International Journal of Engineering Innovation & Research
Volume 2, Issue 6, ISSN: 2277 – 5668

Key Performance Indicators in Cloud Computing

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***Abstract* – Cloud computing has garnered popular support in a relatively short span of time. It is a new method of delivering the distributed resources over internet. It reduces capital expenditure as well as operational expenditure. The number of cloud service providers (CSPs) who provide computing as a utility has increased exponentially in the past few years, providing more options for the customers to choose from. In this paper a model for Trust Management based on Fuzzy Logic has been developed, which can help consumers make an informed choice towards selecting the appropriate CSP as per their requirement.**

***Keywords* – Cloud Service Provider, Trust, Fuzzy Logic, Cloud Analyst.**

I. INTRODUCTION

Distributed computing was developed with the aim to dispose of the need to have expensive supercomputers to solve the problems faced by scientific community. Cloud computing is the latest form of evolution of distributed computing.

Cloud Computing can be defined as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Cloud computing has evolved into a business idea where cloud service providers (CSPs) provide computing as an utility, which needs to be paid as per the usage [1,2].

However cloud is far from being perfect. Like any service it needs proper guidelines to maintain standards and integrity. Since it is a common platform for various parties it becomes increasingly difficult to maintain safety standards. Also, the number of CSPs has gone up in recent years so that the customer has to make a judicious choice based on various parameters such as cost, security, performance etc[3,4]. Here the direct and recommended trust measurements using the concept of fuzzy set theory have been discussed. Their proposed model provide a helpful measure to enhance the robustness, fault tolerance and security of cloud computing [5].

However, it does not define the trust evaluation attributes of the CSP. It is described a model for scalability, availability, security and usability parameters of trust for using fuzzy-set theory. This paper uses fuzzy-inference approach for developing an overall trust rating for a given CSP. Cloud Service Measurement Index Consortium (CSMIC) [6,7, 8] proposes a framework based on common characteristics of cloud services. The aim of this consortium is to define each of QoS attributes given in the framework and provide a methodology for computing a relative index for comparing different cloud services. CSMIC has developed the Service Measurement Index (SMI) which consists of a set of Key Performance Indicators (KPI) that helps to standardize the measurement of business services.

The threats and security issues in cloud computing are discussed in Thus, cloud computing has opened up a new frontier of challenges and the problem of trusting cloud computing is of supreme concern for most enterprises. In order to address a few of these issues related to trusting the Cloud Service Providers, in this paper we propose a model which would help the users of cloud to make an informed choice based on their requirements[9,10].

II. MODEL DESCRIPTION

The most relevant sources of information considered by the trust and reputation models presented before, are direct experiences and witness information. The direct experience is considered as direct trust and the witness information is considered as recommended trust. Based on the location or limit within which the trust is estimated, the trust is classified as Inter Domain.

The Trust Model

Our model architecture concentrates on the estimation of trust value for CSP in Inter and Intra Domain and is based on the Direct and Recommended information. Figure 1 shows the overall architecture of the trust estimation. Cloud Analyst is developed by CLOUDS Laboratory. It is built on top of CloudSim and separates the simulation experimentation from a programming task enabling one to concentrate on the simulation parameters rather than the technicalities of programming. Simulation in Cloud Analyst involves the following steps...

1) Defining and configuration of User Bases.
2) Defining and configuring Data Centers
3) Allocating of Virtual Machines in Data Centers.
4) Review and Adjustment of various other parameters such as Packet size, No of packets, Bandwidth, and Load balancing policies. The Cloud Analyst enables us to model different scenarios of CSPs and User Bases, and provides a comprehensive output detailing the response time, Data Center processing time and total cost involved in the communication and computation.

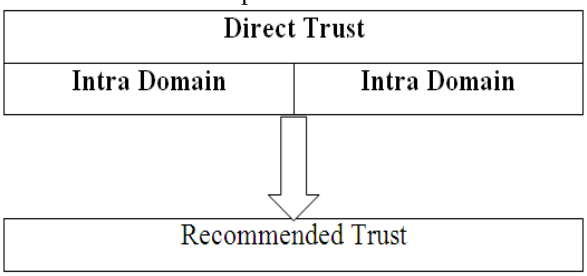

Fig.1. Overall Architecture

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III. Model Parameters

The model parameters are chosen based on the attributes defined by Service Measurement Index. These include Accountability, Agility, Assurance, Financial, Performance, Security, Privacy, and Usability. Each of these attributes consists of a set of Key Performance Indicators (KPIs) which describe the data to be collected for measurement. KPIs are quantifiable measurements, agreed to beforehand, that reflect the critical success factors of an organization. They will differ depending on the organization. However, of the KPIs, not all are measurable i.e. quantifiable, some are qualitative in nature. Based on the KPI that make up the attributes in evaluating the CSPs, we discuss Performance, Financial and Agility, are explained in this model.

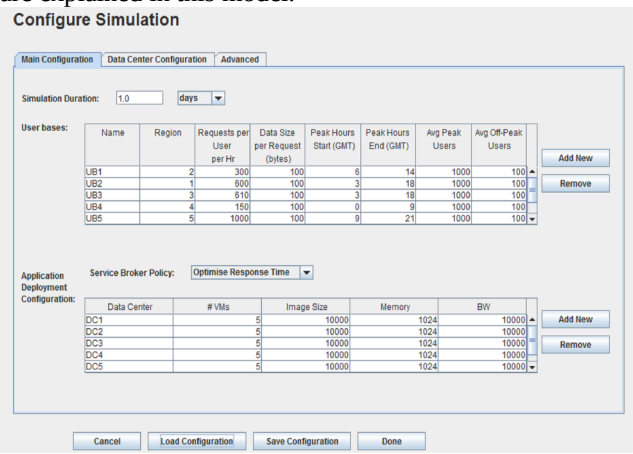

Fig.2. Cloud Analyst configuration window

Factors Impacting Degree of Trust	KPIs of the corresponding attribute
Performance	Accuracy, Functionality, Stability, Interoperability, Service Response Time
Agility	Acquisition and training cost, Ongoing cost, Profit or Cost Sharing
Financial	Adaptability, Capacity, Elasticity, Extensibility, Flexibility, Portability, Scalability.

The evaluation of the trust value for CSP comprises of two stages as shown in Figure 3. The first stage is the implementation with the help of Mamdani Fuzzy Inference System. It takes Performance, Financial and Agility as inputs and produces a range of values which could be easily fed as input to the next level of processing. The Performance attribute is evaluated by passing Data Center (DC) Processing Time, Processor Speed and User Base (UB) Response Time as inputs to the Mamdani FIS. Financial attribute is calculated with the following inputs: Virtual Machine (V.M) Cost, Memory Cost, Storage Cost, and Data Transfer Cost. Finally, Agility attribute has number of Physical Units, Memory Size, and number of V.Ms as its inputs.

IV. Implementation and Results

The implementation consists of two stages. First is simulating the cloud environment, next is using the parameters from the simulation in Fuzzy Logic toolbox to obtain the trust rating.

Simulation Setup

In Cloud Analyst, the scenarios are setup in such a way as to represent user bases across the globe. The user bases remain constant across the scenarios whereas the CSP" s setup changes. So for the same amount of user load we are able to determine the performance of various CSPs. We take an example scenario with five different CSPs each with unique setting representing the geographic diversity, the cost factor, and the processing capabilities.

It describes the values which are taken to simulate the cloud environment using Cloud Analyst. So, five different simulations are run and each produces an output report detailing the Response time, Data Center processing time and the total cost.

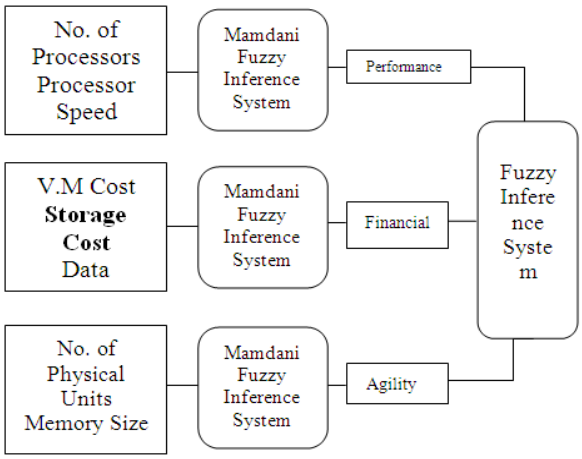

Fig.3. Block Diagram

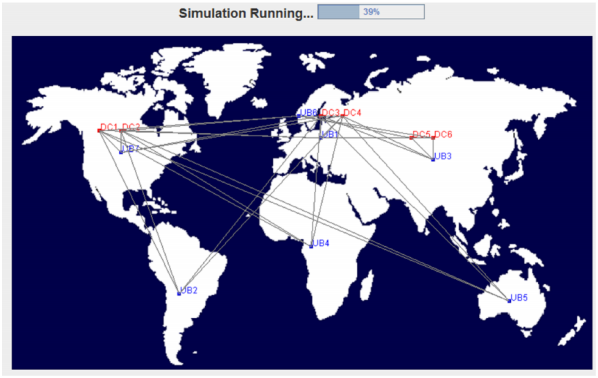

Fig.4. Cloud Analyst Simulator

Fuzzy Logic Implementation Performance

Performance has two input values namely number of processors and the processor speed member functions each.

The output performance has four member functions low, medium, high, and very high. The outputs obtained from the FIS are CSP A-Low, CSP B-Medium, CSP C-Medium, CSP D- Very High, and CSP E-Low.

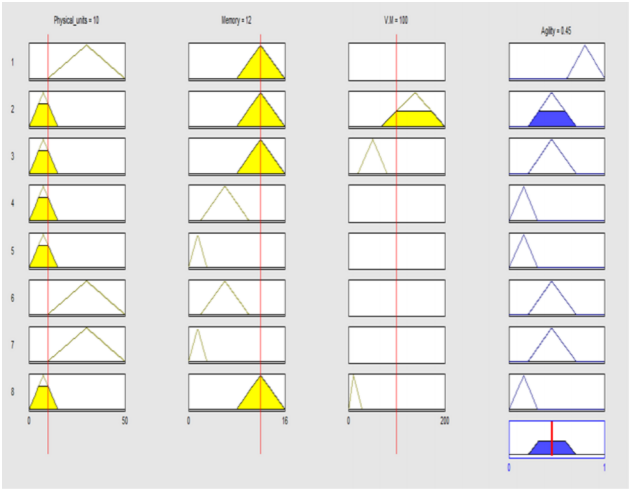

Fig.5.

Financial

The financial block also comprises of three inputs namely V.M cost, Storage cost, Data Transfer cost. The V.M cost input has three member functions whereas storage cost and Data transfer cost have two member functions each. The output financial has three member functions low, medium and high. Here a total of nine rules are written. Given the values of CSPs to the financial model we get results as CSP A-High, CSP B-Medium, CSP C- High, CSP D-High and CSP E-Medium.

Agility

The agility model has three input parameters mapped to one output. Each of the input parameters has different membership functions. Physical units has two member functions while Memory V.M and output Agility have three member functions each. The range of member functions is chosen based on the actual range of values used. A total of eight rules are written. The output Agility has 3 member functions low, medium and high. When the input related to CSP A is fed to the Matlabs FIS, the Agility comes out as Medium. Similarly for CSP B it is medium, CSP C-low, CSP D-medium, CSP E-medium. Fig. 5 shows the sample Rule Viewer when implemented in Matlab.

V. CONCLUSION

In this paper we have shown that the Inter Domain direct trust value for the CSPs can be estimated using the fuzzy logic tool box which can serve as an indicator for the users to choose a CSP as per their requirement. Also, Cloud Service Providers these days do not offer just a single plan to all consumers. They provide a variety of plans to different types of consumers. So in addition to rating different CSPs this model can be used to select a plan based on the users need.

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