CNT4007C Computer Networks, Fall 2019
Instructor: Prof. Ahmed Helmy
Homework 3
On the Data link layer, MAC protocols and Wireless Mobile Networking
Due Date: Nov 14th, 2019 on Canvas *before* **midday** 11:59**am**
**Please also provide an exact hard copy (in class or during the TA office hours)**

*Q1*. Error detection and correction:
  I. Describe how parity bit techniques can *detect and correct* errors in data-link frames? What are its limitations?
  II. Provide an example where the error cannot be detected or corrected. Explain why.
  III. Provide an example where *multiple* errors can be detected and corrected by parity techniques. Explain the limit of your example.

*Q2*. Provide analogy between the operation of CRC and CDMA in terms of how they function at the sender and receiver.

*Q3.* Someone suggested to get rid of the MAC address. 'You only need IP addresses' to route packets! Is this a true statement? Discuss the main implications and consequences of this suggestion on LANs, switching operations (e.g., in data centers), and mobility.

*Q4*. Main communication paradigm over shared media:
  I.     Describe how communication on a shared medium (e.g., Ethernet bus/LAN, or token ring) occurs on the wire at the MAC (data-link) layer for unicast, broadcast and multicast.
  II.    Describe the vulnerability of such method with potential attacks.

*Q5.* Utilization of MAC protocols
  *I.*     Derive the utilization formula for: (a) Ethernet, (b) Token ring (release after reception), and (c) FDDI [which uses Token ring (release after transmission)].
  *II.*    Compare them.
  *III.*   Comment on what happens when the number of stations on the LAN is increased in each case.

*Q6.* MAC utilization
For an Ethernet LAN (shared bus) the data rate was increased from 10Mbps to 100Mbps.
  *I.*   How will the utilization (U) of this network change? [Calculate U for each case]
  *II.*  Suggest two ways in which we can return the utilization to what it was before (By increasing or decreasing another parameter and by how much? Show your reasoning.)
  *III.* One person argued that increasing the number of stations attached to the LAN would reduce the idle time on the LAN and hence increase the utilization. Do you agree?

*Q7.* Discuss whether CSMA/CD is still needed for switched Ethernet and why? If not, why is it still being used?

*Q8.* Why do we need mapping between IP address and MAC address? What table provides such mapping?

*Q9*. Switched ethernet: Which data structure does an ethernet switch use to avoid the inefficiencies of a hub? how does it construct such data structure?

*Q10*. Data center networks:
  I.    What are the two main functions of a data center network?
  II.   What are the two main functions of the data center load balancer (sometimes referred to as a 'layer 4' switch)?

*Q11*. Provide four potential example use cases of infrastructureless multi-hop networks (such as adhoc networks and peer-to-peer wireless networks).

*Q12*. What are the main differences between wired and wireless networks (mention 3 main reasons) and further elaborate on one of those reasons in three sub-points.

*Q13.* Wireless rate adaptation:
  I.    What is rate adaptation in 802.11, and why is it used?
  II.   Discuss in detail its effect on TCP operation and dynamics.

*Q14*. Hidden terminal:
  I.    What is the hidden terminal problem?
  II.   Why does it not exist in wired networks (like Ethernet)?

*Q15*. What type of interference is directly reduced by frequency planning in cellular networks? and how is it reduced?

*Q16*. What are the dimensions in which we can separate the signal for the purpose of multiplexing? Mention five, not including hybrid!

*Q17*. What are the advantages of using spread spectrum (e.g., CDMA) over other multiple access techniques we have studied? Mention five advantages, and for each explain how spread spectrum achieves its advantage.

*Q18*. Someone suggested that 'CDMA systems are limitless in terms of number of simultaneous users supported', argue (with details) for or against this statement.