Performance Evaluation of Wi-Fi Release (IEEE 802.11 A, B, G and N) Using OPNET

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Abstract

WIFI 802.11 is a wireless technology used to provide very high data rate over small areas, is the most widely accepted broad band wireless networking technology, providing high transmission rate among slendered wireless networking technology. This paper contains a comparison of some of the WIFI 802.11 standards authored by the Institute of Electrical and Electronics Engineers (IEEE). It explain some of the differences and similarities parameter (delay, throughput, Load) between the IEEE 802.11, (a, b, g, n) by using OPNET 17.5 simulator. And discuss this parameter depend on results in simulation.

Keywords: WIFI, LAN, IEEE, OPNET, ISM, PSK, QAM, CCK, OFDM, SS.

1. Introduction

Recently, Wi-Fi becomes one of the most popular standards for wireless Internet access technology. Using radio frequency connections between a base station (access point) and devices (client) with add-on or built-in 802.11 wireless cards, Wi-Fi gives access to the Internet and remote corporate and personal data without using the wires and cables of conventional wired networks in public places, houses, and offices. Wireless LAN (WLAN, also known as Wi-Fi) is a set of low tier, terrestrial, network technologies for data communication. The WLAN standards operate on the 2.4 GHz and 5 GHz Industrial, Science and Medical (ISM) frequency bands. It specified by the IEEE 802.11 standards and it comes in many different variations like IEEE 802.11a/b/g/n. The application of WLAN becomes more visible in the consumer market where most portable computers support at least one of the variations.

2. Wi-Fi Types

Types of different variations of WIFI: There are four type of WIFI 802.11 a IEEE 802.11a: It operate in 5 GHZ band with maximum data rate of 54Mbps the major advantage in deploying 802.11a with other IEEE 802.11b band 802.11g is that, they cannot co-exist, as they operate on different frequency band. (3) It less interference because so many device use this frequency. The 5 GHz frequency band uses shorter wavelengths cannot easily to pass through walls. 802.11 b: Has maximum data rate of 11 Mbps 802.11b device experience interface from other products operating in 2.4GHZ band. And it use direct sequence spread spectrum (DSSS). Device operating in the 2.4GHZ range include microwave ovens, Bluetooth devices. 802.11 g: IEEE 802.11g standard also operating in 2.4 GHZ band and data rate 54Mbps and it different in modulation technique it uses orthogonal frequency division multiplexing (OFDM). 802.11 n: IEEE 802.11n has become more popular than other because it improve the performance, it operate in 2.4 and 5GHZ, and data rate 450 Mbps on 8x improvement over its predecessors 802.11g and 802.11a, which offered 54 Mbps and it use multi input multi output technique (MIMO).IEEE 802.11n support the binding of two 20Mbps wide WLAN channel into a single 40Mbps wide channel which double throughput between station and client and it use 64 QAM modulation.
Table of different variations of WIFI:

Table 1: Simplified table of modulation and coding techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>802.11 a</th>
<th>802.11 b</th>
<th>802.11g</th>
<th>802.11n</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSK</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>QAM</td>
<td></td>
<td>√</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>CCK</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>OFDM</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>SS</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

Different type of WIFI Specifications:

Table 2: Comparison of different WIFI standard

<table>
<thead>
<tr>
<th>Standard</th>
<th>Frequency</th>
<th>Data rate</th>
<th>Range</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11 a</td>
<td>5 GHz</td>
<td>54 Mbps</td>
<td>120 m</td>
<td>LAN</td>
</tr>
<tr>
<td>802.11 b</td>
<td>2.4 GHz</td>
<td>11 Mbps</td>
<td>140 m</td>
<td>LAN</td>
</tr>
<tr>
<td>802.11g</td>
<td>2.4 GHz</td>
<td>54 Mbps</td>
<td>140 m</td>
<td>LAN</td>
</tr>
<tr>
<td>802.11n</td>
<td>2.4/5 GHz</td>
<td>248 Mbps</td>
<td>250 m</td>
<td>LAN</td>
</tr>
</tbody>
</table>

3. **OPNET Moduler**

OPNET [11] is a research oriented network simulation tool. It provides a comprehensive development environment for modeling and simulation of deployed wired and wireless networks. OPNET Modeler enables users to create customized models and to simulate various network scenarios. The wireless module is used to create models for wireless scenarios such as WiFi. The Modeler is object-oriented and employs a hierarchical approach to model communication networks. It provides graphical user interfaces known as editors to capture the specifications of deployed networks, equipment, and protocols. The three main editors are Project, Node, and Process Editors. We used OPNET Modeller 17.5 to simulate WiFi types a,b,g and n.

OPNET provides high-fidelity modelling, simulation, and analysis of wireless networks such as interference, transmitter/receiver characteristics, and full protocol stack, including MAC, routing, higher layer protocols, and applications. It also has the ability to incorporate node mobility and interconnect wire line transport networks.

4. **Method**

We used OPNET Modeller 17.5 to simulate WiFi standard categories (a, b, g and n) to compare the performance of each one by simulate the main parameter (delay, load and throughput). As shown in figure below. We used just one access point and 50 work station (client) to simulate the data traffic for 1 hour.
A. Network Components

This section discusses the components used in the suggested network models running on OPNET 17.5 device used in the network at 50 workstation and only one wireless access point.

- **The Application Config** includes a name and a description table that specifies various parameters for the different applications (i.e. web browser HTTP Heavy and FTP heavy applications). The specified application name is used while creating user profiles on "Profile_Config" object.

- **The Profile_Config** is used to create user profiles. These user profiles can be specified on different nodes in the network to generate application layer traffic. The applications defined in the Application_Config are used by this object to configure profiles. Traffic patterns can be specified followed by the configured profiles and the applications.

B. Simulation Scenarios

OPNET Modeller 17.5 has been used for simulation analysis. This section explains the network model used in this study. Four network scenarios have been prototyped as follows,

![Network Architecture](image)

**Fig. 1 NETWORK ARCHITECTURE (A,B,G & N)**

5. Results

The simulation ran for 1 hour; this time had been enough to gain an overview of the network behaviour. The result analysis within the four networks scenarios. Blue: 802.11 a, Red: 802.11 B, Green: 802.11 g, Green light: 802.11 n

A. **Delay Performance in (a,b,g and n):**

Delay is a very important performance characteristic of a network or telecommunications network. The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. Delay may differ slightly, depending on the location of the specific pair of communicating nodes. Although users only care about the total delay of a network, the delay of IEEE 802.11 a, b,g and n taken as shown in figure below:
B. Throughput Performance in (a, b, g and n).

C. Load performance in (a, b, g and n).

In Figure 4 below shows that.
6. Conclusion

The WIFI 802.11 n is the most popular type of WIFI technology, there are simpler and more manageable especially for large installation that’s make wireless connectivity from client to access point, However, In this paper, four scenarios have been conducted namely the models of WIFI techniques. 802.11 (a, b, g and n) . The experiments using OPNET 17.5 has been implemented and the result of the low scenario are recorded load, throughput and delay have been measured, delay results of 802.11g are better than 802.11(a,b,n),load performance of802.11n are betterthan802.11(a,b,g),finally throughput performance of802.11n are betterthan802.11(a,b,g). This means that 802.11n is the best wifi technology among the examined technology.

References

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