# Throughput Analysis of IEEE802.11b Wireless LAN with One Access Point Using Opnet Simulator

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***Abstract:*** *This paper analyse the throughput performance of IEEE 802.11b Wireless Local Area Network (WLAN)with one access point. The IEEE 802.11b is a wireless protocol standard. In this paper, a wireless network was established which has one access point. OPNET Simulator was used to simulate the entire network. Thus the effects of varying some network parameters such as the data rate, buffer sizes, and fragmentation threshold were observed on the throughput performance. Several simulation graphs were obtained and used to analyse the network performance.*

***Index Terms:*** *Throughput Analysis, IEEE802.11b, Opnet Simulator.*

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## 1. Introduction

A Network is a group of devices, such as computers that are connected to each other for the purpose of sharing information and resources. Shared resources can include printers, documents and internet access connections.

A network can be wired or wireless. 802.11b is one of the IEEE protocol standards for wireless networks. It uses a modulation technique known as Direct Sequence Spread Spectrum (DSSS) [1]. Wireless network has some attrib utes or parameters such as data rates, buffer sizes, fragmentation threshold (FTS). It also has some qualities of service or like the Throughput,Delay jitter, Data dropped, Retransmission attempts. But analysis here is only for throughput. The part 1 in this paper deals with introduction ,part 2 deals with overview of wireless network and IEEE802.11b and part3 deals with wireless performance, part 4 deals with access point, and pare5 deals with simulation and results part6 deals with discuss of the result and last part we concluded this paper.

## 2. Wireless Internet and IEEE 802.11b

Wireless LANs provide greater flexibility and portability than do traditional wired LANs.Unlike a wired LAN, which requires a wire to access the network A Wireless LAN connects computers and other components to the network via an Access Point (AP). IEEE 802.11 is an international standard providing transmission speeds ranging from 1Mbps to 54Mbps in either the 2.4 GHz or 5 GHz frequency band, Wireless technologies are playing an increasingly prominent role in the global Internet infrastructure. One of the popular technologies in the wire less LAN market is the IEEE 802.11 b standard. This popular technology provides low-cost wireless Internet capability for end users, with up to 11 Mbps data transmission rate at the physical layer.The IEEE 802.11b standard defines the channel access protocol used at the MAC layer, which can be used for carrying IP packets. Frames that are correctly received over the shared wireless channel are acknowledged (almost immediately) by the receiver. Unacknowledged frames are retransmitted by the sender after a short timeout (typically a few milliseconds), using the same MAC protocol.

## 3. Wireless Web Performance

The overall performance of the Web depends on the behaviours of Web clients, the Web server, and the network in between. The primary challenge in the wireless Internet context is the characteristics of the wireless channel. Communication over wireless links often suffers from limited bandwidth, high error rates, and interference from other users on the shared channel.The obvious concern is that TCP and HTTP performance may decrease over wireless Networks. Our focus in this paper is on the performance of wireless Web access in small area like a classroom. Our primary emphasis is on performance problems due to the wireless network bottleneck, and understanding how these problems affect user perceived performance.

In a wireless network, system throughput is defined as the fraction of time that a channel is used to successfully transmit payload bits. Throughput can be obtained by analysing the possible events that may happen on a shared medium in a randomly chosen slot time [2].

## 4. Wireless Access Point (WAP)

Wireless access points, referred to as either WAPs or wireless APs, are a transmitter and receiver (transceiver) device used for wireless LAN (WLAN) radio signals. A WAP is typically a separate network device with a built-in antenna, transmitter, and adapter.

WAPs use the wireless infrastructure network mode to provide a connection point between WLANs and a wired Ethernet LAN.WAPs also typically have several ports allowing a way to expand the network to support additional clients. Depending on the size of the network, one or moreWAPs may be required. AdditionalWAPs are used to allow access to more wireless clients and to expand the range of the wireless network. Each WAP is limited by a transmissions range, the distance a client can be from a WAP and still get a useable signal. The actual distance depends on the wireless standard being used and the obstructions and environmental conditions between the client and the WAP.[5].

## 5. Results

A network which has one access point and four nodes was set up as shown below.

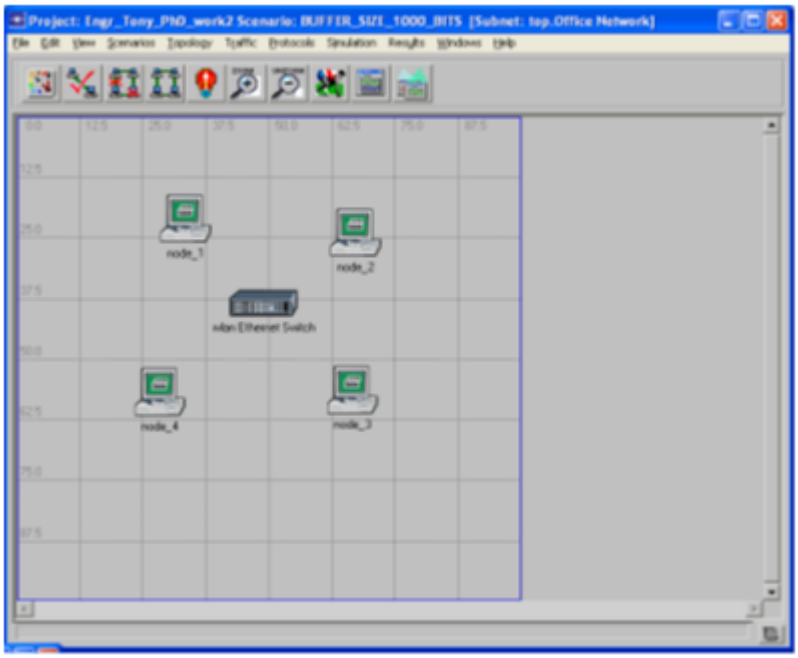


Fig. 1: A network with one access point and four nodes.

Simulations were carried out using OPNET simulator. The effects of varying three network parameters on the throughput as a performance were analysed. The parameters are the data rate, buffer size and fragmentation threshold (FTS).

**A. The Data-Rates (Mbps):**

This signifies the speed of the nodes connected within a network. The WLAN model in OPNET simulator that we used supports data transfer at 1, 2, 5.5 and 11Mbs. These data rates are modelled as the speed of transmitters and receivers connected to WLAN MAC process. Each data rate is associated with a separate channel stream, from the MAC process to the transmitter and from the receiver to the MAC process. The values for different data rates used for the simulation are shown in table 1.

| Attributes (Parameters) | Scenario_1 | Scenario_2 | Scenario_3 |
|---|---|---|---|
| Data-rates | 1Mbps | 5.5Mbps | 11Mbps |
| Buffer Sizes | 12800bits | 12800bits | 12800bits |
| Fragmentation Threshold | None | None | None |

TABLE 1: Table Showing the Data rates Used For Different Scenarios.

Based on the simulation of the three scenarios for the data rates, the graphs in figure 1 were obtained. It is found that when the data-rate was increased from 1Mbps to 11Mbps, the throughput increased. This is predictable from the theoretical view point that as data rate increases, the number of bits received increases [4]. Thus based on the graphical result below, it can be said that when data rate increases in a network, the throughput increase; but when the network is overloaded with several stations, that same throughput decreases, since throughput is the number of bits successfully transmitted per second. The 5.5Mbps is good for the network, and that is why the graph first rose sharply before they became stable.

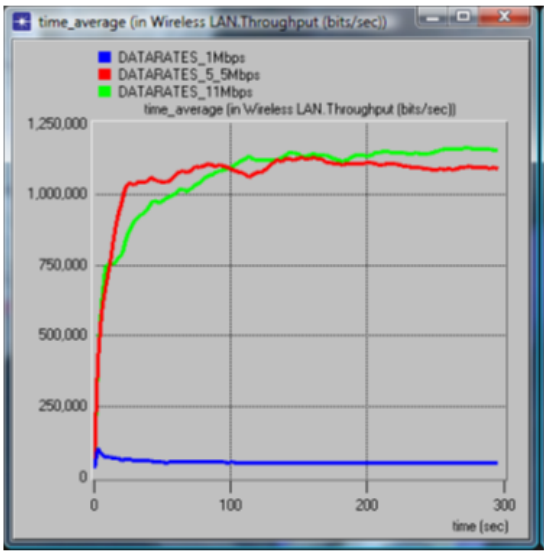


Fig. 2: Throughput study for data rates of 1Mbps, 5.5Mbps and 11Mbps.

**B. Buffer Size (bits) :**

This parameter specifies the maximum length of the higher layer data arrival buffer. If the buffer limit is reached, data received from the higher layer are discarded until some packets are removed from the buffer so as to have some free spaces to store new packets. The table 2 shows the buffer sizes used.

TABLE 2: Table Showing The Buffer Sizes Used.

| Attributes (Parameters) | Scenario_1 | Scenario_2 | Scenario_3 |
|---|---|---|---|
| Data-rates | 11 Mps | 11 Mps | 11 Mps |
| Buffer Sizes | 1000bits | 6400bits | 12800bits |
| Fragmentation Threshold | None | None | None |

The graphs of figure 3 show that when the size of the buffer was increased, the throughput increased. For small size of buffer, the throughput reduces to zero, meaning that packets are dropped or discarded because the buffer has no space to accommodate more packets.

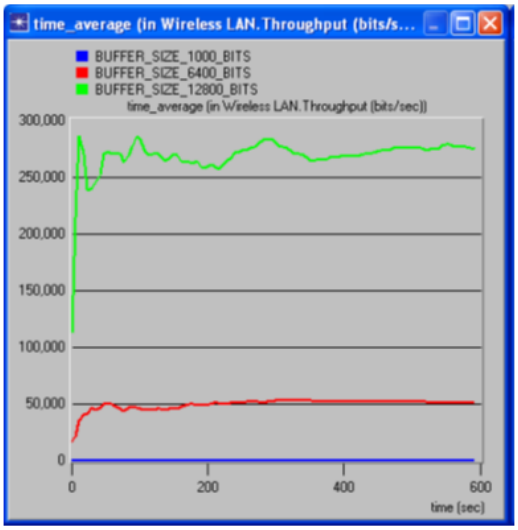


Fig.3: Graphs analysing throughput for different buffer sizes.

**C. Fragmentation Threshold (Bytes):**

This parameter specifies the value to decide if the MAC Service Data Unit (MSDU) received from the higher layers needs to be fragmented before transmission [5]. The number of fragments to be transmitted is calculated based on the size of the MSDU and

the fragmentation threshold. Table 3 shows the three scenarios for the simulation study. The first one is with no fragmentation of incoming packets. The second one is with a fragmentation of 16 bytes, and the third one is with a fragmentation of 256 bytes.

TABLE 3: Table Showing The Fragmentation Threshold (Fts) Used For Different Scenarios.

| Attributes (Parameters) | Scenario-1 | Scenario-2 | Scenario-3 |
|---|---|---|---|
| Data-rates | 11 Mps | 11 Mps | 11 Mps |
| Buffer Sizes | 12800bits | 12800bits | 12800bits |
| Fragmentation Threshold | None | 16 bytes | 256 bytes |

The simulation result in figure 4 indicates that proper fragmentation enhances throughput.

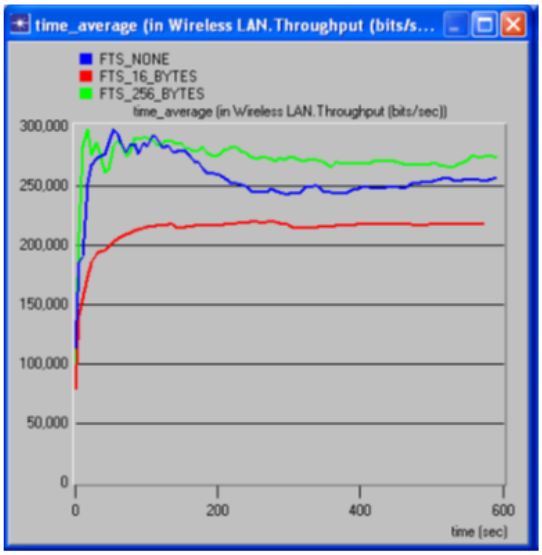


Fig 4: Throughput result for different FTS.

## 6. Discuss

The simulation was completed, it is seen that when a network parameter is setting to different scenarios, the throughput performance is usually affected. The following points are to be noted from the results of this simulation:

1- When the data rate in a wireless network is increased, the throughput increases and packets are delivered more accurately, hence less requirement for retransmission.
2- For a very small size of buffer, if data rate is increased, the throughput reduces to zero approximately, meaning that packets are dropped or discarded because the buffer has no space to accommodate more packets.
3- Proper fragmentation enhances throughput.But fragmentation increases the size of queue and the number of data dropped in a transmission.

## 7. Conclusion

From the results we conclude: that when the data rate in a wireless network is increased, the throughput increases, for buffer size if data rate is increased the throughput reduces to zero, and the correctly fragmentation enhances the throughput of network.

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