Assignment 1 – SENG3500

1. a. No. of packets = Amount of data generated / packet size / seconds per minute
   = $10*10^6$ / (2000-20)*8 / 60
   = 10.522…
   = 10

   b. L_{delay} = (x / L_{link}) + (P_{bits} / L_{trans})
   0.004 = (x / $20*10^6$) + (2000*8/($10*10^6$ /60))
   0.004 = (x / $20*10^6$) + 0.096

   c. 10*(20*8) = **1600 bps**

2. a. R_A = Total bits + packets
   R_A = (200000*8) + ((200000/1560) * 40 * 8)
   = **1.641 Mbps**
   R_B = (145000*8) + ((145000/1560) * 40 * 8)
   = **1.19 Mbps**

   b. P_{router} = ((1.6 + 1.16 * 1000000)) / (3960 * 8)
   = 88.41…
   = **88 packets**

   c. T_{link3} = 88 * (4000 * 8)
   = **2.816 Mbps**

3. a. N_{circ} = R_{link} / R_{user}
   = 4 Mbps / 0.2Mbps
   = **20 users max.**

   b. P_{prob} (x=4) = prob. of 4 current users, n_{pop} = total pop., k_{curr} = current pop., p_{prob} = trans. prob.

   Add the probabilities that there are 1, 2, 3 and 4 users active.

   P_{prob} = $\binom{20}{4} * 0.15^4 * (1-0.15)^{20-4}$ +
   $\binom{20}{3} * 0.15^3 * (1-0.15)^{20-3}$ +
   $\binom{20}{2} * 0.15^2 * (1-0.15)^{20-2}$ +
   $\binom{20}{1} * 0.15^1 * (1-0.15)^{20-1}$

   = (4845 * 0.00051 * 0.07425) +
   (1140 * 0.00338 * 0.06311) +
   (190 * 0.0225 * 0.05365) +
   (20 * 0.15 * 0.04560)

   = 0.18347 + 0.24317 + 0.22935 + 0.1368
   = 0.79279
   = **79.28%**

4. a. $R_{bits/sec} = 2048*8/0.04 * 2$
   $= 819200$
   $=$ **0.8192 Mbps**

   b.

   c. $D_{trans} = 2000\ B / 0.8192\ Mbps$
   $= 19.531\ ms$
   $D_{prop} = 50\ km / 3*10^8\ m/s$
   $= 0.167\ ms$
   $D_{total} = D_{trans} + D_{prop}$
   $=$ **19.698 ms**

5. a. $A_{bits/sample} = 16$, $S_{samples/sec} = 44000$
   $T_{bit\ rate} = 16 * 44000 * 2$
   $=$ **1408 kbps**

   b.

   c. $T_{data\ size}$ = data transmitted in 500 ms in bytes
   $T_{data\ size} = ((1408 / 8) * 1000) / 2$
   $= 88000$ bytes
   $T_{packets} = 88000 / (800 - 8 - 20 - 18)$
   $= 116.711…$
   $=$ **117 packets**

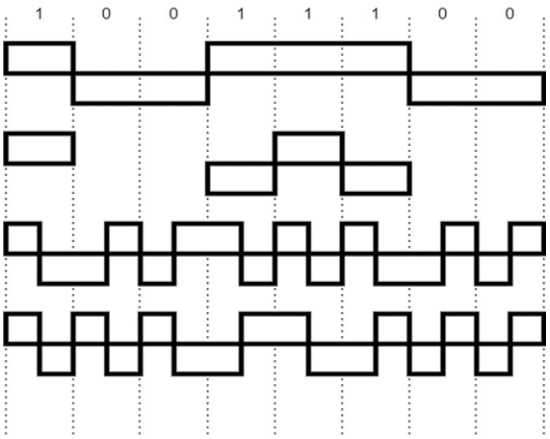
   d. $T_{trans} = (T_{data\ size} * 8) / T_{bit\ rate} * 1000)$
   $T_{trans} = 88000*8 / (1408*1000)$
   $= 0.5$
   $T_{prop} = D_{distance} = S_{speed}$
   $T_{prop} = 100*1000 / 3*10^8$
   $= 0.00033…$
   $T_{delay} = 0.5 + 0.00033$
   $=$ **0.50033 ms**

6. a. Polar NRZ

   b. Bipolar

   c. Manchester

   d. Differential Manchester



7. a. $N_{home} = 200$, $t_{int} = 200$, length = 2500
   $\lambda_{sec} = 1 / (200*10^{-6}) = 5000$
   $\lambda_{hour} = 5000 * 3600 =$ **$18*10^6$**

   b. $\lambda_{bits/sec} = 5000 * (2500*8) = 10*10^7 =$ **0.1 Gb/s**

c. $p = \lambda / \mu$ $\lambda = 5000$ packets/sec

$\mu = R_{Link}/L_{packet\ bits}$

$\mu = 2*10^9 / 2500 * 8$

$p = 5000 / 100000$ $= 100000$ packets/sec

$= \mathbf{0.05}$

d. $D = [p / (1- p)] (1 / \mu) + (1 / \mu)$

$= [0.05 / 0.95] 1/100000 + 1/100000$

$= 0.05263 / 100000 + 1*10^5$

$= 1.053*10^{-5} + 1*10^{-5}$

$= 2.053*10^{-5}$

$= \mathbf{20.53\ \mu s}$