Optimized Multi Objective Resource Assignment and Server Consolidation in Cloud Environment (OMORASCCE)

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***Abstract*— Cloud resources in the data center are assigned to the end user (i.e.) clients by considering the different parameters such as memory availability, CPU speed, storage space and bandwidth availability in the physical machine. The optimal resource allocation in the cloud data center plays a significant role by the cloud provider. The Multi Objective Bin Packing Approach (MOBPA) was proposed in this paper by considering the different strategies to place the Virtual Machines (VMs) in the Physical Machine (PM). The combination of first fit, best fit and worst fit algorithms in the bin packing approach is to minimize the number of bins and packs it collectively. The different sizes of items (VMs) i.e., are placed in the finite number of bins. The resource allocation is further optimized in this paper using the proposed multi objective Particle Swarm Optimization (PSO) algorithm based server consolidation. In this paper, Service Level Agreement (SLA) is also considered between the consumer and the cloud provider to consume the resources.**

Keywords- multi objective bin packing algorithm;pso server consolidation and SLA

I. INTRODUCTION

Cloud computing is a virtualized compute power and storage delivered via platform agnostic infrastructure of abstracted hardware and software accessed over the Internet.Cloud datacenter is a large group of networked computer servers connected to the particular organization for the remote storage, processing, or distribution of large amounts of data storage is termed as Cloud Datacenter.Cloudsim Simulator is a Simulator for the modeling and simulation of cloud computing environment.It facilitates the user to make it easy to solve complex problems and it is provide distributed and scalable environment.It support large scale data center,services and load balancing policies for the management of various parts of the system such as scheduling and provisioning. The bin packing is combinatorial optimization problem. In classical bin packing problem, consider a set of items to be placed optimally in the bins and each items should not exceed the bin sizes. It is distributing the work among all the devices which are present and packing the large amount of items in the same bin is called bin packing problem. The bin packing problem is where items arrive in unknown order to put into the bin before considering the next item. The problem is solved by online algorithms that are first fit, best fit, worst fit algorithms. The bin is chosen to place the items in it based on the resource availability. If the bin is not possible to accommodate the items, then need to choose another bin with the required capacity. The bin packing problem is considered one dimension or higher dimension and items have packed by their sizes, cost, and weight and so on. In our earlier work, we allocate the virtual machine in the physical machine based on the memory availability in the physical machine. The best-fit heuristic approach is used for job placement and the worst-fit heuristic approach is used for VM placement. The max-heap monitoring approach is used for monitoring the memory availability and then the server consolidation procedure is used to further minimize the number of utilization of physical machines. In our previous work, Random Resource Allocation algorithm was proposed to allocate the resources randomly from the Physical Machines (PMs) to Virtual Machines (VMs) and the jobs are assigned to the virtual machines. In this process, resource availability of physical machines is calculated with million instructions per second (mips) and bandwidth parameters.In this proposed Multi Objective Bin Packing Algorithm (MOBPA), the CPU, bandwidth and memory resources are considered to place the virtual machine in the physical machine. The MOBPA objective is to minimize the maximum number of physical machine running, minimize the resource utilization, minimize the energy consumption and maximize throughput of the physical machines.In the classical online algorithm are best fit,first fit and worst fit.These algorithm combination are for job and and VM placement.The combinations are first to first for job and VM placement.Similarly,all the possible combination have done job and VM placement and utilization of resources is calculated. The Particle Swarm Optimization (PSO) algorithm is based on the social behavior of the organisms. This algorithm is a computational method that optimizes the problem and resolves the particles. The swarm is the population of the birds searching the food

and the birds flocking or fish flocking are the examples. The population randomly moved to the source food, because there is no leader in them. The one of the flocks get the closest to the food source and according to all going through to their experiences. Every period of time the particle position will change based on the current position of the particle and velocity. The PSO is assigning the multiple tasks in the cloud environment. It is used to optimize the time as well as the cost for all tasks.In the PSO based server consolidation, physical machines are considered as a particle in which the virtual machines have to place. The fitness value of the particle is calculated based on its resource utilization. The server resource utilization is based on the number of VMs running and the workload running in each VM. Each particle (VMs) need to analyze its resource utilized and the unused VMs still running in the physical machine to shut down and migrate the VMs to another physical machine.The SLA variety of criteria such as latency, reliability, availability, throughput or security. In the resource allocation jobs assignment to the VM and mapping of VM to the PM and consider the resources such as (CPU, RAM, Bandwidth and Power) which guarantee the 99% under resource should utilize within 12 hour.The resources utilization of a PM based on SLA parameter is cost considering and calculated the resource utilization of a clients. Our work is well thought-out as follows in this paper. The related works are discussed in section II. Section III explains the proposed system with the different nature of packing algorithms, Server consolidation procedure and Service level agreement. In the section IV, the implementation of proposed system and results is discussed. Finally the conclusion and future work are discussed section V.

II. LITERATURE SURVEY

The live VMs migration is to attain the load balance of the physical machine in the cloud environment.VM migration process is taking the time, cost and huge amount of memory. To reducing the resource utilization of the physical machine and using the load balancing particle swarm optimization to migrate the extra tasks to put into the VM and it will overcome the resource utilization[1]. In the cloud data centres are wants high energy without paying and its increasing every day. In the green computing the resource allocation is well-organized and eco friendly. In the high energy consumed in the data center to reduce the energy consumption add more number of physical machines execute all the required tasks and then server consolidation to migrate the VMs to another physical machines[2].The dynamic Bin Packing(DBP) is focus on the minimize the total cost of the bins used over time. Using the packing algorithm first fit, best fit, any fit helps the allocation of the VMs to the bin[3].In the bin packing problem solving memetic algorithm it's a combination of genetic algorithm. It is calculate the fitness value and all the population(chromosome) is checking all the fitness value of the chromosome. Using the selection method select good parent and creating pool.In the population if we need more chromosome use reproduction operator then apply local search method in the chromosome [4].In the cloud data center is energy usage is minimal and good performance. In this cloud data center resource CPU and Disks usage is focused to overcome the energy utilization using the particle swarm optimization (PSO) in the data center. The number of virtual machines is to allocate the physical machine is using the first fit and heuristic algorithm and calculating the CPU and Disks usage and those virtual machine is not used for tasks execution still running in the physical machine it should put into save energy state[5].The multi objective bins packing have been using the evolutionary particle swarm optimization. MOEPSO is characterized by the fact that particle movement is directed by either personal best or global best only in each instance. Evolutionary computation techniques need to be hybridized with a heuristic placement routine to pack the sequence of items into bins[6].The large amount of data it is difficult to manage the data and also resource wastage of power.The power management uses the PSO is choose the best node and it make virtual switch and the node connector is verify every level of source node to last node[7]. To reducing the unused PMs, improve power conservation and storage unused in PMs[8]. Item-oriented, branch and-bound stratergy is allocate one item to the block, bin completion is a bin-oriented branch-and-bound algorithm[9].The memetic algorithm one dimesion bin contain singe physical machine to pack all the items[10].The placement of VM into the PM in the datacenter is to deteremine the energy and performance metrics.For VM placement to PM is using first fit decreasing with brute force method[11].In the real time application is important to minimize the round trip time for users request.To manage a VM on the PM hosts is sorted in the ascending order with the help of average lower RTT(round trip time)users request[12].To employment of VM to PM using meta heuristic technique it gives a good quality solutions[13].

III. PROPOSED SYSTEM

The proposed system model is given in Figure 1. The proposed system is simulated with CloudSim simulator in the Eclipse Integrated Development Environment. It is simulated with the 'n' number of physical machines and 'm' number of virtual machines per physical machine. The 'c' number of clients are requesting the resources through the internet. The cloud users are registered their details and job requests which is stored into the Database Manager. The clients and Internet are cloud consumers.The cloud users,Database Manager,Job Pools,PM Pools and VM Repository are Cloud Providers.The VMs are present in VM Repository similarly number of PMs are present in the PM Pool.Clients request the resources (RAM, CPU,Power and Bandwidth) from the cloud provider and registered their specifications and thereby, creating and initiating jobs.

A.Multi Objective Bin Packing Algorithm

The proposed Multi Objective Bin Packing algorithm is considered 'n' items with different sizes which have to be assigned to a minimum number of bins.The first fit algorithm, best fit algorithm and worst fit algorithm is classical online algorithms. The combination of these algorithms allocates the jobs and calculates the VMs resources utilization.In a datacenter created a number of Physical Machines (PMs) and number of Virtual Machines (VMs).In each VMs have different configurations as in memory space allocated, bandwidth and other resources.The bin is considered as physical machines and items(VMs) to allocate into the number of bins.

The Best to First fit algorithms combinations for jobs and VMs placement. The Best fit algorithm(BFA) is allocating the Job to the VM.The First fit Algorithm(FFA) is placing Virtual Machine(VMs) to the Physical Machines(PM). The (BFA) is search entire VMs present and select best VMs for job execution.The FFA is first come first serve based allocation of VMs to PMs.The (BFA) is VM used,total used space,VM free and total time of job execution, utilization of Bandwidth,Memory,and energy effeciency is calculated and compare with our previous work Random Resource allocation algorithm.The evaluation of the effectiveness of our approach is carried out by comparison with all the combination allocation strategies on the cloud and Service Level Agreement(SLA) is for minimize the total cost under time varying workloads.

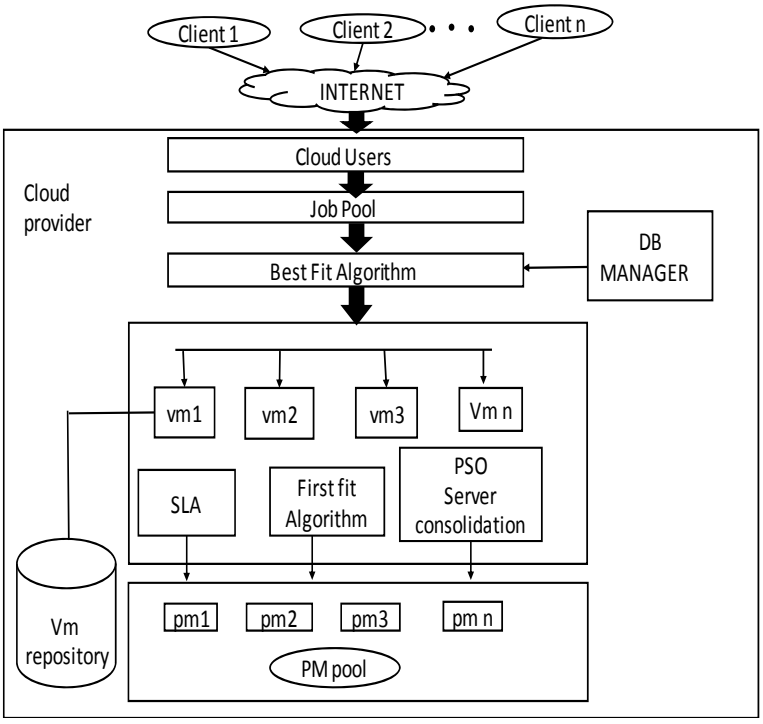

Fig 1.Proposed System Model

ALGORITHM 1. Best Fit Algorithm for Job placement

Input: n number of jobs and VMs

Output: allocation of jobs over to VMset

Begin

List out the number of jobs in an ascending order

//List the VMs in VMset in an ascending order

Broker trying to create VM 0 to 99

//Single physical machine created and fifty VMs.

//Hosts are checking with parameters MIPS and Storage.

Arrange the number of jobs in ascending order

Arrange the number of VM along with its size

Initialize VM status=0

Selecting best jobs to VMs

Calculate the CPU, RAM, BW and Power of each host

Calculate VM used, total used space, VM free and total free space
For each job1in jobset and VM0 in VMset do
If VM0>=job0&&VM status==0 then
Add job1to VM0
VMstatus0← 1 for VM0
Job status0← 1 for job 1
Else
Goto End
EndIf
End for
End: For each job1in jobset do
If jobstatus==0
Add job0 to unsigned jobset
Endif
End For
For each VM0 in VMset do
If VMstatus==0
Add VM0 to unused VM set
End if
End for
End

The best fit algorithm for job placement into the virtual machine shows in this algorithm 1.There are n number of jobs and VMs arrange in ascending order then select best job for assign into the VM calculate CPU,RAM,Memory and Power.The each jobs is check the jobs are less than VM size then allocate first job1 to first VM0.It will check iteratively untill the job is finish to assign.Each jobset have number of jobs if the job status is 0 means it is still not assign any VM.Similarly,For VMset have number VM it check iteratively whether any job is assigned or not.

ALGORITHM 2. First Fit Algorithm for VM placement

Input: n number of VMs and PM

Output: allocation of VMs over PMset

Begin
List out the number of jobs in an arbitrary order
//List the VMs in VMset in an arbitrary order
Broker trying to create VM 0 to 99
//Single physical machine created and fifty VMs.
//Hosts are checking with parameters MIPS and Storage.
Arrange the number of jobs in arbitrary order
Arrange the number of VM along with its size
Initialize PM status=0 for all PMs
Initialize start VM is the first VM from VMset and last-VM is last from VMset
Calculate the CPU, RAM, BW and Power of each host
Calculate VM used, total used space, VM free and total free space
Loop: For each PM1 in PMset do
Loop1: For each VM0 from start-VM to last-VM in VMset
do
If PM1=VM0 then
If PMstatus==1 then
Add VM0 to PM1
PM1← PM1-VM0

Goto Loop1
Else
Add VM0 to PM1
PM1←PM1-VM0
Goto Loop1
End if
Else
PMstatus←1
Add VM0 to used PMset
Start_VM=next VM from VMset(VM0+1)
Goto Loop
Endif
End For
End For
For each PM0 in PMset do
If PMstatus==0 then
Add PM0 to unused PM set
End if
End for
End

The first fit algorithm for VM placement into the PM shows in this algorithm 2. There are n number of jobs and VMs arrange in arbitary order then select first VM for assign into the PM calculate CPU,RAM,Memory and Power.The each VM is check the PM size less than the VM then allocate first VM1 to first PM1.It will check iteratively untill the VM is finish to assign.Each VMSet have number of VMs if the VM status is 0 means it is still not assign any PM.Similarly,For PMset have number PM it check iteratively whether any VM is assigned or not.

B.PSO Based On Server Consolidation

Server Consolidation is an effective technique to increase the utilization of resources while decreasing the energy consumption in a cloud computing environment.To apply this technique, live VM migration technology is used, it combines VMs existing on multiple underutilized servers onto a single server, so that the rest of servers can be put to an energy-saving state.The PSO server consolidation(SC-PSO) in the cloud environment considers VMs as Particle and PMs as Server.The task of a (SC-PSO) is to allocate the VMs to PMs.Each particle needs to analyze its utilized resource and the least workload of PMs.The resource utilization threshold for PM is set to 70% is using Algorithm 3.The proposed system combines resource utilization,server consolidation and uses a limited number of PMs is using Algorithm 4.The PMs are switched to sleep mode until a VM is allocated to in order to conserve energy.

In this process of simulation, resource availability of physical machines is checked with MIPS and Storage parameters and accordingly virtual machines are created and jobs are assigned to the VMs and the Total CPU,RAM,BANDWIDTH and POWER utilization of the host,Total VM free,Total Free Space and migration of VMs into the PMs calculate and comparison between Best to First Fit Algorithm with Server consolidation based on PSO which consider resources CPU,RAM,BANDWIDTH and POWER utilization on PM. The goal is to use the least number of PMs that are enough to run a 'n' number of VMs in a dynamic system, while no prior knowledge of VMs usage during the system run, considering SLA violation and performance degradation. SLAs may a wide variety of criteria, such as latency, reliability, availability, throughput or security. In the resource allocation jobs assignment to the VM and mapping of VM to the PM considering resources(CPU, RAM, Bandwidth and Power)which guarantee the 99% under resource should utilize within 12 hour. In SLA parameter is cost is calculates and the utilization of resources of the particular clients.

ALGORITHM 3.DETECTION OF LEASTUSAGE PM

Input:PM List

Output: Leastusage PM

Begin
For each PM1 in PMSet do
If the occupied resources PM1 is <70% of available resources then

PM1 status =1 // To indicate that PM is leastusage

PM1 is added to Leastusage-PMset

PM1 is removed from PMset

End if

End for

End

The detection of Leastusage PM explains in algorithm 1 .This algorithm is have PMlist as input and check iteratively whether the particular PM usage less than 70% resource utilized than the available resource then the first PM1 is indicate it is leastuse and it remove from the PM set.

ALGORITHM 4.PSO SERVER CONSOLIDATION

Input:PM Set, Underutilised PM

Output: Remove VMs in the underutilised

Switch off the underutilized PM in PMset

Begin

For each PMi in underutilized-PMset do

Number of VMs in PMi //Unused VMs running in the PMi

Migration of VMs=false

Else

Migration of VMs=true

If migration =true

Unused VMs running need to put in new PM

Migration VMs=success //completed migration

End For

End If

End

The migration of VM based on the PSO algorithm explains in algorithm 2.This algorithm is have PMlist as input and list of unused VMs running in the PM need to migrate then it check whether the VM is allocate to the new PM until it finished to allocate the VMs.

C.Service Level Agreement

For all the resources of a particular requests of a particular client

C(r,i)=(Basecost*Ramsize)+(Basecost*energy)+(Basecost*Processingtime)+(Basecostcost*Bandwidth)

Total cost of a particular client when we applied all the requests

$$C(i) = BC(\sum_r(\sum_{ri}+\sum_{ri}+\sum_{ri}+\sum_{ri}))$$

Average cost of a particular clients

$$AC(i) = C(i)/Total(r)$$

For, Total clients

$$C(n) = \sum i=1 \text{ to } n \; AC(i)$$

$$AC(n) = C(n)/n$$

The SLA penalty cost formula is based on the 12 hour calculate resource utilization and its aim is considering resources(CPU,RAM,POWER and BANDWIDTH) 99% should be utilize and calculate each resource occupied by the physical machines.

IV. EXPERIMENTAL SETUP AND RESULT

The minimum hardware requirements are Intel processor, atleast 4GB RAM, Minimum 500GB hard disk where some of the software requirements are Windows and Operating system, java of JDK 1.6version and a CloudSim Simulator in Ecllipse. In a datacenter is Single Physical Machine (PMs) PM1 and 100 Virtual Machines (VMs) vm0, vm1….vm99 are created and each having different configurations as in memory space allocated, bandwidth and other resources. On running simulation setup, initially, the number of VMs created based on the availability of resources. There are various combination algorithm for placement of job and VM.In that all possible combination algorithm calculated resource utilization. Among all the algorithms, the Best to First fit algorithm is one. The Best to First fit algorithms combinations for jobs and VMs placement. The Best fit algorithm(BFA) is allocating the Job to the VMs.The First fit Algorithm(FFA) is placing Virtual Machine(VMs)

to the Physical Machines(PM).The (BFA) is VM used,total used space,VM free and total time of job execution, utilization of Bandwidth,Memory,and energy effeciency is calculated.In graph compare with our previous work Random Resource allocation algorithm.In the Server Consolidation work,considers VMs as Particle and PMs as Server. The Best to First fit algorithms combinations for jobs and VMs placement is optimal algorithm. Comparison of BFA to PSO Server Consolidation and with different number of jobs running in the PMs.

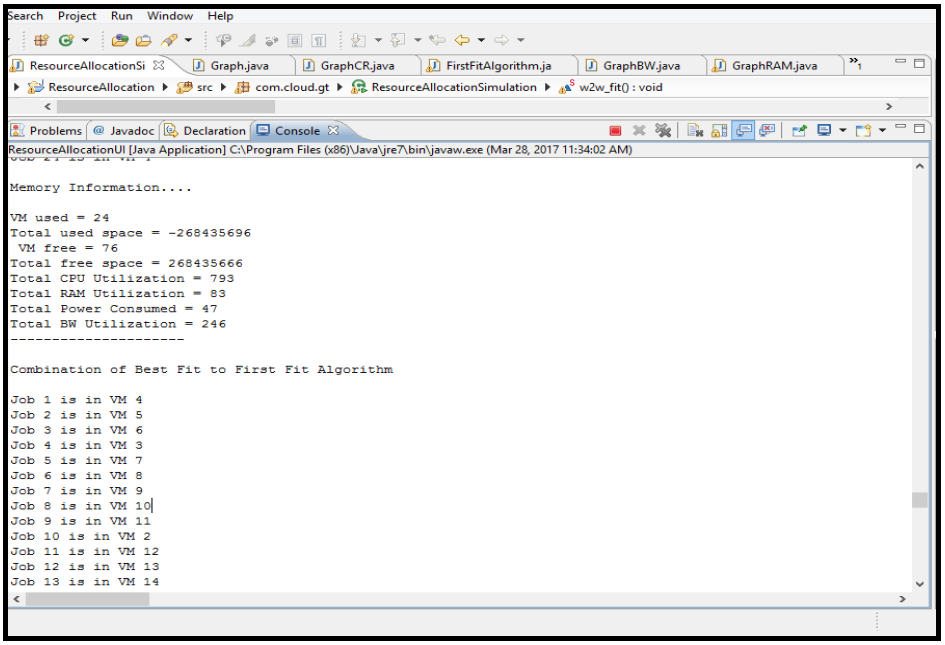

Fig 1. Calculation of total VM used, free space, total CPU, Power, BW and RAM utilization of b2f algorithm

In best to first fit algorithm is creating the new PMs and migrating the VMs to the new PMs then calculates total free space,CPU,RAM,Power and Bandwidth utilization.

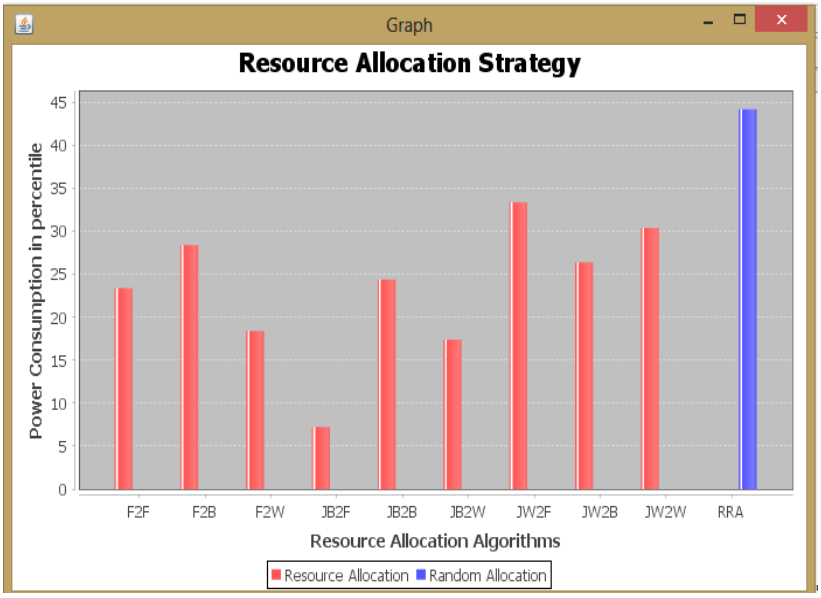

Fig 8.Power consumtion

In this above graph shows that the comparison of all the combination of the algorithms and comparison with random resource allocation of Power utilization of host. In the combination of the algorithm is best to first algorithm is takes low power for job and VM placement. So,among all the algorithms compares best to first fit is optimal resource allocation algorithm.

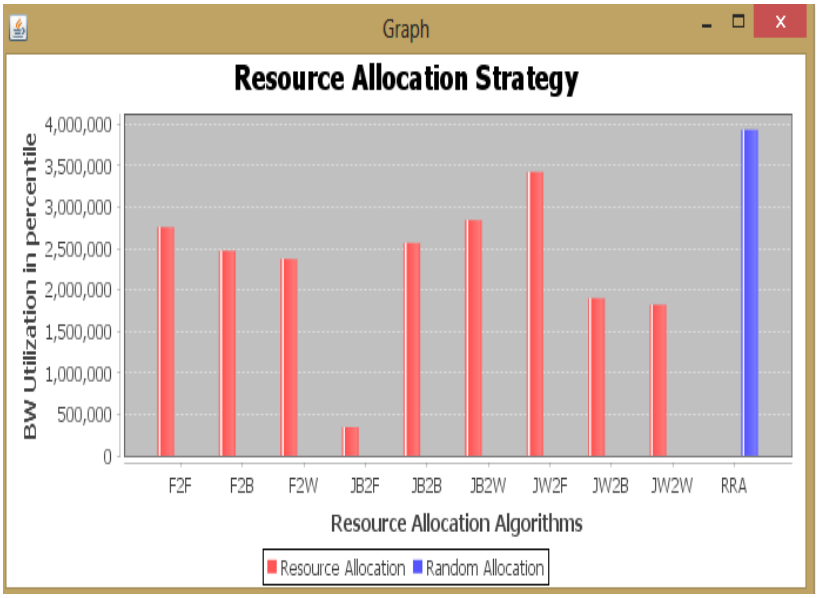

Fig 9.Bandwidth utilization

In this above graph shows that the comparison of all the combination of the algorithms and comparison with random resource allocation of Bandwidth utilization of host. In the combination of the algorithm is best to first algorithm is low bandwidth taking for job and VM placement. So,among all the algorithms compares best to first fit is optimal resource allocation algorithm.

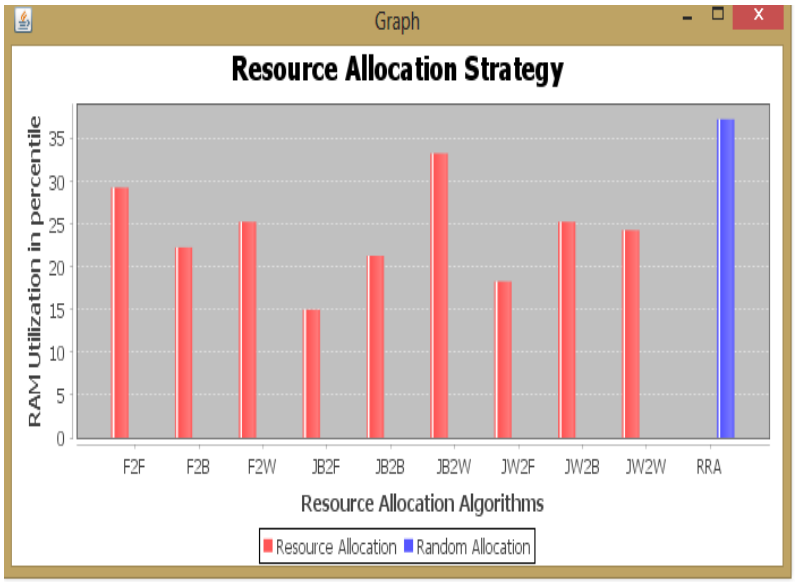

Fig 10.RAM utilization

In this graph shows that the comparison of all the combination of the algorithms and comparison with random resource allocation of RAM utilization of host. In the combination of the algorithm is best to first algorithm is less memory taking for job and VM placement. So, among all the algorithms compares best to first fit is optimal resource allocation algorithm.

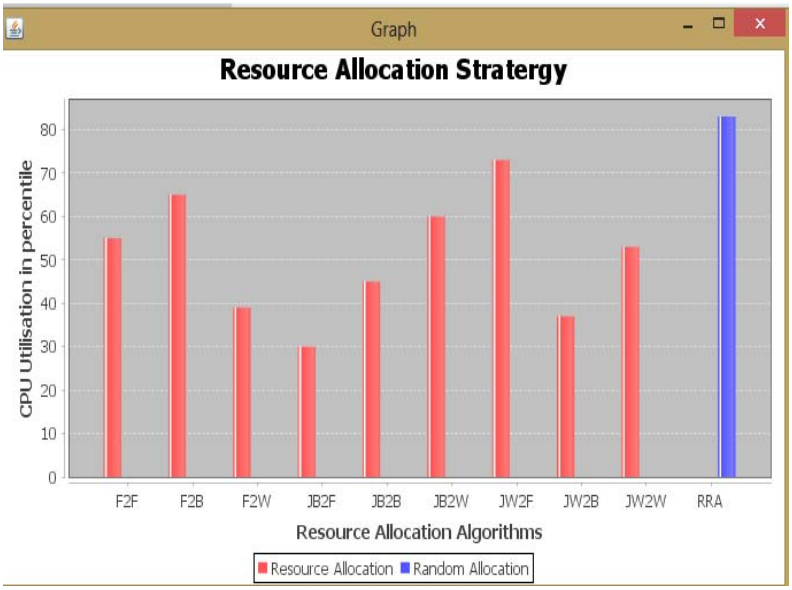

Fig 11.CPU Utilization

In this above graph shows that the comparison of all the combination of the algorithms and comparison with random resource allocation of CPU utilization of host. In the combination of the algorithm is best to first algorithm is taking low processing time for job and VM placement.So,the best to first fit is optimal resource allocation algorithm.

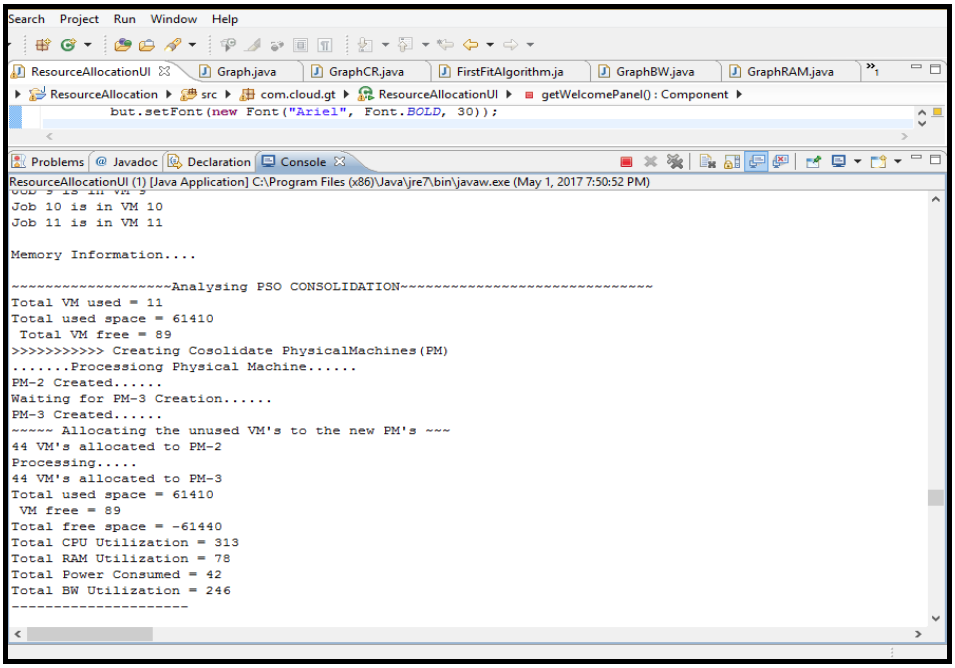

Fig 2. VM Migration of f2b algorithm

In the first to best algorithm is creation of new PMs and migrating the VMs to the new PMs then calculates total free space,CPU,RAM,Power and Bandwidth utilization.

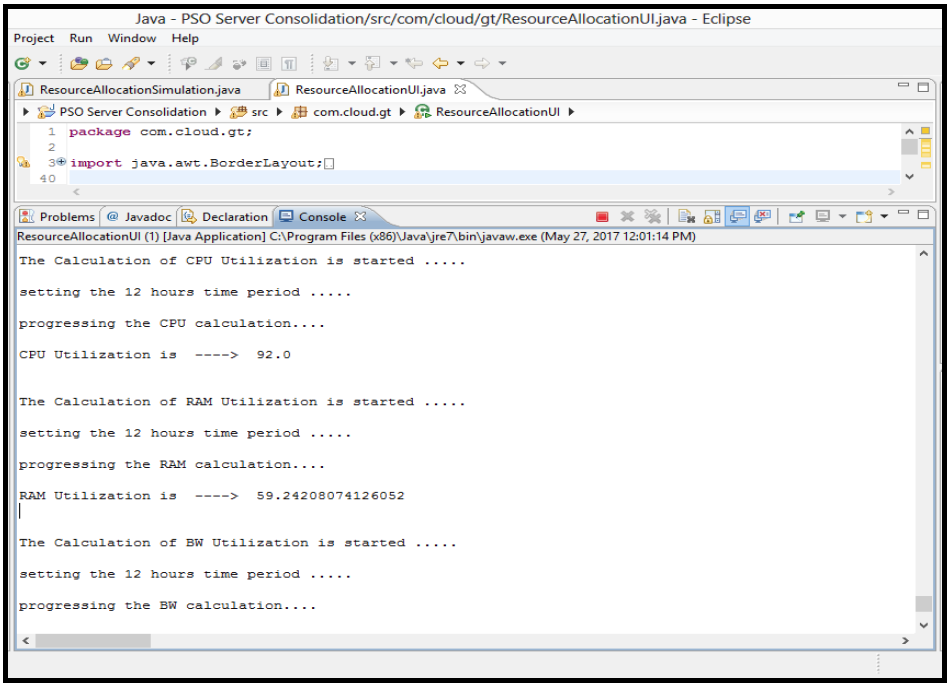

Fig 3.CPU and RAM utilization calculation based on SLA

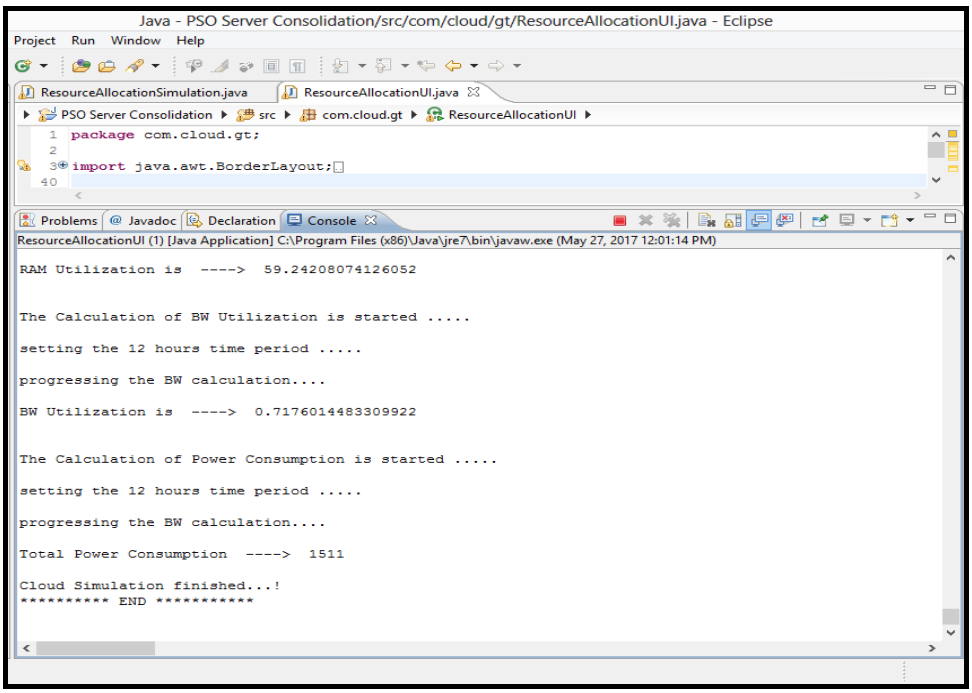

Fig 4.Bandwidth and Power utilization based on SLA

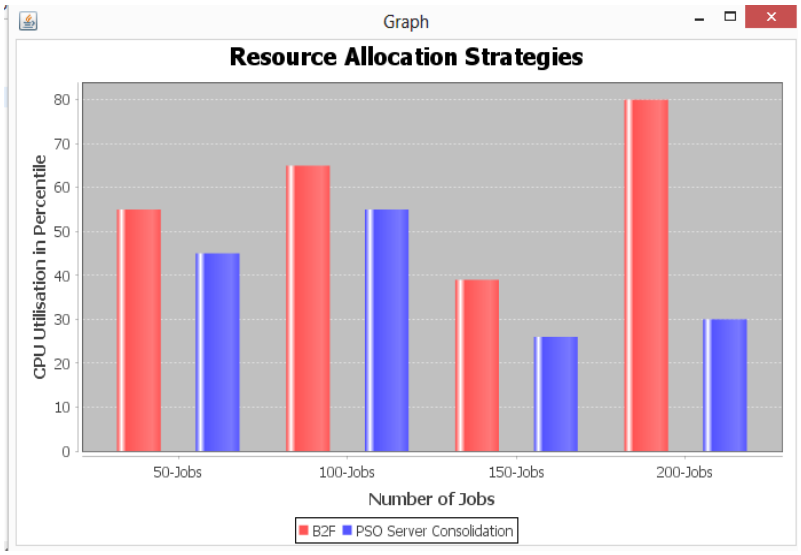

Fig 9.CPU utilization

In the above graph shows that CPU utilization of the number of jobs and comparison between best to first fit algorithm and PSO server consolidation.So,the server consolidation of VM is for 150 jobs is running into the virtual machine is takes least processing time.

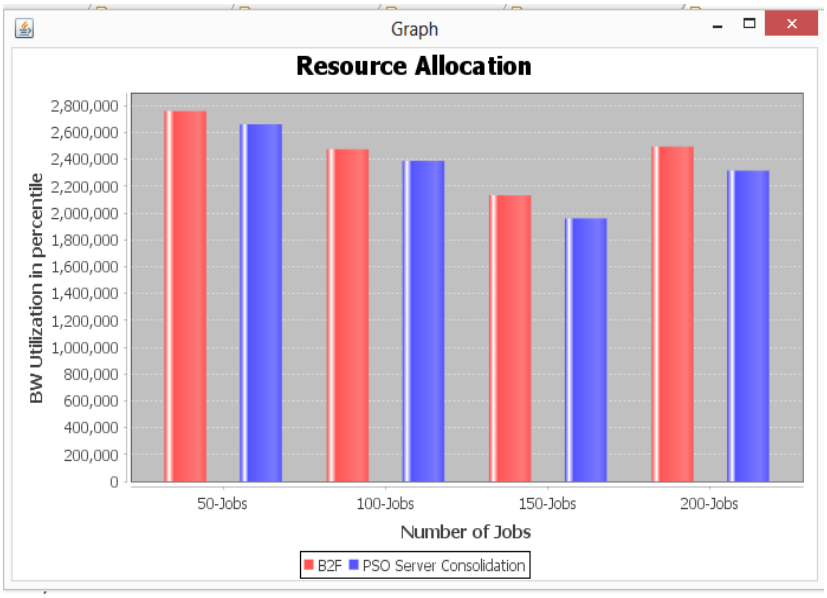

Fig 10.Bandwidth utilization

In the graph shows that Bandwidth utilization of number of jobs are running in the VMs and comparison between best to first fit algorithm and PSO server consolidation is checking how much bandwidth consume for every set of jobs.So,150 jobs is executing takes least bandwidth utilization of the physical machine.

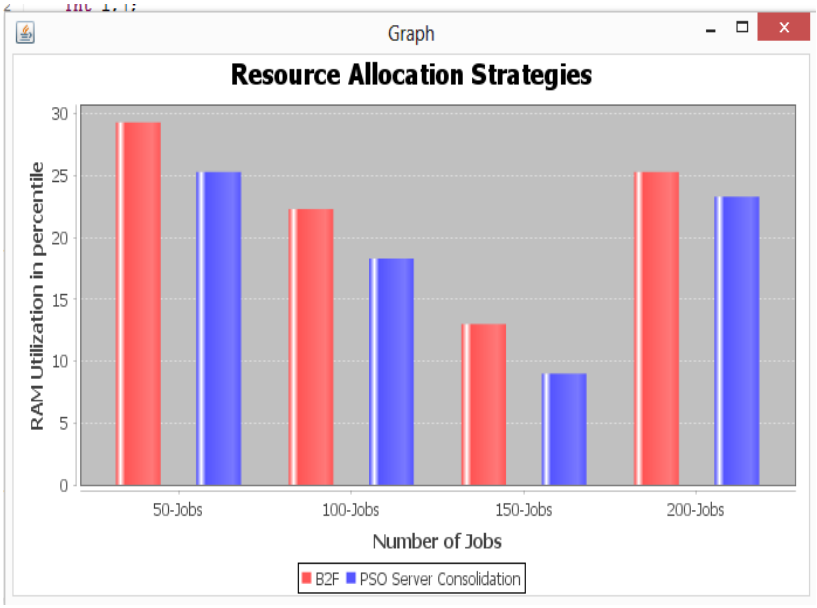

Fig 11.Ram utilization

In the above graph shows that RAM utilization of number of jobs are running in the VMs and comparison between best to first fit algorithm and PSO server consolidation is checking how much memory use for every set of jobs,there by150 jobs is execution it takes less memory for the PSO server consolidation than best to first algorithm.So,the resource allocation based on PSO is optimal algorithm.

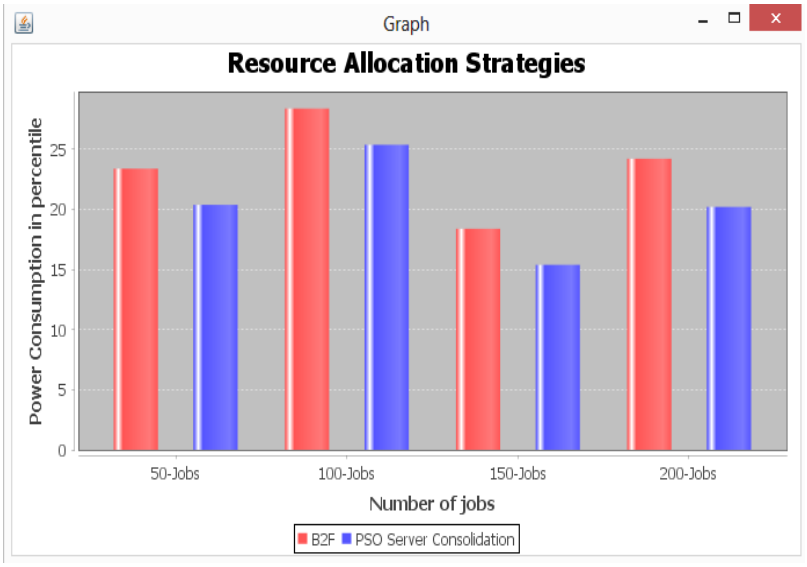

Fig 12.Power utilization

In the above graph shows that Power utilization of number of jobs are running in the VMs and comparison between best to first fit algorithm and PSO server consolidation is checking how much memory use for every set of jobs,there by150 jobs is execution it takes less memory for the PSO server consolidation than best to first algorithm.So,the resource allocation based on PSO is optimal algorithm.

V. CONCLUSION

This proposed work has highlighted the resource allocation in the cloud datacenter aims to allocate the jobs and VMs in a best way.A resource allocation method provide an optimistic solution for all the underlying hardwares since we developed multi objective bin packing algorithm which is given combination of many online algorithms made which is decide job and VMs allocation and comparison also done and also developed algorithm is PSO server consolidation which migration of virtual machines in the different physical machines and running PM put into the sleep mode.to avoid the resource wastage. So, the migration happened it take the Service Level Agreement(SLA) is initiate customer to give proper time to utilize and the resource use within that period of time.For this SLA it is trying to improve the time as well as the cost of the particular customer and provider also.The SLA negotiation process in Cloud computing environments to improve customer satisfaction

levels and integration of this work admission control in Clouds for compute-intensive applications.For future work, the algorithms to optimize the resource uses and minimize the uses of physical machines.We propose SLA,a cost-sensitive virtualized resource management system aim is consider the resources CPU,Power,Memory and Bandwidth 99% should be utilize and it is based on an hour and calculate the cost of each resource occupied by physical machines. Based on the studies, one of the future work identified considering other pricing strategies such as spot pricing to minimize the cost for service providers as well as benefit for customers.

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