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Performance Evaluation of Grid Computing in Trust Related Environment

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***Abstract*— Grid computing refers to the harnessing of computer systems to collaboratively solve a problem requiring a lot of Central Processing Unit (CPU) or data storage and processing far more than one system to handle. Grids are formed with resources owned by many organizations across borders and thus are not dedicated to single user or organization leading to security and trust issues. Various scheduling algorithms with and without security mechanisms have been proposed. In this paper it is proposed to evaluate the performance of some of the popular grid scheduling algorithms along with trust based scheduling algorithms.**

***Keywords*— Grid computing, Scheduling algorithms, Trust, Reputation.**

I. INTRODUCTION

Grid computing can be simply stated as "Distributed computing" taken to the next evolutionary level. The aim of the grid is to create the illusion of a large and powerful self managing virtual computer using a large collection of networked systems sharing their resources[1]. Figure 1 shows the architecture of the grid computing which identifies the system components such as Grid Fabric, Grid Applications and the middle ware which contains the Collective, Resource and Connectivity. This shows the relation between the Grid Protocol and the Internal Protocol Architecture.

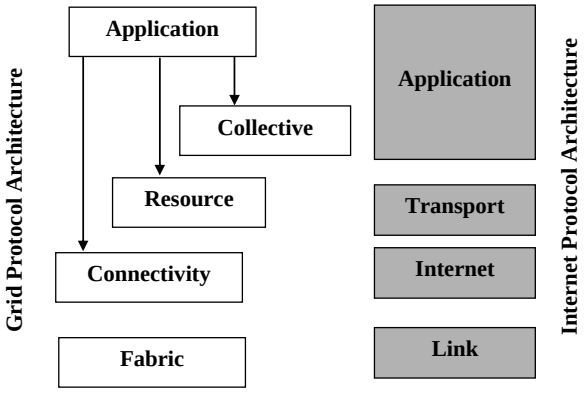


Figure 1 : Architecture of a grid

Grid Fabric consists of all the globally distributed resources that are accessible from anywhere on the Internet. The Fabric Layer includes the local protocols and interfaces for accessing and managing the local resources. Application layer is the highest layer of the structure that grid users "see" and interact with**.** The application layer is often called "Service ware". Grid applications are typically developed using grid-enabled languages and interfaces and brokering and scheduling services provided by grid tools or user level middleware. Applications may be in available Science, Engineering, Business, Finance and more. Grid portals offer Web-enabled application services, where the users can submit and collect results for their jobs that remain as remote resources through the Web.

Though used primarily in technical and scientific projects, grid computing is gaining popularity in the corporate world because of its cost-savings potential. The total time to delivery includes the time for program execution, batch queue waiting and transfer of executable and input/output data to and from the resource. The resource allocation and co ordination is ensured by the resource broker. Scheduling on grid computing not only aims to find an optimal resource which improves the overall system performance but also utilizes the existing resources more efficiently[2]. There are four main resource scheduling strategies: centralized approach, distributed approach, hierarchical approach and multi-agent scheduling. Various scheduling mechanisms have been proposed in the literature with most of the existing mechanism based on efficient allocation of jobs. Various security mechanisms with standards have been proposed in literature with emphasis on authentication, authorization and repudiation. Security implementation increases the total time for completion of a job and this can affect the performance of a grid especially when running a large number of small tasks. An option to overcome this could be implementation of trust among the resources wherein resources are selected based on the trust value the resource has among its peer in the network[3].

Trust is defined as the quantified belief of a trust or with respect to the competence, honesty, security and dependability of a trustee within a specified context. Detailed trust

characteristics are investigated by six properties. Trust cannot be measured objectively but is assumed to be a subjective degree of belief, which extends from complete distrust to complete trust. An action based on trust is taken despite uncertainty[4]. A decision based on trust is related to the trustee's prior experiences and knowledge, which is the reputation of the trustee. Change of trust can dynamically leap without monotonic increase or decrease. Trust is not transitive, so A who trusts B may not trust C who is trusted by B[5].

It is seen that trust behaviour does not follow a rational choice theory as other phenomena do. Social scientists have classified trust into three types. First, there is an interpersonal type of trust. This type is constructed through interactions between agents[6]. The second type of trust is a system trust. The system being an agent becomes a kind of certification for the trustworthiness of the agent and determines the level of trust for the agent. The third type is called dispositional trust. Contrary to the other two types of trust, the dispositional trust of an agent is inherent and does not change if situation changes. Trust is a combination of those three beliefs. Each of the three beliefs is reflected respectively as a direct, indirect and transitive aspect to trust[7,8,9].

In this paper it is proposed to investigate the time performance of executing 300 tasks in a grid with different types of schedulers. Section II describes the experimental setup and section III concludes this paper with result and discussion.

II. LITERATURE REVIEW

A formal definition of both trust and reputation was presented and a model for incorporating trust into Grid systems was discussed by Farag Azzedin and Muthucumaru Maheswaran (2002)[10]. An overview of an open source Grid toolkit known as Gridbus, the architecture of which is fundamentally driven by the requirements of Grid economy was carried out by Buyya and Venugopal (2004)[11].

A general-purpose resource selection framework was put forth by Chuang Liu et al (2002)[12]. They have defined a resource selection service for positioning Grid resources that confirm to application requirements and evaluated them on basis of specified performance model and mapping strategies and returned an appropriate collection of resources, if any where present.

A trust model used to compute and compare the trustworthiness of entities in the same autonomous and different domains was proposed by Baolin Ma et al (2006)[13]. This model offers various methods to handle the problems of users and related resources belonging to the identical or diverse domains.

Zhiguo Shi et al (2007)[14] described a novel anonymous coordination, authentication scenario which is capable of providing efficient and reliable anonymous identity authentication and remote platform attestation for Grid computing systems. Vijayakumar et al. [17] proposed a trust model by considering both trust and reputation with the user's feedback and also the other entities feedback in providing the secured resources for the users to submit their job in the grid environment.

III. EXPERIMENTAL SETUP

Simgrid framework was used to implement a grid network. The network designed has a maximum of eight hops among routers. Three scenarios were considered namely:

- Random policy
- Round Robin policy and
- Trust based policy

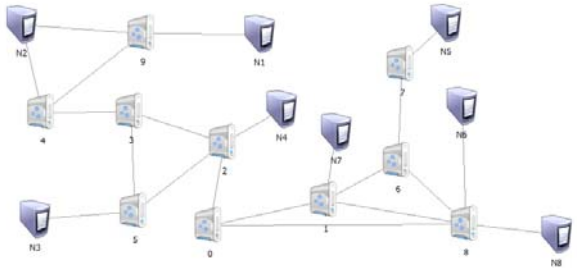


Figure 2. Test bed used to test the trust based system

The block diagram of the proposed simulation environment is shown in figure 2. Eight resources with high computational power located at different geographic locations connected using high speed switches are used. Some of the switches are connected in star topology.

In random scheduling resources are selected randomly and allocated jobs. Once the resource completes the given task, it may be selected again and given the next task. Random scheduling is popular among public grid systems including SETI@home[15] and Condor[16].

In round robin grid scheduling algorithm the systems selects the available resources and divides the task into the total number of resources and allocates the task in a sequential pattern till the last resource is reached. Once the last resource is reached, the next task is scheduled to the first resource. This process continues till all the resources all allocated in the grid system.

The trust based scheduling policy is based on

- IDS Capabilities
- Anti-virus Capabilities
- Firewall Capabilities
- Authentication Mechanism
- Secured File Storage Capabilities
- Interoperability
- Secured Job Execution
- Authorization Mechanism

Each parameter used is associated with a weight and the trust of the given resource is computed by

$$T = \sum_{i=1}^{n} W(i) * A(i)$$

where n is the total number of factors,
W is the weightage and
$A(i)$ is the value of the factor.

The resources are ranked after measuring their individual T value and jobs are scheduled based on the cut off rank.

The time taken to execute 300 tasks of uniform size of 5M and communication size of 0.1M for various scheduling algorithms is shown in figure 3, figure 4 and figure 5. Table I lists the time taken to execute the task.

TABLE I
TIME TO COMPLETE TASK

Scheduling algorithm	Time taken
Random policy	23.26 sec
Round Robin	20.30 sec
Proposed Trust based algorithm	27.02 sec

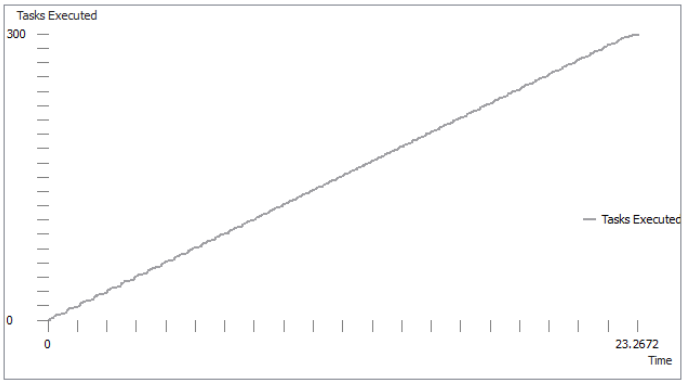


Figure 3. The computational time to execute 300 jobs with random scheduling.

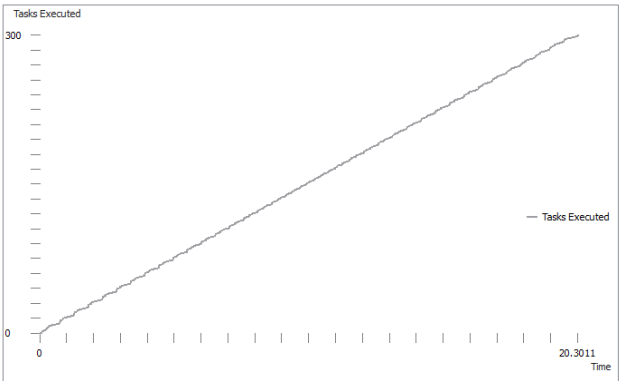


Figure 4. The computational time to execute 300 jobs with round robin scheduling.

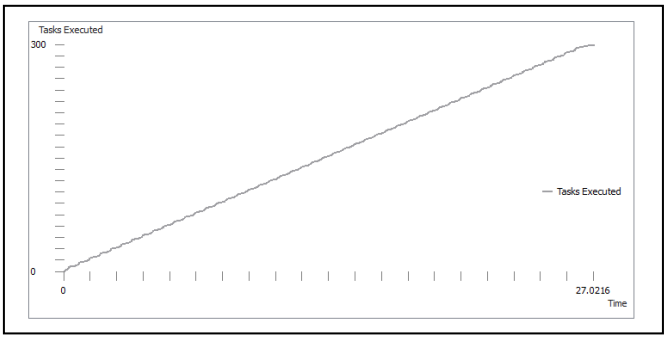
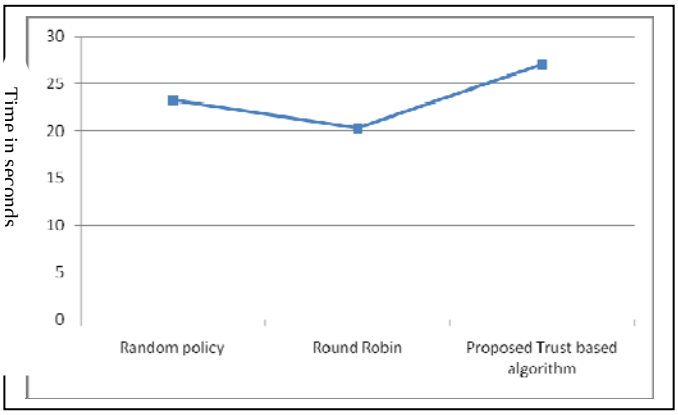


Figure 5. The computational time to execute 300 jobs with resource selection using trust.

It is seen from the experimental setup that the performance variation between round robin scheduling algorithm and random scheduling algorithm is within 12.72%. Whereas the performance degradation due to trust based selection of resources and random scheduling is almost 24.87% as shown in figure 6.



IV. CONCLUSION

In this paper it was proposed to study the performance of different scheduling algorithms and compare the timing performance with a simple trust based scheduling policy. For our study we consider a large number of small tasks assigned to the grid. The results obtained show that implementation of trust increases the total time by almost 25% which is relatively high. The goal of grid systems is to reduce the computation time without compromising security. Further work need to be done in the area of improving the timing and proposing a scheduling algorithms which emphasizes on trust and timing.

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