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Client Classification and Dynamic Pricing of Resources in Cloud using Cloud Simulator

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Abstract— In cloud computing scenarios, the resources like hardware or software or applications can be accessed whenever a client needs. The client needs to get a subscription to avail service. The usages are monitored by service provider for each client over a network. When more number of client issues a request in cloud, scheduling the resources and pricing of taken resources from the cloud have a huge difference on the incomes. The job request from the user is scheduled in cloud is done, based on the need of the client (i.e) client classification algorithm and based on the demand pricing is fixed (i.e) dynamic pricing scheme. These algorithms solves income optimization problem by allocating resources under a given price and pricing of the resources are based on the allocation. The experiments were proposed with cloud simulation. Cloud simulations results are measured with the first come first serve, client classification and dynamic pricing model. The proposed algorithm shows the better resource allocation based on the pricing method.

Keywords- Client Classifcation, Dynamic Pricing, Cloud Sim. First Come First Served.

I. INTRODUCTION

The computing resources used by the user are provided as a service by the cloud based on the need. The above services are considered to be efficient, if they give their best performance. The efficiency of a system is done by scheduling of jobs or resources or tasks on the cloud. Scheduling of jobs allocates the resources to the requested user in a given time period, and all the requested applications can utilize the resources effectively which gives maximum Quality of Service (QoS). More than one job can be allocated to different types of resources based on the condition given by the cloud users and service providers. [1]. Cloud service providers, provide all types of services needed by the user, only if the sufficient profit is met. Getting profit and utilizing the resources is very difficult, because demand spikes also need to be considered. So, cloud service providers have to closely monitor their profits, and expenses in order to remain successful. The available capacity is allocated to the requested clients according to their demand. The cloud user's need their job on time with a low budget. From the cloud service provider's side, the resources are used effectively. Based on the user's need, the application have to be scheduled onto given resources with better QoS, this makes scheduling in cloud environment a difficult task. The scheduling algorithm is to schedule all tasks to virtual machine based on the some constraints to optimize a given objective [2]. The task or job scheduling algorithm is considered as the core element of each providers. The different types of cloud scheduling techniques are static, workflow, dynamic, cloud service, and heuristics scheduling. [3].

1.2 Objective

- The purpose of dynamic job or task scheduling types in cloud systems is to allocate the jobs or tasks to virtual machine using cloud simulator
- Evaluating and comparing the performance of the proposed with on all available processors, minimizing their total CPU time/ burst time, maximizing the processor utilization and reduce the makespan.

1.3 Overview

Task scheduling is executed by static method in cloud. The requested submitted by user is considered as task and it is allocated to vms with the help of same principle in the existing scheduling algorithms, it also leads to increase in the total makespan which is inefficient. In cloud computing, the tasks are different from one another and the aim is to equally distribute the request submitted by the client to the processers.

There are many existing algorithms such as SJF, FCFS, Min-Min etc, but our proposed algorithms are Dynamic Pricing

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Algorithm (DP) and Client Classification Algorithm (CC), which are entirely different than the existing algorithms since the proposed algorithms are dynamic in nature [3][4].

Dynamic Pricing Algorithm and Client Classification Algorithm dynamically allocate the resources to the tasks whenever a new task comes into the ready queue.

II. RELATED WORK

[4] proposed a algorithm to efficiently allocates the resources for each task with high utility. Bipartite graphs are used in order to map to the respective virtual machines only if it satisfies the condition. The virtual machine status can be obtained by the preemption methodology. Results are aggregated by using the divide-and-conquer methodology.

Modern technology require Cloud computing. The author introduced four different approaches and combined these four methods and developed a new method to allocate cloud resources. Added to that, proposed system involves LEPT preemption. Proposed system is improved by the divide-and-conquer in comparing with the existing frameworks The advantage of this algorithm is that the cost consumption by the tasks are very less compared to other algorithms [5]. But, many factors such as the arrival rate of processes, makespan, completion time of the tasks were not considered as major factors which is a drawback. The work of this paper is to increase the turn around time.

[6] American Journal of Intelligent Systems 2018, they developed two new algorithms called Longest and shortest cloud-let fastest processing element [7]. In this two algorithms, the turnaround time of the tasks were reduced and resource utilization was also improved. The scheduling of job is important and required tasks to maximize the profit. The schedule of jobs or tasks to the flexible resources with respect to the given and needed time, which includes searching for correct sequence where jobs are executed based on the transaction and logic constraints. The advantage of this method is, when the give tasks are more, longest cloudlet fastest processing performs better. But, the Quality of Service became a problem in private cloud environment. Including heuristic methods for scheduling jobs is to be done.

[8] used heuristic methods to improve job scheduling in cloud environment. The methods are, Berger game model, Genetic algorithm and Ant-colony Algorithm. Genetic Algorithm involves solving problems by chromosomes. Ant-colony is a new algorithms, which works depends on the behavior and characteristics of ants, how ant is forms line to search for food, which will increase rapidly to know the shorter path. In each path, the number of pheromones are indirectly will increase the probability to give the path to other ants choices. Based upon the experience, scheduler can obtain the predicted result fast as well as without problems. This paper mainly focus on the task scheduling algorithm in terms of comprehensive QoS and constraint expectation. In dynamic environment, task scheduling algorithm increases the scheduling process and balancing the load become a more important one. Users mainly focus on the QoS requirements. This paper focuses on benefit-fairness algorithm with new model and technique called berger's in dynamic environment. The author experimented and result shows that priority is considered compared to fairness.

On analyzing the two important heuristic algorithms, genetic one provides good searching capability but it is not conductive because of the feedback information. [9] Ant colony algorithm provides and increases the overall search techniques by doing it in parallel method as well as distributed method. But the efficiency of ant-colony algorithm is very poor, when the information i the early time itself. So, as the result of analyzing fusion of both the algorithms are used. By combining both the algorithms, the storage of information in one place and search also done quickly. The time and cost consumption was less in this algorithm but cost consumption was greater than the solution proposed by [10] This algorithms was unable to meet the QoS expectations. Load balancing of resource allocation in regard to user demands is the future work to be done.

11] proposed a methodology, in which simulation was implemented with cloud-sim plus simulator. Then task guarantee and virtual machines load balancing are compared with the two other algorithms. The cloud scheduling process became more sensitive matter in order to find the best cloud resources deployment which will improve the overall cloud performance, and improve the quality of service with minimal cost and with minimum failure rate and also increases the utilization of cloud resources as well as increase the total income. Many different cloud applications have been received by the data center. These applications try to get the services using the pay-per-use policy. Because of limited resources scheduling of tasks becomes difficult.

Scheduling in cloud computing is very important to maintain coordination between jobs and their respective resources. This paper provides new cloud scheduling strategy which is done in three different stage strategy (i) task classification via job classifier for creating Virtual Machines(VMs), (ii) the given request are considered as task and is sorted based on the priority given by the client, (iii) tasks gets paired with their matching virtual machine dynamically with low completion time. The results obtained from this paper were maximum utilization rate, minimum waiting time and minimum

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makespan. But, the failure rate value is a bit higher or equal to the other algorithms [13].

III. WORKING PRINCIPLE

A. Client Classification Algorithm

Two main algorithms are proposed in this paper, (i) Client Classification Algorithm and (ii) Dynamic Pricing Algorithm. In the client classification algorithm, clients can raise a request to avail any type of service to the cloud service providers based on the budget of the client. Each service provider provides N number of physical machines where several virtual machines can be hosted in each physical machine. In dynamic pricing algorithm, clustering algorithm is also used to group the historical data of the client and bayes decision algorithm is used to predict the user preferred cloud service packages.

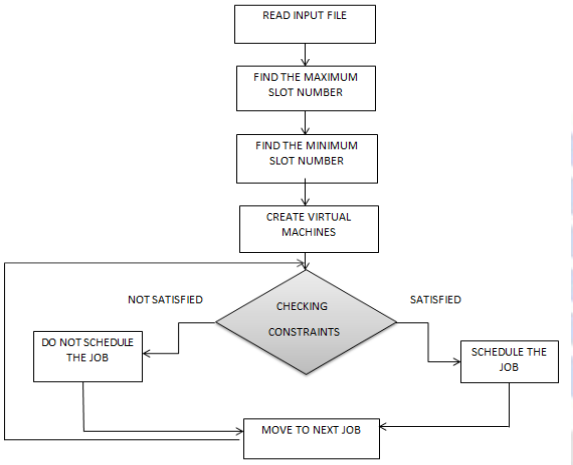

Figure 1 Workflow of Client Classification

The algorithm shown in figure 1 is used to differentiate the services availed by the client. The service provider can easily monitor the usage and very helpful to price the services. The income generation by the service provider is implemented with this client classification algorithm. Steps in the algorithm is as follows

Step 1: Client Affinity: Client affinity describes the relationship between the client and the provider. If affinity = 1 , then client is completely an internal user whereas if affinity = 0 , which specifies that client is completely an external user. Hence, the affinity range lies between 0 and 1.

Step 2: Quality Of Service (QoS): Cloud Provider classifies the tasks as critical task which requires more QoS and tasks which requires less QoS. Critical tasks that requires more Qos has to be bought with higher rates whereas non critical tasks with less QoS can be bought with lower rates. E-Commerce application requires more Qos in order to pIncent losing of money in case if the service is not available. QoS is classified into three ranges. They are, Gold, Silver, and Bronze. The Client Classification policies are applied when there is a negotiation between the client and provider.

Step 3: Price Discrimination: The cost of a task varies with different parameters such as efficiency of resources, timeslot, Quality of Service. Providers fix the price in order to increase their income. Service provides demands for high amount in the peak hours of the day and low amount is asked for the off-peak hour. QoS is not considered for price discrimination, because the gold QoS is not that much cheaper than the silver QoS and silver QoS is not that much cheaper than bronze QoS.

Step 4: Selling of Unused Resources: Resources bought by the users or clients are not completely utilized by the clients. So, the unused resources are sold to the other clients, which increases the income of the provider. Monitoring information provides the information regarding the amount of resources utilized by the service. There are different real market scenarios which involves different values. Client classification policy implies that how can average affinity of the clients can be improved. The paying order can be as follows according to the QoS requirement of the client Gold QoS > Silver QoS > Bronze QoS

When there is an discount in the market, for those service providers who agree to the offer will calculate a cost income function Inc(vt), based on the price and penalties that the client has to pay in order to execute their service. Then, the client will choose the cloud service provider by considering the price and how long the services is needed. The user or client informs about their confirmation to the respective service provider that they need the resource. The services provided by different service providers are: 1. Provider gives priority to the users based on the affinity rate. 2. Providers prioritize the tasks based on the quality of QoS. 3 .Provider

prioritizes either comparing with provider 1(i.e., According to the high affinity) or comparing it with provider 2(i.e., According to high QoS). 4. Provider which executes the policies as same as the provider mentioned in 1 and 2. provider from different organizations may contain the same number of services and resources. Every service provider is fixed the affinity rate for the clients as 25% and 75% based on the cloud market. If the service provider belongs to the same organization, their affinity rate might vary from 0 to 1(ie) non-inclusive to inclusive. The threshold of the affinity rate of all the clients is fixed as 0.25 for all cloud service provider.

On an average one of six clients need good QoS and they are able to pay more may request Gold QoS. The clients who needs good QoS and are able to pay a moderate amount might request Silver QoS and also they have to pay 25% higher than Bronze QoS. Only a small number of the clients might ask for Bronze QoS. When we consider a scenario, If there are more

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number of service providers and only less number of clients, then the prices of the services and resources will be low. If there are more clients and less number of service providers, all the client requests cannot be satisfied at the given time. In order to determine the performance of different policies in all situations, the work was done with different services, clients and providers with different ratios.

Algorithm

Step 1: Read the input file and store the values in respective array list.

Step 2: Finding maximum slot number, i -> 0 to

Slot_Number.size()

for i < Slot_Number do

Maximum= max(maximum, Slot_Number)

end

Step 3: Finding minimum slot number, i -> 0 to Slot_Number do

Minimum=minimum(minimum, Slot_Number)

end

Step 4: Creating Virtual machines with required specifications.

Step 5: Client classification for task acceptance

If job is based on the gold or silver or bronze then

do allocate, end

else

move to next job, end

Step 6: Calculate the income i -> 0 to Number-of-allocated_jobs

for i < number_of_allocated_jobs do

income = income + price_per_slot (allocated job)

end

Step 7: Display the result as graph representation.

The client classification algorithm allocates the job 1 in the timeslot 1 as client has opted for gold for that job and it has been given priority and allocated in the first slot, upcoming jobs also get allocated according to specification given by the client. Client classification algorithm provides an overall income of about 4.5 for the given set of jobs.

Step 5: Income Calculation There are two main actors in cloud market. They are clients and providers. Clients send their service requests to the service providers to get the resources and use their services in the corresponding resources. Each service provider, provides a physical machines in which each host machine can create many virtual machines that may execute single task at a time i.e., Web Services or Batch Jobs.

Inc (vt) is called Income function. Income function defines the amount of money earns by the service provider during a particular period. vt is the time period where the service provider not given the contracted quality of service to the client. Formula for determine the Income is described as follows: $Inc(vt) = (P - R) / (T - IT)(vt - IT) + R - IA$

P – Penalty (Penalty or Extra charge to the client based on the availed service),

R – Income (income earned by the cloud provider),

PT – Penalty Threshold (Limit the client can access the service),

T - Threshold limit for the penalty

IT - Income Threshold (Limit for the cloud provider to use the income),

IA - Invested amount

The above formula implies that provider may violate the Service Level Agreement (SLA) without penalized. 1. If vt<IT , then agreement has not been violated by the client. 2. If vt>PT , then agreement has been violated completed by the clienty. 3. If PT>vt>IT , then Service Level Agreement is partially violated

B. Dynamic Pricing on the Cloud

here are several factors to be considered while considering the pricing on the cloud. The first and foremost thing is to maximize the income for the provider and to provide the clients with higher QoS with lower price. Prices may be influenced by the following factors: The time needed for the cloud service for the client - lease period. Initial amount and final amount are the amount fixed for the resources by the cloud provider to the client. Based on the resource utilization by the client is considered as Rate of depreciation, which describes how many times the resources have been utilized. Quality of Service. Cost of Maintenance. The workflow of dynamic pricing of cloud is shown in figure 2.

3.2.1 PRICING BASED ON USAGE:

The real price can be decided based on the usage of the resources. This model is calculated based on the cost location, resource are the parameters considered to obtain the

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result. In this pricing model, whenever there is a request from the client, price is calculated based on the above parameters. In comparison with the Fixed pricing model, the Dynamic pricing model provides the real-time supply of the resources based on the demand, which gives a more promising charge strategy so that the cloud provider gain larger profit.

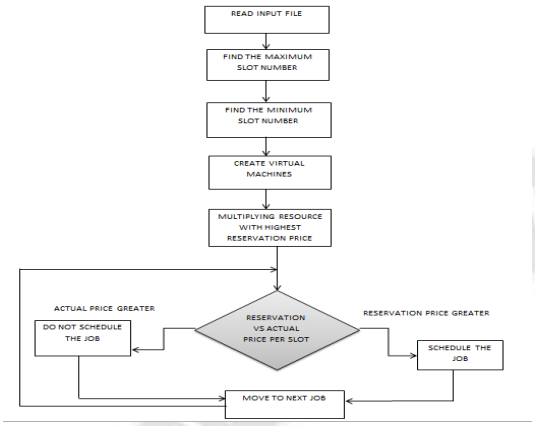

Figure 2 Workflow of Dynamic Pricing

C. Fixed Pricing Vs Dynamic Pricing Model

Fixed pricing model is consistent for a longer period whereas in dynamic pricing model prices vary with respect to time. Fixed pricing guarantees that customer assurance while dynamic pricing focuses on increasing the income and adjusting the price with respect to cost and time.

Pricing has become an important part of cloud providers, so it is very difficult to focus on maximizing the income. Reliability in resources, pricing of the resource and the response time for the connected resources between the client and the provider is also considered for the service quality. The term income management mainly contributes to maximizing the income by opening or closing different rate classes or by adjusting the price for the products dynamically.

D. Dynamic Pricing Algorithm

Step 1: Read the input file and store the values in respective array list.

Step 2: Finding maximum slot number i -> 0 to Slot_Number.size()
for i < Slot_Number do
maximum= max(maximum, Slot_Number)
end

Step 3: Finding minimum slot number i -> 0 to Slot_Number do
minimum = minimum(minimum, Slot_Number)
end

Step 4: Creating Virtual machines with required specifications.

Step 5: Client classification for job acceptance if highest reservation price then do
allocate,
end
else
move to next job, end

Step 6: Calculate the income i -> 0 to number_of_allocated_jobs
for i < number_of_allocated_jobs do
income = income + price_per_slot (allocated job), end

Step 7: Display the result as graph representation.

In Dynamic Pricing Algorithm allocates the given set of jobs in the given timeslots only if they meet the specified condition for cpu, storage and bandwidth. Dynamic pricing algorithm provides an overall income of about 10 for the given set of jobs to be executed in the specified set of timeslot.

IV. Implementation and Result Analysis

Initially, run the project in the Netbeans IDE and find the below window requesting to select the location where the jobs text file is stored. After selecting the file, the file contents will be displayed in the window. Click next to proceed further

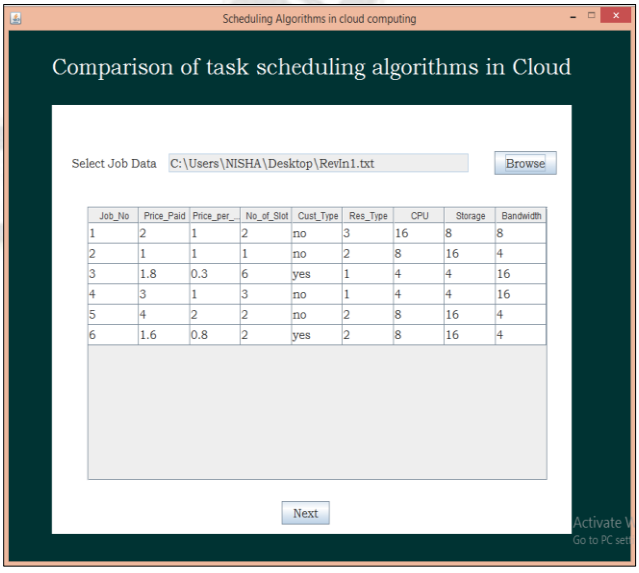

Figure 3 Jobs Location

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In the above Figure 3, the data sheet which displays the job details which need to be allocated is shown. Job_No specifies the tasks which need to get processed in the cpu. Price_paid column denotes the total price paid by each job according to their slot requirement. Price_per_slot denotes the price paid for a single slot by the job. No_of_slot denotes the slot requirement for each job.On multiplying the No_of_slot and Price_per_slot , Price_paid is obtained. Cust_type denote the type of the customer in order to prioritize the customer. Res_type specifies the resource type which the customer opted for, where 3 specifies that the customer has opted for gold, 2 denotes that the customer has opted for silver and 1 specifies that the customer opted for bronze. CPU, storage and bandwidth are the need for each job in order to complete its execution.

Then, there will be a window displaying the algorithms available, FCFS, Dynamic Pricing and Client Classification Algorithm. Choose any of the available algorithms, two new windows will pop up ,

i. Total cost income for the particular algorithm shows in Figure 4, Figure 5, Figure 7)

ii. Graph comparing the bandwidth, storage and CPU for the FCFS , Client Classification and dynamic pricing algorithm (Figure 6, Figure 7, Figure 9). The income of these three algorithms has been compared.

4.1.1 FCFS Algorithm

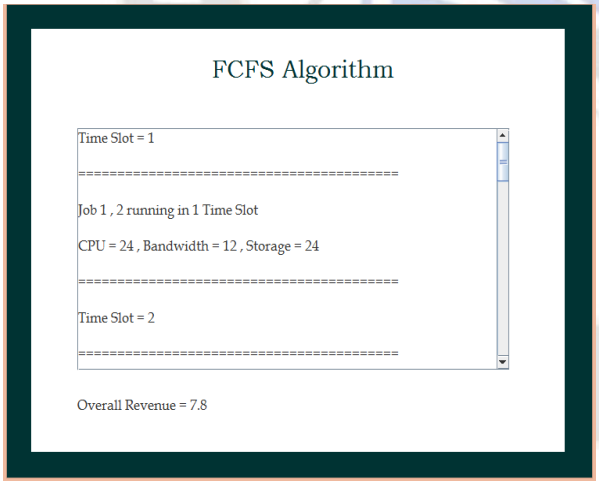

Figure 4 Income of FCFS Algorithm

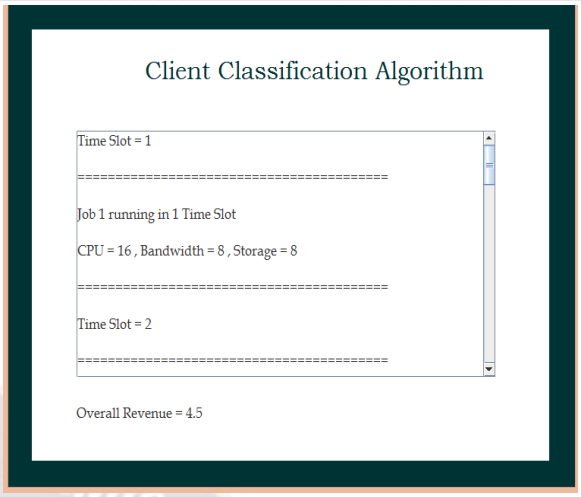

Figure 5 Income of Client Classification algorithm

In the above Figure 4, the jobs get allocated in the timeslot according to the FCFS algorithm. Jobs which arrive first and which meets the given constraint will get allocated first, the same will be followed for upcoming jobs also. FCFS algorithm provides an overall income of about 7.8 for allocating the given set of jobs in the given timeslot. The figure 6, depicts the allocation of jobs in the given timeslot as bar graph. Here, Jobs 1&2 has been allocated in the timeslot 1 which is displayed as 1(1,2) , jobs 1 and 3 gets allocated in the 2nd timeslot 2(1,3), jobs 3 and 4 in the 3rd timeslot, job 3&4 in the 4th timeslot, job 3 and 4 in the 5th timeslot, job 3 alone in the 6th slot and job 3 alone in the 7th slot. Red color used to depict the CPU, Blue color depicts the Bandwidth and green color depicts the storage

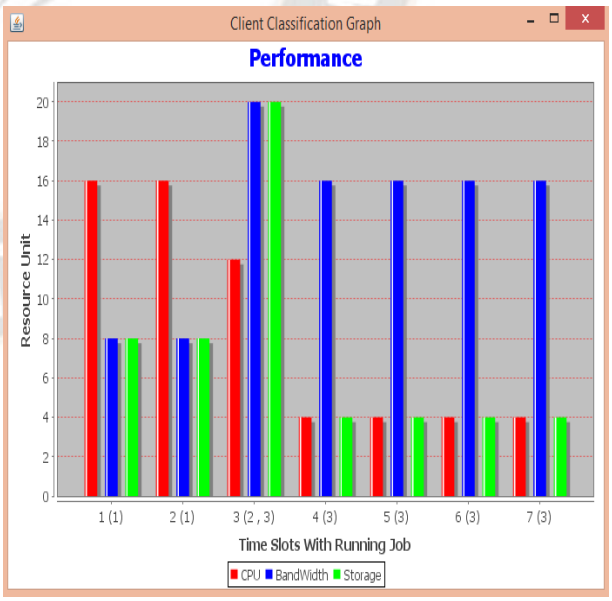

Figure 7 Performance of Client Classification Algorithm

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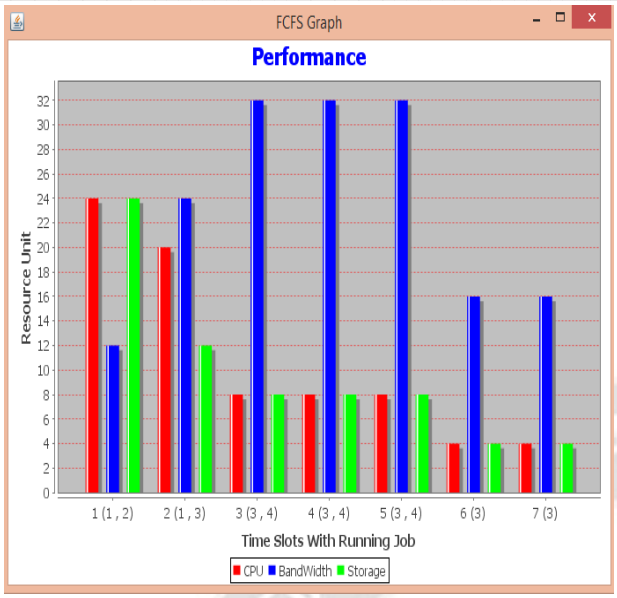

Figure 6 Performance of FCFS Algorithm

A. Performance of client classification Algorithm

In the Figure 5, the jobs get allocated according to client classification algorithm. This algorithm provides overall income of about 4.5 for allocating given set of jobs which is lesser than the FCFS algorithm.

The above Figure 7, depicts the allocation of jobs in the given timeslot as bar graph. Here, Job 1 has been allocated in the timeslot 1 which is displayed as 1(1), job 1 gets allocated in the 2nd timeslot i.e 2(1), jobs 2 and 3 in the 3rd timeslot i.e 3(2,3), job 3 in the 4th timeslot i.e.4(3), job 3 in the 5th timeslot i.e.5(3), job 3 alone in the 6th slot i.e.6(3) and job 3 alone in the 7th slot i.e.7(3). Red color used to depict the CPU, Blue color depicts the Bandwidth and green color depicts the storage.

4.1.3 DYNAMIC PRICING ALGORITHM

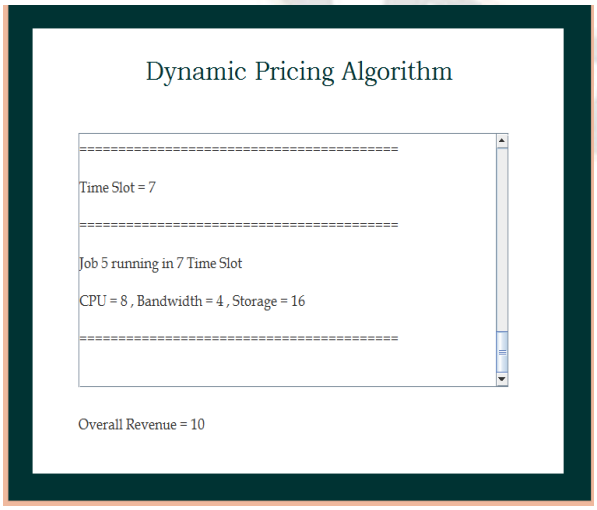

Figure 8 Income of Dynamic Pricing Algorithm

Figure 9 Performance of Dynamic Pricing Algorithm

In the Figure 8, the jobs get allocated according to dynamic pricing algorithm. This algorithm provides overall income of about 10 for allocating given set of jobs which is higher than both FCFS and Client classification algorithm. The above Figure 9 depicts the allocation of jobs in the given timeslot as bar graph. Here, Jobs 1 and 2 has been allocated in the timeslot 1 which is displayed as 1(1,2) , job 1 gets allocated in the 2nd timeslot i.e 2(1), jobs 4 in the 3rd timeslot i.e 3(4), job 4 in the 4th timeslot i.e.4(4), job 4 in the 5th timeslot i.e.5(4), job 5 alone in the 6th slot i.e.6(5) and job 5 alone in the 7th slot i.e.7(5). Red color used to depict the CPU, Blue color depicts the Bandwidth and green color depicts the storage. From the above final observations, the results shows Overall cost for: (i) FCFS Algorithm – 7.8 (ii) Dynamic Pricing Algorithm – 10 (iii) Client Classification Algorithm – 4.8 Hence, the comparison of different task scheduling algorithms, FCFS, Client Classification Algorithm and Dynamic Pricing Algorithms is done and the results are displayed above in the graph format as well as the total income is calculated for each algorithm. As a result of comparing the three algorithms it is evident that the Dynamic Pricing algorithm provides the highest income than compared to FCFS and Client classification algorithm. Cloud provider can get higher income if they use the Dynamic Pricing algorithm for allocating jobs in the timeslots. Client can also get high Quality of service and can pay for resources according to his requirement.

V. CONCLUSION

since there will be millions of users requesting for service in the cloud, allocating these jobs to process is a important one. In the project, two new methods are proposed known as Client Classification Algorithm and Dynamic Pricing Algorithm which provides better QoS and improved performance to all the users. The CPU utilization, storage and the bandwidth used

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is comparatively less than the other existing static task scheduling algorithms. The approach of this project is to choose the service depending upon the user needs, i.e., higher the Quality of Service, the more the users pay for it.In the pIncious algorithms, the client pays the same amount of cost to all types of QoS. The results show that the projected algorithms are better than the existing algorithms.

VI. FUTURE ENHANCEMENTS

The proposed algorithms are experimented with the help of cloudsim tool, where we simulate the cloud environment. But, later this algorithm will be executed in a real world cloud scenario with more efficiency. In this algorithm, the tasks are executed only until the slots are filled, further development will be done to execute 'n' number of tasks simultaneously with the help of other existing algorithms.

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