Reputation Based Resource Selection in Grid Computing

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Abstract - Grid is a kind of distributed and parallel computing, mainly it is used to solve complex problems such as weather forecasting, earth observation and financial modeling etc. Grid differs from normal distributed computing by the way of resource sharing and monitoring. Resource selection and management is an important task of a grid computing system. The security is a major problem in grid, due to its heterogeneous and dynamic nature. As traditional network security cannot meets the security requirements of the grid due to its heterogeneous environment. Identifying honest node from the large group of resources requires dynamic evaluation model. Hence we propose the reputation based trust, which is to consider an important factor for resource selection. In this paper, reputation based trust model is proposed to select an appropriate resource for solving a complex task. The selections of the resources are based on three parameters like direct trust, indirect trust and network efficiency of the resource. The performance of this proposed model is studied in grid environment, it is found to be better utilization of grid resources.

Keywords- grid, trust management, resource, selection, reputation

I. INTRODUCTION

Grid computing has emerged as new field, it enables the aggregation of resources such as computers, storage devices, printers and other devices in the different administrative domains to solve a large problem like weather forecasting and medical analysis of data with the help of internet technology. Today’s need of industries and business problems require huge number of resources to analyze it. The grid is one such technology providing solution to the industry expectation by the way of resource sharing and allocation. Based on the user’s needs it provides resources at minimum overhead and it forms virtual organization to solve a particular task. Interaction between the VOs requires high level of security than normal authentication, encryption and authorization. The selection of the resources from the wide area leads to identifying good resources from the huge pool. Normal security procedures do not meet the user satisfaction level.

To address these problems, we propose a new reputation based trust model that provides continuous evaluation and updating the trust value of the resources. The trust value of the resource is dynamic because it changes with its behavior. Trust is a belief or honesty of a person or an agent. The reputation is an important part in evaluating trust value of the resources. It collects the opinion about a particular resource from the group of users. The trust value varies with the context like printing, storage element and bandwidth. Trust based decision making for resources selection is more effective than normal way of scheduling. Basically trust is classified as identity trust and behavior trust. Identity trust is not flexible and it is static one where as behavior trust is dynamic [4].

II. DEFINITION OF TRUST AND REPUTATION

There is no standard technique for trust calculation, the parameters taken for trust is varying with the applications. Trust is defined as [3] Trust is the firm belief in the competence of an entity to act as expected such that the firm belief is not a fixed value associated with the entity but rather it is subject to the entity’s behavior and applies only within a specific context at a given time. The trust takes many values such as very trustworthy to very untrustworthy. When taking trust based decisions reputation is considered. The definition of reputation
is given as: The reputation of an entity is an expectation of its behavior based on other entities’ observations about the entity’s past behavior at a given time.

In our work trust is calculated by using the parameters direct trust, reputation or indirect trust and Network efficiency. Direct trust is obtained from the direct contact between the resources; it also gets more weightage than indirect trust. The indirect trust is calculated by getting feedbacks from the group of resources who had direct contact with the resources in the domain. The Network efficiency is calculated by using an algorithm. This paper is organized as follows; related work is briefed in section III. Trust model and trust calculation is presented in section IV. The result is discussed in section V. Section VI concludes the work with suggestion of future work.

III. RELATED WORK
Researchers propose various ideas for calculating trust values using reputation. Trust management system proposed by Mohammed Hanif Duard and Yuanda Cao was concentrated on the various parameters such as direct trust, computational trust, execution trust, code trust etc. They discussed the life cycle to calculate and update the value of the trust. The trust value varies with the value like ignorance, completely untrustworthy, partially trustworthy and completely trustworthy. In their work they are not mentioning the lifetime of the trust value [5].

Frag Azzadin and Maheswaran developed a trust management system; they discussed definition of trust and reputation methods. The grid domain is divided into two domains such as client domain and resource domain; they also proposed integration of trust management model into grid metascheduler. The limitation is computational scalability because they consider all the domains in the network, as the number of domain increases the computation overhead is also increased [3].

Li.wen, Ping Lingdi, Lu Kuijun and chen Xiaoping proposed a new trust model that considers both direct trust and the indirect trust, the more importance is given to direct trust. They mentioned the characteristics of direct trust as rise-lowly, decline-quickly, which is used to prevent the malicious behavior of the model. The disadvantage is, the initial trust value is not mentioned in their work. [4].

Dynamic grid model based on recommendation credibility was proposed by wang meng hongxia xia and Huazhu song. They used threshold value to filter out the low credibility nodes from participating trust evaluation process [6].

V.Vijayakumar and R.S.D.Wahida Banu [8] have proposed a method for resource selection in grid environment using trust and reputation. The trust value of each entity is calculated based on self-protection capability and reputation weightage the values are represented in reputation matrix.

Abdul Rahman and Hailes [9] proposed a model for computing the trust for an agent in a specific context based on the behaviors and recommendations. They have given various trust values such as very trustworthy, trustworthy, untrustworthy and very untrustworthy.. This paper has proposed a method for calculating and combining recommendations and updating the trust value. The disadvantage is the storage of all the history of past experiences and received recommendations. On a system with a lot of participants and frequent transactions, requires a huge amount of storage.

The above said model does not consider the network efficiency of the resource. In this model the calculation of trust is focused on network efficiency of the resource, direct trust and reputation.

IV. TRUST MODEL
Globus is an open source to build grid infrastructure. Gird environment is organized as a number of virtual organization formed on their user needs. The resources in the vos are joined together to solve a common problem, once the task is over the vo is destroyed. Each node in the domain store the feedback
values of the resource providers after completion of each job. The values are stored in the individual trust table and the values are changing with the context like storage, computation and printing. The trust model is given in figure 4.1. Metascheduler is a software bundle used for decision making based on the user’s needs. Suppose a resource in vo wants to communicate with other resources, it must submit the job to the metascheduler the metascheduler calls the trust management model to identify the resources with higher trust value. Separate web services are used for collecting the feedback from other resources in the domain. Using the feedback values the trust value is calculated. The new trust value is compared with the trust value stored in the individual trust table if the difference is greater than .5 the new value is updated in the database.

\[ T_e = \alpha \times DT(X_i, X_j, C, t) + \beta \times IDT(X_i, X_j, C, t) + 0.5 \times (NE) \]  

Where \( \alpha, \beta \) are weights given to trust factors DT and IDT

**Computation of Direct Trust**

Direct trust value is a feedback value getting contact of the two resources which is stored in the individual trust table of a node. Each context has separate value for trust and recommender factor. The weightage of the trust value is high if it interacts recently\[3\]. Otherwise the new trust value is calculated, and it is updated in the individual trust table. The equation for direct trust is given as

\[ DT(X_i, X_j, C, t) = ITT(X_i, X_j, C, t) \times \gamma (t - t_{ij}) \]  

Where ITT is individual trust table, \( \gamma (t - t_{ij}) \) is decay function. The decay function is important for trust value calculation because it varies with the time. If it calculates recently the trust value is taken as it is in the database otherwise the new value is calculated. Hence, the decay function is added in the equation.

**Computation of Indirect Trust**

Indirect trust value is important for trust calculation. Direct trust is an individual opinion, taken by an single node. It does not provide good results all the times. Hence the indirect trust is taken for the calculation. The recommendation is accepted those who are having higher recommender factor. The recommender value is assigned by the agent. The mathematical equation is given as:

\[ IDT(X_i, X_j, C, t) = \sum_{k=1}^{n} ITT(X_k, X_j) \times R(X_i, X_k) \times \gamma (t - t_{ij}) \]  

Where ITT is individual trust table, \( \gamma (t - t_{ij}) \) is decay function. The decay function is important for trust value calculation because it varies with the time. If it calculates recently the trust value is taken as it is in the database otherwise the new value is calculated. Hence, the decay function is added in the equation.

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Where ITT is individual trust table, \( R \) is recommendation factor

Depends upon the transaction the recommender factor gets the value from 0 to 1 if \( X_i \) and \( X_j \) is unknown the value is high and a lower value if \( X_i \) and \( X_j \) are known or business partners. The importance of the recommender trust factor \( R \) is used to prevent cheating via collusions among a group of VOs.
Computation of Individual Trust Table

Each node in the VO maintains an individual trust table. The structure of the table is shown in table (1). The table of Xi has the value of trust and recommender factor values for other resources with the specific context are stored. The trust and recommender factor value are changing with the context like printing, storage and computations.

**TABLE 1. Individual Trust Table**

<table>
<thead>
<tr>
<th>Context</th>
<th>Site X_1</th>
<th>X_2</th>
<th>………</th>
<th>X_n</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_1</td>
<td>T</td>
<td>R</td>
<td>T</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>C_2</td>
<td>T</td>
<td>R</td>
<td>T</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>21</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>C_n</td>
<td>T</td>
<td>R</td>
<td>T</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>m</td>
<td>m</td>
<td>n</td>
<td>n</td>
</tr>
</tbody>
</table>

Update the ITT is necessary when the difference between the existing trust value and calculated trust value is high or after n transactions.

**Computation of Network efficiency**

The network efficiency of the domain is calculated by the factor of data transfer speed and the confederation based on the relative speeds of all the other domains in the grid. It is in the scale of 0 to 100. Depends upon the location and time taken for the data transfer, the domain gets the value of 0 to 100. The domain gets the value 100 if it takes longest time. Thus, the network efficiency is inversely proportional to the latency time. The network efficiency is calculated using the following algorithm which is used in the proposed model:

- Domain D_i send an ‘Hello’ message to all domains and note down the time of broadcast of each message.
- When a domain receives an reply ‘Hello’ message, it calculates the current processor load on the domain and sends it back as a ‘Status’ message back to domain S_m.

Based on the message timestamps the domain D_i calculates the round trip latency (RTL). The network efficiency (NE) is calculated as follows:

\[
NE = 1 - \frac{Lat_i}{Lat_{max}}
\]

Where:

- \(Lat_i = \) Round trip latency of the domain
- \(Lat_{max} = \) Maximum of the all domains in the grid

**V. RESULT AND DISCUSSION**

To study the performance of the given model by aggregating the different trust parameters like direct trust, indirect trust and network efficiency. The value for \(\alpha = 0.3\), and \(\beta = 0.2\) is taken for calculation. Compare the three evaluation strategies which are improved one by one. The results are illustrated in the figure 5.1. The graph is plotted between time in y axis and number of resources in x axis; it shows the job completion time of three strategies.

**Time analysis**

*Strategy 1* Trust value depends only on direct trust without considering indirect and network efficiency. The more weightage is given to direct contact done by the resource.

*Strategy 2* This strategy improves strategy 1. The final trust value is combination of direct trust and indirect trust. Sometimes individual opinion is not a perfect one, hence indirect trust is considered. It is an opinion given by group of persons.

*Strategy 3* This strategy improves the strategies 1 and 2, taking direct, indirect and network efficiency for calculation.
The network efficiency of the resource is dynamic so, more weightage is give to network efficiency. From this figure, strategy 3 is better than the rest of the two.

VI. CONCLUSION AND FUTURE WORK

Trust is an important factor in grid for selecting resources in the wide area. This paper develops a trust model based on the user feedback about an entity and network efficiency of the current resource. Which is an effective model to apply in the grid like environment? The performance of the model is studied with the varies of trust factors. And the results proved that recommendation based trust model is appropriate one. For future work we are considering the load of the resource is one of the trust parameter in the proposed work.

REFERENCES


