Queue Length and Radio State MAC Layer Analysis of Host to Host Network Based on WLAN IEEE 802.11

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ABSTRACT
Wireless Local Area Network (WLAN) is becoming increasingly important in present day due to desire of high speed internet anywhere, anytime. This paper presents and evaluates the different radio states of all hosts in the wireless network based on IEEE 802.11 standard. We show through simulation that the queue length has some restriction to receive the packets. We measure through simulation the different parameters like generation of packets, queue length, and different radio states and MAC state information etc. of WLAN network. The performance analysis of WLAN network is done in multi-path propagation and ambient noise.

Keywords
WLAN, MAC, IEEE 802.11

1. INTRODUCTION

The purpose of IEEE 802.11 standard is stated as "to provide wireless connectivity to automatic machinery, equipment, or stations that require rapid deployment, which may be portable or hand-held, or which may be mounted on moving vehicles within a local area" [4]. And the scope is to develop a medium access control (MAC) and physical layer (PHY) specification for wireless connectivity for fixed, portable, and moving stations within a local area. In this section, we only sketch the portions of the IEEE 802.11 standard that are relevant for this paper. A detailed description can be found in [7], [9], [10].

The basic access method in the IEEE 802.11 MAC protocol is the Distributed Coordination Function (DCF), which is a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) MAC protocol. Besides the DCF, the IEEE 802.11 also incorporates an alternative access method known as the Point Coordination Function (PCF)—an access method that is similar to a polling system and uses a point coordinator to determine which host has the right to transmit [2]. The DCF requires that every host, before transmitting, perform a carrier sensing activity to determine the state of the channel (idle or busy). If the medium is found to be idle for an interval exceeding the Distributed InterFrame Space (DIFS), the station continues with its transmission. If the medium is busy, the transmission is deferred until the ongoing transmission concludes. When the channel becomes idle, a Collision Avoidance mechanism is adopted. The IEEE 802.11 Collision Avoidance mechanism is a Binary Exponential Backoff scheme [8], [11], [12], [13]. According to this mechanism, a station selects a random interval, called a backoff interval, which is used to initialize a backoff counter.

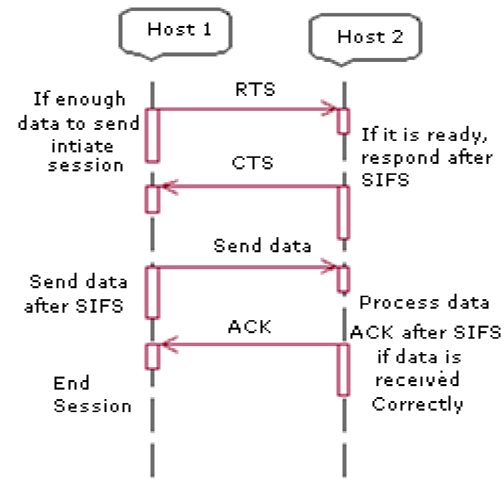

Figure: 1 Data transmission in IEEE 802.11 (DCF mode) using RTS and CTS

It is well known fact that 802.11 DCF can be used as MAC scheme of multi-hop wireless Ad hoc networks. In the following we use Sheu et al. [5] approach for predicting the medium access delay (MAC) of a mobile node in IEEE 802.11 DCF [13] mode. Data transmission by a host in DCF mode using RTS (Request to send) and CTS (Clear to send) handshake to avoid hidden host problem is depicted in Figure 1. Figure 1 shows that if host 1 wants to send data to host 2, it has to send RTS to host 2. If host 2 replied for RTS in terms of CTS means host 2 is ready to receive data after SIFS (Short InterFrame Space). Then host 1 send data after SIFS. Host 2 wills response in acknowledgement if data is received correctly.

2. SIMULATION MODEL STRUCTURE

The model of WLAN network was developed in OMNET ++ simulation software. The network comprises of six wireless nodes (host 0 to host5) associated with one access point. Wireless **access points** (APs or WAPs) are specially configured nodes on wireless local area networks (WLANs). Access points act as a central transmitter and receiver of WLAN radio signals. We include a channel control to establish communication channel and assign ip address to the nodes respectively. Figure 2 shows the simulation model of WLAN network based on IEEE standard.

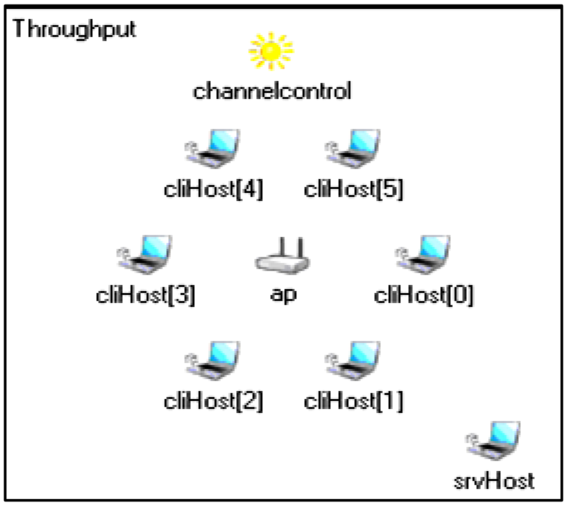

Fig 2: Simulation Model

Table 1 shows the parameters assigned to the WLAN network. The various parameters are: carrier frequency 2.4 GHz, SNIR (signal to noise interference ratio) threshold 4dB. The hosts are moved with different angles within the range of access points. Mobility start angles of all the hosts are given in Table 2.

Table 1: System Parameters

Maximum sending power in (mW)	20 mW
Signal Attenuation Threshold in dBm	-110 dBm
Carrier Frequency of channel in GHz	2.4 GHz
Bit rate	20 Mbps
Snir Threshold	4 dB

Table 2: Mobility start angle for different host

Client Host 0	0 degree
Client Host 1	60 degree
Client Host 2	120 degree
Client Host 3	180 degree
Client Host 4	240 degree
Client Host 5	300 degree

3. SIMULATION RESULTS

Server host is sending acknowledgement to all host as well as to access point that there is availability to send the data frame.

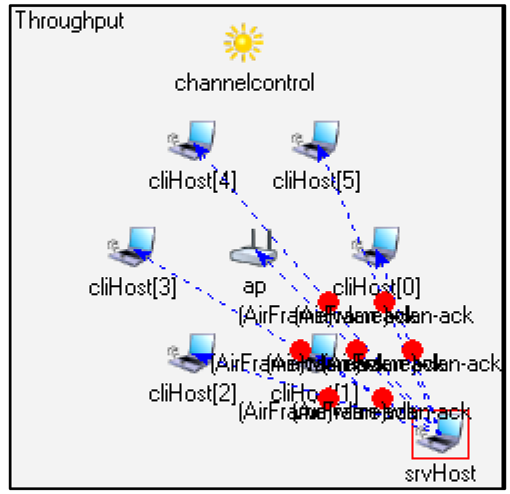

Fig 3: Acknowledgment sending by Server Host in network

So, if any host or access point has data frame to send they can send. Figure 3 shows the acknowledgement send by server host to all other host including access point.

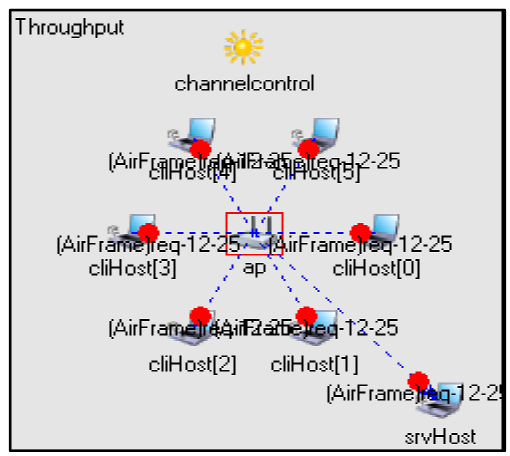

Fig 4: Access point sending Airframe request (12-25)

Table 3 shows state information of all hosts of WLAN network.

Table 3: The state information of all hosts

Host	Mode	State	Back off
Client Host 3	DCF	IDLE	0
Client Host 4	DCF	DEFER	1
Client Host 2	DCF	IDLE	0

Client Host 1	DCF	DEFER	1
Client Host 0	DCF	IDLE	0
Client Host 5	DCF	DEFER	1

In the DEFER state, the Host waits for channel to become idle again at WAITIDLE state. Only when channel is idle for that entire period, the Host will goes to BACKOFF state of the main state machine to perform back off. In all other cases, the Host will start all over. In the BACKOFF state if the channel becomes busy, back off will be paused and the Host moves back to DEFER state. The back off will not be resumed until the Host goes out of DEFER state knowing the channel is available for grab. When back off is done, the channel should be idle, so packets will be sent and host moves back to INITIATE_SESSION state. A figure of mean state shows the states for what timings they are transmitting, receiving or behaves ideally.

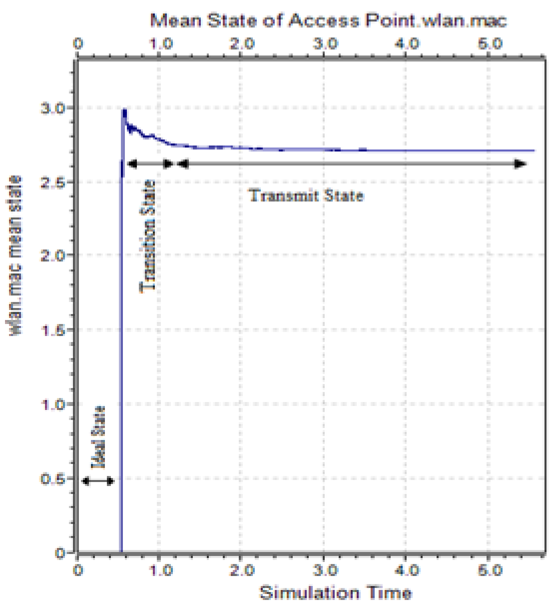

Fig 5: Mean State of Access Point

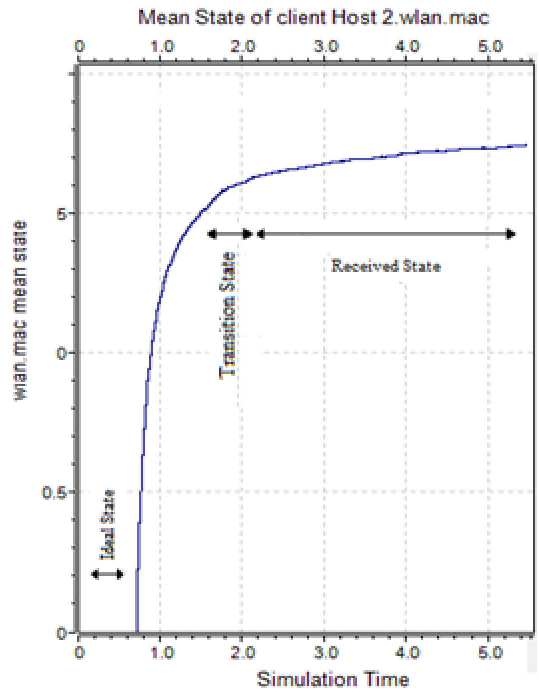

Fig 6: Mean State of Host 2

It has been observed that initially there is some variation in state of all host, access point and server point, but after some time whole the network will settle down with their radio states.

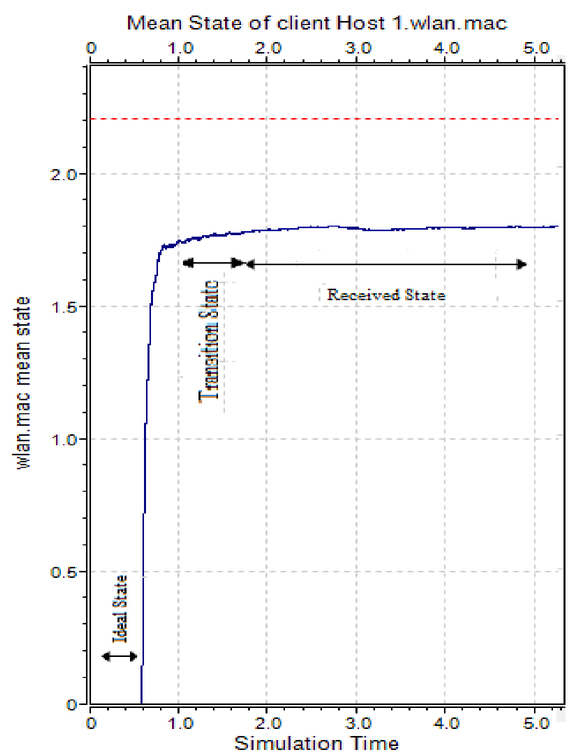

Fig 7: Mean State of Host 1

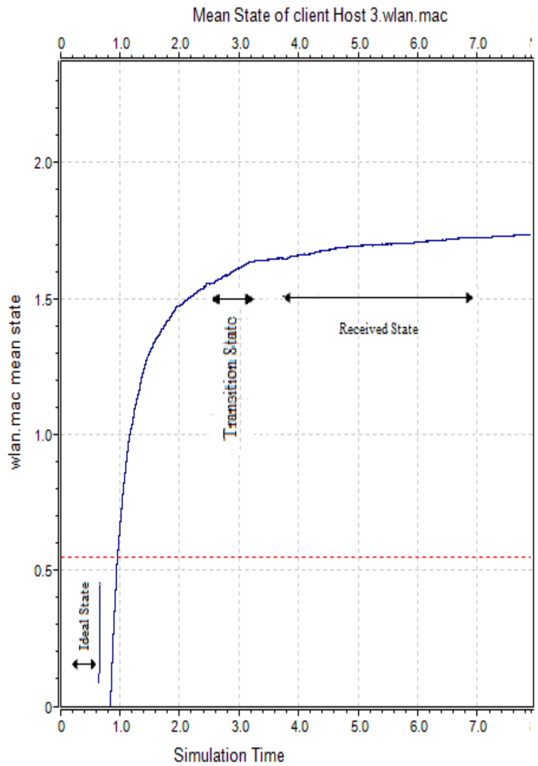

Fig 8: Mean State of Host 3

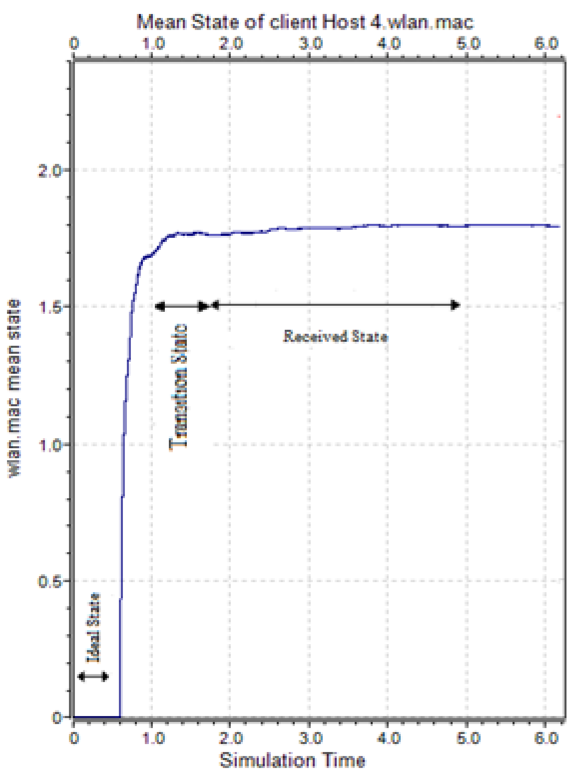

Fig 9: Mean State of Host 4

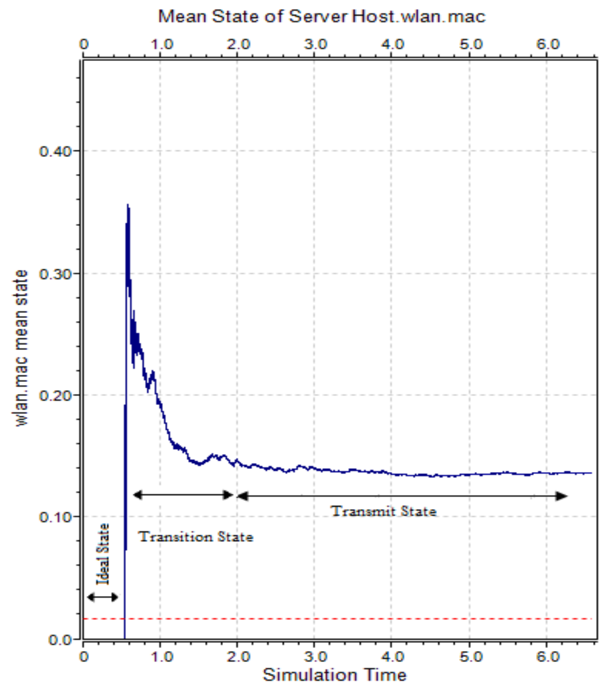

Fig 10: Mean State of Server host

A figure of mean state shows the states for what timings they are transmitting, receiving or behaves ideally.

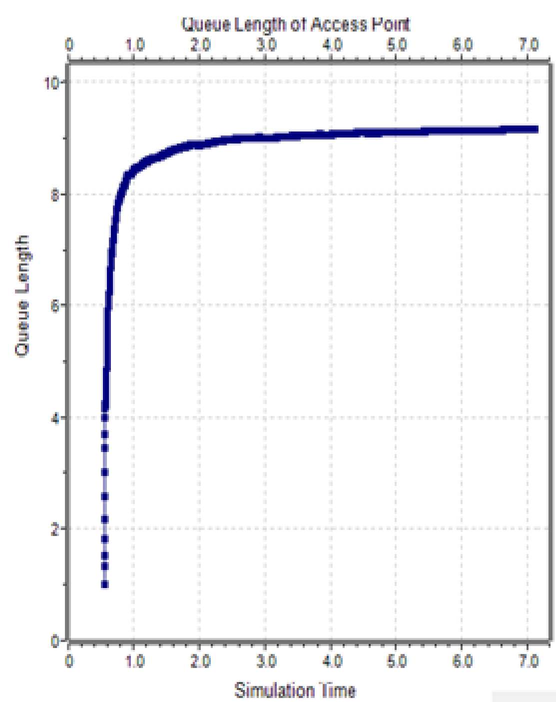

Fig 11: Queue length of Access point

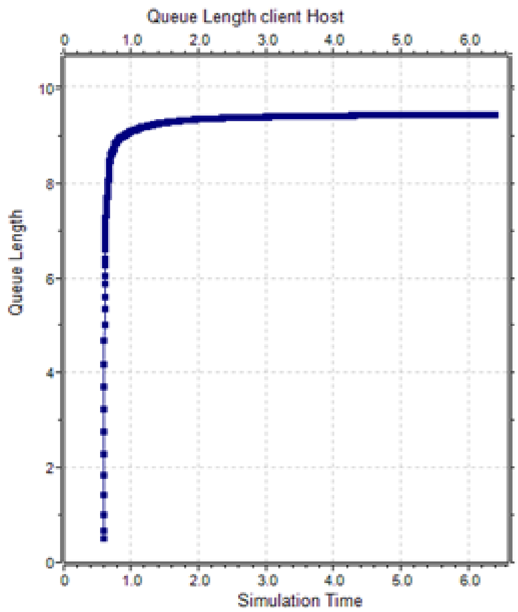

Fig 12: Queue length of Client Host

It has been observed that initially there is some variation in state of all host, access point and server point, but after some time whole the network will settle down with their radio states. Queue length we can define as number of packets are available to host to send in network. It is observed during the simulations that maximum queue length of all hosts as well as access point is 10. When queue length is full then any new arrival to that particular host is dropped.

4. CONCLUSION

In this paper we have discussed various parameters regarding wireless LAN IEEE 802.11 network in terms of queue length, number of packets received, different radio states of all hosts as well as access points and server host. The key focus was to check the radio state and queue length of all hosts as well as access points. It is observed that when queue length approaches to its maximum point i.e. 10, it drops the new arrival. We also present the ideal state, transition state and transmit, receive state of all hosts including access point and server.

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