Network Homework 4

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2. Suppose the information portion of a packet (D in Fagure 5.4) contains 10 bytes consisting of the 80bit unsigned binary representation of the integers 0 through 9. Compute the Internet checksum for this data.

Solution:

Suppose there are 16 data bits. Add them together,

0000000000000001
0000001000000011
0000010000000101
0000011000000111
0000100000001001

We have,

0001010000011001

The one's complement of the sum is 11101011 11100110.

7. In Section 5.3, we provided an outline of the derivation of the efficiency of slotted ALOHA. In this problem we'll complete the derivation.

a. Recall that when there are N active nodes, the efficiency of slotted ALOHA is $\mathrm{Np}(1-\mathrm{p})^{\mathrm{N}-1}$. Find the value of p that maximizes this expression.

b. Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N approach infinity. Hint: (1-1/N)^N approaches 1/e as N approaches infinity.

Solution:

a. The efficiency of slotted ALOHA is

$$\mathrm{E(p)} = Np(1-p)^{N-1}$$

By derivation, we have

$$\mathrm{E'(p)} = \mathrm{N}(1-\mathrm{p})^{\mathrm{N}-1} - Np(N-1)(1-p)^{N-2} = N(1-p)^{N-2}((1-p)-p(N-1))$$

Let

$$\mathrm{E'(p)} = 0$$

Thus, when

$$\mathrm{p}^* = \frac{1}{N}$$

We have the maximum efficiency.

b. When p equals to $\frac{1}{\mathrm{N}}$, the efficiency of slotted ALOHA is

$$\mathrm{E(p^*)} = N \cdot \frac{1}{N}\left(1-\frac{1}{N}\right)^{N-1} = \left(1-\frac{1}{N}\right)^{N-1} = \frac{\left(1-\frac{1}{N}\right)^{N}}{1-\frac{1}{N}}$$

Since

$$\lim_{N\to\infty}\left(1-\frac{1}{N}\right)=1$$

, then

$$\lim_{N\to\infty}\left(1-\frac{1}{N}\right)^{N}=\frac{1}{e}$$

. Thus when n approaching infinity, the efficiency is

$$\lim_{N\to\infty}E(p^{*})=\frac{1}{e}$$

8. Show that the maximum efficiency of pure ALOHA is 1/(2e) Note: This problem is easy if you have completed the problem above!

Solution:

The efficiency of slotted ALOHA is

$$E(p)=Np(1-p)^{2(N-1)}$$

By derivation, we have

$$\begin{aligned}E'(p)&=N(1-p)^{2(N-1)}-Np2(N-1)(1-p)^{2(N-3)}\\&=N(1-p)^{2(N-3)}((1-p)-p2(N-1))\end{aligned}$$

Let $E'(p)=0$, we have $p^{*}=\frac{1}{2N-1}$, the corresponding efficiency is

$$E(p^{*})=\frac{N}{2N-1}\left(1-\frac{1}{2N-1}\right)^{2(N-1)}$$

Let n approach infinity,

$$\lim_{N\to\infty}E(p^{*})=\frac{1}{2}\cdot\frac{1}{e}=\frac{1}{2e}$$

14 Recall that with the CSMA/CD protocol, the adapter waits K・512 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 1Mbps Ethernet? For a 10 Mbps Ethernet?

Solution:

For k = 100, the adapter waits for 51200 bit times.

For 1 Mbps, this wait is

$$\frac{51200\ bits}{1\times 10^{6}bps}=51.2msec$$

For 10 Mbps, the adapter waits for 5.12m sec

15 Suppose nodes A and B are on the same 10 Mbps Ethernet bus, and the propagation delay between the two nodes is 225 bit times. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was success fully transmitted without a collision.

Hint: Suppose at time t = 0 bit times, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of 512 + 64 bit times. So A would finish transmitting the frame at t = 512+ 64 bit times. Thus, the answer is no, if B's signal reaches A before bit time 1=512+64 bits. In the worst

case, when does B's signal reach A?

Solution:

Time	Event
0	A transmits
224	B begins responding
224+225	B’s first responding bit arrives at A
512+64	A finishes transmitting
224+225 < 512+64	A aborts before completing the transmission of the packet, as it is supposed to do.

1) No, A cannot finish transmitting before it detects that B has transmitted.
2) The reasons are listed above.
3) That is to say, if A does not detect the presence of a host, then no other host begins transmitting while A is transmitting.
4) In the worst case, B’s signal reaches A at the time of 449.