IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-6, Issue-2 E-ISSN: 2347-2693

Preference Based Resource Allocation In Cloud Data Center

M.R. Dave[1*], H.B. Patel[2], B. Shrimali [3]

[1*]Computer Engineering Department, LDRP - ITR, KSV, Gandhinagar, India
[2] Computer Engineering Department, LDRP - ITR, KSV, Gandhinagar, India
[3] Computer Engineering Department, LDRP - ITR, KSV, Gandhinagar, India

**Corresponding Author: meghnadave4@gmail.com, Tel.: 9586607315*

Available online at: www.ijcseonline.org

Received: 31/Jan//2018, Revised: 09/Feb2018, Accepted: 23/Feb/2018, Published: 28/Feb/2018

***Abstract*—** Cloud Computing is considered as one of the emerging technologies. Resources are allocated to users for a period of time and payment is made accordingly. Demand based preferential resource allocation is proposed which is based on the demand-supply scenario in the market. Preference based resource allocation technique allocates resources to the users based on the auction mechanism that follows market driven strategy where bid price of resources reflects the current demand. Users are discovered based on the amount capabilities. Payment is calculated based on the service preference chosen by the user. This preference is set by the Cloud Service Provider. Chosen preference decides the actual payment criteria of the winner. Time duration is divided into n time slots in order to give chance to unselected users to bid for resources in next time slot.

***Keywords*—**Cloud Computing, Resource Allocation, Auction, Payment, Preference

I. INTRODUCTION

Cloud Computing has been defined by NIST as "A model for enabling convenient , on-demand network access to shared pool of configurable computing resources(e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or cloud service interaction." Cloud computing technologies can be implemented in a wide variety of architectures under different service models (IAAS, PAAS, SAAS) and deployment models (pubic, private, hybrid, community)[1]. Resource allocation is considered as allocating of available resources as per the users need. Efficient resource allocation is major concern in utility based system[2].

Cloud customers use provider's resources (e.g. processors, memory, storage space, network bandwidth and software etc.) in an on-demand manner[3].

In order to provide services to multiple users simultaneously based on various resource requirements efficient resource allocation technique needs to be implemented that reflects demand-supply scenario of the market that is beneficial to both service provider and service user. Auction mechanism is considered one of the way for resource allocation. Here user is selected based on his payment capacity and requirement for the resources. Allocation of resources is based on bidding where user bids for the resources required. Bid price reflects his need for the resources as well as the payment capacity. Resources are allocated to winners based on preferences, bidding price etc. [2]. Market driven resource allocation mechanism is used to deal with dynamically fluctuating resource demands. It is recently implemented by commercial cloud providers like Amazon EC2 in order to achieve maximum revenue over time. [9]

Preference means on what basis and with whom resources are to be shared. Preference based resource allocation can be based on demand, priority, user's sharing preference, time preference, task that requires large amount of C.P.U. etc. Following shows the classification of resource allocation scheme:

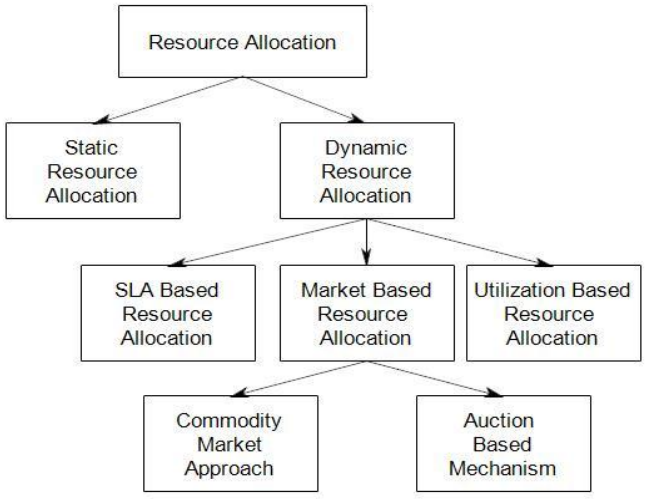

Figure 1: Classification of Resource Allocation

The paper is structured as follows: Section I describes Introduction Section II reflects the Related Work, Section III represents the System Model, Section IV describes Proposed

Resource Allocation Technique, Section V shows the Experimental Evaluation and Section VI depicts Conclusion along with the future work respectively.

II. RELATED WORK

The authors in [2] proposes demand based preferential resource allocation technique that designs market driven auction mechanism to identify users for resource allocation based on payment capacity. This capacity is based on buyer's service preference. Resource bid price reflects the current demand it follows market – supply demand scenario therefore justifying resource utility.

In [3] auction based resource allocation for cloud computing is studied. In this paper various auction models are classified. Framework for resource allocation based on auction is determined. Issues such as efficiency, bidding language, revenue, fairness, marketing environment are taken into consideration for allocating resources. Issues for further studying such i.e. suitability of auction models for the cloud market, co-ordination of cloud providers in auction based resource allocation, optimization in auction based resource allocation, energy-awareness of resource allocation are mentioned.

In [4] author focuses on allocation of VM to the user based analysing characteristics of job where low priority job (job deadline is high) should delay the execution of high priority jobs (job deadline is low) and VM resources should be allocated dynamically with deadline.

One of the major issue in cloud environment is management of resources. In [5] authors have contributed for two criteria i.e. (i) higher preference is given to the tasks that requests large amount of CPU for better utilization of resources and (ii) Since they follow demand based pricing mechanism in order to meet SLA , providers earn more profit and also benefited by less transmission overhead.

A survey on resource allocation is made in [6] where authors have determined various service and deployment models, processes for resource allocation. They have also mentioned situation which should be avoided such as resource contention, resource fragmentation, scarcity, over-provisioning, under-provisioning. Various dynamic allocation models are classified and various research issues are also mentioned.

In [7] various resource allocation problems are determined. Auction management is used to overcome those issues. Combinatorial auction based dynamic resource allocation is proposed by using CA – Provision algorithm where auction for bundle of resources is carried out. Underutilization of resources is minimized.

A truthful and dynamic online resource auction is presented in [8] which avoids the false bidding behaviors of users and reflects the supply-demand curve of various types.

In [9], market driven resource allocation technique has been proposed in order to deal with the fluctuating resource demands. It is recently implemented by commercial Cloud Service Provider like Amazon EC2 with the goal of achieving maximum revenue.

III. SYSTEM MODEL

Preference based resource allocation method is divided into two phases: (i) an open market driven auction process (ii) preference driven payment process. Cloud service provider and cloud users are the main entities. Various resources like memory, processing units, network bandwidth etc. are maintained by cloud service provider in the form of VM. Resources are allocated to the users when they requests for it. Allocation is based on payment capacity and preferences. In turn users makes payment based on quantity of resources allocated and time duration.

Taking into consideration various types of tasks such as input output intensive, processor intensive or memory intensive, there are three types of VM i.e. communication driven, processing driven and storage driven. Total cost includes VM initiation cost, task processing cost, data transfer cost and data storage cost. Tasks and bid prices are declared at the arrival time in order to start the auction process. Symbols and abbreviations used are shown in the following table.

Table 1: Abbreviations

Symbol	Meaning	Symbol	Meaning
AC	Additional Cost	N	Number of cloud users denoted as $n1,n2,\ldots,n_N$
AT	Arrival Time	RAU	Resource Allocation Unit
BPP	Bid Price Payment	RK1	Number of K1 instances required by user
BPK1	User's best bid price for K1 VM instance	RK2	Number of K2 instances required by user
BPK2	User's best bid price for K2 VM instance	RK3	Number of K3 instances required by user
BPK3	User's best bid price for K3 VM instance	SPK1	Starting Price of K1 VM instance

DSC	Data Storage Cost	SPK2	Starting Price of K2 VM instance
DTC	Data Transfer Cost	SPK3	Starting Price of K3 VM instance
ICK1	Initiation cost of K1 VM instance	T	Duration of one allocation round
ICK2	Initiation cost of K2 VM instance	TBP	Total Bid Price
ICK3	Initiation cost of K3 VM instance	TPC	Task Processing Cost
K	Types of VM considered as K1,, K2, K3		

Following figure shows the system model for proposed system:

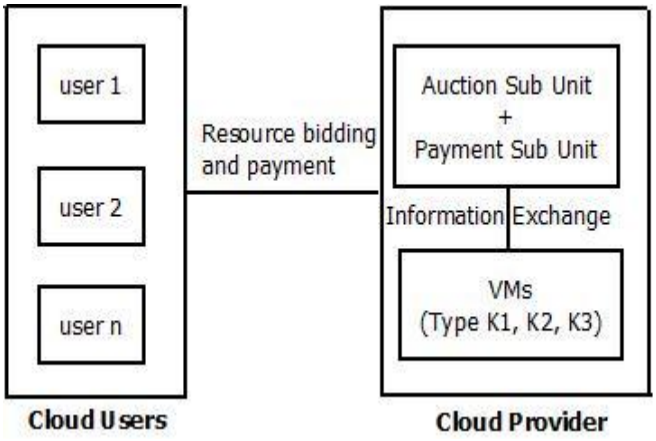

Figure 2: System Model

Consider N cloud users as n1,n2,…..,nN. Cloud service provider manages and maintains all three types of VMs and information about availability and demands of these VMs and it also helps in determining the starting price of each VM type at the start of auction. R.A.U consists of two sub-units

1. Auction Sub-Unit
2. Payment Sub-Unit

Auction sub unit determines winners among bidders and payment sub unit charges winners according to their preferences and bid price.

IV. PROPOSED RESOURCE ALLOCATION TECHNIQUE

Algorithm: Preference Based Resource Allocation Algorithm

1: Declare starting price

2: Users bids for each required VM instance.

3: Calculate TBP (Total Bid Price).

4: Calculate MeanTBP and MeanBPVMType.

5: Determine winners.

6: Revision of bid price by unselected users.

7: Repeat step 4, 5, 6 for n times.

8: Merge winner's list in descending order.

9: Calculate actual payment (AP) based on preference given by user and bid price payment(BPP).

10: Compare AP and BPP.

In this technique, auction is carried out for cloud resources required by the user and they are charged as per the quantity of resources used. Duration for single round of allocation is T. each round consists of three steps:

1. Pre-Auction
2. Market Driven Open Auction
3. Preference Driven Payment

Each of these steps are explained in detail as follows:

1. Pre-Auction

At time t=0, ith round of resource allocation starts. The CSP declares the starting price of each VM instance mentioned as SPK1, SPK2, SPK3 respectively. Consider the following equation:

$$(SPVMType)_i = (MeanBPVMType)_{i-1}$$

As per the above equation, starting price of each VM instance in current allocation round will be based on the previous round's average bid price of same VM type instance. Bid price reflects the current demand. As we are considering last mean bid price as the next starting price which reflects the market-supply scenario and therefore justifies the resource's utility. Therefore allocation is considered as market-driven. Along with starting price, CSP also needs to calculate the additional cost incurred which is shown as follows:

$$AC = DSC + DTC + TPC + IC_{Type}$$

2. Market Driven Open Auction

Consider following example in order to understand the procedure.

Bid format is shown below

AT	RK1	BPK1	RK2	BPK2	RK3	BPK3	TBP

TBP is the summation of best bid prices of K1, K2 and K3 instances of VM. Bid price reflects the highest payment capacity of the user and user's bid price >= starting price. Also if user wins the auction than the actual payment will be less than best bid payment which is shown in the example.

Here we are dividing the auction process into three time slots. Consider 6 users from n1, n2, n3,…..,n6.

N1	1	6	10	3	15	5	8	33
N2	2	3	12	6	14	2	10	36
N3	1	8	11	7	10	2	13	34
N4	2	5	13	2	12	1	10	35
N5	1	4	15	4	18	3	7	40
N6	2	7	14	5	11	4	12	37

At time t=0 to t=T/3 assume that there are three users N1, N2, N3 respectively.

Mean TBP = $\sum_{i=0}^{x} TBP/x$

MEAN TBP = (33+36)/2 = 35

Mean BP = $\sum_{i=0}^{x}(BPVMType)i/x$

Thus, MeanBPK1 = (10+12)/2 = 11

MeanBPK2 = (15+14)/2 = 15

MeanBPK3 = (8+10)/2 = 9

N2 is considered winners as its offered TBP >= MeanTBP. Unselected user can revise its price in another round of auction. Here N1 can rebid for second half such that Revised Bid Price >= Mean Bid Price.
Thus the revised bid price of N1 is as follows.

N1	1	6	15	3	20	5	13	48
N3	1	8	11	7	10	2	13	34
N4	2	5	13	2	12	1	10	35

Now at time t=T/3 to t=2T/3, three users (N1, N3, N4) takes part in the auction process.

MeanTBP = (48+34+35)/3 = 39

$MeanBP_{K1}$ = (15+11+13)/3 = 13

$MeanBP_{K2}$ = (20+10+12)/3 = 14

$MeanBP_{K3}$ = (13+13+10)/3 = 12

In second half round of auction, N1 is considered winners as its offered TBP >= MeanTBP.
After the completion of all auction rounds, the winners of every auction round is merged in a descending order in order to form the winners list. Thus, the descending order of winners is N1, N5, N2, N3. N1 will be given first preference to choose the preference.
By allowing unselected users to rebid with increased bid price increases profitability of service providers as well as it will also be fair to users. This type of auction is termed as open auction. MeanBP calculated in second half of the auction will be considered as starting price in $(i+1)^{th}$ round of auction respectively.

Preference Driven Payment

In this step, payments are made by the winners based on the preference that is chosen. Following preferences is provided by the service provider.

Table 2: Preference Table

Task Deadline Option	Service Time Option	VM Possession Option
D1: Fixed	S1: Immediate	P1: Full Time
D2: Flexible	S2: Flexible	P2: Partial

Winners can choose any of the above preference. Preference decides the actual payment. Example, if task deadline is fixed and wants allocation of VM immediate but wants to hold VM partially than D1S1P2 preference will be chosen. Actual payment is based on the preference given which is shown in the following table:

Table 3: Payment Table

Preferences	Actual Payment Criteria	Payment calculation by winner
D1S1P1	BP of paying winner(i) + AC	AP_i = (RK1 * BPK1)i +(RK2 * BPK2)i +(RK3 * BPK3)i +AC
D1S1P2	BP of the paying winner	AP_i = (RK1 * BPK1)i +(RK2 * BPK2)i +(RK3 * BPK3)i
D2S1P1	BP of the next winner in the list	AP_i = ($RK1_i$*$BPK1_p$) +($RK2_i$*$BPK2_p$) +($RK3_i$*$BPK3_p$)
D2S1P2	BP of 2nd next	AP_i = ($RK1_i$*$BPK1_q$)

	winner	$+(RK2_i*BPK2_q)$ $+(RK3i*BPK3_q)$
D2S2P1	BP of the last winner	$AP_i = (RK1i*BPK1r)$ $+(RK2i*BPK2r)$ $+(RK3i*BPK3r)$
D2S2P2	Mean BP of each VM types	$AP_i = (RK1*MeanBPK1)$ $+(RK2*MeanBPK2)$ $+(RK3*MeanBPK3)$

Calculations for the above preferences is shown as follows:

Table 4: Actual Payment Calculation

	D1S1P1	D1S1P2	D2S1P1	D2S1P2	D2S2P1	D2S2
N4	328	270	258	262	196	248
N3	316	269	286	214	214	267
N1	250	215	164	234	164	211
N2	166	140	186	174	140	175

After calculating actual payment, comparison is made with the Bid Price Payment (BPP) which is calculated using following formula:

$$BPP_i = (RK1*BPK1)_i + (RK2*BPK2)_i + (RK3*BPK3)_i$$

When D1S1P2 preference is selected, APP = BPP. For, D1S1P1, AP will exceed BPP since additional cost is also taken into consideration. Utility of resource allocation for winner is calculated as follows:

$$Utility = BPP_i - AP_i$$

V. EXPERIMENTAL EVALUATION

Experimentation of proposed resource resource allocation technique is carried out on cloudsim environment. It consists of three resources with multiple instances of each, a single clous service provider alongwith multiple users. Here 4 winners are identified.

In figure 3, comparison between Actual Payment and Bid Price Payment is shown. Winners pay an amount which is less than his bid price. Here the strategy is in favor of cloud users.

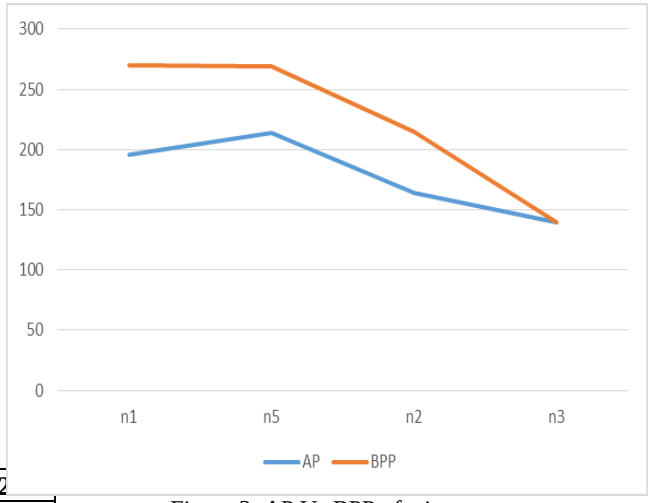

Figure 3: AP Vs BPP of winners

Figure 4 shows the variation in utilities earned by winners according to the actual payment they make based on their given preference.

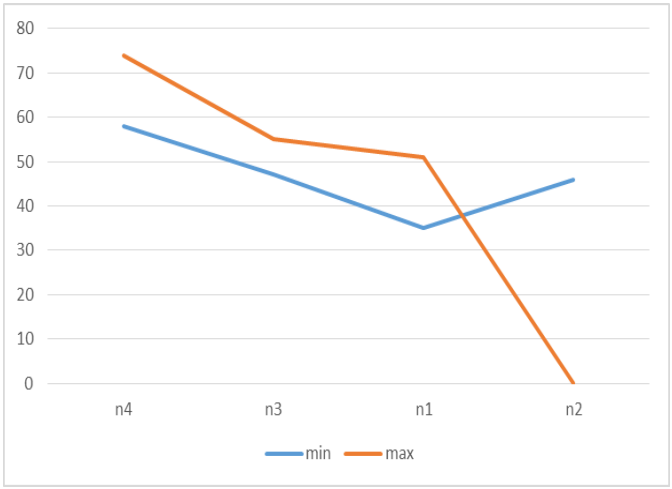

Figure 4: Comparison of Min and Max Utility

In figure 5, comparison is shown with the existing system. Maximum utility is earned by the Cloud Service Provider in the proposed technique.

Users	BPP
N4	270
N3	269
N1	215
N2	140

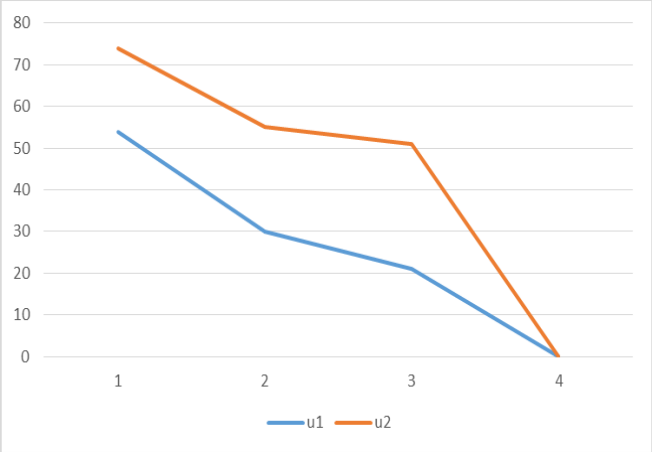

Figure 5: Comparison with the existing system

VI. CONCLUSION AND FUTURE WORK

In this work, classification of resource allocation is described out of which we are considering auction mechanism for allocation of resources. Preference driven strategy for resource allocation is proposed. Managing resources and allocating them in an efficient manner makes the cloud system more efficient. Resource allocation model induces both users and providers that involves truthful auction process and payment is based on the preference given by the user. This involves bid revisions, re-bidding. In the given work we have divided time duration into n slots. In future, work can carried out where we can implement proposed work in cloud environment. Also future work can be extended to propose such allocation technique where less number of VM is required as compared to existing work.

REFERENCES

[1] NIST guidelines for security and privacy issues in public cloud computing by Wayne Jansen and Timothy Grance.

[2] Kumar Narander and Swati Saxena. "A preference-based resource allocation in cloud computing systems." *Procedia Computer Science* 57 (2015): 104-111

[3] Hui Wang, Huaglory Tianfield, Quentin Mair. "Auction based resource allocation in cloud computing" An International Journal 10(2014) 51-66.

[4] Saraswathi, A. T., Y. R. A. Kalaashri, and S. Padmavathi. "Dynamic resource allocation scheme in cloud computing." *Procedia Computer Science* 47 (2015): 30-36.

[5] Dilip Kumar S.M. , Naidila Sadashiv, R. S. Gudar. "Priority based resource allocation and demand based pricing model in peer to peer clouds." *IEEE 2014*.

[6] Samah Alnajdi, Maram Dogan, Ebtesam Al-Qahtani. "A Survey on resource allocation in cloud computing." International journal on cloud computing(2016)

[7] Nehru, E. Iniya, J. Infant Smile Shyni, and Ranjith Balakrishnan. "Auction based dynamic resource allocation in cloud." *Circuit, Power and Computing Technologies (ICCPCT), 2016 International Conference on*. IEEE, 2016.

[8] Zhang, Hong, At al. "A Framework for Truthful Online auctions in cloud Computing with Heterogeneous User Demands." IEEE Transactions on

[9] Zhang, Qi, Quanyan Zhy and Raouf Boutaba "Dynamic Resource Allocation for spot markets in cloud computing environments" Utility and Cloud Computing (UCC), 2011 Fourth IEEE International Conference on IEEE, 2011.

Authors profile

Ms. M. R. Dave pursed Bachelor of Engineering from C. U. Shah College of Engineering and Technology (Gujarat Technological University), Wadhwan City, Gujarat in 2016. She is currently pursuing Master of Engineering at LDRP-ITR, Gandhinagar, Gujarat. Her main research work focuses on Cloud Computing based education.

Mr. H B Patel pursed Bachelor of Engineering from B.V.M Engineering College. He have pursued M.E from M.S.University, Baroda. He have completed his Ph.D from NIT Surat. He was former Dean at Sankalchand Patel University. He is currently working as H.O.D and professor at LDRP-ITR institute, Gandhinagar since 2017.

Ms. B Shrimali have pursued Bachelor of Engineering from Charotar Institute, Changa, Gujarat. She have pursued M.E from G.E.C-G, Gandhinagar, Gujarat. She is pursuing Ph.D from C.U.Shah University, Wadhwancity, Gujarat. She have total 12 years and 6 months of experience in teaching field. Currently she is working as lecturer at LDRP-ITR institute, Gandhinagar, gujarat. Her main research area focuses on cloud computing and language processing. She is also member of ISTE.

