

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2017-2018

DURATION: 1 Hour 30 Minutes

FULL MARKS: 75

CSE 4615: Wireless Networks

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

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

1. a) Have a comparative analysis between wired network and wireless network mentioning their pros and cons on different specifications. 7
- b) Compare the *frequency division multiple access (FDMA)*, *time division multiple access (TDMA)*, and *space division multiple access (SDMA)* with appropriate diagrams. 6
- c) How do the different *Inter-Frame Spaces (IFSs)* defined by *IEEE 802.11* ensure prioritized channel access? 5
- 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. 7

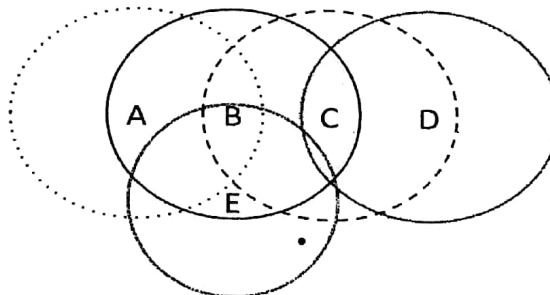


Figure 1: Network topology for Question 1.(d)

For the given scenario, find the exposed terminal and hidden terminal stations while the station D communicates with station C. Answer should includes appropriate justification.

2. a) Mention two fundamental issues of *random access based channel contention* those lead to higher channel wastage. 7
- b) "Recreating the backoff operation of random access based channel contention in the *Frequency Domain* rather than *Time Domain* significantly improves the network throughput gains." 10
 - i. How does the frequency domain backoff ensure such gain? 8
 - ii. Draw a time line diagram for a sample wireless network to clarify the above claim.
3. a) Briefly differentiate the architecture of following *Access Networks* 7
 - i. Wireless Local Area Networks (WLANs)
 - ii. Wireless Sensor Networks (WSNs)
 - iii. Delay Tolerant Networks (DTNs)

- b) Consider a wireless ad-hoc network with three stations (A, B, C) where each of these contends for a shared channel according to *Carrier Sense Multiple Access with Enhanced Collision Avoidance* (CSMA/ECA) protocol. Note here that, CSMA/ECA operates fully decentralized manner using a deterministic backoff after 1st successful transmissions. Let the deterministic backoff value maintained by each stations is 7 (seven). 13

Consider the *RTS/CTS* as a disabled mechanism in this scenario. Draw a time line diagram for the given scenario showing 2 (two) successful data transmission from station B to station C.

The diagram should show the backoff slots considered by all the stations. Note that, the x-axis of the diagram shows time and y-axis shows one horizontal line for each station. The transmission/reception of the frames of any station should represent as rectangles on the horizontal line with source and destination addresses inside the rectangle.

- c) Mention at least 3 (three) strong points of CSMA/ECA protocol over others. 5
4. a) How does a wireless station detect a collided transmission? Is there any difference in collision detection mechanism in these two networks? Justify your answer with appropriate argument and diagram. 8
- b) Consider an *IEEE 802.11e Wireless LAN* consists of three stations (A, B, C) organized in infrastructure less mode. Note here, *IEEE 802.11e* defines a set of quality of service (QoS) enhancements for wireless LAN. Each of these stations contends for a shared channel according to *Enhanced Distributed Channel Access (EDCA)*. With EDCA, high-priority traffic has a higher chance of being sent than low-priority traffic. 17

In the given network, each station maintains two *Access Categories (AC)* labeled as *AC_HP* and *AC_LP* and thus two backoff entities exist in every 802.11e stations. Note here that, the *AC_HP* and *AC_LP* serve the high priority traffic and low priority traffic respectively. The values of EDCA parameter sets are given on Table 1. Consider the *RTS/CTS* as a disabled mechanism in this scenario.

Draw a time line diagram for the given scenario showing one successful transmission from *AC_HP* of station A. The diagram should include the detail back-off process of all the back-off entities which includes the back-off slots, *Arbitration Inter Frame Space (AIFS)* periods.

Note that, the x-axis of the diagram shows time and y-axis shows one horizontal line for each containing back-off entities.

Table 1: Table for Question 4. (b)

Access Category	Minimum Contention Window (CW _{min})
<i>AC_HP</i>	7
<i>AC_LP</i>	15

AIFS

SIFS + 2 Slot time = 34 μ s.

SIFS + 3 Slot time = 43 μ s.