CpE 319 Assignment 4

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1 Problem 2.36

An OC-12c has 12 times the bandwidth of an OC-1 all dedicated to one user, giving an available bandwidth of $49.536 * 12 = 594.432$.

2 Problem 2.37

	best	average	worst
Star	2	2	2
Ring	1	$n/2$	$n-1$
Fully Interconnected	1	1	1

3 Problem 2.39

The transmission time for this data is:

$$T = \text{Time to transmit data} + \text{Store-and-forward} \tag{1}$$

$$T = \lceil \frac{x}{p} \rceil (h+p)b + (h+p)bk \tag{2}$$

To find the optimal value of p, we take the partial derivative with respect to p:

$$\frac{\partial}{\partial p} T = \frac{-xhb}{2p^2} + bk \tag{3}$$

Setting this equal to zero and solving for p gives the optimal value of p:

$$p = \sqrt{\frac{xh}{2k}} \tag{4}$$

4 Problem 2.46

$S = [-1 + 1 - 3 + 1 - 1 - 3 + 1 + 1]$

$$S \cdot A = [+1 - 1 + 3 + 1 - 1 + 3 + 1 + 1]/8 = +1 \tag{5}$$

$$S \cdot B = [+1 - 1 - 3 - 1 - 1 - 3 + 1 - 1]/8 = -1 \tag{6}$$

$$S \cdot C = [+1 + 1 + 3 + 1 - 1 + 3 - 1 - 1]/8 = +1 \tag{7}$$

$$S \cdot D = [+1 + 1 + 3 - 1 + 1 + 3 + 1 - 1]/8 = +1 \tag{8}$$

A sent 1, B sent 0, C sent 1, D sent 1.

5 Problem 3.1

If each packet has an 80% chance of success, the entire message has a $0.8^{10} = 0.107$ probability of success. Thus, the message will need to be sent approximately 10 times on average to be successfully transmitted.

6 Problem 3.4

In a worst-case scenario, every byte of data would be a flag or escape sequence, causing the algorithm to send twice as many bytes (half of which are escapes for the data bytes).

7 Problem 3.7

Open-loop protocols don't require retransmission of data, so for networks with low data rates, they are desirable.

8 Problem 3.8

This still has a Hamming Distance of 2, since only two bit changes (one data and one parity) are needed to convert one codeword to another.

9 Problem 3.9

Five check bits are needed.

1	**2**	3	**4**	5	6	7	**8**	9	10	11	12	13	14	15	**16**	17	18	19	20	21
0	1	1	0	1	0	1	1	0	0	1	1	0	0	1	1	1	0	1	0	1

10 Problem 3.10

The recieved value can be written as:

1	**2**	3	**4**	5	6	7	**8**	9	10	11	12
1	1	1	0	0	1	0	0	1	1	1	1

Check bits with mismatched parity: 2
Error Syndrome: 2

Corrected value:

1	**2**	3	**4**	5	6	7	**8**	9	10	11	12
1	0	1	0	0	1	0	0	1	1	1	1

Or, in hexadecimal, 0xC4F

The decoded data is:

1	2	3	4	5	6	7	8
1	0	1	0	1	1	1	1

Or, in hexadecimal, 0xCF.

11 Problem 3.17

$x^r M(x) =$ 1 0 0 1 1 1 0 1 0 0 0 0

Remainder of $\frac{x^r M(x)}{x^3+1} =$ 0 0 0 1

Transmitted bit string: 1 0 0 1 1 1 0 1 0 0 0 1

Error bit string: 1 0 0 1 1 1 0 1 0 1 0 1

Remainder of $\frac{T(x)+E(x)}{G(x)} =$ 0 1 0 0

Since the remainder is nonzero, we have indeed detected the transmission error.

This generator polynomial will not detect some errors, such as two-bit errors where the flipped bits are four apart, e.g. $E(x) = x^i(x^3 + 1)$.