Serial # 0

- 1 points for not writing your serial number

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE418: Satellite Communications (101)
Quiz 5: Error Control Coding in Satellite Systems
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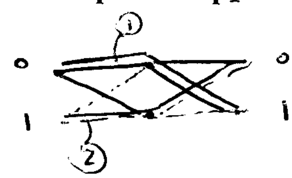
Name: KEY

a. The uplink and the downlink of a satellite link can be represented as binary symmetric channels. If the crossover (error) probability for the uplink is $p_1=10^{-3}$ and the crossover probability for the down link is $p_1=10^{-2}$,

What is the overall crossover probability?



(2)

$$= p_1(1-p_2) + p_2(1-p_1)$$
$$= 10^{-3}(1-10^{-2}) + 10^{-2}(1-10^{-3}) = 0.011$$

notice overall is worse than one link ✓

If the earth station is transmitting a block of bits 11011 what is the probability of receiving 11010 by the satellite? uplink. earth → sat. $p_1 = 10^{-3}$

(2)

$$P(11010 / \text{given } 11011 \text{ transmitted}) = \underbrace{(1-10^{-3})^4}_{\text{Correct}} \underbrace{(10^{-3})}_{1 \cdot \text{error}} = 9.96 * 10^{-4}$$

b. In a satellite link with transmission rate 10 kbit/sec, a block code is used with $d_{min}=4$.
How many errors can this code detect?

3 $\quad d_{min} - 1$ (1)

How many errors can this code correct?

$$\left\lfloor \frac{d_{min}-1}{2} \right\rfloor = \left\lfloor \frac{3}{2} \right\rfloor = 1$$ (1)

If a block size of 10 is used and probability of bit error (crossover) is $p=10^{-2}$, with the above code for error detection.

Find the frequency of retransmission. $P_{det.} = \binom{10}{1}(1-p)^9 p + \binom{10}{2}(1-p)^8 p^2 + \binom{10}{3}(1-p)^7 p^3 = 0.0956$

(2)

$$\text{freq of retransmission} = \frac{1}{0.0956} = 10.4585 \text{ block} \simeq 104.585 \text{ bits.}$$

If stop-and-wait ARQ system is used what is the throughput (assume round trip delay of 0.48 seconds). Comment on the efficiency of stop and wait system in satellite applications.

(2)

$$\frac{10 \text{ bits}}{\frac{10 \text{ bit}}{10\text{K bits/sec}} + 0.48 \text{ sec}} = \frac{10}{0.481} = 20.79 \frac{\text{bits}}{\text{sec}}$$

very low (propagation delay dominate)

Good Luck, Dr. Ali Muqaibel