A Proposed Model to Analyze the Performance of Wireless Local Area Network With the Use of Control Frames

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Abstract: Control frames are the traffic cops of the 802.11 network, assisting with the delivery of data and management frames. Physical carrier sensing is performed constantly by all stations that are not transmitting and receiving. When a station performs a physical carrier sense, it is actually listening to the channel to see whether any transmitters are taking up the channel. Request to send (RTS) and clear to send (CTS) frames are used to enhance the virtual carrier sense process. In this paper, performance of WLAN is analyzed under the control frames and statistics such as Load, Throughput, Delay, Media Access Delay, HTTP Page Response Time, HTTP Object Response Time, FTP Download Response Time, FTP Upload Response Time are presented with the help of OPNET IT Guru 9.1 Environment.

Keywords: Control Frames, WLAN, RTS, CTS, HTTP, FTP, OPNET.

I. INTRODUCTION

Wireless LANs introduce a rich technology capable of replacing traditional local area networks. Wi-Fi is one of the standards for wireless local area networks. Wireless networks consist of wireless devices equipped with wireless cards using radio frequency to transmit data from one location to another. These wireless networks cards have unique MAC addresses, which are formatted similar to the standard ethernet addresses. The speed of a wireless network depends on its access point. The access point has a limited range to maintain a connection to wireless devices. The number of computers that can be attached with an access point relies on the manufacturer of the access point. Some access points can handle ten computers, while others can handle over a hundred computers. The range of a wireless network can be extended by using a wireless relay extension point. Another option is to use multiple access points. These are a series of access points joined together to provide wireless access in a location which is very far from the central access point. Wireless local area networks can be used either to replace the existing LAN technology or to extend its reach and capabilities. Like a conventional LAN system, wireless local area networks can also be arranged in peer-to-peer or on an ad-hoc basis utilizing client adapters. In a WLAN, we define local area in terms of miles and kilometres rather than in feet or meters.

The infrastructure can be changed and moved according to the need and requirements of a particular organization [1] [2]. Wireless local area networks offer reliable and effective solutions to several immediate applications. As a result, it is currently used under many different platforms. A few industries utilizing the technology include education, finance, health care, hospitality, retail, and manufacturing. Like IEEE 802.3 (Ethernet) and IEEE 802.5(Token Ring), the 802.11 standard focuses on the two lower layers (1 and 2) of the Open System Interconnection (OSI) reference model. This reference model divides the Data Link Control (DLC) layer into Logical

Link Control (LLC) and Medium Access Control (MAC) sub layers. In general, the MAC Layer manages and maintains communications between 802.11 stations (radio network cards and access points) by coordinating access to a shared radio channel and utilizing protocols that enhance communications over a wireless medium. Often viewed as the "brains" of the network, the 802.11 MAC Layer uses an 802.11 Physical (PHY) Layer, such as 802.11b or 802.11a, to perform the tasks of carrier sensing, transmission, and receiving of 802.11 frames [3]. Before transmitting frames, a station must first gain access to the medium, which is a radio channel that stations share.

The 802.11 standard defines two forms of medium access, distributed coordination function (DCF) and point coordination function (PCF). DCF is mandatory and based on the CSMA/CA (carrier sense multiple access with collision avoidance) protocol. With DCF, 802.11 stations contend for access and attempt to send frames when there is no other station transmitting. If another station is sending a frame, stations are polite and wait until the channel is free. As collision detection in WLAN is difficult since all wireless stations may not be able to listen each other at all the times. So, The IEEE 802.11 standard includes an optional feature of the RTS/CTS (Request to Send/Clear to Send) function to control station access to the medium when collisions occur [4] [5] [6].

In this paper, an implementation of a simple Wi-Fi deployment with the use of control frames is presented. We have used OPNET IT Guru simulator to simulate the performance of scenario and evaluate various results.

II. OUR APPROACH

Simulation modeling is becoming popular method for network performance analysis because: of its Capability to simulate complex architectures and topologies. It is user friendly (GUI) and designers can test their new ideas and carry

out performance related studies and it is free from the burden of the "trial and error" hardware implementations. Among the various simulators available, Optimized Network Engineering Tools (OPNET) IT Guru Academic Edition is a simulator which is comprehensive and technology neutral in its capabilities. OPNET IT Guru enables the network designers to create a virtual network consisting of relevant hardware, protocols, and application software. The OPNET tool provides a hierarchical graphical user interface for the definition of network models. A network is constructed by graphically connecting network nodes via communications links. OPNET IT Guru comes with an extensive model library, including application traffic models (e.g., HTTP, FTP, E-mail, Database), protocol models (e.g., TCP/IP, IEEE 802.11b, Ethernet), and a broad set of distributions for random variant generation. There are also adequate facilities for simulation instrumentation, report generation, and statistical analysis of results [7] [8] [9].

III. SCENARIO AND SETTINGS

The IEEE 802.11 standard defines a set of wireless LAN protocols that deliver services similar to those found in wired Ethernet LAN environments. The IEEE 802.11 WLAN architecture is built around a Basic Service Set (BSS). A BSS is a set of stations that communicate with one another. When all the stations in the BSS can communicate directly with each other (without a connection to a wired network), the BSS is known as an ad hoc WLAN. When a BSS includes a wireless access point (AP) connected to a wired network, the BSS is called an infrastructure network. In this mode, all mobile stations in the WLAN communicate via the AP, providing access to stations on wired LANs and the world-wide Internet.

The proposed scenario consists of a network of two wireless LANs connected with router. The network infrastructure is shown in Fig. 1. The network has two subnets each consisting of 30 workstations which contain the mix of FTP and HTTP clients as shown in Fig. 2 and the subnets has been connected with router via 100BaseT. The Access Point nodes in subnets connect each subnet to the wired network.

The clients in the Wireless LAN are trying to communicate with servers at the remote site via IP cloud. The IP32_cloud node model represents an IP cloud supporting up to 32 serial line interfaces at a selectable data rate. Through which IP traffic can be modeled. IP packets arriving on any cloud interface are routed to the appropriate Output interface based on their destination IP address. The Routing Information Protocol (RIP) are used to automatically and dynamically create the cloud's routing tables and select routes in an adaptive manner. This cloud requires a fixed amount of time to route each packet, as determined by the "Packet Latency" attribute of the node. Packets are routed on a first-come-first-serve basis and may encounter queuing depending on the transmission rates of the corresponding output interfaces. The Internet "cloud" was configured with a packet discard ratio of 0.001%, which results in one packet being dropped out of every 100,000 packets in the Internet [10].
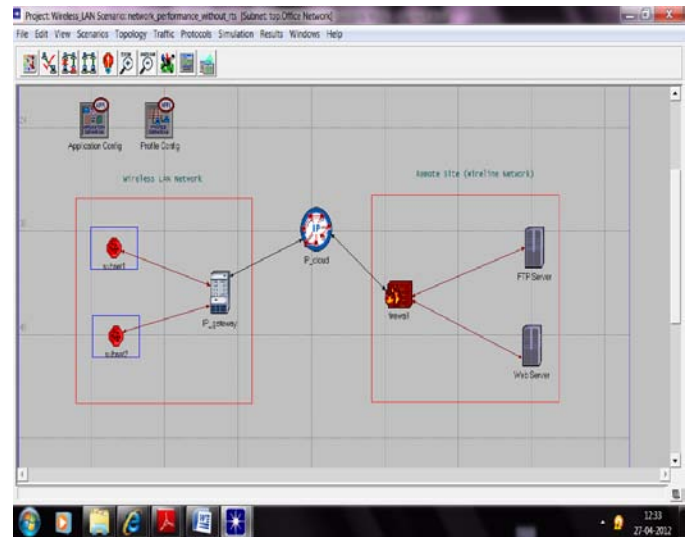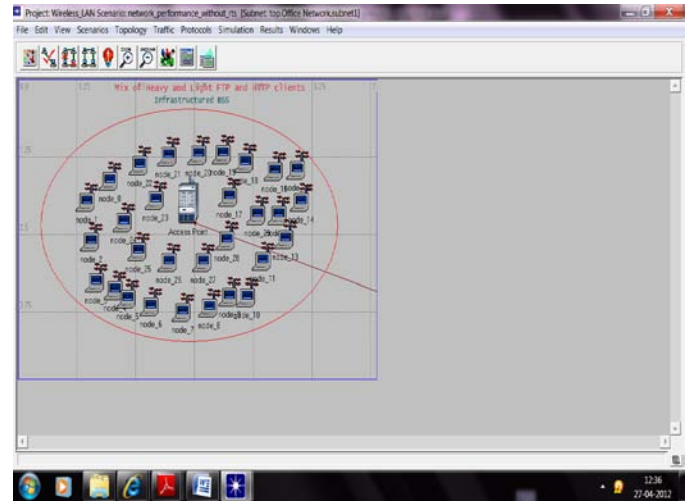

Figure 1. Network Layout

Figure 2. Mix of FTP and HTTP clients

Simulations have been carried out for our model to determine the optimal performance metrics. Table I and II indicate the application description and the wireless traffic generation parameters.

Table 1. Application and Description

Application	File Transfer	Web Browsing
Heavy traffic	File size (bytes) = 50000	Object size = 1000
Light traffic	File size (bytes) = 1000	Object size = 500

A. Efficiency Parameters:

The parameters which describe the performance of network are described below:-

a. Throughput: Throughput refers to how much data can be transferred from one location to another in a given amount of time. It is used to measure the performance of hard drives and RAM, as well as internet and network connections. Throughput is a measure of data rate (bits per second) generated by the application.

Table 2. Wireless LAN Traffic Generation Parameters

Attribute	Value
Start Time Offset (seconds)	uniform (5,10)
Repeatability	Once at Start Time
Start Time(seconds)	uniform (100,110)
Inter-repetition Time	constant (300)
Number of repetitions	Constant (30)
Repetition Pattern	Serial

b. ***Load:*** Network load define the total load on WLAN. Different applications have different effect on network load. Network load also depends upon the type and size of data. For example, for real time applications load will be high as compare to other type of data.

c. ***Average Delay:*** Average Delay is a technical term that can have a different meaning depending on the context. It can relate to networking, electronics or physics. In general it is the length of time taken for the quantity of interest to reach its destination. In computer networks, average delay is the amount of time it takes for the head of the signal to travel from the sender to the receiver over a medium. It can be computed as the ratio between the link length and the propagation speed over the specific medium.

<div align="center">Average delay = d/s where d is the distance and s is the wave propagation speed.</div>

d. ***Media Access Delay:*** It represents the global statistic for the total of queue and contention delays of data packets received by all WLAN MACs in the network from higher layer. For each packet the delay is recorded when the packet is sent to the physical layer for the first time. Hence, it also includes the period of successful RTS/CTS exchange, if this exchange is used for that packet.

e. ***FTP Download Response Time:*** The FTP download response time (sec) describes the time elapsed between sending a request and receiving the response packet. Measured from the time a client application sends a request to the server to the time it receives a response packet. Every response packet sent from a server to an FTP application is included in this statistics.

f. ***FTP Upload Response Time:*** The FTP upload response time (sec) represents the time elapsed between sending a file and receiving the response. The response time for responses sent from any server to an FTP application is included in this statistic.

g. ***HTTP Page Response Time:*** The HTTP page response time (sec) specifies the time required to retrieve the entire page with all the contained in line objects.

h. ***HTTP Object Response Time:*** The HTTP object response time (sec) specifies the response time for each in lined object from the HTML page.

Table III summarizes the efficiency parameters we simulated.

Table 3. Simulated Parameters

Application	Parameter	Unit
HTTP	Page Response Time	Seconds
	Object Response Time	Seconds
FTP	Download Response Time	Seconds
	Upload Response Time	Seconds
WLAN	Throughput	Bits/sec
	Media Access Delay	Seconds
	Delay	Seconds
	Load	Bits/sec

IV. SIMULATED SCENARIO

A simulation model was developed using OPNET. OPNET 802.11b PHY module was used as a standard with maximum data rate up to 11Mb/s. IEEE 802.11b direct sequence was used in which CWmin = 31, CWmax = 1023 and slot time was 20μs. In this section we will introduce the simulated scenario under the impact of control frames and analyse the various results as well. In this research 2 WLAN Subnets each with 30 Users through 1 access points using FTP and HTTP application are connected with outside wire-line network sending the data with the help of control (RTS/CTS) frames. A desirable Threshold value of control frame i.e. 1024 is assigned to each user.

V. RESULT ANALYSIS

Five graphs were selected after simulating our model (Figures 3 through 7). Upon completion and execution of the scenario presented in Fig. 1, the following results are listed. The viewpoints that were studied here are the load and throughput. Fig. 3 shows the average wireless LAN load versus throughput, two of these parameters are of bits/sec unit. Fig. 4 shows the time average in HTTP object response time in seconds which shows approximately fixed HTTP object response time with average time equal to 0.03 seconds and time average in HTTP page response time in seconds and time with average time equal to 0.07 seconds. Fig. 5 shows the average time in FTP Upload Response time in seconds which shows approximately fixed FTP upload response time with average time equal to 0.43 seconds. And time average in FTP Download response time in seconds which shows approximately fixed FTP upload response time with average time equal to 0.43 seconds. Fig. 6 shows the largest value of throughput of the proposed simulation.
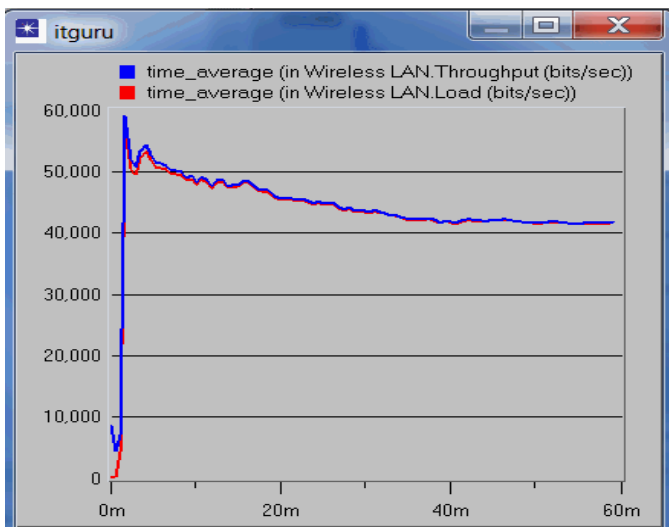
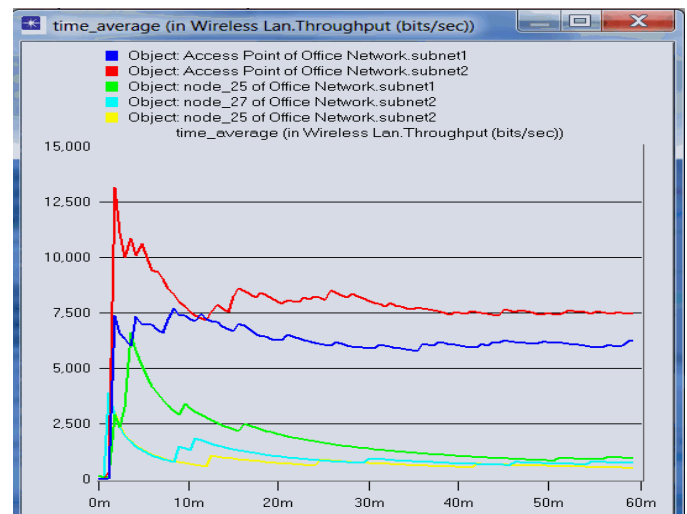Figure 3. WLAN Load and Throughput
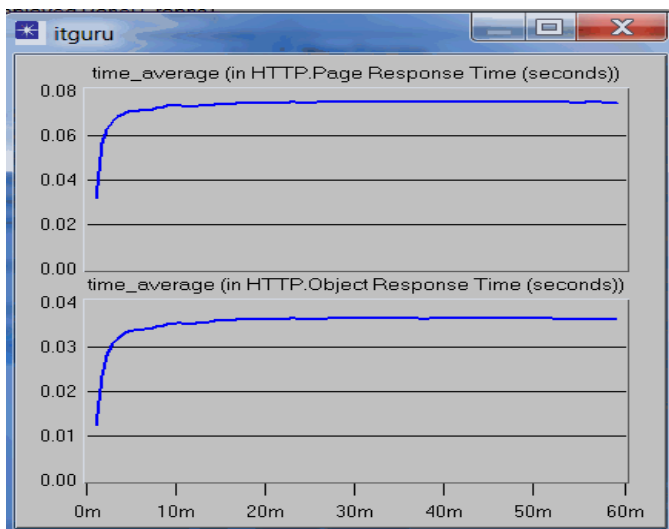

Figure 6. Largest 5 values of throughput
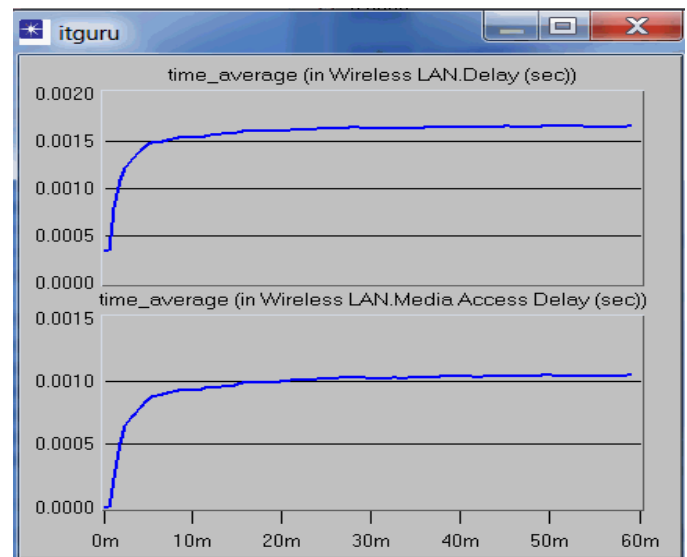

Figure 4. HTTP Page and Object response time
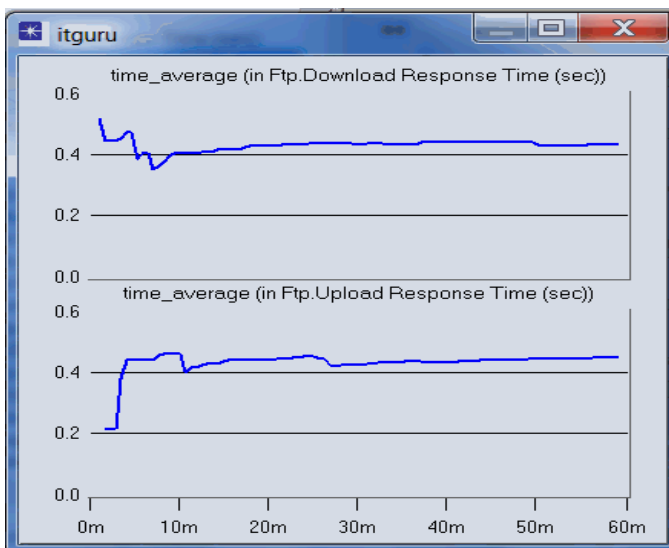

Figure 7. WLAN Delay and Media Access Delay

Implementation of Wi-Fi system with the result that Access point of office network subnet 2 has the largest throughput value. Fig. 7 show delay media Accesses in Wireless LAN in seconds which show approximately fixed delay time equal to 0.0016 and 0.0010 respectively.

VI. CONCLUSION

This paper presented a simulation study of a Model to Implement Wi-Fi system to measure performance factors of Load and throughput under the impact of control frames. The simulations, conducted using OPNET IT Guru 9.1. The simulation results show that Wi-Fi (WLAN) show a good performance for FTP and HTTP which was obviously through a stabile FTP download and Upload response time and HTTP page and object response time.

VII. REFERENCES

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Figure 5. FTP Download and Upload response time

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