Trusted Service Selection In Cloud Computing Using Topsis

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ABSTRACT

Cloud computing is one of the emerging technology. It provides elastic and scalable resources over the internet from remote data center to consumer. Diverse provider and service landscape makes cloud computing marketplace a highly competitive one. But due to dynamic and non-transparent nature of cloud computing, it has given rise to confidentiality, privacy, security issues. The Assurances are insufficient to identify trusted and dependable cloud service. Due to these issues it is very important to select trustworthy service for users their business. Trust is one of most challenging issue in technology of cloud computing. In cloud market place there many services which provide primarily similar functionality. But there is lack of trust element in them which become hinder for user adopting them. Cloud service should provide according to SLA (Service Level Agreement) but in real there is difference between SLA and service they provide. This paper uses Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Ordered Weight Averaging (OWA) algorithm to propose method which help cloud user in selection trusted service selection. OWA calculate weights dynamically for trust parameters. TOPSIS give result not only closet to ideal solution but also the farthest from non- ideal solution. Ideal solution is a solution for which all attribute have the best value. *For experiment real cloud data are used. Dataset is derived from cloud armor project.*

Keyword : - *Cloud Computing , Trust, Topsis, Owa, Service selection*

1. INDRODUCTION

In Internet environment, emergence of cloud computing is considered as revolution. Cloud computing is still an evolving paradigm. Cloud computing is a technology which delivers various services like servers, storage, network, software over the internet in a flexible and on-demand way. Cloud Computing facilitates diverse flavours and numerous kinds of services. Services which are provisioned by cloud computing are classified as per the mode of their delivery. There are mainly three types –Infrastructure as a Service (IaaS), Platform as a Service (Paas), Software as a Service (SaaS) in which services are categorized. Infrastructure as a Service (IaaS) provision storage, processing power, network, operating system.Platform as a Service (Paas) provision platform environment for developing, testing, delivering, managing software application. Software as a Service (SaaS) facilitates software application[1].

Cloud services provide many advantages to cloud consumer in a flexible and low cost manner. But cloud computing technology faces many challenges such as privacy, security, confidentiality due to its distributed, dynamic, and non-transparent environment [1].Cloud consumer wants to be sure among the other things that consumed service is prone from unauthorized access or modification of data or information. Cloud consumer wants to be optimistic that the service is reliable and available and that there is liability and credibility: that is, evidence that proves that proves the originality and integrity of data[2].

In cloud computing consumers data are stored in data centers that are physically secure with hardware and professionally managed with special software. Cloud consumer may feel loss of control over the data once the data are stored or processed over cloud[3]. Cloud consumer may not trust cloud service due to lack of experience between cloud consumer and its providers. The non-transparent and highly distributed nature of cloud computing represent obstacle to the market success and acceptance of cloud service[4].cloud service provider are going to

compete for consumers by feeding service with similar primary function. Thus there will be need to loyally identify dependable service.

Trust is defines level of confidence in something or someone[5].Trust level helps cloud consumer choose trusted cloud service[1].A major role could be played by trust for success of any interaction in cloud environment. It is an indicating factor in predicting the future behavior of an entity in cloud. Trust can be objective and subjective. Objective trust focuses on Service Level Agreement (SLA), Quality of Service (QoS), Security like technical aspects of service while subjective trust focuses on opinion of others about the service (Reputation of Service).

To address trusted service selection we propose a method with uses Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)[6] and Ordered Weight Averaging (OWA)[7] which helps user in making trustworthy service selection.

2. RELATED WORK

This paper[8] represent a fuzzy logic based trust evaluation system that take the user's feedback in fuzzy linguistic term about the cloud service's QoS parameter availability, reliability, portability, privacy, security. To predict trust value they have represented fuzzy goal and constraint in proposed model. To calculate appropriate weight for given feedback they have incorporated fuzzy interference system but it does not show strategy. This paper [9]represent feedback based trust system with parameter such as response time, completion time, speed, cost of services for finding trust value. This paper [10] represented a 'Dempster-Shafer (Ds)' theory based trust model for recording positive and negative uncertain interaction of cloud service and cloud user. This paper [11] represented a naïve Bayes model and the n-gram markov model based feedback based QoS trust model. It also considers correlation between QoS parameter which helps in predict missing assessment and improve the accuracy of trust model. Experimental results show it outperforms traditional naïve Bayes trust model. This paper [12] presented a multi-dimensional trust evaluation system. Trust value consist cloud data trust and reputation of service. Data trust consist data processing, data transmission, data storage, data privacy, data security. Reputation of service consist availability, reliability, turnaround time, service use factors. To integrate them it uses WMA-OWA (weighted moving average –ordered weight averaging) algorithm. This paper[13] developed trust system using domain partition strategy. Transaction count method is used for domain partition. Trust value consist domain and global trust. Domain trust indicates the credibility between two nodes in same domain and global trust indicates credibility between two nodes of different domain. Proposed trust model has faster convergence speed. This paper[14] developed trust model based on multi-agent. It uses centralized mode and set up third party agent in cloud. Trust consist direct trust and recommend trust. Direct trust calculated by interaction between two nodes. Recommend trust average of direct between each pair of nodes. By using third party agent it reduces the single agent's pressure of computation, storage and user's waiting time. This paper [15] developed trust system based compliance checking mechanism using collaboration between users. Each user should prepare report about compliances of system. These compliances responses are aggregated using fuzzy inference system. This paper [2] present multi-layer trust security model based on unified cloud platform trust that apply a fuzzy logic combination of on demand states of several different security mechanism.

3. Proposed Method

Proposed model consist three major entity cloud user, cloud service providers, trust calculation. cloud user which request service and provide feedback after using the service. Cloud service providers provide various services .trust calculation helps the cloud user in selection of trustworthy cloud service.

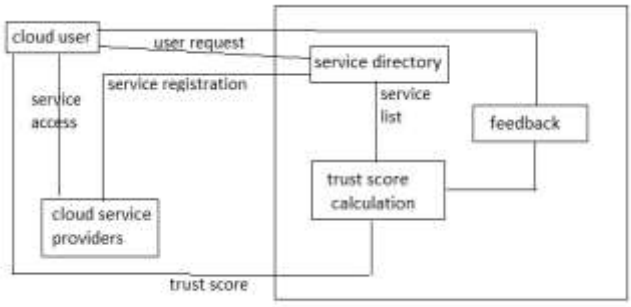

Fig -1: Proposed Model

Trust calculation consist service directory, trust score calculation, feedback. Service directory consist service description of all the services. It send service list according user request to trust score calculation. Feedback module consist feedback about all the services. Trust score calculation module calculates trust score for cloud services using TOPSIS and OWA. Trust score calculation send this trust scores with service.

3.1 Trust Parameter

- Availability: The service availability refers to a feature of the system in which each service such as data storage, networks, servers and many more are available and usable whenever an authenticated user demand.
- Response Time(Rt): It refers to the period between when a user makes a request and a response is given by service to user.
- Accessibility(Ac): It refers to how well user can access the service. seamless access
- Price(P): It refers to cost in terms of currency which user need to pay for service which user is using.

3.2 Ordered Weight Averaging (OWA)

The OWA operator: An ordered weighted averaging operator (OWA)[7][12] of dimension n is a function $F : R^n \rightarrow R$ that has an associated weighting n vector $W = [w_1,w_2,..,w_n]$ property : $\forall w_i \in [0,1]$ and $\sum_{i=1}^{n} w_i = 1$, i=1,2,..n such that F (a1 ,a2 ,..,an) = $\sum_j w_j b_j$ where b_i is the j^{th} largest of a_i.

OWA algorithm is used to calculate the weights for trust parameters.

1: **procedure** INPUT:(ω, n) /* n is the number of factors and ω is the situation parameter which is used for calculation of the most important factor . */
2: **if** $\omega < 0.5$ **then**
3: $\omega = 1 - \omega$;
4: **endif**
5: **if** $\omega \geq 0.5$ **then**
6: Calculate the weight of W1 using Equation: $W_1[(n-1)\omega + 1 - nW_1]^n = [(n-1)\omega]^{n-1} * [((n-1)\omega - n)W_1 + 1]$ */ the value of W1 should satisfy this equation. */
7: Calculate W_n using Equation: $W_n = \frac{((n-1)\omega - n)W_1 + 1}{(n-1)\omega + 1 - nW_1}$
8: for i=2 to (n-1) do
9: Calculate Wi using Equation: $W_i = \sqrt[n-1]{W_1^{n-i} * Wn^{i-1}}$
10: endfor
11: endif
12: Output: Weight $W = [W_1,W_2, \ldots,W_n]$

Table 1. The w1 ~ w4 values for different situation parameter values for n=4

ω =0.5	*ω =0.6*	*ω =0.7*	*ω =0.8*	*ω =0.9*
0.250010	0.347440	0.461371	0.596482	0.764108
0.250003	0.272207	0.275617	0.252031	0.182131
0.249996	0.213265	0.164651	0.106491	0.043412
0.249989	0.167086	0.098360	0.044995	0.010347

3.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) (OWA)

The TOPSIS[16] process to obtain the evaluation results is carried out as follows:

Step 1: Construct an decision matrix consisting of m CS_s (services) and n trust parameters (criteria), with the intersection of each alternative and criteria given as CS_{ij} , i =1, 2,...,m and j = 1, 2,..., n. We therefore have a matrix $(CS)_{m*n}$.
m CS_s are services list given by service registry according to user request. Average value of feedback by users of each services (CS_s) are taken for n trust parameter.
Step 2: The matrix $(CS)_{m*n}$ is normalized to form the matrix $(NCS)_{m*n}$. The values in this matrix range from 0 to 1.

NCS = $(CS_{ij})_{m*n}$, using the normalization method $NSC_{ij}=\frac{CS_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}{}^2}}$. i = 1, 2, · · ·,m, j = 1, 2, · · · , n.

Step 3 A set of weightsWj (for j= 1, 2, . . ., n) such that Wj = 1 have to be decided for Trust parameter. Theses weights are calculated using OWA algorithm.

Step 4: Calculate the weighted normalized decision matrix.
$V_{m*n}=(W_j * NCS_{ij})_{m*n}$ i=1,2,…m & j=1,2….n

Step 5: Determine the Ideal solution (A_I) and the Non-Ideal solution (A_N) for every trust parameter:

$$A_I=\begin{cases}(\min(V_{ij}|i=1,2,..m)|j\epsilon J_-)\\(\max(V_{ij}|i=1,2,..m)|j\epsilon J_+)\end{cases} \quad A_N=\begin{cases}(\max(V_{ij}|i=1,2,..m)|j\epsilon J_-)\\(\min(V_{ij}|i=1,2,..m)|j\epsilon J_+)\end{cases}$$

$=\{V_{Ij}|j=1,2,....n\}$ $=\{V_{Nj}|j=1,2,..n\}$

Where J_+ ={ j=1,2,..n|j associated with criteria having a positive impact}
J_- ={ j=1,2,..n|j associated with criteria having a negative impact}

Step 6: determine separation from ideal and non-ideal solution.

$$S_{i+}=\sqrt{\sum_{j=1}^{n}(V_{ij}-V_{Ij})^2} \quad i=1,2,..m \ \& \ j=1,2,..n$$

$$S_{i-}=\sqrt{\sum_{j=1}^{n}(V_{ij}-V_{Nj})^2} \quad i=1,2,..m \ \& \ j=1,2,..n$$

Step 7: determine the relative closeness to positive ideal solution as represented as trust score.

$$Trust_i=\frac{Si_-}{(Si_+ - Si_-)} \quad i=1,2,..m$$

Step 8: sort or rank services according to $Trust_i$ (i=1,2,..m). Trust value near to 1 are consider more trustworthy.

3.4 Implementation Detail

For feedback of users a sample dataset extracted from Cloud Armor Project [17].Project collected cloud service consumers feedback from leading review website such as Best Computing Provider, Cloud Hosting Reviews and Cloud Storage Review and Raings. They have collected 10,000+ feedbacks given by nearly 7000 consumer to 113 real world cloud services. The Feedback on cloud service is collected on 9 Quality of Service (QoS) parameters. The QoS parameter are availability, response time, accessibility, price, speed, storage space, features, ease of use, technical support and customer service. From this dataset decision matrix is constructed. Decision matrix consist average value of feedbacks given by users to each service.

Table 2. Descision Matrix (CS_{ij})

Cloud Service	Availability	Response time	Accessibility	Price
Bluehost	2.75555	4.25	3.33078	3.56521
Fatcow	4.03953	4	4.00724	4.18552
HostMonster	2.752	3.8	3.37903	3.5
Inmotion	4.61559	4.1	3.69391	4.61548
JustHost	3.59163	3.76954	3.6938	4.02321
Ipage	3.79772	3.94663	4.16371	3.87848
Hostgator	4.38939	4.08552	3.45161	4.41558
Go daddy	3.14008	4.6666	3.78902	3.56032
Green geek	3.65476	3.88047	4.02259	3.96407
Web hosting pad	4.13051	4.29521	4.20404	4.55108

Average value of feebacks given to a service is used to construst decision matrix. For Bluehost service availability value taken as average value of feedback given to BlueHost's Availability.

Table 3.Normalized Decision Matrix (NCS_{ij})

Cloud Service	Availability	Response time	Accessibility	Price
Bluehost	0.233170	0.328802	0.278222	0.278060
Fatcow	0.341817	0.309460	0.334726	0.326440
HostMonster	0.232869	0.293987	0.282252	0.272974
Inmotion	0.390562	0.317197	0.308554	0.359974
JustHost	0.303917	0.291631	0.308544	0.313781
Ipage	0.321356	0.305331	0.347796	0.310292
Hostgator	0.371422	0.316077	0.288314	0.344383
Go daddy	0.265768	0.361037	0.316498	0.277679
Green geek	0.309258	0.300213	0.336008	0.309168
Web hosting pad	0.349516	0.332299	0.351165	0.354951

Weighted Normalized Decision Matrix.

Weight is calculated from OWA algorithm. Let's take ω=0.7 then W_1 =0.461317, W_2 =0.275617, W_3 =0.164651, W_4 =0.098360

Table 4.Weighted Normalized Decision Matrix

Cloud Service	Availability	Response time	Accessibility	Price
Bluehost	0.107578	0.090623	0.045809	0.027350
Fatcow	0.157704	0.085292	0.055113	0.032108
HostMonster	0.107439	0.081028	0.046473	0.026849
Inmotion	0.180194	0.087424	0.050803	0.035407
JustHost	0.140218	0.080378	0.050802	0.030863
Ipage	0.148264	0.084154	0.057265	0.030520
Hostgator	0.171363	0.087116	0.047471	0.033873
Go daddy	0.122617	0.099507	0.052111	0.027312

Green geek	0.142683	0.082743	0.055324	0.030409
Web hosting pad	0.161256	0.091587	0.057819	0.034913

Table 5.Ideal solution and non-ideal solution

Trust parameter	A_I ideal solution	A_N non ideal solution
Availability	0.180194	0.107439
Response Time	0.099507	0.080378
Accessibility	0.057819	0.045809
Price	0.035407	0.026849

Table 6.Separation measure

Cloud Service	S_{i+}	S_{i-}
Bluehost	0.074573	0.010258
Fatcow	0.026945	0.051623
HostMonster	0.076398	0.000928
Inmotion	0.013972	0.073764
JustHost	0.045098	0.033399
Ipage	0.035769	0.042727
Hostgator	0.018465	0.064682
Go daddy	0.058422	0.025224
Green geek	0.041464	0.036755
Web hosting pad	0.020533	0.056843

Table 7.Relative closeness to ideal solution

Cloud Service	$Trust_i$
Bluehost	0.120922
Fatcow	0.657046
HostMonster	0.012006
Inmotion	0.840747
JustHost	0.425481
Ipage	0.544324
Hostgator	0.777917
Go daddy	0.301559
Green geek	0.469895
Web hosting pad	0.734634

Table8.Sorted service list

Cloud Service	$Trust_i$
Inmotion	0.840747
Hostgator	0.777917
Web hosting pad	0.734634
Fatcow	0.657046
JustHost	0.425481
Ipage	0.544324
Green geek	0.469895
JustHost	0.425481
Go daddy	0.301559
HostMonster	0.012006

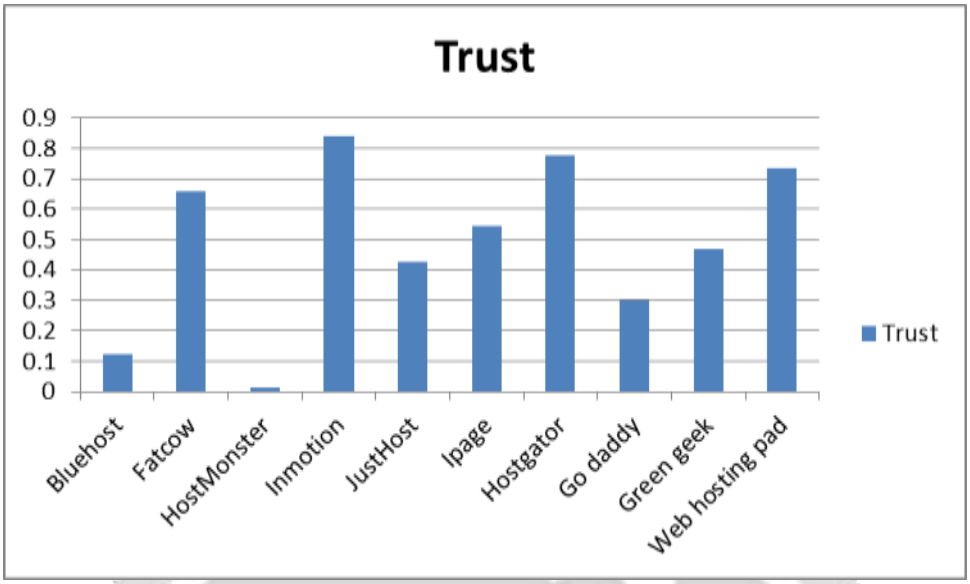

Chart -1: Trust Score of Services

4. CONCLUSIONS

cloud computing technology faces many challenges such as privacy, security, confidentiality due to its distributed, dynamic, and non-transparent environment. There are many cloud services compete with each other with similar primary functionality. In this paper, proposed method uses TOPSIS and OWA algorithm to help user in selection of trustworthy service selection.Topsis give result closet to ideal solution and farthest from non-ideal solution. Ideal solution is a solution for which all attribute have the best value. Cloud Armor Project [17] dataset is used for experimental propose.

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