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Maximum Profit Based tasks Scheduling Over Peer-to-Peer Network for Market-Like Cloud Computing Systems

Sasidharan S

Department of Computer Science and Engineering, Anna University
S.K.P. Institute of Technology, Tiruvannamalai.

Abstract— A sustainable computational cloud computing has two characteristics: it must allow resource providers and resource consumers to make autonomous scheduling decisions, and both parties of providers and consumers must have sufficient incentives to stay and play in the market. In this paper, firstly, by analysis the Cloud computing resources users' jobs then, we considering Cloud computing service providers' destination which is to gain the maximize the success rate of job execution and to minimize fairness deviation among Cloud computing resources. The challenges is to dynamically regulate the service rate for the jobs according to the traffic situation of job entering into the Cloud Computing environment, and make the maximum profits for the Cloud Computing service provider. We present a scheduling scheme and dynamically regulate the service rate, which utilizes a peer-to-peer decentralized framework using local and job scheduling, price adjusting algorithm.

Keywords— Computational cloud, job scheduling scheme, peer to peer.

I. INTRODUCTION

Cloud Computing, which aims at enabling wide-area resource sharing and collaboration is emerging as a promising distributed computing paradigm. According to how they schedule computational jobs to resources, computational cloud can be classified into two types: controlled and market-like clouds. Both types involve sharing and collaboration among resource providers and resource consumers, and the scheduling schemes can be either centralized or decentralized. The key difference between the two lies in who makes scheduling decisions. In a controlled cloud, the cloud system decides when to execute which job on which resource. In a market-like cloud, such decisions are made by each Cloud Computing resource provider/consumer, but all the individual participants utilize some market instruments such as price to achieve the cloud system wide objectives.

This paper focuses on the scheduling problem in market-based computational cloud. In particular, we address the issues of optimizing incentives for both resource consumers and resource providers so that every participant has sufficient incentive to stay and play, leading to a sustainable market. The main challenge, phrased as a scheduling problem, is to schedule jobs of consumers to resources of providers to optimize incentives for both parties and dynamically regulate the service rate for the jobs according to the scheduling environment. Most importantly, such objectives should be realized not by an omnipotent scheduler. Rather, the scheduling scheme should be autonomous. That is, each participant makes decisions on its own behalf, and the individual economic behaviours of all participants work together to accomplish resource scheduling, with optimized incentives being an emergent property of the cloud system. Does such a scheme exist at all? The answer is not obvious.

We formulate the above scheduling problem and investigate market instruments and algorithms to solve the problem. We identify the successful-execution rate of jobs of fairness deviation among resource and dynamically regulate the service rate. As even a sub problem of the formulated scheduling problem is NP-complete, we develop a job scheduling scheme (called MB) using local heuristics. Job announcement, competition degree (CD), and price are defined and used as market instruments. Four heuristic algorithms, local to each participant, are developed to utilize the market instruments and to optimize the incentives. The rest of this paper is organized as follows: Section 2 gives a formal problem statement. Section 3 contrasts with related work. Section 4 presents the Profit-based scheduling scheme in detail. Section presents the conclusion and future work.

II. PROBLEM IDENTIFICATION

We define a scheduling computational cloud as a three-tuple C =(R, S, J, M) as depicted in Fig. 1. The cloud C consists of a set of m resource providers $R = \{R_0 \ldots R_{m-1}\}$ and a set of k resource consumers $S = \{S_0, \ldots, S_{k-1}\}$. Over a time period T, a set n jobs $J= \{J_0,\ldots,J_{n-1}\}$ submitted to the cloud by the consumers, scheduled by the job scheduling scheme M, and executed by resources of the providers. The job scheduling scheme M should employ market instruments to allow each provider and each consumer to make the scheduling decision autonomously. That is, each cloud computing provider Ri can decide whether it would offer its resource, and each cloud computing consumer Sj can decide whether it would use a certain resource to execute its jobs.

A .Cloud Computing Consumers and jobs

In this paper, we only consider computation-intensive jobs,where all communication/networking overheads can be ignored. All jobs are independent of one another. The k consumers altogether have n jobs to execute in time period T. The consumers first submit job announcements to the computational cloud. A job announcement includes the information of job length and job deadline.

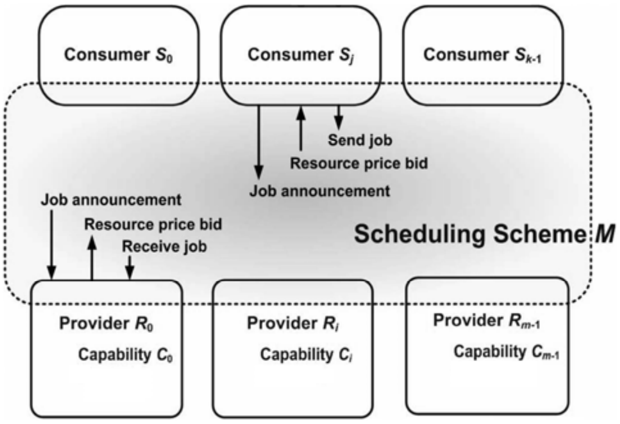

Fig.1. Scheduling in computational Cloud.

Job length is an empirical value assessed as the execution time of the job on a designated standard platform. Job deadline is a wall clock time by which a consumer desires a job to be finished, expressed as a number between 0 and T. Thus, a job with length = 10 and deadline = 100 means that the job's execution takes 10 time units on a designated standard computer, and it must be finished 100 time units after the common base time 0.

B .Cloud Computing Providers and resources

From the scheduling viewpoint, each computing resource provider is modeled with three parameters: capability, job queue, and unit price. Capability is the computational speed of the underlying resource, expressed as a multiple of the speed of the standard platform. The job queue of a resource provider keeps an ordered set of jobs scheduled but not yet executed. Each job, once it is executed on a resource, will run in a dedicated mode on that resource, without time-sharing or preempting. A provider charges for a job according to its unit price and job length. Unit price refers to the price that the resource offers for executing a job of unit length. When a provider with capability 6 bids to execute a job of length 30 at a unit price of 2 and if the consumer accepts the bid and decides to send the job to run there, the job will take 30/6= 5 units of time to complete, generating a profit of 2 x30 = 60 for the provider.

C. Economic utilization of cloud computing resource

Job scheduling system plays a very important role in how to meet Cloud computing users' job QoS requirements and use the Cloud resources efficiently in an economic way. Usually, from the Cloud computing resources consumer sides (we use CCC stands for Cloud computing consumer), users always think which Cloud computing resource can meet their job QoS requirements for computing (such as the due time of job finishing, the computing capacity etc.), how much money they must pay for the Cloud Computing resources. While, from the Cloud Computing resource providers(CCRP) side, the CCRP always think how they can gain the maximum profits by offering Cloud Computing resources, apart from meeting the CCC's job QoS requirements. To make these two ends meet, the job scheduling system must take efficient and economic strategies for CCC's differentiated service QoS requirements. Focus on this issue, this paper put forward an optimistic differentiated service job scheduling system for CCRP and CCC.

III. RELATED WORK

Much attention has been devoted to the area of scheduling in distributed computing However, to the best of our knowledge, there is still no work investigating effective scheduling to optimize incentives for both consumers and providers, utilizing market information. Many previous research projects focused on optimizing traditional performance metrics, like system utilization, system load balance, and application response time in controlled cloud. They did not consider market-based cloud, where providing sufficient incentives for participants is a key issue.

Many projects have investigated the effectiveness of introducing economic models and theories into distributed resource scheduling. Researches in study incentives for participants to behave honestly. Our work learned from these researches, like using the bidding model and price mechanism. However, these researches only consider provider objectives (for example, bigger profit and larger utilization), whereas we focus on optimizing incentives for providers. The willingness of provider parties to stay and play is critical for building a sustainable market. Enterprise is a task scheduler for distributed market like computing environments. The work shows the effectiveness of a bidding model for a decentralized scheduling framework. Spawn is a market-based computational system that utilizes idle computational resources in distributed network of heterogeneous computer workstations. Identify the distributed resource management challenges and requirements of economy-based cloud systems and discuss various representative economy-based systems. They also present commodity and auction models for resource allocation.

The evaluation results of computational and data cloud environments demonstrate the effectiveness of economic models in meeting users' QoS requirements. We choose a consumer initiated bid model in our work. Compute P2P is architecture for enabling Internet computing, using peer-to-peer (P2P) networks for sharing of computing resources. The work focuses on modeling pricing with the game theory and microeconomics to deal with selfish behavior and proves that its model guarantee the incentive for all the providers to share resources and not to cheat. Job scheduling system is a hot and one of core research areas in Cloud and Grid Computing. It plays a similar role in Cloud and Grid Computing. Job scheduling system is responsible to select the best suitable resources in a Cloud or Grid for CCU's jobs, by taking some static and dynamic parameters restrictions of CCU's jobs into consideration. Most research work in Grid Computing can be used directly in Clouding Computing environment. Today, we can find many research work have done on Job scheduling in Grid computing. References provided a board view for the roles of job scheduling in a Grid computing environment. The presented topologies of job scheduling system in Cloud or Grid are classified into centralized and decentralized schedulers. Due to the implementation complexity of decentralized schedulers, most related works are on centralized schedulers. Reference gave a brief description of a modeling and performance evaluation of hierarchical job scheduling, showed an iterative scheduling algorithms on the grids.

Presented a novel stochastic algorithm for QoS-constrained workflows job scheduling in a web service-oriented put forward a definition, modeling and simulation for a Cloud Computing scheduling system to get high throughput of computing etc.. In recent years, more and more academic researchers began to study the QoS of job scheduling system; we can see that references put forward the approach of QoS performance analysis for Cloud Computing services with dynamic scheduling system. However, most research papers rarely mention the differential service-oriented QoS guaranteed job scheduling system in a Cloud computing environment. Apart from this, very a few papers care about for the how to make the maximum profits for CCRP. For, the conditions of existence for a Cloud Computing environment are that it must make profits for the CCRP with the lowest system costs. To meet the CCC's job QoS requirement, job scheduling system should use the Cloud computing resource as little as possible.

In this paper, we first put forward an differentiated service job scheduling system for a Cloud computing, then by analysis the differential QoS requirements of CCC's jobs, we build the corresponding non-preemptive priority M/G/1 queuing model for this system. In addition, considering CCRP's destination which is to gain the maximum profits by offering Cloud computing resources, we also backed the system cost function for the queuing model. Based on the model and system cost function, from the goals of both

CCC and CCRP, we gave the corresponding algorithm to get the approximate optimistic value of service to each job with different priority. Analysis and number results show that our approach for job scheduling system can not only guarantee the QoS requirements of the CCC's jobs, but also can make the maximum profits for the CCRP.

IV. PROFIT BASED SCHEDULING SCHEME

We propose an incentive-based scheduling scheme employing a P2P decentralized scheduling framework. The scheme is characterized as follows: 1) each consumer or provider autonomously makes scheduling decisions, 2) all scheduling algorithms are local to a resource provider, and 3) three market instruments, job announcement, price, and Competition Degree (CD), are used.

A. *Peer to peer scheduling framework*

Our scheduling framework takes advantage of the P2P technology, utilizing its characteristics of decentralization and scalability. A central server is far from robust, and the maintenance is costly. Aside from that, as every participant in the computational cloud is autonomous and acts individually, a decentralized scheduling infrastructure is more favorable. Furthermore, owing to the dynamics of cloud environments, players may enter or leave at will at any time. A P2P network can handle such dynamics. The computational Cloud C has several portals, via one of which a provider can join the cloud. When entering, the provider gets the information of designated neighbors from the portal and then connects into the P2P network.

A consumer submits a job announcement to the computational cloud via one portal. Then, the job announcement spreads throughout the P2P network, similar to query broadcast in an unstructured P2P system. The providers that receive a job announcement may bid for the job. We want to realize the complete competition among all the providers based on two considerations. First, the job execution time is sufficiently long such that the overhead of executing them on remote computers becomes relatively negligible. Thus, all the providers should have an equal chance to compete for any job, no matter where their geographical locations are. Second, the number of providers will not be too large, typically not more than several hundreds, for a provider represents an administrative domain, within which local scheduling policies are employed.

The P2P scheduling infrastructure enables the effective interactions between consumers and providers and jobs are scheduled as a result. Fig. 2 depicts the complete sequence of steps that a single job goes through in the scheduling scheme M.

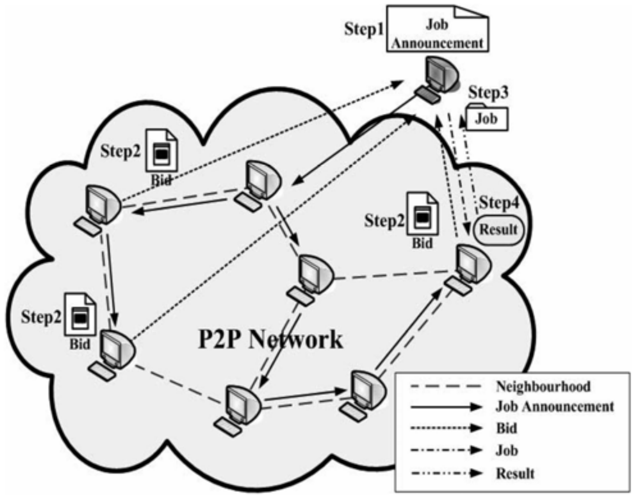

Fig. 2: The steps a single job goes through in the incentive-based scheduling scheme.

All jobs from consumers follow the same steps:

Step 1: A consumer submits a job announcement to the cloud, and the job announcement is broadcast to all the providers.

Step 2: Each provider, upon receiving a job announcement, estimates whether it is able to meet the deadline of the job. If yes, the provider sends a bid that contains the price for the job directly back to the consumer; otherwise, the provider ignores the job announcement.

Step 3: After waiting for a certain time, the consumer processes all the bids received, chooses the provider who charges the least, and sends the job to the selected provider.

Step 4: The provider who receives the job inserts it into its job queue. When the job is finished, the provider sends the result to the consumer. The value of the parameter waiting interval in step 3 should try not missing any potential bid and also making decisions as soon as possible.

B. *Profit-Based Scheduling Algorithms*

We design three algorithms for providers. The job competing algorithm describes how a provider bids when receiving a job announcement in step 2. The local scheduling algorithm is responsible for arranging the execution order of jobs in the job queue of a provider. It starts when a provider receives a job in step 4. The price-adjusting algorithm helps a provider to dynamically adjust its unit price and CD properly over the period of its participation in the cloud.

V. CONCLUSIONS

In this paper, we put forward a differential service-oriented and self-adaptive job scheduling system in Cloud Computing environment. Analysis show that our approach for job scheduling system can not only guarantee the dynamically regulate the service rate for the jobs, but also can make the maximum profits for the CCSP. To the best of our knowledge, the job scheduling system in our paper maybe the first paper to consider both the dynamically regulate of jobs and Cloud Computing service providers' profits.

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