4. Flow Control

4.1 [1 2]
4.2 [1 2 3 4 5 6]
4.3 [1 2 3]
4.4 [1]
4.5 [1]

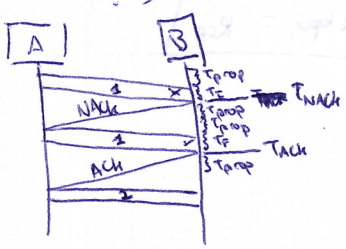
4.1. Efficiency Analysis [1 2]

4.1.1.

Compare the effective flow rate and efficiency obtained with S&W, ~~go-back~~ G-BN and selective repeat on a link with these parameters. Assume ~~error frames~~ receiving an erroneous frame sends a NACK.

a) $T_{prop} = 10\,ms$
b) $C = 2400\ bps$
c) $p_e = 10^{-4}$
d) $S_F = 1024\ b$
e) $S_{ACK} = 24\ b$
f) $S_{NACK} = 16\ b$

S&W



Assuming error-less acks

$T_{T_x} = T_F$;

$P_e \equiv$ probability of error in a frame $= (1-(1-p_e)^{S_F}) = 1-(1-10^{-4})^{1024} = 0.09734$

$T_{SW} = (1-P_e)(2T_{prop} + T_{T_x}) + P_e(1-P_e)(4T_{prop} + 2T_x) + P_e^2(1-P_e)(6T_{prop} + 3T_x) + \dots =$

$+T_{ACK}$ $+T_{NACK}+T_{ACK}$ $+2T_{NACK}+T_{ACK}$

$= \sum_{k=1}^{\infty} (1-P_e) P_e^{k-1} (2kT_{prop} + kT_{T_x} + (k-1)T_{NACK} + T_{ACK}) = (1-P_e)\left(\sum_{k=1}^{\infty} P_e^{k-1} \cdot k(2T_{prop} + T_{T_x} + T_{NACK}) + \sum_{k=1}^{\infty} P_e^{k-1} (T_{ACK} - T_{NACK}) \right) =$

$= (1-P_e)\left((2T_{prop} + T_{T_x} + T_{NACK}) \cdot \frac{1}{(1-P_e)^2} + (T_{ACK} - T_{NACK}) \cdot \frac{1}{1-P_e} \right) = \frac{2T_{prop} + T_{T_x} + T_{NACK}}{1-P_e} - T_{NACK} + T_{ACK}$

$\eta_{SW} = \frac{T_{T_x}}{T_{SW}} = \frac{T_{T_x}}{\frac{2T_{prop} + T_{T_x} + T_{NACK}}{1-P_e} - T_{NACK} + T_{ACK}} = \frac{\frac{1024\,b}{2400\,b/s}}{2 \cdot 10\,ms + \frac{1024\,b + 16\,b}{2400\,b/s}} = 0.8440 = \boxed{84.40\,\%}$

$1-0.097 \quad + \frac{24\,b - 16\,b}{2400\,b/s}$

$R_{SW} = C \cdot \eta_{SW} = 2400 \cdot 0.8440 = \boxed{2025.51\ bps}$