SIMULATION AND ANALYSIS OF WIRELESS LOCAL AREA NETWORK USING OPNET

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Abstract: The objective of this paper is to investigate the performance of the wireless local area network (WLAN). In this paper we are going to use OPNET Modeler 9.1 to simulate the wireless network. In this paper we present a simulation study to analyze how the network load on different Access Points affects the wireless network. From the simulation model, we find out the performance parameters network delay, throughput and load. The analysis helps us to estimate and optimize the performance of the wireless local area network.

Keywords: WLAN, OPNET, Performance, Simulation.

Introduction: WLANs are local area networks [1] that do not use traditional cable or wired systems. Instead, they use a spread spectrum technology [2, 3] based on radio waves to connect computers and peripherals over a network. The outstanding feature of such networks is giving the users the freedom of mobility while they are connected to the network. Every station that can be connected to an 802.11 network is called a station. A station may be a wireless client or an Access Point. A Basic Service Sets (BSS) [2] is a set of stations that can communicate with one another. When BSS contains no access point and all the stations in the BSS communicate directly with each other, the BSS is called an independent BSS (IBSS) that is also known as ad-hoc network. Such network has no connection to a wired network or other Basic Service Sets. When a BSS includes an access point (AP), the BSS is no longer independent and is called an infrastructure BSS (IBSS). An infrastructure BSS can communicate with stations in the other BSSs using AP. The AP provides both the connection to the wired LAN and the local relay function within the BSSs. A set of connected BSSs is called an Extended Service Set (ESS). A Distribution System (DS) that can be a wired or a wireless LAN connects access points in such a system.

Wireless technologies are playing an increasingly prominent role in the global Internet infrastructure [3]. The table 1 shows the various IEEE wireless LAN standards [4, 5]. This popular "WiFi" (Wireless Fidelity) technology provides low-cost wireless Internet capability for end users, with high data transmission rate at the physical layer. Communication over wireless links often suffers from limited bandwidth, high error rates, and interference from other users.

Our focus in this paper is on the performance of wireless local area network [13]. From simulation we find out the performance parameters network delay, throughput and load.

TABLE 1. IEEE Wireless LAN Standards

Standard	Release Date	Op. Frequency	Data Rate (Mbps)	ange (Indoor)	Compatibility
802.11	1999	5 GHz	2	10 meters	802.11 only
802.11a	1999	5 GHz	54	50 meters	802.11a
802.11b	1999	2.4 GHz	11	100 meters	802.11g
802.11g	2003	2.4 GHz	54	100 meters	802.11b

The analysis helps us to estimate and optimize the performance of the wireless local area network.

Network Setup: In this work we used OPNET (Optimized Network Engineering Tool) Modeler 9.1 [6] to simulate the wireless network. The OPNET tool provides a hierarchical graphical user interface [7] for the definition of network models. A network is constructed by graphically connecting network nodes via communications links.

We start building the networking model with creating a project with Model Family "wireless_lan". A wireless office network is created with two Access Point (AP) and workstations. The AP is connected to a wireless LAN server which provides applications used for the workstations. We also define applications and profiles by adding a node for each, and we associate the workstation with the profiles in order to use the applications.

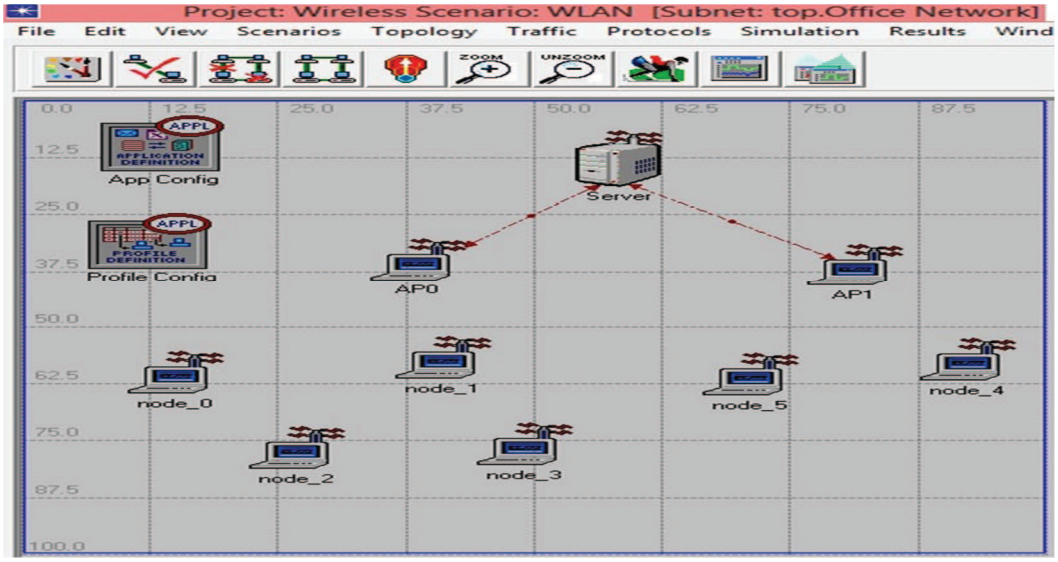

Fig 1. Wireless Network Model

Simulation and Results: A Wireless LAN network was built using OPNET Modeler 9.1 [6]. The WLAN consisted of a Wireless LAN Server. The wlan_server node model represents a server node with server applications running over TCP/IP and UDP/IP [8]. This node also supports IEEE 802.11 connection at 1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps. The operational speed can be specified on the node itself. In addition to the wireless LAN Server 2 Access Points (AP0, AP1) and 6 workstations (wlan_wkstn) node 0 to node 5 are used in the network. The workstations are associated with Access Points as (node 0 to node 3) with AP0 and (node 4 and node 5) with AP1. The HTTP application [11] is specified in the Application Configuration.

A profile will be created for this application to be supported by all wlan_wkstn nodes. The effect of user's load [9] on different Access Points is analysed in terms of delay, load and throughput [11].

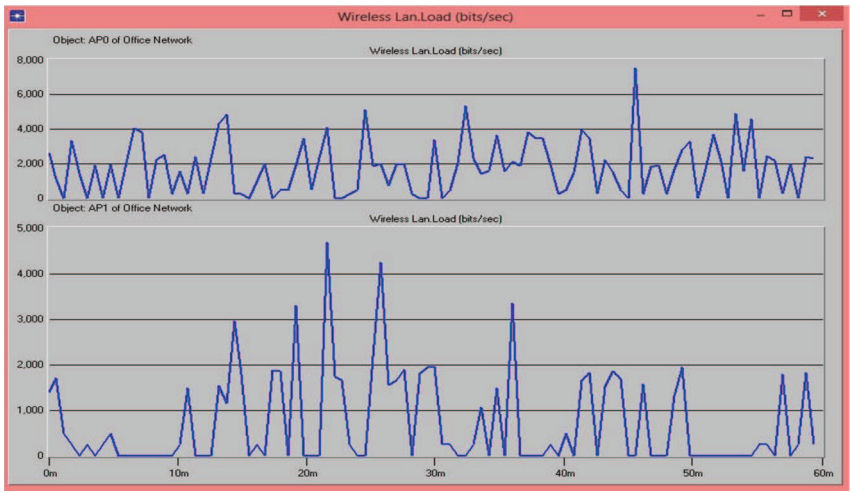

Fig 2. Load on AP0 and AP1

Figure 2 shows a comparison between overall load on AP0 and AP1. As the number of user increase on the access point the load increases [9, 10].

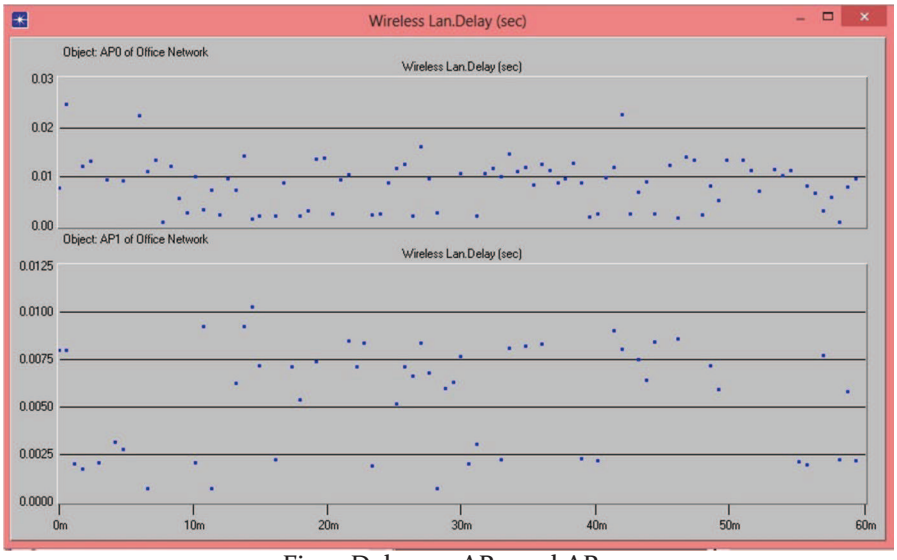

Fig 3. Delay on AP0 and AP1.

Figure 3 shows the effect of load in terms of delay. The figure 3 shows comparison between delay [12] on AP0 and AP1. As the delay on AP0 is more than the AP1.

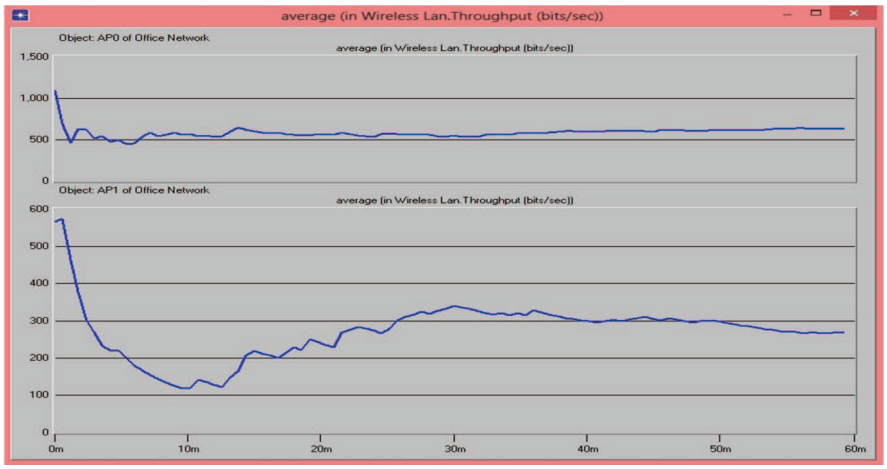

Fig 4. Throughput on AP0 and AP1

Figure 4 shows the overall throughput result. The AP1 is having the minimum load so the curve shape is smooth and reaches at the end but AP0 curve moves up and stays till the data in not transferred. In terms of effect of load the AP1 shows the better throughput as compare to AP0.

Conclusion: This paper presented a simulation study of Wireless LAN in office network scenario. The simulations, conducted using OPNET Modeler 9.1 [6], were carefully parameterized and validated with empirical measurements from a WLAN environment. Overlaid statistics [7] shows the overall results of load, delay and throughput of the network. The simulation results show, as the users association with the access point increases the load on the access point increases and delay also increases.

The result shows the throughput on the access points increases as the users association is decreases which means the as the network load increases the throughput decreases. In future we can extend this work with mobile workstations and with larger network models.

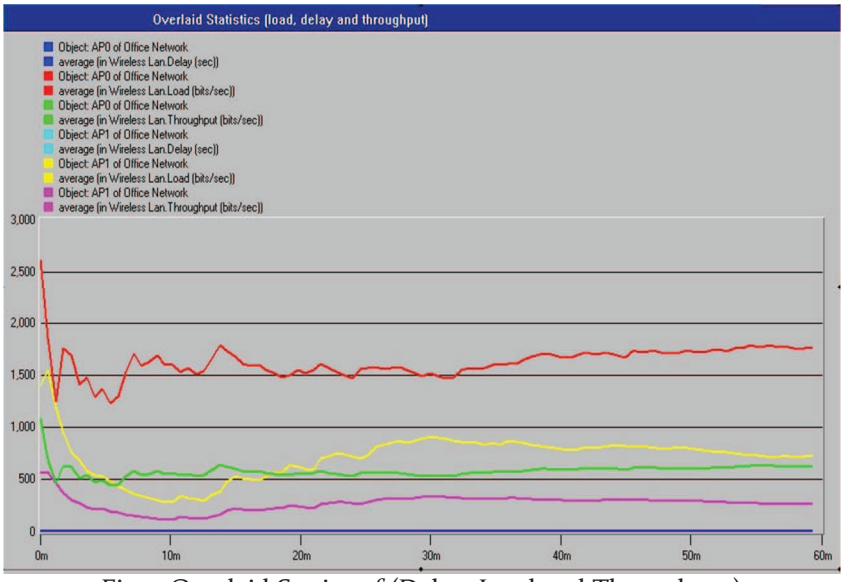

Fig 5. Overlaid Statics of (Delay, Load and Throughput)

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