UNIVERSITI PUTRA MALAYSIA

MODELING OF RELAY DEPLOYMENT IN MULTIHOP RELAY NETWORK

MILAD M. ALI SALIH AL-DOOGHACHI

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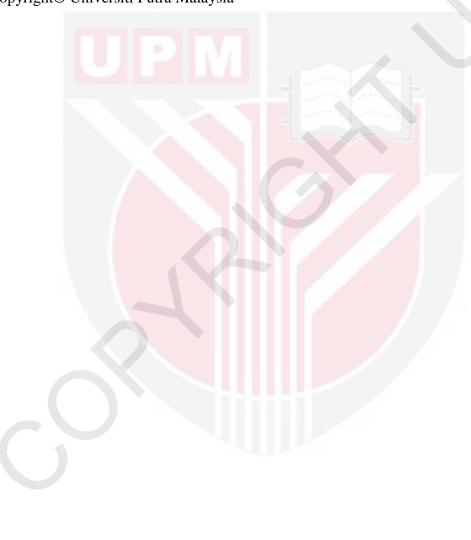**MODELING OF RELAY DEPLOYMENT IN MULTIHOP RELAY NETWORK**

By

MILAD M. ALI SALIH AL-DOOGHACHI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirement for the Degree of Master of Science

January 2014

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DEDICATION

This thesis is especially dedicated to my dearest and precious father, my

compassionate mother, my brother and sisters

all of my friends

and to my beloved home land IRAQ

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

MODELING OF RELAY DEPLOYMENT IN MULTIHOP RELAY NETWORK

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MILAD M. ALI SALIH AL-DOOGHACHI

January 2014

Chairman: **Associate Professor Alyani binti Ismail, Ph.D.**

Faculty   : **Engineering**

Worldwide interoperability for microwave access (WiMAX) system is becoming more popular to be a better choice to the DSL and cable broadband services and also supports point to multi point and mesh networks. However, the fixed and mobile networks have some inherent problems such as low (SNR) at the cell edge, as well as dead spot that exists due to signal transmission is often affected by geographic conditions, such as buildings in cities and underground environments, shadowing, which leads to non line-of-sight (NLOS) communication. Therefore, WiMAX multi-hop relay technology is a key enabler to meet the growing demand and requirements for a good coverage, while minimizing the wireless backhaul requirement to increase link capacity and throughput enhancement. The MMR scheme employs relay stations (RSs) to the coverage the dead spot or can be used to provide extended network deployments temporary for emergency circumstances or special events.

In this study, the performance of three hop relay network has been evaluated using the Amplify and Forward Relay (AF) and Non Amplify and Forward Relay (NAF) due to the ability of relay to provide better performance in short distance. In addition of the relay station effect on the performance of the network in different applications the three hop network in both cases was successfully evaluated to provide better link quality to subscribers and enhance the data rate of the system.

In this thesis, the author proposed an accurate noise modeling for WiMAX MMR network to enhance the system performance in terms of Signal-to-Noise Ratio (SNR) estimation procedure, channel assignments, link capacity and data rate were studied based on the simulation implicated using MATLAB software version 7.4 (R2007a).

The results show that the performance of system base on multi-hop relaying is one of the most promising technologies that provides a more cost-effective enhancement of coverage, user throughput (25% higher total in data rate), and provides a better link (22% higher total in link-capacity) quality to subscriptions when the RS adopts to amplify and forward (AF) scheme.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan ijazah Master Sains

PEMODELAN KERAHAN RELAY DALAM MULTIHOP RELAY RANGKAIAN

Oleh

MILAD M. ALI SALIH AL-DOOGHACHI

Januari 2014

Pengerusi: **Profesor Madya Alyani binti Ismail, Ph.D.**
Fakulti: **Kejuruteraan**

Keantarakendalian di seluruh dunia untuk sistem akses gelombang mikro (WiMAX) menjadi lebih popular untuk menjadi pilihan yang lebih baik kepada perkhidmatan jalur lebar DSL dan kabel dan juga menyokong titik ke pelbagai titik dan rangkaian mesh. Walau bagaimanapun, rangkaian tetap dan mudah alih mempunyai beberapa masalah yang wujud seperti rendah (SNR) di pinggir sel, serta tempat mati yang wujud disebabkan oleh isyarat penghantaran kerap dipengaruhi oleh keadaan geografi, seperti bangunan di bandar-bandar dan persekitaran bawah tanah, bayang yang membawa kepada komunikasi bukan barisan-penglihatan (NLOS). Oleh itu, teknologi geganti WiMAX multi-hop adalah pemboleh utama untuk memenuhi permintaan yang semakin meningkat dan keperluan untuk perlindungan yang baik, di samping mengurangkan keperluan wayarles backhaul untuk meningkatkan kapasiti link dan peningkatan pemprosesan. Skim MMR menggunakan stesen geganti (RSs) untuk liputan tempat yang mati atau boleh digunakan untuk menyediakan rangkaian lanjutan pembekalan sementara untuk keadaan kecemasan atau acara-acara khas. Prestasi sistem juga boleh diperbaiki apabila pelbagai-hop geganti berkerjasama berasaskan teknik dieksploitasi. Teknik ini adalah pemprosesan menghantar data serentak melalui pelbagai laluan yang berbeza dan kemudian menggabungkan maklumat yang diterima.

Dalam kajian ini, prestasi tiga hop rangkaian 'relay' telah dinilai menggunakan Forward Relay (AF) dan Bukan menguatkan dan Forward Relay (NAF) disebabkan oleh keupayaan relay untuk memberikan prestasi yang lebih baik dalam jarak pendek. Di samping kesan stesen relay kepada prestasi rangkaian dalam aplikasi yang berbeza tiga rangkaian hop dalam kedua-dua kes telah berjaya dinilai untuk menyediakan kualiti link yang lebih baik kepada pelanggan dan meningkatkan kadar data sistem.

Dalam tesis ini, penulis mencadangkan satu kaedah pengiraan untuk rangkaian MMR WiMAX untuk meningkatkan prestasi sistem dari segi Nisbah Isyarat-Hingar (SNR) prosedur anggaran, tugasan saluran, kapasiti link dan kadar data telah dikaji berdasarkan simulasi terbabit menggunakan MATLAB versi perisian 7.4 (R2007a).

Hasil kajian menunjukkan bahawa prestasi asas sistem pada multi-hop menyampaikan adalah salah satu teknologi yang paling menjanjikan serta menyediakan peningkatan yang lebih berkesan kos liputan, pemprosesan pengguna (jumlah 25% lebih tinggi kadar data), dan menyediakan pautan yang lebih baik (jumlah 22% lebih tinggi dalam pautan berkapasiti) berkualiti kepada langganan apabila RS pakai untuk menguatkan dan menggunakan (AF) skim.

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And finally, I would like to express my sincere gratitude to all those mention above who not only provided much needed time but also their continued support and inspiration which strengthened my pledge to overcome all obstacles in completing this task, and I dedicate this thesis to these people whom I love very much.

I certify that a Thesis Examination Committee has met on 15 January 2014 to conduct the final examination of Milad M. Ali Salih on his thesis entitled "Modeling of Relay Deployment in Multihop Relay Network" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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Date: 10 March 2014

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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DECLARATION

Declaration by graduate student

I hereby confirm that:

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Declaration by Members of Supervisory Committee

This is to confirm that:
- The research conducted and the writing of this thesis was under our supervision;
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Name of
Chairman of
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