RESOURCE ALLOCATION METHOD IN MULTI-CLOUD ENVIRONMENT USING MARKET ORIENTED SCHEDULING STRATEGY

M.Andrew Ezhil Daniel, S.Rohini, K.Pradeep

***Abstract*: Cloud computing provides the user to interact the computing technology and also provides services through internet technology. Cloud environment provides the marketing strategies to the user by getting the service in pay-per-use model. in cloud market there are so many private cloud service providers are available and are self-indulgent providers. If these providers are utilized by some vendors they earn some beneficial amount. In order to prevent the users from using these kinds of providers a cloud workflow model is proposed that estimates the truthfulness of the providers by finding the best resource provider. The mechanism performs task-service assignment based on QoS constraints and provides better optimization of cost.**

***Keywords:* workflow, cloud resource, truthfulness, Auction**

I INTRODUCTION

Cloud computing is the feature of computing technology. Cloud computing delivers the computing resources through virtualization based on internet technology. It provides a shared pool of computing resources like storage, network, server, etc. Meanwhile, cloud service providers are responsible to satisfy the QoS(Quality of service) based on SLA(Service Level Agreement). Cloud computing provides three services: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). In Fig.1 the cloud model gives the Overall process of the cloud environment. Based on the resource availability cloud can be classified as three different types:

Public clouds: It offers a service based on pay-per-use.
Private clouds: Cloud resources that can be accessed and used by the user within the organization.
Hybrid clouds: Bring together public and private clouds.

Workflow is a processing model for describing the scientific applications in cloud computing. Cloud workflow is arranged sequence of activities and events, designed to achieve a definite business objective. In this Workflow Monitoring Service (WFMS) is a system for defining, monitoring, managing data flow and communication flow between tasks.

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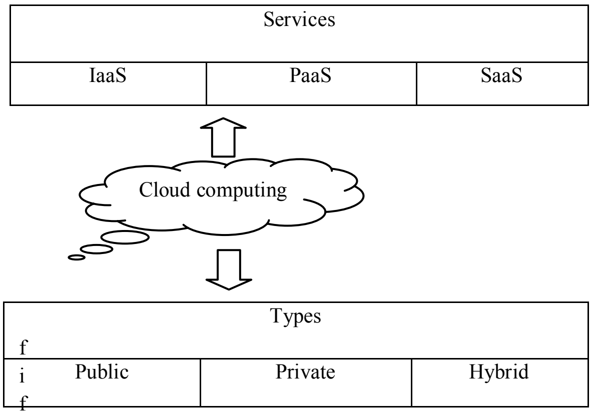

fig.1 Cloud Model

Scientific workflows and WFMSs have emerged to solve the problem and provide an easy-to-use way of specifying the tasks that have to be performed in cloud application. In this WFMS manage the execution of various dependent tasks. Cloud environment provides the marketing strategies to the user by getting their service in pay-per-use model.

The multi-cloud environment includes a set of self-indulgent providers with private about their resources. Their motive is to get more revenue from the user. Resource allocator act carefully and do not trust the information submitted by the providers. On the allocator gives more money to the resource provider.

Proposed mechanism helps them to decide the time and cost for the resource, also find the truthfulness about the resources. Based on this resource information we are going for the auction to find the best resource provider in the cloud market [3]. The truthful mechanism gives the truthfulness about the resource.

II RELATED WORK

The related work in three main areas: multi-cloud computing, Market oriented scheduling mechanism in distributed systems, and workflow scheduling.

A Multi-cloud Computing

In cloud research domain multi-cloud computing is relatively new and no extensive ideas available. In sky computing [4] introducing the distributed virtual site of several clouds. In [5] mention the important issues and structural elements for utility oriented federation of multiple cloud environments is checked. The important role of cloud brokers in multi-cloud environment splitting the user needs to multiple providers. In multi-cloud

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environment many private cloud resource providers available, they provide the resource based on pay-per-use model.

B Market Oriented Scheduling

Market oriented scheduling in distributed system allows the broker to getting the resource based on varies scheduling strategies. In Grid economy survey [6] mention the varies approaches. In market oriented mechanism introduces new approach for selecting the cloud provider is Auction. In cloud market provides the decentralized scheduling problem. It allows some advantages, markets are decentralized and communication is limited to the exchange of bids and prices between agents [7]. In the distributed environment agents may manipulate the load allocation scheduling for their own benefit and selfish behavior, it may affect the effectiveness of the resource [8].

In [9] introduces a dynamically allocating the resources using market-based model. In this dynamic allocation method follows nash-equlibrium. This model introduces the various agents participating in each auction. Users demanding multiple shared of auction resources. In [10] proposes a continuous double auction mechanism tasks in grids. The authors of [11] approach the scheduling problem of selfish behavior in grids. The scheduling problem of selfish behavior in prisoner dilemma game [2] respect to makespan and monetary cost. The proposed approach based on new instantiation of the protocol between the scheduler and resource allocator using the real-time group auction.

C Workflow Scheduling

Workflow scheduling in distributed system is an assignment that allocates the workflow tasks to resources. Workflow scheduling is a type of global task scheduling it mapping and managing the inter-dependent tasks on shared resources. Many existing heuristics workflow scheduling approaches transforms the problem in to single objective optimization problem.

Among this multi-objective algorithm, we investigating the optimization makespan and cost. In this multi-objective scheduling is to derive an objective function that takes into all criteria. In our case consider two objective functions time and cost. In this paper [12] proposes a workflow planning method, which considers simultaneously optimizing multiple objectives. The major benefit of this workflow planning is to generate a set of alternative trade-off solutions and estimating their QoS requirements of workflow executions.

The authors of [13] propose two market oriented scheduling workflow policies for scheduling the independent tasks in hybrid clouds. All these workflow scheduling algorithms are static approaches that do not consider the dynamic load of the resources in real environment. The different price model in the commercial multi-cloud environment gives the doubtful in provider information about their resources. By that our proposed model gives the new pricing model for the resource require in the cloud environment. This model gives the information about their resource and finds the best provider. The truthful mechanism as give the truthfulness about the resource. Auction method as gives the basic approach to find the best resource provider in the cloud market.

III PROBLEM OVERVIEW

In this section, The cloud workflow scheduling problem minimize two objectives: make span and monetary cost of the execution. In this workflow individual tasks *i* as a pair *(i,j)* means task *i* is assigned to resource *j*. Schedule the entire workflow as sched={(i,j)|i∈[n]}, where j is able to calculate the real Completion time $t_{i,j}^{real}$ and the real computation cost $c_{i,j}^{real}$ for executing every task i. To calculate the real completion time is sum of two components: the time to transfer input data and the effective execution time.

In this model the real completion time of a task, the resource must consider a number of internal details such as vm current load, vm start-up, task workload, communication bandwidth and so on.

These informations are not considering in this model. Based on the real completion time of the single task, workflow makespan as the time required for executing the whole workflow without violating the control and data flow dependencies between its tasks:

$$\textbf{\textit{Makespan(DAG,sched)}}=\max_{i\in[n](i,j)\in sched} t_{i,j}^{real} \qquad \textbf{(1)}$$

Similarly, cost as the sum of the costs of executing all workflow tasks

$$\textbf{\textit{Cost (DAG, sched)}}=\sum_{i\in[n](i,j)\in sched} t_{i,j}^{real} \qquad \textbf{(2)}$$

Based on this private information we are going for the auction to find the best resource provider namely winner *w,* if the winner for the task is $t_{i,w}.c_{i,w}=\min_{j\in[m]}\{t_{i,j}\cdot c_{i,j}\}$, where f($s_{i,..}$) is a strategy function. The payment for the submitted task in the auction is given by the objective function

$$\textbf{\textit{pay(i,j)}} = \begin{cases} \frac{t_{i,x}\cdot c_{i,x}}{t_{i,j}}, if\ j = wt_{i,j}^{real} \le t_{i,j}; \\ f\left(s_{i,..}\right),\ if\ j = wt_{i,j}^{real} > t_{i,j} \\ 0, if\ j \ne w \end{cases} \qquad \textbf{(3)}$$

IV WORKFLOW MODEL

In cloud workflow application model represented as *DAG (T,D),* where T is the set of nodes represents the dependent tasks and D indicates the dependencies between data and control flows. Each task t is characterised by its workload *l(t).* In *D=(t,r,flow*($t_1 \ldots t_n$)*),* where *flow*($t_{1,\ldots} t_n$) is the output task dependencies between tasks.

In this multi-cloud model (fig.2) workflow tasks are coordinated by workflow coordinator. It coordinates the workflow and non-workflow tasks. The workflow tasks are scheduled based on pso(particle swarm optimization) algorithm. This scheduling is performed in two levels: first level is Task-to-Service assignment. In this level we determine the service for the particular task which it require. In this second level the

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Service-to-Resource assignment, in this level determine the resource for the particular service is performed.

Based on this scheduling the resource is allocate dynamically. In this model service is assign using vm assignment. Then time and cost is estimated for the task, when the task demand is increased

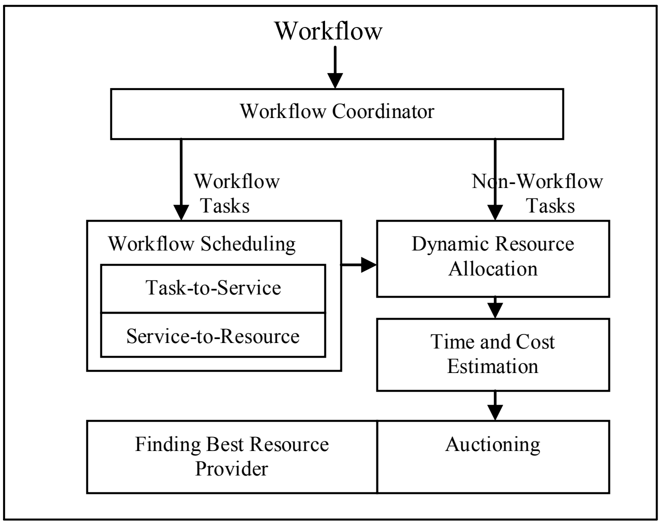

Fig. 2. Multi-cloud Architecture

Based on our estimation entering the cloud market and using auction mechanism we find the best resource provider. Truthfulness of the information is verified based on game theory [2].

V MULTI-CLOUD WORKFLOW SCHEDULING

In the multi-cloud environment the user requirements are increasing based on demand change, by that we can allocate the resources dynamically. Many heuristic algorithms are available to perform the workflow scheduling. The proposed model considers the multi objective constraints based on finding of optimal allocation of the resources. In this workflow scheduling strategy model, the optimal allocation of the resources is performed based on two levels scheduling in a platform layer. First level scheduling is Service-level scheduling. It allocates suitable service for individual workflow instances. Based on this scheduling one system will act as the coordinator peer remaining system act as the peers in the environment. The static information about the peers and the coordinator peer will allocate the service to the peers. By that each workflow gets the service from the cloud environment.
Second level scheduling is Task-level scheduling. It is a type of dynamic scheduling which aims to optimize the Task-to-vm-assignment. In this Task-level, scheduling is generated based on static information about the service, the running time status is dynamically changing because of current workload of the vm.

A Time and Cost Estimation

When submitting a DAG to be executed, the makespan for the estimated time due to varying the current load of the resource is given by

$$\textit{Makespan}(DAG,sched)=\max_{t\in[n](t,r)\in sched} t_{t,r}^{real}+l(t)_{t,r} \quad (4)$$

In that cost for the workflow is also considering the waiting time for the resource to getting the service,

$$\textit{Cost}(DAG, sched)=\sum_{i\in[n](i,j)\in sched} t_{i,j}^{real}+wt_{t,r} \quad (5)$$

Where *wt* is the current waiting time for the resource. In this private information is known only to the resource allocator. The changing demand will get the resource privately using auction mechanism. Based on this information, the resources can be obtained privately.

Computation cost is given by

$$W_{t,r} = \frac{instructions}{p_r} \quad (6)$$

$W_{t,r}$ represents the computation cost(execution time) of the task t in the resource r and p_r is the processing capacity of resource r in instructions per second.

Communication cost:

$$C_{t,r} = \frac{data_{t,r}}{f_{r,p}} \quad (7)$$

$C_{t,r}$ represents the communication cost (time to transfer data) between nodes t_l and t_n using the link f between resources r and p. If r = p, then $C_{t,r} = 0$.

Then priority P_i of the tasks are estimated based on the time instant during scheduling process. This priority is based on the computation cost

Priority:

$$P_t=\begin{Bmatrix} W_{t,r},\ suc(n_i)=\emptyset \\ W_{t,r}+max_{\forall n_r\in suc(n_t)}(C_{t,r}+P_r), otherwise \end{Bmatrix} \quad (8)$$

P_t is the priority level of node i at a given time instant during the scheduling process.

Earliest Start Time:

$$EST(n_t, r_r)=\begin{cases} Time(r_r), & if\ t=1 \\ max\{Time(r_k), ST_t\}, & otherwise \end{cases} \quad (9)$$

$$ST_t = \max_{\forall n_h\in pred(n_t)}(EST(n_{h,r_k})+w_{h,k}+C_{h,t}) \quad (10)$$

Where

$EST(n_t, r_k)$ represents the earliest start time possible for node i in resource k at a given scheduling instant.T ime(r_k) is the time when resource k is available to execute node i.

Estimated Finish Time:
EFT (n_t, r_k) = EST (n_t, r_r) + $w_{i,r}$
EFT (n_i, r_k) represents the estimated finish time of task t in resource *r*.

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Dynamic hybrid workflow scheduling approach based on this scheduling follow two steps:

1.Intial schedule : schedule the workflow in the private cloud *R;*
2.While the makespan is larger than the deadline:

- Select the tasks to reschedule;
- Select resources from the public cloud to compose the hybrid cloud *H*;
- Reschedule the selected tasks in *H*.

VI EXAMPLE

The DAG represents the workflow of a task T, Whose independent subtask are($T_1, T_2, T_3, T_4, T_5, T_6, T_7$),where the values represent the current load of each VM Resources.
From the above DAG select the task for which private resource is needed.

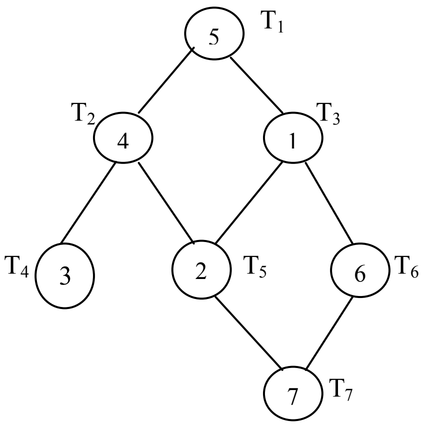

Fig. 3 Multi-cloud Architecture

Total time=Computation time +communication time

$$c = \frac{instruction\ per\ second}{processing\ of\ resource} + \frac{Data\ flow}{Resource\ flow}$$

$$c = \sum_{r,s=1}^{n} \frac{Is}{Pr} + \sum_{t,r=1}^{n} \frac{d_{t,t+1}}{j_{r,r+1}} \qquad \textbf{(11)}$$

For example: In order to calculate the total time(T), consider the summation of computational time as(500mips per 20processed resources) and communication time as(flow of 2data per resource) is 27.

Private Resource Task	Completion Time
T_2	27
T_5	19.1
T_6	22

TABLE 1 Private resource value calculation

Let T2, T5 and T6 be the task that requires private resources. The estimated time to complete for these tasks calculated from formula (11) is 27, 19.1 and 22 respectively. Thus the overall completion time for the given workflow is 68.1 sec. If 1 $ is the cost to process for 60 sec then the cost to process 68.1 sec be 1.05 $. Comparing this value with the service provider the provider that provides minimum cost can be selected based on auctioning.

VII CONCLUSION

Cloud computing is the feature of computing technology. It provides the services to the user in pay-as-use model. In this research we dynamically allocate the resource to the user. In cloud market there are so many private cloud service providers are available and some may self -indulgent providers. We find the best resource provider in the cloud market. When the service demand is increasing, we are getting the private service from the cloud providers in the cloud market. Based on this we give the new pricing model and find the truthfulness about the resource. The proposed model considers the multi objective constraints based on finding the optimal allocation of the resources. The truthfulness also estimates using the game theory. We use pso algorithm to optimally find the resource for the workflow tasks. The proposed mechanism gives the cloud workflow model. In this cloud workflow model assigning services to the task which it required for the cloud application and these assignments based upon QoS constraints. By this truthful information we are entering the cloud market and finding a best resource. We use the auction mechanism to find the best resource provider.

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