Virtual Machine Provisioning and Allocation in a Cloud Environment using Improved Auction Based Model

Nagadevi.S, S.V.Kasmir Raja

Abstract: ***VM provisioning is one of the key aspect of infrastructure as a cloud. The provisioning and allocation of VM must be economical for both the user and the provider. There were many schemes proposed by researchers. But, it is still a challenge for the providers to make efficient use of the available resources. Here, we have studied various techniques applied by the providers for VM provisioning and allocation. We proposed a new provisioning and allocation method for efficient utilization of resources.***

Index Terms: ***VM provisioning, allocation, auction-based, utilization***

I. INTRODUCTION

Cloud computing paradigm is based on the model of pay for what you use. The infinite availability of resources at the back end leads to the cloud computing model. The efficiency and flexibility of cloud paradigm is due to readily available virtualized environments and machines.

Nowadays, organizations move their business into their own datacentres. Datacentres provide the environment for the user's applications to run. Efficient utilization of data centre resources is the key issue of every organization. With the help of virtualization concept, organizations virtualizes their physical resources to service many requests. When the user of a data centre gives the request to run an application, the vms created and aligned to them by the cloud service provider (CSP). The key challenges faced by the organizations in maintaining the data centre are:

(i). How to reduce the power consumed by unused (idle resource)

(ii). How to dynamically schedule the vms among the user's application to improve multi-dimensional resource usage.

In IAAS, resources are provided to the user as virtual machines. These virtual machines are also known as VM instances. In a cloud, multiple VM instances could run on a single physical machine. Each of these VM instances is having its own configuration for Memory, RAM and Bandwidth etc. Based on the configuration of the VM instances, these are categorized as Small, Large, and Extra-Large as in Amazon EC2.Cloud provider increases its revenue by providing multiple types of VM instances to the users.

Revised Manuscript Received on May 05, 2019.

Nagadevi .S, SRM Institute of Science and Technology, Chennai, India

S.V.Kasmir Raja, Dean, Research, SRM Institute of Science and Technology, Chennai, India

Provisioning in IaaS cloud is performed through managing and deploying user applications. It involves three different processes.[1][2][3].

1. Virtual Machine Provisioning: Providing virtual machines to the users according to the requirements of their applications.
2. Resource Provisioning: user requirement is mapped to the available resources and scheduling the available virtual machines with in a physical machine.
3. Application Provisioning: matching the user applications requirement to the scheduled virtual machines and deploying applications in within VMs

The process of assigning virtual machine instances that matches with the user's requirement is known as virtual machine provisioning. Virtual Machine provisioning enables the cloud providers to make efficient utilization of available resources and make a good profit out of it [4].

A cloud provider provisions their resources either statically or dynamically. In static Virtual machine provisioning the current demand of the user is not considered. i.e. provider pre-provisions a set of resources to the requested user. In dynamic provisioning, the current demands of the users are considered to make efficient utilization of resources.

The payment method for either of the provisioning method is being decided by the cloud provider as fixed price model and auction based model. Price of each and every virtual machine is fixed. It will not vary for varying circumstances. But, in auction- based model user's bids for instances and may obtain resources for minimum cost than in a fixed price model.

Any VM provisioning scheme may be evaluated based on the following parameters:

- Dynamic or static provisioning scheme
- Single resource type or multiple resource type
- Fixed price model or auction based model
- Improves providers revenue or users benefit

II. BACKGROUND

Virtualization is a key concept of cloud computing. Data centers virtualizes their physical resources to improve resource utilization, revenue maximization, power consumption and so on. Virtual machines are created as separate entity to run users applications [5] as shown in Fig.1.

A virtual machine (VM), is an instance of IaaS cloud running as a separate entity in the physical machine as shown in Table 1.

The cloud service providers initially create VMs on basis of users' request and the resources (ex. Storage) can be extended at runtime according to user needs. Usually the resources are assigned in the physical server at which the VM has been deployed which creates overhead for VM host server and in turn requires more servers has to be installed in the cloud data centers. Hence the existing scenario creates overhead for users and cloud service providers in terms of performance and profit level respectively.

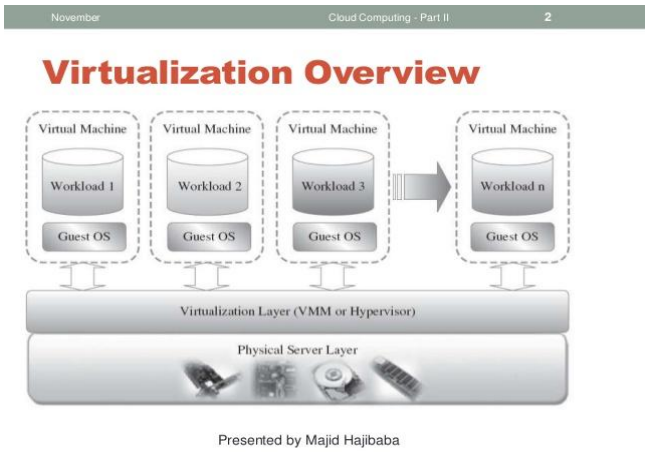

Fig. 1 Virtualization

Table. 1 VM instance types offered by Amazon EC2.

Instance Type	CPU	Memory (GB)	Storage	Network (Gbps)
medium	1	2	EBS	10
large	2	4	EBS	10
x-large	4	8	EBS	10
xx-large	8	16	EBS	10
xxxx-large	16	32	EBS	10

III. VM PROVISIONING AND ALLOCATION BASED ON AUCTION BASED MODEL

In [6], the bid is submitted to the provider by the user. The request is given for the bundle of VM instances. Users are not gaining any incentives for lying for the bid amount. Truthful Greedy and Optimal mechanisms used Dynamic VM provisioning and Allocation .To model this integer programming model is used. Multiple types of resources are considered as in Amazon EC2. Users are given incentives for their true valuation of the requested bundle. The proposed method finds out a near optimal solution for dynamic VM provisioning and Allocation to meet the dynamic market demand and produce high revenue for the cloud providers. Payments for each used is evaluated.

In[7], a Combinatorial auction-based mechanism (CA-PROVISION) was used for dynamic virtual machine provisioning and allocation. In cloud Fixed-price resource allocation is not seems to be more economic efficient. So, an auction based model was proposed for dynamic VMPAC. This method considers the dynamic resource demand of the users and maximizes the utility of a user as well as a provider. The requested VM instances are granted based on the bid amount.

In [8] they developed an online mechanism for virtual machine provisioning and allocation (OVMAP) in cloud environment. It is an auction based model for getting the requests from users, determines the payment for the user. Considers multiple types of resources and makes no assumptions on future requirement of resources. It allows the user to use the allocated resource for the entire period of allotment. OVMAP is proved to be incentive compatible. The results show that the online mechanism obtains better revenue than offline mechanism.

In [9] they developed a polynomial-time approximation scheme for VM provisioning and allocation in a heterogeneous resource environment. It is an approximation method to improve the providers benefit. Also, determines the payment to be paid by the user.

In [6][7][8][9], auction based model was designed to get the bid amount from 99users for the available resources. Users are provided with incentives for revealing the trueness of their bidding.

In [10], they designed an auction-based online mechanism for virtual machine provisioning, allocation and pricing. This method is invoked as soon as the user places a request for the required resources or the allocated resources are released. It is also an incentive-compatible.

In [6] to [10], auction-based model was used. Users cannot be provided with partial allocation of resources i.e. granting one or two types of VM instances out of 4 VM types. Providers are forced to provision the whole bundle of instances.

In [11] they have addressed the physical machine management problem (PMRM) in cloud environment. Winner determination algorithm is used to select the virtual machines and provides the virtual machines to users. A payment function is used to determine the amount to be paid by the user to the provider. In the proposed technique they have achieved an approximation ratio of 3.

In [12] authors implemented empirical performance - cost analysis of provisioning and allocation policies In IaaS clouds. Analysed eight provisioning and four allocation policies in detail.

In [13] authors proposed a virtual machine provisioning technique that adapts the incoming workload changes with respect to applications and guarantees QoS. To analyse the behaviour and performance of applications Queuing Network System model is used. This technique detects changes in workload intensity (arrival pattern and resource demand) and allocates multiple virtualized IT resources to achieve QoS.

[14], designed and implemented a TIMER-Cloud framework User's request are processes based on deadlines. They consider multiple heterogeneous computing nodes of various resources like number of cores, memory and so on. In addition to Earliest Deadline First allocation scheme, they also used resource utilization and dominant resource request as constraints. They proposed two Time-Sensitive Resource Factor (TSRF) based allocation schemes TSRF and TSRF/DR. Euclidean Distance based mapping heuristic was used to select the appropriate computing nodes for each request by considering all types of resources.

Proposed technique serves up to 12% more user requests and achieves up to 8% more system rewards for the over-loaded scenario with 140% system load.

In [15] this paper resource utilization level of various VMs are evaluated. Resource utilization pattern of different VNs shows resource misalignment in time which leads to resource over-provisioning. They proposed three vm resource utilization pattern refinement algorithms. These algorithms shows 74% increase in resource efficiency and it also reduces the number of physical machines needed up to 47%.

In [16] [17] a combined resource scheduling and provisioning method as designed to execute scientific workload on IaaS cloud. Using meta-heuristic optimization algorithm (PSO), an optimized schedule is generated which minimizes the execution cost and also meets the user's deadline.

In [18] In this paper OCRP(Optimal Resource Provisioning algorithm was proposed using stochastic programming model. OCRP reduces the resource provisioning cost of consumers. The total cost of resource provisioning is minimized. The cloud broker implements the OCRP algorithm to make an optimal decision for provisioning the resources for hosting the VMs. There are multiple vm classes to execute different types of jobs. Each VM class contains different amount of resources in each resource type (CPU, Storage, N/K). The stochastic programming model is used with deterministic equation formulation, Sample average approximation and Benders decomposition to reduce the resource provisioning cost.

IV. IMPROVED AUCTION BASED MODEL

Provisioning and Allocating virtual machines to the users using improved auction based model is defined as follows:

Here, we assumed Cloud provider consists of m number of physical machines PMs = {1,…., m}. We also consider n number of virtual machines = {1,…..n}, of R resource types R={1,…,R}. The resources are cpu, memory and storage etc.

V. SYSTEM MODEL

In our proposed system we assumed heterogeneous cloud environment. i.e. different types of virtual machines. All the virtual machine instances has its own configuration for memory, CPU, bandwidth and etc.. We also assume dynamic resource allocation. Virtual machines are allocated to the user at runtime. This will provide the user with dynamic control over the resource provisioning

Resource provisioning is done in such a way that minimum cost incurred by the user and time taken is minimum with optimized resource allocation, i.e. resources to be provisioned should be used maximum such that there is no wastage of any resource.

It is a technique for allocation of dynamic resources in a heterogeneous environment in order to meet the QOS of a service provider in a cloud. It aims to optimize the cost of users and also benefiting the resource providers (virtual machines) by optimizing (maximizing) their multi attribute resource utilization.

VI. PROPOSED ALGORITHM

Procedure: Improved Auction Based model

Step 1: Collecting the bid amount from various users
Step 2: Determine the winner among the bidders.
Step 3: Choose the approximate VM using Non-Dominant sorting algorithm.
Step 4: Choose approximate PM to place the selected VM
Step 5: Finally, calculate the amount to be paid by the users.

VII. CONCLUSION AND FUTURE WORK

Thus, we have analysed various techniques on virtual machine provisioning and allocation. Based on the literature survey we proposed a provisioning algorithm based on non-dominant sorting. We will be implementing this model using Cloudsim simulation tool. Using theoretical evaluation we achieved a solution better than some of the other solutions. In future we will demonstrate that our implementation is achieves better performance.

REFERENCES

1. A. Quiroz, H. Kim, M. Parashar, N. Gnanasambandam, and N. Sharma, "Towards autonomic workload provisioning for enterprise grids and clouds," in Proceedings of the 10th IEEE/ACM International Conference on Grid Computing (GRID'09), 2009
2. K S Manjunath and Anirban Basu, Effective Technique for VM Provisioning on PaaS Cloud Computing Platform , International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 4– No.6, December 2012
3. Rehana Begam, Wei Wang, Member, IEEE, and Dakai Zhu, Senior Member, IEEE, TIMER-Cloud: Time-Sensitive VM Provisioning in Resource-Constrained Clouds, TRANSACTION ON CLOUD COMPUTING, VOL. XX, NO. YY, XXXX, 2017
4. David Villegas, Athanasios Antoniou, Seyed Masoud Sadjadi, and Alexandru Iosup, An Analysis of Provisioning and Allocation Policies for Infrastructure-as-a-Service Clouds: Extended Results, An Analysis of Provisioning and Allocation Policies for Infrastructure-as-a-Service Clouds: Extended Results, Draft, Dec 2011.
5. Aaqib Rashid , Amit Chaturvedi, A Study on Resource Pooling, Allocation and Virtualization Tools used for Cloud Computing , International Journal of Computer Applications (0975 – 8887) Volume 168 – No.2, June 2017
6. Mahyar Movahed Nejad, Lena Mashayekhy, Daniel Grosu, Truthful Greedy Mechanisms for Dynamic Virtual Machine Provisioning and Allocation in Clouds, IEEE Transactions on Parallel and Distributed Systems Vol 26, NO 2, Feb 2015
7. Sharrukh Zaman, Daniel Grosu, A Combinatorial Auction-Based Mechanism for Dynamic Virtual Machine Provisioning and Allocation in Clouds, IEEE Transactions on Cloud Computing Vol 1 NO 2 July-December 2013
8. Lena Mashayekhy, Mahyar Movahed Nejad, Daniel Grosu, and Athanasios V. Vasilakos, An Online Mechanism for Resource Allocation and Pricing in Clouds,IEEE Transactions on Computers Vol. 65 No.4 April 2016
9. Lena Mashayekhy, Mahyar Movahed Nejad and Daniel Grosu, A PTAS Mechanism for provisioning Allocation of Heterogeneous Cloud Resources, IEEE Transactions on Parallel and Distributed Systems, Vol. 26 No.9 September 2015
10. Lena Mashayekhy, Mahyar Movahed Nejad , Daniel Grosu and Athanasios V Vasilakos An Online Mechanism for Resource Aloocation and Pricing in Clouds, IEEE Transactions on Computers, Vol. 65 No.4 April 2016

11. Lena Mashayekhy, Mahyar Movahed Nejad and Daniel Grosu, Physical Machine Resource Management in Clouds:A Mechanism Design Approach, IEEE Transactions on Cloud Computing , Vol. 3 No.3 September 2015
12. David Villegas, Athanasios Antoniou, Seyed Masoud Sadjadi, and Alexandru Iosup, An Analysis of Provisioning and Allocation Policies for Infrastructure-as-a-Service Clouds: Extended Results, An Analysis of Provisioning and Allocation Policies for Infrastructure-as-a-Service Clouds: Extended Results, Draft, Dec 2011.
13. Rodrigo N. Calheiros, Rajiv Ranjan and Rajkumar Buyya "Virtual Machine Provisioning Based on Analytical Performance and QoS in Cloud Computing Environments" 2011 International Conference on Parallel Processing
14. C. Qu, R. N. Calheiros, and R. Buyya, "A reliable and cost-efficient autoscaling system for web applications using heterogeneous spot instances," Journal of Network and Computer Applications, vol. 65, pp. 167 – 180, 2016
15. Chenhao Qu, Rodrigo N. Calheiros, and Rajkumar Buyya A Reliable and Cost-Efficient Auto-Scaling System for Web Applications Using Heterogeneous Spot Instances ,September, 2015
16. Liuhua Chen, Haiying Shen, Considering Resource Demand Misalignments To Reduce Resource Over-Provisioning in Cloud Datacenters, IEEE INFOCOM 2017 - IEEE Conference on Computer Communications
17. Maria Alejandra Rodriguaz and Rajkumar Buyya, "Deadline Based Resource Provisioning and Scheduling Algorithm for Scientific Workflows on Clouds",IEEE Transactions on Cloud Computing, vol. 2, No. 2, APRIL-JUNE 2014.
18. Optimization of Resource Provisioning Cost in Cloud Computing, IEEE Transactions on Services Computing, Vol. 5, No.2 April-June 2012.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication