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p3.

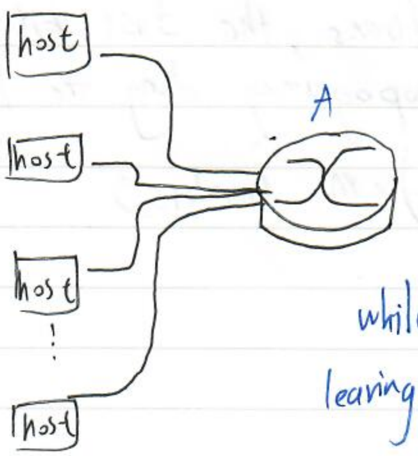
a. circuit-switched network would be more appropriate.

Reason: The application will contine running for a long period of time meanwhile need steady transmition.

When it use circuit-switched networks, the resources would be reserved for the users until the users release the resources, hence is suitable for users who need continuous network service.

On the other hand, packet-switched networks is suitable for users who need burst network service.

b. below depicts the worst case



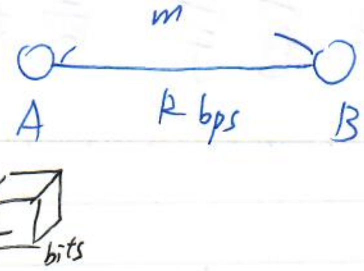
the rate of packets running into the router A would be $\sum_{i}^{n} N/K$ (bps)

while the rate of packets leaving router A is LR (bps)

if $LR > \sum_{i}^{n} N/K$, no congestion control is needed.

However, if process time can't be negligible, it would be another case.

No P6. ..
Date



$p = s \ (m/s)$

(a) $d_{prop} = \frac{m}{s}$ (seconds)

(b) $d_{trans} = \frac{L}{R}$ (seconds)

(c) end-to-end delay $= d_{prop} + d_{trans} = \frac{m}{s} + \frac{L}{R}$

(d) at time $t = d_{trans}$, the last bit just left host A and started to propagate along the link.

(e) $d_{prop} > d_{trans}$, when $t = d_{trans}$, the first bit of the packet is still propagating along the link and it is $\left(\frac{d_{prop} - d_{trans}}{d_{prop}}\right) \times m$ (meters)

away from host B

p6 (contd)

(f) $d_{prop} < d_{trans}$, when $t = d_{trans}$

the first bit of the packet would be at host B, waiting for the total bits to arrive so that the packet can be processed.

(g) $s = 2.5 \times 10^8$ $L = 120$ bits $R = 56$ kbps

$d_{prop} = \frac{m}{s}$, $d_{trans} = \frac{L}{R}$

$\frac{m}{2.5 \times 10^8} = \frac{120}{56 \times 10^3} \Rightarrow m \simeq 535.7$ (km) $_{\#}$

P8. (a) $\frac{3M}{150k} = 20$ users can be supported.

$\therefore$ (FDM - frequency division muliplexing can help 20 users use the Network simultaneously)

(b) 0.1 $\Rightarrow$ a user use 10% of time transmitting

ie, at a moment, the probability of a user transmitting via network is also 10%

P 8 (contd)

(c) 120 users

p(n users transmitting)

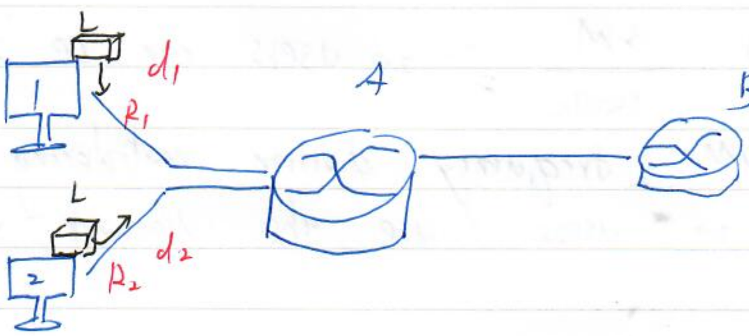
$= C_n^{120} \times (10\%)^n (1-10\%)^{120-n}$

(d) $\sum_{i=21}^{120} C_i^{120} (10\%)^i (90\%)^{120-i}$

$= 1 - \sum_{i=0}^{20} C_i^{120} (10\%)^i (90\%)^{120-i}$

$\simeq 0.00794119225$ (By online binomial CDF calculator)

P 11.



assume at $t=0$, host 1 & host 2 send packet simultaneously, the first packet arriving router A

at $t = \min\left\{ d_1 + \frac{L}{R_1}, \; d_2 + \frac{L}{R_2} \right\}$

P11 (contd)

assume the link Rates between router A & router B is R_{AB}, then no queuing delay will happen

if

$$\underbrace{\min\left\{d_1+\frac{L}{R_1},\ d_2+\frac{L}{R_2}\right\}}_{\text{the time when the first packet arrives A}} + \underbrace{\frac{L}{R_{AB}}}_{\text{the time spent on sending first packet on the AB link}} < \underbrace{\max\left\{d_1+\frac{L}{R_1},\ d_2+\frac{L}{R_2}\right\}}_{\text{the time when the second packet arrives A}}$$

(d_1, d_2) which satisfy the above inequality expression are the answers #

P22. packet loss probability $= p$

(1) $(1-p)^N$ (2) X denotes the random variable of # times needed to transmit the packet

$$P(X=n) = (1-K)^{n-1} \times K \quad \text{where} \quad K = (1-p)^N$$

$$E[X] = \sum_{n=0}^{\infty} [1-K]^{n-1} \times K = \frac{1}{K} = (1-p)^{-N} \quad \left(\text{geometric distribution}\right)$$

Therefore the average times of retransmittion

is $\boxed{(1-p)^{-N} - 1}$ #

No. P25: A 20k (km) B speed $= 2.5\times10^{8}$ (m/s)

$R = 2\,Mbps$

(a) $2M \times \dfrac{20k \times 10^{3}}{2.5\times10^{8}} = 160\,k$ (bits)

(b) 

when the first arrived host B the $d_{prop} \times R$ bits just left host A

800 k bits

$\Rightarrow \boxed{160\,k \text{ bits}}$ #

(c) the maximum number of bits in the link at the same time

(d) $\dfrac{20k\ (km)}{160k\ (bits)} = \underline{125\ m}$ #, longer than a football field

(e) $\dfrac{m}{R\cdot d_{prop}} = \dfrac{m}{R\times\frac{m}{s}} = \boxed{\dfrac{S}{R}}$ #

Chuyu culture

P31.

No.
Date

$8 \cdot 10^6$ bits // 2Mbps each link

a. (1) about $\frac{8 \cdot 10^6}{2M} = 4(S)$ (2) 12 (S)

b. 800 個 10000 bits long packets

(1) $\frac{10000}{2M} = 5$ ms (2) 10 (ms)

C. 15 ms later the first packet reach destination

20 ms later the second ...

:

$(15 + 5 \times 799)$ms " 800th "

Therefore it takes 4010 ms for message to reach the destination, which is much less than the result in part (a).

d. once packet loss happens, the source can retransmitted the lost packets instead of the whole message to save a large amount of time.

Furthermore, if the packet is too large, it may take too much space at routers, and hence cause higher probability of packet loss of other Internet users.

e. not every packet would follow the same route during transmitting, therefore the order of the arrival of packets may be out of the expectation and need more strategy to handle this issue.

Second, every packets carry not only messages but also headers, therefore the total size increase as packets number increase.

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destination www.facebook.com

a.

	13:32					
# hops						
13	26.082	25.908			average	8.602571
13	4.294	4.221	4.449		standard deviation	7.269977
13	5.834	5.809	8.717			
13	4.053	4.092	4.069			
13	7.521	7.617	7.77			
	17:08					
13	5.612	5.613	5.609		average	5.215267
13	4.365	4.673	4.544		standard deviation	0.88469
13	4.794	4.869	4.842			
13	4.163	4.158	4.776			
13	6.745	6.74	6.726			
	02:53					
13	8.799	9.316	8.572		average	5.9326
13	3.894	3.835	3.626		standard deviation	1.96023
13	4.215	5.472	5.451			
13	4.335	4.141	4.977			
13	7.306	7.297	7.753			

edge-star-mini-shv-01-tpe1.facebook.com (31.13.87.36) is the destination.

b. the number of routers remain 13 for 50 data, but the paths change from time to time.

c. Since I did this task in NTU, the ISP the packets pass through involved (TAnet – Taiwan academic network, TPIX-TW – PeeringDB – an IXP, and the facebook ISP located in US).

In this case, no large delay occur at the peering interfaces between adjacent ISPs.

d. –(a)

destination: www.ucla.com - gateway.lb.it.ucla.edu [164.67.228.152]

13:32:
delay

average – 155ms deviation- 5.664ms

17:08:
average – 122ms deviation- 13.664ms

02.53:

average – 134ms deviation- 7.664ms

(calculated via excel)

d-(b) No, the hops remain 20 in all data.

d-c about 4 ISPs are involved in the task, which are TAnet, ASnet, Indiana University ISP, and UCLA network. No apparent large delay occurred at peering interfaces.