INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATIONS AND ROBOTICS
ISSN 2320-7345

A SURVEY ON AUCTION BASED RESOURCE ALLOCATION IN CLOUD ENVIRONMENT

Shirley Sequeira R[1], Karthikeyan P[2]

[1] Post-Graduate Student, Department of Computer Science and Engineering, Karunya University, India
[2] Assistant professor, Department of Computer Science and Engineering, Karunya University, India

Abstract: The cloud computing is one of the emerging technologies that allows the resource providers to lease their resources with a price, for various services in cloud environment and to allocate their resource to different kind of cloud users based on the user's demand. Resource management and allocation efficiency is one of the key factors that affect the performance of the service provided by the cloud. This paper provides a survey on the various auction techniques used for resources allocation in the cloud environment. The main idea to go for auction mechanism rather than market based pricing strategy is for the need for optimal allocation and scheduling of resources. An auction technique facilitates the cloud user's to specify their preferences form the number of available resources in clouds based on their need through bids to attain resource. The performance metric used and the benefit gained for different kinds of auction techniques are different in the cloud environment. This paper concludes that the Combinatorial Auction focuses on bundle of items which makes the allocation of resources more efficient and benefits both the cloud provider and the cloud user.

Keywords: Cloud Environment, Combinatorial Auction, Resource allocation.

I. INTRODUCTION

Cloud computing is one of the latest computing technique that mainly focuses on the sharing of the computing resource. The cloud computing is also known as distributed computing which manages multiple systems connected over a network. The cloud computing environment contains two main participants which include the cloud providers and the cloud users. The cloud providers provide a resource for lease in the cloud for a particular price. The cloud user can request for the resource and pay the price for using the resource. There two main mechanisms for mechanisms for paying for the resource usage in the cloud [7]. They are pay as you go and the long term contract. These two payment mechanism differs from each other in only one aspect that is in the pay as you go method the user pays for the resource used by the user for the period of time. In the long term contract, a contract for the payment for the resource is fixed for a long duration of time. The cloud environment is very much similar to the grid environment.

There is a great need for the need for the resource in the cloud environment. Since there a lots of users distributed geographically over a wide area the resources are also widely distributed. Hence the management of resources helps to make efficient allocation resources. If the resources are being managed in a efficient way then the pricing of the resources will become an easy task. There are two main standard economic models for the allocation of resources, they are market based approach and the auction methodology. In the market based the price for the particular resource is being fixed prior and the user is charged according to their usage and the price for the resources is allocated publically. But this method has certain disadvantages, since the price is being fixed prior it becomes economically inefficient, and the fixed values will not change based on the demand and supply. In the auction model, the price of the resources is decided as a agreement between the cloud user and the resource provider.

The paper is structured as follows. Section 2 presents the auction models. Section 3 discusses about the various auction models and Section 4 discusses about the combinatorial for the allocation of resources and resource management in the cloud environment.

I. AUCTION MODEL

Auction mechanism is one of the advantageous and beneficial methods than the other existing mechanisms and which do not depend upon the demand and supply. In order to overcome the disadvantages of the market based approach the auction based approach is now being widely used in the pricing and the resource allocation. In this approach, there is no fixed price. The price for the resource varies based on the demand and the supply. Both the buyer and the seller are free to provide with their valuation and a agreement is made over the price determined for the resource. And this approach gains profit to both the buyer and the seller.

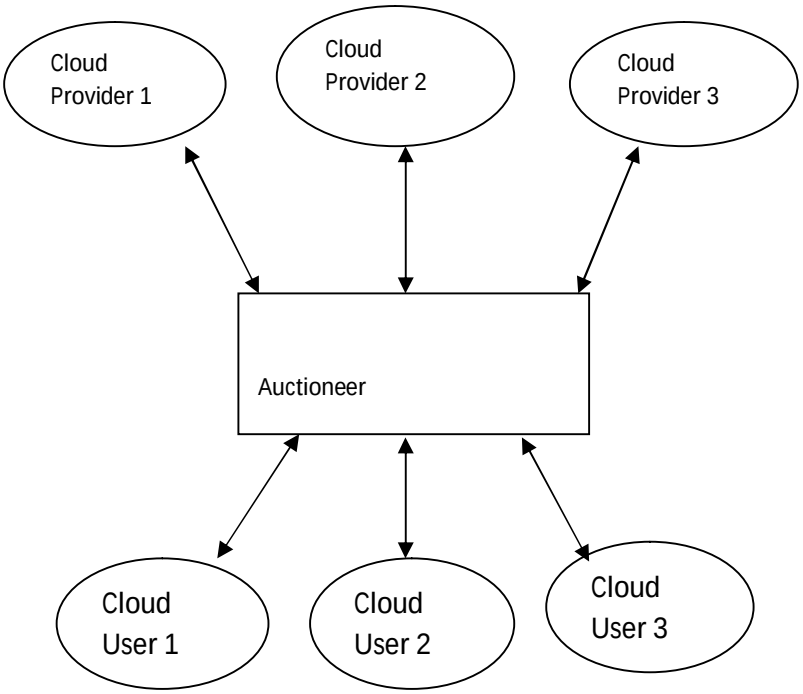

Fig 1: Auction Mechanism

The auction technique is mainly used to allocate the resource to the requesting user from a group of resource providers who provide various resources for accessing various service provided by the cloud environment. The user's send the request for the resource through bids and the resource provider sends their fixed price limit for the resource as an ask to the auctioneer. The user with the highest bid usually wins the auction. The auctioneer's main duty is the allocation and the management of the resources in the auction.

II. CLASSIFICATION OF AUCTION MODELS

The auction models is classified into two major types based on the number of items that the cloud user bid in the auction mechanism[2].They are namely the single item and the multi item auction. The different type of auction can be broadly classified under these two broad types of auction as shown in the figure 2.

The single item auction is auctioning of a single unit or multiple unit of the homogenous item. And the types of auction under this category are fixed price auction, reverse auction and Vickery auction. The multi unit auction refers to auction on single unit or multiple unit of heterogeneous items. Some of the auction that comes under this technique is continuous double auction and combinatorial auction.

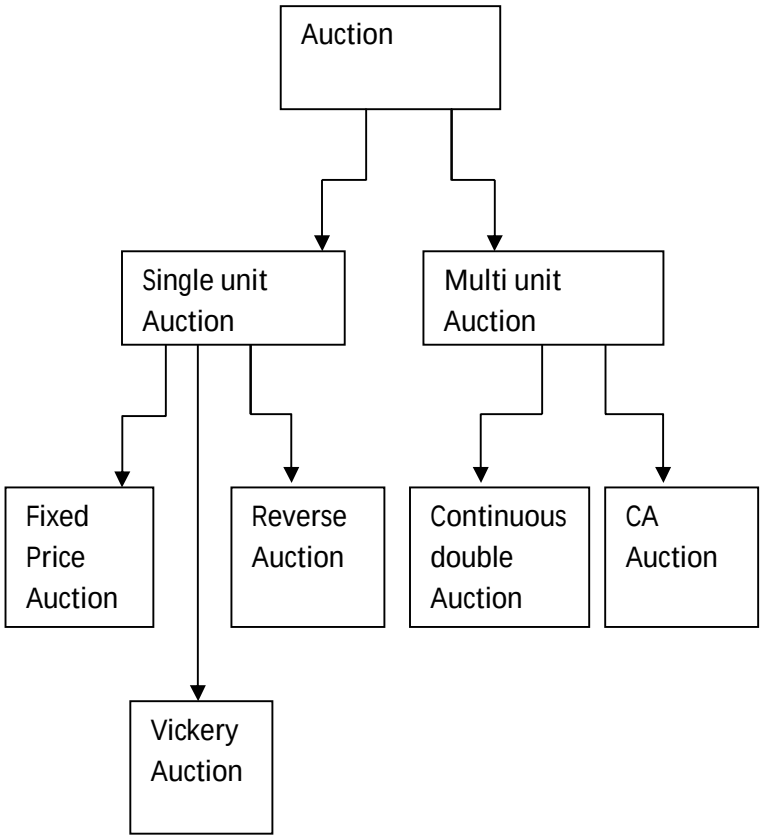

Fig. 2 Classification of Auction

3.1 Fixed Price Auction

The fixed price auction is one of the widely used auction technique that is being used to sell the resource in the cloud environment [7]. The fixed price auction allows the seller to fix a particular price for the resource known as the fixed price .The buyer provides with the bid that holds the value, the buyer is willing to pay for the resource. The winner of the auction is determined by comparing the price of both the seller and the buyer. Among the group of buyer whose bid request is greater than the fixed price of the seller is the winner of the auction and other lose the auction. The main advantage of this auction type is that, the allocation efficiency is high because uses the first come first serve basis. It suffers form the major disadvantage that is it profits only the seller because the fixed price does not depend on the demand and supply.

3.2 Vickery Auction

The Vickery auction is also known as second price sealed auction. It is same as the first price sealed auction. The only main difference is that, the buyer provides their price they are willing to pay to the seller. The buyer bid request is not known among the group of bidders. And the buyer with the highest price wins the auction. The buyer pays the price of the second highest bid. It provides great benefit to the buyers than the sellers.

3.3 Reverse Auction

Reverse auction is one of the popular auction methods used by large organizations in order to get their resources [6]. It is just the reverse of the forward auction. In a reverse auction, the buyer provides with a request for a required good or service. Sellers then place bids for the amount they are willing to be paid for the good or service, and at the end of the auction the seller with the lowest amount wins. The main advantage obtained by using reverse auction is that the computation time required to process the request for resource is very low.

3.4 Double Auction

In the double auction the buyer and the seller submit their bid and ask request simultaneously to the auctioneer [3]. The auction mechanism sorts the ask and the bid in ascending and descending order and look for a match with the help of meta-scheduler. The meta-scheduler will perform the matching process by collecting the details of all available resources from the scheduler. If a match is found, the average of the values is taken and this value is the auction price for the resource. The unmatched request between the ask and bid is again rescheduled to the meta-scheduler with new ask and bid values and the same matching process will be repeated until all matching are found. This auction mechanism benefits both the seller and the buyer.

3.5 Combinatorial Auction

The combinatorial auction is one the beneficial auction method available in the cloud environment for resource allocation. The main aim of this auction is that the buyer can buy a group of items rather than individual item as in fixed price auction. As the auction is done over group of items it is profitable to both the buyer and the seller. It contributes greatly to improve the revenue generation and allocation efficiency.

I. COMBINATORIAL AUCTION BASED RESOURCE ALLOCATION

Combinatorial auction is one of the type auctions that belonged to the multi item auction. The main feature that makes the combinatorial auction very favourable one is that it allows the buyer to buy a package of items rather than an individual item. Since the auction is done on group of items it provides efficient allocation of resources and it helps to greatly improve the revenue generation to both the cloud provider and the cloud user. Another feature that the combinatorial auction holds is that it allows the buyer to express their true valuation that they are willing to provide for the requesting resource.

There are two main aspects of the combinatorial auction that is truthfulness and utility. The concept of truthfulness deals with the price the buyer willing to pay for the requesting resource. The term utility refers to the difference between the price calculated by the auction mechanism and the amount the buyer actually pays.

One of the challenges available in the combinatorial auction is the winner determination problem. The winner determination problem is NP-complete problem [7]. So there are mechanisms that are being implemented in the combinatorial auction method in order determine the winner efficiently and obtain higher allocation efficiency.

There are two mechanism that are being used in the combinatorial auction, namely CA-LP (Linear Programming) and CA-GREEDY mechanisms which helps out to provide efficient allocation and higher revenue generation.

CA-LP (Linear Programming) Mechanism

The CA-LP (Linear Programming) uses a linear program for processing every buyer's request to allocate the requested resource efficiently [1]. In the previously available CA-LP mechanisms, if conflicting resources are found the resource will be removed from the available number of resources. This mechanism calculates a price for every user which has to be paid to obtain any particular request using binary search. One of the major feature of this methodology is that it check the request of resource from the users does not exceed the available number of resources [7]. Another feature is that it does not discard the conflicting items during the auction process.

The step by step procedure how the CA-LP (Linear Programming) works is has given below

- The request of resource is collected from the user as bid which contains the resource needed and the valuation.
- Reduce the number of available resources.
- Solve a linear program for every user's request for resource.
- Obtain a random number and the fractional allocation value for the resource. Both the values that are generated will be between the limit zero to one.
- Check for the condition that the fractional allocation is always greater than the random number generated and the request of resources does not exceed the available number of resources.
- Only if the above condition is satisfied the buyer is declared as the winner else the buyer will not be allocated with any resource.
- Next step is to perform payment calculation for the winners and no payment is calculated for others.
- The payment calculation is done ,by doing binary search on the range from zero to the user specified valuation
- Again solving the linear program, and checking the condition given above will obtain a critical value, which is the payment the buyer has to pay.

CA-GREEDY Mechanism

The CA-GREEDY Mechanism is one of the beneficial auction mechanisms that belong to the combinatorial auction [4]. The mechanism uses a greedy technique to allow efficient allocation of resources. The existing techniques does not check whether the buyer's request for the resources exceed the available number of resources. The weight of the resource is calculated by using only the number of virtual machine instances requested. The main feature of this CA-GREEDY auction [7] is that it always checks the buyer request for the resource does not exceed the available number of resources. This mechanism uses a greedy technique to allow efficient allocation of resources. The main feature of this mechanism is that it always checks the buyer request for the resource does not exceed the available number of resources.

The step by step procedure how the CA-GREEDY mechanism works is has given below

- Collect the bids from the user which contains the requested resource and valuation they are willing to pay for the resource.
- Calculation of the size of the resource is calculated using the number of resources and the weighted value of the resource.
- The bid density is being calculated and ordered in descending order.
- Checks for the condition that the request of resource does not exceed the available number of resources.
- When the above condition is satisfied, the buyer with the highest bid density is declared as the winner of the auction

The payment for the combinatorial auction is the winner pays the amount of the second highest valuation of bid density

When the combinatorial auction is compared to the various other auction mechanism. The fixed price auction is mainly used to auction over a single unit of time .It needs very less computation time and the allocation is efficient. It mainly favours the seller, since the price is fixed. In the case of Vickery auction the computation time needed for allocation is very low. The revenue generation is quite low. This auction favours the buyer. The reverse auction requires very less computation time, but the allocation of resources is not much efficient. It mainly favours the users. In the double auction, the allocation of resources is efficient .It favours both the buyer and the seller. The combinatorial auction provides higher generation of revenue and the profits both the buyer and the seller. The following table compares the various auction methods using the various different parameters like the allocation efficiency, revenue generation and the computation time

Table 1 Comparison between the various action modules

Types Of Auction	**Computation Time**	**Allocation Efficiency**	**Revenue Generation**	**Profit**
Continuous Double Auction	Low	High	Medium	Both user and provider
Reverse Auction	Very Low	Medium	Low	User
Fixed Price Auction	Very Low	High	High	Provider
Vickery Auction	Low	High	Low	User
Combinatorial Auction	Very Low	Very High	High	Both user and provider

CONCLUSION

This paper mainly focuses on the various auction methods and the auction based allocation mechanism. The combinatorial auction produces higher revenue generation and provides allocation efficiency with less computational time. It favours both the buyer and the seller. The combinatorial auction is one the suitable auction methods for the resource allocation in the cloud environment.

REFERENCES

[1] A. Archer, C. Papadimitriou, K. Talwar, E. Tardos, An approximate truthful mechanism for combinatorial auctions with single parameter agents, Internet Mathematics 1 (2) (2005) 129–150.

[2] T. S. Chandrashekar, Y. Narahari, Charles H. Rosa, Devadatta M. Kulkarni, Jeffrey D. Tew, and Pankaj Dayama,Auction-Based Mechanisms for Electronic Procurement", IEEE Transactions On Automation Science And Engineering, (2007)1545-5955.

[3] S.K. Garg, S. Venugopal, J. Broberg, R. Buyya ,Double auction-inspired metascheduling of parallel applications on global grids, Journal of Parallel and Distributed Computing ,2012.

[4] D. Lehmann, L.I. O'Callaghan, Y. Shoham, Truth revelation in approximately efficient combinatorial auctions, Journal of the ACM 49 (5) (2002) 577–602.

[5] T. Sandholm, Algorithm for optimal winner determination in combinatorial auctions, Artificial Intelligence 135 (1–2) (2002) 1–54.

[6] Xingwei Wang, Jiajia Sun, Hongxing Li, Chuan Wu and Min Huang,A Reverse Auction Based Allocation Mechanism in theCloud Computing Environment, Appl. Math. Inf. Sci. **7**, No. 1L, 75-84 (2013).

[7] S. Zaman, D. Grosu, Combinatorial auction-based allocation of virtual machine instances in clouds, in: Proc. 2nd IEEE Int'l Conf. on Cloud Computing Technology and Science, CloudCom 2010, pp. 127–134.