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Chapter 7

Data Com. Course

Data link Control protocol.

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Problems:-

7.3 $R = 4$ kbps, propagation delay $= 20$ms. For what range of frame size does stop-and-wait give an efficiency of at least 50% ?

* propagation time :- Time for a bit traverse the link.
* Transmission time :- Time taken to emit all bits into medium.
* Stop-and-wait flow control :- A flow control protocol in which the sender transmits a block of data and then awaits an acknowledgment befor transmitting the next block, Destination can stop flow by not sending ACK.

Solution :- See Appendix 7.A

$$t_{prop} = \frac{\text{Distance}}{\text{velocity}} = \frac{d}{V}$$

$$t_{frame} = \frac{\text{frame length}}{\text{data Rate}} = \frac{L}{R}$$

$$a = \frac{t_{prop}}{t_{frame}} = \frac{20 * 10^{-3}}{L/(4*10^3)} = \frac{80}{L}$$

* Utilization or efficency of the line :-

$$U = \frac{1}{1+2a} = \frac{1}{1+(160/L)} \geq 0.5 \Rightarrow 1 \geq 0.5 + \frac{80}{L}$$

$$0.5 \geq \frac{80}{L} \Rightarrow L \geq \frac{80}{0.5} \Rightarrow \boxed{L \geq 160 \text{ bits}}$$

Therefore, an efficiency of at least 50% requires a frame size of at least 160 bits.

7.4 1000-bit frames on a 1-Mbps satellite channel with a 270-ms delay. What is the maximum link utilization for:

(a) Stop-and-wait flow Control ?

Solution:-

$$a = \frac{t_{prop}}{t_{frame}} = \frac{270 * 10^{-3}}{L/R} = \frac{270 * 10^{-3}}{10^3/1*10^6} = 270$$

$$\therefore U = \frac{1}{1+2a} = \frac{1}{1+2(270)} = 1.8 * 10^{-3} \simeq \boxed{0.002}$$

(b) Continuous flow Control with a window size of 7 ?

* Sliding-window flow Control :- A method of flow control in which a transmitting station may send numbered packets within a window of numbers. The window changes dynamically to allow additional packets to be sent.

Solution:-

$$a = 270$$

$$U = \frac{W}{1+2a} = \frac{7}{541} = \boxed{0.013}$$

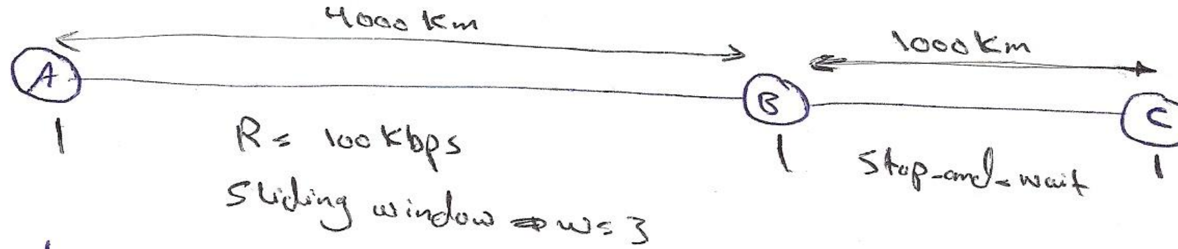
(c) Repeat b for $W = 127$?

$$U = \frac{127}{541} = \boxed{0.23}$$

(d) Repeat b for $W = 255$?

$$U = \frac{255}{541} = \boxed{0.47}$$

[7.5] In the following figure, frames are generated at node A and sent to node C through node B.



- t_{prop} is $5\ \mu s/Km$ for both lines.
- Full duplex lines between the nodes.
- All data frames are 1000 bits long.

Determine the minumum data rate required between nodes B and C so that the buffers of node B are not flooded?

Solution:-

In order to not flood the buffers of B, the average number of frames entering and leewing B must be the same over along interval.

A ⟶ B :-

$$t_{prop} = 4000 * 5\mu s = 20\ ms$$

$$t_{frame} = \frac{L}{R} = \frac{1000}{100 * 10^3} = 10\ msec$$

$*\because w = 3 \Rightarrow$ A can transmit three frames to B and then must wait for ack. The first frame takes $\underline{10\ msec}\ t_{frame} + 20\ msec\ t_{prop}$ to arrive to node B, for ack from B to A there is additional $20\ msec\ t_{prop}$.

$\therefore$ A can transmit 3 frames in $\boxed{50\ msec}$

$B \to C$

$t_{prop} = 1000 * 5 \mu sec = 5$ msec

$t_{frame} = \frac{L}{R} = \frac{1000}{R}$

- B Can transmit one frame to C at time, So for the frame to be recieved at C it takes $\Rightarrow 5 + t_{frame}$
- In addion to C's ack to B $\Rightarrow$ It will be $(10 + t_{frame})$ for one frame

$\therefore$ For 3-frames the total time will equail $[30 + 3t_{frame}]$

$30 + 3t_{frame} = 50$

$\therefore t_{frame} = 6.66$ ms

$R = \frac{L}{t_{frame}} = \frac{1000}{6.66 * 10^{-3}} = \boxed{150 \text{ Kbps}}$

7.10 Tow nodes A, B use a sliding-window protocol with a 3-bit sequence number, windows size = 4. Assuming A is transmitting and B is receiving, show the window positions for the following succession of events :-

(a) Befor A sends any frames? maximum windows size $= 2^3 - 1 = 7$

Solution:-

3-bit sequence number $[0 - (2^3 - 1)] \Rightarrow (0 - 7)$

$w = 4$

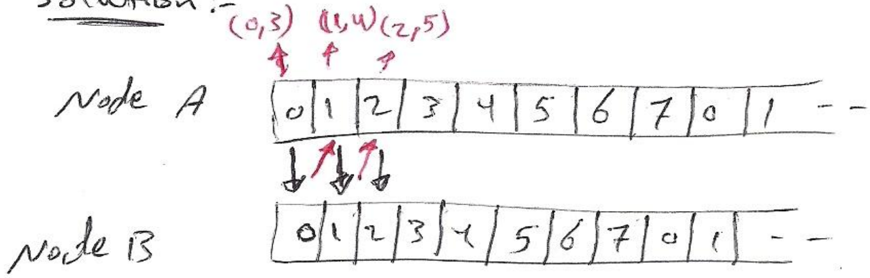
Node A | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | ...

window = (0, 3)

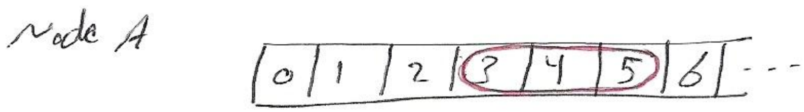
Node B | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | ...

(b) After A sends frames 0, 1, 2 and recieves ack. from B for 0 and 1 ?

Solution :-



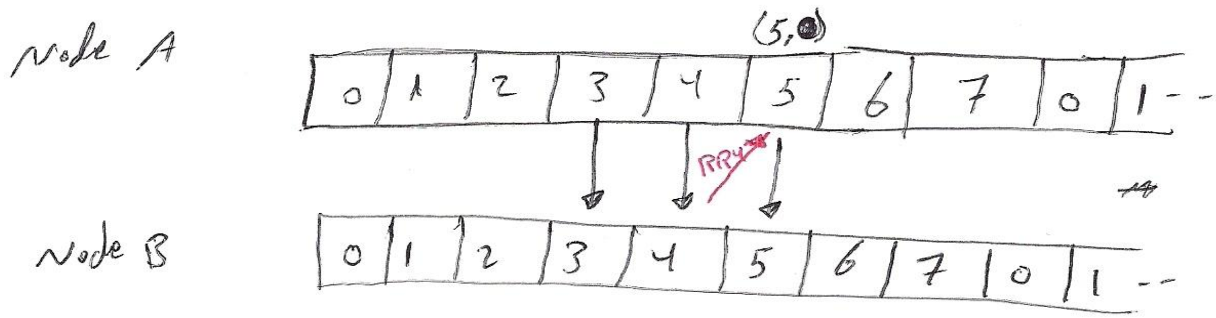
window (3, 5)



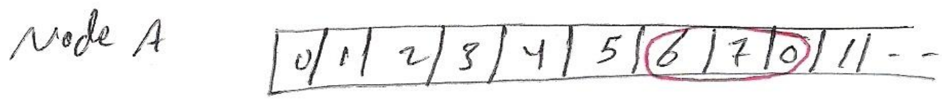
It is equal to using RR2 (receive ready) 2 for w = 4 so it will be from 2 to frame 5, But frame 2 already received so it will be from frame 3 to frame 5 .

(c) After A sends frames 3, 4, and 5 and B ack 4 and the ack is received by A .

Solution :-



∴ window (6, 0)



- using RR4 , This mean that B is ready for four frames starting frame 5, But frame 5 already received , so w will be from 6 to 0

7.13 Two stations communicate via a 1-Mbps, $t_{prop} = 270$ ms, using HDLC frames of 1024 bits with 3-bit sequence numbers, what is the maximum possible data throughput? (not counting the 48 overhead bits per frame)

Solution:

$$a = \frac{T_{prop}}{T_{frame}} = \frac{270 * 10^{-3}}{1024/10^{6}} = 263.7$$

Flag	Addr	Control	Info	FCS	Flag
8	8	8 or 16		16 or 32	8

$$U \le \frac{w}{1+2a} = \frac{2^{3}-1}{1+2(263.7)} = 13.25 * 10^{-3}$$

Throughput for (1024) $= U * R = (13.25 * 10^{-3})(10^{6}) = 13.25$ Kbps

But,

Actual dat per frame $= 1024 - 48 = 976$ bits

$\therefore$ Actual throughput $= \frac{976}{1024} * 13.25$ kbps $= \boxed{12.63 \text{ kbps}}$

Another Solution:

Total time (Frame1) = $2T_{prop} + T_{frame} = 2(270\text{ms}) + (1024/10^{6}) = 540 + 1.024 = 541.024$ msec

Data per frame = 1024 – 48 = 976

Throughput for frame1= (976 / 541.024 msec) = 1.8 kbps

Throughput for window= 7 * 1.8 kbps = $\boxed{12.6 \text{ kbps}}$

* HDLC ⇒ High level Data Link Control
* FCS ⇒ Frame check sequence.
* We have not allowed for the overhead for the HDLC frame.

The HDLC = 2* frame bytes + 1*Address byte + 1 Control byte + 2* FCS bytes
= 6bytes = 48 bits.