CS 438 PS2

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1.

10 (a)

P1 = 0.6W Pn = 2uW

10log10(P2/P1) = -30dB

so we can get P2 = 0.0006W = 600uW

N = 10log(P2/Pn) = 10log10(300) = 24.77 dB

(b)

According to Shannon' Law:

C = B log2(1 + S/N)

= (4500 – 500) log2(1 + P2/Pn)

= 4000 * log2(300)

= 32934 bps

(c)

10log10(Pmin/P1) = 10log10(0.003/0.6) = -23 dB

max length = 23/2 = 11.5 km

2.

(a)

10 Since 64 = 2^6, each symbol could carry 6 bits

data rate = 6 * 2000 = 12000 bps

(b)

According to Shannon' Law:

C = B log2(1 + S/N)

=> 2 * 10^9 = 400 * 10^6 * log2(1 + S/N)

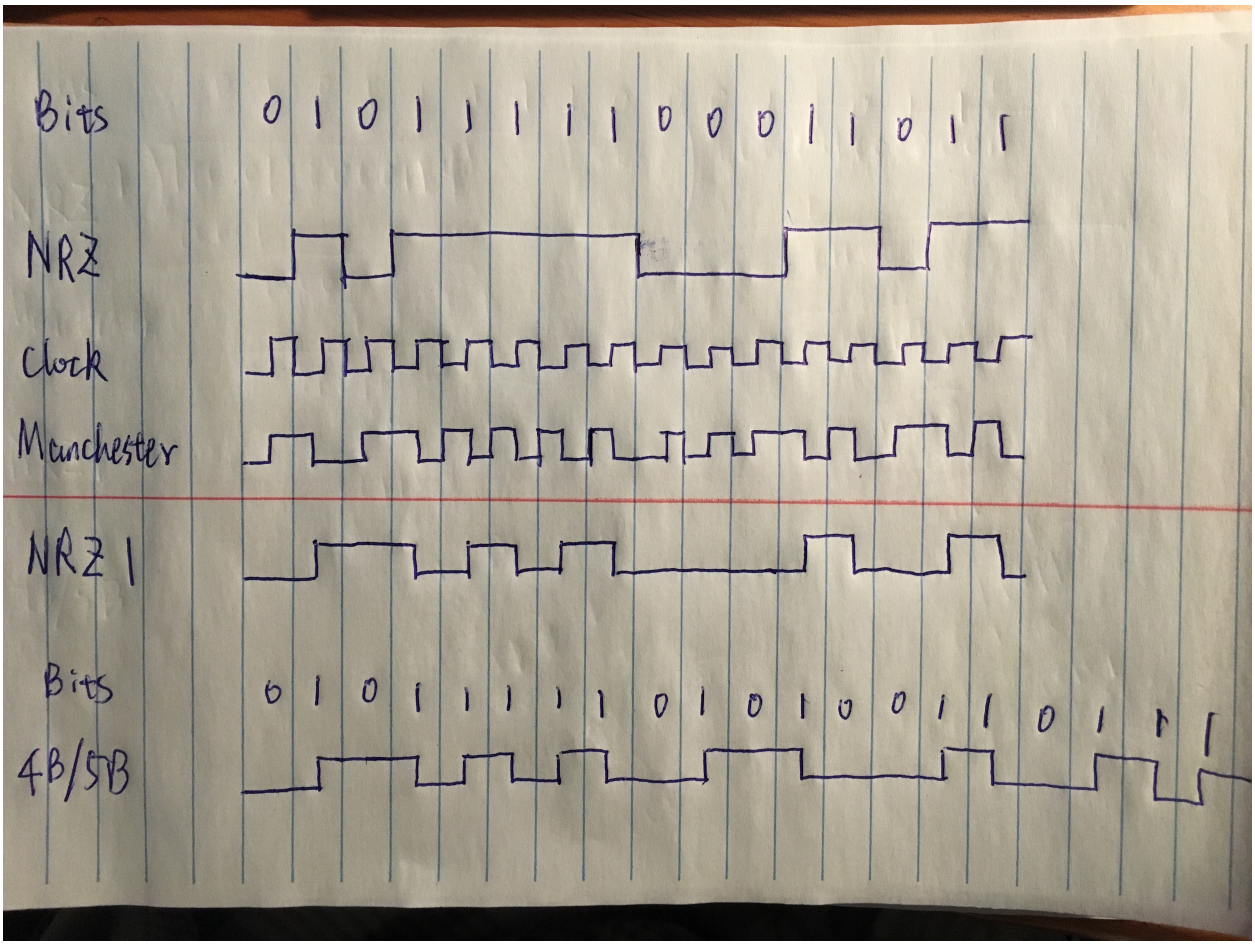
then we can get:

S/N = 31

SNR = 10log10(S/N) = 14.91 dB

3.

10 (a)



(b)
T3 carrier's data rate is 44.736Mbps, according to Shannon's Law:
C = B log2(1 + S/N)
=> 44.736 * 10^6 = 25 * 10^6 * log2(1 + S/N)
so we can get S/N = 2.457
SNR = 10log10(S/N) = 3.90 dB

4.
(a)
10
Since there are 4 data points which means there are 4 symbols, it can carry 2 bits.
data rate = 2 * 2000 = 4000 bps

(b)
Since there no change on phase, and the only change is on amplitude, the modem only need to use amplitude modulation.

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5.

(a)

DLE = 0000 1010 STX = 0000 0010 ETX = 0000 0011

So the sent frame is:

0000 0010 0000 1010 0000 1010 1111 1111 0101 0000 0110 0000

1111 1111 0000 1110 0000 0011

(b)

The frame is:

0111 1110 0000 1010 1111 10111 0101 0000 0110 0000

1111 10111 0000 1110 0111 1110

(c)

10000 10100 11111 11110 10101 00000 10110 00000

11111 11110 10000 11100

(d)

efficiency of (a) = 48 / 72 = 66.7%

efficiency of (b) = 48 / 66 = 72.7%

efficiency of (c) = 48 / 60 = 80%

10

6.

(a)

Since the remainder of M(x)/C(x) is 11, we need to append (0011) to the original message, the sent message will be 100001101000011

The error message is 100001100000011, then

The remainder of 1000011000011/C(x) is 100, which is not 0, CRC test failed, and there is error.

(b)

The remainder of M(x)/C(x) is 101, so the bit sequence is not correctly encoded.

(c)

If the errors are not detected, then the error will happen in two rows and two columns, each error row has two error bits, and each error column also has two error bits. So the probability that the error will not be detected is:

$$\frac{\binom{n}{2} * \binom{k}{2}}{\binom{nk}{4}}$$

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7.

(a)

average RTT:

cs.illinois.edu: 4.328ms

Illinois.edu: 3.134ms

Stanford.edu: 74.842ms

Sydney.edu.au: 293.281ms

(b)

hops:

cs.illinois.edu: 9

Illinois.edu: 9

Stanford.edu: 19

Sydney.edu.au: 21

According to the above result, the more hops it takes, the higher RTT it will have. However, the relationship between the hops and the RTT is not linear, I think the RTT might also depend on the physical distance between two peers.