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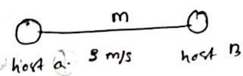
(6)

(a) when a data packet is transmitted to the transmission media. and then received to the destination. the time took for this process is called propagation delay.

So, $d_{prop} = \frac{m}{s}$



(b) transmission time of the packet is to take time to push the packet from host to the transmission medium.

$\therefore d_{trans} = \frac{L}{R}$

(c) Ignoring processing delay and queuing delay the end-to-end delay is

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

(d) for $t=0$ at the $d_{transmison}$ delay. The bit is Just leaving host A

(e) As the propagation delay (d_{prop}) is greater then transmission delay (d_{trans}), ($d_{prop} > d_{trans}$) the first bit of the packet is in the link but not reached to Host B.

(f) when the propagation delay is less then the transmission delay. that means the time it takes for a signal to propagate from sender to receiver is shorter then the time it takes to tramit the entire packet. it mean. the first bit is reached to host B.

(g)

$$d_{trans} = d_{prop}$$

$$\frac{L}{R} = \frac{m}{s}$$

$$m = \frac{L}{R} \times s$$

$$= \frac{1500 \times 8}{10 \times 10^6} \times 2.5 \times 10^8$$

$$= 300 \text{ km}.$$

$s = 2.5 \times 10^8 \ ms^{-1}$

$L = 1500$ byte
$= 1500 \times 8$ bit

$R = 10$ Mbps
$= 10 \times 10^6$ bps
$= 10^7$ bps

(7) time to require to transmit the packet or transmission delay is.

$$d_{trans} = \frac{L}{R}$$

$$= \frac{56 \times 8}{10 \times 10^6} \text{ s}$$

$L = 56$ byte
$= 56 \times 8$ bit

$R = 10$ Mbps
$= 10 \times 10^6$ bps

before the packet is transmitted all the bit need to be generated. this require

$$d_{serialization} = \frac{56 \times 8}{64 \times 10^3} \text{ s}$$

$\therefore$ total time $= d_{prop} + d_{trans} + d_{serialization}$

$$= \cancel{\frac{56 \times 8}{10 \times 10}}\ 10 \times 10^{-3}\text{s}\ \cancel{10 \text{ ms}} + \frac{56 \times 8}{10 \times 10^6} + \frac{56 \times 8}{64 \times 10^3}$$

$$= \cancel{0.}\ 17.0448 \text{ ms}$$

(8)

(8)

(a) as here is the link capacity is 10 Mbps, and the user requirement is 200 kbps. so,

the user can be supported $= \dfrac{\text{link capacity}}{\text{user requirement}}$

$= \dfrac{10\times10^6}{200\times10^3} = 50$ user

(b) Given, the user transmit 10% of the time. that the given user is transmitting 0.1 so,

$P(\text{trans}) = 0.1$

(9)

(a) the number of user $= \dfrac{\text{Link capacity}}{\text{User data rate When busy}}$

$= \dfrac{1\ \text{Mbps}}{100\ \text{kbps}}$

$= \dfrac{10^6}{100\times10^3}$

$= \dfrac{10^6}{10^5} = 10$ user

(10)

$d_{end\text{-}to\text{-}end} = d_{1prop} + d_{2prop} + d_{3prop} + t_{1trans} + t_{2trans} + t_{3trans}$

$+ d_{proc} + d_{proc}$

$= \frac{m_1}{s} + \frac{m_2}{s} + \frac{m_3}{s} + \frac{L}{R_1} + \frac{L}{R} + \frac{L}{R} + 3 + 3$

$= \frac{5000 \times 10^3}{2.5 \times 10^8} + \frac{4000 \times 10^3}{2.5 \times 10^3} + \frac{1000 \times 10^3}{2.5 \times 10^3} + \frac{1500 \times 8}{2.5 \times 10^6} + \frac{1500 \times 8}{2.5 \times 10^6} +$

$\frac{1500 \times 8}{2.5 \times 10^6} + \cancel{3+3}\, 3 \times 10^{-3} + 3 \times 10^{-3}$

$= 1600.0404\,s$

(12) the arriving packet must first wait for the link to transmit $= \frac{4.5 \times 1500 \times 8}{2.5 \times 10^6} = 21.6$ ms

so, the queing delay is 21.6 ms.

for n packet the queueing delay is $\Rightarrow$

$= \frac{nL + (L - x)}{R}$

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(15) total delay is $d = \dfrac{L/R}{1 - I}$

$$= \frac{L/R}{1 - \frac{aL}{R}} = \frac{1/\mu}{1 - a/\mu} = \frac{1}{\mu - a}$$

(16) The total number of packet in the system includes those in the buffer and the packet that is being transmitted. so, $N = \underline{10+1}$;

$N = ad$

$100 = a\left(20 + \frac{1}{100}\right)$

$a = 5$ packet/s

(23)

(a) if the bottleneck link and both packets ~~are sent back to back~~ is the first link the B is queued at the first link waiting for the transmission of packet A ∴ So, the packet inter arrival time is simply L/R

(b) if the second link is bottleneck link and both packet are send back to back

that is :
$$\frac{L}{R_s} + \frac{L}{R_s} + d_{prop} < \frac{L}{R_s} + d_{prop} + \frac{L}{R_c}$$

if we send the second packet T second letter. we will ensure that there is no queuing delay for the second packet

If we have $\frac{L}{R_s} + \frac{L}{R_s} + d_{prop} + T >= \frac{L}{R_q} + d_{prop} + \frac{L}{R_q}$

Thus the maintain value of T is $L/R_c - L/R_s$

(25)

(a) bandwith delay product, $R \cdot d_{prop}$

$= 5 \times 10^6 \times 2.5 \times 10^8$

(b) maximum number of bit in the link =

bandwith delay product $= 5 \times 10^6 \times 2.5 \times 10^8$

(c) bandwidth delay product of a link is the maximum number of bit that can be sent in the link.

(d) the width of a bit = length of link/bandwidth delay product. so, 1 bit is 125 meters long which is longer than a football feild.

(e) $\frac{S}{R}$ the formula is $\frac{S}{R}$

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(a) geostationary satelite is 36000 km away

so, propogation delay is $\frac{d}{s} = \frac{36000 \times 10^{3}}{2.4 \times 10^{8}}$

$= 150$ ms

(b) bandwidth delay product is $= R \cdot d$

$= 10$ mbps $\times 150$ ms

$= 10 \times 10^{6} \times 150 \times 10^{-3}$

$= 1500000$ bits.

(c) it is equal to the bandwidth delay product which is 15 0000.

(31)

(a) time to send message from source to destination is = $\frac{8 \times 10^6}{\cancel{5} \times 10^6} = \cancel{4s}\ 1.6$ sec

So the actual time is $1\cancel{0^4}6 \times 3 = \cancel{12}$ s 4.8

(b) time to send 1st packet from src to destination is $\frac{1 \times 10^4}{\cancel{5} \times 10^6} = \cancel{5\,ms} = 2$ ms

So, 1st packet is received at time

2×2 sec $= 4$ sec.

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(c) Time at which 1st packet is Received at the

dest host, $= 2 \times 3 = 6$ ms.

Every 5 msec one packet will be received

thus the packet received time 6 ms + 799 × 2

= 1604 msec

so, the delay is using message segmentation is

(1/3)

(d) (i) without message segmentation the bit error are not tolerated. if there is a single bit error the whole message should be re-transmitted.

(ii) Without message segmentation huge packets are sent into a network. Routers have to accommodate these huge packet.

(e)

(i) Packet has to be put in sequence at the destination.

(ii) message segmentation in many smaller packet. Since header size is usually the same for all packet.

(33)

there are F/S packets. each packet is $S = 80$ bits

time at which the last packet is received at the first router is $\frac{S+80}{R} \times \frac{F}{S}$. at $\frac{F}{S-2}$ packets are at the destination.

transmission total time delay: $\frac{S+80}{R} \times (\frac{F}{S} + 2)$

$\frac{d}{dS}$ delay $= 0$; $S = \sqrt{40}$.