Optimization Of Load And Energy Over Cloud Computing System Based On Nature Inspired Algorithms

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Abstract: Workflow is the major feature of cloud computing nowadays. Cloud computing is one of the firmest raising expertise in the world. Numerous operations in the cloud are established on workflow implementation. Scheduling in common is NP-hard problem. To resolve this type of problems comprehensive approaches cannot be used. Only non-exhaustive methods can be used in order to get suitable results. Cloud computing is a paradigm that is surrounded by multiple resources, which helps in resource utilization. Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (Saas) are named as services of cloud computing. In the IaaS models, users can rent infrastructure of the data center as a service. Some of the examples of IAAS are Google Compute Engine (GCE) and Amazon Web Service (AWS). In the PaaS models, users can take services like operating system and database. Some of the examples of PAAS are Microsoft Azure and Google App Engine. In the SaaS models, users can access and install application software and databases via Internet. Examples of SAAS are Citrix GoToMeeting and Google Docs. In this paper author has used a metaheuristic methods called bat algorithm and Cat swarm algorithm. Bat algorithm is exactly intended for enhancing hard problems. The objective of optimization for energy consumption on cloud has also been discussed in the paper. Along with the optimization techniques, the detailed literature reviews have been presented. The performance of the proposed work will be analyzed by using the various performance parameters such as response time, energy efficiency and execution time. In this paper algorithms named as CSO and BAT are discussed. To achieve the results, CloudSim simulators and standard programming languages have been used. Different graphs of both the methods have been implemented for the simplification. Results are mentioned via using parameters such as response time, execution time, energy consumption etc.

Index Terms: cloud computing, job scheduling, SAAS, PAAS, IAAS, CSO, BAT

1 Introduction to the cloud computing

Cloud computing is a developing arena of computing where various assets such as hardware and software are presented as a service to a consumer but not as a manufactured article. The finest portion about these resources is that the consumers do not have to be alert of the physical locations of the services and the formations of these assets that are offering the essential resource [1] This technique is famous and efficient because it delivers multilevel concept and a set of virtualization coatings by which it becomes a more effectual network-based source computing. Approximately, it has been observed that there are 3 types of facilities of cloud computing (1) platform as a service (PaaS) (2) software as a service (SaaS), and (3) infrastructure as a service (IaaS) [2]. The most used definition of cloud is given by NIST which states that “Cloud computing is the procedure that permits suitable resources, agreeing as per the requirements of the user on condition to access the network to various computing resources which can be networks, servers, storage, applications and services that can be apportioned and free speedily with least controlling work.” In cloud computing, there are four deployment models, five characteristics and three services models that are separated into 4 classes are- (1) public cloud (2) private cloud (3) community cloud (4) hybrid cloud.

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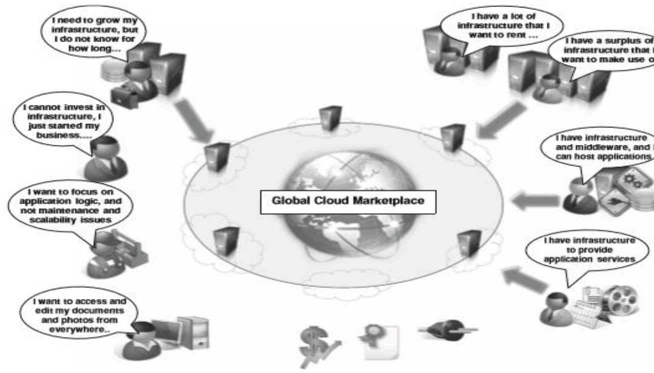

Fig.*1-Vision of cloud computing*

In figure 1, all the facilities that a user can get from cloud are mentioned. It is basically a vision of cloud computing. It is also well- defined as a service subcontracting arrangement where a client can subcontract his facility from a third event. Cloud computing in recent time is getting over every ones nervous and it is not possible to ignore its advantages. The Advantages of cloud may include e-mail, companies to outsource data, folders and many other requests through virtual platforms through the medium of servers which are associated among them and which can be retrieved anywhere and at any time. The only thing for accessing the cloud services is to have internet connection. Cloud computing has bring a lot for IT department apart from global and internal organization of the company. Cloud computing has given a lot for back up of data, new tools and perspectives are uplifted by cloud computing for evolution in companies. The origin of cloud computing have started far before when flowcharts and presentations were used for presenting servers infrastructure of the Internet. For storage purpose cloud has done a lot work and almost every company these days is using this advantage of cloud. The main purposes of this paper are – CSO workflow scheduling that provides a best scheduling system is discussed in detail. The other optimizing technique named as

BAT algorithm for workflow scheduling is discussed. Cloudsim simulator is used and results and outputs are shown with the help of graphs and tables.

1.1. Cloud computing models

As Fig. 2 designates, cloud facility providers offer facilities that could be classified into the following 3 groups:

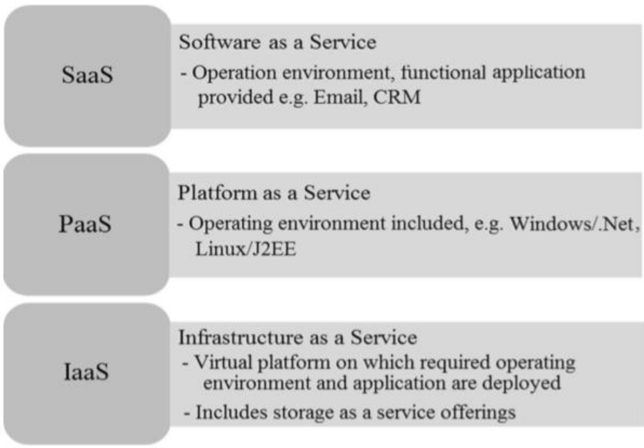

Fig. 2*- Services of cloud computing*

Figure 2 shows the services of cloud computing and the first one is Infrastructure as a Service which lets clients to use computing assets such as loading and processing power. Another service is Platform as a Service which is a growth platform providing the Software services that gives cloud customers to implement cloud services and applications and the last one is Software as a Service that brings superior software that is tenuously obtainable by customers.

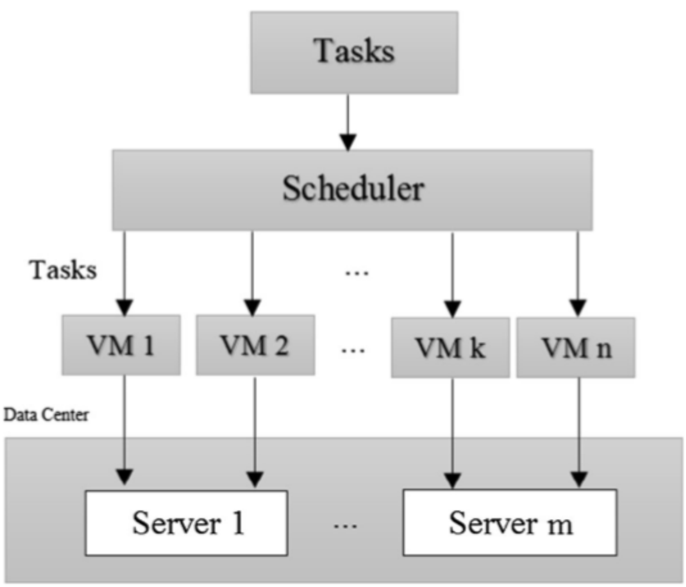

Fig.3*- Mapping in Job Scheduling*

1.2. Job scheduling

Job scheduling comes under the load balancing where its main work is to remove the burden from the VMs who have been assigned lot of work as compared with others and assign those overloaded work to under loaded VMs. The overall performance of system can be achieved using load balancing. The algorithms used for load balancing are classified in two different types' i.e static load balancing algorithms and dynamic load balancing algorithms. Job scheduling scheme is the core and stimulating issue in a cloud computing scheme. Old-style job scheduling structures only reflect how to encounter the QoS desires for the resources employers. They rarely reflect how to implement the extreme profits for the resource suppliers. Here, a job scheduling scheme shows a very significant part in how to encounter cloud computing consumer's job QoS necessities and use the cloud facilities effectively in an financial way. Job scheduling problem which tells to the efficiency of the cloud computing services is one of the well-known combinatorial optimization problems. In figure 3, job scheduling stabs to map jobs to the suitable virtual machines for attaining purposes such as lowest makespan, job execution time, job transferring time, prices, etc.

2. Related work

Jia Yu and Rajkumar Buyya et al in [11] proposed a modest Genetic algorithm optimization of QoS, limit and low-priced which discovers optimal answer in polynomial time. it depends on heterogeneous and reservation-based service-oriented arrangement for discovering optimal result. Gurmeet sing et al in [12] proposed workflow job clustering technique for getting the better results in the execution time. It is completed by decrease in time by disregarding certain queue waiting time. Zhifeng Yu et al in [13] introduced a planner guided technique for scheduling numerous workflows vigorously. The planned method plans each job in each workflow vigorously and provides results in improved performance as the amount of simultaneous workflows goes high. Salim Bitam et al in [15] proposed a job scheduling technique called as bee colony optimization (BCO) which is powerfully implemented on the numerous NPC problems. These procedure goals to a reasonable load delivery over the dispersed assets for decreasing the conclusion time of job. The investigational results of this technique show that BCO is much better than GA as completion time is better. Pei-Wei Tsai et al in [19] explained that the GA, ACO, BCO, etc. never achieve makespan better than PSO, since PSO attains the native optima much faster than evolutionary procedures and it has worthy junction rate amongst swarm algorithms. But PSO and another techniques result in advanced repetitions for receiving the suitable solutions, which is not wanted when the application's size is very big. So to overcome this problem the authors come up with the concept of CSO for planning jobs. CSO is nearly the same as modest PSO but certain changes are there that create it superior than PSO. Zin shee et all in [10] introduced a procedure that is a metaheuristic algorithm which is intended for optimization dedications. This is one of the lately industrialized skills which were chiefly meant at resolving engineering glitches. Metaheuristic techniques are famous for optimization. There are numerous other metaheuristic procedures that are intended for optimization. The greatest basic problematic of optimization is expansion or minimalize of a function. Numerous metaheuristic procedures focus on this feature of optimization.References must be listed at the end of the paper. Do not begin them on a new page unless this is absolutely necessary.

3. Simulator used
CloudSim simulator used for cloud was given by Buyya which take help of all the infrastructure and applications which are presented in a cloud. This approach makes the work easier and more feasible. Cloudsim approach help in checking the feasibility of various events. Cloudsim is simulated by various applications of cloud computing, cloud infrastructures, service brokers, cloud allocation policies and many more. To begin with the simulation process, Cloudsim under goes few important steps.

1. Make m cats over necessary amount of sizes s
2. Assign unplanned speeds to all cats
3. Arbitrarily allocate cats to seeking and tracing modes
4. Compute fitness of all and learn the non-dominated cats
5. For every cat, if cat is in seeking mode, do seeking mode processes, else do tracing mode processes on it and change it to its novel location
6. If end situation does not arrive, go to step 3, else break

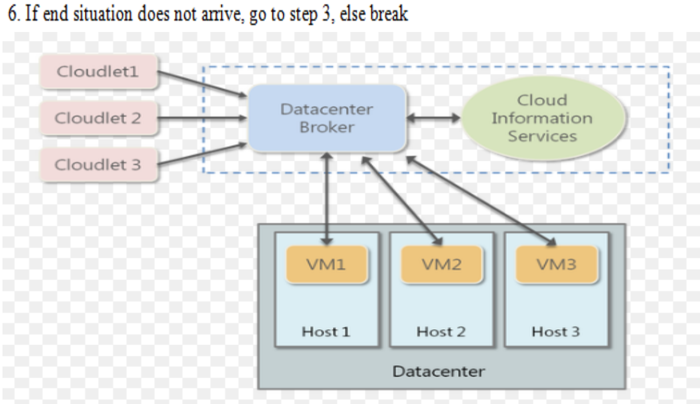

***Fig. 4**- Cloudsim components*

Following are the steps which are followed during the execution of cloudsim:

- Brokers who are proportional to the users are to be selected.
- Variables are to be initialized.
- Cloudsim information service is to be made.
- Cloudlets are to be created. Various parameters for cloudlets are number of jobs, output size, number of PE's used for executing the job, length and size of the file.
- Data center to be created. Data center may include storage size; RAM size, MIPS, Bandwidth and number of PEs etc.
- Broker instances to be created, as they help in communication process.
- Virtual Machines to be created, which include storage size, MIPS, Bandwidth, number of PEs.
- Once VM and cloudlets are created, they are submitted to the broker.
- Start Simulation.
- Stop Simulation

3.1. Introduction to CSO
The mutual performance of cats in actual world has motivated the growth of a new swarm-based optimization method called as cat swarm optimization. It was introduced in 2007 by Chu and Tsai. The action of cats normally comprises spending their most of the time in resting but attentive, with relaxed and intended approach called as seeking mode. There is another mode called as tracing mode when hunting targets as they travel with great velocity. This technique is inspired by the behavior of cats to get difficult answer for optimal explanations. CSO algorithm is discussed in detail and is given below:

3.2. Introduction to BAT
In this paper author has developed another approach based on a heuristic method called Bat algorithm. Bat algorithm is intended by Xin-She Yang. This procedure is a metaheuristic algorithm which is intended for optimization dedications. This is one of the lately industrialized skills which were chiefly meant at resolving engineering glitches. Metaheuristic techniques are famous for optimization. There are numerous other metaheuristic procedures that are intended for optimization. The greatest basic problematic of optimization is expansion or minimalize of a function. Numerous metaheuristic procedures focus on this feature of optimization. Typically a decent algorithm is branded by the competence of exploiting or reducing more precisely. The algorithm for BAT is given below.

Objective function $f(x), X = (x_1, \ldots . x_d)^T$
Initialize the bat population $x_i (i = 1,2, \ldots , n)$ *and* v_i
Define pulse frequency f_i *at* x_i
Initialize pulse rates r_i *and the loudness* A_i
while *(t < Max number of iterations)*
Generate new solutions by adjusting frequency, and updating velocities and locations/solutions
    if *(rand>* r_i*)*
    Select a solution among the best solutions
    Generate a local solution around the selected best solution
    end if
    Generate a new solution by flying randomly
    if *(rand <* A_i *&* $f(x_i) < f(x_*)$ *)*
    Accept the new solutions
    Increase r_i *and reduce* A_i
    end if
Rank the bats and find the current best x_*
end while
Results / Visualizations

4. Simulation outputs
Some screenshots of the output of the algorithms are shown below. Cloudsim and cloud analyst have been cast-off for the results. To estimate and match the presentation of the proposed model basic parameters have been used.

- For load balancing such as Selection of VMs, Execution Time, etc.
- For Energy Consumption such as Energy Consumption, Utilization, etc.
- For Resource Migrations such as Response Time, Migration Time, etc.

System Used

Server Id	Server Name	Speed	Request Type
1	System A(1000)	1000 (MISP)	type1
2	System B(1500)	1500 (MISP)	type1
3	System C(1000)	1000 (MISP)	type1
4	System D(2000)	2000 (MISP)	type2
5	System E(3000)	3000 (MISP)	type2

Simulation Result

Algorithm	ThroughPut	Response Time	Execution Time	Energy Consumption
PSO	100	0.11666666666666667	91.17864285714286	8206.077857142856
CSA	100	1.2142857142857142	58.38571428571428	5254.714285714285
CSO	100	2.3333333333333335	54.89999999999999	4941
BAT	100	0	77.6	6984

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***Fig. 5**- Result 1 of CSO, BAT, PSO, CSA*

Figure 5 shows the screenshots of algorithms named as CSO and BAT. These are implemented in the simulator called Cloudsim. Output has been shown in the form Throughput, Response time, execution time and energy consumption. Outputs of these two algorithms vary according to the no of jobs. So this screenshot provides results when total no of jobs are 5

System Used

Server Id	Server Name	Speed	Request Type
1	System A(1000)	1000 (MISP)	type1
2	System B(1500)	1500 (MISP)	type1
3	System C(1000)	1000 (MISP)	type1
4	System D(2000)	2000 (MISP)	type2
5	System E(3000)	3000 (MISP)	type2
6	System F(1500)	1500 (MISP)	type1

Simulation Result

Algorithm	ThroughPut	Response Time	Execution Time	Energy Consumption
	100	0.11666666666666667	121.5198095238095	10936.782857142856
x 1134	100	0.8571428571428571	120.59999999999998	10854
CSO	100	2.1904761904761907	66.1652380952381	5954.871428571429
BAT	100	0	83.20038095238094	7488.034285714284

***Fig. 6** -Result 2 of CSO and BAT, PSO, CSA*

In Figure 6 Outputs of these two algorithms vary according to the no of jobs. So this screenshot provides results when total no of jobs are 5. It shows the screenshots of algorithms named as CSO and BAT. These are implemented in the simulator called Cloudsim. Output has been shown in the form Throughput, Response time, execution time and energy consumption.

System Used

Server Id	Server Name	Speed	Request Type
1	System A(1000)	1000 (MISP)	type1
2	System B(1500)	1500 (MISP)	type1
3	System C(1000)	1000 (MISP)	type1
4	System D(2000)	2000 (MISP)	type2
5	System E(3000)	3000 (MISP)	type2
6	System E(1500)	1500 (MISP)	type1
7	System E(2500)	2500 (MISP)	type2

Simulation Result

Algorithm	ThroughPut	Response Time	Execution Time	Energy Consumption
PSO	100	0.11666666666666667	218.60680000000002	19674.612
CSA	100	0	79.74242424242424	7176.818181818181
CSO	100	2.3333333333333335	76.83353454545454	6915.018109090908
BAT	100	0	136.1742424242424	12255.681818181818

***Fig. 7**- Result 3 of CSO and BAT, PSO, CSA*

In Figure 7 output has been shown in the form Throughput, Response time, execution time and energy consumption. It shows the screenshots of algorithms named as CSO and BAT. These are implemented in the simulator called Cloudsim. Outputs of these two algorithms vary according to the no of jobs. So this screenshot provides results when total no of jobs are 7

Server Id	Server Name	Speed	Request Type
1	System A(1000)	1000 (MISP)	type1
2	System B(1500)	1500 (MISP)	type1
3	System C(1000)	1000 (MISP)	type1
4	System D(2000)	2000 (MISP)	type2
5	System E(3000)	3000 (MISP)	type2
6	System F(1500)	1500 (MISP)	type1
7	System G(2500)	2500 (MISP)	type2
8	System H(1500)	1500 (MISP)	type1

Simulation Result

Algorithm	ThroughPut	Response Time	Execution Time	Energy Consumption
PSO	100	0.11666666666666667	248.3905194805195	22355.146753246754
CSA	100	0	94.40580547558832	8496.522492802947
CSO	100	2.0952380952380953	103.58030911159327	9322.227820043396
BAT	100	0	101.633406954679	9147.00662592111

***Fig. 8**- Result 4 of CSO and BAT, PSO, CSA*

Figure 8 also shows the screenshots of algorithms named as CSO and BAT. This screenshot provides results when total no of jobs are 8. These are implemented in the simulator called Cloudsim. Output has been shown in the form Throughput, Response time, execution time and energy consumption. The outputs of these two algorithms vary according to the no of jobs.

5. Output tables and graphs

The results of CSA, PSO, CSO and BAT are calculated and parameters are shown in tables. The results of all the approaches are shown in the form of the graphs. Four tables are created with parameters like response time, execution time, Energy consumption.

Sr. No.	Parameters name	Comparison between Algorithms with 6 jobs			
		PSO	CSA	CSO	BAT
1	Throughput	100	100	100	100
2	Response Time	0.116	1.213	2.333	0
3	Execution Time	91.178	58.385	54.899	77.6
4	Energy Consumption	8206.077	5254.714	4941	6984

***Table 1**- Simulation results for Algorithms for 5 number of jobs.*

Table 1 shows the output of CSO, BAT, PSO, CSA algorithms in 5 no of jobs. Various parameters are shown in this table, These are response time, execution time, energy consumption. Total no of jobs are 5 in this table.

Sr. No.	Parameters name	Comparison between Algorithms with 6 jobs			
		PSO	CSA	CSO	BAT
1	Throughput	100	100	100	100
2	Response Time	0.116	0.857	2.190	0
3	Execution Time	121.519	120.599	66.165	83.200
4	Energy Consumption	10936.782	10854	5954.87	7488.034

***Table 2**- Simulation results for Algorithms for 6 numbers of jobs*

Table 2 shows the output of CSO, BAT, PSO, CSA algorithms in 6 no of jobs. Various parameters are shown in this table, These are response time, execution time, energy consumption. Total no of jobs are 6 in this table.

Sr. No.	Parameters name	Comparison between Algorithms with 6 jobs			
		PSO	CSA	CSO	BAT
1	Throughput	100	100	100	100
2	Response Time	0.116	0	2.333	0
3	Execution Time	218.606	79.742	76.833	136.17
4	Energy Consumption	19674.612	7176.818	6915.018	12255.68

***Table 3**- Simulation results for Algorithms for 7 numbers of jobs*

Table 3 shows the output of CSO, BAT, PSO, CSA algorithms in 7 no of jobs. Various parameters are shown in this table, These are response time, execution time, energy consumption. Total no of jobs are 7 in this table.

Sr. No.	Parameters name	Comparison between Algorithms with 6 jobs			
		PSO	CSA	CSO	BAT
1	Throughput	100	100	100	100
2	Response Time	0	0	2.095	0
3	Execution Time	248.390	94.405	103.580	101.633
4	Energy Consumption	22355.146	8496.522	9322.227	9147.0066

***Table 4**- Simulation results for Algorithms for 8 numbers of jobs*

Table 4 shows the output of CSO, BAT, PSO, CSA algorithms in 8 no of jobs. Various parameters are shown in this table, These are response time, execution time, energy consumption. Total no of jobs are 8 in this table.

Response time for algorithms in different jobs:
The difference among the considerations of these algorithms is given below. The enactment of these algorithms has been evaluated in different environments. The Author has already discussed the configurations of virtual machine and cloudlets. So to get better results author has tested various algorithms in different number of jobs. The results of these algorithms are presented in the form of graphs. All the results are implemented in simulation kit named as Cloudsim. Figures shown below give the comparison of two algorithms by taking multiple jobs. Table 1, 2, 3 and 4 has been shown the performance comparison of algorithms with different parameters.

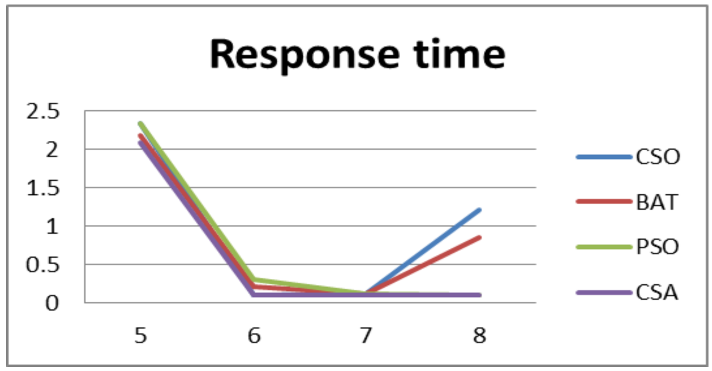

***Fig. 9**- Response time for algorithms*

The comparisons of both algorithms have been done with the help of simulator. This graph shows the response time of both algorithms. In this scenario algorithm worked on different jobs. When no of jobs= 5, Response time of CSO= 2.333, BAT=0, CSA= 1.214, PSO=0.116
No of jobs= 6, Response time of CSO= 2.190, BAT =0, CSA= 120.599, PSO=0.116
No of jobs= 7, Response time of CSO= 2.333, BAT =0, CSA= 0, PSO=0.116
No of jobs= 8, Response time of CSO= 2.095, BAT =0 , CSA= 0, PSO=0.116

Execution time for algorithms in different jobs

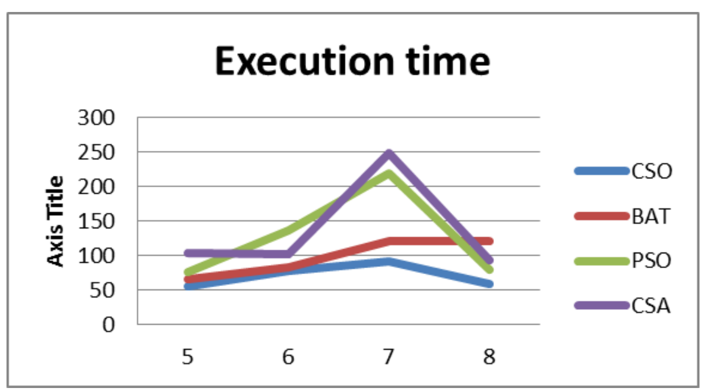

***Fig. 10** -Execution time for algorithms in different jobs*

This graph shows the Execution time of both algorithms. In this scenario algorithm worked on different jobs. When no of

jobs= 5, execution time of CSO= 54.899, BAT =77.6, CSA= 58.385, PSO=91.178
No of jobs= 6, execution time of CSO= 66.165, BAT =83.200, CSA= 120.599, PSO=121.519
No of jobs= 7, execution time of CSO= 76.833, BAT =136.17, CSA= 79.742, PSO=218.606
No of jobs= 8, execution time of CSO= 103.580, BAT=101.633, CSA= 94.405, PSO=248.390

Energy consumption for algorithm in different jobs

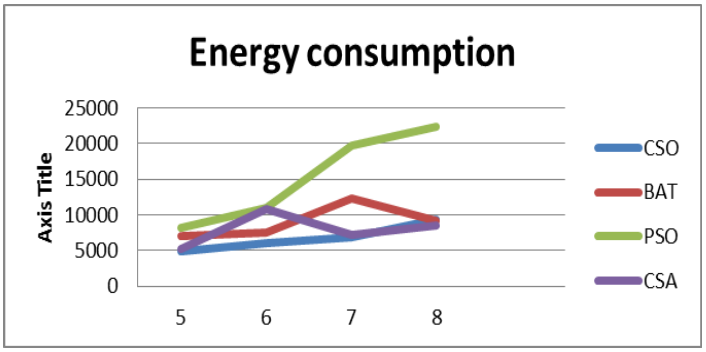

Fig. 11- *Energy consumption for algorithms in different jobs*

This graph shows the Execution time of both algorithms. In this scenario algorithm worked on different jobs. When no of jobs= 5, Energy consumption of CSO= 4941, BAT =6984, CSA= 5254.7142, PSO=8206.0778
No of jobs= 6, Energy consumption of CSO= 5954.87, BAT =7488.034, CSA= 10854, PSO=10936.782
No of jobs= 7, Energy consumption of CSO= 6915.018, BAT =12255.68, CSA= 7176.818, PSO=19674.612
No of jobs= 8, Energy consumption of CSA= 8496.522, PSO=22355.146, CSO= 9322.227, BAT=9147.0066

6. Conclusion

Cloud computing is a developing arena of computing where various assets such as hardware and software are presented as a service to a consumer but not as a manufactured article. The finest portion about these resources is that the consumers do not have to be alert of the physical locations of the services and the formations of these assets that are offering the essential resource. In the last few years existence of cloud computing has replaced the landscape of Information technology. It has been envisioned that cloud computing will be provided as 5th utility that will contribute the fundamental computing services. It offers numerous service models and deployment models. In this paper various Cloud Computing and load balancing are also discussed. Though some difficulties exist in Cloud computing and to handle load balancing is one of them. A Technique that distributes the huge dynamic local workload across all the Nodes is called as load balancing. In this paper related work of job scheduling has been discussed. Two algorithm named as CSO and BAT are explained in detail with their working area and their results and comparison with CSA and PSO have been shown using simulator CloudSim. Different parameters such as Execution Time, Energy Consumption, Utilization, Response Time, Migration Time, etc. are used. Different services of cloud are also discussed in this paper. In future work Proposed Hybrid Energy efficient model will be implemented and Cloudsim simulator for cloud computing will be used to show all the results of the proposed technique.

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