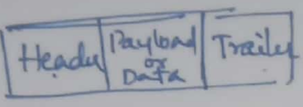
Datalink layer

16/04/2021 ①

Function of DL
1) Framing ✓
2) flow control ✓
3) Error Control ✓

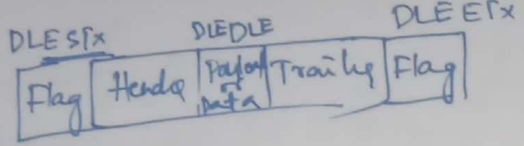
I Framing

frame format



(n,k)

(n-k)



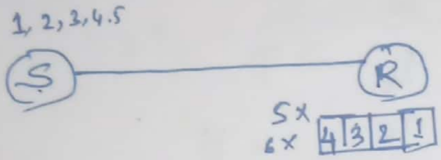
1) Bit Oriented → 01111110 → flag
2) Byte oriented
   ↳ DLE STX   DLE ETX

$$011111\overset{0}{\uparrow}10$$

Bit stuffing

0 ↓

Flow Control

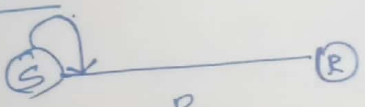


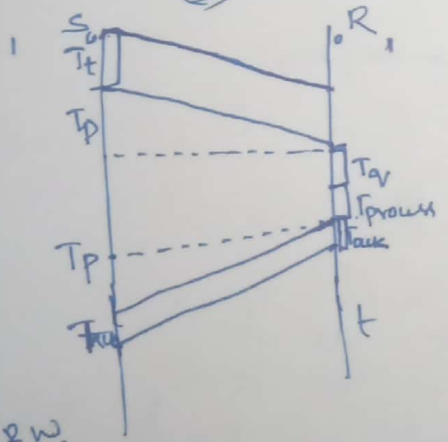
load > Capacity of Buffer

Receive can't handle those packets

→ Stop and Wait protocol
→ Sliding Window protocol < Goback N, Selective repeat

Stop and Wait





T_t = Transmission time

$T_t = \frac{L}{B}$

T_p = Propogation time

$T_p = \frac{d}{v}$

T_q or T_{Buffer}

$T_{process}$

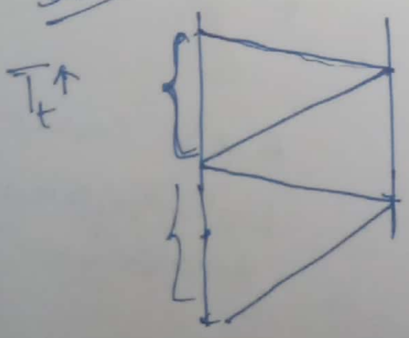
$$\text{Total Time} = T_{total} = T_{t_{data}} + T_p + \cancel{T_q} + \cancel{T_{process}} + T_{ack} + T_{p_{ack}}$$

$$= T_t + T_p + T_{ack} + T_p$$

$$= T_t + 2 * T_p + \cancel{T_{ack}}$$

$$\boxed{T_{total} = T_t + 2 * T_p}$$

S&W



$$\text{Efficiency } \eta = \frac{\text{Usefull time}}{\text{Total Cycle time}}$$

$$= \frac{T_t}{T_t + 2 * T_p}$$

$$= \frac{1}{1 + 2 * \frac{T_p}{T_t}}$$

$$a = \frac{T_p}{T_t}$$

$$\text{Efficiency } \eta = \frac{1}{1 + 2a}$$

Window size
Sending $\underleftarrow{1+2a}$ □

Throughput
or
Effective BW
or
BW utilization

$$= \frac{L \text{ (Packet size)}}{T_t + 2 * T_p}$$

$$= \frac{\frac{L}{B} \times B}{T_t + 2 * T_p}$$

$$= \frac{T_t}{T_t + 2 * T_p} \times B$$

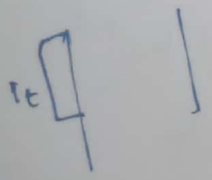
$$= \eta \times B$$

100 Mbps
50%

$$= 0.5 \times 100 \text{ Mbps}$$

Factor Effecting ~~Throughput~~ (or) ~~Bandutilization~~

$$= \frac{T_t}{T_t + 2 * T_p} \times B$$



$$= \frac{1}{1 + 2a}$$

$$a = \frac{T_p}{T_t}$$

$$T_t = \frac{L}{B} \quad T_p = \frac{d}{V}$$

$$= \frac{1}{1 + 2 * \frac{T_p}{T_t}}$$

$$= \frac{1}{1 + 2 * \frac{\overset{\checkmark}{d}}{\boxed{V}} \times \frac{\boxed{B}}{L \checkmark}}$$

B & V. Constant

L → length of packet or size
d → distance

$$= d\uparrow \quad \eta\downarrow$$
$$L\uparrow \quad \eta\uparrow$$

A link has a transmission speed of 10^6 bits/sec. If user data packet size of ....

1) calculate the efficiency for a stop & wait protocol for $T_t = 1$msec & $T_p = 1$msec

$$\eta_t = \frac{1}{1+2a} \times 100 \qquad a = \frac{T_p}{T_t} = \frac{1m}{1m} = 1$$

$$= \frac{1}{1+2} = \frac{1}{3} = \underline{\underline{33\%}} \qquad \underline{67?}$$

Stop & wait protocol is good for LAN
not for WAN

2) If the efficiency have to be 50% In case of S&W what is the relationship b/w. T_t & T_p

$$\eta = \frac{T_t}{T_t + 2 * T_p}$$

$$\frac{T_t}{T_t + 2 * T_p} = 0.5 = 1/2$$

$$2 T_t = T_t + 2 * T_p$$

$$T_t > 2 * T_p \qquad T_t = \frac{L}{B}$$

$$\frac{L}{B} \geq 2 * T_p$$

$$\boxed{L \geq 2 * T_p * B}$$

If BW = 4Mbps $T_p = 10$msec. what is the length of the packet for an efficiency of 50%.

$$L \geq 2 * T_p * B$$

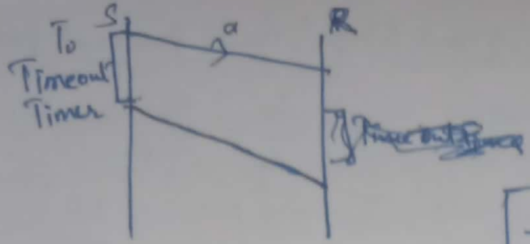
$$L \geq 2 * 10 \times 10^{-3} \times 4 \times 10^{6}$$

$$\boxed{L \geq 8 \times 10^{3} \text{ bits}}$$

$$\text{Throughput} = \eta * B$$

$$= 1/2 \times 4 \text{Mbps}$$

$$= \underline{2\text{Mbps}}$$



with
S&W Timer

Stop & wait ARQ

In S&W protocol If we want to send 10packets from S to Receiver out of which every 4th packet being transmitted is lost How many packets we are sending

1 2 3 4 5 6 7 8 9 10
↑

4 5 6 7 8 9 10
↑

7 8 9 10
↑

10

13 packets

Suppose that the stop and wait protocol is used on a link with a bitrate of 64kbits persecond and 20milliseconds Propogation delay. Assume that the transmission time for acknowledgement and processing time at the nodes are negligible. Calculate the minimum frame size in bytes to achieve a link utilization of 50%.

$$L \geq 2 * T_p * B$$

$$L \geq 2 * 20 \times 10^{3} * 64 \times 10^{3}$$

$$L \geq 2 \times \frac{20}{1000} \times 64 \times 10^{3}$$

$$L \geq 2560$$

$$\frac{2560}{8} \text{ Bytes}$$

$$= \underline{320 \text{ bytes}}$$

A link has a transmission [illegible] of 10 [illegible]. [illegible] 1000 bytes each. ~~A~~ Assume that the acknowledgement has negligible transmission delay and its Propogation delay is the same as the data propogation. also assume that Processing delay at nodes are negligible. The efficiency of the stop and wait protocol in this setup is exactly 25%. Calculate the Value of oneway Propogation delay in milliseconds.

$$\eta\% = \frac{T_t}{T_t + 2*T_p} = 1/4$$

$$T_t = \frac{L}{B}$$

$$4T_t = T_t + 2*T_p$$

$$= \frac{1000 \times 8}{1000000}$$

$$3T_t = 2*T_p$$

$$T_t = \underline{8000}$$

$$T_p = \frac{3 \times 4000}{10^6}$$

$$\underline{T_p = 12 \text{ millisec}}$$

A channel has a bit rate of 40kbps and oneway Propogation delay of 20msec. The channel uses stop and wait protocol. The transmission time of the acknowledgement frame is negligible. Calculate the minimum frame size required to get channel efficiency of atleast 50%.

$$L \geq 2 \times T_p * BW$$

$$L \geq 2 * \frac{20}{1000} \times 40 \times 10^3$$

$$\underline{L \geq 1600 \text{ bits}}$$

Consider two hosts 'x' and 'y' connected by a single direct link of rate 10^6 bits/sec.. The distance between hosts is 10000 km. The Propogation speed is along the link is 2×10^8 m/s.. Host 'x' sends a file of 50000 bytes as one Large message to host 'y' Continuously. let the transmission & Propogatio delay be 'p' miliseconds & 'q' miliseconds respectively. then Calculate the Values of 'P' and 'q'

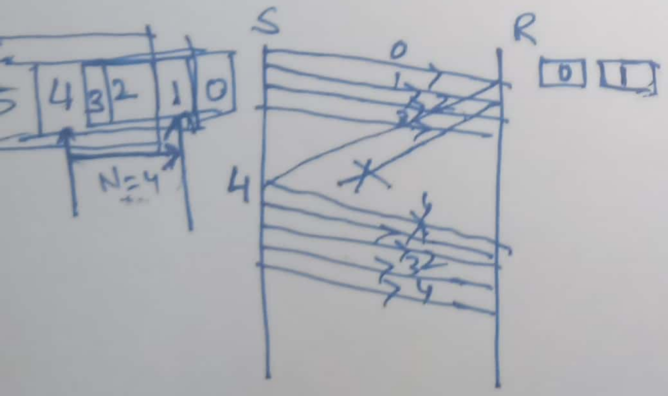
Sliding Window Protocol

↳ Go Back N

↳ Selective Repeat

1+2a

GB 4

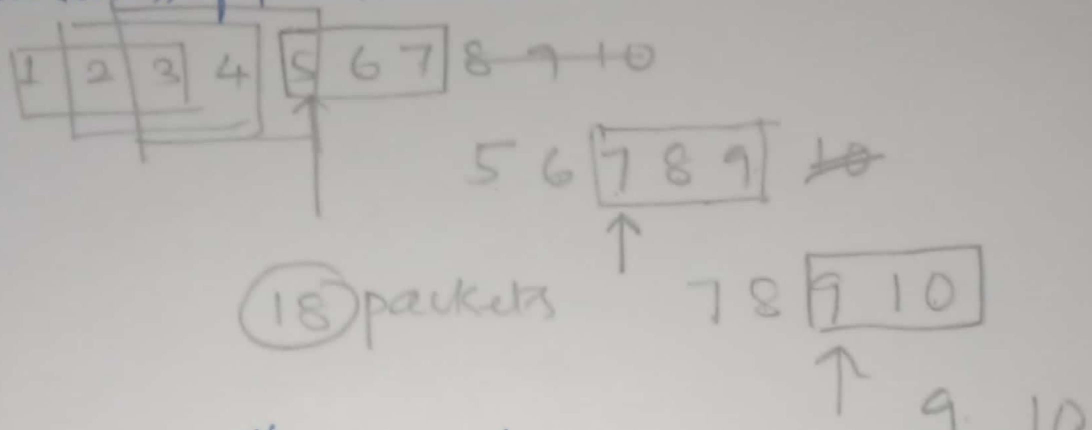


LAST LOST

In GB 3 If every 5th packet being transmitted
in total 10 packets. How many total transmissions of

1 2 3 4 $\boxed{5 \quad 6 \quad 7}$ 8 9 10

In GB3. If every 5th packet being transmitted is lost. in total of 10packets How many total transmissions of packets are done.



In GB4 If every 6th packet being transmitted is lost it is desired to transmit 10 packets. How many total transmission of packets done