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

MID SEMESTER EXAMINATION **SUMMER SEMESTER, 2020-2021**

DURATION: 1 HOUR 30 MINUTES **FULL MARKS: 50**

CSE 4615: Wireless Networks

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

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

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1. a) Consider the network topology of a multi hop wireless network illustrated in Figure 1. In the given scenario, stations *A, B, C, D,* and *E* all have qui-sized transmission ranges which are depicted by circle surrounded by respective stations. Assume that all the stations operate in same frequency band and two stations transmissions will interfere if and only if they transmit at the same time and their transmission areas overlap. Consider the *RTS/CTS* transmission is a disabled in this scenario. 5.5 (CO1) (PO2)

   i. For the given scenario, identify four (4) possible cases of *Hidden Station Problem*. Your answer will provide the possible hidden stations for a pair of sender and receiver in a table.

   ii. Why does the *Hidden Station Problem* arise?

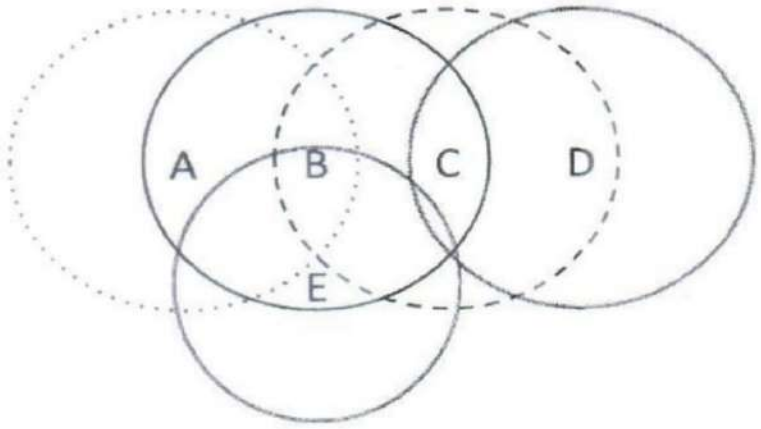

Figure 1: Network topology for question 1 (a)

b) Analyze the limitation of detecting collision by a transmitting station in wireless network. Your answer should include appropriate justification and diagram. 4.5 (CO2) (PO2)

c) In this problem, we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 32 mbps bit stream on the fly. Host A then groups the bits into 2-kilobyte packets. There is one link between Hosts A and B; its transmission rate is 20 Mbps and its propagation delay is 20 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal. 3.5 (CO3) (PO1)

How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

2. a) Consider a *Basic Service Set (BSS)* of IEEE 802.11 wireless LAN (WLAN) consists of three stations *(A, B, and C)*. Assume that all the stations operate in same frequency band and they can all hear each other transmissions. Consider the *RTS/CTS* transmission is enabled in this scenario. — 8.5 (CO3) (PO1)

Draw a Timeline Diagram representing the sequence of actions for a successful Retransmission of two MPDUs (fragmented portion of a single MAC Service Data Unit) from *Station A to Station B.*

The diagram should depict the detailed backoff procedure performed by all the stations in the *BSS*. Consider the minimum *Contention Window*, CW_{min} value is four (4). Note that the x-axis of the diagram shows time and y-axis shows the contending stations in *BSS*. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period.

b) *Distributed Coordination Function (DCF)* is the fundamental *Medium Access Control (MAC)* technique of the IEEE 802.11-based WLAN standard. *DCF* employs a carrier-sense multiple access with collision avoidance *(CSMA/CA)* with binary exponential backoff algorithm. However, the inherent structure of *DCF* results in decreased throughput efficiency.

i. Identify the root cause behind the throughput inefficiency of IEEE 802.11 *DCF*. — 5 (CO2) (PO2)

ii. Propose one possible solution to improve the IEEE 802.11 *DCF* throughput efficiency. — 4 (CO4) (PO3)

iii. Identify the challenge(s) associated with your proposed solution. — 4 (CO1) (PO2)

3. a) How is the *QoS (Quality of Service)* assured in IEEE 802.11 *PCF (Point Coordination Function)*? Justify your answer with appropriate diagram. — 4 (CO1) (PO2)

b) Suppose users share a 8 Mbps link. Also suppose each user requires 950 kbps when transmitting, but each user transmits only 18 percent of the time. — 5 (CO1) (PO2)

i. When circuit switching is used, how many users can be supported?

ii. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

iii. Suppose there are 220 users. Find the probability that at any given time, exactly 90 users are transmitting simultaneously.

c) Compare the following terminologies with appropriate examples: — 3.5 (CO1) (PO2)

i. Multiplexing

ii. Modulation

iii. *Multiple Access*

d) Define *Access Networks* with appropriate taxonomy. — 2.5 (CO1) (PO1)