B.Sc. Engg. CSE 8th Semester

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **SUMMER SEMESTER, 2017-2018**

DURATION: 3 Hours — **FULL MARKS: 150**

CSE 4805: Wireless Networks

Programmable calculators are not allowed. Do not write anything on the question paper.

There are 8 (eight) questions. Answer any 6 (six) of them.

Figures in the right margin indicate marks.

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1. a) Define the *Access Networks* with a hierarchical classification. 7

   b) Describe the importance of RTS/CTS (Request to Send / Clear to Send) frames in any multi hop wireless networks. 7

   c) Clarify the neighborhood of a link in a multi-hop wireless ad-hoc network with the aid of a diagram. 6

   d) Consider the topology of a wireless network illustrated in Figure 1. In the given scenario, the station *A*, *B*, *C*, and *D* all have equi-sized transmission ranges, while station E has a smaller transmission range. Assume that, two nodes' transmissions will interfere if and only if they transmit at the same time and their transmission areas overlap. Further, assume that losses only occur due to collisions. Consider the *RTS/CTS* as an enabled mechanism in this scenario. 5

   For the given scenario, if *station A* sends data to *station B* and *station C* sends data to *station D* (as fast as they can), and no collision detection mechanism is used, what is the throughput of their transfer as a proportion of their send rate?

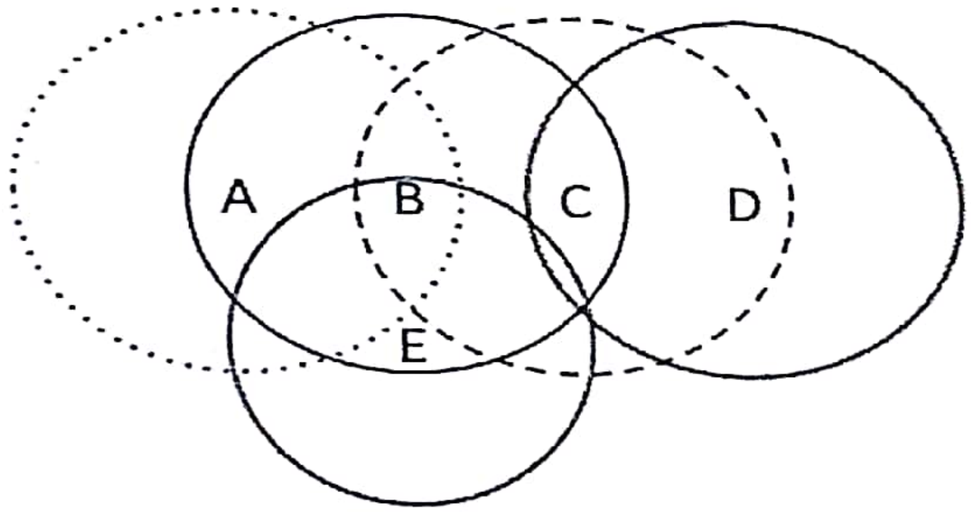

Figure 1: Network topology for Question 1.d

2. a) An *Independent Basic Service Set (IBSS)* consists of three stations (*A, B, C*) those follow *IEEE 802.11 Distributed Coordination Function (DCF)* as *Medium Access Control* Protocol. 12

   Draw a time line diagram showing *one successful re-transmission* of *MSDU* (MAC Service Data Unit) from station A to station C. The diagram should include the back-off process of all the contenders which includes the back-off slots, DIFS period and the SIFS period. Note that, the x-axis of the diagram shows time and y-axis shows one horizontal line for each containing stations.

   b) How is the *QoS (Quality of Service)* assured in *IEEE 802.11e EDCF* (Enhanced Distributed Channel Access)? 13

3. a) How does routing in *Delay Tolerant Network* work? 5

   b) Clarify the main idea of *CSMA/ECA (Carrier Sense Multiple Access with Enhanced Collision Avoidance)* protocol which creates a collision-free schedule in a fully decentralized manner 13

c) The IEEE 802.11 MAC efficiency degrades rapidly as the PHY data rate increases. The graph illustrated in Figure 2 shows such a phenomenon of IEEE 802.11 MAC for a sample network. Clarify the reason behind such phenomenon.

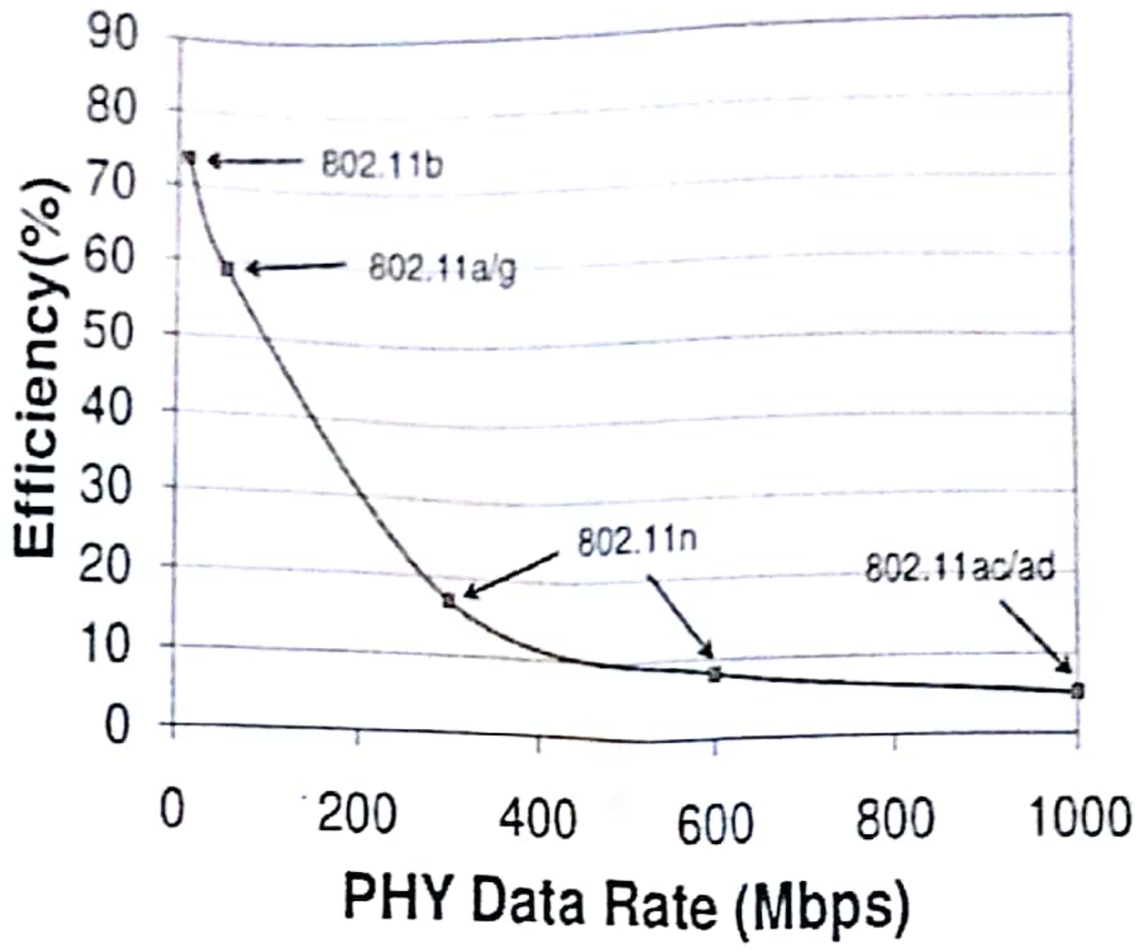

Figure 2: Graph for question 3.c

4. a) IEEE 802.11 WLANs perform channel contention in time domain which possesses greater channel wastage.
   i. Address the specific reasons behind such inefficiency caused by time domain channel contention. 6
   ii. Discuss a promising channel contention mechanism which effectively overcomes these limitations introducing back-off operation using extra frequency bands (EFB). 9
   b) "Post back-off can reduce the delivery delay in lightly loaded systems" - Justify this statement. 5
   c) How does node scanning procedure work in WLAN? 5

5. a) Mention few effective approaches to extend the network life-time of *Wireless Sensor Networks (WSNs)*. 7
   b) What is the fundamental idea of *Sensor-MAC (S-MAC)* protocol in enhancing network life-time of WSNs? 9
   c) Contention-based asynchronous duty cycle MAC protocols transmit long preamble during low power listening (LPL) period. However, such long preamble transmission may occupy the medium for much longer than actual data transmission. Discuss the significant contribution of *Receiver-Initiated MAC (RI-MAC) protocol* in resolving such limitation in asynchronous duty cycled WSN. 9

6. a) *Receiver Initiated Medium Access with Simple Polling (RIMA-SP)* uses a new control packet called *No-Transmission-Request (NTR)*, and an additional collision avoidance waiting period(*w*). Clarify the importance of *(NTR)* and (*w)* in *RIMA-SP* with the aid of an appropriate example. 8
   b) Discuss the contribution of *Low-Energy Adaptive Clustering Hierarchy (LEACH)* protocol in enhancing the network lifetime of a WSN. 8
   c) Clarify the role of *CDMA* in minimizing interference between clusters formed by *LEACH*. 3
   d) Timing Synchronization Function (TSF) synchronizes all the stations within an *Independent Basic Service Set (IBSS)* to a common clock. Let an IBSS consists of 4 stations A, B, C, and D, and their present clock times are 14.00, 14.08, 13.55 and 14.05 respectively. Discuss the time synchronization procedure followed by these stations in the given scenario. 6

7. a) Mention few characteristics and complexities of *Mobile Ad-hoc Networks (MANET)*. 5

b) How is the *Expected Transmission Count (ETX)*, a path metric for multi hop wireless networks calculated? 7

c) Mention the motivation of *Expected Transmission Time (ETT)* routing metric. 6

d) Discuss the concept of *Wastage Aware Routing Metric* in *Energy-Harvesting Wireless Sensor Networks (EH-WSNs)*. 7

8. a) How does the *congestion control* mechanism differ from *flow control* mechanism? 5

b) *Long Term Evolution (LTE)* standard has introduced a number of new technologies when compared to the previous cellular system. Describe those in brief. 7

c) Mention the significance of *Warning Bit* and *Choke Packets* in *Congestion Control*. 6

d) "Traditional TCP schemes may suffer from severe performance degradation in a wireless environment" - Justify the statement. 7