Exercises

P1

Suppose the information content of a packet is the bit pattern 1110 0110 1001 1101 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? Your answer should be such that a minimum-length checksum field is used.

Answer

1 1 1 0 1

0 1 1 0 0

1 0 0 1 0

1 1 0 1 1

1 1 0 0 0

P5

Consider the generator, G=10011, and suppose that D has the value 1010101010. What is the value of R?

Answer

The length of G is r = 5, so the length of R = r - 1 = 4.

Then divide G = 10011 into 1010101010 0000, we get the result 1011011100 with the remainder 0100.

So R = 0100.

P10

Consider two nodes, A and B, that use the slotted ALOHA protocol to con- tend for a channel. Suppose node A has more data to transmit than node B, and node A's retransmission probability p_A is greater than node B's retrans- mission probability, p_B.

a. Provide a formula for node A's average throughput. What is the total efficiency of the protocol with these two nodes?

b. If $p\boldsymbol{A} = 2p\boldsymbol{B}$, is node A's average throughput twice as large as that of node B? Why or why not? If not, how can you choose $p\boldsymbol{A}$ and $p\boldsymbol{B}$ to make that happen?

c. In general, suppose there are N nodes, among which node A has retrans-mission probability $2p$ and all other nodes have retransmission probability p. Provide expressions to compute the average throughputs of node A and of any other node.

Answer

a. A's average throughput is $p\boldsymbol{A}(1-p\boldsymbol{B})$.

The total efficiency is $p\boldsymbol{A}(1-p\boldsymbol{B})+p\boldsymbol{B}(1-p\boldsymbol{A})$.

b. A's average throughput is $p\boldsymbol{A}(1-p\boldsymbol{B})=2p\boldsymbol{B}(1-p\boldsymbol{B})=2p\boldsymbol{B}-2p\boldsymbol{B}^2$.

B's average throughput is $p\boldsymbol{B}(1-p\boldsymbol{A})=p\boldsymbol{B}(1-2p\boldsymbol{B})=p\boldsymbol{B}-2p\boldsymbol{B}^2$.

So A's average throughput is not twice as large as that of node B.

$p\boldsymbol{A}$ should equal $2p\boldsymbol{B}/(1+p\boldsymbol{B})$.

c. A's average throughput is 2p(1-p)^(N-1).

Others' average throughput is p(1-2p)(1-p)^(N-2).

P11

Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probabil- ity p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

a. What is the probability that node A succeeds for the first time in slot 5?

b. What is the probability that some node (either A, B, C or D) succeeds in slot 4?

c. What is the probability that the first success occurs in slot 3?

d. What is the efficiency of this four-node system?

Answer

a. $P(A)=p(1-p)^3$

$P=P(A)(1-P(A))^4=p(1-p)^3(1-p(1-p)^3)$^4

b. $P=4p(1-p)^3$

c. $P=4p(1-p)^3(1-4p(1-p)^3)^2$

d. efficiency$=4p(1-p)^3$

P17

Recall that with the CSMA/CD protocol, the adapter waits 512K bit times after a collision, where K is drawn randomly. For K=100, how long does the adapter wait until returning to Step 2 for a 10 Mbps broadcast channel? For a 100 Mbps broadcast channel?

Answer

For a 10Mbps broadcast channel, 512*100/(10*10^6)=5.12*10^-3s=5.12ms.

For a 100Mbps broadcast channel, 512*100/(100*10^6)=5.12*10^-4=512μs.