

UNIVERSITI TEKNOLOGI MARA

**PERFORMANCE ANALYSIS OF THE
IEEE STANDARD 802.16a
USING QUALNET SIMULATOR**

FUZI YUNUS

Dissertation submitted in partial fulfillment of the requirements
for the degree of

Master of Science (Computer Networking)

Faculty of Computer and Mathematical Sciences

May 2009

ABSTRACT

The IEEE 802.16a standard is amendment of the IEEE 802.16 standard. It emerged as a broadband wireless access technology; promise to deliver high data rates over large areas to a large number of users in the near future.

The aim of the project is to analyze the performance of the bandwidth used on the downlink for base station in the IEEE 802.16a standard. The analysis will involve result from the simulation of the standard model using the QualNet Simulator environment and theory. The concepts of the model involved in a simulator are to improve our understanding regarding the usage of this standard in wireless network.

Implementation within the simulator implies to firstly build basic blocks, which are the basis for more advanced features, and then implement the model step by step up to a working solution.

Finally, a direction for simulator improvement and simulation optimisation concludes the project, which has managed to provide a working, realistic implementation of the IEEE 802.16a standard into the QualNet simulator. Then, based on extensive simulations, this project presents the realistic attainable throughput/bandwidth expected WiMAX compatible systems based on the IEEE802.16a standard in various scenarios.

ACKNOWLEDGEMENT

Alhamdulillahirabbil 'alamin. Firstly, I'd like to thank the Almighty ALLAH (SWT) for guiding me through this half year of hard work. Thank you for helping me to make the correct decision even when I am unable to see the path ahead as well as for keeping me healthy, fit and strong to do this thesis.

I have been fortunate enough to have the support of so many people and without it this would not have been possible. While most people did not help directly on the project, every one of them contributed in some way towards helping me to get where I am today, even things like just being a friend, going out, and having fun. Others were responsible for giving me a push in the right direction in life, and for everyone listed here, I am eternally grateful for their help.

I sincerely wish to express my gratitude to my supervisor Dr. Kamaruddin Mamat for his support, guidance, patience and encouragement throughout the course of this research. Also, I am greatly indebted to him for his critical review of the manuscript of my thesis. Deepest gratitude dedicated to all lecturers who have taught CS778 Batch 3.

I would like to state that I could never ever have come this far without all the love and support from my beloved husband, Khuzair Yahaya and my two kids, Muhammad Zulhilmi and Muhammad Zulhaziq. I will always love you all.

I would also like to express my gratitude to my entire best friend, especially Hartima, Eviyanti, Ahmad Fuad and Ayyoub who supported me through the times when my sanity was fragile and for their patient understanding of my sense of isolation.

Thank you very much!

TABLE OF CONTENT

| | PAGE |
|---|-------------|
| ABSTRACT | ii |
| ACKNOWLEDGEMENTS | iii |
| TABLE OF CONTENT..... | iv |
| LIST OF TABLE | viii |
| LIST OF FIGURES..... | ix |
| LIST OF GRAPH..... | xi |
| LIST OF ABBREVIATIONS..... | xii |
| | |
| CHAPTER 1 | |
| INTRODUCTION | |
| 1.1 Overview..... | 1 |
| 1.2 Problem statement..... | 1 |
| 1.3 Significance of Study..... | 2 |
| 1.4 Research Objectives | 3 |
| 1.5 Research Scope | 3 |
| 1.6 Summary | 3 |
| | |
| CHAPTER 2 | |
| LITERATURE REVIEW | |
| 2.1 Introduction..... | 5 |
| 2.2 Wireless Communication..... | 5 |
| 2.2.1 Evolution of wireless technologies..... | 5 |
| 2.2.2 Issues..... | 6 |
| 2.3 Broadband Wireless Access Systems..... | 6 |
| 2.3.1 Possible Deployments..... | 7 |
| 2.4 The IEEE 802.16 Standards..... | 10 |

| | | |
|----------|---|----|
| 2.4.1 | Scope..... | 10 |
| 2.4.1[a] | Convergence Sublayer (CS)..... | 10 |
| 2.4.1[b] | MAC Common Part Sublayer (MAC CPS)..... | 11 |
| 2.4.1[c] | Privacy Sublayer | 11 |
| 2.4.1[d] | Physical Layer (PHY)..... | 11 |
| 2.4.2 | Radio Frequency Band..... | 11 |
| 2.4.3 | Main Principle..... | 12 |
| 2.4.3[a] | Connections..... | 12 |
| 2.4.3[b] | Scheduling..... | 14 |
| 2.4.4 | TDD Scheduling..... | 17 |
| 2.4.4[a] | Slot Allocation and Maps..... | 18 |
| 2.4.4[b] | Physical Slots and Minislots..... | 18 |
| 2.4.5 | Quality of Service (QoS)..... | 19 |
| 2.4.6 | Network Layer Adaptation..... | 19 |
| 2.5 | The IEEE 802.16a Standard..... | 20 |
| 2.5.1 | Amendments to the IEEE 802.16 standard..... | 20 |
| 2.5.2 | Frequency Band Covered..... | 20 |
| 2.5.3 | Physical Layer Specifications..... | 20 |
| 2.5.4 | The Mesh Mode..... | 21 |
| 2.6 | Traffic Types..... | 22 |
| 2.6.1 | Constant Bit Rate..... | 22 |
| 2.6.2 | Variable Bit Rate..... | 23 |
| 2.6.3 | File Transfer Protocol..... | 24 |
| 2.6.4 | Theory Analysis..... | 25 |
| 2.7 | Summary..... | 26 |

CHAPTER 3

METHODOLOGY

| | | |
|-----|---------------------------|----|
| 3.1 | Research Methodology..... | 27 |
| 3.2 | Research..... | 28 |