CS 4220 Computer Networks

HW-4

Q1. Consider we are sending a bit stream 10011101.
(a) Calculate the parity bit.
(b) The bit stream is padded with 0 to form a 16-bit word: 0x9D00. Please calculate the checksum of data 0x9D00 using the checksum method (1's complement).
(c) The bit stream is transmitted using the standard CRC method described in the text. The generator 1001. Show the actual bit string transmitted. Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. Give an example of bit errors in the bit string transmitted that will not be detected by the receiver.
Solution:
(a) Original bits: 10011101
Count of 1's = 5 (odd)
Even parity: add 1 to make the total number of 1's even $\rightarrow$ codeword = 100111011
Odd parity: add 0 to make the total number of 1's odd $\rightarrow$ codeword = 100111010
(b) Data = 0x9D00 = binary 10011101 00000000
Sum = 0x9D00 since there is only one 16-bit word.
1's complement = 0x62FF (binary 01100010 11111111)
(c) The frame is 10011101. The generator is 1001. The message after appending three zeros is 10011101000. The remainder on dividing 10011101000 by 1001 is 100. So, the actual bit string transmitted is 10011101100. The received bit stream with an error in the third bit from the left is 10111101100. Dividing this by 1001 produces a remainder of 100, which is not equal to 0. Thus, the receiver detects the error and can ask for a retransmission.
If the transmitted bit stream is converted to any multiple of 1001, the error will not be detected. A trivial example is if all ones in the bit stream are inverted to zeros.

Q2. What is the meaning of collision in dynamic channel allocation?
Solution: When two or more devices attempt to transmit data simultaneously over the same communication channel, frames interfere with each other, resulting in corrupted data that cannot be correctly interpreted by the receiving station.

Q3. Explain the difference between frequency-division multiplexing (FDM) and time-division multiplexing (TDM).
Solution: FDM divides the frequency, while TDM divides the time.

Q4. What are the differences between CSMA/CD and CSMA/CA? Which one is used for Ethernet? Which one is used for a Wireless network? Why?
Solution: CSMA/CD and CSMA/CA are both used to control access to a shared medium, but they differ in how they handle collisions.
CSMA/CD detects collisions after they happen. A device listens before sending, and if a collision occurs, it stops and retransmits later.

CSMA/CA tries to avoid collisions before they happen by waiting, using random backoff, and sometimes RTS/CTS. The sender first sends an RTS, and the receiver replies with a CTS, telling others to wait. After that, the sender transmits the data frame.
Ethernet uses CSMA/CD because devices on a wired shared medium can detect collisions. Wireless networks use CSMA/CA because collision detection is difficult in wireless communication, so they must try to avoid collisions instead.

Q5. Consider two Ethernet networks. In network (a), stations are connected to a hub via full- duplex cables. In network (b), stations are connected to a switch using half-duplex cables. For each of these networks, why is CSMA/CD (not) needed?
Answer: CSMA/CD is needed in both cases. CSMA/CD is always needed with a hub. Because the cables are connected electrically, stations are in the same collision domain. CSMA/CD is needed with a switch when half-duplex cables are used, because data moving to a station can collide with data moving to the switch.