CSC358H5: Principles of Computer Networking — Winter 2025

Worksheet 4: Error Detection and Correction, MAC Approaches, Ethernet Collision Recovery, Ethernet Protocols Feild

Q0 Knowledge Check (from Week 04 Lecture)

0.a (Hamming Distance Between Two Binary Strings) Find the Hamming distance between the two codewords 00001010 and 01000110.

0.b (Hamming Distance of A Coding Scheme) Consider the $(8, 7)$ coding which appends a parity bit to each 7-bits, *i.e.*, if $(d_1, D_2, d_3, d_4, d_5, d_6, d_7)$ is the message, then it calculates the parity bit as $p_1 = d_1 \oplus d_1 \oplus d_3 \oplus d_4 \oplus d_5 \oplus d_6 \oplus d_7$ and the final 8 7-bit codeword is $(d_1, D_2, d_3, d_4, d_5, d_6, d_7, p_1)$. Find the Hamming distance of this coding scheme.

0.c (Hamming Theorem) Fill in the blanks:

> **Hamming Theorem:** Let d be the Hamming distance of a coding scheme. The coding scheme can detect up to any _____ bits of error and correct up to any _____ bits of error.

0.d (True/False) It is more difficult to detect collision in shared wired LANs compared to shared wireless LANs. ☐ True ☐ False

0.e (Medium Access Control) In lecture, we studied three Medium Access Control (MAC) approaches to share a broadcast medium. Explain these three approaches and name some examples for each of these approaches.

Q1

Consider the Ethernet frame fields. For each field, name the task that it is needed for. Choose from the following list of tasks:

(i) Get the frame to the destination and get responses back to source
(ii) Tell host what to do with the frame once arrived
(iii) Indicates the length of the data field
(iv) Carries the actual data being transmitted
(v) Synchronization
(vi) Ensures a minimum frame size of 64 bytes
(vii) Signals the start of the actual frame

Field	Task
Preamble	
Start Frame Delimiter (SFD)	
MAC addresses	
Length / Type	
Data	
Padding	
Frame Check Sequence (FCS)	

Q2 (Internet Checksum as (N, K) Block Coding)

In this problem, we define a (N, K) coding scheme, named *CSC358 block coding*, which relies on the Internet Checksum. *CSC358 block coding* transforms any 10-byte message into a codeword by appending its Internet Checksum to the end of the original message.

2.a Specify the value of N and K for this (N, K) coding scheme, *i.e.*, CSC358 block coding.

$N =$ $K =$

2.b What is the Hamming distance of this coding scheme? Justify your answer.

Q3 **(Ethernet Collision and Backoff)** Suppose Hosts A and B share the same Ethernet link to send their frames. Assume that they have unlimited number of frames to send. Suppose that A and B attempt to send their frames at the same time and as a result, there will be a collision detected by both. Assume that this is the first detected collision for their frames. Thus, A and B should select a backoff time uniformly at random form $0 \times T$ and $1 \times T$, where $T = 51.2$ μs is the Slot Time. Assume that A selects 0 and B selects $1 \times T$ for backoff. Thus, A wins and sends the frame while B is waiting. Assume that the transmission delay of A and B's frames are equal to T.

3.a When A is done with sending its frame, both A and B tries to transmit again and there will be a collision. Thus, A selects timeout randomly from 0 and T, and B selects from 0, T, $2T$, or $3T$. Find Probability of A winning this and transmit before B.

3.b Suppose A wins the second round (*i.e.*, the round in part **3.a**). When A is done with sending its frame, both A and B tries to transmit again and there will be a collision. Find the probability of A winning third round and transmit before B.

3.c Assume the same procedure repeats, *i.e.*, A wins the k^{th} round and sends its frame, and then both A and B tries to transmit again and there will be a collision. Find the probability of A winning the $(k+1)^{\text{th}}$ round and transmit before B, in terms of k. Show that this probability is larger than $1 - \frac{1}{2^k}$.

3.d Find the probability of A winning every round after the third round.