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Energy Efficient Cloud Computing Using Job Scheduling Algorithms: A Systematic Review

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Abstract: ***Cloud computing is a model for transferring computer based services, wherein resources are recovered from the Internet through online tools and applications rather than an immediate connection with a server. The ability to allocate and de-allocate cloud computing resources with insignificant minimal management effort led to the growth of cloud computing. In this way, adjusting cloud computing resources to give better execution environment and also management to end clients is essential. Load balancing in cloud computing implies adjusting three critical stages through which a demand is processed. The three of the phases are 1. Selection of data centre, 2. Scheduling of virtual machine and lastly, 3. Scheduling of task. This paper introduces a reviews of different energy efficient scheduling techniques in a cloud domain. A short analysis of different scheduling parameters considered in these techniques is additionally exhibited.***

Keywords: Energy management, Energy efficient resource allocation, VM consolidation, cloud computing, Data centres.

I. INTRODUCTION

Cloud computing has developed as a computing framework that empowers fast conveyance of computing resources as an utility in a powerfully adaptable, virtualized way. The benefits of cloud computing over conventional computing incorporate dexterity, low section cost, gadget autonomy, and versatility [1]. Cloud models utilize the datacenter as the fundamental unit in its engineering [2] [3]. A cloud model can be seen as an accumulation of greatly appropriated data centers [4]. As it were, it is an arrangement of cloud specialist organizations that offer management by means of their data centers situated far and wide.

A data center [5] or server farm is a gigantic, repository for the huge storage, complex calculation, and administration of information. A data center is a homestead for facilitating a substantial number of servers or for preparing components, groups, as well as impressive measures of storage to serve client demands. As of now, cloud computing gives dynamic administrations over the Internet, for example, applications, information, memory, bandwidth, and IT administrations.

The unwavering quality and execution of cloud administrations rely upon different components, which incorporate assignment scheduling. Scheduling should be possible at the assignment level, asset level, or work process level. In this paper, we primarily center around undertaking scheduling approaches. Cloud clients send solicitations to the server farm for computing jobs. These solicitations are called tasks. A tasks is a little bit of work that ought to be executed inside a given time frame. Tasks scheduling dispatches the undertakings gave by cloud clients to the cloud supplier, who will assign out them to accessible resources [2].

II. VIRTUAL MACHINE SCHEDULING

The task of an assignment by the scheduler is subjected to various limitations. Limitations are normally on either time requirements or resources availability. A job may incorporate data entry and preparing, programming access, and storage functions. The data center orders tasks as per the administration level agreement. Each undertaking is then allocated to one of the accessible servers. Thus, the servers play out the asked for undertaking. A reaction or result is transmitted back to the client [6]. Scheduling is an balancing situation in which procedures or tasks are booked according to the given necessities and utilized algorithm. The objective of scheduling calculations in distributed frameworks is to spread the load on the processors and to expand their use while limiting aggregate errand execution time. Employment scheduling, a standout amongst the most popular advancement issues, assumes a key part to enhance adaptable and dependable frameworks.

In Cloud Computing VM scheduling algorithm are utilized to plan the VM solicitations to the Physical Machines (PM) of the specific Data Center (DC) according to the prerequisite satisfied with the demand for resources (i.e. RAM, Memory, Bandwidth and so on). In the present period there are such a significant number of cloud suppliers in showcase that have diverse limit of Data Centers and Physical Machines accessible. Sales Force, Amazon, Microsoft office 365 and Windows Azure, Oracle Cloud, Google Apps and so forth are the main cloud suppliers in 2018 [7] [8]. In general scheduling algorithm works in three levels as given below [9].

1. Find most appropriate physical machine.
2. Determine most efficient provisioning scheme.
3. Schedule the job in virtual machine.

III. SCHEDULING MODEL

As appeared in the fig. 1, the scheduling model in a cloud server farm comprises of four segments, to be specific, computing element, work scheduler, work waiting queue, and work arrival process [10].

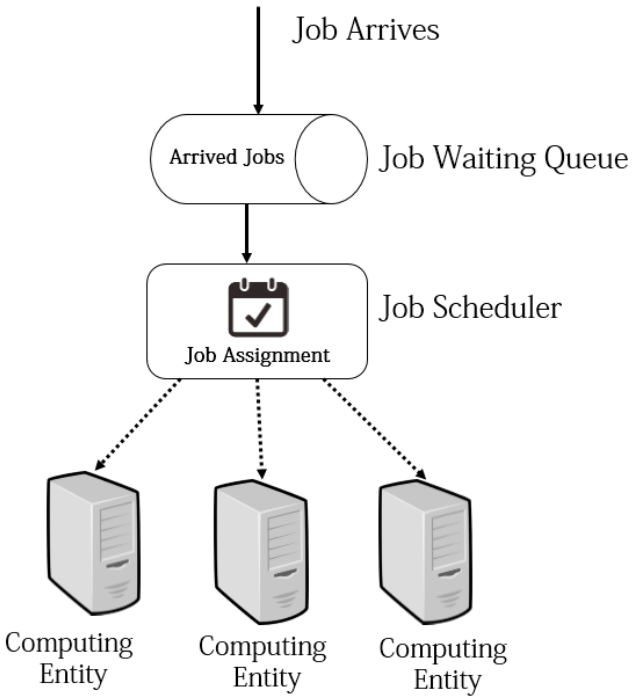

Fig. 1. Components of Cloud Computing Environment

- Computing entity is provided through the implementation of a virtualization technique in the cloud computing system. A number of virtual machines that provide computing facilities, such as the operating system and software, are present in the cloud system to process the submitted tasks.
- Job scheduler is an important component of the scheduling process in a cloud computing environment. A Job scheduler decides the execution request of the job holding up in the line.
- Job waiting queue line is the line of job for execution holding up to get appointed to a specific machine.
- Job arrival process is the technique in which jobs arrive into the scheduling system.

IV. LITERATURE SURVEY

In this section we presents existing work done in the field of energy efficient cloud computing model.

Shahin et al. [11] proposes a scheduler which applies the column generation technique to handle the integer linear/quadratic programming optimization problem. Also, the cut-and solve-based algorithm and the call back method are proposed to reduce the complexity and computation time. Proposed work advances the state of the art in workload estimation and dynamic power management of cloud DCs, and the results will be helpful to cloud service providers in achieving energy saving.

Liu et al. [12], implemented an optimized scheduling methodology to decrease control utilization while fulfilling task reaction time limitations during scheduling. This methodology is an insatiable approach that chooses the base number of the most efficient server for scheduling. The undertakings are heterogeneous in nature with the end goal that they constitute diverse energy utilization levels and have different assignment reaction times. The ideal task depends on least energy utilization and least fulfillment time of a job on a specific machine.

Kliazovich et al. [13], proposed DENS or server farm energy-efficient system network-aware scheduling. In this framework, the scheduling of tasks is performed by consolidating system awareness and energy productivity. DENS fulfills QoS prerequisites and enhances work execution. This framework lessens the quantity of computing servers and keeps away from hotspots. System awareness is gotten by utilizing feedback channels from the principle network switches. This technique has less computational and memory overhead.

Kliazovic et al. [14], proposed e-STAB or Energy-Efficient Scheduling for Cloud Computing Applications with traffic load balancing. The analysts basically centered around energy-efficient job scheduling that considers traffic load adjusting in cloud data centers. They likewise took a gander at the movement necessities of cloud applications. e-STAB limits congestion and communication delays in the system.

Liu et al. [15], Presented the Adaptive Energy-efficient Scheduling (AES) system, which joins the Dynamic Voltage Scaling (DVS) procedure with the versatile tasks duplication technique. In the principal stage, a versatile edge based tasks duplication procedure is proposed, which can acquire an optimal threshold. In the second stage, the gatherings are planned on DVS-empowered processors to decrease processor energy at whatever point tasks have slack time because of dependencies. This calculation can adequately save energy while keeping up great execution.

Mehdi et al. [16], proposed a two-stage minimum completion algorithm (2PMC) that chooses machines for task scheduling in light of the normal minimum completion time of every single accessible machine. This algorithm thinks about the load of the machine before scheduling the tasks. The completion time of a task on the machine can be defined as the sum of the execution time of the task on that machine and the ready time of that particular machine.

TABLE I. Shows comparison between various existing approaches

Ref. No.	Algorithm Method Used	Scheduling Parameters Used	Tools Used	Findings	Environment
[11]	Cut and Solve Algorithm, Kalman Filter	Energy Consumption	MATLAB	The proposed system estimate the workload of the server and manage the power dynamically.	CLOUD
[12]	Server Provisioning and Task Scheduling	Energy Consumption	MATLAB	The experimental outcomes shows that the energy saved by applying proposed algorithm is increased by 70%.	CLOUD
[13]	DENS: data center energy-efficient network-aware scheduling	Traffic Load Balancing, Congestion Control	GreenCloud Computing	Proposed mechanism minimized the amount of computation needed by the servers. It also utilizes the traffic and handle congestion efficiently.	CLOUD
[14]	E-STAB: Energy Efficient Scheduling for Cloud Computing Applications with Traffic Load Balancing.	Energy efficiency, Network Awareness, Quality of service, performance	GreenCloud Computing	Based on traffic load and congestion control mechanism, load balancing and energy efficient computing is achieved.	CLOUD
[15]	Adaptive Energy Efficient Scheduling	Energy Consumption	SimGrid	The proposed method loses some performance but succeed in saving energy.	CLOUD
[16]	Minimum Completion Time Algorithm	Completion Time, DC Load	GreenCloud	The method tries to improves the load of data center hence saving the over all energy	CLOUD

Table I, shows the detail comparison of existing approaches for cloud energy efficient model. Selection of scheduling algorithm is essential while dealing with the overall energy of the system. Hence the scheduler and other various components are important to attain the energy efficient cloud computing environment.

V. Conclusion

Efficient scheduling algorithm plays a huge part in the execution of a cloud computing framework. This paper reviews about existing tasks scheduling calculations and quickly breaks down every technique. Most algorithm perform scheduling in light of a couple of parameters. A superior scheduling calculation can be created from existing strategies by including more measurements, which can bring about great execution and yields that can be deployed in a cloud environment later on.

This paper outlines some current energy scheduling calculations utilized as a part of a cloud domain. It has been resolved that the best power-saving rate level can be accomplished by utilizing cloud based energy consumption model and also other methods.

Various algorithm are compared like cut and solve, server allocation, E-STAB algorithms. These algorithm perform well when load on the system are not more than 80%. Hence there is a need for further investigation and enhancement in the field of cloud computing with heavy load of dataset.

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