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A Broker based Strategy for Dynamic Resource Negotiation and Allocation in Cloud Aware Application

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ABSTRACT
Cloud computing has became a buzzword owing to availability and on-demand services that have changed the way working of all business organizations resulting in exponentially growth of cloud based applications. IaaS (Infrastructure as a Service) has played a key role in making the resources Like CPU, RAM, bandwidth, hard-disk; VMs etc. available on demand. Customers have to pay only for the resource they have actually used. In this paper a dynamic resource negotiation strategy by broker is introduced where the broker plays negotiators role and helps customers and vendors to dynamically negotiate on the pricing attribute of deal. When the customer needs resource he quotes his price constraints to broker who searches for best resource from the available vendors that satisfy his price attribute. A new attribute i.e. deviation from the price, customer gives to vendor has been introduced in this paper. If the deviation matches, then broker allocates the resource to particular customer. This helps customers and vendors in finding timely resource allocation while broker is able to increase his customer base.

KeywordsCloud Computing, IaaS, Resource Broker, Price Deviation.

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I. INTRODUCTION

In the past 10 years, a cloud computing service has grown exponentially. A number of IT giants are setting up their own public or private cloud to provide on demand service. These organizations provide various types of service based on "per pay" model. Various services provided by cloud computing vendor can be categorized as IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). The IaaS deals with providing IT infrastructure to customer so that they do not have to process and maintain their own Infrastructure. PaaS provide different types of platform to the customer on demand. The SaaS provides application software to the customer without the need of in house installation these applications.

Among various types of cloud servers, IaaS, which provides resource on demand, has been considered in this paper. The broker play intermediately role in finding best fit search for the client and vendor. For a contract between this two parties i.e. cloud vendor and customer, key issues like when to provide service, at what price and what if price given by the parties did not match are to be considered [2]. To arrive at a contract, various negotiation strategies have been introduced. A resource negotiator for infrastructure helps them in this negotiation process [3]. In the market various types of customers, brokers or agents and vendors are present. Customers dynamically enter and leave the market. The customers have their flexibility of when they need service and only one vendor cannot satisfy their requirement. The reason may be types of service not provided by the vendor, service quality, price etc [4].

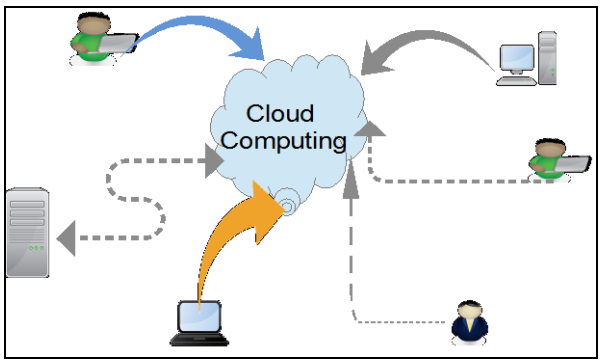

Figure 1. cloud computing environment

To overcome the negotiation problem, a broker based dynamic resource negotiation has been proposed. Broker stores different attributes of cloud vendors services, dynamically matches attribute of client requirement with these attributes and then allocate job for them. In this paper, for matching different attribute for vendor and client, the key

attribute considered is price. In ordinary situation, if price did not match no communication taken place between these two parties. A new attribute is introduced for the parties i.e. percentage of deviation in prices in which two parties can bear to rent out and to borrow the service. This help in increasing customers for vendor and broker. Broker plays vital role in negotiation process using the new attribute.

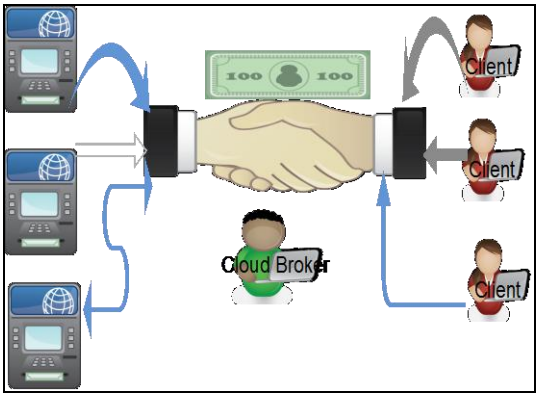

Figure 2 Cloud Broker Negotiation

II. LITERATURE REVIEW

To select the suitable service provider who fulfills the requirement of client among various available vendors is a complex issue. Different cloud vendors provide various mechanisms for resource allocation. A mechanism use diverse features like SLA (Service level agreement), QoS (Quality of Service), trust, price etc for negotiation between client and provider. The negotiation process catches this types of attributes from two parties to make deal between them. The cloud broker helps the clients in such conditions and providers in matching best combination.

The cloud computing model provides effective solution for complex and rigid IT based problem. In [9] authors had presented the idea of cloud bursting and cloud brokerage. The architectural framework which is capable of brokering cloud services is also presented. These steps necessary for cloud brokerage and challenges faced due to cloud bursting were identified.

With the growth of the cloud computing, management of disperse cloud provider has become a difficult task. There is lack of collaborative work among existing cloud brokers. To solve such situation, a novel approach was presented in [10] where the meta-broker for inter-cloud environment was presented. This meta-broker establishes association between different cloud broker for exchanging service which is transparent to the user.

In [12] a toolkit named CloudSim was presented by the author. The toolkit was developed in the CLOUDS laboratory at the computer science and software engineering department of university of Melbourne, Australia. It is open source software with library primarily based on JAVA and is useful for modeling and simulation of cloud computing environment. By using this toolkit, different resource provisioning mechanism can be tested. The CloudSim uses Time-Based scheduling and Space-Based Scheduling and plays vital role in testing resource provision algorithms and in simulation of real world cloud computing applications.

In [11] non-blocking resource broker was proposed for private cloud to improve performance. The brokering mechanism regularly updates the dynamically added or deleted service in the different virtual cluster at the datacenters. The proposed I/O model helps in load balancing, resource initialization, and optimized resource discovery to improve the performance in a private cloud.

The authors have proposed decision making algorithms and then extended Haizea advance resource reservation for negotiation process. The negotiation process involves three main issues viz. negotiation protocol, negotiation objectives and agents decision making model. The algorithms proposed by author are algorithm to generate counter offers and algorithm for user side selection policy. The experimental results were evaluated on the basis of system utilization, number of accepted request, and number of rejected requests [7].

Grid computing allows large scale resource sharing, and resource management. Bargaining model for grid resource allocation considering market dynamics, the strategies and protocol for grid resource negotiation mechanism are discussed in [6]. In this paper, Grid resources negotiation model and issues for building the model were proposed. The comparison and analysis of different strategies and protocol bargaining were also aggregated.

In Cloud based services environment, customer feels great flexibility as they don't have to worry about functional and non-functional requirement of infrastructure, platform etc. They simply use the required services as on demand. But they lack Quality of Service (QoS) according to Taylor their business needs [5]. An et, al. have presented concurrent negotiation policy which helps in establishing QoS and evaluates different negotiation strategies. The Cloud Negotiation Support Services (CNSS) based-architecture and two phase negotiation protocol is communicated [5].

The dynamic negotiation for resource allocation is challenging task in cloud computing environment. In [4], automatic negotiate resource leasing contracts were proposed where, agents were used to make contract from service provider to customer for resource leased for a fixed time interval. To maintain the highly dynamic nature of cloud platform, agent is able to charge penalty to third party for decommiting the contract. The author shows that

decommitment improves resource allocation efficiency.

Self-Managing application maintains resource access and guideline for run time support system needed in distributed applications. In [3] self-managing application plan and help each other in maintaining heterogeneous resources. These support infrastructure for autonomous resource negotiation. The negotiation model presented by Mobach, Overeinder, & Brazier includes Host Manager and Domain coordinator as main entity. The host managers have different information regarding resource like usage, availability etc. Virtual machines are represented by domain coordinator where a host has aggregated.

In [2], price and time-slot negotiation (PTNs) for cloud service reservation is presented where agents make multiple negotiation proposals in parallel. A time-slot utility function is designed to distinguish first choice among available different time slots. The empirical result for PTNs agent gain faster agreement and have higher usefulness as compared to other negotiation approaches. The author also performed case study to show the PTN method for cloud resources.

The cloud computing represents a market where various provider with different services and resources are available for consumer as "pay for" model. In such a scenario, Service Level Agreement (SLA) is required to maintain negotiation among various parties in the market. In [1] cloud agency, a design is presented where broker helps different vendors and service providers in keeping resources busy. Broker also assists clients in identifying best suitable service for them at best price.

III. PROBLEM STATEMENT AND PROPOSE SOLUTION

As seen in previous section negotiation in cloud computing environment is the need of the hour. In this section, a dynamic resource negotiation strategy is proposed where broker collects different parameter from client e.g., resource, time of usage, price etc,. Price is considered to be an important parameter for negotiation. The broker also maintains list of services, resources and their characteristics provided by the vendors.

It should be oblivious that, negotiation takes place only when both the parties want to make a deal with some compromise. If they do not want any type of fine-tuning and continue to stand rigid, then no further negotiation will be possible. Therefore, both parties must agree upon some condition and then further negotiation takes place between the two parties.

In general, a broker searches for the services in the market, comparing price given by the service provider with the price which client is prepared to pay. If the price matches from various available providers then resource is allocated. But if match is not found, then no further communication takes place between parties. In the novel negotiation strategy proposed in this paper, the broker searches and matches the price and if no exact matching possible, then the algorithm finds the lowest deviation between price given by vendor and price quoted by the client. These can be found with the help formula given in equation (1) and equation (2)

Let N=select (Max) price put by the client i : i=1 to n;

dev-amount= price put by provider j – N : here j is jth provider for some resource R_n *(1)*

Then the average of deviation amount is taken as:

dv-amt.= dev-amount / total no. of participants (including provider) available at time T. (2)

The *dv-amount* by the provider is lower and by the clients is higher. Certainly, negotiation only takes place when the price bid by client is lower than the price given by provider and client is in need for the service. *dv-amount* is distributed among the parties equally at time *T* because, if at time *T*, status of resources available at provider is true (ie resources are free) and the *dev-amount* between the parties is same. However, if after time *T*, or at the same time, *dev-amount* is different (higher or lower) available at time *T*, then one to one *dv-amt.* is distributed among provider and client(s).

In this way, provider keeps resources busy which otherwise may be ideal due to absence of flexible pricing mechanism. Therefore, revenue of provider will increase and the number of clients at provider and broker side increase. Clients also get benefited by dynamic resource negotiation.

IV. ALGORITHM FOR DYNAMIC RESOURCE NEGOTIATION

Let R_i be the set of resources provided by P_j, the status (*ST*) indicates the availability of the resource and C_k denotes the capacity of resource at provider side. (i.e. total number of such resources which can be discrete)

Step-1. Broker receives requirement from client side and price he is ready to pay.

Step-2. Broker searches and selects the resource from the different vendors

Step-3. Vendor whose price is either equal to price bid by the customer or dev-amount is least which is calculated as in equation (1) is selected.

Step-4. dev-amount (negotiation price) is equally distributed as in equation (2).

Step-5. Check the status of resource before allocating (ie whether it is free or not) and also if
the capacity of resource available.

Step-6. Repeat Step-2 to Step-5

Step-7. Exit.

V. RESULT ANALYSIS AND EXPERIMENTAL SETUP

To perform the experiment CloudSim is been used. This toolkit is used for simulation of cloud computing environment and performance evaluation of resource provisioning algorithm presented in [12]. It supports service brokerage, provisioning and allocation policies. The prerequisite for setup of CloudSim environment on windows is latest version of java platform and to set the CLASSPATH variable for it and value for this is like .\cloudsim-3.0.3\jars\cloudsim-3.0.3.jar

In Table 1 and Table 2, the attributes are CID is client ID have been generated randomly, dv-amt is the difference in amount between the two parties, dv-amt shared is the negotiation amount for which client goes high the price he puts and providers go low for the price they put. In Table-2, Res-ID is resource ID of provider's resource, capacity is total number of such resources available at providers side, status shows whether resource is busy or free (0-free and 1- busy) resource allocation show W-waiting, RA-resource allocated which is indicated by 1.

As compared to general resource allocation strategy, where customers submit their resource requirement along with the price he is ready to pay. The broker on behalf of customers selects the best resource which matches client's requirement and price. The only condition for allocation is matching of price. Therefore, if resource requirement matches but difference in bid price by the client and provider price differ then no deal takes place.

Table 1 Static Resource Allocation Data Without dv-amt

(Client D) CID	Client Price	(Vendor ID) VID	Vendors Price	(deviation amount) dv-amt	Static Resource Allocation
1	800	5001	876	76	0
8	90	5009	132	42	0
9	76	5008	144	68	0
7	88	5009	88	0	1
49	566	5013	600	34	0
83	498	5067	524	26	0
76	35	5046	76	41	0
82	97	5010	115	18	0
43	129	5050	170	41	0
15	53	5087	53	0	1
99	48	5099	89	41	0
42	69	5032	110	41	0
65	31	5044	40	9	0
59	547	5099	560	13	0
37	33	5000	50	17	0
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

Table 2 Dynamic Resource Allocation Data using dv-amt

CID	Client Price	VID	Vendors Price	dv-amt	dv-amt shared	Res-ID	Capacity	Status	Resource Allocation Status	
1	800	5001	876	76	38	1001	1	1	W	0
8	90	5009	132	42	21	1006	2	0 1	RA, W	1
9	76	5008	144	68	34	1008	3	0 0 1	RA, RA, W	1
7	88	5009	88	0	0	1009	2	0 0	RA, RA	1
49	566	5013	600	34	17	1010	1	0	RA	1
83	498	5067	524	26	13	1090	1	0	RA	1
76	35	5046	76	41	21	1008	2	1 1	W, W	0
82	97	5010	115	18	9	1001	4	1 1 1 0	W, W, W, RA	1
43	129	5050	170	41	21	1007	1	0	RA	1
15	53	5087	53	0	0	1115	1	1	W	0
99	48	5099	89	41	21	1162	1	1	W	0
42	69	5032	110	41	21	1009	3	0 0 1	RA, RA, W	1
65	31	5044	40	9	5	1500	2	1 0	RA,W	1
59	547	5099	560	13	7	1501	1	0	RA	1
37	33	5000	50	17	9	1006	1	1	W	0
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.

As shown in Figure 3, it is clear that the chance of resource allocation in dynamic strategy adopted by broker is far better with the static allocation strategy. The dotted line shows resource allocation only when price is equal. But solid line shows resource allocation with negotiated price. The only case when resource is not allocated here is if the status of resource is busy and the resource capacity of the service provider is insufficient.

In Figure 4, resource utilization chart is shown. In the figure, dotted line indicates the resource utilization while using static negotiation allocation policy and other line represents dynamic negotiation allocation policy. From graph it is obvious that percentage of resource utilization increases in dynamic negotiation mechanism as compare to static negotiation mechanism. Thus, to increase the resource utilization dynamic negotiation policy is better. This not only helps clients in negotiation but also increases business for broker and service providers.

VI. CONCLUSION

The available clouds brokering mechanism lack in dynamical negotiations between the cloud vendor and the client. The necessity of negotiation was realized only when client is in need of some service and service provider needs to sell or rent the service of resource available with them. However, price between them did not match. Therefore, with straight forward negotiation the deal is going to cancel. However, there may be a chance due to deviation in quotes by both the parties. Thus, in this paper dynamically negotiation strategy for cloud broker is proposed where deviated amount is used for further negotiation. Both the parties agree to go down or up (depending on if the party is vendor or client) for the deviate amount so as to make the transaction possible. This will help both the parties in reaching mutual agreement.

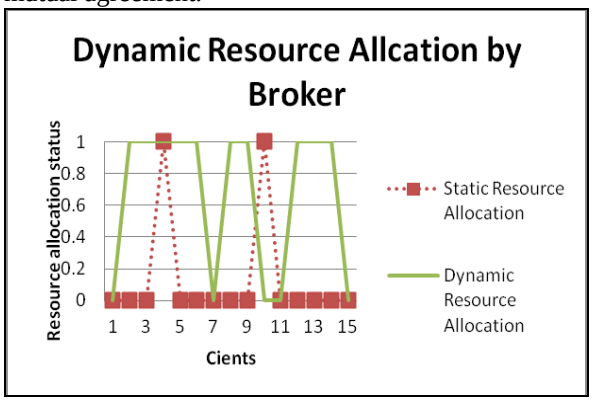

Figure 3 Dynamic Resource Allocation by Broker

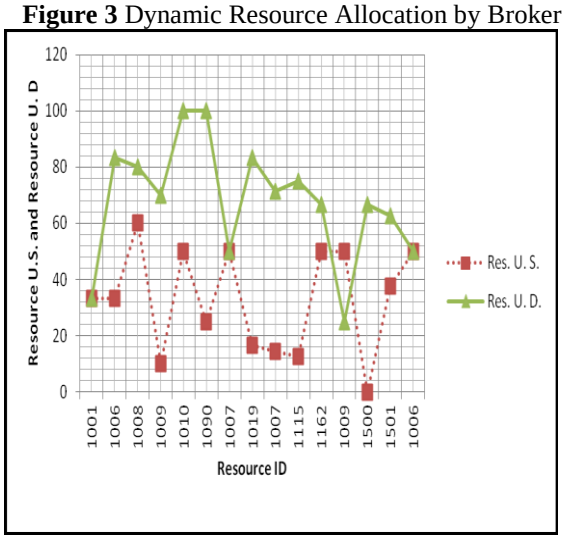

Figure 4 Resource utilization chart

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