

**UNIVERSITI TEKNOLOGI MARA**

**ANALYSIS OF TIME PERFORMANCE ON  
HETEREGENOUS CLUSTER**

**HANISAH BT SHAMSUDDIN**

Thesis submitted in partial fulfillment of the requirements  
for the degree of

**Master of Science in Computer Networking**

**Faculty of Information Technology and Quantitative Sciences**

**May 2009**

## ACKNOWLEDGEMENT

Alhamdulillah, a very thankful to ALLAH SWT for giving me a chance to complete my Thesis in a good health condition.

I would like to say my greatest thanks to my beloved parents who act as my backbone and support me mentally and financially all the time towards my journey to be an educated person.

First of all, I would like to thanks Pn Siti Arpah, my supervisor for her trust and kindness in helping me to complete my thesis. Thank you so much for your advice and your great opinion in order to improve my thesis.

I would like to express my greatest gratitude to a few of FTMSK lecturers, Miss Raihana, En Farok and others in helping me to get an excellent result throughout these years of my master program. Thank you so much and I will never forget the kindness of yours.

I also would like to dedicate a million thanks to my fellow course mate, to all this course ( CS778) students for being there, helping me in any sort of ways and always give their good advice and idea till the end of this master program.

Lastly, I would like to say my million thanks to all who have been involved directly or indirectly towards one mission, to complete this thesis that entitled Analysis of Time Performance on Heterogeneous Cluster.

## ABSTRACT

Sequential computing concept will always give time constraint problem to who are involve in complex computation like calculate and estimating weather forecast, rendering animation computation and many more in almost their daily works. Sequential computing also will lead to many others problem like high cost maintenance if system crash, performance problem and many more. Therefore, there are many parallel computing solution concept being introduced by developers and inventors. There are many real time simulation and advanced modeling concept being introduced for our benefit. However, there is less user can afford to have parallel supercomputers. So, low cost parallel computing solution that consists of few computer or PC being connected in one network can substitute supercomputers. In this research, there are few testing had been conducted to analyze the time performance in this heterogeneous cluster. 10 equations running being conducted in matrix multiplication calculation programming and 15 running for CPI calculation programming. In CPI calculation programming, it will compute the value of Pi by numerical integration in both parallel and sequential computing concept. Then, in matrix multiplication programming, it will compute the matrix calculation by 10 different 2x2 matrix size. It is expected that time of processing the calculation program in parallel will be much more less than sequential which means processing calculation or computation in parallel computing concept is faster that sequential computing concept.

## TABLE OF CONTENTS

ACKNOWLEDGEMENT .....	i
ABSTRACT .....	ii
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
LIST OF GRAPH.....	xi
LIST OF ABBREVIATION.....	xiii

### CHAPTER 1 INTRODUCTION

1.1 Introduction .....	1
1.2 Research Background .....	2
1.3 Problem Statement .....	3
1.4 Research Objectives .....	5
1.5 Research Scope and Limitations .....	5
1.6 Research Significance .....	6

### CHAPTER 2: LITERATURE REVIEW

2.1 Introduction.....	7
2.2 Overview of Time Performance in Heterogeneous Cluster.....	7
2.2.1 A Cluster Computer and its Architecture.....	8
2.3 Sequential Computing Concept.....	10
2.4 Parallel Computing Concept.....	10
2.4.1 Parallel Main Approach.....	12
2.4.2 Parallel Programming Model and Tools.....	13
2.4.2.1 Parallelizing Compilers.....	13
2.4.2.2 Parallel Languages.....	14
2.4.2.3 Virtual Shared Memory.....	15
2.5 Message passing Library.....	15
2.6 Methodical Design of Parallel Algorithms.....	18
2.6.1 Partitioning.....	19
2.6.2 Communication.....	19

2.6.3 Agglomeration.....	20
2.6.4 Mapping.....	20
2.7 Parallel Programming Paradigms.....	21
2.8 Task-Farming (or Master/Slave).....	21
2.9 Matrix Multiplication Algorithm.....	23
2.10 Network Topologies.....	25
2.10.1 Network Topologies : Star Topologies.....	25
2.10.2 Star Topologies Advantage.....	25
2.11 Similar/Related Work/Research.....	27
2.11.1 A System for Load Balancing a Heterogeneous Cluster .....	27
2.11.2 Parallel Programming Models and Paradigms.....	27
2.11.3 Eestimating The Optimal Configuration of a Heterogeneous Cluster: The Case of NAS Parallel Benchmarks.....	28
2.11.4 A Proposal for a Heterogeneous Cluster ScaLAPACK (Dense Linear Solvers).....	28
2.11.5 Analysis of Parallel Matrix Multiplication Program.....	29
2.11.6 Research Methodology: ASP Cluster Overview.....	30
2.11.6.1 Introduction.....	30
2.11.6.2 Characterization of Parallel Cluster.....	32
2.11.6.2.1 Hardware Installation.....	32
2.11.6.2.2 Network Configuration and Testing.....	34
2.11.6.2.3 Software Installation.....	37
2.11.6.2.4 Configuring Nodes.....	42
2.11.6.2.5 Linux Installation Validation.....	55
2.11.6.2.6 MPICH Library Installation.....	59
2.11.6.2.7 MPICH Installation Validation.....	63

## CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction.....	69
3.2 Research Methodology Phase.....	71