Task Two Extra Credit

McKenzie Eshleman

2)

a) amplitude and phase variation

b) parity

c) Guided

d) impulse noise

e) intermodulation

f) analog

g) A periodic signal

h) Redundancy

i) half-duplex

j) wireless

3) $F = 20\ \text{KHz}$

$T = \frac{1}{20\text{KHz}} = 50\mu s$

$\lambda = \frac{c}{f} = \frac{3\times10^8}{20\text{KHz}} = 15\times10^3$

4) $B_n = \frac{2}{T}\int x(t)\sin(2\pi f_o n t)\,dt$ $\qquad x(t) = \begin{cases} -1 & 0 \le t \le 1 \\ 3 & 1 \le t \le 2 \end{cases}$

$T = 2\text{ms} \Rightarrow f_o = \frac{1}{T} = 500\ \text{Hz}$

$$B_n = \frac{2}{T}\left[\int_0^{t/2}(-1)\sin(2\pi f_o n t)\,dt + \int_{T/2}^{T}(3)\sin(2\pi f_o n t)\,dt\right]$$

$$= \frac{2}{T}\left[(-1)\left(\frac{-1}{2\pi f_o n}\right)\cos 2\pi f_o n t\Big|_0^{T/2} + 3\left(\frac{-1}{2\pi n f_o}\right)\cos(2\pi f_o n t)\Big|_{T/2}^{T}\right]$$

$$= \cancel{\frac{2}{T}}\left(\frac{1}{\cancel{2}\pi \cancel{f_o} n}\right)\left\{\left[\cos 2\pi f_o n \cancel{T/2} - \cos \cancel{2}\pi f_o n(0)\right]\right]$$

$$= -3\left[\cos \cancel{2\pi} \cancel{f_o} n \cancel{T} - \cos \cancel{2}\pi \cancel{f_o} n \cancel{T/2}\right]$$

$$= \frac{1}{\pi n}\left[4\cos \pi n - 4\right]$$

$$B_n = \frac{1}{\pi n}\left[-1^n - 1\right]$$

5) $f_c = 6\times10^4\ \text{Hz}$ $\quad Bw = 40\ \text{mHz}$ $\quad C = 320\times10^6\ \text{bps}$

$G_r = 3\text{dB}$ $\quad P_T = 3\text{w}$ $\quad G_T = 2\text{dB}$ $\quad T = 295\text{K}$

$C = B\log_2(1 + SNR)$ $\qquad SNR = \frac{P_r}{K + B}$

$2^{C/B} - 1\ kT B = P_r$

$$\left[2^{\frac{320\times10^6 \div 9}{40\times10^6}} - 1\right](1.38\times10^{-23})(295)(40\times10^6) = P_r$$

$$P_r = 7.7\times10^{-11}\ \text{W}$$

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6)

$$2^{\frac{C}{2B}} = SL$$

$$2^{\frac{320\times10^6}{2\cdot 40\times10^6}} = SL \quad = 16\ SL = 4\text{ bits}$$

8) Based on the graphs above I would reccomend 8-QPSK, because it allows for the data rate to be doubled.

10) $C = 200\times10^6$ $\quad f = 3\times10^9$ $\quad G_T = 30dB$ $\quad Ae = 0.6A$ $\quad A = 1.8\times1$ $\quad Bw = 50\times10^6$ $\quad T = 300K$

$$Gr = \frac{4\pi Ae}{\lambda^2} = \frac{4\pi(0.6)(1.8)}{\lambda^2} \qquad \lambda = \frac{3\times10^8}{3\times10^9} = 0.1$$

$$Gr = 1.35\times10^3 \qquad GrdB = 10\log_{10}(1.35\times10^3) = 31.326\,dB$$

11) Path loss = ? $\quad d = 1\times10^3 m$

$$\frac{(4\pi d)^2}{\lambda^2} = L$$

$$LdB = -20\log(f) + 20\log(d) - 10\log(A_T A_R) + 169.54$$

$$= -20\log(3\times10^9) + 20\log(1\times10^3) - 10\log\left[10^{\frac{31.32}{10}} \times 1.8^{30/10}\right) + 169.54$$

$$LdB = -21.32876\,dB$$

12) $Pn = ? = KTB$

$$C = B\log_2(1+SNR) \qquad SNR = \frac{Pr}{Pn} \to KTB$$

$$Pn = \underset{K}{(1.38\times10^{-23})}\,\underset{T}{(300)}\,\underset{B}{(50\times10^6)}$$

$$Pn = 207\times10^{-15}W$$

13) 2/3 Shannons $\quad SNR = ?$

$$C = B\log_2(1+SNR)$$

$$\left(2^{\frac{200\times10^6\,(2/3)}{50\times10^6}} - 1\right) = SNR = 63$$

$$SNRdB = 10\log_{10}(63) = 17.993dB$$

14) $Pr = ?$

$$SNR = \frac{PR}{PN}$$

$$SNR \times PN = PR$$

$$(63)(207\times10^{-15}W) = PR$$

$$PR = 1.304\times10^{-11}W$$

Task Two: Extra Credit

18) Based on question 17, there is an error because the results of the checksum is FFFE, where E should be an F

19)

a) NRZI

10111010

b) Bipolar AMI

01110010

c) Differential Manchester

01001001

20) Symbol is the state of the carrier