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Credibility-based cloud media resource allocation algorithm

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ABSTRACT

Traditional cloud media resource allocation algorithms have the problem of low efficiency during resources allocation in cloud environment, which is caused by lacking credibility between media resource nodes, a credibility-based cloud media resource allocation (CCMRA) algorithm is proposed in this paper. According to the continuous double auction mechanism, the resource applicants and resource owners submit their requests to the allocation agents. Based on the total credibility, the allocation agents allocate the media resources to get the optimal allocation sequence for higher allocation efficiency and Quality of Service (QoS). Finally, the effectiveness of the proposed algorithm is proved by the simulation.

1. Introduction

In cloud environment and wireless network, there exist a lot of dynamic and heterogeneous media resources, and these media resources are shared by multiple resource applicants simultaneously (Wang et al., 2011). Allocating media resources efficiently can not only improve the media resource utilization greatly, but also increase the economic QoS and performance QoS (Zhang et al., 2013). How to improve the allocation utility is an eager problem to be solved nowadays.

Researchers have studied a lot about the utility problem of media resource allocation. Among them, the ant colony algorithm, particle algorithm, genetic algorithm etc. are representative and universe (Xing-wei et al., 2012). The particle swarm algorithm has been proposed in Gong et al. (2012) to solve the problems of resource scheduling and maximize the workload profits. The double auction based Nash equilibrium algorithm has been proposed in Sun et al. (2010) to allocate media resources, and meanwhile it takes the social and economic QoS into account.

All the above papers have solved the utility problem of media resource allocation, but none of them considered the issue of media resources credibility, which resulted in the low resource allocation efficiency. In cloud environment, the already allocated media resources may fail to arrive at the resource applicants because of the network instability or the nodes dishonesty, otherwise, the already applied resource applicants may not need the resources because the tasks have been finished or the price has been changed. What is more, the credibility of one of the transaction participants affects the other's utility directly.

As a result, some researchers put forward the concept of resource credibility. Concept of node trust based on double auction has been proposed in Shi-Wei and Yu (2011), it combined the node credibility with the resource price which had improved the success rate and stability of resource allocation to some extent. The credibility was defined as an attribute of quality of information in Ciftcioglu and Yener (2012), it considered the network utility which depended on both information credibility and timeliness to find the optimal power allocation. Trust model in optimal resource allocation for a virtual organization has been proposed in Shu-gang and Jian-hua (2011) by using trust mechanism to improve service satisfaction, the resource trust was divided into direct trust and indirect trust, then resources were allocated based on the total trust value of each resource allocation chain. All the above papers considered the credibility of resources, but ignored the credibility between the resource nodes.

In this paper, the concept of credibility between the resource nodes is proposed considering both the resource owners and the resource applicants. Then we set the maximum utility function to get the optimal allocation sequence. Finally the allocation agents allocate the media resources based on the credibility of the optimal allocation sequence, which can avoid the resource waste caused by network instability.

This paper is organized as follows. Section 1 is the research environment in cloud. Section 2 formulates the cloud media resource allocation model. Section 3 presents the resource pricing

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strategies. The media resource credibility is proposed in Section 4. Section 5 is the CCMRA algorithm. Finally the simulation is carried out in Section 6 and Section 7 is the conclusion.

2. Research environment

As shown in Fig. 1, the resource applicants, resource owners and resource agents are all in the cloud environment. Firstly, the resource owners and the resource applicants submit their own information (e.g., the task deadline, the number of required resources etc.) to the resource agents simultaneously. Then, the resource agents get the optimal allocation sequence based on the CCMRA algorithm. Finally, the resource owners and resource applicants form transactions to allocate resources based on the optimal allocation sequence.

When a resource applicant needs to apply for media resources, it sends the number of required resources, the deadline of the task and other attributes (e.g., the budget and the highest price within its affordability etc.) to the allocation agents. The allocation agents allocate resources based on the resource applicants' highest price and the resource owners' lowest price. Then the resource agents allocate resources as the maximum utility sequence based on the media resource credibility.

3. Cloud media resources allocation model

In the network, media resource allocation is a many-to-many transaction, especially in the cloud environment which is of more complexity and variability. As shown in Fig. 2, the service layer, the user layer and the agent layer of the CCMRA model correspond to the sellers, buyers and auctioneers of the CDA model respectively. The resource applicants and resource owners allocate media resources through the allocation agents. Resource applicants submit the number of required resources and the price to the allocation agents. The resource owners uninterrupted submit the number of remaining resources and acceptable price to the allocation agents. After receiving the information of the resource applicants and resource owners, the allocation agents get the allocation sequence with the maximum utility value considering the price, deadline and the credibility based on the CCMRA, then allocate the media resources to the corresponding resource applicants.

Definition 1. Let $U=\{u_1,u_2,\ldots,u_m\}$ be the set composed of m resource applicants, each task of resource applicant u_i is t_i, so the task set of U can be described as $T=\{t_1,t_2,\ldots,t_m\}$. And t_i has four attributes $t_i=\{tid_i,l_i,b_i,d_i\}, i\in[1,m]$, where tid_i is the ith task's identify, l_i is the ith task's length, b_i is the ith task's budget, and d_i is the deadline of the task.

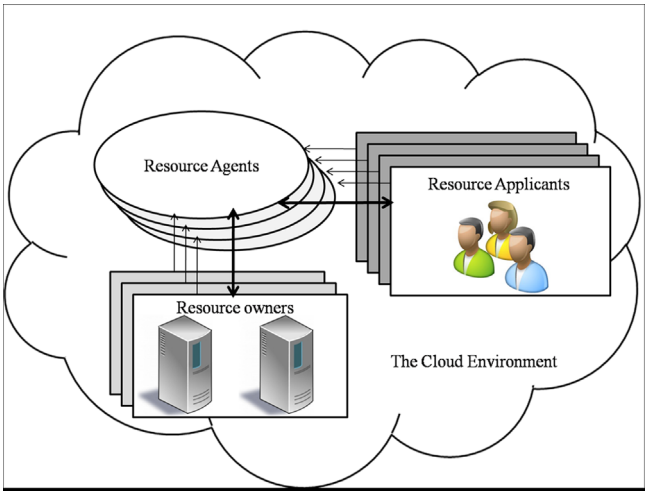

Fig. 1. Cloud media resources allocation research environment.

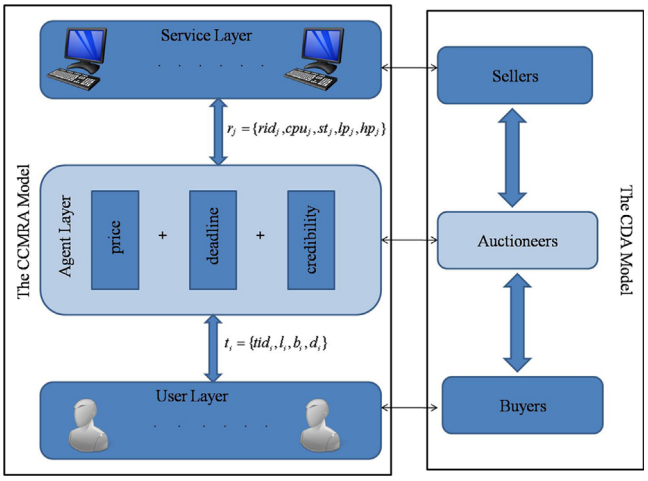

Fig. 2. Credibility-based media resource allocation model.

Definition 2. Let $O=\{o_1,o_2,\ldots,o_n\}$ be the set composed of n resource owners, each resource of resource owner o_j is r_j, so the resource set of O can be described as $R=\{r_1,r_2,\ldots,r_n\}$. And r_j has five attributes $r_j=\{rid_j,cpu_j,st_j,lp_j,hp_j\}, j\in[1,n]$, where rid_j is the jth media resource's identify, cpu_j is the jth media resource's computing ability of solving the task, st_j is the start time to deal with a new task (i.e. the current workload of resource r_j), lp_j is the jth media resource's lowest price, and hp_j is the jth media resource's highest price.

Definition 3. The media resources allocation probability matrix as follows:

$$P=\begin{pmatrix} p_{11},p_{12},\ldots,p_{1n} \\ p_{21},\ p_{22},\ldots,p_{2n} \\ \cdot\quad\ \cdot\quad\ \cdot \\ p_{m1},p_{m2},\ldots,p_{mn} \end{pmatrix}.$$

where p_{ij} is the probability of resource applicant u_i submitting a task to resource r_j, and

$$0\le p_{ij}\le 1 \ \text{ and } \ \sum_{i=1}^{m} p_{ij}=1 \ \text{ and } \ \sum_{j=1}^{n} p_{ij}=1,$$

which means that the probability should be at the range of [0,1], and the total sum of each row or column should be 1.

4. The media resource allocation participants' pricing strategies

During the resources allocating, the resource allocation participants (e.g., resource applicants and resource owners) have different pricing strategies, and submit their price and requirement to the allocation agents. The purpose of allocation agents is to achieve the economic QoS and performance QoS to maximize the social benefits.

4.1. The resource applicants' pricing strategy

As described in Anthony and Jennings (2003), there are many factors which may affect the resource applicants' price, among them the number of remaining resources and average remaining