WLAN Improvisation Using OPNET

Submitted by:

Alishey Farrukh 14019019120

Muhammad Nouman 14019019092

Aqsa Abdullah 14019019110

Supervised by: Sir Hassan Tariq

Department of Electrical Engineering

School of Engineering

University of Management and Technology Lahore

WLAN Improvisation using OPNET

Submitted to the faculty of Electrical Engineering Department of the University of Management and Technology Lahore

In partial fulfillment of the requirements for the degree of

Bachelor of Science

In

Electrical Engineering

_____

Project Advisor

_____

Director Undergraduate Studies

Department of Electrical Engineering

School of Engineering

University of Management and Technology Lahore

Declaration

We declare that the work contained in this report is my own, except where explicitly stated otherwise. In addition this work has not been submitted to obtain another degree or professional qualification.

Signed: _____

Alishey Farrukh

Signed _____

Mohammad Nouman

Signed _____

Aqsa Abdullah

Dated: 2nd June 2018

ACKNOWLEDGEMENTS

Thanks to ALLAH ALMIGHTY for the blessings he bestowed on us to complete this project and thanks to our family for their continuous support.

Further we feel privileged to thank Sir Hassan Tariq for his continuous support and guidance throughout the project. And secondly, I would like to thank Muhammad Bin Tariq my batch mate for helping and guiding throughout the project practically and with his moral support. Further I would extend my thanks to Alishey Farrukh's best friend Amna Aziz for helping with Photoshop and many image tools.

I would extend my thanks to UMT digital library for the easy access of IEEE explore library.

Dedicated to our families

Contents

Acknowledgements 4
List of Figures 7
Abbreviations 9
Abstract 10
Chapter#1 Introduction 11
Chapter#2 Motivation and Literature Review 12
1. Introduction to OPNET 12
2.1.1 What is OPNET? 12
2.1.2 Overview of OPNET IT Guru 13
2.1.3 For Education OPNET IT Guru 16
2.1.4Three Tiered OPNET Hierarchy 18
2.1.5 OPNET Methodology and Workflow 26
Chapter#3 Problem Statement 28
3.1 Proposed Solution 28
Chapter#4 Engineering Methodology and Design 29
4.1 IEEE 802.11 Wireless LAN 29
4.1.1 Wireless LAN Evaluation 29
4.1.3 Basic Architecture of WLAN 31
4.2Wireless LAN Parameters 37
4.2.1 Selection of WLAN Parameters on OPNET 37
4.2.2 Important Wireless Local Area Network Parameters 39
Chapter#5 Implementation and Results 41
Chapter#6 Advantages 71
Chapter#7 Applications 72
Chapter#8 Conclusions 73
Chapter#9 Future Aspects 74
Chapter#10 References 75

LIST OF FIGURES

Figure 1 IT Guru WorkFlow[2] 14
Figure 2 network domains and sub networks [4] 20
Figure 3 node domain [4 21
Figure 4 special kinds of nodes [4] 22
Figure 5 from node domain to process domain 23
Figure 6 Node Domain 24
Figure 7 Process Domain attributes 25
Figure 8 Simulation Methodology of OPNET 26
Figure 9 OPNET Modeller 27
Figure 10 Two computers interconnected over wireless links [5] 30
Figure 11 Data Transmission over the carrier waves 31
Figure 12 OSI Reference Model for a wireless LAN adapter 32
Figure 13 Ad-Hoc Architecture of WLAN 35
Figure 14 Infrastructure architecture of WLAN 36
Figure 15 Frequency Hopping Delay (sec) 41
Figure 16 Frequency Hoping Media access delay (sec) 42
Figure 17 Frequency Hoping Throughput (bit/sec) 43
Figure 18 Direct Sequence Delay (sec) 44
Figure 19 Direct Sequence Media Access Delay (sec) 45
Figure 20 Direct Sequence Throughput (bits/sec) 46
Figure 21 Infra-Red Delay (sec) 47
Figure 22 Infra-Red Media Access delay (sec) 48
Figure 23 Infra-Red Throughput (bits/sec) 49
Figure 24 OFDM Delay (sec) 50
Figure 25 OFDM Media Access Delay (sec) 51
Figure 26 OFDM Throughput (bits/sec) 52
Figure 27 Extended Rate PHY Delay (sec) 53
Figure 28 Extended Rate PHY Media Access Delay (sec) 54
Figure 29 Extended Rate PHY Throughput (bits/sec) 55
Figure 30 Frequency Hopping Delay (sec) 56
Figure 31 Frequency Hopping Media Access Delay (sec) 57
Figure 32 Frequency Hopping Throughput (bit/sec) 58
Figure 33 DSSS Delay (sec) 59
Figure 34 DSSS Media Access Delay (sec) 60
Figure 35 DSSS Throughput (bits/sec) 61
Figure 36 Infra-Red Delay (sec) 62
Figure 37 Infra-Red Media Access Delay (sec) 63
Figure 38 Infra-Red Throughput (bits/sec) 64
Figure 39 OFDM Delay (sec) 65
Figure 40 OFDM Media Access Delay (sec) 66
Figure 41 OFDM Throughput (bits/sec) 67

Figure 42 Extended Rate PHY Delay (sec) 68
Figure 43 Extended Rate PHY Media Access Delay (sec) 69
Figure 44 Extended Rate PHY Throughput (bits/sec) 70

ABBREVIATIONS

LAN Local Area Network

WLAN Wireless Local Area Network

WPAN Wireless Personal Area Network

WMAN Wireless Metropolitan Area Network

WWAN Wireless Wired Area Network

OPNET Optical Network Engineering Tool

OLSR Optimized Link State Routing

DSSS Direct Sequence Spread Spectrum

OFDM Orthogonal Frequency Division Multiplexing

ACE Application Characterization Environment

VNE Virtual Network Environment

DES Discrete Event Simulator

GUI Graphical User Interface

ARPANET Advanced Research Projects Agency Network

IBM International Business Machine

IEEE International Electrical and Electronics Engineer

Wi-Fi Wireless Fidelity

OSI Open Systems Interconnection

LOS Line of Sight

FCC Federal Communication Commission

ABSTRACT

In this era of fast paced technologies wireless networks have become more desirable for users rather than the wired networks. But, unfortunately it has a drawback of low bandwidth. Despite the fact it is more likely due to mobility, flexibility and it having cheap physical medium (air). Network performance based on IEEE 802.11 have become more popular during this era.

For researchers to evaluate the network performance and telecommunication evaluation computer simulation has become a vital tool.[2] Simulation is more preferred as there is more availability of strong simulators and there is built-in flexibility in validation that is offered by the model construction and simulation. There are several network simulators available in the market but OPNET IT Guru is more preferable.

[3]OPNET IT Guru enables the user's easy creation of virtual scenarios and the factors changing with fast and effective outcomes which can definitely carried forward in practical use. There are several factors that affect the network performance of WLAN of which a few are throughput, increased retransmission, propagation delay, network delay, queuing delay, load delay, media access delay, bandwidth and many more.

[4]In our paper we will be providing variation in the factor of bandwidth in the provided ranges available on OPNET IT GURU and will be checking its effect caused on the factors of media access delay, load delay and throughput on four technology models which are being used. Our technology models include Frequency hopping, 802.11a, 802.11g and Direct Sequence Spread Spectrum. The number of users will be varied on four technologies and also along the buffer size will be varied and result will be concluded to be evaluated.

CHAPTER#1 INTRODUCTION

In this world of fast paced technology WLAN has become an essential to move with this world. As it is the internet that is connecting the countries across the internet and has made world a global village. [4]When its speed isn't effective users face various issues over different technologies which need to be encountered before the technology switch occurs and that is a huge damage to the eco-system firstly and secondly to the technology of the WLAN.

In our paper we have worked over the few factors that affect the four WLAN technologies which are as follows:

1. 802.11 a
2. 802.11 g
3. Frequency Hopping
4. Direct Sequence Spectrum

These technologies are mostly in demand but what hinders their performance are a few networking parameters which need to be encountered which include buffer size, throughput, media access delay, load delay and many more. Of the enlisted we will be considering the variation of buffer size at 64k, 128k, 256k and 1024k. The effects of changing buffer sizes on all the networks will be tabulated and the best one working on each buffer size will be considered out. The number of users will be varied along which the effect of changing buffer size will be encountered over the parameters of throughput, media access delay and load delay.