

Problem 20

Throughput = $min\{R_s, R_c, R/M\}$

Problem 31

a) Time to send message from source host to first packet switch = $\frac{8\times10^6}{2\times10^6}\sec = 4\sec$

With store-and-forward switching, the total time to move message from source host to destination host = $4\sec\times 3\ hops = 12\sec$

b) Time to send 1st packet from source host to first packet switch = . $\frac{1\times10^4}{2\times10^6}\sec = 5\ m\sec$. Time at which 2nd packet is received at the first switch = time at which 1st packet is received at the second switch = $2\times5m\sec = 10\ m\sec$

c) Time at which 1st packet is received at the destination host = $5\ m\sec\times 3\ hops = 15\ m\sec$. After this, every 5msec one packet will be received; thus time at which last (800th) packet is received = $15\ m\sec + 799 * 5m\sec = 4.01\sec$. It can be seen that delay in using message segmentation is significantly less (almost 1/3rd).

PART-02

Question1 [6Marks] **[CLO 3]**

a. propagation delay and switching delay in a queue are ignored.

Calculate the Total delay by using the below formula,
Total delay = Queuing delay + Transmission delay

$$\text{Total delay} = d_{queue} + d_{trans}$$
$$= \frac{IL}{R(1-I)} + \frac{L}{R}$$
$$= \frac{L}{R}\left[\frac{I}{1-I} + 1\right]$$
$$= \frac{L}{R}\left[\frac{I+1-I}{1-I}\right]$$
$$= \frac{L}{R}\left[\frac{1}{1-I}\right] \text{sec}$$

b.
Let us assume that the transmission is represented by x.

So, the transmission delay $x = \frac{L}{R}$

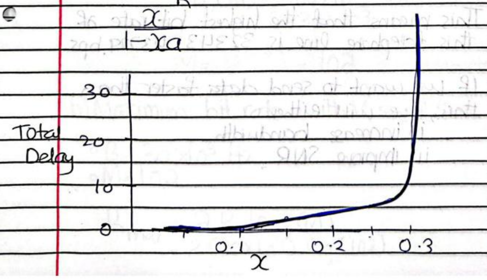
Traffic intensity $I = \frac{La}{R} = xa$

Hence, the total delay= $\frac{x}{1-xa}$

R(1-I)

b) Let $\frac{L}{R}$ be x, total delay is

$\frac{x}{1-xa}$



Question2 [9Marks] **[CLO 3]**

Q4

a) Throughput is limited by the minimum of the capacity of the links
Here minimum is R1, so throughput is 500 kbps.

b) Divide the size of the file by the throughput to get maximum time to transfer to B:

$$t = \frac{4 \times 10^6 \times 8}{500 \times 10^3} = 64 \text{ secs}$$

c) R2 being reduced to 100kbps means throughput will now be 100 kbps

$$t = \frac{4 \times 10^6 \times 8}{100 \times 10^3} = 320 \text{ secs}$$