CLOVER

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2031 1314

ELEC 1010 HW5

1\. a) ~~Error~~ Errors = 011011101 original sequence: 011011101

$\quad\quad$ 011111101

P(error on 4th ~~4th~~ bit) $= (0.95)^8 (0.05) = 0.0332$

b) Errors = 011011101

$\quad\quad$ 111011100

P(error on 1st and last bit) $= (0.95)^7 (0.05)^2 = 0.0017$

c) P(1 bit error) $= \binom{9}{1} (0.05)(0.95)^8 = 0.2985$

d) P(2 bit error) $= \binom{9}{2} (0.95)^7 (0.05)^2 = 0.0629$

e) P(3 bit error) $= \binom{9}{3} (0.95)^6 (0.05)^3 = 0.0077$

2\. a) $C = 1 + \varepsilon \log_2 \varepsilon + (1-\varepsilon)\log_2(1-\varepsilon)$

$= 1 + (0.05)\log_2(0.05) + (0.95)\log_2(0.95) = 0.7136$

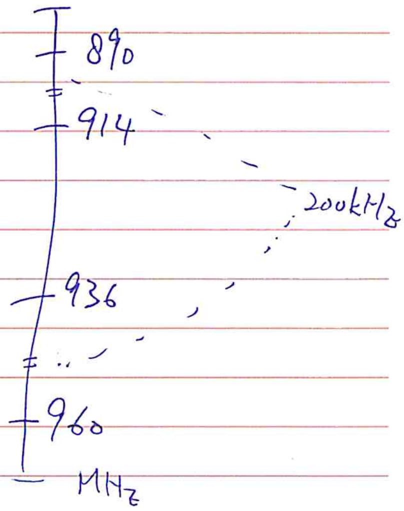
b) To achieve an error-free communication, coding rate should be less than C (channel capacity).

As $0.8 > 0.7136$, it is not possible to achieve.

3\. a) $914 - 890 = 24\text{MHz}$

$\frac{24 \times 10^6}{200 \times 10^3} = 120$ frequency channels

$\frac{120}{3} = 40$ frequency channels per service provider



b) $40 / 4 = 10$ channels

c) $10 \times 7 \times 700 = 49000$ subscribers

4\. a) $PN_A \cdot PN_B =$

$$\begin{array}{r} 1111 \\ 1010 \\ \hline +1-1+1-1 = 0 \end{array}$$

$\therefore$ They are orthogonal to each other.

4. b) Encoded message A

$$\begin{array}{cccc} 1111 & 1111 & 1111 & 0000 \\ \cdot\ 1111 & 1111 & 1111 & 1111 \\ \hline +1+1+1+1 & +1+1+1+1 & +1+1+1+1 & -1-1-1-1 \end{array}$$

Encoded message B

$$\begin{array}{cccc} 1111 & 0000 & 0000 & 1111 \\ 1010 & 1010 & 1010 & 1010 \\ \hline +1-1+1-1 & -1+1-1+1 & -1+1-1+1 & +1-1+1-1 \end{array}$$

c) Encoded msg A · PNA

$$\begin{array}{cccc} +1+1+1+1 & +1+1+1+1 & +1+1+1+1 & -1-1-1-1 \\ \underbrace{+1+1+1+1}_{+4} & \underbrace{+1+1+1+1}_{+4} & \underbrace{+1+1+1+1}_{+4} & \underbrace{+1+1+1+1}_{-4} \end{array}$$

decoded as 1 1 1 0

d) ~~Endeoc~~ Encoded msg A · PNB

$$\begin{array}{cccc} +1+1+1+1 & +1+1+1+1 & +1+1+1+1 & -1-1-1-1 \\ +1-1+1-1 & +1-1+1-1 & +1-1+1-1 & +1-1+1-1 \\ \hline \underbrace{+1-1+1-1}_{0} & \underbrace{+1-1+1-1}_{0} & \underbrace{+1-1+1-1}_{0} & \underbrace{-1+1-1+1}_{0} \end{array}$$

decoded as 0000 (No output), signal is cancelled

Difference
= 56-24
= 32ms

e) encoded msg A + encoded msg B = +2 0 +2 0 . 0 +2 0 +2   0 +2 0 +2   0 -2 0 -2

f) Output =

$$\begin{array}{cccc} +2\ 0\ +2\ 0 & 0\ +2\ 0\ +2 & 0\ +2\ 0\ +2 & 0\ -2\ 0\ -2 \\ +1-1+1-1 & +1-1+1-1 & +1-1+1-1 & +1-1+1 \\ \hline \underbrace{\quad}_{+4} & \underbrace{\quad}_{-4} & \underbrace{\quad}_{-4} & \underbrace{\quad}_{+4} \end{array}$$

= 1 0 0 1

5. Delay of P1 from A to S $= \frac{10\,KB}{10\,Mbps} = \frac{10\cdot(8)(10)^3}{10\ (10)^6} = 0.008s = 8ms$

Delay of P1 (S to B) $= \frac{10KB}{5Mbps} = \frac{10(8)(10)^3}{5(10)^6} = 16ms$

Arrival times of p1 = 8 + 16 = 24ms

Delay of p2 (A to S) $= \frac{20\,KB}{10\,Mbps} = 16ms$

Delay of p2 (S to B) $= \frac{20\,KB}{5\,Mbps} = 32ms$

Arrival time of p2 = 8ms + 16ms + 32ms