FINEST CLOUD RESOURCE FACILITY IN CLOUD ENVIRONMENT

Ushakiran V. Bhosle[1] and Bankat M. Patil[2]
P.G. Dept., M. B. E. Society's College of Engineering, Ambajogai, Maharashtra, India

ABSTRACT

Now a day's many peoples are attracted towards the cloud to use different computing resources, which are provided by the different cloud providers in the cloud environment. In cloud computing environment, cloud providers provide two provisioning plans for cloud consumers to use resources, namely reservation plan and on-demand plan. In this work we compare the analysis of two resource provisioning algorithms such as OCRP and EVU by considering provisioning plans. In this paper, OCRP algorithm is compared with EVU algorithm of resource provisioning. Experimental results show that the OCRP minimizes the on-demand cost of resource provisioning as compared to the EVU algorithm

KEYWORDS: *Cloud environment, cloud resource, resource provisioning.*

I. INTRODUCTION

Cloud computing is defined as a large-set of computing resources available at cloud provider side and these resources provided to users by using Internet only [1, 2]. In cloud computing environment, cloud users called cloud consumers. The computing resources can be storage, software, processing power, network bandwidth, etc. Different cloud consumers such as government sector, research institutes and industry sector use cloud computing resources to solve their growing computation and storage problems [2]. Three main reasons to select the cloud computing is as follows:

- Rapid decrease in hardware cost
- Increase in processing power
- Increase in storage capacity.

Cloud computing includes 3 different service models such as infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). In cloud computing, IaaS service model is mostly used. In this model, the virtual machines are used to provide resources to cloud consumer.

In cloud computing environment, resource provisioning mechanism provides a set of computing resources to the cloud consumers for processing their jobs and for storing their data [1]. Cloud provider offers two provisioning plans, namely reservation plan and on-demand plan. Reservation plan is a long-term plan and on-demand plan is a short-term plan. The pricing for reservation plan can be based on onetime fee and before using any resource cloud consumer need to pay the minimum amount first, and then only get access to that reserved resource. The pricing for on-demand plan can be based on pay-per-use basis that is when any resource is required, then only reserve that resource and utilize it finally. The price of on-demand plan is greater than reservation plan.

Reservation plan faces two problems such as under-provisioning problem and over-provisioning problem. When the reserved resources are insufficient to fulfil the demand then that problem is known as under-provisioning problem. The under-provisioning problem is solved by using on-demand plan, in which consumer can reserve more resources when required but the on-demand plan is costlier than reservation plan. When the reserved resources are more than the demand, then that problem is known as over-provisioning problem. In over-provisioning, resources are not utilized fully. The cloud consumer need to minimize the total cost of resource provisioning for under-provisioning and over-

provisioning problems that is the on-demand cost and over-subscribed cost respectively. To solve these problems, the optimal computing resource management is the main point.
The remaining part of this paper is organized as follows: Section 2 represents literature review, in which different resource provisioning methods are discussed. Section 3 represents system architecture and description of resource provisioning in cloud environment. Section 4 explained different resource provisioning algorithms used by the OCRP. Section 5 represents experimental results which are observed. Finally we conclude in Section 6.

II. LITERATURE REVIEW

Different techniques to reduce resource provisioning problems related to cost, performance and usability. Such techniques are advance reservations, multi-level scheduling, and infrastructure as a service (IaaS) are introduced [3]. The on-demand service for grid to provide greater flexibility with lower cost and speed up data processing usually proposed [4]. The Just-in-time scalability proposed based on profile for cloud applications. Just-in-time scalability adjusts the resources automatically depending on workload. When workload is maximum then resources are added otherwise when workload is minimum then resources are removed [5]. A new high performance distributed computing resource management paradigm named resource slot proposed [6]. Resource slot is a network of logical machines across time and space. Resource slot is a combination of target resource programming and virtualized resource provisioning framework. An adaptive resource provisioning scheme for optimization of resources utilized to get expected quality of service, increases the revenues of infrastructure providers and decreases the resource request blocking probability proposed [7]. In all of above references the future demand of cloud consumer did not considered.
Optimization framework for resource provisioning problem proposed [8] and this problem is solved using limited look-ahead control scheme. YuuZuu reservation method proposed, which is a more flexible reservation method [9]. DREAM reservation system implemented by making the use of YuuZuu reservation, in which reservation allocation function, demand analysis function and price optimization functions are included. Classic K-nearest-neighbors approach for adding database replicas to application allocations in dynamic content web server clusters proposed [10].
A broker based resource provisioning and an allocation of virtual machine is done [11]. Autonomic virtual resource management for resource provisioning in cloud proposed [12]. Min-max resources used to allocate virtual machines and share based mechanism for hypervisor in virtualization technologies proposed [13]. Management algorithm for dynamic placement of virtual machines by violating SLA proposed [14].
Stochastic programming proposed [15]. Stochastic programming solves resource planning under uncertainty in various fields, such as production planning, financial management, and capacity planning. Optimal virtual machine placement (OVMP) algorithm proposed to minimize the cost for hosting virtual machine placement in multiple cloud provider environments, when demand and price uncertainty problem occurs. OVMP algorithm gives the optimal solution based on stochastic integer programming (SIP) [16].

III. SYSTEM ARCHITECTURE AND DESCRIPTION

3.1 Cloud Resource Provisioning Environment

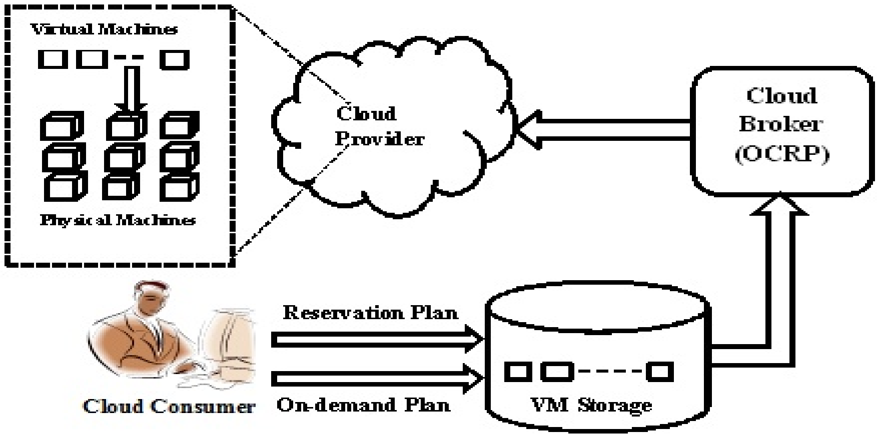

Figure 1: System architecture for cloud resource provisioning environment

Figure 1 shows the system architecture for cloud resource provisioning environment, in which the environment consists of 4 main elements [1], [19], [20], [21], [22]. These are

- Cloud Consumer: Cloud consumer is a person who demands to use the cloud resources, provided by cloud providers.
- Virtual Machine Storage: VM storage first takes the job from cloud consumer and then integrates with software required by that job.
- Cloud Broker: Cloud broker plays an important role in resource provisioning. Cloud broker is present at the consumer side it always tries to fulfil the cloud consumer demand and reduce cloud providers resource provisioning cost.
- Cloud provider: Cloud providers are responsible to provide the resources, demanded by cloud consumers.

3.2 Provisioning Plans

Cloud provider provides 2 resource provisioning plans for cloud consumers. These are

- Reservation Plan: This plan is best suited for medium to long term plan. Advance resource reservation is compulsory, to use the resources.
- On-Demand Plan: This plan is best suited for short term plan when the reserved resources are insufficient then this plan is used but the cost of this plan is more than the reservation plan.

3.3 Provisioning Phases

Three resource provisioning phases are observed by the cloud broker. The provisioning phase is nothing but the different time intervals for resources used. These are

- Reservation Phase: In this phase the resources are reserved without knowing the future demand of cloud consumer.
- Expending Phase: In this phase the reserved resources are utilized for a period of time.
- On-Demand Phase: When the reserved resources are insufficient to meet the demand that time this phase work.

3.4 Provisioning Stages

Provisioning stage is the time difference, in which the cloud broker takes a decision of resource provisioning as per the selected plan, and also allocates VMs to the cloud provider for utilizing the provisioned resource.

3.5 Reservation Contracts

A cloud provider offers multiple reservation plans with multiple reservation contracts for cloud consumers. Before using any resource, reservation plan reserves that resource with reservation contract.

3.6 Uncertainty of Parameters

Uncertainty parameters such as cloud consumer demands and cloud provider prices, these parameters are need to handle by the cloud broker. The solution for these uncertainties can be obtained from stochastic integer programming. Stochastic integer programming takes the set of uncertainty of parameters. Uncertainty of parameters also called as scenarios. The uncertainty of parameters can be formulated as follows [1]:

$$U = U_1 \times U_2 \times U_3 \times \ldots\ldots \times U_n \tag{3.6}$$

3.7 Provisioning Costs

Provisioning costs are depends on the provisioning phases that's why the names for provisioning costs are reservation costs, expending costs and on-demand costs. And to minimize all these costs the OCRP algorithm is used. Any type of cost can be calculated by using follows [1]:

$$\text{Cost} = \sum (\text{No. of resources reserved} \times \text{Unit price of each reserved resource}) \tag{3.7}$$

IV. ALGORITHMS

Stochastic programming model uses different scheduling algorithms for resource provisioning. Some Scheduling algorithms are first in first out, shortest job first, round-robin, priority scheduling, etc. The need of scheduling algorithm is for quick response to the consumer demands. In cloud environment, many consumers require resources to do their work. So there is a queue of demands, also called jobs. To handle this queue, priority scheduling algorithm is applied to get optimal solution. And the optimal solution gives minimized price for demanded resource which is beneficial to cloud consumer. The priority scheduling algorithm is best suited for OCRP.

4.1 Stochastic Integer Programming For OCRP

In cloud environment, multiple cloud providers provide a large pool of resources to consumer. To provide these resources virtual machines need to be placed. The goal of this algorithm is to minimize all types of costs, and at the same time meeting the demands of consumer. Stochastic integer programming is the mathematical formulation for an optimal cloud resource provisioning [1, 16]. Following steps gives the minimum cost for stochastic integer programing.

Stochastic Integer Programming Algorithm Steps:

i. Calculate first term; in this multiply the reservation cost of first stage with the number of VMs provisioned in first stage without considering uncertainty parameter.
ii. Calculate second term; in this multiply the reservation cost of a stage with the number of VMs provisioned in same stage by considering the uncertainty parameter.
iii. Calculate third term; in this multiply the expending cost of a stage with the number of VMs provisioned in same stage by considering the uncertainty parameter.
iv. Calculate fourth term; in this multiply the on-demand cost of a stage with the number of VMs provisioned in same stage by considering the uncertainty parameter.
v. Finally add all these terms; this addition gives the minimum cost.

$$Z = \sum_{i\in I}\sum_{j\in J}\sum_{k\in K} C_{ijk}^{(R)}\, x_{ijk}^{(R)} + \Big(\sum_{i\in I}\sum_{j\in J}\sum_{k\in K}\sum_{t\in T_k} C_{ijkt}^{(r)}(\omega)\, x_{ijkt}^{(r)}(\omega) + \sum_{i\in I}\sum_{j\in J}\sum_{t\in T}\Big(\sum_{k\in K} C_{ijkt}^{(e)}(\omega)\, x_{ijkt}^{(e)}(\omega) + C_{ijt}^{(o)}(\omega)\, x_{ijt}^{(o)}(\omega)\Big)\Big) \tag{4.1}$$

4.2 Deterministic Equivalent Formulation

The probability distribution for all scenarios of stochastic integer programming formulation can be applied and then it converted into deterministic integer programming, also called as deterministic equivalent formulation [1, 17]. In this paper, the probability distribution considered for both demand and price uncertainty. The probability distribution value is always in between 0 and 1.

Deterministic Equivalent Formulation Algorithm Steps:

i. Calculate first term; in this multiply the reservation cost of first stage with the number of VMs provisioned in first stage without considering uncertainty parameter.

ii. Calculate second term; in this multiply the probability distribution value, reservation cost of a stage and the number of VMs provisioned for same stage by considering the uncertainty parameter.
iii. Calculate third term; in this multiply the probability distribution value, expending cost of a stage and the number of VMs provisioned for same stage by considering the uncertainty parameter.
iv. Calculate fourth term; in this multiply the probability distribution value, on-demand cost of a stage and the number of VMs provisioned for same stage by considering the uncertainty parameter.
v. Finally add all these terms; this addition gives minimum cost.

$$\hat{Z}_\Omega = \sum_{i\in I}\sum_{j\in J}\sum_{k\in K} C_{ijk}^{(R)}\, x_{ijk}^{(R)} + \left(\sum_{\omega\in\Omega}\sum_{i\in I}\sum_{j\in J}\sum_{k\in K}\sum_{t\in T_k} p(\omega) C_{ijkt}^{(r)}(\omega)\, x_{ijkt}^{(r)}(\omega) + \sum_{\omega\in\Omega}\sum_{i\in I}\sum_{j\in J}\sum_{t\in T} p(\omega)\left(\sum_{k\in K} C_{ijkt}^{(e)}(\omega)\, x_{ijkt}^{(e)}(\omega) + C_{ijt}^{(o)}(\omega)\, x_{ijt}^{(o)}(\omega)\right)\right) \quad (4.2)$$

4.3 Benders Decomposition

Benders decomposition algorithm [1, 18] applied on stochastic programming model to solve the problem. The main objective of this algorithm is to divide the main problem of resource provisioning into smaller problems which can be solved separately and simultaneously. The main reason to divide stochastic programming model is due to the multiple complicating variables used in this model which takes much time for calculation. As a result, benders decomposition reduces the computation time. The benders decomposition algorithm explained below:

Benders Decomposition Algorithm Steps:

i. Consider the resource provisioning is the main problem.
ii. Divide the main problem of resource provisioning into multiple smaller sub-problems.
iii. Calculate the sub-problem separately and simultaneously.
iv. After calculation compare the values of sub-problems.
v. If comparison gives smaller value then Stop.
vi. If comparison not gives smaller value then again go to step iii and follow same steps until the comparison gives smaller difference value.

V. EXPERIMENTAL RESULTS

In this section, two resource provisioning algorithms are compared. These are optimal cloud resource provisioning (OCRP) and expected-value of uncertainty provisioning (EVU). EVU uses the average values of uncertainty parameters and solved by using deterministic equivalent formulation for VM allocation to cloud providers.

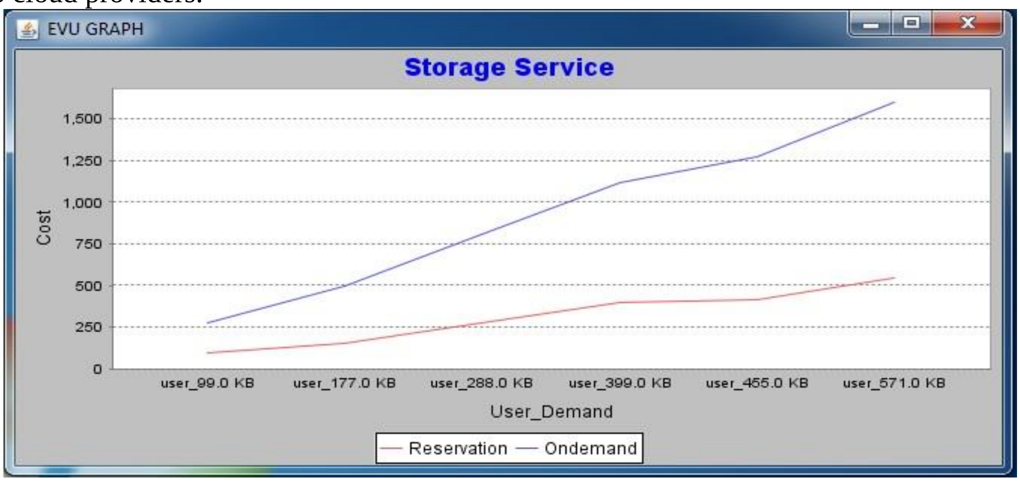

Figure 2: Resource provisioning using EVU algorithm

EVU algorithm reserves the VMs when required with respect to the uncertainty value. In Figure 2, two costs are compared. These costs are reservation plan cost and on-demand plan cost. We observe that the reservation plan cost is always less than the on-demand plan cost. For increasing demand the cost get increased for both provisioning plans. This algorithm cannot give optimal solution. Figure 2 shows the idea about EVU algorithm.

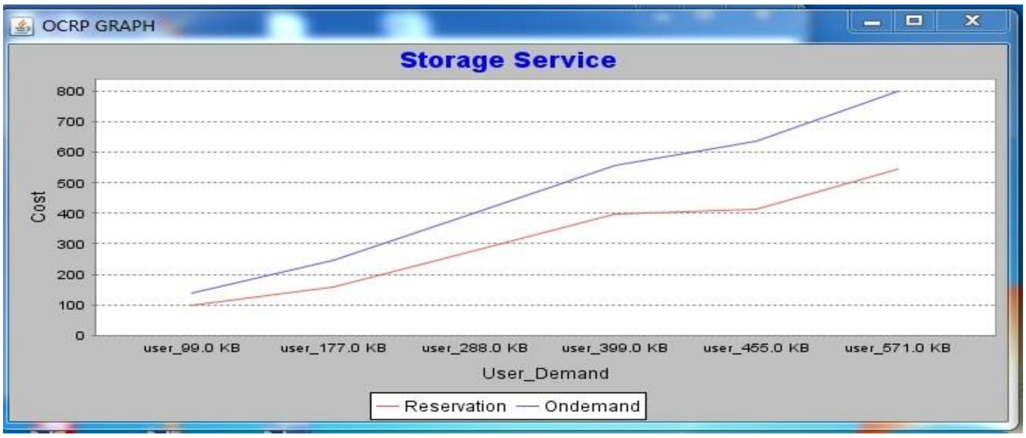

Figure 3: Resource provisioning using OCRP algorithm

OCRP algorithm reserves the VM by considering consumer future demand and provider future price. We observed that reservation plan is cheaper than on-demand plan but this condition is not always true. Sometimes the on-demand plan gives less or equal cost as compare to reservation plan. Due to this reason OCRP gives optimal value for resource provisioning. Figure 3 shows the idea about OCRP algorithm.

VI. CONCLUSION AND FUTURE WORK

OCRP includes stochastic programming model and Benders decomposition algorithm. These algorithms are helpful to solve the problem of uncertainty of under-provisioning and over-provisioning problems related to demand and price uncertainty. Every consumer is satisfied because the cloud broker uses OCRP. Due to the use of OCRP the resource provisioning cost gets minimized. Experimental result shows that the OCRP is best in cost as compare to EVU algorithm. Finally conclude that for increasing cloud market the OCRP gives finest solution for cloud resource provisioning, in which OCRP effectively save the total cost of resource provisioning.

In future uncertainty parameters will be completely eliminated. So that consumers get access to resources without caring the uncertainty problems.

REFERENCES

[1] S. Chaisiri, B. S. Lee, and D. Niyato "Optimization of Resource Provisioning Cost in Cloud Computing" IEEE TRANSACTIONS ON SERVICES COMPUTING, VOL. 5, NO. 2, APRIL-JUNE 2012
[2] I. Foster, Y. Zhao, and S. Lu, "Cloud Computing and Grid Computing 360-Degree Compared," Proc. Grid Computing Environments Workshop (GCE '08), 2008.
[3] G. Juve and E. Deelman, "Resource Provisioning Options for Large-Scale Scientific Workflows," Proc. IEEE Fourth Int'l Conf. e-Science, 2008.
[4] Z. Huang, C. He, and J. Wu, "On-Demand Service in Grid: Architecture Design, and Implementation," Proc. 11th Int'l Conf. Parallel and Distributed Systems (ICPADS '05), 2005.
[5] Y. Jie, Q. Jie, and L. Ying, "A Profile-Based Approach to Just-in-Time Scalability for Cloud Applications," Proc. IEEE Int'l Conf. Cloud Computing (CLOUD '09), 2009.
[6] Y. Kee and C. Kesselman, "Grid Resource Abstraction, Virtualization, and Provisioning for Time-Target Applications," Proc. IEEE Int'l Symp. Cluster Computing and the Grid, 2008.
[7] A. Filali, A.S. Hafid, and M. Gendreau, "Adaptive Resources Provisioning for Grid Applications and Services," Proc. IEEE Int'l Conf. Comm., 2008.
[8] D. Kusic and N. Kandasamy, "Risk-Aware Limited Lookahead Control for Dynamic Resource Provisioning in Enterprise Computing Systems," Proc. IEEE Int'l Conf. Autonomic Computing, 2006.

[9] K. Miyashita, K. Masuda, and F. Higashitani, "Coordinating Service Allocation through Flexible Reservation," IEEE Trans. Services Computing, vol. 1, no. 2, pp. 117-128, Apr.-June 2008.
[10] J. Chen, G. Soundararajan, and C. Amza, "Autonomic Provisioning of Backend Databases in Dynamic Content Web Servers," Proc. IEEE Int'l Conf. Autonomic Computing, 2006.
[11] L. Grit, D. Irwin, A. Yumerefendi, and J. Chase, "Virtual Machine Hosting for Networked Clusters: Building the Foundations for Autonomic Orchestration," Proc. IEEE Int'l Workshop Virtualization Technology in Distributed Computing, 2006.
[12] H.N. Van, F.D. Tran, and J.-M. Menaud, "SLA-Aware Virtual Resource Management for Cloud Infrastructures," Proc. IEEE Ninth Int'l Conf. Computer and Information Technology, 2009.
[13] M. Cardosa, M.R. Korupolu, and A. Singh, "Shares and Utilities Based Power Consolidation in Virtualized Server Environments," Proc. IFIP/IEEE 11th Int'l Conf. Symp. Integrated Network Management (IM '09), 2009.
[14] N. Bobroff, A. Kochut, and K. Beaty, "Dynamic Placement of Virtual Machines for Managing SLA violations," Proc. IFIP/IEEE Int'l Symp. Integrated Network Management (IM '07), pp. 119-128, May 2007.
[15] F.V. Louveaux, "Stochastic Integer Programming," Handbooks in OR & MS, vol. 10, pp. 213-266, 2003.
[16] S. Chaisiri, B. S. Lee, and D. Niyato, "Optimal Virtual Machine Placement across Multiple Cloud Providers," Proc. IEEE Asia-Pacific Services Computing Conf. (APSCC), 2009.
[17] GNU Linear Programming Kit (GLPK), http://www.gnu.org/software/glpk,2012.
[18] A. J. Conejo, E. Castillo, and R. Garcia-Bertrand, "Linear Programming: Complicating Variables," Decomposition Techniques in Mathematical Programming, chapter 3, pp. 107-139, Springer, 2006.
[19] S. P. Praveen, U. Tulasi, B. Vishnu and A. Yuvakrishna, "A New Approach for Optimizing Resource Provisioning in Cloud computing Using OCRP Algorithm" IJDCST @December Issue- V-1, I-8, SW-3.
[20] M. Manikandaprabhu and R. Sivasenthil, "Resource Provisioning Cost of Cloud Computing by Adaptive Reservation Techniques" International Journal of Computer Trends and Technology (IJCTT) - volume4 Issue5–May 2013.
[21] P. Aradhya and K. Shivaranjani, "Exploring Resource Provisioning Cost Models in Cloud Computing" International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue10 – Oct 2013.
[22] K. Satheeshkumar, K. Senthilkumar and A. Selvakumar, "OCRP Implementation to Optimize Resource Provisioning Cost in Cloud Computing" International Journal of Latest Trends in Engineering and Technology (IJLTET) Vol. 4 Issue 1 May 2014.

AUTHORS

Ushakiran V. Bhosle presently a P.G. student in the Computer Science & Engineering Department at M. B. E. Society's College of Engineering, Ambajogai, India. She completed her Bachelor degree in Information Technology Department from M. S. Bidwe Engineering College, Latur, under S.R.T. M. University, Nanded, India. She is pursuing her Master Degree from the College of Engineering, Ambajogai. Her areas of research interest include computer networks and cloud computing.

Bankat M. Patil is currently working as a Professor in P.G. Computer Science & Engineering Department in M.B.E. Society's College of Engineering, Ambajogai, India. He received his Bachelor's degree in Computer Engineering from Gulbarga University in 1993, MTech Software Engineering from Mysore University in 1999, and PhD Degree from Indian Institute of Technology, Roorkee, 2011. He has authored several papers in various international journals and conferences of repute. His current research interests include data mining, medical decision support systems, intrusion detection, cloud computing, artificial intelligence, artificial neural network, wireless network and network security.