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A NEW SELECTION ALGORITHM BASED ON REPUTATION AND CONTRACT-MANAGEMENT

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ABSTRACT

In Grid, the reputation of users is the important indicator for service selection, particularly in the situation with the combination of Grid technologies and economic models. A contract-management model based on reputation evaluation and a service selection algorithm are proposed in this paper. The applied strategy facilitates the users of similar reputation to carry out transactions. The experimental results illustrate that the model is effective. It not only can improve the success rate of the users with good reputation, but also can speed up the elimination of the users with poor reputation.

Keywords: *Grid Market, Grid Architecture for Computational Economy, Reputation value, Contract-management，Structure of GMACT*

1. INTRODUCTION

For the recent year, the issue of insecurity prevails in the grid environment. Every grid participant’s random joining and exiting has brought tremendous difficulties for the grid management. Furthermore, some insincere or even malicious behaviors have seriously restricted the development of grid [1]. One solution lies in the adoption of economic approaches to establish the grid market model and recruit economic measures to restrict problems existed in its application. This is the so-called grid economy [2].

There has been an extensive discussion about grid economy in the academic circle. So far as the regulating of participants’ behavior is concerned, [3] has raised a Grid Architecture for Computational Economy (GRACE) to realize the source transaction management in the grid environment. [4~5] adopt the soft incentive way, which relates service providers’ reputation value to the quantity of service. The more service the user renders, the higher his reputation value will be. [6~7] adopt hard incentive methods, which enables service providers to obtain virtual currency and allows them to use the money for other services. In addition, [8] constructs the user’s reputation based on the payment information during the transaction and conducts the management in the manner of a middleware. [9] has proposed to add reputation calculation model in GRACE to evaluate and store grid users. Through the behavior restriction of users with a low reputation value, it could eliminate the adverse effects. [10] compares the grid resource provider (GSP) and the grid resource consumer (GSC) to seller and buyer in the merchandise trade, and proposes to employ economic factors (transaction volume and transaction time) to establish reputation value. [11~12] introduce a contract-management system into GRACE and fix down the transaction activities of both resource provider and demander in the form of a contract, in order to maximize both sides’ benefits.

Based on the contract-management [12] has proposed, this paper has added a reputation value calculation model. If a grid user boasts a larger transaction volume and longer transaction time, he has relatively higher reputation value. Therefore, it is quite possible for him to sign a contract with another user with a high reputation value and conduct resource transaction. The experiment has indicated that the proposal and algorithm in this paper are effective.

The structure of this paper is as follows. The first section is the introduction. The second section introduces the calculation model of reputation value. The third section includes the related analysis of GRACE and contract-management system. The fourth section proposes resource selection and calculation model of contract signing. The fifth

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section is about the simulation experiment and result analysis. The last is the conclusion and prospects.

2. CALCULATION MODEL OF REPUTATION VALUE

One grid user A's reputation value is defined as A's behavior calculation in this paper, written as Rep_A. This value is managed by the third party, and it varies as the user's behavior varies.

There are many participants in the grid, and they constitute a rather complicated group. Among them, some are resource users (buyers) and some are resource providers (sellers). So far as a certain user is concerned, one might be a buyer sometimes and a seller another time. Users' reputation value represents users' behavior and its evaluation rests on user information.

User information is the information of participation in the grid, which contains user identification, registration time of user in the grid, deposit account, transaction times, transaction success rate, and etc. It is generally believed that the longer the user in the grid, the more the transaction times and the higher success rate, the higher reputation is.

During the resource transaction, if user *A* uses a service of *B*, it indicates that *B* satisfies SLA (Service Level Agreement is a formal contract between service provider and consumer[13]). Then, *A* and *B* will mutually write a record S_{AB} of successful implementation for each other, or the default party will be given a failure record F_{AB} by the other side. In this way, every participant will have a record vector to keep track of the transaction situation one is involved in. If we set tim_B as the time *B* registers in Grid *Z* and TIM_Z as the time to establish Grid *Z*, then, Rep_A can be represented as:

$$Rep_A = \alpha \cdot \frac{\sum_i S^i_{AB}}{\sum_i S^i_{AB} + \sum_i F^i_{AB}} + \beta \cdot \frac{tim_B}{TIM_Z}$$
$$(0 \le \alpha ,\ \beta \le 1,\ \ \alpha + \beta = 1)$$

Among them, α and β represent weight; *i* is the serial number of transaction, demonstrating the user's *i*th transaction. The first item represents the success rate of transaction between *A* and *B*. The higher the calculation value of this formula is, the higher the user's reputation is.

If a grid participant does not transact according to SLA, it means the tearing up of the contract. It will be hard to establish a high reputation. Besides, how long a user exists in the grid also constitutes a parameter for the calculation of reputation value. The longer the user is in the grid, the more impossible it is to tear up the contract. Based on this calculation model, *A*'s reputation value is [0,1]. The higher it is, the higher reputation value will be.

3. CONTRACT-MANAGEMENT AND REPUTATION MANAGEMENT BASED ON GRACE

3.1 GRACE Mechanism

GRACE that Buyya has proposed is a preferable plan to realize the source transaction in the grid economic environment. Its core modules are mainly GRB (Grid Resource Broker), GSC (Grid Service Consumers) and GSP (Grid Service Providers). Grid Resource Broker is the intermediary mechanism between the resource buyer and seller. GSC carries out resource discovery, resource selection, resource binding, and etc. through GRB. It also conducts grid resource application and data processing, and returns the results to users. Trade Server of GRD has a bulletin board to release information resources (resource attribute, using price, etc.) for GSC to select. Figure 1 shows the diagrammatic sketch of the transaction between resource broker of GSC and GSP in GRACE.

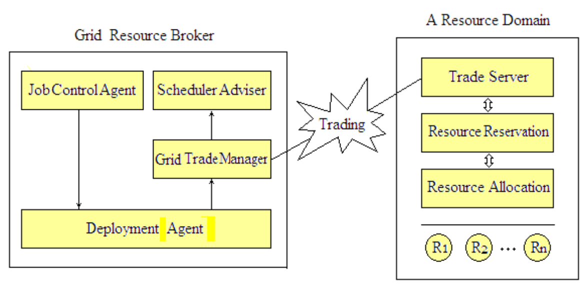

Figure 1. The core modules of GRACE

In this figure, Grid Trade Manager represents the buyer and takes the responsibility to negotiate with seller's resource domain to attain the lowest cost of resource use.

3.2 A new Management Structure

[12] adds a third party of entrust mechanism between the buyer and the seller to be responsible for both party's contract management. A new system structure is formed, named GMACT (Grid Market Architecture Based on Contract-management and Third-party Depository Service). This paper has added reputation management module based on it, as shown in figure 2.

The contract manager (CM) mechanism in this figure enables the buyer and the seller to sign contract through the resource quality and price

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information GRACE has provided. Payment Manager (PM) mechanism manages users' marginal deposit and is responsible for the contract payment and penalty of the transaction. In Payment Manager (PM), Third-party Depository Service (TDS) is set. Every user sets an account in PM and carries out capital allocation through TDS mechanism. The buyer cannot directly pay the seller and the seller cannot directly pay penalty to the buyer. All the capital transfer should be accomplished by PM. It implies that every user needs different amount of deposit for the operation of TDS. If the contract is successively completed, TDS will transfer buyer's accounts payable to the seller's account, as what is prescribed in the contract. Reversely, penalty will be paid according to the contract. This kind of payment mechanism is equal to both the buyer and the seller. Any side is to be punished upon contract violation, and it will be realized through capital transfer.

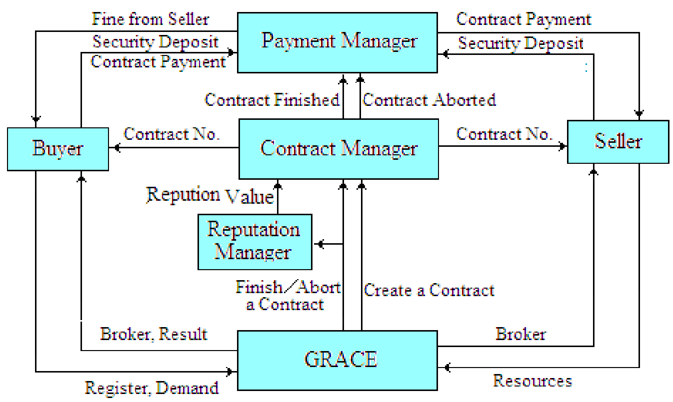

Figure 2. Structure of GMACT

3.3 Structure of Reputation Evaluation Model

Figure 3 describes the model structure, including 4 parts: information collection, reputation calculation, reputation storage and reputation report.

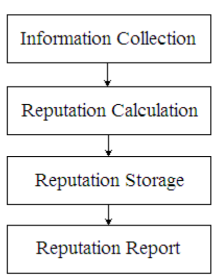

Figure 3. Structure Of Reputation Evaluation Model

The component of information collection is responsible for collecting grid information, mainly including resource service information the seller provides, registration time of grid user, record of resource transaction, etc. All of these are provide by information server or other servers in the grid structure.

The component of reputation calculation is responsible for calculating grid participants' reputation value based on reputation calculation model and information the component of information collection has provided.

The component of reputation storage is responsible for storing the grid users' reputation value. The component of reputation report could report users' reputation value through a public server. This component could adopt the API method, which enables the system to inquire about every participant's reputation.

4. CONTRACT SIGNING CALCULATION BASED ON REPUTATION

Users' reputation is divided into three grades, i.e. high, medium and low grade. A reputation value higher than 0.75 is graded high and that lower than 0.35 is graded low. Others boast a medium grade. Every newly registered grid user is given an initial reputation value of 0.5. The strategy this paper has adopted is to let participants of the same level to conduct the transaction, i.e. transaction between buyers and sellers with high reputation, as well as the transaction between buyers and sellers with low reputation. The aim is to not only enable the transaction between users with good reputation to improve the success rate, but also to speed up users with poor reputation to withdraw from the grid for their irresponsibility in the transactions.

Set grid Z requires the buyer to submit the following tasks: Length of the task, Deadline and maximum Payment, Seller in grid Z could provide

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grid resources like the quantity of machines, element quantity of processor and price. Based on this, the system could calculate the execution time $Time_j$ and operation cost C_j of a buyer's task on resource *j*.

The guideline for this calculation is as follows. For a buyer, if he boasts enough deposit (⩾N) and his reputation value Rep_{buyer} is not low (> ε), he will be served by the system. The system will investigate every seller's deposit and reputation value in the seller set (SEL). If the same standard is achieved, the system will put the sellers that could meet the buyers' demand (maximum time and cost) into the set CT that grid service has selected. Then, the system selects two users of a similar reputation to sign the contract. The core of the calculation of contract signing is as follows:

Step1: If(Deposit($buyer$)<N)Then Goto 8;
Step2: Calculate(Rep_{buyer});
Step3: If (Rep_{buyer}< ε) Then Goto 8;
Step4: CT:=NULL;
Step5: For each $j \in$ SEL Do
  Step5-1: If(Deposit(j)<N) Then exit;
  Step5-2: Calculate(Rep_j);
  Step5-3: If (Rep_j< ε) Then exit;
  Step5-4: Compute $Time_j$ and C_j;
  Step5-5: If($Time_j \leqslant Deadline_c$ & $C_j \leqslant$Tmax) Then
    Put j into CT;
Step6: $seller := \min_{i \in CT}\{|Rep_{buyer}-Rep_i|\}$;
Step7: Create_Contract($buyer$, $seller$);
Step8: End.

The function Deposit (*i*) in this calculation is used to inquire about user *i*'s deposit. The function Calculate (*i*) calculates user *i*'s reputation value according to the function in section 2.

5. EXPERIMENTS

We have adopted GridSim to carry out this experiment. This experiment platform has provided a function library to simulate various types of service in the grid environment. Tasks received in the grid are encapsulated into Gridlet. GridStatistics() of GridSim is used to collect experimental data.

In our experimental environment, there are three types of resources that resource seller has provided. The operational speed of PE of every resource (Processing Element) is equally 377 MIPS (Million Instructions Per Second). The details of parameters are shown in Table 1.

Table 1. The Type Of Resources

ID	Type	Mechine Number	PE Number	Price(G$)
1	Intel Pentium	2	4	2
2	Sun Solaris	4	16	4
3	Alpha Server	4	16	5

To better reflect the dynamic characteristics of the grid, this paper allows randomly choosing any type from the three of the Gridlet that the user provides. Length, deadline and payment of various types of Gridlet are set according to values in Table 2.

Table 2. The Setting Of Tasks

ID	Length (MI)	Deadline(sec)	Payment(G$)
1	2,400	10	20
2	4,500	20	25
3	6,000	40	30

The total number of Grid users (i.e. resource buyers) specified in this experiment is 30. Among them, 10 users boast relatively low reputation value of 35%. Other 10 users boast medium reputation value of 50%. The remaining 10 users boast a high reputation value that could reach 75%. The initial reputation value that the system has set for the 30 users is 0.5, which is taken as the default value before the transaction.

We set ε as 0.1 and N as the infinite. Figure 4 has given the curve of users' reputation value after 20 transactions.

It could be drawn from this curve that 1) whatever the initial value is set at, uses with a high integrity boasts a relatively high reputation value. 2) Those users with a reputation of 50%, their reputation value does not maintain about 0.5, but descend. Based on the transaction principle between users of similar reputation value, the success rate between users with a reputation value of 50% is only 25%. In other words, an average of 4 transactions between the two sides could bring them a success recordS_{AB}, while they respectively obtain 1.5 failure records F_{AB}. 3) Similarly, users with a reputation value of 35%could not maintain their reputation value at about 0.35. Instead, it decline dramatically. Based on the calculation in this paper, the transaction right is lost when the reputation value declines below ε . It could be seen that from the 12th transaction, the curve is in a flat state, which proves that this part of users have already lost their transaction qualification.

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The transaction principle between users of similar reputation value this paper has proposed differs greatly from the contract-management with no reputation value. It could effectively prohibit users with a low reputation to transact with users with a high reputation value, which enables the transaction between buyers and sellers with high reputation, as well as the transaction between buyers and sellers with low reputation. The former could obviously raise the success rate of transaction, and the latter will result in their loss of transaction qualification due to their dramatically declining reputation value, which will not greatly affect the success rate of the transaction. Figure 5 has given the comparison of these two methods.

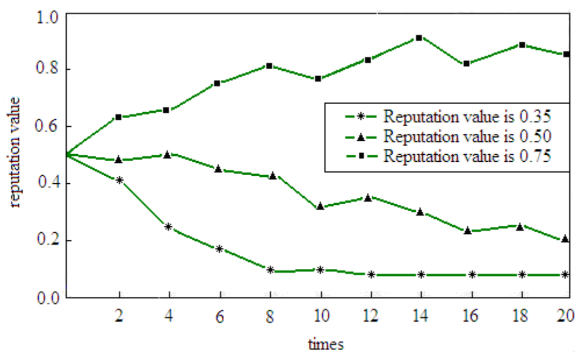

Figure 4. Curve Of Reputation Value

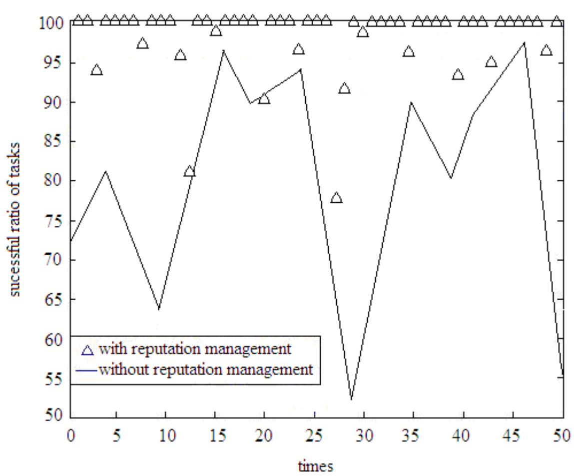

Figure 5. Comparison Of Two Management Methods

From this figure, it could be seen that the success rate of reputation value management gradually increases as the times of transaction increase. This is due to undesirable users' loss of transaction qualification after several times of transactions.

6. CONCLUSION AND FUTURE WORK

This paper proposes a new grid transaction management model, which integrates the calculation of users' reputation value into contract management. Based on it, this paper has given a relatively practical calculation of contract management in resource transaction. The simulation experiment has proved that this model and its corresponding calculation help to increase the success rate of resource transaction and improve the interests of both the buyer and the seller. It is effective for the safety of the grid and the prevention of fraud in the grid.

For the future, we will further improve the evaluation system of users' reputation value to estimate the grid participants' reputation more accurately.

REFRENCES:

[1] Ian Foster, C.Kesselman, "The Globus project: a status report", *Proceedings of the 7th Heterogeneous Computing Workshop [C]. Washington,IEEE Computer Society*,1997,4-18.

[2] Ian Foster, C.Kesselman, "The Grid:Blueprint for a New Computing Infrastructure(2nd Edition)[M] ",*Morgan Kaufmann,San Fransisco,CA*,2004.

[3] R. Buyya, R. Abramson, J. Giddy and H. Stockinger, "Economic models for resource management and scheduling in Grid computing", *Concurrency and Computation: Practice and Experience Concurrency Computat: Pract. Exper*. 2002; 14:1507–1542 (DOI: 10.1002/cpe.690)

[4] M. Feldman, K. Lai and I. Stoica, " Robust incentive techniques for peer-to-peer networks", *Proceedings of the 5th ACM Conference on Electronic Commerce, New York*, 2004, pp.102-111.

[5] Y. Kwok, S, Song and K. Hwang, "Selfish grid computing: Game-Theoretic modeling and NAS performance results", *Proceeding of the 15th International Symposium on Cluster Computing and Grid, Washington*, 2005, pp. 1143-1150.

[6] B. Chun, J. Ng and D. Parkes, "Computational resource exchanges for distributed resource allocation", *Technical Report, Harvard University*, 2004.

[7] R. Zhou and K. Hwang, " PowerTrust: A Robust and Scalable Reputation System for Trusted Peer-to-Peer Computing", *IEEE Transaction on Parallel and Distributed Systems*, Vol 18, No 5, May, 2007, pp.460-473.

[8] A. Barmouta and R. Buyya, "GridBank: A Grid Accounting Services Architecture (GASA) Distributed Systems Sharing and Integration",

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Proceedings of the 17th Annual International Parallel and Distributed Processing Symposium, USA, 2003, pp.245-252.

[9] J. Magowan, “Extreme blue grid accounting project (Grid service accounting extensions–GSAX) ”, *GGF Resource Usage Service Working Group*, 2003.

[10] R. Buyya, D. Abramson and S. Venugopal, “The Grid Economy”, *Proceedings of the IEEE, Vol.93, No.3, March*, 2005, pp.698-714.

[11] Xiaohang Wang, Yuebin Xu, Guanfeng Liu, Zhenkuan Pan and Junyan Wang . “A New QoS guaranteed Mechanism Based on SLA in Grid Market”. *Proceedings of the Pacific-Asia Conference on Circuits, Communications and System*,2009, pp.197-201.

[12] Lingyu Xu,Yinghua Sun, “Research on Economic models With Contract Management Mechanism in Grid”, *Proceedings of the Pacific-Asia Conference on Circuits, Communications and System*, 2010, p197-201.

[13] Y. Wang and K. Lin, “Reputation-Oriented Trustworthy Computing in E-Commerce Environments”, *IEEE Internet Computing, July/August*, 2008, pp.55-59.