Std ID :- 11700551

Assignment - 1.

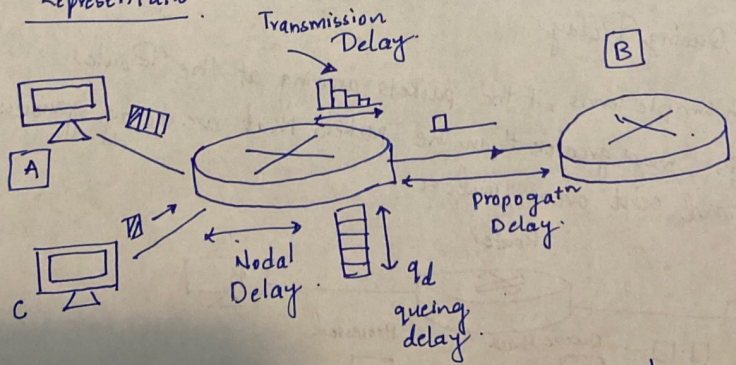
CSCE 5580 . [006] - Computer Networks.

Question - 1. [Packet Switching Architecture].

Q1. a] In a packet switching Architecture, there could be several components that contribute for the overall delay that is experienced when a "packet" moves from point 'A' to point "B" in a network. Some of the main components of delay would be.

a) Processing Delay.
b) Queuing Delay.
c) Transmission Delay.
d) Propogation Delay.

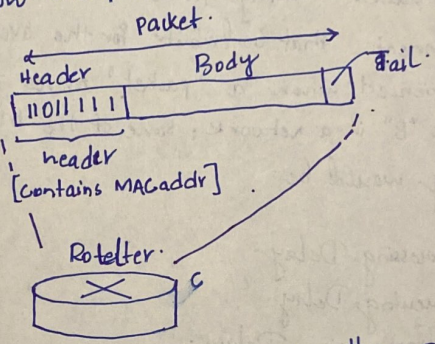
Representation.



Total Delay $d_T = d_{proc} + d_q + d_t + d_{prop}$.

a) Processing Delay.

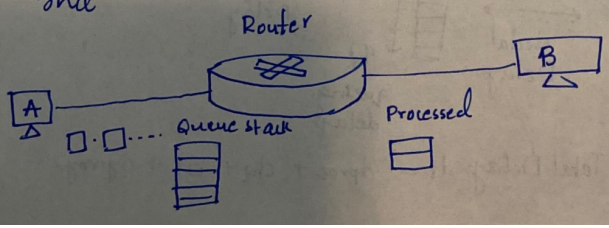
- This delay is due to the Router / Switch that manages all the packets that are meant to be sent on Correct Path.
- The Delay is because of the time taken by the router to examine the packet's header and locate it's End Destination and next location and place the packet on the correct path.



- Many tasks are by default checked by the Routers (i.e Error checking, Routing Table Valid Entry) etc.

(b) Queing Delay

→ In simple Terms, if the packets arriving at the Router is way greater than the packets that are being processed and sent over router.



→ This is where the jam occurs, if the Router processing speed is low, then the packets arrive and stack up in the router.

→ It depends on Congestion Level

→ It follows an Order, so the earlier you arrive, the earlier you get processed.

(c) Transmission Delay.

→ This delay is defined as the amount of ~~pe~~ time for packets to be physically Transmitted Over the media (i.e wired / wireless)

→ It relies on factors like

- Bandwidth aka. length.
- Size of the packet.
- Formula:-

$$d_{Transm^n} = \frac{\text{Length of Packet (bits)}}{R \text{ (Transm}^n \text{ Rate) (bps) } \frac{bits}{s}} = secs.$$

(d) Propogation Delay.

Propogation Delay is the Time taken for the packet to travel from the Soure to Destination in forms of a Physical media.

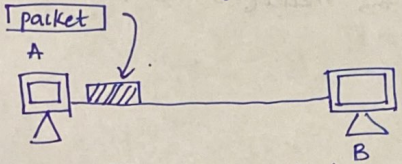
- Factors that effect Propogat^n Delay.
  - a) Distance b/w Transmittor, Receiver.
  - b) Speed.
- Delay ~~Distance~~ cannot be reduced by reducing distance.

(b) Differences between Transmission and Propogation Delay.

- Delay :- Time taken for the packet to be sent over posit^n A to position B.

a) Transmission Delay.

→ The time taken to transmit a data / packet to the type of transmission media is called as Transmission delay.



Let B be bits Bandwidth and 'L' be the size of data / packet size then

$$d_t = \frac{\text{size of Total Packet}}{\text{Bandwidth}} = \frac{L}{B}$$

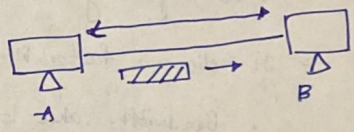
$$d_t = \frac{L}{R} = \frac{\text{bits}}{\text{bits/sec}} = \text{sec}$$

Factors Effecting d_t :-

- Multiple devices to one router, then delay becomes significant.
- If Bandwidth increases, Transmission delay decreases.
- Even increasing switches / Routers increases delay.

b) Propogation Delay.

- After placement of packet in the medium by the switch, the time taken by packets to propogate through the media (wired/wireless) to reach destination.



Propogat^n Delay : $d_{prop} = \frac{\text{Distance}}{\text{velocity}}$

$$\downarrow d_{prop} \propto \frac{1}{\text{Velocity}} \uparrow$$

Factors

- Distance is directly proportional to the delay.
- Velocity is inversly proportional.

Q.1 [c]

(c) Is Propogation Delay be affected if the length of packet is relatively (Noticably) increased?

Ans:- $$\text{Propogation Delay} = \frac{\text{distance (length of the media)}}{\text{Propogation speed } (2\times10^8 \text{m/s})}$$

- The propogation delay of a packet in media is primary determined by the "physical properties" through which the signal goes. aka (wire cable, optic cable)
- But, it is not affected by the length of packet. (not directly!)
- It indirectly affects the overall delay.
- Impact of Length of Packet:-

  Here, the propogation delay does not change, but the Overal Transmission time will be affected.

  Because, if we consider a large packet, it definetely takes a lot time to transmit over the media.

Total Propogation Time = Propogation Delay + Transmission Delay

- So, In Conclusion, it does not directly affect the propogatn delay, but it does effect the Overall Transmission time which is an important factor to be considered in Communication Systems.

Question-2.

A] Network Type that is best suitable is

"Circuit Switched Network".

Reason:-

a) Here, if we are dealing with long sessions and a steady rated is used, then Circuit switched N/w is the best option.

b) Because of many factors we would choose circuit Switched over Packet Switched.

c) Here, the connection is dedicated so, (BW and N/w Capacity) are fixed for every time; It is well suited for connections where data transmission rati is steady. It also provides low latency.

d) "Resource Allocation" is very important and Circuit Switching does manage them Effectively.

e) Here, one thing to observe is that the "Circuit Switched N/w" are only flexible and Effecient for steady varying patterns.

Question-2.

[B]

here, we Assume a Circuit-Switched N/w. with total capacity of

- 150 mbps.
- Each user's Required B/w = 10Mbps.
- Max users that can be Supported = ?

Total B/w = 150Mbps.

= 150000Kbps.

Each users = 10Mbps.

Max Users we can afford = $(150000/10000)$ Kbps

= 15Kbps.

15 number of users are supported.

Question-3.

(A). Solution:-

given Packet Switched N/w has 150 Mbps.

Each user has B/w of 10Mbps.

So, there are 29 users who gets to transmit any time.

Probability for Exactly One user:- $(r=1)$.

By Binomial Distribut^n Formulae = $^nC_r \cdot p^r (1-p)^{n-r}$

$n = 29$.

$r = 1$. [one user]

$p = 0.1$.

$(1-p) = 0.9$, it is failure

$$BD = {}^{29}C_1 * (0.1)^1 (0.9)^{29-1}$$

$$= 29 * (0.9)^{28}$$

$$= 0.151770.$$

Ques-3.

Solution for B.

Aim:- To calulate Summative Probability upto 15/29 users.

We use Binomial Distribution. $= {}^{n}C_r \cdot p^r \cdot (1-p)^{n-r}$

here, $n = 29$.

$r = 0, 1, \ldots, 15.$

$q = 0.9.$

$$P(r \leq 15) = {}^{29}C_0 (0.1)^0 (0.9)^{29} + {}^{29}C_1 (0.1)^1 (0.9)^{28} + \ldots$$

$$\ldots + {}^{29}C_{15} (0.1)^{15} (0.9)^{14}$$

$${}^{29}C_0 (0.1)^0 (0.9)^{29} = 0.04710.$$

$${}^{29}C_1 (0.1)^1 (0.9)^{28} = 0.051770$$

$${}^{29}C_2 (0.1)^2 (0.9)^{27} = 0.236087$$

$${}^{29}C_3 (0.1)^3 (0.9)^{26} = 0.236087$$

$${}^{29}C_4 (0.1)^4 (0.9)^{25} = 0.170507$$

$${}^{29}C_5 \cdot (0.1)^5 (0.9)^{24} = 0.094726$$

$${}^{29}C_6 (0.1)^6 (0.9)^{23} = 0.042100.$$

$^{29}C_7(0.1)^7(0.9)^{22} = 0.015370$

$^{29}C_8(0.1)^8(0.9)^{21} = 0.004696.$

$^{29}C_9(0.1)^9(0.9)^{20} = 0.001217$

$^{29}C_{10}(0.1)^{10}(0.9)^{19} = 0.000276$

$^{29}C_{11}(0.1)^{11}.(0.9)^{18} = 0.000051$

$^{29}C_{12}(0.1)^{12}(0.9)^{17} = 0.000008$

$^{29}C_{13}(0.1)^{13}(0.9)^{16} = 0.000001$

$^{29}C_{14}(0.1)^{14}.(0.9)^{15} = 0.000000$

$^{29}C_{15}(0.1)^{13}.(0.9)^{14} = 0.000000$

Total Probability = $P(n=0) + P(n=1) + P(n=2) + \dots + P(n=15)$

$= 0.04701 + 0.151770 + 0.236087 + \dots$

$+ 0.000008 + 0.000001 +$

0.000000

$P(n \leq 15) = 0.999999.$

Question - 3[c]

Solutn:- In above, we got $P(n \leq 15) = 0.00000$

P values of 15 users are

$P = (1 - 0.999999)$

$= 0.000001$

nearly "0".

hence, packet switching is better than Circuit Switching

Ques:
[4]

(A) Calculating Transmissn and Propogatn Delay on Link = 1.

Transmissn Delay on Link 1

L = Packet Length
R = Transmn Rate (Link BW)

$T_d = L/R$

Given, Packet Length = 8000 bits

Link BW = 100×1000000

$= 100000000$ bits

$= \frac{8000}{100000000}$

$= 0.08$ millisec.

Propogation Delay = D/S.

D = physical Link, S = speed of propn

$= 3000 / 3 \times 10^8$

$= 1/10^5$

$= 0.01$ millisec.

Ques:- 4[B]

Soln:-

Calculating Transmission and Propogation Delays on Link=2.

Transmissn Delay = L/R

= 8000/1000000

= 0.8millisec.

Propogat^n Delay

= D/s

= 5000000/3×10^8

= 5/300

= 16.67 milliseconds

Quest^n = 4[C]

Soln:- Calculating Transm^n and Propog^n Delays on Link = 3

Td = L/R

= 8000/10 00000000

= 0.008 millisecs

= 8 microseconds.

Propog^n Delay = (D/s)

= (200/ 3×10^8)

= 0.66/10^5

= 0.066 millisecs

= 6.6usec.

Ques- 4(D)

Solutⁿ :-

We need to calculate Total Delay.

$$\text{Total Delay} = 0.08 + 0.01 + 0.8 + 16.67 + 0.008 + 0.066$$

$$= 17.634 \text{ milliseconds.}$$

Ques- 4[E]

soln :-

We assume $T_d = T_{prop}$.

$$L/R = D/S$$

~~D = L/(R*S)~~

$$D = \left(\frac{L \times S}{R}\right)$$

$$= 8000\left(3 \times 10^3 / 100 * 10^6\right)$$

$$= 24000 \text{ mts.}$$

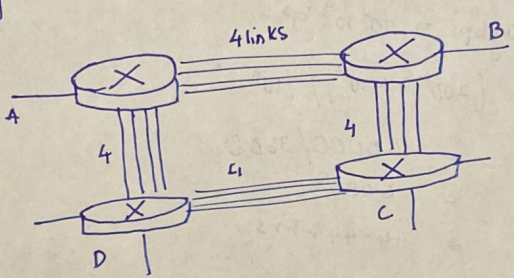
Question-5.

Ques-5 [A].

Maximum Number of Connections supported :-

solution :- Every Router has 4 Connections.
So, 16 simultaneous Connect^n's can be supported.

Ques-5 [B]



User A and user User C to be Connected.

Two paths is possible = ABC, ADC.

4 Connect^n 4 Connect^n

8 possible Connections

Ques-5 [C].

Aim :- Connect 4 users at A to endeser to C.
Connect 4 users at B to end Users to D.

solut^n :- 4 Connect^n's can be to A to C.
2 from B and two from D.

8 Connections

Question - 6.

Solution :-

Given the length of data = 200tb.

We need to deliver within 24hrs.

here, We need to Convert tb = bits.

$200\ tb = 200 * 8 * 10^{12}$ bits.

$10gbps = 10^* 10^9$ bps

$Td = (200^* 8 * 10^{12}) / (10^* 10^\wedge 9)$

$= 160000/3600$

$= 1600/36$

$= 44.444$ hrs.

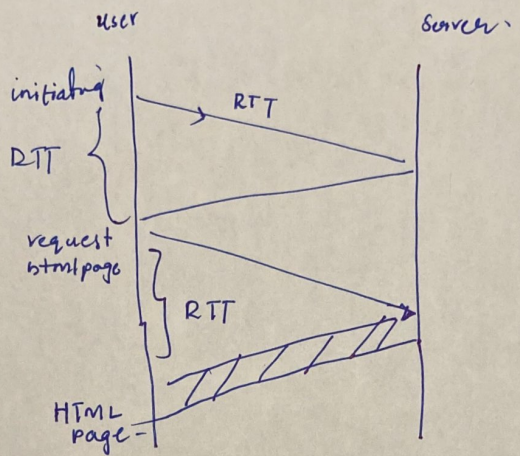
Question - 7.

Two Advantage of Protocol Layers.

1) Any modifications made on one layer do not affect the other layers.

2) Task segmentation makes implementation easier.

Question-7.



Total Non-Persistant HTTP Resp Time = 2RTT + File Transfer Time

$= 2(5) + 4$

$= 14$ seconds