ENEL 573 - Assignment #3

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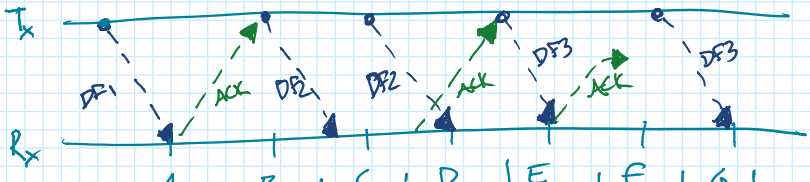
Q1:



	A	B	C	D	E	F	G
(0) ACK	0-1	1-2	1-2	0-	0-3	1-4	1-4
Tx	0-1	0-1 1-2	0-1 1-2 (2)	0-1 1-2 (2)	0-1 1-2 (2) 0-3	0-1 1-2 (2) 0-3 (2)	0-1 1-2 (2) 0-3 (2)
Rx	0-1	0-1	0-1 1-2	0-1 1-2 ~~1-2~~	0-1 1-2 ~~1-2~~ 0-3	0-1 1-2 ~~1-2~~ 0-3	0-1 ~~03~~ 1-2 1-2 0-3
totals	Rx-1 Tx-1	Rx-1 Tx-1	Rx-2 Tx-3	Rx-3 Tx-3	Rx-4 Tx-4	Rx-4 Tx-5	Rx-5 Tx-5

Rx - Received

Tx - sent

* The rejected packets are crossed out in red

Q2:

$N_F = 2000$ bits Overhead = 0.05 (5%)

ACK - 0.10 (10%)

efficiency - 0.05 (5%)

$R = 10$ Mbits/s $= 10 \cdot 2^{20}$ bits/s

ACK = $0.10(N_F) = 200$ bits

Overhead = $0.05(N_F) = 100$ bits

length = 2000 + 200 + 100

$= 2300$ bits

$$U = \frac{L/R}{\frac{L}{R} + T_{total}}$$

$$0.05 = \frac{2300/10 \cdot 2^{20}}{\frac{2300}{10 \cdot 2^{20}} + T_{total}}$$

$$T_{total} = \frac{\frac{2300}{10 \cdot 2^{20}}(1 - 0.05)}{0.05}$$

$$= 0.00416 \text{ sec}$$

$$= \boxed{4.16 \text{ ms}}$$

Q3%

- 4MB file
- 10000 Bit Frame
- 208 Bit overhead
- 112 Bit Ack
- $t_{prop} = 1\ \mu s$
- $t_{proc} = 64\ \mu s$

a) error free:

$4MB = 4 \times 2^{20}$ Bytes

$= 32 \times 2^{20}$ Bits

$=$ 32 MBit

(32 MBit / 10000 Bits)

3355.4432 (ceiling)

3356 frames

3356 (10000 + 208 + 112)

10320 (3356) = 34633920 Bits

$$\frac{34633920}{2 \cdot 2^{20}} = 16.5147 \text{ secs} \ *$$

b) $P[\text{no error}] = (0.9999)^{N_f} =$ 0.368

36.8 % of frames succeed

$$\frac{36.8\%}{100\%} = \frac{3536}{x}$$

$$x = 9123.0099 \approx \boxed{9123}$$

$$10320(9123) = 94149360 \text{ bits}$$

$$\frac{94149360}{2^{21}} = \boxed{44.894 \text{ sec}} \ast$$

Q4:

a) $P[\text{frame error} \geq 2 \text{ bits}] = 1 - P[1 \text{ bit or None}]$

$$P[\text{None}] = (1-p)^N$$

$$P[1 \text{ bit}] = \binom{N}{1}(p)(1-p)^{(N-1)}$$

$$\boxed{P[\text{retransmit}] = 1 - \left(Np(1-p)^{(N-1)} + (1-p)^N\right)}$$

b) $p = 0.0001 \qquad N = 10000$

correction:

$$P[\text{retransmit}] = 1 - \left[(10000)(0.0001)(0.9999)^{9999} + 0.9999^{10000} \right]$$

$$= 1 - \left[(0.9999)^{9999} + 0.9999^{10000} \right]$$

$$= 1 - [0.3679 + 0.3679]$$

$$= 1 - [0.7357]$$

$$= 0.264 = \boxed{26.4\%}$$

No correction:

$$P[\text{retransmit}] = 1 - [0.9999^{10000}]$$

$$= 0.632 \approx \boxed{63.2\%}$$

C) Assuming a file size and header + overhead info as given in Q3:

Frames → 336

→ 9123

frames → [illegible]

No correction → $\boxed{9123}$

correction → $(0.7357)^{-1}(3356)$

$= 4561.6$

$\approx \boxed{4562}$

d)

$\frac{4562}{9123} = 0.50 \rightarrow$ 50% of retransmissions

It improves the efficiency of transmission by 50% (100% better)

Q5)

error free:

$P = 0.001 \rightarrow (0.999)^N = P_{ef}$

$P_{ef} = 0.75 \rightarrow (0.999)^N = 0.75$

$N \log(0.999) = \log(0.75)$

$N = \frac{\log(0.75)}{\log(0.999)} = \underline{287.538}$

floor

$N = 287$ ← frame length of 287 bits