Dual Strategy based Negotiation for Cloud Service During Service Level Agreement

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Abstract- **Various hardware and software resources which are available across the internet are termed as cloud. Cloud computing attracts many consumers with the pay as you use concept. In cloud computing, it is always a challenge to provide resources with lesser cost and acceptable quality of service. The cloud providers and cloud consumers might not have same preference all the time, so we need negotiation. Negotiation is the way in which communication is established to arrive at a mutual decision. To address negotiation, we present a Automated negotiation approach for cloud services, which is based on Association Rule Based dual strategy; in which a software agent or a broker will negotiate on behalf of their human counterparts helping the Cloud Service Consumer (SC) to select their best fitting Cloud Service Providers (SP), who can provide quality service at a lesser price . Our agent will work on the negotiation considering functional and QoS (Quality of Service) requirements in a single negotiation session.**

Keywords- Cloud Computing; SLA Negotiation; Negotiation Strategy; Automated Negotiation

I. INTRODUCTION

Cloud computing provide various services to customers Software, Infrastructure, and Platform as a Service are the examples. Various marketing techniques are used by the provider to sell their resources. As various consumers tend to use personalized services, Service Level Agreements (SLAs) emerge as a key aspect in Cloud computing. Service Level Agreement [1,7] is the contract that is been accepted by the Cloud SP and service consumer (SC) that defines the Quality of Service (QoS), which is achieved through a negotiation process [2].

The whole process of negotiation is complex and tiring as the resources are diverse and a particular resource selection at a lower price for executing task depends on the individual requirement and preferences of the SC [4]. SLA negotiation process is necessary because each SC is self-regulating entities with varying objectives and QoS requirements. However this SLA negotiation process should be automated as it cannot be expected that SP and SC have the ability to conduct the negotiation process by themselves and reach to equally satisfactory agreement.

Consider Fig.1 where two agents Agent1 and Agent 2 involved in negotiation process. Both of them negotiate and arrive at a mutually exclusive offer ‘o’.

Consider; x- Previous offers
0 -Acceptable offer

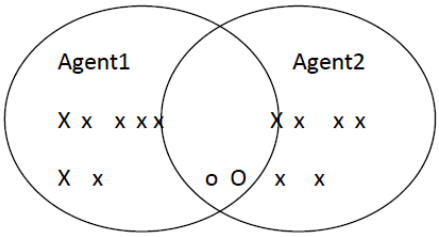

Figure 1. Negotiation Structure

II. LITERATURE SURVEY

For studying the cloud computing negotiation we have to first understand various negotiation method which are predominantly used in various fields.

A. Automated Negotiation

As per psychology negotiation is the process in which a person cannot come to a solution by himself. So for the decision to be taken he takes help from some who is well versed in that field. It can be a common phenomenon which occurs in day to day life. Simple terms like deciding how many slides a presentation should have or deciding a meeting venue or time , or perhaps involving major decisions in life also[4].

Actually, research on negotiation has been influenced by multiple disciplines, including mathematics, management, psychology, economics, and political science. Two approaches are adopted in studying negotiation, i.e., the normative approach and the descriptive approach [3]. The descriptive approach derives from social psychology and organizational behavior, whereas the normative approach arises from game theory, economics, and mathematics. This thesis adopts the normative approach, where negotiation is represented as a game.

When computers involve in negotiation on behalf of human, it is called automated negotiation. It has been studied mostly in electronic commerce and multi-agent systems .Various approaches have been discussed widely in negotiation.

1) *Agent-Based Approaches*

"An agent will analyze the environment and act as per the need." [4]. Agents are used for negotiation purpose for very long years. They are expected to alleviate some of the efforts of humans during negotiations, assist individuals who are less qualified for negotiation, and in some situations, replace human negotiators altogether . Three types of agent-based approaches to automated negotiation are heuristic, argument-based, and learning.

2) *Game-Theoretic Approaches*

Game theory studies interactions that occur between selfish agents. It is relevant to automated negotiation, since participants in a negotiation can be reasonably assumed to be self-interested. To find the optimal negotiation strategies and the corresponding equilibria, agents must reason strategically. Given a negotiation scenario, game theory can be applied to two critical aspects. On the one hand, it can be utilized to design an appropriate negotiation protocol, which governs the interactions among negotiation agents. On the other hand, it can be employed to contrive negotiation strategies, which agents can adopt to maximize their payoffs.

Mechanism design, a branch of game theory, can be employed to design negotiation protocols with certain desirable properties. As an example, one such property is Pareto optimality, where an outcome cannot be improved for one agent without making the other agent worse off.

B. *Service Level Agreement*

Managing and allocating resources in a cost effective manner is very much important for the service provider. An SLA (Service Level Agreement) [5] is the important role in resource allotment. It is a decision making process between the provider and the consumer.

A service-level agreement is a negotiated agreement among two parties, where one is the consumer and the other is the service provider. This is needed for both the formal and informal contract. Service level agreement is used in almost all the service provision systems and not only in cloud. If SLA is violated penalties are defined. Hence it can be defined as a legal contract between the consumer and the provider. Many grid systems are also using SLA while negotiations.

III. NEGOTIATION STRATEGIES

Negotiation is done when there is some objectives to be reached, and the goal of agents will be different. In Table (1) objectives of providers and consumers are mentioned briefly.

The provider's main aim is to increase profit by utilizing resources efficiently as possible. Resource should never be idle and because of that, they will be ready to make compromise in terms of cost in less rush time

TABLE.1 OBJECTIVES OF PROVIDER AND CONSUMER

Objectives	**cost**	**availability**	**Other benefits**
Service consumer	Reduce the cost	Available all the time	Reliability, Timeline adherence
Service provider	Maximize the profit	Charge more based on up time	Maximum number of consumer, Resource should not be idle

Basic concepts in automated negotiation include negotiation agent, negotiation object, negotiation protocol, and negotiation strategy. The relative importance of each concept varies according to the negotiation context, that is, in some cases; negotiation protocol is the dominant concern, whereas in other cases negotiation strategy becomes decisive.

- Negotiation Agent refers to the participants involved in a negotiation, which includes service providers, service consumers, and, in some situations, a mediator or a third party in the context of web services and cloud services.
- Negotiation Object is a set of issues over which an agreement must be reached between negotiation agents. Issues (or attributes), which are assumed to be independent in this thesis, refer to nonfunctional properties of web services and cloud services. In a simple case, it could be a single issue like price; whereas in a complex case, it may cover hundred of issues such as price, service quality, penalties, and constraints.
- Negotiation Protocol specifies various rules to be followed. Allowable participants, various states of negotiation and the various events that trigger the state.
- Negotiation Strategy is the decision-making technique that negotiation agents employ to achieve their objectives, under a given negotiation protocol.

Concession and tradeoff negotiation strategies [6] are the most widely discussed strategies in any negotiation scenario.

A. *Concession Strategies*

The main idea of concession strategies [6] is that, in preparing a counter proposal, the total utility of a reference proposal is reduced for one party, and, accordingly, the values of some of its attributes are adjusted to favor the other party. To lure the other party to accept proposal a certain amount of utility can be reduces from the reference proposal, when one makes some concession.

Concession strategies have been used to acquire web services. When the time limit is reached, concession

strategy can be applied for arriving at a mutual satisfactory agreement.

B. *Tradeoff Strategies*

In a tradeoff strategy [6], the total utility which is calculated based on various negotiation parameters remains same in the due course of negotiation. It is tried in such a way that small adjustments are made on various parameters keeping the total benefit in concern.

For example if the consumer want to acquire a resource for ten dollars and if the resource is not available in the time when he has requested ; he will be ready to acquire the same resource at the time what the provider allocates but for a lesser price.

IV. PROPOSED SYSTEM

There is a need for innovation in this Cloud Negotiation which answers the following questions.

- There need to be a negotiation model where all the parameters including price time and QoS be considered in a single negotiation.
- A model in which quality of the provider can be measured.
- A automated negotiation model which will choose the negotiation strategy based on past negotiation sessions.
- An intelligent selection of negotiation strategy which will satisfy both the customer and the provider.

The main target of this work is to develop an automated negotiation mechanism in which the cloud consumer will be able to use the cloud services which will be available in desired cost along with quality.

A. *Multi party negotiation*

In the proposed system, we implement multi party negotiation [3] where many agents negotiate with multiple providers using negotiation strategies as shown in Fig.2.

Figure 2. Multi party negotiation

We assume that the Cloud Service Consumer (SC) wants to avail the database service of the Cloud Service Provider (SP).The consumer will be having a set of Data Sets in which she wish to perform various database operations. So the consumer will be providing the Datasets to the provider and the provider is expected to mine the needed results based on consumer query.

The Agent will work on behalf of human counterparts choosing the provider based on various parameters as we mentioned already using Association Rule. For each parameter we will formulate a utility function and find out a variability matrix using which the tactic selection is made.

We propose a dual strategy; in which the consumer makes an agreement with the provider through negotiation for accessing cloud storage.

B. *Proposed Architecture*

The proposed architecture (Fig.3) consists of service consumer who request for DB service from available providers. The different agents (negotiation tactics) to be chosen are based on the variability matrix. Followed by automatic filtering of the providers based on past history.

Negotiation takes place on available attributes and once mutual agreement is reached, the service level agreement can be created. Based on the agreement the consumer will store dataset in cloud space provided by the agreed provider.

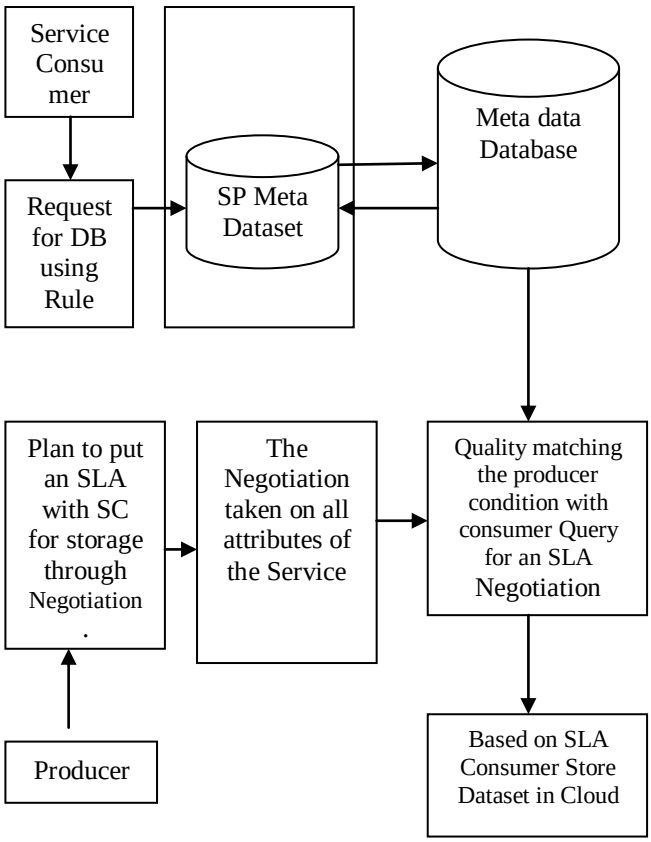

Figure 3. Proposed Architecture.

C. *Types of Agents*

An agent [5] makes its first offer and the opponent responds with another one. The interaction continues until an agreement is found or the negotiation time expires. Types of agents are:

- *Dual agent*: this agent employs the dual strategy which is defined later in this paper. That is, applying the trade-off strategy until it reaches a deadlock, and then making an offer with the concession tactic.
- *Hit and Miss agent*: the next strategy to compute the new offer is chosen randomly. For instance: concession, trade-off, trade-off, concession, trade-off, concession, concession...
- **S***wap agent*: altering both strategies throughout the negotiation process, one at a time: concession, trade-off, concession, trade-off, concession, trade-off.
- *Trade off agent*: in this case, the agent only applies the trade-off tactic while the utility of the offer received is higher than the previous one received. Otherwise, the aspiration level is decreased by a fixed 0.05 value and a new proposal is generated.
- *Concession agent*: this agent only uses the concession tactic during the negotiation.

D. Dual strategy

A negotiation thread between agents a and b at time tn is a finite sequence of proposals from one agent to the other ordered over time:

$$X^{t_n}_{a\leftrightarrow b} = (\mathbf{x}^{t_0}_{a\rightarrow b}, \mathbf{x}^{t_1}_{b\rightarrow a}, \mathbf{x}^{t_2}_{a\rightarrow b}, \ldots) \quad (1)$$

Optionally, the last element of the sequence is {accept, reject}

Dual strategy is a combination of the two strategies discussed above (Concession and Trade-off) as shown in Fig .4.

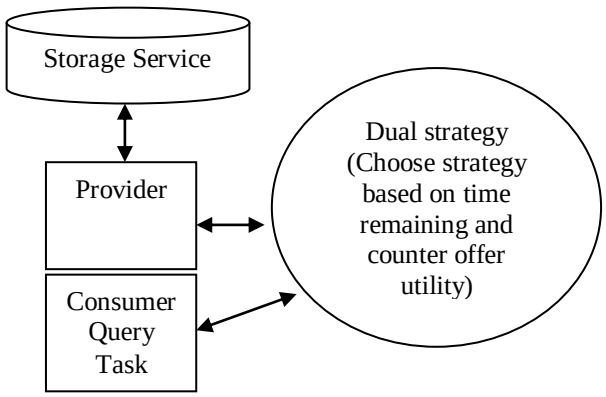

Figure 4 .Dual Strategy

By using dual strategy; the benefits of both the negotiation models are exploited .There is a higher chance of agreement made when dual strategy is implemented benefiting both the consumer and the producer.

Algorithm dual strategy:

V a(x) - agent a's utility function,
V a(y) - agent b's proposals.
t_n - time at nth instant
t_{max} - maximum time
$\emptyset$ - offer to be given
x^* - counter offer

```
While(t<t_max ){
∅ =(Va(x) U Va(Y)/XY);
}
If (∅ [t_n] ≥ ∅ [t_{n-1}] ){
        x*=Trade off strategy(); }
Else{
        x*=Concession Strategy(); }
If (t=t_max ){
        withdraw and terminate;}
Else {
        accept proposal y or terminate };
```

E. Experimental Analysis

If no agreement is reached in a given negotiation step, we difference our aspiration level expecting to find, in a lower level, a new proposal that satisfies both participants. To manage this behavior the agent applies a trade-off tactic to maintain the aggression aspect level until a deadlock is achieved. A deadlock is detected when the last offer proposed by the opponent does not improve the utility of the offer proposed before. Our example in Table (2) shows the dual strategy behavior from the initial state until a deadlock situation is detected:

TABLE.2 OFFERS BETWEEN PROVIDER AND CONSUMER

t	V a(x)	V a(y)
T0	0.800	
T1		0.200
T2	0.800	
T3		0.334
T4	0.800	
T5		0.329
T6	0.751	

where V a(_) is agent a's utility function, x, agent a's proposals, and y corresponds to agent b's proposals. The initial aspiration level is set to 0.8. At time t0 agent a proposes an offer. Then, agent b offers a proposal in time t1 with a utility value of 0.2 for agent a. The process continues until time t5, where b's utility proposal decreases compared to the proposal received in time t3. The dual strategy detects the deadlock situation. Thus, in time t6 agent a computes the new proposal decreasing the current aspiration level to 0.751.

V. CONCLUSION AND FUTURE SCOPE

The two negotiation models used complement each other.

- The Trade-off model maintains the agent's utility while sacrificing negotiation time.
- The Concession model ensures that agent's offers converge if given enough time (sacrifices utility)
- The Weakness of one model is the Strength of the other.

The multiple choices of agents (tactics) make sure that the negotiation succeeds in less amount of time. In the best case the first agent chosen (concession strategy) arrive at a mutually acceptable agreement. And in the average case the dual strategy will be implemented for making the deal successful exploiting the benefits of both the negotiation strategies. The worst case scenario where all agents are used and even then no agreement is reached; needs introspection. And this needs to be analyzed for a better success rate.

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