A REVIEW: COMPARISON OF COOPERATIVE SCHEDULING MECHANISMS IN P2P COMPUTING SYSTEM

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Abstract

Grid computing is an upcoming technology which combines the resources from different locations to solve large tasks.Peer to peer (P2P) computing is a kind of computing in which large number of computers are connected through internet and their resources are utilized to solve large problems or tasks. It uses the idle cycles of all the computers connected to the network for solving huge parallel applications. An efficient scheduling mechanism is the most important challenge taken by the peer to peer network for utilizing the resources properly and also to assign the tasks to the resources effectively. Cooperation is very important because users in P2P networks tend to use the resources without providing any profit in response. In this paper, a comparative study has been done about several cooperative scheduling mechanisms that show their efficiency of improving the poor resource utilization and scalability.

Keywords: Grid computing; P2P computing; cooperative scheduling; resource utilization

I. Introduction

Grid computing consists of geographically distributed heterogeneous resources. Grid system has a dynamic nature in which resources may join and leave the system at any time. Because of this dynamic nature of Grid the system face the difficulty to schedule resources which results in poor resource utilization and its management. The scheduling is the process of allocating jobs to available resources. In order to perform proper scheduling of jobs to the resources several techniques has been developed but still it is impossible to achieve proper resource utilization. When resources are allocated to jobs, resources with good performance may get assigned to jobs thus overloading the resource and reducing the proper utilization of resources of the system.

P2P computing systems uses the CPU idle cycles of computers connected through Internet. They use the resources to execute largeparallel distributed applications. Such systems require an efficient scheduling mechanism so that the tasks can be assigned to the heterogeneous computing resources. However, since scheduling mechanisms in decentralized environments require long processing times, the centralized scheduling methods seems to be inefficient. This is because they may cause bottleneck and a single point of failure.

The development of incentive techniques is necessary to bring cooperation and resource sharing among peers to improve system performance. Cooperation is appreciated because users in P2P networks use maximum resources they get but offer only less number of resources. A two-levelscheduler mechanism is used for distributing parallel applications in P2P computing systems in an efficient way.

This paper is organized as follows. In Section II we do the discussion onthe key concepts in this paper. InSectionIIIwe present the comparative study. In Section IVwe do the discussion on Cooperative scheduling mechanism. In Section V we perform the comparison of various scheduling mechanism. We conclude in Section VI.

II. Key Concepts

A. Grid computing

Grid computing is a term referring to combining various resources together which is widely dispersed for executing large tasks. It provides mechanisms that help to use and access large number of heterogeneous resources. A grid system is said to be *dynamic* because the resources and tasks changes rapidly. The grid is *heterogeneous*because various kinds of resources and tasks which are widely distributed are gathered together

from different sources to solve a common goal. The grid system provides the user the capabilities with*large scale*, i.e. the system should be capable to collect large number of resources and tasks and provide the users a secure way to access them.

B. Peer-to-Peer computing

Peer-to-Peer (P2P) computing is widely used as a distributed paradigm for developing applications, ranging from large scale scientific applications to small ad hoc information sharing, by combining the resources from various sources to solve tasks. However, the heterogeneous and dynamic nature of the peers across various domainsbrings the challenge for resource sharing in the grid environment.

However, resource management in these environments is a complex one. These systems need effective mechanism for decent resource sharing, get adapted to changing dynamic nature, preventing from various internet attacks from participating peers, and coordination of the different policies, different cost models and varying loads in different peers.

C. Cooperative scheduling

Cooperative Scheduling is where processors share information between them in making the resource allocation decision. This defines that how independent the process are so that they can itself decide how to use their own resources and how to take decisions regarding them. In the cooperative situation all processors works with its own scheduling task, but they all work together to achieve a goal of better efficiency. But in the non-cooperative, the processors act as independent entities and make decisions regarding their resources without affecting the rest of the system.

D. Resource utilization

Resource utilization does the balancing of the load efficiently.A distributed system may have any number of processes unexpectedly demanding more processing power. Once if the algorithm is implemented successfully the resources can be valued and moved to the processors with fewer loads more efficiently.

III.Comparative Study

This section includes a study on various cooperative scheduling mechanisms in improving scalability and the system performance of the peer to peer systems.The mechanisms assume that 10,000 workers are randomly distributed among 50 managers. It is also assumed that maximum of 400 peers can be distributed per area. The peers are also supposed to be mono-task in nature.

A. Cooperative and decentralized workflow scheduling in global grids

Cooperative and decentralized workflow scheduling in dynamic and distributed grid environment [4], was developed to overcome the lack of cooperation mechanism that can lead to inefficient scheduling across distributed resources and also inefficient resource utilization.

The mechanism uses distributed hash table based d-dimensional logical index space. The participants in the system work together.It provides a methodology for utilizing the DHT based spatial index for managing coordination objects and decentralizing the system. It provides a decentralized resource provisioning algorithm for mapping the tasks to the resources by the coordination space. With the implementation of the mechanism not only the performance bottlenecks are eliminated but also efficient scheduling with enhanced scalability will be achieved.

B. Coordinated load management in peer to peer systems

The Coordinated load management in peer to peer grid systems [5],was developed for resource allocation and decentralized coordination.Resource brokering services control the whole management of the applications in the distributed Grid computing environments.

The coordinated load management mechanism uses a Distributed Hash Table for efficient management of the coordination objects. Specifically, in this mechanism the resource brokers and resources are organized based on a DHT overlay. In this approach, resource brokers post their resource needsby using a Resource Claim object into the coordination space, while resource providers notifies their resourceby using a Resource Ticket object. These objects are mapped to coordination services using a hashing technique.

C. Cash based mechanism

The performance of the peer to peer systems depends on level of cooperation in the system. Existing peer to peer lacks cooperation. Various solutions for the problem had been developed earlier are complex in practice or do not provide strong incentives for cooperation. The cash based mechanism [3] is based on the idea that by offering uploads revenue is brought to the node and payment to be made for performing downloads.

The users use tokens for trading bytes within the system. The users should be awarded for offering uploads and staying online in the systems and pay for performing downloads. A user can performthe download only if he/she has tokens to download the complete file.The cash based systems are too complex.

D. An Exchange-based incentive mechanisms

The performance of peer to peer resource sharing networks depends on the cooperation of participants. The exchange based incentive mechanism [2], provides incentive for cooperation in peer to peer system. The approach provides strong incentives for file sharing, offers increase in service time to users when compared to free riders, without the complexity of cash based and credit based systems.

The basic idea is that peers give high priority to the peers that can provide a service in return. The mechanism is suitable for systems with more load or overloaded systems. It provides strong incentives for users to share resources.

E. Incentive mechanism for scheduling jobs in a peer-to-peer computing system.

The incentive and scheduling mechanism [1], was developed based on credits with a two level topology. The low level implements a non negative credit function. The reinvestment of credits increases peer cooperation. The upper level is introduced to improve scalability and scheduling is achieved irrespective of number of peers with improved scalability.

The global incentives mechanism can be improved if it considers the replicated and multi task execution on each peers. The mechanism limits the free riders into the system and improves the system throughput.

F. The social network algorithm to improve peer cooperation

The social network algorithm [6],was developed to include credit transfer between peers. The mechanism is developed so that it rewards cooperative peers and punishes the misbehaving peers.

The credit transfer between the peers seems to be less secure. The history of credit transfer between the peers is not maintained and this affects the secure transfer. The credit transfer mechanism helps to prevent misbehaving peers by takingaway the credits and transferring it to more cooperative peers. The social network algorithm provides mechanism that improves the cooperation among peers and increases the delivery ratio and also the success ratio.

IV.CooperativeScheduling Mechanism

Cooperative scheduling mechanism [7], was developed with a two level topologyfor distributed and parallel applications in peer to peer computing systems. The low level scheduling is performed by each manager at the individual area.The information required about the resources is assumed to be known by the scheduler. The low level scheduler uses scheduling policy to perform near optimal mapping of tasks. Due to the scalability issues the high level scheduling is introduced. The upper level requires more scheduling information. To reduce the information required in this level of scheduling, scheduling criteria is used to schedule task among the areas.

The distributed scheduler is used for assigning task among areas. The tasks are distributed in a balanced and efficient way. The scheduling cost is also reduced and managed by the use of the mechanism. The cooperative scheduling mechanism is designed to work on huge, distributed and heterogeneous environment.

V.Comparison

The comparison of various cooperative scheduling mechanisms is done using different parameters and is shown in Table 1.

Table 1. Parametric comparison of cooperative scheduling mechanisms

Parameters/Papers	**Distributed Hash Table based spatial index**	**Cash based mechanism**	**Exchange based Incentive Mechanisms**	**Incentive mechanism**	**social network algorithm**
Dynamicity	Less	More	More	More	More
Cooperative	Medium	Medium	Yes	Yes	Yes
Resource Utilization	More	Less	Less	More	Less
Scope	Local	Local	Global	Global	Global
Process Migration	No	No	No	Yes	No
Stability	Small	Large	Small	Large	Small
Scalability	Medium	Low	Low	High	Low

VI.Conclusion

The various cooperative scheduling mechanisms have been studied and classified. Their merits and demerits have also been discussed. The goal of this study is to provide comparison on different mechanisms and insight into the characteristics of each mechanism. The study will help to develop more capable and competent scheduling mechanisms. The future work can be done by giving importance on eliminating the demerits of mechanisms so that it can be made more efficient in dynamic environment.

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