UNIVERSITI PUTRA MALAYSIA

PERFORMANCE ANALYSIS ON MULTI-ATTRIBUTE COMBINATORIAL DOUBLE AUCTION MODEL FOR RESOURCE ALLOCATION IN CLOUD COMPUTING

SUAD ABDALLA MOHAMED EL-SHERKSI

FSKTM 2017 20

PERFORMANCE ANALYSIS ON MULTI-ATTRIBUTE COMBINATORIAL DOUBLE AUCTION MODEL FOR RESOURCE ALLOCATION IN CLOUD COMPUTING

BY

SUAD ABDALLA MOHAMED EL-SHERKSI

Thesis Submitted to the Faculty of Computer Science and Information Technology in Fulfillment of the Requirements for the Degree of Master of Computer Science

Universiti Putra Malaysia (UPM)

January 2017

Dedication

In The Name of Allah, The Most Beneficent, the most Merciful

To the soul of my beloved mother, **Fatima**

Her prayers guided me to success

Her place never be replaced

Her love never be lost

May Allah grant her soul forever in Firdaws of Paradise

To my best friend, my husband, **Ali Khalifa**

Whose unlimited love and support has made my dreams come true,

My eternal gratitude

To my little sons **Al-Ryan and Asser**

The source of my joy, the shine of my happiness

My prayers and unconditional love

To my sisters, brothers and friends

My eternal love

I dedicate my humble project work

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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Chairman: AP Dr. Zurina Mohd Hanapi
Faculty: Computer Science and Information Technology

Cloud computing is a distinctive form of the recent well-developed distributed computing which supplies multiple services to the customers on their demand. Recently, the main concern of cloud computing is a typical resource management, especially in terms of resource allocation. Various number of methods were and still being proposed by researchers in order to provide sufficient solutions that overcome the issues of current resource allocation methods. In this work, a performance analysis is conducted on a dynamic market based algorithm for resource allocation in virtual machines of the cloud. For multi-attribute combinatorial double auction model where the simulation experiments was performed to simulate the actual business auctions' procedures in order to consider the profits for both the cloud customers and providers, manage the QoS metrics that being provided to cloud customers, and apply penalties on false QoS providers as well as compensating the customers. The results showed that multi-attribute combinatorial double auction model has enhanced the previous

combinatorial double auction resource allocation model by including QoS in provider's bids, prevented SLA violation by penalty imposition and guaranteed customers' satisfaction with delivered service. And for further analysis two more parameters were measured which are execution time and VMs' utilization was improved.

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

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januari 2017

Pengerusi: AP Dr. Zurina Mohd Hanapi
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Pengkomputeran Awan (Cloud Computing) adalah salah satu daripada bentuk pengkomputeran teragih yang menyediakan pelbagai perkhidmatan kepada pelanggan berdasarkan permintaan. Kebelakangan ini, kebimbangan utama Pengkomputeran Awan adalah berkaitan dengan pengurusan sumber, terutamanya dari segi pengagihan sumber. Pelbagai kaedah samaada yang telah ataupun masih dicadangkan oleh pihak penyelidik dengan menyediakan penyelesaian yang sewajarnya untuk mengatasi isu-isu semasa yang berkaitan dengan kaedah pengagihan sumber. Dalam kajian ini, satu analisis prestasi telah dijalankan kepada algoritma pasaran yang dinamik berasaskan kaedah pengagihan sumber menggunakan mesin maya awan (Cloud Virtual Machine). Untuk model Multi-Attribute Combinatorial Double Auction di mana eksperimen simulasi yang dilakukan untuk mensimulasi prosedur di dalam mempertimbangkan keuntungan bagi kedua-dua pihak iaitu pelanggan dan pembekal, seterusnya dapat menguruskan metrik kualiti perkhidmatan (QoS) yang disediakan kepada pelanggan.

Ianya juga dapat mengenakan penalti kepada penyedia *QoS* palsu juga pampasan kepada pelanggan. Hasil kajian menunjukkan bahawa model pengagihan sumber bagi Multi-Attribute Combinatorial Double Auction dengan memasukkan QoS di dalam tawaran pembekal dapat menghalang pelanggaran perjanjian tahap perkhidmatan (SLA) dengan mengenakan penalti seterusnya memastikan kepuasan pelanggan dapat dijamin seiring perkhidmatan yang disediakan. Untuk analisis selanjutnya, dua parameter diukur iaitu masa perlaksanaan dan penggunaan mesin maya telah dapat ditambah baik.

ACKNOWLEDGEMENTS

This thesis owes its existence to the help, support and inspiration of several people. Firstly, I would like to express my sincere appreciation and gratitude to my supervisor AP Dr. Zurina Mohd Hanapi. Without her continuous optimism, enthusiasm, encouragement and support this project would hardly have been completed. I'm also extremely indebted to my assessor Dr. Masnida Hj Hussin for her guidance and encouragement without forget to mention that what I have learnt in her advanced simulation and modelling classes have been a great knowledge for me to use in this project. I also express my warmest gratitude to the head of department of Distributed computing; Dr.Abdullah Muhammed, for his generosity and kindness during his classes that I was honored to attend on my last two semesters. A special appreciation is given to Prof Dr. Ramlan Mahmod who distinctly taught us how to read and summarize journal articles and improve my academic writing skills by attending his research methodology course.

Last but not least, my deepest gratitude to all staff, academicians and colleagues at faculty of computer science and information technology-UPM for their meaningful support, wonderful and never to be forgotten moments during my studying journey of the past two years; For you all, I would say "May Allah reward you all in the Paradise".

APPROVAL

A thesis prepared by Suad AbdAlla Mohamed El-Sherksi with the title **"MCDAM MODEL FOR RESORCE ALLOCSATION IN CLOUD COMPUTING"** submitted in partial to fulfilment of requirement of the master of Computer Science and Information Technology Universiti Putra Malaysia.

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DECLARATION

I declare that this thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and it is not concurrently submitted to other institutions.

SUAD ABDALLA MOHAMED EL-SHERKSI

Date:

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LIST OF ABBRIVAITIONS

QoS	Quality of Service
NIST	National Institute of Standards and Technology
CPU	Central Processing Unit
SLA	Service-Level Agreement
QBM	Queuing-Based Method
HBM	Heuristic-Based Method
MOM	Market Oriented Method
MLM	Machine Learning Method
BPM	Bin-Packing Method
VM	Virtual Machine
OCT	Open Cloud Testbed
DCSim	Data Center Simulation
CDOSim	Cloud deployment option Simulator
GDCSim	Green Data Center Simulator
MIPS	Millions of Instructions Per Second
MBs	Mega Bytes
B/S	Bits per Second
cost/MI	cost per Million of Instructions

CHAPTER 1

INTRODUCTION

1.1 Background

Cloud computing is a service computing model where users have the ability to access this environment requesting for a service according to certain requirements without any knowledge of the location of physical component or service delivery mechanism. The essential idea of cloud computing can be described as a worldwide software which can be used anywhere any time by huge number of users instead of consumption of the product and resources by installing this software on each individual computer. Data centers are the base infrastructure of cloud computing and providers are responsible for data centers' maintenance and monitoring permanently. The enterprise usage of this paradigm would eliminates individual computing costs. The heterogeneity of users' requirements imposes responsibility on service providers in terms of service availability, quality and delivery. The main principle of cloud datacenters is allocation of resources based on the user request with optimal performance, lower energy consumption and lower cost.

As mentioned in Mohamaddiah et al., (2014) NIST have represented the cloud architecture consisting several units, the most recognizable are:

Cloud Provider: to provide service to cloud users.

Cloud Broker: manages interactions between user and provider.

Cloud Consumer: service user.

The Resource Allocation process according to Mohamaddiah et al., (2014) is one of the bases of successful Resource Management in distributed environment especially Cloud computing. As shown in Figure 1.1, the other bases of Resource Management are Resource Monitoring and Resource discovery.

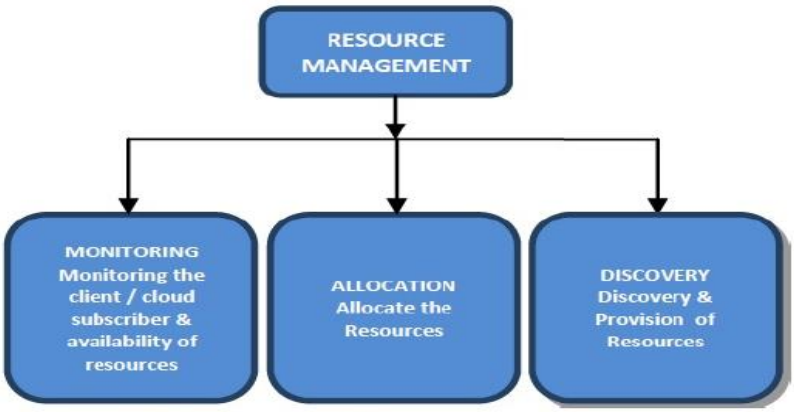

Figure 1.1 Resource Management branches.
Source: (Mohamaddiah et al., 2014)

Compared to grid computing which focuses on dividing the job into tasks to be scheduled with the proper scheduling algorithm, Cloud computing focuses more on the perception of Virtualization and resource allocation, since cloud computing is considered as well-developed business model. Therefore, efficient solutions are required in terms of allocation of resources to meet consumers' demands. Most of the approaches that was used for grid computing scheduling were applicable to cloud computing, most of those schemes aims for maximizing the system utility regardless to the market nature of cloud computing which require to increase the competition level among users as well as providers. Before describing the resource allocation mechanisms, Resources should be introduced first. A Resource can be a physical or virtual item that will be utilized by a consumer Singh and Chana, (2016). Different

types of resources involved in resource management in cloud computing are illustrated in Figure 1.2.

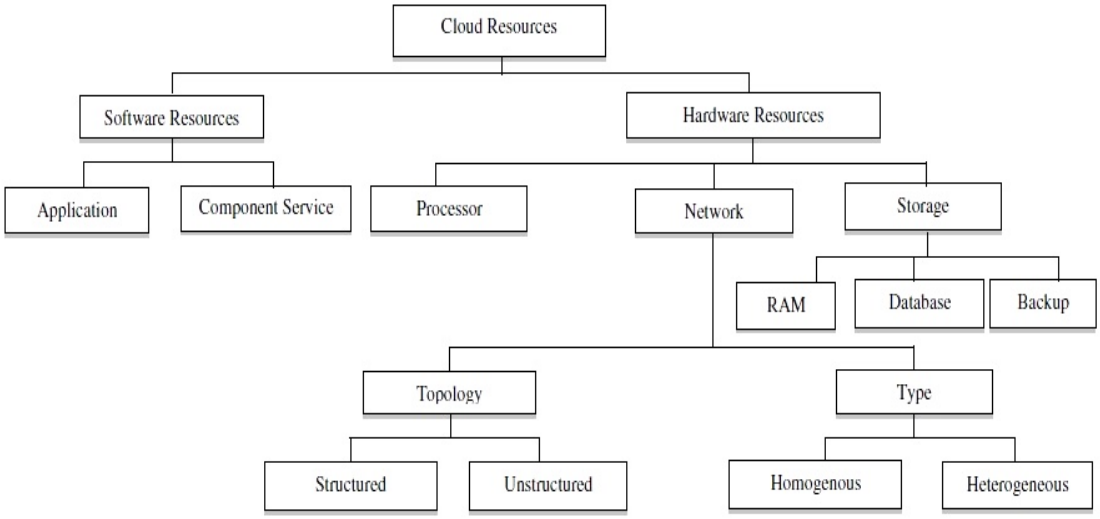

Figure 1.2 Classification of resources
Source: (Singh and Sukhpal, 2015)

Allocation of resources is the process of assigning the resources after being requested by the customer based on certain requirements. The allocation is divided into two basic categories:

Static Allocation: where the user must be able to request the resource from cloud providers earlier according to its requirements. In this case either low or over resource utilization is probable.

Dynamic Allocation: on-demand request applied by cloud user, here the level of utilization is better than the static allocation but the problem in this case will be resource availability.

Resource allocation algorithms is very interesting research area in due to the issues of cloud computing that need to be solved. For instances customers' satisfaction,

maximized revenue of providers, execution time minimization, reduction of energy consumption or execution cost minimization or other efficient performance factors which might result from an optimal resource allocation algorithm.

Generally an optimal resource allocation process is known to be a challenging job to cloud scientists as they are required to seek for the satisfaction of customers as equal as providers.

The available resources such as memory, storage, CPU, network bandwidth etc. necessary to be assigned to the demanded customers economically for professional resource management process. However, management of Quality of services (QoS) and customer satisfaction with the received QoS is considered as one of the current cloud problems that need to be solved (Gouda et al.,2013).

Load balancing, resources utilization, maximizing the revenue of cloud computing parties and more goals clearly reflects the importance of efficient resource allocation in cloud computing. Some of the distinguished benefits of resource allocation process within the scientific society of the cloud are:

- There is no medium or place limitations by means that the resource can be reached by customer anywhere and anytime.
- The increasing number of resource providers eliminates the scarcity of resources in cloud market.

- Reduce the general consumption of software and hardware components by users which will save a big amount of money as well as protection of environment by saving energy.
- No software or hardware needed, just an internet connection.

1.2 Significance of the study

The market based resource allocation schemes are ideal for providing resources on demand to consumers in terms of pricing and trade Yousafzai et al., (2016). In addition to a various range of advantages, malicious users (Zombie clients) for example can be detected using some statistical pricing schemes that performs some analysis on historical users' data. The problem with pricing schemes that they do not consider issues such as utilization of resources or fault tolerance mechanisms. Another goal need to be achieved in resource allocation is considering the Quality of Service (QoS) for effective scheduling. Requirements of QoS could be one of many parameters such as security, scalability, availability, response time, throughput, performance etc.

1.3 Problem Statement

Current market-based approaches such as auctions have been widely used in cloud computing for efficient resource management and to enhance the economic productivity and revenue maximization. The issue with the current auctions mechanism that they mainly rely on the lowest price only which is offered by one provider in order to determine the auction winner. Besides, they basically look forward to increase provider's profit. And most significantly, there is no guarantee that this provider will provide a good quality resources to cloud customers. Therefore, the

proposed multi-attribute combinatorial double auction model (MCDAM) will be implemented to perform an analysis on its ability for solving the above mentioned issues.

1.4 Objectives

A performance analysis on multi-attribute combinatorial double auction model MCDAM for Resource allocation in cloud computing Virtual machines. The implementation of the proposed model will be performed to:

i. Estimates the utility for both providers and brokers.
ii. The utility will be calculated based on the quantified value of QoS parameter and price.
iii. Penalty will be imposed on false QoS providers.
iv. Customers who received false QoS are compensated.

1.5 Scope

This work presents a performance analysis of MCDAM for Virtual machines allocation. This MCDAM can calculate the utility for both providers and brokers where the utility will be calculated based on the bid price and the quantified value of QoS parameter. However, Imposing penalty on providers of VMs who in fact offer low QoS as well as compensating the unsatisfied customers.

1.6 Organization of thesis

The rest of this project report is organized as follows:

Chapter 2: conducts the literature review of the Resource allocation algorithms in Cloud Computing.

Chapter 3: the research methodology is dissected.

Chapter 4: Scenarios of simulation and System implementation.

Chapter 5: Discussion of Simulation results.

Chapter 6: Conclusion and future work.

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