DESIGN AND ANALYSIS OF DATA RATE AND TRANSMIT POWER OF WIRELESS LAN USING OPNET MODULER

[1]Rakesh Kumar, [2]Prof.(Dr.) R. K. Khanna, [3]Dr. Vishnu Shrivastava
[1]P.hD. Scholar, [2]Professor, [3]Emeritus Scientist and Professor- AcSIR
[1]Department of ECE,
[1]Vivekananda Global University, Jaipur, India

Abstract : ***Wireless communication between mobile users is becoming more popular than ever before. This is due to recent technological advances in mobile laptop computers and wireless data communication devices, such as wireless modems and wireless LANs. This has resulted in lower prices and higher data rates, which are the two main reasons why mobile computing continues to enjoy rapid growth.***
we have analyzed the performance of IEEE 802.11g Wireless Local Area Network (WLAN) with one access point. The IEEE 802.11g is a wireless protocol standard. A wireless network was established with one access point and OPNET IT Guru Simulator 14.5 (Academic edition) was used to simulate the entire network. Wireless network has some attributes or parameters such as data-rate and transmit power etc. It also has some qualities of service or metrics like the delay, media access delay, queue size, throughput, data dropped and retransmission attempts, network load etc. But our analysis here is only for delay, media access delay, queue size and throughput performance.
Several simulation graphs were obtained and used to analyze of wireless network with good throughput, minimum access delay and queue size.

IndexTerms - Access Point (AP), Medium Access Control (MAC), OPNET, Wireless local area networks (WLANs), Data-rate, buffer size, fragmentation threshold, and throughput.

I. INTRODUCTION

Wireless local area networks(WLAN) enable people on the move to communicate with anyone, anywhere at any time with a range of multimedia services The exponential growth of cellular telephones and mobile systems coupled with spreading of laptops and palmtops indicate a bright future for such networks both as standalone as well as network infrastructures. However, the WLAN performance is a key factor in spreading and usage of such technologies. So this deals with the optimization techniques based on the advanced network simulator, OPNET. The OPNET (Optimized Network Engineering Tool) can be best described as a set of decision support tools, providing a comprehensive development environment for the specification, simulation and performance analysis of communication networks, computer systems, and applications and distributed systems. There are two different approaches for enabling wireless communication between two hosts. In modern era, computer communication networks are growing rapidly day by day. Communication technology facilitates users by providing user friendly services such as file transferring, print sharing, video streaming and voice conferencing. Internet is a global system of interconnected computer networks. Today Internet is playing a vital role in communication networks. Computer communication networks are based on a technology that provides the technical infrastructure, where routing protocols are used to transmit packets across the Internet and different attributes that we assign in wireless networks specifying the quality of service (Qos) of any wireless network. This paper looks at some of these problems and tries to evaluate the performance of IEEE 802.11g infrastructure wireless network.

II. NETWORK DESIGN

Project Editor is used to develop network models. Network models are made up of subnets and node models. This editor also includes basic simulation and analysis capabilities. The Project Editor is the main staging area for creating a network simulation. From this editor, we can build a network model using models from the standard library, choose statistics about the network, run a simulation and view the results.
Node Editor is used to develop node models. Node models are the objects in a network model. They are made up of modules with process models.
Process Editor is used to develop process models. Process models control module behavior and may reference parameter models.
ICI Editor is used to Create, edit, and view interface control information (ICI) formats. ICIs are used to communicate control. The network design can be done through two methods, one is automatically and the other is manually. The first method is automatically generating different topologies using rapid configuration. The second method is by dragging different kind of objects from the object palette to the project editor workspace. A user can also import some predefined scenarios from the hard drive. But however wireless network cannot be designed by importing scenarios [53]. Next step is the configuration of each LAN node, which is done both by using the predefined parameters in OPNET and manual configuration of node's attributes. The entire system and LAN nodes in this system are built based on some values and settings that we believe would enable us to obtain reliable results.

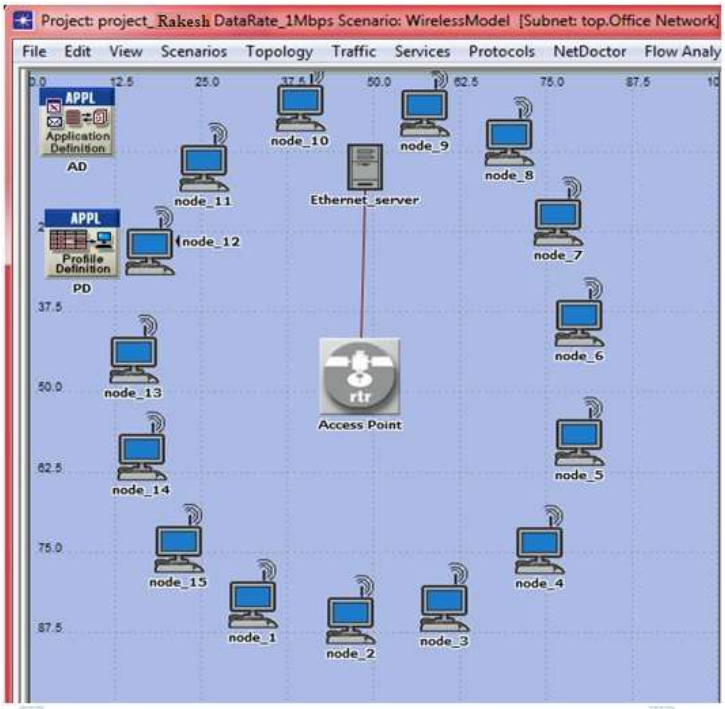

Fig.1 Network Model of 15 nodes with one access point

2.1 Performance Parameters

There are different kinds of parameters for the performance evaluation of the different attributes. These have different behaviors on the overall network performance. We have evaluated four parameters for the comparison of our study on the overall network performance. These parameters are delay; media access delay, Queue size and throughput for consideration QoS of WLAN.

Delay: Hence all the delays in the network are called packet end-to-end delay, like buffer queues and transmission time. Sometimes this delay can be called as latency; it has the same meaning as delay. The packet end-to-end delay is the time of generation of a packet by the source up to the destination reception [5]. So this is the time that a packet takes to go across the network.

Delay Media Access: We measure media access delay as the time from when the data reaches the MAC layer until it is successfully transmitted out on the wireless medium.

Queue size: Queue size and waiting time can be looked at, or items within queues can be studied and manipulated according to factors such as priority, size, or time of arrival. Networks of queues are systems which contain an arbitrary, but finite number 'm' of queues. Customers, sometimes of different classes, travel through the network and are served at the nodes. The state of a network can be described by a vector (k1,k2,….,ki), where ki is the number of customers at queue i.

Throughput: In a wireless network, system throughput is defined as the fraction of time that a channel is used to successfully transmit payload bits [7]. Throughput can be obtained by analyzing the possible events that may happen on a shared medium in a randomly chosen slot time.

2.3 Network Model

The first network model consists of four scenarios for **15 nodes** configured for the 4 referred data rates as:

Scenario 1: DATA RATE 15 (1Mbps) Scenario
Scenario 2: DATA RATE 15 (12Mbps) Scenario
Scenario 3: DATA RATE 15 (36Mbps) Scenario
Scenario 4: DATA RATE 15 (54Mbps) Scenario

The second network model consists of four scenarios for **15 nodes** configured for the 4 referred transmit power as:

Scenario 5: TRANSMIT POWER 15 (5mw)
Scenario 6: TRANSMIT POWER 15 (20mw)
Scenario 7: TRANSMIT POWER 15 (50mw)
Scenario 8: TRANSMIT POWER 15 (100mw)

III. RESULTS AND DISCUSSION

A network which has one access point and 15 nodes was set up as shown below. Simulations were carried out using OPNET IT Guru simulator (Academic edition). The effects of varying data rate and transmit power on the delay, media access delay, queue size and throughput as a performance metric were analyzed.

This signifies the speed of the nodes connected within a network. The WLAN 802.11g model in OPNET IT Guru 14.5 supports data transfer from 1Mbps to 54Mbps. These data rates are modeled as the speed of transmitters and receivers connected to WLAN MAC process.

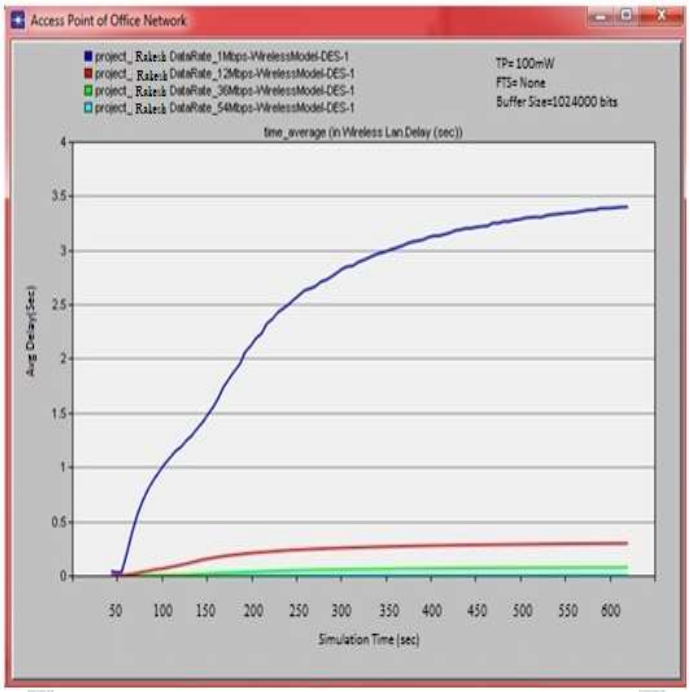

Fig. 2 Delay for data rates 1Mbps, 12Mbps, 36Mbps and 54Mbps

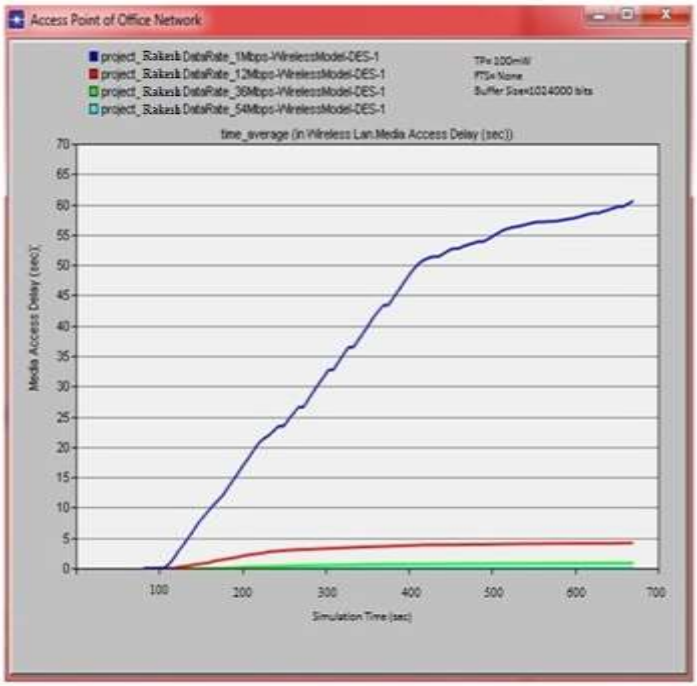

Fig. 3 Media Access Delay for data rates 1Mbps, 12Mbps, 36Mbps and 54Mbps

Based on the simulation of the four scenarios for the data-rates, the graph in fig. 2 was obtained. It is found that when the data-rate is increased from 1Mbps to 54Mbps, the delay decreased. As per the simulation of the four scenarios for the data-rates, the graph in fig. 3 was obtained. It has been concluded that when the data-rate is increased from 1Mbps to 54Mbps, the media access delay decreases. It is conclusively proved that when data-rate increases in a network, the Delay and media access delay decreases.

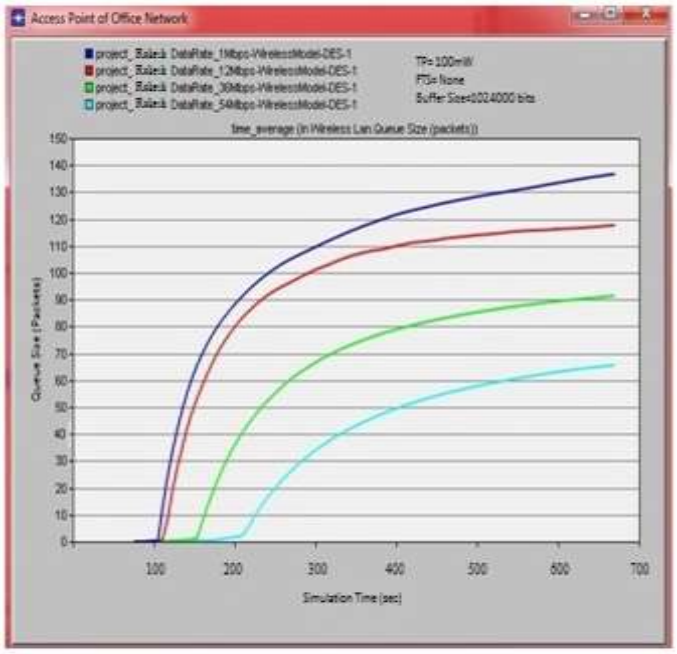

Fig. 4 Queue Size Study for data rates 1Mbps, 12Mbps, 36Mbps and 54Mbps

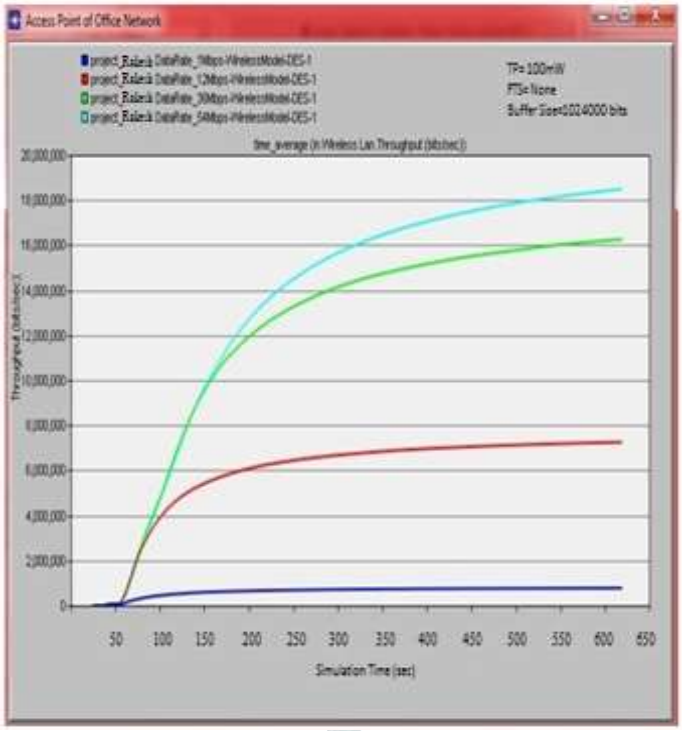

Fig. 5 Throughput Study for data rates 1Mbps, 12Mbps, 36Mbps and 54Mbps

In order to compare queue size of the four scenarios for the data-rates as shown in fig. 4 is obtained. It is found that when the data-rate is increased from 1Mbps to 54Mbps, the queue size decreased.

Similarly, as per the simulation of the four scenarios for the data-rates, the graph in fig. 5 was obtained. It has been found that when the data-rate is increased from 1Mbps to 54Mbps, the throughput increases.

When the data rate increases from the above investigations as shown in figures, the delay, media access delay, queue size decreases and throughput increases, hence we concludes that maximum number of data bits successfully transmitted through the wireless network in minimum time of duration.

The transmit power level of clients can be controlled by a wireless infrastructure device. The client chooses the actual transmit power level, choosing between the lower of the access point value and the locally configured value. In radio transmission, **transmitter power output** (**TPO**) is the actual amount of power (in watts) of radio frequency (RF) energy that a transmitter produces at its output. The transmit power of the access point and the client adapter can be useful to allow for different coverage area sizes and, in the case of the client, to conserve battery life.

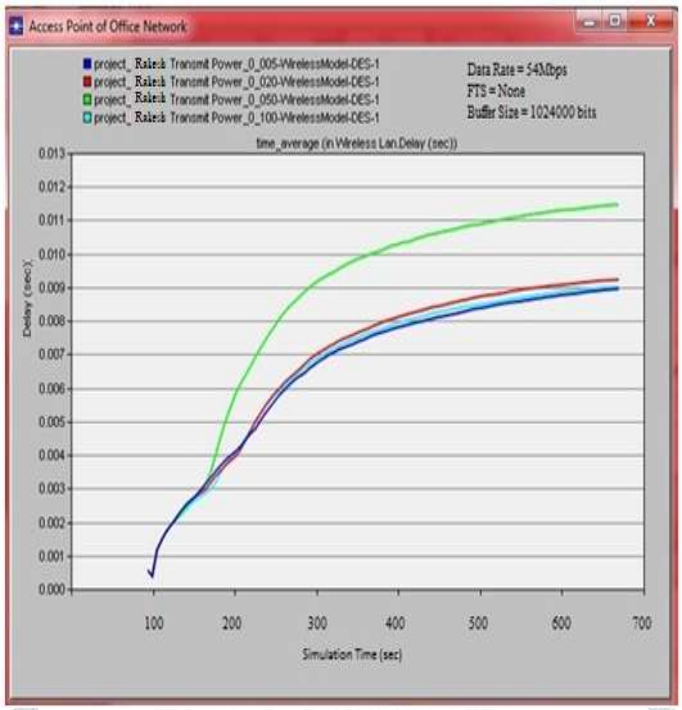

Fig. 6 Delay results for different transmit power

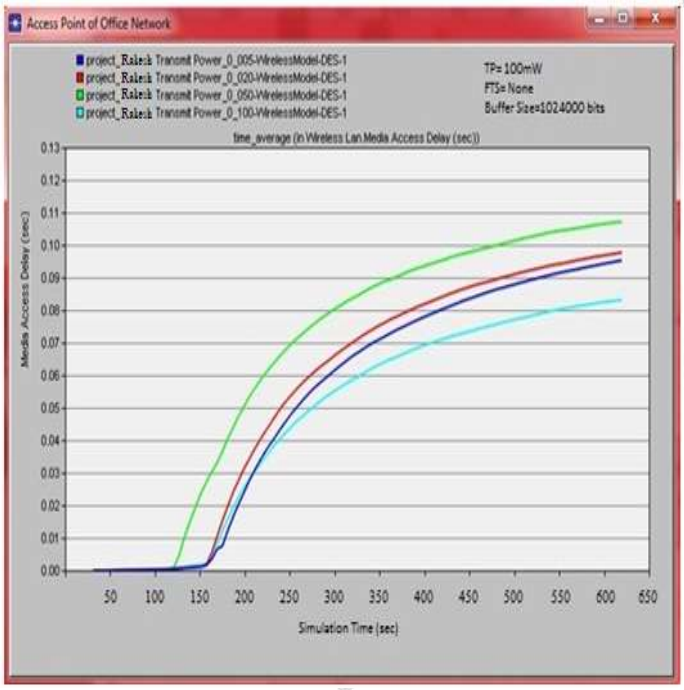

Fig.7 Media Access Delay results for different transmit power

Based on the simulation of the four scenarios for the Transmit Power, the graph in fig. 6 was obtained. It is found that initially when the Transmit power is increased from 0.005W to 0.050W, the Delay increased. But by increasing more power above 0.050 to 0.100W the delay is decreased for high data rate of 54Mbps.thus we concludes that for any wireless network the data rate and transmit power should be at high value to get efficient transmission in maximum coverage area within minimum time of duration.

Similarly, the graph in fig. 7 was obtained. It is found that initially when the transmit power is increased from 0.005W to 0.050W, the media access delay increases. But by increasing more power above 0.050W to 0.100W the media access delay is decreased for high data rate of 54Mbps. Thus based on graphical result above we concludes that for any wireless network the data rate and transmit power should be at high value to get efficient transmission for long distance within minimum time of duration.

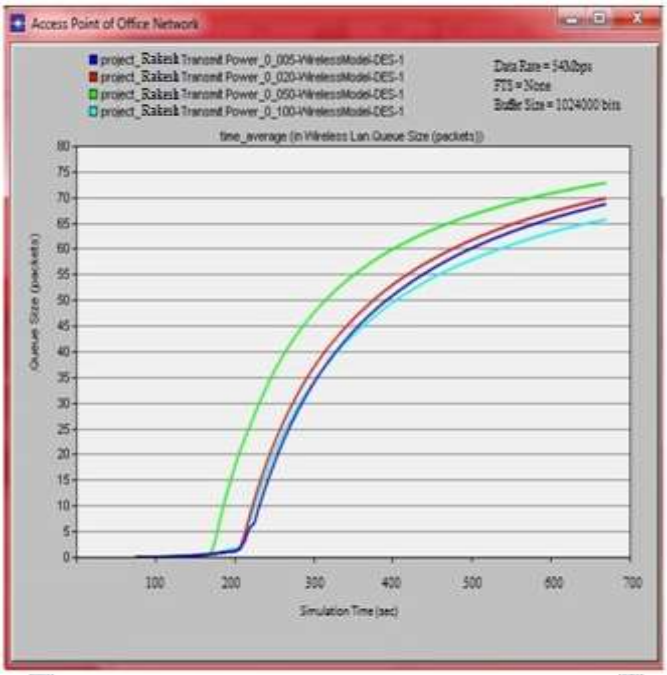

Fig.8 Queue Size results for different transmit power

Fig.9 Throughput results for different transmit power

Based on the simulation of the four scenarios for the transmit power, the fig. 8 shows that by increasing more power above 0.050 to 0.100w, the queue size is decreased.

In order to compare the throughput of the four scenarios for the Transmit Power, the graph in fig. 9 was obtained. It has been found that when the transmit power in wireless network is increased, the throughput remain constant, and the packets are delivered more accurately at high data rate, hence there is less requirement for retransmission.

When the transmit power increases from the above investigations as shown in table 5.4, the delay, media access delay, queue size decreases (1-2%) and throughput remain constant, hence we concludes that the transmit power of the access point can be useful to allow for different coverage area sizes by changing the transmit power in wireless network.

IV. CONCLUSION

This Paper focuses on the designing of the wireless network. It was found that the main challenges of such type of network are delay, media access delay, queue size and throughput. Having completed this simulation, it is seen that when a network parameters such as data rate and transmit power is tuned to different scenarios, the delay media access delay, queue size and throughput performance metric is usually affected.

When the data-rate in a wireless network is increased and other parameters such as transmit power, fragmentation threshold and buffer size are constant the delay, media access delay and queue size decreases and throughput increases; so that maximum packets are delivered more accurately within minimum time, hence less requirement for retransmission.

The transmit power of the access point and the client adapter can be useful to allow for different coverage area sizes and, in the case of the client, to conserve battery life. When the transmit power in a wireless network is increased and other parameters such as data rate, fragmentation threshold and buffer size are constant, the delay, media access delay and queue size decreases (1-2%) and throughput remain constant, hence we concludes that the transmit power of the access point can be useful to allow for different coverage area sizes by changing the transmit power in wireless network.

V. ACKNOWLEDGMENT

I wish to express my deep sense of gratitude to my supervisor's, Prof.(Dr.) R. K. Khanna(Professor) and Dr. Vishnu Shrivastava (Emeritus Scientist(CSIR) & Professor (AcSIR)), CSIR-CEERI, Pilani, for guiding from the inception till the completion of the paper. I sincerely acknowledge for giving his valuable guidance, support for critical reviews and comments for giving the final shape of the paper. I would like to thank Mr. Mukesh Kumar Saini, Asst. Prof., Sobhasaria Engineering College, Sikar, for his excellent guidance and kind co-operation during Writing the paper. Finally I would like to express my heartfelt thanks to all supporting staff members, my family members and friends who have been a constant source of encouragement for successful completion of the Paper.

REFERENCES

[1]. LAN MAN Standards Committee of the IEEE Computer Society, "Part 11: wireless LAN medium access control (MAC) and physical layer (PHY)specifications," ANSI/ IEEE Standard 802.11, 1999 Edition.

[2]. OPNET LABS, "Creating Wireless Network", 2006.

[3]. G.Bianchi, "Performance analysis of the IEEE 802.11 Distributed Coordination Function", IEEE Journal on Selected Areas in Communications, Vol. 18. No.3 March 2000.

[4]. IEEE Standard, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environment", 2010.

[5]. Haitao Wu, Shidnan Cheng, Yong Peng, Keping Long, Jian Ma. Performance of reliable transport protocol over IEEE 802.11 wireless LAN: Analysis and enhancement. IEEE; 2002.

[6]. L. Bononi, M. Conti, and L. Donatiello, "Design and performance evaluation of a distributed contention control (DCC) mechanism for IEEE 802.11 wireless local area networks," in Proceedings of First ACM International Workshop on Wireless Mobile Multimedia, Oct. 1998, pp. 59-67.

[7]. OPNET Technologies, Inc., "Wireless LAN model description," http://www.opnet.com/products/library/WLAN_Model_Guide1.pdf.

[8]. Chetoui Y. and Bouabdallah N., Adjustment mechanism for the IEEE 802.11 contention window: An efficient bandwidth sharing scheme, Computer Communications Journal, Vol. 30. No. 13

[9]. Gurpinder Singh Sidhu, Sanpreet Singh, Satpinder Singh Sidhu," QoS Issues of Media Access Delay and Throughput in WLAN", ISCET, ISBN: 978-71-910205-0-3, 2016.

[10]. Grilo A. and Nunes M., "Performance Evaluation of IEEE 802.11e", Proc. IEEE Personal, Indoor and Mobile Radio Communications (PIMRC), vol. 1, pp. 511 -517, September 2002.