HANDOVER FAILURE AVOIDANCE IN WIRELESS HETEROGENEOUS NETWORK BY USING MATLAB SIMULATION

AZIZUL BIN BABA

A project report submitted in partial fulfilment of the

requirements for the degree of

Master of Engineering (Electronic & Telecommunications)

School of Electrical Engineering

Faculty of Engineering

Universiti Teknologi Malaysia

DECEMBER 2018

ACKNOWLEDGEMENT

In the name of Allah, the Beneficent, the Merciful. First of all I praise Allah, the Almighty, on whom ultimately, we depend for sustenance and guidance.

I would like to express my deep sense of gratitude to my honourable supervisor, Dr. Muhammad Ariff bin Baharudin my supervisor for his endeavour approach and outstanding supervision throughout this research. Their patience and immense knowledge have helped me along this research journey.

Last but not least, I would like to dedicate this thesis to my family especially my parents and sisters; whom I forever indebted. Thank you for the endless love, inspiration, drive, and support you all have given me.

ABSTRACT

During the ever emerging network with dense amount of interconnected devices environment, seamless, stable, sustainable and reliable network connection is very crucial in providing the best services to user's specifically mobile data user. The success rate of mobile users' handover from current serving cell to another target cell has to be at its optimum. However, with the advancement of this technology of ensuring the trade-off between handover failure and unnecessary handover is taken care of ensuring that only required handover is pursued in order to save the network resource utilization capacity. Hence, there is a need to have better system performance to ensure handover failure is avoided as much as possible. In general, there are several method that can be and has been well research to mitigate the issue on handover failure before which taken into account the RSS measure, time travelling estimation, handover necessity estimation, triggering condition and others. This study aims to enhance the current applied method which use time travelling estimation for a mobile users to stay inside the WLAN coverage area before it is being decided whether to handover or remain connected with the current serving network. The enhancement proposed the increase in overlapping area for a BS and MS to have sufficient time to initiate the handover so that handover failure can be avoided to lower than previous method. Consequently, the system model will compare the result from previous method and this newly proposed measure has improved the total handover failure occurrences by 50%, that every 100 failures from the previous method, this proposed method able to reduce the numbers of handover failure to only 50. However this result does not work with the speed on an MS greater than 30km/h. Hence with this result, it is proposed that for speed higher than 30km/h the same method remains in use to avoid any handover failure to the system.

ABSTRAK

Di dalam kepesatan rangkaian komunikasi masa kini yang penuh dengan kepelbagaian peranti mudah alih ini, satu sambungan yang lancar, stabil, mampan dan boleh diharap merupakan satu aspek yang sangat penting bagi memastikan pengalaman pengguna data muda alih berada pada tahap paling optimum. Oleh yang demikian, kadar keberjayaan sesuatu sambugan peranti itu diambil alih oleh dari satu pengkalan penyedian rangkaian kepada satu pengkalan penyediaan rangkaian yang lain perlulah pada kadar yang memuaskan. Namun demikian, dengan berkembang pesatnya teknologi ini timbal balik diantara kegagalan dalam penyerahan dan penyerahan yang tidak perlu haruslah diberikan perhatian lebih berat bagi memastikan sumber rangkaian tidak dibazirkan kepada sambungan yang tidak perlu. Jadi, satu sistem yang mempunyai prestasi yang lebih baik bagi menangani masalah kegagalan dalam penyerahan sambungan ini perlu untuk di wujudkan. Secara am nya, terdapat pelbagai kaedah yang telah di aplikasikan oleh para penyelidik sebelum ini di dalam bidang yang sama. Sebagai contoh, mengambil kira pengiraan kadar kekuatan isyarat yang diterima (RSS) oleh satu peranti mudah alih, syarat pencetus sambungan dan banyak lagi. Penyelidikan ini bertujuan untuk mempertingkat prestasi penyerahan sambungan dari satu pengkalan penyediaan ke satu yang lain. Penambahbaikan yang dicadang di dalam penyelidikan ini ialah untuk menambahkan jarak pertembungan di antara dua pangkalan penyediaan bagi membolehkan penyerahan sambungan dilakukan pada kadar yang lebih efektif. Jadi, model sistem yang terbaru ini menampilkan peningkatan kadar kegagalan dalam penyerahan sambungan berkurang pada kadar purata 50% dari sistem sebelumnya. Akan tetapi, hasil daripada penambahbaikan ini hanya berkesan untuk kadar halaju 30km/j dan kebawah. Bagi kadar halaju yang melebihin 30km/j kami mencadangkan agar sistem sedia ada digunakan untuk mengurangkan kadar kegagalan penyerahan sambungan.

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

LIST OF ABBREVIATIONS

MS	–	Mobile Stations
BS	–	Base Stations
WLAN	–	Wireless Local Access Networks
4G	–	4-th Generation Networks
VHD	–	Vertical Handover Decision
HetNet	–	Heterogeneous Network
SDR	–	Software Define Radio
CR	–	Cognitive Radio
RSSI	–	Received Signal Strength Indicator
UE	–	User Equipment
HO	–	Handover
MC	–	Macro Cells
SC	–	Small Cells
SINR	–	Signal-to-Interference Noise Ratio
LUI	–	Locally Unique Identity
NSI	–	Network Status Information
AP	–	Access Point

LIST OF SYMBOLS

R	–	WLAN radius
P_{Tx}	–	AP transmit power
d_{ref}	–	Distance between the AP and the reference point
PL_{ref}	–	Path loss at the reference point
PL_{ref}	–	Path loss exponent
σ	–	Standard deviation of shadow fading
τ_i	–	Handover delay from cellular network to WLAN
τ_o	–	Handover delay from WLAN to cellular network
P_f	–	Tolerable handover failure probability

CHAPTER 1

INTRODUCTION

1.1 Background

This chapter will discuss the insights and the introduction in regards to handover failure reduction in heterogeneous networks. Essentially the significance of this research and modification will impact the result of reduction of handover failure when a mobile stations (MS) moves from one point to another point till the end of a coverage of one respective base stations.

As technology advances through an evasive revolution of industry, the advancement of mobile technology has already been the focal topic for every researcher in the industry in regards to seamless mobility model. In regards to the deployment of latest modern technology over the 4G networks or WLAN network, this envisioned to more efficient methodology lays out to help delivering desired output of the proposed method. As data traffic increases over the cause of the increasing data users or mobile data users, it is required for sufficient growth in the network capacity and also better coverage to handle many users that will stay connected within the said network for a fair amount of time and better network quality during the handover from one point to another.

As we look into the network deployment site, adding more base stations (BS) into the network will incur an extra cost without considering the quality of the network that is being served. The implementation and design stage has to include many edges of consideration ensuring connection are still being handoff accordingly in between these BS. Even if the MSs are said to serve quality network within the area of coverage, however if the methodology used to pass the MS from one coverage area to another, failure will occur and this disruption in connection is one of the factor that needs to be taken care off.

In heterogeneous network, many cells type are deployable depends on the requirements and the demands of specific networks. These cells type can be of Pico cell, microcell ad femtocell [1].

1.2 Problem Statement

In heterogeneous network coverage network, the deployment of the network can consist of various network architecture, either from 3G, 4G or even 5G network, seamless connection is require ensuring the connection will stay intact for best user experience. In many cases, there will be a trade-off between the handover failures and also the unnecessary handover of a MS. Usually the excessive amount of unnecessary handover over the network can caused more occurrences of handover failure. With different BS can serves different radius of coverage, distance between one BS to another can play much bigger role to decide when and during what range of distance an MS should be handoff to another BS without having to disconnect from the old BS and restart reconnection with the new BS.

During other research on this handover failure, focused has been put through so that the measurement of received signal or RSS is measured accordingly in making a decision when is the right time to initiate a handover. However this method involving massive metric decision to the MS which result to more complicated solution to the handover failure study [1].

On the other hand, a region of handover that is commonly used for researcher in this area had to be improved in ensuring that the size is not to shallow or small till it cannot cater the speed of a MS leaving one specific BS. In this thesis, focus will be on looking towards the variances of size on overlapping area impacting the result of handover failure with different speed [2].

1.3 Research Objectives

The main objective for this research is to develop a reduction of total handover failure over different speed of MS in a heterogeneous network. To achieve the main goal, other specific objectives of this research include: -

i. To develop and improved overlapping decision boundary for handover from one BS to another BS

ii. To optimize the random path projection when MS change its direction before making a handover

iii. To achieve an improved performance of coding that result to the better handover in heterogeneous network.

1.4 Scope of Works

This research is limited to only the following scopes:

i. Currently, there are numbers of research that has been done worldwide on regards to handover failure over the heterogeneous network. Previous research involves in the study of handover estimation, the trade-off between the travelling time in the cell and RSS measurements, triggering condition in soft handover to the rate of handover failure and also the trade-off between handover failure and amount of unnecessary handover. However, the focus of this study only limits to the reduction of handover failure over the heterogeneous network.

ii. Design and implementation of Matlab code are the improvement made from previous research done using Vertical Handover Decision (VHD) which focused on comparing different method of the best handover and also improved the ratio of handover failure.

iii. As the model of this research study is mainly on the heterogeneous network, no significant network environment is chosen as the desired network inside this study.

iv. Analysis method and optimization techniques and method used in the Matlab 2018b version provided by UTM library.

1.5 Significance of Research Work

In general, there has been several other research papers or journal that been discussing this topics in a more comprehensive ways. The primary aspiration for this study is to unleash the potential of current coding scheme provided by previous researcher and improve the rate of handover failure through the observation of its reduction when a MS travelling in the coverage of any particular BS.

Although several studies has been put through to cover significance improvement and the correlation with other factors impacting the total handover failure reduction, there is still room of improvement for lesser connection to be broken down during the handover initiation.

1.6 Organization of Thesis

This thesis consists of 6 chapters. Chapter 1 introduces the thesis which includes a problem statement, thesis objectives, the significance of research work, and the research scopes. Chapter 2 gives the overview on the foundation for further understanding the handover failure avoidance and also the method used in previous research area. This chapter also discussing the existing work related to handover failure in heterogeneous network.

Later than it followed by Chapter 3 which provides the methodology of this research. Chapter 4 will be discussing about the technique that will be used to test the MATLAB code in regards to the handover failure ad Chapter 5 elaborates on the result gathered from the simulation using MATLAB and later Chapter 6 gives the conclusion and also future works recommendation.

REFERENCES

1. la X. Yan, “Optimization of Vertical Handover DEcision Processes for Fourth Generation Heterogeneous Networks,” Department of Electrical and Computer Systems Engineering, Australia, 2010.

2. L. Z. N. N. Mohanad Alhabo, "A Trade-Off Between Unnecessary Handover and Handover Failure for Heterogeneous Network," European Wireless, University of Leeds, UK, 2017

3. L. Yun, L. Man, C. Bin, W. Yong and L. Wenjing, "Dynamic optimization of handover parameters adjustment for conflict avoidance in long t erm evolution," China Communications, vol. 10, no. 1, pp. 56 - 71, 2013.

4. 3. I. G. X. C. David Lopez-Perez, "Theoretical Analysis of Handover Failure and Ping-Pong Rates for Heterogeneous Networks," in International Workshop on Small Cell Wireless Networks 2012, London, UK, 2012.

5. B. R. N.-H. P. Hyung-Deug Bae, "Analysis of Handover Failures in LTE Femtocell Systems," Mobile Communications Technology Research Department, ETRI, Korea, 2011.

6. S. N. T. Sandra Brigit Johnson, "An Optimized Algorithm for Vertical Handoff in Heterogeneous Wireless Networks," in IEEE Conference on Information and Communication Technologies (ICT 2013), TamilNadu, India, 2013.

7. M. M. H. L. Jin Cao, "Unified Handocer Authentication between Heterogeneous Access Systems in LTE Networks," in Globecom 2012 - Wireless Networking Symposium, 2012.

8. F. A. J. V. K. R. Georgios Kollias, "Handover Performance in LTE-A HetNets Through Inter-Site Distance Differentiation," in 2014 IEEE 19th International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD), 2014.

9. A. A. Gustavo Nader, "An Approach for the analysis of UWB interference on Third-Generation (3G) Wireless Networks," MSV, Mobile Satellite Ventures, Reston, USA, 2007.

10. A.-S. P. J.-Y. L. B.-C. K. Hyun-Seo Park, "Two-Step Handover for LTE HetNet Mobility Enhancements," ICTC, pp. 763-766, 2013.

11. M. S. D. L.-P. I. G. Karthink Vasudeva, Analysis of Handover Failures in Heterogenous Networks with Fading, 2015.

12. J. J. S. L. A. N. S. R. Jung-Min Moon, "On The Trade-Off between Handover Failure and Small Cell Utilization in Heterogenous Network," in IEEE ICC 2015 - Workshop on Advanced PHY and MAC Techniques for Super Dense Wireless Networks, 2015.

13. J. J. Y. Z. S. S. Koichi Adachi, "A Distributed Resource Reservation Scheme for Handover Failure Reduction," IEEE Wireless Communications Letters, pp. 537-540, October 2015.

14. A. Z. H. O. S. Mahmood, "An Optimized Travelling Time Estimation Mechanism for Minimizing Handover Failures from Cellular Networks to WLAN," in International Conference on Estimation, Detection and Information Fusion (ICEDIF 2015), Harbin, CHINA, 2015.

15. R. C. Y. C. Zheng Huang, "Theoretical Analysis of Handover Failure Rate in Heterogenous Network Under Random Shadowed Model," Key Laboratory of Mobile Communication Technology, Chongqing University of Posts and Telecommunications, Chingqing, CHINA, 2015.

16. Y.-S. C. Hyun-Seo Park, "Taking Advantage of Multiple Handover Preparations to improve handover performance in LTE Networks," in 8th International Conference on Future Generation Communication and Networking, Daejeon, Korea, 2014.

17. M. S. D. L.-P. I. G. Karthik Vasudeva, "Analysis of Handover Failures in Heterogeneous Networks with Fading," Dresden University of Technology, Bell Laboratories, Germany, Ireland, 2014.

18. D. Chen, J. Liu, Z. Huang, Z. Zhang and J. Wu, "Theoretical Analysis of Handover Failure and No Handover Rates for Heterogenous Networks," in 2015 International Conference on Wireless Communications & Signal Processing (WCSP), China, 2015.