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REVERSE AUCTION TO TRADE UNUSED CLOUD COMPUTING RESOURCES

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Abstract— The cloud computing model eliminates the requirement for expensive initial investments in infrastructure while still delivering practical benefits. The direct selling model is utilised in the cloud computing market in order to allot resources for a predetermined cost. The supply-demand rate is not something that cloud service providers consider when making business decisions. Numerous market-based resource allocation models and algorithms have been projected in previous works to demonstrate that dynamic pricing models may be more suitable for cloud resource providers as well as customers. These models and algorithms have been projected to demonstrate that dynamic pricing models may be more suitable for cloud resource providers as well as customers. A mechanism known as a reverse auction is used in the system that is being proposed in order to facilitate the trading of unused cloud computing resources that are unable to be distributed by means of direct selling. An adaptive bidding strategy is utilised in auctions to provide feedback to the provider regarding the actions that should be taken. This mechanism addresses the issue of resource underutilization by utilising resource overbooking and resource pooling as its two primary means of solving the problem. In order to access resources from resource pools without having to pay a penalty and in order to increase datacenter utilisation, resource pooling is an extremely efficient method that can be used. Resource pools can be accessed by service providers. Despite the fact that overbooking is typically done in order to avoid financial penalties for service providers.

Index Terms— Overbooking, resource pooling, adaptive strategy, and reverse auction

I. INTRODUCTION

Cloud computing is a method of providing information technology (IT) services over the internet that results in immediate cost savings. This method involves connecting a large number of systems to private or public networks in order to provide infrastructure that can dynamically scale up or down. Through the use of cloud computing, which provides pay-as-you-go pricing in addition to numerous other advantages, anything can be obtained as a service. Customers and service providers alike should work toward the same objective: obtaining the best possible QoS at a cost that is reasonable. Cloud service providers often rent out some of their unused resources to other service providers or clients who require them to complete their tasks. This helps cloud service providers reduce the amount of waste they produce. In order for providers to achieve their goal of maximising revenue, they need a strategy for effectively managing available resources. When it comes to determining the cost of the resources or services that they offer, cloud service providers employ a variety of different pricing strategies. Service providers have an obligation to be aware of the marketing rate of the identical service or resource that is made available by competing providers in order to sustain a high level of business and generate high profits. An auction is a type of market mechanism that can be thought of as having a set of rules that determine prices as well as the distribution of resources among the various participants [1]. Participants place bids in competition with one another, and the amount of each bid increases after each round. An auctioneer is the person who oversees an auction and is responsible for displaying the bid amounts and announcing the winner. An auctioneer is responsible for responding to each demand request that is made by a customer.

In this paper, the concept of the reverse auction is proposed as a means to address the issue of resource underutilization as well as to facilitate the trading of unused resources. The customer's requests are taken care of by the auction broker. The winner who placed the bid that was the lowest overall will be awarded the right to fulfil the requirements of the customers. In order to take part in the auction, numerous service providers must first register with the auction broker, providing the broker with their contact information as well as the resources at their disposal. The auction broker will make the final decision regarding the type of auction (whether ER auction or SPSB auction). Once the service providers have gained an understanding of the user requirements of the customer, they should make reservations for the relevant resources. Even though the resource is not currently available, the provider may still participate in an auction that includes an overbooking feature. If the requirements of the customer and the capacity of the data centre are compatible, the service provider has the ability to reserve the resources and participate in an auction.

If there is less demand than there is capacity, the service provider has the ability to reserve the resources by drawing from the overbooking pool. The consortium of service providers will then load up and participate in the auction format of their choosing. The person who places the lowest bid will walk away as the winner of the auction. If the selected service provider is unable to fulfil the requirements set forth by the client, they are referred to as a "defaulter." The defaulting providers are required to pay the penalty that has been assessed against them. In order to fulfil the requirements of the clientele, re-assignment is utilised, in which the next lowest bidder is selected as the winner. In the event that there is not a provider who is able to satisfy the demand, a second auction call for proposals will be issued. A resource pooling mechanism has been added in order to avoid penalising defaulters while still making use of the resources that are contained within the resource pool. The unused resources of customers are gathered from datacenters and stored in resource pools in order to address the problem of resource underutilization. This solution is more cost-effective than imposing a penalty, so it is in the best interest of service providers to implement it.

II. WORK THAT IS CONNECTED

It can be difficult to ascertain what the appropriate cost for usage should be for cloud service providers because there are so many different service providers offering cloud services. Amazon began leasing out the unused capacity in order to increase revenue and address the issue of resource underutilization. This allowed Amazon to address both issues simultaneously. In accordance with the on-demand pricing model, the customers were billed for the cloud computing capacity that they used for an hour. Customers are eligible for discounts only when they make reservations or commit to paying flat rates for an extended period of time.

The resource or service can be accessed by the cloud user on a pay-as-you-go basis for as long as the user requires, and the user will only be charged for the amount of time that they actually used the resource or service. Amazon's spot instance price model allows for the sale of unused cloud computing resources by utilising bids and offers in conjunction with market pricing. When using spot instances, users are not permitted to place bids for more than one instance of a given resource at a time. The authors of [5] and [6] show that the Amazon spot price is ineffective in discouraging users from engaging in malicious behaviour and that the model is unclear. Additionally, they show that the Amazon spot price is unclear. The direct-sell and fixed-price model prevents providers from allocating all of their available computing capacity to customers.

A portion of the available resources are also unsold, which results in the service providers receiving no revenue from the sale of those resources. The authors of [2] discussed various strategies for resource allocation and also proposed a market exchange framework. This framework enables consumers and providers of resources to engage in resource trading with one another. Dilip Kumar and his colleagues [3] conducted a classification analysis on each pricing strategy that they discussed in their article about the various resource management pricing strategies. The author of "4" proposed a drive system to increase system utilisation and occupancy rate, but it was found to be ineffective under a variety of different conditions involving the workload. According to the research conducted by Marcel Risch and colleagues[7], an examination of the computing markets, more specifically Popcorn, Spawn, GRACE, and Tycoon, revealed that each strategy exhibited a degree of rigidity in its capacity to evaluate novel market designs and gauge performance in a competitive environment. GridEcon is a platform that was developed as part of the GridEcon project. Its purpose is to analyse new market designs and make use of value-added services in cloud computing in order to solve the issues that are caused by these methods. When a match is found with the suggested allocation mechanism, both providers and consumers communicate their ask prices and bid prices, respectively, in the market exchange. This happens when a transaction is completed. The issue of resource underutilization is addressed in [8] through the presentation of the most effective dynamic pricing strategy, which involves the management of user demands. The authors of [9] suggested using the CaaS (Cache as a Service) model in order to get the most out of cloud computing in terms of performance and profit. In [10], the author maximised revenue by jointly adopting a number of different pricing plans. He then used a benchmark algorithm to evaluate and compare the effectiveness of jointly adopting a number of different pricing plans. The most important difference between [10] and other works is found here.

The authors presented the Combinatorial Double Auction (CDA) model in [11]. This model groups the auction and modifies the price between users and providers in order to maximise revenue. The winner of the auction is determined with the help of an algorithm that adjusts prices. In their study [12], Wubin Li et al. looked at the various algorithms that can be used to provide cost-optimal cloud services in dynamic pricing schemes. The authors of proposed a two-phase gaming model in [13] in order to optimise the utilisation of resources while striking a balance between the costs and benefits incurred by users and providers.

They also developed virtual resource brokers so that cloud environments could be analysed and their resources could be set up. Vinu Prasad et al. [14] discussed the participation of a number of different cloud vendors in the simultaneous procurement of multiple resources. It has been suggested that the Combinatorial Auction Branch on Bids (CABOB) model be used to determine who the winner of the auction will be. It is suggested in [15] that the CA PROVISION mechanism be used for dynamic resource provisioning in response to user requests and in order to maximise profit. The efficiency of the real group auction system [16] is evaluated in terms of its performance, complexity, stability, and optimality, which demonstrates its usefulness to the bidders and is to their advantage.

By using MDT-Auction [17], the user is able to select the cloud service provider that best meets their requirements and preferences. An online reverse auction [18] is essentially a traditional bid with the action performed in the opposite direction: rather than the seller offering a product for sale, the buyer will offer a contract to the seller whose bid was the lowest. Paolo Bonacquisto and colleagues [19] and [20] proposed the procurement auction market as a means of maximising the use of datacenters. In addition, they discussed the challenges associated with the various bidding strategies that service providers employ during auctions. In their paper [21], Jian Zhao et al. discussed the two challenges that cloud storage providers encounter when participating in online procurement auctions. The fact that cloud storage services are reliant on cloud datacenters, as well as the fact that cloud service providers incur significant costs when purchasing resources, contribute to the challenges that cloud service providers are currently confronted with.

III.SYSTEM ARCHITECTURE

A marketplace acts as a conduit for secure financial transactions between cloud resource providers and users. When considering the issue from the point of view of the service providers, it is important to note that services are provided at reduced prices in response to the demand of customers, and that resource pooling and overbooking are utilised to solve issues related to underutilization. Customers are able to conduct searches across all of the service providers in a single location and purchase the required resources at the most competitive price. The market presents the opportunity to increase data centre utilisation to a greater degree. Each individual customer request is sent through to the marketplace, where it is taken care of by the auction broker.

A public auction is held by the auction broker in order to determine which suppliers are eligible to take part in the auction. Multiple service providers are permitted to take part in the auction given that it is open to the general public and that they are required to register with an auction broker. In the end, the key to being a successful service provider is meeting the demands of your customers. The cloud broker will load two different kinds of auctions: the English Reverse auction (abbreviated as ER) and the Second Bid Sealed Price auction (abbreviated as SPSB). The ER auction is broken up into a number of rounds, and the total time allotted to each round is set in advance. The level of competition in an auction determines the number of rounds that are held in the auction. The bid price offers made by the suppliers will be made public during each round of the competition, and at the conclusion of each round, everyone will be informed of the winning bid price. The conclusion of the auction will not take place, however, until all remaining discounts from providers have been offered. In contrast to the ER auction, the SPSB auction is a single round auction in which providers only have the opportunity to place one bid before the auction is over. In order for the suppliers to participate in the auction, they will need to make a reservation for their available resources with the auction broker.

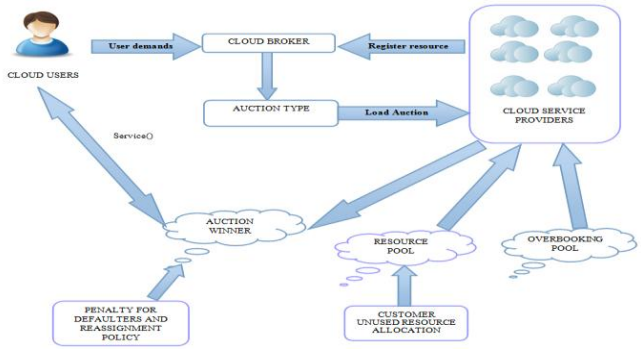

Fig. 1. System Architecture

A cloud service provider has the option to take part in an auction with an overbooking feature even while the provider is in the process of reserving a resource. If the resource is part of the overbooking pool, then it is possible to make a reservation for it. Mechanisms for resource pooling are often favoured in situations like this one. During the process of determining the winner, the winner should be prepared to fulfil the needs of the customers. When a supplier is unable to meet the demand of a customer because a necessary resource is not available, the supplier is said to be in default. The defaulters will be required to pay a penalty because they were unable to fulfil the requirements that were set forth by the customer.

In order to satisfy the needs of the customer, the following victor needs to be selected. The Reassignment policy is used to select the subsequent candidates for winning in order to satisfy the demand. In the event that there are no suppliers available to satisfy the demand, the auction will be restarted. In order to avoid defaulting and penalties, resource pooling is an option to consider in the event that the winner is unable to meet demand as a result of overbooking. When resource pooling is performed, the utilisation rates of datacenters are calculated to determine which customers have underutilised resources. Gathering the unused computer capacity to establish a new host helps meet the demand of customers and prevents service providers from going into default. The fundamental objective of the process known as resource pooling assisted reverse auctioning is to effectively and efficiently utilise the resources of a datacenter without wasting any of those resources. Under the direct-sell and fixed-price model, the providers are unable to completely distribute their available computer capacity. A portion of the computing resources that do not contribute to the generation of revenue is referred to as "spare" or "unused" resources. These resources are still available for purchase. If the suppliers are unable to do so using the direct-sell pricing model, then an alternative supply-demand based pricing model can be chosen to allocate the unused resources. Instead of receiving payment for the underutilised resources, providers would want to sell them for less money, which would cover the expense of running any additional equipment. This would make the providers more profitable.

loss. The auction system, in which customers compete against one another in auctions to distribute resources, is the one that is suggested. If virtual machines are not sold during a certain time period, the providers will suffer a loss because they are the ones who have to pay to maintain the actual equipment.

Users and those providing the service also stand to benefit from the use of the reverse auction system. Customers send in their requests to the cloud broker so that they can take part in an auction and purchase resources at a lower price. Providers can increase the utilisation of their datacenters by granting rights to use to any excess capacity that may be available.

This method of a reverse auction can be used by providers to maximise the achievement of the business goal and generate the most money possible.

In order to put the mechanism of the reverse auction into action, these steps are taken:

In the first step of the auction process, a database should be created to keep track of information about the datacenter, user needs, provider registration, and reserved resources.

Step 2: Create a user demand by asking for the resource with MIPS, the number of processing elements, the bandwidth range, the amount of RAM, and the number of virtual machines. This will allow you to obtain the resource for the lowest possible profit by selecting the bidder with the lowest price.

Step 3 involves the user demand being received by the cloud broker, who is responsible for handling all client requests.

Step 4: There are two types of auctions, ER auctions and SPSB auctions, that can be used to fulfil the requirements of a customer through the use of an auction process. A particular auction format is selected and loaded by the cloud broker on the basis of consumer demand.

In order for the cloud service providers to be able to take part in an auction, step 5 requires that they register their information with the cloud broker. Each individual who provides services is required to register their identity using a unique name and ID. Step 6 requires the cloud service provider to first make a reservation for their available resources with the cloud broker before they are allowed to take part in an auction.

Step 7: In response to the demand, a large number of data centres of varying capacities are established.

Step 8: The cloud service provider will now need to log in with a unique name and ID in order to check the demand from users and participate in an auction.

Step 9: Confirm that the resource is available by comparing user demand requests to the capacity of the cloud service provider for each component of the resource. Doing so will allow you to determine whether or not the resource can meet user demand.

If (service provider capacity >= user demand)

Reserve the resources

Else

Check overbooking pool

Overbooking ()

Service provider capacity/2 + service provider capacity = capacity in overbooking pool

End if

If (overbooking pool resources >=user demand)

Reserve the resources

Else

Check in resource pool

If (provider = ready to serve demand)

Service to user ()

Else

Calculate utilization rate ()

Integrate customer unused resources with new host ()

Serve demand ()

End if

End if

9.1 It is important to verify the availability of a resource before placing a bid on it. In the event that resources are available, provisions will be made for participation in the event. 9.2 In the event that an auction takes place, the resources have been secured and set aside. If the resources necessary for participation are not immediately available, the overbooking facility is an option that can be chosen to reserve them.

10. While going through the process of overbooking, compare the demand of each user with the capacity of the service provider. The service providers are unable to take part in the auction because they do not have the necessary resources. When the capacity of the service provider is compared to the user demand for the service, in order to reserve the resources, the capacity of the service provider needs to be greater than the user demand.

10.1 The service provider capacity is cut in half and added to the existing service provider capacity in order to provide resources for the overbooking pool. If there is enough demand for the resources in the overbooking pool, then those resources will be reserved for participation.

10.2 It is not possible to reserve resources if the user demand is insufficient or if it is higher than the amount that is allowed for overbooking pool resources. Without first having reserved some of the available resources, the service providers are unable to take part in the auction. The facility for resource pooling is available to the service provider.

In the eleventh step, the resource pool will gather any unused resources that the customer has and integrate them with the new host.

Step 12: The provider who is behind on payments can use resources from the resource pool to bring themselves up to date and avoid penalties, which will result in an increase in the amount of time that the datacenter is being utilised.

A Method That Is Adaptable

An adaptive strategy recommends the appropriate way to proceed in the auction market and provides assistance in making decisions regarding whether or not to take part in a particular auction, whether or not to place a bid in a particular round, or what price to make an offer at. If the task is stretched out over a longer period of time and the resources are committed for a longer period of time, there is a possibility that the supplier will lose the opportunity to complete brief profitable assignments. Bidding at an auction can involve varying degrees of aggression from different providers. Providers shouldn't accept a fee that is less than the machine's operating expenses. This method of random selection can be utilised to assist in making decisions regarding what steps are to be taken in an auction market.

The misuse of available resources

Service providers now have the ability to compete for more client requests than they can ultimately fulfil thanks to the capability of overbooking. Providers are permitted to take part in auctions even if they do not currently possess any resources at the time that they join the bidding process. Providers who abuse the overbooking process in order to maximise their profits are subject to financial penalties.

Sharing of available resources

Instead of letting unused resources go to waste, customers contribute them to a storage facility that serves as a resource pool. This contribution reduces the amount of traffic on the network as well as issues with server storage in datacenters. The cloud storage pool receives contributions of local resources from users of the cloud storage service. In the event that the resource is not already part of the overbooking pool, the provider is free to make use of the resource pool. The service provider who is unable to meet the demand can avoid defaulting and penalties by reserving the unused resources from the resource pool. This will allow the service provider to meet the demand. Users of cloud storage are encouraged to provide the cloud storage provider with selling bids that include information on the number of resources they intend to provide as well as how they would like to be compensated for their contributions. As a result, mechanisms for resource pooling contribute to the avoidance of default and punishment.

IV.RESULTS AND ANALYSIS

In order to simulate the method of reverse auctioning, CloudSim 3.0.3 is utilised. Customers send their requests for resources to the cloud broker so that they can obtain those resources. A database is built to store and retrieve information about the resources utilised by service providers, datacenters, reserved resources, and user demand. This information can be found in the database. Once the customer demands have been communicated to the cloud broker, various cloud service providers will register their information and available resources with the cloud broker in order to take part in an auction. CloudSim 3.0 is used to initiate the creation of each entity, and virtual machines for the data centres are constructed.

In order for a service provider to take part in the auction, which is illustrated in Figure 2, the resources must first be reserved with an auction broker to determine whether or not they are available. An auction broker is the individual in charge of running an auction for a service provider. At the conclusion of the auction, each service provider will then reveal which of their bids was selected as the winning one.

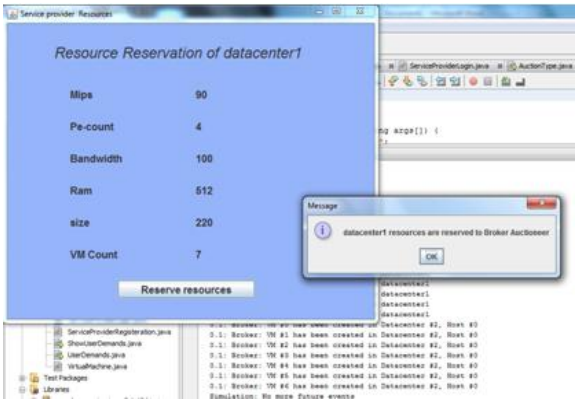

Fig. 2. Resource reservation

Figure 3 illustrates the possible outcomes of the auction. If the winner of the auction is unable to meet the demand at the time that they are announced as the winner, the service provider in question will be considered a defaulter and will be required to pay a penalty.

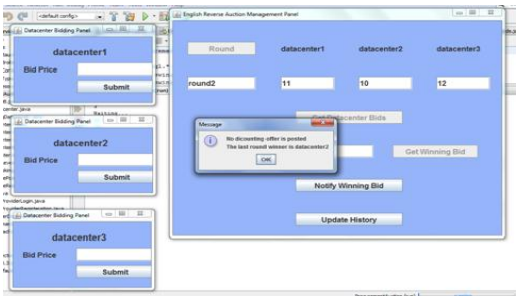

Fig. 3. Auction scenario

By utilising a resource pooling feature, the service provider can increase the utilisation of the datacenter and avoid incurring penalties. A determination is made regarding the datacenter's utilisation rate. In order to satisfy the demand, a new host can be constructed, which will additionally incorporate the customers' unused resources into its system. Pooling resources helps service providers avoid incurring fines and increases data centre utilisation at the same time.

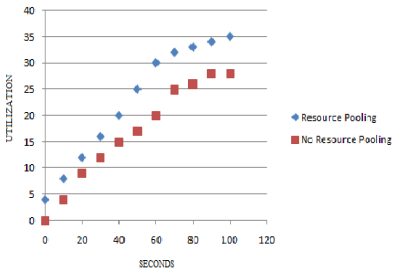

Fig. 4. ER Auction

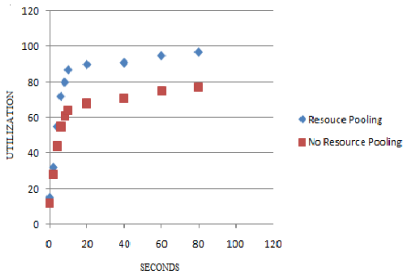

Fig. 5. SPSB Auction

The utilisation of data centres is measured by using an overbooking method in the works that are currently available. Even though the overbooking option has the effect of reducing the penalty, its utility in single-round auctions is limited. The suggested job makes better use of its data centres when resource pooling is used, which helps avoid getting punished. Figures 4 and 5 illustrate how resource pooling increases datacenter utilisation in the context of the ER auction and the SPSB auction, respectively.

V. CONCLUSION

The utilisation of a method known as a reverse auction to trade extra cloud computing power with customers who have a requirement for it is the primary contribution that this work makes. When a cloud service provider participates in an auction, the overbooking facility ensures that they are still able to compete even if a particular resource is not available. Cloud service providers who commit fraud by using the overbooking system in an attempt to increase their revenue will be subject to a penalty. The most difficult problems that cloud service providers face can be simplified through the pooling of their resources. The consumers' extra resources are added to the resource pool as contributions by those consumers. When weighed against the cost of the penalty, the fact that the penalised provider can obtain resources from the resource pool at a reduced cost is a significant benefit.

The procedure of the reverse auction can be expanded through the use of service level agreements.

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