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QoS based Resource Provision in Cloud Network: Fuzzy Approach

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***Abstract*—Cloud computing has known as one of the most advanced platform providing the online access to the resources on pay per-use basis. An important factor in cloud computing environments is to maximize profit by accepting all incoming requests and to minimize SLA violation that causes penalty for cloud providers. Achieving these goals highly depends on optimum usage of available resources in data-centres. So far other works have focused on provisioning QoS in the cloud. We propose an algorithm to improve resource management and finally we use fuzzy inference Mamdani system to apply our expertise knowledge to solve the problem.**

***Index Terms*— cloud computing, resource provision, bandwidth utilization, Fuzzy inference system.**

I. INTRODUCTION

Cloud computing (CC) has grown in popularity in recent years thanks to technical and economic benefits of the on demand capacity management model. Many cloud operators are now active on the market, providing a rich offering, including Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS) solutions.

The cloud technology stack has also become main stream in enterprise data centers, where private and hybrid cloud architectures are increasingly adopted. CC to put it simply, means “Internet Computing.” The Internet is commonly visualized as clouds; hence the term “cloud computing” for computation done through the internet. With CC users can access database resources via the Internet from anywhere, for as long as they need, without worrying about any maintenance or management of actual resources. Besides, databases in cloud are very dynamic and scalable. CC is unlike grid computing, utility computing, or autonomic computing. In fact, it is a very independent platform in terms of computing. The best example of cloud computing is Google Apps where any application can be accessed using a browser and it can be deployed on thousands of computer through the internet.

Cloud Computing provides the facility to access shared resources and common infrastructure, offering services on demand over the network to perform operations that meet changing business needs. The location of physical resources and devices being accessed are typically not known to the end user. It also provides facilities for users to develop, deploy and manage their applications ‘on the cloud’, which entails virtualization of resources that maintains and manages itself. Over time many big Internet based companies

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(Amazon, Google…) have come to realise that only a small amount of their data storage capacity is being used. This has led to the renting out of space and the storage of information on remote servers or "clouds". Information is then temporarily cached on desktop computers, mobile phones or other internet-linked devices. Amazon's Amazon Elastic Compute Cloud (EC2) and Simple Storage Solution (S3) are the current best known facilities.

II. RELATED WORK

Paper [1], proposes various resource allocation strategies and their challenges are discussed in detail. According to Author that this paper would benefit both cloud users and researchers in overcoming the challenges faced.

Paper [2], the approach of this paper shows that with additional imprecise information (e.g. expected daytime performance) the up and down scale mechanism of such an infrastructure can be improved and SLA violation can be avoided. Author shows how a common cloud computing scaling service could be enabled to guarantee QoS parameters. Especially the KPI, request-response-time, has been the focus. The extended QoS provisioning architecture with an fuzzy control module has been described. A detailed description of possible new information to improve the scaling control system has been discussed.

Paper [3], proposes a joint-VM provisioning approach in which multiple VMs are consolidated and provisioned together, based on an estimate of their aggregate capacity needs. This paper presents three design modules to enable such a concept in practice. Specifically, a performance constraint describing the capacity need of a VM for achieving a certain level of application performance; an algorithm for estimating the aggregate size of multiplexed VMs; a VM selection algorithm that seeks to find those VM combinations with complementary workload patterns.

Paper [4], proposes an energy aware resource allocation provision data center resources to client applications in a way that improves energy efficiency of the data center, while delivering the negotiated Quality of Service (QoS). This paper conduct a survey of research in energy-efficient computing and propose: architectural principles for energy-efficient management of Clouds; energy-efficient resource allocation policies and scheduling algorithms considering QoS expectations and power usage characteristics of the devices.

Paper [5], in this paper proposes a new Fuzzy mathematical to attain better scope for Flexibility, scalability and availability of distributed testing environment provide unlimited resources with scalability flexibility and availability of distributed testing environment is created for cloud computing which opens new opportunities for software testing. The model is analysed using AND logic fuzzy rules and OR logic fuzzy rules. Mamdani fuzzy additive rule model is used for the same.

Paper [6], this paper investigated issue of resource management in cloud environment. It is shown that poor resource management in cloud result in dramatic decline in resource utilization. A mathematical model is proposed for this issue. In addition, a fuzzy system is presented novel method for modelling and exploiting of human expertise. The results obtained with fuzzy and heuristic algorithms are compared with those obtained with original algorithm of resource request dispatching in Eucalyptus. Results show that using these algorithms result in at most %65 improvement in resource utilization than original request.

Paper [7], this paper provide the model to evaluate the performance of cloud. Aim is to cater the performance on the cloud infrastructure level and the application level**.** Compared to traditional performance evaluation of cloud this fuzzy logic model provides the clear idea of how the infrastructure and applications on cloud play their role in performance. This paper is very helpful for the new researchers to have the idea about cloud environment and know about many factors involved in performance enhancement or degradation.

Paper [8], this paper considers the QOS parameters specified by the user to allocate the resource so that the resource allocation can be done in a cost effective manner. Most of the previous methods consider only cost and time as QOS parameters but in this method considered memory wastage, throughput, response time, cpu utilization, as the QOS parameters which has to be satisfied for the users.

Paper [9], propose that multiple Cloud users with different QoS and cost enter the cloud to obtain their resources. The cloud broker prioritizes them according to their cost and QoS. The cloud users then form the prioritized Queue (FIFO) themselves based on the priority given by the cloud broker starting from the highest priority to the lowest priority. The cloud users are then obtained with the resources that match their requirements by the cloud vendors using fuzzy logic.

III. PROPOSED WORK

In this project we have come out with scheme for providing resource to the customer based on fuzzy inference. The resource is the one of the important component in the cloud, and the customer requirement for resource with their parameters satisfaction has become a challenge.
The parameter specification of each customer are uncertain they are various such as time of resource requirement, the size of the file want to uploaded on the cloud, priority specified values is infrastructure based or software based or platform based, etc. Hence we have come with block diagram as given below.

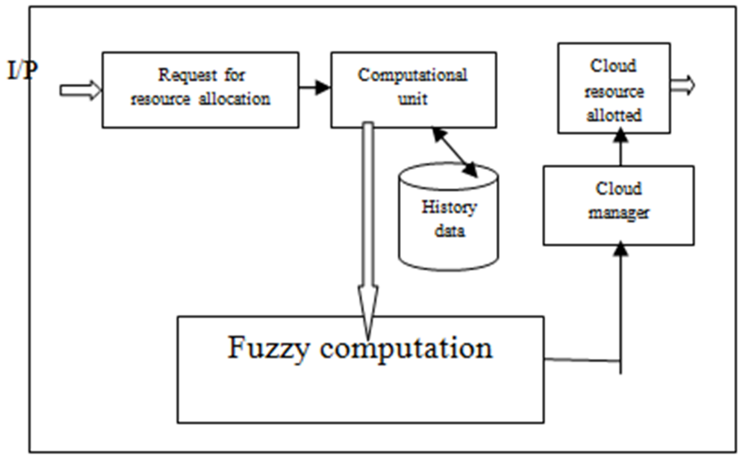

Fig 1, proposed block diagram

A. Request for resource management

In private cloud environment there is always more request than the resource available. Hence they require resources management to render the service for the customers with best price and high reliability. Therefor all over customer request are given to resource management entity.

B. Computational unit

The computational unit is to analyse each input for its QoS parameter extraction such as the time required for storage of the data, and size of the data and its priority. The computational unit stores all these QoS parameters as history data for every customer and also parallel passes to fuzzy controller for its cost computation.

C. History data

This block will stores all information, crisp value and user's information. All collected data is input data to the fuzzy control module where the data is fuzzified, results propagated by the fuzzy inference engine and quantified by defuzzification.

D. Fuzzy inference process

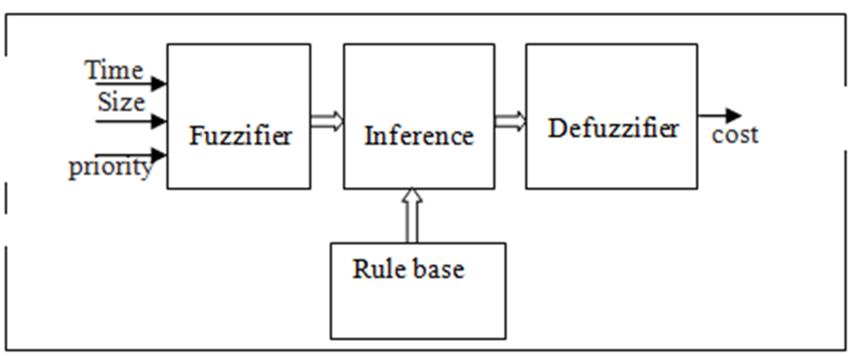

Fig 2, fuzzy inference process

Fuzzy inference is the process of formulating the mapping from a giving input to an output using fuzzy logic. The mapping then provides a basic from which decisions can be made. Fuzzy inference process scheme consider three parameters for fuzzification: time of the application for how many months user want to access, size how much data space user want to use, and priority of the application.

E. Fuzzifier

Transforms the system inputs, which are crisp numbers, into fuzzy sets. This is done by applying a fuzzification function. The first step is to take the inputs and determine the degree to which they belong to each of the appropriate fuzzy sets via membership functions. In the Fuzzy Logic Toolbox, the input is always a crisp numerical value limited to the universe of discourse of the input variables and output is a fuzzy degree of membership in the qualifying linguistic set (always the interval between 0 and 1). Fuzzification of the input amounts to either a table lookup or a function evaluation.

F. Inference

Simulates the human reasoning process by making fuzzy inference on the inputs and IF-THEN rules. Fuzzy inference is sometimes called fuzzy reasoning or approximate reasoning. It is used in a fuzzy rule to determine the rule outcome from the given rule input information. Fuzzy rules represent control strategy or modelling knowledge/experience. When specific information is assigned to input variables in the antecedent, fuzzy inference is needed to calculate the outcome for output variables in the rule consequent.

G. Defuzzifier

Transforms the fuzzy set obtained by the inference engine into a crisp value and transfer truth value into output. Defuzzification is a mathematical process used to convert a fuzzy set or fuzzy sets to a real number. It is a necessary step because fuzzy sets generated by fuzzy inference in fuzzy rules must be mathematically come out with one output as cost. For fuzzy controller with more than one output variable, defuzzification is carried out for each of them separately but in a very similar fashion. In most of the cases, only one defuzzifier is employed for all output variables. It the process of producing a quantifiable result in fuzzy logic given fuzzy sets and corresponding membership degrees. It is typically needed in fuzzy control systems. These will have a number of rules that transform a number of variables into a fuzzy result, that is, the result is described in terms of membership in fuzzy sets. In defuzzifier output is taken as cost.

H. Rule base

Stores IF-THEN rules provided and compute output truth values. Fuzzy rules are linguistic IF-THEN-constructions that have the general form "IF A THEN B" where A and B are (collections of) propositions containing linguistic variables. A is called the premise and B is the consequence of the rule. In effect, the use of linguistic variables and fuzzy IF-THEN- rules exploits the tolerance for imprecision and uncertainty. In this respect, fuzzy logic mimics the crucial ability of the human mind to summarize data and focus on decision-relevant information.

IV. SIMULATIONS AND RESULTS

The proposed scheme is simulated by using Matlab version 7.12.0(R2011a) and C programming. In this section, we describe various models used in simulations such as time, size, priority and cost. The performance parameters are also presented.

A. Performance parameters

The performance parameters considered for evaluation of the proposed scheme are as follows.

- **Bandwidth utilization**: It is defined as the ratio of the sum of the bandwidth utilized by the applications to the maximum bandwidth of the cell.
- **Percentage of allocation:** It is defined as the ratio of the number of users allocated to the total number available.
- **User's rejection**: It is defined as the ratio of the number of users rejected to the number of users requested for connection.

B. Results

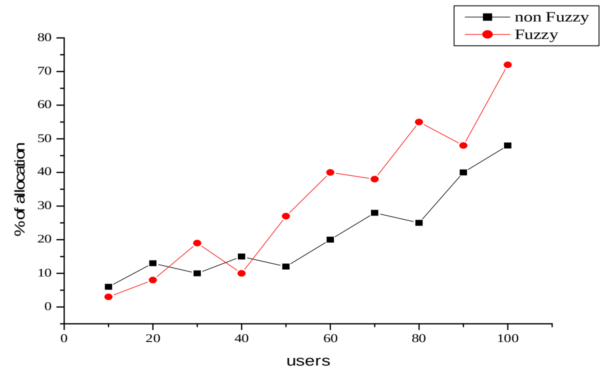

Fig. 3 percentage of allocation vs. users

In the above fig. 3 as the users increases allocation also increases, initially when the users are less allocation factor is almost same in Fuzzy and non-Fuzzy system. 40 percentage increases in users, makes utilization increased by 18 percentages. Fuzzy based scheme rejects less number of users as compared to other schemes.

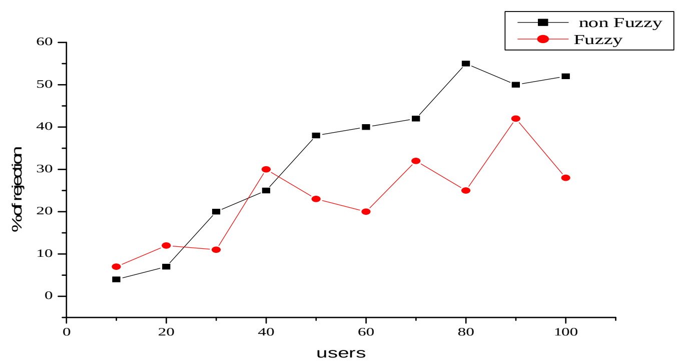

Fig.4 percentage of rejection vs. users

In the above fig. 4 up to 20 users percentage of rejection is almost same in both Fuzzy system and non-Fuzzy, but after 40 users, up to 10 percentage of rejection decreases in Fuzzy system compare to non-Fuzzy system and utilization will decreased by 10 percentage in non-Fuzzy system this means percentage of allocation is more with the proposed scheme as compared to other schemes.

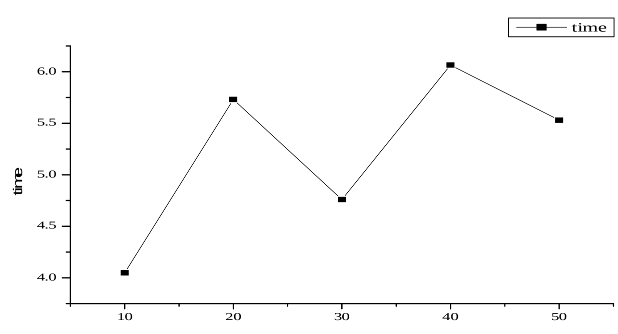

Fig. 5 time vs. users

In above fig. 5 it shows how much time it requires to allocate the users demand according to priority, as the user's increases allocation time also increases.

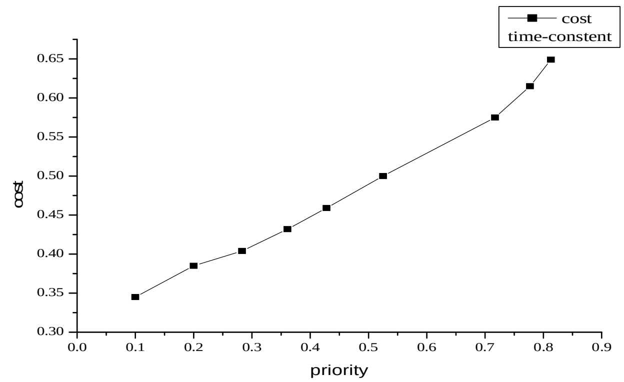

Fig. 6 cost vs. priority by keeping time constant

In above fig.6 by keeping time constant as the no. of users increases priority increases to users, cost also increases linearly.

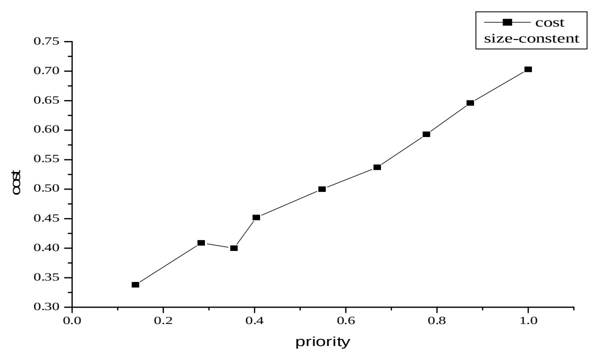

Fig 7, cost vs. priority by keeping size constant

In above fig.7, by keeping size constant, up to priority 0.4 cost is not increased much but after 0.4 as the priority to user increases linearly cost is also increases.

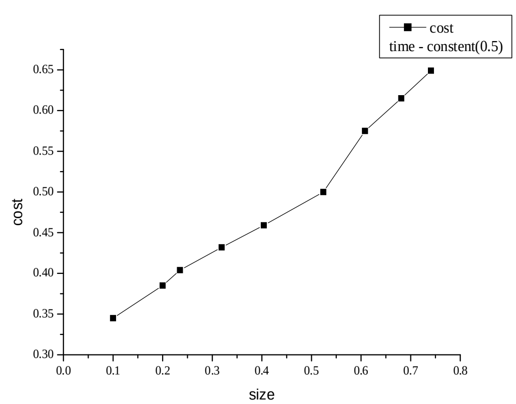

Fig. 8 cost vs. size by keeping time constant

In above fig. 8, by keeping time constant, as the size increases the bandwidth utilization also increases as well as cost. The utilization reaches certain saturation level after certain number of applications.

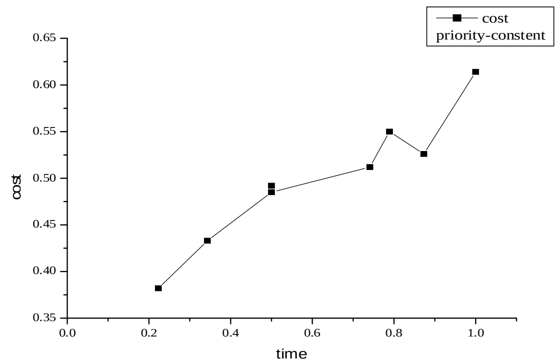

Fig. 9 cost vs. time by keeping priority constant

In above fig. 9, by keeping priority constant, as the application increases according to user demand execution of program time also increases therefore cost also increases linearly.

V. Conclusion

It is shown that poor resource management in cloud result in dramatic decline in resource utilization. Our result shows using fuzzy logic scheme improves resource utilization in cloud compare with non-Fuzzy scheme. Incoming requests makes better results using fuzzy algorithms. It means requests can be balanced between federated clouds computing with regard to their ratio of resources. Experimental results also reveal that fuzzy algorithms can improve resource utilization of cloud in all type of incoming requests by at least 20% improvement.

The basic and most important factor is the performance of the cloud. So the cloud provider has to make sure that the cloud infrastructure performance and application performance must be met. The increasing number of user may give timely profit to the cloud provider but the performance factor will always matter.

So in our future work this project is done for private cloud, we propose for public cloud and proposes higher level resource manager for balancing incoming requests to cloud.

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