COMBINATORIAL OPTIMIZATION OF TOPOLOGICAL DESIGN IN COMPUTER COMMUNICATION NETWORK

By

SALISU GARBA MOHAMMED

**Thesis submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in Fulfilment
of the requirements for the Degree of
Master of Science**

October, 2004

DEDICATION

This thesis is dedicated to my parents in Nigeria, Alhaji Garba Mohd and Hajiya Saratu Zakari, and my brother Lawal Garba Mohd whose selfless sacrifices and dedications have made it possible for me to reach this stage of my studies.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the requirements for the degree of Master of Science

COMBINATORIAL OPTIMIZATION OF TOPOLOGICAL DESIGN IN COMPUTER COMMUNICATION NETWORK

By

SALISU GARBA MOHAMMED

October, 2004

Chairman: Mohd Rizam Bin Abu Bakar, Ph. D.

Faculty: Science

We are living in a new era of information revolution, in which our economy, society, culture and political life are increasingly shaped by computers and communications. The field of telecommunications and networking has, in particular, witnessed more significant developments than many other fields of human knowledge.

The communication systems and digital technologies have resulted in the buildup of massive information banks by government, industries and individuals, which are required for efficient, available, reliable and integrity of international and commercial information.

The study in this thesis focuses on the problem of locating concentrators in a computer communication network whereby a concentrator will be located in an area that can provide an efficient service at a minimum cost. A mathematical model using facility location problem is developed. The objective is to minimize the cost of setting up and operating the communications network subject to capacity constraints. A lagrangian relaxation approach using subgradient optimization techniques is used to develop a heuristic solution procedure.

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

PENGOPTIMUMAN KOMBINATORIK BAGI RANCAGAN TOPOLOGI REKABENTUK DALAM JARINGAN KOMUNIKASI KOMPUTER: REHABATEK MASALAH MENYELURUH

Oleh

SALISU GARBA MOHAMMED

Oktober, 2004

Pengerusi: Mohd Rizam Bin Abu Bakar, Ph. D.
Fakulti: Sains

Komputer memainkan peranan yang penting dalam mencorak kehidupan di era baru dalam revolusi informasi dimana pembangunan ekonomi, sosial, kebudayaan dan politik pesat berkembang. Bidang jaringan telekomunikasi telah menyaksikan pembangunan yang sangat pusat selari degan- bidang ilmu yang.

Sistem komunikasi dan teknologi digital telah membuahkan suatu pembangunan mantap dalam pusat informasi melalui kerajaan, industri dan individu. Pembangunan ini memerlukan kecekapan, kebolehdapatan/kesenangan, kebolehpercayaan dan integriti di peringkat antarabangasa dan juga informasi komersial.

Pengajian tesis ini memfokus kepada permasalahan untuk menempatkan ‘concentrator’ di dalam sesebuah jaringan komunikasi komputer. ‘concentrator’ ini akan ditempatkan di kawasan dimana ia boleh menghasilkan suatu kemudahan kecekapan pada kos yang minimum model matematik menggunakan kemedahan lokasi dibina.

Objektif ialah untuk meminimumkan kos pengaturan dan operasi jaringan komunikasi tartakluk upada kapasiti kehayun. Di sini, pendekatan teknik ‘pengenduran lagrange menggunalan subhecerunan’ digunakan untuk membentik prosedur ‘selesaian heuristik’.

ACKNOWLEDGEMENTS

During the preparation and the development of this study, help and assistances has come from innumerable people, and to this collectively I express my thanks. And gratitude.

I wish to express special gratitude to Associate Prof.Dr. Rizam Bin Abu Bakar, the chairman of the supervisory committee for his keen interest, valuable contribution, tireless guidance and encouragement throughout the undertaking of this research work.

Thanks and gratitude also to my committee members: Associate Prof. Dr. Mohd Othman, and Associate Prof. Dr. Azmi Jaafar for their invaluable editing corrections/advice that brought the thesis to completion.

Sincere appreciation goes to my family particularly my parents for their love, care, and spiritual support through their fervent prayers. The help of my brother Dr. Mohd Lawal Garba cannot be given a passing comment.

I am highly indebted to the entire staffs of the Mathematics Department for their diverse cooperation and hospitality of the Malaysians. I am also grateful to my brothers in Malaysia, These Include Abdulkareem, Lawan, Ahmed, Umar, Nasiru and Umar.

I would like to thanks Dr. Ezra Jamal for her Mummy guidance and caring throughout my staying in Malaysia, and my appreciation to her children Ali & Maryam for their brotherly & sisterly care.

Finally, I am expressing my special thanks to my friends Ahmed Hurairah, Faiz, Dr. Usman, Ahlam, Erma and many others for their friendly care.

Praise and thanks to Almighty ALLAH for the wonderful guidance, good health and direction (Alhamdulillah).

I certify that an Examination Committee met on 25th October 2004 to conduct the final examination of Salisu Garba Mohammed on his Master of Science thesis entitled "Combinatorial Optimization of Topological Design in Computer Communication Network" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

KASSIM HAROON, Ph.D.
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
(Chairman)

MANSOR BIN MONSI, Ph.D.
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
(Member)

ROZITA JOHARI, Ph.D.
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

GULAM RUSUL RAHMAT ALI, Ph.D.
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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

MOHD RIZAM BN ABU BAKAR, Ph.D.
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

MOHAMED OTHMAN, Ph.D.
Associate Professor
Faculty of Computer Science and Information Technology,
Universiti Putra Malaysia
(Member)

AZMI JAAFAR, Ph.D.
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

_____
AINI IDERIS, Ph.D.
Professor
Dean of Graduate School
Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it have not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

SALISU GARBA MOHD

Date:

TABLE OF CONTENTS