**ASSIGNMENT-1**

**NETWORKS**

1) Which layers in the Internet protocol stack does a router process? Which layers does a link-layer switch process? Which layers does a host process?

**Ans:** The router possesses the following layers-

1.physical layer

2.link layer

3.network layer

The layers that a link-layer switch possess are-

1.physical layer

2.link layer

The layers that the host possess are-

1.physical layer

2.link layer

3.network layer

4.transport layer

5.application layer

2)Is HFC transmission rate dedicated or shared among users? Are collisions possible in a downstream HFC channel? Why or Why not?

**Ans:** The HFC transmission rate is shared among the users.

And it is not possible to have collisions in a downstream HFC channel.

The collisions are not possible because all the packets originate from a single source node called the head end hence there are no collisions.

3)Review the car-caravan analogy in the textbook. Assume a propagation speed of 100 km/ hour. a. Suppose the caravan travels 150 km, beginning in front of one tollbooth, passing through a second tollbooth, and finishing just after a third toll-booth. ? What is the end-to-end delay?

b. Repeat (a), now assuming that there are eight cars in the caravan instead of ten.

**Ans:**

The given constraints are-

1. Distance – 150km
2. Speed – 100km/hour
3. The toll booth services 1 car at 12 secs

Hence the time taken by car is (distance/speed)= 150km/100km/hr

=1.5hours= 90mins

Hence time taken to service 10 cars at 3 tollbooth intervals is given by,

3\*12\*10= 360secs=6 mins.

The total delay time is given by-

6 mins + 90 mins = 96mins

b) when there are 8 cars then,

the time taken by the car is = 1.5hours = 90mins

time taken to service 8 cars = 8\*12\*3= 288secs= 4.8mins

Hence the total delay time is = 90mins + 4.8mins = 94.8mins.

4) Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let di, si, and Ri denote the length, propagation speed, and the transmission rate of link i, for i = 1, 2, 3. The packet switch delays each packet by dproc. Assuming no queuing delays, in terms of di, si, Ri, (i = 1,2,3), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5 \* 108 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay?

**Ans:**

1st end system requires L/R1 to transmit the packet onto the first link

2nd end system requires L/R2 to transmit the packet onto the second link

3rd end system requires L/R3 to transmit the packet onto the third link

Packet propagation is given by - d/s

Queuing delay = 0

L = 1500 bytes

Si= 2.5 \* 108 m/s

Ri= 2Mbps

Dproc = 3ms

D1= 5000km=5000000m

D2= 4000km=4000000m

D3=1000km=1000000m

Dqueue=0

Dtrans= L/R

Dprop= D/S

**dnodal = dproc + dqueue + dtrans + dprop**

**dend-end = L/R1+ L/R2+ L/R3+ d1/s1+ d2/s2+ d3 /s3 + dproc**

**delay for 1st link when i=1**

**(12000/2000000) + ((5\*106) / (2.5\*108)**

**=0.026sec**

**Delay for 2nd link i=2**

**0.003+(12000/2000000)+((4\*106)/(2.5\*108))**

**=0.025sec**

**Delay at 3rd link i=3**

**= 0.003+(12000/2000000)+(1\*106)/(2.5\*108))**

**=0.013 sec**

**total delay= 0.026sec + 0.025sec + 0.013sec= 0.064sec**

**hence, total delay = 64ms**

5) Suppose you would like to urgently deliver 40 terabytes data from Boston to Los Angeles. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx over-night delivery? Explain Why?

**Ans:** converting 40 terabytes into bits we get-

L=40\*1012\*8 =3.2 \* 1014bits

**R=100Mbps = 100 \* 106 bps**

**L/R = (3.2 \* 1014/100 \* 106)**

**= 320000 seconds**

Hence if we use the dedicated link, it will take 37 days.

While fedex delivery transfer is over night. hence it is more preferable to use fedEx since it takes lesser time to send when compared to dedicated link.

6)Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 100 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 100 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 40 Mbps per second.

a. What is the maximum achievable end-end throughput (in Mbps) for each of four clientto-server pairs, assuming that the middle link is fair-shared (i.e., divides its transmission rate equally among the four pairs)?

b. Which link is the bottleneck link for each session?

c. Assuming that the senders are sending at the maximum rate possible, what are the link utilizations for the sender links (RS), client links (RC), and the middle link (R)?

**Ans:**

**Given-**

R = 100Mbps= 100\*106 bps

Rs =100Mbps= 100\*106bps

Rc =40Mbps= 40 \* 106bps

1. Transmission capacity = 100Mbps

Required for 4 client-to-server pair

Hence the maximum achievable end-end throughput is given by (100/4) = **25Mbps**

1. Since the end-end throughput is given as 25Mbps this is the one-quarter of the transmission link capacity hence the bottleneck link Is the **middle link or the middle hop.**
2. **link utilization for sender links-(Rs)-**

(40/100)\*100 = 40%

Hence utilization is 40% for Rs

**link utilization for client links-(Rc)-**

The link utilization for client link (Rc) is 100% as it is utilizing full of it’s capacity. Hence it is 100%

**link utilization for middle links-(R)-**

The link utilization for middle link is also 100% as it utilizes it’s full capacity.