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Task Ranking Based Allocation of Scientific Workflows in Multiple Clouds with Deadline Constraint

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Abstract: ***The advent of Cloud computing as a new model of service provisioning in distributed systems, progress researchers to investigate its benefits and drawbacks in executing scientific applications such as workflows. One of the effective problem in Clouds is workflow scheduling, the problem of satisfied the QoS of the user like deadline as well as minimizing the cost of workflow execution. Existing work QoS based workflow scheduling algorithm based on a novel concept called Partial Critical Paths, which tries to minimize the cost of workflow execution while meeting a user defined deadline. Today cloud provider's mainly concentrate about the increasing their revenue. This will lead to the selfish behavior which may cause the QoS violation of cloud users. In the existing work, workflow scheduling is done in only single cloud where there may be the situation occurs in which enough resources are present to satisfy the user demand. And also the priority of tasks is not considered in the scheduling of tasks. In that case the existing work will still continue to process the user demands in order to increase their revenue. To address this problem, a novel replication aware dynamic workflow scheduling is introduced with the consideration of ranking of tasks for multi cloud. The main objective of this algorithm is to dynamically allocate the workflow across multiple cloud domains with the consideration of reduction of cost for processing those workflows as well as satisfying the QoS requirement of user. This is achieved by ranking the tasks based on their load level and its successor tasks load level. The experimental results prove that the proposed methodology can provide the better result than the existing methodology.***

Keywords: cloud computing, Multi cloud, Task replication ranking, Workflow Scheduling

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1.INTRODUCTION

The traditional approach to resource access in grid environments is based on a queuing model that provides best effort quality of service. In the case of handling scientific workflow scheduling with task replication in the single cloud environment, that will lead to an problem of unsatisfied user QoS demands. Because in the case of single cloud environment, the cloud provider will search for appropriate VM within it for satisfying the users QoS demands. If none of the VM satisfies the users QoS demands, still it will continue to process that workflow due to the absent of multi cloud environment. If the multi cloud environment is existing, then also there is a chance of selfish behaviour where the cloud providers intend to increase their revenue. One way to improve quality of service for workflow applications is to use a model for resource allocation based on provisioning. With a provisioning model, resources are allocated for the exclusive use of a single user for a given period of time.

In static provisioning the application allocates all resources required for the computation before any jobs are comply, and delivery the resources after all the jobs have finished. In dynamic provisioning resources are allocated by the system at runtime. The resources allows the pool of available resources to grow and shrink according to the changing needs of the application. The latest emergence of Cloud computing is a significant step towards realizing the utility computing model since it is heavily driven by industry vendors. Cloud computing assurance to deliver reliable services through next-generation data centers built on virtualized compute and storage technologies.

The main objective of the algorithm is to dynamically allocate the workflow across multiple cloud domains with the consideration of reduction of cost for processing those workflows as well as satisfying the QoS requirement of user. This is achieved by ranking the tasks based on their load level and its successor tasks load level. In dynamic provisioning resources are allocated by the system at runtime. The resources allows the pool of available resources to grow and shrink according to the changing needs of the application.

Many high-performance computing and scientific workloads in cloud environment, such as those in bioinformatics and geoinformatics, are complex workflows of individual jobs. The workflow is usually organized as a directed acyclic graph,in which the constituent jobs are either control or data dependent. Control flow dependency specifies that one job must be completed before other jobs can start. In contrast, dataflow dependency consideration that a job cannot start until all its input data is accessible. Control flow is the more commonly used abstraction to reason about the relationship between different jobs, but show how dataflow information is more valuable to effectively utilize the storage.

2.RELATED WORK

2.1 Meeting Deadlines of Scientific Workflows in Public Clouds with Task Replication

In execution of scientific workflows in clouds either tries to minimize the workflow execution time ignoring deadlines and budgets or focus on the minimization of cost while trying to meet the application deadline. Additionally,previous research implements limited contingency strategies to correct delays caused by underestimation of tasks execution time or fluctuations in the delivered performance of leased cloud resources maintaining the Integrity of the Specifications.

To address limitations of previous research, the algorithm that uses idle time of provisioned resources to replicate workflow tasks to mitigate effects of performance variation of resources so that soft deadlines can be met. The amount of idle time available for replication can be increased if there is budget available for replica execution, which allows provisioning of more resources than the minimal necessary for meeting the deadline.

2.2 Deadline Constrained Workflow Scheduling Algorithms for Iaas Cloud

Cloud computing is the latest emerging trend in distributed computing that delivers hardware infrastructure and software applications as services. The advent of Cloud computing as a new model of service provisioning in distributed systems encourages researchers to investigate its benefits and drawbacks on executing scientific applications such as workflows. One of the most effective problems in Clouds is workflow scheduling, the problem of fullfilling the QoS requirements of the user as well as minimizing the cost of workflow execution.

Partial Critical Paths which aims to minimize the cost of workflow execution while meeting a user defined deadline. Workflows constitute a common model for describing a wide range of scientific applications in distributed systems. The workflow is defined by a Directed Acyclic Graph in which each computational task is represented by a node and each data or control dependency between tasks is represented by a directed edge between the corresponding nodes.

2.3 Performance Analysis of High Performance Computing Applications on the AWS Cloud

Cloud computing is computing in which large groups of remote servers are networked to allow the centralized data storage. It has emerged as an essential paradigm for accessing distributed computing resources. Clouds can be classified as public, private or hybrid.

It relies on restricting sharing of resources to achieve coherence and economies of scale, similar to a utility over a network. While cloud computing has proven itself useful for a wide range of e-science applications, its utility for more tightlycoupled HPC applications has not been proven. To evaluate the ability of cloud computing to meet the computing needs.

2.4 Grids and Clouds: Making Workflow Applications Work in Heterogeneous Distributed Environments

Clouds have recently appeared as an option for on-demand computing,in the business sector, clouds can bring computational and storage capacity which result in infrastructure savings for a business. When using the cloud, applications pay only for what they use in terms of computational resources, storage, and data transfer in the cloud.

Virtualization also opens up a greater number of resources to legacy applications. It require a very specific software environment to execute successfully. Today, struggle to make the codes that they rely on for weather forecast, and many other computations work on different execution sites. The codes that have been designed and validated many years ago for fear of breaking their scientific quality.

Clouds and their use of virtualization technologies may make these legacy codes much easier to run,the environment can be adapted with a given operating system.

The needed directory structure can be created to anchor the application in its preferred location without interfering with other users of the system. However, in order to make good use of such environments, scientists need to be able to figure out how many resources they need, for how long, and what would be the associated costs.

3.PROPOSED SYSTEM

The new cloud technologies can also potentially provide benefits to today's science applications. To address the problem, a novel replication aware dynamic workflow scheduling is introduced with the consideration of ranking of tasks for multi cloud. The main objective of the algorithm is to dynamically allocate the workflow across multiple cloud domains with the consideration of reduction of cost for processing those workflows as well as satisfying the QoS requirement of user. This is achieved by ranking the tasks based on their load level and its successor tasks load level.

There are an increasing number of Cloud Services available in the Internet. Cloud services can be a part of a system and different Cloud Servers that would provide different services. The present work have defined a multiple cloud environment. Each cloud server is decribed with certain limits in terms of memory and the CPU specifications, the users enter to the system and the user request is performed in terms of processes.

To represent the parallel user requests, number of requests are generated by the users. All these requests are to be managed by the cloud servers in parallel by using the multiple clouds concept. As like existing work, this is also attempts to reduce a cost and execution time to meet user specified QoS constraint. The work will calculate the rank for each and every task in the workflow based on its load and its dependency among each other.

The rank is calculated by using the below formulae:

$$Rank(i)=\{load(i)+max\{comm(i,j)+rank(j)\}\} \quad (1)$$

In the equation (1) load (i) represents the workload of task i and comm (i, j) is the output of tasks i to j.

Each process must be executed within the cutoff limit,but if more than one processes occur at same time and not get executed before the deadline, in such case the processes is exchanged from one cloud server to other called the process migration. In the present work, a parametric analysis is performed to identify the requirement of process migration and based on this analysis the migration will be performed on these processes. The effectiveness of the work is identified in terms of successful execution of the processes within the time limits.

When the users are submitted their tasks first the dependacny among them will be calculated in order to rearrange the flow of execution with the consideration of the reduced cost and deadline. After that tasks will be ranked based on their load level in order to make sure the entire workflow is completed within time.

Based on that tasks will be sorted and will be allocated to the resources. Allocating the tasks in the sorted order will be selected by starting the auction process. After that the tasks will be allocated in the winning resource and running the schedule parent. The path and next tasks need to be executed will be found by running the schedule parent and schedule path algorithms

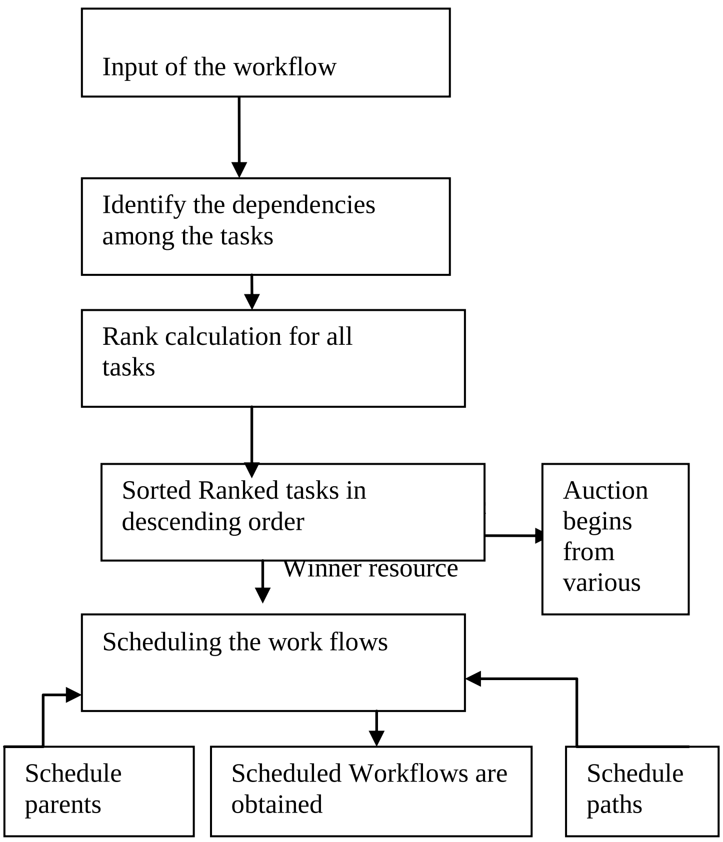

Figure 1 System Flow Diagram

The optimized scheduling with reduction of cost and deadline will be done by starting the auction process. From the auction, the best resource will be selected for processing the workflow submitted by the user. The workflow path allocation will be selected by running the PC-ICP algorithms.

3.1 Creating cloud network

The simulation toolkit enables modeling and simulation of Cloud computing systems and application provisioning environments. The CloudSim toolkit based on both system and behavior modeling of Cloud system components such as data centers, virtual machines and provisioning policies.

3.2 Identifying dependency between tasks

The dependency between the tasks is computed as follow relationship. The DAG will be constructed which will defines the flow of execution of tasks. The nodes in the DAG represent the set of tasks and the edge represents the flow of execution among tasks, where the output of one task will be the input of another task.

3.3 Rank computation of tasks

The rank is calculated based on the load of the tasks in the resource. The tasks are scheduled in the appropriate VM's based on the ranking of tasks. The tasks are ranked by considering the workload of the tasks. For each unscheduled tasks rank will be computed and after ranking, the task will start to auction. Based on the auction value, the resource provider will bid his requirement. The efficient resource will be selected for scheduling the tasks on the VM's available in the resource.

3.4 Finding winner resource by Auction

The set of tasks based on its rank will start its auction will submit its input and output requirement to the scheduler . After the task submits its workload details, the resource will bid its capacity of processing task. The auctioneer will selects the winner resource with the high computation capability.

3.5 Data transfer aware provisioning adjust

After selection of resources, the tasks will be allocated to the VM's based on the start time and end time of tasks. Based on the processing time of tasks, the VM's start time and end time will be decided. The VM's start time and end time will be mentioned based on the flow of tasks.

3.6 Scheduling workflow

It is based on the task and VM utilization time, the task will be scheduled to the appropriate VM. The scheduled task will compute the output before the start time of the tasks.

3.7 Task replication

The task replication process works in a semi active replication technique for fault tolerance, with the difference that here tasks are replicated across performance independent hosts rather than failure independent locations.

4. PERFORMANCE ANALYSIS

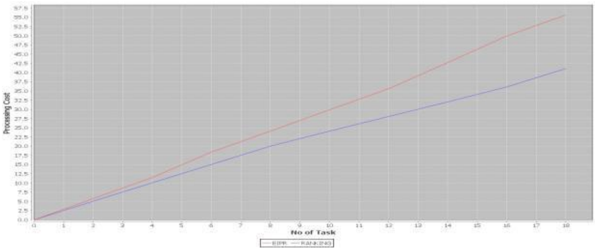

Figure 2 Processing Cost

The graph is plotted with number of task in X axis and processing cost in Y axis.The processing cost of Ranking is less than processing cost of EIPR.

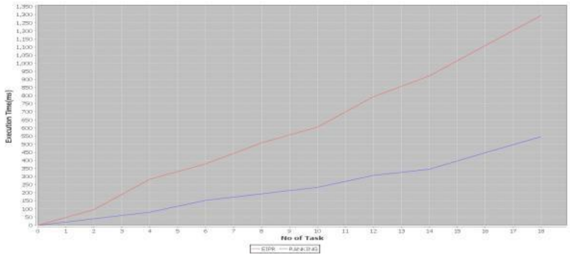

Figure 3 Average Execution Time

The graph is plotted with number of task in X axis and execution time in Y axis.The execution time of ranking is less than execution time of EIPR.

5. CONCLUSION AND FUTURE WORK

The two resources with the same characteristics may have different performance in a given time, the results in variation in the execution time of tasks that may lead to delays in the workflow execution. In the work scientific workflow scheduling is done across the multi clouds with the satisfaction of user QoS demands particularly like deadline and cost of execution of tasks. The workflow scheduling is done efficiently with the better coverage among multi clouds.

The deadlock avoidance can be considered in the future research. Extended to the distributed workflow schedulers which can coordinate each other to map the instances and jobs into multiple storage constrained sites while avoiding deadlock. Making applicable in reality if the numbers of workflows as well as the constituent jobs are large.

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