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Green Cloud Computing: Making Cloud as Environmental Friendly

Valarmathi K[1],Haritha Sankar S[2], Kayalvizhi E[2],Pavithra M[2],Gemila B[2]
[1]*Assistant Professor,Easwari Engineering College*
[2]*Easwari Engineering College*

Abstract:Cloud computing*is a type of internet based computing that provides shared computer processing resources and data to computers and other devices on demand [**pay per-use model]** which is changing the world around us. The reason to go for cloud computing is that it gives cost effective, flexible, mobility, secure, scalable, etc. However, the growing demand of cloud infrastructure has considerably increased the energy consumption of data centers, that has become a critical issue and thereby it increased the emission of carbon dioxide **(co2)** which is not environmentally friendly. To overcome this issue the technique called **Green cloud computing** appears that can not only save energy, but also reduce operational cost. In this paper, the energy consumption is reduced in data centers by scheduling the job using priority algorithm at the rate of Power Usage Effectiveness [PUE] called **PPScheduling Algorithm**. Power usage efficiency (PUE) is a metric used to determine the energy efficiency of a data center. Before the job is allocated to the data center, PUE rate for each data center is calculated and the data center with the efficient or average PUE rate is chosen for the job allocation in order to reduce the power consumption which in turn control the co2 emission in the environment.*

I. Introduction

Users can store, access and share any amount of information in cloud. The cloud computing trend sounds nebulous, but it's not so fuzzy when you view the value proposition from the perspective of IT professionals. This technology can achieve communication, storage, processing, high performance, hosting and services on demand to cloud customer. The growing of social applications and e-business need to increase the number of data centers. According to IDC (International Data Corporation) report, the global IT cloud services spending is estimated to increase from $16 billion in 2008 to $42 billion in 2012, representing a compound annual growth rate (CAGR) of 27% [1]. Today, a typical datacenter with 1000 racks need 10 Megawatt of power to operate, which result in higher operational cost. Thus, for a datacenter, the energy cost is a significant component of its operating and up-front costs. According to a report published by the European Union, a decreases in emission volume of 15%-30% is required before year 2020 to keep the global temperature increase below 2 degree Celsius

II. Data center

The data center is a large group of networked computer server typically used by organization for the remote storage, processing, retrieving or distribution of large amount of data. These cloud storage provider are responsible for keeping the data available, accessible, physical environmental protected and running. Energy use is a central issue for data center. Power draw for a data center range from kW for a rack of server. when the outside temperature is below 12 or 13 degree C, outside air can be used to effectively cool heat absorbed by the air conditioning system. Where in the case of above 26 degree C it is difficult to cool so that we use a power usage effectiveness (PUE) calculation for each data center. Normally data center with 1 to 1.9 is efficient, 2 to 2.5 is average and above 2.5 is inefficient

Figure 1: A Data Center.

Type of data that can be stored in data center:

The amount of electronic information (eg : document, images, emails and videos) organization produce is a staggering. Storing all the digital data in our data center be expensive. That's why cloud data center which often comes at a fraction of cost of storing the information on-premises has become increasingly popular.

Scheduling in Cloud:

An essential requirement in cloud computing environment is scheduling the current jobs to be executed with the given constraints. Cloud Computing is also about how IT is provisioned and used and not only about technological improvements and also the scheduling of data centers. The main target of scheduling is to maximize the resource utilization and minimize processing time of the tasks. The scheduler should order the jobs in a way where balance between improving the quality of services and at the same time maintaining the efficiency and fairness among the jobs. An efficient job scheduling strategy must aim to yield less response time. so that the execution of submitted jobs takes place within a stipulated time and simultaneously there will be an occurrence of intime resource reallocation. As a result of this, jobs takes place and more number of jobs can be submitted to the cloud by the clients which ultimately results in accelerating the business performance of the cloud system [5].

Existing Model:

Theexisting model proposes a new hybrid algorithm for reduction of energy consumption and makespan by combining ant colony optimization algorithm (ACO) and cuckoo search algorithm. The disadvantage of ant colony optimization has been overcome by cuckoo search. The energy consumed is calculated and the improvement rate is compared with ACO algorithm with respect to number of task.

Ant colony optimization:

For solving computational problems ant colony optimization technique can be used because of the probabilistic nature, ant colony optimization is used to discover best path through graphs, based on activity of ants looking for a path among their colony in search of food source. This idea has been used to solve various numerical problems; many problems have come out based on various distinct features of ant behaviors.

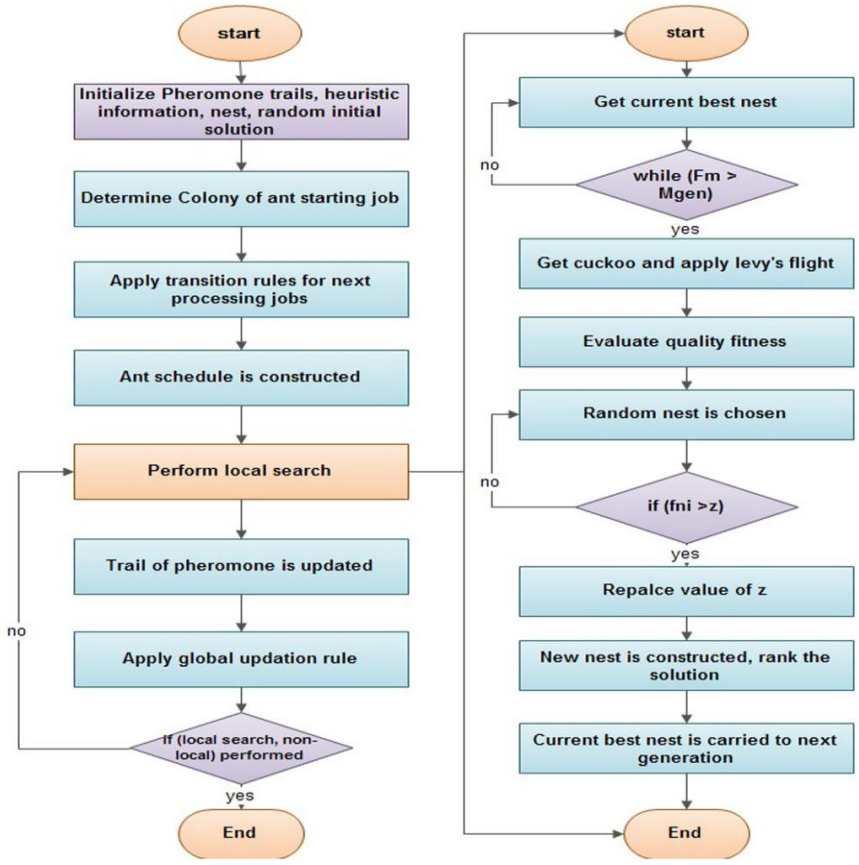
Cuckoo search:

Cuckoo search is used for the optimization problem, it has been seen that performance of the cuckoo search is higher than other Meta heuristic algorithms.

Representation of cuckoo search (CS): each and everyegg in the nest denotes a solution; a new solution is represented by a cuckoo egg. The main motivation of cuckoo egg is to derive the best solution and to replace the solution, which is not so-good in the nests. Each nest contains exactly one egg.

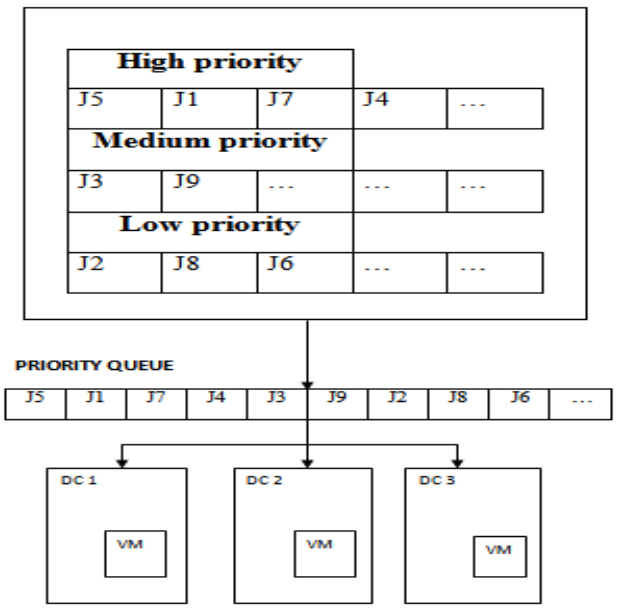
Working

Working of this algorithm is done by the initialization of pheromone, heuristic information, number of nest and random initial solution has to be done. The jobs that have to be done by the colony of ants are determined. For processing of next job, transition rule have to be applied. Construction of ant scheduling for each and every ant is carried out, that is which ant has to execute first is scheduled. Finding resources for job scheduling in cloud computing has been performed using the cuckoo search process, since cuckoo search is very easy to implement that is local search in ant colony optimization is performed using cuckoo search. Trail of pheromone is updated using a new solution and global updation is also carried out. Once local search and other non-local are performed process is terminated.[6]



Proposed Model

This model aims at analyze and investigate priority job scheduling algorithms under cloud environment to provide quality service for the tasks and guarantee fairness amongst the jobs served. Several algorithms & protocols are proposed regarding the scheduling mechanism of the cloud computing. But very few algorithms are proposed to detect the scheduling mechanism in cloud computing. Most of the authors consider a regular monitoring region in their protocol, which is not a real life scenario. Practically the monitoring region is always irregular as the clouds are randomly deployed. So we propose an algorithm to schedule the jobs in cloud computing. Most of the authors consider the FCFS scheduling for processing the jobs. In this condition it decreases the resources utilization and utilization of server. [8]



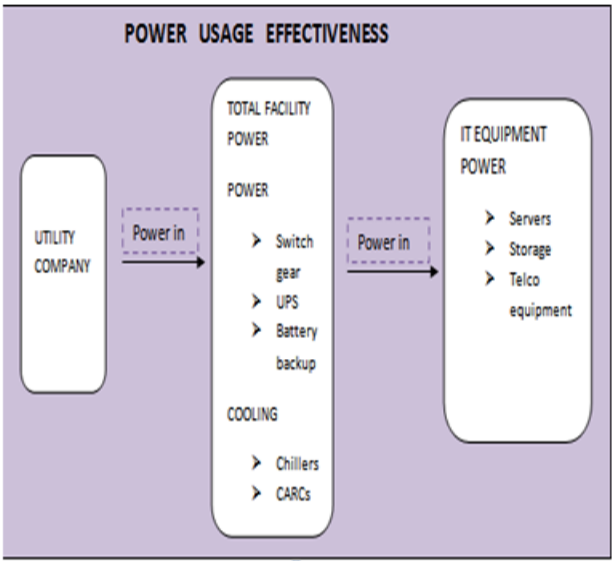
It is not easy to deploy the simulated work directly to the real world because cloud services are layered services and it takes additional scenarios also into consideration. For example when we are providing a service as cloud, we have several tasks that have higher priorities and needed to be finish first and there will be some other tasks which are defined earlier and needed to be performed according to the scheduled time. These are the scenarios that differs the simulated work with the real world. To map the simulation in real world more effectively first divide jobs into high, medium and low priorities. Based on these priorities the jobs are scheduled in the priority queue [7].

Power usage effectiveness (PUE)

Power usage efficiency (PUE) is a metric used to determine the energy efficiency of a data center. PUE is becoming a key tool used in selecting a data center.PUE is the ratio of total amount of energy used by a computer data center facility to the energy delivered to computing equipment.

An ideal PUE is 1.0. Anything that is not considered a computing device in a data center (i.e. lighting, cooling, etc.) falls into the category of facility energy consumption [9].

$$\text{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$



[10]

Example for Calculation of Pue:

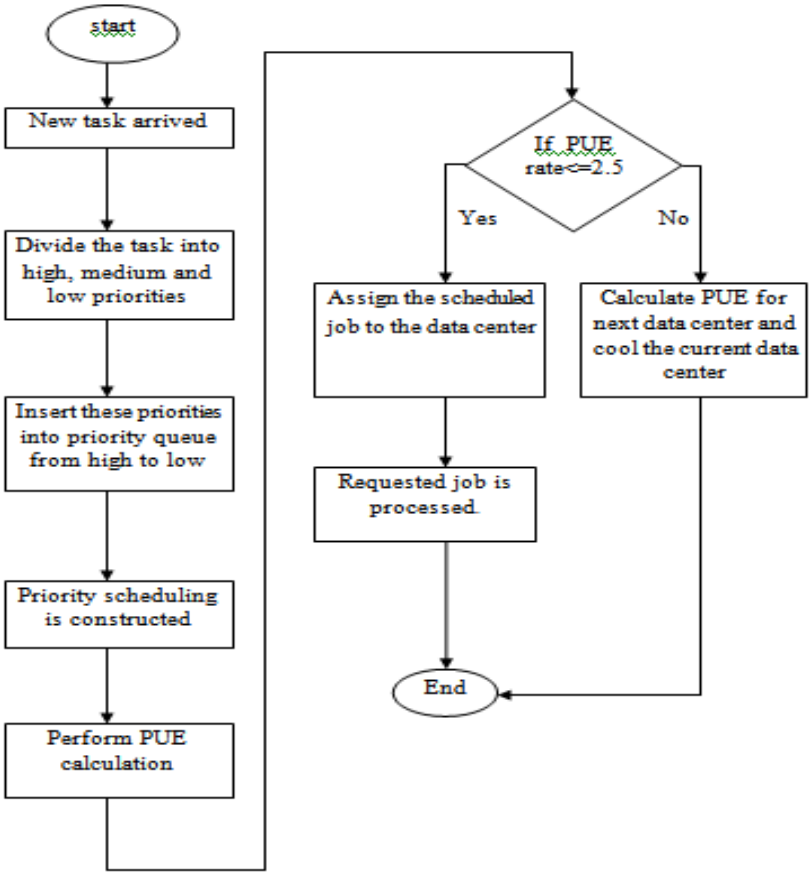
DATA CENTER 1 TFE=1600 IEE=2800 **PUE=1.75** (EFFICIENT)	**DATA CENTER 2** TFE=2900 IEE=7800 **PUE=2.69** (IN EFFICIENT)
DATA CENTER 3 TFE=6400 IEE=6645 **PUE=1.04** (VERY EFFICIENT)	**DATA CENTER 4** TFE=2000 IEE=4000 **PUE=2** (AVERAGE)

For example: Initially, PUE for data center1 is calculated whose PUE is 1.75(that is efficient data center) and the first scheduled job is assigned to DC1 after that PUE for DC1 is updated which is 2.3(average). so the second scheduled job can assigned to DC1 after that again updating PUE which results in 3.01(very inefficient), thus it cannot be allowed to perform the job. Then it checks for PUE of DC2 which is 2.96 (inefficient) so the scheduled job is assigned next DC3 whose PUE is 1.04 (efficient) and so on the process goes.

TABLE1:

Task	PRIORITY	PUE	DATA CENTER	UPDATING PUE
J5	HIGH	1.75	DC1	2.3
J1	HIGH	2.3	DC1	3.01
J7	HIGH	2.69 1.04	DC2 DC3	NOT INCLUDED 1.79
J4	HIGH	1.79	DC3	2.2
J3	MEDIUM	2.2	DC3	2.64
J9	MEDIUM	2	DC4	2.19
J2	LOW	2.19	DC4	2.9
J8	LOW	2.84 1.62	DC1 DC2	NOT INCLUDED 2.02
J6	LOW	2.02	DC2	2.46

PUE and Priority scheduling algorithm:



When the multiple client request to access the cloud data, based on the timing the priority is allocated. The priority is of three levels high priority is for shortest deadline jobs, medium priority is for medium deadline jobs, and the low priority is for longest deadline jobs. And from high to low priority the job is scheduled. The PUErate for each data center is calculated. If the PUE rate is less than or equal to 2.5 then the scheduled job is allocated to the data center. Otherwise that data center is not allocatedand it is allowed to cool by cooling process either externally or internally. The PUE rate is calculated for next data center and so on.

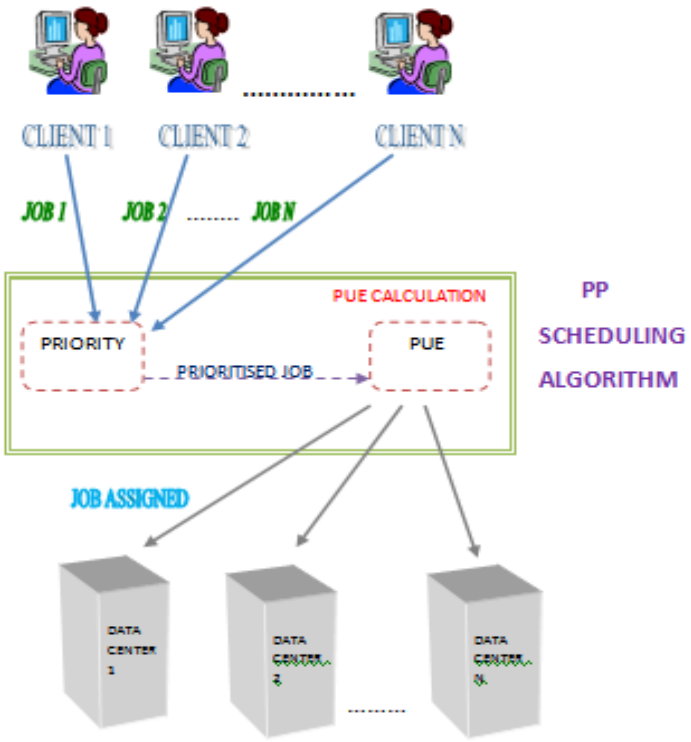


Figure 5: Architecture of Pp Scheduling

III. Conclusion

In existing model, ant colony organization schedules the job and cuckoo search chooses the best VM and in proposed model we schedule the job using priority scheduling and best data center is chosen by using PUE rate. In this paper the problem of energy consumption in data center is investigated. PP scheduling algorithm was proposed and it is implemented in the architecture of PP scheduling. With the help of power usage effectiveness (PUE), the scheduled job is assigned efficiently to the data center. By this the data center with high PUE rate are forced to stop and allowed to cool which reduces the power consumption in the data center which in turn controls the emission of co2. Along with power consumption it schedule the job within their deadline, which results in load balancing with time efficiency.

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