

Trust Based Cloud Service Provider Selection

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Abstract - With the new emerging technologies the cloud marketplace has identified many new cloud service providers which provide a similar service and offerings. The services and offerings are provided in an agreement named as Service Level Agreement (SLA). The SLA is the agreement that has been established between the providers and the users. The services provided in the SLA by the providers are not consistent and satisfiable for the consumers. The environment like a cloud, the quality of service is said to be a very important parameter. In order to reduce the inconsistency of SLA it proposes Trust Based Cloud Service Provider Selection which provides the scalable and reliable cloud service providers to the consumers. In the proposed work the trust value is estimated with the interaction between the users and the providers. With the help of the ratings provided to the cloud service providers' by the users, the trustworthiness is estimated by confidence level, which is determined by the recent interaction and the interaction intensity. The competence is estimated by the parameters like security, availability, policies provided by the providers to the users. The trustworthiness and competence are combined to find the cloud service providers of user needs and the performance is estimated.

Index Terms – Cloud Service Provider, Service Level Agreement(SLA), Trust.

I. INTRODUCTION

Cloud computing plays a vital role in storage [28][9][29] of users' data, providing the network access, software and infrastructure as services[27][24]. It provides more resource utilization to the cloud consumers. Consumers have no need to maintain the servers; they are allowed to pay according to the usage of services. It has some security issues, assurances and policy that are not satisfied with the providers to the consumers that are made in the SLA document. The cloud consumers have a multiple choices to choose a provider for their requirement process. Selecting the best cloud service provider is difficult since the users or client uses the unknown third-party resources in order to maintain their data. The Service Level Agreement (SLA) [4] provided by cloud providers are the prime important one. In this agreement the responsibilities between the cloud service provider and consumer.

Cloud service provider provides [7] users the immediate access of a large range of resources. Cloud consumers have a wide range of choice of cloud service providers. Cloud Service Level Agreements (Cloud SLAs) are an important one for the relationship between a cloud service, customer and a cloud service provider [14] of a cloud service. The service provider must have the property like availability, response time and performance. The services and the storage space specified in the SLA are not satisfied and the trust and transparency are not maintained. The trust and competence

overcome the problem of finding the best cloud provider. The trustworthiness and competence are said to be estimated by considering the interaction with the users and providers.

II. RELATED WORK

The existing techniques in the field of analyzing the cloud service provider selection are by extracting the data and feedback of the cloud service providers. Nirnay Ghosh *et al.*, [20] presented an initial study of trust based cloud service providers by providing the interactions of the users with the cloud service providers. The combination of trustworthiness and competence is used in order to estimate the cloud service providers. Trustworthiness is experienced by considering the personal feedback about the cloud service provider through direct interactions or from feedbacks related to the reputations of the consumers. Competence is said to be estimated based on transparency of SLA that are provided by the providers to the consumers. Talal H. Noor *et al.*, [28] produced the Trust as a service framework where it is used to manage the trust in the cloud environments. It introduced a credible method that is used to access the cloud service providers with the factors like trustworthiness and finds the difference between the valuable and the malicious trust feedback. The trust feedback assessment and storage are allowed to be managed in a distributed way. The cloud service providers [31][23] are estimated with the SLA parameters, the security and availability has to be considered. The security attack has to be determined by considering the attacks that are produced during the servicing time period.

Paolo Massa *et al.*, [22] the bootstrapping method consists of two ways of finding the recommender system where the new user can be compared. From the two ways the initially the traditional way is used by asking the new users to rate the items of their choice in order to find the users with the same taste and findings and generate recommendations for the new user. The another way is the elicitation of trust where the new user is allowed to explicitly indicate other users and make them to analyse how he/she trusts. Audun Jøsang *et al.*, [1] the beta reputation system is very flexible and is very simple while using in the real time applications. It has the problem against agents changing identities other than assuming that some authentication mechanism is in place. It has a centralized approach where decentralized approach has adapted the beta reputation.

Icaaman da Silva *et al.*, [16] Trust based framework is said to be used in order to select the service. A trust model is said to be used in order to calculate the services, which is found by analysing the past experience of the user and feedback about the services which are used by the cloud users. The level of trust is taken into account by considering the level of trust that is provided to the providers by users. Users are grouped into three categories, namely trusted, non-trusted, and unknown users. The trust values are calculated by considering user ratings that are classified by the feedbacks. By comparing the ratings provided, the malicious feedback are said to be identified. The development mechanisms uses feedbacks and rating of services composition of specified services in analysing and calculating of the trust values. Supriya M *et al.*, [26] The Fuzzy Logic is said to be used in modelling the Trust Management, which can help consumers to have a various kind of choices in selecting the Cloud Service Providers as per the requirement. Cloud Service Providers these days won't provide a single plan of service to all cloud consumers. The providers have a variety of plans for different types of consumers. So in order to rate different providers the users or the consumers who use the services from the providers are allowed to select the plans based on the users need.

Dimah H., Alahmadi *et al.*, [21] The Recommendation System framework which draws the user needs by considering the users' interest in the online social network [3]. Selvan *et al.*, [25] Twitter, the Online Social network is used to produce the feedback of the providers in the real time environment. This approach overcomes the overlooked use of OSNs [32] in Recommendation Systems utilizes the available information from such networks. Bearing in mind that a user's selection is said to consider as the important one by considering his/her trusted friends and their opinions, this paper presents a framework to apply a new source of data to personalize recommendations by mining their friends' short text posts in micro-blogging. ISTS suggest

recommendations have used measuring the implicit trust between friends based on the intercommunication activities, by acquiring the sentiment analysis rating to reflect the knowledge behind friends' short posts, so-called micro-reviews, using sentiment analysis techniques by knowledge of various online social networks, the language features are empowered the extracted sentiment. Casey Whitelaw *et al.*, [16] The sentiment analysis contains two main approaches, namely the first is to learn a positive/negative document classifier based on frequent occurrence of words frequencies of the various words in the text and various learning approaches are used to select or weight different parts of a text to be used in classification. Nilashi *et al.*, [11] The Rapid Miner tool is used to analyze the naïve bayes classifier for the datasets rather than Text Miner which is not that much efficient. The recommended system uses the naïve bayes classifier in order to find that whether the user would like a given provider or not. Fabio *et al.*, [13] SentiWordNet is an extension of WordNet that is used to provide the weights of the words that are in the dictionary. It contains PosScore, NegScore and ObjScore in it, that is used to form the weight of the words.

Jenn-Wei Lin *et al.*, [18] The QoS-aware data replication algorithm is used in the cloud systems. There are two algorithms in it namely, Initially it provides the creative idea about the high-QoS first-replication in order to perform data replication. In order to achieve the two minimum objectives, the second algorithm transforms the QoS-aware data replication algorithm problem into the well-known minimum-cost maximum-flow (MCMF) problem. The existing MCMF algorithm is used to solve the QADR problem, the second algorithm is used to produce the best solution to the QADR problem in polynomial time, but it takes more computational time than the first algorithm. Mohammed Alhamad *et al.*, [19] The proposed scheme enables cloud users to evaluate the trustworthiness of cloud service providers by creating the cloud data centers. Supriya M *et al.*, [26] Cloud computing has found the support of the consumers to the providers by providing the efficient form of services to the users. It is a new method of delivering the distributed resources over the internet. The trust can also be determined by the help of Fuzzy Logic has been developed, which can make the cloud consumers to select the best cloud service provider selection as per their requirement according to their own form of approaches in their choices. F. Liu *et al.*, [14] The NIST cloud computing definition is widely accepted as a detailed description of cloud computing technologies and cloud services that are given to the consumers by the providers. It has a simple cloud taxonomy that has three service models available to cloud consumers that are provided by the providers are cloud software as a service (SaaS), the cloud platform as a service (PaaS), and cloud infrastructure as a service (IaaS). Xi Chen *et al.*, [30] A various number of challenges are occurred in the implementing process of cloud technique by considering the improvement of the Web application performance and

decreasing the cost. In order to achieve the more profits, security [15][19] of cloud-based service application providers must be secured by the provider's security measures.

III. TRUST BASED CLOUD SERVICE PROVIDER SELECTION

Cloud service providers [14] are allowed to store the large sets of data and are managed by the host company and are maintained by multiple servers. The cloud consumer has a wide variety of choices to choose a service provider. The cloud service providers are selected by considering the parameters like security, performance, availability, SLA parameters through the trust estimation and the competence. The trust value estimation is preceded by considering the trustworthiness and the confidence level. At the confidence level the recent interaction ratings are taken by providing more weight to the providers which are provided by the users by the interaction with the providers.

A. Trust Based Cloud Service Provider Selection

The trust based cloud service provider [2] is selected by considering the users need for the providers. The Cloud service provider maintains the well-designed cloud platform that is suitable for business continuity and disaster recovery. It improves the centralization of data with multiple users can simultaneously work on the data rather than waiting for it to be saved. The services must contain the parameters like availability, security, performance and response time. The service providers are allowed to satisfy the consumer's requirements and must be a trustworthy one.

B. Trust Based System Architecture

The trust based cloud service provider is identified by considering the interaction rating in order to estimate, the trust between the providers and the consumers as described in the Fig.I. The confidence level has interaction ratings that are collected from the users which are rated to the cloud service providers by their efficient performance, availability, response time. The SLA parameters are used in order to find the competence. By considering the trust and competence the trusted cloud service provider can be determined.

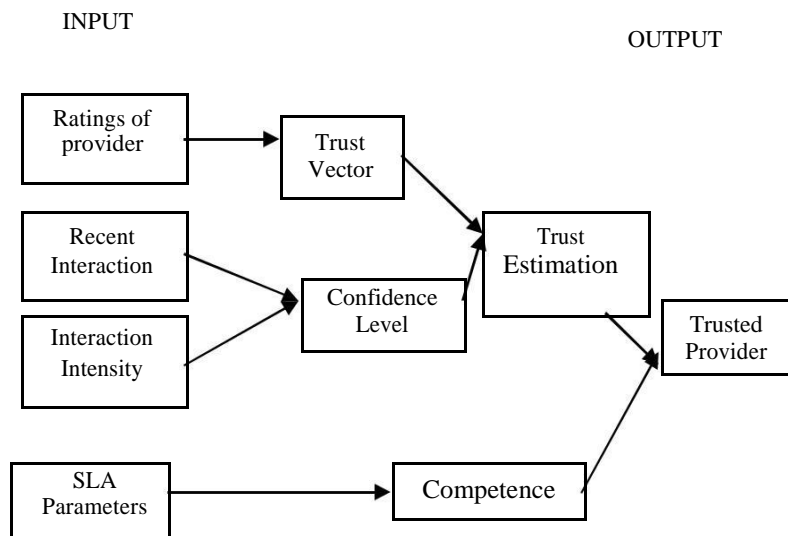


Fig. I Trust Based System Architecture

The interaction between the provider and consumer are considered as the main form of trust estimating parameters. The SLA parameters are also considered as the key for finding the cloud service provider.

C. Estimating the trust value

The trust is estimated by considering the ratings [12] that are provided by the users or cloud consumers to the cloud service providers. The overall rating is grouped into according to the ratings that are given to the providers. The trust estimation computes trust between a customer and providers by considering direct interaction that are occurred between them. Then the probability of the rating is said to be estimated and the trust factor (Eqn 1) is said to be determined.

Estimating the trust value

$$= \sum_{i=1}^n () \quad \text{(Eqn 1)}$$

Where
 - Degree of Trust
 - Weight of the recent interaction - Rating at the particular time period () - probability of the rating

Algorithm 1 – Estimating The Trust Value

Input: provider id, ratings, user id
Output: trust estimation value
Initialization:
 Initialize the User U_i
 Provider P_k
 Rating R_k
Declaration
 Rating $\{R_1, \dots, R_k\}$

Process

BEGIN

Step-1 : Initialise the User U_i and the Provider P_k

Step-2 : Provide the ratings to the provider P_k

Step-3 : Analyze the total ratings of the provider P_k

Step-4 : Find the probability of the rating $P(R_k)$

Step-5 : Calculate the Expected Degree of Trust μ_{cj}

Step-6 : Estimated trust value is produced

END

D. Estimating Confidence Level

The confidence level (Eqn 2) is said to be determined by considering the interaction intensity, recent interaction and ratings of the users to the providers. The interaction of the users with the providers are said to be estimated with the recent interaction ratings. As the interaction increases, it reduces the complication in finding the optimal service provider. The intensity of interaction is said to be increased if the interaction of the users with the providers increases. Past experience is associated with the future, giving a measure of their trustworthiness.

Estimating the confidence value

$$C_i = \frac{I_i + \sum_{j=1}^n R_j^i \cdot F_j}{R_{max} + \sum_{j=1}^n R_j^i \cdot F_j} \quad (Eqn 2)$$

Where

- Confidence level

I_i - Interaction intensity

F_j - Trustworthiness

R_j^i - User rating

R_{max} - Maximum user rating

I_i - Recent interaction

F_j - Weight of the recent interaction

R_j^i - Rating at the particular time period

F_j - probability of the rating

Algorithm 2-Estimating Confidence Level

Input: user id, ratings, another user id

Output: Confidence level estimation

Initialization:

Initialize the User U_i

User list U

Provider P_k

Rating R_k

Interaction intensity I_i

Declaration

Rating $\{R_1, \dots, R_k\}$

User list $\{U_1, \dots, U_i\}$

Process

BEGIN

Step 1: Collect the users starting from an arbitrary collection

Step 2: The Past interaction and recent interactions R_i ratings are said to consider

Step 3: Rank each of the user rating U_i to generate the user list U according to the total number of ratings

Step 4: The Interaction intensity I_i is estimated by calculating the user rating, maximum rating and the average rating of the provider given by the users.

Step 5: Calculate the confidence level by considering the interactions.

END

E. Competence Estimation

In the competence estimation [10] the SLA parameters of the cloud service providers are said to be considered and the competence (Eqn 3) is said to be determined by computing the transparency of SLA, since the parameters provided are not satisfied from the services, a fairly approach is by considering the mean transparency of all parameters.

Estimating the competence

$$C_i = \frac{\sum_{j=1}^n T_j}{n} \quad (Eqn 3)$$

Where

param- parameters(i^{th}) in SLA

n- Aggregated number of SLA parameters param(

) - transparency of SLA parameter

Algorithm 3 – Competence Estimation

Input: provider id, ratings, user id

Output: trust estimation value

Initialization:

Initialize the User U_i

Provider P_k

Rating R_k

Competence C_i

Declaration

Rating $\{R_1, \dots, R_k\}$

Process

BEGIN

Step-1 : Initialize the User U_i and the Provider P_k

Step-2 : Provide the ratings to the provider P_k

Step-3 : Calculate the SLA parameter's value

Step-4 : Find the probability of the rating $P(R_k)$

Step-5 : Calculate the competence, value C_i

END

This section describes the detailed description for all the modules of the Trust Based Cloud Service Provider Selection and also the diagrammatic representation for the Trust Based Cloud Service Provider Selection and modular diagram for this framework. And the algorithm for all the modules was also explained in detail according to the sequence of the Trust Based Cloud Service Provider Selection process.

IV EXPERIMENTAL RESULTS

A. Experimental Setup

The Trust Based Cloud Service Provider Selection involves the procedure of finding the cloud service provider for the effective use of their resources by the cloud consumers. The trustworthiness and the competence are said to be determined with the interaction of providers with consumers that are provided as in the form of ratings [12][18][10]. The Extended Epinion dataset is used in order to find the trust, it contains 5000 user feedbacks in it. The dataset file contains the item id, rating, userID, date. Trust Based Cloud Service Provider helps to efficiently find the cloud service provider, it uses trustworthiness and competence estimating technique in finding the effective cloud service provider.

B. Performance Analysis of Trust Based Cloud Service Provider

In this section, the trustworthiness and competence are said to be determined, calculating the evaluation of the ratings that are provided by the users to the cloud service providers by the interaction with the providers. The trust estimation is determined by calculating the various parameters. The competence is determined by the interaction with the providers and SLA parameters.

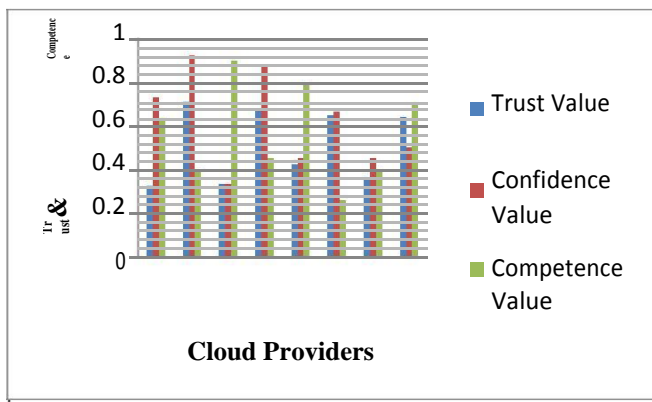


Fig. II Comparison Between Trust and Competence

The trust estimation Fig II is said to be determined, calculating the trust estimated by the ratings of providers and the confidence level by considering the recent interaction, interaction intensity and the ratings of the providers provided by the users. The confidence level is said to be determined by considering the recent interaction with the users and the providers.

The competence is said to be estimated with the SLA parameters and the cloud control matrix. In order to achieve best findings of cloud service provider, it must give balanced cloud resources and dynamic workloads.

In the competence estimation the SLA parameters of the cloud service providers are said to be considered and the competence is said to be determined by computing the transparency of SLA, since the parameters provided are not satisfied from the services, a fairly approach is by considering the mean transparency of all parameters.

By comparing the value of the trustworthiness the trust estimation is said to be calculated. This experimental result shows efficient results by using this trustworthiness and competence estimation.

V CONCLUSION AND FUTURE WORK

The cloud service providers are determined based on the interaction of the providers and the users. It also considers various parameters like security and availability. The trustworthiness and competence are said to be estimated with the interactions with the users with the cloud service providers and the recent interaction of the providers. The confidence level is established by considering the recent interaction and interaction intensity of the providers with the users. Later the trust network has to be formed, that contains the indirect interaction can also be formed by the users and providers. Then the trust has to be estimated from the social network like Twitter, from that the direct communication and feedback of the users to the providers can be determined.

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