

**COMPARISON STUDY OF RELAY SELECTION SCHEMES
IN LONG TERM EVOLUTION (LTE) NETWORK**

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A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Electrical – Electronics & Telecommunications)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

JANUARY 2014

To my beloved family and friends

ACKNOWLEDGEMENT

I dedicate this entire work to my honorable lecturer and supervisor,
to my beloved family and all my close friends for their support and encouragement
that has constantly been a part of this success.

I would like to show my highest gratitude to my supervisor, Dr. Leow Chee Yen for
his invaluable support, patient and especially his encouragement and guidance to this
project which helped me to learn and understand this project and complete it
successfully

Special thank to my parents Mr. & Mrs. Matthews, my siblings and my fiancé
Prakash Rajah for their support, love, encouragement and advice throughout my
thesis completion period. . Special thanks to course mates for their support which
helped me to complete this thesis.

ABSTRACT

In Long Term Evolution Advanced wireless network, relaying is the most vital technology to extend the coverage of network, develop capacity of the network system. Wireless relaying has been recognized as the key technology to extend coverage to improve the throughput of system. A lot of factors are considered in this relaying technology to enhance the throughput such as location of relay, relay selection schemes, relay selection algorithm, and etc. Several of studies are being done on all the possible relay selection schemes and number of algorithm designed. There is no comparison study done, in current literature to compare the centralized and distributed relay selection scheme in the same study. This study investigates the effect of relay in terms of capacity in both centralized and distributed relay for fixed distance and random distance. The performance of the proposed relay placement algorithm is evaluated using numerical simulations. The algorithm of relay selection is based on threshold fixed; SNR in this study, to choose the relay which has a value higher than what is required. Any relay with lesser value is ignored, and the best relay among chosen relay is selected to transmit the signal. For centralized system, this is based on the feedback system which involves Channel State Information (CSI) and for distributed system it is based on the algorithm. This study doesn't include the latency and overhead constraints caused by CSI.

ABSTRAK

Di Long Term Evolution Advanced rangkaian tanpa wayar, geganti adalah teknologi yang paling penting untuk memperluaskan perlindungan ini adalah rangkaian, membangunkan kapasiti sistem rangkaian geganti Wireless telah diiktiraf sebagai teknologi utama untuk melanjutkan liputan untuk meningkatkan daya pemprosesan sistem. Banyak faktor yang dipertimbangkan dalam teknologi ini menyampaikan untuk meningkatkan daya pemprosesan seperti lokasi geganti, skim pemilihan relay, relay algoritma pemilihan, dan lain-lain. Pelbagai kajian sedang dilakukan ke atas semua kemungkinan skim pemilihan relay dan beberapa algoritma direka. Tidak ada kajian perbandingan dilakukan, dalam kesusasteraan semasa untuk membandingkan relay skim pemilihan berpusat dan diedarkan dalam kajian yang sama. Kajian ini menyiasat kesan relay dari segi keupayaan kedua-dua geganti berpusat dan diedarkan untuk jarak tetap dan jarak secara rawak. Prestasi algoritma penempatan geganti yang dicadangkan dinilai dengan menggunakan simulasi berangka. Algoritma pemilihan relay adalah berdasarkan kepada ambang tetap, SNR dalam kajian ini, untuk memilih geganti yang mempunyai nilai yang lebih tinggi daripada apa yang diperlukan. Apa-apa relay dengan nilai kurang diabaikan, dan geganti yang terbaik di kalangan relay dipilih dipilih untuk menghantar isyarat. Bagi sistem berpusat, ini adalah berdasarkan kepada sistem maklum balas yang melibatkan Channel Maklumat Negeri (CSI) dan bagi sistem teragih ia berdasarkan algoritma. Kajian ini tidak termasuk kependaman dan kekangan overhead yang disebabkan oleh CSI.

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LIST OF ABBREVIATIONS AND SYMBOLS

RS	-	Relay Station
RN	-	Relay Node
LTE	-	Long Term Evaluation
eNB	-	Base Station
eNodeB	-	Base Station
UE	-	User Equipment
Df	-	Direct Forward
Coop	-	Cooperative
E	-	Ergodic
Es	-	Transmitter Source Energy
Er	-	Receiver /Destination Energy
Nt	-	Number of Transmitter Antenna
Nr	-	Number of Receiver Antenna
CAPEX	-	Capital Expenditure
OPEX	-	Operational Expenditure
LTE	-	Long Term Evolution
GSM	-	Global System for Mobile Communications
UMTS	-	Universal Mobile Telecommunications System
SNR	-	Signal to Noise Ratio

CSI	-	Channel State Information
MIMO	-	Multiple Input Multiple Output
SISO	-	Single Input Single Output
MAC	-	Multiple Access phase
AF	-	Amplify Forward
DF	-	Decode Forward

CHAPTER 1

INTRODUCTION

1.1 Project Background

The growing demand for wireless communication is accommodated by new technologies to serve users with high speed rate data transmission with better coverage. The evolution of wireless cellular system to 4G is widely studied to improve LTE- Advanced system, the enhanced LTE mobile communication standard.

High data rate that can be achieved through LTE is one of the main factors driving towards the growth of this new technology. However the data rates reduction at cell edges, where signal levels are lower and interference levels are higher, is the main problem faced by all technologies. Although many alternate methods such as MIMO technology, OFDM and advanced error correction techniques improve throughput under many conditions, the problems experienced at the cell edges are not fully mitigated.

Current demand and growth in communication system, calls for a better cell edge performance, in which technology enhancements are based on the

improvement of cell edge performance with comparatively low cost. LTE relays are proposed as a solution to address the issue.

LTE advanced system introduce deployment of Relay Nodes (RN) to extend the cell coverage and improve the capacity and throughput. Relay Nodes are functioned to receive message from source nodes process it and forward it to its projected destination nodes. Effect of relay selection has great impact on performance enhancement factors such as coverage; throughput and fairness are taken into account and studied to provide better quality of service.

1.2 Problem Statements

In highly dense wireless network; there are typically several fixed relay nodes or distributed (user) nodes present in the region between source and destination. However making decision on which potential relay that can be selected to serve a network among all the available relays is the most crucial and difficult part of relaying system . The understanding of identifying the potential relay based on factor to be improved has lead to number of selection schemes. Factor that generally been studied to get, the best throughput, the best coverage and the minimal transmission delay.

The deployment of relay nodes for LTE advanced networks still in study as a promising solution to meet the growing demand for data rate and extension of coverage. The modeling of relay selection is the most crucial part of this deployment

of relay nodes technology to enhance its performance as there are many schemes are proposed in various studies based on the parameters to be improved.

Two selection schemes that was studied in this thesis are the centralized relay selection scheme and distributed selection scheme. In centralized scheme fixed nodes are deployed and the relay will be selected to help the source to forward its information based on perfect knowledge channel information. This scheme requires complete channel state information (CSI) which needs considerable number of overheads and increases the transmission delay. The improvement in capacity and coverage of a network also can be achieved by another relay selection known as device to device (D2D) or distributed relay selection in which UEs act as relays. In contrast to centralized relay selection, D2D relay operation uses medium access layer (MAC) mechanism a data communication protocol which allows independent link adaption of both the eNB- UE link referred to as the traditional radio link (TRL) and the UE-UE link referred as crossed line (XL). To possibly communicate several terminal or network nodes with a multiples access network and incorporate a shared medium the MAC sub layer provides address and channel access control mechanism.

1.3 Objective

In wireless network, relay selection plays a significant role in system performance. Objective of this study, firstly is to investigate the efficiency of centralized relay selection system compared to distributed user or device to device (D2D) relay selection system in terms of performance and secondly to study factors that contributes to the improvement of throughput (capacity)

1.4 Scopes of work

Scope of project covered to achieve objective as below:

- (i) Understand the LTE-Advanced technology and relaying system
- (ii) The study focuses on centralized relay selection scheme using decode and forward approach.
- (iii) A simulation using MATLAB (No measurements involved) to be carried out.
- (iv) The channel bandwidths, transmission bandwidths, and resource partitioning to be used in the simulation model match that of a LTE Release 10 system.

1.5 Project Report Outline

This is written to bring the reader step by step going in the main core of the content of the thesis and brief explanation of chapters covered in this thesis.

Chapter 1 provides the introduction to this project where brief background of the study problem and to the statement of the problem and followed by the objective, and the scope of the study.

Chapter 2 covers literature review which an overview of LTE Advanced network and Relaying System which including the concepts, benefits, limitations and applications. It will also cover explanation on Centralized and Distributed Relay Selection System.

Chapter 3 discusses about research methodology of two way relay in term of capacity and explains detail each of the methodology. This chapter also includes the Gantt chart for project part 1 and part 2. This is important to make sure my study in line with the problem. The simulation process is done by using MATLAB software. The design diagram also include in this chapter to give general idea about schematic diagram and block diagram.

Chapter 4 describes the detail about system model and protocol that will be used in the simulation. The key simulation parameters are presented in the form of tables and figures. Explanations of one way relay, two way relay, amplify forward and capacity over distance in term of equation discuss in this part.

Chapter 5 presents the result based on the simulation. Detailed explanation and discussion will be elaborated in this chapter.

Chapter 6 concludes the project objective and summarizes the whole literature including summarization of the future works that are needed to be done.

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