ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task is incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned our efforts with success.

I express my gratitude to my eminent supervisor Associate Prof. Chandra K Jha. He taught me how to solve problems in all the walk of life. Due to the course of this research on many different occasions, I have greatly benefited by his approach towards solving problems.

I would like to sincerely thank Asst. Professor Anup Bholna, AIM& ACT Department for his kind support and guidance throughout my research work.

I convey my cordial thanks to Prof. Aditya Shastri, Vice Chancellor, Banasthali University for the kind permission to undertake the study in this institution.

I also express my gratitude for honorable Prof. G. N Purohit, Dean, and AIM&ACT. He encouraged me to pursue research and to become a good teacher.

I also owe a debt of appreciation and gratefulness to the teaching and non-teaching staff. Grateful acknowledgements are due to the Computer Science staff for their cooperation throughout my research work.

It gives me immense pleasure to mention my cordial thanks to my lovable Friends, and all the research scholars of department for their consistent encouragement, precious support, cooperation, and inspiration. I treasure all precious moments we shared and would really like to thank them. I would like to pay my high regards to My Parents and for their love, blessings, sincere encouragement and inspiration throughout my life. Also I feel great pleasure in expressing my thankfulness to my brother Mr. Mukesh Kumar Sharma for his constant affection and encouragement.

Above all I thank almighty God who showered his blessings upon me throughout the period of my work.

Place: Banasthali (Raj) Ms. Yogita Kaushik

Date:
ABSTRACT

In modern era Cloud computing is a hot and burning topic among the researcher. Cloud computing has fulfilled dreams of computing in IT world to provide maximum resource utilizations. It provides flexibility, more capacity, ecosystem and service-oriented ideas. In IT field for small and big Enterprise trying to setup public, private and hybrid cloud for storing and transferring their process to the users. In this research work an algorithm is developed which solves the problem of resource utilization, performance degradation and availability. In thesis the role of virtualization technology in the cloud environment and how it plays a very big role in utilization of resources is explained. MERT (minimum expected response time) is calculated and on that bases, maximum response time is reduced. This system identifies how a user request reaches to data centers and checks the quality of request on the basis of different parameter that is bandwidth, response time, and throughput. It is based on queue for storage of requests followed by sorting concept. In proposed algorithm checked the availability, size (capacity), MERT and least loaded parameters to check and select VM for request, which increases the recourse utilization. In Proposed algorithm check with the parameters of least load the concept of overloading or under loading server with the concept of shifting is used. After the completion of all requests, VM destroys itself and release all the resources. Also the compression of various dynamics algorithm is shown in which we include honey bee algorithm, throttled algorithm, biased random algorithm with different elements in cloud environment with different metrics mainly used elements such as performance, resource utilization and minimum cost.

Keywords: Cloud computing; load balancing, Virtual machine, MERT, Eclipse javaIDE (Cloud), Round Robin Algorithm, Honeybee algorithm, Equally Spread Current Execution Algorithm, Throttled Load Balancing Algorithm, Cloud-Analyst.
# Table of Contents

Abstract

List of Figures

List of Tables

List of Abbreviations

1. Introduction .................................................................01-25

1.1 Cloud computing Service Models.........................................4
  1.1.1 Service models .........................................................4
  1.1.2 Deployment models in cloud computing...............................6
  1.1.3 Characteristics of cloud computing.....................................8
  1.1.4 Cloud services...........................................................9
  1.1.5 Cloud Service Providers................................................10

1.2 Load balancing............................................................12
  1.2.1 Cloud load balancing ...................................................12
  1.2.2 Types of load balancing................................................13
  1.2.3 Existing load balancing algorithm....................................13

1.3 Technology behind cloud computing....................................15
  1.3.1 Virtualization ...........................................................15
  1.3.2 Hypervisor and its types...............................................16
  1.3.3 Multi-tenancy............................................................17

1.4 Reason behind performance degradation ...............................17

1.5 Metrics of load balancing ...............................................20

1.6 Evolution of scheduling algorithm.....................................21
1. Motivation

1. Objective and Scope

1. Organization of thesis

2. Literature Survey

3. Research Methodology

3.1 Research Methodology

3.2 Steps in algorithms

3.3 Flow chart of Proposed SKYMAX Algorithm

3.4 Phase in algorithm

3.5 Tools requirements

4. Experimental Environment

4.1 Experiment 1 to check the performance between existing algorithms in simulation (round robin, ESCE and Throttled)

4.2 Experiment 2 to check the performance between Throttled and honey bee Algorithm

4.3 Experiment 3 to check the performance proposed SKYMAX algorithm

4.4 Experiment 4 to check the performance between Throttled Algorithm and proposed SKYMAX Algorithm

5. Conclusion and Future Work

6. References
List of Figures

Figure 1.1 a cloud is used in network diagrams to depict the Internet .................. 01
Figure 1.2 Software as a service (SaaS) .............................................................. 04
Figure 1.3 Downfall (: Platform as a service (PaaS) ........................................... 05
Figure 1.4 Infrastructure as a service (IaaS) ....................................................... 06
Figure 1.5 Cloud computing development models .............................................. 07
Figure 1.6 Comparison of various algorithms ..................................................... 15
Figure 1.7 Type I Hypervisor ............................................................................. 16
Figure 1.8 Type II Hypervisor ............................................................................ 16
Figure 1.9 Problems in Cloud ........................................................................... 17
Figure 1.10 Problems with heavy load ............................................................... 19
Figure 3.1 Process Diagram of Research Methodology ...................................... 40
Figure 3.2 Flow chart of proposed SKYMAX algorithm .................................... 44
Figure 3.3 CloudSim Architecture ..................................................................... 49
Figure 3.4 Network communication diagrams ................................................... 53
Figure 3.5 CloudSim class design diagram ....................................................... 55
Figure 3.6 CloudAnalyst diagram .................................................................... 58
Figure 4.1 Average response time Comparison graph ........................................ 63
Figure 4.2 Average RST Comparison Graph ..................................................... 63
Figure 4.3 Total Cost ......................................................................................... 65
Figure 4.4 Calculated Overall Performance ...................................................... 65
Figure 4.5 Average response time Comparison graph ........................................ 67
Figure 4.6 Average RST Comparison Graphs ................................................... 67
Figure 4.7 Total Cost ....................................................................................... 69
Figure 4.8 Calculated Overall Performance ...................................................... 69
Figure 4.9 Average response time Comparison graph ........................................ 72
Figure 4.10 Average RST Comparison Graphs .................................................. 72
Figure 4.11 Total Cost .................................................................................... 74
Figure 4.12 Calculated Overall Performance .................................................. 74
Figure 4.13 Average response time Comparison graph .................................... 77
Figure 4.14 Average RST Comparison Graphs ................................................ 77
Figure 4.15 Total Cost .................................................................................... 79
Figure 4.16 Calculated Overall Performance .................................................. 79
Figure 4.17 Average response time Comparison graph .................................... 82
Figure 4.18 Average RST Comparison Graphs ................................................ 82
Figure 4.19 Total Cost .................................................................................... 83
Figure 4.20 Calculated Overall Performance .................................................. 83
Figure 4.21 Average response time Comparison graph .................................... 86
Figure 4.22 Average RST Comparison Graphs ................................................ 86
Figure 4.23 Total Cost .................................................................................... 87
Figure 4.24 Calculated Overall Performance .................................................. 88
Figure 4.25 Average response time Comparison graph .................................... 90
Figure 4.26 Average RST Comparison Graphs ................................................ 90
Figure 4.27 Total Cost .................................................................................... 92
Figure 4.28 Calculated Overall Performance .................................................. 92
Figure 4.29 Average response time Comparison graph .................................... 95
Figure 4.30 Average RST Comparison Graphs ................................................ 95
Figure 4.31 Total Cost .................................................................................... 96
Figure 4.32 Calculated Overall Performance .................................................. 96
Figure 4.33 Average response time Comparison graph .................................... 99
Figure 4.34 Average RST Comparison Graphs ............................................................... 99
Figure 4.35 Total Cost ........................................................................................................ 100
Figure 4.36 Calculated Overall Performance ................................................................. 100
Figure 4.37 Average response time Comparison graph .................................................. 103
Figure 4.38 Average RST Comparison Graphs ............................................................... 103
Figure 4.39 Total Cost ........................................................................................................ 104
Figure 4.40 Calculated Overall Performance ................................................................. 105
Figure 4.41 Represent Average response time ............................................................... 107
Figure 4.42 Represents Average Request servicing time ................................................. 108
Figure 4.43 Comparison Overall Average response time Represent ................................ 109
Figure 4.44 Comparison Overall Request servicing times ............................................. 111
Figure 4.45 Comparison of Total cost ........................................................................... 112
List of Tables

Table 1.6 Evolution of scheduling algorithm ........................................ 21
Table 3.1 Data Size assumption table ................................................. 47
Table 4.1 Configuration setup ........................................................... 62
Table 4.2 Average Response Time ...................................................... 63
Table 4.3 Average Data center processing time .................................... 63
Table 4.4 Calculate Cost of algorithm ............................................... 64
Table 4.5 Result comparison of load balancing algorithms (Overall performance) ......................................................... 64
Table 4.6 Configuration Setup ........................................................... 66
Table 4.7 Average Response Time ...................................................... 66
Table 4.8 Average Data center processing time .................................... 67
Table 4.9 Calculate Cost of algorithm ............................................... 67
Table 4.10 Result comparison of load balancing algorithms (Overall performance) ......................................................... 68
Table 4.11 Configuration Setup ........................................................... 68
Table 4.12 Average Response Time ...................................................... 70
Table 4.13 Average Data center processing time .................................... 70
Table 4.14 Calculate Cost of algorithm ............................................... 71
Table 4.15 Result comparison of load balancing algorithms (Overall performance) ......................................................... 73
Table 4.16 Configuration Setup ........................................................... 75
Table 4.17 Average Response Time ...................................................... 75
Table 4.18 Average Data center processing time .................................... 76
Table 4.19 Calculate Cost of algorithm………………………………………..76
Table 4.20 Result comparison of load balancing algorithms (Overall performance)……………………………………………………………………78
Table 4.21 Configuration Setup…………………………………………………78
Table 4.22 Average Response Time……………………………………………80
Table 4.23 Average Data center processing time……………………………..81
Table 4.24 Calculate Cost of algorithm………………………………………..83
Table 4.25 Result comparison of load balancing algorithms (Overall performance)……………………………………………………………………83
Table 4.26 Configuration Setup…………………………………………………85
Table 4.27 Average Response Time……………………………………………85
Table 4.28 Average Data center processing time……………………………..85
Table 4.29 Calculate Cost of algorithm………………………………………..87
Table 4.30 Result comparison of load balancing algorithms (Overall performance)……………………………………………………………………87
Table 4.31 Configuration Setup…………………………………………………89
Table 4.32 Average Response Time……………………………………………89
Table 4.33 Average Data center processing time……………………………..90
Table 4.34 Calculate Cost of algorithm………………………………………..91
Table 4.35 Result comparison of load balancing algorithms (Overall performance)……………………………………………………………………91
Table 4.36 Configuration Setup…………………………………………………93
Table 4.37 Average Response Time……………………………………………93
Table 4.38 Average Data center processing time……………………………..94
Table 4.39 Calculate Cost of algorithm.............................................96
Table 4.40 Result comparison of load balancing algorithms (Overall performance).................................................................96
Table 4.41 Configuration Setup.......................................................97
Table 4.42 Average Response Time................................................98
Table 4.43 Average Data center processing time.................................98
Table 4.44 Calculate Cost of algorithm.............................................100
Table 4.45 Result comparison of load balancing algorithms (Overall performance).................................................................100
Table 4.46 Configuration Setup.......................................................102
Table 4.47 Average Response Time................................................102
Table 4.48 Average Data center processing time.................................104
Table 4.49 Calculate Cost of algorithm.............................................104
Table 4.50 Result comparison of load balancing algorithms (Overall performance).................................................................106
Table 4.51 Configuration Setup.......................................................106
Table 4.52 Average Response Time................................................107
Table 4.53 Average Data center processing time.................................108
Table 4.54 Calculate Cost of algorithm.............................................108
Table 4.55 Configuration Setup.......................................................110
Table 4.56 Average Response Time................................................110
Table 4.57 Average Data center processing time.................................111
Table 4.58 Calculate Cost of algorithm.............................................112
List of Equations

Equation 3.1 Calculated estimated finish time………………………………..51
Equation 3.2 Calculated estimated finish time………………………………..51
Equation 3.3 Calculated estimated finish time………………………………..52
Equation 3.4 Calculated estimated finish time………………………………..52
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Arr}_t$</td>
<td>Arrival time</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Time</td>
</tr>
<tr>
<td>ER</td>
<td>Existing Result</td>
</tr>
<tr>
<td>FIFO</td>
<td>First Come First Out</td>
</tr>
<tr>
<td>$\text{Fin}_t$</td>
<td>Finish Time</td>
</tr>
<tr>
<td>IaaS</td>
<td>Infrastructure as a Service</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/ Output</td>
</tr>
<tr>
<td>PaaS</td>
<td>Platform as a Service</td>
</tr>
<tr>
<td>PR</td>
<td>Proposed work</td>
</tr>
<tr>
<td>QoSC</td>
<td>Quality of Service Checkers</td>
</tr>
<tr>
<td>SaaS</td>
<td>Software as a service</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>SA</td>
<td>Service Acceptor</td>
</tr>
<tr>
<td>TVM</td>
<td>Tracking virtual Machine</td>
</tr>
<tr>
<td>Tdelay</td>
<td>Transmission delay</td>
</tr>
<tr>
<td>Tlatency</td>
<td>Network latency</td>
</tr>
<tr>
<td>Ttransfer</td>
<td>Time taken</td>
</tr>
</tbody>
</table>