International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Special Issue 31(September, 2015), PP. 226-230

CLIENT TRUST AND PRIORITIZATION BASED WORKFLOW SCHEDULING IN CLOUD

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***Abstract*— Trust management is an important component of cloud security. Many trust mechanisms have been proposed to address user/client concern related to security, accountability, reliability and privacy. These methods focus on evaluating cloud services and vendors to ensure client's trust on the service provided. But, insider attacks also pose a significant challenge to enterprise security. According to Cloud Security Alliance, data breaches and cloud service abuse rank among the greatest cloud security threats. To mitigate such security risks, trust being a two-way street, there's a need for Cloud Service Provider (CSP) to have trusted clients. In this paper, Client Trust and Prioritization based WorkFlow Scheduling (CTP-WFS) model is proposed to prioritize and provide guaranteed service to trusted customers. Both old and new customers would have better usability experience. This approach implicitly avoids Denial of Service attacks. CTP-WFS will boost long term revenue generation while avoiding some security attacks.**

***Keywords* — Workflow Scheduling, Client Trust, Prioritization, Fuzzy Sets, Cloud Computing.**

I. INTRODUCTION

Cloud computing is the latest buzz in the computer world. It's evolving like never before, with companies of all shapes and sizes adapting to this new technology. Industry experts believe that this trend will only continue to grow and develop even further in the coming few years.

Cloud is a 'cloud of resources' over internet that can be accessed by end users anywhere, anytime. Resources in cloud are virtually infinite that are aggregated to be shared. These resources can be in the form of hardware, software, infrastructure, storage and so on. Cloud provides multi-tenancy of these virtualized resources. Users can pay as per their flexible needs. Cloud allows on-demand services with massive processing power and high elasticity that reduces capital expenditure and maintenance cost.

Typically, three service models are offered by cloud: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Depending on business requirements, cloud can be implemented as Private Cloud, Public Cloud, Community Cloud or Hybrid Cloud. Cloud has found wide applications in business, social networks, industries, government and science. It is a promising technique for integration of enterprise systems. It allows business enterprises to reduce capital cost, streamline processes, globalize workforce, improve accessibility and increase collaboration. These benefits have led to rapid growth of cloud and its challenges. Large number of requests generated should be managed efficiently to improve customer satisfaction.

Cloud's emergence has led to new risks that clients should consider while evaluating cloud services and vendors. Security has always been top concern for cloud adoption. Strategies are developed to understand risks and protect data on cloud. But, cloud security is more than just physical controls. People, processes, policies and products are the key aspects of cloud security. The need for trust arises as an important factor especially in vital data and transaction processing applications. Moving to cloud is not restricted to purchasing a specific product or service. Rather it's like a partnership between the client and the CSP. Both client and vendor must commit to communication and transparency. This would help deal complex problems with ease and maximize the potential for client success.

Cloud model helps break complex problems into services that can be integrated to provide secure and scalable solution. These services are represented in the form of orchestrated business activity patterns called workflows. Workflows help automating business processes, to ease out the complexity of task execution and management. Since, workflow requests sometimes

exceed resource availability, scheduling comes into picture. Scheduling, systematically organizes resources to serve composite services. Workflow scheduling is used to assign best possible cloud service for workflow tasks. It aims to make the most of cloud services and meet user QoS requirements.

Any algorithm which is proposed for scheduling of large scale resources is NP-hard problem. In this paper, scheduling strategy is proposed to optimize time, profit and client trust factor. Client requests are prioritized based on these metrics. To achieve this, workflow planning problem is modeled as a multi-objective optimization problem. In this approach, groups of conflicting objectives are simultaneously optimized. This paper is an effort to balance different conflicting requirements of enterprises as well as to endow esteemed customers with prompt services by developing CTP-WFS model. Usability experience of all customer groups would be improved explicitly through CTP-WFS and implicitly by preventing loss and service disruption due to Denial of Service attack.

II. Related Work

Economic globalization and increasing competition has procreated the need for system integration. As a result, many large enterprises opt for integration of various enterprise systems [1,2]. Cloud computing provides collaborative environment with large pool of cloud services. But heterogeneous problems in data formats, structures and semantics pose a challenge for smooth collaborative business process [3-5].

Integrating cloud services into a composite service can be facilitated by workflows. Workflows are used for automation of business process in large-scale distributed systems. Workflows help to execute and manage complex business process smoothly [6,7]. The workflows can be depicted as a series of multiple tasks that simplify the coordinated execution process. The process of allocating workflow tasks to most appropriate cloud service is referred to as Workflow Scheduling. Workflow scheduling algorithms strive to generate approximate or near-optimal solutions as WFS being NP-hard problem, it is impossible to produce an optimal solution in polynomial time. Several scheduling algorithms have been developed to meet the complicated need of organizational practices but most of them focus on minimizing execution time and cost.

Large-scale distributed systems have inherent uncertainty and unreliability. Moreover, cloud computing environment mostly consist of geographically distributed and assorted service providers. To avoid failure-prone network, trust factor comes into picture. Trust is an integral and essential part of enterprise business as it influences decision support and helps analyzing current trend. Generally, customers get the opportunity to rate the CSPs and provide feedback where feedback rate can be calculated as $R = P / (P+N)$, where P is the number of positive rating and N is the number of negative ratings. Another mechanism referred as PowerTrust Model can be used to rate trust factor where trust value is based on the feedback of successful transactions. Kamvar et al [8] proposed a distributed and secure method, named the EigenTrust algorithm, to compute global trust value. In this, a binary rating model was used to evaluate local successful transaction from each peer. [9] suggests a bi-objective WFS algorithm that aims to minimize makespan time while maximizing reliability on heterogeneous systems. Recommendation Systems [10,11] use collaborative filtering model to facilitate service selection. Trust WorkFlow Scheduling (TWFS) algorithm combines direct trust with recommended trust to compute trust metric and then uses multiobjective model to optimize the group of conflicting objectives (time, cost and trust) simultaneously [12].

The aforementioned solutions provide a valuable insight into the challenges and potential of trust-based solutions for WFS. In this paper, reverse trust based elucidation is proposed where CSP rates the customer based on the predefined metrics. This trust factor is then used to prioritize client request to improve customer satisfaction.

III. Proposed Mechansim

In this section, CTP-WFS model is proposed that looks at workflow scheduling from CSP perspective. WFS problem is treated as a fuzzy multi-objective problem which is subject to time, profit and trust constraints.

A. CTP-WFS Model

Client is at the heart of business relationships. It is a key to maintaining old customers and gaining new ones. Customer's buying decisions are driven by the trust on the CSP. Given today's highly competitive scenario, it's equally important for CSP's to have trusted customers. A mechanism to efficiently handle requests from all user groups both old and new is proposed as shown in figure 1:

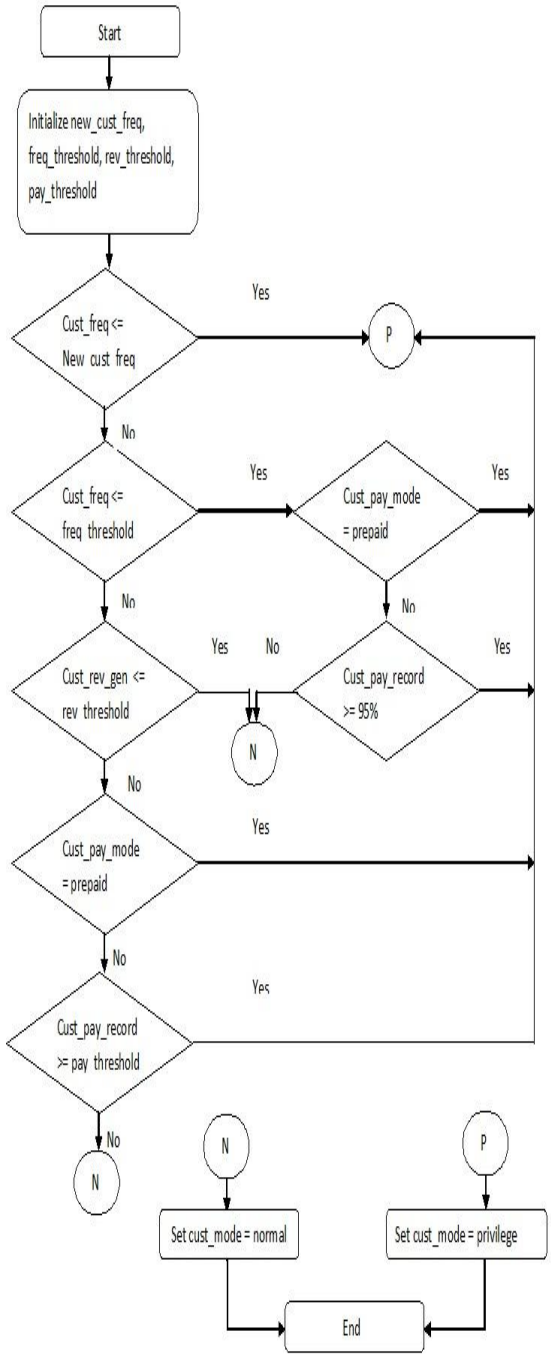

Fig. 1 CTPWFS Flowchart

Algorithm-1. Pseudo – code for CTPWFS algorithm

Input: Set of client requests
Output: Customer Mode of each client
Functions:
setCustomerMode() {

```
1.  If (cust_freq <= new_cust_freq) {
2.          Set Customer Mode as Privilege
3.  }
4.  Else If (cust_freq <= freq_threshold) {
5.          If (cust_pay_mode == prepaid) {
6.              Set Customer Mode as Privilege
7.          }
8.      Else If (cust_pay_record >= pay_threshold) {
9.              Set Customer Mode as Privilege
10.         }
11.         Else Set Customer Mode as Normal
12. }
13. Else If (rev_gen <= rev_threshold) {
14.         Set Customer Mode as Normal
15.     }
16.     Else If (cust_pay_mode == prepaid) {
17.         Set Customer Mode as Privilege
18.     }
19.     Else If (cust_pay_record >= pay_threshold) {
20.             Set Customer Mode as Privilege
21.         }
22.         Else Set Customer Mode as Normal
23. }
```

New customers are attracted by providing guaranteed service whereas old customers are retained, who have decreased access frequency in past few months, by treating them as new customer and confidence is regained. Genuine customers are identified and prioritized based on criteria such as frequency of access, revenue generated and payment record. Overall, this would lead to improve usability experience, increase total number of customers and subsequently boost long term revenue generation.

B. Fuzzy Model

Using max-min operator, the membership function of objectives is formulated by separating every objective into its maximum and minimum values.

1) Membership Function for Trust Evaluation

A general client-trust metric combines frequency of requests, revenue generated and payment record. Based on comparison with set thresholds for above listed parameters, customer_mode is set to be "privilege" or "normal" and trust factor is set accordingly. Using Max-min operator, the membership function for client-trust is formulated as below:

$$U_{Ri}(ct_x) = \frac{ct^i_x - ct^i_{min},}{ct^i_{max} - ct^i_{min}} \quad \text{if} \quad ct^i_{min} <= ct^i_x <= ct^i_{max}$$

$$U_{Ri}(ct_x) = 0, \quad \text{if} \quad ct^i_{min} <= ct^i_x$$

$$U_{Ri}(ct_x) = 1, \quad \text{if} \quad ct^i_{max} <= ct^i_x$$

A value of trust ct_i close to maximum trust ct_{max} indicates that the client is an esteemed customer and hence, his request should be prioritized.

2) Membership Function for Response Time

There is a set of requests R from clients that would need different processing times PT_x depending upon length of client request in MI (Million Instructions), virtual machine processing speed in MIPS (Million Instructions Per Second). Based upon nature of client request, data transfer time DTT_x would be considered. If a new VM is to be initiated, even VM initiation time IT_x will be taken into account. All these three parameters will constitute the Total Response time T_x.

$T_x = PT_x + DTT_x$, if new VM is not initiated
$T_x = PT_x + DTT_x + IT_x$, if new VM is initiated

And the list of requests will be sorted in an ascending way based on the value of time. Max-min operator is used to formulate the membership function for time.

$$U_{Ri}(t_x) = \frac{t^i_{max} - t^i_x}{t^i_{max} - t^i_{min}}, \quad \text{if} \quad t^i_{min} <= t^i_x <= t^i_{max}$$

$$U_{Ri}(t_x) = 0, \quad \text{if} \quad t^i_{max} <= t^i_x$$

$$U_{Ri}(t_x) = 1, \quad \text{if} \quad t^i_{min} <= t^i_x$$

Closer the value of time t_i is to minimum time t_{min}, lesser the response time is and the more the objective is satisfied.

3) Membership Function for Profit

Let a client submit new request at submission time with maximum price B_x to CSP. Let the total cost incurred by CSP be represented by C_x. Processing cost PC_x and data transfer cost DTC_x along with VM initiation cost IC_x constitute for total cost C_x.

$$C_x = PC_x + DTC_x + IC_x$$

The profit gained by CSP is defined as difference between budget and total cost.

$$P_x = B_x - C_x$$

Similar to the membership function to trust evaluation, the membership function for the profit of the i*th* request can be defined using max-min operator.

$$U_{Ri}(p_x) = \frac{p^i_x - p^i_{min}}{p^i_{max} - p^i_{min}}, \quad \text{if} \quad p^i_{min} <= p^i_x <= p^i_{max}$$

$$U_{Ri}(p_x) = 0, \quad \text{if} \quad p^i_{max} <= p^i_x$$

$$U_{Ri}(p_x) = 1, \quad \text{if} \quad p^i_{min} <= p^i_x$$

Low value of profit p_i signifies that the membership value is low. Higher the value of p_i better is the profit earned and more the objective is achieved. The list of requests is stored in descending order based on profit.

4) WFS Model

The workflow planning problem is a multi-objective optimization problem in which groups of conflicting objectives are simultaneously optimized. WFS require policies to strike a balance for the different requirements. The optimization of the workflow is to prioritize genuine requests R_i in order to achieve minimum execution time and maximum profit while meeting the constraints of client-trust. In order to satisfy the multiple criteria simultaneously, a compromise should be made to find a suitable solution. Using max-min operator, the aforementioned fuzzy model can be converted into crisp model.

The degree of overall satisfaction is the minimum of all membership values. The fuzzy decision may be considered as the choice that satisfies all of the objectives.

$$\lambda^i_j = \min \{ U_{Ri}(ct_x), U_{Ri}(t_x), U_{Ri}(p_x) \}$$

The selection of services for WFS is the maximum of all degrees of satisfaction.

$$\lambda^i_k = \max \{ \lambda^i_j \}$$

To consider the relative importance of objectives, the selection model can be formulated by the weighted arithmetic mean operator.

Maximize $U*W^T$

$w_{ct} + w_c + w_p = 1$, for $w_{ct}, w_p, w_t \in [0,1]$

where W is the weight vector containing w_{ct}, w_c, w_t,
w_{ct} means the weight of client trust,
w_p means the weight profit,
w_t means the weight of response time.

Thus, weight factors will help the model to be flexible and can be used to evaluate significance of each parameter to maximize revenue and build good client relationships.

IV. CONCLUSION

Trust is more important than money and will ultimately determine cloud computing success. In this project, a novel client-trust based approach for workflow scheduling, CTP-WFS, is presented. The proposed scheduling algorithm adopts a client-trust metric and prioritizes client requests based on the trust factor. The client-trust metric is a composite factor constituted by parameters such as payment on time, frequency of use and revenue generated. The weights of different criteria can be adjusted based on business needs. In this model, response time, profit and client-trust parameters are considered simultaneously to yield a genuinely optimal

and beneficial solution while improving usability experience.

REFERENCES

[1] L. Xu, "Enterprise systems: State-of-the-art and future trends," IEEE Trans. Ind. Informat., vol. 7, no. 4, pp. 630–640, Nov. 2011.

[2] J. Guo, L. Xu, Z. Gong, C. Che, and S. Chaudhry, "Semantic inference on heterogeneous e-marketplace activities," IEEE Trans. Syst., Man, Cybern. A, Syst., Humans, vol. 42, no. 2, pp. 316–330, Mar. 2012.

[3] M. Dikaiakos, D. Katsaros, P. Mehra, G. Pallis, and A. Vakali, "Cloud computing: Distributed internet computing for IT and scientific research," IEEE Internet Comput., vol. 13, no. 5, pp. 10–13, Sep./Oct. 2009.

[4] R. . Mietzner, F. Leymann, and T. Unger, "Horizontal and vertical combination of multi-tenancy patterns in service-oriented applications," Enterprise Inf. Syst., vol. 5, no. 1, pp. 59–77, Feb. 2011.

[5] M. . Tan, Y. Xu, W. Xu, L. Xu, X. Zhao, L. Wang, and L. Fu, "A methodology toward manufacturing grid-based virtual enterprise operation platform," Enterprise Inf. Syst., vol. 4, no. 3, pp. 283–309, Aug. 2010.R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital- to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.

[6] N. . Ranaldo and E. Zimeo, "Time and cost-driven scheduling of data parallel tasks in grid workflows," IEEE Syst. J., vol. 3, no. 1, pp. 104–120, Mar. 2009.

[7] J. Ma, K. Wang, and L. Xu, "Modelling and analysis of workflow for lean supply chains", Enterprise Inf. Syst., vol. 5, no. 4, pp. 423–447, Nov. 2011.

[8] S. D. Kamvar, M. T. Schlosser, and H. Garcia-Molina, "The eigentrust algorithm for reputation management in P2P networks," in Proc. Int. Conf. WWW, 2003, pp. 640–651.

[9] L. Duan, W. Street, and E. Xu, "Healthcare information systems: Data mining methods in the creation of a clinical recommender system," Enterprise Inf. Syst., vol. 5, no. 2, pp. 169–181, May 2011.

[10] R. Sakellariou, H. Zhao, E. Tsiakkouri, andM. D. Dikaiakos, "Scheduling workflows with budget constraints," in Proc. Workshop Integr. Res. Grid Comput., Pisa, Italy, 2005, pp. 189–202.

[11] J. Yu and R. Buyya, "A taxonomy of workflow management systems for grid computing," J. Grid Comput., vol. 33, no. 3/4, pp. 171–200, Sep. 2005.

[12] W.Tan, Y. Sun, L. Li, G. Lu and T. Wong, "A Trust Service-Oriented Scheduling Model Workflow Applications in Cloud Computing," IEEE SYSTEM JOURNAL, VOL.8 NO.3 Sep 2014