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A Review on Different Scheduling Algorithms for Workflows in Cloud environment

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Abstract— Now days cloud computing has been widely accepted because of its scalability and "pay per use" model. Organizations hosted complicated business processes and scientific applications in the cloud. Usually application comprises of many interdependent tasks or sub processes, and are represented in the form of service workflows. Cloud infrastructure provider wants to maximize utilization of its resources while cloud users are interested in to reduce makespan of workflow along with QoS imposed by them. Hosting a service workflow over appropriate resources is a critical part among all other activities. It seemed scheduling workflow in cloud is NP-complete problem. In this paper we are studying different scheduling algorithms and resource scheduling based on Quality of Service (QoS) imposed by user.
Keywords: Workflow Scheduling, Quality of Service(QoS)

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I. INTRODUCTION

According to National Institute of Standards and Technology (NIST)Cloud computing is best described as 'a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction'. Cloud Computing is a super internet based computing model in which tens of thousands of computers and servers are connected into a computer cloud. Nowadays everybody is not ready to purchase the devices that provide the services. The users rather purchase the services provided by the devices at the big servers. The users from different locations just like to have the services and pay for the time being they are availing the services. It delivers applications which are accessible from web browsers, desktop and mobile apps.

While comparing with traditional desktop computing, cloud computing delivers many advantages, such as flexible scalability, high power conservation, pay-as-you-use and economies of scale. Therefore deploying traditional business services on cloud computing, where computing resources are in form of Virtual Machine (VM) instances that can be rented from one or more infrastructure service providers can cut down prior investment and lower down daily operating cost. Seeing that benefits, tendency becomes to migrate existing enterprise applications into the IaaS (Infrastructure as a Service) cloud. So as, more and more cloud services hosted by cloud service providers (e.g., SaaS providers) will be provided to interested end users, which are deployed on Virtual Machine (VM) instances rented from one or more third-party infrastructure vendors. Often there are following parties: Cloud infrastructure providers, Cloud service providers and end users.

The cloud service provisioning process can be simply outline as follows: The end user sends his service request to the cloud service provider; the cloud service provider accepts the user request and applies to the underlying cloud infrastructure vendors such as Amazon or any IaaS provider for virtual resources on demand; The cloud infrastructure vendor responds to resource rent request, and then allocates VM instances to the corresponding cloud service provider for processing the cloud user request; Eventually, the cloud service provider charges end user for processing his/her service request and pays the cloud infrastructure vendor for renting VM instances to deploy service capacity [1].

Like many applications, workflow of many scientific and business applications also can be executed in cloud computing environment. Execution of a workflow primarily involves workflow scheduling. Workflow scheduling requires mapping of workflow tasks with available resources in such a way that some predefined criteria is met. Workflow scheduling is popularly known as NP-complete problem and key issue in workflow management system. Moving our workflow to Cloud computing allow us to exploit the benefits of cloud for workflow execution. Workflows are represented by a Directed Acyclic Graph (DAG) where, each node represents a task and the corresponding edge between nodes represents data dependency between child and its parent tasks. Workflow scheduling is the problem of mapping of workflow tasks on suitable resources while satisfying the constraints imposed by the user. Workflow scheduling is a key concern in workflow management systems. Proper workflow scheduling can have significant impact on the performance of the workflow application [2].

II. RELATED WORK

A. *Multiple QoS Constrained Scheduling*

Scheduling workflow on cloud has many QoS constraints. So it is a challenge for cloud service provider to schedule with multiple constraints. To address this problem, M. Xu et al. [3] proposed multiple QoS constrained scheduling strategy of workflow for cloud computing. Scheduling strategy consider multiple QoS constraints like budget and time. An experimental result shows that this algorithm produces better results than RANK_HYBD algorithm.

B. Look ahead Variant of the Heterogeneous Earliest Finish Time Algorithm

It is an extension version of Heterogeneous Earliest Finish Time Algorithm. The key idea is to consider information of its descendent tasks. Then make scheduling decision that will be beneficial for task itself and its children. , HEFT is already a fast and simple algorithm. The experimental results shows that proposed algorithms may shorten the makespan in some cases by up to 20% on average.

C. Algorithm based on Energy Efficient Optimization Methods

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable. This algorithm with Energy Management and Regulation is being deployed in Hadoop distributed file system also known as GreenHDFS. It focuses on usage of the resources that are partially utilized during executing in the environment. This algorithm examines the energy utilization of different computing resources which mixed up in cloud like node, storage, switch and network. The work has been done over the resources CPU, main memory and storage device till now while future work comprises temperature and fan speed. Nodes in cloud computing are like servers including more than one core CPU which facilitates parallel services. The energy utilization depends on the type of the job either it is I/O or storage or compute intensive. The cluster is obtained so as to save energy. The user is requiring first to choose type of the job and then the job is in execution mode again the type is analyzed by counting the number of instruction execution speed. They used basics of Round Robin algorithm. The algorithm has three phases: Preparation of Infrastructure, Preprocessing of Job and Job Execution. These estimates are nearly close to the monitoring method used is indirect i.e. by sensors. The algorithm is still used by Eucalyptus and data processing program is Hadoop. The algorithm compared with the basic round robin algorithm in original environment.

D. Optimizing Virtual Machine for High Performance Computing

It is a High Performance Computing (HPC) conscious novel scheduler implemented on Open Stack Scheduler. Here HPC aware strategies (hardware awareness and topology awareness) are implemented which enhances the performance by allowing cloud providers to better make use of the infrastructure building more profits. Open stack is a scheduler who selects a physical resource where Virtual Machine is provided. Open stack receives Virtual Machine request as part of RPC message. While host capability is a significant input for scheduler who contains listing of physical servers and their capabilities. Algorithm has two steps: first to Filtering (which exclude hosts who do not have required capability) and then Weighing (which calculate fitness of filtered list using cost functions (e.g. free memory in a host)), followed by sorted list of hosts VM provisioning takes place. As scheduling Open Stack do not consider type of application, process priorities, processor heterogeneity and topology of network. HPC-Aware Scheduler comprises of two techniques: Hardware awareness/homogeneity (where cloud users are unaware of underlying hardware where VMs are placed by ensuring that all VMs are allocated some task) and Topology awareness (as users are unknown of the cluster the VMs are packed to nodes in same rack compared to any placement policy which distribute them over the cluster). The first modification need to switch the use of group scheduling for considering k VMs problem as a single scheduling problem. First of all topology aware algorithm works as described next filtering phase (firs making a list then maximum number of servers) then using this build plan. For sake of homogeneity the scheduler make a group of the hosts then applies algorithm to those groups which considers the configuration (currently CPU frequency). The correctness of platform for an HPC application relies on characteristics of application are performance requirements and user preferences. The main focus is High Performance Computing applications which are comprised of k parallel instances requiring synchronization and allocating VMs in topology aware manner to provide considered list of VMs to application user. Future work considers the mixture of HPC and non-HPC applications.

E. SaaS Cloud Partial Critical Paths (SC-PCP)

It is one of the heuristic algorithms for schedule workflow on cloud. Author evaluate its performance on scientific workflows of LIGO (gravitational physics), SIPHT(biology),Montage (astronomy), CyberShake (earthquake science), Epigenomics (biology).The objective of algorithm is to minimize workflow execution cost within the user defined deadline. It extends the critical path heuristic where it first schedules the fastest workflow which is obviously more expensive. Then it reschedules services of each task of workflow such that the total scheduling length won't get violated than user deadline. The experimental results reveal that SC-PCP outperforms another highly cited algorithm called Deadline-MDP. Furthermore, the experiments show that the computation time of the algorithm is very low for the Decrease Cost and the Fair policies, but is much longer for the Optimized policy, although still acceptable for the mentioned workflows.

F. Dynamic Provisioning Dynamic Scheduling(DPDS)

The main objective of algorithm is to maximize the number of user-prioritized workflows that can be completed given budget and deadline constraints. Authors developed three algorithms to corroborate the key concept: two dynamic algorithms, DPDS and WA-DPDS(Workflow admission algorithm for DPDS), and one static algorithm, SPSS(Static Provisioning Static Scheduling).They were evaluated via simulation on ensembles of synthetic workflows, which were generated based on statistics from real scientific applications. The results of experiments reveals that the two algorithms which considers the structure of the workflow and task runtime estimates (WA-DPDS and SPSS) produce better results than the simple priority-based scheduling strategy (DPDS), who makes provisioning decisions based purely on resource utilization.

G. *Adapting Market-Oriented Scheduling Policies for Cloud Computing*

Rajkumar Buyya et al.[8] proposed two market-oriented scheduling policies for increasing the computational capacity of the local resources by hiring resources from an IaaS provider. Policies consider user provided deadline and budget in their scheduling. Cost Optimization scheduling policy minimizes the cost incurred for running the application while Time Optimization scheduling policy minimizes the application completion time. Author evaluated these policies in real environment using Gridbus broker as a user-level broker. It was observed that in the Time Optimization policy, time required to completion reduces almost linearly by rising the budget. But, in case of Cost Optimization the completion time does not improve after a certain budget (100 cents in performed experiments). It is concluded that the efficiency of the Time Optimization and Cost Optimization policies can potentially increase by increasing the budget. At last, it is observed that different workload types can get completed before the deadline and within the budget using the proposed policies.

H. *Genetic based Scheduling algorithm*

Jia Yu et al. [9] proposed scheduling of workflow based on genetic algorithm which takes into account two Quality of Service constraints: budget and deadline. Mentioned algorithm schedules workflow application so as to minimize the makespan (while user imposed deadline should not get violated.) or to minimize so called execution cost (while user imposed budget should not get violated.). Authors mainly considered heterogeneous environment to handle deadline and budget. They compared this proposed approach with existing genetic algorithms and their performance results show that stated technique reduces the execution time within specified deadline as well as reduces execution cost within budget specified earlier. Described approach is directly applied to large environments consisting of heterogeneous machines on both balanced and unbalanced data structure where many of the genetic algorithms failed to work.

I. *The Hybrid Cloud Optimized Cost scheduling algorithm*

Hybrid cloud is nothing but the merging of private and public cloud, where the user has Flexibility provided by public cloud resources so that it can be aggregated to the private resources as necessary. It addresses the problem of decision, which resources should be rent from the public cloud and merge to the private cloud. It has time constraint on scheduling. Authors performed an extensive experimental and simulation result which reveals that HCOC can reduce costs while achieving the given desired execution time. Along with the knowledge of machine cost it also aware about multicore nature to reduce makespan.

J. *Binary Integer Program*

With the increase in heavy load on internal private cloud-deciding which task of workload to outsource in public cloud is not trivial. Therefore Ruben Van den Bossche[11] et al. proposed a binary integer program formulation of the scheduling problem and calculate the computational costs of this technique with respect to the problem's key parameters. In the context of hybrid cloud scheduling, they have outlined a software architecture model for the HICCAM (Hybrid Cloud Construction and Management) project in order to highlight and emphasize the purpose of the Optimization Engine component. During scheduling applications in the public cloud, this approach seems to perform well in terms of cost minimization, scalability and feasibility. The addition of network costs to proposed model hardly influences the solver's performance but state that, with the current relations between runtime and network traffic costs, the determining cost factor in all but very network-intensive applications is clearly the runtime. But this approach becomes much less feasible in a hybrid cloud setting due to very high solve time variances. hardly influences the solver's performance but state that, with the current relations between runtime and network traffic costs, the determining cost factor in all but very network-intensive applications is clearly the runtime. But this approach becomes much less feasible in a hybrid cloud setting due to very high solve time variances.

III. CONCLUSION AND FUTURE WORK

In Cloud Computing, Scheduling workflow of an application seems NP-hard Problem and it has to play vital role to achieve Quality of Service. In this paper, we studied different scheduling algorithms and enlisted their merits involved in the different scheduling algorithm. These algorithms tell us what kind of parameters we should take into consideration while scheduling workflow in cloud. From the literature reviewed, it is clear that lot of work has already been in the area of workflow scheduling but still there are very few work done to explore budget constrained scheduling algorithm for workflow application. In future, in order to achieve budget as QoS, we need an efficient scheduling algorithm called greedy. According to the greedy approach -"A greedy algorithm always makes the choice that looks best at that moment. That is, it makes a locally optimal choice in the hope that this choice will lead to a globally optimal solution.

REFERENCES

[1] Zhipiao Liu, Qibo Sun, Shangguang Wang, Hua Zou, Fangchun Yang, "Profit-driven Cloud Service Request Scheduling Under SLA Constraints" Journal of Information & Computational Science 9: 14 (2012).

[2] Ranjit Singh and Sarbjeet Singh, "Score based deadline constrained workflow scheduling algorithm for cloud systems", International Journal on Cloud Computing: Services and Architecture (IJCCSA) ,Vol.3, No.6, December 2013.

[3] M. Xu, L. Cui, H. Wang, Y. Bi, "A Multiple QoS Constrained Scheduling Strategy of Multiple Workflows for Cloud Computing", IEEE International Symposium on Parallel and Distributed Processing with Applications.2009.

[4] Liang Luo, Wenjun Wu and Dichen Di,Fei Zhang,Yizhou Yan,Yaokuan Mao, 'A Resource Scheduling algorithm of Cloud Computing based on Energy Efficient Optimization Methods', IEEE 978-1-4673-2154-9, Vol. 12 (2012).

[5] Abhishek Gupta, Laxmikant V. Kale, 'Optimizing VM Placement for HPC in the Cloud', ACM 978-1-4503-1754-2, San Jose, California, USA, September 21, 2012, PP: 1-6

[6] S. Abrishami and M. Naghibzadeh, "Deadline-constrained workflow scheduling in software as a service Cloud" Department of Computer Engineering, Ferdowsi University of Mashhad, Mashhad, Iran.

[7] Maciej Malawski, Gideon Juvey, Ewa Deelmany and Jarek Nabrzyskiz. " Cost- and Deadline-Constrained Provisioning for Scientific Workflow

Ensembles in IaaS Clouds." Proceeding SC '12 Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis, IEEE Computer Society Press Los Alamitos, CA, USA, 2012.

[8] J.Yu and R. Buyya, "Scheduling Scientific Workflow Applications with Deadline and Budget Constraints using Genetic Algorithms", Scientific Programming Journal,2006, pp. 217-230.

[9] J.Yu and R. Buyya, "Scheduling Scientific Workflow Applications with Deadline and Budget Constraints using Genetic Algorithms", Scientific Programming Journal,2006, pp. 217-230.

[10] L. F. Bittencourt and E. R. M. Madeira, "HCOC: A Cost Optimization Algorithm for Workflow Scheduling in Hybrid Clouds", J. Internet Svcs. And App., December 2011 pp. 207–227.

[11] Ruben Van den Bossche et al.,"Cost-Optimal Scheduling in Hybrid IaaS Clouds for Deadline Constrained" IEEE 3rd International Conference on Cloud Computing Workloads, 2010.

[12] Luiz F. Bittencourt, Rizos Sakellariou and Edmundo R. M. Madeira, "DAG Scheduling Using a Lookahead Variant of the Heterogeneous Earliest Finish Time Algorithm," in Parallel Distributed and Network-Based Processing (PDP), 2010 18th Euromicro International Conference ,pp 27 – 34.