SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of Electronics and Communication Engineering

Laboratory Report Cover Sheet

18ECC303J – COMPUTER COMMUNICATION NETWORKS

EVEN SEM 2022-23

Name :

Register No :

Section :

Venue :

Experiment title : Simulation of CSMA/CA protocol and to study its performance

PARTICULARS	MAX MARKS	MARKS OBTAINED
Pre lab & Post lab	10	
Lab performance	15	
Record	05	
Viva	10	
Total	**40**	

Report Verification

Staff Name:

Signature with date:

4.Simulation of CSMA/CA protocol and to study its performance

4.1 Introduction

The purpose of this experiment is to introduce you the concepts of virtual channel sensing using RTS/CTS, physical medium reservation and RTS-CTS-DATA-ACK cycle. In this lab you will be able to implement the CSMA/CA protocol for packet communication between a number of nodes connected to a common bus.

4.2 Hardware Requirement

- 3PCs with NIU card
- Network Emulation Unit
- Jumper Cables

4.3 Background

Carrier Sense Multiple Access With Collision Avoidance (**CSMA/CA**), in computer networking, is a wireless network multiple access method in which:

- a carrier sensing scheme is used.
- a node wishing to transmit data has to first listen to the channel for a predetermined amount of time to determine whether or not another node is transmitting on the channel within the wireless range. If the channel is sensed "idle," then the node is permitted to begin the transmission process. If the channel is sensed as "busy," the node defers its transmission for a random period of time. Once the transmission process begins, it is still possible for the actual transmission of application data to not occur.

CSMA/CA is a modification of pure Carrier Sense Multiple Access (**CSMA**). Collision avoidance is used to improve **CSMA** performance by not allowing wireless transmission of a node if another node is transmitting, thus reducing the probability of collision due to the use of a random time. Optionally, but almost always implemented, an IEEE 802.11 RTS/CTS exchange can be required to better handle situations such as the hidden node problem in wireless networking.

CSMA/CA is a layer 2 access method, not a protocol of the OSI model. A node wishing to send data initiates the process by sending a Request to Send frame (RTS). The destination node replies with a Clear to send frame (CTS). Any other node receiving the RTS or CTS frame should refrain from sending data for a given time (solving the hidden node problem). The amount of time the node should wait before trying to get access to the medium is included in both the RTS and the CTS frame. This protocol was designed under the assumption that all nodes have the same transmission range.

RTS/CTS is an additional method to implement *virtual carrier sensing* in Carrier sense multiple access with collision avoidance (CSMA/CA). By default, 802.11 relies on *physical carrier sensing* only which is known to suffer from the hidden terminal problem.

RTS/CTS packet size threshold is 0-2347 octets. Typically, sending RTS/CTS frames does not occur unless the packet size exceeds this threshold. If the packet size the node wants to transmit is larger than the threshold, the RTS/CTS handshake gets triggered. Otherwise, the data frame gets sent immediately. RTS/CTS packets carry the expected duration of the data transmission, which will have some implications.

4.4 Pre lab questions

1. What is the difference between CSMA/CD and CSMA/CA?

2. What are hidden terminal problem and exposed terminal problem?

3. What is DCF?

4. What is the use of RTS/CTS handshake protocol?

5. What is random back off algorithm?

4.5 Procedure

Steps to configure Receiver:

1. Click on the CSMA/CA icon 

from the desktop on one PC.

2. Click the Configuration  button.

PC 1 Receiver

Configuration menu for Access point:

PC 1	
Node id	0
Protocol	ALOHA
Baud Rate	8Kbps (At both the config menu and NEU)
Duration	100 s
Packet Length	100
Bit Delay	0 (at NEU)
Direction	Receiver
My Address	1

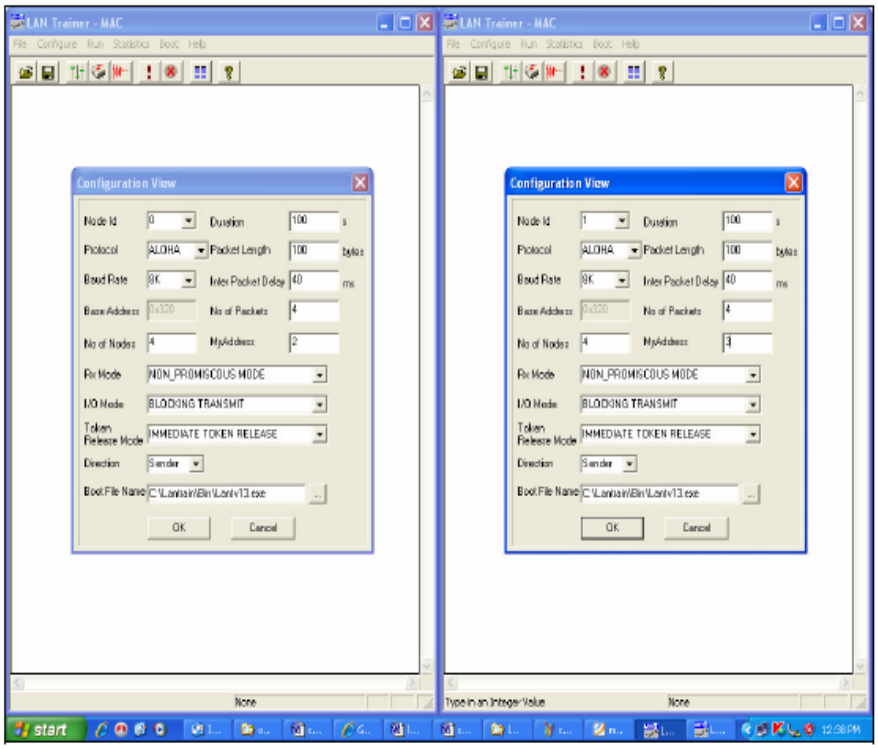
Note: There should be only one Access Point and no clients in PC1. Set the topology as BUS.

Steps to configure Clients nodes:

3. Click on the **CSMACA** icon  from the desktop on the second PC.

4. Click the Configuration  button in the window in the second PC.

PC 2



Setting the configuration menu for client nodes:

PC 2	
Node id	**0** on config menu 1 and **1** on config menu 2
Protocol	ALOHA
Baud Rate	8Kbps (At both the config menu and NEU)
Duration	100 s
Packet Length	100
Bit Delay	0 (at NEU)
Direction	Sender
My Address	**2** on config menu 1 and **3** on config menu 2

Note: Here the My Address should be **2** for Node Id **0** and should be **3** for Node id **1.** If PC3 is used, then the My Address should be **4** for Node Id 0 and should be **5** for Node id 1 on that PC.

$$G = \frac{N * P}{C * t_a}$$

→ Equation A

G is the generated load in the network.

N is the number of nodes participating in the network (for CSMA/CA N is the number of clients). For example, let us say that 2 nodes (using 1 computer; 4 nodes using 2 computers). In CSMA/CA the access point is considered as load generating node.

P is the packet length expressed in bits; say 100 bytes (800 bits).

C is the data rate normally set as 8kbs, which is selected in the NEU.

$\mathbf{t_a}$ is the inter packet delay expressed in seconds; the time interval between two consecutive packets generated.

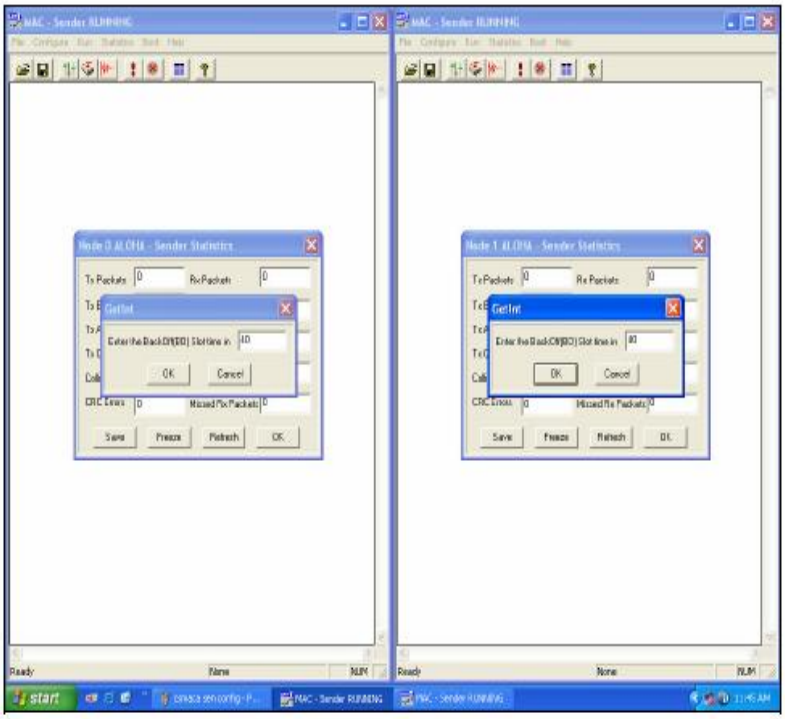
So, lets assume $\mathbf{t_a}$= 40 milliseconds and substitute the above mentioned parameters in the Equation A which leads to G = 5. Like wise assume various values of $\mathbf{t_a}$ to generate offer loads in the range of 0.1 to 10. Substitute the value of $\mathbf{t_a}$ in the configuration menu.

5. Click **OK** button and Download the driver to the NIU using the BOOT button  command. Booting from any one of the applications is enough.

6. Run the experiment by clicking button  or by choosing RUN → Start from each application. Follow the same procedures in the client side also. Once when you press the run button the following window will appear.

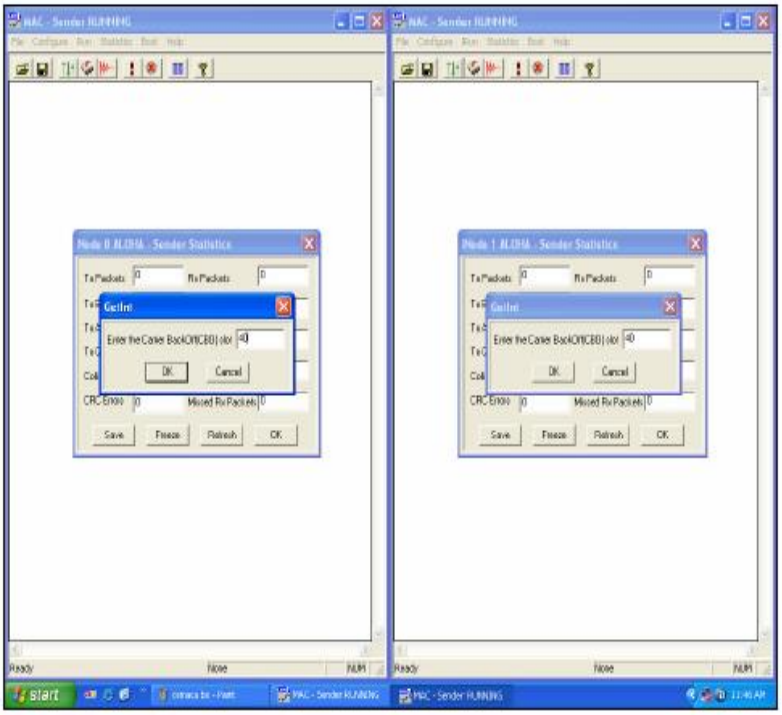
7. Set the **Back-off time** as 40 ms simultaneously in both the windows.

PC2



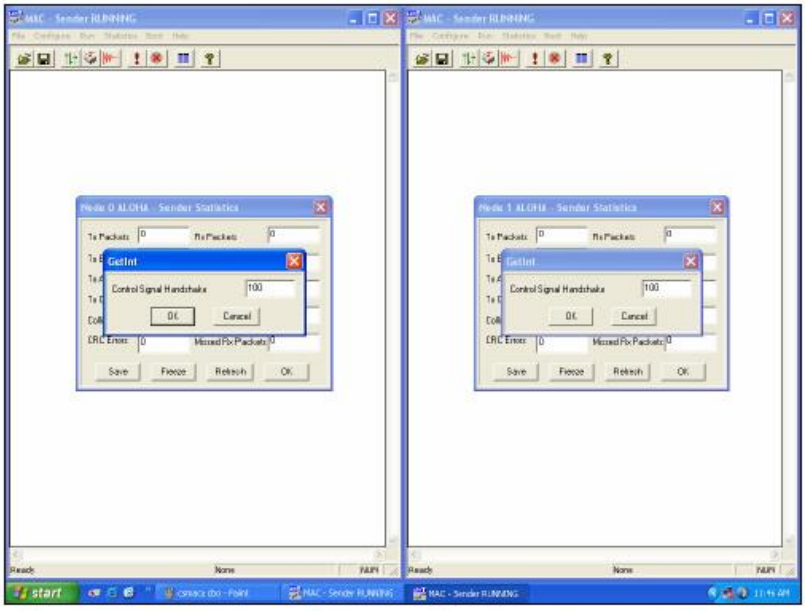
8. Set the **Carrier Back-off time** as 40 ms simultaneously in both the windows.

PC 2



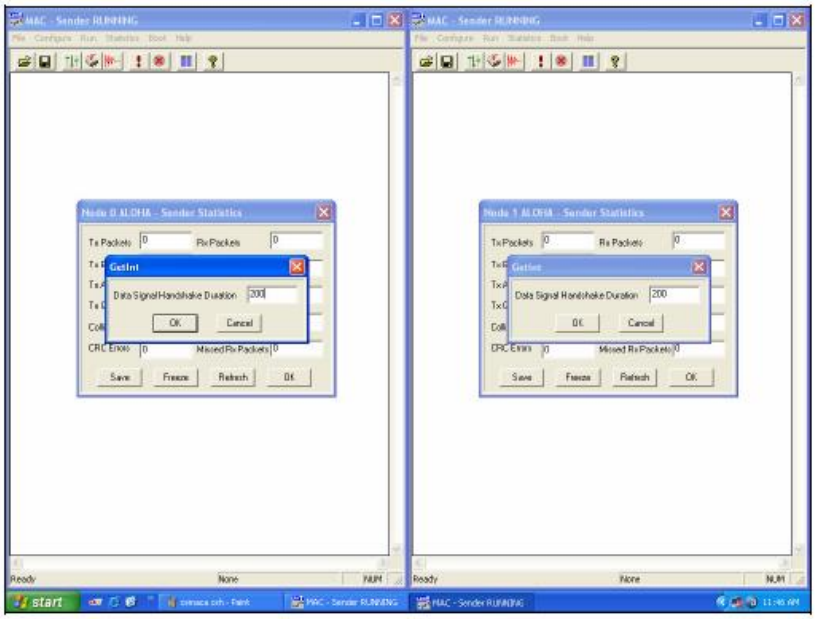
9. Set the **Control Signal Handshake** equal to Packet length (for this case it is 100 as the packet length is 100 bytes) simultaneously in both the windows.

PC 2



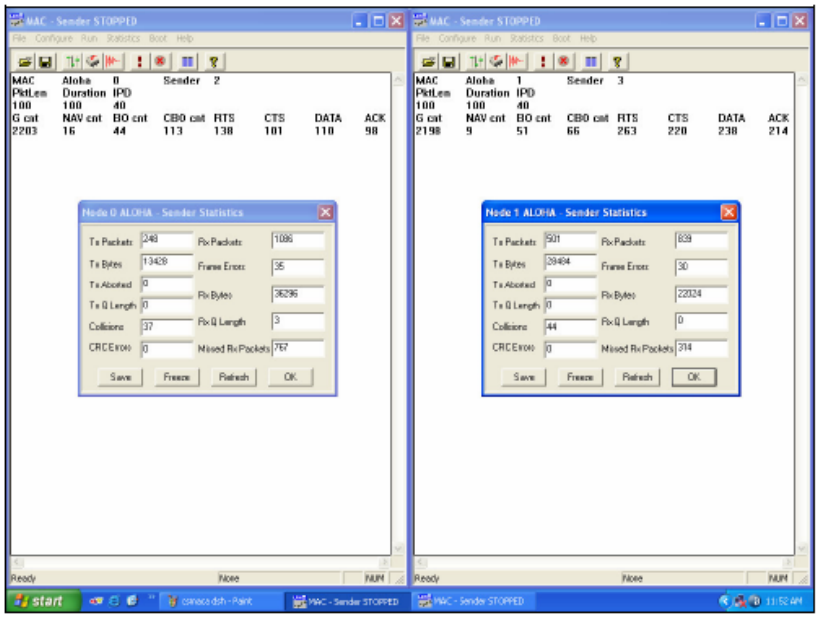
10. Set the **Data Signal Handshake** equal to twice the Packet length (for this case it is 200 as the packet length is 100 bytes) simultaneously in both the windows.

PC 2



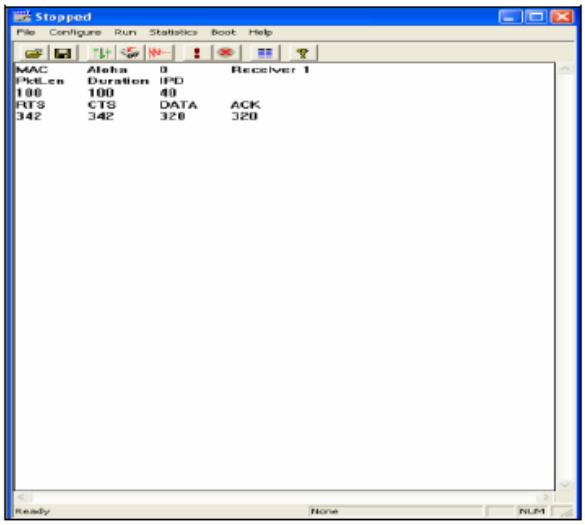
11. After 100 secs both the nodes stops transmitting and the following screen appear.

PC 2



12. Once the Sender stops press the **OK** button in the receiver Node and Press the **stop**  Butt
and the following screen appears

PC1



Note down the readings once the experiment is completed.

13. Repeat the above steps for various values of $\mathbf{t_a}$.

14. Calculate the Practical offered load from the below given formula and plot the graph between the practical Offered load and Throughput.

Note: You can also use the template for plotting the graph. Please refer *Appendix-1* to plot the graph using the template.

15. Repeat the experiment for various values of Packet length, Node, Data rate.

Calculation of Practical Throughput for CSMA/CA:

$$X = \frac{\text{(Sum of ACK counts in all the clients * Packet Length * 8)}}{\text{(Duration of Experiment * Data Rate)}}$$

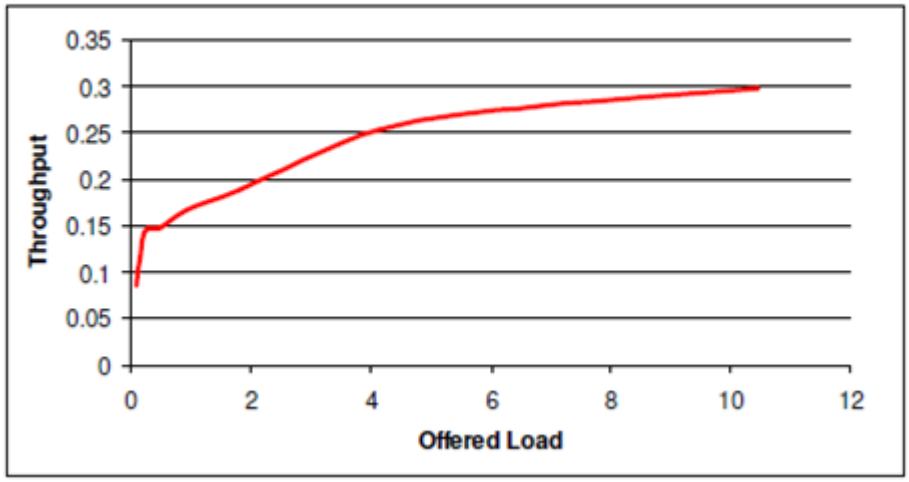
Calculation of Practical Offered Load for CSMA/CA:

$$G = \frac{\text{(Sum of G count in all the clients * Packet Length * 8)}}{\text{(Interpacket delay * Data Rate)}}$$

Model Tabulation:

IPD (ms)	G Count1	G count2	Ack count1	Ack count2	Practical G	X-Practical Throughput
2000	49	50	43	39	0.099	0.082
800	120	117	67	76	0.237	0.143
400	255	258	82	91	0.513	0.173
200	470	473	99	83	0.948	0.182
100	925	925	98	91	1.85	0.189
40	2046	2046	160	138	4.092	0.298
20	3467	3468	176	43	6.935	0.319
10	5231	5224	184	151	10.455	0.335

Model Graph:



Tabulation

IPD (ms)	G Count1	G count2	Ack count1	Ack count2	Practical G	X-Practical Throughput

4.6 Post lab questions

1. What is NAV?

2. What do you mean by exponential back off algorithm?

3. Fragment a 1000-byte packet into five 200 bytes packet and compare the throughput obtained with single 1000-byte packet transmission

4. In what situations can collision occur in WLAN network? How to solve the collisions or minimize the probability of collisions?

5. What is the choice of contention window?

RESULT

Thus, CSMA/CA protocol is simulated and its performance is studied