RELAYING TECHNIQUES IN 4G NETWORK

NOOR ZALINA BINTI KAMARUDIN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

RELAYING TECHNIQUES IN 4G NETWORK

NOOR ZALINA BINTI KAMARUDIN

This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Computer Engineering) With Honours

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Dedicated especially for beloved my parents, my siblings and to all friends whose encouragement and support with great help in completing it.

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ABSTRACT

Relaying techniques in 4G networks is a new technology for wireless standard. The relaying techniques involves the wimax 802.16j (multihop relay) and the 4G (Fourth (4) Generation). This wireless is designed to evaluate the throughput performances instead when the relay station and the mobile station has relative distance due to mobility by using two relaying techniques which is transmit diversity amplify forward, transmit diversity decode and forward, receive diversity amplify forward, receive diversity decode and forward. Through this simulation of the relative distance of the relay station and the mobile station, we can find out the throughput performances of the WIMAX 802.16j.

ABSTRAK

Menyampaikan teknik dalam rangkaian 4G teknologi baru untuk piawaian tanpa wayar. Teknik- teknik melibatkan 802.16j WIMAX (relay multihop) dan 4G. Jalur lebar tanpa wayar ini direka untuk menilai prestasi daya pemprosesan ketika stesen relay dan stesen mobil mempunyai jarak relatif menggunakan dua teknik penyampaikan iaitu menguat dan menghantar, membetulkan dan menghantar. Melalui simulasi jarak relative dari stesen relay dan stesen mobil, kite boleh mengetahui prestasi daya pemprosesan dari wimax 802.16j.

TABLE OF CONTENT

RELAYING TECHNIQUES IN 4G NETWORK i
DECLARATION iv
ACKNOWLEDGEMENT vii
ABSTRACT viii
ABSTRAK ix
TABLE OF CONTENT vii
LIST OF TABLE ix
LIST OF FIGURE x
ABBREVIATIONS xi
CHAPTER 1 1
INTRODUCTION 1
1.1 PROJECT OVERVIEW 1
1.2 PROBLEM STATEMENT 1
1.3 OBJECTIVES OF THE PROJECT 2
1.4 SCOPES 2
1.5 CONTRIBUTION 2
1.6 THESIS OUTLINE 3
CHAPTER 2 4
LITERATURE REVIEW 4
2.1 INTRODUCTION 4
2.2 WIMAX 5
2.3 LONG TERM EVOLUTION (LTE) 7
2.4 WIMAX VS LTE 10
2.5 COOPERATIVE DIVERSITY TECHNIQUES 13
2.6 RELAYING TECHNIQUES 15

2.7 SUMMARY 18
CHAPTER 3 19
METHODOLOGY 19
3.1 INTRODUCTION 19
3.2 PROJECT METHODOLOGY 20
3.3 FLOWCHART 22
3.4 SIMULATION ENVIRONMENT 23
3.5 GANTT CHART 25
3.6 SUMMARY 27
CHAPTER 4 28
RESULT AND DISCUSSION 28
4.1 INTRODUCTION 28
4.2 RESULT AND DISCUSSION 29
4.3 SUMMARY 36
CHAPTER 5 37
CONCLUSION 37
5.1 CONCLUSION 37
5.1.1 The coding that implement in matlab is successfully achieved. 38
5.1.2 Data analysed from the graph is match between the literature review and theory. 39
5.2 Future work 40
REFERENCES 41

LIST OF TABLE

NO	TITLE	PAGE
2.1	Advantages of LTE	8
2.2	Evolution towards 4G	12
3.1	Information about built in simulation	24
3.2	Throughputs formula	25
4.1	Percentage of throughput between two different techniques	35

LIST OF FIGURE

NO	TITLE	PAGE
3.1	System Development Life Cycle (SDLC)	20
3.2	Gantt chart for final year project	26
4.1	Graphs amplify and forward	30
4.2	Graphs decode and forward	31
4.3	Graphs amplify and forward	32
4.4	Graphs decode and forward	33
4.5	Basic idea to calculated distance using x axis and y axis.	34

ABBREVIATIONS

AF	-	AMPLIFY AND FORWARD
AMC	-	ADAPTIVE MODULATION CODING
BS	-	BASE STATION
CF	-	COMPRESS AND FORWARD
CRC	-	CYCLIC REDUNDANCY CHECK
CSI	-	CHANNEL STATE INFORMATION
DF	-	DECODE AND FORWARD
MS	-	MOBILE STATION
RS	-	RELAY STATON
STBC	-	SPACE TIME BLOCK CODING

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

The aim of this project is to study the characteristic and the utility of relaying in future wireless systems. The focus was mainly on the relaying techniques and the 4G in case of relative distance between the relay station and the mobile station due to the mobility influenced the throughput performances. This project also included the study of IEEE 802.16j, the multihop specification for 802.16 or WIMAX standard. I studied some relevant research papers, modeled the simulation scenarios based on the results of these papers and gained some valuable knowledge about it.

1.2 PROBLEM STATEMENT

The problem that always occur when poor transmission and receive by the relay station and the mobile station. The relative distance between the relay station and the mobile station due to the mobility influenced the wireless throughput performance for two relaying techniques which are amplify and forward, decode and forward. This problem will guide to design the relative distance and simulate the network model.

1.3 OBJECTIVES OF THE PROJECT

Specifically the objective of this project is to evaluate the throughput performances when the relay station and the mobile station have relative distance due the mobility using relaying techniques**.**

1.4 SCOPES

This project involves simulation of relative distance between the relay station and the mobile station due to mobility. This will divided into three stages which are:

1. To design the network model of 802.16j (multihop relay) due the relatives distance.
2. To simulate the network model of the 802.16j (multihop relay).
3. To evaluate the wireless throughput performances.

1.5 CONTRIBUTION

The significant of this project are:

1. To reduce the poor transmission and receive wireless throughput by knowing the relative distance between the relay station and the mobile station.

1.6 THESIS OUTLINE

This report contains 5 chapters that explain in details about the entire project. Chapter 1 emphasised about the introduction. This chapter focusing on the overview of this project, the objective and thesis outline.

Chapter 2 covers the literature review on the WIMAX and the 4G. This chapter discuss about the comparison between the WIMAX and the 4G technology. This chapter also consist of the four relaying technology wireless that has been used in the relay and five cooperative diversity scheme that used between relays.

Chapter 3 describes in details in methodology and the system design. This chapter cover up all the project implementation to achieve the goal. This chapter specially discusses about the method or procedure to finish up the project.

Chapter 4 analysed in detail the result of the simulation f the network model designed before. This chapter consist of throughput evaluation by using comparison of the result. The discussion also involves of disadvantages and advantages by using two relaying techniques.

Chapter 5 is conclusion which is driven from chapter 4 and future plan for this thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The 4G networks are beginning to make a mark on the wireless pages contains with WiMAX and LTE. Cooperation between 3GPP and GSM is to develop wimax and LTE towards 4G. Instead to achieve this massive achievement, techniques used in relay are discovered and research on this technique will be deeply studied. In this case, techniques that has been used is amplify forward (AF) and decode and forward (DF). As theory, techniques amplify and forward were not so good to transmit and receive a better throughput compared to decode and forward technique. Further details will be discussed in chapter 4.

2.2 WIMAX

WIMAX or worldwide interoperability for microwave access is one the branch of technology developed in nowadays. This technology represents the shifting in telecommunication technology. This technology offers cheaper, smaller and simpler technology compared to existing broadband such as cable, fiber and 3G wireless. [1]

The current WiMAX revision provides up to 40 Mbit/s with the IEEE 802.16m update expected to offer up to 1 Gbit/s fixed speeds. Based on IEEE 802.16 standard, WIMAX got the name by WIMAX 2001 which is when the found that wimax provide communication, support and cooperation between operation of the standard. This technology is suitable for large building base which is using busy traffic of networking such as internet access, voice data transfer rates and much more. WIMAX as solution to that can replace the problem which is used services provided by cable modems, LAN, optic or DSL technology.

WIMAX evolved from a Wi-Fi, IP-based background. WIMAX went through several stages of development, that to standardized the IEEE 802.16 for global deployment of wireless broadband network. Revision by revision is needed to establish the standard until the 802.16m is the most advanced version. Each revision done is to increase coverage capacity and service performance. For this simulation method, WIMAX multihop relay (802.16j) was used because the relay techniques have been implemented.

Although this technology is similar to Wi-Fi, WIMAX has a larger range and allows transferring data in high speeds. This is because the single base station of wimax can cover up to the entire metropolitan or city area. It is allows for mobility relatively than hop to hop coverage of Wi-Fi.

The IEEE 802.16 standard forms the basis of WIMAX and is sometimes referred to colloquially as WIMAX, Fixed WIMAX, Mobile WIMAX, 802.16d and 802.16e. Clarification of the formal names is as follow:

802.16-2004 is also known as 802.16d, which refers to the working party that has developed that standard. It is sometimes referred to as "Fixed WIMAX," since it has no support for mobility.

802.16e-2005, often abbreviated to 802.16e, is an amendment to 802.16-2004. It introduced support for mobility, among other things and is therefore also known as "Mobile WIMAX".

Mobile WIMAX is has the most commercial interest to date and is being actively deployed in many countries. Mobile WIMAX is also the basis of future revisions of WIMAX.

WIMAX is sometimes referred to as "Wi-Fi on steroids" and can be used for a number of applications including broadband connections, cellular backhaul, hotspots, etc. It is similar to Wi-Fi but it can also permit usage at much greater distances. WIMAX is more effective on a larger scale and it is more cost-effective because the cost of moving traditional broadband services to the next is more expensive.

2.3 LONG TERM EVOLUTION (LTE)

LTE is the most recent in the line of the GSM broadband network evolution development. Telecommunication standards have improved and advanced over time, going from GSM Technology to GPRS, to EDGE, to WCDMA, to HSPA, and finally to LTE. The LTE technology became the fastest form of Internet connection. HSPA only offered 11.5 Mb/s uplink speeds and 28 Mb/s downlink speeds, whereas LTE offers data speeds of up to 100 Mb/s downlink and 50 Mb/s uplink.

LTE is the reviewed by 3GPP to evolution of 3G mobile system. LTE is needed for higher data rates and greater efficiency which can achieved with HSDPA/HSPUPA, and or with new interface which is defined as 3GPP LTE.

LTE is needed for packet switched optimized system which is evolve UMTS towards packet only system. It is also needed for high quality of services which is can explained of used of licensed frequencies to guarantee quality of services, reduce control plane latency and reduce round trip delay. LTE also is needed for cheaper infrastructure which is simple architecture and reduce the number of network elements.

Data rate for LTE is also calculated for uplink and downlink which is :

i. Instantaneous downlink peak data rate of 100Mbit/s in a 20MHz downlink spectrum (i.e. 5 bit/s/Hz)
ii. Instantaneous uplink peak data rate of 50Mbit/s in a 20MHz uplink spectrum (i.e. 2.5 bit/s/Hz)

Coverage of cell range, cell capacity and mobility can be describes as:

Table 2.1: advantages of LTE [2]

Cell range	• 5 km - optimal size • 30km sizes with reasonable performance • up to 100 km cell sizes supported with acceptable performance
Cell capacity	• up to 200 active users per cell(5 MHz) (i.e., 200 active data clients)
Mobility	• Optimized for low mobility (0-15km/h) but supports high speed

LTE also have a latency which is for user plane is less than 5ms (millisecond) and for control plane is less than 50ms (millisecond). The advantages of LTE can be describes as below.

1. Improved spectrum efficiency
2. Cost-effective migration from Release 6 Universal Terrestrial Radio Access (UTRA) radio interface and architecture
3. Improved broadcasting
4. IP-optimized
5. Scalable bandwidth of 20MHz, 15MHz, 10MHz, 5MHz and <5MHz
6. Co-existence with legacy standards (users can transparently start a call or transfer of data in an area using an LTE standard, and, when there is no coverage, continue the operation without any action on their part using GSM/GPRS or W-CDMA-based UMTS)

2.4 WIMAX VS LTE

WIMAX is based on a IEEE standard (802.16), and like that other popular IEEE effort, Wi-Fi, it's an open standard that was debated by a large community of engineers before getting ratified. In fact, we're still waiting on the 802.16m standard for faster mobile WIMAX to be ratified. The level of openness means WIMAX equipment is standard and therefore cheaper to buy — sometimes half the cost and sometimes even less. Depending on the spectrum allotted for WIMAX deployments and how the network is configured, this can mean a WIMAX network is cheaper to build.

As for speeds, LTE will be faster than the current generation of WIMAX, but 802.16m that should be ratified in 2009 is fairly similar in speeds.

The crucial difference is that, unlike WIMAX, which requires a new network to be built, LTE runs on an evolution of the existing UMTS infrastructure already used by over 80 per cent of mobile subscribers globally. This means that even though development and deployment of the LTE standard may lag Mobile WIMAX, it has an advantage.